960598-TL

AT&T

Florida Relay Service Technical Proposal

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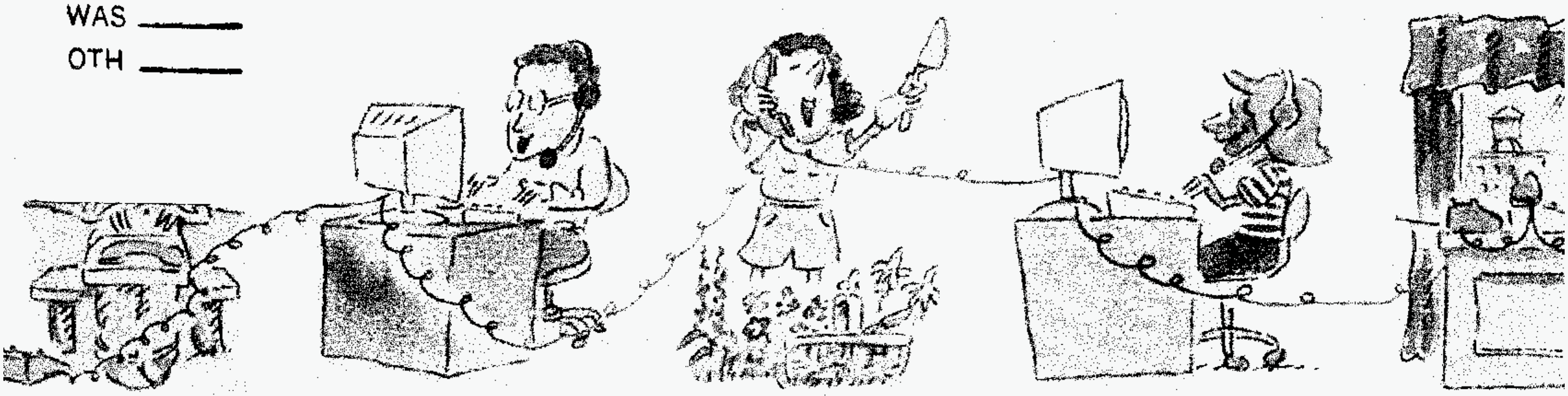
October 2, 1996



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FPSC-RECORDS/REPORTING

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October 1, 1996

Mr. Richard Tudor
c/o Blanca Bayo
Division of Records and Reporting
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

Dear Mr. Tudor,

AT&T is pleased to respond to the Florida Public Service Commission's Request For Proposal (RFP) for statewide Florida Telecommunications Relay Service (FTRS) Docket No. 960598-TP. I certify that I am AT&T's representative authorized to make our proposal. AT&T has a certificate of public convenience and necessity to provide local and interchange service in Florida. We have carefully reviewed your RFP and AT&T has the resources and expertise to comply with all the requirements that have been outlined.

The Florida Public Service Commission (FPSC) can be assured of our service to the deaf and hard of hearing community. AT&T, the first telecommunications company to enter this field, celebrates ten years as a relay provider this year; we have provided operator services for TTY users since 1980. Our users are quite pleased with our service as evidenced by recent customer satisfaction surveys conducted by an independent research firm which place AT&T #1 among national relay providers. We are continuously updating our technology with a focus on customers and quality; AT&T wants relay users to experience a relay call that truly is functionally equivalent to a standard telephone call. AT&T has demonstrated an ability to develop personnel and call centers which replicate and embrace the spirit of service that is critical to satisfying the Relay Service users in the state of Florida.

As requested, we have provided twenty (20) two-sided copies of our technical proposal. The price proposal is submitted in a separate, sealed envelope. Should you have any questions relative to our bid response, please contact Maripat Brennan, National Account Manager, on 908-231-6196. Also, her address and fax number are noted above. Thank you for the opportunity to bid for the provision of Florida Telecommunications Relay Service. We sincerely hope Florida chooses AT&T, the best TRS available!

Sincerely,

Susan P. Hobart

EXECUTIVE SUMMARY

AT&T is pleased to respond to the Request For Proposal (RFP) from the Florida Public Service Commission (FPSC) to provide statewide Florida Relay Service (FRS). AT&T is excited about the opportunity to provide Florida consumers with high quality, customer-focused relay service. We applaud the FPSC's efforts to ensure that Florida residents have access to the most functionally equivalent TRS available in the industry.

10 YEARS OF RELAY SERVICE EXPERIENCE

AT&T celebrates our tenth anniversary as a relay service provider at the end of this year. We have succeeded in the relay business because we have learned from experience - learned that we need to listen to our customers, both the organization that pays for the service and the people who use the service. Today, **almost one third of AT&T's relay service leadership team is deaf**, so our employees are our toughest customers.

We know that customers want **high quality relay service that is reliable, accurate, fast and transparent**. We also understand that they want billing to be compatible with their calling plans - whether local or long distance. The FPSC can expect Florida relay users to receive flexible billing options through their local exchange company, AT&T or other long distance carriers, which means eligibility for all their discount calling plans.

In addition to relay services, AT&T pioneered **Operator Services for the Deaf (OSD), the oldest and largest commercial service nationally available to text telephone users, in June, 1980**. AT&T is the only company providing fully integrated traditional operator services and telecommunications relay service.

HIGHEST CUSTOMER SATISFACTION

AT&T is the only relay provider who can substantiate the **Number One** claim, which is based on annual customer satisfaction surveys of our customers and those of our competitors. In 1995 and 1996 surveys conducted by an independent research firm, **AT&T's relay customers rated us higher than Sprint's or MCI's customers rated them.**

AT&T currently has 19 TRS contracts, including 16 states, the District of Columbia, the Virgin Islands, and Puerto Rico. We operate 11 centers, all of which are managed by trained professionals.

Our TRS state clients are quite pleased with AT&T service. Alabama, Delaware, Georgia, Maine, New York, Pennsylvania, Puerto Rico, the Virgin Islands, Virginia, and Washington have all extended their contracts with us. We are currently negotiating a contract extension in the District of Columbia. Illinois, Kentucky, Tennessee, Vermont and West Virginia remained with AT&T after a rebid process.

We are awaiting a rebid decision in New Jersey. Our newest TRS states are Rhode Island and Mississippi. After competitive bids, AT&T was awarded the contracts in January and August 1996, respectively. Furthermore, the Federal Communications Commission (FCC) has certified all AT&T TRS state programs.

RIGOROUS INTERNAL TESTING

AT&T rigorously tests CA performance through our extensive "mystery shopping" program, in which a consulting firm evaluates all of our centers against each other, and other major providers' centers, and recommends corrective actions. In addition, an annual timing study is performed to measure and compare the length of each component of the call, thereby ensuring optimum efficiency by identifying potential areas of improvement.

FISCAL RESPONSIBILITY

We have learned that a balance must be struck between the service needs of the relay user and the fiscal needs of the FPSC. For this reason, the **price we bid is all-inclusive for the life of the contract.** For example, we have upgraded our equipment to provide state-of-the-art features many times over the past ten years, enhanced methods and procedures frequently, and expanded our outreach programs but the bid price is the only charge to the FPSC.

A PARTNERSHIP

AT&T views the relationship with the FPSC as a partnership in the provisioning of TRS. A survey of our clients would indicate that AT&T has established very favorable relationships with them and provides an excellent price-value equation. Upon award of Florida's contract for Telecommunications Relay Service, AT&T is confident that by working closely with the FPSC we will transition to the new agreement with minimal effort. We are recognized for methods and procedures that will transition operations to calling centers without disrupting relay service. The FPSC can be assured that the Florida relay users will have access to professional, enthusiastic CAs and a superior AT&T technical platform.

SINGLE POINT OF CONTACT

If selected as Florida's TRS provider, Russell Fleming, the Florida Account Manager will oversee the contract, outreach program and education activities. Russell will be the single point of contact for all Florida TRS needs. He will be responsible for managing AT&T's relationship with the FPSC, our outreach partners and the relay users.

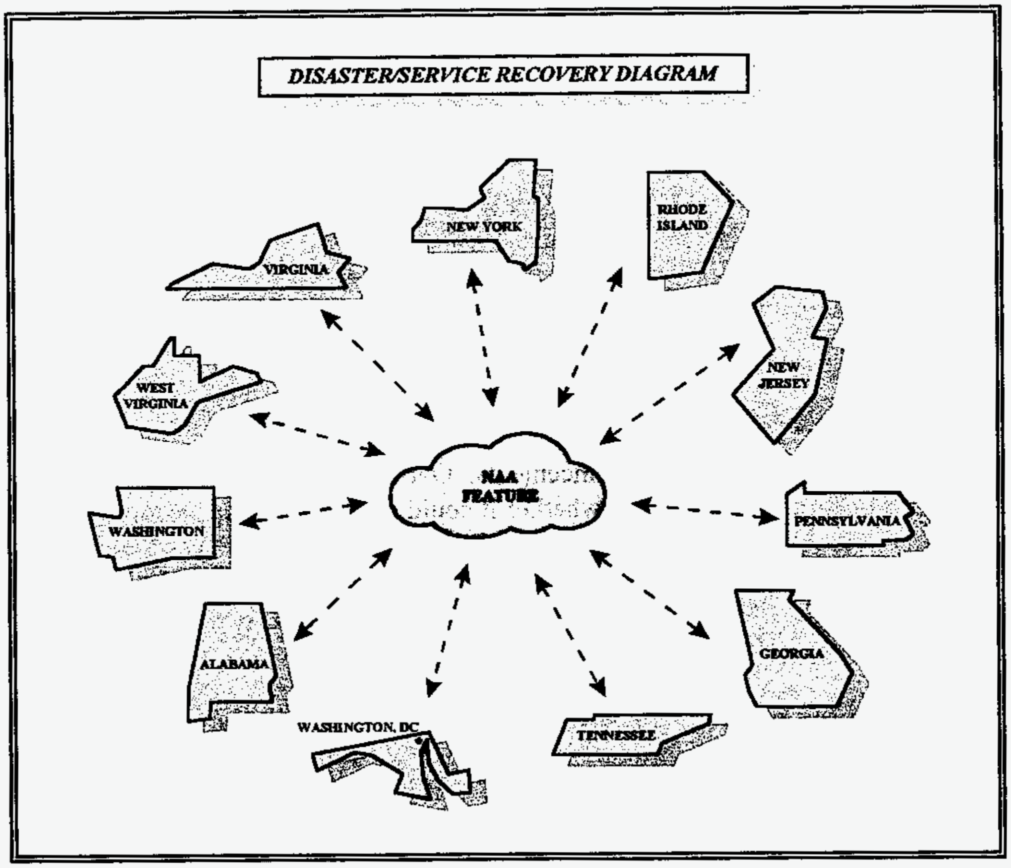
TECHNOLOGY LEADERSHIP

AT&T is the market leader in technology enhancements. Our second generation TRS technology is so sophisticated that a competitor inquired as to whether it could purchase or license the technology from AT&T. Our proprietary Special Network Accessibility Platform (SNAP) was designed to be consistent with our commitment to the needs of relay customers and make call handling as functionally equivalent and efficient as possible. This will benefit Florida relay users by enabling new capabilities and reducing non-conversational call time.

Our SNAP platform was the first to interact directly with the text telephone caller by preparing the dialing sequence and the billing information automatically from the caller's input before the Communications Assistant (CA) comes on the line; the CA presses one key to complete the call. SNAP gives the caller more independence and control over call set-up, and more equivalence with conventional telephone service. The faster set-up means that the overall call length is decreased, thus saving the FPSC "per minute" charges.

AT&T plans to provision FRS through an instate Florida center handling 100% of Florida's traffic. Emergency conditions, as described in Section B.24, will be handled through AT&T's National TRS Network via the Next Available Assistant (NAA) feature. With eleven relay centers, AT&T has more relay centers than any other provider. **The FPSC can be assured that AT&T's NAA feature instantaneously reroutes service when a natural or other disaster occurs.**

The following diagram represents our interconnectivity in the event of a disaster or service recovery.



MOVING TO THE FUTURE

AT&T is absolutely confident that the demonstrated professionalism of our Communications Assistants, the superiority of our leading edge technical platform, the strong community partnerships providing outreach and education and the proven quality of our service will consistently surpass the needs of Florida relay users for years to come. We are equally confident that the working relationship between the Florida Public Service Commission and AT&T will grow strong as we move together toward achieving cost effective, world class service.

AT&T

FILING CHECK LIST

Check List Item No.	Initials of Bidder's Contact Person	Brief Title	Page No. Of Bidder's Proposal	Pass/Fail OR Maximum Points
1.		Format (RFP ref. Section C-1 and D)	NA	N/A
2.		Transmittal Letter, Address, Contact Person, Tel. and Fax No. and Legal Name of Bidder, (RFP ref. C-2)	First Tab	P/F
3.		Check List (RFP ref. C-8 and E)	5	P/F
4.		Certification by FPSC and FCC (RFP ref. A-5) (See Transmittal Letter)		
5.		Can provide by June 1, 1997 (RFP ref. B-3)	11	P/F
6.		Term of Contract (RFP ref. B-4)	14	P/F
7.		Access Numbers (RFP ref. B-5)	15	P/F
8.		Location of Relay Center (RFP ref. B-6)	16	100
9.		Availability of System to Users (RFP ref. B-7)	18	P/F
10.		Minimum CA Qualifications and Testing (RFP ref. B-8)	19	100
11.		CA Training (RFP ref. B-9)	22	100
12.		Staff Training (RFP ref. B-10)	34	100
13.		Counseling (RFP ref. B-11)	36	25

Check List Item No.	Initials of Bidder's Contact Person	Brief Title	Page No. Of Bidder's Proposal	Pass/Fail OR Maximum Points
14.	APW	Procedures for Relaying Communications (RFP ref. B-12)	38	100
15.	APW	Languages Served (RFP ref. B-13)	44	P/F
16.	APW	Shift Advisor/Consultant (RFP ref. B-14)	45	P/F
17.	APW	Confidentiality (RFP ref. B-15)	46	P/F
18.	APW	Voice and Hearing Carryover (RFP ref. B-16)	53	50
19.	APW	Obscenity (RFP ref. B-17)	55	P/F
20.	APW	Emergency Calls (RFP ref. B-18)	56	50
21.	APW	Blockage (RFP ref. B-19)	57	200
22.	APW	Answer Time (RFP ref. B-20)	58	200
23.	APW	Equipment Compatibility (RFP ref. B-21)	60	P/F
24.	APW	Transmission Levels (RFP ref. B-22)	61	P/F
25.	APW	Measuring Equipment Accuracy (RFP ref. B-23)	62	P/F
26.	APW	Emergency Operations (RFP ref. B-24)	63	50
27.	APW	Intercept Messages (RFP ref. B-25)	66	P/F
28.	APW	Service Expansion (RFP ref. B-26)	67	50

AT&T

Check List Item No.	Initials of Bidder's Contact Person	Brief Title	Page No. Of Bidder's Proposal	Pass/Fail OR Maximum Points
29.	AHW	New Technology (RFP ref. B-27)	69	50
30.	AHW	Consumer Input (RFP ref. B-28)	70	100
31.	AHW	Complaint Resolution (RFP ref. B-29)	77	50
32.	AHW	Charges for Incoming Calls (RFP ref. B-30)	79	P/F
33.	AHW	Billing Arrangements (RFP ref. B-31)	80	50
34.	AHW	End User Billing (RFP ref. B-32)	84	50
35.	AHW	Relaying Interstate or International (RFP ref. B-33)	86	50
36.	AHW	End user Selection of Carrier (RFP ref. B-34)	88	50
37.	AHW	Recipient of Toll Revenues (RFP ref. B-35)	90	P/F
38.	AHW	Long Distance Call Billing (RFP ref. B-36)	91	50
39.	AHW	Special Needs (RFP ref. B-37)	93	25
40.	AHW	All Unsolicited Features in Basic Relay Service Price Proposal (RFP ref. B-38)	95	200

Check List Item No.	Initials of Bidder's Contact Person	Brief Title	Page No. Of Bidder's Proposal	Pass/Fail OR Maximum Points
		Optional Services Not In Basic Relay Service Price Proposal		
41.	[initials]	a. Custom Calling Services (RFP ref. B-39a)	107	Optional/0 Points
42.	[initials]	b. 900/976 Services (RFP ref. B-39b)	108	Optional/0 Points
43.	[initials]	c. Enhanced Transmission Speed and Interrupt Capability (RFP ref. B-39c)	109	Optional/0 Points
44.	[initials]	d. Other Optional Features (RFP Ref. B-39d)	110	Optional/0 Points
45.	[initials]	Submission of Monthly Invoice (RFP ref. B-41)	112	P/F
46.	[initials]	Travel (RFP ref. B-42)	113	P/F
47.	[initials]	Reporting Requirements (RFP ref. B-43)	114	P/F
48.	[initials]	Liquidated Damages (RFP ref. B-44)	117	P/F
49.	[initials]	Transfer to New Provider (RFP ref. B-45)	118	P/F
50.	[initials]	Insurance (RFP ref. B-46)	119	P/F
51.	[initials]	Public Entity Crimes (RFP ref. C-3)	121	P/F
52.	[initials]	Financial Information (RFP ref. C-4)	122	P/F
53.	[initials]	Experience and customer references (RFP ref. C-5)	123	200
54.	[initials]	Bid Security Deposit (RFP ref. C-6)	129	P/F

Check List Item No.	Initials of Bidder's Contact Person	Brief Title	Page No. Of Bidder's Proposal	Pass/Fail OR Maximum Points
55.	JAH	Subcontractors (RFP ref. C-7)	130	P/F
56.	JAH	PRICE PROPOSAL (RFP ref. Section D) Must be filed in a separate sealed envelope marked: "Sealed - To Be Opened Only By the FPSC Proposal Opening Officer"	Page 1 Section D Price Proposal	See RFP Sec. D & E
		MAXIMUM TOTAL POINTS		2000

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SECTION B

3. Commencement Date

The commencement date for the service is June 1, 1997. Bidders shall provide a work schedule showing how they can meet that deadline and shall provide a statement that they can provide the complete service by that date.

AT&T Response

AT&T understands and will comply.

FLORIDA RELAY SERVICE IMPLEMENTATION PLAN

Week of:	Trigger	Network & Equipment	Personnel	Outreach & Education
12/15/96 (24 wks. - 6/1/97)	Receive letter of intent	Begin assembling center implementation team	Begin narrowing center manager recruitment	Begin developing potential outreach partner list
12/22/96		Preliminary planning	Continue manager search	Continue list development
12/29/96		Preliminary planning	Continue manager search	Continue list development
1/5/97		Preliminary planning	Interview center manager candidates	Continue list development
1/12/97 (20)	Sign contract Confirm FL requirements	Confirm equipment configuration	Hire center manager; implement hiring and training operations plan	Review potential partner list with FPSC and Advisory Board for input and agreement
1/19/97		Place equipment orders for PBX and CA positions Review and edit floor plan	Begin advertising for supervisors, Communications Assistants, clerical support*	Contact agreed upon potential partners to discuss interest in outreach partnership
1/26/97		Finalize floor plan with operational efficiencies and environmental layout	Continue advertising; implement other hiring activities, i.e., job fairs, college, etc. as required	Continue contacting potential partners

*AT&T will advertise in newspapers local to the current relay service and will hire current FRS staff if they pass our testing and interviewing process.

Week of:	Trigger	Network & Equipment	Personnel	Outreach & Education
2/2/97		Hire appropriate vendors for construction, furniture installation and placement of equipment	Continue advertising, other activities, as required Begin testing, interviewing	Continue contacting potential partners Developing outreach materials
2/9/97		Confirm network requirements; issue orders for network Begin construction	Continue advertising Continue testing, interviewing Begin hiring	Negotiate partnership agreements Continue developing outreach materials
2/16/97 (15)		Begin weekly construction meetings to monitor progress Continue construction	Continue advertising Continue testing, interviewing Continue hiring	Negotiate partnership agreements Review outreach materials with FPSC and Advisory Board
2/23/97		Continue construction Monitor progress	Continue testing, interviewing Continue hiring	Negotiate partnership agreements
3/2/97		Continue construction Monitor progress	Continue testing, interviewing Continue hiring Begin training trainers	Review outreach partnership agreements with FPSC and Advisory Board
3/9/97		Install uninterruptible power supply and generator Begin training room construction	Continue testing, interviewing Continue hiring	Train outreach partners
3/16/97		Begin PBX, SNAP equipment installation Complete training room	Complete hiring Complete training trainers	Train outreach partners
3/23/97 (10)		Begin CA positions installation	Begin 1st set of CA classes, day and evening	Train outreach partners
3/30/97		Continue CA positions installation Install network configuration	Continue 1st set of CA classes	Finalize plan to begin outreach program

Week of:	Trigger	Network & Equipment	Personnel	Outreach & Education
4/6/97	Receive certificate of occupancy	Complete CA positions installation; Begin acceptance testing and protocol procedures	Complete 1st set of CA classes	Work with outreach partners to schedule events, forums, etc.
4/13/97		Continue acceptance testing and protocol procedures	Begin 2nd set of CA classes, day and evening	Begin outreach education on new relay service
4/20/97		Continue acceptance testing and protocol procedures	Continue 2nd set of CA classes	Continue outreach education on new relay service
4/27/97 (5)		Complete acceptance testing and protocol procedures	Complete 2nd set of CA classes	Continue outreach education
5/4/97		Trouble shoot as required	Begin 3rd set of CA classes, day and evening	Continue outreach education
5/11/97		Trouble shoot as required	Continue 3rd set of CA classes	Continue outreach education
5/18/97		Trouble shoot as required	Complete 3rd set of CA classes	Continue outreach education
5/25/97 (1)	AT&T FRS available for calls	Network and equipment completely tested and available for calls	CAs fully trained and available for calls	Complete initial outreach education on new relay service
6/1/97	OPEN CENTER			

4. Term of Contract

Service shall begin on June 1, 1997. The term of the contract will be an initial three year period. Upon mutual agreement between the FPSC and the provider, the contract may allow for the term to be extended for an additional period.

AT&T Response

AT&T understands and will comply.

AT&T

5. Access Numbers

There shall be a single access number for TDD users and a single access number for voice users. TDD access shall be by using the number 800-955-8771 and voice access shall be by using the number 800-955-8770. At its discretion, the provider may utilize a separate number for access by users of ASCII terminals. The provider must request FPSC authority to use additional numbers for relay access (e.g., Spanish access, ASL access, etc.). If a caller calls the wrong access number, the system shall process the call without requiring the caller to redial.

AT&T Response

AT&T understands and will comply.

Besides taking over the TTY and voice 800 numbers from the current provider, AT&T offers a separate ASCII toll-free number to access the relay center.

ASCII users enjoy the fast access to the relay center by using a separate toll-free number instead of coming in on the Baudot line and switching to ASCII. As ASCII speeds increase in the marketplace, AT&T is ready to respond to the user's needs.

In addition, if a relay user should dial the wrong number, AT&T's platform will check for both ASCII and Baudot handshake signals in each and every call set-up.

6. Location of Relay Center

The provider shall not be required to physically locate the relay center in the State of Florida, however, evaluation points will be awarded if traffic is handled at a Florida located relay center. The bidder shall identify the location(s) of the relay center(s) that it plans to utilize to handle Florida relay traffic; if this involves more than one location, the bidder shall identify the locations where relay traffic will be handled, the percentage of traffic it expects initially to handle at each location and how it will decide to allocate the traffic to multiple locations over time.

The minimum percentage of Florida traffic that will be handled at a Florida located relay center (except when emergency conditions exist at the Florida located relay center) shall be specifically stated in the proposal. Evaluation points will be awarded based on this minimum percentage of Florida traffic to be handled at the Florida located relay center. A maximum of 100 points shall be awarded if all Florida relay traffic (except in emergency conditions) is to be handled at a Florida located relay center; if a lesser percentage is to be handled at a Florida located center, then the number of points shall be equal to the percentage of Florida traffic to be handled at a Florida located relay center. For example, a bidder proposing a relay service that will handle 75% of Florida's relay traffic in state (except under emergency conditions) will receive 75 points. Emergency conditions that would justify handling what is normally Florida traffic outside the state would include situations such as natural disasters, bomb threat, etc. and would not include traffic spikes.

Throughout the life of the contract, the provider shall provide a written notification to the FPSC whenever it makes a change in the traffic handling plan contained in its bid proposal regarding how the percentage of Florida traffic handled outside of the state is distributed. The minimum percentage of Florida traffic to be handled at a Florida located center shall not be changed during the life of the contract.

AT&T Response

AT&T understands and will comply.

AT&T will handle all (100%) Florida traffic from a relay center located in Maitland, Florida. The center will be operated in a region of the state that is known for drawing from a rich labor pool (e.g. metropolitan Orlando) and for its ability to provide world-class service. See the pages that follow this section for a picture of the Florida Relay Center and the center's floor plan. Within the available space, AT&T will provide a new relay center environment that is customized to the needs of the residents of the state and tailored to the human needs of the relay center workers. Traffic will be handled by a relay center outside of Florida only in the event of an emergency condition, such as a natural disaster.

See Section B.24 for details on Emergency Operations and Uninterruptible Power. AT&T will subcontract and partner with Matrixx Marketing to support the operations of the relay center. Refer to Section C.7 Subcontractors for details.

The Florida Relay Center, located at *851 Trafalgar Court, Maitland, FL 32751,* will be part of the Lincoln Property Building complex which has approximately 154,000 sq. ft. of leasable space. Approximately 10,000 square feet of space will be secured initially to allow for unimpeded expansion capability to support for growth due to call volume increases. When deciding on a location for the center, AT&T reviewed local infrastructure support facilities, as well as locations near AT&T networking and Bell South offices. In addition to supporting backup power and generator footprints, the AT&T facility will include a facility totally customized to the unique needs of relay center work.

In AT&T's partnership with MATRIXX, the state will benefit by AT&T's leveraging of the experience gained in constructing Relay call centers that handle millions of calls annually, employing 1,100 workers. The facility offers an infrastructure that will support the human needs and comfort of the workers. This is a modern office building which will be tailored to the needs of the Florida Relay Service.

Located in an Orlando suburb, the Florida Relay Center will be a neighbor to the University of Central Florida (UCF). UCF offers classes that specialize in working with people with language and hearing disorders. A clinic is also associated with the university to assist deaf and hard of hearing individuals.

By having access to AT&T's relay service, a rich labor pool and a community sensitive to the deaf, hard of hearing and speech disabled, the FPSC can be assured more efficient operations and a higher level of Florida relay user satisfaction.

*7. **Availability of System to Users***

The service shall be designed to relay local, intrastate toll and interstate and international calls that originate or terminate in Florida. Relay service shall be available 24 hours per day every day of the year.

No restrictions shall be placed on the length or number of calls placed by customers through the relay center.

AT&T Response

AT&T understands and will comply.

8. Minimum CA Qualifications/Testing

The provider shall adequately supervise and train its employees to always be courteous, considerate and efficient in their contact and dealings with its customers and the public in general, and shall make checks from time to time to ensure that courteous service actually is being rendered.

Bidders shall specify how they plan to demonstrate that CAs meet all necessary proficiency requirements. CAs shall be able to quickly and accurately type TDD relay messages. The provider shall use valid, unbiased tests for CAs on subjects including, but not limited to:

a) Basic skills in English grammar.

b) A minimum typing speed of 55 correct words per minute.

c) Minimum spelling skills sufficient to quickly and easily spell words comparable to a beginning college level conversation.

d) An understanding of characteristics of limited written English and American Sign Language (ASL) as it may be reflected in the written language of TDD users.

e) Deaf culture.

f) Ethics, e.g., how a CA deals with situations he may encounter.

g) Confidentiality.

h) Clarity of speech.

Any person who has not passed this examination shall not be utilized as a CA. CAs shall be retested at least annually.

AT&T Response

AT&T understands and will comply.

AT&T understands that relay customers want courteous, considerate and efficient CAs relaying their calls. AT&T's management design provides for effective supervision and training of employees, incorporating a system of service checks to ensure courteous service is always received. A monthly Methods Verification process is in place that ensures the consistent delivery of courteous service and adherence to AT&T methods and procedures.

AT&T has in place a rigorous, unbiased testing process that will assess a CAs skills in meeting the necessary proficiency requirements. To qualify for employment, a CA is required to pass a group of tests. These tests are designed for college level conversation.

They ensure that CAs will be capable of handling a variety of call types ranging from conversations between small children to those which include professionals, such as doctors, lawyers and engineers.

These tests cover numerous topics such as basic skills in English grammar, vocabulary, spelling, reading, comprehension, mathematics, the ability to follow directions and typing.

Before becoming a Florida Communication Assistant, applicants would be required to meet our qualifications on the following tests (Test Standards are strictly adhered to):

a) 12th grade level English grammar - General Comprehension and Ability Screen-Tests English grammar, reading accuracy, following directions, drawing relationships and number grouping.

b) Typing a minimum of 55 correct words per minute - Typing Test - Assesses the applicant's typing speed and accuracy at 55 correct words per minute..

c) Beginning college level spelling skills - Spelling Test - Screens the applicant's spelling skills including knowledge of spelling rules and principles. The applicants must demonstrate ability to quickly, easily, and accurately spell words.

In addition a Customer Service Screen is conducted to accurately and objectively assess customer service skills.

During Initial Training, CAs would be required to pass tests on the following before relaying customer calls.

d) Understanding of Characteristics of limited written English and American Sign Language (ASL) - The CAs will be tested on ability to understand deaf or hard of hearing people using limited English and to translate limited typed English to correct spoken English.

e) Deaf Culture - The CA will be administered a test on knowledge of the deaf culture and be observed and rated on sensitivity and ability to serve and interface with deaf and hard of hearing customers.

f) Ethics - CAs are administered a test on knowledge of rules and policies around our Code of Ethics. CAs must pass this test before relaying customer calls. CAs are assessed both in initial and subsequent training, via role plays and exercises on how they would handle a variety of situations concerning ethics.

g) Confidentiality - CAs are required to sign a personal pledge of both Confidentiality and Code of Ethics before becoming a CA. CAs are also tested on their knowledge of Confidentiality Standards. CAs must demonstrate the knowledge and ability to deliver confidentiality of service before becoming a CA.

h) Clarity of Speech - CAs are assessed on Clarity of Speech in initial and subsequent training. They will be required to pass an assessment on their skill in order to become a CA.

Any person who does not meet and pass these assessments and examinations will not be utilized as a CA. CAs will be retested annually.

9. CA Training

Each bidder shall demonstrate in its proposal how ongoing CA training will be provided by including with its proposal an outline of a proposed CA training plan. The provisions for CA training shall include, but not be limited to, an understanding of limited written English and ASL, deaf culture, needs of hearing and speech disabled and dual sensory impaired users, ability to speak in a tone of voice consistent with the intent and mood of the conversation, operation of relay telecommunications equipment, how to handle hearing and voice carryover, ethics, confidentiality and other requirements of the Provider's operating policies and procedures. Training shall include both simulated and live on-line call handling.

AT&T Response

AT&T understands and will comply.

Provided is an outline of how CA training will be delivered including the CA initial training plan. The training includes education on limited written English and ASL, use of voice to communicate tone and mood, hearing and voice carryover, ergonomics, customer service and the relay service delivery methods and procedures. The Initial Training program called Cross Cultural Training also provides education and awareness of the deaf culture and needs of the hard of hearing. Ethics and Confidentiality training are taught and reinforced at several points in initial and follow up training. Training includes both simulated and live on-line training with a coach.

CA Training Curriculum

When CAs are hired, they first go through an intensive Initial Training Program. At the end of the Initial Training Program, the CAs receive a personal mastery portfolio which allows employees to have unlimited access to information that helps them manage and develop their individual performance on a daily, as well as on going basis. Training is identified and designed from the employee's individual performance plan. AT&T also requires that CAs receive additional training and development each year. Throughout the course, simulated calls are practiced on every call situation, these calls are done in a classroom setting. AT&T also welcomes individuals from the deaf community to be involved in CA training activities.

Training programs are developed and delivered in partnership with deaf members of AT&T's staff and members of the deaf, hard of hearing and speech disabled community.

Outline of Training Curriculum for CAs

- Orientation: Introduction to AT&T and Relay Services
- Cross Cultural Training: Introduction of our Relay Users and ASL training
- Technical Training: Introduction to SNAP
- Ergonomics: Introduction to how Communication Assistants can prevent injuries on the job.
- Customer Service Training: Enhance knowledge of our Customer Service focus, understand the mandates of the ADA, knowledge of the attributes of a high quality call.
- CA Assessment Skills: Once the CA has completed the Initial Training, he/she will take written and hands-on diagnostic tests to analyze areas of development and skill levels. The CAs will have an opportunity to handle live calls with the trainers sitting next to them for coaching purposes. After completing the diagnostics, it will be decided whether the CA would be qualified to handle live calls without the trainers' presence.
- On Going Training: When the CAs receive their individual performance development plan, their training needs are identified and then tools are created for them. Examples of on-going training and tools are:

  Methods and Procedures Job Aids
  Training Tips on Attributes of a Quality Call
  Typing Tutorials
  Ergonomics
  Diversity Training
  Alliance Classes
  Customer Service Training
  ASL and Deaf Culture Subsequent Training
  Upgrades in Technology
  Continual emphasis on confidentiality

  A performance management process is in place to provide continuous coaching and diagnostic exercises. This reinforces the skills developed by the CAs and checks that the CAs apply the skills/knowledge correctly. The training team and management team members are available on a daily basis for coaching purposes.

Following is a more detailed outline:

CA TRAINING

Day 1: CA Orientation and Introduction to Relay Service

- Objectives
- What is Relay Service
- Our Statement of Direction
- Communications Assistant Code of Ethics
- Pledge of Confidentiality
- AT&T's "Our Common Bond"
- A Personal Responsibility (AT&T Code of Conduct)
- Equal Employment Opportunity Policy Statement
- AT&T/ACS Organizational Structure
- Relay Center Policies and Procedures
- Forms and Sign-Up Sheets
- Introduction to Relay Devices
- Open Dialogue
- Evaluation Form

Day 2: Cross Cultural Training

Module 1: Who are your customers?
Who are the relay users and identify the diverse users.

A. Defining terms (Deaf, Hard of Hearing, Late Deafened, Speech Disabled)

B. Richness of Diversity in Communication Needs

Module 2: Window into Deaf Culture
An in-depth discussion of what Deaf culture is all about.

A. Hearing Loss
B. Assistive Devices & Closed Captioning
C. Sign Language
D. Traditions
E. Humor
F. History
G. People with Speech Disabilities

Module 3: Communication Considerations
Identify various modes of communication in the Deaf, and Hard of Hearing, Late Deafened Community

A. How Language is Learned
B. ASL Grammar/Syntax Activity
C. Age of Onset of Hearing Loss
D. Types of Sign Language
E. Translation of ASL
   1. Grammar
   2. ASL translation exercise

Module 4: Making Phone Calls Easy for Everyone
Recognize the importance communication plays in our everyday life and how we are dedicated to making phone calls easily and equally accessible for everyone.

A. Importance of Communication and Accessibility
B. Expectations of Relay Calls
C. Relay Practice Calls/Role Play Activity
D. Videotape: Customer Expectations of a Quality Call

Module 5: Customer Expectations and the CAs Responsibilities
Identify key customer expectations such as: non-intrusion, efficiency, smooth call set up, confidentiality, communication of special circumstances, relevant background noises, emotional tone and spirit, and Code of Ethics in depth

A. TTY Customer Expectations
B. Voice Customer Expectations

Module 6: Text Telephone Devices
Description of how a TTY works.

A. Various brands of TTYs
B. How does it work?
C. How to identify a TTY Call
D. How to make a TTY Call
E. Problem Solving Transmission Difficulties

Day 3: Cross Cultural Training (Continued)

Module 7: TTY Etiquette
Explanation of TTY Etiquette.

A. Etiquette
   1. 5, 10, or 20 Rings
   2. On Hold
   3. Slow Typing
   4. Emotions on TTY
   5. OOPS!
   6. How many SKs
B. Etiquette Differences Among Voice and TTY calls
C. Abbreviations

Module 8: ASL Gloss
Description of what is American Sign Language and its grammatical rules and syntax.

A. ASL Gloss Activity
B. ASL Resources
C. TTY Practice and Role Play
D. More ASL translation exercises

Module 9: Attributes of a Quality Call
Identify TTY etiquette and protocol. Distinguish key elements of a quality call that will satisfy both relay parties.

A. Quality as perceived by customers

B. Attributes of a quality call:

1. Macro CA ID number and gender
2. Make sure a hearing person has used relay before
3. Explains relay service clearly
4. Acknowledges the call in less than 5 seconds
5. Informs TTY caller of status within 10 seconds (ringing, busy)
6. Informs TTY caller of hearing person's gender
7. Provides descriptive, relevant background noise
8. Keep customer informed of progress of call
9. Speaks clearly
10. Speaks at an understandable speed
11. Makes a smooth transition of the relief procedure
12. Keep both customers informed of relief procedure
13. Completes the relief procedure in 25 seconds or less
14. Executes the relief procedure in the correct place
15. Relays accurately
16. Conveys emotional tones
17. Is attentive to what is being voiced
18. Offers to make another call

Module 10: The Relay Process
How to handle various types of calls efficiently such as: computerized machines, switch FPSC operations, neutral facilitation skills.

A. Keep callers apprised of their status while on hold

B. Follow company procedural guidelines

C. Handle calls that involve computerized systems, answering machines, switch FPSC operators

D. Handle calls that involve call refusals

Module 11: The Path Forward
Evaluation, insights, and application of what was learned and identify areas of growth for ongoing CA development.

A. Evaluation and Post Test

B. Sense of commitment to Code of Ethics

Day 4: Technical SNAP Training

Unit 1 Keyboard, Log On and Log Off, Windows
Learning Objectives: After Completing Unit 1, you will be able to accurately and efficiently:

- log on and off of SNAP
- name and locate the SNAP windows
- explain representations by icons
- access all SNAP windows
- practice utilizing windows

Unit 2 SNAP Billing Window
Learning objectives: After completing Unit 2, you will be able to accurately and efficiently complete a billing record including fields and menu options.

Unit 3 Basic Relay, Voice Carryover (VCO), Hearing Carryover (HCO)
Learning Objectives: After completing Unit 3, you will be able to accurately and efficiently:

- complete a basic relay call
- complete a voice carryover call
- complete a hearing carryover call
- transfer the customer

Simulated call practices will be performed.

Day 5: Technical SNAP Training (Continued)

Unit 4 Call Situations
Learning Objectives: After completing Unit 4, you will be able to accurately and efficiently handle:

- sequence calls
- emergency calls
- calling card and bill to third number calls
- answering machines
- international calls
- dialing touch tones
- placing a call using carrier of choice
- directory assistance
- Telebraille calls
- service recovery
- troubleshooting

Unit 5 Infrequent Call Situations and Guidelines
Learning Objective: After completing Unit 5, you will be able to identify and process infrequent call situations and you will become familiar with AT&T and ADA guidelines such as:

- verbatim
- user billed audio text calls
- relay terminology
- branding
- SLAM calls
- calls that terminate to another Relay Center
- one minute hold
- conference calls/Easy Reach 700 numbers
- request for time
- cellular phones
- language line requests
- AT&T Relay Customer Service information line
- PC settings
- USA Direct Calls

- obscene or harassing calls
- 1 800 CALL ATT, 1 800 COLLECT, 1 800 OPERATOR
- AT&T Long Distance Relay

Unit 6 Text-to-Speech (TTS)
Learning Objective: After completing Unit 5, you will be able to accurately and efficiently handle a text-to-speech call by:

- activating and deactivating TTS
- providing an explanation of the TTS feature

Day 6: Ergonomics and Customer Service

Ergonomics (In A.M.)

I. Introduction
   A. The VDT Environment
   B. The Science of Ergonomics

II. Office Lighting
   A. Worker Concerns
      1. Headache
      2. Eye Strain
      3. Other Health Concerns
   B. Screen Glare (Reflected, Veiling, Direct)
   C. Tips for Increasing Eye Comfort
      1. Reposition
      2. Tilt and Swivel VDT
      3. Adjust Monitor Height
      4. Control Window Light
      5. Adjust VDT Screen
      6. Minimize Your Own Reflection
      7. Adjust Task Lighting
      8. Try a Glare Screen
      9. Take Vision Breaks

III. VDT Radiation Emissions

A. Employee Concerns

B. Radiation and Electromagnetic Spectrum

1. Center for Disease Control (CDC) & National Institute for Occupational Safety and Health (NIOSH) Investigations

2. VDT Safety

IV. Office Noise and Acoustics

A. Office Noise

1. Comfortable Noise Level

2. Speech Privacy

B. Acoustic Design and Materials

C. Tips for Controlling Office Noise

V. Repetitive Motion Injuries

A. Categories of RMIs

1. Tendon Injuries

2. Neck and Back Injuries

3. Nerve Compression

4. Bones and Joints

5. Thoracic Outlet Syndrome

B. Prevention

1. Worker Awareness

2. Making the Workstation Fit

3. Ideal Body Position

4. Chair Adjustment

5. Ergonomic Aids

6. Good Work Practices

7. On-the-Job Exercises

VI. Review and Conclusion

Customer Service (In P.M.)

A. Objectives
B. Customer Service Focus
C. The Americans with Disabilities Act
D. Common Elements of Communications
E. Relay Service Performance Standards
F. The Attributes of a Quality Call
G. Important Ways of Communicating with the Customer
H. Standard Relay Phrases
I. How to Handle Challenging Calls
J. Completing a Customer Contact Form
K. Service Recovery

ON-GOING TRAINING CURRICULUM

AT&T requires that CAs receive additional hours of training and development each year. Various elements of the curriculum can include:

- providing service to meet customer expectations
- technical efficiency
- ergonomics
- methods and procedures
- upgrades
- continual emphasis on confidentiality

Throughout the training curriculum, simulated calls are practiced after every call situation. These calls are conducted in the classroom environment. The on-going training curriculum is centered around presentation of new information and then the opportunity for the CA to practice new skills or knowledge. Training is concluded with an assessment of the CAs new knowledge or skill. Follow-up training is provided depending on results of assessment.

Continuous coaching reinforces the CAs skills and verifies that the CAs apply the skills/knowledge correctly. Training team members are available on a daily basis for coaching purposes.

10. *Staff Training*

All relay center staff, including management, shall receive training in ASL, deaf culture, needs of hearing, speech and dual sensory impaired users, and ethics and confidentiality. Each proposal should include an outline of a staff training plan indicating training topics and time frames as well as explaining how individuals or organizations (such as deaf service centers, state agencies, universities, etc.) representing the hearing impaired community would be used to assist with the training.

AT&T Response

AT&T understands and will comply.

All TRS employees, trainers, supervisors and managers attend Orientation, Cross Cultural Training on the needs of deaf, hard of hearing, speech disabled and dual sensory users, diversity workshops, counseling, support and referral skills workshop, basic and intermediate ASL courses and technical training. These courses, workshops and seminars are at the core of the AT&T TRS Staff Training Plan.

Training programs are developed and delivered in partnership with deaf members of AT&T's staff and deaf, hard of hearing and speech disabled community.

AT&T provides its staff with opportunities to attend workshops with state agencies and universities. AT&T has also partnered with state agencies in the development and execution of training.

Once the staff employees have completed the core courses, training and development plans are established for each individual. These plans are tailored to the areas of development, strengths and career plans of each individual.

The following are some of the seminars, courses and training vehicles used in AT&T staff training plans:

- Computer Literacy
    - PC and Word Processing Courses
- Customer Service Training
    - Handling Difficult Customers
    - Resolving Complaints
    - Problem Solving
    - Understanding your Customers

- Personal Development
  - Organizational Skills
  - Time Management
  - Financial Planning
  - Retirement Planning
- Management Training
  - Supervisory Skills
  - Listening Workshop
  - Interpersonal Communications
  - Communication Skills
- Workplace Effectiveness Skills
- Tuition Assistance Plan
  - Program pays tuition for management employees to further their education at colleges, universities and training schools
- Labor Relations
- Methods and Procedures Refreshers
  - One on One
  - Hands On
  - Lecture
- Forcing and Scheduling
- Attendance Administration
- Training Delivery and Development
- Advance ASL Seminars & Certification

The core of AT&T staff training curriculum is provided on the job. The management training outlined, plus courses in labor relations, customer service and additional ASL training are planned for the next six to nine months on the relay assignment. Subsequent training is planned based on the developmental needs of the staff member.

11. Counseling of CAs and Staff

Bidders are required to outline a counseling and support program that will help CAs and staff deal with the emotional aspects of relaying calls. Those providing this staff support shall have training in dealing with the emotional aspects of handling relay calls. However, in counseling sessions, the CA shall not give to the support person the names of callers involved. The counseling support system shall follow the confidentiality provisions of this RFP.

AT&T Response

AT&T understands and will comply.

In each TRS center, there is a support system in place for the Communications Assistants to deal with the emotional aspects of relaying calls. Communications Assistants have access to both professional internal and external counseling and support services. CAs do not give any support person or counselor the names of callers or any other confidential information. They adhere to AT&T's Pledge of Confidentiality.

Internal Support

- Management trained in counseling, support and referral skills
- Resource managers & supervisors are accessible 7 days a week 24 hours a day
- Accessibility to private huddle rooms designed specifically for private counseling sessions
- External referrals to professional support services.
- Extensive training of managers on people with disabilities

External Counseling and Support Services

- Support from internal Employee Assistance Program, (EAP) or external counseling program
- Additional counseling is also available to employees from Employee Assistance Program (EAP) for substance abuse, domestic situations, and any potential distressing situation that may have an impact on the performance of the communication assistant

Relay Service Counseling Process

- All Communication Assistants are informed by resource managers in training of the importance of abiding by the Code of Confidentiality & Ethics.

- Emphasis is placed that if a situation of relaying an emotional call should interfere with the CAs ability to effectively deliver a quality relay call, the CA should request support from the on-call supervisor.
- Another CA or a second supervisor who may be better able to handle the stress will take over the call.
- The CA is then referred to the resource manager
- The resource manager will analyze the situation to determine if he/she can provide the support or refer the CA or employee to professional counseling.

The following are specific actions taken to aid the employee.

1. Resource manager will talk through the situation, listen and provide the private place and time for the CA to work through the situation.

2. The resource manager will then determine if a referral to a medical program is required.

3. If the services of a professional counselor are deemed necessary, a trained professional will meet with the CA immediately and talk through the issue privately.

4. All sessions and subsequent counseling activities are determined based on the specific case.

5. All counseling activities and discussions are confidential, neither the center nor the staff are informed.

6. Employee Assistance Program counselors will then assess the ability of the CA to provide service. A recommendation is made to either return the CA to work, to provide the employee an additional leave of absence or recommend another solution.

7. The employee will return to the center with or without counseling when he/she is assessed to be able to perform the work.

12. Procedures for Relaying Communications

The system shall be designed to convey the full content of the communication. Unless requested otherwise by a user, the CA shall relay all calls according to the following procedures.

AT&T Response

AT&T would be happy to share our complete Methods and Procedures Manual with the proposal evaluators if the contents could be kept confidential. Contact Maripat Brennan, National Account Manager, at 908-231-6196 to review the manual.

a) The method to be used in the system is for the CA to be identified by a number (not name) followed by "M" if male and "F" if female. The provider shall establish a method which will allow identification of the CA in the event a complaint is filed or a user wants to praise the work of the CA.

AT&T Response

AT&T understands and will comply.

AT&T CAs are identified by four numerics, followed by an "M" (male) or "F " (female), for example, CA #1234F (for TTY calls). Internally, AT&T utilizes an easily accessed database to facilitate identification of a CA in the event that a complaint is filed or a user wants to commend the service provided by the CA.

b) The system shall keep the user informed on the status of the call, such as dialing, ringing, busy, disconnected or on hold throughout the call session. The system shall provide feedback to callers on call status within 10 seconds after a caller has provided the number to call and continue to provide feedback until the call is answered.

AT&T Response

AT&T understands and will comply.

The CA simply presses function keys programmed with the various status messages keeping the user well informed on the progress of their call set up.

c) *All users shall have the option of telling the CA what aspects of the call that he/she will handle. For example, the TDD user may voice the call (voice carryover), rather than have the CA do it or the caller may ask that relay be explained as soon as someone answers the call.*

AT&T Response

AT&T understands and will comply.

The user has complete control over the call.

d) *When the call is first answered and at all times during the conversation, the system shall type to the TDD user or verbalize to the non-TDD user verbatim what is said or typed unless the relay user specifically requests summarization. If the CA summarizes the conversation, the CA shall inform both parties that the call is being summarized.*

AT&T Response

AT&T understands and will comply.

We will only summarize the conversation at the request of the relay user.

e) *When the CA is asked to explain relay to a user, the CA shall express the term "explaining relay" to the other user on the call to let them know what is happening rather than transmitting all of the explanation. The CA shall not inform the telephone user that the TDD user is hearing or speech disabled unless the TDD user asks the CA to do so.*

AT&T Response

AT&T understands and will comply.

We would never inform the telephone user that the TTY user is hearing or speech disabled unless the TTY user requests it.

f) When speaking for the TDD user, the CA shall adopt a conversational tone of voice appropriate to the type of call being made and conveying the intent and mood of the message. The CA shall also indicate identifiable emotions by typing those in parentheses, (e.g., he's laughing, he's crying). Any identifiable background noises shall be relayed to the TDD user in parentheses. The CA shall identify to the TDD user, if identifiable, the gender of voice users when they first come on the line. All of the above should be done automatically unless the user asks that it not be done.

AT&T Response

AT&T understands and will comply.

We will deliver the call as requested. If the user does not ever want background noises relayed, the user can choose that option as part of their Relay Choice℠ Profile.

g) CAs shall indicate to the user, if known, if another person comes on the line.

AT&T Response

AT&T understands and will comply.

h) All comments directed to either party by the CA or to the CA by either party shall be relayed. These comments shall be typed in parentheses. However, comments between the CA and a relay user at the beginning of a call which deal with billing information need not be relayed to the other user.

AT&T Response

AT&T understands and will comply.

i) CAs shall verify spelling of unfamiliar proper nouns, numbers, addresses, information about drug prescriptions and other unfamiliar words that are spoken and are to be relayed.

AT&T Response

AT&T understands and will comply.

j) The CA will stay on the line until both parties have terminated the call.

AT&T Response

AT&T understands and will comply.

k) CAs shall not counsel, advise or interject personal opinions or additional information into any relay call. This also means the CAs shall not make any value judgments on the profanity or obscenity or legality of any messages. Furthermore, the CAs shall not hold personal conversations with anyone calling the system.

AT&T Response

AT&T understands and will comply.

AT&T CAs have been trained not to counsel, advise, or interject personal opinions or additional information into any relay call as indicated in FCC Guidelines as well as in AT&T's Code of Ethics. Furthermore, CAs shall not hold any personal conversations with anyone calling the Florida Relay Service even when prompted by customers except to extend a polite and concise response of "Thank You" if a relay user comments on a job well done.

l) CAs will leave messages on answering machines or other voice processing systems using the following steps:

xiii. The CA will relay any message received from the called party's machine/system.

xiv. If the caller transmits a message, the CA shall attempt to leave the message and advise the caller if the machine/system timed out before completing the message. At the caller's request, the CA shall make as many repeat calls as necessary at no cost to complete the message

AT&T Response

AT&T understands and will comply.

CAs will leave messages on answering machines or other voice processing systems if the standard phone or TTY user reaches one while making a call and the answering machine or voice processing systems allows the caller to leave a message.

- The CA will inform the caller that an answering machine has been reached and will transmit to the caller the full content of the outgoing message, unless otherwise directed by the caller.
- The CA will not ask the caller if he/she wishes to leave a message but will instead be guided by the caller's direction since asking would require the CA to violate the Code of Ethics by adding information to the message being relayed.

- The CA will translate the caller's complete message to the machine either by voice or by TTY.

- The CA will confirm to the caller that the message has been left.

- The caller will only be charged for one call regardless of the number of re-dials required to capture the full outgoing message and/or leave a message.

m) CAs will retrieve messages from voice processing systems and relay a TDD message to a voice user or a voice message to a TDD user. The provider shall have procedures for obtaining any necessary system access codes from the user and keeping that information confidential. Upon request by a user, the CA shall listen to messages on the user's own answering machine (e.g., at his home while the user is at home) and shall relay back contents of such messages to the user.

AT&T Response

AT&T understands and will comply.

AT&T CAs have been trained in procedures for retrieving messages from voice processing systems and then relaying the text message to the non-TTY user or voice message to the TTY user where the caller remains on the line. CA procedures include:

- Notifying the caller that a voice processing system has been reached and relaying the complete outgoing message or information.
- Securing the system access codes from the caller to complete call processing.
- Transmitting any additional prompts, messages, or information.
- Completing the call as requested by the caller.
- The caller will be charged for only one call (last call) regardless of the number of attempts in retrieving the messages in their entirety.

In addition, AT&T will provide a special service called Single Line Answering Machine (SLAM) which allows customers who have only one telephone line to call the Relay Center and request to have their messages retrieved and delivered from their answering machines without the need to remain on the line. The caller will only be billed one call regardless of the number of attempts for the entirety of the messages. Key procedures for the SLAM service are outlined below:

1. Customer at home calls Florida Relay and requests messages to be retrieved from home answering machine.

2. CA gets call details and asks caller to hang up and allow answering machine to pick up on call back.

3. CA calls and retrieves messages.

4. CA calls customers back and delivers a summary of messages.

n) Users shall not be required to give their names or the name of the party they are calling, unless needed for billing.

AT&T Response AT&T understands and will comply.

o) For each incoming call, the CA shall without delay make as many outgoing calls as requested by the caller.

AT&T Response AT&T understands and will comply.

We do not limit the number of calls or the length of calls.

p) If a user requests that a CA of a specific gender be used, the system shall comply whenever possible.

AT&T Response AT&T understands and will comply whenever possible.

q) If a user requests that the same CA be used during the entire conversation, the system shall comply whenever possible.

AT&T Response AT&T understands and will comply whenever possible.

13. Languages Served

At all times, the provider shall make available CAs with the capability to provide relay service to users who use either English, Spanish or ASL (American Sign Language) on their relay call. Translation from one language to another is not required.

AT&T Response

AT&T understands and will comply.

AT&T provides Relay Service to customers who use either Spanish, English or American Sign Language (ASL) on their calls.

CAs are trained and routinely provide ASL translating on relay calls. Training is introduced in the Initial and Cross Cultural Program. ASL skills are further developed during coaching, developmental and Advance ASL courses.

In addition, multilingual operators are available through AT&T Language Line℠. AT&T Language Line Services give access to professional interpreters in over 260 languages and dialects instantly, including Spanish, French, German, Polish, Japanese, as well as Thai, Korean, Swedish and Chinese at an additional cost. Relay users may use the AT&T Language Line to assist them in any foreign language needs they have. The caller must understand English.

14. Shift Advisor/Consultant

On each shift the provider shall employ in the relay center at least one person who is highly knowledgeable of ASL in order to serve as an advisor/consultant to assist CAs in understanding the intent of messages and properly communicating the full content of communication.

AT&T Response

AT&T understands and will comply.

AT&T will provide at the Florida Relay Center persons who are highly knowledgeable of ASL. These employees will serve to advise, coach and consult CAs on the intent of the relay customer's message and how to effectively communicate the full content of ASL communications.

15. Confidentiality of Calls

As required by s.427.704(1)(c), F.S., all calls shall be totally confidential; no written or electronic script shall be kept beyond the duration of the call. CAs and supervisory personnel shall not reveal information about the content of any call and, except for the minimum necessary for billing, complaint processing, statistical reporting or training purposes as further described in this RFP, shall not reveal any information about a call. CAs and supervisory personnel shall be required to sign a pledge of confidentiality promising not to disclose the identity of any callers (except for the reasons discussed in this section) or any information learned during the course of relaying calls, either during the period of employment as a CA or after termination of employment.

a) When training new CAs by the method of sharing past experience, trainers shall not reveal any of the following information:

i. names of the parties to the call

ii. originating or terminating points of specific calls

iii. specifics of the information conveyed

b) CAs shall not discuss, even among themselves or their supervisors, any names or specifics of any relay call, except as necessary in instances of resolving complaints, bill processing, emergencies or for training purposes. CAs may discuss a general situation with which they need assistance in order to clarify how to process a particular type of relay call. CAs should be trained to ask questions about procedures without revealing names or specific information that will identify the caller.

c) Watching or listening to actual calls by anyone other than the CA is prohibited except for training or monitoring purposes or other purposes specifically authorized by the Commission. FPSC staff shall be permitted to observe live calls for monitoring purposes but shall also comply with the confidentiality provisions above.

d) A copy of the Confidentiality Policy shall be provided to a user upon request and at no cost.

AT&T Response

AT&T understands and will comply with items a - d.

AT&T understands that Florida customers expect the same level of confidentiality and convenience as standard telephone users. Confidentiality is crucial to the success of relay service and must be strictly adhered to. Florida relay users must have the confidence in their service and know that their privacy is protected.

- To ensure customer privacy, we do not maintain written or electronic scripts of any conversation. CA and TTY typing appears on the screen only during the conversation and is automatically cleared when the conversation is terminated. The TRS system records retains the minimum information necessary for billing purposes only. The billing information is sent downstream and is no longer accessible by the CA.

- CA and supervisory personnel do not reveal any information about any call, including the fact that the call occurred. Only in the instances of resolving complaints or when a CA is having difficulty with a call, can the call be discussed. However it must be done without revealing the names, gender, ages, or numbers of either party.

- CAs are required to adhere to the rules of confidentiality during the training process. Trainers are trained to present scenarios and procedures without revealing names or specifics about the callers. All CAs are then required to sign a Pledge of Confidentiality promising not to disclose the identity of any caller, fellow CA, or any information learned during the course of relay calls. Following is a copy of the Pledge of Confidentiality. This applies during the period of employment as a CA and after termination of employment. A copy of the Confidentiality Policy shall be provided to a user upon request and at no cost.

- All CA and supervisory personnel must adhere to the AT&T Code of Ethics and will keep all communicated information strictly confidential. Following is a copy of the Code of Ethics.

- All employees must adhere to additional company policies, practices, and instructions, as well as legal and common sense standards that govern workplace conduct. Following is a copy of Our Common Bond.

CODE OF ETHICS
AND
COMMUNICATIONS ASSISTANT'S
PLEDGE OF CONFIDENTIALITY

CODE OF ETHICS

1. Communications Assistants will keep all call information strictly confidential. The only exception to this is if a call has to be transferred to another CA or the Support Desk.

2. Communications Assistants must never give out customer's telephone numbers.

3. Communications Assistants must never give out information about themselves except their gender and CA number.

4. Communications Assistants will convey the content and spirit of the speaker.

5. Communications Assistants will not counsel, advise, or express personal opinions. The CA may be asked to describe the tone of voice of the Voice Party.

6. Communications Assistants, as employees of AT&T, will strive to maintain high professional standards in compliance with the Code of Ethics.

PLEDGE OF CONFIDENTIALITY

I, the undersigned Communications Assistant for the AT&T Telecommunications Relay Service, do hereby recognize the serious and confidential nature of this position and therefore promise in all good faith and conscience to abide by the following guidelines:

1. Under no circumstances will I disclose to any individual the identity of any caller or information I may learn about the caller while relaying his/her messages.

2. Under no circumstances will I act upon any information I may learn while relaying.

3. Under no circumstances will I disclose to anyone the names, schedules, or personal information of any fellow Communications Assistant or supervisor working here at the AT&T Telecommunications Relay Service.

4. I will share upon request any information about the caller with persons who have a supervisory function over my work.

5. In the event of my resignation or termination of my employment, I will continue to hold in strictest confidence all information related to the work I have performed as a Communications Assistant.

Name (*sign*) ______________________________

Name (*print*) ______________________________ Date ____________________

CONFIDENTIALITY POLICY
PRIVACY OF COMMUNICATIONS

Over the years, privacy of communications has been basic to AT&T's business, not only because it is required by law, but because the public has placed its trust in the integrity of AT&T's people and service. All AT&T customers have the right to expect and demand that their conversations are kept private.

With the ever increasing volume of data transmission over the network, this trust has taken on a special significance at AT&T. Today it is the responsibility of every AT&T employee to protect not only the privacy of conversations on the network, but also the flow of information in data form, that in the wrong hands could have serious economic or legal consequences for the parties involved.

Our basic rules for privacy have not changed. Violating any one of them could tarnish a reputation AT&T has worked hard to maintain over many years. The basic rules are:

- Don't tamper with or intrude upon any transmission, whether by voice, non-voice, or data.
- Don't listen to or repeat anyone else's conversation or communication, or permit them to be monitored or recorded except as required in the proper management of the business.
- Don't allow an unauthorized person to have access to any communication transmitted over AT&T facilities. This includes divulging information about who was speaking or what was spoken about, except as authorized by the customer or required in the proper management of the business.
- Don't install or permit installation of any device that will enable someone to listen to, observe, or realize that a communication has occurred, except as authorized by an official service or installation order in accordance with Company practices.
- Don't use information from any communication, or even the fact that a communication has occurred, for your personal benefit or for the benefit of others.
- Don't disclose information about customer billing arrangements, or the location of equipment, circuits, trunks, and cables to any unauthorized person.

Contact the AT&T Corporate Security Organization if you believe that the privacy of any communication has been compromised, or if you receive a subpoena, court order, or any other type of request for information from anyone (including law enforcement and other government agencies) concerning any AT&T service.

OUR COMMON BOND

We commit to these values to guide our decisions and behavior

RESPECT FOR INDIVIDUALS - We will treat each other with respect and dignity, valuing individual and cultural differences. We will communicate frequently and with candor, listening to each other regardless of level or position. Recognizing that exceptional quality begins with people, we will give individuals the authority to use their capabilities to the fullest to satisfy their customers. Our environment will support personal growth and continuous learning for all AT&T people.

DEDICATION TO HELPING CUSTOMERS - We will truly care for each customer. We will build enduring relationships by understanding and anticipating our customers' needs and by serving them better each time than the time before. AT&T customers can count on us to consistently deliver superior products and services that help them achieve their personal or business goals.

HIGHEST STANDARDS OF INTEGRITY - We will be honest and ethical in all our business dealings, starting with how we treat each other. We will keep our promises and admit our mistakes. Our personal conduct will ensure that AT&T's name is always worthy of trust.

INNOVATION - We will believe innovation is the engine that will keep us vital and growing. Our culture will embrace creativity, seek different perspectives and risk pursuing new opportunities. We will create and rapidly convert technology into products and services, constantly searching for new ways to make technology more useful to customers.

TEAMWORK - We will encourage and reward both individual and team achievements. We will freely join with colleagues across organizational boundaries to advance the interest of customers and shareowners. Our team spirit will extend to being responsible and caring partners in the communities where we live and work.

By living these values, AT&T will achieve a standard of excellence worldwide that will reward our shareowners, our customers, and all AT&T people.

Signed

Name Date Manager

16. Voice and Hearing Carryover

Provider shall provide both voice and hearing carryover upon request of the user. A TDD user may request voice carryover (VCO) which will allow him/her to speak directly to the telephone user and receive the message typed back on the TDD. Also, a TDD user may request hearing carryover (HCO) which will enable the TDD user to directly hear what the telephone user is saying and type back his/her message which will be spoken by the operator.

The provider shall provide 2-line VCO which will allow a relay user with two telephone lines and a conferencing feature to use one of his lines for a TDD call to the relay center and his second line for a voice call directly to the called party using the relay center line.

The provider shall make provision for two persons who are hearing disabled to speak for themselves by means of voice carryover to voice carryover (VCO to VCO) and for two persons who are speech disabled to hear for themselves by means of hearing carryover to hearing carryover (HCO to HCO).

AT&T Response

AT&T understands and will comply.

AT&T was the first to recognize customers' need for expanded voice carryover service, and in 1994 responded by introducing Voice to Voice[SM] Relay. Voice to Voice provides VCO users more choices, e.g., two hearing disabled relay customers may use relay service without typing. If AT&T is selected as the Florida Relay provider, AT&T will provide Voice to Voice Relay. Voice to Voice users will have the ability to connect in acoustic and direct connect TTY modes.

In addition, AT&T will provide Voice to Voice users the ability to access the Florida Relay using voice communications without the TTY transmission that is normally required to set up a relay call. In order to do so, users will need to presubscribe to our Relay Choice[SM] customer profile database. This will enable those users the option of turning the service on and off at will.

Also, AT&T will provide relay service for 2-line VCO calls. This occurs when a VCO user facilitates two lines from their home/office and the CA will type the hearing person's responses only. No CA interaction besides this functionality is necessary.

The following matrix lists AT&T's currently offered Voice and Hearing Carryover features. See Section B.38 for other services offered to Florida.

AT&T

AT&T TRS SERVICE FEATURES

Feature	*Description*
Carryover Preference	Part of the Relay Choice^{SM} Profile, SNAP will automatically activate VCO or HCO for both outbound and inbound calls through relay.
Hearing Carryover (HCO)	HCO enables TTY users who can hear to directly hear the voice person's message. The CA then voices the TTY user's typed response back to the voice caller.
Hearing Carryover with Privacy	This feature allows for more call privacy, because the CA does not hear the voice part of the conversation.
Hearing to Hearing Relay (HTH)	HTH expands the HCO capability by allowing two speech impaired individuals to hear the CA read the typed conversations.
Two-line Voice Carryover	A customer with conference calling capability on his or her phone line can utilize the Two-line VCO feature by using one line for voicing and the other for receiving Baudot or ASCII transmission. Since the Two-line VCO user is directly connected to the hearing party, the Two-line VCO user can talk directly to the hearing party without waiting for "GAs," and without alternately picking up and putting down the handset. This feature allows for a more natural, interactive relay call.
Voice Carryover (VCO)	VCO enables TTY users who can speak to voice their message directly to the non-TTY user. The CA then types the non-TTY user's response back to the TTY user.
Voice Carryover with Privacy	This feature adds privacy to a VCO call; the CA does not hear the VCO user's part of the conversation.
Voice to Voice Relay (VTV)^{SM}	This feature expands the VCO capability by allowing two hearing impaired individuals to voice their parts of a call while the CA types for both parties. VTV is ideal for two TTY users who can speak but who may not know how to type or may be physically unable to type.
Voice Carryover to Text (VTT)	VTT allows a relay call between a VCO user and TTY user. The VCO user voices to the CA who proceeds to type the message to the TTY user. The CA then types the TTY user's response to the VCO user.

17. Obscenity Directed at the Operator

CAs do not have to tolerate obscenity directed at them. A proposal should specify how the provider will handle these situations.

AT&T Response

AT&T understands and will comply.

AT&T CAs are not required to tolerate obscenity directed at them prior to, during, or after a relay call. CAs have been trained to attempt to direct the caller back to the processing of the relay call. If the obscenities continue in a manner that obstructs the CA from relaying the call in a quality manner, the CA will excuse the other party and will refer the customer causing the obscenities to the supervisor. The supervisor will take over the call and handle the situation appropriately. The situation will be documented and kept on file for future reference. In some cases, if we have a repeat offender, it will be reported to AT&T Corporate Security and the Florida Public Service Commission will also be notified of the situation.

18. Emergency Calls

Although most of Florida is covered by 911 communication centers prepared to handle TDD calls directly, the bidder shall develop and follow a policy for handling and referring emergency calls. The policy may include procedures for referring callers to emergency services and numbers other than 911.

AT&T Response

AT&T understands and will comply.

AT&T provides CAs with immediate and direct access to a database that contains emergency agency listings. Using the caller's ANI, the CA can quickly secure the emergency agency listing and complete the relay call which allows for immediate emergency attention. Each emergency call is given the CAs undivided attention. A supervisor works with the CA in any emergency call situation. CAs will do whatever is necessary – including passing the caller's telephone number and other details to the emergency agency – to ensure the rendering of emergency service.

19. Blockage

Provider is responsible for ensuring that 99% of calls reaching the relay center per day are either answered or continue to receive a ringing signal.

Provider is also responsible for ensuring that 97% of monthly random inbound test calls initiated by FPSC staff from various Florida locations are either answered or continue to receive a ringing signal.

Calls that are blocked must receive a network blockage signal of 120 impulses per minute.

AT&T Response

AT&T understands and will comply.

AT&T Telecommunications Relay Services Grade-of-Service is the same as that required for Toll & Assistance Operator or other critical Attendant Services. Officially, this equates to a 99% success rate during the eleventh busiest hour annually (365 days x 24 hours). However, actual call handling capacity is realistically much better. The service access is engineered with an additional fifteen percent to provide above contracted grade-of-service. This accommodates facility ordering intervals and facilitates growth and/or unexpected service demands. Also, a review of utilization data (available upon request) indicates that TRS centers may run between 60 to 75 percent of capacity to expedite any service recovery situation.

If trouble does occur in the AT&T network, a signal set to 120 cycles per minute will be provided to all callers.

20. Answer Time

Provider is responsible for answering 90% of all calls per day within 10 seconds of reaching the relay switch. Elapsed time is calculated from the time inbound calls reach the relay switch. In calculating the percentage of calls meeting the answer time standard, the numerator shall be the total number of calls per day that are answered (with a CA ready to serve) in 10 seconds or less. The denominator shall be the total number of calls per day reaching the relay switch except that the total shall not include calls abandoned within 10 seconds after reaching the relay switch. However, calls abandoned after 10 seconds shall be included in the denominator. (Exception: If the Provider is unable to differentiate between calls abandoned within 10 seconds and those abandoned after 10 seconds of reaching the relay switch, then all abandoned calls shall be included in the denominator.)

Provider is also responsible for answering 90% of random inbound FPSC staff test calls per month within 20 seconds after the last digit is dialed. Test calls may be initiated from various Florida locations by Commission Staff.

AT&T Response

AT&T understands and will comply.

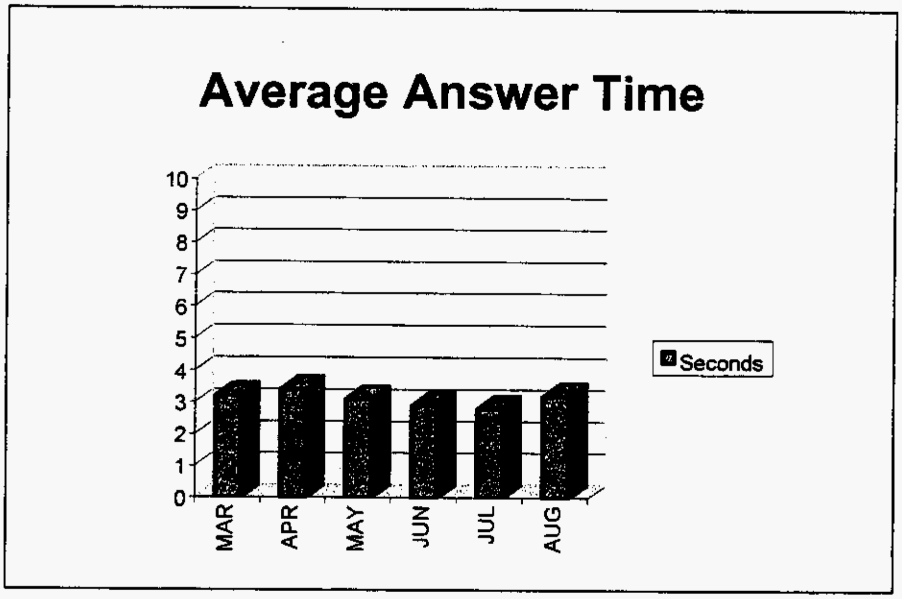
AT&T answers 100% of Baudot and ASCII calls immediately with system ready to accept call details. Ninety percent of all callers (Baudot, ASCII and voice) are connected to a CA ready to serve within 10 seconds. In fact, the average connect time is about 3 seconds.

AT&T can identify calls abandoned after 10 seconds and will include them in the denominator of the answer time calculation.

AT&T's Accessibility Management Staff (AMS) is rich with experience matching call demand with human resources. They monitor and record call volume trends that vary by time of day, day of week, holiday, time-change, season, school year and other calendar events. They are able to build models using this historic data which equip them to predict future calling trends with great accuracy.

By successfully modeling calling trends, AMS is able to match resources to meet calling demand and deliver superior answer time results consistently.

During the last 6 months, AMS has allowed AT&T to deliver answer time results for its customers with remarkable consistency.



As you can see, while AT&T commits to delivering relay service such that 90% of all calls are answered in 10 seconds, calls consistently average about a 3 second answer time.

21. Equipment Compatibility

It is necessary for the system to be capable of receiving and transmitting in both Baudot and ASCII codes as well as voice. It is also required that relay systems be capable of automatically identifying incoming TDD signals as either Baudot or ASCII. All equipment shall be compatible with the basic protocol of TDDs distributed in Florida through the Administrator (Ultratec Model Nos. 100, 200, 400 and 4425 and Ameriphone Dialogue VCO).

AT&T Response

AT&T understands and will comply.

AT&T's platform facilities use only Ultratec modems. In establishing a platform, AT&T reviewed and tested the modem vendors that were the main providers in the industrial and residential marketplace. In all our test protocols, Ultratec continued to be the best source of quality modems. AT&T's platform will connect to Ultratec models 100, 200, 400, 4425 and the Ameriphone Dialogue VCO phone with no difficulty or extend connect timeframes.

22. Transmission Levels

Transmission levels must be maintained within industry standards for crosstalk and distortion for relay calls. Bidder must provide along with its proposal a copy of transmission level standards adopted by the Industry Carrier Compatibility Forum or equivalent acceptable industry standards. Provider must provide updates to those standards as amended during the term of the contract and must meet the then current standards for 95% of calls per month as measured from an end user's perspective.

Transmission shall be at adequate volume levels and be free of excessive distortion. The total levels of noise and crosstalk shall be such as not to impair communications.

AT&T Response

AT&T understands and will comply.

The PBX system transmission characteristics AT&T will comply with is the American National Standards Institute/Electronic Industries Association (ANSI/EIA) PBX standard TIA/EIA - 464B. At any point in time, revisions are made to this standard, AT&T will amend all copies to signify the change and implement theses changes while maintaining 95% of calls per month.

Also, AT&T's network and PBX are completely digital and will not incur distortions, noise, or crosstalk in any relay conversation.

Please see the technical proposal binder marked ORIGINAL for the transmission standard.

23. Measuring Equipment Accuracy

Every meter, recording and ticketing device used to capture call details for billing subscribers or the FPSC/Administrator as well as for providing traffic information shall be tested prior to its installation and shall be accurate 97 percent of the time to within a 1 second grace period. All equipment shall be maintained in a good state of repair consistent with safety and adequate service performance.

AT&T Response

AT&T understands and will comply.

24. Emergency Operations and Uninterruptible Power

In addition to a minimum of thirty (30) minutes battery capacity sufficient to operate each relay center processing Florida relay traffic at busy season busy hour load, each relay center shall have installed emergency power generating equipment capable of maintaining the relay center's operations for extended periods of time. The uninterruptible power system shall support the switch system and its peripherals, switch room environmental (air conditioning, fire suppression system, emergency lights and system alarms), operator consoles/terminals, operator work site emergency lights, and Call Detail Record recording. Provisions shall be made to meet emergencies resulting from failure of power service, sudden and prolonged increases in traffic, storms, lightning, etc. Employees shall be instructed as to the procedures to be followed in the event of emergency in order to prevent or mitigate interruption or impairment of relay service.

The bidder shall describe its plan for dealing with all types of natural and man-made problems (e.g., hurricanes, lightning strikes, fires, etc.) which either isolate the relay center and prevent calls from reaching the center or cause the center to be unable to operate. In addition, the plan should detail the steps which will be taken to deal with the problem and restore relay service.

The provider shall inform the contract manager of any major interruptions to the operation of the relay center extending beyond five minutes duration. The contract manager shall also be informed when it becomes known to the relay center that any portion of the state is isolated for more than five minutes from the relay center. The provider shall also provide a report after restoration of service.

AT&T Response

AT&T understands and will comply.

Uninterruptible Power Supply (UPS)

All of AT&T's current relay centers, as well as our planned center in Maitland, are equipped with generators. In the event of a power failure in a center, there is sufficient backup power to support the switch, its peripherals and adjuncts until the generator reaches full power in approximately 30 seconds. The generator and UPS support the switch room environmentals (e.g., air conditioning, fire suppression systems, emergency lights, and alarm systems) and the CA work site emergency lights, consoles/terminals and call detail recording. Our system will generate sufficient public power to operate until power is restored.

AT&T's relay system architecture incorporates multiple levels of automated power backup. The first tier in the architecture, including our PBXs, is engineered with individual internal power battery packs which provide automatic and instantaneous power backup in the event of any normal public power failure. This design prevents even momentary loss of power which might otherwise interrupt customer service.

A second tier of automated power is a top quality Best℠ uninterruptible power supply system in every one of AT&T's Relay Centers. Each UPS is capable of providing power for an extended period of time, until the third tier of automated power backup takes over. This power backup unit ensures that even in the rare occurrence of a possible failure in any component's internal UPS, the system wide power is automatically and continuously maintained.

Disaster Recovery Plan

AT&T implemented Next Available Assistant (NAA) to ensure virtually uninterruptable customer service in the event of natural or man-made disasters. With NAA, calls are instantly and automatically routed to other AT&T centers with available CAs. (Following is a chart showing AT&T's vast network of centers.)

All of our relay centers are equipped with backup power and services to ensure virtually uninterrupted relay service. The ultimate goal of the Disaster/Service Recovery Plan is 100% up time and no service level degradation.

The cause for service interruptions can be natural or man-made. The affected element could be the center itself, cable between the center and the local telephone company service office, or cable between AT&T offices. In each of these instances, the AT&T TRS Network strives to ensure that customers receive high quality relay service.

AT&T has several plans for ensuring uninterrupted service including:

1. AT&T's Accessibility Management Staff monitors our service around the clock

2. AT&T's Next Available Assistant (NAA) automatically detects failure and reroutes calls

3. Each center is equipped with a generator for power backup

4. The equipment has a duplicate common control

5. An inventory of spare parts are always on-site

6. SNAP technology supports automatic emergency transfer

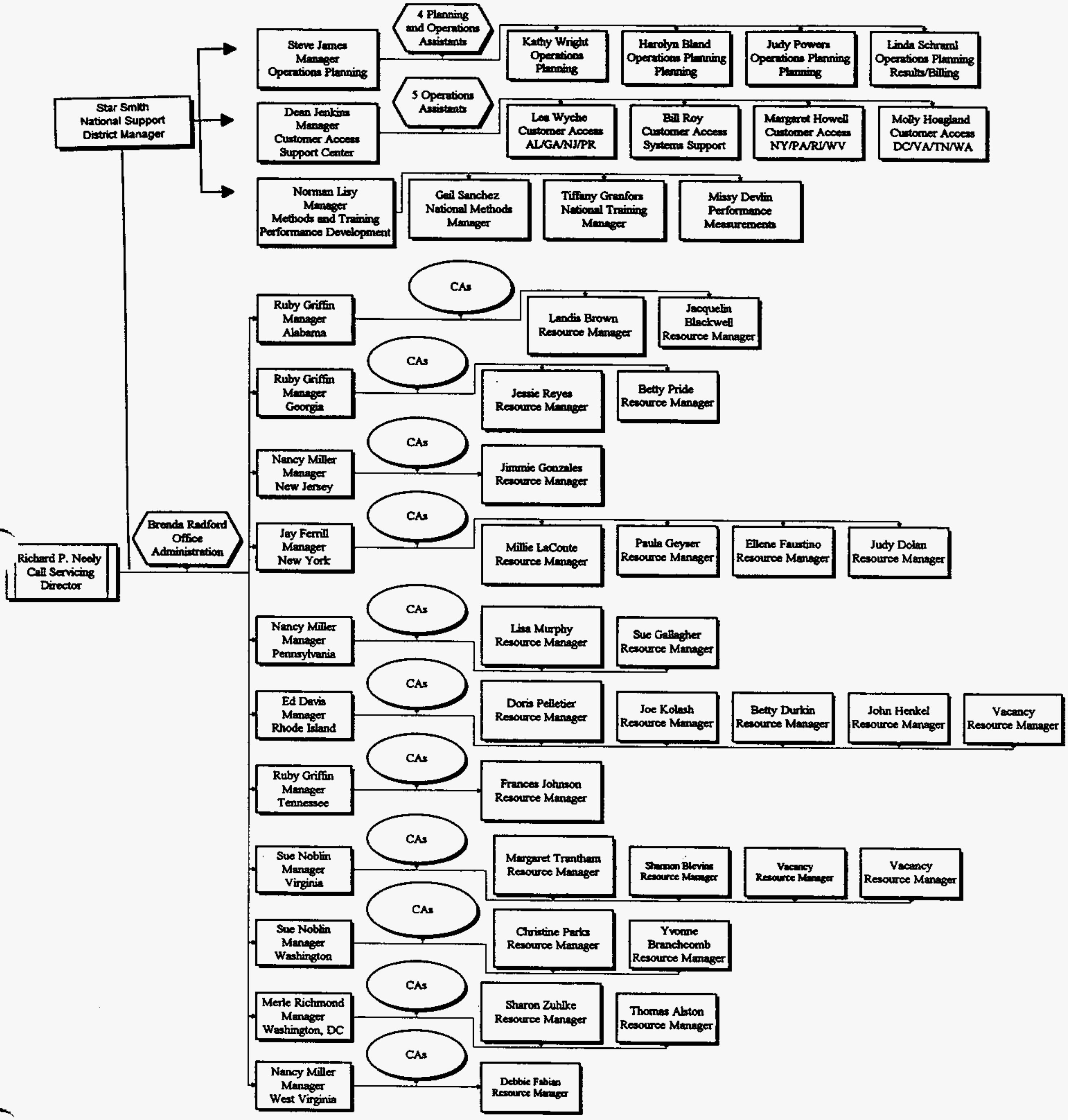
7. AT&T's Service Recovery Plan provides relay center backup

8. Intercept messages

9. AT&T has the most reliable network in the industry

As part of AT&T's disaster recovery procedure, contact will be made to the contract manager of any major interruptions lasting longer then five minutes within one hour of the occurrence. When AT&T becomes aware that a portion of the state cannot reach the relay center, the contract manager will also be informed within that same hour. Reports of location outages will be provided to the contract manager after restoration of the location outage.

TRS SERVICE DELIVERY



25. Intercept Messages

Intercept messages as appropriate shall be provided if a system failure occurs.

AT&T Response

AT&T understands and will comply.

AT&T has provisioned numerous network messages in the event that any of our relay centers develop difficulties in completing calls. These messages are in Baudot, Voice, ASCII and Spanish format and cover acts of nature, work stoppage, weather delays or technical difficulties. These messages are initiated to inform customers of potential delays in call completion.

Following are sample intercept messages:

1. Thank you for calling. We are currently experiencing technical difficulties. Please try your call later.

2. Thank you for calling. Due to emergency conditions, we are unable to answer your call at this time. Please try your call again later.

3. Thank you for calling, Due to extreme weather conditions we are unable to answer your call at this time. Please try your call again later.

26. Service Expansion

Bidder shall show the capability of expanding services in response to increasing demand. Bidder shall develop and illustrate in its proposal a detailed plan of how this expansion will be accomplished. The plan shall include, but not be limited to, trunking capacity, CA work stations, personnel staffing and equipment capacity. The plan shall also indicate how any time lag shall be avoided to meet any increased call volume. The above plans shall allow the provider to be able to maintain all standards listed in the RFP.

AT&T Response

AT&T understands and will comply.

Our service management teams are charged with maintaining sufficient space, furniture, equipment, network, hardware, software and qualified personnel to provide the required levels of service. The service managers review center traffic information on a daily basis and utilize the data to update the current trend and growth projection. AT&T is not only concerned with maintaining a high level of service, but is firmly committed to expanding and improving upon its service. When AT&T designs and builds a relay center, certain parameters are part of the basic design. To illustrate this point, each relay center has approximately an additional 20 percent of center capacity over and above the highest forecasted call volumes for the next year.

With this as a starting point, AT&T will continue to review traffic volumes on a daily basis, as well as forecast potential volumes month by month. This daily review will include, but will not be limited to, the amount of available CA positions, the current workforce headcount, network capacity, modem availability and PBX usefulness. If any of these items falls below a 10% cushion, AT&T will immediately take the necessary steps to build the capacity limits into the 15 to 20 percent arena. This plan may include:

- Testing and hiring additional staff
- Placing orders for additional network capacity
- Installation of additional positions for call handling
- Placing more modems in the platform
- Building more capacity in the PBX carriers

It is expected that the buffer will be maintained in the Florida Relay Center will not interfere with the service levels and operation of the daily relay traffic.

The growth projections for Florida will be based on historical traffic information, recent traffic trends and economic projections for the United States, Florida and regions within the state.

This on-going process allows TRS center management to anticipate growth and to prepare for that growth. As expansion becomes necessary for FRS, a time table will be established and procedures will be initiated to procure the necessary equipment, network capacity and personnel. Regular updates will be given to the state as the implementation process begins. The ultimate goal of this process is to ensure that the required levels of service are always maintained.

27. *New Technology*

The users should be allowed to benefit from advancing technology. Bidder should describe the methodology and process it will use to keep abreast of technological changes in the provision of relay service, to inform the FPSC and Administrator that new enhancements are available and at what price, and to provide the FPSC the opportunity to purchase such enhancements or upgrades to the service.

AT&T Response

AT&T understands and will comply.

AT&T generally works on an annual development cycle with a minimum of one major release per year. We refer to this process as the Product and Feature Realization Process, which begins with a conception of a new idea and ends when it is integrated into the relay system for customer use. Throughout this process we will work closely with the FPSC, the Advisory Board and users of the relay system to ensure the needs of consumers are balanced with the fiscal needs of the FPSC.

With ten relay service patents to its credit, AT&T has a proven track record of pioneering many of the relay industry's premier features, e.g., Next Available Assistant (NAA), Upfront Automation (customer initiated dialing) and the SNAP system.

We credit our success as the leader of innovative technologies to the highly collaborative team process we enjoy among our engineers, product managers, marketing managers and account managers. This team works collectively with feedback received from our State Administrators, Advisory Boards, consumer surveys, Relay Customer Service and community forums to make their ideas into reality.

While we can design custom applications for our states (at prices agreed to in advance), we typically design our features in a universal manner so that all of our state customers can benefit from them. When states agree to "universally" designed applications that become a part of AT&T's Basic Service Offering, e.g., NAA and the Relay Choice℠ Profile, there is no additional cost passed to the state. In fact, many of our features have resulted in more efficient calls, therefore bringing cost savings to our states.

28. Consumer Input and Participation in Advisory Committee and FPSC Proceedings

The telephone users shall have input on the quality of the delivery of service. Bidders shall develop a plan to include the Commission and its Advisory Committee in any evaluation of the system. A bidder shall not include travel or per diem costs of the FPSC or its Advisory Committee in its bid price since those costs will be funded by State. An outline of this plan shall be included with the bidder's proposal. The plan should explain methods for consumer input and how the recommendations from these evaluations will be incorporated into the policies of the relay center. This does not preclude the provider from conducting additional internal evaluations which use relay staff. The results of any service quality evaluation shall be reported to the FPSC office quarterly.

Bidders are encouraged to include in the consumer input plan methods for working with organizations serving hearing and speech impaired individuals statewide to conduct periodic community forums. The community forums shall be for the purpose of gaining user input on the quality of relay service and for responding to user questions and problems on use of the relay service. The community forums shall be planned and conducted in conjunction with organizations serving people with hearing and speech impairments.

The provider shall participate in all meetings of the Advisory Committee and all FPSC workshops and hearings relating to relay service unless excused by the contract manager.

AT&T Response

AT&T understands and will comply.

AT&T strongly believes in Florida users providing input on the quality of our relay service.

Customer Satisfaction Tools

AT&T's Consumer Input Plan includes the following measurement tools for obtaining a balanced assessment of the quality of AT&T Relay Service in meeting our Florida users' needs:

- Mail Survey - A mail survey is conducted annually by an independent research company (deKadt Marketing & Research, Inc.). The objective is to measure users' satisfaction with AT&T Relay Service compared with that of users of competitors' services. The surveys are mailed to users throughout the country, and Florida users will receive the surveys after implementation of the Florida Relay Center.

- Call Handling Measurements - Hundreds of test calls are placed through all AT&T relay centers, and the Sprint and MCI National Relay Centers. This annual testing uses twenty different scripts. The objective is to measure the strengths and weaknesses of the AT&T Relay Service on key areas of call handling.

- Methods Verification - The AT&T Relay Operations organization places a minimum 30 calls monthly to each of the 11 AT&T Relay Centers. Five different methods are selected and verified each month. The objective is to ensure that our Communications Assistants are processing calls the way they should. The Florida center will be added to this monthly program.

These three measurement tools will provide the needed assessment of the quality of our Florida Relay Service. The data results, along with direct feedback from the Advisory Committee and the Commission monthly test call program allows for development of action plans which focus on improving and clarifying methods and procedures, developing new or remedial training to introduce or reinforce CA skill and knowledge, and identifying potential new features and functions to improve the nature of relay calls. These tools are primary vehicles for understanding current performance and achieving continuous and sustained improvement.

Community Forums

AT&T will conduct periodic community forums throughout the State of Florida with organizations serving the hearing and speech disabled. We conduct such forums in our current relay states and believe they are an excellent way of receiving direct consumer input on the quality of service and understanding the needs of the community. We also use these forums to address consumers' questions and introduce new relay services and features. Forum feedback contributes to the development of new relay features as well.

We would work with the FPSC, the Advisory Committee and the organizations to determine the number of forums and a schedule that would ensure extensive state coverage.

Advisory Committee and FPSC Participation

AT&T's Florida Account Manager, Russell Fleming, would be an active participant in all Advisory Committee meetings and FPSC workshops and hearings relating to relay service. If for any reason Russell is unavailable, then Kelly Stephens, AT&T Account Support Manager or Maripat Brennan, National Account Manager would support Florida's activities. See the following pages for background on Russell Fleming, Kelly Stephens, Maripat Brennan and Sue Decker, the TRS Product Manager.

Russell Fleming
AT&T Florida Account Manager

Russell Fleming joined AT&T Relay Services in 1991 as the Georgia Outreach/Resource Manager. His role was to provide initial and on-going training to Communication Assistant and staff and was responsible for additional duties, including marketing, educating and promoting AT&T Relay Services to Georgia consumers. As the Outreach Manager, Russell developed programs with a variety of agencies serving the deaf, hard of hearing, deaf-blind, speech disabled and other disabled communities.

In 1994, Russell added outreach responsibilities for the state of Alabama. Similar to his activities for the state of Georgia, Russell partnered with agencies to ensure that consumers in Alabama realized the benefits of AT&T Relay Services. Russell became Account Manager for Alabama and Georgia in 1995. His new responsibilities include assuring contract compliance with the Public Service Commission as well as oversight of the outreach partnerships in both states. He has also led many projects for the AT&T Relay Services Account team. Russell's experience with these two medium size states prepare him well for his next assignment as the Florida Account Manager.

Russell is an alumnus of Athens State College in northern Alabama. He is a member of Alabama Association of the Deaf, Georgia Association of the Deaf, former Secretary of Georgia Association of the Deaf, member of National Self Help for the Hard of Hearing and the Personnel Chairperson for the Georgia Council for the Hearing Impaired. He is currently pursuing a Masters Degree in Adult Education.

Kelly J. Stephens
AT&T Account Support Manager

Kelly Stephens joined AT&T Relay Services as the New Jersey Outreach/Resource Manager in 1991. Her primary role was to generate and promote awareness about TRS on a statewide basis through presentations and marketing to targeted segments. She also interfaced with many key advocates and organizations to solicit consumer input to ensure that the quality of relay services was maintained.

Kelly became a Resource Manager for the relay center in the District of Columbia in June 1993. She provided support for approximately 140 Communications Assistants and managed various functions, such as training design and delivery, job performance, policy enforcement and customer relations.

In October 1995, Kelly moved to AT&T's Accessible Communications Service business unit as Account Support Manager. Her responsibilities included supporting and directing the Account Mangers in contract compliance, project management, implementation of state plans, and ensuring that state customer needs are met.

Kelly is an alumna of the National Technical Institute for the Deaf (NTID) and continues to be involved in NTID alumni activities. She is currently on the committee for the NTID Leadership Campaign. Kelly is also active in community advocacy such as the New Jersey Association for the Deaf and Deaf Awareness Week, Inc. She is the AT&T representative on the TDI 1997 national convention committee.

Maripat Brennan
AT&T National Account Manager

After twelve years in sales and marketing positions in New Jersey Bell Telephone, Maripat Brennan joined AT&T in 1982. As Product Manager for System 75 PBX, she determined customer requirements for new product releases. During the mid-80s, she worked extensively in branch office operations, including the Business Automation Platform effort that implemented consistent office automation equipment and software in all business sales offices. In 1988, Maripat moved to Government Affairs where she directed activities associated with AT&T's relationship with Southwestern Bell Corp., Alltel and Contel telephone companies.

Maripat began supporting AT&T's relay services in November, 1991, working state regulatory and legislative activities concerning TRS. In 1994, she became the TRS National Account Manager (NAM), responsible for ensuring contract compliance in all AT&T relay states. She continues as NAM but her responsibilities have expanded to include national sales and outreach/education. Located in New Jersey, Maripat manages a team of nine deaf and hard-of-hearing Account Managers who are the primary points of contract for all state related relay activities. Equally important to assuring continued excellent state relationships is the role Maripat plays in the development of these managers in support of their progression within the AT&T corporate structure.

During the past two years, Maripat has traveled extensively, attending several state association conventions as well as the 1996 Self Help for Hard of Hearing and National Association for the Deaf national conventions. She has participated in the National Association of State Relay Administration (NASRA) national annual meetings and regularly attends the semi-annual meetings of the Interstate TRS Advisory Council.

Sue Decker
AT&T TRS Product Manager

Sue Decker joined AT&T Relay Services in 1993 as the Marketing and National Outreach Manager. Her primary role was to manage the outreach managers and help them generate and promote awareness of TRS on a statewide and national basis. Since joining AT&T, Sue has had experience in a variety of AT&T units, including Consumer Products Marketing. She has also been Product Manager of AT&T's line of Accessible Telephone Products (i.e., amplified handsets and TTYs).

In 1996, Sue became the AT&T TRS Product Manager. Her responsibilities include developing new features and maintaining the existing relay product features.

Sue was a charter member of AT&T's National Special Needs Center as a Service Representative. In that role, she helped deaf and other disabled AT&T customers throughout the country understand the changes brought on by AT&T corporate restructuring. In the Summer of 1994, Sue was selected for a special assignment in Bulgaria to project manage AT&T's sponsorship of the World Games for the Deaf. In Bulgaria, she helped to rebuild Bulgaria's telephone system. Her efforts brought operator and relay services to American athletes and expatriates.

AT&T

29. *Complaint Resolution*

The provider shall establish procedures regarding complaints, inquiries and comments regarding system services and personnel. The provider shall ensure that any caller to the relay center having a complaint will be able to reach a supervisor or administrator while still on line during a relay call. All complaints received by supervisors or in writing shall be documented, including their resolution, and kept on file and available to the Commission upon request. In addition, the relay center shall have a toll-free Customer Services telephone number available and accessible to the public statewide for the purpose of reporting service or other deficiencies. Records of such reports and copies of written reports regarding service or other deficiencies shall be maintained for the life of the contract and for twelve (12) months after conclusion of the contract period. This record shall include the name and/or address of the complainant, the date and time received, the CA identification number, the nature of the complaint, the result of any investigation, the disposition of the complaint and the date of such disposition. Each signed letter of complaint shall be acknowledged in writing or by contact by a representative of the provider. The necessary replies to inquiries propounded by the Commission's staff concerning service or other complaints received by the Commission shall be furnished in writing within fifteen (15) days from the date of the Commission inquiry.

AT&T Response

AT&T understands and will comply.

AT&T recognizes customer feedback as a true measure of the success of our service. Therefore, AT&T has established procedures that allow users of the Florida TRS to express their comments, inquiries, complaints and commendations about the relay service and personnel. The information will be documented, along with resolution, kept on file and reported to the Florida Public Service Commission (FPSC) upon request. Resolution of complaints will include procedures that allow for appeal to the FPSC. All complaint information will be kept confidential. These procedures will be explained in appropriate FRS outreach and information materials.

If a customer comments unfavorably about the service and the CA believes that customer satisfaction can be achieved immediately, the CA will attempt to do so. Additionally, if the CA has difficulty handling the call and believes that an extended discussion is needed, or that the matter requires management involvement, the CA will offer to immediately connect the call to a manager/supervisor or administrator while on line.

Briefly described below are the procedures on complaint resolution:

On-line Transfer - The procedure includes immediate, on-line transfer to a manager/supervisor or administrator trained in complaint, comment, and inquiry handling. Managers and supervisory personnel abide by the same Code of Confidentiality as Communication Assistants.

When the manager/supervisor receives the on-line transfer or critical comment from the customer, the manager proceeds as follows:

1. Prepares a customer contact memorandum
2. Considers the complaint from the customer's point of view
3. Resolves the criticism as satisfactorily as possible
4. Does not hesitate to escalate the complaint to the next higher management level if needed
5. Documents the investigation and resolution
6. Follows up with the customer to ensure satisfaction with resolution

Nationwide 800 Customer Number - AT&T operates a separate, nationwide, toll-free published 800 number accessible to both TTY and voice users. This service is available 24 hours a day and allows users to call with questions, comments, commendations, and complaints regarding the relay service.

Acknowledgment - Each signed letter of complaint will be acknowledged in writing or by contact by a representative of AT&T. AT&T will respond in writing and within 15 days to the Commission on any complaint or inquiry received.

Records of customer contacts and copies of written letters regarding service or other concerns will be maintained for the life of the contract and for twelve months following the expiration date of the contract. This record will include the name and/or address of the complainant, the date and time received, the CA identification number, the nature of the complaint, the result of any investigation, the disposition of the complaint, and the date of such disposition.

All complaints received by supervisors or in writing will be documented, including their resolution, and kept on file and will be available to the FPSC upon request.

AT&T

30. Charges for Incoming Calls

The Provider shall make no charge to the users for making calls (incoming) to the relay service.

AT&T Response

AT&T understands and will comply.

Calls to the Florida Relay Service (FRS) will be handled at no cost to the person making the call. Customers will access the Florida Relay Service via a toll free 800 number. No portion of the expense of calls to the Florida Relay Service will be charged to the caller.

31. Billing Arrangements

Provider shall bill for charges for collect calls, person-to-person calls, calls to or from hotel rooms and pay telephones, and calls charged to a third party. Provider shall also arrange for billing to any industry standard local exchange company or alternative local exchange company calling card. For calls billed by or on behalf of the provider, the bidder shall include a complete description of how users will be billed for all calls. This description shall include the bidder's procedures for obtaining billing information from the local exchange and alternative local exchange companies, whether the billing will be performed directly by the provider itself or contracted, specific credit cards or telephone calling cards to which calls can be billed, and a sample bill format. The bidder shall also explain how it will respond to customer inquiries about erroneous bills and how credits will be issued or refunds made.

AT&T Response

AT&T understands and will comply.

AT&T has the capability and technology to provide billing for direct distance dialed and alternate billed calls to include the handling of AT&T calling cards, collect calls, person-to-person, calls to or from hotel/motel rooms, pay telephones, major credit cards and calls charged to a third party.

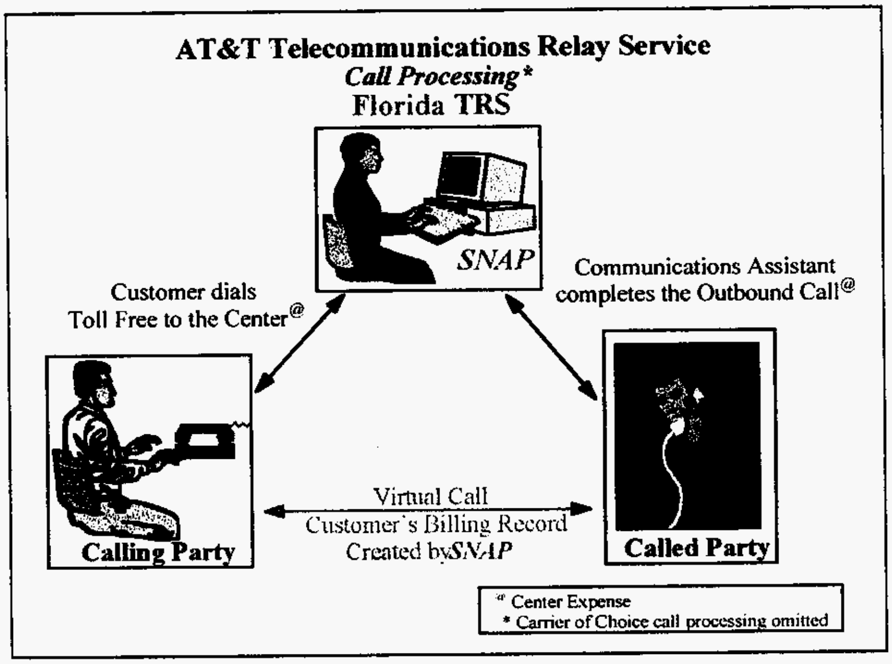
AT&T currently processes calls to proprietary calling cards which can be validated via an 800 number platform and/or the TRS Carrier of Choice platform. To our knowledge, all proprietary calling cards meet the criteria for one of these two scenarios. However, if a LEC provisions a calling card with non-standard access or validation methodology, a unique solution must be established. AT&T is committed to working with any LEC to establish a method of billing to its proprietary calling cards.

Call Processing

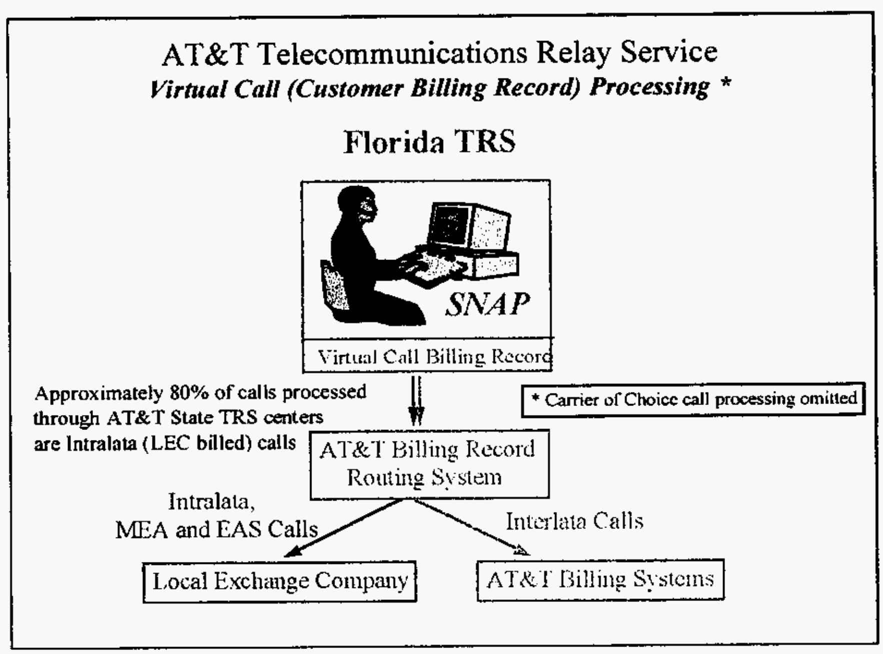
Users of the Florida Relay Service will be billed in the following manner.

The customer will access the Florida Relay Service toll free via the published numbers.

AT&T's patented SNAP platform automatically captures all call information pertaining to the billing of relay calls, and creates a Virtual Call billing record as illustrated in the following figure. AT&T will create for each relay assisted call an Exchange Message Interface (EMI) record as described in Bellcore Publication SRISD 000320. See **Billing Record**, in this section, for additional detail.



The AT&T rated Message Telecommunications Services "Virtual" TRS record and the Local Exchange Carrier's local recorded Message Telecommunications Services "Virtual" TRS record will be transmitted to the appropriate billing contractors via existing electronic transmission procedures, see the following illustration.



The receiving billing contractor will be responsible for establishing the necessary internal procedures for billing the calls and collecting the associated revenue. The user will be charged for a point-to-point call per his/her carrier's tariffed rates, charges, and applicable discounts.

Local and intraLATA TRS messages will be printed on the customer's LEC portion of the bill.

AT&T interLATA and international messages will be printed on the AT&T portion of the LEC bill.

The charges will appear on the end user's bill as a direct-dialed, point-to-point call.

AT&T messages can be billed to the AT&T Universal Card, American Express Card, Diner's Club Card and Master Card.

Billing Record

AT&T will create for each AT&T and Local Exchange Company (LEC) Message Telecommunications Services (MTS) relay assisted call an Exchange Message Interface (EMI) record as described in Bellcore Publication SRISD 000320. The record will contain, at a minimum, the following information:

a) Telephone number or calling card to be billed (NPA-NXX-LINE).

b) Originating Telephone Number (NPA-NXX-LINE).

c) Terminating Telephone Number (NPA-NXX-LINE).

d) Date

e) Start Time

f) End Time (the time when either the called party or the calling party hangs up).

g) Length of call to the nearest full second (the amount of time in between start time and end time).

h) The phrase "VIA Relay" will be populated in the "TO" place on the billing record.

The following is a sample bill format.

Sample Bill Format

AT&T

XYZ TELEPHONE COMPANY

XXX-555-1212-123 May 1, 1996 Page X

AT&T DETAIL OF ITEMIZED CALLS

NO.	DATE	TIME	PLACE		AREA-NUMBER	*	MIN	AMT
1	APR 1	1015AM	TO VIA RELAY	NJ	609-XXX-XXXX	E	15	X.XX
2	APR 1	223PM	TO ATLANTA	NJ	404-XXX-XXXX	E	5	X.XX
3	APR 5	947PM	TO VIA RELAY	MT	406-XXX-XXXX	N	5	X.XX
4.	APR 9	1034PM	TO ORLANDO	FL	305-XXX-XXXX	E	5	X.XX

CALLING CARD

1.	APR 1	1015AM	TO VIA RELAY	NJ	201-XXX-XXXX			
			FR WASHINGTON	DC	202-XXX-XXXX	EC	8	X.XX
2.	APR 12	444AM	TO BROOKLYN	NY	718-XXX-XXXX			
			FR ANYTOWN	DC	202-XXX-XXXX	DC	18	X.XX

KEY *-RATE APPLIED:

D -DAY E -EVENING
N -NIGHT/WKEND DC -DAY CALL CARD
EC -EVENING CALL CARD

AT&T TOTAL ITEMIZED CALL CHARGES XXX.XX

Responses to customer inquiries about erroneous bills will be handled as follows:

- Local call charges - the customer will be referred to his/her Local Exchange Company's business office. Calls can be made via relay or directly through a LEC TTY number, if available.

- AT&T call charges - the customer will be referred to the AT&T Long Distance Service Center. Calls can be made via relay or directly through the AT&T TTY number.

Credits will be issued by the customer's Local Exchange Company or the AT&T Long Distance Service Center.

32. End User Billing for Intrastate Calls

Intrastate toll calls placed through the relay system and billed by or on behalf of the provider shall be billed to the voice or TDD caller at 50% of the provider's rate for non-relay calls. An additional 10% discount (60% total discount) shall apply to calls to or from the dual-sensory impaired; the provider shall develop a system for identifying such users and applying the discount to their calls. Timing for timed intrastate call billing shall begin when the relay operator advises both parties to proceed and shall not include any initial time by the operator to explain how relay service works.

The bidder shall explain how its discount toll plan subscribers would be billed for relayed calls billed by or on behalf of the provider. For example, if a bidder offers a discount for over 5 hours of usage per month, the bidder should explain how a subscriber to that service would be billed for any relay calls made during the month.

The provider shall not charge the end user more for non-message toll relay calling than would be charged for the same call if billed by the end user's local exchange or alternative local exchange company. The provider can accomplish this by obtaining necessary billing information about the end user's local company in order to ensure that it does not bill in excess of those rates (e.g., extended area service calls, extended calling service calls, etc.)

In the alternative, the provider can collect necessary billing information and turn that billing information over to the end user's local company so that the end user's local company can bill for relay calls under the local company's rates. If this alternative approach is taken, the provider shall submit the billing information to the local company in an industry standard format and the provider shall incur whatever costs are required to correctly format the billing information so that the local company can bill the calls.

Of the two approaches described above, the bidder should indicate how it will initially bill calls and the provider shall advise the contract manager whenever it changes billing methodologies.

AT&T Response

AT&T understands and will comply.

Discount Toll Plan Subscribers

Intrastate calls placed through the Florida relay service will receive a 50% discount of standard toll charges for hard of hearing customers and a 60% discount for dual impaired customers.

LEC Calls

Historically, most TRS calls are recorded as LEC relay billing records. AT&T's SNAP system automatically records the basic information needed to bill customers. LEC billing records created in SNAP are sent, unrated, to the appropriate LEC via existing, industry standard, electronic transmissions feeds. This allows customers to be billed by the same company which would bill the customer's "non-relay" call. The customer's LEC can include calls in the customer's basic service charge, apply discounts, calling plans, etc. based on its own tariff, without an exchange of customer specific billing data. The LEC also bills and collects the revenue from the customer as its own, including calls billed to non-proprietary LEC calling cards.

AT&T Calls

When AT&T is the chosen carrier, AT&T's SNAP system automatically records the basic information needed to bill customers. AT&T records created in SNAP are sent to the same AT&T billing system which would bill a similar "non-relay" call. AT&T messages will be rated by AT&T using the appropriate FCC tariffed rates for interstate and international TRS calls and using the AT&T Florida tariff for intrastate relay calls. Relay calls are included in AT&T discounts, optional calling plans and promotions.

Carrier of Choice Calls

Alternate IXC calls are processed via TRS carrier of choice functionality. AT&T will capture the customer's call detail and billing information and then transmit the call information via trunks to the other interchange carrier's network. The chosen carrier will be responsible for completing, recording and establishing the necessary internal procedures for billing the calls and collecting the associated revenue. This functionality allows the IXC carrier of choice to create, rate, apply discounts, bill the call detail records and collect the revenue.

The benefit to the above billing arrangements, which are already in place today, is that AT&T's billing method ensures that customers receive exactly the same rate as hearing customers for all their LEC, IXC and AT&T calls, less any applicable discounts. Also, relay usage can be combined with <u>any</u> calling plan for <u>any</u> company.

33. Relaying Interstate and International Calls

The provider shall be required to relay interstate and international calls that originate or terminate in Florida. The provider shall not include in its bill for Florida relay service any charges or time associated with interstate or international calls.

If relayed interstate or international calls are to be billed by the provider to the end user at a rate higher than the rate for a nonrelay call, the provider shall quote the rate to the party to be billed before beginning the call. The bidder should indicate how its rate for interstate and international calls will compare to the rate for nonrelay calls and whether any discounts will apply to interstate and international relay calls.

AT&T Response

AT&T understands and will comply.

As mentioned in Section 32 (on the previous pages), AT&T messages will be rated by AT&T using the appropriate FCC tariffed rates for interstate and international TRS calls. Relay calls are included in AT&T discounts, optional calling plans and promotions.

Outbound international calls are processed in the same manner as intrastate and interstate calls. See Section B.31, Call Processing, for further details.

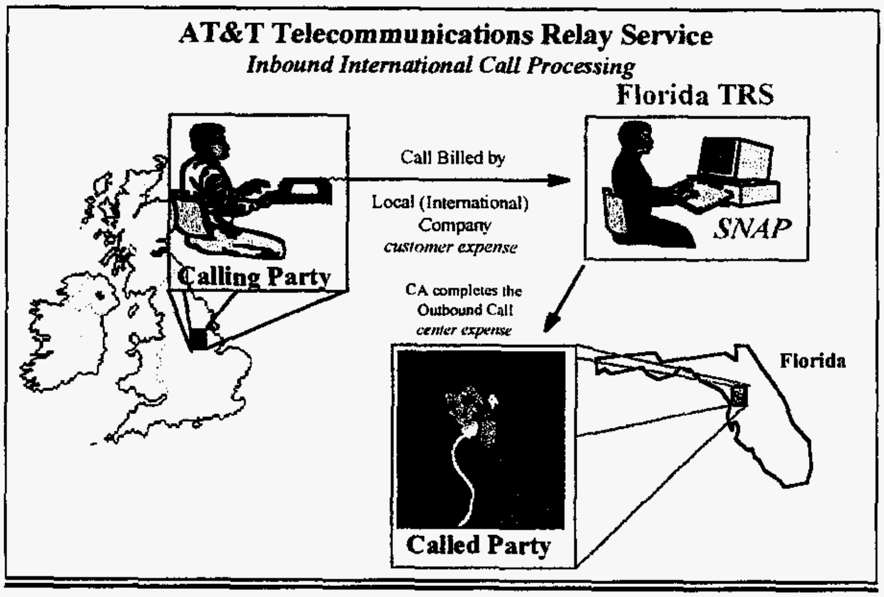
INBOUND INTERNATIONAL CALLS

Call Processing

From an international location, customers access the Florida Relay Service via a normal Plain Old Telephone Service (POTS) number. This call is billed by the telecommunications carrier providing service at the international location. Upfront automation in SNAP populates the forward number based on customer input for call completion purposes. The CA reviews the customer's request and set up and then completes the call. When the call is connected to the called party, the CA begins to relay the conversation.

Billing

Customers originating the call via the POTS line are billed by their local (international) telecommunications carrier. Any method of billing accepted by that (international) carrier can be used. The Florida Relay Service incurs the expense for call completion from the center to the called party. See the following illustration.



34. End User Selection of Carrier

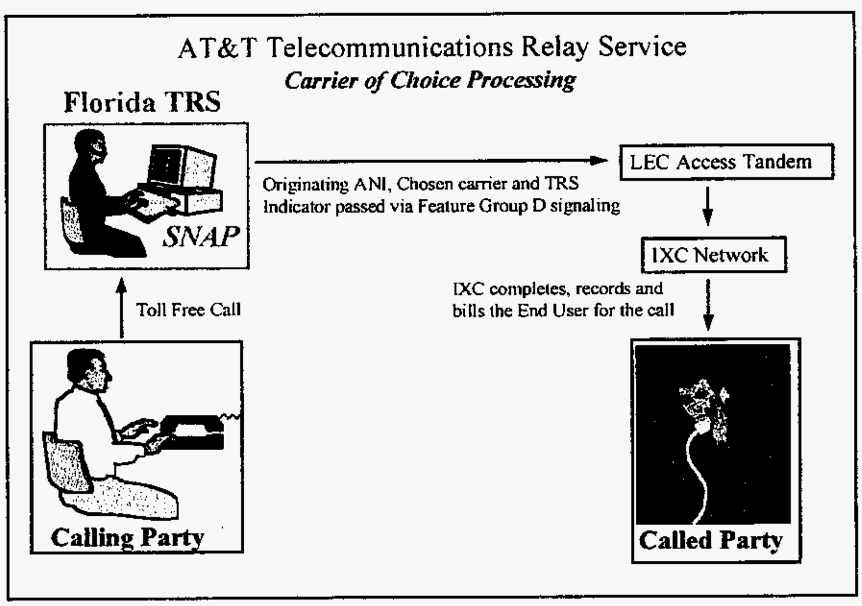
The provider shall allow a caller to select an interexchange company other than the provider for billing purposes. In such case, the provider shall supply the services of the relay center for the call but provide billing information to the requested interexchange company so that the requested company can correctly bill the relay call. The provider shall route the outgoing call portion of the relay call to the requested interexchange company and shall be responsible for the cost of access through associated local exchange company tandems and, where tandem access is not provided, for connections to the requested carrier through other forms of access. The provider must meet current and subsequent requirements of the Industry Carriers Compatibility Forum for handling end user requests for a carrier other than the provider.

AT&T Response

AT&T understands and will comply.

Carrier of Choice Call Processing

Customers access the Florida Relay Service via a toll-free number. Upfront automation in SNAP populates the forward number based on customer input for both call completion and billing purposes. The CA reviews the customer's request and set up and then completes the call. SNAP routes the call to a LEC access tandem, which forwards the call directly to the chosen carrier's network. The chosen carrier's network completes the call and creates a billing record. When the call is connected to the called party, the end user billing timer starts and the CA begins to relay the conversation. See the following illustration.



Billing

Customers are billed by their chosen carrier based on the billing record created in the chosen carrier's network.

AT&T will meet current and subsequent requirements of the Industry Carriers Compatibility Forum.

35. Recipient of Toll Revenues

The relay provider shall be allowed to retain the toll revenues for all long distance calls billed by or on behalf of the provider.

AT&T Response AT&T understands and will comply.

36. Long Distance Call Billing

Operator-handled calls shall be carefully supervised and disconnects made promptly. A check of the timing clock shall be made at least once each twenty-four (24) hours to ensure that the clocks are synchronized and that the time is correct. Clock deviations shall not be in excess of 12 seconds. Bidders shall specify the record system for identifying and documenting long distance and toll calls for billing purposes. The record shall contain, at a minimum, the following information:

a) telephone number or credit card number to be billed (NPA-prefix-line number)

b) originating and terminating telephone number (NPA-prefix-line number)

c) originating and terminating exchange name

d) date

e) start time

f) call duration to the full second (the time in between start time and end time)

Long distance calls billed to subscribers shall be listed chronologically and reflect the connect time of such calls based on the appropriate time zone. Bidders shall also fully describe the billing system and billing process that will be used, including identification of any subcontractors, specific duties of the subcontractors, and how the billing record detail will be transmitted to the billing agent (if any).

AT&T Response

AT&T understands and will comply.

Details regarding the billing system used for handling long distance call billing and the bill record is detailed in Section 31, Call Processing and Bill Record. These sections identify the billing process that will be used, the information included in the bill record and how the billing record detail will be transmitted to the billing agent (LEC or alternate IXC).

AT&T's billing arrangements will support the capability of Florida Relay Service customers to place the following calls:

- Calls originating and terminating within the State of Florida - local, intraLATA and interLATA.
- Calls originating within the State of Florida and terminating at points outside the state - interstate.
- Calls originating outside the State of Florida and terminating at points within the state - interstate.
- Outbound international calls.

37. Special Needs

The provider will not be required to provide Special Need services. However, consideration will be given for additional evaluation points for proposals that include Special Need services as a part of the basic relay service.

Special Needs is defined as limiting factors of a physical or literacy nature that preclude a person who is hearing, speech or dual-sensory (both hearing and visually impaired) disabled from using basic relay service. Special Needs includes: (1) physical limitations, either temporary or permanent, which preclude use of a TDD with or without adaptations for persons with manual dexterity limitations (e.g., paralysis, severe arthritis, broken fingers) and (2) markedly limited ability either to read or write English or Spanish which precludes user from being able to use the relay service. (It should be understood that relay service does not include translation from one language to another for the Special Needs population or for any other consumers.) Special Needs does not include (1) unavailability of telephone service at the caller's home or business, (2) inability to communicate in either English or Spanish (i.e., where caller can only communicate in a language other than English or Spanish), or (3) handling complex calls (e.g., intervening in a call with a doctor to explain a medical procedure.)

The bidder shall describe what steps will be taken to provide telecommunications assistance to persons with hearing, speech and dual-sensory impairments who have special needs. This description shall include the types of services that would be provided, the prices to end users (if any) for those services, how those services would operationally be provided, how parties other than the provider would be involved in providing Special Needs services and how the provider would assure that those parties would fulfill their portion of the service obligation.

AT&T Response

AT&T understands and will comply.

The Deaf Service Centers in Florida have extensive experience in dealing with the Special Needs population in the state. As part of our Outreach partnership plan, AT&T contracts with organizations that have specific knowledge of how to deal with different segments of the relay user community including deaf, hard-of-hearing, speech disabled and deaf-blind populations. We would address the Special Needs population through partnerships with specific Deaf Service Centers.

Their primary role would be to educate the Special Needs population on the relay service features that would meet their particular requirements. For example, a person with a hearing loss and severe arthritis but who speaks would be informed about the various voice carryover features that could meet their needs.

Special Needs communities would include groups and individuals with cerebral palsy, people recovering from strokes, speech disabled, etc. Workshops, community forums and one-on-one trainings would be some of the educational activities offered. Feedback from these activities could drive the development of new features offered through Florida Relay Service. For example, if it is determined that there is a sizable group of individuals who have speech and motor disabilities, a speech to speech program could be developed to allow calls between individuals who have limited speech ability and cannot type, and traditional telephone users.

To assure fulfillment of our partner's obligations, AT&T and the partner agree on the number of activities that the partner will perform as part of the contract. The partners are required to provide monthly reports indicating their activities in order to receive reimbursement from AT&T. (AT&T does not charge a fee to the end users for any of these services.) We follow up periodically to assess the quality of the partner's performance, to ensure they are living up to the agreement, and to get feedback from the community and individuals who have received the services.

38. Unsolicited Features in Basic Relay Service

The provider will not be required to provide unsolicited features in its basic relay service. However, consideration will be given for additional evaluation points for proposals that include unsolicited features. The cost to the state for these unsolicited features must be included within the basic relay service price proposal.

Any additional features not described elsewhere in the RFP, and which the bidder is including in its basic relay service and price proposal, which a bidder would like to propose should be fully described indicating how the feature would work, how it would improve the system, which users would benefit from the feature and any other information which would allow the FPSC and PRC to evaluate the feature.

AT&T Response

AT&T understands and will comply.

The following matrix lists AT&T's TRS and OSD features. Some of these features have been previously described elsewhere in AT&T's Technical Proposal.

AT&T TRS SERVICE FEATURES

Feature	*Description*
AT&T Language Line[SM]	This service provides foreign language translation for over 260 languages and dialects including Spanish, French, German, Polish, Japanese, as well as Thai, Korean, Swedish, and Chinese at an additional cost to the user. Relay users may use the AT&T Language Line to assist them in any foreign language needs they have. The caller must be English based.
AT&T Relay Customer Service (RCS)	RCS is staffed by dedicated attendants to resolve customer inquiries, commendations, and complaints regarding Telecommunications Relay Service. Customers can reach AT&T RCS via a nationally published 800 toll free number, 1-800 682-8786 (TTY) or 1-800 682-8706 (Voice).

Feature	*Description*
Automatic Number Identification (ANI), Integrated Services Digital Network (ISDN) and Automated Route Selection (ARS)	With ANI, the calling party's number is delivered to the relay center. ISDN adds an incremental level of professionalism to our already automated inbound call center, integrating voice, data, and other services over a single pair of telephone wires. ARS routes outgoing calls over the public switched network based on the preferred route available at the time the call is placed.
Background Noise	CAs communicate to the TTY users not just spoken words from the voice user, but also any appropriate sounds that can be detected over the telephone, providing additional information to the TTY users. When this feature is selected as part of the Relay Choice^{SM} Profile, the TTY user can elect not to be advised of background noises.
Billing Equivalency for Consumers	AT&T provides flexible billing options through a customer's local exchange company, AT&T, or other long distance companies so that relay users have the same billing options as non-relay users.
Calling Card Billing	AT&T accepts calling cards for billing intralata and interlata calls.
Carrier of Choice	Carrier of Choice enables the user to choose any carrier in any jurisdiction, provided that carrier meets the minimum industry standard for TRS Carrier of Choice. Customers may also choose to incorporate Carrier of Choice preference in the Relay Choice^{SM} Profile.
Carryover Preference	Part of the Relay Choice^{SM} Profile, SNAP will automatically activate VCO or HCO for both outbound and inbound calls through relay.
Commercial Credit Card Billing	AT&T accepts commercial credit cards (e.g., Mastercard, Diners Club, American Express, etc.) for billing domestic relay and operator assisted calls. This option will only be accepted on interstate and interlata calls within the United States, Puerto Rico and the U.S. Virgin Islands.
Connection Mode (ASCII, Baudot, Turbo Code, Voice, other)	Part of the Relay Choice^{SM} Profile, SNAP will automatically connect the caller in the mode of preference for both outbound and inbound calls through relay.
Customer Call Set-up	This feature, part of our SNAP system, allows the TTY user to initiate dialing the number giving the caller more control and greater call handling efficiency.

AT&T

Feature	*Description*
Customer Satisfaction Tools	AT&T uses an independent research firm to perform mail surveys and test calls annually. Each month, we make 300+ "mystery shopping" test calls to our centers to verify compliance with five different methods and procedures. Additional tools are mentioned in Section B.28.
Directory Assistance	Customers can call the relay number to request relay calls to any intrastate or interstate directory assistance bureau.
Emergency Call Handling	AT&T provides CAs with immediate and direct access to a database that contains most emergency agency listings. Using the caller's ANI, the CA can quickly secure the emergency agency listing and complete the relay call, providing fast emergency attention.
FCC Certification Support	The FCC requires all state TRS programs to meet their minimum requirements as outlined in §64.604. We provide an information package to our states to assist them in the application process.
Fully Integrated Computerized Workstations	Our single integrated workstation combines the dialing, billing and relaying aspects of the call, making maximum use of macro function keys and smart messages, with a focus on the importance of ergonomics to the Communications Assistants' well-being.
Hearing Carryover (HCO)	HCO enables TTY users who can hear to directly hear the voice person's message. The CA then voices the TTY user's typed response back to the voice caller.
Hearing Carryover with Privacy	This feature allows for more call privacy, because the CA does not hear the voice part of the conversation.
Hearing to Hearing Relay (HTH)	HTH expands the HCO capability by allowing two speech impaired individuals to hear the CA read the typed conversations.
Higher Transmission Speeds	AT&T's relay service will connect to and communicate in all of the current industry standard protocols. Our platform automatically sets the transmission speed to meet the speed of the caller's equipment.
Instantaneous Service Recovery	With Next Available Assistant traffic balancing and our Disaster/Service Recovery Plan, AT&T can ensure virtually uninterruptable customer service.

AT&T

Feature	*Description*
Interactive and Non-Interactive Beepers/Pagers	AT&T will process calls to interactive beepers/pagers. Interactive beepers/pagers provide the caller with instructions and information about the service and allow the caller to enter the requested information. These calls can be relayed to the TTY user. Relay calls that terminate to non-interactive beeper/pager services are handled as a relay call. The CA will relay exactly what is heard without adding any additional information.
Interstate and Intrastate Toll Carrier of Choice	AT&T has provided Carrier of Choice since July 26, 1993. Part of the Relay Choice℠ Profile, this new SNAP feature identifies the chosen long distance and regional toll carriers. It will automatically populate the billing record with this carrier and dial the forward number using COC routing.
Memory Dialing	Part of the Relay Choice℠ Profile, this feature displays to the CA up to twenty memory dial listings for label and associated telephone numbers. When customers request one of these, the CA highlights the listing and SNAP automatically populates the billing screen and dials the number.
Next Available Assistant (NAA)	NAA, a feature of our Advanced 800 Network, is an AT&T technological advancement that routes callers to the next CA available in the AT&T relay system, providing faster and more consistent answer performance cost effectively. This feature will be used for service recovery for Florida.
Originating Line Screening	This feature immediately provides the CA with specific information about billing or calling restrictions pertinent to the originating line. This may include, but is not limited to, coin, hotel, prison, and hospital.
Regionally Restricted 800 Numbers	AT&T's state-of-the-art technology enables CAs to easily and automatically process a toll free number that has been identified as being regionally or geographically restricted.

AT&T

Feature	*Description*
Relay Choice^{SM} Profile	This feature will enable a relay user to presubscribe to various features. The Relay Choice^{SM} Profile is designed to speed up the delivery of the call. With the software enhancement scheduled to begin in October, 1996 and complete in March, 1997, users can initially select options such as interstate carrier of choice, intrastate toll carrier of choice, connection mode, carryover preference (HCO, VCO, other), spelling correction, background noise, and memory dialing (Speed Dial List).
Reports	Comprehensive reports package provided; specific, customized reports available.
Retrieval of Answering Machine Messages	AT&T Relay Centers process and complete requests to retrieve messages from answering machines when the caller remains on the line and provides a forward number for the CA to call.
Single Line Answering Machine (SLAM)	This feature involves retrieving messages, usually from home answering machines, when the caller is at home. The caller disconnects from the call, the CA retrieves the messages, and then calls back with the messages.
Special Network Accessibility Platform (SNAP)	AT&T's leading edge relay platform has had eight upgrades since originally deployed in 1993. This system, developed and continuously upgraded to make AT&T's relay service as functionally equivalent to standard telecommunications as possible, was the first to put actual call setup (customer initiated dialing) in the hands of the users of the service.
Spanish Relay	This service employs bilingual (Spanish/English) CAs who have been assessed as qualified and proficient in reading, writing, and spelling in Spanish. AT&T Bilingual CAs are specifically trained on processing and relaying calls in Spanish.
Spelling Correction	This feature, part of the Relay Choice^{SM} Profile, will automatically correct common CA typographical errors and will spell out non-TTY abbreviations that may be used by the CA in voice to text translation.

Feature	*Description*
Touch Tone Carryover (TCO)	This feature enables TTY users to enter their account number and personal identification number (PIN) directly into an interactive system without divulging this sensitive information to the CA.
TRS/OSD Integration	AT&T began providing Operator Services for the Deaf (OSD) in 1980, preceding the inception of relay service. AT&T provides OSD for all 50 states and has contracts with local exchange carriers to provide their TTY customers with operator services equivalent to hearing customers. OSD provides directory assistance services, toll services, emergency interrupt, busy line verification, and special billing arrangements such as third party, collect, calling card, and person-to-person calls. This integration with relay technology allows the same CA to handle OSD and relay calls without the need to have the customer hang-up and dial the relay number or transfer the call to another office. Conversely, if the customer dials the relay number and then needs operator services, the same CA can handle the OSD call.
Two-line Voice Carryover	A customer with conference calling capability on his or her phone line can utilize the Two-line VCO feature by using one line for voicing and the other for receiving Baudot or ASCII transmission. Since the Two-line VCO user is directly connected to the hearing party, the Two-line VCO user can talk directly to the hearing party without waiting for "GAs," and without alternately picking up and putting down the handset. This feature allows for a more natural, interactive relay call.
Typing Speed -- Minimum 55 wpm	Entry level typing speed for Communications Assistants is 55 words per minute. Hiring at this speed ensures our employees will be typing even faster within a relatively short period of time.
Unrestricted Length and Number of Calls	Callers can make any number of calls as well as calls of any length.

Feature	Description
Upfront Automation	Upfront Automation allows a TTY customer to initiate dialing the call. TTY users are empowered, giving them more control and greater call handling efficiency. Our SNAP system interacts directly with the caller by preparing the dialing sequence and the billing information from what the caller types to the system. The Communications Assistant simply presses one key to complete the call.
Voice Carryover (VCO)	VCO enables TTY users who can speak to voice their message directly to the non-TTY user. The CA then types the non-TTY user's response back to the TTY user.
Voice Carryover with Privacy	This feature adds privacy to a VCO call; the CA does not hear the VCO user's part of the conversation.
Voice to Voice Relay (VTV)^{SM}	This feature expands the VCO capability by allowing two hearing impaired individuals to voice their parts of a call while the CA types for both parties. VTV is ideal for two TTY users who can speak but who may not know how to type or may be physically unable to type.
Voice Carryover to Text (VTT)	VTT allows a relay call between a VCO user and TTY user. The VCO user voices to the CA who proceeds to type the message to the TTY user. The CA then types the TTY user's response to the VCO user.

AT&T is pleased to offer the State of Florida and its relay customers, the Relay Choice^{SM} Profile. With the introduction of the Relay Choice Profile in the first quarter of 1997, AT&T will propel its relay customers to a new level of calling experience.

The Relay Choice Profile will be the most sophisticated database in the industry. Customers can create a customized calling profile to further facilitate and enhance calls they make and receive through relay.

During the first phase, Relay Choice Profile features will include:

- automatic activation of interstate Carrier of Choice
- automatic activation of intrastate Carrier of Choice
- automatic activation of Connection Mode
- automatic activation of carryover preference (HCO, VCO, Telebraille)
- automatic activation of Spelling Correction (on/off)
- background noise (on/off)
- memory/speed dialing

The Relay Choice Profile is activated automatically for both inbound and outbound calls. Customers may instruct the CA to manually override any of the automated features.

In consideration of potential heavy demand for creating the profiles and to minimize impacts to the relay service performance, AT&T has established the following plans to collect its customers' data.

To create a profile, text customers (TTY and PC) may dial toll free to an interactive computer program. The interactive computer will step the customer through a series of prompts, resulting in the creation of a private individualized profile. Similarly, voice customers may dial toll free and verbalize their profile information to a customer service representative. Customers may update their profiles as often as they like and at their convenience. All customers will be mailed a copy of the profile form and will have the choice of responding via mail. All information collected in the profile will be confidential and secured by the personal identification number.

Additional features will be made available following the implementation of Phase One. These features will be shared with the FPSC and the Advisory Board immediately upon award of the bid to AT&T.

Other AT&T Groups Dedicated to Customers with Disabilities	*Description*
AT&T Accessible Communications Long Distance Service Center (ACLDSC)	ACLDSC handles inquiries concerning residential long distance service for TTY users. Customer billing inquiries and questions concerning AT&T consumer services such as discount plans can be answered at the center by dialing toll-free: 1-800-833-3232 (TTY) or 1-800-872-3883 (Voice)
AT&T Long Distance Relay	AT&T offers AT&T Long Distance Relay to customers who choose AT&T as their provider for long distance calls and international calls. Customers can reach AT&T Long Distance Relay service by dialing toll free: 1-800-855-2880 (TTY) or 1-800-855-2881 (Voice) or 1-800-855-2882 (ASCII) or 1-800-855-2883 (Telebraille)

Community Outreach

AT&T believes it is critical to emphasize the value of the Florida Relay Service to all people including individuals who are deaf, hard of hearing, speech disabled, and deaf-blind as well as hearing people. Everyone needs to be aware of the availability of FRS as well as service feature enhancements. AT&T will be pleased to work with the FPSC to ensure the outreach and advertising is consistent with program goals.

Our intent is to educate people who will benefit directly from the relay service, and/or who can share the information with someone who can. Through education, we hope to heighten awareness and sensitivity among all people, hearing and otherwise.

Outreach Activities include the following:

1) Partnering with and training community members and non-profit organizations serving the needs of people who are deaf, deaf-blind, hard of hearing or speech disabled on the delivery of Florida outreach activities.

2) Developing an annual outreach Partner activity plan to meet the needs of its key stakeholders. This includes:
    - Deaf, Deaf-blind, Late Deafened Adults and Hard of Hearing Individuals
    - Speech Disabled Individuals
    - Business and Hearing Individuals who are potential relay users

3) Managing and coordinating the implementation of outreach activities such as:
    - Acting as a clearing house for outreach referrals and requests
    - Delivering presentations to targeted groups
    - Exhibiting at local, state, regional, and national events annually
    - Hosting annual community forums
    - Participating in advisory board meetings

4) Coordinating and managing public communications, media, and advertising for outreach activities such as:
    - Producing and distributing brochures (see attached sample state relay service brochure)
    - Developing and producing a variety of marketing give-away items
    - Writing articles and/or advertisements for various newsletters and publications
    - Providing an AT&T relay exhibit both for use throughout the term of the contract
    - Work with local exchange companies to include FRS information in telephone directories.
    - Produce PSAs for a television advertising campaign.

5) Managing requests for sponsorships of various events.

6) Continually keeping up-to-date on politics and trends in the relay industry and modifying and improving outreach activities.

7) Developing relationships with key advocates and working to deepen those relationships.

Today, AT&T has over 30 partnerships with non-profit organizations across the country. We actively seek, through an RFP type process, to establish partnerships with local agencies/organizations and/or with individuals for Outreach services. AT&T draws upon the expertise in the local deaf community as well as geographic knowledge to customize its outreach programs to best fit with local consumers.

Activities of the potential partners may include:

a) Community forums
b) Presentations to deaf groups
c) Presentations to hard of hearing groups
d) Presentations to speech disabled groups
e) Presentations to deaf-blind groups
f) Presentations to elderly groups
g) Presentations to civic clubs
h) Presentations to businesses
i) Presentations to hospitals and clinics
j) Exhibits at various conventions and activities within the community
k) Provide consumer feedback to AT&T

Benefits

By partnering with community based organizations, the outreach program brings the following benefits to Florida:

- Increased consumer awareness and knowledge of Florida TRS.
- Increased productivity and efficient use of Florida TRS by end users.
- Stimulation of information exchange between the community and outreach team.
- Stimulation of the local economy.
- Empowers the users.

Continuing our tradition of providing access to high technology for our customers, AT&T Relay Service has launched a new site on the World Wide Web, offering a range of information about its products and services. Included on AT&T's Home Page is information regarding our TRS and OSD services. Users may connect directly by providing the Universal Resource Located (URL) address of:

http://www.att.com/relay

39. *FPSC Optional Services Not Included in Basic Relay Service But Available to Provide at Additional Cost*

The following services will not receive evaluation points for the purpose of determining which bidder will be selected to provide relay service. However, once a provider is selected, the FPSC will determine which of the following services it may wish to add to the basic relay service and negotiate the conditions under which these optional services may be offered. If a bidder offers a service in this section and the FPSC chooses to purchase the service, the provider must provide the service.

For each item, the bidder should include the price per billable minute (or other basis) which it would charge for the purchase of the optional service over and above the price for basic relay service. That price per billable minute (or other basis) should be listed separately in the price proposal. The proposal should also indicate how each feature would work, how it would improve the system, which users would benefit from the feature, any direct charges that would be billed to the user, and any other information that would allow the FPSC to evaluate the feature.

AT&T Response

AT&T understands and will comply. See Sections 39.a.-d. for further details.

39.a Custom Calling Services

The provider will not be required to provide custom calling type services unless required for certification by the FCC. No additional evaluation points will be awarded to a bidder based on a proposal to provide services which offer functionalities similar to those of one or more of the following custom calling services. The proposed charge to the Administrator for custom calling service should be separately stated in the price proposal.

The bidder shall explain how a user could receive functionalities similar to those of the following services in conjunction with a relayed call. The bidder shall also indicate what additional cost would apply to the caller, if any. If no separate charge to the relay user is stated, it will be assumed there is no separate charge.

a) Three-way calling which would allow a user with only one telephone line to conduct a conversation with two other parties at the same time.

b) Last number redial which would allow the caller to dial the relay center and have the CA dial the last number called via relay without the caller having to give the number to the CA.

c) Call trace which would allow the caller to dial the relay center and have the CA provide the number of the last call made to the caller via relay.

AT&T Response

AT&T is prepared to work with the FPSC and the 10 LECs serving customers in Florida to define and develop technological solutions for providing three-way calling, last number redial and call trace.

The technical development expense will be identified in cooperation with the LECs because each has a unique version of the service and its own cost structure. AT&T will pass along only the expense identified and associated with custom development and agreed to by the State. No profit or markup will be passed to the State.

As an alternative plan, AT&T and the State will work together to define acceptable non-technological solutions to act as surrogates to the LEC services. This can be achieved at no additional charge to the State and will involve developing methods and procedure guidelines for CAs to follow.

39.b Access to 900/976 Services

The provider will not be required to provide access to 900/976 service unless required for certification by the FCC. No additional evaluation points will be awarded to a bidder based on a proposal to provide 900/976 service. The proposed charge for 900/976 service should be separately stated in the price proposal.

The bidder should explain how it could provide relay service users with access to 976 and 900 number services. Bidders are to describe how such access can be provided, how callers can disconnect without being charged and a methodology for billing the user directly for any charges incurred from the 900/976 service. The bidder should describe how it would deal with denied 900/976 calls and high bill complaints for 900/976 calls. If this service is provided, before placing the call, the CA shall advise the caller that there will be a charge for the call.

AT&T Response

AT&T, through the facilities provisioned on our Carrier of Choice platform will provide Florida customers with access to 900 telephones numbers. AT&T can accomplish call completion to pay-for-use phone numbers.

We do not anticipate billing problems because the technical platform incorporated into our relay service offering has the capability of passing the customer's ANI out onto the network for direct billing to the customer.

Customers with billing issues will be directed to the company responsible for billing them. In addition, customers can block 900 number calls through their LEC. AT&T can identify the block and refuse unauthorized calls.

To ensure customers are not billed for disconnecting before the bill timer begins, AT&T would develop methods and procedures for its CAs to follow. While AT&T can provide this service, we are concerned that customers may incur very large bills over which AT&T has no control. See Section D., Price Proposal, for pricing information.

39.c Enhanced Transmission Speed & Interrupt Capability

The provider will not be required to provide the enhancements described below unless required for certification by the FCC. No additional evaluation points will be awarded to a bidder based on a proposal to provide these enhancements. The proposed charge to the Administrator for the enhancements below should be separately stated in the price proposal.

Enhancements may include the ability both to send and receive typed communications at the same speed as typed or transmitted. Enhanced protocols may also include the ability to send and receive interrupt signals while another party is typing. The bidder should state what requirements would exist in order for the relay user to be able to utilize the above enhancements.

AT&T Response

Protocols and Turbo Code

AT&T's telecommunications equipment and station terminals for the Florida Telecommunications Relay Service will automatically identify calls as Baudot, ASCII or voice. In the case of Baudot or ASCII, AT&T's platform automatically sets the transmission speed to meet the speed of the caller's equipment.

Florida Relay Service will connect to and communicate in all of the current industry standard protocols and the new Turbo Code enhanced protocol. Both ACSII and Turbo Code protocols provide interrupt signals while the other party is typing. To use ASCII or Turbo Code the customer must have equipment with the compatible software. See Section D., Price Proposal, for pricing information.

39.d Other Optional Features

Any additional features not described elsewhere in the RFP which a bidder would like to propose should be fully described. Examples might include, but are not limited to, features such as: providing a caller profile identifying to the CA the caller's preference regarding use of calling card, carrier of choice, use of HCO/VCO, descriptions of background noise; video interpreting; use of speech synthesis equipment instead of a CA to convert text to speech; use of voice recognition equipment instead of a CA to convert speech to text; etc.

No additional evaluation points will be awarded to a bidder based on a proposal to provide these unsolicited features. The proposed charge for any unsolicited features offered under this section should be separately stated in the price proposal.

AT&T Response

Text-to-Speech

With this breakthrough service, a TTY or telebraille user can have his/her typed text converted to a synthesized computer voice when calling a hearing person. The CA relays spoken words back to the TTY or telebraille user as typed or Braille text. This feature provides greater privacy since the CA is not involved in the TTY user's portion of the conversation. Text-to-Speech is accessed through a dedicated toll free 800 number.

Video Relay Interpreting Trial

AT&T and/or a partner(s) will provide an interactive Video Relay Service trial for relay calls from sign language users to voice users and vice-versa without the use of a TTY. The AT&T Video Relay Center and remote sites will be equipped with ITU industry standard H.320 audio/video teleconferencing equipment that can accept audio/video calls at 128Kbps or 384Kbps or better based on available technology at the time of the trial. When operated at 384Kbps, and at Full Common Image Format (FCIF) resolution, the equipment will achieve a full 30 frames per second. Users calling from lesser equipped desktop units will benefit from the additional image processing and superior encoding techniques implemented by the equipment at the Video Relay Center.

In consultation with the Commission, AT&T will provide all interpreters and compatible video equipment (i.e., camera, monitor, codec, software, etc.) to support the Video Relay Interpreting Trial. AT&T will establish two (negotiable) remote locations within Florida. Personnel, who usually will be deaf or hard of hearing, at the remote sites will be available to assist users in setting up and placing calls. Remote site Video Relay Interpreting trials will take place during two separate time periods.

Functions performed by the Project Team are:

- Installation
- End-to-end testing and application integration
- Maintenance of all equipment utilized
- Training personnel in the use of the video-conferencing hardware, software, video call placement and video call answering

All Video Relay interpreters will receive standard CA training in addition to specialized Video Relay training. All AT&T Video Relay interpreters will be RID certified interpreters at the CSC or CI/CT level or will be CCASD/NAD certified interpreters at level 4 or level 5 and will adhere to the RID Code of Ethics. These interpreters will have the skill to ensure that the subject matter and attitudes of both parties are conveyed while transmitting all conversations and communications accurately and objectively.

Video Relay Interpreting will be available at each remote site for 30 hours during a ten day trial period. A separate 800 or other toll-free access number may be established by AT&T for the Video Relay Interpreting Trial.

Upon successful completion of this trial, AT&T will be willing to negotiate with the FPSC for full implementation under mutually agreeable terms and conditions.

See Section D, Price Proposal, for pricing information for Text to Speech and the Video Relay Interpreting Trial.

41. Submission of Monthly Invoice

By the 7th calendar day of the month (or the subsequent business day if the 7th falls on a Saturday, Sunday or holiday), the provider shall submit a detailed invoice (showing billable minutes and rates) to the Administrator [defined in s.427.703(1)] at the contracted price for the previous month's activity. The accounting period used to prepare monthly invoices shall be the calendar month. Payment shall not exceed the prices contained in the contract. The invoice and supporting documentation shall be prepared in such a way as to allow the Administrator or the FPSC to audit the invoice. A copy of the monthly invoice shall be submitted to the contract manager at the same time it is submitted to the Administrator.

AT&T Response

AT&T understands and will comply.

42. Travel

The Provider will not be entitled to a separate payment from the FPSC or the Administrator for any travel expense which occurs as a result of this contract.

AT&T Response AT&T understands and will comply.

43. Reporting Requirements

The provider shall provide to the Commission's Division of Communications and the Administrator the following written reports by the 25th calendar day of each month reporting data for the previous month. (More frequent or more detailed reports shall also be provided upon request.)

a) Total daily and monthly

i. number of incoming calls (separately stating whether incoming calls originate as Baudot, ASCII or voice calls.) The number of incoming calls which are general assistance calls shall be footnoted on the report.

ii. number of incoming call minutes associated with each of the categories of incoming calls in a.i. above

iii. number of outgoing calls (provide two breakdowns of this total: one separately stating completed calls and incomplete calls, and one separately stating whether calls terminate as Baudot, ASCII or voice calls)

iv. number and percentage of incoming Florida calls received at each relay center operated by the provider (Total should equal the number of incoming calls in item a.i. above.)

a) Average daily and monthly blockage rate.

b) Range of answer times for the month and daily and monthly number an percent of incoming calls answered within 10 seconds.

c) Total daily and monthly number of outgoing calls (including both completed and incomplete) of the following lengths:

- *0 - 10 minutes*
- *>10 - 20 minutes*
- *>20 - 30 minutes*
- *>30 - 40 minutes*
- *>40 - 50 minutes*
- *>50 - 60 minutes*
- *>60 + minutes*

Total of d. should equal total of a.iii.

e) On a daily basis for the month, number of outgoing calls and average length of calls by hour of day. (Total should equal total of a.iii.)

f) Number of local, intraLATA toll, intrastate interLATA, interstate and international calls for the month. (Total should equal total of a.iii.)

g) Number of outgoing calls and average length of completed outgoing calls originated by TDD users and voice users (identified separately). (Total number of calls should equal total in a.iii.)

h) The provider shall provide monthly summary reports to the FPSC and the Administrator regarding number of complaints received categorized by topic areas.

i) The provider shall report monthly to the FPSC and the Administrator the results of any user evaluations conducted.

j) The provider shall report monthly on new subcontractors being used to assist in providing relay service and shall identify the scope of their role in the process and the relationship of the subcontractor to the provider.

k) By March 1, the provider shall provide to the Administrator and the contract manager forecasted relay usage figures and costs to the Commission for the upcoming fiscal year (July 1 - June 30).

The provider shall include information on its capability and willingness to provide ad hoc reports including new information in the bidder's database or new formats for existing information.

AT&T Response

AT&T understands and will comply with the items requested in Section B.43.A-K

AT&T is committed to ensuring accuracy in the data we collect and report for the relay services we provide. We exemplify this through our ongoing commitment to enhance the technology that supports our data collection and reporting systems as TRS continues to evolve. Our most recent enhancement, the SNAP Automated Reports Generator (SARG), was implemented in January, 1996. SARG was specifically designed to upgrade, support and better automate AT&T's data collection, validation, reporting and retention capabilities.

AT&T will utilize SARG to supply the data necessary to generate Florida Relay Service Monthly Traffic Reports. All required data/written reports will be provided to the Commission's Division of Communications and the Administrator by the 25th calendar day of each month for the previous month.

Upon request, AT&T will furnish the Commission with more frequent/detailed or ad hoc reports readily available through SARG. If such reports are not available, AT&T will consult with the Commission to discuss the feasibility of developing a report or identify a solution that satisfies the Commission's needs and is acceptable with both parties. Over time report formats may change due to AT&T TRS reporting system enhancements. If such changes occur, AT&T will notify the Commission to ensure their understanding of new reporting formats and/or methodologies.

Please reference Figures A through H on the following pages to review Florida Relay Service Sample Report Formats that align with requirement items A through H of this section, and they are:

ITEM(S)	REFERENCE	FORMAT Florida Relay Service Sample Reports
A - i/ii	Figure A	Incoming Call Detail Carriage
A - iii/F/G	Figure B	Outgoing Call Detail Carriage
A - iv	Figure C	AT&T Relay Center Incoming Call/Percent
B/C	Figure D	Average Call Performance
D	Figure E	Outgoing Call Length
E	Figure F Figure G	Outgoing Calls Outgoing Average Call Length
H	Figure I	Customer Contact Summary
Subsequent to Items A - H	Figure H	Year to Date Summary

If selected as the Florida Relay Service Provider, AT&T will meet with the Commission to discuss all reporting methodologies and their associated formats to ensure their reporting needs are satisfied.

FIGURE: A

Florida Relay Service
Incoming Call Detail/Carriage
Sample Report
00/00/00 to 00/00/00 (Daily by Month)

	CALLS						MINUTES					
DAY	Baudot	ASCII	Voice	Spanish	TOTAL	*GA	Baudot	ASCII	Voice	Spanish	TOTAL	*GA
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
TOTALS												

**GA (General Assistance) Calls are included in Incoming Call/Minute Totals*

Carriage:

Local												
Intra												
Inter/Intra												
Total Intra												
Interstate												
nternational												
TOTAL												

FIGURE: B

Florida Relay Service
Outgoing Call Detail/Carriage
Sample Report
00/00/00 to 00/00/00 (Daily by Month)

	CALLS							COMPLETED AVERAGE CALL LENGTH				
DAY	*Baudot*	*ASCII*	*Voice*	*Spanish*	*COMPLETE*	*INCOMPLETE*	*TOTAL*	*Baudot*	*ASCII*	*Voice*	*Spanish*	*TOTAL*
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
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22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
TOTALS												

**GA (General Assistance) Calls are included in Incoming Call/Minute Totals*

Carriage:												
Local												
Intra												
Inter/Intra												
Total Intra												
Interstate												
International												
TOTAL												

FIGURE: C

Florida Relay Service
AT&T Relay Center Incoming Call/Percent
Sample Report
00/00/00 to 00/00/00 (Daily by Month)

CENTER	A		B		C		D		E		F		G		H		TOTAL CENTERS	
DAY	*Incoming*	%	*Incoming*	%	*Incoming*	%	*Incoming*	%	*Incoming*	%	*Incoming*	%	*Incoming*	%	*Incoming*	%	*Incoming*	*100%*
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
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30																		
31																		
TOTALS																		

FIGURE: D

Florida Relay Service
Average Call Performance
Sample Report
00/00/00 (Daily by Month)

	AVERAGE			AVERAGE LENGTH OF CALL			
DAY	*Blockage*	*Answer Spd.*	*% Incoming in 10 Sec.*	*Baudot*	*ASCII*	*Voice*	Total
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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26							
27							
28							
29							
30							
31							
TOTALS							

FIGURE: E

Florida Relay Service
Outgoing Call Length
Sample Report
00/00/00 to 00/00/00 (Daily by Month)

	NUMBER OF CALLS BY LENGTH IN MINUTES						
DAY	*0 to 10*	*10+ to 20*	*20+ to 30*	*30+ to 40*	*40+ to 50*	*50+ to 60*	*60+*
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
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22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
TOTAL							

FIGU[illegible] F

Florida [illegible] Service
Outgoing Calls
Sample Report
00/00/00 to 00/00/00 (Hourly by Day & Month)

DAY	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
1																								
2																								
3																								
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27																								
28																								
29																								
30																								
31																								
TOTAL																								

FIGURE: G

Florida Relay Service
Outgoing Average Call Length
Sample Report
00/00/00 to 00/00/00 (Hourly by Day & Month)

DAY	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00
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FIGUR)

Florida R)Service
Year to Date Summary
Sample Report
by Year

PERFORMANCE DATA	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	YTD
Incoming Calls													
Baudot													
ASCII													
Voice													
Spanish													
Total Incoming Calls													
Outgoing Calls													
Baudot													
ASCII													
Voice													
Spanish													
Total Outgoing Calls													
Outgoing Completed Average Call Length													
Baudot													
ASCII													
Voice													
Spanish													
Total Average Call Length													
Session Call Carriage (Break-Out)													
Local													
Intralata													
Interlata/Intrastate													
TOTAL INTRASTATE (Billable)													
Interstate													
International													
TOTAL CALLS													
Session Minute Carriage (Break-Out)													
Local													
Intralata													
Interlata/Intrastate													
TOTAL INTRASTATE (Billable)													
Interstate													
International													
TOTAL Minutes													
Answer Performance													
Blockage													
Average Answer Speed (Seconds)													
% Calls Answered In 10 (Seconds)													

FIGURE: I

Florida Relay Service
Customer Contact Summary
Sample Report
by Month

I. COMMENDATIONS	TTY	VOICE	TOTAL
CA/OPERATOR RELATED			
RELAY RELATED			
OTHER			
TOTAL COMMENDATIONS:			
II. COMPLAINTS			
CA/OPERATOR RELATED			
* ATTITUDE & MANNER			
* TYPING SKILL/SPEED			
* ENGLISH/GRAMMAR			
* OTHER			
EQUIPMENT			
* DISCONNECT			
* ANSWER/WAIT TIME			
* GARBLED WORDS			
* OTHER			
METHODS RELATED			
* MISCELLANEOUS			
* BILLING/RATE			
* SCOPE OF SERVICE			
* OTHER			
TOTAL COMPLAINTS:			
III. INQUIRIES/COMMENTS			
GENERAL INFORMATION			
OUTREACH/MARKETING			
EXPLAIN RELAY			
TT DISTRIBUTION/PURCHASE			
LEC SERVICE			
BILLING/RATE			
COMPUTER SETTINGS			
TECHNICAL RELATED			
OTHER - Answer Phrase			
TOTAL INQUIRIES/COMMENTS:			
GRAND TOTAL:			

44. Liquidated Damages for Failure to Initiate Services on Time or to Provide Contracted Services for the Life of the Contract.

Implementation of the Florida Relay Service in a timely matter is essential. Failure by the Provider to implement the service by June 1, 1997 shall be considered a significant and material breach of the Provider's commitment. For every day the service is delayed, the Provider shall pay to the Administrator, for deposit in its operating fund, the sum of $25,000 per day.

Liquidated damages shall accrue in amounts up to the following amounts per day of violation:

a) For failure to meet answer time, blockage rate or transmission level requirement - $5,000

b) For failure to meet complaint resolution requirement - $1,000

c) For failure to provide reports - $500

d) For failure to provide contracted services for the life of the contract, the FPSC reserves the right to require the payment by the Provider, of liquidated damages in an amount commensurate with the duration and extent of the system deficiencies.

Any liquidated damages may be paid by means of the Administrator deducting the amount of the liquidated damage from a monthly payment to the provider. Such action shall only occur upon order of the FPSC.

AT&T Response

AT&T understands and will comply.

AT&T has provided relay services for ten years and we have never been assessed liquidated damages of any type in the implementation or on-going operations of our state relay services.

45. Transfer to New Provider

When relay service is transferred to a new provider, the provider shall make every effort to ensure that service is transferred to the new provider so that relay users do not experience an interruption in service. The relay service and consumer service 800 or other telephone numbers shall be made available to the new provider, with the new provider paying any costs associated with transferring the numbers to the new provider's use.

AT&T Response

AT&T understands and will comply.

46. Insurance Coverage

The provider shall provide insurance coverage for itself and all of its employees used in connection with performance of services under this Agreement and ensure that all subcontractors shall be similarly covered. Such policies shall be shall hold the FPSC harmless from all claims of bodily injury, including death, and property damage, including loss of use, by provider, its employees, agents or subcontractors and their employees. This insurance will include Worker's Compensation as required by law and comprehensive general liability and bodily injury insurance in amounts that are commercially reasonable under the given circumstances.

AT&T Response

AT&T understands and will comply.

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September 20, 1995, Wednesday, BC cycle

SECTION: Domestic Money. Financial Report.

LENGTH: 598 words

HEADLINE: MOODY'S AFFIRMS AT&T CORP <T.N> SNR UNSECURED DEBT

DATELINE: NEW YORK, Sept 20

BODY:

Moody's Investors Service has confirmed the Aa3 senior unsecured long term debt rating of AT&T Corp and its guaranteed subsidiaries and the Prime-1 short term rating for commercial paper of AT&T Corp, following the company's announcement that it will execute a management led break up of AT&T Corp into three publicly traded companies.

Approximately $ 15 billion in long-term debt affected.
The restructured AT&T Corp. will be left with the Communications Services Group -- which includes its core long distance business -- both wireline and wireless, the Universal Card operations and the newly formed AT&T Solutions group.
Equipment manufacturing and computer manufacturing will be in separate legal entities, and AT&T's remaining 86 percent interest in AT&T Capital Corporation will be sold.

In confirming the ratings Moody's said that it expects that AT&T Corp, the ultimate obligor of the AT&T debt rated by Moody's, will continue to benefit from the powerful and highly predictable cash flows of the company's long distance business. Furthermore, the rating agency said that the capital structure of the Communications Services entity, when it is finalized sometime prior to the end of 1996, could result in an improvement in the existing ratings for AT&T Corp.

The rating agency also said that it expects the proceeds from the sale of assets and/or initial public offerings of the units to be spun off will be used to help reduce the current AT&T debt rated by Moody's. The Aa3 senior rating confirmed is for:
AT&T Corp. -- senior debt.
AT&T Capital Corporation -- only the senior debt guaranteed by AT&T Corp.
AT&T Credit Corporation -- only the senior debt guaranteed by AT&T Corp.

NCR -- guaranteed medium term notes.
AT&T Corp's (P) Aa3 shelf registration and its Aa3 counterparty rating.
AT&T Corp's Prime-1 commercial paper rating has been confirmed. The new AT&T Corp maintains a 60 percent market

share in U.S. long distance and it has a strong national
position in the wireless service industry.

Once divested, the other operations, such as Communications Equipment which includes Network System the number two global telecommunications equipment manufacturer, will operate as stand-alone entities and be in a position to fund their own growth.

Over the longer term an independent Communications Equipment entity should be able to increase its sales penetration with the US Regional Bell Operating Companies (RBOCs), independent phone companies, and the PTT Ministries of international governments because it will be free from the constraint of its affiliation with AT&T Corp's Communications Services Group as potential regulatory changes and industry globalization bring AT&T Corp in competition with these providers.

AT&T faces many near term challenges. The company will have to balance new business opportunities and their inherent risks within the context of achieving strong financial goals while executing its break-up strategy.

Moody's expects margin pressure to continue across all major business groups and cost reductions will need to be implemented.

Moreover the company's troubled computer business, AT&T Global Information Solutions, is undergoing severe restructuring and will be eliminating about 8500 employees for which there will be a third quarter charge of $ 1.5 billion.

AT&T Corp., headquartered in New York City, is the leading provider of U.S. long distance and cellular telecommunication services, and is one of the largest global manufacturers of telecommunications equipment.

LANGUAGE: ENGLISH

LOAD-DATE: September 21, 1995

January 2, 1996, Tuesday, BC cycle

SECTION: Domestic Money. Financial Report.

LENGTH: 309 words

HEADLINE: MOODY'S AFFIRMS AT&T CORP <T.N> RATINGS

BODY:
(Press release provided by Moody's Investors Service Inc.)

NEW YORK, Jan 2 - Moody's Investors Service has confirmed the Aa3 senior unsecured long term debt rating of AT&T Corp. and its guaranteed subsidiaries and the Prime-1 short term rating for commercial paper of AT&T Corp. following the company's announcement of a $ 4 billion after-tax charge to fourth quarter earnings to cover personnel reductions of approximately 40,000, real estate and equipment consolidations and writedown of certain assets, in anticipation of the break up of AT&T Corp. into three publicly traded companies.

Approximately $ 16 billion of debt affected.

Cash outlays associated with severance costs, Moody's noted, will be front loaded in 1996. Proceeds from the sale of AT&T Capital, the IPO and capitalization of Systems and Technology, and other asset sales are expected to be cash neutral to positive Moody's said.

Going forward these cost cutting moves should improve margins, increase cash flows and further solidify the company's Aa3 senior unsecured rating.

The rating agency also said that AT&T faces many long term challenges as deregulation and increased competition will exert pressure on telecommunication margins. However, the rating agency went on to say that AT&T is well-positioned to meet the competition and potentially can improve its credit rating over the longer term.

However, the rating agency also pointed out that the ultimate capital structure of the various AT&T units after the split has not been established as yet, but the rating agency is confident that AT&T's credit quality will not be seriously impaired.

AT&T Corp., headquartered in New York City, is the leading provider of U.S. long distance and cellular telecommunications services, and is one of the largest global manufacturers of telecommunications equipment.

LANGUAGE: ENGLISH

LOAD-DATE: January 3, 1996

Northern Trust

The Northern Trust Company
50 South LaSalle Street
Chicago, Illinois 60675
USA
TEL 312.630.6000

September 23, 1996

Mr. Richard Tudor
Division of Records and Reporting
The Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, FL 32399-0850

Re: AT&T

Mr.Tudor,

We are pleased to reply to your request for a credit reference on our above named customer. The Northern Trust Company has maintained a lonstanding banking relationship with AT&T since its post-divestiture reorganization in 1984 and with many of its predecessors for fifty years prior to that time. We currently provide significant credit support to the company and serve as one of its primary operations banks. We view AT&T and its subsidiaries in a very strong financial condition warranting our sizable credit support and representing an entirely satisfactory relationship.

Sincerely,

Eric Q. Strickland

Eric Q. Strickland
Vice President
Relationship Manager

5. *Experience and Customer References*

For each state in which the bidder has or is providing relay service, the bidder shall indicate: (1) when the bidder began operating the system, (2) the number of outgoing calls for the most recent month, and (3) the total duration of the contract. If the bidder's relay service is available for testing by means of a number that can be dialed from within Florida, bidder should provide the telephone numbers that can be used to dial the bidder's relay service.

The bidder shall provide the names of three customer references, including specific contact name and phone number, to whom the bidder has provided the bid service or a similar service. If no customer references are available or applicable, explain and provide three alternative references explaining the relationship of the reference to the bidder.

AT&T Response

AT&T understands and will comply.

AT&T is the most experienced professional provider of Telecommunications Relay Service (TRS) in the industry. Our experience with TRS began on January 1, 1987, when we opened the California Relay Service, but our experience with the deaf and hard of hearing communities started much earlier. In 1980, AT&T began offering Operator Services for the Deaf (OSD), and in 1981, we began giving discounts on long distance calling to certified TTY users.

AT&T has responded to the FPSC's request for experience and customer references. Also, we have provided information on our long distance service, operator services, and customer satisfaction results.

AT&T Telecommunications Relay Contracts

State	Service Establishment Date	Contract Location	Length of Contract	Outgoing Call Volume August 1996
Alabama	3/1/89	2200 Riverchase Ctr Birmingham, AL 35244	3 year extension 4/97-3/2000	54,445
California	1/1/87	20931 Burbank Blvd. Woodland Hills, CA 91367	1/87 - 11/91	NA
Delaware	1/10/91	15 LaSalle Square Providence, RI 02903	1 year extension 1/97-12/97	13,308
District of Columbia	5/6/92	725 13th Street NW Washington, DC 20005	Negotiating 3 year extension 5/97 -4/00	52,451

State	Service Establishment Date	Contract Location	Length of Contract	Outgoing Call Volume August 1996
Georgia	4/1/91	5856 Buford Highway Norcross, GA 30071	2 year extension 4/96-3/98	97,721
Illinois	6/10/90	831 Park Avenue Norton, VA 24273	Rebid 5 year contract 2/95-1/2000	170,756
Kentucky	10/1/91	2200 Riverchase Ctr Birmingham, AL	Rebid 26 months 7/96-9/98	47,755
Maine	12/01/90	15 LaSalle Square Providence, RI 02903	3 year tariff 5/94-4/97	22,552
Mississippi	11/1/96	2200 Riverchase Ctr. Birmingham, AL 35244	3 year contract 11/96-10/99	NA
Montana	4/1/91	2901 3rd Avenue Seattle, WA 98121	4/1/91-2/29/96	NA
New Jersey	12/02/91	1300 Whitehorse Hamilton Square Rd. Trenton, NJ 08690	Awaiting rebid decision	99,458
New York	1/01/89	300 Clifton Corp. Pkwy. Clifton Park, NY 12065	6 month extension 1/1/97-6/30/97	348,050
Pennsylvania	9/24/90	60 West Avenue Wayne, PA 19087	Tariff	148,815
Puerto Rico	7/15/93	15 LaSalle Square Providence, RI 02903	1 year extension 7/96-6/97	5,922
Rhode Island	1/30/96	15 LaSalle Square Providence, RI 02903	5 year contract 1/30/96-12/31/2000	18,902
Tennessee	9/17/90	7104 Crossroads Blvd. Brentwood, TN 37073	2 year extension 10/96-9/98	82,202
Vermont	7/1/91	15 LaSalle Square Providence, RI 02903	2 year extension 7/96-6/98	13,953
Virgin Islands	7/26/93	15 LaSalle Square Providence, RI 02903	3 year extension 7/96-6/99	18,902
Virginia	2/1/91	831 Park Avenue Norton, VA 24273	18 month extension 9/96-6/98	129,094
Washington	6/26/93	2901 3rd Avenue Seattle, WA 98121	2 year extension 7/96-6/98	114,721
West Virginia	8/7/92	300 Foxcroft Avenue Martinsburg, WV 25401	Permanent Certificate	15,304

AT&T LONG DISTANCE RELAY SERVICE

AT&T Relay Service may be tested from within Florida by placing long distance or international calls through AT&T Long Distance Relay Service. If the state chooses to make calls from one Florida location to another, please contact Maripat Brennan (908 231-6196) for specific arrangements. Customers can reach AT&T Long Distance Relay Service by dialing toll free:

1 800 855-2880 (TTY)
1 800 855-2881 (Voice)
1 800 855-2882 (ASCII)
1 800 855-2883 (Telebraille)

The following information indicates that approximately 21,000 AT&T Long Distance Relay calls originated in Florida between January and August 1996.

AT&T Interstate Completed Calls
Originated In Florida

MONTH	NUMBER OF CALLS	NUMBER OF MINUTES
January	2,647	24,803
February	2,817	24,671
March	3,201	26,683
April	2,624	22,184
May	2,448	21,593
June	2,567	21,535
July	2,279	18,472
August	2,377	20,013
Year to Date	20,960	179,954

AT&T OPERATOR SERVICES FOR THE DEAF

AT&T began providing Operator Services for the Deaf (OSD) in 1980, preceding the inception of relay service. AT&T provides OSD for all 50 states and has contracts with local exchange carriers to provide their TTY customers with operator services equivalent to hearing customers. OSD provides directory assistance services, toll services, emergency interrupt, busy line verification and special billing arrangements such as third party, collect, calling card and person-to-person calls.

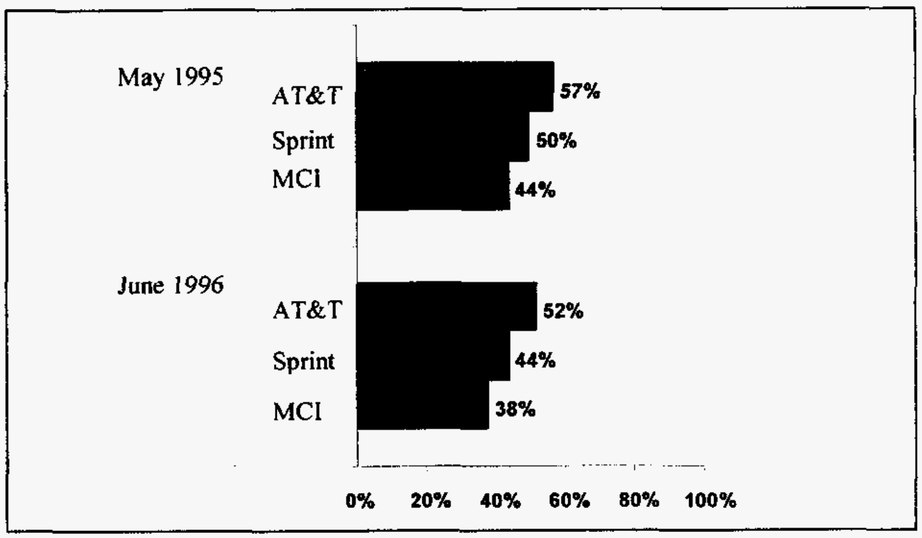
AT&T is the only provider of fully integrated TRS/OSD services. This integration allows the same CA to handle OSD and relay calls **without the need to have the customer hang-up and dial the relay number or transfer the call to another location.** Conversely, if the customer dials the relay number and then needs operator services, the same CA can handle the OSD call. OSD is reached by dialing toll-free 1-800-855-1155.

HIGHEST CUSTOMER SATISFACTION

For the past two years , AT&T has demonstrated the highest levels of customer satisfaction compared to MCI or Sprint. AT&T is the only provider who can substantiate the Number One claim, which is based on an independent research firm's annual customer satisfaction survey of our customers and those of our competitors.

Overall satisfaction with AT&T's Relay Service performance has remained statistically stable even though there has been a decrease from 57% (customer rating AT&T with a score of 9 or 10 on a 10 point scale) in May 1995 to 52% in May 1996. Although a slight erosion is seen for the overall positive satisfaction scores, less than satisfactory ratings have not increased.

Trended AT&T Vs. Sprint & MCI Overall Satisfaction
9/10 out of 10



Report Date: July 23, 1996

CUSTOMER REFERENCES

Illinois Relay Service Illinois Telecommunications Access Corp. 907 Clocktower Dr., Suite B Springfield, IL 62704	Trudy Snell Executive Director, ITAC TTY: 217 698-0943 Phone: 217 698-4170 Fax: 217 698-0943
Delaware Relay Service Bell Atlantic-DE, Inc 901 Tatnall St. Wilmington, DE 19810	Carol Bickerdyke Regulatory Manager Phone: 302 576-6362 Fax: 302 576-1135
Vermont Telecommunication Relay Service Vermont Department of Public Service 120 State Street, Drawer 20 Montpelier, VT 05620-2761	Carol Martin Assistant to the Commissioner Phone: 802 828-4005 Fax: 802 828-2342

Also, AT&T would like to share two recent quotes from the Kentucky and the Mississippi orders that awarded AT&T the TRS contracts in each of these states.

Kentucky, Administrative Case No. 357, Order dated September 24, 1996.

"The Commission has also reviewed the list of features to be included in the contract price by each company (AT&T, Sprint). All features were similar with the exception of these items to be provided by AT&T; Integrated Services Digital Network, Automated Route Selection, Billing Equivalency for Consumers, Call Waiting, Customer Satisfaction Tools, Higher Transmission Speeds, Instantaneous Service Recovery, Originating Line Screening, Text to Speech, Touch Tone Carryover, and Voice Carryover to Text.

AT&T will provide more features and estimated lower total contract price. These two factors most definitively determine the "most cost effective method of providing TRS" and provide the most benefits to the citizens of the Commonwealth."

Mississippi, 90-UA-156, Order dated August 23, 1996.

"The Mississippi Public Service Commission has studied and considered all of the proposals and is of the opinion that it would be in the best interest of the citizens of this state for AT&T Communications to provide the Dual Party Relay System in Mississippi."

The St Paul
Surety

Seaboard Surety Company
Burnt Mills Rd. and Rte. 206
Bedminster, NJ 07921-0751

PROPOSAL BOND

Know all Men by these Presents:

THAT WE, AT&T Communications Inc., Rm. 2A02, 745 Rt. 202/206, Bridgewater, NJ 08807

as principal, and SEABOARD SURETY COMPANY, a corporation under the laws of the State of New York, having its principal place of business in the City of New York, New York, as surety, are held and firmly bound unto
Florida Public Service Commission
Capital Circle Office Center, 2540 Schumard Oak Blvd, Tallahassee, FL 32399-0850

as obligee, in the sum of Five Hundred Thousand and 00/100 ($500,000.00)

DOLLARS, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

SIGNED, sealed and dated this 20th day of September 1996 .

WHEREAS, the said principal is herewith submitting its proposal for
Florida Telecommunications Relay Service

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that if the aforesaid principal shall be awarded the contract upon said proposal and shall within the required number of days after the notice of such award enter into a contract and give bond for the faithful performance of the contract, then this obligation shall be null and void; otherwise the principal and surety will pay unto the obligee the difference in money between the amount of the bid of the said principal and the amount for which the obligee may legally contract with another party to perform the said work if the latter amount be in excess of the former; but in no event shall the surety's liability exceed the penal sum hereof.

AT&T Communications Inc.
Barbara M. Babiak, Asst.Treasurer Principal

By: Barbara M Babiak

SEABOARD SURETY COMPANY

By: Nancy H. Zaleski
NANCY H. ZALESKI AGENT & Attorney-in-Fact

original returned
to AT+T

Form 136

Certified Copy

No. 11056

SEABOARD SURETY COMPANY

ADMINISTRATIVE OFFICES, BEDMINSTER, NEW JERSEY

0000 2550

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That SEABOARD SURETY COMPANY, a corporation of the State of New York, has made, constituted and appointed and by these presents does make, constitute and appoint John Goodloe or Thomas W. Patrick, Jr. or Bruce E. Carr or Nancy H. Zaleski or John L. Lubatti

of Fort Lauderdale, Florida

its true and lawful Attorney-in-Fact, **to make, execute and deliver on its behalf insurance policies, surety bonds, undertakings and other instruments of similar nature** as follows: Without Limitations

Such insurance policies, surety bonds, undertakings and instruments for said purposes, when duly executed by the aforesaid Attorney-in-Fact, shall be binding upon the said Company as fully and to the same extent as if signed by the duly authorized officers of the Company and sealed with its corporate seal; and all the acts of said Attorney-in-Fact, pursuant to the authority hereby given, are hereby ratified and confirmed.

This appointment is made pursuant to the following By-Laws which were duly adopted by the Board of Directors of the said Company on December 8th, 1927, with Amendments to and including January 15, 1982 and are still in full force and effect:

ARTICLE VII, SECTION 1:

"**Policies, bonds, recognizances, stipulations, consents of surety, underwriting undertakings and instruments relating thereto.**
Insurance policies, bonds, recognizances, stipulations, consents of surety and underwriting undertakings of the Company, and releases, agreements and other writings relating in any way thereto or to any claim or loss thereunder, shall be signed in the name and on behalf of the Company

(a) by the Chairman of the Board, the President, a Vice-President or a Resident Vice-President and by the Secretary, an Assistant Secretary, a Resident Secretary or a Resident Assistant Secretary; or (b) by an Attorney-in-Fact for the Company appointed and authorized by the Chairman of the Board, the President or a Vice-President to make such signature; or (c) by such other officers or representatives as the Board may from time to time determine.

The seal of the Company shall if appropriate be affixed thereto by any such officer, Attorney-in-Fact or representative."

IN WITNESS WHEREOF, SEABOARD SURETY COMPANY has caused these presents to be signed by one of its Vice-Presidents, and its corporate seal to be hereunto affixed and duly attested by one of its Assistant Secretaries, this 9th day of July, 1991.

SEABOARD SURETY COMPANY 1927 STATE OF NEW YORK

Attest:

(Seal) Lia A. Rispoli
Assistant Secretary

SEABOARD SURETY COMPANY,
By Michael B Keegan
Vice-President

STATE OF NEW JERSEY
COUNTY OF SOMERSET ss.:

On this 9th day of July, 1991, before me personally appeared Michael B. Keegan a Vice-President of SEABOARD SURETY COMPANY, with whom I am personally acquainted, who, being by me duly sworn, said that he resides in the State of New Jersey; that he is a Vice-President of SEABOARD SURETY COMPANY, the corporation described in and which executed the foregoing instrument; that he knows the corporate seal of the said Company; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said Company; and that he signed his name thereto as Vice-President of said Company by like authority.

(Seal) FELICE M. ZUBRYCKI NOTARY PUBLIC STATE OF NEW JERSEY

FELICE M. ZUBRYCKI
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires June 4, 1996

Notary Public

CERTIFICATE

I, the undersigned Assistant Secretary of SEABOARD SURETY COMPANY do hereby certify that the original Power of Attorney of which the foregoing is a full, true and correct copy, is in full force and effect on the date of this Certificate and I do further certify that the Vice-President who executed the said Power of Attorney was one of the Officers authorized by the Board of Directors to appoint an attorney-in-fact as provided in Article VII, Section 1, of the By-Laws of SEABOARD SURETY COMPANY.

This Certificate may be signed and sealed by facsimile under and by authority of the following resolution of the Executive Committee of the Board of Directors of SEABOARD SURETY COMPANY at a meeting duly called and held on the 25th day of March 1970.

"RESOLVED: (2) That the use of a printed facsimile of the corporate seal of the Company and of the signature of an Assistant Secretary on any certification of the correctness of a copy of an instrument executed by the President or a Vice-President pursuant to Article VII, Section 1, of the By-Laws appointing and authorizing an attorney-in-fact to sign in the name and on behalf of the Company surety bonds, underwriting undertakings or other instruments described in said Article VII, Section 1, with like effect as if such seal and such signature had been manually affixed and made, hereby is authorized and approved."

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the corporate seal of the Company to these presents this 20TH day of SEPTEMBER 1996

SEABOARD SURETY COMPANY 1927 STATE OF NEW YORK

original returned to AT+T

Diana M. Kleint
Assistant Secretary

Form 957 (Rev. 7/84)

For verification of the authenticity of this Power of Attorney you may call, collect, 201-658-3500 and ask for the Power of Attorney clerk. Please refer to the Power of Attorney number, the above named individual(s) and details of the bond to which the power is attached. In New York, Dial 212-627-5444.

STATE OF NEW JERSEY

COUNTY OF UNION

On this Twenty fourth **day of** September **, 1996, before me personally came** Barbara M. Babiak **to me known and who, being duly sworn by me, did depose and say that (he) (she) resides at** Berkeley Heights**; and that (he) (she) is the** Assistant Secretary **of the corporation described in and that executed the foregoing instrument.**

Brian E. Stuhr

My Commission Expires
04-01-2001

Brian E. Stuhr
(Notary Public)

SURETY ACKNOWLEDGMENT

STATE OF FLORIDA

COUNTY OF BROWARD

On *September 20, 1996,* before me personally came *Nancy H.Zaleski*, to me personally known who being by me duly sworn did depose and say that she resides in *Fort Lauderdale, FL,* that she is the Attorney-in-fact of *Seaboard Surety Company,* the corporation described in, and which executed the within instrument; that he knows the seal of said corporation; that the seal affixed by order of the Board of Directors of said corporation and that he signed his name thereto by like order..

Charlotte Ann Carter

CHARLOTTE ANN CARTER
NOTARY PUBLIC, STATE OF FLORIDA

Personally Known ✓ OR Produced Identification ____
Type of Identification Produced ____________

CHARLOTTE ANN CARTER
NOTARY PUBLIC, STATE OF FLORIDA
COMMISSION NO. 477663
COMISSION EXPIRES JULY 2, 1999

6. *Bid Security Deposit*

A bid security deposit in the amount of $500,000 shall be furnished to the FPSC with the original of the proposal. The bid security deposit shall be in the form of a bond, a certified or cashier's check, or bank money order that is valid through at least January 31, 1997 and is payable to the Florida Telecommunications Relay, Inc. The bid security deposit will be held without cashing.

If a bond is used, the bond shall be issued from a reliable surety company acceptable to the FPSC, licensed to do business in the State of Florida and shall be signed by a Florida Licensed Resident Agent. Such a bond shall be accompanied by a duly authenticated power of attorney evidencing that the person executing the bond on behalf of the Surety had the authority do so on the date of the bond.

The unsuccessful bidders' bid security deposit shall be returned, without interest, within thirty (30) days after disqualification, withdrawal or signing of the contract. The successful bidder's bid security shall be returned, without interest, upon signing of the contract and furnishing the Performance Bond as specified herein. If the successful bidder fails to sign a contract within thirty (30) days after the Letter of Intent or fails to deliver the Performance Bond as specified herein, the bid security shall be forfeited to the Telecommunications Access System Fund.

AT&T Response

AT&T understands and will comply.

The original document can be found in the binder labeled **Original.**

7. *Subcontractors*

If the bidder proposes to use subcontractors, the bidder shall identify those subcontractors and indicate the scope of their role in the provision of relay service. The bidder should also indicate what experience the subcontractor has in providing the service for which it would contract with the Provider.

AT&T Response

AT&T understands and will comply.

AT&T will partner with MATRIXX Marketing in a subcontractor arrangement to manage the relay service center environment. The systems, processes and procedures along with training and personnel management practices are tailored after AT&T's existing Relay Service Operation. The Florida center will be a direct extension of AT&T. As a business partner with AT&T, MATRIXX has demonstrated an ability to develop personnel and call centers that replicate and embrace the spirit of service that is critical to satisfying the relay service users in the state of Florida. MATRIXX's function in the relationship of supporting AT&T and the end users, deaf and hard of hearing citizens of the state of Florida, is to provide qualified personnel and management staff that can operate in a high pressure, sensitive environment which requires delicacy and an appreciation of the service being offered. AT&T will participate in the management and operation of the relay team dedicated to serving the needs of the citizens of the state of Florida.

EXPERIENCE

The experience MATRIXX has, supporting a leading national healthcare provider, is relevant to the role it will have partnering with AT&T in supporting the relay service. This healthcare customer care center requires all personnel to handle a variety of call types that pertain to medical conditions and procedures. Customer care advocates must handle all of these communications with callers in a professional, nonjudgmental manner. Information provided must be accurate and professionally handled. There is a clear understanding that no personal opinions can be offered and that no opportunity to influence callers is allowed.

The way in which MATRIXX supports this type of call handling is built into its basic processes and company culture. MATRIXX begins the process by predetermining with AT&T what specific skill sets and personality types will be best suited to meet the needs of a specific program. The profiling and screening process enables MATRIXX to select and train only those individuals who qualify and meet the screening criteria. Throughout all phases of the customized hiring and interview process, the types of calls that personnel are required to handle are discussed and each applicant is asked numerous times if he/she will have any problem or personal objection to handling sensitive calls. Part of the process requires each new employee to sign an acknowledgment stating he/she understands the sensitive and confidential nature of the calls and that each communication must be handled in a professional manner. Prospective customer care associates are provided with the grading forms that will be used to track their progress and productivity. Their screening and hiring process will be managed by recruiters, trainers and supervisors who are dedicated to the program and who will have a thorough and complete understanding of all requirements and any unique complexities associated with providing superior service. Lack of complying will result in termination.

Throughout the training process and after call handling begins, agents are given instruction and counseling on how to handle various types of sensitive calls. In MATRIXX's health care program, personnel are required to discuss these calls in a professional manner and respond to the callers questions with specific information. Personnel may not under any circumstances offer suggestions, opinions or counsel callers about the call. As many of these calls center around life and death situations, it is not infrequent that callers attempt to draw the customer care associate into a more personal discussion. If the caller initiates such a conversation, MATRIXX's customer care associates are instructed to courteously and professionally direct the caller back to the original reason for the call.

MATRIXX will operate the relay service with personnel specifically selected to a unique job profile. The hiring and training process will reflect and will be modeled after existing AT&T Relay employee standards. MATRIXX has extensive experience in supporting transparent calling center extensions for major corporations across America. It has developed a methods and procedures plan that implements transition from the parent company to its calling centers so seamlessly that the callers, customers or members utilizing the service benefit by receiving consistently seamless quality in the telephone interaction. MATRIXX does not accomplish the world class service it provides alone. As part of its implementation plan for the relay service for the State of Florida, MATRIXX and AT&T will function as a tightly integrated team. MATRIXX will be responsible for the overall management of the calling center and all of the processes which create the foundation for a successful operation. AT&T will function as the industry expert, providing background, training support and fine tuning the operation to support the specific function of relay services. The

AT&T relay team will have absolute and final authority in decision concerning center development and operation. AT&T is the industry leader in relay center operations and MATRIXX is the industry leader in developing operations which are mirror images of its clients centers. This will provide the State of Florida with the best of all possible worlds. A MATRIXX designed and managed calling center that will provide the highest level of professional service available at efficiencies that make quality affordable; and AT&T product management that will provide leadership, and the background expertise derived from our vast experience in supporting many other states with relay services. AT&T management team members, who have experience in relay services, will be on premises in the Maitland facility to oversee the initial implementation and until such time as the entire process has been developed so as to assure the best possible service for the citizens of Florida. Additionally, MATRIXX, will also draw upon the resources of its parent company, Cincinnati Bell, Inc., for management resources and their years of experience in the operator services arena to further support a smooth transition of the relay service from the incumbent provider to AT&T.

MATRIXX Marketing, a firm that accounts for over 20% of Cincinnati Bell, Inc. revenues, manages over 100,000,000 telephone conversations annually. It employs over 10,000 people in nineteen call centers in the US and Europe. MATRIXX is the largest manager of AT&T 800 numbers in the country, with over 20,000 in use today. It has excelled in its ability to attract and develop people who are service oriented and understand what is needed to satisfy the caller by providing a level of service that is consistent with the AT&T heritage of providing operations that result in an outstanding service record and service quality.

FLORIDA RELAY SERVICE CENTER PERSONNEL

MATRIXX will team with AT&T to parallel best practices in the recruitment and training of personnel for the Relay Services Center Operation. This will include the melding of existing training processes about how to work in a high volume, pressure packed call center environment along with the sensitivities needed to emulate the "Spirit of Service" that is part of AT&T's heritage. The AT&T reputation of the "Spirit of Service" - placing the customer and user first will ensure an operation which is flexible and designed to satisfy this critical constituency of the state of Florida.

An existing member of the management team that supports the AT&T Wireless Long Distance Customer Care Center in Maitland has a hearing loss. She has supervisory experience and over twenty five years industry experience in customer contact situations as a result of her tenure with Northwestern Bell and MATRIXX. She, along with existing and recruited resources from the community, will be part of the management team we utilize to operationalize the program.

An estimated twenty percent of the workers in metropolitan Orlando have fluency in both English and Spanish. The AT&T MATRIXX partnership can provide workers who have the appropriate level of Spanish speaking skills and the appropriate level of accent neutral English skills to satisfy the users of the relay service.

A unique aspect of being located in the metropolitan Orlando area is our ability to utilize some of the training sponsored by Disney University in the area of quality service, people management and leadership.

MAITLAND FACILITY

MATRIXX Marketing currently manages an AT&T Wireless Long Distance Customer Care center in the Maitland Business Center office park in Maitland. MATRIXX occupies the anchor building in the office park, with over 100,000 square feet of space available for expansion. MATRIXX's physical plant is well positioned to handle the near term needs of operating the center in 1997 and any anticipated growth requirements. The attractive demographics of the metropolitan Orlando area will support an improvement in service quality to relay users.

Metropolitan Orlando contains a workforce that is relatively young, with a large number of workers expected to enter the full time job market in the next few years. The identified labor supply is more than adequate to support the current and anticipated growth needs of the operation.

The location of the facility is in close proximity to one community college and two four-year colleges and will allow for the attraction of labor to support the requirements of operating a 24 hour a day, 365 days per year operation.

Metropolitan Orlando is the nation's fastest growing employment market, with growth exceeding eight percent per year, helping to ensure a large enough supply of labor to allow for the AT&T MATRIXX team to be selective in our personnel recruitment.

Metropolitan Orlando has been ranked by Fortune magazine as one of the top sixty cities in the United States for workers and is regarded as one of the intellectual capitals in the country. The high school graduation rate in the community is among the highest in the country.

AT&T MATRIXX PARTNERSHIP

We feel the State of Florida needs and deserves an operation that provides value to the users. The AT&T MATRIXX partnership brings together a resource that will:

- Allow the Florida Relay Service users access to AT&T's industry leading technology. Our technology has consistently resulted in a decrease in the time needed to complete relay calls. This has significant implications from both a user satisfaction level and operational cost perspective for the State of Florida.

- Operation of the center in a region of the state that is located to draw from a labor source (metropolitan Orlando) that is collectively known for its ability to provide world class service. Our plan is to utilize best practices management techniques that emanate from the partnership of industry leaders to allow for an operation that is managed consistently with the excellence that comes from marketplace-driven companies. The result is a more efficient operation and a higher level of satisfaction for this critical constituency in Florida.

- The combination of AT&T and MATRIXX, as part of the Cincinnati Bell, Inc. family of companies, provides a flexible work force and management team, motivated by providing a world class operation that is positioned to support the growing population of Florida into the twenty first century. MATRIXX specializes in managing programs that are seamless extensions of a client's operation. The Maitland facility will include AT&T staff on the management team, both on premises and at the headquarters level. This teaming of AT&T and MATRIXX results in a more adaptable, fluid management team and resource workers. Cincinnati Bell Telephone, which manages an extensive customer care environment, will be an additional resource to the AT&T MATRIXX team as we develop and operate the relay services center operation.

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AMERICAN NATIONAL STANDARD

ANSI / TIA / EIA-464-B-1996
APPROVED: March 29, 1996

TIA / TIA - 464 - B

TIA/EIA STANDARD

Requirements for Private Branch Exchange (PBX) Switching Equipment

TIA/EIA-464-B

(Revision of EIA/TIA-464-A and Incorporation of EIA/TIA-464-A-1)

APRIL 1996

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

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(From Standards Proposal Nos. 2396 and 2396-1, formulated under the cognizance of the TR-41.1 Subcommittee on Multiline Terminal Systems.)

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1 INTRODUCTION

1.1 General

This standard is one of a series of technical standards on user premises telephone equipment prepared by TIA Engineering Committee TR-41. This document fills a recognized need in the telecommunications industry, brought about by the interconnecting of public and private networks using equipment supplied by different manufacturers. It will be useful to anyone engaged in the manufacture of telecommunications terminal equipment and to those purchasing, operating, or using such equipment.

The requirements in this issue are formulated to ensure compatibility with existing networks while recognizing needs of all-digital connections and the Integrated Services Digital Network (ISDN).

1.2 Purpose

This standard establishes performance and technical criteria for interfacing and connecting with the various elements of public and private telecommunications networks. Compliance with these requirements should assure quality service. In some cases, quality performance requires location-oriented options or equipment changes in the PBX. This flexibility is needed to accommodate differences between network switching systems.

Therefore, to assure satisfactory performance, two items are needed: equipment design compliance and a process for configuring the PBX to the requirements of its telephone serving area.

1.3 Categories of Performance Criteria

In accordance with EIA Engineering Publication EP-7-A, Style Manual for Standards and Publications of EIA, TIA, and JEDC, (Ref A1), two categories of performance standards are specified, mandatory and advisory. The mandatory performance criteria are designated by the word "shall"; advisory are designated by the word "should", "may", or "desirable" (which are used interchangeably in this standard). The mandatory criteria generally apply to safety and protection, signaling and compatibility. They specify the absolute minimum acceptable performance levels in areas such as transmission and equipment parameters and durability.

Advisory or desirable criteria represent product goals. In some instances, these criteria are included in an effort to assure universal product compatibility even with equipment and facilities operational in statistically small quantities. In other cases, advisory criteria are presented when their attainment will enhance the general performance of the product in all its contemplated applications.

Where both a mandatory and an advisory level are specified for the same criterion, the advisory level represents a goal currently identifiable as having distinct compatibility or performance advantages, or both, toward which future designs should strive.

2 SCOPE

2.1 General

This standard covers requirements for digital PBXs. The standard anticipates that the majority of digital PBXs manufactured and sold in North America will have ISDN functionality and compatibility. Such digital PBXs are referred to in the remainder of this standard as Integrated Services PBXs (ISPBX). For digital PBXs which do not have this functionality, all of the requirements in this standard apply except for those which are specific to the ISDN functionality.

For the purposes of this standard, the PBX is considered to be a device that performs switching functions between station apparatus interfaces, between the station apparatus interfaces and network (CO) and special trunk interfaces, and between trunk (network and special trunk) interfaces. Station interfaces considered in this standard consist of two different types. Conventional analog station interfaces are assumed to be compatible with the parameters specified in ANSI/EIA/TIA-470A-1987, Telephone Station Instruments with Loop Signaling, (Ref A2). Integrated Services Digital Network (ISDN) compatible station interfaces are assumed to be compatible with the parameters specified in ANSI/EIA/TIA-579-1991, Acoustic-To-Digital and Digital-To-Acoustic Transmission Requirements for ISDN Terminals (Ref A3).

Network trunk interfaces transmit and receive network supervisory and communication signals and are of two types: analog and digital.

The requirements in this standard are intended to assure satisfactory user voicegrade services in a high percentage of installations both initially and over some period of time as the network grows and changes occur in telephone serving equipment.

2.2 Compliance Reference Point

Compliance with this standard is determined at the PBX interface boundaries and is not to be construed as a constraint on the internal coding or switching techniques of the PBX.

2.3 Compliance Interpretation

A PBX complies with this standard when it conforms to the requirements applicable to the interfaces with which it is equipped. For satisfactory service, a PBX should be capable, through the proper selection of equipment options, of satisfying the requirements applicable to its serving area. The requirements for the individual types of PBX interfaces vary between public network carriers and, in some cases, between network switching machines; therefore, multiple options are stated for satisfying a particular requirement.

2.4 Conformance with Regulatory and Safety Standards

This standard is intended to be in conformance with Part 68 of the FCC Rules and Regulations (Ref A4)[1] and with safety requirements specified in UL1459, Standard for Safety — Telephone Equipment (Ref A5)[2], but it is not limited to the scope of these rules or requirements. If requirements in either of these documents are more stringent than those contained in this standard, the provisions of those documents apply. In addition to the requirements in this standard, a PBX is subject to environmental considerations given in ANSI/EIA/TIA-571-1991, Environmental Considerations for Telephone Terminals (Ref A6).

1. It is expected that, during 1995, the requirements in Part 68 of the FCC Rules and Regulations will be harmonized with the Canadian terminal attachment requirements in CS-03. Every effort has been made to keep the requirements in this standard in conformity with the terminal attachment requirements in both Canada and the USA.

2. It is expected that Underwriters Laboratories in the USA and the Canadian Standards Association in Canada will publish a binational product safety standard for Information Technology Equipment, based on the international standard, IEC-Publication 950. The document will be known as UL-1950/CSA C22.2 No. 950, third edition and is expected to be published in early 1995. Conformity with this new standard will be mandatory in the early 2000's and will allow for compliance with harmonized US, Canadian and International requirements. This vehicle can be used by North American manufacturers as soon as the standard is published. However, until the effective date in the early 2000's, compliance with UL-1459 in the USA and with CSA C22.2 No. 250 in Canada will be acceptable.

3 DEFINITIONS

This section contains definitions of terms needed for the proper understanding and application of this standard, which are not believed to be adequately treated elsewhere.

3.1 Digital Switching

Digital switching, as employed in this standard, is defined in IEEE Standard 100-1984, IEEE Standard Dictionary of Electrical and Electronic Terms, (Ref A7).

3.2 PBX Definitions

3.2.1 ISPBX

An ISPBX is a PBX that provides connectivity to and between ISDN and ISDN-like terminals and/or facilities. Such terminals and facilities may consist of single or multiple channels (e.g., Basic Rate Access and Primary Rate Access).

3.2.2 Satellite PBX

A satellite PBX is a Private Branch Exchange that is homed on a main PBX through which it receives calls from the public network and may connect to other PBXs in a private network.

The satellite PBX does not have a public network directory number and all calls are routed from the main PBX via satellite PBX tie trunks. For outgoing service, calls may be routed directly over access lines, if provided, or over tie trunks through the main PBX and access lines. The satellite PBX is usually located in the same local area as its main PBX and is connected to the main PBX via short haul satellite PBX tie trunks.

3.3 Interfaces

3.3.1 Digital Trunk Interface

A digital trunk interface connects to one end of a digital trunk facility, or to the digital end of a combination trunk facility or a digitally terminated analog trunk facility. Digital trunk facilities include integrated service type trunks as well as non-ISDN digital trunks.

3.3.2 Analog Trunk Interface

An analog trunk interface connects to one end of an analog trunk facility, or to the analog end of a combination trunk facility or a digitally terminated analog trunk facility.

3.3.3 Digital Line Interface

A digital line interface connects to a digital telephone set with separate transmit and receive paths. Acoustic voice signals from the user are converted to digital signals to the transmit pair, and digital signals from the receive pair are converted to acoustical signals to the user. Digital sets include, but are not limited to, ISDN-compatible station terminals.

3.3.4 Analog Line Interface

An analog line interface connects to a 2-wire analog on-premises (ONS) or off-premises (OPS) station.

3.4 Network Access Lines

In ANSI Standard T1.508-1992, Network Performance - Loss Plan for Evolving Digital Networks (Ref A8), connections between a digital PSTN office (e.g., a DEO) and customer equipment, such as an ISPBX, are referred to as "access lines". Ref A8 defines two types of access lines, analog and digital; these designations determine the network loss specifications and the network loss values associated with each type of access line.

3.4.1 Analog Access Lines

For loss planning purposes, an analog access line interface at the PBX is defined as an interface for which the network will accord analog access line loss treatment (as defined in Ref A8). The network loss treatment of analog access lines consists of the application of network loss (typically 0, 3 or 6 dB) by the PSTN office in the receive path of (i.e., towards) the access line. No network loss is applied in the access line transmit direction for any connection.

The analog access line designation is not dependent on the actual nature of the network interface or facility, although traditionally an analog access line would utilize analog facilities and terminate at an analog interface at the customer premises. However, a wholly or partly digital facility, including a digital termination at the customer premises, would still be treated by the PSTN as an analog access line if it exhibits the loudness characteristics assumed for an analog access line. That is, when one or more of the following elements of an access line are analog:

Network Interface (NI);
Facility (wholly or any portion thereof);
Network switch termination;

the network switch will treat the line as an analog access line.

3.4.2 Digital Access Lines

For loss planning purposes, a digital access line interface at the PBX is defined as an interface for which the network will accord loss treatment as for an interconnecting network with respect to connections through the network (as defined in Ref A8). This loss treatment consists of loss inserted by the network (generally the digital end office, DEO) on connections terminating to an analog access line in the analog access line receive direction. No loss is inserted by the DEO in the digital access line receive direction. For connections to the PSTN, no loss is inserted by the DEO in either direction.

Digital access lines have a digital NI, a digital termination at the serving CO, and a digital network facility with no analog portions. Examples of digital access lines are: ISDN BRA, ISDN PRA, Switched 56 Digital Data, and direct DS1 connections to digital end offices.

3.5 Abbreviations

Abbreviations, other than in common usage, which appear in this standard are defined below.

3.5.1 PBX Interfaces

ONS — Line interface to on-premises station
OPS — Line interface to off-premises station
ICS — Digital line interface to ISDN Compatible Station (meeting requirements of Ref A3)
A/TT — Analog trunk interface to tie trunk
IST — Digital trunk interface to integrated services trunk
ISD/TT — Digital trunk interface to integrated services trunk and digital interface to non-ISDN digital or combination tie trunk[3]
S/ATT — Analog trunk interface to analog satellite PBX tie trunk
S/DTT — Digital trunk interface to digital satellite PBX tie trunk
AAL(A) — Analog trunk interface to analog PSTN access line
AAL(D) — Digital trunk interface to analog PSTN access line
DAL — Digital trunk interface to digital PSTN access line
A/TO — Analog trunk interface to analog toll office (TO) trunk

Some uses of these interfaces are shown in Fig 1.

3.5.2 Other Abbreviations (including PBX Trunk Types and Channel Bank Equivalents)

AEO — Analog End Office
ARLP — Acoustic Reference Level Plan
ATO — Analog Tandem Office[4]
DEO — Digital End Office
DID — Direct Inward Dialing
DPO — Dial Pulse Originating (Channel Unit)
DPT — Dial Pulse Terminating (Channel Unit)
DRS — Digital Reference Signal
DTO — Digital Tandem Office
ERL — Echo Return Loss
FX — Foreign Exchange
FXO — Foreign Exchange Office (Channel Unit)
FXS — Foreign Exchange Subscriber (Channel Unit)
IEC — Interexchange Carrier
LEC — Local Exchange Carrier
OOLR — Overall Objective Loudness Rating
PSTN — Public Switched Telephone Network
ROLR — Receive Objective Loudness Rating
SAO — Special Access Office (Channel Unit)
SAS — Special Access Subscriber (Channel Unit)
SRL — Singing Return Loss
TOLR — Transmit Objective Loudness Rating
WATS — Wide Area Telephone Service

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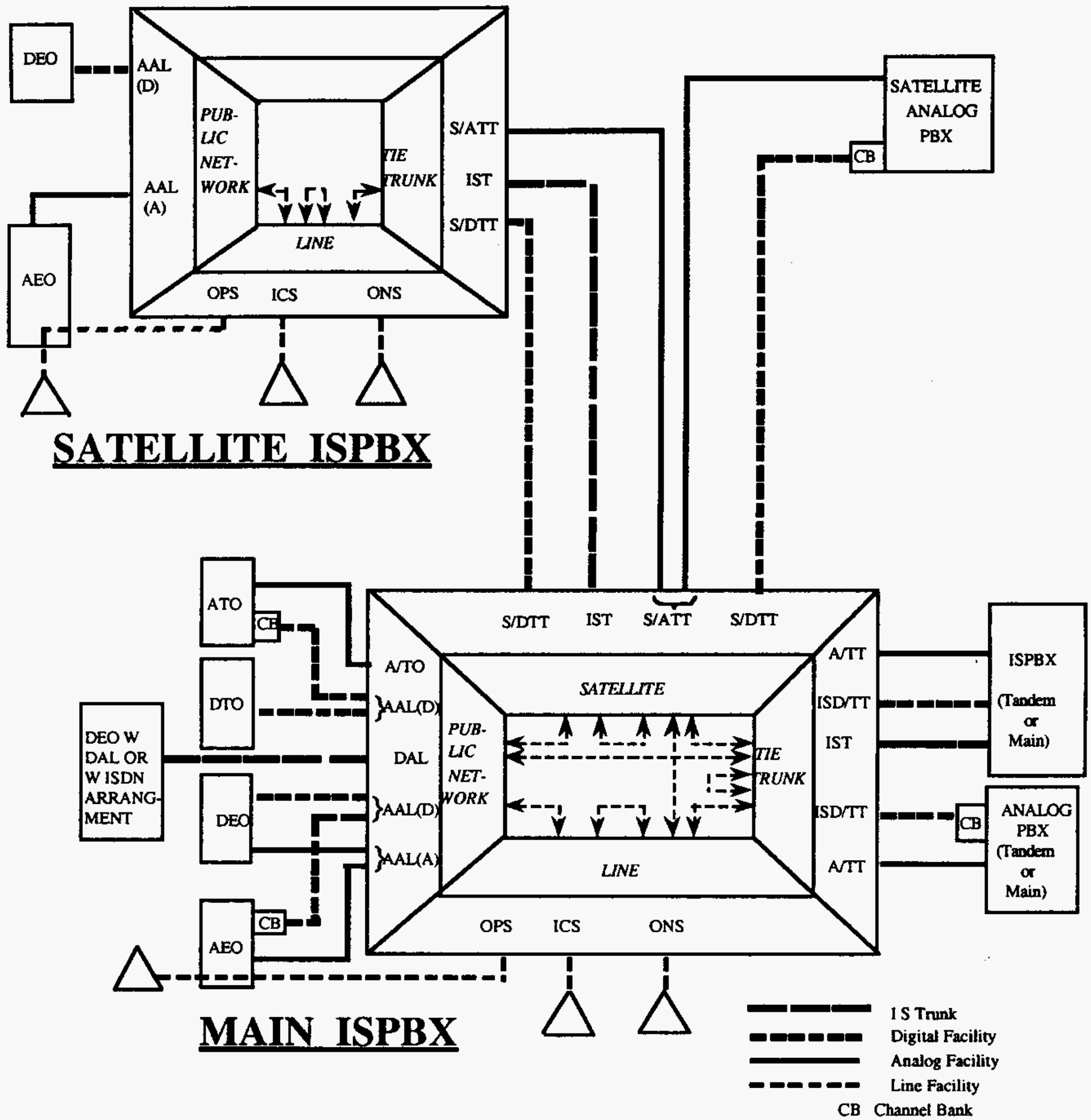
3. In ANSI Standard EIA/TIA-464A-1989 Private Branch Exchange (PBX) Switching Equipment For Voiceband Applications (Ref A9), this interface was designated by the notation "D/TT".

4. Historically, TO denoted a Toll Office, now known as a Tandem Office. In the present context, TO denotes any office other than the EO (CO).



NOTES:

1. Dashed lines with arrow heads show internal PBX connections
2. ICS, IST, and DAL interfaces and connections apply to ISPBXs defined in 3.2.1

Figure 1 - Representative PBX Network Connections

4 INTERFACE REQUIREMENTS

Note: The requirements in this section assume a ringer equivalence number (REN) of 5. If the PBX has a REN of less than 5, then the requirements designated by the parenthetical expression (REN) need to be appropriately scaled in accordance with Section 68.312 of the FCC Rules and Regulations (Ref A4)

4.1 Public Network Access Interface - Analog

Note: For brevity, the term "network" is used in this section to denote public network. The term "network" replaces the traditional reference to "Central Office" or "CO" except in cases where the CO performs a specific function.

4.1.1 Supervision - Ground Start Access Lines

Ground start access lines provide either two-way Direct Outward Dial (DOD) and attendant-handled incoming call service[5], one-way DOD service, or one-way attendant-handled incoming service. Common (CO) battery loop supervision, Dual Tone Multifrequency (DTMF) or loop dial pulse (DP) signaling, alerting signals (ringing), and voiceband electrical energy are transmitted across the two-wire ground start access line interface.[6]

Two types of network battery are used at present. One is conventional battery with the negative lead connected to the ring conductor and the positive lead connected to the network ground. The other is floating battery that is a feature of recently-developed local switching systems, which are being deployed throughout the network. In the ground-start application, floating battery looks like conventional battery during the following intervals: (1) the idle state, (2) the service request state, (3) the first 210 ms of the addressing state, and (4) the alerting state. It looks like the conventional battery during all but the first 50 ms of the disconnect sequence as well. In all the other call states (remaining part of the addressing, call processing, and communication states), battery is connected between tip and ring with neither of its leads grounded.

As noted above, floating battery looks like conventional battery only during the first 210 ms of the addressing state; i.e., tip ground present. After at least 210 ms of the addressing state have elapsed, the network disconnects the ground from the tip. A failure of the terminal to provide loop closure before tip ground disconnect may terminate the call. For loop-closure timing criteria for ground start trunks with digital interfaces, see 6.2.4. On lines with floating battery, the disconnect sequence also differs from lines served by conventional battery. On lines with floating battery, when the terminal requests a disconnect; i.e., opens the loop, the network responds by reapplying ground to the tip (no tip ground is present - see above call states) conductor within 50 ms of the terminal disconnect. The network then disconnects the tip from ground and opens the loop (in actual implementations, these two actions do not have to be simultaneous; the loop may be opened before ground is removed from the tip), thus indicating that the call has been disconnected and that the network has returned to the idle state. On lines with floating battery disconnected during the addressing state, the network will not reapply tip ground.

The criteria for ground-start signaling on lines with floating battery are such that, if a terminal complies with them, it is compatible with ground-start signaling on all lines (conventional or floating battery). Terminals requiring the tip conductor to be grounded in the addressing and

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5. Attendant-handled includes all call answering methods which perform the functions of an attendant, e.g., night-answering arrangements, automated attendant, and Direct Inward System Access.

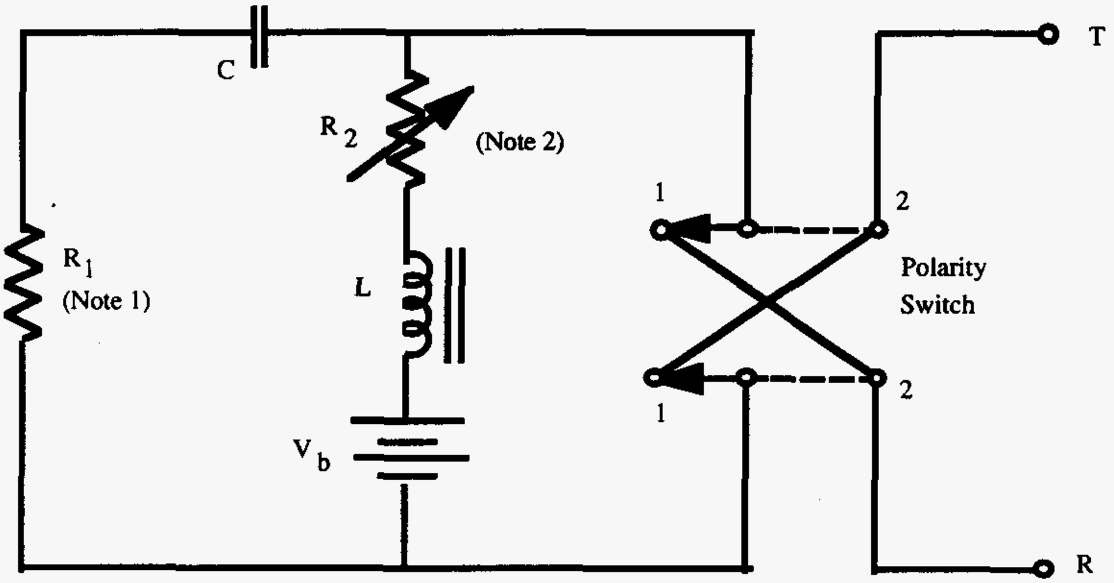
6. The battery feed voltage range and maximum currents that can be encountered on ground start and on loop start access lines are defined by the network steady-state dc voltage vs. current characteristics given in ANSI T1.401-1993, Interface Between Carriers and Customer Installations – Analog Voicegrade Switched Access Lines Using Loop-Start and Ground-Start Signaling (Ref A10)

communications state are not compatible with network floating battery configurations and may not, in all cases, be accommodated by the network.

4.1.1.1 *Idle State*

4.1.1.1.1 The PBX shall maintain an idle condition when the external dc resistance between tip conductor and ground at the interface is 30 KΩ, or greater.

4.1.1.1.2 In the on-hook state, the power delivered into the loop simulator circuit in Fig 2 shall not exceed -55 dBm within the frequency band 200 to 4000 Hz.



R_1 = 600 Ω (±1%)
L ≥10 henry, up to 150 mA
C = 500 μF (-10%, +50%)

Condition	V_b		Polarity Switch Position	$R_2 + R_L$ (Note 2)
	Min	Max		
1	42.5 V	56.5 V	both 1 & 2	400 to 1740 Ω
2	105 V		2	1300 to 2000 Ω

NOTES:

1. Termination R_1 is normally connected. Remove termination R_1 or replace it by the alternative terminations in Fig 18 when specified.
2. Resistance $R_2 + R_L$ shall be continuously variable across the ranges given in the chart.

Figure 2 - Loop Simulator Circuit

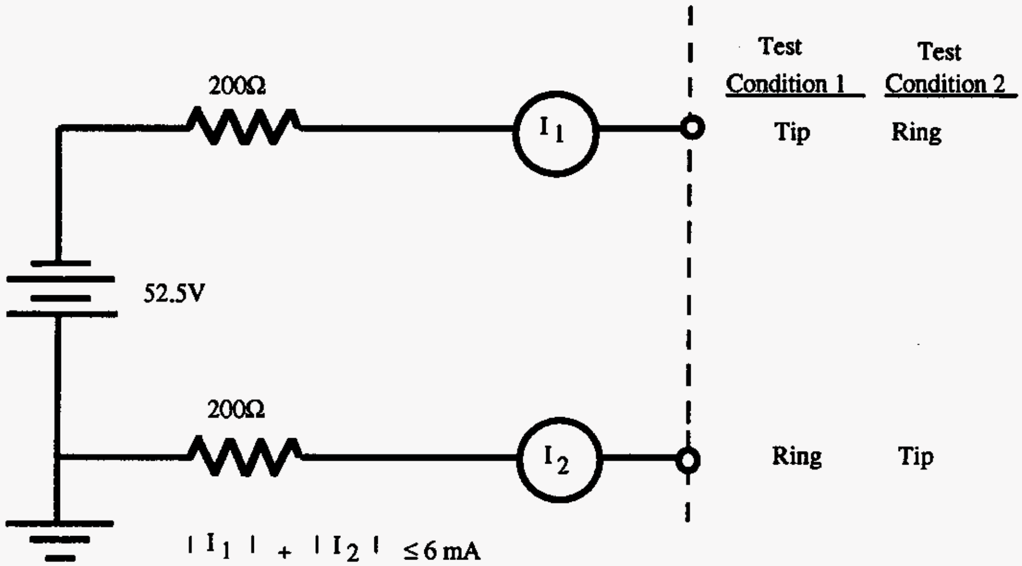


Figure 3 - On-hook Condition Test Circuit

4.1.1.1.3 The PBX trunk circuit shall draw no more than 1.7 mA dc in the ring conductor during idle circuit conditions, measured with the tip conductor open and -52.5 V battery in series with a 500-ohm resistor connected between the ring conductor and PBX ground. To ensure network recognition of idle, the PBX shall meet the two test conditions shown in Fig 3.

4.1.1.1.4 No potential more positive than PBX ground shall be applied to either the tip or ring conductor.

4.1.1.1.5 To facilitate mechanized testing procedures by presenting a recognizable termination signature, it is desirable that the PBX have one of the characteristics included in Table 1.

4.1.1.2 Seizure - Incoming Call

4.1.1.2.1 Incoming seizure shall occur in response to either ground on the tip conductor or the appearance of ringing potential, or both. It is desirable that PBXs not depend on tip conductor voltage change from open to ground as the only indication of incoming call seizure.[7]

4.1.1.2.2 Ground start access lines shall provide for detection of ground applied on the tip conductor at the network interface as an indication of incoming seizure. This ground shall be detected when the tip-to-ground dc voltage-versus-tip-conductor-current falls within the network operating region of Fig 5 for lines with conventional batteries and within the network operating region of Fig 6 for lines with floating batteries.

4.1.1.2.3 The PBX trunk circuit shall operate properly with up to ±3 V dc earth potential difference between network and PBX grounds.

4.1.1.2.4 During the application of the test voltages listed in Table 2, the total impedance of the parallel combination of the ac impedance across tip and ring conductors and the ac impedance from the ring conductor to ground (with ground on the tip conductor) shall be greater than the values given in Table 2. This is necessary to prevent ringing pre-trip.

7. The network may not provide a disconnect signal before it provides an incoming seizure for the next call.

Table 1 - Acceptable Ground Start Terminations

Signa-ture	R_{tr} (KΩ)	R_{tg} (KΩ)	R_{rg} (KΩ)	V_{tg} (volt)	V_{rg} (volt)
A	$18<R_{tr}<25$	>100	>100	0	0
C	>54	$7<R_{tg}<13$	R_{tg}	$-55<V_{tg}<-40$	V_{tg}
D	>54	$7<R_{tg}<13$	>100	$-55<V_{tg}<-40$	0
E	>54	$7<R_{tg}<13$	$27<R_{rg}<35$	$-55<V_{tg}<-40$	V_{tg}
F	>54	$27<R_{tg}<35$	R_{tg}	$-29<V_{tg}<-18$	V_{tg}
G	>54	$27<R_{tg}<35$	R_{tg}	$-55<V_{tg}<-40$	V_{tg}
H	>54	$27<R_{tg}<35$	>100	$-55<V_{tg}<-40$	0
J	>54	$14<R_{tg}<20$	$27<R_{rg}<35$	$-55<V_{tg}<-40$	V_{tg}
K	>54	$27<R_{tg}<33$	>100	$-29<V_{tg}<-18$	0

The values in this table are the three-terminal equivalents (Fig 4) and do not necessarily represent the actual circuit configuration.

The designations in the signature column correspond to various terminations recognized as ground start access lines by mechanized loop testing equipment and have no specific significance for PBXs.

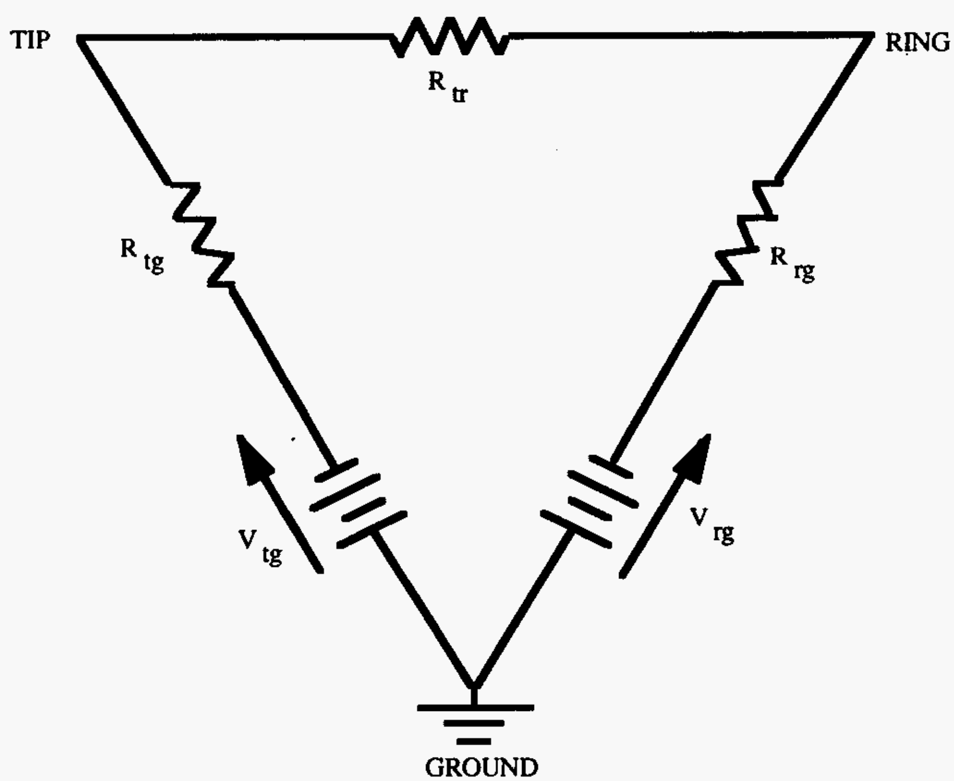


Figure 4 - Three-terminal Loop Signature Equivalents

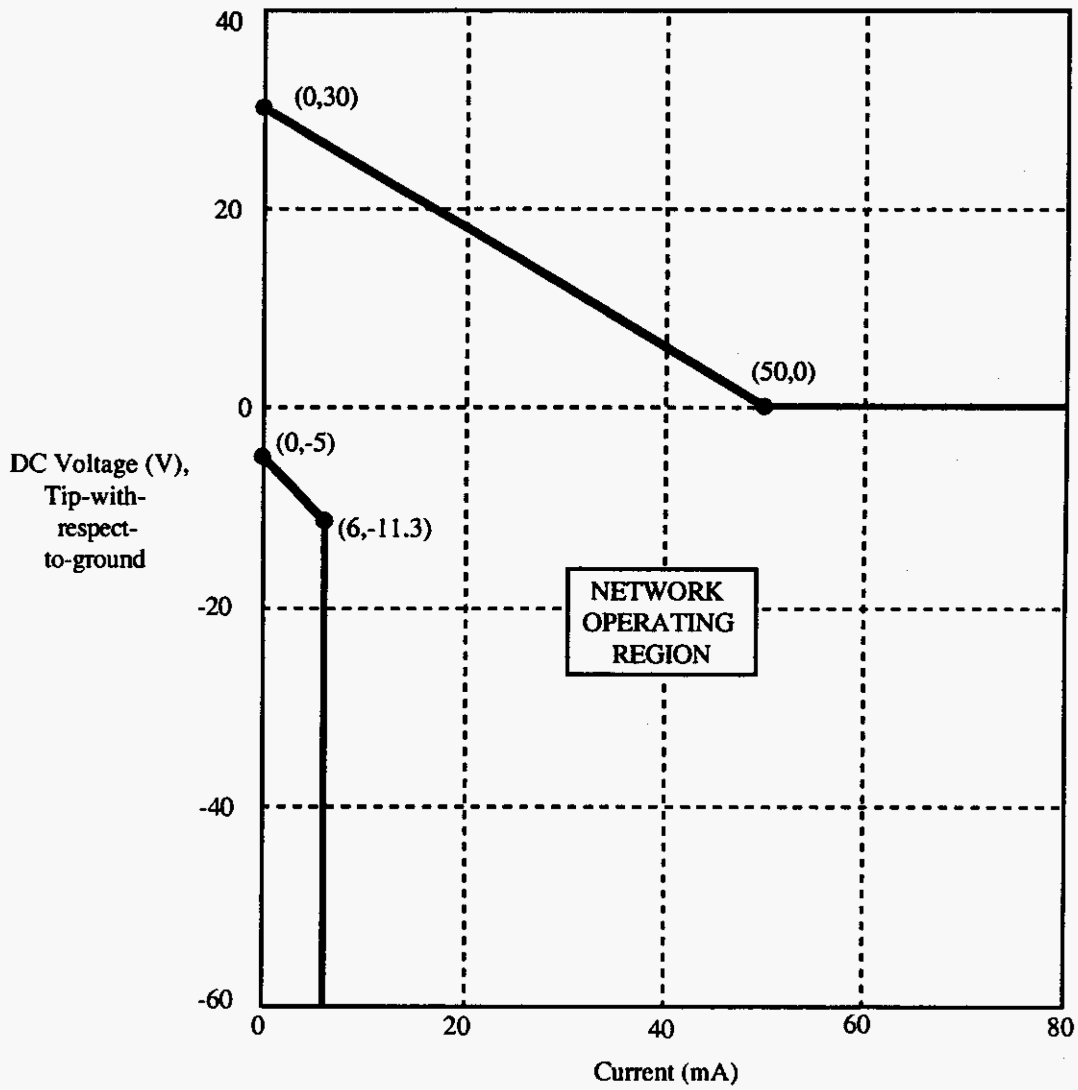


Figure 5 - Network steady-state tip-to-ground dc voltage-versus-tip-conductor-current characteristics for ground-start signaling on lines with conventional batteries

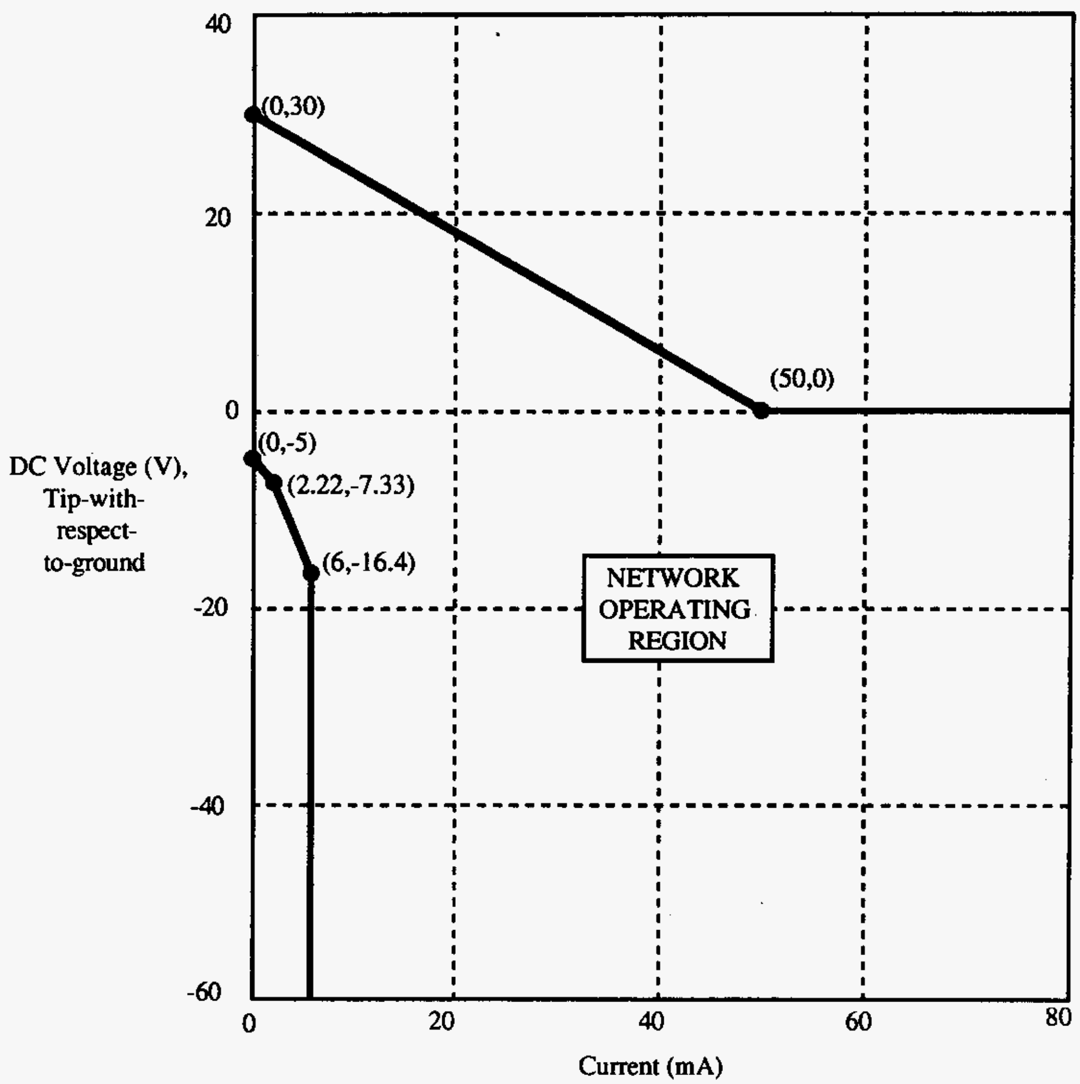


Figure 6 - Network steady-state tip-to-ground dc voltage-versus-tip-conductor-current characteristics for ground-start signaling on lines with floating batteries during the alerting state

4.1.1.2.5 During the application of voltages listed in Table 2, the total dc current flowing between tip and ring conductors shall not exceed 3.0 mA; it is desirable that it not exceed 1.0 mA.

Table 2 - AC Impedance Pre-trip Requirements

Ringing Type	Range of compatible ringing frequencies (Hz)	Voltage Range		Minimum Impedance (Ω)
		AC Signal V(rms)	DC Bias V(dc) (Note 1)	
A	17	40 - 130	0 - 105	1400
	20	40 - 130	0 - 105	1400
	23	40 - 130	0 - 105	1400
	27 - 33	40 - 130	0 - 56.5	1000
B	15.3 - 34	40 - 130	0 - 105	1600
	>34 - 49	62 - 130	0 - 105	1600
	>49 - 68	62 - 150	0 - 105	1600

Notes on Table 2:

1. Where range extension is used, the voltage may be as high as ± 105 V dc. This higher range extension voltage is not specifically noted in FCC Part 68, Table 68.312-1.
2. The ringer equivalence number (REN) is defined to be the value determined in FCC Part 68 ("Ringer Equivalence Definition"), followed by the ringer type letter indicator representing the frequency range for which the number is valid. If Ringer Equivalence is to be stated for more than one Ringing Type, testing shall be performed at each frequency range to which Ringer Equivalence is to be determined, and the largest resulting Ringer Equivalence Number so determined will be associated with each Ringing Type letter designation for which it is valid.

   The ringer equivalence is five times the impedance limitation listed in Table 2, divided by the minimum measured AC impedance during the application of simulated ringing as listed in Table 2. In this table and throughout this document, a ringer equivalence number (REN), as defined in Part 68.312 of the FCC Rules and Regulations, of 5 is assumed.
3. For AC impedance performance requirements, see 4.1.1.2.4 and 4.1.2.2.1 for ground-start and loop-start, respectively.

4.1.1.2.6 Alerting shall occur in response to either tip ground or to ringing (with tip ground also applied).[8]

8. Use of incoming ringing as the alerting signal insures compatibility with carrier failure activation of trunk conditioning. This optional carrier feature has been implemented in both analog and digital carrier system equipment.

   Carrier failure activation of trunk conditioning is used to prevent the seizure of a defective trunk by the PBX for an outgoing call. Approximately 2.5 seconds after a carrier system failure is detected, a permanent tip ground is applied toward the PBX to hold the trunk busy. (If an existing call is in progress when the failure is detected, the carrier terminal removes the tip conductor ground for 2 seconds to release the existing connection before sending the permanent seizure signal.) Upon restoral of the carrier system, the tip ground is removed, restoring the trunk to its normal idle state, available for service.

4.1.1.2.7 When the PBX uses the tip ground alone as the alerting signal, alerting shall not commence until the ground has persisted for at least 1 second at the interface, but alerting shall commence within 8 seconds after receipt of tip ground.

4.1.1.2.8 When the PBX responds to incoming ringing as the alerting signal, the trunk circuit shall respond to the voltage signals in Table 3.

Table 3 - Ringing Response Table

Ringing Type	Range of compatible ringing frequencies (Hz)	Voltage Range	
		AC Signal V(rms)	DC Bias V(dc)
A	17	40 - 130	0 - 105
	17 - 23	55 - 130	0 - 105
	27 - 33	95 - 130	0 - 56.5
B	15.3 - 34	40 - 130	0 - 105
	>34 - 49	62 - 130	0 - 105
	>49 - 68	62 - 150	0 - 105

4.1.1.2.8.1 The PBX shall be able to respond to ringing bursts of 2 seconds out of every 6 seconds.

4.1.1.2.8.2 The PBX shall not respond to momentary bursts of ringing less than 125 ms in duration. The PBX shall commence alerting within 8 seconds of the start of the initial ringing burst.

4.1.1.2.9 To test for a recognizable impedance signature, the network may apply test signals, not intended for alerting. It is desirable that the PBX not respond to these signals:

- Signals of -40 or -60 V dc, with and without a superimposed sinusoidal signal of 10 V rms or less at 24 Hz, applied tip-to-ground and ring-to-ground simultaneously for 0.8 second;
- A signal of -20 V dc, with and without a superimposed sinusoidal signal of 10 V rms or less at 24 Hz applied tip-to-ground with ring grounded for 0.8 second;
- Grounding of the tip or ring or both, each through 5000 Ω for 0.1 second;
- Grounding of the tip for up to 1 second, simultaneously with the sequential application to the ring of -10 V dc only, and -20 V dc with a superimposed sinusoidal signal of 5 V rms or less at 30 Hz, for up to 0.5 second each;
- Sequential application of -10 V dc only, and -20 V dc with a superimposed 30 Hz sinusoidal signal of 5 V rms or less applied tip to ground and ring to ground simultaneously for up to 0.5 second each.

4.1.1.2.10 Two-way trunk circuits shall be made busy to outgoing seizure within 100 ms of the application by the network of ground on the tip conductor.

4.1.1.2.11 No audible tones shall be sent to the network by the PBX after incoming seizure and before answer.

4.1.1.3 *Answer Supervision*

4.1.1.3.1 To answer a call, the PBX shall apply a termination across the tip and ring having a voltage-versus-current function, V(I), at the interface that falls in the combined acceptable regions

A and B shown in Fig 7 (normal power available) or Fig 8 (commercial power outage). It is desirable that the voltage-versus-current function, V(I), at the interface falls in the combined acceptable region A shown in Figs 7 or 8.

In this state, the dc resistance from tip-to-ground and ring-to-ground shall be greater than 30 KΩ. No voltages shall be applied to tip and ring other than those used for signaling, supervisory, and transmission purposes.

4.1.1.3.2 The PBX shall provide a transmission path from the answering attendant to the interface within 160 ms after application of the answer signal. It is highly desirable that the PBX minimize or eliminate any ringing signal that might be heard by the attendant. When the call is extended to a station, the PBX shall provide a two-way transmission path between a called station and calling facility within 400 ms of station answer to avoid clipping initial speech energy.

4.1.1.3.3 Over the range of loop conditions specified by the loop simulator circuit in Fig 2, the loop current shall, for at least 5 seconds after the PBX goes to the normal off-hook state occurring in response to ringing (called party off-hook condition), either exceed that which would flow through a 200-ohm termination or not decrease by more than 25 percent from the maximum value attained during this 5-second interval, unless the equipment is returned to the on-hook state during this interval.

4.1.1.4 *Seizure - Outgoing Call*

4.1.1.4.1 To initiate an outgoing seizure, the trunk circuit shall ground the ring conductor through a local resistance of 550 Ω maximum as seen at the interface.

4.1.1.4.1.1 For 2-way access lines, ground on the ring conductor shall appear within 50 ms of selection of the access line for an outgoing call.

4.1.1.4.2 The trunk circuit shall switch from ground start to a loop supervisory mode within 210 ms after the network applies ground on the tip conductor. The PBX shall recognize the application of tip ground when the tip to ground dc voltage-versus-tip-conductor-current falls within the network operating region of Fig 5 for lines with conventional batteries and within the network operating region of Fig 9 for lines with floating batteries.

4.1.1.4.3 During the conversion from ground start to loop supervisory state, the ring conductor current shall not fall below 17 mA for more than 1 ms. (This assumes no change or interruption of the network provided battery feed circuit and facilities.)

4.1.1.4.4 Once the loop mode is established, spurious opens (other than those caused by contact bounce) that cause the loop current to fall below 17 mA for longer than 1 ms shall not occur, unless the address signaling sequence has been completed. (This assumes no change or interruption of the network provided battery feed circuit and facilities.)

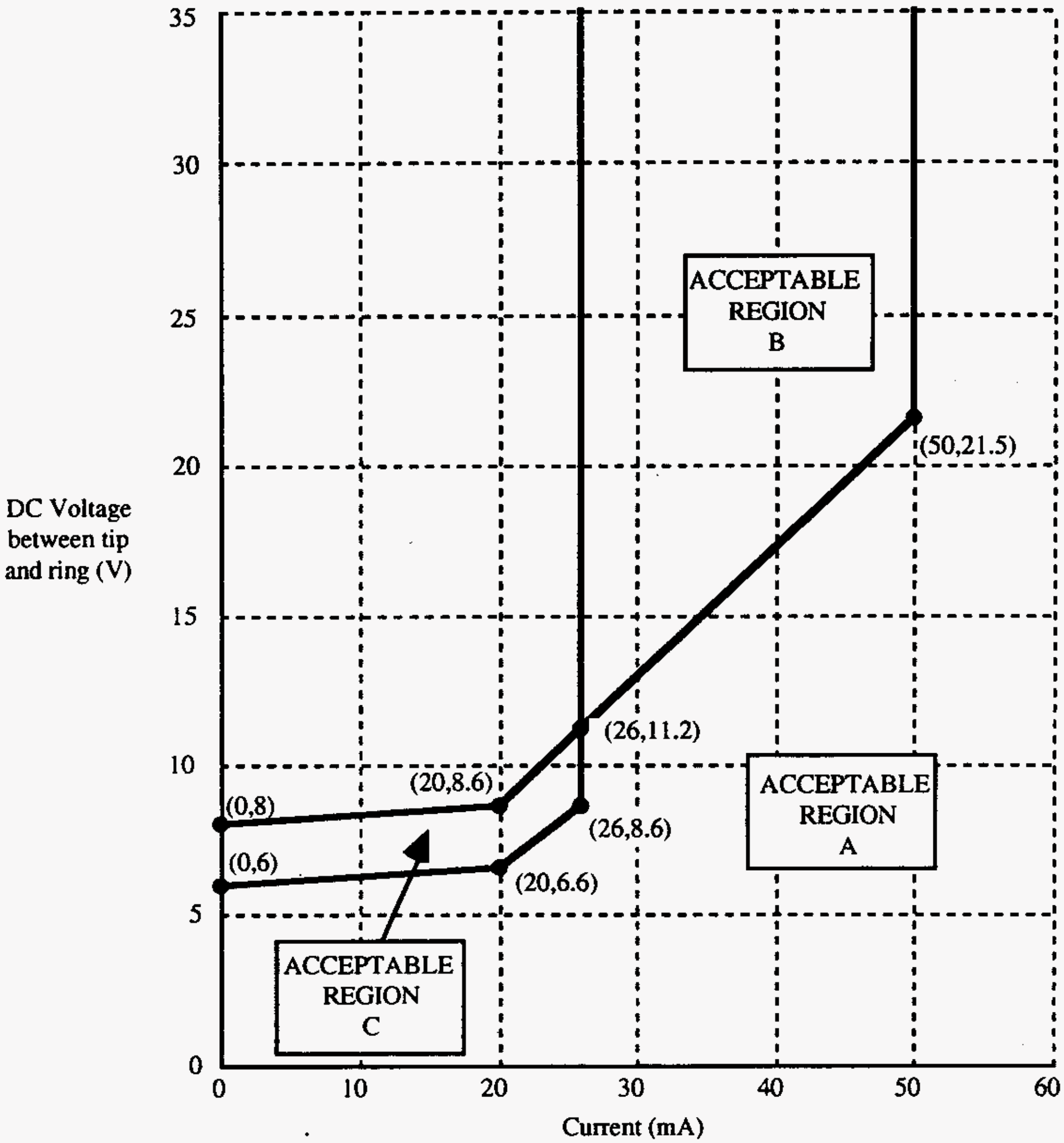


Figure 7 - Tip-to-Ring steady-state dc voltage-versus-current characteristics when normal power is available

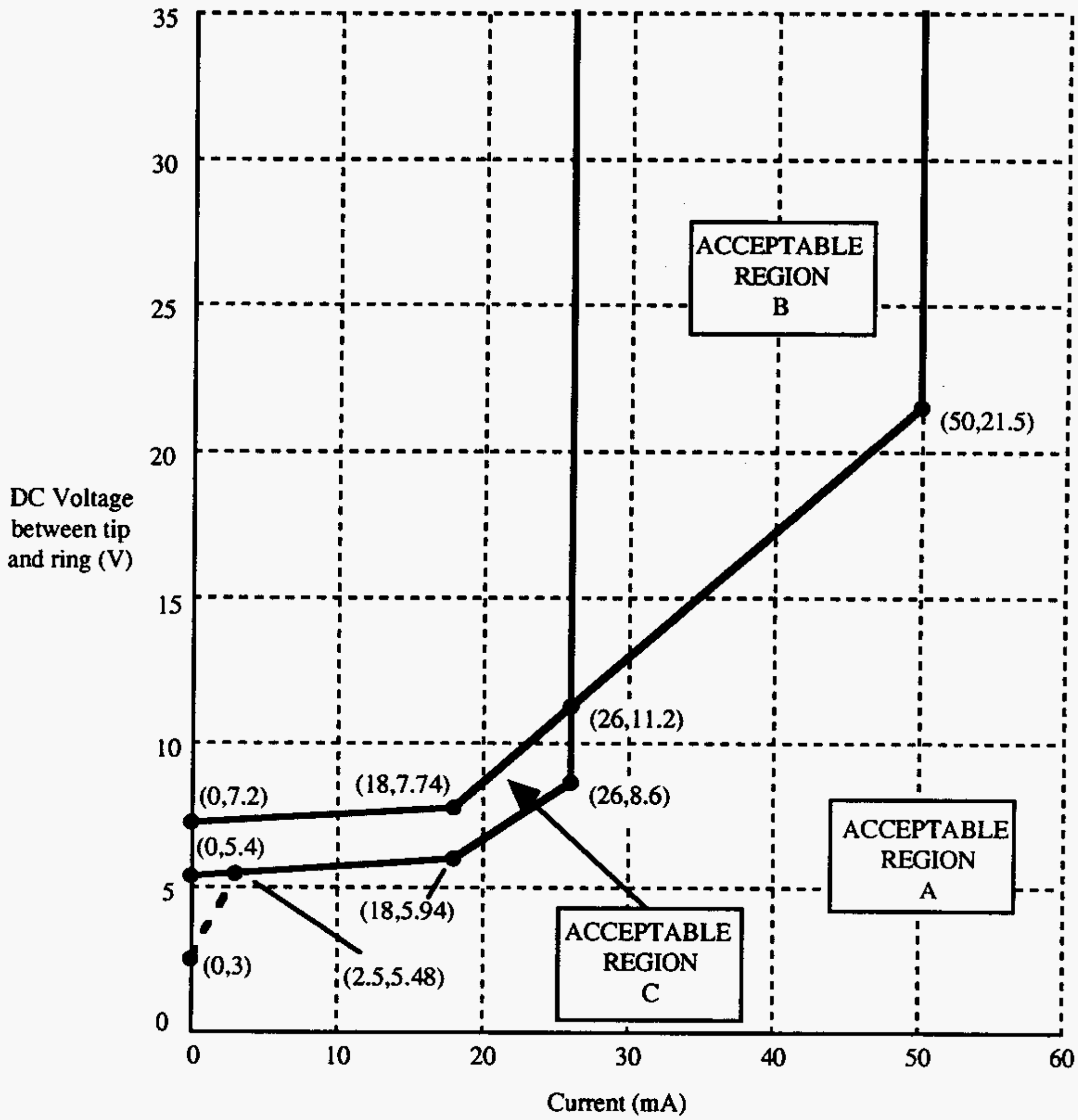


Figure 8 - Tip-to-Ring steady-state dc voltage-versus-current characteristics during commercial power outage

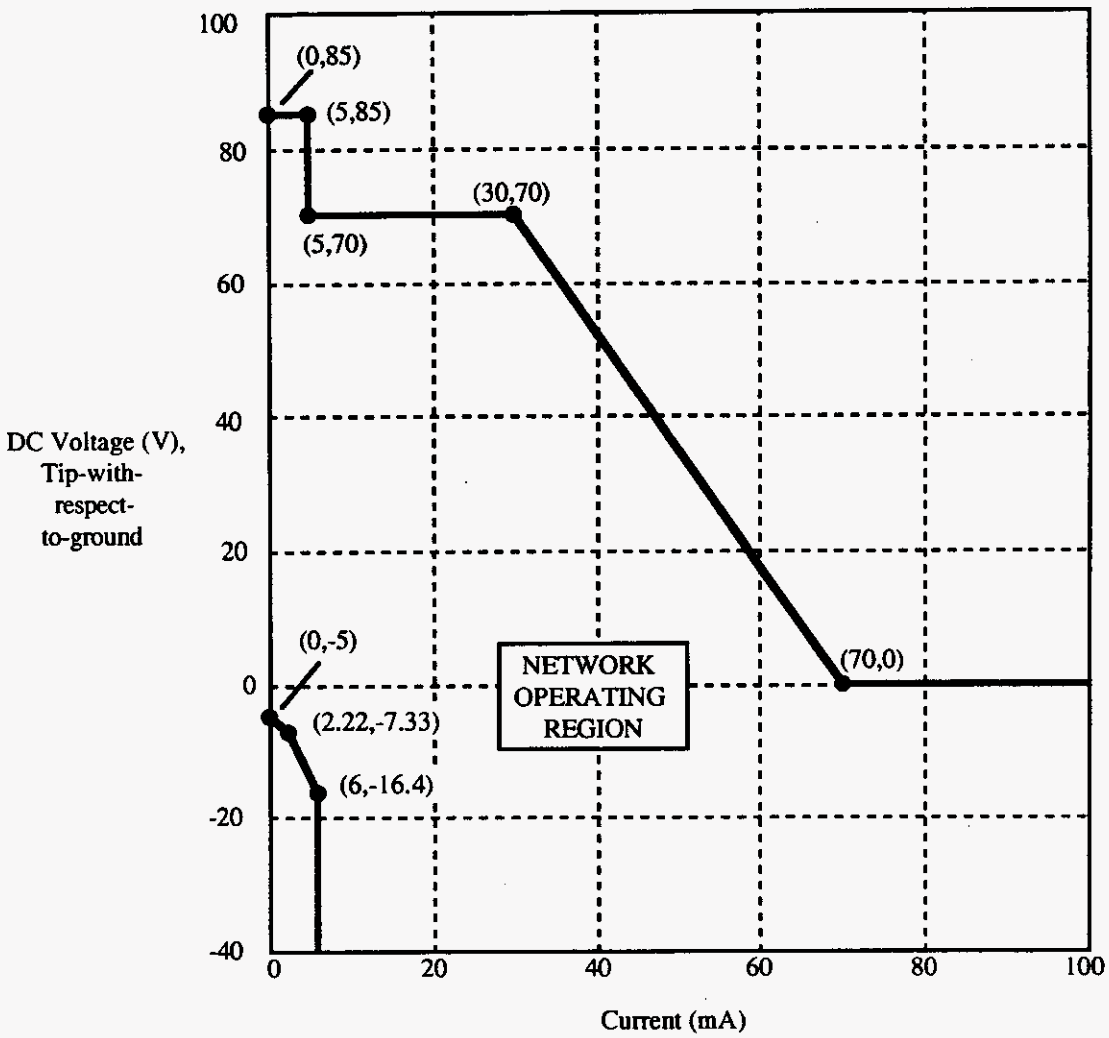


Figure 9 - Network steady-state tip-to-ground dc voltage-versus-tip-conductor-current characteristics for ground-start signaling on lines with floating batteries following network application of tip ground and prior to PBX removal of ring ground.

4.1.1.5 *Outgoing Address Signaling*

4.1.1.5.1 After conversion to loop supervision as described in 4.1.1.4.2 and during address signaling, the PBX shall provide a termination across the tip and ring as follows:

- For lines with DTMF addressing, the steady-state dc voltage-versus-current characteristic shall be within the combined acceptable regions A, B, and C shown in Fig 7 (normal power available) or Fig 8 (commercial power outage). It is desirable that the voltage-versus-current function, V(I), at the interface falls in the acceptable regions A and C shown in Figs 7 or 8. This characteristic shall be maintained until the completion of dialing. Following the completion of addressing, the steady-state dc voltage-versus-current characteristic shall be within the combined acceptable regions A and B shown in Fig 7 (normal power available) or Fig 8 (commercial power outage). It is desirable that the voltage-versus-current function, V(I), at the interface falls in the combined acceptable region A shown in Figs 7 or 8.
- For lines with dial pulse addressing, the steady-state dc voltage-versus-current characteristic shall be within the combined acceptable regions A and B shown in Fig 7 (normal power available) or Fig 8 (commercial power outage). It is desirable that the voltage-versus-current function, V(I), at the interface falls in the combined acceptable region A shown in Figs 7 or 8. This characteristic shall be maintained until the called end answers or the call disconnects prior called end answer.

In this state, the dc resistance from tip-to-ground and ring-to-ground shall be greater than 30 KΩ. Network control signals shall not be transmitted until 20 ms after this state is entered.

4.1.1.5.2 The PBX shall transmit address signals in accordance with the requirements of 6.1 (Dual Tone Multifrequency) or the recommendations of Annex E (Dial Pulsing).

4.1.1.5.3 If senderized operation with dial tone detection is used, the PBX shall distinguish between dial tone and noise, where dial tone consists of 350 Hz and 440 Hz (± 2%) at a level of -26 dBm (-29 dBm per frequency) measured across a 600-ohm termination at the interface, with a noise level of 40 dBrnC. The maximum expected dial tone level is -7 dBm (-10 dBm per frequency).

4.1.1.6 *Call Supervision*

4.1.1.6.1 Once the call is answered by the PBX (incoming call) or far end (outgoing call), the steady-state dc voltage-versus-current characteristic shall be within the combined acceptable regions A, B, and C shown in Fig 7 (normal power available) or Fig 8 (commercial power outage). It is desirable that the voltage-versus-current function, V(I), at the interface falls in the acceptable regions A and C shown in Figs 7 or 8.

4.1.1.6.2 The PBX shall maintain loop dc continuity during momentary interruptions of network battery and ground or both as outlined in 4.1.1.7.3. The PBX shall maintain dc loop continuity regardless of the polarity of the network loop.

4.1.1.6.3 The PBX shall not generate momentary breaks in the dc path through the trunk circuit exceeding 100 ms, any such interruptions to be separated by at least 900 ms on outgoing calls and for longer than 10 seconds on incoming calls, except to signal disconnect or, on outgoing calls, to flash-recall a network operator. If the PBX automatically generates flash signaling, it shall generate an on-hook indication of 300 ms to 1 second to signal a flash request.

4.1.1.6.4 Over the range of loop currents specified by the loop simulator circuit in Fig 2, the PBX shall not deliver signals into a 600-ohm termination at the tip and ring terminals from sources internal to the equipment with energy in the 2450- to 2750-Hz band unless at least an equal amount of energy is present in the 800- to 2450-Hz band. In addition, the insertion loss (assuming 600-ohm source and terminating impedances) of through transmission paths from other equipment to the network at any frequency in the 800- to 2450-Hz band shall not exceed the loss at any frequency in the 2450- to 2750-Hz band by more than 1 dB (maximum loss in the 800- to 2450-Hz band minus minimum loss in the 2450- to 2750-Hz band $\leq$1 dB).

4.1.1.7 *Disconnect Sequences*

4.1.1.7.1 *Disconnect Originated by the PBX*

The PBX trunk circuit shall open (150 KΩ minimum resistance) the loop toward the network for a minimum of 50 ms, and then return to the idle state as described in 4.1.1.1, while maintaining the trunk busy to outgoing call seizures.

On receipt of a 150 ms or longer removal of network ground from either the tip or the ring conductor, the PBX shall remove the outgoing trunk busy condition. It is desirable that the PBX interpret a 100-ms or longer removal of the tip or ring ground as a valid network disconnect signal.

NOTE: There is no guarantee that the network will provide a disconnect signal before it provides an incoming seizure for the next call.

The PBX shall idle the trunk within 200 ms of the removal of network ground.

4.1.1.7.2 *Disconnect Originated by the Network*

The PBX shall interpret a 600-ms or longer open-loop condition (removal of tip and/or ring ground) as a valid network disconnect.

The PBX shall idle the trunk within 850 ms of the removal of network ground. The PBX shall maintain a busy indication toward the network until the trunk has been idled.

4.1.1.7.3 *Hit Protection*

The PBX shall ignore open-loop conditions of less than 350 ms duration if separated by more than 100 ms.

4.1.2 *Supervision - Loop Start Access Lines*

Loop start access lines are used to provide attendant-handled one-way incoming call service, and direct-dialed one-way outgoing call service. Loop start trunks shall not be provided as two-way trunks. Common (CO) battery loop supervision, Dual Tone Multifrequency (DTMF) or loop dial pulse (DP) signaling, alerting signals (ringing), and voiceband electrical energy are transmitted across the two-wire loop start trunk interface.[9]

4.1.2.1 *Idle State*

4.1.2.1.1 In the on-hook state, the power delivered into the loop simulator circuit in Fig 2 shall not exceed -55 dBm within the 200- to 4000-Hz frequency band.

4.1.2.1.2 The dc resistance between tip and ring conductors, and between each of the tip and ring conductors and earth ground shall be greater than 5 KΩ (REN) for applied dc voltages not exceeding 100 V, and shall be greater than 30 KΩ (REN) for voltages between 100 and 200 V.

4.1.2.1.3 No dc potential shall be transmitted from the PBX across the interface.

4.1.2.1.4 To facilitate mechanized loop testing procedures by presenting a recognizable termination, it is desirable that the PBX have impedance characteristics as given in Table 4.

4.1.2.2 *Seizure - Incoming Call*

4.1.2.2.1 During the application of the test voltages listed in Table 2, the impedance (REN) between the tip and ring conductors (defined as the quotient of applied ac voltage divided by

9. See footnote 6

resulting true rms current) shall be greater than the values given in Table 2. This is necessary to prevent ringing pre-trip.

4.1.2.2.2 During the application of test voltages listed in Table 2, the total dc current flowing between tip and ring conductors shall not exceed 3.0 mA, and it is desirable that it not exceed 1.0 mA.

Table 4 - Acceptable Loop Start Terminations

Termination Type	Frequency (Hz)	Test Voltage (V)	Impedance (KΩ)
I	24	3 to 10	$4 \leq \lvert Z \rvert \leq 18$ (see note 3)
II			
Part 1	24	10	$\lvert Z1 \rvert \leq 40$
Part 2	24	2.5	$\lvert Z2 \rvert \leq 4 \lvert Z1 \rvert$ (see note 5)

Notes on Table 4:

1. For recognized impedance signatures, the PBX should satisfy the requirements for either termination Type I or for both part 1 and part 2 of termination Type II.
2. $\lvert Z \rvert$ represents the absolute magnitude of impedance.
3. The values shown apply for a termination having a REN of one or less as defined in the FCC Rules. For an REN greater than unity, the minimum value in the table listed for termination Type I (4 KΩ) should be divided by the actual REN of the PBX.
4. The signature of a PBX may be either termination Type I or Type II, or a combination of several impedances of Types I and II connected in parallel (as long as the REN of the PBX does not exceed the allowed REN of the access line to which the PBX is connected).
5. $\lvert Z1 \rvert$ represents the impedance resultant from the conditions of termination Type II part 1. $\lvert Z2 \rvert$ represents the impedance resultant for the conditions of Type II part 2.

4.1.2.2.3 The tip-to-ground and ring-to-ground impedances at frequencies and voltages given in Table 2 shall be greater than 100 KΩ.

4.1.2.2.4 The tip-to-ground and ring-to-ground impedances over the frequency range 60 to 660 Hz, for voltages up to 50 V rms, shall exceed 20 KΩ.

4.1.2.2.5 The PBX trunk circuit shall respond to the voltages shown in Table 3.

4.1.2.2.5.1 The PBX shall respond to ringing bursts of 2 seconds duration out of every 6 seconds, and shall commence alerting within 8 seconds.

4.1.2.2.5.2 The PBX shall not respond to momentary bursts of ringing less than 125 ms in duration.

4.1.2.2.5.3 The PBX shall cease alerting within 5.2 to 8 seconds after the end of the last ringing burst from the network.

4.1.2.2.5.4 To test for a recognizable impedance signature, the network may apply test signals, not intended for alerting. It is desirable that the PBX not respond to these signals:

- Signals of 10 V rms or less, at 24 or 30 Hz, superimposed on -70 to +70 V dc, on tip (with ring grounded), on ring (with tip grounded), or on both tip and ring, with respect to ground;
- AC signals of 10 V rms or less, tip-to-ring or tip-to-ground and ring-to-ground at any frequency from 5 to 1000 Hz;
- DC voltages from zero to ±200 V, tip-to-ring, tip-to-ground, or ring-to-ground.

The conditions described above may be applied during mechanized maintenance procedures. Such tests are applied sequentially; the series of test may last up to 12 seconds.

4.1.2.2.5.5 If a PBX does not present a signature as described in 4.1.2.1.4, it is desirable that it not alert on application of 33 V rms or less at 24 Hz for 2 seconds or 60 V rms or less at 24 Hz for 0.8 seconds or less, tip-to-ring or tip and ring with respect to ground.

4.1.2.2.6 Where the serving network switch is arranged to provide immediate tip-ring reversal upon seizure toward the PBX, the PBX, if optionally equipped for this service, shall mark the outgoing access to the trunk busy within 100 ms of appearance of battery potential on the tip conductor.

4.1.2.2.7 No audible tones shall be returned by the PBX toward the network after seizure and before answer.

4.1.2.3 Answer Supervision

4.1.2.3.1 Effecting Near-end Answer Supervision

To answer a call, the PBX shall apply a termination across the tip and ring having a voltage-versus-current function, V(I), at the interface that falls in the combined acceptable regions A and B shown in Fig 7 (normal power available) or Fig 8 (commercial power outage). It is desirable that the voltage-versus-current function, V(I), at the interface falls in the combined acceptable region A shown in Figs 7 or 8.

In this state, the dc resistance from tip-to-ground and ring-to-ground shall be greater than 50 KΩ. No voltages shall be applied to tip and ring other than those used for signaling, supervisory, and transmission purposes.

4.1.2.3.2 Detecting Far-end Answer Supervision

Far-end answer supervision can be provided from some network offices. A PBX may, optionally, use this capability to enhance call accounting features.

Following called party answer, the network (where equipped for this service) will reverse the tip and ring polarity on the access line. This reversal will be maintained as long as the connection is maintained and the called party remains off-hook.

A PBX equipped for reverse polarity detection of far-end answer shall detect a polarity reversal lasting for 2 s or longer and reject reversals lasting for 1.5 s or less.

4.1.2.3.3 Completion of Transmission Path

The PBX shall provide a transmission path from the answering attendant to the interface within 160 ms after application of the answer signal. It is highly desirable that the PBX minimize or eliminate any ringing signal that might be heard by the attendant. When the call is extended to a station, the PBX shall provide a two-way transmission path between a called station and calling facility within 400 ms of station answer to avoid clipping initial speech energy.

4.1.2.3.3 *Current Continuity*

Over the range of loop conditions specified by the loop simulator circuit in Fig 2 (with R disconnected) the loop current shall, for at least 5 seconds after the PBX goes to the normal off-hook state occurring in response to ringing (called party off-hook condition), either exceed that which would flow through a 200-ohm termination or not decrease by more than 25 percent from the maximum value attained during the 5-second interval, unless the equipment is returned to the on-hook state during the 5-second interval.

4.1.2.4 *Seizure - Outgoing Call*

4.1.2.4.1 To seize the trunk for an outgoing call, the PBX shall terminate the tip and ring with a termination as given in 4.1.2.3.1.

4.1.2.4.2 The PBX shall provide a voice band transmission path between the interface and the calling terminal for the purpose of call progress tone transmission.

4.1.2.4.3 Once the loop mode is established, spurious opens, other than those caused by contact bounce, that cause the loop current to fall below 17 mA for longer than 1 ms shall not occur, except for legitimate dial pulses, unless the address signaling sequence is completed. (This assumes no change or interruption of the network provided battery feed circuit and facilities.)

4.1.2.5 *Outgoing Address Signaling*

4.1.2.5.1 The PBX shall transmit address signals in accordance with the requirements of 6.1 (Dual Tone Multifrequency) or the recommendations of Annex E (Dial Pulsing).

4.1.2.5.2 If senderized operation with dial tone detection is used, the PBX shall distinguish between dial tone and noise, where dial tone consists of 350 Hz and 440 Hz (±2%) at a level of -26 dBm (-29 dBm per frequency) measured across a 600-ohm termination at the interface, with a noise level of 40 dBrnC. The maximum expected dial tone level is -7 dBm (-10 dBm per frequency).

4.1.2.6 *Call Supervision*

4.1.2.6.1 The PBX shall provide for continued call supervision in accordance with the conditions given in 4.1.2.3.1. The PBX shall maintain dc loop continuity, during momentary interruptions of network battery, ground, or both, as outlined in 4.1.2.7.2. The PBX shall maintain dc loop continuity regardless of the polarity of the network loop.

4.1.2.6.2 The PBX shall not generate momentary breaks in the dc path through the trunk circuit exceeding 100 ms and separated by at least 900 ms, on outgoing calls or for longer than 10 seconds on incoming calls, except to disconnect from the call or, on outgoing calls, to flash-recall a toll operator. If the PBX automatically generates flash signaling it shall generate an on-hook indication of 300 ms to 1 second duration to signal a flash request.

4.1.2.6.3 Over the range of loop currents specified by the loop simulator circuit in Fig 2, the PBX shall not deliver signals into a 600-ohm termination at the tip and ring terminals from sources internal to the equipment with energy in the 2450- to 2750-Hz band unless at least an equal amount of energy is present in the 800- to 2450-Hz band. The insertion loss (assuming 600-ohm source and terminating impedances) of through transmission paths from other equipment to the network at any frequency in the 800- to 2450-Hz band shall not exceed the loss at any frequency in the 2450- to 2750-Hz band by more than 1 dB (maximum loss in the 800- to 2450-Hz band minus loss in the 2450- to 2750-Hz band ≤ 1 dB).

4.1.2.7 *Disconnect Sequence*

4.1.2.7.1 *Criteria for Transmission of PBX Disconnect*

4.1.2.7.1.1 When the PBX party disconnects, the PBX connection shall be released and the disconnect shall immediately be passed to the network. To disconnect, the trunk circuit shall go on-hook, increasing the resistance between tip and ring and from tip to ground, and from ring to ground as given in 4.1.2.1.

4.1.2.7.1.2 When generating a disconnect, within 850 ms of the onset of the on-hook, the PBX shall return to the idle state as described in 4.1.2.1; i.e., the PBX shall be prepared to process a new incoming signal properly.

4.1.2.7.1.3 If the PBX originated the call, in order to assure that the network recognizes the on-hook as a disconnect, it is desirable that the on-hook be maintained for 1 second minimum without flash timing or 1.5 seconds minimum with flash timing, after which time a new outgoing call may be initiated.

For calls incoming to the PBX, the network will not allow a new call to be originated or received by the on-hook PBX until the calling party goes on-hook or, if the calling party remains off-hook, until the PBX on-hook has been maintained for 10 seconds to 4 minutes.

4.1.2.7.2 *Criteria for Detection of Network Disconnect*

The PBX shall not interpret loop opens of less than 350 ms as network disconnect signals, but shall interpret loop opens greater than 600 ms as network disconnect signals. PBXs shall not be designed to depend on loop current interrupts for use as primary disconnect signals, since the telephone network currently provides no systemwide standard release signals on loop start lines.

4.1.2.7.3 *Return to Idle*

When a network disconnect signal is received by the PBX, the PBX switching connection shall be dropped (if not already dropped), and the trunk circuit returned to the idle state within 850 ms of initiation of the open.

4.1.3 *One-Way Direct Inward Dialing (DID) Service Network Access Interface*

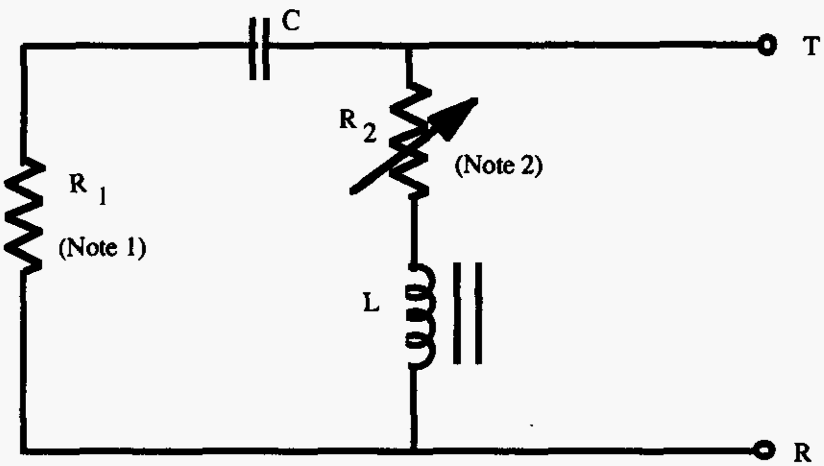
4.1.3.1 *Definition*

Direct Inward Dialing (DID) provides for direct dial access to PBX stations from the public switched network. Direct Inward Dialing requires transmission of address signals from the serving network to the PBX. This signaling may involve a register-sender interface, requiring PBX supervisory compatibility with wink start, delay dial, or immediate start dial supervision.

4.1.3.2 *Idle Condition*

4.1.3.2.1 To ensure proper recognition of the idle condition by the network, the PBX shall maintain an idle condition when the external dc resistance across the tip and ring conductors at the interface is 15 KΩ or greater. In the idle condition, the PBX shall provide a battery supply voltage on the ring conductor of -41.0 V dc, minimum, and -56.5 V dc, maximum, with respect to ground and 0 to -5 V dc with respect to ground on the tip conductor.

4.1.3.2.2 The power delivered into the DID loop simulator circuit (Fig 10) in the idle condition shall not exceed -55 dBm unless the PBX is arranged to inhibit incoming signals.



R_1 = 600 Ω (±1%)
L ≥10 henry, up to 150 mA
C = 500 μF (-10%, +50%)

NOTES:

1. Termination R_1 is normally connected. Remove termination R_1 or replace it by the alternative terminations in Fig 18 when specified.
2. Resistance $R_2 + R_L$ shall be continuously variable over the range of 400 to 2450 Ω

Figure 10 - DID Loop Simulator Circuit

4.1.3.3 Seizure - Incoming Calls

The PBX shall recognize a resistance of 2450 Ω or less between tip and ring conductors at the interface as a network seizure.

4.1.3.4 Incoming Address Signaling

4.1.3.4.1 Signaling Protocols

Three signaling protocols exist: immediate start, wink start and delay dial. The serving telephone company usually determines, based on network equipment capabilities, which of these protocols will be used.

4.1.3.4.1.1 Immediate Start

With immediate start, the network does not wait for a PBX response to the connect signal before initiating outpulsing. Address signaling used with immediate-start consists of only dial pulsing, either Loop Pulsing or Battery and Ground Pulsing.

4.1.3.4.1.2 Wink Start

With wink start, the network waits for a short-duration PBX off-hook response to the connect signal before initiating outpulsing. Address signaling used with wink start consists of DTMF or dial pulsing, either Loop Pulsing or Battery and Ground Pulsing.

As soon as the PBX is ready to receive address signaling, it shall reverse the battery and ground (consistent with 4.1.3.7.2.1) toward the network for 140 to 290 ms (wink start). This signal shall commence when the PBX is ready to receive address signals. However, the start of the wink signal shall not occur earlier than 100 ms after receipt of the incoming seizure signal. In addition to the signaling function, the wink start signal serves as an integrity check that will identify a malfunctioning trunk and allow the network to send reorder tone rather than a "high-and-dry" condition to the calling party.

4.1.3.4.1.3 Delay Dial

With delay dial, the network receives a PBX off-hook response to the connect signal and waits for the PBX to return an on-hook response before initiating outpulsing. Address signaling used with delay dial consists of DTMF or dial pulsing, either Loop Pulsing or Battery and Ground Pulsing.

The battery reversal (off-hook signal) transmitted toward the network shall start no later than 150 ms after receipt of the connect signal. The delay dial shall persist at least 140 ms and shall end (return to normal battery polarity) when the PBX is ready to receive address signals. It is desirable that the delay dial (battery reversal) signal not start earlier than 100 ms after receipt of the incoming seizure signal. In addition to the signaling function, the delay dial signal serves as an integrity check that helps identify a malfunctioning trunk, resulting in reorder tone being transmitted from the network to the calling party.

4.1.3.4.2 Receipt of Incoming Address Signals

4.1.3.4.2.1 DTMF

The PBX shall be prepared to detect the first address digit within 50 ms and up to 20 seconds after returning normal battery polarity (on-hook). The network may send the digits in a string of evenly spaced pulses or may have varying intervals as long as 20 seconds between them.

PBX DTMF receivers shall conform to the requirements of 6.1.5 but with the following signal timing:

Cycle time, minimum	93 ms
Duration of two-frequency signal, minimum	40 ms
Signal-off time, minimum	40 ms
Rise Time, maximum	10 ms

4.1.3.4.2.2 Dial Pulse Signaling

When immediate start is used, the PBX shall be prepared to register incoming dial pulses within 65 ms of network seizure. When wink start or delay dial is used, the PBX shall not register any pulses for 30 ms after returning to the normal battery polarity. The PBX shall be prepared to register dial pulses within 55 ms after returning to normal battery polarity.

4.1.3.4.2.2.1 Loop Pulsing

The network generates loop pulses by opening and closing contacts, or the electronic equivalent, in series with the loop. During the make interval, the network will have steady-state dc voltage-versus-current characteristics within the network operating region shown in Fig 11. During the break interval, the tip-to-ring resistance will be 15 KΩ or greater. During the remainder of the outpulsing state, the network provides a termination having steady-state dc voltage-versus-current characteristics within the networking region shown in Fig 12.

4.1.3.4.2.2.2 Battery and Ground Pulsing

In battery-and-ground pulsing, the network applies a negative voltage with respect to ground to the tip conductor and ground or a positive voltage to the ring conductor. Two pulsing contacts, or the electronic equivalent, are used to open and close both the tip and ring sides of the circuit. During the make interval, and immediately following each digit for a time that may range from 0 to an entire interdigital interval, the network will have steady-state dc voltage-versus-current characteristics within the network operating region shown in Fig 13. During the break interval, the network tip-to-ring resistance will be at least 30 KΩ, and no dc voltage will be applied. During the remainder of the outpulsing state, the network will have steady-state dc voltage-versus-current characteristics within the network operating region shown in Fig 12.

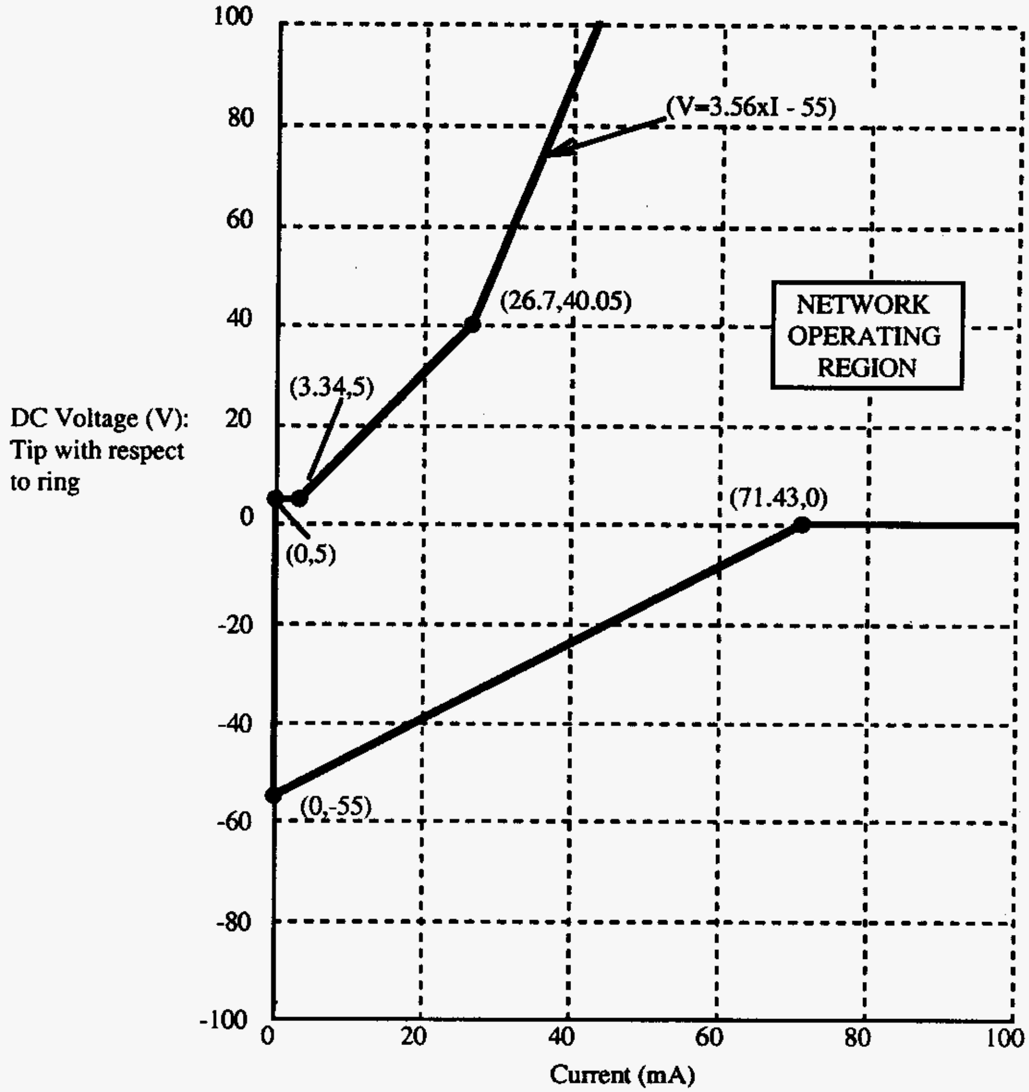


Figure 11 - Network Steady-State DC Voltage-versus-Current Characteristics during the Make Intervals of the Outpulsing State of Loop Pulsing

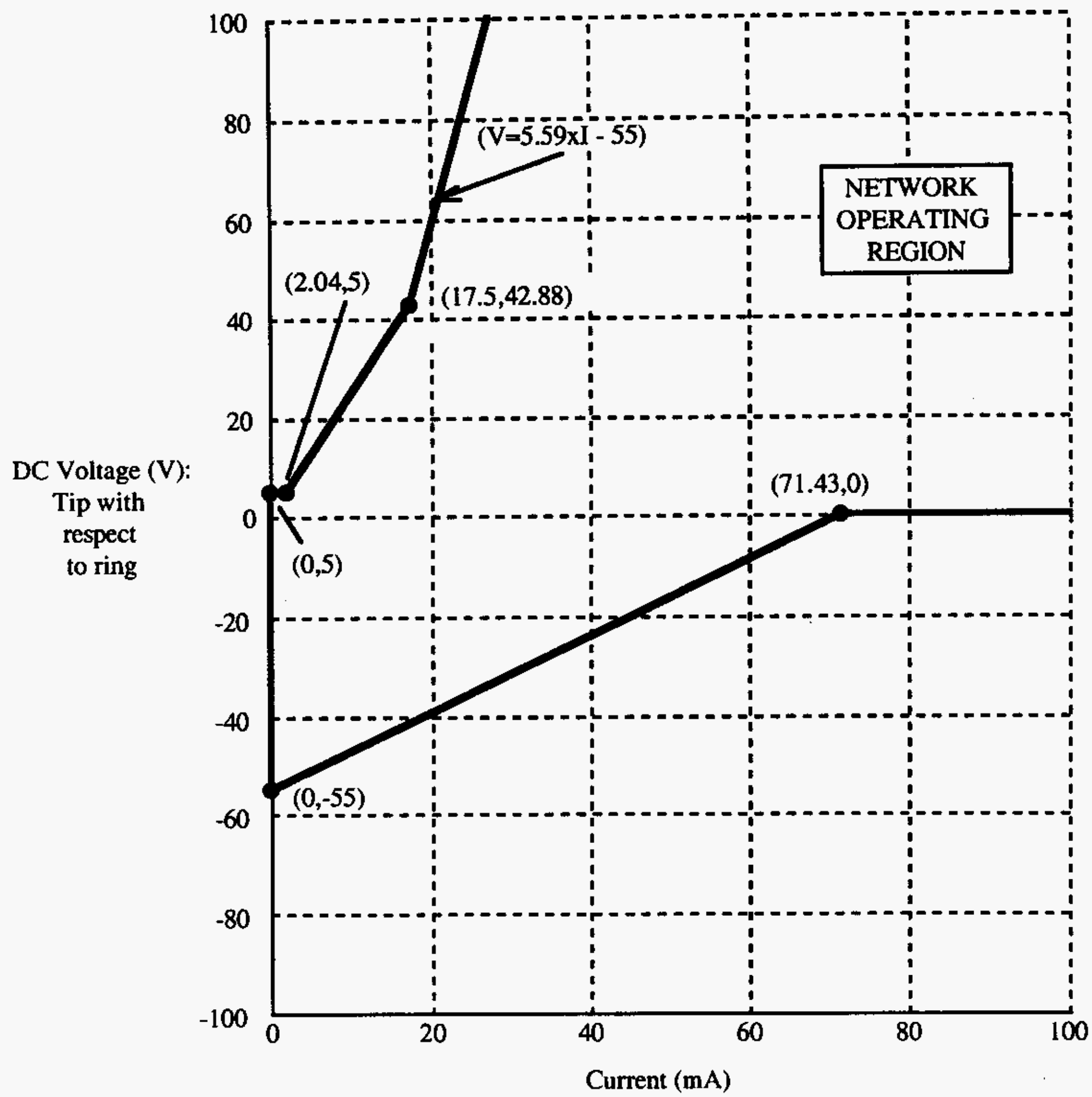


Figure 12 - Network Steady-State DC Voltage-versus-Current Characteristics in the Off-Hook State (Except the Make Intervals)

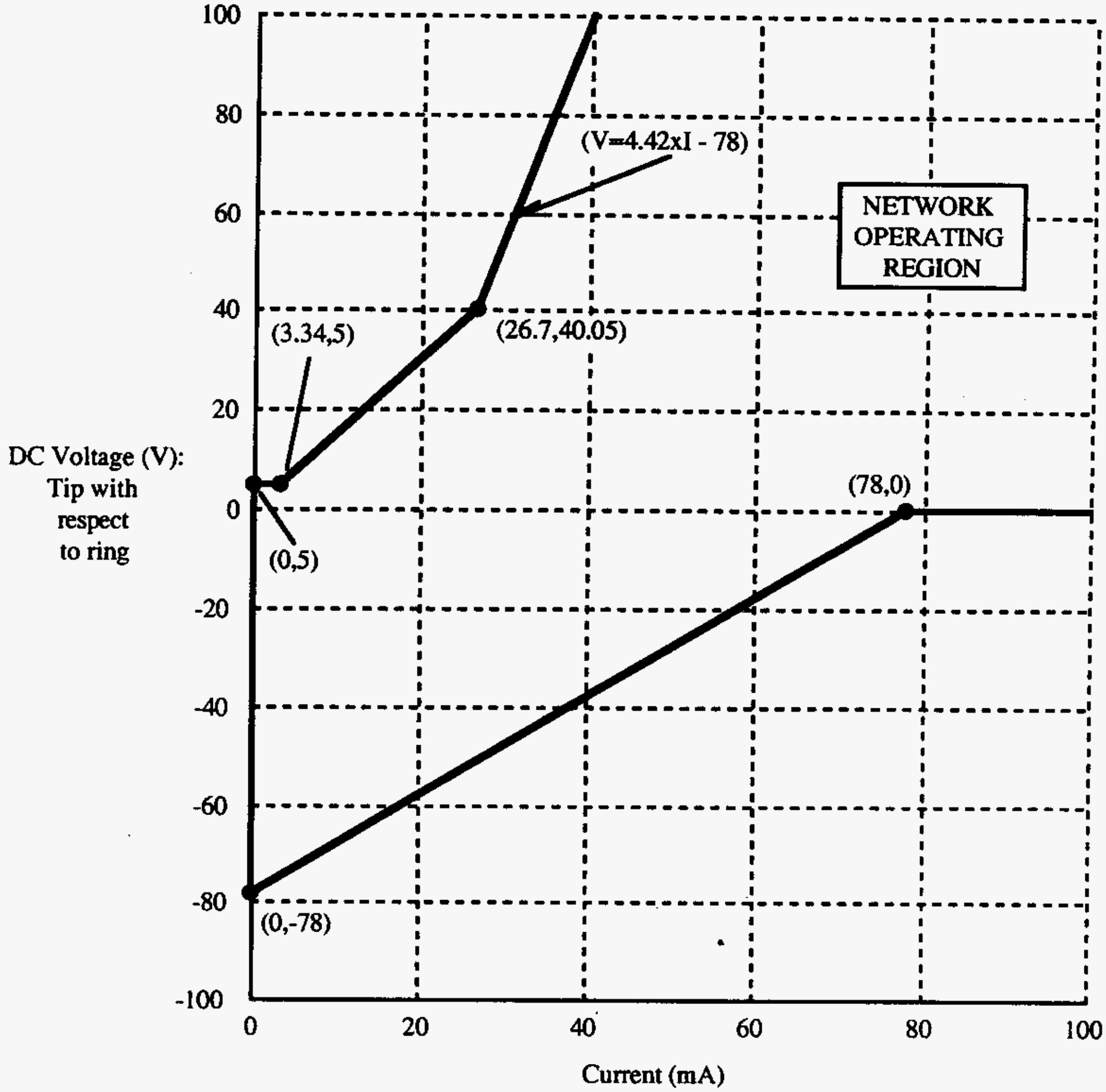


Figure 13 - Network Steady-State DC Voltage-versus-Current Characteristics during the Make Intervals of the Outpulsing State of Battery-and-Ground Pulsing

4.1.3.4.2.2.3 *Loop Pulsing Test Criteria*

In the Loop Pulsing test circuit of Fig 14, the PBX shall register dial-pulse digits generated by contact P1 under the following test conditions:

(1) Repetition rate of 8 to 11 pulses per second, percent break of 42 to 76, and interdigital intervals of at least 300 ms

(2) All values of R2 from R2 = 0 Ω to R2 = 1500 Ω , with

(a) All values of R3 from R3 = 0 Ω to R3 = (1500 - R2) Ω,

(b) C1 = 0 mF and also C1 = (0.001)(R2) mF,

(c) All values of R1 from R1 = 30 KΩ to R1 = 300 KΩ or greater,

(d) All values of R4 from R4 = 30 KΩ to R4 = 300 KΩ or greater, and

(e) Switch SW open and also closed

4.1.3.4.2.2.4 *Battery-and-Ground Pulsing Test Criteria*

In the battery-and-ground pulsing test circuit in Fig 14, the PBX shall register dial-pulse digits generated by contacts P2 and P3 under the following test conditions:

(1) Repetition rate of 8 to 11 pulses per second, percent break of 46 to 76, and interdigital intervals of at least 300 ms

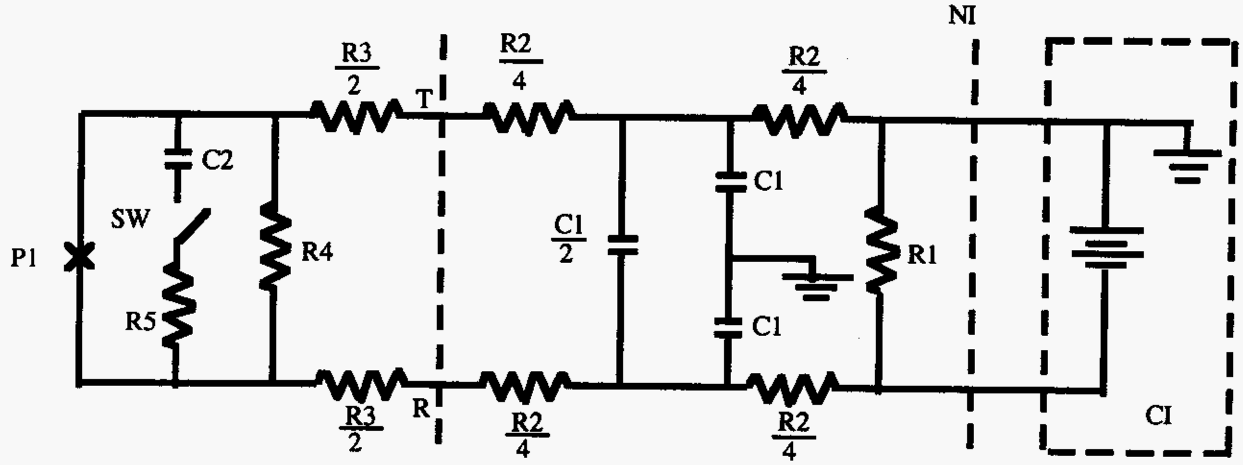
(2) All values of R3 from R2 = 0 Ω to R2 = 2450 Ω, with

(a) All values of R3 from R3 = (770 - R2) Ω to R3 = (2450 - R2) Ω (negative values shall be set to 0 Ω),

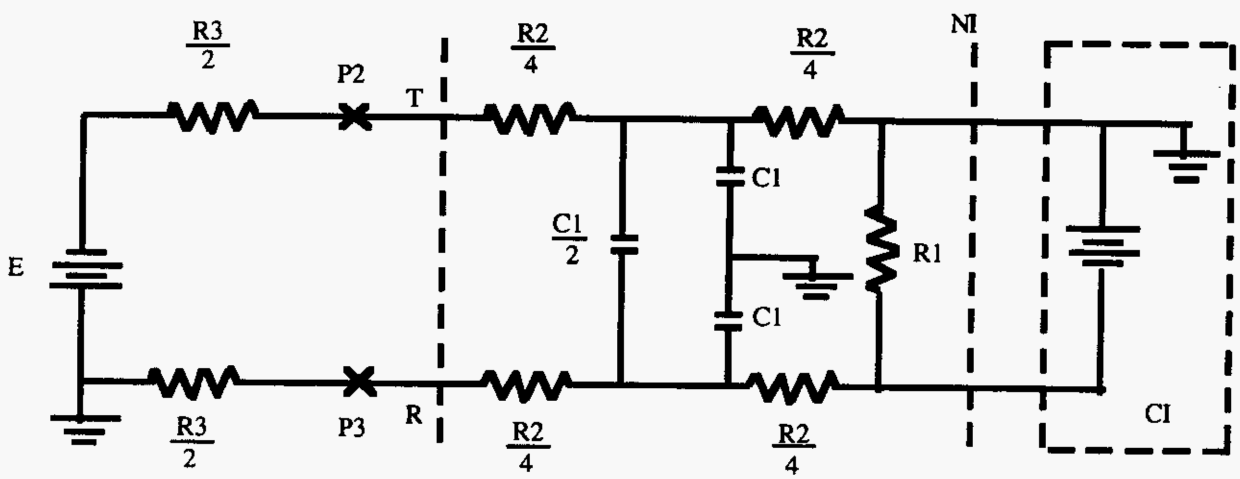
(b) C1 = 0 mF and also C1 = (0.001)(R2) mF,

(c) All values of R1 from R1 = 30 KΩ to R1 = 300 KΩ or greater, and

(d) All values of E from E = 42.5 V to E = 52.5 V.



(a) Loop Pulsing



(b) Battery and Ground Pulsing

Figure 14 - Test Circuit for Dial Pulsing

4.1.3.4.2.2.5 PBX Dial Pulse Receiving Characteristics

When receiving dial pulses from the network, the PBX shall:

(1) Tolerate an earth potential difference of ± 3 V dc between PBX and network grounds

(2) Ignore spurious breaks lasting 10 ms or less that may occur prior to the first dial pulse, during make intervals, during interdigital intervals, and after dial pulsing

(3) Ignore spurious makes of 10 ms or less that may occur during break intervals

(4) Ignore any pulses that occur after 180 ms from the end of the previous break pulse of the final digit of the address.

4.1.3.4.2.2.6 PBX Dial Pulse Time-out Interval

Permanent signal and partial dial time-out intervals for address signaling shall not be less than 5 seconds. When the PBX recognizes a permanent signal or partial dial condition on a senderized trunk, it shall transmit reorder tone as described in 6.3 toward the calling party.

4.1.3.5 Intercept Treatment

When calls are completed to either a vacant code or a permanently restricted station, the PBX shall either route the call to a recorded announcement or to the attendant. The PBX shall not transmit any special intercept or "no such number" tone to the calling termination.

4.1.3.5.1 Recorded AnnouncementIntercept

This intercept treatment shall operate with delayed cut-through so that the announcement will be heard from the start of the message. Audible ring shall be returned during the interval before the start of the announcement, and this interval shall be as short as possible.

4.1.3.5.2 Attendant Intercept

While the attendant is being alerted, audible ring shall be returned to the calling party. When the call is answered by the attendant, the PBX shall provide answer supervision as given in 4.1.3.7.2 below.

4.1.3.6 Call Progress Signals

After address signaling and before answer, the appropriate call progress signals as described below shall be returned to the calling party by the PBX. No audible tones other than the following shall be returned by the PBX to the calling party.

(1) Busy tone shall be returned to the calling party to indicate that the called station is busy.

(2) Reorder tone shall be returned to the calling party as an indication that the call cannot be completed due to network blocking or the lack of equipment.

(3) Audible ring shall be returned to the calling party to indicate that the called station is being alerted or that a recorded announcement will follow.

These tones shall conform to the specifications given in 6.3. The maximum delay between completion of address signaling and provision of a path for transmission of call progress information shall be 1.5 seconds.

4.1.3.7 Answer

4.1.3.7.1 Conditions for Returning Answer Supervision

In order to comply with FCC Part 68, the PBX shall return answer supervision as shown in Tables 5 and 6.

Table 5 - Answer Supervision Requirements for DID Calls Terminating at the PBX or PBX Private Network

PBX Response/Condition for DID Calls from the network which terminate at the PBX or PBX Private Network	Answer Supervision	
	Required	Not Required
Answered by a station	X	
Answered by an attendant	X	
Routed to a recorded announcement that can be administered by the PBX user	X	
Routed to a dialing prompt or voice recording equipment	X	
Unanswered		X
Routed to a busy signal		X
Routed to a reorder signal		X
Routed to a recorded announcement stating "number invalid", "not in service", or "not assigned", that cannot be administered by the PBX user		X
Routed, via forwarding, hunting, etc., to a station that does not answer		X

Table 6 - Answer Supervision Requirements for DID Calls Routed Back to the PSTN

PBX Response /Condition for DID Calls from the network which are routed (forwarded, etc.) back to the PSTN	Answer Supervision	
	Required	Not Required
1. Via Access Line That Returns Answer Supervision:		
Answer Supervision Received from the PSTN (Note 1)	X	
Answer Supervision Not Received from the PSTN		X
2. Via Access Line That Does Not Return Answer Supervision:		
Answered (Note 2)	X	
Routed to "number invalid", "not in service", or "not assigned" recordings	X	
Unanswered		X
Routed to a busy signal		X
Routed to a reorder signal		X

Notes on Table 6:

1. The PBX shall return answer supervision on the DID trunk within 500 milliseconds after it has received answer supervision.
2. The PBX may determine if the call has been answered on the outgoing access line by detection of voice energy, or the removal of audible ringback signal, or both. An acceptable alternate method is to declare the call answered and return answer supervision on the DID trunk when a timing period has expired. This timing period shall be set to be no more than 20 seconds and shall start when the outgoing call's last address digit has been sent on the outgoing access line.[10] This method will cause answer supervision to be returned for all conditions listed in part 2 of the table.

4.1.3.7.2 Answer Supervision - Electrical

4.1.3.7.2.1 PBX Battery Reversal

When the call is answered by either the called station or PBX attendant, the PBX shall reverse battery and ground toward the network. The PBX shall provide a battery supply voltage on the tip conductor of -41.0 V dc minimum -56.5 V dc maximum with respect to ground through a resistance that is consistent with 4.1.3.7.2.2 below, and 0 to -5 V dc on the ring conductor with respect to ground through a resistance that is consistent with 4.1.3.7.2.2 below.

4.1.3.7.2.2 PBX Battery Feed Resistance

The PBX battery supply voltage and the resistance in tip and ring within the DID circuit shall be such that it maintains a V(I) function at the interface that falls within the acceptable region in Fig 15.

10. As a means of preventing toll fraud, the network may not establish a two-way transmission path until the PBX returns answer supervision to the network. Although the method here described allows a time value of up to 20 seconds, the time value should be selected so that the duration of the one-way transmission path is short enough to be not noticeable to the calling and calling parties.

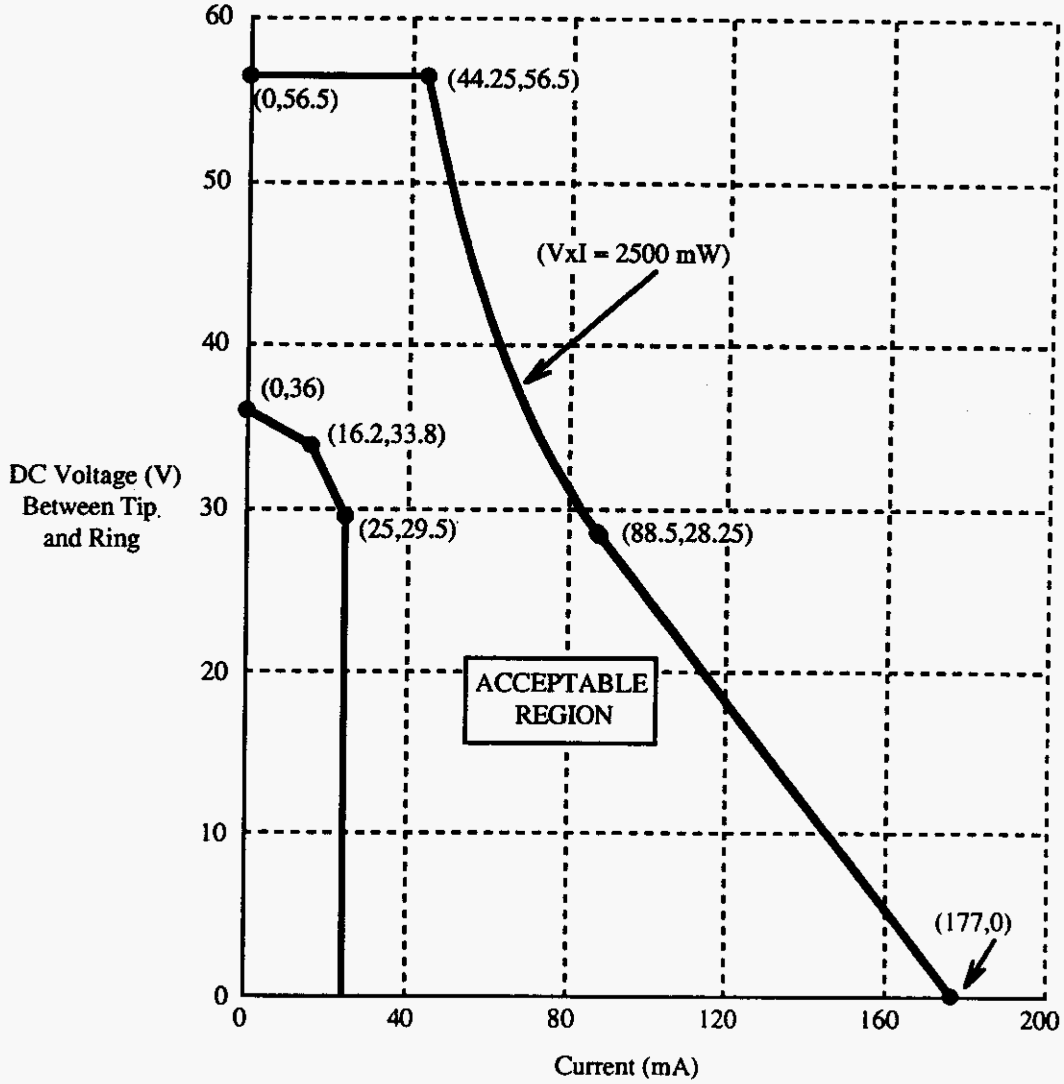


Figure 15 - PBX Steady-State DC Voltage-versus-Current Characteristics for DID

4.1.3.7.2.3 Maintaining Call Supervision - DC

The PBX shall maintain battery on the tip conductor and ground on the ring conductor toward the network until disconnect. The PBX shall ignore opens (15 KΩ or greater across tip and ring) from the network that persist for 150 ms or less.

4.1.3.7.2.4 Maintaining Call Supervision - AC

The PBX shall not deliver signals into the loop simulator circuit (Fig 10) from sources internal to the PBX with energy in the 2450- to 2750-Hz band unless at least an equal amount of energy is present in the 800- to 2450-Hz band. In addition, the insertion loss (assuming 600-ohm source and terminating impedances) of through transmission paths from other equipment to the network at any frequency in the 800- to 2450-Hz band shall not exceed the loss at any frequency in the 2450- to 2750-Hz band by more than one dB (maximum loss in the 800- to 2450-Hz band minus minimum loss in the 2450- to 2750-Hz band ≤ 1 dB).

4.1.3.7.3 Answer Sequences

The PBX shall provide a two-way voiceband transmission path between a called attendant and calling facility within 160 ms of answer to avoid clipping initial speech energy. It is highly desirable that the PBX minimize or eliminate any ringing signal that might be heard by the attendant. When a call is terminated or extended to a station, the PBX shall provide a two-way voiceband transmission path between a called station and calling facility within 400 ms of station answer to avoid clipping initial speech energy. The period between answer and the return of answer supervision to the network shall be less than 0.5 second.

4.1.3.8 Disconnect

4.1.3.8.1 Transmission of PBX Disconnect to the Network

When the PBX party disconnects before a network disconnect signal is received, the PBX network connection (between the trunk circuit and the station) shall be dropped and the disconnect shall be immediately passed to the network. To signal this disconnect, the PBX shall restore battery to the ring conductor and ground to the tip conductor toward the network. The PBX shall then await network disconnect as described in 4.1.3.8.2.1. and 4.1.3.8.2.3.

4.1.3.8.2 Network Disconnect

4.1.3.8.2.1 Detection of Network Disconnect by the PBX

The PBX shall recognize 15 KΩ or greater resistance across tip and ring as an open. The PBX shall ignore opens from the network that persist for 150 ms or less. The PBX may interpret opens between 150 and 700 ms from the network as a valid network disconnect. The PBX shall interpret a 700-ms or longer open from the network as a valid network disconnect, although this duration of open will not always be present.

4.1.3.8.2.2 PBX Response to Network Disconnect.

If the called station or attendant has not disconnected, that is, remains off-hook after receipt of the network disconnect signal, the PBX shall restore battery to the ring conductor and ground to the tip conductor between 150 and 700 ms of the initiation of the network open. In addition, the PBX shall drop the connection between the trunk circuit and the station or attendant between 150 and 700 ms of the initiation of the network open.

4.1.3.8.2.3 Return to the Idle State.

The PBX trunk circuit shall be capable of processing a new incoming call within 700 ms after initiation of the network open.

4.1.4 *System Failure Transfer*

4.1.4.1 *General*

4.1.4.1.1 System Failure Transfer (SFT) provides a limited communications capacity if a PBX fails. Some or all of the analog network access lines are then temporarily connected to predetermined telephones.

4.1.4.1.2 The PBX is assumed to be FCC-registered equipment. The telephone is assumed to be FCC-registered and complying with EIA/TIA-470A (Ref A2).

4.1.4.1.3 The station equipment designated for use during system failure may have to be equipped with a means of supplying a ground-start signal to originate calls when in the system failure mode and shall be equipped with a rotary dial, or equivalent line-powered DP generator when the network accepts only dial pulsing.

4.1.4.1.4 Other special-purpose or proprietary telephones are not considered in this section.

4.1.4.1.5 The network access lines are analog 2-wire, loop or ground start, one-way or two-way, according to 4.1.1 and 4.1.2. FX, WATS, and other trunks having the same electrical signaling characteristics may be transferred by equipment described in this section, but are not considered specifically.

4.1.4.1.6 Trunk circuits having E&M and other signaling methods are not considered in this section.

4.1.4.2 *Requirements*

4.1.4.2.1 *Operation*

4.1.4.2.1.1 In practice, SFT has usually been implemented using electro-mechanical relays to do the required switching of T&R connections. This is because relays are function reliably without local power (de-energized) and to maintain the electrical isolation, transmission balance, and power surge strength required for the access line port, while passing dc current, voiceband, and signaling signals from the station terminal to the access line. The scheme shown in Fig 16 shows relays as an example.

4.1.4.2.1.2 The SFT equipment can be in one of two states, called the "transferred" state and the "normal" state.

4.1.4.2.1.3 In the normal state, the predetermined station lines are subject to the requirements of 4.5. The network access lines are subject to the requirements of 4.1.

4.1.4.2.1.4 In the transferred state, the SFT equipment will establish a direct connection between the predetermined telephone lines and access lines and will disconnect these lines from the PBX.

4.1.4.2.1.5 The holding signal is a control message or signal transmitted from the PBX to the SFT equipment to indicate that it should be in its normal state or that it should return to the normal state from the transferred state. This signal is typically (but not necessarily) a dc voltage of 42.5 to 56.5 V.

4.1.4.2.2 *Transfer Conditions*

4.1.4.2.2.1 A holding signal is extended to the normally-energized transfer device; e.g., relay. This signal shall be automatically removed in the absence of input power to the PBX and/or internal voltage(s) required for PBX operation.

4.1.4.2.2.2 The holding signal shall be removed and the transferred state shall commence within 1 second after loss of input power to the PBX or detection of the absence of any internal voltage required for minimum PBX call processing.

4.1.4.2.2.3 It is desirable that an option be provided to also remove the holding signal upon detection of major PBX functional failure including inability to:

(1) Supply local talking battery.

(2) Originate trunk calls of any kind.

(3) Respond to incoming seizure.

4.1.4.2.3 *Restoral Conditions*

4.1.4.2.3.1 The holding signal shall be automatically reapplied after restoral of the power or clearing the functional fault of the PBX, except as noted in 4.1.4.2.3.3.

4.1.4.2.3.2 Upon reapplication of the holding signal, idle transferred station lines and trunks shall return to their normal states within 150 ms.

4.1.4.2.3.3 When the network provides disconnect supervision, it is desirable that transferred station lines and trunks return to their normal states only after a loop current interruption greater than 50 ms duration (allowing completion of conversation).

4.1.4.2.3.4 When the network provides disconnect supervision, it is additionally desirable to provide the option of return to the normal states only after an interruption of loop current greater than 1.5 seconds (allowing completion of dialing and hook flashing).

4.1.4.2.4 *Supervision, Signaling and Transmission*

4.1.4.2.4.1 In normal operation (i.e., in the presence of a holding signal), the SFT equipment shall have no measurable effect on the supervision, signaling, and transmission parameters of the PBX trunk circuit as described in this standard.

4.1.4.2.4.2 In the transferred state, the termination seen from the public network interface through the de-energized transfer device and the station loop shall comply with EIA/TIA-470A (Ref A2), except as modified by the following:

(1) For all values of current flow possible using the test arrangement shown in Fig 17, the sum of the magnitudes of the dc voltage drops in tip-and-ring conductors attributed to the SFT device shall not exceed the corresponding voltage drop across a 60-ohm resistor.

(2) It is desirable that the series dc resistance in the through-transmission mode be less than 3 Ω.

(3) The insertion loss of a series device connection is defined as the 1000-Hz power level difference between the power delivered from a source to a terminating output port with and without the series device path between the input and output ports connected.

(4) The 1000-Hz insertion loss shall be between 0.0 and 0.6 dB with the transfer device in the through-connection mode.

NOTE: When tests in through-connection mode are described, both ports of the equipment shall have terminations of 600 Ω. On one port, the termination includes the necessary driving circuitry (oscillator, return loss sets, four-tone generator, etc.) while, on the other port, a detector is bridged across the termination as necessary.

(5) In the through-connection mode the transfer device shall comply with the following values:

Frequency (Hz)	Mandatory Frequency Response (dB)	Desirable Frequency Response (dB)
200	-0.1 to +1.0	-0.1 to +0.3
300	-0.1 to +0.8	-0.1 to +0.2
3000	-0.1 to +0.8	-0.1 to +0.2
3400	-0.1 to +1.0	-0.1 to +0.3

(6) Dynamic Range. With the transfer device in the through-connection mode, the compression of a 1000-Hz tone relative to a tone at an excitation level of -9 dBm shall be less than:

1000-Hz Maximum Tone Power (dBm)	Compression (dB)
0	0.1
4	0.1
7	0.4

(7) Intermodulation Distortion. With measurements made as defined in 5.7.1 and the transfer device in the through-connection mode, R2 shall exceed 45 dB and R3 shall exceed 53 dB.

(8) Relative Envelope Delay. With the transfer device in the through-connection mode, envelope delay difference shall comply with the following:

Frequency Band (Hz)	Envelope Delay (µs)
1000 to 3000	140
400 to 3200	280

(9) Return Loss. It is desirable that the return loss, measured as defined in Annex D, exceed 18 dB and that the single-frequency return loss exceed 12 dB.

(10) The transverse balance, measured using the connection shown in Fig 53 (see 5.6.2.2), shall comply with the following criteria:

CO Trunk Interface	Equipment State	Minimum Frequency Balance Range Requirement (dB)	(Hz)
Loop Start	Both on-hook and off-hook	60 40	200 to 1000 1000 to 4000
Ground Start	Off-hook	40	200 to 4000

(11) In the through-connection mode, the transfer device shall meet or exceed the following longitudinal-to-metallic balance requirements:

Frequency (Hz)	Minimum Balance (dB)
200	63
500	63
1000	63
3000	58

(12) With the transfer device in the through-connection mode, there shall be no adjustments that will allow net amplification to occur in any terminal port-to-network port through-transmission path within the frequency range 200 to 4000 Hz, when measured from a 600-ohm source into the loop simulator circuit of Fig 2. The net gain of the equipment shall be designed so as not to exceed 0 dB. However, the gain for any single unit of equipment may exceed 0 dB as much as 1.5 dB provided that the net gain, averaged over all units of production, is no greater than 0 dB. If frequencies other than 1000 Hz are more appropriate because of an intended application, the input impedance determination and any required tests shall be performed at these frequencies.

(13) With the transfer device in the through-connection mode, the loss in any through-transmission path at any frequency in the 600-to-4000 Hz band shall not exceed the loss at any frequency in the 3995-to-4005-Hz band by more than 3 dB. This applies at all values of dc loop current that the network port is capable of drawing when connected to the loop simulator circuit of Fig 2 with the polarity switch in position 1.

(14) In the through-connection mode the transfer device shall comply with the metallic and longitudinal signal power criteria described in 5.9, except use the Loop Simulator Circuit of Fig 2 for these tests;

NOTE: Use Fig 18 resistive termination (b) for the measurement required by 5.9. Use Fig 18 resistive terminations (d) and (e) for the metallic and terminations (a) and (c) for the longitudinal requirements for the measurements required by 5.9.

(15) When the transfer device is in the through-connection mode, and a network port is connected through the transfer device to its terminal port, which is terminated with 600 Ω resistance, the impedance seen at the network port shall be 600 (±120) Ω.

(16) In the transferred state, supervision and signaling operations are different. Stations associated with SFT equipment shall provide appropriate user instructions with respect to outward seizure on ground-start trunks (unless automatic ground is provided) and cautions with respect to dialing sequences.

(17) In transferred operation on ground-start trunks, provision shall be made to ground the ring lead for outward seizure. This is possible:

(a) by the use of a ground button on the telephone where the user determines the duration of the ground application.

(b) automatically, by providing a measured ground pulse within the transfer device when an off-hook occurs.

(18) The grounding means shall be capable of operation independently of PBX power.

(19) It is desirable that the ground be applied at off-hook and removed upon detection of the tip ground by the transfer device independently of the user and not requiring the ground button. Such transfer devices shall comply with the outgoing seizure requirements of 4.1.1.4.

(20) Outward address signaling shall be that of the telephone's dial pulse or DTMF signals.

(21) Inward alerting shall be that which is normally applied from the network access line to the PBX. The telephones designated for transfer service shall be compatible with this ringing. It is desirable that the REN of the transfer device be low to allow multiple extension telephones.

4.1.4.2.5 Make-Busy Considerations

It is desirable that the SFT equipment busy out the associated PBX line circuit (if any) in the transferred state to provide the correct indication to a caller if restoral is delayed by a call in progress. This can be accomplished by means appropriate to the particular PBX design, e.g., placing a short (off-hook) across the line circuit if a "permanent" does not adversely affect the PBX.

It is also desirable that the SFT equipment busy out the associated trunk circuit to prevent its outward seizure during delayed restoral. This can be accomplished by means appropriate to the particular PBX design, e.g., grounding the tip conductor of the PBX trunk circuit if this does not adversely affect the PBX or network.

4.1.4.2.6 Maintenance Considerations

4.1.4.2.6.1 Location

The transfer devices may be integral with the PBX cabinet or with a plug-in PBX trunk circuit or they may be physically separate, e.g., wall-mounted.

4.1.4.2.6.2 Manual Control

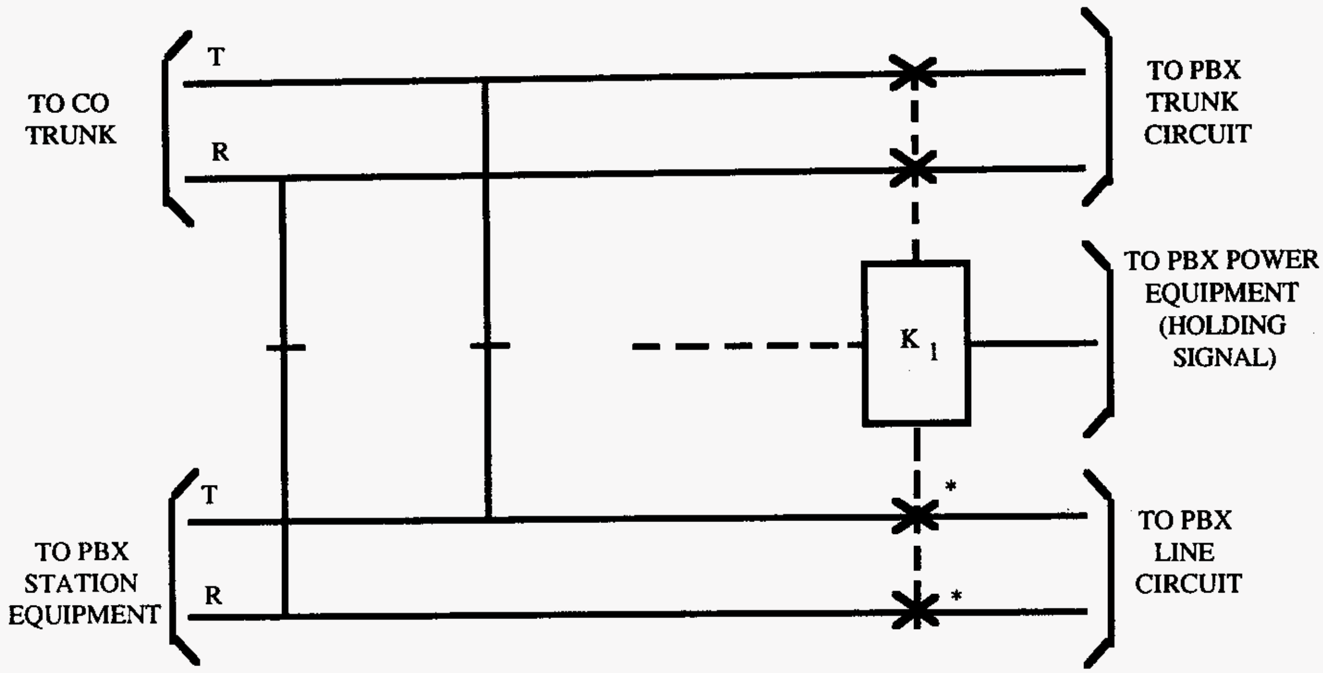
In addition to the automatic operation of the holding signal, it shall be possible to manually de-energize the transfer devices. It is desirable that this be provided individually for each device.

4.1.4.2.7 Installation Wiring

All installation wiring related to the trunk circuits and the station lines involved in SFT are subject to the provisions in Part 68 of the FCC Rules and Regulations (Ref A4), relating to installation of other than fully-protected premises wiring.

4.1.5 One-way 911 CAMA Access Interface

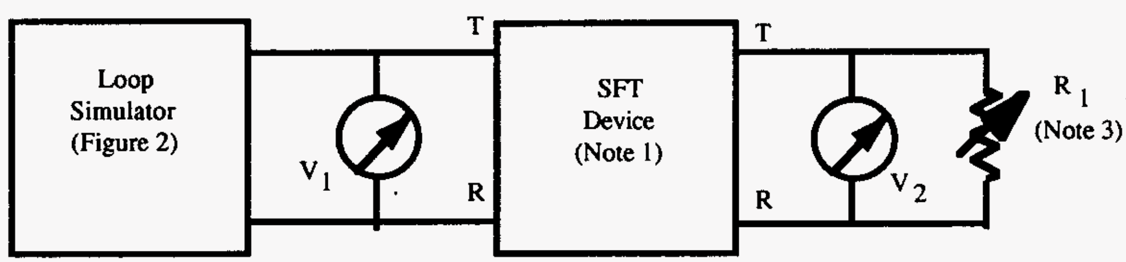
One-way CAMA access provides PBX stations with dedicated network access to an Enhanced 911 system. 911 CAMA access permits the PBX to transmit address signals and the Caller's Emergency Service Identification (CESID) to the Enhanced 911 system. This analog access interface requires interoperability with network-provided reverse battery supervisory signaling, wink-start outpulsing control, and multifrequency address signaling. Refer to ANSI T1.411-1995, Telecommunications – Interface Between Carriers and Customer Installations – Analog Voicegrade Enhanced 911 Switched Access Using Network-Provided Reverse-Battery Signaling [Ref A31].



NOTES:

1. Contacts are make before break.
2. Contacts designated (*) are unnecessary if the station is used exclusively for system failure transfer.

Figure 16 - Typical Arrangement of Electro-Mechanical System Failure Transfer Device For PBX



NOTES:

1. Replace the SFT device with resistors for the tests of 4.1.4.2.4.2(1) and (2), as specified.
2. SFT voltage drop = $V_1 - V_2$
3. Resistor R_1 shall range from 0 to 400 Ω. R_1 represents the station equipment resistance.

Figure 17 - Voltage Drop Test Arrangement for SFT Device

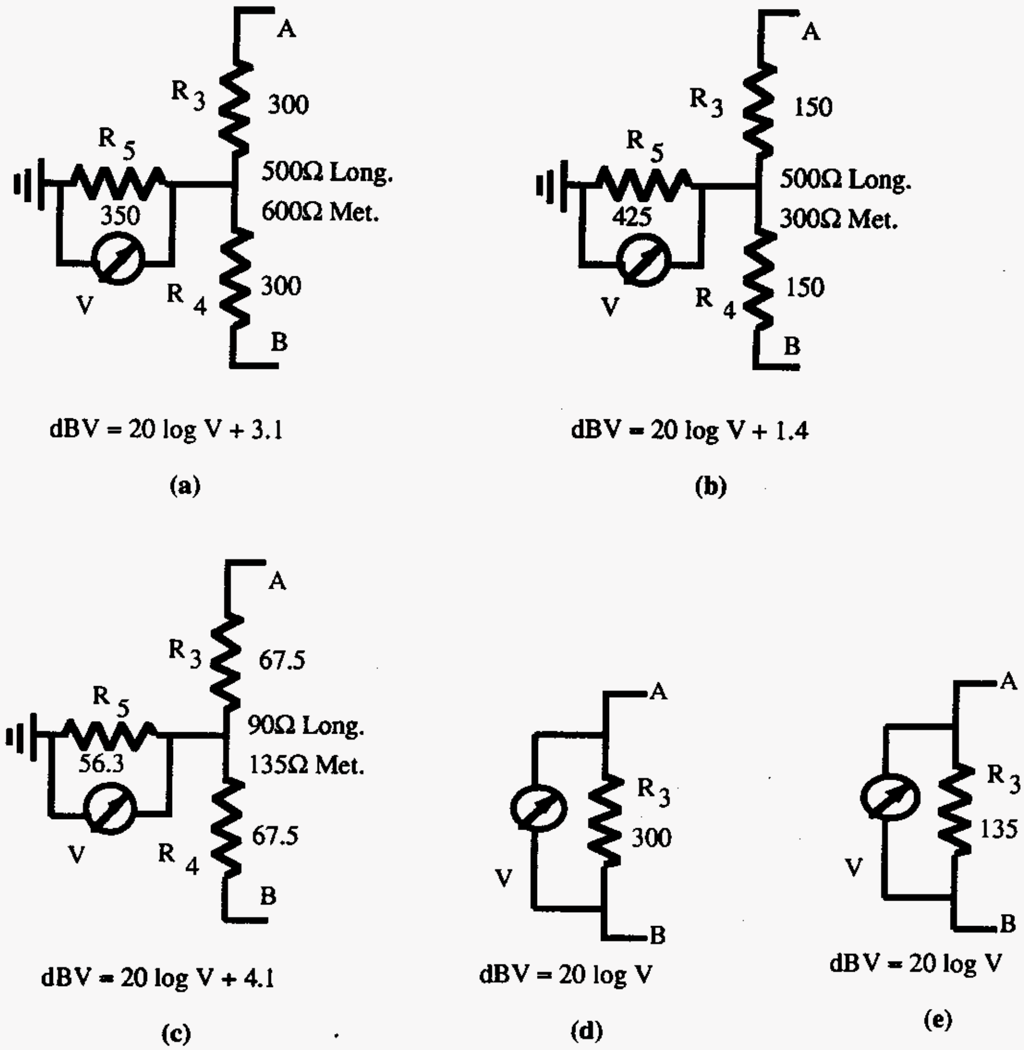


Figure 18 - Resistive Terminations for Signal Level Tests

4.2 Private Network Interface - Analog

4.2.1 Introduction

This section gives design criteria for 4-wire and 2-wire analog (not digital) PBX tie trunks employing E and M (E&M) signaling, intended to perform reliably with similar trunk circuits, signaling equipment, and trunk facilities of numerous manufacturers.

4.2.2 Definitions

4.2.2.1 A PBX tie trunk is a direct circuit extending between two PBXs with no intermediate switching. The physical connection between the two PBXs may consist of either one (2-wire) or two (4-wire) pairs of wires or may involve 4-wire terminating sets, repeaters, carrier systems, and one or more COs (where no switching of the tie trunk occurs).

4.2.2.2 A tandem tie trunk network exists when a number of PBXs are interconnected by tie trunks in a way that enables a PBX station user or attendant to reach other PBX stations or attendants in the network. This is accomplished by coordinated signaling and switching through intermediate PBXs in the network.

4.2.2.3 Tie trunks can be classified by:

(1) Use (2-way, incoming, outgoing).

(2) Method of completion of incoming calls (automatic or dial repeating).

(3) Network function (tandem, intertandem, nontandem).

Dial repeating tie trunk circuits provide for dial selection of the desired station on incoming calls at the terminating end of the connection. Automatic tie trunk circuits signal the PBX attendant at the distant end directly upon seizure; selection of the desired station at the terminating end is done by the PBX attendant.

4.2.2.4 PBX tie trunks are designed to operate into signaling equipment on the same premises using a common signaling interface. This common interface consists of a uniform system of leads designated the E&M signaling leads. Intermediate facility signaling links may then use duplex (DX) or single frequency (SF) signaling systems, or out-of-band built-in systems such as those in T1 carriers. Any such conversion employed by the common carrier usually provides operational transparency.

4.2.2.5 The E&M lead signaling interface is the FCC-registrable[11] tie trunk interface intended for universal compatibility with common carrier external facility signaling equipment.

4.2.2.6 Type I signaling is included because of its simplicity and widespread use throughout the telephone industry. It may be used where current return through the grounding system, with its attendant noise interference, can be tolerated by the PBX.

4.2.2.7 Type II signaling has been included for use in cases, such as electronic PBXs, where current return through paired leads is required to minimize interference with other circuitry. This interface also provides for direct back-to-back operation of E&M trunk circuits.

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11. Although this section of the standard has been written in conformance with the requirements of Part 68 (Ref A4) of the FCC Rules and Regulations effective at the date of writing, users of this standard are referred to the current issue of the FCC document to ensure compliance with the latest FCC requirements.

4.2.3 E&M Lead Signaling

4.2.3.1 General

The criteria in this section relate to tie trunk interfaces when measured with no connections made to tie trunk facilities or any other termination unless otherwise stated herein. Several E&M lead signaling interface arrangements are in common use in the telephone industry. The two most-widely used types, Type I and Type II (Fig 19) are described. The following paragraphs define unique requirements pertaining to E&M lead signaling when used in PBX tie trunks.

4.2.3.1.1 No dc voltage shall be applied by the PBX to the tip and ring conductors of the trunk facility.

4.2.3.1.2 The dc current in the E lead shall not exceed 100 mA. (This limit is for channel equipment protection; the current under normal operating conditions is much lower.) It is recommended that this current be no less than 2 mA to ensure adequate wetting current flow through the E-lead contact.

4.2.3.1.3 The PBX shall not deliver power in excess of -55 dB (with respect to 1 mW) at the tip and ring interface, within the frequency band 200 to 4000 Hz, into a 600-ohm resistive termination while the trunk circuit is in the on-hook state.

4.2.3.1.4 The PBX shall not deliver signals into a 600-ohm termination connected across the tip and ring interface (from sources internal to the registered equipment or circuitry) with energy in the 2450-2750 Hz band, unless at least an equal amount of energy is present in the 800-to-2450 Hz band.

4.2.3.2 Type I Signaling

4.2.3.2.1 Voltage Limitations

4.2.3.2.1.1 M-lead surge suppression shall be provided to assure that voltages to ground do not exceed 80 V. For relay contact implementation, a power dissipation capability of at least 0.5 watt shall be provided in the surge suppression shunt path[12] (See Fig 19A).

4.2.3.2.1.2 No significant ac voltage (maximum 5 V peak) shall appear between E or M lead and (earth) ground.

4.2.3.2.1.3 The open-circuit dc voltage between the E&M leads and ground shall not exceed 56.5 V and shall not be more positive than ground.

4.2.3.2.1.4 The transient voltage between the E lead and ground, resulting from E-lead contact opening shall not exceed:

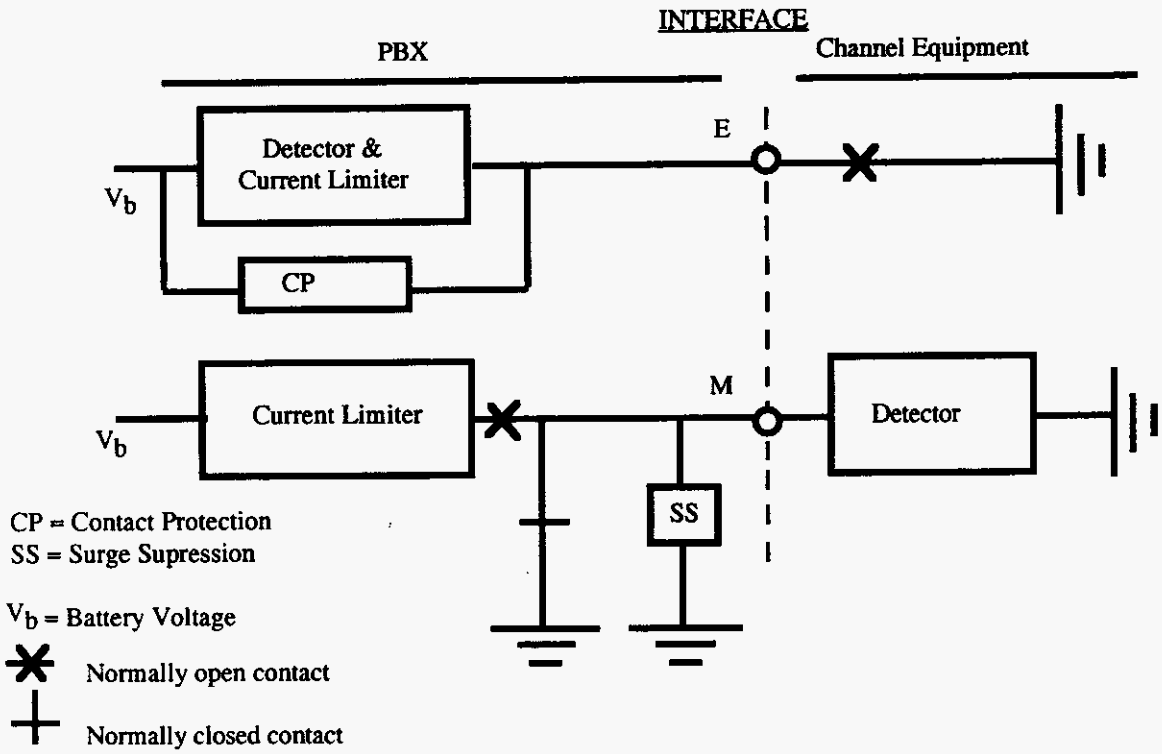
(1) 300 V peak.

(2) A rate-of-change of 1 volt per microsecond.

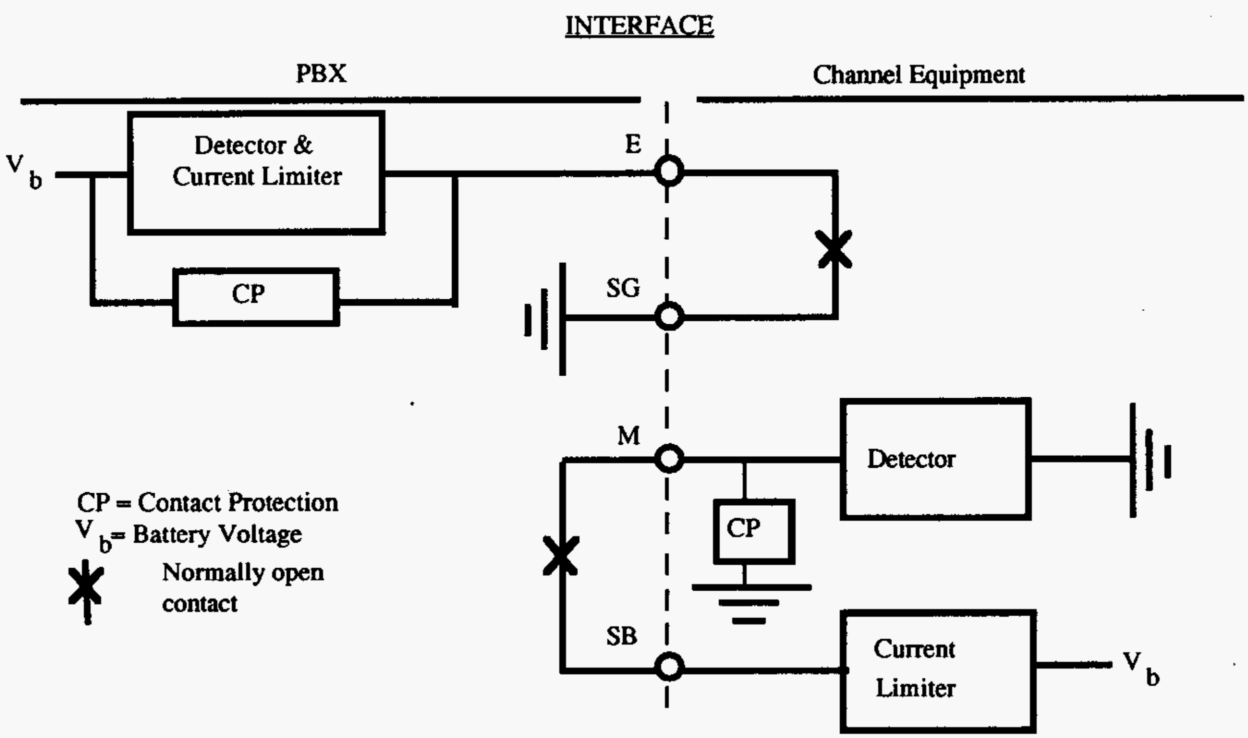
(3) An 80-volt level for longer than 10 ms.

---

12. In the past, a 1000-ohm, 5-watt resistor has been used to protect wetted-mercury and wire spring relay contacts. However, a zener diode with a breakdown voltage of 68 (±10%) volts, connected between the M lead and ground, is now recommended as a general replacement for a resistor to minimize power consumption.



(a). E & M Lead Signaling - Type I



(b). E & M Lead Signaling - Type II

Figure 19 - E & M Lead Signaling

4.2.3.2.2 *On-Hook*

In any state, the PBX shall assure that an open circuit (20 KΩ, or greater, resistance) between the E lead and ground is recognized as an on-hook signal from the channel equipment. The open-circuit voltage between the E lead and ground is between -42.5 and -56.5 V*.

As long as the trunk circuit resides in the on-hook state, the PBX shall assure that:

(1) Ground is maintained on the M lead.

(2) The voltage between the M lead and PBX ground does not exceed 1 V dc when tested with the M lead connected through a 1000 (±1%) Ω resistor to a -50 (±1) V dc source (referenced to ground.)

* Throughout this section of the standard, where a voltage range of -42.5 to -56.5 V is stated, it is to be understood that the nominal design voltage shall be -48 V dc.

4.2.3.2.3 *Off-Hook*

In any state, the PBX shall assure that ground through a resistance of up to 150 Ω on the E lead is recognized as an off-hook signal from the channel equipment.

As long as the trunk circuit resides in the off-hook state, the PBX shall assure that:

(1) A dc voltage of -42.5 to -56.5 V is maintained on the M lead.

(2) The change in voltage between the M lead and ground does not exceed 5 V while a current of 0 through 85 mA dc flows through the M lead.

(3) No other trunk circuits shall be put out of service or operationally affected if the M lead on one trunk circuit is short-circuited to ground.

4.2.3.3 *Type II Signaling*

4.2.3.3.1 *Voltage Limitations*

4.2.3.3.1.1 The open-loop channel equipment voltages appearing at the interface are as follows: (See Fig 19B.)

(1) On the SB lead, -42.5 to -56.5 V dc.

(2) On the M lead, 0 or ±12 V.

4.2.3.3.1.2 Ground shall be maintained on the SG lead.

4.2.3.3.1.3 No significant ac voltage (maximum 5 V peak) shall appear:

(1) Between the E lead and (earth) ground.

(2) Between the M, SG, or SB leads to ground from sources within the PBX.

4.2.3.3.1.4 No significant dc voltage (maximum 5 V) shall appear between the M, SG, or SB leads to ground from sources within the PBX.

4.2.3.3.1.5 The open-circuit dc voltage between the E lead and ground shall not exceed 56.5 V and shall not be more positive than ground.

4.2.3.3.1.6 The transient voltage between the E and SG leads, as measured at the interface, resulting from E-SG loop opening shall not exceed:

(1) 300 V peak.

(2) A rate-of-change of 1 volt per microsecond.

(3) An 80-volt level for more than 10 ms.

4.2.3.3.1.7 No current sensors shall be employed in the M and SB leads. There is no need for protection of the M-SB loop contact from current surges because the M-lead signaling circuit limits the M-lead-to-ground potential to 300 V and the rate of change to 1 volt per microsecond. However, if additional protection is provided, it shall not introduce a capacitive impedance between the M and SB leads or between the M lead and ground.

4.2.3.3.2 On-Hook

In any state, the PBX shall assure that an open circuit (20 KΩ, or greater resistance) between the E and SG leads is recognized as an on-hook signal from the channel equipment. The open-circuit potential between the E and SG leads is between -42.5 and -56.5 V.

As long as the trunk circuit resides in the on-hook state, the PBX shall assure that the M-SB loop contact is held open. To hold leakage currents within acceptable bounds, the following limits shall be satisfied:

(1) The current in the M lead is not greater than 100 mA when the SB lead is open and the M lead is connected to PBX ground;

(2) The current in the M lead is not greater than 100 mA when the SB lead is connected to a -50 (±1) V source (referenced to ground) and the M lead is connected to PBX ground.

(3) The current in the M lead is not greater than 24 mA when the SB lead is open and the M lead is connected to a ±12 V dc source (referenced to ground).

4.2.3.3.3 Off-Hook

In any state, the PBX shall assure that a resistance of 300 Ω or less in series with a 2 V dc source connected in opposition to the E-lead battery voltage between the E and SG leads, measured at the interface, is recognized as an off-hook signal from the channel equipment.

Signaling from the PBX trunk circuit toward the interface shall be done by joining the M-SB loop contact to the M and SB leads.

As long as the trunk circuit resides in the off-hook state, the PBX shall assure that:

(1) The M-SB loop contact is held closed.

(2) The change in voltage between the M and SB leads does not exceed 2 V while a current of 0 through 50 mA dc flows through the M-SB loop contact.

(3) The absolute value of the SB-lead current does not deviate more than 10 percent from the absolute value of the M-lead current.

4.2.3.4 Address Signaling - Sending

4.2.3.4.1 Dial Pulse Address Signaling

See Normative Annex E (E4, E&M Trunk Dial Pulse Signaling)

4.2.3.4.2 DTMF Address Signaling

During senderized DTMF address signaling through the trunk circuit, the PBX shall assure that the DTMF sending requirements given in 6.1.3 and 6.1.4 are met.

4.2.3.5 Address Signaling - Receiving

4.2.3.5.1 Dial Pulse Address Signaling

See Normative Annex E (E4, E&M Trunk Dial Pulse Signaling)

4.2.3.5.2 DTMF Address Signaling

During receipt of DTMF address signals by the E&M trunk circuit, the PBX shall assure that the DTMF receiving requirements given in 6.1.5 are met.

4.2.4 *Call Sequence Criteria*

4.2.4.1 *Incoming Seizure*

4.2.4.1.1 The PBX shall recognize an off-hook signal at the interface as an incoming seizure signal. To minimize the probability of glare, the PBX shall mark the trunk busy to outgoing service within 100 ms of the start of incoming seizure.

4.2.4.1.2 Alerting requirements for attendant-completing trunk circuits are as follows:

(1) During alerting, audible ring shall be transmitted toward the interface.

(2) To avoid unnecessary alerting due to line hits, alerting shall not begin until incoming seizure persists for at least 150 ms.

(3) To avoid delaying a call, alerting shall begin within 9 seconds of start of seizure.

4.2.4.2 *Incoming Address Signaling*

4.2.4.2.1 An immediate-start PBX shall be ready to receive dial pulses within 65 ms of seizure by a far-end PBX which is not arranged to receive address control (delay) signals. Return of dial tone is optional.

4.2.4.2.2 The PBX shall be capable of controlling receipt of address signals using each of the methods (1, 2, and 3) described below. The specific method is selected according to the requirement of the far-end PBX.

(1) The PBX shall be able to return dial tone when it is ready to receive address signals. Dial tone shall be removed within 500 ms after the start of the first address character.

(2) The PBX shall be able to send a delay dial (off-hook) signal toward the far-end PBX. The signal shall start no later than 150 ms after start of the seizure signal. It shall persist for no less than 140 ms and shall end (return to on-hook) when the PBX is ready to receive address signals. The PBX shall not register any pulses for 30 ms after returning to the on-hook state. The PBX shall be prepared to register dial pulses within 70 ms after returning to the on-hook state. To ensure universal compatibility with older crossbar offices having the marker glare detection feature, it is desirable that the delay dial (off-hook) signal not start earlier than 100 ms after receipt of the incoming seizure signal. (In addition to the signaling function, the delay-dial signal serves as an integrity check that helps identify a malfunctioning trunk, resulting in reorder tone being transmitted from the far-end PBX to the caller.)

(3) The PBX shall be able to send a wink (off-hook/on-hook sequence) signal toward the far-end PBX, which persists for 140 to 290 ms (200 ms nominal). This signal shall commence when the PBX is ready to receive address signals; however, the start of the wink signal shall not occur earlier than 100 ms after start of the incoming seizure signal. The PBX shall not register any pulses for 30 ms following the return to on-hook state. The PBX shall be prepared to register dial pulses within 70 ms following the return to on-hook state. (In addition to the signal function, the wink signal may serve as an integrity check to help identify a malfunctioning trunk, resulting in reorder tone being transmitted from the far-end PBX to the caller.)

4.2.4.2.3 The permanent signal and partial-dial time-out interval for address signaling shall not be less than 10 seconds. When the PBX recognizes a permanent signal or partial-dial condition on a trunk, it shall transmit reorder tone toward the calling party.

4.2.4.3 *Transmission of Answer Supervision*

4.2.4.3.1 When the call is answered, the PBX shall transmit an off-hook signal toward the trunk interface as an answer signal. The PBX shall maintain this off-hook signal until disconnect.

4.2.4.3.2 When a call is routed to a public network access line, answer supervision shall be transmitted toward the tie-trunk interface upon completion of outpulsing to the access line.

4.2.4.3.3 In tie trunk-to-tie trunk (tandem) service, answer supervision shall be passed from the outgoing to the incoming tie trunk as soon as it is received.

4.2.4.3.4 The PBX shall provide a two-way voiceband transmission path between a called attendant and the calling facility within 160 ms of attendant answer to avoid clipping initial speech energy. It is highly desirable that the PBX minimize or eliminate any ringing signal that might be heard by the attendant. When a call is terminated or extended to a station, the PBX shall provide a two-way voiceband transmission path between the called and calling facilities within 400 ms of station answer to avoid clipping initial speech energy. The period between answer and transfer of answer supervision to the tie trunk shall be less than 500 ms.

4.2.4.4 *Outgoing Seizure*

To reduce the probability of glare, the PBX shall seize the trunk within 50 ms of selection of the trunk for an outgoing call. The PBX shall cause the trunk circuit to send an off-hook signal toward the interface as a seizure signal.

4.2.4.5 *Outgoing Address Signaling*

The PBX shall comply with the requirements of 4.2.4.5.1 for cut-through operation. If the PBX is arranged for optional senderized operation in private switched network applications, it shall also comply with the requirements of 4.2.4.5.2 for non-cut-through operation.

4.2.4.5.1 *Cut-Through Operation*

4.2.4.5.1.1 In cut-through operation, the PBX shall pass dial tone and other call progress tones from the distant PBX to the calling party. The PBX shall also pass DTMF and dial pulse address signals to the distant PBX in compliance with 4.2.3.4.2 and Annex E4.1, respectively.

4.2.4.5.1.2 The PBX shall establish a two-way voiceband transmission path between the calling facility and the outgoing tie trunk interface within 500 ms following the end of each dial pulse digit train.

4.2.4.5.2 *Non-Cut-Through Operation*

4.2.4.5.2.1 In the senderized mode of operation, the PBX shall transmit DTMF and dial pulse address signals to the distant PBX in compliance with 4.2.3.4.2 and Annex E4.1, respectively.

4.2.4.5.2.2 When the tie trunk operates in a delay dial mode, the PBX shall ignore off-hook signals of less than 50 ms duration. The PBX shall recognize off-hook signals of 100 ms or longer duration as delay dial signals and shall delay start of outpulsing until at least 70 ms after receipt of end of delay dial (on-hook) signal. If the delay dial signal or the end of delay dial (on-hook) signal has not been received by 5 seconds after seizure, the PBX shall treat the call as blocked by releasing the trunk and extending reorder tone toward the caller.

4.2.4.5.2.3 When the tie trunk operates on wink start, the PBX shall ignore off-hook signals of less than 50 ms duration. The PBX shall recognize off-hook signals of 100 to 350 ms duration as wink start signals and shall delay start of outpulsing until at least 70 ms after receipt of end of wink (on-hook) signal. The PBX may treat a call encountering an interval longer than 350 ms from the start of a wink start signal as a blocked call and handle it as described in 4.2.4.5.2.2, above.

4.2.4.5.2.4 In the senderized mode of operation, the PBX shall establish a two-way voiceband transmission path between the calling facility and the outgoing tie trunk interface within 500 ms following release of the sender.

4.2.4.6 Detection of Answer Supervision

Following address signaling, the PBX shall detect an off-hook signal at the interface as an answer signal.

4.2.4.7 Disconnect

Tie trunks may be arranged for flash capability. Flash signals are transmitted over flash-capable tie trunks to initiate internal calling features; e.g., call transfer.

4.2.4.7.1 Transmission of Disconnect

When the PBX has determined that the near-end party has disconnected, the PBX shall switch the outgoing trunk supervision state from off-hook to on-hook to send a disconnect signal if both ends have been off-hook for at least 1.6 s. If both ends have not been off-hook for 1.6 s, the procedures in 4.2.4.7.5 shall apply.

4.2.4.7.2 Transmission of Flash

The transmission of a flash is only valid when both ends of the trunk are off-hook. The PBX shall switch the outgoing trunk supervision state from off-hook to on-hook and back to off-hook to send a flash signal. The on-hook period shall last between 350 ms and 1100 ms. It is desirable that the on-hook period last 400 ms.

4.2.4.7.3 Detection of Far-End Disconnect or Flash

The PBX shall detect a transition from off-hook to on-hook as a disconnect signal from the far end according to the following criteria. The PBX shall ignore an on-hook of 150 ms or less. On non-flash-capable trunks, the PBX may interpret an on-hook between 150 and 700 ms as a disconnect and shall interpret an on-hook of 700 ms or greater as a disconnect. It is desirable that the PBX interpret an on-hook of 400 ms or greater as a disconnect. On flash-capable trunks, the PBX shall interpret an on-hook between 300 and 1000 ms as a flash and any on-hook lasting longer than 1500 ms as a disconnect. In the case where the call is made to a ground start access line, the incoming tie trunk in the PBX shall provide disconnect supervision when the network removes ground from the tip conductor of the access line.

4.2.4.7.4 Idling the Trunk Circuit

After both ends of the trunk have gone on-hook as described in 4.2.4.7.5 and 4.2.4.7.6:

(1) On flash-capable trunks, each end shall hold the trunk idle for 400 to 1200 ms before releasing it (mutual idle). It is desirable that both ends hold the trunk idle for 600 ms. After the mutual idle period, the PBX shall hold the trunk busy to outgoing service for at least 800 ms. The PBX shall be able to properly process a new incoming call received within 800 ms of the end of the mutual idle period.

(2) On non-flash-capable trunks, the PBX shall hold the trunk busy to outgoing service for at least 800 ms. The PBX shall be able to properly process a new incoming call received within 800 ms of both ends going on-hook.

4.2.4.7.5 Disconnect Sequences - Answer Supervision Not Returned

On all tie trunk calls on which answer supervision is not returned, the PBX shall meet the requirements in (1), (2), and (3) below when serving as an originating, tandem, and terminating system, respectively;

(1) When the originating PBX determines that the calling party has disconnected (as described in 4.5.10.1, Station Disconnect and Flash Timing), the PBX switching connection shall be dropped and a disconnect shall be sent toward the far-end switching system. The outgoing trunk circuit shall be idled as soon as a disconnect is sent.

(2) At tandem PBXs, when a disconnect is detected by the incoming trunk circuit the switching connection shall be dropped and the incoming trunk circuit shall be idled. The disconnect shall be passed to the outgoing trunk. The outgoing trunk circuit shall be idled as soon as a valid disconnect signal has been sent.

(3) When the terminating PBX recognizes a disconnect signal from the incoming trunk, the connection between the called facility and the incoming trunk circuit shall be dropped and the trunk shall be idled. If the called facility is a network access line that has not yet released, the disconnect shall be passed forward and the network access line shall be held busy until a network disconnect signal has been received. If the called facility is a station that has not gone on-hook, that station shall be treated as described in 4.5.10.2, Station Disconnect Requirements.

4.2.4.7.6 Disconnect Sequences - Answer Supervision Returned

In the following requirements, "near-end" refers to that PBX whose party disconnects first, and "far-end" refers to that PBX whose party remains off-hook. A forward disconnect is sent from the near-end to the far-end. Later, a backward disconnect is returned from the far-end to the near-end when either the party at the far-end goes on-hook or a forward disconnect is validated and the far-end tandem PBX generates a backward disconnect in accordance with criterion (3), (4), or (5) below:

(1) When the near-end PBX determines that its party has disconnected, as described in 4.5.10.1, while off-hook supervision is being maintained from the far-end, the switching connection shall be dropped and a disconnect shall be sent forward. The PBX shall idle the outgoing tie trunk when the off-hook signal has been removed (backward disconnect signal).

(2) Upon receiving a disconnect, all tandem PBXs shall pass a forward disconnect signal. When a backward disconnect signal is received from the far-end, all tandem PBXs shall pass that disconnect signal, drop their connections, and idle their tie trunks.

(3) It is desirable that PBXs at tandem points drop their connections and generate their own backward disconnects toward the near-end when forward disconnect is received, its validity is verified and it is subsequently transmitted. This permits all switching facilities and trunks between this tandem PBX and the near-end PBX to be idled before far-end disconnect is received.

(4) If the off-hook far-end facility is a network access line, the far-end PBX, upon recognition of a forward disconnect signal, shall drop the connection, transmit a forward disconnect signal to the network access line, transmit a backward disconnect signal to the incoming tie trunk, and make the tie trunk idle after a valid backward disconnect signal has been transmitted. The network access line shall then be held busy until a disconnect is received from the network.

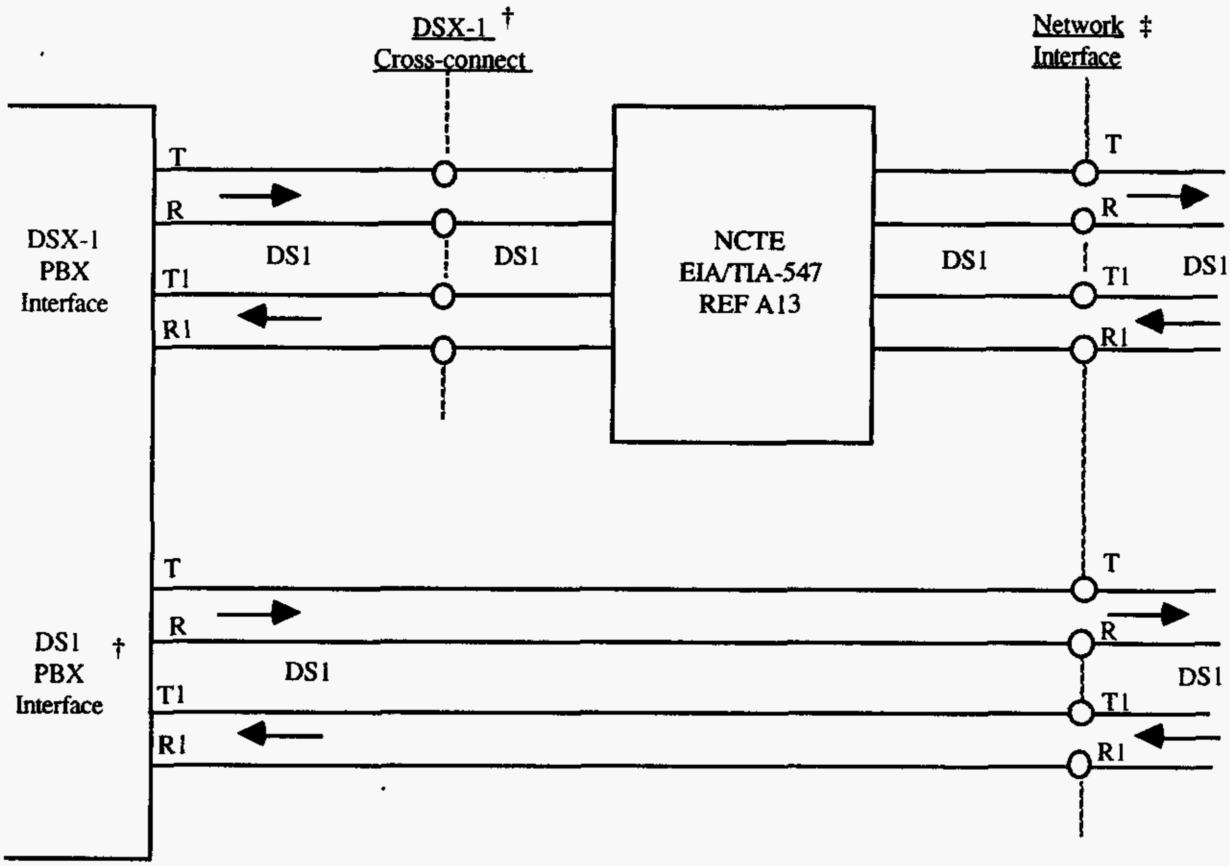
(5) If the off-hook far-end facility is a station line, the PBX, upon recognition of a forward disconnect signal, shall drop the connection, transmit a backward disconnect signal to the incoming tie trunk, and make the tie trunk idle after a valid backward disconnect signal has been transmitted. If the station remains off-hook, it shall be treated as described in 4.5.10.2.

4.3 Network Interface - Digital (DS1 and DSX-1)

4.3.1 Electrical and Physical Characteristics of the 1.544 Mb/s PBX Interface

This section specifies the physical and electrical characteristics of the 1.544 Mb/s PBX interface, both at the DSX-1 PBX interface when terminated by a limited function NCTE or DSX-1 compatible equipment, and at the DS1 PBX interface when not terminated by an NCTE. The DS1 PBX interface is equivalent to the interface between the DS1 facility and the NCTE. When the DS1 line is connected to the DS1 PBX interface, the PBX terminates the DS1 line and provides the necessary critical interface circuit functions to keep the DS1 line working properly. Connections to the DSX-1 PBX interface and to the DS1 PBX interface are shown in Fig 20.

The requirements for 1.544 Mb/s facilities are based on those of standard T1 carrier. The line code is either Alternate Mark Inversion (AMI) with Zero Code Suppression (ZCS) or Bipolar Eight Zero Substitution (B8ZS).



NOTES:

1. † Electrical Characteristics are defined at this point (see 4.3.1.1, 4.3.1.2)
2. ‡ Electrical Characteristics at the NI are defined in ANSI T1.403-1995, Network-to-Customer Installation - DS1 Metallic Interface (Ref A12)
3. NCTE is described in ANSI EIA/TIA-547-1989, Network Channel Terminal Equipment for DS1 Service, (Ref A13)

Figure 20 - 1.544 Mb/s PBX Interface Connections

4.3.1.1 DSX-1 Electrical Interface

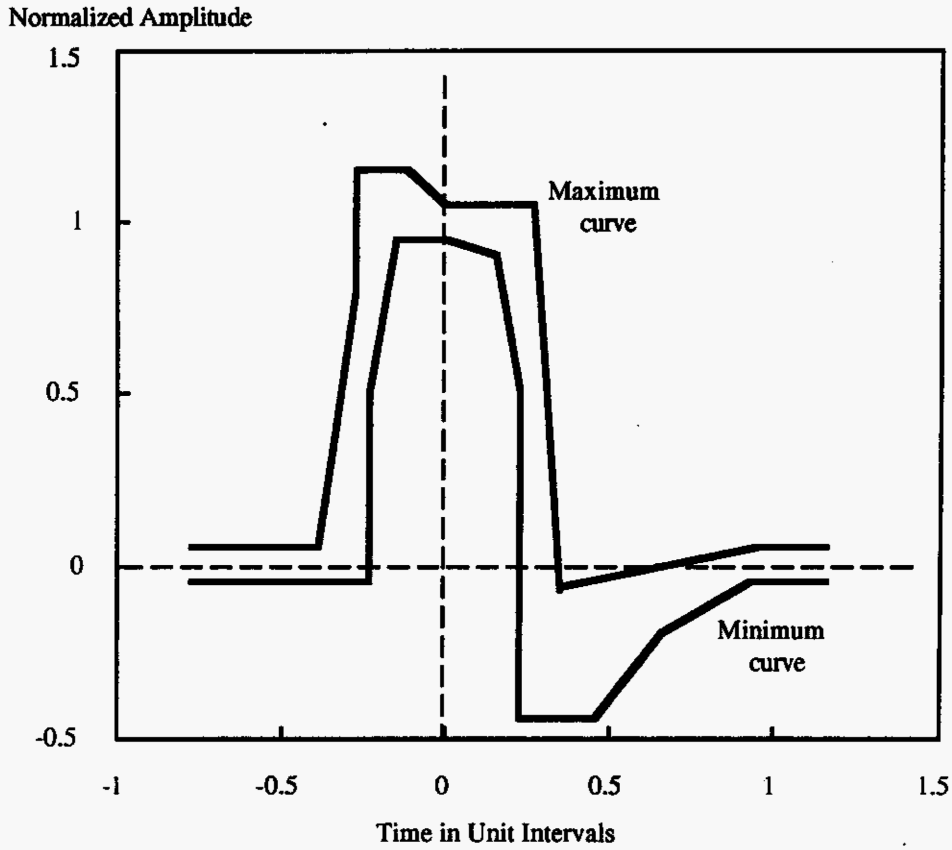
The electrical specifications describe the DSX-1 PBX interface and, at the DSX-1 cross-connect interface, the characteristics of the signals received from and transmitted to the DS1 facility. The signal delivered by the facility is received on the PBX T1 and R1 leads at the interface (Fig 20). The signal delivered by the PBX to the interface is transmitted on the T and R leads.

NOTE: The terms transmit and receive are used to refer to signals from the perspective of the PBX.

The requirements for the electrical interface are summarized below:

Line Rate:	1.544 Mb/s ± 50 b/s. The tolerance is for operating without any synchronization to a network clock (e.g., self-timed, free-running). During synchronized operation, the line-rate accuracy shall be as specified in ANSI T1.101 [Ref A14] for the appropriate stratum level.
Line Code:	Alternate Mark Inversion (AMI), except when B8ZS is used to achieve clear channel capability. (See text for pulse density constraints.)
Test Load:	100 Ω resistive ± 5%
Pulse Amplitude	The amplitude of an isolated pulse shall be between 2.4 V and 3.6 V.
Pulse Shape:	An isolated pulse shall fit the template shown in Fig 21 at the cross-connect point. An isolated pulse is defined as a pulse preceded by at least four zeros, and followed by at least one or more zeros..
Power Levels:	For an all-ones transmitted pattern, the power in a 3 ± 1 kHz band centered at 772 kHz shall be 12.6 to 17.9 dBm. The power in a 3 ± 1 kHz band centered at 1544 kHz shall be at least 29 dB below that at 772 kHz.
Pulse Imbalance:	In any window of 17 consecutive bits, the maximum variation in pulse amplitudes shall be less than 200 mV, and the maximum variation in pulse widths (half amplitude) shall be less than 20 ns.

Fig 21 presents the DSX-1 pulse template. Note that the corner points and the template shown in Fig 21 are normalized. The actual midpoint amplitude of the pulse at the cross-connect point can be between 2.4 V and 3.6 V. The electrical interface is based on the DSX-1 specification; i.e., equipment designed for operation with DS1 facility losses of up to 6 dB at 772 kHz. For example, using 22 gauge ABAM type cable, which has a loss of 6 dB at 772 kHz for 200 m (655 feet), the distance between the DSX-1 interface in the PBX and a cross-connect point can be up to 200 m (655 feet). The distance from the cross-connect point to the DSX-1 interface in an NCTE for this example can also be up to 200 m (655 feet). Thus, a maximum separation (based on DSX-1 connectivity) of 400 m (1310 feet) is possible in this example.



NOTE: 1 Unit Interval = 648 nanoseconds

DSX-1 Pulse Template Corner Points			
Minimum Curve		Maximum Curve	
Time (Unit Intervals)	Normalized Amplitude	Time (Unit Intervals)	Normalized Amplitude
-0.77	-0.05	-0.77	0.05
-0.23	-0.05	-0.39	0.05
-0.23	0.50	-0.27	0.80
-0.15	0.95	-0.27	1.15
0.00	0.95	-0.12	1.15
0.15	0.90	0.00	1.05
0.23	0.50	0.27	1.05
0.23	-0.45	0.35	-0.07
0.46	-0.45	0.93	0.05
0.66	-0.20	1.16	0.05
0.93	-0.05		
1.16	-0.05		

Successive corner points are joined by straight lines to form the template shown above

Figure 21 - DSX-1 Cross-Connect Isolated Pulse Template

4.3.1.2 DS1 Electrical Interface

The electrical specifications describe the characteristics of the signals received and transmitted to the DS1 facility at the DS1 PBX interface (Fig 20). The signal delivered by the carrier is received on the PBX T1 and R1 leads. The signal delivered by the PBX to the carrier is transmitted on the T and R leads. The characteristics of the signals at the DS1 PBX interface are not symmetrical; i.e., some of the electrical requirements differ for the transmit and receive signals.

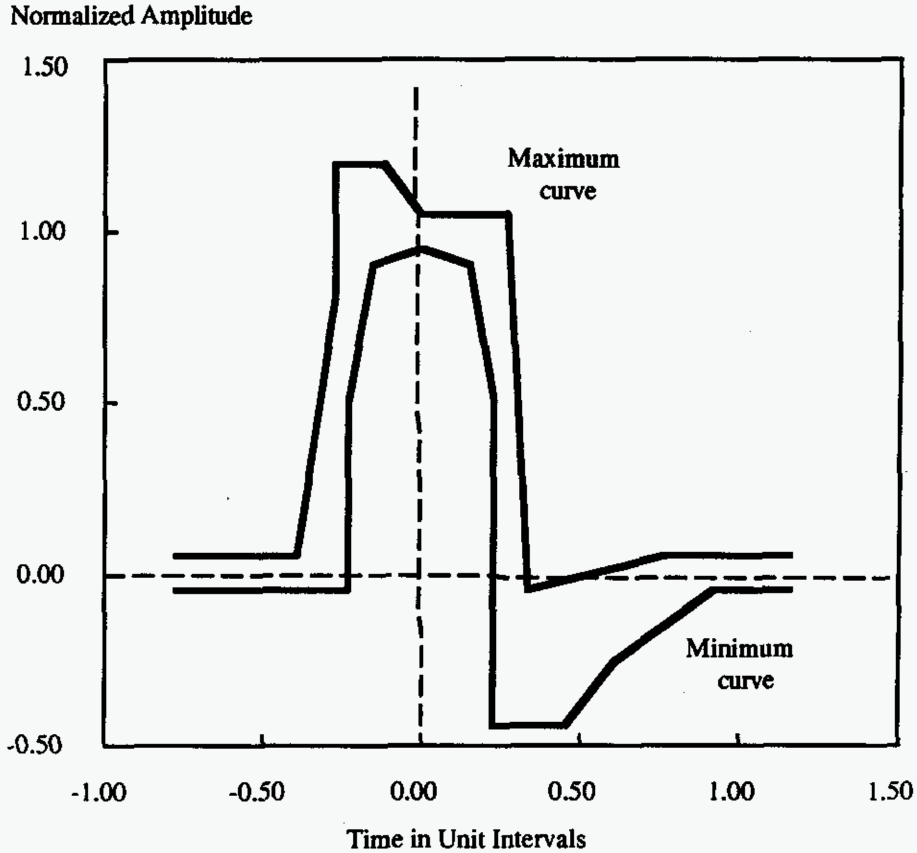
NOTE: The terms transmit and receive are used to refer to signals from the perspective of the PBX.

The requirements for the electrical interface are summarized below:

Line Rate:	Network Timed:	1.544 Mb/s ± 50 b/s (Note 2)
	PBX Timed:	1.544 Mb/s ± 50 b/s
Line Code:	Alternate Mark Inversion (AMI), except when B8ZS is used to achieve clear channel capability.	
Test Load:	Resistive termination of 100 Ω ± 5%.	
Pulse amplitude	An isolated pulse transmitted from the Network to the PBX shall have a base-to-peak amplitude between 2.25 V and 3.6 V. An isolated pulse transmitted from the PBX to the Network shall have a base-to-peak amplitude between 2.4 V and 3.6 V.	
Pulse Shape:	The shape of an isolated pulse shall conform to the template shown in Fig 22. An approximation of an isolated pulse is a pulse preceded by at least four zeros and followed by at least one zero.	
Power Levels:	For an all "ones" transmitted pattern, the power in a 3 ± 1 kHz band centered about 772 kHz shall be in the range 12.4 to 19.7 dBm and the power in a 3 ± 1 kHz band centered about 1544 kHz shall be at least 25 dB less than the power measured at 772 kHz.	
Pulse Imbalance:	In any window of 17 consecutive bits, the maximum variation in pulse amplitudes shall be less than 200 mV and the maximum variation in pulse width at half amplitude shall be less than 20 ns.	
60 Hz Pulse Amplitude Variation:	Pulse amplitude may vary at a 60 Hz rate as a result of longitudinal currents in the powering loops of T1 repeaters. In such cases, the envelope of the pulse amplitude shall be limited as shown in Fig 23. Any pulse amplitude in the ranges given above may be used as the 100% point in Fig 23.	

Notes:

1. The signal received by the PBX at the network interface has the characteristics specified above, with the exception that the pulse characteristics will be those of the standard signal transmitted through a cable pair with a loss in the range of 0.0 to 16.5 dB at 772 kHz into a 100 Ω termination. The lower limit of the standard pulse amplitude shall be 2.25 V rather than 2.4 V.
2. Older equipment may have rate variations up to ± 200 b/s.

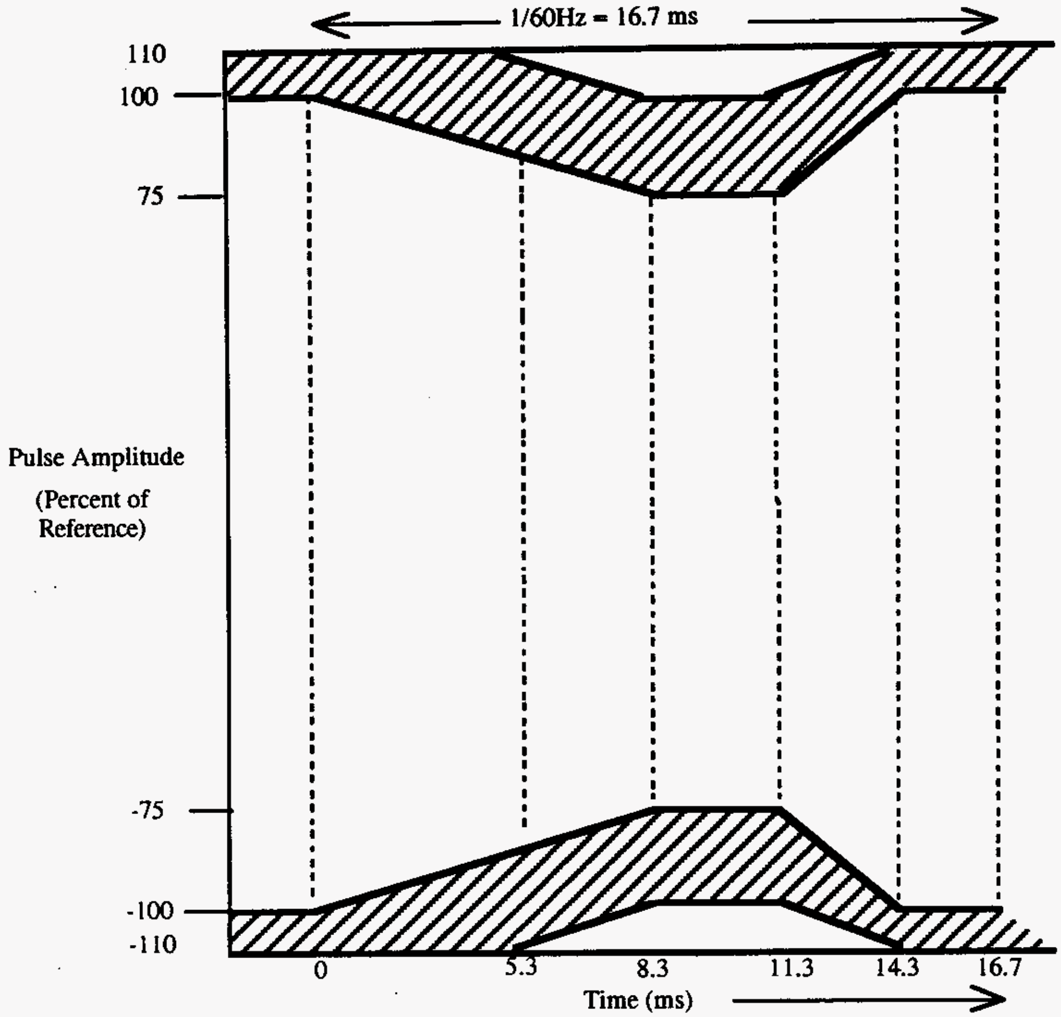


NOTE: 1 Unit Interval = 648 nanoseconds

DS1 Pulse Template Corner Points			
Minimum Curve		Maximum Curve	
Time (Unit Intervals)	Normalized Amplitude	Time (Unit Intervals)	Normalized Amplitude
-0.77	-0.05	-0.77	0.05
-0.23	-0.05	-0.39	0.05
-0.23	0.50	-0.27	0.80
-0.15	0.90	-0.27	1.20
0.00	0.95	-0.12	1.20
0.15	0.90	0.00	1.05
0.23	0.50	0.27	1.05
0.23	-0.45	0.34	-0.05
0.46	-0.45	0.77	0.05
0.61	-0.26	1.16	0.05
0.93	-0.05		
1.16	-0.05		

Successive corner points are joined by straight lines to form the template shown below:

Figure 22 - DS1 PBX Interface Isolated Pulse Template



NOTES:

1. Envelope of pulse amplitudes shall lie within the shaded areas .
2. Reference (100 percent point) may be any amplitude in the range of pulse amplitudes (see text).

Figure 23 - Pulse Amplitude Envelope with 60 Hz Longitudinal Currents

4.3.1.2.1 Line Build Out (LBO) Networks

To ensure that a usable DS1 signal is available to the carrier, selectable artificial lines, or equivalent losses, shall be included in the transmit direction as part of the PBX interface circuitry. As a minimum, selectable values of 0.0, 7.5, and 15.0 dB of loss at 772 kHz shall be available. The loss introduced by the PBX LBO network shall not be flat. It should have the frequency characteristics similar to those of twisted-pair cable. Examples of such characteristics are found in Annex E of T1.403, Network-to-Customer Installation - DS1 Metallic Interface (Ref A12).

4.3.1.2.2 Powering Arrangements

The PBX shall not apply any power (except signal power) to the network interface. For some carriers' digital span lines, power is simplexed from a 60 mA constant current source at the carrier's office and looped back by the circuitry of the PBX DS1 interface. When this simplex current is provided at the network interface, the critical interface functions may be powered by the simplexed current. The total simplexed power at the DS1 interface shall not exceed 4 watts and should not exceed 1.5 watts.

The PBX may provide local power for the critical interface circuitry. In any case, the PBX shall not cause the DS1 line to oscillate if the PBX experiences a power failure or is disconnected.

4.3.1.3 Impedance Matching

The characteristic impedance of exchange cables used to provide DS1 service is nominally 100 Ω at 772 kHz. To assure that performance objectives are met, this impedance should be matched by the PBX at the DSX-1 or DS1 interface.

4.3.1.4 Longitudinal Balance

To ensure proper operation, longitudinal balance of the PBX interface circuitry, in the transmit and receive paths, shall be greater than 35 dB from 50 kHz to 1.544 MHz for each path.

4.3.1.4.1 Pulse Density Constraints

The pulse density of a DSX-1 or DS1 signal, except for the quasi-random signal, at the interface shall conform to the following constraints:

(1) In each window of 8 (n+1) bits, where "n" can equal 1 through 23, there shall be at least n "ones" present.

(2) No more than 15 consecutive "zeros."

4.3.1.5 Synchronization Requirements

A PBX connected to the public network by DS1 signals is required to be synchronous to the public network timing reference; either by using a DS1 signal received from the public network as its reference for timing all outgoing DS1 signals, or by providing an equivalent accuracy of signal frequency. Public network synchronization rules and definitions are given in ANSI T1.101-1994, Synchronization Interface Standards for Digital Hierarchies (Ref A14). Requirements for private network synchronization are given in ISO/IEC IS 11753, Synchronization Methods and Technical Requirements for PISNs (Ref A15). Guidelines for North American private network planning are presented in Annex F.

4.3.1.5.1 Jitter and Wander

Jitter is short-term variation of the significant instants of a DSX-1 or DS1 signal from its ideal positions in time. Wander is long-term variation of the significant instants of a DSX-1 or DS1 signal from its ideal positions in time and applies when the timing is traceable to a primary reference source. The boundary between long-term and short-term variation is 10 Hz. The magnitudes of jitter and wander are specified in terms of unit intervals (UI) for three frequency bands. One UI is equal to 648 ns (one pulse period). The frequency bands are:

(1) Band 1 (Jitter): 10 Hz to 40 kHz.

(2) Band 2 (Jitter): 8 kHz to at least 40 kHz.

(3) Band 3 (Wander): 0 to 10 Hz.

The weighting function for Band 1 is shown in Fig 24 and the weighting function for Band 2 is shown in Fig 25.

4.3.1.5.2 PBX Output Jitter

At the interface, the jitter of the PBX signal shall not exceed the following limits, in both bands simultaneously:

(1) Band 1: 0.5 UI, peak-to-peak.

(2) Band 2: 0.07 UI, peak-to-peak.

4.3.1.5.3 PBX Output Wander

At the interface, the wander of the PBX signal shall not exceed the following limits:

(1) 23 UI peak-to-peak, in any 1-hour interval.

(2) 28 UI peak-to-peak, in any 24-hour interval.

4.3.1.5.4 PBX Jitter and Wander Input Tolerance

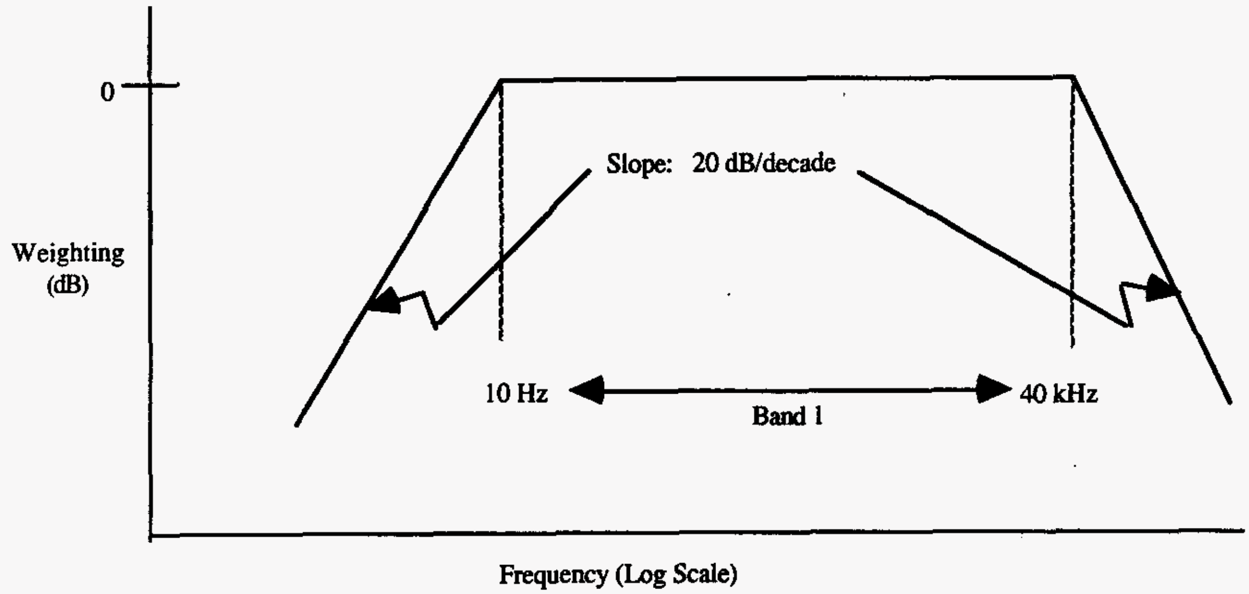
The PBX shall accept signals at the interface with the following jitter and wander characteristics (simultaneously in Band 1 and Band 2):

(1) Band 1 (Jitter): 5.0 UI peak-to-peak.

(2) Band 2 (Jitter): 0.1 UI peak-to-peak.

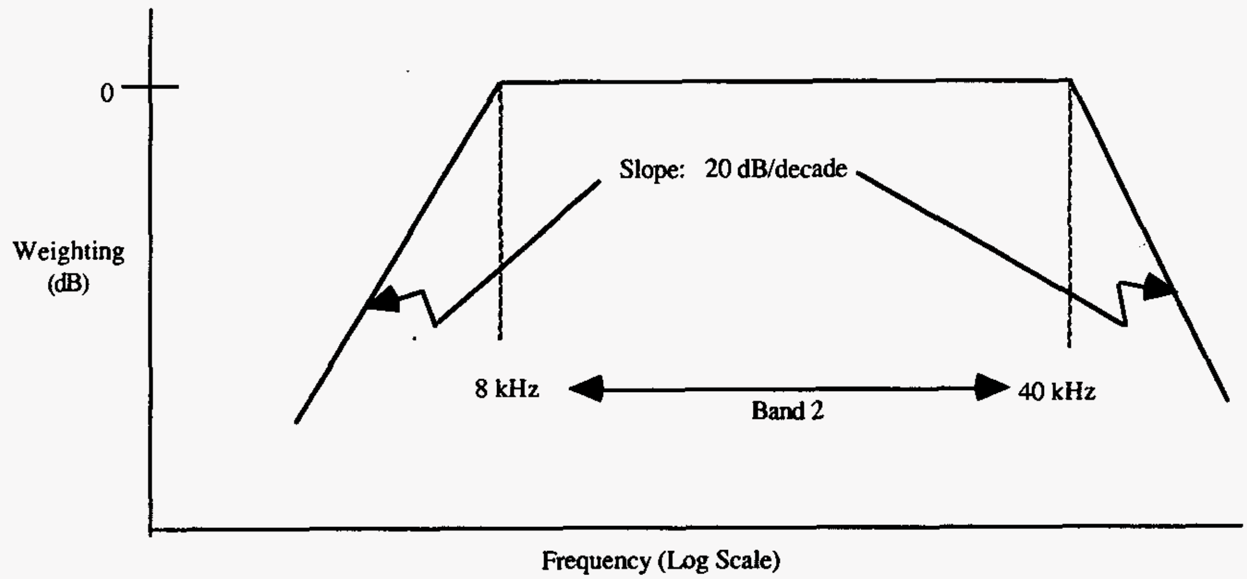
(3) Band 3 (Wander): 23 UI peak-to-peak, in any 1-hour interval.

(4) Band 3 (Wander): 28 UI peak-to-peak, in any 24-hour interval.



NOTE: 40 kHz represents the upper limit for Band 1 cutoff frequency based on currently available test equipment.

Figure 24 - Frequency Weighting Function for Band 1 Jitter Specification



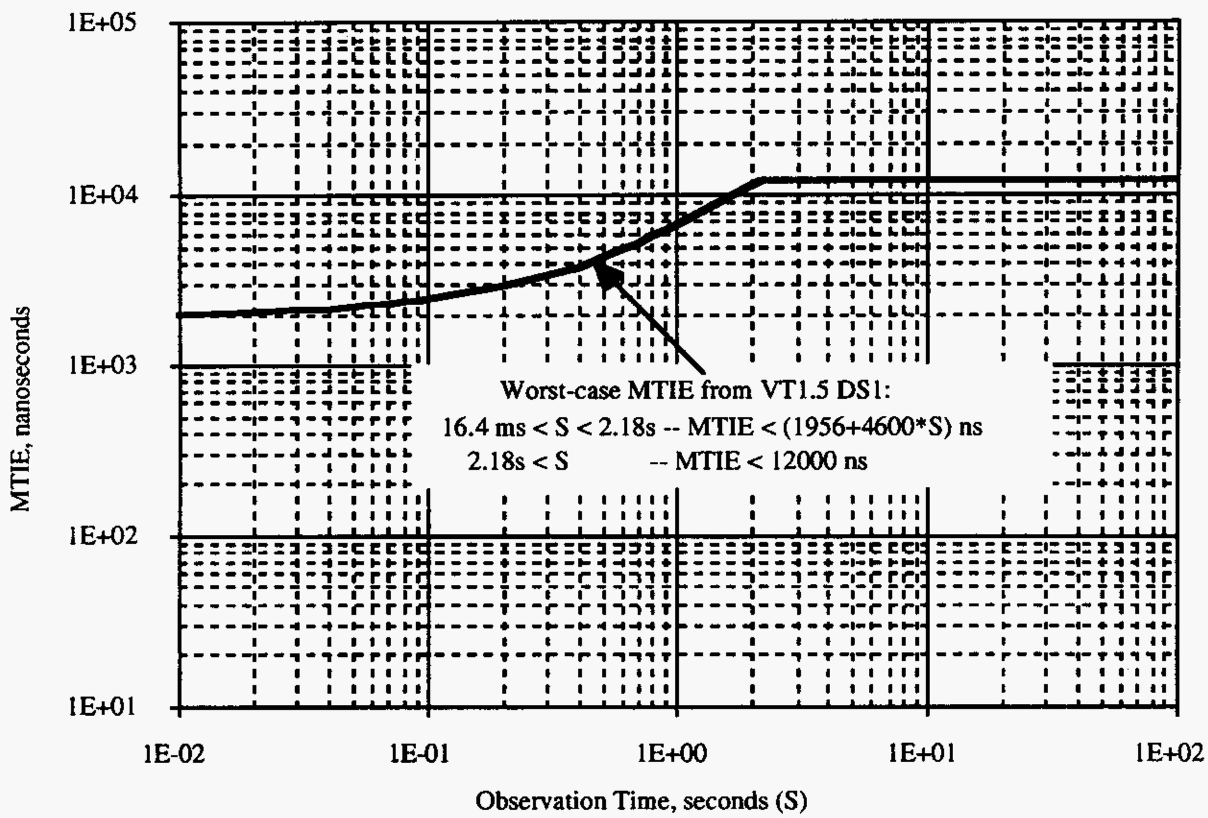
NOTE: 40 kHz represents the upper limit for Band 2 cutoff frequency based on currently available test equipment.

Figure 25 - Frequency Weighting Function for Band 2 Jitter Specification

4.3.1.5.5 PBX Input Phase Transient Tolerance

The DS1 signal used as the timing reference from the public network may experience phase-time transients in addition to the jitter and wander identified above. Since many independent mechanisms (e.g., T1 protection switching, SONET VT pointers) can contribute to DS1 phase deviation in the public network, an absolute limit for phase transient tolerance cannot be specified but a high probability of satisfactory performance of a PBX in slave timing mode can be achieved if the PBX can accept transients within the mask of Fig 26.

Satisfactory operation when subjected to such transients means that the PBX output DS1 signals track the phase of the reference input with minimal undershoot or overshoot, and without the PBX switching to an alternate reference.



(MTIE = Maximum Timing Interval Error)

Figure 26 - Maximum MTIE for VT1.5 Pointer Transient (Proposed)

4.3.1.6 Clear Channel Capability

For new equipment, Bipolar Eight Zero Substitution (B8ZS) is the method of providing clear channel capability at the DSX-1 or DS1 interface.

4.3.1.6.1 B8ZS Encoding

When B8ZS coding is used, "ones" density is obtained without altering data. B8ZS coding replaces any eight consecutive zeros of the DSX-1 or DS1 signal with the pattern shown in Fig 27 and discussed below.

With B8ZS coding, each group of eight consecutive zeros is removed and the B8ZS code is substituted. If the pulse preceding the inserted code is transmitted as a positive pulse (+), the inserted code is 000+-0-+. If the pulse preceding the inserted code is a negative pulse (-), the inserted code is 000-+0+-. In both cases, bipolar violations occur in the fourth and seventh bit positions of the inserted code. B8ZS coding is done at the 1.544 Mb/s level; i.e., framing bits are included in the coding.

4.3.1.6.1.1 Decoding B8ZS Signals

To decode B8ZS coded signals, the receiver shall continuously monitor the incoming DS1 signal for B8ZS code words. When a B8ZS code word is detected, it shall be replaced by eight zeros. Note that when a DS1 signal is coded using B8ZS, bipolar violations that are detected due to zero substitution should not be used in error rate calculations.

4.3.1.6.1.2 Transmitting B8ZS Coding

At present, transmitting B8ZS coding must be limited to on-premises, campus, and some network applications. For remote applications that require use of network facilities, B8ZS coding cannot be used unless the network indicates that the access DS1 facility requires B8ZS. An end-to-end clear DS1 network-provided path is possible when both access facilities and all intervening facilities are clear. Even though present applications of B8ZS coding are mostly limited to local applications, it is included in this specification to take advantage of existing facilities that permit clear channels and to support evolution to future capabilities.

Equipment meeting this specification should incorporate B8ZS coding but include the capability for disabling it when interfacing network facilities that do not support clear channels.

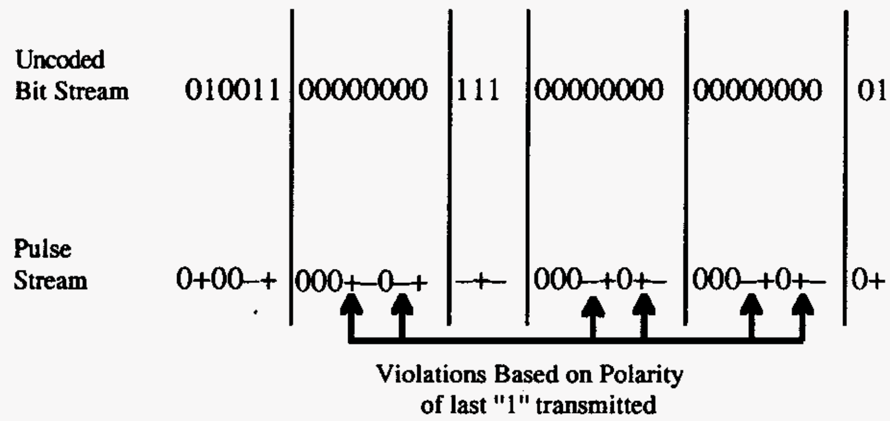


Figure 27 - Example of Bipolar Eight Zero Substitution (B8ZS)

4.3.1.6.2 *Zero Code Suppression*

For applications where B8ZS coding cannot be used, Zero Code Suppression as shown in Fig 28 may be provided. This is done by detecting an all zero octet in a channel and substituting at least one "1" for a "0" somewhere in the octet. For example, a 1 could be placed in the second least significant bit position (bit 7) before AMI coding. Framing bits are not included in Zero Code Suppression. Zero Code Suppression is performed on a per-channel basis so that adjacent channels are not affected by a channel that is violating the "ones" density constraints.

	Channel n-1	Channel n	Channel n+1	
Uncoded Bit Stream	01001100	00000000	11100000	
Zero Code Suppression Done Prior to DS-1 Line Coding		00000010		Forced "1" in 2nd least significant bit position
AMI Pulse Stream at DS-1 Level	0+00—+00	000000—0	+—+00000	

NOTE: The framing bit is not included in the bit stream to be processed under ZCS. In addition, the octets examined for all zeros must be aligned with channel octets.

Figure 28 - Example of Alternate Mark Inversion with Zero Code Suppression

4.3.2 *Signal Formats for 1.544 Mb/s Facilities*

For 1.544 Mb/s applications, two framing formats are supported:

(1) The Superframe Framing (SF) format used by the D4 member of the D-channel bank family.

(2) The Extended Superframe Framing format (ESF).

Both formats are specified in ANSI T1.107-1988, Digital Hierarchy - Formats Specification (Ref A16).

Because ESF is being gradually introduced in North American transmission systems, all 1.544 Mb/s implementations supporting ESF framing shall also have the capability of supporting SF framing if common carrier provided transmission systems are to be used.

The SF and ESF do not in themselves impose restrictions on the use of the 192 information bits within a frame. The customer may use the information bits as required, unless the line is to interface a digital channel bank or other central office equipment that requires specific bit assignment within the frame.

Regardless of the framing format used, the following conditions shall be met for 1.544 Mb/s facilities:

(1) The maximum average reframe time shall be less than 50 milliseconds in the absence of errors (maximum average reframe time is the average time to reframe when the maximum number of bit positions must be examined for the framing pattern).

(2) Framing shall be declared to be lost when framing bits are in error in the range of two of four, two of five, or three of five for a period greater than or equal to 2 seconds, and less than or equal to 10 seconds.

4.3.2.1 *Frame*

The DSX-1 or DS1 frame is specified in Ref A16.

4.3.2.1.1 *Frame Structure*

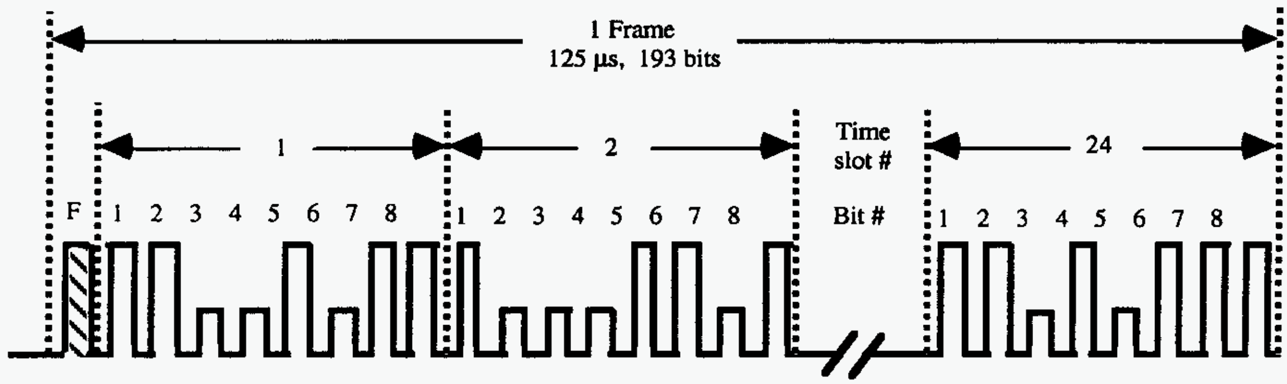
The frame consists of 24 eight bit words (octets) and one frame bit for a total of 193 bits per frame, as shown in Fig 29. The nominal bit rate of the outgoing DSX-1 or DS1 signal is 1.544 Mb/s, and the frame repetition rate is 8 kHz.

4.3.2.1.1 *Channel Numbering*

Channels are numbered sequentially from 1 to 24 in the order that they are presented to a receiver.

4.3.2.2 *Superframe Format*

In the Superframe Framing format, the frame bit is time shared to identify both channel framing and signaling channel framing as shown in Fig 30. Both channel framing and signaling framing identify the location of time slot one and signaling framing identifies those frames in which signaling channels A and B are normally transmitted when using robbed bit signaling.



Sampling Frequency: 8000 Hz
Output Bit Rate: 1.544 Mb/s
Bits/Frame: 193
Time Slots/Frame: 24 (Sequential Assignment)

Figure 29 - 1.544 Mb/s Signal Format

Frame Number	Bit Number	F Bit		Information Coding Bits	Signaling Bit	Signaling Channel
		F_S	F_T			
1	0	-	1	1-8	-	
2	193	0	-	1-8	-	
3	386	-	0	1-8	-	
4	579	0	-	1-8	-	
5	772	-	1	1-8	-	
6	965	1	-	1-7	8	A
7	1158	-	0	1-8	-	
8	1351	1	-	1-8	-	
9	1544	-	1	1-8	-	
10	1737	1	-	1-8	-	
11	1930	-	0	1-8	-	
12	2123	0	-	1-7	8	B

F_S - Signaling Channel Framing (Sequence ...001110...)

F_T - Terminal Framing (Sequence ...101010...)

Figure 30 - Superframe Framing Format

4.3.2.3 Extended Superframe Framing Format

As an option to the use of the Superframe Framing format, the Extended Superframe Framing format (ESF) may be used. ESF will replace the earlier SF format as the standard for DS1 level framing in North America. The ESF format is described in Ref A12. It is planned for implementation in all new designs of DS1 level equipment that frame on a pattern contained within the framing bit position of the DS1 1.544 Mb/s signal. ESF framing is not compatible with SF framing.

The ESF framing format "extends" the DS1 superframe structure from 12 frames (2316 bits) to 24 frames (4632 bits) and redefines the 8 kb/s framing bit position. The 8 kb/s ESF channel is divided into 2 kb/s for channel framing and signaling channel framing, 2 kb/s for a Cyclic Redundancy Check code (CRC-6), and 4 kb/s for a data link. The ESF also supports multiple state signaling.

4.3.2.3.1 2 kb/s Framing Pattern

As shown in Fig 31 beginning with frame 4 (Extended Superframe bit 579), the framing bit of every fourth frame forms the pattern 001011 . . .001011. This pattern is used to determine channel and signaling channel synchronization. Frame synchronization is used to locate the 24 DS0 channels in each frame. Superframe synchronization is used to identify where each particular frame is located within the superframe to perform the CRC-6 checks and identify the relationship of signaling information to DS0 channels.

4.3.2.3.2 2 kb/s Cyclic Redundancy Check, CRC-6

The cyclic redundancy check code, CRC-6 is a method of performance monitoring that is contained within the F-bit position of frames 2, 6, 10, 14, 18, and 22 of every superframe (see Fig 31). The CRC-6 code has the ability to detect most errors that occur on the DS1 signal and can be used in various applications such as false framing protection, protection switching, performance monitoring, and line verification before, during, and after maintenance. The CRC-6 is capable of detecting 63/64 (98.4%) of all CRC Message Blocks (CMBs) containing transmission errors. It does not give an indication of the number of errors in a CMB, only that there was at least one.

The CRC-6 message block check bits CB1, CB2, CB3, CB4, CB5, and CB6 are contained within the Extended Superframe (ESF) format bits 193, 965, 1737, 2509, 3281, and 4053 respectively, as shown in Fig 31. The CRC-6 Message Block (CMB), shown in Fig 32, is a sequence of 4632 serial bits that is coincident with an ESF. By definition, CMB N begins at bit position 0 of ESF N and ends with bit 4631 of ESF N. The first transmitted bit of a CMB is the most significant bit of the CMB polynomial.

For the purpose of generating the CRC-6 sequence, each F-bit position in the CMB should be set to a binary one. That is, the information in the F-bit position will have the value "1" in the calculation of the CRC-6 bits. All information in the other bit positions will be identical to the information in the corresponding ESF bit positions.

The Check-Bit sequence CB1 through CB6 transmitted in ESF N+1 is the remainder after multiplication by the polynomial X^6 and then division (Modulo-2) by the generator polynomial $X^6 + X + 1$ of the polynomial corresponding to CMB N. The first check bit (CB1) is the most significant bit of the remainder; the last check bit (CB6) is the least significant bit of the remainder. Each ESF contains the CRC-6 check bits generated for the preceding CMB.

At the transmitter, the initial remainder of the division for each CMB is preset to all zeros and is then modified by division by the generator polynomial (as described above). The division is performed on CMBs after the F-bits are set to a binary "1". The remainder bits should then be inserted into the check bit positions of the subsequent ESF.

At the receiver, the initial remainder of the division for each received CMB is preset to all zeros and is then modified by division by the generator polynomial. The resulting remainder is compared on a bit-by-bit basis with the CRC-6 check bits contained in the subsequently received ESF. The compared check bits will be identical in the absence of transmission errors.

A mathematical example of the generation of check bits is shown in Fig 33. For simplicity a CMB length of 10 bits has been used instead of the actual length of 4632 bits.

ESF Frame Number	ESF Bit Number	F-Bit Assignment			Bit use in each Time Slot		Signaling Bit Use Options	
		FPS	*{F}*DL	CRC	Traffic	Sig.	T	Sig. Chnl.
1	0	-	m	-	1-8	-		
2	193	-	-	CB1	1-8	-		
3	386	-	m	-	1-8	-		
4	579	0	-	-	1-8	-		
5	772	-	m	-	1-8	-		
6	965	-	-	CB2	1-7	8	-	A A A
7	1158	-	m	-	1-8	-		
8	1351	0	-	-	1-8	-		
9	1544	-	m	-	1-8	-		
10	1737	-	-	CB3	1-8	-		
11	1930	-	m	-	1-8	-		
12	2123	1	-	-	1-7	8	-	A B B
13	2316	-	m	-	1-8	-		
14	2509	-	-	CB4	1-8	-		
15	2702	-	m	-	1-8	-		
16	2895	0	-	-	1-8	-		
17	3088	-	m	-	1-8	-		
18	3281	-	-	CB5	1-7	8	-	A A C
19	3474	-	m	-	1-8	-		
20	3667	1	-	-	1-8	-		
21	3860	-	m	-	1-8	-		
22	4053	-	-	CB6	1-8	-		
23	4246	-	m	-	1-8	-		
24	4439	1	-	-	1-7	8	-	A B D

FPS: Framing Pattern Sequence (...001011...)
*{F}*DL: 4 kb/s *{Facility}* Data Link (message bits m)
CRC: CRC-6 Cyclic Redundancy Check (check bits CB1-CB6)
Option T: Traffic (Bit 8 not used for robbed-bit signaling)

Figure 31 - Extended Superframe Framing (ESF) F-Bit Assignments

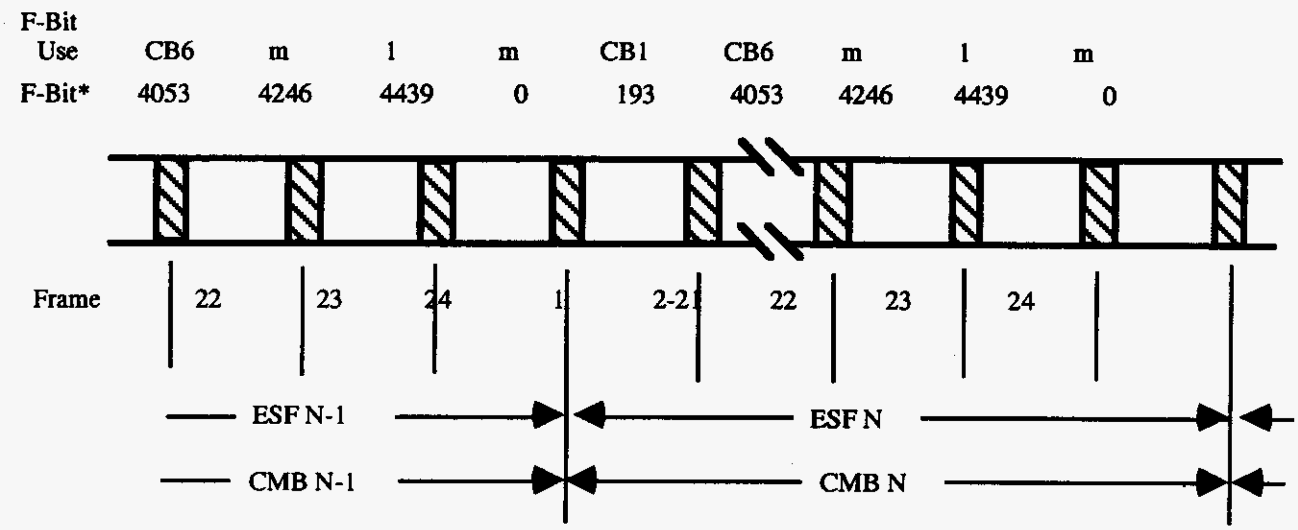


Figure 32 - ESF/CMB Relationship

<Divisor> <Dividend (CMB * 10^6)>

1 0 0 0 0 1 1 | 1 1 1 0 0 1 0 1 0 1 0 0 0 0 0 0

1 0 0 0 0 1 1
1 1 0 0 0 1 1
1 0 0 0 0 1 1
1 0 0 0 0 0 0
1 0 0 0 0 1 1
0 0 0 0 1 1 1
0 0 0 0 0 0 0
0 0 0 1 1 1 0
0 0 0 0 0 0 0
0 0 1 1 1 0 0
0 0 0 0 0 0 0
0 1 1 1 0 0 0
0 0 0 0 0 0 0
1 1 1 0 0 0 0
1 0 0 0 0 1 1
1 1 0 0 1 1 0
1 0 0 0 0 1 1
1 0 0 1 0 1 0
1 0 0 0 0 1 1

Remainder - > 0 0 1 0 0 1

Check Bits (Remainder) to be sent in CMB N+1:	CB1	CB2	CB3	CB4	CB5	CB6
	0	0	1	0	0	1

Figure 33 - Mathematical Check-Bit Generation

4.3.2.3.3 False Framing Protection

It is possible to couple the Cyclic Redundancy Check of the ESF framing format with the reframing algorithms to insure that the valid framing pattern contained within the framing bit positions is the only pattern the reframer can lock onto permanently. False framing protection could be implemented using the ESF format as follows. When the reframer sees more than one candidate for reframe, it locks onto the first candidate and then checks the CRC-6 code. If this code indicates continuous errors, the reframer then searches for the next available candidate, locks onto it, and then checks the CRC-6 code again.

4.3.2.3.4 Data Link

Beginning with frame 1 (ESF bit 0) of the superframe (see Fig 31), every other 193rd bit is part of the 4 kb/s data link. The ESF data link (DL) is used to carry performance information and control signals across the DS1 interface. The specification of these signals is the same for both directions of transmission[13]

Performance information appearing in one direction of transmission is a quantification of the quality of transmission in the opposite direction.

Two signal formats are used on the DL:

(1) Bit-patterned signals: repeated patterns (codes).

(2) Message-patterned signals: messages using a Q.921 LAPD protocol.

The bit-oriented signals carry priority messages and command-and-response messages. The message-oriented signals carry performance monitoring information. The structure of the information within the message-oriented protocol is bit assigned. The monitored parameters are in 4.3.2.3.4.2.1; the formats of the generated messages are in 4.3.2.3.4.1.3 and 4.3.2.3.4.2.1

Operation, administration, and maintenance of the network may cause other messages to appear at the DS1 interface (the PBX should be able to disregard any such undefined messages). Use of the DL for other terminal-to-network communications or for any terminal-to-terminal messages beyond the described set is for future study. Network architecture is such that the DL may be discontinuous relative to the DS1 payload, and end-to-end continuity of the DL cannot be guaranteed. When idle, the DL shall contain continuous repetitions of the data link idle code - 01111110.

4.3.2.3.4.1 Bit-Patterned Messages

Bit-oriented messages are pre-emptive. When sent, they overwrite other signals on the DL. Table 7 lists two categories of bit-oriented messages ("priority" and "command and response") and the specific functions associated with each.

4.3.2.3.4.1.1 Priority Messages

Priority messages indicate a service affecting condition. They shall transmit continually until the condition no longer exists, but, for not less than 1 s. These messages may be interrupted for a maximum of 100 ms per interruption with a minimum interval of one second between interruptions.

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13. Equipment that uses the data link exclusively for Yellow Alarm and for an "all-ones" idle code exists in the network and will continue to exist. The Yellow Alarm is a repeating 16-bit pattern of 8 "ones" followed by 8 "zeros" (0000000011111111). This pattern is transmitted continuously for 256 ± 4 times or until the out-of-frame condition no longer exists, whichever is longer. Such equipment cannot take advantage of the standard features described in this section. Thus, when such equipment is connected to equipment that meets the specifications of this section, performance information and control signals appear in one direction only.

4.3.2.3.4.1.2 Command and Response Messages

Command and response messages are transmitted to perform various functions. The loopback commands of Table 7 activate and deactivate the line loopback and payload loopback functions of the PBX as described in 4.3.2.5. Command and response messages that are labeled "Reserved for network use" shall not be generated by the PBX. The use of the network loopback and protection switching functions of Table 7 are not covered in this standard. Command and response code words shall be repeated at least 10 times as a continuous transmission.

4.3.2.3.4.1.3 Format of Bit-Oriented Messages

Data link bit-oriented messages shall be of the format:

0xxxxxx011111111

with the rightmost bit transmitted first. Table 7 lists two categories of bit-oriented message functions and their associated 16-bit codewords. Table 8 lists unassigned codewords. Codewords for priority messages shall be repeated continually until the condition that initiated the message is removed. The minimum duration shall be as specified for Remote Alarm Indication in 4.3.2.4.1.4.

4.3.2.3.4.2 Message-Oriented Signals

Message-oriented signals are signals conforming to an HDLC protocol as defined below. Two message-oriented signals are defined for the ESF data link. One is a periodic performance report generated by the source/sink DS1 terminals. The other is a path, test, or idle signal identification message that may be optionally generated by a terminal or intermediate equipment on a DS1 circuit.

4.3.2.3.4.2.1 Format of Message-Oriented Performance Report

To carry performance reports, the carrier signal and the PBX signal shall conform to the level 2 protocol (LAPD) specified in ITU-T (formerly CCITT) Recommendation Q.921, ISDN User-Network Interface Data Link Layer Specification (Ref A17). This application shall use a subset of the full capabilities of the Q.921/LAPD protocol. The message structure is shown in Fig 34, where the following abbreviations are used:

(1) SAPI: Service Access Point Identifier.

(2) C/R: Command/Response.

(3) EA: Extended Address.

(4) TEI: Terminal Endpoint Identifier.

(5) FCS: Frame Check Sequence.

This message structure is that of a Q.921/LAPD unnumbered and unacknowledged frame. The performance report shall use only the SAPI/TEI values shown in Fig 34.

The source of the performance report shall generate the Frame Check Sequence (FCS) and the zero stuffing required for transparency. Zero stuffing by a transmitter prevents the occurrence of the flag pattern (01111110) in the bits between the opening and closing flags of a Q.921/LAPD frame by inserting a zero after any sequence of five consecutive ones. (A receiver removes a zero following five consecutive ones.) The data elements in the performance report are arranged so that zero stuffing will never occur in the information field. Thus, except for the FCS, the line signal duplicates the list sequence of the report, and the message is of constant length from the opening flag to the end of the information field.

Throughput of the data link may be reduced to less than 4 kb/s in some cases. The performance report is always passed[14].

4.3.2.3.4.3 Transmission Error Events

The occurrences of transmission error events indicate the quality of transmission. The occurrences that shall be detected and reported are:

(1) No events

(2) CRC error

(3) Severely errored framing

(4) Frame synchronization bit error

(5) Line code violation

(6) Controlled slip

These are defined as follows:

- CRC Error Event

  A CRC error event is the occurrence of a received CRC code that is not identical to the locally calculated code.

- Severely Errored Framing Event

  A severely errored framing event is the occurrence of two or more framing bit pattern errors within a 3-ms period. Contiguous 3-ms intervals shall be examined. The 3-ms period may coincide with the ESF. This framing error indicator, while similar in form to criteria for declaring a terminal has lost framing, is only designed as a performance indicator, existing terminal out-of-frame criteria will continue to serve as the basis for terminal alarms.

- Frame Synchronization Bit Error Event

  A frame synchronization bit error event is the occurrence of a received framing bit pattern error.

- Line Code Violation Event

  A line code violation event for an AMI-coded signal is the occurrence of a received excessive zeros (EXZ) or bipolar violation. A line code violation event for a B8ZS-coded signal is the occurrence of a received bipolar violation that is not part of a zero-substitution code.

  Note: some existing equipment may not detect EXZs

- Controlled-Slip Event

  A controlled-slip event is the occurrence of a replication or deletion of the data bits of a DS1 frame by the receiving terminal. A controlled slip occurs when there is a difference between the timing of a synchronous receiving terminal and that of the received signal of such magnitude as to exhaust the buffering capability of the synchronous terminal.

4.3.2.3.4.4 Message-Oriented Performance Report

The carrier signal and the PBX signal shall include a performance report sent each second using a bit-assigned message structure. The one-second timing may be derived from the DS1 signal or

14. The performance report with SAPI 14 should be constructed and inserted on the data link by the source terminal that constructs the information payload of the DS1 signal. The performance report with SAPI 14 should be delivered without alteration to the same terminal that sinks the information payload of the DS1 signal.

from a separate equally accurate (±32 ppm) source. The phase of the one-second periods with respect to events is arbitrary; i.e., the one-second timing does not depend on the time of occurrence of any error event.

The performance report contains performance information for each of the four previous one-second intervals. This is shown in Fig 34, octets 5 through 12, and by an example in Table 9.

Counts of events shall be accumulated in each contiguous one-second interval. At the end of each one-second interval, a modulo 4 counter shall be incremented, and the appropriate performance bits shall be set in the t = 0 octets (octets 5 and 6 in Fig 34). These octets and the octets that carry performance bits of the three preceding one-second intervals form the performance report.

4.3.2.3.4.5 Path and Test Signal ID Message(s)

Path and test signal identification messages are optional messages that may be sent on the ESF data link. One is used to identify the path between the source terminal and the sink terminal, and is referred to as a path ID (PID). The other is used by test signal generating equipment and is referred to as a test signal ID (TSID). If sent, they shall conform to the format and content requirements specified in Ref 12, Annex A.

4.3.2.3.4.6 Special Carrier Applications

A carrier may require the use of the ESF data link for purposes related to the provisioning or maintenance of the DS1 facility or circuit. Examples of these functions are:

(1) Communicating performance information within the Network.

(2) Providing protection switching control.

(3) Providing clear channel capability.

Such uses may cause interruptions, delays, or reduction of throughput on the ESF data link, but should not impact the timely transmission of the bit-oriented messages and of the performance report. The performance report shall always be passed.

4.3.2.3.4.6 DS1 Idle Code

Generation and detection of the DS1 idle signal is optional. If provided, the DS1 idle signal shall meet the requirements defined in Annex D of ANSI T1.403 (Ref A12). The idle signal indicates that the normal signal source is not present. The DS1 idle signal is not to be confused with the data link idle code defined in 4.2.3.4.2.

Octet #	Octet Label									Octet Content
	8	7	6	5	4	3	2	1		
1	Flag									01111110
2	SAPI						C/R	EA		00111000 or 00111010
3	TEI							EA		00000001
4	control									
5	G3	LV	G4	U1	U2	G5	SL	G6	t_0	
6	FE	SE	LB	G1	R	G2	Nm	N1		
7	G3	LV	G4	U1	U2	G5	SL	G6	$t_0 - 1$	One-second Report
8	FE	SE	LB	G1	R	G2	Nm	N1		
9	G3	LV	G4	U1	U2	G5	SL	G6	$t_0 - 2$	
10	FE	SE	LB	G1	R	G2	Nm	N1		
11	G3	LV	G4	U1	U2	G5	SL	G6	$t_0 - 3$	
12	FE	SE	LB	G1	R	G2	Nm	N1		
13 & 14	FCS									variable
15	Flag									01111110

Figure 34 - Performance Report Message Structure

ADDRESS	INTERPRETATION
00111000	SAPI=14, C/R=0 (CI) EA=0
00111010	SAPI=14, C/R=1 (Carrier) EA=0
00000001	TEI=0, EA=1

CONTROL	INTERPRETATION
00000011	Unacknowledged Information Transfer

ONE-SECOND REPORT	INTERPRETATION
G1 = 1	CRC Error Event = 1
G2 = 1	1 < CRC Error Event 5
G3 = 1	5 < CRC Error Event 10
G4 = 1	10 < CRC Error Event 100
G5 = 1	100 < CRC Error Event 319
G6 = 1	CRC Error Event 320
SE = 1	Severely-Errored Framing Event 1 (FE shall = 0)
FE = 1	Frame Synchronization Bit Error Event 1 (SE shall = 0)
LV = 1	Line Code Violation Event 1
SL = 1	Slip Event 1
LB = 1	Payload Loopback Activated
U1, U2 = 0	Under study for synchronization
R = 0	Reserved (Default value is 0)
NmNl = 00, 01, 10, 11	One-second report module 4 counter

FCS	INTERPRETATION
VARIABLE	CRC16 Frame Check Sequence

Figure 34 *(continued)*

Table 7 - Assigned Bit-patterned ESF Data Link Messages

Function	Codeword (note 1)
Priority Messages	
Remote Alarm Signal (Yellow Alarm)	00000000 11111111
Loopback retention	00101010 11111111
ISDN (international)	00011100 11111111
Command and Response Messages	
Line Loopback Activate	00001110 11111111
Line Loopback Deactivate	00111000 11111111
Payload Loopback Activate	00010100 11111111
Payload Loopback Deactivate	00110010 11111111
Reserved for network use (loopback activate)	00010010 11111111
Universal Loopback (deactivate)	00100100 11111111
ISDN Loopback	00101110 11111111
ISDN Loopback	00100000 11111111
Protection Switch Line 1 (note 2)	01000010 11111111
Protection Switch Line 2	01000100 11111111
Protection Switch Line 3	01000110 11111111
Protection Switch Line 4	01001000 11111111
: : :	: : :
Protection Switch line 24	01110000 11111111
Protection Switch line 25	01110010 11111111
Protection Switch Line 26	01110100 11111111
Protection Switch Line 27	01110110 11111111
Protection Switch Acknowledge	00011000 11111111
Protection Switch Release	00100110 11111111
Don't use for Sync (note 3)	00110000 11111111
Stratum 2 traceable	00001100 11111111
±20 ppm clock traceable	00100010 11111111
Stratum 4 traceable	00101000 11111111
Stratum 1 traceable	00000100 11111111
Synchronization traceability unknown	00001000 11111111
Stratum 3 traceable	00010000 11111111
Reserved for network sync	01000000 11111111
Understudy for maintenance	00101100 11111111
Understudy for maintenance	00110100 11111111
Reserved for Network use	00010110 11111111
Reserved for Network use	00011010 11111111
Reserved for Network use	00011110 11111111
Reserved for Network use	00111010 11111111
Reserved for customer	00000110 11111111
Reserved for customer	00001010 11111111
Reserved for customer	00000010 11111111
Reserved for customer	00110110 11111111

Notes on Table 7:

(1) Rightmost bit transmitted first.

(2) The "protection switch line" codes of the form 01XXXXX011111111 use the five bits designated X to contain the binary representation of the number of the line, 1 through 27, to be switched to a protection line (e.g. the code for line 25 is a 1 followed by 11001 which is the binary representation of 25).

(3) Use of this block of codewords is described in ATIS T1X1 Technical Report No. 33 (Ref A18).

Table 8 - Unassigned ESF Data Link Codewords

Codeword (note 1)	
00111100 11111111	
01111000 11111111	
00111110 11111111	
01111010 11111111	
01111100 11111111	
01111110 11111111	(Note 2)

Notes on Table 8:

(1) Rightmost bit transmitted first

(2) Assignment of this codeword should be avoided due to its similarity to the DL idle code described in 4.3.2.3.4

Table 9 - Example - ESF Data Link Performance Report Messages

For t =	
$t_0 - 3$	Slip = 1, all other parameters = 0, NmN1 = 01
$t_0 - 2$	Severely-errored framing event = 1, all other parameters = 0, NmN1 = 10
$t_0 - 1$	CRC error events = 1, all other parameters = 0, NmN1 = 11
t_0	CRC error events = 320, all other parameters = 0, NmN1 = 00
$t_0 + 1$	CRC error events = 0, all other parameters = 0, NmN1 = 01
$t_0 + 2$	CRC error events = 6, all other parameters = 0, NmN1 = 10
$t_0 + 3$	CRC error events = 40, all other parameters = 0, NmN1 = 11

	$t = t_0$	$t = t_0 + 1$	$t = t_0 + 2$	$t = t_0 + 3$
FLAG	01111110	01111110	01111110	01111110
ADDRESS OCTET 1	00111000	00111000	00111000	00111000
ADDRESS OCTET 2	00000001	00000001	00000001	00000001
CONTROL	00000011	00000011	00000011	00000011
MESSAGE OCTET 1	00000001	00000000	10000000	00100000
MESSAGE OCTET 2	00000000	00000001	00000010	00000011
MESSAGE OCTET 3	00000000	00000001	00000000	10000000
MESSAGE OCTET 4	00010011	00000000	00000001	00000010
MESSAGE OCTET 5	00000000	00000000	00000001	00000000
MESSAGE OCTET 6	01000010	00010011	00000000	00000001
MESSAGE OCTET 7	00000010	00000000	00000000	00000001
MESSAGE OCTET 8	00000001	01000010	00010011	00000000
FCS OCTET 1	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx
FCS OCTET 2	xxxxxxxx	xxxxxxxx	xxxxxxxx	xxxxxxxx
FLAG	01111110	01111110	01111110	01111110

4.3.2.4 *On Line Maintenance Functions*

The PBX is responsible for declaring alarms and status conditions. The PBX shall transmit alarm signals toward the network for detected failures, as described below. The PBX may also signal these failure conditions to the user via local indicators.

4.3.2.4.1 *Fault Conditions*

4.3.2.4.1.1 *Out-of-Frame Condition (OOF)*

An OOF condition shall be declared by the PBX with the occurrence of a particular density of framing bit errors (i.e., n or more errors out of m consecutive framing bits). Typical values of n and m are 2 out of 4, 2 out of 5, and 3 out of 5. Loss of Frame failure is declared when an OOF condition persists for a period T, where $2 \leq T \leq 10$ seconds.

4.3.2.4.1.2 *Loss of Signal (LOS)*

An LOS defect is the occurrence of 175 ± 75 contiguous pulse positions with no pulses of either positive or negative polarity at a DS1 line interface. A LOS failure shall be declared by the PBX when the LOS defect persists for a period T, where 2 seconds < T < 10 seconds.

4.3.2.4.1.3 *Excessive Bipolar Violations (BPV)*

An excessive bipolar violation condition shall be declared when any digital signal has BPVs in excess of the threshold setting. The threshold setting for the BPV time shall be approximately 1000 seconds with a BPV rate of 10^{-6} BPVs per bit.

4.3.2.4.1.4 *Remote Alarm Indication (RAI)*

A Remote Alarm Indication Signal (previously called the Yellow Alarm) is a signal transmitted in the outgoing direction when a terminal determines that it has lost the incoming signal. The PBX shall transmit an RAI signal as defined below.

The form of the RAI signal depends on the framing format in use. Facilities providing SF framing use an inband RAI signal that consists of setting bit 2 in every channel to zero. Facilities providing ESF framing use transmission of a repeating 16-bit pattern consisting of eight ones followed by eight zeros (0000000011111111) continuously on the ESF data link for the duration of the alarm condition but not for less than one second.

The following timing conventions should be applied in sending or receiving the RAI signal:

(1) The out-of-frame condition should persist for 2.5 ± 0.5 seconds before sending the Yellow Alarm.

(2) The RAI should not be cleared unless the out-of-frame condition has cleared for more than 15 ± 5 seconds.

(3) Detection of the RAI should occur within 335 to 1000 milliseconds.

(4) The minimum time between the end of one transmission and the beginning of another transmission shall be one second. Certain services provided by the network may require longer time intervals than these minimum values, or may require equal "on" and "off" intervals, or both.

4.3.2.4.1.5 *Carrier Group Alarm*

The Carrier Group Alarm function is defined as either being in the Red Alarm condition (PBX cannot frame on the received DS1 signal for 2.5 ± 0.5 seconds) or receiving a RAI (which indicates that the far endpoint cannot frame on the transmitted DS1 signal).

The PBX should freeze its signaling state as soon as it loses frame synchronization on its DS1 input. This should be done so that, for a 50% “ones” density, the probability of freezing an incorrect signaling state should be less than 5%. If frame synchronization is not regained after the nominal 2.5 second interval , the carrier group alarm state is entered. Once in this state, existing calls should be dropped and no new calls allowed.

If frame synchronization is re-acquired for 15 ± 5 seconds or an incoming RAI subsides for 100 to 1000 ms, the interface shall leave the carrier group alarm state.

4.3.2.4.1.6 Alarm Indication Signal (AIS)

AIS is a signal transmitted in lieu of the normal signal to maintain transmission continuity, and indicate to the receiving terminal that there is a transmission interruption located either at the equipment originating the AIS signal or upstream of that equipment. When a valid signal is available, the AIS may be removed. The AIS is an unframed, all "ones" signal.

Either the PBX or the far-end equipment may busy out an entire DS1 facility by sending an AIS. If an AIS is received and since it is unframed, the Remote Alarm Indication signal shall be transmitted to the far end.

4.3.2.4.1.7 Other Alarms

Other DS1 related alarm functions monitored by the PBX include slip rate detection which may be used for detecting loss of loop timing.

4.3.2.5 Loopbacks

The PBX shall provide a loopback function by automatic, manual, ESF data link, inband or other[15] means to assist in trouble isolation procedures. Line loopback is provided by looping the receive line-pair to the transmit line-pair. ESF data link or inband signaling for control of loopbacks is recommended. Inband signaling is the use of message channels to also carry signaling information.

4.3.2.5.1 Inband Line Loopback Activation

The PBX shall activate the loopback when it receives from the network a framed pulse sequence consisting of a "1" followed by four "0's" repeated for at least 5 seconds. The frame alignment bits overwrite the code pattern.

4.3.2.5.2 Inband Line Loopback Deactivation

The PBX shall deactivate the loopback when it receives from the network a framed pulse sequence consisting of a "1" followed by two "0's" repeated for at least 5 seconds. The frame alignment overwrites the code pattern.[16]

4.3.2.5.3 Loopback Signals for the ESF

Signaling for loopback activation and deactivation by means of the ESF channel is controlled by bit-oriented messages in the ESF data link. These messages are described in 4.3.2.3.4.1.

4.3.2.5.4 PBX Operation During Line Loopback

When line loopback is activated, the PBX received data signals shall be transmitted back to the network. The received data signal shall be regenerated by the PBX without change in framing format or removal of any bipolar violations. The line loopback shall also operate upon the receipt of the patterns listed for inband line loopback (activation or deactivation) without framing to accommodate embedded equipment that sends unframed (nonstandard) control signals.

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15. This loopback may be provided by adjunct equipment such as NCTE.

16. Embedded equipment exists which may be activated by the line loopback deactivate code and block the code from reaching the PBX, requiring manual intervention to deactivate the line loopback.

4.3.2.5.5 PBX Operation During Payload Loopback

When payload loopback is activated, the received information bits (192 information bits per frame) are transmitted in the outgoing direction. The framing bits (frame synchronization, CRC, and DL) are originated at the point of payload loopback. The payload loopback shall maintain bit-sequence integrity[17] for the information bits; however, the payload loopback need not maintain the integrity of eight-bit time slots, frames, or superframes. Payload loopback commands are described in 4.3.2.3.4.1.

4.4 Network Interface - Digital (ISDN)

4.4.1 ISDN Primary Rate Access Requirements (DSS1)

4.4.1.1 Introduction

The ISDN Primary Rate Access, as specified below, can be used as a trunk access to most local exchange or inter-exchange carriers in the United States and in Canada. However at this time, some manufacturers' implementations do not fully meet the standards listed below, therefore, to insure compatibility with a given installation, specific Central Office Switch manufacturers' specifications should be checked for deviations.

4.4.1.2 Electrical and Physical Requirements

The electrical and physical requirements of the ISDN Primary Rate Access (U) Interface are specified in ANSI T1.408-1990 Integrated Services Digital Network (ISDN) Primary Rate - Customer Installation Metallic Interfaces Layer 1 Specification (Ref A19).

4.4.1.3 Data Link Layer Requirements

The Data Link (layer 2) requirements for the ISDN Primary Rate Access Interface are specified in ANSI T1.602-1989, Telecommunications - Integrated Services Digital Network - Data-Link Layer Signaling Specification for Application at the User-Network Interface (Ref A20).

4.4.1.4 Network Layer Requirements

The Network (Layer 3) requirements for the ISDN Primary Rate Access Interface Circuit Switched Bearer Services are specified in ANSI T1.607-1990 Integrated Services Digital Network (ISDN) - Layer 3 Signaling Specification for Circuit-Switched Bearer Service (Ref A21).

4.4.2 ISDN Private Network Signaling Requirements (PSS1)

4.4.2.1 Introduction

This section describes the requirements for PBX-to-PBX connectivity when two or more PBXs are connected to form a private or enterprise network. The PBXs may be connected by using PRI or BRI interfaces, however, only the PRI interface requirements are specified at this time.

PSS1 is an ISO standard for Private Telecommunication Networks based on ITU (formerly CCITT) Q.931/2 standards. The PSS1 Standards define the signaling protocol for PBX-to-PBX signaling at the Q reference point. Q.931/2 defines call control for applications such as PBX-to-network and is based on a master-slave or asymmetrical relation. PSS1, on the other hand, defines the call control signaling, as well as services, applicable to a peer-to-peer or symmetrical relation.

The PSS1 Protocol Model (Fig 35) is based on the ISO Reference Model. The Protocol Control entity provides services to Call Control. Primitives exchanged across the boundary between Call

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17. This requires that the timing of the transmitted payload loopback signal be synchronized with the timing of the received payload loopback signal.

Control and Protocol Control correspond to the information flows exchanged between the Call Control functional entities. Protocol Control provides the mapping between these primitives and messages transferred across the inter-PBX link. In order to transfer messages, Protocol Control uses the services of the Data Link Layer, which in turn uses the services of the Physical Layer. The actual Data Link Layer and Physical Layer Protocols visible at the Q reference point are dependent on the PBX interconnection scenario. (See ISO 11579, Information Technology - Telecommunications and Information Exchange Between Systems - Reference Configuration for Private Integrated Services Networking (PISN) Exchanges, Ref A22).

The generic functional protocol ISO 11582, Information Technology - Telecommunications and Information Exchange Between Systems - Private Integrated Services Network - Generic Functional Protocol for the Support of Supplementary Services - Inter-exchange signaling procedures and protocol, (Ref A23) provides the means to exchange signaling information for the control of supplementary services over a private or enterprise network. It does not, by itself, control any supplementary service but rather provides generic services to specific Supplementary Service Control entities. Procedures for individual supplementary services based on these generic procedures are defined in other standards or may be manufacturer-specific.

The generic functional protocol operates at the Q reference point between two PBXs in conjunction with a Layer 3 protocol for Basic call control (ISO 11572, Information Technology - Telecommunications and Information Exchange Between Systems - Private Integrated Services Network - Circuit Mode Bearer Services - Inter-exchange Signaling Procedures and Protocol, Ref A24). Together, these use the services of the Signaling Carriage Mechanism.

The generic functional protocol provides mechanisms for the support of supplementary services which relate to existing basic calls or services that are entirely independent of any existing basic calls. In performing a supplementary service, whether call independent or call related, procedures in ISO 11582 are applicable for information transfer procedures.

For the support of supplementary services, both Basic Call Control, ISO 11572 and Generic Functional Procedures 11582, are required in addition to compliance with the specific supplementary service standard. The supplementary services requirements are currently under development in ANSI and ISO.

4.4.2.2 Electrical and Physical Requirements

No electrical and physical requirements are specified for the Private Integrated Services Network. Specific requirements are dependent on the PBX interconnection scenario. See ISO 11579.

4.4.2 3 Data Link Layer Requirements

No Data Link (layer 2) requirements are specified by ISO for the Private Integrated Services Network. Specific requirements are dependent on the PBX interconnection scenario, however, some guidance on Peer to Peer communication considerations for Layer 2 are given in ETSI Standard pri-ETS 300 170 Private Telecommunications Network (PT); Inter-exchange signaling Data link layer protocol. Also see ISO 11579.

4.4.2.4 Network Layer Requirements

The Network (Layer 3) requirements for the Private Integrated Services Network are specified in ISO 11572 (Ref A24)

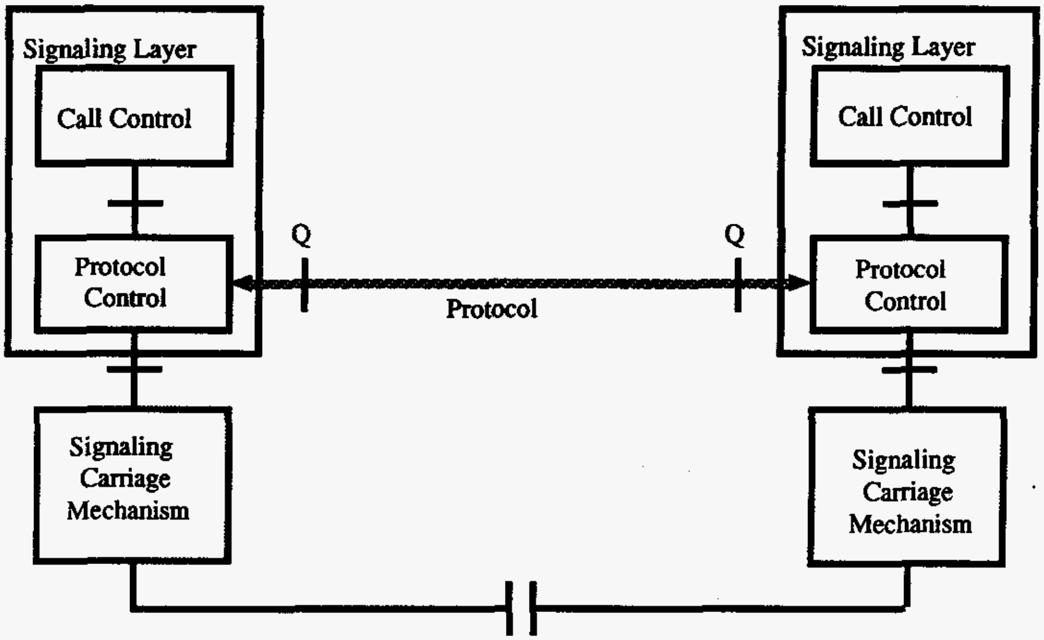


Figure 35 - PBX-to-PBX Protocol Model

4.4.3 ISDN Basic Rate Access Requirements

4.4.3.1. Introduction

The ISDN Basic Rate Interfaces at the U and T Reference points, as specified below, can be used either as a trunk access to local or inter-exchange carriers or as a station interface on the line side of the PBX. The ISDN S Interface, as specified below, can be used as a Station Interface on the line side of the PBX.

4.4.3.2 ISDN Basic Rate U Reference Point

4.4.3.2.1 Electrical and Physical Requirements

The electrical and physical requirements for the ISDN Basic Rate U Interface are specified in ANSI TI.601-1992, Integrated Services Digital Network (ISDN) - Basic Access Interface for use on Metallic Loops on the Network Side of the NT (Layer 1 specification) (Ref A25).

4.4.3.2.2 Data Link Layer Requirements

The Data Link (Layer 2) requirements for the ISDN Basic Rate U Interface are specified in ANSI T1.602-1989 (Ref A20).

4.4.3.2.3 Network Layer Requirements

The Network (layer 3) requirements for the ISDN Basic Rate U Interface Circuit Switched Bearer Services are specified in ANSI T1 607-1990 (Ref A21).

4.4.3.3 ISDN Basic Rate S and T Reference Points

4.4.3.3.1 Electrical and Physical Requirements

The electrical and physical requirements for the ISDN Basic Rate S and T Interfaces are specified in ANSI TI.605-1991, Integrated Services Digital Network (ISDN) - Basic Access Interface for S/T Reference Points (Layer 1 Specification) (Ref A26).

4.4.3.3.2 Data Link Layer Requirements

The Data Link (Layer 2) requirements for the ISDN Basic Rate S and T Interfaces are specified in ANSI T1.602-1989 (Ref A20).

4.4.3.3.3 Network Layer Requirements

The Network (layer 3) requirements for the ISDN Basic Rate S and T Interfaces Circuit Switched Bearer Services are specified in ANSI T1 607-1990 (Ref A21).

4.5 Analog Station Interface

4.5.1 General

4.5.1.1 The PBX analog station interface connects the PBX to station or other equipment conforming to ANSI Standard EIA/TIA-470A (Ref A2).

4.5.1.2 Station equipment may be located either on the premises of the PBX to which it is connected (referred to as "on-premises," abbreviated ONS), or at the end of a transmission facility of considerable length (referred to as "off-premises," abbreviated OPS). The traditional OPS scenario is one where the connection between the PBX and the remote station equipment passes through, but is not switched at, the serving network switch.

4.5.1.3 ONS and OPS station interfaces are two-wire with signals including:

(1) PBX battery for talking and supervisory purposes.

(2) Ringing from the PBX for alerting station equipment.

(3) Station-originated dc signals for supervisory purposes.

(4) Dial pulses and Dual Tone Multifrequency (DTMF) address signals from the station equipment for address signaling.

4.5.1.4 OPS facilities are tariffed and are classified by the FCC as follows:

(1) *Class A* for PBX OPS interfaces having a station loop resistance limit of 200 Ω or less and minimum loop current of 16 mA or greater.

(2) *Class B* for PBX OPS interfaces having a station loop resistance limit of 2300 Ω or less and minimum loop current of 16 mA or greater.

(3) *Class C* for PBX OPS interfaces having a station loop resistance limit of 3300 Ω or less and minimum loop current of 16 mA or greater.

4.5.1.5 This standard refers to the maximum station conductor loop resistance (R) and to the remote terminal ringer equivalence (N) in order for the PBX and station interfaces to be compatible. These are provided to give manufacturers a choice of loop range and terminals per loop necessary in the design of PBXs.

4.5.1.6 The requirements in this section are intended to assure acceptable performance provided the manufacturer's specified limitations are observed. It is desirable that the parameter (N) of the PBX be a minimum of 5, since this will ensure that any FCC-registered terminal device with which the PBX is otherwise compatible can be connected to the station interface.

4.5.1.7 It is desirable that a PBX have a station loop resistance capability of at least 300 Ω for ONS application.

4.5.1.8 Unless specified otherwise, the criteria that follow apply to both ONS and OPS interfaces.

4.5.2 *Battery Voltage*

4.5.2.1 *On-Premises Interface*

4.5.2.1.1 Battery voltages applied by the PBX to the station interface tip and ring (T&R) leads for supervisory purposes shall not exceed 56.5 V dc and shall have no ac component in excess of 5 V peak.

4.5.2.1.2 The characteristic of the dc battery source applied by the PBX to the station interface T&R leads shall result in a loop current within the range of 20 to 140 mA being delivered into a load connected across the interface leads, having a load resistance that falls within the combined acceptable regions A and B shown in Fig 7 (normal power available) or Fig 8 (commercial power outage) if backup power is provided to the PBX. It is desirable that the voltage-versus-current function, V(I), at the interface falls in the combined acceptable region A shown in Figs 7 or 8. This requirement applies throughout the full loop resistance range (R) specified for the PBX by the manufacturer.

4.5.2.1.3 It is desirable that the battery voltage source supplied by the PBX to ONS deliver between 36 and 63 mA into a 130-ohm resistive load connected across the station interface T&R leads. This is typically accomplished with a 42.5 to 56.5-volt, 800-ohm source or a 19 to 29-volt, 400-ohm source.

4.5.2.1.4 It is desirable that the battery voltage supplied to ONS interfaces be negative with respect to ground.

4.5.2.1.5 The PBX shall not interrupt battery on the ring conductor or ground on the tip conductor or both for longer than 300 ms, except to transmit disconnect toward the station interface.

4.5.2.2 *Off-Premises Interface*

4.5.2.2.1 Battery voltages applied by the PBX to OPS interface T&R for supervisory purposes shall not exceed 56.5 V dc and not have any ac component in excess of 5 V peak.

4.5.2.2.2 The PBX shall apply supervisory battery between the OPS tip and ring conductors with a steady-state DC voltage-versus-current characteristic within the acceptable region of Fig 36 for Class A interfaces, Fig 37 for Class B interfaces, and Fig 38 for Class C interfaces.

4.5.2.2.3 Except for a Class A OPS interface, the maximum current (dc) delivered into a short circuit connected across the interface leads shall not exceed 140 mA.

4.5.2.2.4 For Classes A, B, and C OPS interfaces, the current (dc) delivered into the station loop simulator (Fig 39) shall be at least 16 mA for Conditions 1 and 2.

4.5.2.2.5 The battery voltage supplied to station conductors for OPS lines shall be negative with respect to ground. (This is to prevent electrolysis damage to network equipment.)

4.5.2.2.6 The PBX shall not interrupt battery on the ring conductor or ground on the tip conductor, or both, for longer than 300 ms, except to transmit disconnect toward the station interface.

Note: The Loop Current Feed Open (LCFO) state, (removal of ring battery and/or tip ground) may not be recognized and transmitted by some network elements and should not be relied on as a disconnect signal.

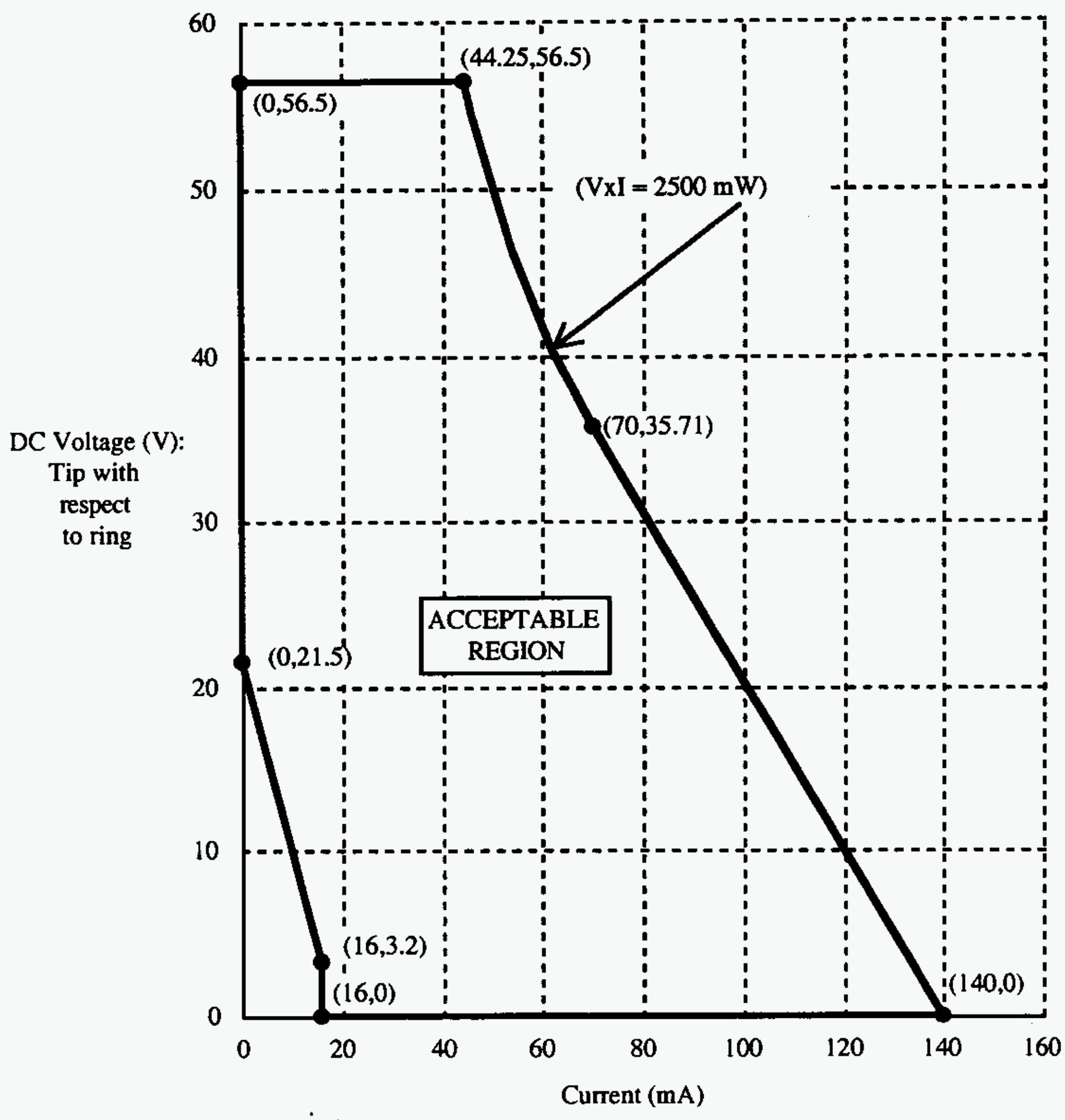


Figure 36 - Steady-State DC Voltage-versus-Current Characteristics for OPS Class A Interfaces

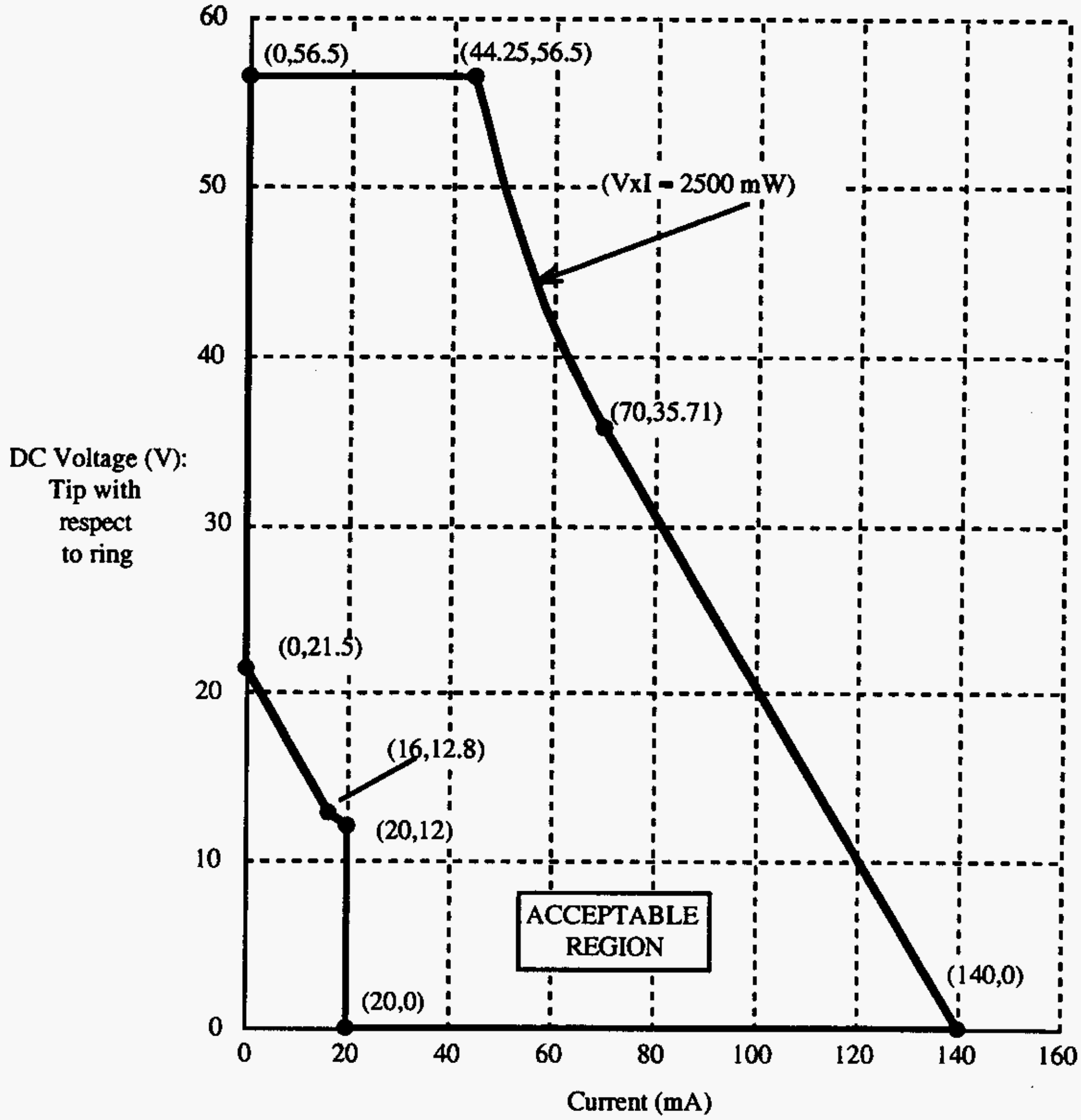


Figure 37 - Steady-State DC Voltage-versus-Current Characteristics for OPS Class B Interfaces

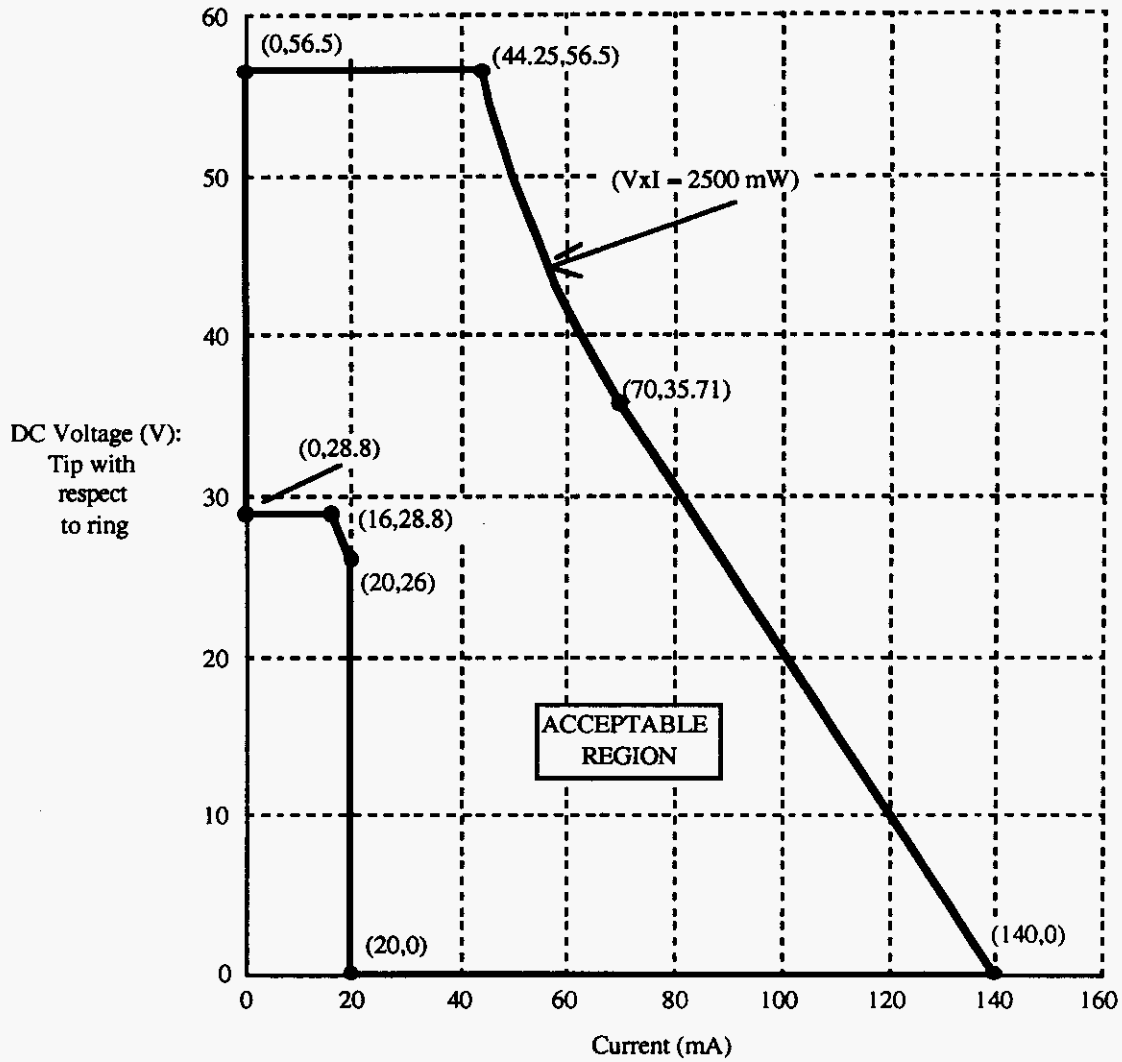
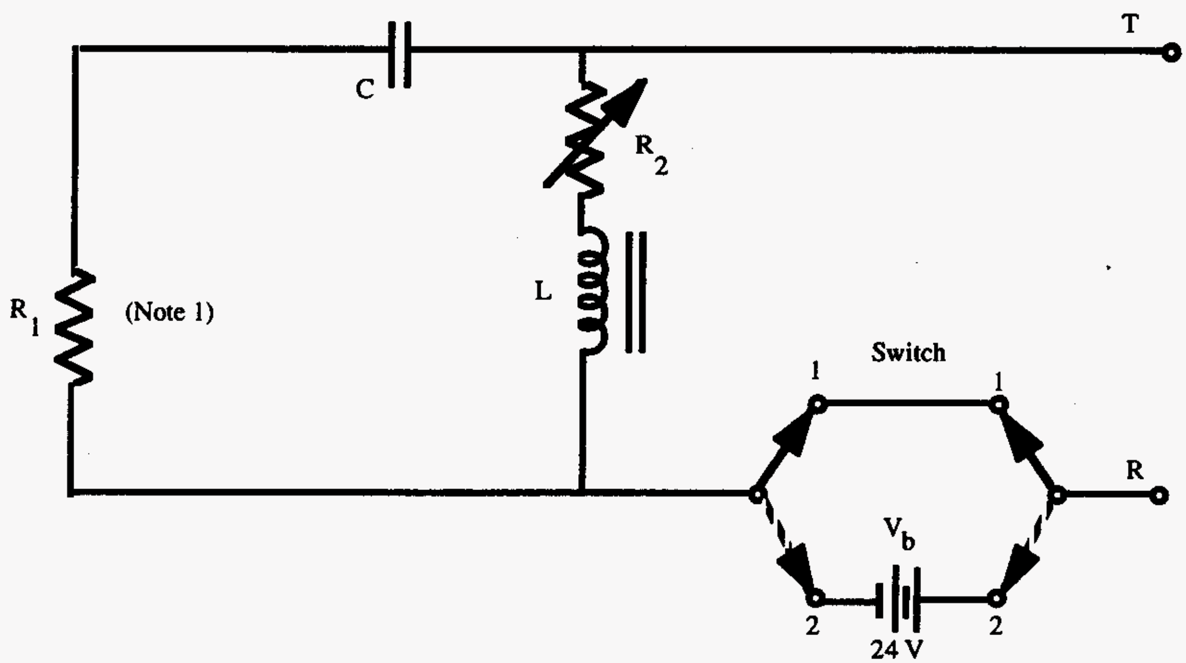


Figure 38 - Steady-State DC Voltage-versus-Current Characteristics for OPS Class C Interfaces



C = 500 µF (-10%,+50%)
R_1 = 600 Ω (± 1%)
L_1 ≥10H

Condition	Switch Position	$R_2 + R_L$ Continuously Variable over the Range:		
		Class A	Class B	Class C
1	1	R_L to 200Ω	R_L to 800Ω	R_L to 1800Ω
2	2	Not Applicable	200 to 2300Ω	900 to 3300Ω

NOTES:

1. Termination R_1 is normally connected. Remove termination R_1 or replace it by the alternative terminations in Fig 18 when specified.
2. Resistance $R_2 + R_L$ shall be continuously variable across the ranges given in the chart.

Figure 39 - Off-Premises Loop Simulator Circuit

4.5.3 *Ringing*

4.5.3.1 *General*

4.5.3.1.1 PBX ringing shall comply with Table 10.

Table 10 - PBX Ringing Voltage Ranges and Terminating Impedances

Ringing Frequency (Hz)	Terminating Impedance (Ω)	Ringing Voltage (V rms)
17 - 23	10,000/(N)	55 - 130
20	8,000/(N)	40 - 130
27 - 33	10,000/(N)	95 - 130

where (N) = the number of station ringer equivalence with which the PBX is designed to work.

4.5.3.1.2 It is desirable that the PBX ringing voltage be within the range 75 to 100 V rms.

4.5.3.1.3 The PBX shall apply ringing to station lines, interrupted in a manner that produces one of the following:

(1) At least one burst of ringing of minimum 0.8-second duration in any 6-second interval.

(2) At least one burst of ringing of minimum 0.6-second duration in any 4-second interval.

(3) At least one burst of ringing of minimum 0.5-second duration at 55 V rms, or greater, in any 4-second interval.

4.5.3.2 *Ringing – Additional Requirements for OPS Interfaces*

4.5.3.2.1 Ringing to OPS lines shall be applied only across the ring conductor and PBX ground and shall be used only for station alerting.

4.5.3.2.2 The ringing voltage shall be less than 300 V peak-to-peak and less than 200 V peak-to-ground as measured across a resistive termination not less than 1 MΩ.

4.5.3.2.3 Ringing shall be interrupted so as to create silent intervals of at least 1-second (continuous) duration, each separated by no more than 5 seconds. During silent intervals, the voltage between tip-to-ground and ring-to-ground shall not exceed 56.5 V dc and shall not have an ac component in excess of 5 V peak.

4.5.4 *Ringing Trip*

4.5.4.1 *Ringing Trip – General*

The PBX shall trip ringing upon called party answer.

4.5.4.1.1 The PBX shall trip ringing within 150 ms after detecting a station line off-hook (answer) signal, as given in 4.5.6.2. It is desirable that ring trip occur within 100 ms after detecting off-hook.

4.5.4.1.2 Ringing shall not be reapplied if answer supervision (off-hook) is detected during the silent (off) interval.

4.5.4.2 *Ringing Trip – OPS*

4.5.4.2.1 A current-sensitive tripping circuit, connected in series with a ring lead, shall cause ringing to be tripped in response to the off-hook signal received upon called party answer, according to the response time and the maximum peak-to-peak current characteristic given in Fig 40.

4.5.4.2.2 The ringing trip circuit of the PBX shall have one of the following characteristics as verified using the ringing trip test circuit in Fig 40.

(1) No greater than 100 mA peak-to-peak current shall be drawn when resistor R is set at 1500 Ω or greater; or

(2) If the current under (1) above exceeds 100 mA peak-to-peak, then, in addition to a tripping circuit that meets the characteristics of Fig 40, a 19-to-56.5 volt "monitoring" voltage shall be present between ring (or tip) to ground during silent intervals (as a warning indication to craftspersons working on the line).

4.5.5 *Ringing Pre-trip*

To assure adequate protection against false ringing trip, the PBX ringing trip circuit shall not trip ringing when tested under the following conditions:

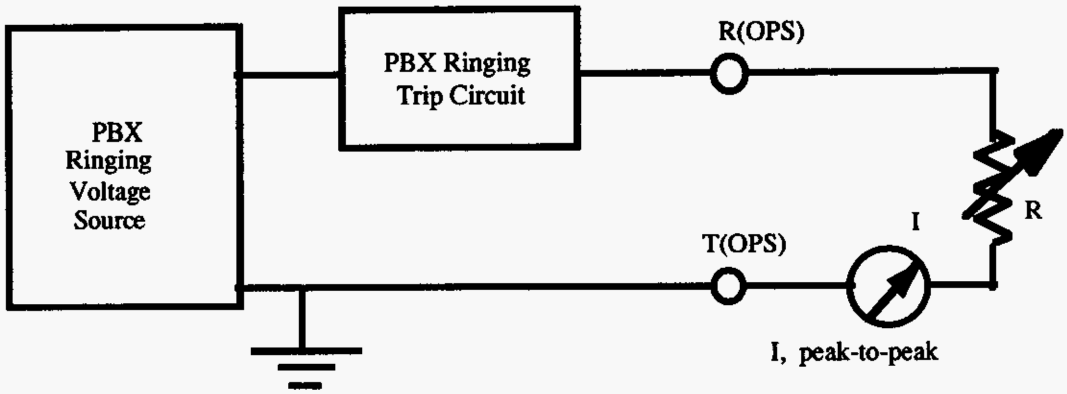
(1) A terminating impedance simulating on-hook impedance, connected across the station line conductors and composed of the parallel combination of 15,000 Ω resistance and a series connection of resistance and capacitance whose impedance at the specified frequency is as shown in Table 11.

(2) A loop resistance range between the PBX station interface and the terminating impedance equal to the specified station working loop resistance of the PBX.

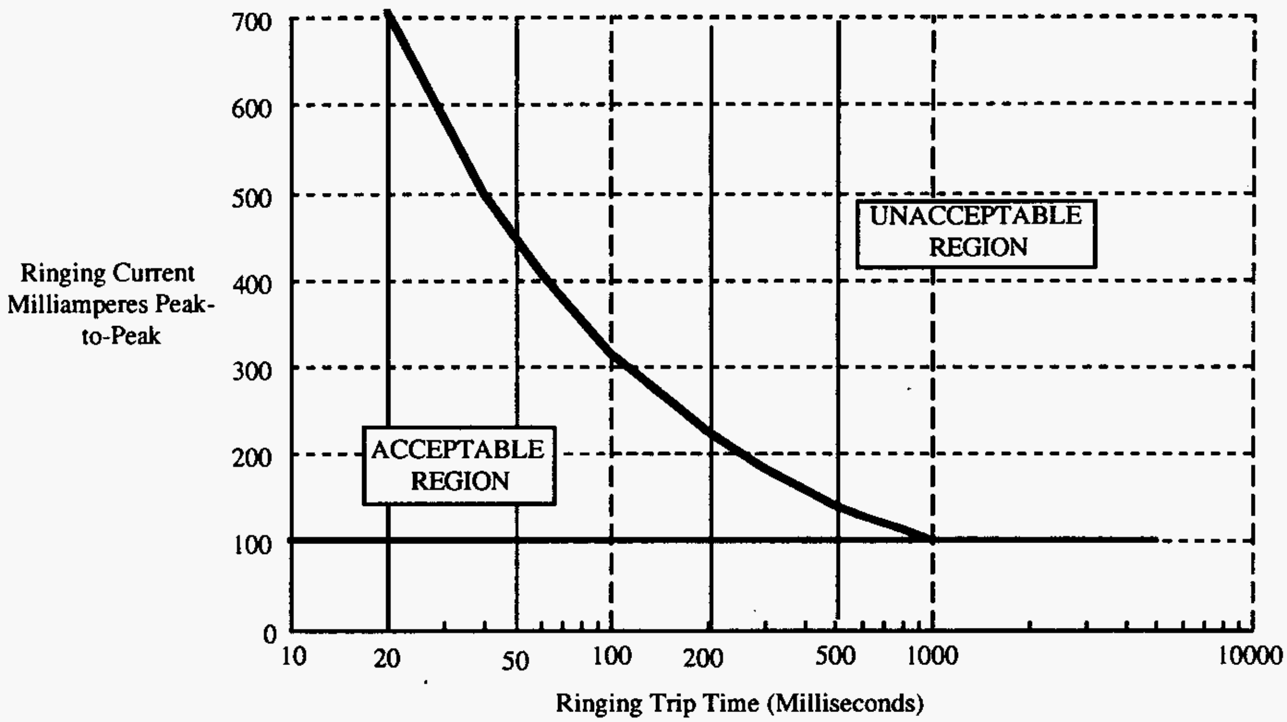
Table 11 - Ringing Pre-trip Test Impedance (ohms)

Ringing Frequency (Hz)	AC Terminating Impedance (Ω)	
	Classes B & C	Class A
17-23	7000/(N)	1400
27-33	5000/(N)	1000

where (N) = the number of station ringer equivalence with which the PBX is designed to work.



Ringing Trip Test Circuit



NOTES:

1. Vary resistor R to obtain the desired trip current.
2. The equation of the curve is $I = \frac{100}{\sqrt{t}}$, where I is in mA, and t is in seconds.

Figure 40 - Ringing Trip Requirement for PBX OPS Interface

4.5.6 Loop Supervision

4.5.6.1 Recognition of Idle Condition

4.5.6.1.1 The PBX shall recognize a resistance of greater than 15 KΩ tip-to-ring at the station interface as an on-hook signal.

4.5.6.1.2 When the station interface is in the idle state (on-hook), it is desirable that spurious off-hook signals of 150 ms or less be ignored to prevent false seizures.

4.5.6.2 Recognition of Seizure

4.5.6.2.1 The PBX shall recognize an impedance that falls within the combined acceptable regions A and C shown in Fig 7 (normal power available) or Fig 8 (commercial power outage) as a line off-hook signal. This requirement applies for all loop lengths specified by the manufacturer. For outgoing calls following called party answer, and for incoming call except for the first second of operation, the PBX shall recognize an impedance that falls within the combined acceptable regions A, B, and C shown in Fig 7 or Fig 8 as a line off-hook signal.

4.5.6.2.2 The PBX shall recognize a transition from the on-hook to the off-hook state while the station interface is idle as a request for service.

4.5.6.2.3 Dial tone shall be sent to the station interface when the PBX is ready to accept address signals.

4.5.7 Recognition of Address Signaling

4.5.7.1 The PBX shall register address signals from station lines in accordance with the requirements of 6.1 (Dual Tone Multifrequency) or the recommendations of Annex E (Dial Pulsing).

4.5.7.2 The PBX shall remove dial tone within 500 ms after detecting the start of the first address character.

4.5.7.3 The PBX shall wait at least 10 seconds for receipt of the first digit after dial tone has been sent to a station before applying permanent signal.

4.5.7.4 The PBX shall provide a partial dial time-out interval of not less than 5 seconds for station dialing, except when critical timing for abbreviated dialing code detection is used, in which case the interval shall not be less than 4 seconds.

4.5.7.5 It is desirable that the PBX transmit a disconnect signal as described in 4.5.10.2.5 toward the station interface within 2 minutes after detection of a permanent or partial-dial time-out at the interface.

4.5.8 Alerting

4.5.8.1 The PBX shall alert a station interface by applying ringing, as described in 4.5.3, across the tip-and-ring station-line conductors with the tip conductor effectively at ground potential.

4.5.8.2 While ringing is applied, the PBX shall ignore off-hook signals of:

(1) 25 ms, or less, duration for off-premises station (OPS) lines.

(2) 20 ms, or less, duration for on-premises lines. It is desirable that off-hook signals of 25 ms duration be ignored for on-premises lines.

4.5.9 Voice Path on Answer

The PBX shall provide a two-way voiceband transmission path between the station interface and the calling party interface within 400 ms after answer to avoid clipping initial speech energy.

4.5.10 Call Supervision

4.5.10.1 Station Disconnect Signal and Flash Signal Timing

4.5.10.1.1 If flash signals generated by the station equipment are used by the PBX to initiate internal calling features, the PBX shall:

(1) Ignore on-hook intervals of 150 ms or less.

(2) Interpret on-hook intervals of 300 ms to 1 second as valid flash signals.

(3) Interpret on-hook intervals of 1.5 seconds or greater as valid disconnect signals.

4.5.10.1.2 If flash signals generated by the station equipment are not used by the PBX to initiate internal calling features, the PBX shall interpret on-hook intervals of 300 ms or greater as valid disconnect signals.

4.5.10.2 Disconnect Requirements

4.5.10.2.1 Upon recognition of a valid disconnect signal from station equipment, the PBX shall release the switching connection and restore the station interface state to on-hook (idle), as described in 4.5.6.1.

4.5.10.2.2 When a valid disconnect signal is received from station equipment on a station-to-station connection or from the trunk on a trunk-to-station connection, the PBX shall initiate disconnect timing.

4.5.10.2.3 Disconnect timing duration shall be 4 seconds to 2 minutes (the shorter timing being the more desirable) unless the PBX connects the off-hook station equipment to dial tone after time-out, in which case disconnect timing shall not be less than 2 seconds.

4.5.10.2.4 It is desirable that at disconnect time-out the PBX send a disconnect signal toward the station equipment that remains off-hook. This disconnect signal shall consist of interrupting loop current to the station interface for at least 600 ms.

4.5.10.2.5 If the station equipment remains off-hook after disconnect time-out and the sending of the disconnect signal (if sent), the PBX shall take one of the following actions:

(1) Disconnect the station from the switching network, returning no tones until the station equipment goes on-hook, at which time the station interface shall be restored to on-hook (idle) state as described in 4.5.6.1.

(2) Apply a distinctive tone (reorder or busy, as specified in 6.3, Call Progress Signals) toward the station interface until the station equipment goes on-hook, at which time the station interface shall be restored to on-hook (idle) state as described in 4.5.6.1.

(3) Apply a distinctive tone (reorder or busy) toward the station interface for approximately 10 seconds, then proceed as in (1) above.

(4) Time for 2 seconds after receipt of the other-end disconnect signal, then apply dial tone toward the station interface until the station equipment either goes on-hook or initiates address signaling for another call.

5 TRANSMISSION REQUIREMENTS

5.1 Preamble

5.1.1 General

5.1.1.1 The use of mu-law encoding/decoding, defined in ITU-T (formerly CCITT) Recommendation G.711 (1984), Pulse Code Modulation of Voice Frequencies (Ref A27), as the standard for network elements and terminal equipment in the United States and Canada requires that mu-law interfaces be employed by PBXs to provide compatibility.

5.1.1.2 The transmission requirements contained in this standard are based on an industry-developed and adopted fixed loss and level plan. The requirements were developed with the objective of maintaining or improving the quality of service for connections within existing and evolving communication networks.

5.1.2 Requirements for Analog PBXs

With analog, or mixed analog/digital networks, the quality of an end-to-end connection is determined by the additive impairments of:

(1) each analog link;

(2) the analog-to-digital (A/D) and digital-to-analog (D/A) conversions associated with each digital link, and

(3) terminal equipment, e.g., PBXs.

Historically, requirements for analog PBXs were determined by allocating a portion of the maximum desired overall degradation, based on the expected contribution of analog and mixed analog/digital network interconnections. Type I requirements (analog PBX transmission requirements in Ref A9) are not part of this standard.

5.1.3 Requirements for Digital PBXs

5.1.3.1 In digital networks, the additive impairments associated with analog or mixed analog/digital networks are eliminated. When terminal equipment are digitally connected to these networks, A/D or D/A conversions take place only on the terminal side of the terminal interface boundary. The resulting improved performance permits the relaxation of many requirements for PBXs that are connected to these networks.

5.1.3.2 It is recognized that the relaxation of requirements for digital PBXs will result in some degradation (as compared to analog PBXs) in connections to analog and to mixed analog/digital networks. The effects of these degradations have been carefully evaluated; economic factors and transmission quality have been considered, using a weighting based on the frequency of occurrence of the various types of connections. The resulting transmission quality compromises are considered to be acceptable during the evolution toward all-digital networks throughout the United States and Canada.

5.1.3.3 The requirements contained in this standard are based on current understanding of required performance and on capabilities of state-of-the-art technology. As technology evolves or as performance needs change, these requirements will become subject to change.

5.1.4 *Measurement Method*

5.1.4.1 *General*

5.1.4.1.1 The transmission performance parameters for PBXs are given for connections between the following interface categories:

(1) On-Premises Station (ONS)

(2) Off-Premises Station (OPS)

(3) ISDN-Compatible Station (ICS)

(4) Tie Trunk (various types)

(5) PSTN Trunk (various types)

(6) ISDN-compatible Trunk (IST, IS/DTT)

5.1.4.1.2 Trunk interfaces are further divided into 2-wire and 4-wire categories. Requirements for 4-wire trunk interfaces apply to 4-wire PBX trunk interfaces that connect directly to 4-wire connecting facilities. They also refer to 2-wire PBX trunk interfaces that connect to 4-wire facilities through a 4-wire term set (4WTS) or other similar device. The 4WTS or other device may or may not be part of the PBX 2-wire trunk interface. Four-wire connecting facilities are used in tie trunk and other private switched network applications.

5.1.4.1.3 In some PBX 4-wire analog trunk interface applications, the PBX incorporates the standard transmission levels of +7 dB and -16 dB TLP that are normally associated with the connecting facility. When this type PBX interface is in use, the applicable transmission requirements shall be adjusted to account for these levels.

5.1.4.1.4 Unless otherwise specified, transmission requirements contained here apply with station and trunk interfaces terminated in a nominal impedance of 600 Ω.

5.1.4.1.5 Unless otherwise specified, all measurements shall be made at an equipment access point which is connected to the equipment by no more than 15 meters of cable.

5.1.4.2 *Gain Ripples in the Measurement Path*

In any digital PBX, connections from a 2-wire analog port to a 2-wire analog port will constitute a closed-loop feedback system. The feedback signal will cause ripples in the net through-gain response of a 2-wire to 2-wire connection. If care is not exercised, the ripple effect will influence measurement accuracy. The following two techniques for avoiding ripple influence on measurements are suggested:

(1) Perform test measurements on a 2-wire to 4-wire basis. This approach eliminates the feedback signal. Where appropriate, the requirements contained in these sections have been divided into transmit and receive portions to facilitate this approach. It will be necessary to employ a digital test meter and designated digital test sequences for these types of measurements.

Alternatively, a half-channel test, in which the two directions of transmission are terminated within the switching fabric, may be used (see 5.5).

(2) Maintain a high-quality impedance match at each 2-wire to 4-wire interface to minimize the feedback signal. This approach requires use of a test impedance that closely matches the hybrid balance impedance. To satisfactorily reduce the ripple caused by the feedback signal, a hybrid balance of 25 dB (or greater) should be maintained at each 2-wire to 4-wire interface in the test connection.

5.1.4.3 Level Translation

5.1.4.3.1 Each of the requirements in this section has been written with respect to the zero-level point in the switch, which is the level corresponding to an overload point of +3 dBm in analog-to-digital conversion. Where other than zero level has been used (see 5.3.1), the appropriate level translation to zero level has been included.

5.1.4.3.2 In many cases, the level translations are caused by the loss insertion requirements imposed on the PBX (see 5.1.4.1). In these cases, it is acceptable to measure compliance with the loss switched out (zero loss) and to evaluate the requirement at the interface that corresponds to the zero loss case. This may result in certain simplifications of the evaluation process for line-to-trunk and trunk-to-trunk connection types. However, the appropriate interface loss shall be included in the measurements of insertion loss, quantization distortion, and gain tracking.

5.1.4.4 Percent Compliance and Desirable Performance Levels

5.1.4.4.1 Many of the requirements contained in this standard are written in terms of a required level of performance and a percentage of connections that must comply with the required performance. From a design standpoint, however, the intent of the requirements is that all circuit designs meet the required performance. The percent compliance requirements are intended for use during system performance evaluation, not during the design process.

5.1.4.4.2 For evaluation purposes, many requirements are applicable with a 95 percent compliance factor. In each case, to obtain better overall consistency of performance, it is desirable that requirements be met by 99 percent of the connections.

5.1.4.4.3 The required level of performance for the various specifications in this standard were derived by examining the tradeoffs between technological capability and desirable performance. From a performance point of view, it is desirable to establish requirements that are more stringent than the mandatory levels presented. In those instances where a desirable level of performance has been identified, this level of performance has been recommended. These recommendations are not accompanied by a percent compliance factor and should be viewed as performance improvement goals. They should be interpreted from the same design perspective, evaluation perspective, or both, discussed in the preceding paragraphs.

5.1.4.5 Dial-up Port for Trunk Testing

To avoid the gain variations that can occur among different terminations, it is recommended that a special dial-up port be designated for trunk testing. However, it should be recognized that even when using a single termination to test all trunks, consideration for gain tracking variation in the dial-up port must be included. The gain tracking variation will occur because different trunk losses will cause different signal levels at the dial-up port. The tracking variation will be limited by the gain tracking requirements at the various interfaces (see 5.4.4)

5.1.4.6 Digital Test Port Availability

For circuit and line-up purposes, the ISPBX shall have provisions for a test port, or equivalent, that enables DRS-level testing at an IST interface.

5.1.5 Conformance Levels

Many requirements in this section are stated in terms of a statistical level of conformance (e.g., "95 percent of connections"). Where a large number of measurements may be required to do exhaustive testing to gain a specific percent conformance to a requirement, an appropriate sampling methodology, such as is described in Annex B, may be used.

5.2 Loss Plan

The insertion loss of a PBX connection is defined as the 1-kHz level difference between the power delivered from a source connected across an input port to a measuring instrument connected across an output port,

(1) With the path through the PBX included in the connection.

(2) With the path through the PBX replaced by a direct connection.

For the insertion loss tests, both the signal source and the measurement instrument shall have 600 Ω impedance at 1 kHz unless otherwise described in 5.5. The insertion loss values are expressed as absolute loss between interface ports. Insertion losses are independent of the interface signal levels of 5.3.1.

5.2.1 Insertion Loss Criteria for ISPBX

Nominal values for interface-to-interface connections involving ISPBX lines and private network facilities are given by the ISPBX loss plan presented in Table 12. Nominal values for ISPBX connections between PSTN access lines are given in Table 13. The ISPBX interfaces described in the loss plan are given in 3.5.1 and illustrated in Fig 1.

5.2.1.1 Integrated Services Trunk Requirement

The ISD/TT row and column loss insertion values shall be provided by the ISPBX. It is desirable that the ISPBX provide the IST row and column values. For guidelines in the use of these values, refer to Application Notes (7.1).

5.2.1.2 Port-to-Port Loss Table Interpretation

In Tables 12 and 13, arrows at the row and column designators indicate the transmission direction in which the coordinate loss values are to be inserted. For example, coordinate 5D indicates a nominal port-to-port loss of 3 dB from the IST interface to the A/TT interface and 0 dB loss from the A/TT interface to the IST interface. Negative values denote gain; e.g., -3 indicates 3 dB gain.

The port designations in Tables 12 and 13 indicate the specific application for which the loss plan was developed. These ports may, however, be used for other applications, as long as the resulting gains comply with the FCC rules for through-gain transmission (maximum net amplification between ports) [Ref A4: Section 68.308(b)(5)]

Table 12 - ISPBX Loss Plan for Lines and Private Network Trunks

		[A] ONS	[B] OPS	[C] ICS	[D] A/TT	[E] DAL & IST	[F] ISD/TT	[G] S/ATT	[H] S/DTT
		↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓
[1] ONS	→	6	3	3	3	3	3	3	3
	←	6	3	6	3	6	9	3	3
[2] OPS	→	3	0	-3	2	3	0	2	2
	←	3	0	0	2	6	6	2	2
[3] ICS	→	6	0	0	0	0	0	0	0
	←	3	-3	0	-3	0	0	-3	-3
[4] A/TT	→	3	2	-3	0	0	-3	0	0
	←	3	2	0	0	3	3	0	0
[5] DAL & IST	→	6	6	0	3	0	0	6	6
	←	3	3	0	0	0	0	0	0
[6] ISD/TT	→	9	6	0	3	0	0	6	6
	←	3	0	0	-3	0	0	0	0
[7] S/ATT	→	3	2	-3	0	0	0	0	0
	←	3	2	0	0	6	6	0	0
[8] S/DTT	→	3	2	-3	0	0	0	0	0
	←	3	2	0	0	6	6	0	0
[9] AAL(A)	→	0	0	-6	0/2	-3	-3/0	0	0
					Note 2		Notes 1,2		
	←	0	0	-3	0/2	3	3/6	0	0
[10 AAL(D)	→	3	0	-3	2	0	0/-3	0	0
						Note 7	Note 3		
	←	3	0	0	2	3	6/3	0	0
[11 A/TO Note 4	→	6	3	0	0	-3	-3	3	3
	←	6	3	3	0	3	3	3	3

(Values in dB)

Table 13 - ISPBX Loss Plan for Inter-Access Line Connections

	AAL(A) ↑ ↓	AAL(D) ↑ ↓	DAL ↑ ↓
AAL(A) → ←	0 0	0 0	-3 3
AAL(D) → ←	0 0	0/3 Note 5 0/3	-3/0 Note 6 3/6
DAL → ←	3 -3	3/6 Note 6 -3/0	0 0

Notes on Tables 12 and 13:

(1) The [-3,3] value pair should be provided for connections between an AAL(A) port and a ISD/TT port serving as the interface to a combination tie trunk to a satellite PBX.

(2) It is desirable that the low-loss option ([0,0] or [-3,3]) be used when the ISPBX-network access line loss is greater than or equal to 2 dB and the ERL ≥ {18,13} and SRL ≥ {10,6} measured into a 900 Ω + 2.16 μF termination at the network switch. (The notation {M,L} signifies that the median value is M and the lower limit is L.)

(3) The [0,6] loss pair shall always be provided. The [-3,3] loss pair is a desirable option to be used for internetwork applications in which no significant configuration will encounter echo, stability, or overload problems because of the reduced loss. With the [-3,3] loss pair, subscriber station DTMF signals transmitted through the DEO into the private network might experience nonrecoverable digit mutilation in secondary signaling applications. (DTMF signaling after the connection has been established; e.g., for order entry) because of the 3 dB gain.

(4) This port designation and associated loss requirements are retained for compatibility with remaining analog higher-rank offices in the PSTN. Such offices as well as analog connections to digital higher-rank PSTN offices are expected to be phased out.

(5) Use 3/3 values when either or both analog access lines exceed 1.6 ms round-trip delay (about 40 miles)

(6) Use the 0/6 values for AAL(D) to DAL connections to a local DEO; use -3/3 values for connections to a higher level digital office.

(7) For AAL(D) to IST (private network trunks) only; use Table 13 for AAL(D) to DAL connections

5.2.2 *Digital PBX Loss Plan Assumptions*

The port-to-port losses for ISPBXs were developed based on the loss plans for public and private networks. The ISPBX loss plan is intended to provide satisfactory loss-noise-echo Grade-of-service (GOS) performance and compatibility with the public and private network loss plans.[18] The following assumptions were the prime considerations:

(1) The transmission loss and level plan of the PSTN, which is a hybrid network and is evolving toward an all-digital network with some fixed loss as described in Ref A8, forms a basis for the private network loss plan.

(2) Transmission facilities to be used have losses compatible with the ISPBX port-to-port losses.

(3) ISPBX port-to-port losses associated with analog interfaces (A/TT, AAL(A), A/TO) apply to any trunks with analog terminations at the ISPBX.

(4) ISPBX port-to-port losses associated with digital interfaces (IST, ISD/TT, AAL(D))) apply to any trunks with digital terminations at the ISPBX.

5.2.3 *ISPBX Port Assumptions*

5.2.3.1 *IST Ports*

When connected to a line port (ONS or ICS), the acoustic levels at the IST interface are:

TOLR = -46 dB
ROLR = +51 dB

These levels are consistent with those specified for ISDN terminals (5.2.3.3) and with the Acoustic Reference Level Plan (5.3.2.2). Furthermore, these levels are consistent with the specified digital network interface (NI) levels found in Table 4.2 of Ref A8.

5.2.3.2 *Analog Line Ports*

The ISPBX loss plan is based on 6 dB fixed loss from end PBX to end PBX for digital on-net connections. For the private network to emulate the PSTN, on-premises stations (ONS) and off-premises stations (OPS) ports are class-marked differently, and 3 dB of additional PBX loss is specified for ONS to make ONS loops similar to average end office (EO) loops and to provide sufficient talker echo control. With this 3 dB of added loss, it is assumed that ONS ports at the digital PBX will connect sets having characteristics equivalent to 500-type telephone sets; i.e., such that with loops of 2.74 km (9 kft) of 26 gauge cable and normal battery feed and impedance characteristics, the mean acoustic levels at the EO line interface are:

TOLR = -46 dB
ROLR = +48 dB

Such sets, in conjunction with the short loops, current-limited battery feed, and 600 Ω terminating impedance typical of ONS port, result in ONS port characteristics of TOLR = -50 to -49 dB and ROLR = +44 to +45 dB. For the ISPBX loss plan formulation, the values used are

TOLR = -49 dB
ROLR = +45 dB

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18. Historically, loss on inter-network connections involving PSTN end offices is inserted in the transmission path from the PSTN toward the PBX by the PSTN end office. The value of this inserted loss is dependent upon the particular PSTN configuration. Digital integrity cannot be maintained to a digital PBX when loss is inserted in the transmission path. There are applications that preclude loss insertion by the end office for this reason. The ISPBX loss plan is consistent with the plan for migration of loss beyond the end office (Ref A8). On digital inter-network connections, this is achieved by assigning to the ISPBX the loss normally inserted by the PSTN End Office.

5.2.3.3 *Digital Line Ports*

Digital line ports connect sets that have electro-acoustic characteristics inherent in the set design. The private network loss plan accommodates proprietary digital sets for which the manufacturer may specify the characteristics to suit certain applications or design trade-offs. This accommodation is realized through the application of the ARLP (5.3.2.2). The ISPBX loss plan specifically addresses digital terminals with electro-acoustic characteristics commensurate with the ISDN environment; such terminals are described as ISDN-Compatible Stations (ICS).

The ISDN telephone set transmission performance should emulate that of a 500-type carbon transmitter telephone set on a 2.74 km (9 kft) 26 gauge non-loaded loop. As noted above, for such set/loop combinations the TOLR and ROLR are -46 dB and +48 dB, respectively.

Loss required to control echo in mixed ISDN/non-ISDN connections will be provided in the ISDN station set instead of in the associated digital switch to preserve bit integrity in the digital bit stream to the ISDN station. A single compromise value (nominal 3 dB) of loss will be provided instead of providing a complex capability for switching in 0, 3 or 6 dB of loss as is presently done in Public Switched Telephone Network (PSTN) connections. The 3 dB of loss is added to the ROLR of 48 dB of the 500-type station set to provide an ROLR of 51 dB for the ISDN station set. Thus, the ICS electro-acoustic characteristics are:

TOLR = -46 dB
ROLR = +51 dB

These characteristics result in an Overall Objective Loudness Rating (OOLR) of 5 dB in all-digital connections, regardless of distance or type. This differs from the existing mixed network loss plan for which the OOLR depends on the type of call, type of facilities, and connection configuration (e.g., 2 dB for intra-PBX calls, 8 dB for digital tie trunk calls, assuming ONS characteristics defined above).

5.2.4 *ISPBX Loss Ranges*

The following ranges for the nominal values are allowed for each category of connections.

(1) Station Interface to Station Interface Loss Ranges

(a) The 1-kHz connection loss shall fall within the following ranges:

1) ONS to ONS connections: 4.5 to 7.5 dB

2) ONS to OPS connections: 2.0 to 4.0 dB

3) OPS to OPS connections: 0.0 to 0.5 dB

(b) It is desirable that the 1-kHz connection loss fall within the following ranges:

1) ONS to ONS: 5.5 to 6.5 dB

2) ONS to OPS: 2.5 to 3.5 dB

Note: Loss ranges for connections including ICS ports are under study.

(2) Station Interface to Trunk Interface Loss Ranges

The average 1-kHz loss shall fall within the ranges of loss bounded by the nominal loss values given in Table 12 and those values plus 0.5 dB for all station-to-trunk interface connections.

(3) Trunk Interface to Trunk Interface Loss Ranges

The average 1-kHz loss shall fall within the ranges of loss bounded by the nominal loss given in Tables 12 and 13 and those values plus 0.5 dB.

5.2.5 Loss Variation

Loss (gain) variation is the allowable deviation from the average 1-kHz loss. Loss variation for any particular connection path is the difference between the loss of that connection path and the average 1-kHz loss for the category of connection of concern. Loss variation is measured on all connections through the PBX of the same connection category. It should be noted that, for purposes of loss variation determination, ONS-to-ONS, ONS-to-OPS, and OPS-to-OPS connections shall be treated as separate categories. The 1-kHz loss variation for 95 percent of the connections within each category shall fall within the following mandatory limits; it is a design objective that the variation fall within the desirable limits.

(1) Station-to-Station (ONS and OPS) Connections

Mandatory ± 1.0 dB

Desirable ± 0.3 dB

(2) Station-to-Trunk Connections

Mandatory ± 0.7 dB

Desirable ± 0.4 dB

(3) Trunk-to-Trunk Connections

Mandatory ± 0.7 dB

Desirable ± 0.4 dB

5.2.6 Digital Pad Disabling

When the loss requirements of Tables 12 and 13 are implemented by digital pads, such pads shall be disabled on digital data calls to maintain bit integrity on such calls.

5.3 Interface Levels

5.3.1 Reference Signal Power Levels

5.3.1.1 This subsection describes the standard output signal levels that are recommended at the various analog and digital facility interfaces. The interface levels are significant because all signal power levels for ISPBXs associated with the requirements contained in this standard are written with respect to 0 dBm signal levels at output interfaces. The appropriate translation of the requirements to any other interface level is discussed in each individual subsection.

5.3.1.2 Each interface level is defined in terms of its correspondence to the digital milliwatt (DMW).[19] The relationship to the DMW is that at an analog-to-digital interface, the interface level is defined as the analog signal power, in dBm, which would be converted to the standard digital sequence representing the DMW. In turn, the interface level at a digital-to-analog interface is the analog signal power, in dBm, which would result from D/A conversion of the DMW standard digital sequence. The interface level is intended to be a unitless quantity that represents the relative signal powers (and the A/D, D/A conversion levels) at various points in the switch.

Note: The DMW is not recommended for transmission over DS1 facilities because it could cause frame misalignment in channel banks as well as interference due to its sampling rate harmonic relationship. A related term is the Digital Reference Signal (DRS) which is an encoded representation of a 0 dBm, 1020 (+2/-7) Hz signal. This signal may be transmitted over the network. For reference level purposes, the DRS is the equivalent to

19. DMW is the encoded representation of a 0 dBm, 1004-Hz signal. The standard digital milliwatt sequence and the corresponding analog sine wave have been established by the CCITT (now ITU) in Recommendation G.711 (1984), (Ref A27, Table 6).

the analog milliwatt signal in analog facilities. The use of 1020 Hz as a reference frequency is recommended in ITU-T (formerly, CCITT) Recommendation O.6 (1988), 1020 Hz Reference Test Frequency (Ref A28).

5.3.1.3 For example, the recommended output level for an OPS port is 0. The zero-level designation means that a standard digital milliwatt signal internal to the PBX results in a 0-dBm sine wave outgoing at the OPS interface. Similarly, the output interface level for an ONS line is -3.

5.3.1.4 A standard output signal level is designated at each interface. This output level (OL) represents the standard signal level at which the interface transmits to the facility.

5.3.1.5 For digital interfaces, the values given represent the analog signal power that would result if the digital signal were converted into analog. In addition, the designated levels represent the signal level after insertion of the appropriate value of loss, as indicated in 5.3.1.6.

5.3.1.6 The reference output interface levels (OL) are listed in Table 14 for each interface when connected to the indicated interface port classes. The purpose for designating OLs is that they provide a reference point for other requirements in the standard. They are not, by themselves, a requirement on ISPBXs.

5.3.2 Acoustic Reference Levels

5.3.2.1 Introduction

Achieving satisfactory end-to-end connection acoustic performance is a primary objective of the ISPBX loss plan formulation. In conjunction with terminals for which the electro-acoustic characteristics are defined in applicable standards (Ref A2, A3), the port-to-port electrical loss insertion requirements as specified in the ISPBX Loss Plan (Tables 12 and 13) are designed to meet this objective.

Modern business communications systems combine PBXs with terminals and terminal interfaces possessing a diversity of electro-acoustic characteristics. For such systems, meeting a singular electrical loss insertion algorithm standard will not satisfy the connection objectives. A more flexible technique is to delineate a set of reference acoustic levels at PBX interfaces that would then meet the interface requirements to the PBX independently of the acoustic parameters of terminals connected to that interface. The approach of specifying interface levels and, as a corollary, defining a loss/level plan in such terms is called the Acoustic Reference Level Plan (ARLP).

In actual implementation, the ARLP requirements will be met via a combination of station apparatus electro-acoustic transducer efficiencies and inserted electrical loss in the PBX. With standard (analog) telephone sets, the electrical loss is unchanged from that prescribed by earlier presentations of the ISPBX loss plan (muPBX Port-to-Port Loss, Table 13 in Ref A9). Conversely, the ARLP forms the basis on which the electrical insertion loss values of the ISPBX loss plan (Tables 12 and 13) are formulated.

The electrical loss insertion in the ISPBX loss plan generally assures that adequate echo return losses exist at connection ends. However, since ARLP values by themselves may not ensure the presence of adequate echo return loss, a requirement for minimum echo return loss, looking into the acoustic interface is associated with the level requirements for each interface. This return loss is denoted by ERL(A).

Table 14 - Output Interface Reference Signal Levels

Interface Port Class	Connected to Interface Port Class	Output Level (OL) (dB)
ONS	All other ports	-3
OPS	All other ports	0
ICS	ONS, ICS	0
ICS	OPS	+3
ICS	A/TT	+3
ICS	IST, ISD/TT	0
ICS	S/ATT, S/DTT	+3
ICS	AAL(A)	+3
ICS	AAL(D), ATO	0
A/TT	ONS	0
A/TT	OPS	-2
A/TT	Any tie trunk	0
A/TT	AAL(A)	0 (Note 2)
A/TT	AAL(D)	-2
A/TT	A/TO	0
IST	ONS, ICS	0
IST	OPS	-3
IST	Any tie trunk	0
IST	AAL(A), AAL(D)	0
IST	A/TO	+3
ISD/TT	ONS, OPS	0
ISD/TT	A/TT	+3
ISD/TT	Any tie trunk except A/TT	0
ISD/TT	AAL(A)	+3 (Note 2)
ISD/TT	A/TO	+3
ISD/TT	AAL(D)	0
S/ATT, S/DTT	OPS	-2
S/ATT, S/DTT	All other ports	0
AAL(A) (Note 1)	ONS	+3
AAL(A)	All other ports	0
AAL(D)	Any port	0
A/TO	ONS, OPS	-3
A/TO	A/TT, ISD/TT	0
A/TO	S/ATT S/DTT	-3

Notes on Table 14:

(1) ONS - AAL(A) connections shall have zero loss. To realize zero loss, the ports at each interface must be at the same level. To accomplish this, either the ONS – AAL(A) connection must shift to zero OL or the AAL(A) interface levels must change for ONS vs. OPS connections, as shown here.

(2) This value is predicated on using the low-loss option of the ISPBX port-to-port losses (see Note 2 of Tables 12 and 13).

5.3.2.2 Acoustic Reference Level Plan

The Acoustic Reference Level Plan is illustrated in Fig 41. By specifying acceptable ranges of TOLR and ROLR[20] and minimum values of ERL that a terminal/ISPBX combination provides at each ISPBX interface, satisfactory end-to-end performance can be ensured without specifying terminal characteristics and/or PBX inserted electrical loss.

Interface acoustic reference values for ISPBXs are given in Table 15. These reference values are applicable for proprietary terminals (terminals not designed to the requirements of Ref A2 or Ref A3) connected to the ISPBX. An ISPBX incorporating the electrical losses specified in Table 12 will meet the ARLP interface values given in Table 15 for connections to ISPBX line ports.[21]

5.3.2.3 Acoustic Reference Level Plan Requirements

An ISPBX shall be designed to meet the interface values given in Table 15 within the indicated range for connections to line ports serving proprietary sets (see Application Notes). It is desirable that the ISPBX be designed to meet the nominal ARLP values for TOLR and ROLR at each interface. The ERL values shall be met for every connection at each interface.

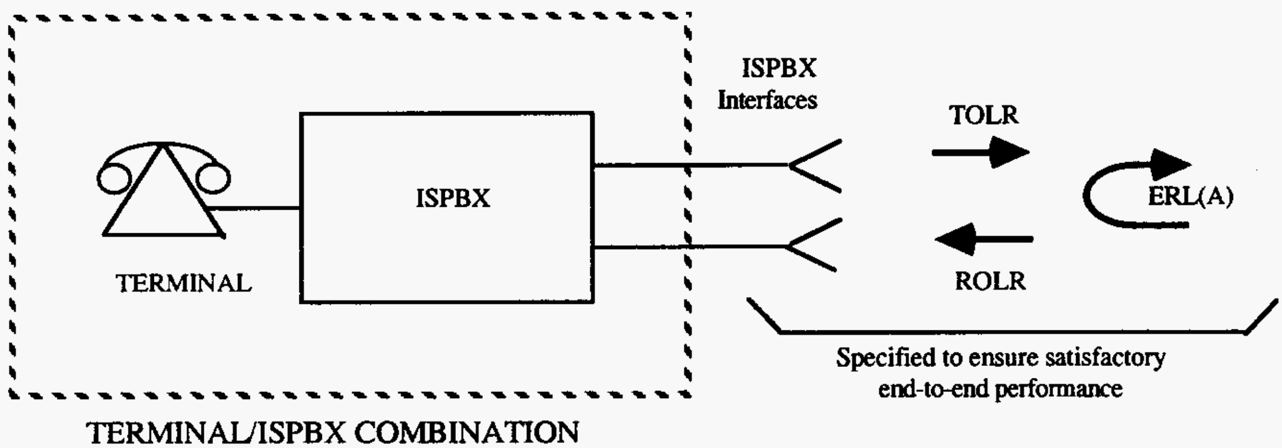


Figure 41 - Acoustic Reference Level Plan

20. TOLR and ROLR are measures of terminal electro-acoustic efficiency. Definitions of TOLR and ROLR are given in Method for Determining Objective Loudness Ratings of Telephone Connections, ANSI/IEEE Standard 661-1979 (Ref A29); applications of TOLR and ROLR are described in Standard Methodology for Specifying Voice Grade Channel Transmission Parameters and Evaluating Connection Transmission Performance for Speech Technology, ANSI/IEEE Standard 823-1989 (Ref A30).

21. For ISD/TT connected to ICS ports, ARLP values are identical to those for IST.

Table 15 - Interface Acoustic Reference Values for ISPBX (Note 1)

ISPBX Interface	Port Designation	TOLR (dB) min.	TOLR (dB) nom.	TOLR (dB) max.	ROLR (dB) min.	ROLR (dB) nom.	ROLR (dB) max.	ERL(A) (dB)
On-premises line (from ONS port — Note 2)	ONS	-48	-43	-38	+46	+51	+56	N/A
On-premises line (from ICS port — Note 2)	ONS	-45	-40	-32	+49	+54	+59	N/A
ISDN-compatible line (including DAL)	ICS	-54	-46	-38	+43	+51	+56	N/A
Off-premises line	OPS	-51	-46	-38	+43	+48	+53	N/A
Analog tie trunk	A/TT	-51	-46	-38	+43	+48	+53	18
Digital tie trunk (Note 3)	ISD/TT	-51	-46	-38	+49	+54	+59	24
Analog Access Line; analog interface	AAL(A)	-54	-49	-41	+40	+45	+50	12
Analog Access Line; digital interface (Note 4)	AAL(D)	-51	-46	-38	+43	+48	+53	18
Analog TO trunk	A/TO	-48	-43	-35	+46	+51	+56	24
Satellite tie trunk	S/ATT, S/DTT	-51	-46	-38	+43	+48	+53	18
Integrated services trunk	IST	-51	-46	-38	+46	+51	+56	21

Notes on Table 15:

(1) The values in this table pertain to connections between the designated interface and an ONS or ICS port. Tolerances on ROLR and on ONS port TOLR are assumed to be ±5.0 dB; to be compatible with the TOLR tolerance range for ISDN terminals in Ref A3, the maximum TOLR values in this table are extended to nominal + 8 dB. For this reason, the TOLR ranges for the two ONS cases (first two rows) are dissimilar.

(2) For an ONS interface, the ARLP requirements differ between connection to another ONS port or to an ICS port; reflecting the intent to align ICS connections to equivalent loudness on intra-PBX connections.

(3) For connections from ICS to ISD/TT, ROLR values are +46, +51, +56 dB, respectively.

(4) The ARLP requirement for the AAL(D) interface is such that it conforms to the criteria for analog access lines in Ref A8; thus, for AAL(D) connections to the PSTN, a DEO inserts the required public network loss (e.g., 6 dB receive-side loss for connections to a digital tandem connecting trunk).

5.4 Loss Parameters

5.4.1 Frequency Response (Attenuation Distortion)

Frequency response requirements are shown pictorially in Figs 42a to 42e. Requirement values for each connection category are tabulated above the figure. All values are stated relative to the loss measured at 1004 Hz. The symbol (+) denotes more loss; the symbol (-) denotes less loss than measured at 1004 Hz.

The frequency response requirements shall be met by 95 percent of the connections for all connection categories.

(1) *Station-to-Station Interfaces and Station-to-2-wire Trunk Interfaces.*

Frequency (Hz)	Frequency response (dB) Min.	Max.
60	+20.0	—
200	0.0	+5.0
300	-0.5	+1.0
3000	-0.5	+1.0
3200	-0.5	+1.5
3400	0.0	+3.0
3400 to 4000	$28\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-28$	—
4000 to 4600	$32\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-28$	—
4600 to 12000	+60.0	—

Points from 60 to 3400 Hz are connected by straight lines on a linear (Response), log (Frequency) plot.

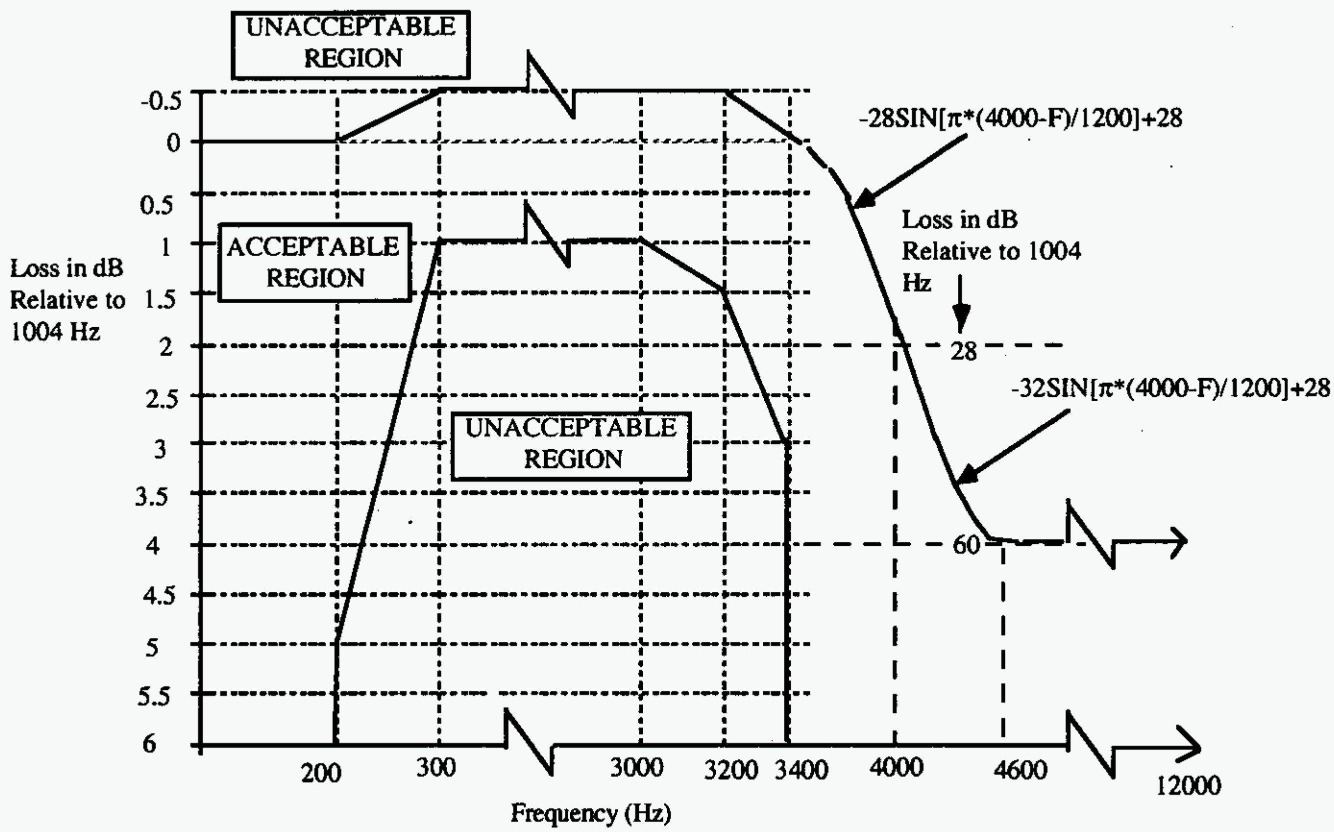


Figure 42a - ISPBX Frequency Response Requirements, 2-Wire to 2-Wire

(2) *Station-to-4-wire Analog Trunk Interfaces and 2-wire Analog Trunk-to-4-wire Analog Trunk Interfaces.*

Frequency (Hz)	Frequency response (dB) Min.	Max.
60	+20.0*	—
200	0.0	+4.0
300	-0.4	+0.65
3000	-0.4	+0.65
3200	-0.4	+1.5
3400	0.0	+3.0
3400 to 4000	$28\sin\left\{\frac{\pi(4000\text{-}F)}{1200}\right\}\text{-}28$	—
4000 to 4600	$32\sin\left\{\frac{\pi(4000\text{-}F)}{1200}\right\}\text{-}28$	—
4600 to 12000	+60.0	—

* 20 dB is the minimum required 60-Hz loss relative to 1 kHz for 2-wire port to 4-wire port connections; for 4-wire port to 2-wire port connections, the minimum required loss is 16 dB.

Points from 60 to 3400 Hz are connected by straight lines on a linear (Response), log (Frequency) plot.

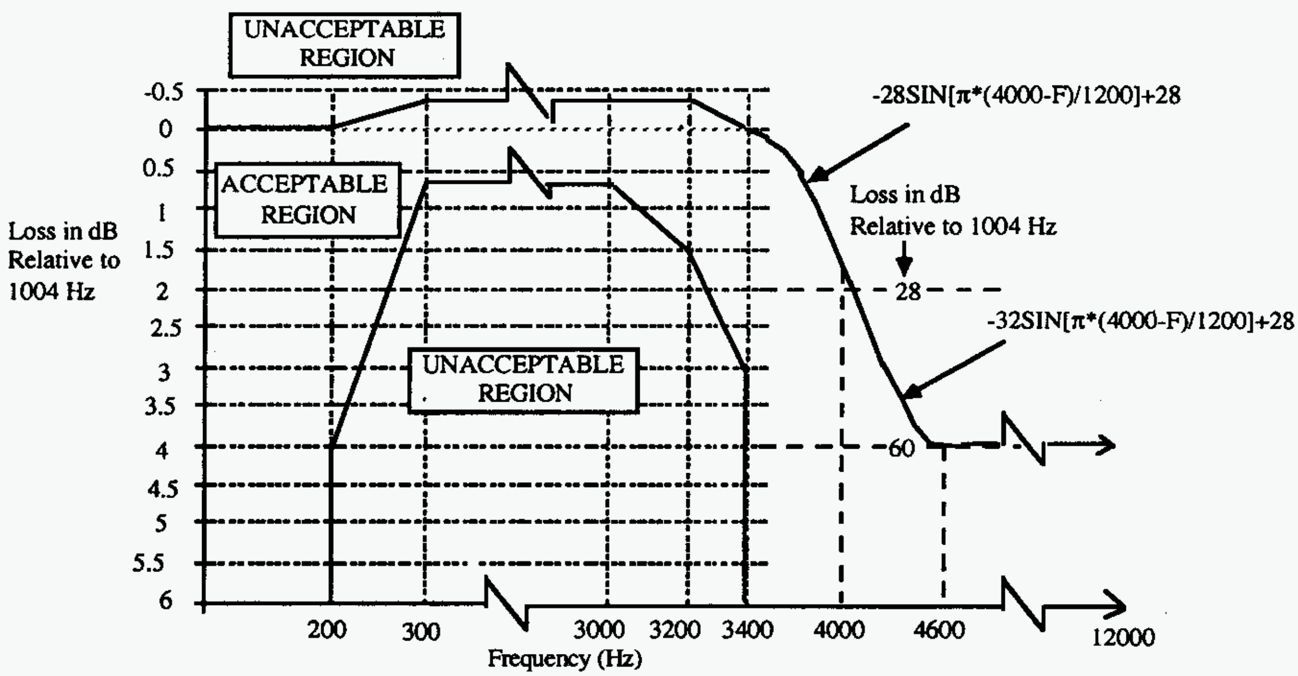


Figure 42b - ISPBX Frequency Response Requirements, 2-Wire to 4-Wire

(3) 4-wire Analog Trunk-to-4-wire Analog Trunk Interfaces.

Frequency (Hz)	Frequency response (dB) Min.	Max.
60	+16.0	—
200	0.0	+3.0
300	-0.3	+0.3
3000	-0.3	+0.3
3200	-0.3	+1.5
3400	0.0	+3.0
3400 to 4000	$28\sin\left\{\frac{\pi(4000\text{-}F)}{1200}\right\}\text{-}28$	—
4000 to 4600	$32\sin\left\{\frac{\pi(4000\text{-}F)}{1200}\right\}\text{-}28$	—
4600 to 12000	+60.0	—

Points from 60 to 3400 Hz are connected by straight lines on a linear (Response), log (Frequency) plot.

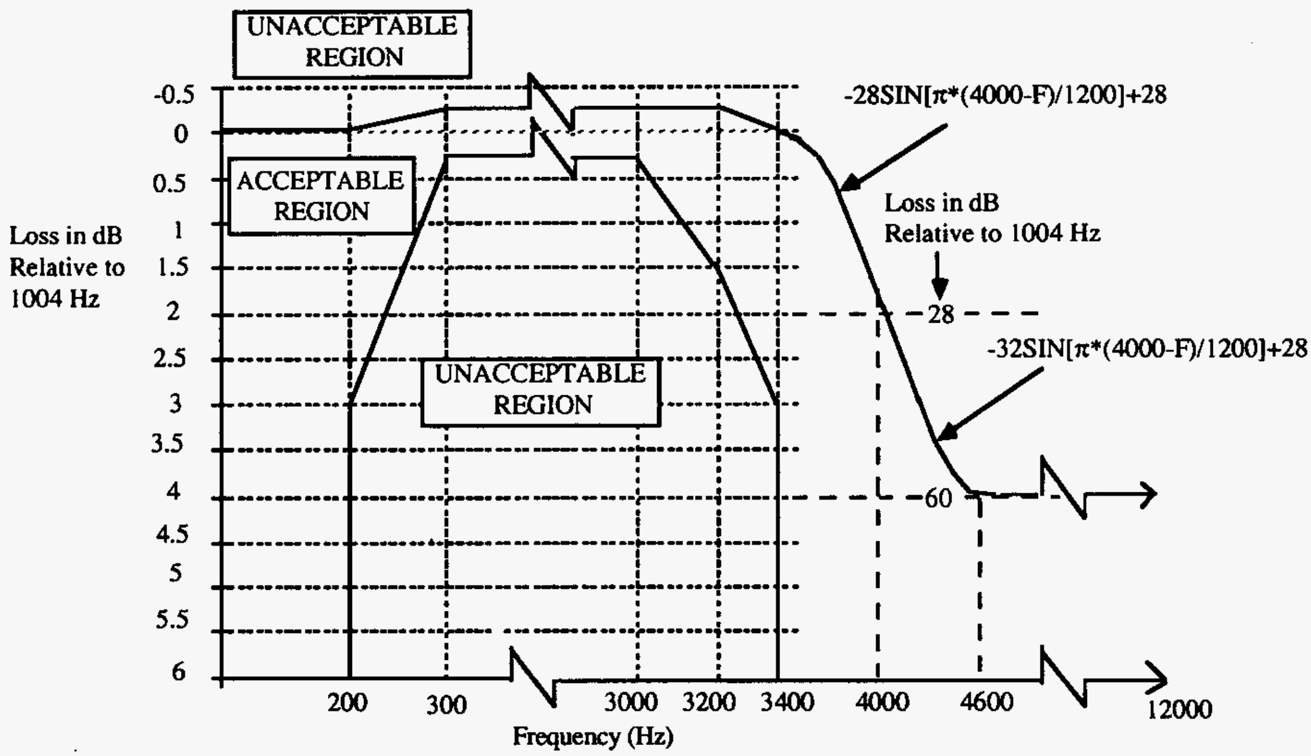


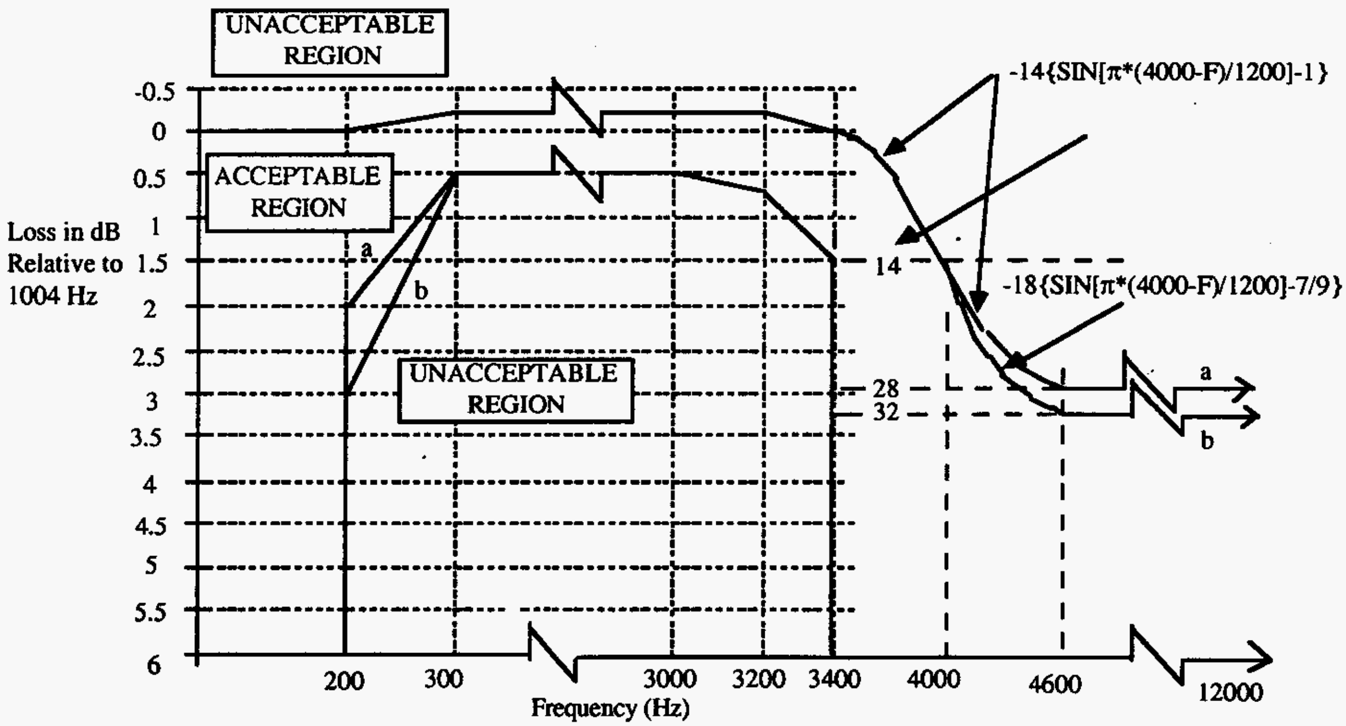
Figure 42c - ISPBX Frequency Response Requirements, 4-Wire to 4-Wire

(4) Station-to-Digital Interfaces and 2-wire Analog Trunk-to-Digital Interfaces.

Frequency (Hz)	Frequency response (dB) Min.	Max.
60	+20.0	—
200 *	0.0	+2.0
300	-0.25	+0.5
3000	-0.25	+0.5
3200	-0.25	+0.75
3400	0.0	+1.5
3400 to 4000	$-14\left[\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-1\right]$	—
4000 to 4600 *	$-14\left[\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-1\right]$	—
4600 to 12000 *	+28.0	—

* For digital-to-analog conversion the values are as shown above. For analog-to-digital conversion, the maximum attenuation value at 200 Hz changes to +3.0 dB and the minimum value curve from 4000 to 4600 Hz changes to $-18\left[\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-\frac{7}{9}\right]$ and from 4600 to 12000 Hz changes to +32.0 dB.

Points from 60 to 3400 Hz are connected by straight lines on a linear (Response), log (Frequency) plot.



a. Digital-to-Station or 2-wire trunk
b. Station or 2-wire trunk-to-digital

Figure 42d - ISPBX Frequency Response Requirements, 2-Wire to Digital

(5) *4-wire Analog Trunk-to-Digital Interfaces.*

Frequency (Hz)	Frequency response (dB)	
	Min.	Max.
60	+16.0	—
200 *	0.0	+1.0
300	-0.15	+0.15
3000	-0.15	+0.15
3200	-0.15	+0.75
3400	0.0	+1.5
3400 to 4000	$-14\left[\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-1\right]$	—
4000 to 4600 *	$-14\left[\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-1\right]$	—
4600 to 12000 *	+28.0	—

* For digital-to-analog conversion the values are as shown above. For analog-to-digital conversion, the maximum attenuation value at 200 Hz changes to +2.0 dB and the minimum value curve from 4000 to 4600 Hz changes to $-18\left[\sin\left\{\frac{\pi(4000-F)}{1200}\right\}-\frac{7}{9}\right]$ and from 4600 to 12000 Hz changes to +32.0 dB.

Points from 60 to 3400 Hz are connected by straight lines on a linear (Response), log (Frequency) plot.

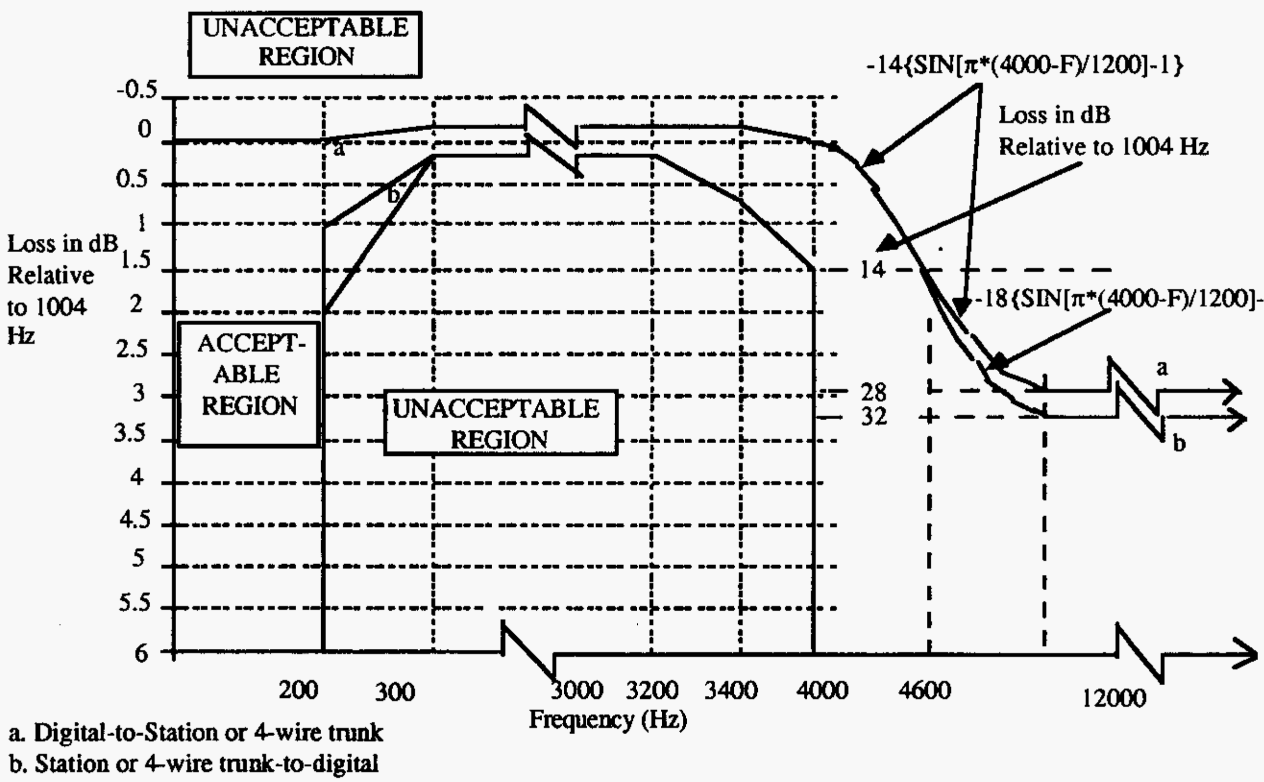


Figure 42e - ISPBX Frequency Response Requirements, 4-Wire to Digital

5.4.2 Overload of ISPBXs

At a zero-level interface (5.1.4.3.1), overload should occur for a sinusoidal signal whose average power is greater than +3 dBm. Minimal overload levels for all ISPBX analog interfaces are listed in Table 16.

Table 16 - Overload Levels at ISPBX Input Interfaces

Interface	Overload Level (dBm)	
	Desirable	Mandatory
ONS	6	3
OPS	3	3
S/ATT	3	3
A/TT	0	0
AAL(A)	0	0
A/TO	0	0

5.4.3 Overload Compression

For 95 percent of station-station, station-trunk, and trunk-trunk connections, the compression of a 1-kHz input signal relative to a 1-kHz, 0-dBm input signal shall not exceed the values shown in Fig 43.

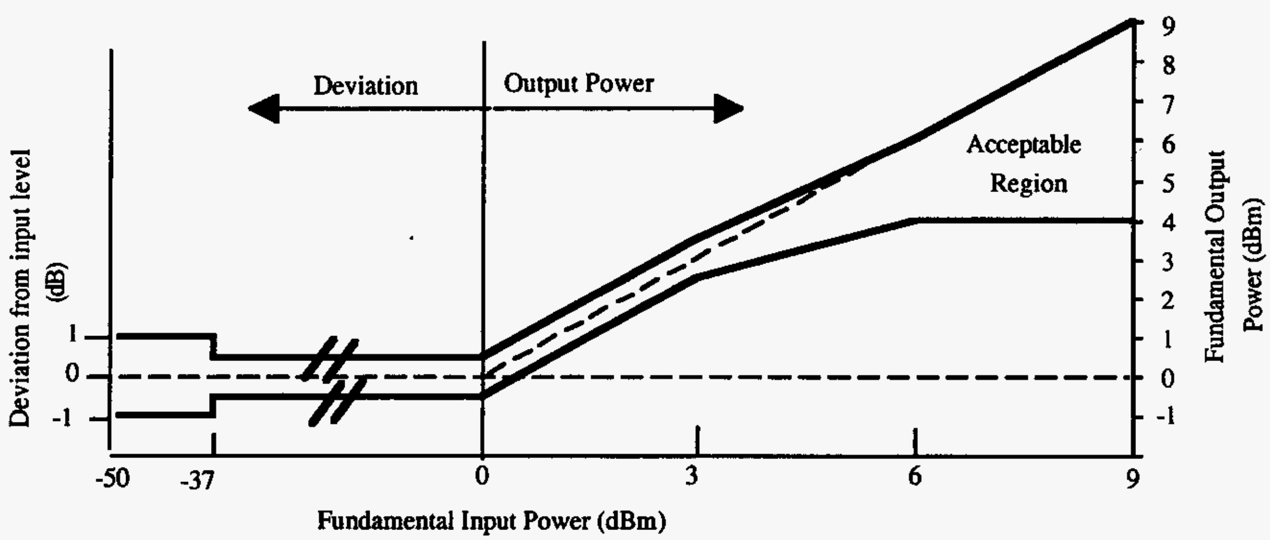


Figure 43 - Overload Compression

5.4.4 Tracking Error

For all PBX connections in each connection category, the tracking error shall not exceed the following limits of Table 17:

Table 17 - ISPBX Tracking Error Limits

(1) Analog-to-Analog Connections

Input Signal	Tracking Error (dB)	
Level Range (dBm)	Maximum (99 percent)	Average
0 to -37	±0.5	±0.25
-37 to -50	±1.0	±0.5

(2) Digital-to-Analog and Analog-to-Digital Connections

Input Signal	Tracking Error (dB)	
Level Range (dBm)	Maximum (99 percent)	Average
0 to -37	±0.25	±0.125
-37 to -50	±0.5	±0.25

5.5 Return Loss, Echo, and Delay

5.5.1 Hybrid Balance Requirements

For each interface, the 2-wire (line side or trunk side) port shall be terminated with the appropriate test termination network (see 5.5.1.1 through 5.5.1.3). The test termination networks should consist of passive elements. The hybrid balance, when measured as described in 5.5.2, shall exceed the values in Table 18 on 95 percent of the interfaces.

5.5.1.1 ONS Station

For on-premises stations, 600 Ω is recommended as the test termination network. This network has been selected to match the distribution of telephone set impedances expected in the PBX on-premises environment.

5.5.1.2 OPS Station/Two-Wire Trunk - Impedance Distribution

For OPS ports and two-wire trunk ports that connect to facilities without line treatment[22], the test termination network shown in Fig 44 is recommended. This network has been found to provide the best single compromise to the distribution of OPS line and 2-wire trunk impedances expected in the North American telephone network.

5.5.1.3 OPS Station/Two-Wire Trunk - Standard Interface

For OPS ports and two-wire trunk ports that connect to facilities with line treatment, a test termination network of 600 Ω is recommended.

22. As used in this context, the term "line treatment" means any equipment (e.g., an impedance compensator, a repeater, or a range extender) that presents a nominal impedance of 600 ohms at the interface connecting to the port.

Table 18 - ISPBX Minimum Hybrid Balance Requirements

Interface	Test Term'n Network	Frequency Band	Minimum Hybrid Balance Requirement	
			Mandatory	Desirable
ONS Lines	600 Ω	500-2500 Hz	22 dB	-
		200-500 Hz	equal to or greater than the values located on a straight line intersecting 17 dB at 200 Hz and 22 dB at 500 Hz	-
		2500-3400 Hz	equal to or greater than the values located on a straight line intersecting 22 dB at 2500 Hz and 17 dB at 3400 Hz (Note)	-
OPS Lines, Network Access Lines, DID, and Tie Trunks	600 Ω or Fig 44	500-2500 Hz	22 dB	-
		200-500 Hz	equal to or greater than the values located on a straight line intersecting 17 dB at 200 Hz and 22 dB at 500 Hz	-
		2500-3400 Hz	equal to or greater than the values located on a straight line intersecting 22 dB at 2500 Hz and 17 dB at 3400 Hz (Note)	-

Note. All points are plotted on a log/linear scale with the impedance values in dB on the linear axis and the frequency in Hz on the logarithmic axis.

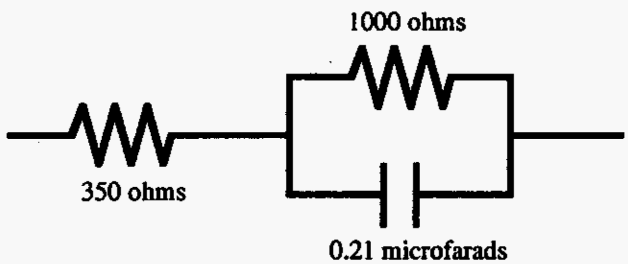


Figure 44 - OPS/2-Wire Trunk Test Termination Network

5.5.2 *Measurement*

The measurement technique described in this section is applicable to line/trunk units that connect to 2-wire analog interfaces.

Examples of test arrangements for testing for compliance with hybrid balance requirements are shown in Figs 45 and 46. In Fig 45, the impedance of the signal generator, Z_G, and the signal detector, Z_O, should match the impedance of the 4-wire port.

These tests can be made with the line/trunk unit in an extender board, or a path can be set up between the line/trunk unit and a 4-wire interface (an analog or digital trunk or a trunk/line maintenance position). If test access is from an analog interface (see Fig 45), the generator impedance (Z_G) and the detector impedance (Z_O) should match the interface impedance (600 Ω). If a digital interface is used (see Fig 46), the detector and generator should be equivalent digital instruments.

Following are the steps for measuring hybrid balance:

1. Measure the 1004-Hz loss, L_1, from the 2-wire port (using a generator with a 600-ohm source impedance) to the receiving 4-wire interface. Also, measure the 1004-Hz loss, L_2, from the sending 4-wire interface to the 2-wire port of the trunk/line unit, with the 2-wire port terminated in 600 Ω.
2. Terminate the 2-wire port of the trunk/line unit with the appropriate test termination network (see 5.5.1.1 to 5.5.1.3).
3. Connect a return loss measuring set (RLMS), conforming to ANSI/IEEE Standard 743-1984, Standard Methods and Equipment for Measuring the Transmission Characteristics of Analog Voice Frequency Circuits (Ref A31) (or an equivalent digital instrument), to the 4-wire interface.
4. Measure Hybrid Balance

   NOTE: For single-frequency measurements, a signal source external to the RLMS may be required. The output of this signal source must be "zeroed" in the RLMS, just as is done with the internal signal when calibrating the set.
5. Determine the adjusted values from the measured values in step 4 by correcting for the losses measured in Step 1:

   $$ERL_{adj} = ERL - (L_1 + L_2)$$

   The single-frequency values are determined in a like manner.
6. The adjusted values of step 5 are used to determine compliance with the Hybrid Balance requirements.

5.5.3 *Input Impedance Requirements*

Requirements are given only for paths through the switch for which the connecting port interface (the interface on the other side of the switch) is 4-wire. In this way, the measured results are independent of any feedback resulting from imperfect balance of the far-end hybrids on 2-wire interfaces. While such imperfect balance does influence 2-wire interface input impedance and loss of the switch when it connects two 2-wire lines, the effects on in-service performance are controlled by having separate requirements for hybrid balance (5.5.1) and insertion loss (5.2.1).

The requirements for the input impedance are given in terms of a reference network and minimum return loss. If the input impedance is denoted by Z_1 and the impedance of the reference network by Z_2, the return loss is defined in Annex D. The return loss is a function of frequency and increases without limit as the input impedance approaches the reference value.

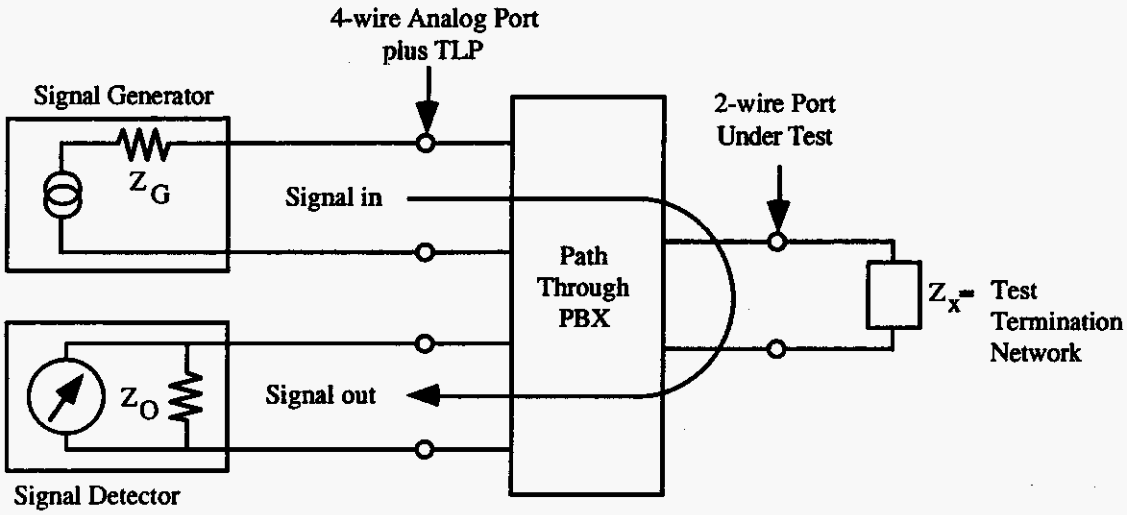


Figure 45 - Equipment Connections for Testing 2-Wire Analog Port Hybrid Balance Using Full Channel Method

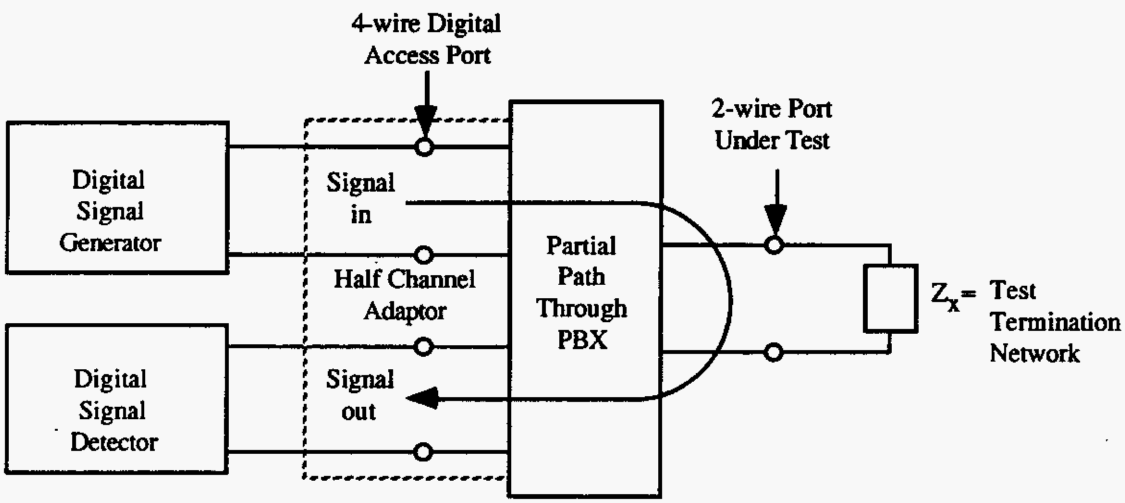


Figure 46 - Equipment Connections for Testing 2-Wire Analog Port Hybrid Balance Using Half Channel Method

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For each 2-wire and 4-wire analog port, the input impedance (Input Z) in terms of return loss, single frequency return loss (SFRL) and echo return loss (ERL) shall exceed the values in Table 19 on 95 percent of the interfaces.

Table 19 - ISPBX Input Impedance Requirements

Interface	Reference Impedance	Frequency Band	Minimum Return Loss Requirement	
			Mandatory	Desirable
ONS/OPS Lines (Note 2)	600 Ω	500-2500 Hz	22 dB	26 dB
		200-500 Hz	equal to or greater than the values located on a straight line intersecting 14 dB at 200 Hz and 22 dB at 500 Hz	equal to or greater than the values located on a straight line intersecting 14 dB at 200 Hz and 26 dB at 500 Hz
		2500-3400 Hz	equal to or greater than the values located on a straight line intersecting 22 dB at 2500 Hz and 14 dB at 3400 Hz (Note 1)	equal to or greater than the values located on a straight line intersecting 26 dB at 2500 Hz and 14 dB at 3400 Hz
ONS/OPS Lines (Note 2)	Complex Impedance (Note 3)	500-2500 Hz	22 dB	-
		200-500 Hz	equal to or greater than the values located on a straight line intersecting 14 dB at 200 Hz and 22 dB at 500 Hz	-
		2500-3400 Hz	equal to or greater than the values located on a straight line intersecting 22 dB at 2500 Hz and 14 dB at 3400 Hz (Note 1)	-
Network Access Lines, DID, and Tie Trunks	600 Ω	500-2500 Hz	22 dB	26 dB
		200-500 Hz	equal to or greater than the values located on a straight line intersecting 14 dB at 200 Hz and 22 dB at 500 Hz	equal to or greater than the values located on a straight line intersecting 14 dB at 200 Hz and 26 dB at 500 Hz
		2500-3400 Hz	equal to or greater than the values located on a straight line intersecting 22 dB at 2500 Hz and 14 dB at 3400 Hz (Note 1)	equal to or greater than the values located on a straight line intersecting 26 dB at 2500 Hz and 14 dB at 3400 Hz

Notes on Table 19:

(1) All points are plotted on a log/linear scale with the impedance values in dB on the linear axis and the frequency in Hz on the logarithmic axis.

(2) ONS ports shall meet the mandatory input impedance requirement when using a reference impedance consisting of either 600 Ω or a complex impedance as described in Note (3). OPS ports shall meet the mandatory input impedance requirement with a reference impedance of 600 Ω and may, optionally, also meet the input impedance requirement with a complex reference impedance.

(3) This option allows flexibility in the design of line input impedance for specific applications or terminations. The recommended reference impedance for measuring the return loss of lines designed with a complex input impedance network is either:

- The network shown in Fig 44, or
- A network consisting of a 275 Ω resistance in series with a parallel circuit of 780 Ω resistance and 0.15 µF capacitance.

Examples of a test arrangements for testing for compliance with the above requirements are shown in Figs 47 through 50 The reference impedances shown in these figures are as indicated in Table 19. For interfaces designed to 600 Ω in series with 2.16 µF capacitance it is appropriate to use a reference impedance of 600 Ω in series with 2.16 µF.

5.5.4 Echo Control Considerations

Private networks should be designed to provide echo control as required for calls associated with ISDN bearer capability coding of either speech or 3.1 kHz audio. In an all-digital private network with digital sets designed to the requirements of Ref A3, echo control is achieved by adherence to the ISPBX Loss Plan (Table 12); no additional echo control is required.

In private networks with mixed analog/digital terminals and facilities, compliance with the ERL requirements of the ARLP (Table 15) will assure adequate echo return loss to allow normal network echo control rules to be applied for calls within the network.

Private network voice calls to or from the PSTN, using ISDN bearer capability coding of either speech or 3.1 kHz audio, should expect normal PSTN echo control treatment.

Hybrid analog/digital calls to or from the PSTN present echo return loss towards the PSTN by meeting the ERL requirements of Table 15. However, such calls are subject to degradation at the digital terminal end due to reflections at an analog far-end termination of the PSTN connection. Thus, such connections may require the application of echo control rules in the private network segment of the connection. This needs to be coordinated with the PSTN service provider according to guidelines in Ref A8.

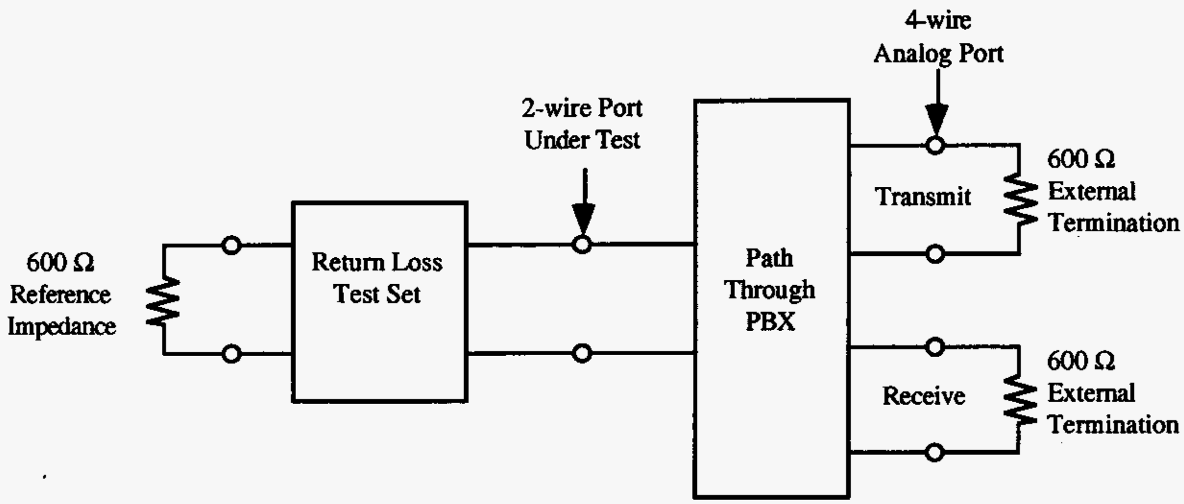


Figure 47 - Equipment Connections for Testing 2-Wire Analog Port Input Impedance Using Full Channel Method

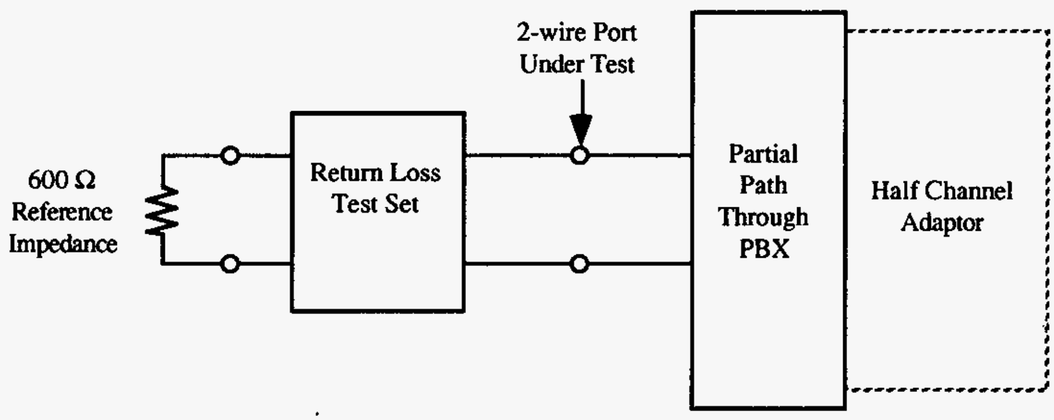


Figure 48 - Equipment Connections for Testing 2-Wire Analog Port Input Impedance Using Half Channel Method

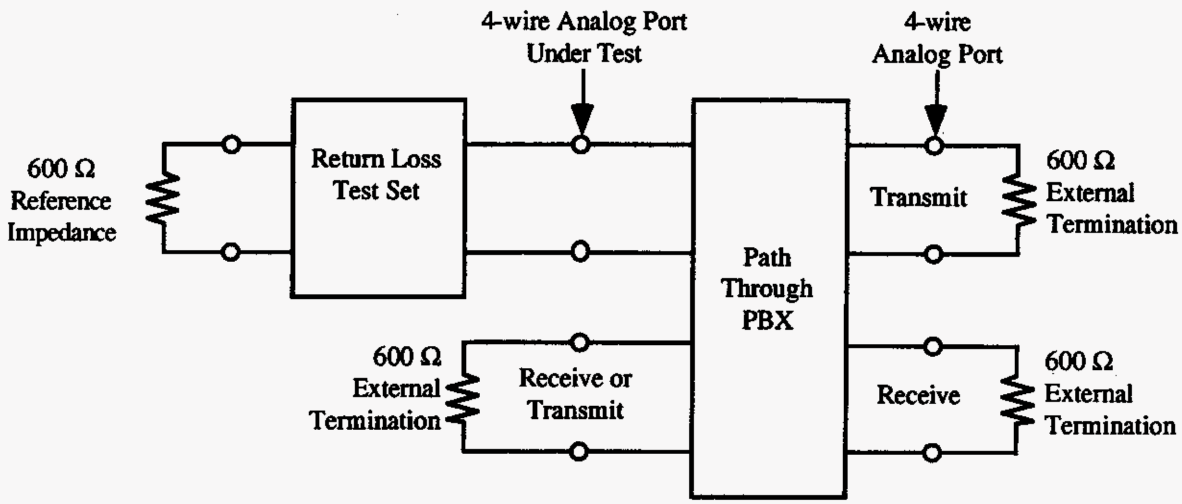


Figure 49 - Equipment Connections for Testing 4-Wire Analog Port Input Impedance Using Full Channel Method

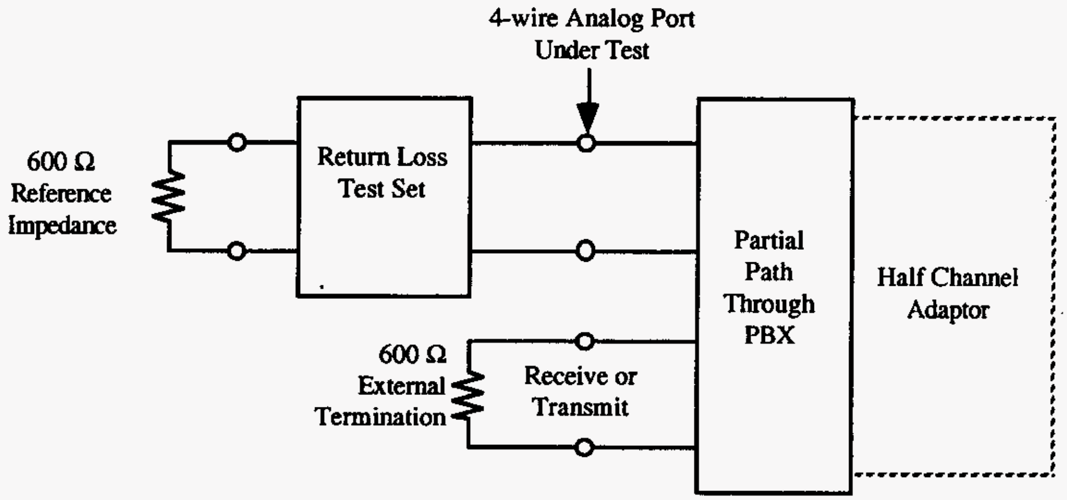


Figure 50 - Equipment Connections for Testing 4-Wire Analog Port Input Impedance Using Half Channel Method

5.5.5 *Echo Path Delay*

The round-trip echo path delay associated with 95 percent or more of all PBX connections in each port-to-port connection category for all frequencies in the range of 300 to 3400 Hz shall be equal to or less than the following values:

Table 20 - Echo Path Delay for ISPBXs

PBX Connection Type Interface-to-Interface	Round-Trip Delay (ms)
Station-to-Station	3.0
Station-to-Analog Trunk	3.0
Analog Trunk-to-Analog Trunk	3.0
Station-to-Digital Interface	2.4
Analog Trunk-to-Digital Interface	2.4
Digital Interface-to-Digital Interface	2.0

5.6 Noise and Distortion Impairments

5.6.1 *Idle-Channel Noise*

Idle-channel noise (noise in the absence of signal) is the short-term, average, absolute noise power as measured with a 3A type noise measuring set or equivalent with flat or C-message weighting. When testing a connection, all analog interfaces, except the one(s) being tested, are terminated with appropriate impedances, and all digital input ports, other than the one(s) being tested, are supplied a digital equivalent of zero V.

5.6.1.1 *C-Message-Weighted Noise*

The maximum (95 percent) C-message-weighted absolute noise power at an interface shall not exceed the values given below. It is desirable that the mean C-message weighted absolute noise power also comply with the values shown in the table. For both maximum and mean C-message-weighted noise, the values apply for the relevant connection category (or categories) regardless of the interface transmission level. The only exception is the AAL(A) interface where noise power up to 3 dB above the stated values is allowed. This is done to accommodate implementations that build gain into circuits associated with this interface. Gain up to 3 dB is permitted by the loss and level transmission plan.

Table 21 - ISPBX C-Message Weighted Noise Requirements

C-Message Weighted Noise (dBrnC) in the Absence of Signal		
Connection Type	Mean (Desirable)	95% (Mandatory)
Analog-to-analog	16	20
Analog-to-digital	15	19
Digital-to-analog	9	13

Compliance with the 13 dBrnC noise requirement for digital-to-analog (D/A) units is to be tested by feeding 19 dBrnC of noise in digital form to the D/A unit input. This can be accomplished as shown in Fig 51. With the switch in position 1, the noise generator output is varied until D/A test set shows 19 dBrnC. With the switch in position 2, the noise measuring set indicator must not exceed 20 dBrnC.

5.6.1.2 3-kHz Flat Noise

(1) The 3-kHz flat weighted noise shall not exceed 39 dBrn on 95 percent of the connections.

(2) The 3-kHz flat weighted noise shall not exceed 35 dBrn on 50 percent of the connections.

For interface transmission levels other than 0 dB, the 3-kHz flat weighted noise requirement should be shifted by a value that corresponds to the difference between the transmission level at that interface and 0 dB.

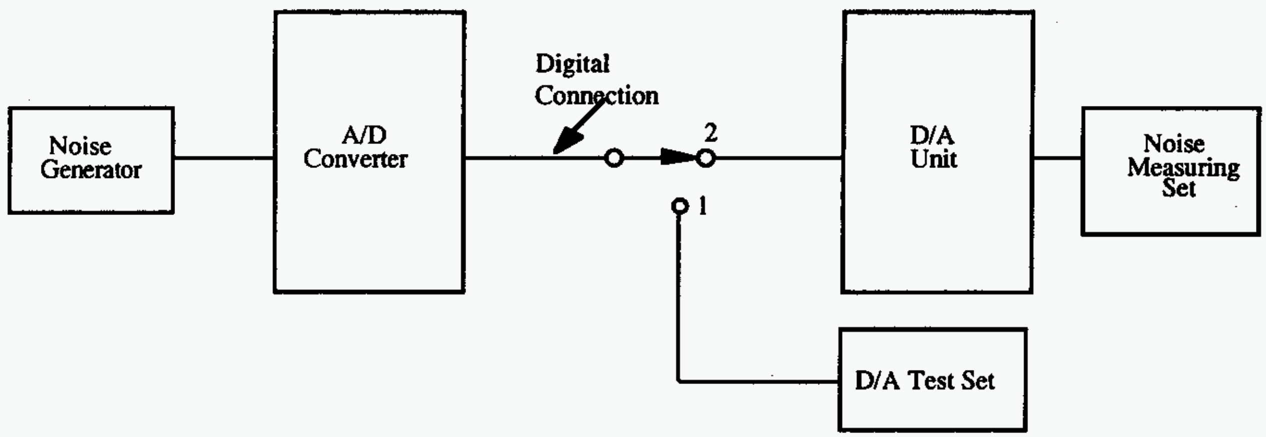


Figure 51 - Idle-Channel Noise Test Arrangement

5.6.2 Longitudinal Balance (Analog Interfaces)

The PBX interfaces that are subject to longitudinal balance requirements include loop/ground start network access lines, reverse battery (DID) trunks, and OPS lines.

5.6.2.1. Longitudinal-to-Metallic Balance

(1) Definition. The longitudinal-to-metallic balance is defined as:

Longitudinal Balance (dB) = 20 log|Vs / Vm|.

where Vs is the disturbing longitudinal voltage and Vm the resulting metallic voltage of the same frequency.

(In this case, the disturbing signal is longitudinal in nature. A low conversion of longitudinal into metallic noise is required to limit noise on the talking circuit.)

(2) Method of Measurement. The test procedure is detailed in Standard Test Procedure for Measurement of Longitudinal Balance of Telephone Equipment in the Voice Band, ANSI/IEEE Standard 455-1985, Standard Test Procedure for Measurement of Longitudinal Balance of Telephone Equipment in the Voice Band (Ref A32). It is recommended that a frequency selective voltmeter is used. These tests shall be conducted for only the off-hook state of the PBX.

(3) Requirement. The longitudinal-to-metallic balance, when measured according to Ref A32 shall meet or exceed the criteria of Table 22.

It is desirable that the average balance be within the region labeled "desirable" in Fig 52.

Table 22 - ISPBX Longitudinal-to-Metallic Balance Requirements

Frequency (Hz)	Minimum Balance (dB)	Average Balance (dB)
200	58	63
500	58	63
1000	58	63
3000	53	58

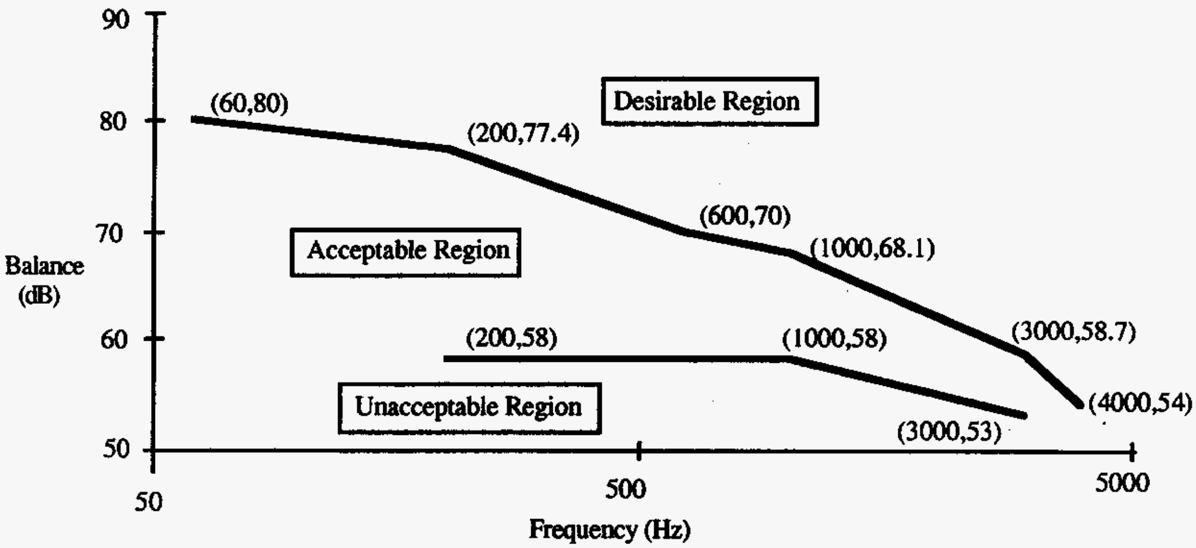


Figure 52 - Longitudinal Balance Limits

5.6.2.2 Transverse Balance (Metallic-to-Longitudinal Balance)

(1) Definition

Transverse balance is defined as:

Transverse Balance (dB) = 20 log |Vm / Vs|

where Vs is the longitudinal rms voltage produced across a 500-ohm longitudinal termination and Vm is the metallic rms voltage across the tip-and-ring interface terminals of the PBX when a voltage (at any frequency in the specified frequency range) is applied from a balanced 600-ohm metallic source. The metallic voltage shall be set so that Vm equals 0.775 V rms (0 dBm) when a 600-ohm termination is substituted for the PBX.

Transverse balance (metallic-to-longitudinal balance) is specified in Part 68 of the FCC Rules and Regulations (Ref A4) to ensure that a metallic signal is not converted into a longitudinal signal that could cause excessive noise in other pairs of a multipair cable.

(2) Method of Measurement. The test procedure is outlined in Part 68 of the FCC Rules and Regulations (Ref A4). A test circuit that satisfies the stated conditions is shown in Fig 53.

(3) Requirements. The minimum transverse balance requirements are given in Table 23. The conditions for performing these measurements on the PBX are:

(a) All values of dc loop current that the interface under test is capable of drawing when connected to the FCC Part 68 loop simulator circuit for CO trunk interfaces or the FCC Part 68 line simulator circuit for OPS and DID interfaces.

(b) All reasonable conditions of application of earth ground to the PBX under test.

(c) All CO trunk or OPS interfaces not under test, terminated in their appropriate networks or in some cases grounded (see (h), below).

(d) All other than CO and OPS interfaces terminated in circuits appropriate to those interfaces.

(e) Both on-hook and off-hook states.

(f) Impedances of the balance test circuit shall be 600 Ω metallic and 500 Ω longitudinal, as in Fig 53.

(g) Termination of all interfaces not being measured shall be as follows:

CO trunk Fig 54

OPS, off-hook Fig 55

OPS, on-hook (unterminated).

(h) For station line interfaces designed to isolate longitudinal currents introduced through premises wiring (fully-protected) or through nonregistered equipment, or both, either the T or R conductor of all ONS station interfaces shall be grounded and the T or R conductors shall be both:

1) Terminated in an impedance that will reflect 600 Ω to the network port to which it is connected for through transmission (see Fig 56).

2) Unterminated.

(i) For station line interfaces not designed to isolate longitudinal currents introduced through premises wiring (unprotected), the T&R conductors of all ONS station interfaces shall be both:

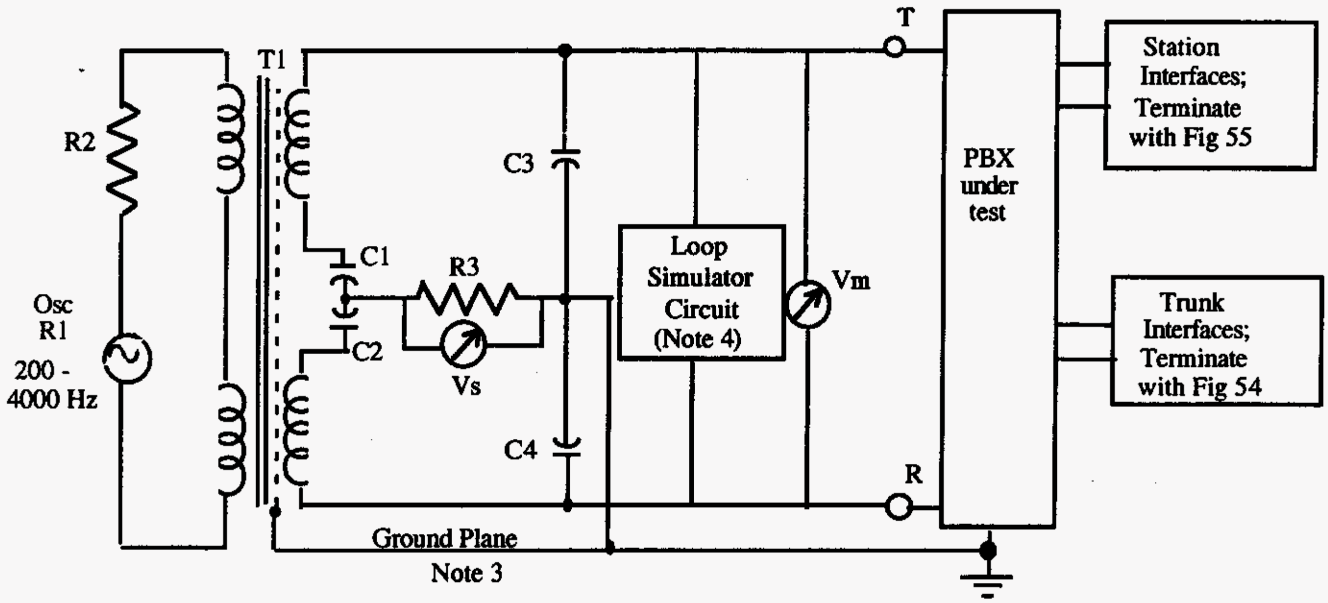
1) Terminated in a metallic resistance of 600 Ω and a longitudinal resistance of 150 Ω (see Fig 55).

2) Unterminated.

(j) The criteria given in Table 23 shall be met for all possible combinations of through transmission paths between CO trunk interfaces and station line interfaces of the PBX.

Table 23 - Transverse Balance Requirements

Interface	State	Frequency Range (Hz)	Minimum Balance (dB)
CO Trunk-Loop Start	On-hook	200-to-1000	60
		1000-to-4000	40
	Off-hook	200-to-4000	40
CO Trunk-Ground Start	Off-hook	200-to-4000	40
Reverse Battery (DID)	Off-hook	200-to-4000	40
OPS Line	Off-hook	200-to-4000	40

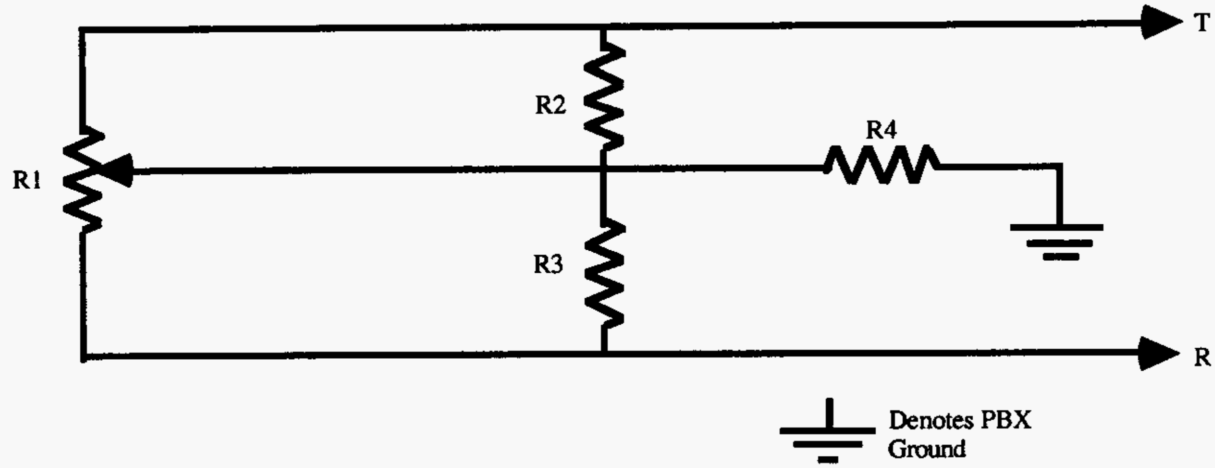


T1 -	WECo #111C or 119E or ADC 118F or equivalent
C1, C2 -	8 μF, 400 V dc, matched to within 0.1 %
C3, C4 -	100 to 500 pF adjustable trimmer capacitors
Osc -	Audio oscillator with source resistance, R1, ≤ 600 Ω
R2 -	Selected such that R1+R2 = 600 Ω
R3 -	500 Ω
⏚ -	PBX Ground

NOTES:

1. Vm shall not be measured at the same time that Vs is measured.
2. Use trimmer capacitors C3 and C4 to balance the test circuit to 20 dB greater balance than the equipment standard for all frequencies specified, with a 600-ohm resistor substituted for the PBX.
3. Exposed conductive surfaces on the exterior of the PBX shall be connected to the ground plane for this test,
4. Use loop simulator of FCC Part 68 for CO trunks with resistor R1 disconnected. Use line simulator of FCC Part 68 for OPS lines and DID trunks with resistor R1 disconnected.

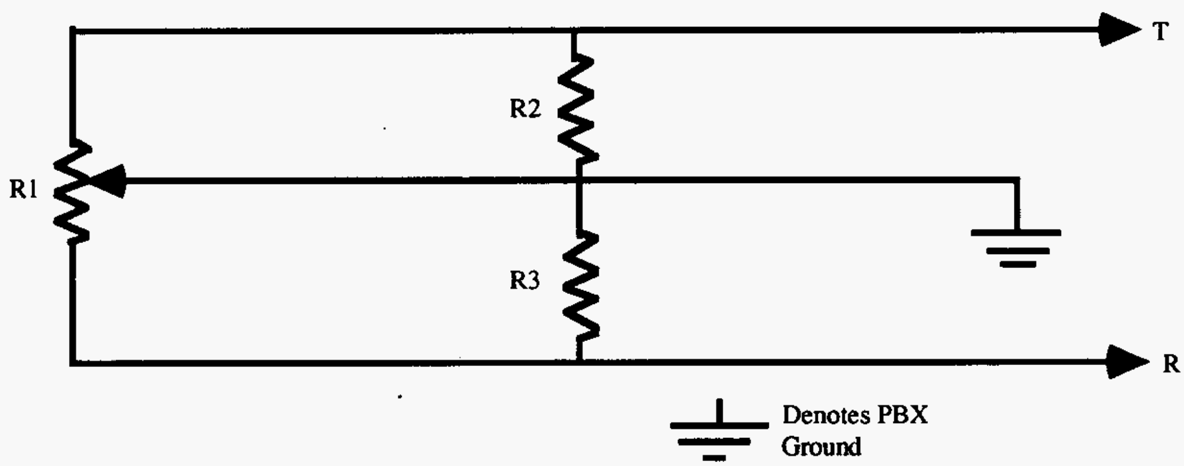
Figure 53 - Transverse Balance Test Circuit



R1 = 300 Kohms
R2, R3 = 300 ohms
R4 = 350 ohms

NOTE: Potentiometer R1 is used to adjust the balance of this termination. R1 shall be adjusted to obtain a balance equal to or greater than 60 dB from 200 to 1000 Hz, and 40 dB from 1000 to 4000 Hz.

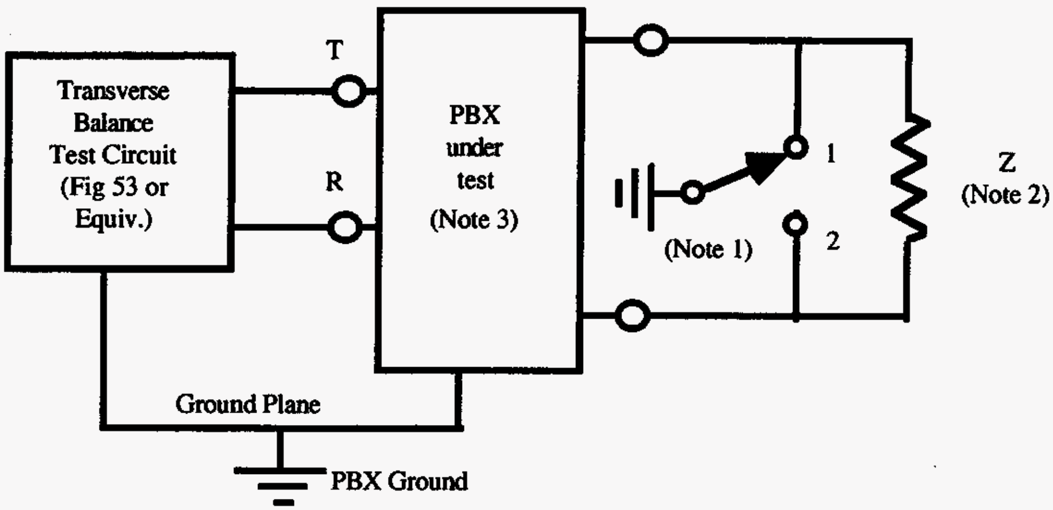
Figure 54 - Off-Hook Termination for CO Trunk Interfaces Not Under Test



R1 = 300 Kohms
R2, R3 = 300 ohms

NOTE: Potentiometer R1 is used to adjust the balance of this termination. R1 shall be adjusted to obtain a balance equal to or greater than 60 dB from 200 to 1000 Hz, and 40 dB from 1000 to 4000 Hz.

Figure 55 - Off-Hook Termination for OPS or Unprotected ONS Interfaces Not Under Test



NOTES:

1. The switch shall be positioned as specified in 5.6.2.2 (3) (h).
2. The value of Z shall be selected so as to reflect 600 Ω at the T&R interface.
3. Exposed conductive surfaces on the exterior of the PBX shall be connected to the ground plane for this test.

Figure 56 - Test Termination Arrangement for Station Interfaces with Longitudinal Current Isolation

5.6.3 Crosstalk

5.6.3.1 Requirement

The crosstalk coupling loss for every combination of through connections of all interface categories, over the 200-to 3200-Hz frequency band, shall comply with the following criteria:

(1) The crosstalk coupling loss between any established connection through the PBX and at least 95 percent of all other through connections shall be at least 75 dB, and it is desirable that this loss be at least 80 dB.

(2) The crosstalk coupling loss between any established connection through the PBX and any other through connection shall be at least 70 dB.

5.6.3.2 Test Arrangement

A test arrangement for measuring crosstalk coupling loss is shown in Fig 57. It may be desirable when making crosstalk measurements, that a 10-dBrnC level of noise exist at the input interface of the disturbed connection.

5.6.3.3 Procedure

(1) Vary resistors R1 through R4 (referring to Fig 57) to obtain the full loop current ranges specified for the PBX interfaces under test, as measured by the 0-200 mA dc meters.

(2) Calibrate the 600-ohm oscillator at 1004 Hz to a level of 0 dBm into a separate 600-ohm resistor. Then, reconnect the oscillator, without changing its level, into the test circuit as shown in Fig 57.

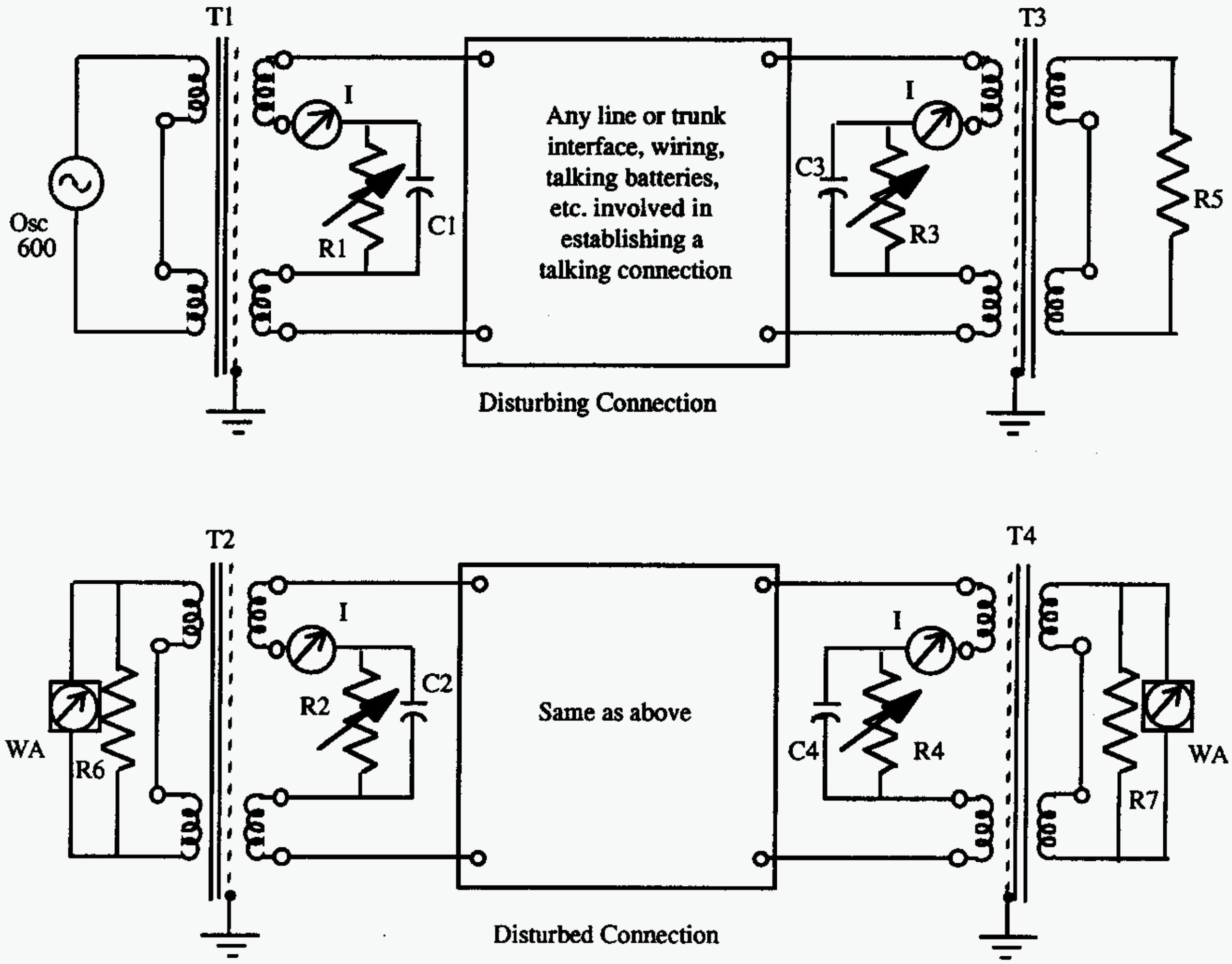
(3) Take readings on both wave analyzers in the disturbed connections:

- (a) Select the higher power reading and subtract it from the calibrated level of the oscillator. The result is value A.
- (b) Interchange the oscillator and load resistor R5 and repeat (a). The result is value B.
- (c) Interchange the disturbing and disturbed connections and repeat (a) and (b). The results are values C and D.
- (d) Select the lowest power value of A, B, C, and D. This is the value of crosstalk coupling loss for that pair of connections.

(4) Repeat (3) for all frequencies over the range 200-to-3200 Hz.

(5) Repeat (4) for all loop current values according to (1).

(6) Repeat (5) for all pairs of connections of the PBX.



R1 to R4: 2000Ω C1 to C4: 10µF, 400 V dc T1 to T4: Zin = Zout
R5 to R7: 600Ω I: Meter, 0-200 mA dc
T1 to T4: WeCo #111C or 119E or ADC 118F or equivalent

WA: Wave Analyzer (H.P. 302A or Equiv.)
Osc: Oscillator (H.P. 204 or Equiv.)

Figure 57 - Crosstalk Coupling Loss Test Circuit for PBXs

5.6.4 Quantization Distortion

Ninety-five percent or more of all of the connections in each connection category shall comply with the following requirements. The signal level-to-distortion level ratio shall equal or exceed (numerically) the following mandatory values for 1004-Hz sinewave input signal levels and C-message-weighted output (distortion) levels.

Table 24 - ISPBX Quantization Distortion Requirements

(1) Analog-to-Analog Connection

Input Signal Level (dBm)	Input/Output Level Ratio Mandatory	Desirable
0 to -30	33	37
-40	27	31
-45	22	26

(2) Digital-to-Analog and Analog-to-Digital Connections

Input Signal Level (dBm)	Input/Output Level Ratio Mandatory	Desirable
0 to -30	35	–
-40	29	–
-45	25	–

For PBXs having other than 0-dBm transmission level, sinewave input levels given above shall be shifted by an amount corresponding to the difference between the actual TLP used and 0 dBm. The input/output level ratio values given above will not change for such cases.

5.6.5 Single-Frequency Distortion

Ninety-five percent or more of all connections in each connection category shall comply with the following distortion limit:

For input signals at a constant 0-dBm level and any single frequency in the range of 0 to 12 kHz, the corresponding output signal power level at any other single frequency shall not exceed -28 dBm.[23]

For PBXs having other than +3 dBm overload point, the power level of the input signal and the distortion limit level shall be shifted by an amount corresponding to the difference between the actual overload point used and +3.dBm.

5.7 Other Impairments

The following requirements shall only apply to PBXs intended to pass voiceband data with transmission rates up to and including 14,000 bps (V32 bis). The following requirements are given, in addition to the voice requirements, to verify that the PBX will function in a manner that will not be seen as an impairment to the performance of voiceband data modems.

23. The -28 dBm limit is dependent upon the characteristics of the transmit and receive filters of the PBX. In the 0- to 3400-Hz frequency range, the limit value is influenced by the characteristics of the receive filter; in the 3400- to 4600-Hz range the limit value is dependent upon both transmit and receive filters; and in the 4600-Hz to 12-kHz range, the limit value is dependent upon the characteristics of the transmit filter and should be -32 dBm.

5.7.1 *Intermodulation Distortion*

5.7.1.1 Intermodulation or harmonic distortion is caused by nonlinearities present in the electric-to-electric transfer function of the PBX. This form of distortion is of primary concern to the transmission of data.

5.7.1.2 Intermodulation distortion is measured using the four-tone method that employs two pairs of equal-level tones transmitted at a total, composite power level of -13 dBm. One pair consists of the frequencies 857 and 863 Hz; the second pair uses the frequencies 1372 and 1388 Hz.

5.7.1.3 Intermodulation distortion is measured as the second- and third-order products resulting from the application of the four tones. The second- and third-order products are denoted as R2 and R3, respectively. R2 is the average power level in the 503-to-537 Hz and 2223-to-2257 Hz frequency bands, expressed in dB below the received power level. R3 is the total power level in the 1877-to-1923 Hz frequency band, expressed in dB below the received power level.

5.7.1.4 At input port signal power levels other than 0 dBm, the four-tone signal power levels shall be shifted by a value that corresponds to the difference between the signal level at the interface and 0 dBm. Since the R2 and R3 products are expressed in dB below the received signal level, their values are not affected by non-zero reference signal levels.

5.7.1.5 The intermodulation distortion limits on 95 percent or more of all connections within each category shall meet or exceed the values given in Table 25.

Table 25 - Intermodulation Distortion Limits for PBXs

Connection Interface Categories	Distortion Limits (dB below received level)	
	R2	R3
(1) ISPBXs (up to 4.8 kb/s data) (all ports)	39	51
(2) ISPBXs (up to 9.6 kb/s data) (all ports)	46	56

The distortion limits given in Table 25 (1) above are intended to represent satisfactory transmission of data at rates up to 4.8 kb/s.

ISPBXs designed to transmit data up to 9.6 kb/s shall comply with the intermodulation distortion limits given in Table 25 (2).

5.7.2 *Envelope Delay*

5.7.2.1 *Definitions*

Envelope Delay (ED) of a system is the propagation time through the system of a low-frequency sinusoidal envelope of an amplitude modulated sinusoidal carrier. If the frequency range of interest is denoted by R[24], the carrier frequency is varied throughout R to obtain the ED as a function of frequency. The carrier is 50 percent amplitude-modulated with a sinusoidal signal of frequency 83.3 Hz.

24. A general symbol R is used here because the frequency range of interest may change with application. For example, for mandatory requirements of this section R = [800 Hz, 2700 Hz], while for objective requirements R = [500 Hz, 3000 Hz].

Relative Envelope Delay (RED) is the difference between the ED at a given frequency f and the global minimum ED within the range R.

5.7.2.2 Relative Envelope Delay (RED) Requirements

(1) Station Interface-to-Trunk Interface and Trunk Interface-to-Trunk Interface

On 95 percent of the connections of this type

— in the frequency range from 800 Hz through 2700 Hz, the RED curve shall lie below curve A in Fig 58;

— it is desirable that in the frequency range from 500 Hz through 3000 Hz, the RED curve lie below curve B in Fig 58.

(2) Station Interface-to-Station Interface

The requirements for this connection allow twice the RED of those in 5.7.2.2(1). More precisely, let A' be a curve obtained by multiplying by 2 each ordinate of the curve A in Fig 58 and let B' be a curve obtained by multiplying by 2 each ordinate of the curve B in Fig 58. Then the RED requirements for connections of this type are obtained from those in 5.7.2.2(1) by substituting A' for A and B' for B.

5.7.3 Absolute Delay

The absolute delay in all port-to-port paths shall be less than 1.5 ms.

5.7.4 Impulse Noise

The following impulse noise limits shall be met under fully loaded busy-hour PBX traffic conditions.

(1) On 95 percent or more of all connections through each connection category, the impulse noise level shall not exceed zero counts above 55 dBrnC over a measurement interval of five minutes.

(2) It is desirable that the impulse noise level not exceed zero counts above 47 dBrnC over a measurement interval of five minutes.

5.7.5 Jitter

Jitter on a port-to-port connection shall not exceed 2 degrees within the 4- to-300 Hz frequency band.

5.7.6 Gain Hit

There shall be no more than one gain hit per hour at a threshold level of 3 dB. If there is more than one hit in a period of 1 hour, the subsequent hour shall have zero hits. A gain hit is an incidental modulation resulting in a rapid positive or negative shift of signal gain lasting for a period of at least 4 ms.

5.7.7 Phase Hit

There shall be no more than one phase hit per hour exceeding a threshold of 20 degrees. If there is more than one phase hit in a period of 1 hour, the subsequent hour shall have zero hits. A phase hit is an incidental modulation resulting in a rapid positive or negative shift of signal phase lasting for a period of at least 4 ms.

5.7.8 *Dropout*

There shall be no more than one dropout per hour exceeding a threshold of 6 dB. If there is more than one dropout in a period of 1 hour, the subsequent hour shall have zero dropouts. A dropout is a negative gain hit lasting a period of at least 10 ms.

5.7.9 *Peak Power to Average Power Ratio (P/AR)*

The PBX shall pass a signal, analog port to analog port, with a P/AR with a ratio of =95.

P/AR = 100 x ((2Ep/EFWA)-1) where Ep is the normalized peak and EFWA is the normalized full rectified average of the envelope.

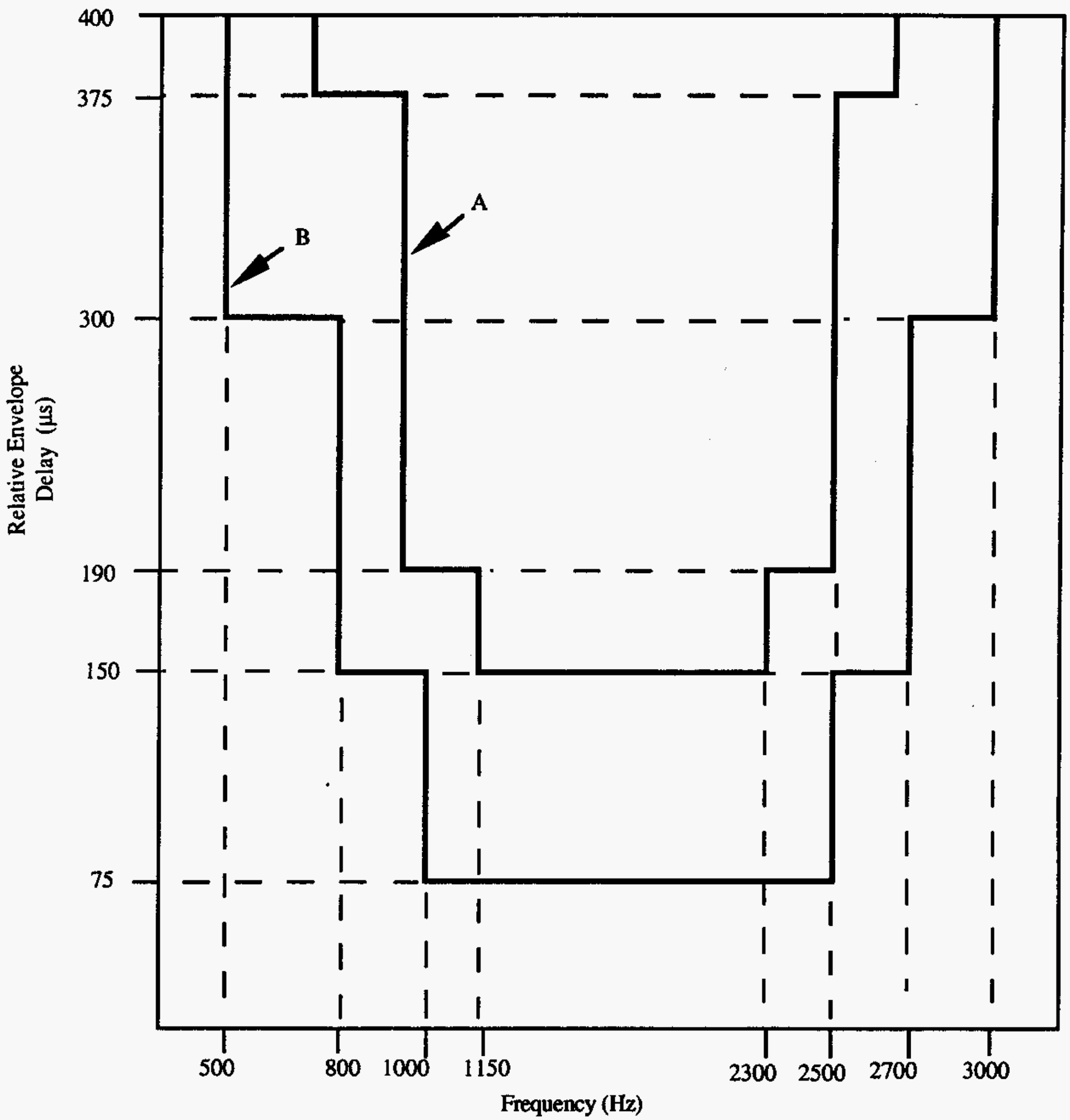


Figure 58 - Relative Envelope Delay vs. Frequency

5.8 Digital Data Transmission Through The ISPBX

The following requirements shall apply to ISPBXs intended to switch data in a digital form. Such PBX's have port that are equipped with standard data interfaces, such as RS-232C, V.35, RS-423. The following requirements are given, in addition to the voice requirements, to verify that the PBX will function in a manner that will not be seen as an impairment to the performance of data transfer.

5.8.1 Data Path Characteristics

5.8.1.1 Data Transparency

The PBX shall provide at the output, once the connection has been established, the same data bit stream order and timing as that of the input data unless protocol conversion is applied to the data within the PBX. The data port-to-port compatible data port path that is provided by the ISPBX shall pass any valid user data transparently or pass the data through a protocol conversion in a manner that will retain the effective (virtual) data transparency, integrity and error rate requirements of 5.8.1.1.

5.8.1.2 Throughput

The data port to compatible data port path shall be capable of providing a user data throughput rate in both directions equal to each of the bit rate specified for the PBX on a continuous basis. Data should be transmitted through the PBX in a manner that will maintain the clocking and timing information inherent in the input data as required in the appropriate data standard.

5.8.1.3 Continuity of Permanent Data Connections

There shall be:

a) no minimum duration of call for the data connection through the PBX when permanent data connection (i.e., calls can be "nailed-up" on a permanent basis) is a feature and assigned as such, or:

b) a statement that a permanent connection is not a feature of the equipment and the specification for the maximum time that a data connection can be maintained.

Permanent data connections shall have the ability to re-establish connection and data traffic without human intervention after any restarts or maintenance testing of the PBX that may interrupt the connection

5.8.1.4 Bit Error Rate Test (BERT).

The data port to compatible data port path that is provided by the ISPBX shall exhibit a bit error rate of less than one error in 1 x 108 bits at the highest stated bit rate of the ports.

5.8.2 Messages for Call Progress

For all digital data connection the PBX shall provide the following indicators defined in Table 26 or equivalent by such means as visual indications, screen messages (text or icons), or audio signals. These indicators allow the data user to be as informed in a similar manner as a voice user of the PBX of call's progress within the PBX.

Table 26 - Call Progress Messages for Digital Data

INDICATOR	INFORMATION
1) IDLE AND AVAILABLE FOR USE	to a data terminal when the data link for that data terminal is operative
2) OUT OF SERVICE	to a data terminal when the data link for that data terminal is inoperative
3) CONNECT	to both the originating and terminating data terminals when a data path has been successfully established between originating and terminating data terminals
4) NO CONNECT	to the originating data terminal when a call attempt to a terminating data terminal is unsuccessful
5) DESTINATION BUSY	to an originating data terminal when the called data terminal is busy
6) LOCAL PROCEDURE ERROR	to an originating data terminal during call set-up when either a nonexistent command or a time-out has occurred
7) ADDRESS NOT OBTAINABLE	to the originating data terminal when called address is not enabled for call receipt
8) ACCESS BARRED	to the originating data terminal when the called address is barred
9) OUT OF ORDER	to the originating data terminal when the called data terminal, within the PBX, is inoperable; or the data interface is busied out in the PBX
10) DISCONNECT	to the data terminal that initiates the disconnect command
11) REMOTE DISCONNECT	to a data terminal when the other data terminal that is attached to another interface of the PBX in a session originates a disconnect.

Notes on Table 26:

1. If a call was made from outside of the digital portion of the PBX through the use of a modem then, in addition to the requirements in 5.8.2, all the modems protocol would be carried transparently to the terminal attached to the PBX.
2. The Hayes Standard AT Command Set has become a recognized data industry standard and should be considered in the design of the indicators.

5.9 Signal Levels

The ISPBX shall comply with FCC Rules and Regulations Part 68 (Ref A4), section 68.308, for the following signal level limitations:

(1) In-band Signal Power Limits
   (a) Internal Signal Sources Not intended for Network Control Signaling
   (b) Internal Signal Sources Intended Primarily for Network Control Signaling
   (c) Through Transmission
   (d) Idle State Circuit Stability for Tie Trunks
   (e) Metallic Signal Power at Frequencies in the range 3995 to 4005 Hz
   (f) Longitudinal Voltage in the 100- to 4000-Hz Frequency Range
(2) Out-of-Band Signal Voltage Limits
   (a) Metallic Voltage
   (b) Longitudinal Voltage

The above listed signal limitations shall apply to:

(1) Analog Access Lines with analog ISPBX interface (ground start, loop start, DID)
(2) OPS Lines
(3) Analog Tie Trunks

6 SIGNALING REQUIREMENTS

6.1 Network Signaling - Analog

This section covers address signaling using in-band tones. Although address signaling using dial pulsing (DP) is still in widespread use, current PBX signaling development is primarily directed towards tone signaling. The mature state of DP technology and requirements make it appropriate to lists such requirements in a normative annex (Annex E). This section covers requirements for Dual Tone Multifrequency Signaling (DTMF).

In many cases, tone signals are used for signaling in the network. Therefore, tone signals sent by the calling PBX toward the network between the end of dialing and the end of call-processing may interfere with network signaling. The PBX should not send voiceband signals during the call-processing state.

6.1.1 Definition

Dual Tone Multifrequency (DTMF) address signaling is a method of signaling using the voice transmission path. This method employs twelve distinct signals, each composed of two voiceband frequencies, one from each of two geometrically-spaced groups designated "low group" and "high group." The selected spacing assures that no two frequencies of any group combination are harmonically related. A fourth high-group frequency (1633 Hz) used in certain special applications is not covered in this standard.

6.1.2 Criteria for DTMF Signal Processing

The following criteria are intended to ensure that DTMF signals received at and transmitted by the PBX will provide reliable service in accomplishing the following functions:

(1) Process signaling through the voice transmission path from terminal equipment to DTMF receivers in the PBX.

(2) Process signaling through the voice transmission path from the PBX to network equipment DTMF receivers.

(3) Process address signaling through the voice transmission path from network DTMF senders to DTMF receivers in the PBX.

6.1.3 Signaling Frequencies

DTMF signals shall consist of two sinusoidal tones, one from a high group of three frequencies and one from a low group of four frequencies, which represent each of the characters shown below:

		Nominal High Group Frequencies (Hz)		
		1209	1336	1477
Nominal Low Group Frequencies (Hz)	697	1	2	3
	770	4	5	6
	852	7	8	9
	941	*	0	#

6.1.4 *DTMF Generator Characteristics*

DTMF signals shall have the following characteristics when measured into a 600-ohm resistive test termination on the tip and ring conductors at the network interface.

6.1.4.1 *Signal Levels*

DTMF generators shall have the following steady state power levels:

Per frequency, nominal	-6 to -4 dBm
Per frequency, minimum, low group	-10 dBm
Per frequency, minimum, high group	-8 dBm
Per frequency pair, maximum	+1 dBm
Per frequency pair, desirable maximum	0 dBm

The maximum difference in power level between the frequency components of a frequency pair shall not exceed 4 dB, and the level of the high-frequency component shall equal or exceed the level of the low-frequency component.[25]

6.1.4.2 *Frequency Deviation*

The frequency components shall be within 1.5 percent of their nominal values (6.1.3).

6.1.4.3 *Pulsing Timing for DTMF Signals*

Duration time of the elements of the DTMF signal cycle are defined as follows:

— Rise Time

The time interval that begins when either frequency of the frequency pair exceeds -55 dBm and ends when both frequencies of the pair exceed 90 percent of their respective steady-state amplitudes. Rise time starts when the signal-off time ends.

— Pulse Duration

The time interval that begins when the amplitude of the last frequency of the frequency pair exceeds 90 percent of that frequency's steady-state value and ends when either frequency amplitude falls below 90 percent of its respective steady state value. Pulse duration starts when the rise time ends.

— Fall Time

The time interval that begins when the pulse duration ends and ends when both frequencies of the pair fall below -55 dBm.

— Signal-Off Time

The time interval that starts when the fall time ends and ends when the rise time of the next pulse starts.

— Interdigital Interval

The sum of the fall time, signal-off time, and rise time. The interdigital interval starts when the pulse duration ends.

— Cycle Time

The sum of the pulse duration and the interdigital interval.

25. Many countries require that the level of the higher frequency must be 2±1 dB higher than the lower one.

Signal timing and pulsing rate (recommended range for DTMF sending is 7 to 10 digits per second) for DTMF senders shall be as follows:

Cycle time, minimum	100 ms
Duration of two-frequency signal, minimum	50 ms
Signal-off time, minimum	45 ms
Interdigital interval, maximum	3 s
Rise Time, maximum	5 ms

The first digit shall be outpulsed between 70 ms and 5 seconds after reception of dial tone. With ground start operation, the network tip ground alone shall not be used as a start dial signal. In ground start operation with network switches in which dial tone and tip ground appear simultaneously, or dial tone and battery and ground appear simultaneously, the first digit shall be outpulsed between 70 ms and 5 seconds after the tip conductor is grounded. In any case, outpulsing shall never begin until the PBX has converted to the loop supervisory mode.

6.1.4.4 Voice Suppression

Voice energy from the station line or other source shall be suppressed by at least 45 dB relative to the normal acoustic-to-electric transmit efficiency of the voice transmitter during DTMF signal transmission. When senders are used, the suppression shall be maintained continuously until address signaling is completed.

6.1.4.5 Extraneous Frequency Components

The total power of all extraneous frequencies in the voiceband above 500 Hz accompanying DTMF signals shall be at least 16 dB below the level of each frequency component.

6.1.4.6 Tone Leak

In signal OFF intervals during transmission of address signals, no DTMF component shall leak onto the transmission path at a level higher than -55 dBm. During non-signaling periods, tone leak from DTMF generators shall comply with the noise parameters in 5.61.

6.1.4.7 Transient Voltage

Any transient voltage generated shall be constrained to occur within the first 5 ms after the end of the signal-off interval and shall have an absolute peak magnitude not greater than 12 dB above the absolute peak voltage of the ensuing steady-state DTMF pulse.

6.1.4.8 Sender Source Impedance

The PBX, during generation of DTMF signals, shall have a return loss at its output terminals against 600 Ω of greater than 3.5 dB at all DTMF frequencies over the range of loop currents supplied by the loop simulator circuit of Fig 2.

6.1.5 Receiver Characteristics

6.1.5.1 Signal Frequencies

DTMF receivers shall provide reliable reception of the frequency-pair signals for the twelve characters given in 6.1.3.

6.1.5.2 Frequency Deviation

The receiver shall register the frequency-pair signals when both frequencies fall within 1.5% of their nominal values[26]; the receiver shall not register a signal when either frequency deviates more than 3.5% from its nominal value.

6.1.5.3 Registration Time

The receiver shall register DTMF signals as short as 40 ms, shall recognize interdigital intervals as short as 40 ms, and shall reject DTMF signals with a duration less than 23 ms. The receiver shall register DTMF signals having cycle times (tone ON plus tone OFF interval) of 93 ms or greater.

6.1.5.4 Recognition Level

Receivers shall register DTMF signals having a power per frequency of -25 to 0 dBm and with the high-frequency tone power +4 to -8 dB relative to that of the low-frequency tone, as measured into a 600-ohm test termination substituted for the receiver.

6.1.5.5 Registration in the Presence of Dial Tone

Receivers shall register DTMF signals in the presence of precise dial tone. Precise dial tone from PBXs is the combination of 350 and 440 Hz (2.0 percent) at a level of -16 dBm (±3.0 dB) per frequency at the input to the receiver. These frequency and level tolerances are wider than specifications for new dial tone supplies (6.3, Table 29) but precise dial tone supplies currently in the field may have deviations as wide as those given.

6.1.5.6 Registration in the Presence of Message Circuit Noise

Receivers shall register DTMF signals in the presence of message circuit noise with an error rate less than one in 10,000 frequency-pair signals, using a test arrangement as shown in Fig 59. The DTMF digit generator is set with each frequency at its nominal value (6.1.3) and with its signal level set at -20 dBm, as calibrated into a 600-ohm test termination as shown in Fig 60. Pulsing rate is fixed at ten DTMF signals per second, with 50-ms tone ON time and 50-ms tone OFF (interdigital interval) (6.1.5.3). Message circuit noise shall be simulated by a 0- to 3-kHz band-limited Gaussian white noise generator set at a level of -35 dBm (55 dBrn or 53 dBrnC) as calibrated into the same test termination and shown in Fig 61.

For this test, all twelve DTMF signal combinations shall be incorporated in the sequence of pulses.

6.1.5.7 Registration in the Presence of Impulse Noise

Receivers shall register DTMF signals in the presence of impulse noise with error rates as described below, using a test arrangement as shown in Fig 62. The DTMF digit generator shall be set with each frequency at its nominal value (6.1.3) and with its signal level set at -20 dBm, as calibrated into a 600-ohm test termination as shown in Fig 60. Pulsing rate shall be fixed at ten DTMF signals per second, with 50 ms tone ON time and 50 ms tone OFF (interdigital interval) (6.1.5.3). Impulse noise shall be simulated by a square-wave pulse generator producing pulses 0.5 ms wide at a pulse rate of approximately 20 pps, driving through a 700- to 2100-Hz bandpass filter with output levels set as specified below, calibrated into a 600-ohm test termination as shown in Fig 63.

For these tests, all DTMF signal combinations shall be incorporated in the sequence of pulses.

Test No. 1: Noise source, Fig 63, set at 0.112-volt (zero-to-peak) output level; error rate shall be no more than 10 registration errors in 10,000 frequency-pair signals (16.7 minutes).

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26. DTMF receiver tolerances no longer require the 5 Hz offset which, at one time was specified to compensate for FDM carrier shift, since not many FDM carrier systems are in use anymore.

Test No. 2: Noise source, Fig 63, set at 0.200-volt (zero-to-peak) output level; error rate shall be no more than 500 registration errors in 10,000 frequency-pair signals (16.7 minutes).

These tests shall be made with test equipment providing a termination to the source of 600 Ω and equipped with a C-message-weighted filter. The 0.112-volt output level will read approximately 73 dBrnC and the 0.200-volt output level will read approximately 78 dBrnC.

6.1.5.8 Double-Digit Registration

Receivers shall register DTMF signals in the presence of impulse noise with double-digit error rates as specified below, using a test arrangement as shown in Fig 62. The DTMF digit generator shall be set with each frequency at its nominal value (6.1.3) and with its signal level set at -20 dBm, as calibrated into a 600-ohm test termination as shown in Fig 60. Pulsing rate shall be fixed at 4 DTMF signals per second, with 180-ms tone ON time and 70-ms tone OFF (interdigital interval) (6.1.5.3). Impulse noise shall be simulated by a square-wave generator arranged and calibrated the same as for Impulse Noise Tests (6.1.5.7) as shown in Fig 63.

For these tests, all 12 DTMF signal combinations shall be incorporated in the sequence of pulses.

Test No. 1: Noise source, Fig 63, set at 0.112-volt (zero-to-peak) output level; double-digit error rate shall be no more than four registration errors in 4000 pulses (16.7 minutes).

Test No. 2: Noise source, Fig 63, set at 0.200-volt (zero-to-peak) output level; double-digit error rate shall be no more than 200 registration errors in 4000 pulses (16.7 minutes).

6.1.5.9 Registration in the Presence of Signal Echoes

Receivers shall register accurately DTMF signals in the presence of signal echoes that are delayed 20 ms, and reduced in level 10 dB with respect to the incident signal.

6.1.5.10 Digit Simulation (Generation of False Digits)

The average incidence of digit simulation by the receiver caused by speech, room noise, etc., before DTMF signaling and during interdigital intervals, shall be less than one occurrence in 3000 calls for the digits zero to nine and one occurrence in 2000 calls for all 12 characters.

6.1.5.11 Input Impedance

The minimum input impedance for the DTMF receiver over the 0 to 4 kHz (including dc) frequency range shall be 40 KΩ.

6.1.5.12 Longitudinal Balance

Longitudinal balance to ground shall be at least 50 dB over the band from 60 to 4000 Hz, using the test method described in IEEE Standard 455-1985 (Ref A32).

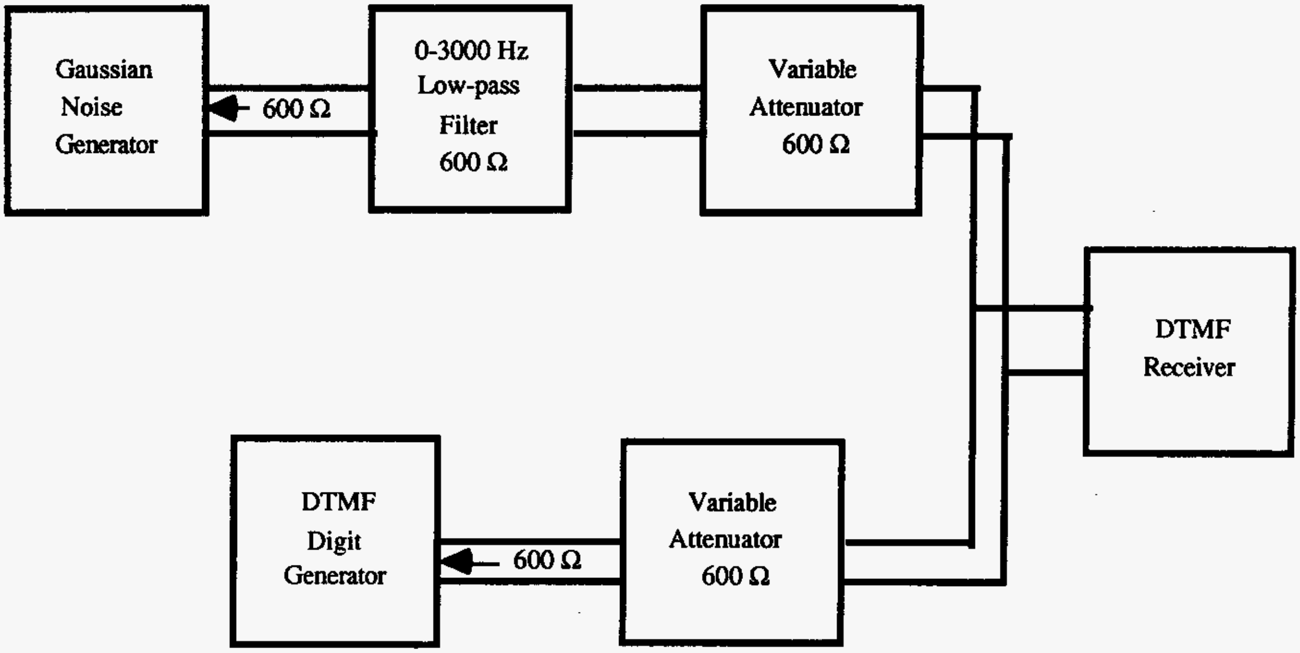


Figure 59 - Gaussian Noise Test of DTMF Receiver

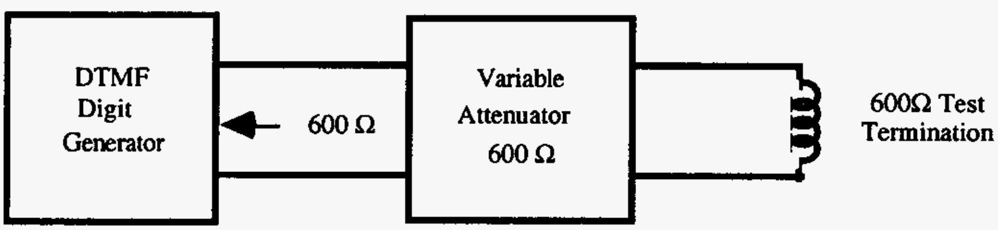


Figure 60 - DTMF Digit Source

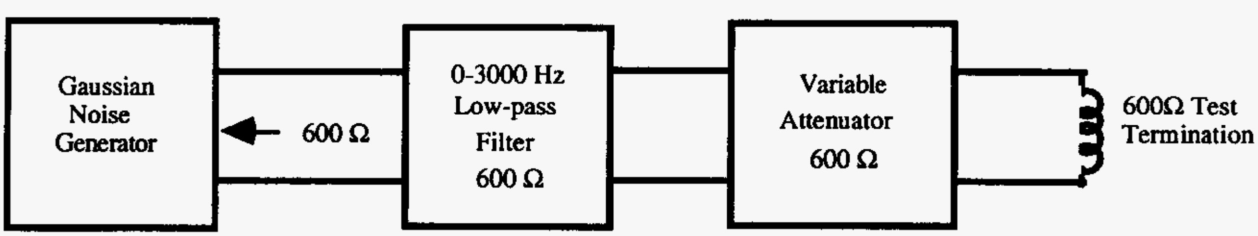


Figure 61 - Gaussian Noise Source

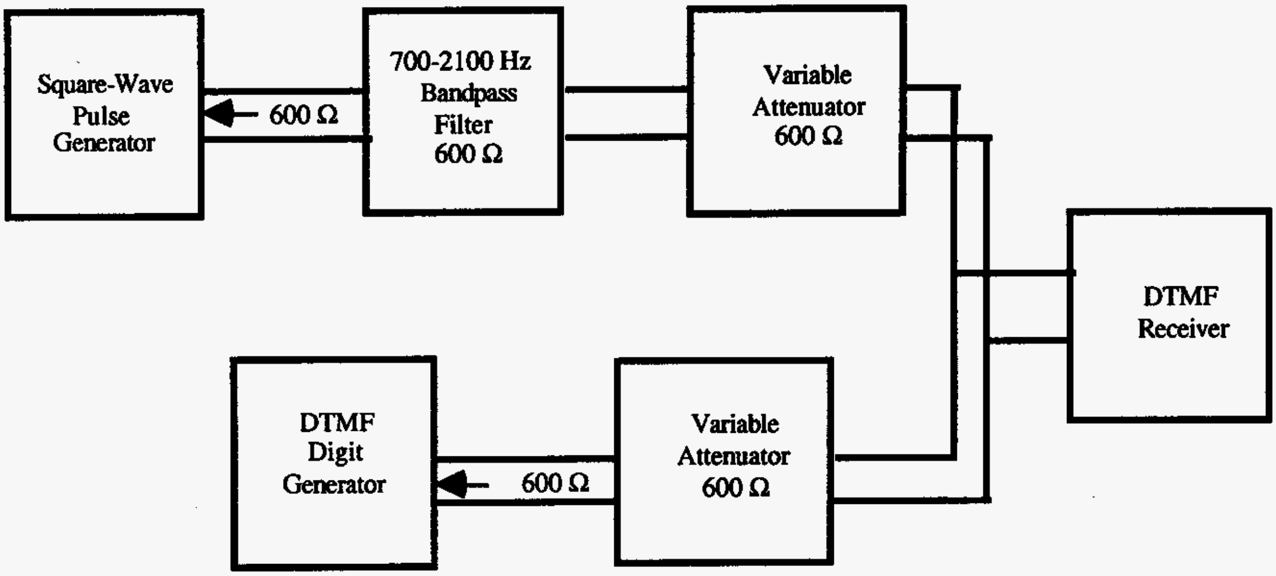


Figure 62 - Impulse Noise Test of DTMF Receiver

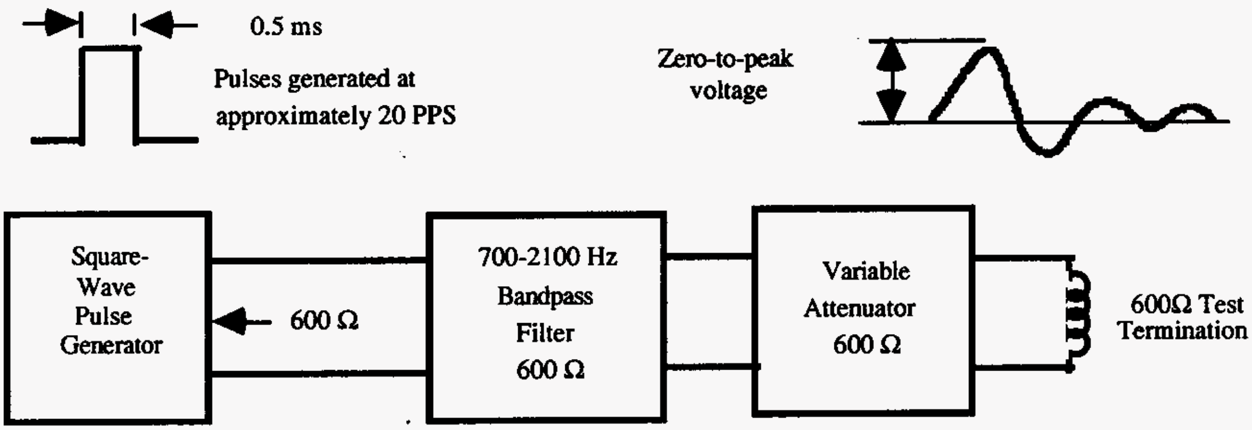


Figure 63 - Impulse Noise Source

6.2 Digital Signaling and Supervision

6.2.1 General

This section covers the basic channel-associated signaling requirements for digital interface of ISPBXs. The signaling protocol is compatible with the A&B bit signaling protocol used by D-type channel units in the Superframe Framing format (SF) and with the A, B, C, and D bit protocol associated with the Extended Superframe Framing format (ESF). These signaling protocols allow the far end to terminate on a channel bank in the case of combination trunk or to terminate on a digital interface using the same protocol at a digital network node or another ISPBX. Subsections 6.2.2 through 6.2.6 below cover the SF signaling protocol in detail. Subsection 6.2.7 tabulates the ESF signaling protocols currently being proposed.

6.2.1.1 Signaling Interface Types

Table 27 lists the signaling trunk types and the equivalent channel units.

Table 27 - PBX Interface Type and Channel Unit Equivalent

PBX Interface Type	D-Bank Equivalent	
	PBX End	Far end
TIE-TRUNK	4W E&M	4W/2W E&M
911-CAMA TRUNK[27]	DPO	DPT
CO/FX/WATS	SAS/FXS	SAO/FXO
DID	DPT	DPO
OPS	SAO/FXO	SAS/FXS

6.2.1.2 Dial Pulse Address Signaling

Dial Pulse address signaling using A&B bits shall be supported.

6.2.1.3 Trunk Signaling by Trunk Type

Sections 6.2.2 through 6.2.7 define the sequence of states for processing calls at the digital trunk interfaces using A&B robbed-bit signaling in the SF format. The sequence of operations is similar to that of the analog trunk to allow combination trunk connection. Where timing is required, the appropriate timing parameter for the analog trunk shall be used. In the tables, an X indicates that the received signaling bit is not required for determining the signaling state and, depending on the terminating equipment, may be an unreliable source of such information. Therefore, it should be ignored.

27 "911-CAMA" trunk in this section denotes the customer access to the Enhanced 911 Network, defined in ANSI T1.411-1994, (Ref A11).

6.2.2 *DID, 911-CAMA, and Tie Trunk Signaling*

For DID and 911-CAMA access, as well as for 2-wire E&M, 4-wire E&M, and loop reverse battery tie trunks, the A&B signaling corresponding to supervision states is identical. DID access is incoming only from the network, 911-CAMA access is outgoing only to the network. For DID access and for one-way incoming loop-reverse battery tie trunk, the signaling states at the PBX are the same as those supported by an interface historically referred to as Dial Pulse Terminating (DPT). For 911-CAMA access and for one-way outgoing loop-reverse battery tie trunk, the signaling states at the PBX are the same as those supported by an interface historically referred to as Dial Pulse Originating (DPO). Signaling and supervision are as follows:

Transmit to Network or Trunk

State	A	B
On-Hook	0	0
Off-Hook	1	1
Dial Pulse (DP) Break	0	0
DP Make	1	1

Received from Network or Trunk

State	A	B
On-Hook	0	X
Off-Hook	1	X
Dial Pulse (DP) Break	0	0
DP Make	1	1

Note: In the Transmit-to-Network-or-Trunk Table, the DP states apply only to Tie Trunks.

6.2.2.1 *Outgoing Call - Basic Operation (Tie Trunk only)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Idle State	0	0	0	X	(1)
Near-end PBX Goes Off-Hook (waiting to begin dialing)	1	1	0	X	
Far End Returns Wink (ready to receive digits):					(2)
State During Wink	1	1	1	X	
State After Wink	1	1	0	X	
Near-end PBX Dial Pulses Called Number	1	1	0	X	(3)
Waiting for Answer	1	1	0	X	
Far-end Answer	1	1	1	X	(4)

Notes:

(1) Both near and far end are in on-hook state.

(2) Applies to wink start trunks only.

(3) For DP outpulsing, the transmit signaling A and B states are replaced by “DP”.

(4) Applies to answered calls only.

6.2.2.2 Outgoing Call - 911-CAMA Trunk

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Idle State	0	0	0	X	
Near-end seizure	1	1	0	X	
Far End Returns Wink (ready to receive digits):					
State During Wink	1	1	1	X	
State After Wink	1	1	0	X	
Near-end PBX Sends Called Number	1	1	0	X	
Far End Returns CESID Request Signal	1	1	1	X	(1)
Near-end PBX Sends CESID	1	1	1	X	
PSAP Answers	1	1	1	X	(2)

Notes:

(1) CESID = Caller Emergency Station Identification number.

(2) PSAP = Public Service Answering Point.

6.2.2.3 Incoming Call - Basic Operation (Tie Trunk or DID)

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Idle State	0	0	0	X	(1)
Far End Goes Off-Hook (request for digit receiver)	0	0	1	X	
Near-end PBX Returns Wink (ready to receive digits)					(2)
State During Wink	1	1	1	X	
State After Wink	0	0	1	X	
Far End Sends Called Number	0	0	1	X	(3)
Waiting for Answer	0	0	1	X	
Near-end Answer	1	1	1	X	(4)

Notes:

(1) Both near and far end are in on-hook state.

(2) Applies to wink start trunks only.

(3) For DP outpulsing, the receive signaling A state is replaced by “DP”.

(4) Applies to answered calls only.

6.2.2.4 Disconnect Procedures

6.2.2.4.1 Far End Goes On-Hook First (Tie Trunk or DID)

	Transmit Signaling		Receive Signaling	
	A	B	A	B
Talking State	1	1	1	X
Far End Goes On-Hook (far-end party hangs up)	1	1	0	X
Near-end PBX Goes On-Hook (idle state)	0	0	0	X

6.2.2.4.2 PSAP Disconnects First (911-CAMA Trunk)

	Transmit Signaling		Receive Signaling	
	A	B	A	B
Communication State	1	1	1	X
PSAP Disconnects	1	1	0	X
Near-end PBX Goes On-Hook (idle state)	0	0	0	X

6.2.2.4.3 Near-end PBX Goes On-Hook First (Tie Trunk or DID)

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Talking State	1	1	1	X	
Near-end PBX Goes On-Hook (near-end party hangs up)	0	0	1	X	(1)
Far End Goes On-Hook (idle state)	0	0	0	X	

Note:

(1) The PBX must not present a new outgoing call until the far end has disconnected.

6.2.2.4.4 Near-end PBX Goes On-Hook First (911-CAMA Trunk)

	Transmit Signaling		Receive Signaling	
	A	B	A	B
Communication State	1	1	1	X
Near-end PBX Goes On-Hook (near-end party hangs up)	0	0	1	X
PSAP Disconnects (idle state)	0	0	0	X

6.2.2.4.5 Near-end PBX Abandons Outgoing Call Before Far-end Answer (Tie Trunk or DID)

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Waiting for Answer	1	1	0	X	
Near-end PBX Goes On-Hook (near-end party hangs up)	0	0	0	X	(1)

Note:

(1) The PBX must not present a new call for a timing guard interval to permit far end to detect abandon.

6.2.2.4.6 Far End Abandons Incoming Call Before Answer (Tie Trunk or DID)

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Waiting for Answer	0	0	1	X	
Far End Disconnects (far-end party hangs up)	0	0	0	X	(1)

Note:

(1) The PBX must not present a new call for a timing guard interval to permit the far end to return to idle state. The PBX must be immediately ready to receive a new call.

6.2.2.4.7 Enhanced 911 System Trunk Make-Busy Procedure (911-CAMA Trunk)

	Transmit Signaling		Receive Signaling	
	A	B	A	B
Idle State	0	0	0	X
Trunk Made Busy	0	0	1	X
Trunk Made Idle	0	0	0	X

6.2.2.5 Trunk Condition Emulation

Trunk condition emulation is as follows:

Transmitted Signaling

Supervision State	A	B	Trunk Condition: Tie Trunk	Trunk Condition: DID Access (DPT emulation)
On-Hook (Idle State) (Note 1)	0	0	M Lead Grounded or Open	Normal Battery
Off-Hook (Communication State)	1	1	M Lead Battery or Loop Closed	Reverse Battery

Received Signaling

Supervision State	A	B	Trunk Condition: Tie Trunk	Trunk Condition: DID Access (DPT emulation)
On-Hook (Idle State) (Note 2)	0	X	E Lead Open	Loop Open
Off-Hook (Communication State) (Note 3)	1	X	E Lead Grounded or Loop Closed	Loop Closed

Notes:

(1) For 911-CAMA Trunk connections, carrier failure causes transmit signaling to enter the idle state (if not already in the idle state) and to remain in the idle state upon and following removal of the carrier failure.

(2) For 911-CAMA Trunk connections, carrier failure, while in the idle state, causes receive signaling to enter the communication state until the carrier failure is removed, at which time the receive signaling reverts to the idle state.

(3) For 911-CAMA Trunk connections, carrier failure, while in the communications state, causes receive signaling to enter the idle state for a period of 2-3 seconds, following which, the signaling reverts to the communications state. Upon removal of the carrier failure, receive signaling enters the idle state and remains in the idle state.

6.2.3 *Loop Start Access Lines (including loop start FX/WATS Trunk)*

For the loop-start access line, there are two transmitted signaling states (loop open or loop closed) and four possible received states (ringing, not ringing, current feed reversal, and current feed open). The signaling states at the PBX are the same as those supported either by an interface historically referred to as Foreign Exchange Station (FXS) or by an interface historically referred to as Special Access Station (SAS). The signaling states for the FXS interface are shown in the tables. For the SAS interface, the transmit signaling table B-bit entry is replaced by its complement, i. e., 0 is replaced by 1 and 1 by 0; likewise, the receive signaling table A-bit entry is replaced by its complement.

Transmit to Network

State	A	B
Loop Open	0	1
Loop Closed	1	1
Dial Pulse (DP)	DP	1

Received from Network (Note 1)

State	A	B
Ringing	0	0
Current Feed (Not Ringing)	0	1
Current Feed Reversal (Note 2)	0	1/0
Current Feed Open (Note 3)	1	1

Notes:

(1) On incoming calls, and on outgoing calls when network equipment does not provide current feed reversal and current feed open (notes 2 and 3), the received signaling state shall be ignored when the loop is closed.

(2) This state, with signaling bit B alternating between one and zero in successive superframes, may be used for called party answer supervision, associated with a loop-start access line supplemental feature known as line-side answer supervision. This state cannot be produced by all network equipment.

(3) This state cannot be produced by all network equipment. A no-battery state of duration > 600 ms indicates network disconnect.

6.2.3.1 *Outgoing Call - Basic Operation (Loop Start)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Idle State	0	1	0	1	
PBX Closes Loop (waiting for dial tone)	1	1	0	1	
Dial Pulsing	DP	1	0	1	(1), (2)
Completion of Dialing	1	1	0	1	
Far-end Answer	1	1	0	1/0	(3)

Notes:

(1) PBX delays for dial tone before entering this state.

(2) For DTMF dialing, the entry DP is replaced by a 1.

(3) When provided by the network

6.2.3.2 Incoming Call - Basic Operation (Loop Start)

	Transmit Signaling		Receive Signaling	
	A	B	A	B
Idle State	0	1	0	1
Network Applies Ringing:				
- (during ringing application)	0	1	0	0
- (interval between ringing applications)	0	1	0	1
PBX Presents Call	0	1	0	1
PBX Answers Call	1	1	0	X
Normal Talking State	1	1	0	X

6.2.3.3 Disconnect Procedures

6.2.3.3.1 PBX Disconnects First (Loop Start)

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Talking State	1	1	0	X	
PBX Opens Loop (near-end party hangs up)	0	1	0	X	
Idle State	0	1	0	1	(1)

Note:

(1) The PBX must provide for a time delay before presenting a new call or detecting an incoming call from the network (4.1.2.7).

6.2.3.3.2 Network Disconnects First (Loop Start) - (Note 1)

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Talking State	1	1	0	X	
Network opens current feed loop (far-end party hangs up)	1	1	1	X	
Idle State	0	1	0	1	(2)

Notes:

(1) When network provides the current feed open state

(2) The PBX must provide for a time delay before presenting a new call or detecting an incoming call from the network (4.1.2.7).

6.2.3.3.3 *Network Abandons Incoming Call (Loop Start)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Network Applies Ringing: - (during ringing application)	0	1	0	0	
- (interval between ringing applications)	0	1	0	1	
Network Abandons (caller hangs up)	0	1	0	1	(1)
PBX Stops Presenting Call	0	1	0	1	(2)

Notes:

(1) The PBX distinguishes a network abandon from the interval between ringing applications only by timing.

(2) Time limit expires, trunk is immediately available for new outgoing call or detection of new incoming call.

6.2.4 *Ground Start Access Line (including ground start FX/WATS trunk)*

The ground access line has the most complex signaling protocol of the interfaces supported. There is one case where the transmitted A&B bit code has a different meaning depending on the received code. Therefore, the transmitted code must be quickly changed to prevent the distant channel unit from generating an unwanted signaling state towards the network.

The signaling states at the PBX are the same as those supported either by an interface historically referred to as Foreign Exchange Station (FXS) or by an interface historically referred to as Special Access Station (SAS). The signaling states for the FXS interface are shown in the tables. For the SAS interface, the transmit signaling table B-bit entry is replaced by its complement; likewise, the receive signaling table A-bit entry is replaced by its complement.

Transmit to Network

State	A	B
Loop Open	0	1
Loop Closed	1	1
Ring Ground (service request)	0	0
Dial Pulse (DP)	DP	1

Received from Network

State	A	B
Ringing	0	0
Current feed (not ringing)	0	1
Current feed reversal	0	1/0
Loop Open (no current feed)	1	1

6.2.4.1 *Outgoing Call - Basic Operation (Ground Start)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Idle State	0	1	1	X	
PBX Grounds Ring (waiting for dial tone)	0	0	1	X	
Network Grounds Tip (dial tone applied)	0	0	0	X	(1)
PBX Removes Ring Ground	0	1	0	X	(1),(4)
PBX Closes Loop	1	1	0	X	(2),(4)
Dial Pulsing	DP	1	0	X	(3)
Completion of Dialing	1	1	0	X	
Far-end Answer	1	1	0	1/0	(5)

Notes:

(1) These are transient states. PBX must close loop quickly to avoid false signaling.

(2) At this time, the network is providing dial tone and digit sending may begin.

(3) For DTMF dialing, the entry DP is replaced by a 1.

(4) In some network configurations, a delay in applying a loop closure in excess of 50 ms after indication of a tip ground from the network may interrupt call processing or result in a false "one" digit being registered.

(5) When provided by the network

6.2.4.2 *Incoming Call - Basic Operation (Ground Start)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Idle State	0	1	1	X	
Network Grounds tip					
- (interval between ringing applications)	0	1	0	1	
- (during ringing application)	0	1	0	0	
PBX Presents Call	0	1	0	1	(1)
PBX Answers Call	1	1	0	X	
Normal Talking State	1	1	0	X	

Note:

(1) PBX delays presentation of call until ringing application is detected.

6.2.4.3 *Disconnect Procedures*

6.2.4.3.1 *Network Disconnects First (Ground Start)*

	Transmit Signaling A	Transmit Signaling B	Receive Signaling A	Receive Signaling B	Note
Talking State	1	1	0	X	
Network Removes Tip Ground (far-end party hangs up)	1	1	1	X	(1)
PBX Opens Loop (idle state)	0	1	1	X	

Note:

(1) This state is valid for brief transitions only. The PBX must open the loop quickly as the network may present a new incoming call at any time after the tip ground is removed. Leaving the loop closed is treated as answer.

6.2.4.3.2 *PBX Disconnects First (Ground Start)*

	Transmit Signaling A	Transmit Signaling B	Receive Signaling A	Receive Signaling B	Note
Talking State	1	1	0	X	
PBX Opens Loop (near-end party hangs up)	0	1	0	X	(1)
Network Removes Tip Ground (idle state)	0	1	1	X	

Note:

(1) The PBX must not present a new outgoing call until the network has removed tip ground.

6.2.4.3.3 *PBX Abandons before Network Has Returned Tip Ground (Ground Start)*

	Transmit Signaling A	Transmit Signaling B	Receive Signaling A	Receive Signaling B	Note
PBX Waiting for Tip Ground	0	0	1	X	
PBX Removes Ring Ground (caller hangs up)	0	1	1	X	(1)

Note:

(1) PBX must ignore network signaling for a timing guard interval to protect against delayed network response to PBX ring ground.

6.2.5 *Off-Premises Station*

For the off-premises station, there are two transmitted signaling states, ringing or not ringing, and two received states, loop open or loop closed.

The signaling states at the PBX are the same as those supported either by an interface historically referred to as Foreign Exchange Office (FXO) or by an interface historically referred to as Special Access Office (SAO). The signaling states for the FXO interface are shown in the tables. For the SAO interface, the transmit signaling table A-bit entry is replaced by its complement; likewise, the receive signaling table B-bit entry is replaced by its complement.

Transmit to Network (towards OPS terminal)

State	A	B
Ringing	0	0
Not Ringing	0	1

Received from Network (away from OPS terminal)

State	A	B
Loop Open	0	1
Loop Closed	1	1

6.2.5.1 *Station-Originated Call - Basic Operation (OPS)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Idle State	0	1	0	1	
Station Closes Loop (Off-Hook)	0	1	1	1	
Dial Pulsing					
(Break)	0	1	0	1	(1)
(Make)	0	1	1	1	
Completion of Dialing	0	1	1	1	

Note:

(1) Applies to rotary dial off-premises station only. For DTMF dialing, state is same as dial pulse make.

6.2.5.2 *Terminating Call to Station - Basic Operation (OPS)*

	Transmit Signaling		Receive Signaling	
	A	B	A	B
Idle State	0	1	0	1
PBX Applies Ringing				
- (During Ringing Application)	0	0	0	1
- (Interval Between Ringing Application)	0	1	0	1
Station Answers Call	0	1	1	1
Normal Talking State	0	1	1	1

6.2.5.3 *Disconnect Procedures*

6.2.5.3.1 *Station Goes On-Hook (OPS)*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
Talking State	0	1	1	1	
Station Opens loop (On Hook)	0	1	0	1	(1)
Idle State	0	1	0	1	

Note:

(1) No changes are made to the transmitted signaling, whether the PBX disconnects first or after the station goes on-hook.

6.2.5.3.2 *PBX Abandons Terminating Call to OPS*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Note
PBX Applies Ringing:					
- (During Ringing Application)	0	0	0	1	
- (Interval Between Ringing Application)	0	1	0	1	
PBX Abandons	0	1	0	1	(1)

Note:

(1) Abandonment is distinguishable from the interval between ringing application only by timing.

6.2.5.3.3 *PBX Disconnects First*

	Transmit Signaling		Receive Signaling		
	A	B	A	B	Notes
Talking State	0	1	1	1	
PBX Opens Loop (LCFO)	1	1	1	1	(1)
PBX Returns to Idle State	0	1	X	1	(2)
Station On-hook	0	1	0	1	

Notes:

(1) The Loop Current Feed Open (LCFO) state, (removal of ring battery and/or tip ground) may not be recognized and transmitted by some network elements and should not be relied on as a disconnect signal.

(2) The received signaling A bit (shown as X) will be 0 or 1 depending upon whether or not the station has gone on-hook, respectively.

6.2.6 *Table of Signaling States*

Table 28 defines the A&B-bit signaling channel states as they appear at the digital interface.

Table 28 - Summary of A&B Bit Signaling States

PBX Port Type	PBX Interface Historic Equivalent		PBX Port Condition to Interface	Transmit Signaling @		Receive Signaling @		Far-end Interface Condition towards PBX
				A	B	A	B	
Tie Trunk (outgoing), 911-CAMA access	DPO	XMT	Loop Open	0	0	—	—	—
			Loop Closure	1	1	—	—	—
		RCV	—	—	—	0	X	Normal Battery
			—	—	—	1	X	Reverse Battery
Tie Trunk (incoming) or DID access	DPT	XMT	Normal Battery	0	0	—	—	—
			Reverse Battery	1	1	—	—	—
		RCV	—	—	—	0	X	Loop Open
			—	—	—	1	X	Loop Closure
Tie Trunk	4W E&M or 2W E&M	XMT	M-Lead Open or Grounded	0	0	—	—	—
			M-Lead Battery	1	1	—	—	—
		RCV	—	—	—	0	X	E-Lead Open
			—	—	—	1	X	E-Lead Grounded or Looped
Off-Premises Extension (Note 1)	FXO(SAO)	XMT	No Ringing	0[1]	1	—	—	—
			Ringing	0[1]	0	—	—	—
		RCV	—	—	—	0	1[0]	Loop Open,
			—	—	—	1	1[0]	Loop Closure
Access Line, FX/WATS --------- Ground or Loop Start (Note 1)	FXS(SAS)	XMT	No Loop Current, No Ring Ground	0	1[0]	—	—	—
			No Loop Current, Ring Ground (Note 2)	0	0[1]	—	—	—
			Loop Current, No Ring Ground (Note 3)	1	1[0]	—	—	—
		RCV	—	—	—	1[0]	1	Current Feed Open or No Tip Ground, --No Ringing
			—	—	—	0[1]	1	Current Feed or Tip Ground --No Ringing
			—	—	—	0[1]	0	Current Feed or Tip Ground --Ringing
			—	—	—	0	1/0	Current Feed Reversal

Legend for Table 28:

@ A and B signaling channel states are shown as they exist on the DS1 line.

X Any listed state or condition

Notes on Table 28:

(1) Where the state is different for the SAS or SAO, it is shown in parenthesis.

(2) For loop start, the ring ground transmit state does not apply.

(3) Except for brief transitions, this transmit state is valid only when the receive state corresponds to a far-end condition of tip ground or current feed.

6.2.7 *ESF Signaling Formats*

The following tables present the ESF robbed-bit signaling protocols currently being formulated.

6.2.7.1 *DID, Tie Trunk, and 911-CAMA Trunk Signaling*

Transmit to Network or Trunk

State	A	B	C	D
On-Hook	0	0	0	0
Off-Hook	1	1	1	1

Received from Network or Trunk

State	A	B	C	D
On-Hook	0	0	0	0
Off-Hook	1	1	1	1

6.2.7.2 *Loop Start Access Lines (including loop start FX/WATS Trunk)*

Transmit to Network or Trunk

State	A	B	C	D
Loop Open	0	1	0	1
Loop Closed	1	1	1	1

Received from Network or Trunk

State	A	B	C	D
Ringing	0	0	0	0
Curr. Feed Not Ringing	0	1	0	1
Rev. Curr. Feed	0	1	0	0
Loop Open (no current feed)	1	1	1	1

6.2.7.3 *Ground Start Access Line (including ground start FX/WATS trunk)*

Transmit to Network or Trunk

State	A	B	C	D
Loop Open	0	1	0	1
Loop Closed	1	1	1	1
Ring Ground (service request)	0	0	0	0

Received from Network or Trunk

State	A	B	C	D
Ringing	0	0	0	0
Current Feed (not ringing)	0	1	0	1
Rev. Curr. Feed	0	1	0	0
Loop Open (no current feed)	1	1	1	1

6.2.7.4 *Off-Premises Station*

Transmit to Network or Trunk

State	A	B	C	D
Ringing	0	0	0	0
Not Ringing	0	1	0	1

Received from Network or Trunk

State	A	B	C	D
Loop Open	0	1	0	1
Loop Closed	1	1	1	1

6.3 Call Progress Signaling

6.3.1 Definition

Call progress signals (tones) are audible signals provided toward a caller during the process of setting up, holding, or transferring a call. This standard applies to call progress signals heard by the following types of callers:

(1) On-premise and off-premise PBX station users.

(2) PBX attendants.

(3) Callers located in the public switched telephone network (PSTN).

(4) Callers located in other PBXs or other switching systems accessing this PBX via tie trunks or other facilities.

Call progress signals consist of single-frequency and dual-frequency combinations of sinusoidal voltages applied in specific cadences and in accordance with specific ON-OFF patterns. This standard essentially follows the telephone industry Precise Tone Plan.

6.3.2 Call Progress Signals Used in PBXs

The signals covered by this standard are as follows:

Standard Signals	*Other Signals*
Dial	Recall Dial
Reorder	Special Audible Ring
Busy	Line Lockout Warning
Audible Ring	Intercept
	Call Waiting
	Busy Verification
	Executive Override
	Confirmation
	Stutter Dial

The objective of this standard is to encourage and promote the uniform adoption throughout the industry of the call progress signals herein defined to minimize user confusion that can result when a number of different manufacturers' PBXs are in use in any given association.

6.3.3 Call Progress Signals Sent to the PSTN

The four signals that find most frequent use in PBXs are Dial, Reorder, Busy, and Audible Ring. These four signals are classified "standard" for convenience and are listed in Table 29. Although some of the remaining signals, classified "other," can also be sent through the PSTN, this standard requires conformity only to the four "standard" signals, specifying the "other" signals as desirable (Table 30). This minimizes user confusion, reoriginations, and errors in central office switching system performance indices relating to percent failure of call completion due to trunk busy conditions and various equipment failures. See 4.1.3.6 for special requirements pertaining to DID.

Table 29 - Standard Call Progress Signals

Name	Frequency	Permissible Power Level Per Frequency (Note 1) CO Trunk Interface* Max.		All Other Interfaces** Max.		Freq. to Freq. Balance	Interruption Pattern
		CO Trunk Interface* Max.	CO Trunk Interface* Min.	All Other Interfaces** Max.	All Other Interfaces** Min.		
	(Hz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	
Dial Tone	350 + 440	-16	-17.5	-16	-26	3	No Interruption Pattern (Steady Tone)
Reorder Tone	480 + 620	-19.5	-22.5	-19.5	-35	3	Repetition of tone ON for 0.25 ± 0.025 s, and tone OFF for 0.25 ± 0.025 s.
Busy Tone	480 + 620	-19.5	-22.5	-19.5	-35	3	Repetition of tone ON for 0.5 ± 0.05 s, and tone OFF for 0.5 ± 0.05 s.
Audible Ring Tone	440 + 480	-14.5	-17.5	-14.5	-30	3	Repetition of tone ON for 0.8 to 1.2 s and tone OFF for 2.7 to 3.3 s. or tone ON for 1.8 to 2.2 s and tone OFF for 3.6 to 4.4 s

* These power levels apply at the interface to the switched telecommunications network, i.e., Analog or Digital CO trunk interface (ground start, loop start, and one-way direct inward dial facilities).

** All other interfaces include off premise stations and tie trunks.

Table 30 - Other Call Progress Signals

Name	Frequency	Permissible Power Level Per Frequency (Note 1)				Freq. to Freq. Bal'ce	Interruption Pattern
		CO Trunk Interface*		All Other Interfaces**			
		Max.	Min.	Max.	Min.		
	(Hz)	(dBm)	(dBm)	(dBm)	(dBm)	(dBm)	
Recall Dial Tone	350 + 440	-16	-17.5	-16	-26	3	Three bursts of tone ON for 0.08 to 0.12 s, and tone OFF for 0.08 to 0.12 s, followed by dial tone.
Special Audible Ring Tone	440 + 480	-14.5	-17.5	-14.5	-30	3	Repetition of combined tones ON for 0.8 to 1.2 s, followed by 440 Hz tone ON for 0.2 s, and tone OFF for 2.7 to 3.3 s.
Intercept Tone	440 + 620	-12.5	-15.5	-12.5	-33	n/a	Repetition of alternating the two frequencies, each ON for 0.16 to 0.30 s, with a total cycle duration of 0.5 ± 0.05 s.
Call Waiting Tone	440	n/a		-12.5	-33	n/a	One application, for 0.1 to 0.3 s., followed by a second application about 10 seconds later (Note 3)
Line Lockout Warning Tone	(Note 2)	n/a			n/a	Tone ON for approximately 10 s once.	
Busy Verification Tone	440	-12.5	-15.5	-12.5	-33	n/a	One burst of tone ON for 1.5 to 2.0 s, (Note 4) before attendant intrudes, followed by bursts of tone ON for 0.5 to 0.8 s, 8 to 10 s apart for as long as the interruption lasts.
Executive Override Tone	440	-12.5	-15.5	-12.5	-33	n/a	One burst of tone ON for 2.0 to 4.0 s, (Note 4) before overriding station intrudes.
Confirmation Tone	350 + 440	-16	-17.5	-16	-26	3	Three bursts of tone ON for 0.08 to 0.12 s, 0.08 to 0.12 s apart.
Stutter Dial Tone	350 + 440	-16	-17.5	-16	-26	3	Repetition of tone ON for 1.25 ± 0.025 s, and tone OFF for 0.25 ± 0.025 s.

* These power levels apply at the interface to the switched telecommunications network, i.e., CO trunk interface (ground start, loop start, and one-way direct inward dial facilities).

** All other interfaces include off-premise stations and tie trunks.

Notes on Table 29 and Table 30:

1. All power values shall be as measured into a 600-ohm load at the line or trunk interface of the PBX. See 5.9 for in-band signal power limits for specific interface types. The requirements in 5.9 may be more restrictive than the permissible power limits given in these tables.
2. Line Lockout Warning Tone is no longer recommended; however, when it is required either Intercept Tone, Reorder Tone, or Busy Tone may be used.
3. The application of Call Waiting tone may be a single tone burst or multiple tone bursts, e.g., to permit the called user to tell the difference between externally-originated and internally-originated calls. The application should be twice, once when the incoming call arrives, and then again approximately 10 seconds later if the call-waiting line (the called user) has not yet responded.
4. The difference in duration between Busy Verification and Executive Override Tones is intended to be sufficient to permit ready distinction between the tones.
5. Stutter Dial Tone is used as an indication to the user, e.g., message waiting. In message waiting applications, Stutter Dial Tone is also known as Message Waiting Dial Tone.
6. Studies have shown that the lower level tones that are transmitted over trunks should be six dB hotter at the trunk interface (than at the line interface) to compensate for increased loss on the end-to-end connection. In the case of tones used at higher levels, the 6-dB difference is not used since power at trunk interfaces must be limited to -13 dBm0 total when averaged over any three-second interval to prevent carrier overload. Maximum permissible powers listed are consistent with this requirement taking into account the allowable interruption rates for the various tones. Uninterrupted tones, such as Dial Tone and Intercept Tone, shall be continuously limited to -13 dBm.

6.3.4 Definitions of Call Progress Signals

6.3.4.1 Standard Signals

6.3.4.1.1

Dial tone is applied toward a caller as an indication that the PBX is ready to receive address signals. Dial tone shall be removed immediately upon recognition of the first keyed address signal or immediately upon recognition of the first rotary dial pulse, or upon permanent timeout.

6.3.4.1.2

Reorder tone is variously referred to as paths-busy tone, all-trunks-busy tone and fast-busy tone. This signal is applied toward the caller when call blockage is encountered due to unavailability of equipment or channels. This signal shall be held applied as long as the caller remains off-hook. On calls originated by a local PBX caller, in some instances, a PBX may disconnect the signal approximately 30 seconds after the caller has been connected to Reorder tone. On incoming calls from the public network or other switching systems, the PBX shall not disconnect the signal until it receives a disconnect indication from the caller.

6.3.4.1.3

Busy tone, sometimes referred to as slow-busy tone, is applied toward the caller as an indication that the called station line or all lines in a called line hunting group are busy. This signal is normally held applied as long as the caller remains off-hook. In some instances on calls originated by a local PBX caller, a PBX may disconnect the signal approximately 30 seconds after the caller has been connected to Busy tone. On incoming calls from the public network or other switching systems, the PBX shall not disconnect the signal until it receives a disconnect indication from the caller.

6.3.4.1.4

Audible Ring tone, sometimes referred to as ringback tone, is applied toward the caller as an indication that the called station, an attendant, or other destination is being or has been alerted. This signal shall be held applied as long as the caller remains off-hook and shall be removed when the called station, attendant, or other destination answers. If the called party does not answer, Audible Ring tone shall be held applied until the caller hangs up.

6.3.4.2 *Other Signals*

6.3.4.2.1

Recall Dial tone is applied toward a PBX caller who is on an established connection and has signaled, by hookswitch flash or other means, that the keying or dialing of additional digits is desired. Recall Dial tone shall be removed immediately upon recognition of the first keyed address signal, immediately upon recognition of the first rotary dial pulse or upon permanent timeout.

6.3.4.2.2

Special Audible Ring tone is transmitted to the calling PBX party to indicate that the called line or location has the Call Waiting feature and is being alerted. The Special Audible Ring Signal is intended to sound like regular Audible Ring for the untrained user, yet provide a distinctive signal for the knowledgeable user.

6.3.4.2.3

Line Lockout Warning tone is applied to a PBX station line if the line is off-hook but fails to complete dialing within a specified interval or if the line fails to disconnect at the conclusion of a call. A unique tone signal is no longer required. Intercept Tone, Reorder Tone, or Busy Tone may be applied for approximately ten seconds after the line has been placed in lockout. Intercept Tone or Busy Tone shall never be returned over trunks as a Line Lockout Warning indication. Trunks shall be given Reorder tone.

6.3.4.2.4

The PBX should have means to provide an indication to the PBX station user that the call has been blocked by the PBX. Intercept tone may be used for this purpose; however, the use of intercept tone will not effectively provide the PBX station user with information for reporting call blockage. This signal shall be removed when the calling party disconnects (see 4.1.3.5 for DID intercept treatment).

6.3.4.2.5

Call Waiting tone is applied to a busy PBX line to indicate to the station user that a call is waiting. It consists of a single tone burst or multiple tone bursts, e.g., to permit the called user to tell the difference between externally-originated and internally-originated calls. The application of the burst or multiple bursts should be twice, once when the incoming call arrives, and then again approximately 10 seconds later if the call-waiting line (the called user) has not yet responded. The tone shall be heard only by the party being called.

6.3.4.2.6

Busy Verification tone is a burst of tone applied to a connection to indicate to all members of the connection that an attendant is about to enter the connection. Intermittent signal burst shall continue to be applied to the connection as long as the attendant remains connected.

6.3.4.2.7

Executive Override tone is a burst of tone applied to a connection to indicate to all members of the connection that an overriding party will be bridged onto the connection.

6.3.4.2.8

Confirmation tone consists of bursts of tone applied toward a PBX station or an attendant to indicate that a feature has been successfully activated or deactivated.

6.3.4.2.9

Stutter dial tone is applied toward a caller as an indication that the PBX is ready to receive address signals and to indicate another condition, e.g., message waiting. Stutter dial tone shall be removed immediately upon recognition of the first rotary dial pulse, or upon permanent timeout.

6.3.5 Electrical Standards for Call Progress Signals

6.3.5.1

Dial, Reorder, Busy, and Audible Ring signals consist of standard tones that comply with the industry standard precise tone plan. This tone plan is based on the use of four pure tones assigned either singly or in pairs (not modulated). These tones are applied continuously and at a variety of cadences. The frequencies, their levels, and their cadences shall be as described in Table 29.

6.3.5.2

It is desirable that PBXs of new design provide "other" call progress signals in accordance with Table 30. However, it is recognized that some PBXs of current design will not comply with Table 30.

6.3.5.3

Frequency tolerance shall be ± 0.5% per frequency.

6.3.5.4

At the trunk interface, noise and distortion products from the generation of call progress tones shall be at least 40 dB below the total power of the fundamental tone levels.

6.3.5.5 Longitudinal Balance

The longitudinal-to-metallic balance of tone generation shall be greater than:

Frequency	Minimum Balance
200 Hz	50 dB
500 Hz	47 dB
1000 Hz	44 dB
3000 Hz	42 dB

using IEEE Standard 455-1985 (Ref A32) for measuring balance.

6.3.5.6 Split Connection (Call Waiting Tone)

If a connection is split during application of a signal, an idle circuit termination (which meets the return loss criteria above) shall be applied toward the station to which the signal is not applied. Noise toward the station to which the signal is not applied shall be no greater than 50 dBrnC during splitting.

6.3.5.7 Measuring Techniques

Unless specified otherwise, measuring techniques shall be those outlined in IEEE Standard 743-1984 (Ref A31).

7 APPLICATION NOTES

7.1 ISPBX Loss Insertion Application Guidelines

Tables 12 and 13 (ISPBX Loss Plan) enable the user to select from several digital port interfaces. For digital access lines to the PSTN, the user may select either the DAL/IST designation, when provided in the ISPBX, or the AAL(D) designation, as appropriate. For tie trunks and for integrated services trunks used as tie trunks, the applicable designations are IST and ISD/TT. In order to assist the user in selecting the appropriate digital port for various applications, the following guidelines are given.

7.1.1 Network Access Lines

(1) On the basis of performance models representing prevalent ranges for various network parameters and representative diversities of terminations, there is no clear advantage to using either the DAL or AAL(D) port designation on digital access lines to a local DEO when the DEO:[28]

(a) inserts no loss in digital to digital connections

(b) inserts network loss in analog access line connections in the receive path of the analog access line

Use either IST or AAL(D) port designations when the DEO is arranged to provide loss treatment for digital connections between the DEO and the ISPBX.

(2) Use the AAL(D) designation on digital access lines to DEOs that do not provide loss treatment according to the criteria of (1), above.

(3) Use the DAL port designation, when provided, on digital access lines to digital tandem switches or to IEC offices.

7.1.2 Tie Trunks

Due to the wide variety of network architectures and complexities, it is not possible to state universal guidelines for selecting between IST and ISD/TT port designations for digital tie trunks. Consideration of the following network characteristics may be useful in the application of these port designations to a specific network.

(1) For networks in which echo is adequately controlled and in which

(a) hybrid tandem connections (in which digital tie trunks are concatenated with analog tie trunks and/or with digitally interfaced analog access lines) predominate:

ISD/TT is recommended (provides lower end-to-end connection loss)

(b) most connections are established over single tie trunks or tandemed digital trunks:

IST is recommended (provides lower end-to-end connection loss)

---

28. These DEO attributes conform to the stipulations in Ref A8 for connections to "interconnecting networks". It is envisioned that a private network is included in the concept of "interconnecting network"; i.e., that a digital connection between a DEO and an ISPBX will be accorded loss treatment as for interconnecting networks. See 3.4.1 and 3.4.2 for a discussion on access line loss treatment.

(2) For networks with long delay connections and without echo control devices such that connection loss is the controlling factor for echo control and in which

(a) hybrid tandem connections (in which digital tie trunks are concatenated with analog tie trunks and/or with digitally interfaced analog access lines) predominate:

IST is recommended (provides more end-to-end connection loss)

(b) most connections are established over single tie trunks or tandemed digital trunks:

ISD/TT is recommended (provides more end-to-end connection loss)

The same designation (IST or ISD/TT) should be used on both ends of a tie trunk.

7.2 Proprietary Terminals

Proprietary station sets employing analog transmission techniques should provide electro-acoustic performance equivalent to that of stations connected to ONS ports, when operated and measured in conjunction with the host ISPBX. See Fig 64 (a).

Proprietary station sets employing digital transmission techniques should provide electro-acoustic performance equivalent to that of stations connected either to ONS ports or to ICS ports, when operated and measured in conjunction with the host ISPBX. See Fig 64 (b).

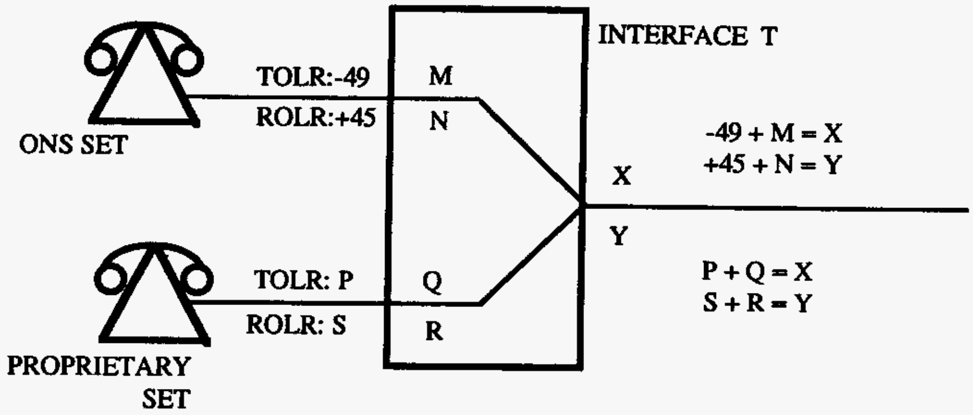
In Fig 64, X and Y represent, respectively, TOLR and ROLR values (as defined by the Acoustic Reference Level Plan, 5.3.2) at interface T. M and N represent Tables 12 or 13 electrical losses in the ISPBX which, with the ONS or ICS parameters, result in the values X and Y. Q and R represent manufacturer-defined electrical losses which, with the proprietary set parameters P and S, result in the values X and Y.

7.3 REN Scaling

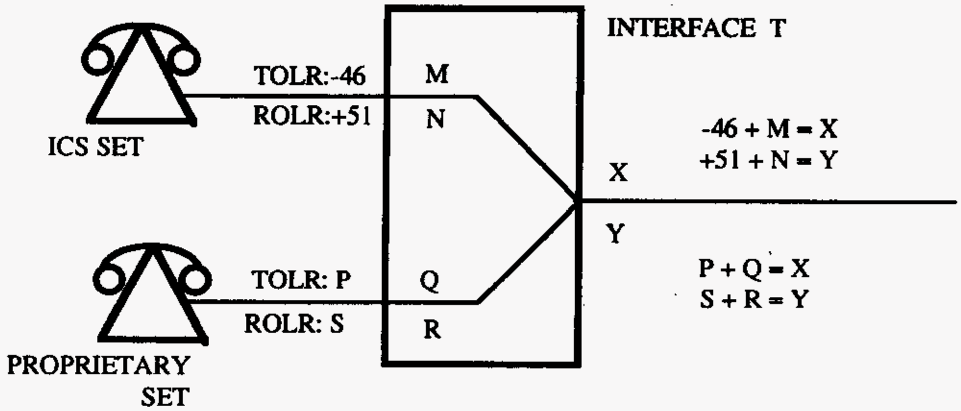
The following examples illustrate the use of scaling to convert criteria based on REN = 5.0 used in the text of this standard into criteria corresponding to actual REN values other than 5.0.

7.3.1 If an impedance of ≥100 KΩ is specified, the corresponding impedance specification for a PBX having REN = 4.0 will be 5/4 x100 (≥ 125 KΩ).

7.3.2 If a current of ≥0.6 mA is specified, the current specification for a PBX having REN = 2.0 will be 2/5 x 0.6 (≥ 0.24 mA).



a. Equivalency of Analog Proprietary Sets to ONS Sets



b. Equivalency of Digital Proprietary Sets to ICS Sets

Figure 64 - Proprietary Terminals

ANNEX A. REFERENCES

This annex is informative only and is not part of this standard.

A1 EIA Engineering Publication EP-7-A, Style Manual for Standards and Publications of EIA, TIA, and JEDC

A2 ANSI Standard EIA/TIA 470A-1987, Telephone Instruments with Loop Signaling

A3 ANSI Standard EIA/TIA 579-1991, Acoustic-To-Digital and Digital-To-Acoustic Transmission Requirements for ISDN Terminals

A4 Part 68 of the FCC Rules and Regulations

A5 UL-1459, Standard for Safety – Telephone Equipment

A6 ANSI Standard EIA/TIA 571-1991, Environmental Considerations for Telephone Terminals

A7 IEEE Standard 100-1984, IEEE Standard Dictionary of Electrical and Electronic Terms

A8 ANSI Standard T1.508-1992, Network Performance - Loss Plan for Evolving Digital Networks

A9 ANSI Standard EIA/TIA-464A-1989, Private Branch Exchange (PBX) Switching Equipment For Voiceband Applications

A10 ANSI T1.401-1993, Interface Between Carriers and Customer Installations – Analog Voicegrade Switched Access Lines Using Loop-start and Ground-Start Signaling

A11 ANSI T1.411-1994, Interface Between Carriers and Customer Installations – Enhanced 911 Switched Access Using Network-Provided Reverse Battery Signaling

A12 ANSI T1.403-1995, Network-to-Customer Installation - DS1 Metallic Interface

A13 ANSI Standard EIA/TIA-547-1989, Network Channel Terminal Equipment for DS1 Service

A14 ANSI Standard T1.101-1994, Synchronization Interface Standard

A15 ISO/IEC IS11753, Synchronization Methods and Technical Requirements for PISNs

A16 ANSI T1.107-1988, Digital Hierarchy - Formats Specification

A17 ITU-T (formerly CCITT) Recommendation Q.921 (1984), ISDN User-Network Interface Data Link Layer Specification

A18 ATIS T1X1 Technical Report No. 33

A19 ANSI T1.408-1990, Integrated Services Digital Network (ISDN) Primary Rate - Customer Installation Metallic Interfaces Layer 1 Specification

A20 ANSI T1.602-1989, Telecommunications - Integrated Services Digital Network - Data-Link Layer Signaling Specification for Application at the User-Network Interface

A21 ANSI T1.607-1990, Integrated Services Digital Network (ISDN) - Layer 3 Signaling Specification for Circuit-Switched Bearer Service

A22 ISO Standard 11579, Information Technology - Telecommunications and Information Exchange Between Systems - Reference Configuration for Private Integrated Services Networking (PISN) Exchanges

A23 ISO Standard 11582, Information Technology - Telecommunications and Information Exchange Between Systems - Private Integrated Services Network - Generic Functional Protocol for the Support of Supplementary Services - Inter-exchange signaling procedures and protocol

A24 ISO Standard 11572, Information Technology - Telecommunications and Information Exchange Between Systems - Private Integrated Services Network - Circuit Mode Bearer Services - Inter-exchange Signaling Procedures and Protocol

A25 ANSI TI.601-1992, Integrated Services Digital Network (ISDN) - Basic Access Interface for use on Metallic Loops on the Network Side of the NT (Layer 1 specification)

A26 ANSI TI.605-1991, Integrated Services Digital Network (ISDN) - Basic Access Interface for S/T Reference Points (Layer 1 Specification)

A27 ITU-T (formerly CCITT) Recommendation G.711 (1984), Pulse Code Modulation of Voice Frequencies

A28 ITU-T (formerly CCITT) Recommendation O.6 (1988), 1020 Hz Reference Test Frequency

A29 ANSI/IEEE 661-1979, Method for determining Objective Loudness Ratings of Telephone Connections

A30 ANSI/IEEE 823-1989, Standard Methodology for Specifying Voice Grade Channel Transmission Parameters and Evaluating Connection Transmission Performance for Speech Technology

A31 ANSI/IEEE 743-1984, Standard Methods and Equipment for Measuring the Transmission Characteristics of Analog Voice Frequency Circuits

A32 ANSI/IEEE 455-1985, Standard Test Procedure for Measurement of Longitudinal Balance of Telephone Equipment in the Voice Band

A33 Donald B. Owen, Handbook of Statistical Tables

A34 Selected Techniques of Statistical Analysis for Scientific and Industrial Research and Production and Management Engineering

A35 Bellcore, Telecommunications Transmission Engineering, Vol. 3. Ch. 12, 1990

A36 TA-NPL-000436, Digital Network Synchronization Plan

ANNEX B. VERIFICATION AND ANALYSIS

This annex is informative only and is not part of this standard.

B1 Introduction

Subject to practical limitations, compliance with a requirement would be met by physical testing or engineering analysis. However, it is recognized that it would not always be possible or practical to physically test all connections in large PBX's. For this reason, statistical verification techniques are included as an alternative to 100% exhaustive testing.

NOTE: With the permission of the Canadian Standards Association, the material in this annex is reproduced from CSA Standard CAN/CSA-T512-M91, Functional and Compatibility Requirements for Private Branch Exchange (PBX) Switching Equipment for Voiceband Applications, Appendix E (Verification and Analysis), which is copyrighted by CSA.

B2 Statistical Verification

B2.1 General

These guidelines are included in order to provide a statistical methodology for verifying that the requirements of this Standard have been met to an acceptable level of confidence. This testing approach is available as an alternative to exhaustive testing for demonstrating compliance for requirements that would be difficult or impossible to test in an exhaustive manner.

B2.2 Sampling

The minimum sample taken shall include all applicable types or classes of trunk or station interfaces associated with the PBX.

B2.3 Confidence Level

A confidence level (C) of 90% (=0.90) shall be used for all calculations.

B2.4 Testing Procedure

Step 1. Identify from the requirements whether the test set is

(a) one-sided with a lower limit (L_L) given;

(b) one-sided with an upper limit (L_U) given; or

(c) two-sided (with both a lower limit and an upper limit given).

Step 2. Identify what the probability level (P) is from the requirement.

Step 3. Take measurements for a small (n) number of connections chosen in compliance with B2.2.

Step 4. Calculate the following:

$\sum x$, sum of the sample values

$\sum x^2$, sum of the squares of the sample values

$$\bar{x} = \frac{\sum x}{n}, \text{ the sample mean}$$

$$s = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}, \text{ the sample standard deviation}$$

Determine K from Table B1 (using either the one-sided or two-sided table according to the determination of clause 2.4, Step 1) and the probability limit (P), the confidence level (C) and the sample number (n).

Note: K represents the value of the deviation of the specified probability limit (P) from the sample population mean (X) in terms of the sample standard deviation (s); assuming that the sample is random and that the underlined distribution of the parameter in question is normal.

Step 5. Determine whether the test has established compliance:

(a) $L_L < X - sK$; or

(b) $L_U > X + sK$; or

(c) $(L_U < X + sK)$ AND $(L_U > X + sK)$;

Where the test criterion are not met it does not necessarily mean that the specification has not been met; rather, that this fact has not been determined to the required level of confidence. This shall be resolved with additional samples.

B2.5 Example of One-Sided Test

Consider a requirement for crosstalk to be "at least 70 dB for 95% of all possible connections".

Step 1. This is a one-sided test with a lower limit (L_L) of 70 dB given.

Step 2. A probability of 95% is given.

Step 3. Measurements for a small (n = 6) number of connections are as follows:

Number	x	x^2
1	81.5	6642.25
2	78.9	6225.21
3	82.1	6740.41
4	80.4	6464.16
5	79.3	6288.49
6	82.6	6822.76

Step 4. Calculate:

$$\sum x = 484.80$$

$$\sum x^2 = 39{,}183.28$$

$$\bar{x} = \frac{\sum x}{n} = \frac{484.80}{6} = 80.80$$

$$s = \sqrt{\frac{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}{n-1}} = \sqrt{\frac{39183.28 - \frac{(484.80)^2}{6}}{5}} = 1.51$$

K = 3.093 from Table B1 (one sided; P = 0.95; C = 0.90; n = 6)

Step 5. Determine whether the test has established compliance.

$L_L < X - sK$

$70 < (80.80 - 1.51\,(3.093))$

$70 < 76.13$ = true

Thus this test has established compliance with the requirements for crosstalk loss.

B2.6 Example of Two-Sided Test

Consider a requirement for analog station-to-station frequency response at 3000 Hz to be "between -0. 1 dB and + 1.0 dB for 95% of all possible connections".

Step 1. This is a two-sided test with a lower limit (L_L) of -0. 1 dB and an upper limit (L_U) of +1.0 dB given.

Step 2. A probability of 95% is given.

Step 3. Measurements for a small (n = 7) number of connections are as follows:

Number	x	x^2
1	0.341	0.1163
2	0.416	0.1731
3	0.322	0.1037
4	0.251	0.0630
5	0.304	0.0924
6	0.297	0.0882
7	0.357	0.1274

Step 4. Calculate:

$$\sum x = 2.288$$

$$\sum x^2 = 0.764$$

$$\bar{x} = \frac{\sum x}{n} = \frac{2.288}{7} = 0.327$$

$$s = \sqrt{\frac{\sum x^2 - \frac{\left(\sum x\right)^2}{n}}{n-1}} = \sqrt{\frac{0.764 - \frac{(2.288)^2}{7}}{6}} = 0.052$$

K = 3.452 from Table B1 (two sided; P = 0.95; C = 0.90; n = 7)

Step 5. Determine whether the test has established compliance:

(L_L < X - sK) AND (L_U > X + sK)

(-0.1 < 0.327 - 0.052 (3.452)) AND (1.0 > 0.327 + 0.052 (3.352))

(-0.1 < 0.147) AND (1.0 > 0.507)

true AND true = true;

Thus this test has established compliance with the requirement for analog station-to-station frequency response at 3000 Hz.

Table B1 - Tolerance Factors (K Factors) for Normal Distributions at 90% Confidence Level (C = 0.90)

Number of meas. (n)	Probability (P)					
	One-sided			Two-sided		
	0.90	0.95	0.99	0.90	0.95	0.99
02	10.253	13.090	18.500	15.978	18.800	24.167
03	4.258	5.311	7.340	5.847	6.919	8.974
04	3.188	3.957	5.438	4.166	4.943	6.440
05	2.744	3.401	4.668	3.494	4.152	5.423
06	2.494	3.093	4.243	3.131	3.723	4.870
07	2.333	2.893	3.972	2.902	3.452	4.521
08	2.219	2.754	3.783	2.743	3.264	4.278
09	2.133	2.650	3.641	2.626	3.125	4.098
10	2.066	2.568	3.532	2.535	3.018	3.959
11	2.012	2.503	3.444	2.463	2.933	3.849
12	1.966	2.448	3.371	2.404	2.863	3.758
13	1.928	2.403	3.310	2.355	2.805	3.682
14	1.895	2.363	3.257	2.314	2.756	3.618
15	1.866	2.329	3.212	2.278	2.713	3.562
16	1.842	2.299	3.172	2.246	2.676	3.514
17	1.819	2.272	3.137	2.219	2.643	3.471
18	1.800	2.249	3.106	2.194	2.614	3.433
19	1.781	2.228	3.078	2.172	2.588	3.399
20	1.765	2.208	3.052	2.152	2.564	3.368
21	1.750	2.190	3.028	2.135	2.543	3.340
22	1.736	2.174	3.007	2.118	2.524	3.315
23	1.724	2.159	2.987	2.103	2.506	3.292
24	1.712	2.145	2.969	2.089	2.489	3.270
25	1.702	2.132	2.952	2.077	2.474	3.251
30	1.657	2.080	2.884	2.025	2.143	3.170
35	1.623	2.041	2.833	1.988	2.368	3.112
40	1.598	2.010	2.793	1.959	2.334	3.066
45	1.577	1.986	2.762	1.935	2.306	3.039
50	1.560	1.965	2.735	1.916	2.284	3.001
60	1.532	1.933	2.694	1.887	2.248	2.955
70	1.511	1.909	2.663	1.865	2.222	2.920
80	1.495	1.890	2.638	1.848	2.202	2.894
90	1.481	1.874	2.618	1.834	2.185	2.872
100	1.470	1.861	2.601	1.822	2.172	2.854
120	1.452	1.841	2.574	1.804	2.150	2.826
300	1.386	1.765	2.477	1.740	2.073	2.725
500	1.362	1.736	2.442	1.717	2.046	2.689
Infinity	1.282	1.645	2.326	1.645	1.960	2.576

B3 References

Values for one-sided tolerance limit factors are taken from the following:

> Donald B. Owen, Handbook of Statistical Tables, (Copyright 1962), by Addison-Wesley Publishing Co., Inc., Reading, Massachusetts (Ref A33). Table on page 126. Reprinted with permission of the publisher. Assigned to the General Manager of the United States Atomic Energy Commission, 1962.

Values for two-sided tolerance limit factors are reprinted with the permission of the publisher from the following:

> Chapter II by Albert H. Bowker (Stanford University) of Selected Techniques of Statistical Analysis for Scientific and Industrial Research and Production and Management Engineering by the Statistical Research Group, Columbia University, Applied Mathematics Panel, Office of Scientific Research and Development (Ref A34); Edited by Churchill Eisenhart (National Bureau of Standards), Millard W. Hastay (National Bureau of Economic Research), and W. Allen Wallis (University of Chicago); First Edition, McGraw Hill Book Company Inc., New York, (Copyright 1947), pp. 102-107.

ANNEX C. ACOUSTIC REFERENCE LEVEL PLAN -- DESCRIPTION AND RATIONALE

This annex is informative only and is not part of this standard.

C1 Introduction

Current loss and level planning for private network voice terminals that interface digital facilities for connections to the public network and to other terminals in a private network is based on the concept of providing a compromise optimum value of electrical end-to-end loss in such connections. The fundamental example of this concept is embodied in the TIA-464-A loss plan for ISPBXs.

The ISPBX loss plan is structured on the insertion of port-to-port electrical loss (or gain). As in the fixed loss plan for public networks, these losses are discrete values, representing a compromise for a range of connection lengths.

The loss/gain quantities prescribed in the loss plan were derived from Grade-of-Service (GOS) studies that defined the optimum compromise connection loss for each type of connection illustrated in Fig 1. These studies assumed that the connections terminate to standard telephone sets with the electro-acoustic characteristics typical of sets conforming to Ref A2. Although these characteristics for a set on a short PBX loop with reduced current feed do not precisely emulate those on an average local exchange loop, the inclusion of the equivalent local exchange loop loss (3 dB) resulted in generally satisfactory transmission performance on nearly all intra-PBX and private network connections and on most connections to public network switches.

The extension of digital technology to terminals, together with the increased diversity of terminal characteristics and the gradual trend towards all-digital connections within the ISDN environment, suggests that an alternative loss/level planning approach, based on specified acoustic levels at defined interface classes, would better meet the needs of this environment. This approach is based on a systems view, wherein station apparatus and the PBX are considered as a whole, with the loss plan described in terms of an acoustic (user) to electrical (network) standard. The concept of defining a loss/level plan in such terms is called the Acoustic Reference Level Plan (ARLP).

The ARLP, when applied to private network voice terminals, provides advantages with respect to terminal design as well as to network planning. Among these are:

- Any connection of a given class and type will have a known terminal-to-terminal acoustic loss or range of loss.
- The installation on the terminal side of the interface at which the acoustic levels are specified may be considered as a single system for design purposes, thus enabling the supplier to optimize the selection of acoustic and electrical parameters for any given set and switch that combine to achieve the specified acoustic levels at the interface.
- Standardization of systems and demonstration of compliance will be simplified.
- Networking will be made easier with respect to assessing transmission performance; for example, the impact of alternate routing strategies on end-to-end acoustic loss can be identified.

C2 Acoustic Reference Level Plan Description

The ARLP applies to voice terminal interfaces for connections between a facility and a terminating device (e.g., a station set). The basic ARLP requirements do not apply to tandem connections between trunks or access lines. For such connections, the electrical loss insertion algorithms of the ISPBX loss plan continue to be applicable. However, for transmission analysis purposes, the acoustic levels from a defined ARLP interface can be extrapolated to any point along a connection.

In the PBX environment, the ARLP defines levels at the PBX interface to tie trunks and public network access lines when such facilities are connected through the PBX to station apparatus (ONS or ICS). Trunks and access lines may be analog or digital. Public network access lines generally connect to the local serving office of the LEC (traditional PBX-CO trunks) but may also connect to IECs. Station apparatus may consist of standard telephone instruments (sets conforming to Ref A2), ISDN-compatible digital terminals, or proprietary terminals, analog or digital. The interface for analog terminals may utilize technologies for optimizing power consumption, e.g., constant current feed arrangements, thereby altering the traditional electro-acoustic characteristics; the use of local powering could also alter these characteristics.

Since the ARLP is defined at the facility interface, the electrical loss within the PBX for connections to station interfaces is not explicitly specified by the plan. In actual implementation, it is expected that the ARLP provisions will be met via a combination of station apparatus electro-acoustic transducer efficiencies and inserted electrical loss in the PBX. In many instances, the electrical loss will be unchanged from that prescribed by the ISPBX loss plan, particularly in conjunction with standard telephone sets. Furthermore, the ARLP also forms the basis on which the electrical insertion loss values of the ISPBX loss plan in this standard are formulated. In a more general sense, however, the ARLP gives the system supplier the flexibility to tailor electrical loss insertion to accommodate unique station characteristics that differ from those of standard telephone sets, and yet be in compliance with loss plan standards.

The electrical loss insertion in the ISPBX loss plan generally assures that adequate echo return losses exist at connection ends. Dissociating the electrical loss from the ARLP requirements necessitates that an explicit specification be included to ensure echo performance. The ARLP, therefore, includes requirements on minimum ERL as seen at the interface.

C3 Acoustic Reference Level Plan Rationale

The numerical values in Table 15 are derived from an assessment of current acoustic performance of connections with the application of the ISPBX loss plan together with the assumed characteristics of a standard PSTN loop appearance at a local serving office and on the subjective effects of end-to-end acoustic loss. The derivations for the ARLP values associated with AAL(A), A/TT, ISD/TT, AAL(D), and DAL/IST are described below.

C3.1 Analog Access Line - Analog Interface, AAL(A)

In ANSI T1.508 (Ref A8), analog access lines are assumed to be terminated by equipment having nominal loudness characteristics (as seen by the public network switch) of:

TOLR: -46 dB

ROLR: +48 dB

(These values are based on a 2.74-km (9-kft) 26-gauge cable loop and a 48-volt power supply. A typical PSTN subscriber line terminated with a telephone set conforming to Ref A2 would exhibit these levels at the network interface.)

The ARL (acoustic reference level) at the AAL(A) is defined so as to make a PBX station appear, at the network interface, acoustically equivalent to a PSTN subscriber line. An average access line facility loss of 3 dB is assumed, based on the historic ICL objectives for special service circuits of 0.0 to 4.0 dB if without gain, 3.5 dB with gain (Bellcore, Telecommunications Transmission Engineering, Vol. 3. Ch. 12; Ref A35). This leads to:

TOLR: (-46) -3 = -49 dB

ROLR: (+48) -3 = +45 dB

It might be observed that this results in an acoustic end-to-end loss (OOLR)[29] of 2 dB (considered near optimum for short connections) on calls from a PBX station to a typical PSTN subscriber (i.e., analog access line), calculated by:

OOLR = -49 + 3 + 48 = 2 dB (PBX set to PSTN station), or

-46 + 3 + 45 = 2 dB (PSTN station to PBX set)

Likewise, a call from a PBX to a distant public network location will have an OOLR of 8-10 dB, within the range generally considered as providing good-or-better performance for such connections. For example, on an all-digital PSTN connection:

OOLR = - 49 + 3 + 6 + 48 = 8 dB (PBX set to PSTN station), or

- 46 + 6 + 3 + 45 = 8 dB (PSTN station to PBX set)

C3.2 Analog Access Line - Digital Interface, AAL(D)

The AAL(D) ARLP requirements follow from the objective of having a PBX station appear, acoustically, like a PSTN subscriber line at the network interface; with a digital (zero-loss) facility, the nominal PBX interface levels are the same as the nominal network interface levels.

C3.3 Analog Tie Trunk Interface, A/TT

Applying the ISPBX loss plan to an analog tie trunk connection (with VNL loss design) results in an end-to-end electrical loss of VNL+6 dB (ONS-A/TT loss insertion by the PBX is 3 dB, each direction). Depending on the station set current feed arrangements, set transducer efficiency, and loop length, the corresponding acoustic end-to-end loss (OOLR) over analog tie trunks will be in the range of from VNL to VNL+4 dB.[30] Assuming the average OOLR to be VNL+2 dB, the nominal ARLP requirements for A/TT in Table 15 follow. For a single link analog tie trunk connection:

OOLR = -46 + VNL + 48 = VNL+2

C3.4 Digital Tie Trunk Interface, ISD/TT

By analogous reasoning, digital tie trunk connections based on the ISPBX loss plan have electrical loss of 12 dB (3 + 9) and OOLRs in the range of 6-10 dB. The Table 15 nominal ARLP requirements for ISD/TT provide OOLR of 8 dB over a digital tie trunk connection. It may be observed that this is corresponds directly with the nominal OOLR on all-digital PSTN connections between two typical analog access lines (OOLR = -46 + 6 +48 = 8 dB).

C3.5 Integrated Services Trunk Interface, IST

To be compatible with ISDN and ISDN-compatible services, the IST interface has the same acoustic values as those proposed for ISDN terminals; i.e., TOLR = -46 dB, ROLR = +51 dB.

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29. In the strictest sense, acoustic end-to-end loss and OOLR are not precisely equivalent since the TOLR and ROLR components of the latter include frequency-weighting in their computation. For the purposes of this document, the distinction is not significant.

30. The acoustic loss (OOLR) is TOLR + electrical loss + ROLR. For sets conforming to Ref A2 and served by PBXs, the sum of TOLR and ROLR generally lies between -2 and -6 dB. For example, the initial muPBX loss plan formulation appears to have been based on assumed TOLR and ROLR values of -47 and +43 dB, respectively.

C3.6 Echo Return Loss

The values for ERL in the Acoustic Reference Level Plan — defined at the facility interface and denoted by ERL(A) — are based on the notion of an Acoustic Echo Path Loss (AEPL). On a terminal-to-terminal basis, AEPL is defined by:

$AEPL = \Delta A + ERL + \sum L$

where: ΔA = acoustic difference at talker terminal
= TOLR + ROLR (at terminal)

ERL = echo return loss (at predominant echo point)

$\sum L$ = sum of electrical loss (including loss in end-switches) in the two directions of transmission to the predominant echo point

Under the ARLP concepts, a computation from interface to interface, using the talker-end reference acoustic levels and the reflecting-end ERL(A) should yield the same AEPL as the above computation. To illustrate this, consider the IST interface:

Set-to-set:

$AEPL = (-4) + 12 + 2(9) = 26$ dB

derived by: ΔA = -4 dB (TOLR = -49, ROLR = +45 dB)
ERL at ONS port: 12 dB (mean)
L, per the ISPBX loss plan (Table 12), is 9 dB, ONS-IST-ONS

Interface-to-interface:

$AEPL = 5 + ERL(A) + 2(0) = 26$ dB

derived by: ΔA = 5 dB (TOLR = -46, ROLR = +51 dB)
L, IST interface to IST interface, is 0 dB

Thus:

$ERL(A) = 26 - 5 = 21$ dB for the IST interface.

Other ERL(A) values in Table 15 are similarly derived.

The loss insertion between ONS and a facility port specified in the ISPBX loss plan and, for IST, in the ISPBX loss plan, together with the mean ONS port ERL of 12 dB, will result in the Table 15 ERL values. For other PBX/terminal designs with loss insertion and terminal characteristics differing from those presumed for ONS in these loss plans, the ERL(A) values of Table 15 are to be considered an adjunct to the ARLP requirements.

C4 Application Of The ARLP And ISPBX Loss Plan In Network Connections

As was noted above, the ARLP concept is a useful tool in network performance assessment. This is illustrated in Figs C1 and C2. Fig C1 shows the derivation of interface levels at an IST/DAL port and the resulting connection loudness loss (OOLR). Fig C2 shows the derivation of interface levels at an ICS port.

C4.1 IST Interfaces

In Fig C1 (three pages), the ISPBX on the left connects one of the defined ISPBX ports to the IST/DAL port leading to the "near interface" acoustic levels through the application of the ISPBX loss plan for that port-to-IST/DAL port path. To illustrate the derivation of end-to-end loudness loss, an IST connection is made between each near-end ISPBX to a far-end ISPBX ONS port.

The TOLR and ROLR of the connecting ISPBX port depend on the connection origin. In the case of tie trunks the levels are the nominal ARLP levels of the originating PBX (modified by facility loss, if any). For analog access lines at the ISPBX, the levels reflect the nominal levels of analog access lines at a connecting DEO (again, modified by facility loss for analog facilities).

The asymmetry in OOLR for some connections ensues from the fact that the IST/DAL port accommodates a variety of connection scenarios; both to the PSTN and to other private network nodes. In general, PSTN connections have a far-end loss asymmetry of 6 dB (from the network loss insertion in the receive side at a digital connection termination), whereas in ISDN-compatible private networks, the far-end loss asymmetry is 3 dB. In general, the added loss on one side provides additional echo protection.

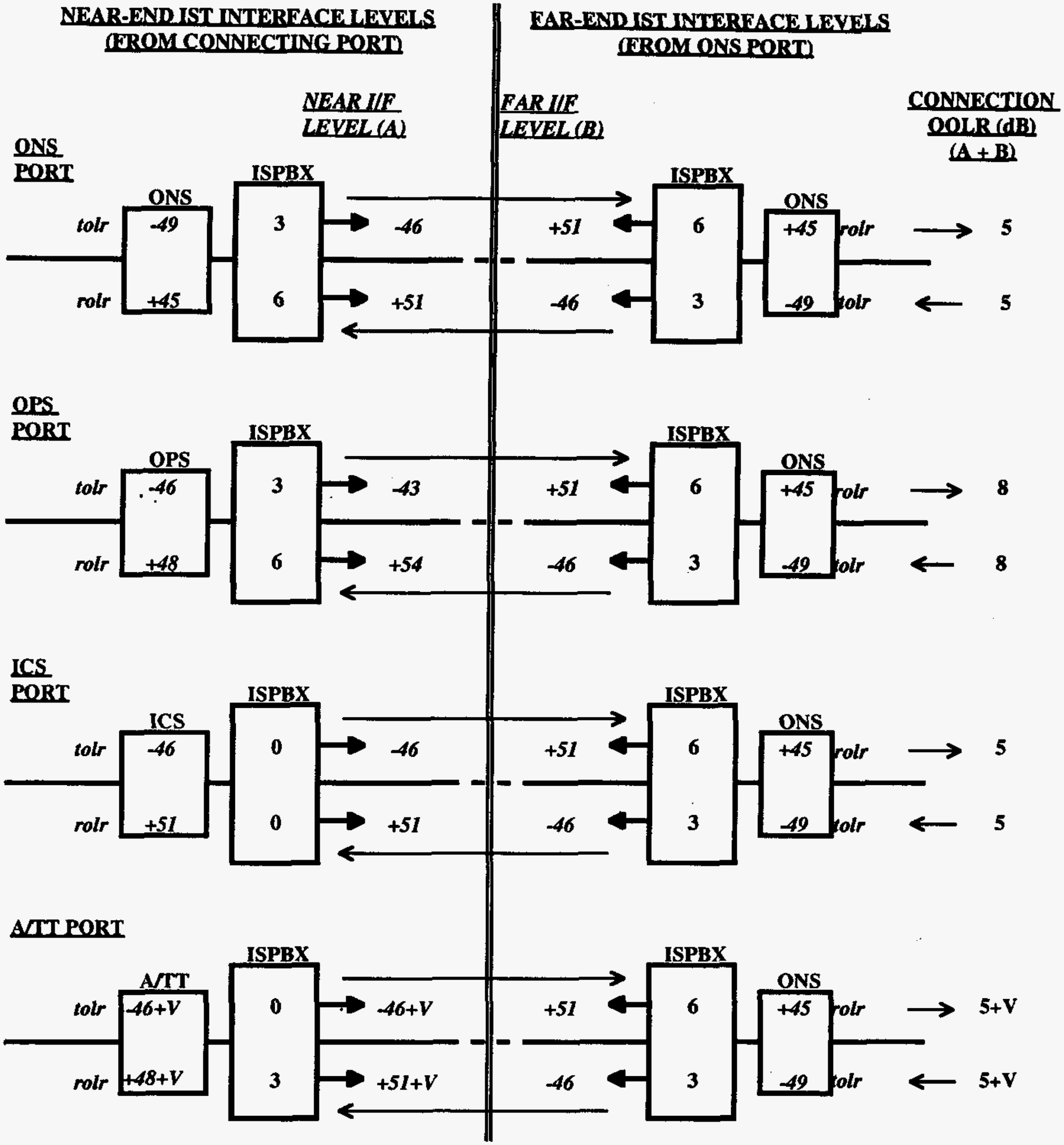
The notation used in this figure as well as in Fig C2 is as follows:

- Interface levels are in italics
- Loss values, including end-to-end loudness, are non-italic.
- Thin arrows denote direction of transmission
- Heavy arrows denote interface level values, presented to the network (i.e., the vertical double line); these do not represent direction of transmission.

Note that the OOLR values are simply the addition of corresponding (facing) interface levels presented to the network.

C4.2 ICS Interfaces

Fig C2 shows the nominal acoustic levels for each ISPBX trunk port when connected to an ICS port. The ISPBX loss plan design is intended to provide the ARLP values for each of these interfaces. For connections to line ports, the ISPBX loss plan provides line-to-line OOLR or 5 dB to ONS and 2 dB to OPS (to minimize contrast between ICS and ONS connections for OPS users).



"+V" = plus VNL. Distant port assumed to be ONS

Figure C1 - IST Acoustic Interface Levels

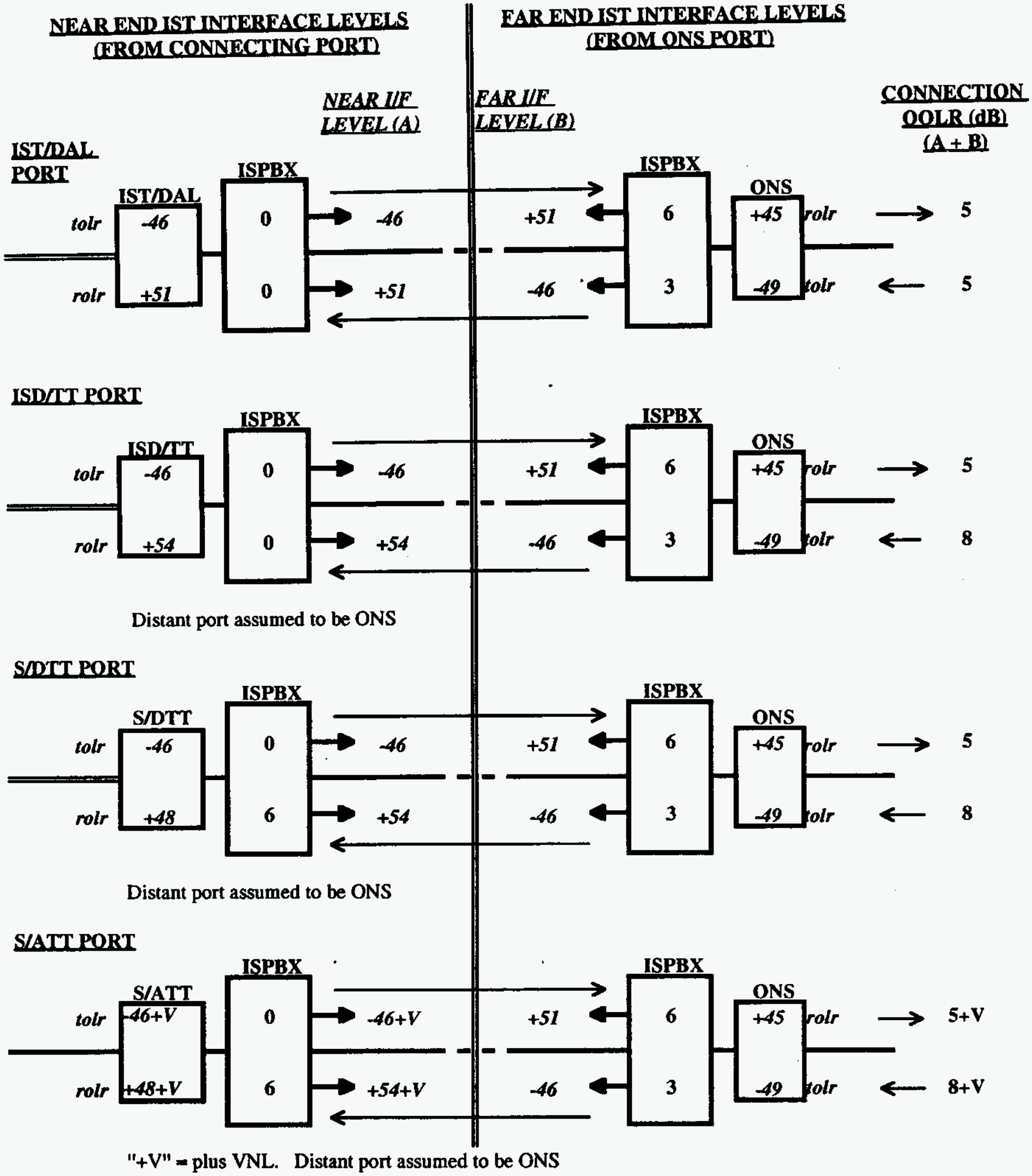


Figure C1 *(continued)*

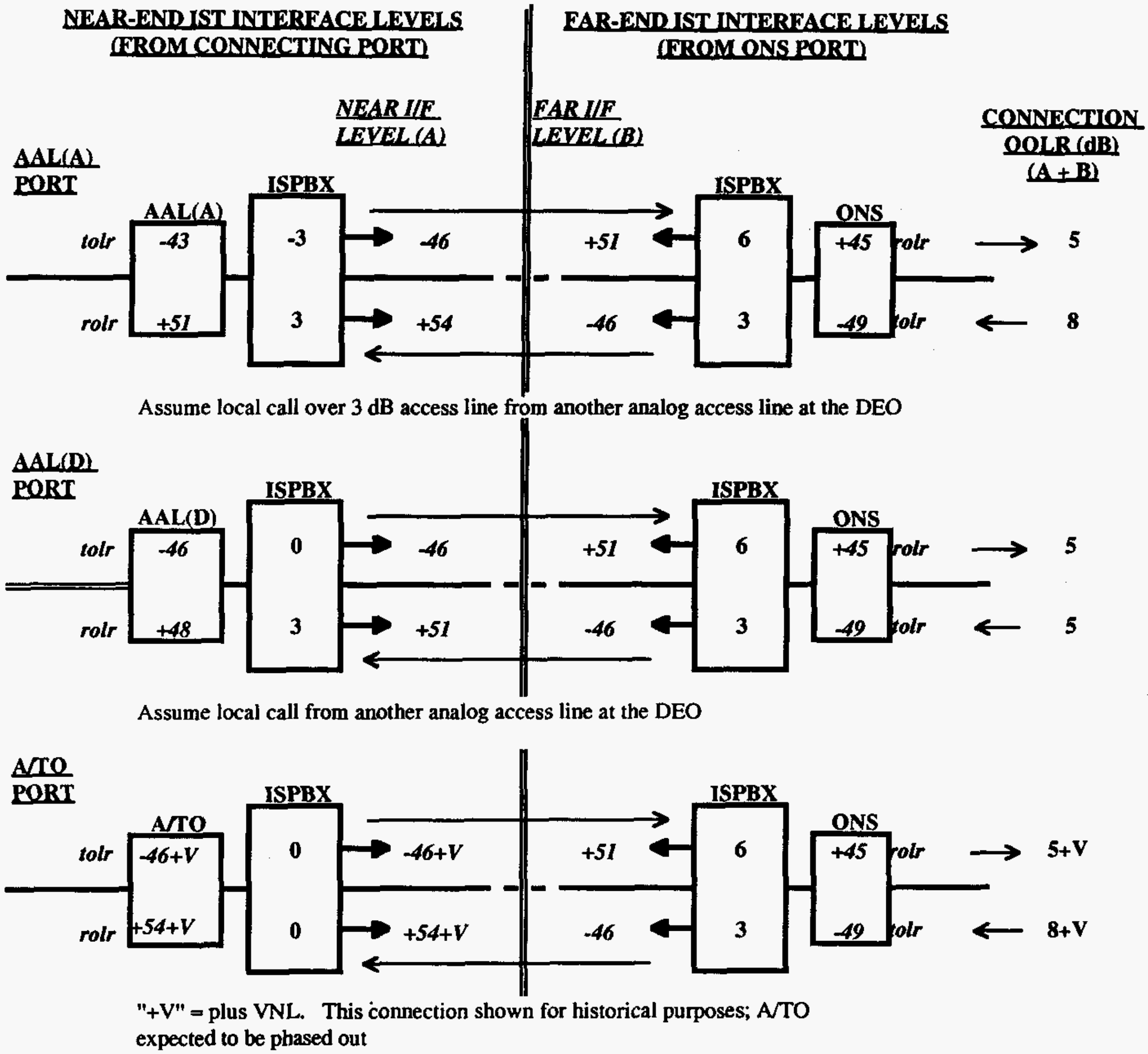


Figure C1 *(concluded)*

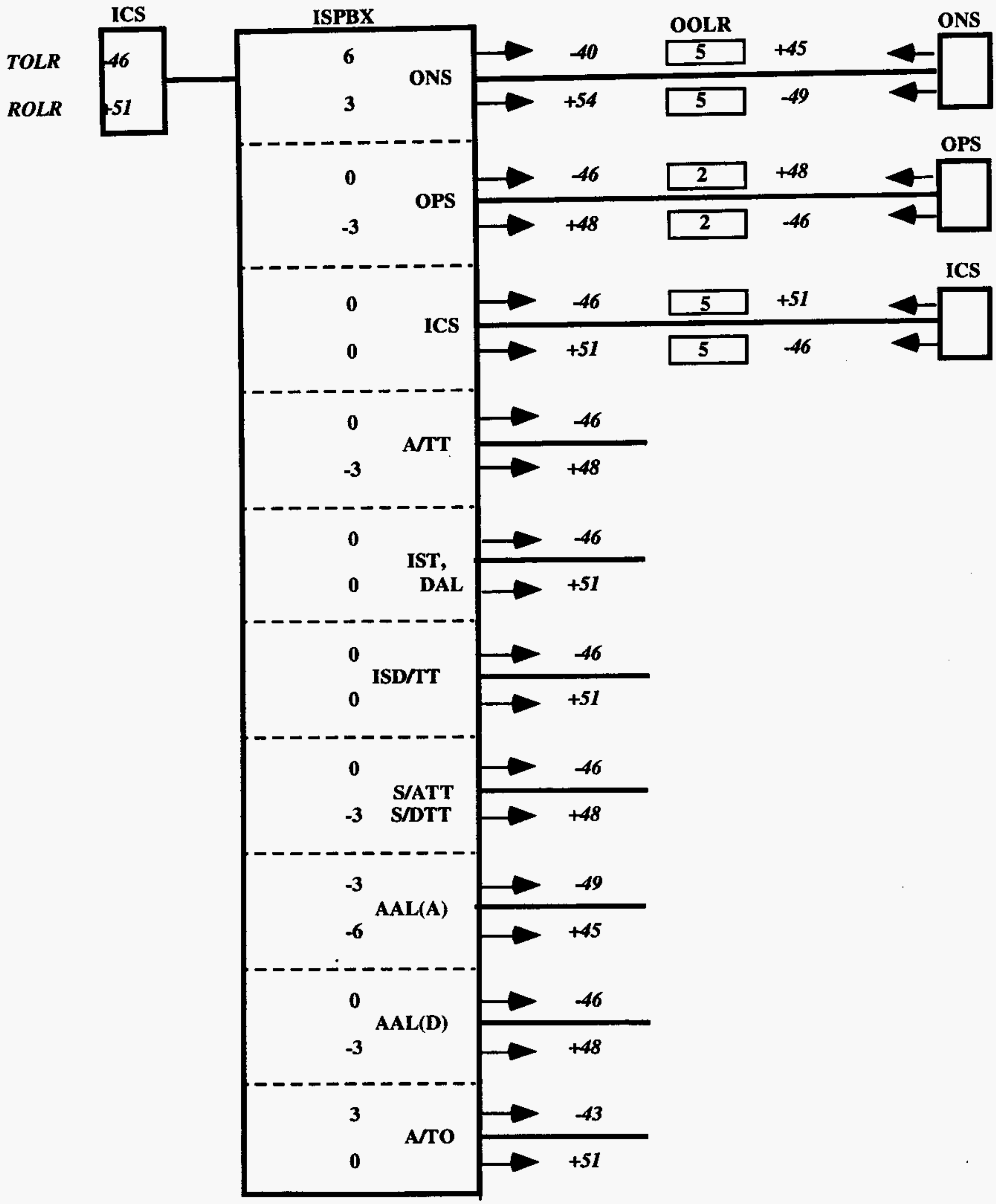


Figure C2 - ICS Acoustic Interface Levels

ANNEX D. LOSS DEFINITIONS

This annex is informative only and is not part of this standard.

Echo return loss (ERL) is a weighted average of the return loss values over the frequency range 400 to 3400 Hz. Frequency multiples of 8 kHz must be avoided; the table below shows one convention for avoiding multiples. ERL is calculated as follows:

$$\mathrm{ERL} = -10\log_{10}\left\{\frac{\sum_{i=1}^{N} W(f_i)10^{\frac{-RL(f_i)}{10}}}{\sum_{i=1}^{N} W(f_i)}\right\}\ \mathrm{dB}$$

where

$RL(f_i) =$ Return loss or transhybrid loss, in dB, at frequency f_i,

$W(f_i) =$ Weighting factor at frequency f_i (see the following table).

Frequency fi (Hz)	ERL Weights W(fi)
402	0.0631
602	0.6761
803	1.0000
1004	1.0000
1205	1.0000
1405	1.0000
1606	0.9550
1807	0.7586
2008	0.4467
2208	0.1995
2409	0.0813
2610	0.0324
2811	0.0129
3011	0.0051
3212	0.0021
3413	0.0009

Return loss (RL) at an impedance discontinuity in a transmission path is the ratio (in dB) of the power level of an incident signal to the power level of the resulting reflected signal. The general expression for return loss is:

$$RL = 20\log\left|\frac{Z(1)+Z(2)}{Z(1)-Z(2)}\right| \text{ dB}$$

where Z(1) and Z(2) are the impedances at each side of the discontinuity.

Single-frequency return loss (SFRL) is the lowest value of nonweighted return loss occurring in the frequency range 200 to 3200 Hz.

Single-frequency transhybrid loss (SFTHL) is the lowest value of loss, from the input pair to the output pair of the same 4-wire interface, occurring in the frequency range 200 to 3200 Hz.

Transhybrid loss (THL) is the loss from the input pair to the output pair of the same 4-wire interface.

ANNEX E. DIAL PULSE SIGNALING

This annex is normative and is part of this standard.

E1 Foreword

This annex provides dial pulse signaling requirements for sending dial pulses to the central office, receiving dial pulses from stations, and for receiving and sending of dial pulses via E&M tie trunks. While it is not necessary for a PBX to provide these signaling methods in order to comply with this standard, it is required that the PBX comply with the requirements of this annex when used in an application covered by this annex. This annex is normative and is a part of this standard.

Definitions specific to this annex are:

(1) break interval: That portion of the dial pulse in which the pulsing circuit is in an on-hook state.

(2) dial pulse: A change in the direct current of a signaling system to provide address information.

(3) dial-pulse period: One complete cycle of a dial pulse, consisting of fall time, break interval, rise time, and make interval.

(4) dial-pulse signaling: A method of transmitting a telephone address over a direct current path. The current is changed at the transmitting end, in a defined pattern. The number of changes indicates the digit being transmitted.

(5) make interval: That portion of the dial pulse in which the pulsing circuit is in an off-hook state.

E2 Outgoing Dial Pulse Signaling To The Network

E2.1 Network Characteristics

The network at the network interface (NI) will accept dial pulses at the rate of 8 to 11 pulses per second that have from 58 to 64 percent break, with the equivalent of up to five C4A type ringers bridged across the line.

The network will present an inductance of not more than 30 h during the address signaling state.

E2.2 PBX Characteristics

During the address signaling state, dial pulses from the PBX shall comply with the waveform criteria in E.2.3 and E.2.4 and satisfy all of the additional requirements in E.2.5.

The waveform of the loop current at the NI is required to lie within a prescribed template when the PBX is pulsing into a test circuit. Two test circuits are specified: noninductive and inductive, together with their corresponding templates. The dial pulses from the PBX shall pass both tests.

E2.3 Waveform Criteria with Noninductive Termination

For all values of R1 between 0 and 1500 Ω, the current into the test circuit shown in Fig E1 shall comply with each of the following:

(1) Within the interval from $t=T_1$ to $t=(T_1 + 125)$ ms or to the start of the next break interval, if any, the current into the test circuit shall be within the template of Fig E2, where $t=T_1$ is the time when the current becomes less than 14 mA. T1 is the time at which the dial pulse break interval begins.

(2) Within the interval from $t=(T_1 + 53)$ ms to $t=T_2$ ms, where $t=T_2$ is the time when the current becomes larger than 14 mA, the current:

(a) Shall be nondecreasing.

(b) Shall increase to 14 mA before $t=(T_1 + 80)$ ms.

(3) Within the interval from $(T_1 + 91)$ ms to $(T_1 + 125)$ ms, the current in the test circuit shall decrease to 14 mA (except for waveforms associated with the last pulse in a digit pulse train). T_3 is the time when the test circuit current falls below 14 mA.

(4) In the time interval from $(T_2 + 1)$ ms to $(T_2 + 5)$ ms:

(a) The current in the test circuit shall not be less than 18 nor greater than 125 mA.

(b) The ratio of maximum to minimum current values shall not exceed 1.3.

(5) In the time interval from $(T_2 + 5)$ ms to $(T_3 - 1)$ ms:

(a) The current in the test circuit shall not be less than 22.4 nor greater than 125 mA.

(b) The ratio of maximum to minimum current values shall not exceed 1.2.

For any dial pulse period, the ratio $(T_2 - T_1)/(T_3 - T_1)$ shall be greater than, or equal to, 0.58 and less than, or equal to, 0.64. T_2 is the time at which the dial pulse break interval ends and the dial pulse make interval begins. T_3 is the time when the dial pulse make interval ends and the break interval of a subsequent dial pulse begins.

E2.4 Waveform Criteria with Inductive Termination

For all values of R1 between 0 and 1500 Ω, the current in the test circuit shown in Fig E3 shall be within the template of Fig E4 from $t=(T_{01} + 2)$ ms to $t=(T_{01} + 125)$ ms or to the start of the next break interval, if any, where $t=T_{01}$ is the time when the current falls below 20 mA. To reduce the possibility of error in detecting dial pulses in the network, the current in the test circuit should be constrained inside the nonshaded area of Fig E4. The inductor specifications are given in Fig E5.

E2.5 Additional Requirements

In addition to the criteria in E2.3 and E2.4, the PBX shall comply with each of the following:

(1) Dial pulses shall not start before 70 ms after reception of dial tone.

(2) Interdigital intervals shall be at least 700 ms long. The value of 700 ms is based on step-by-step technology. Newer switching systems require only 350 ms.

(3) Spurious breaks in the current shall not exceed 1 ms in duration during any of the following intervals:

(a) The off-hook interval after dial tone begins before dial pulsing.

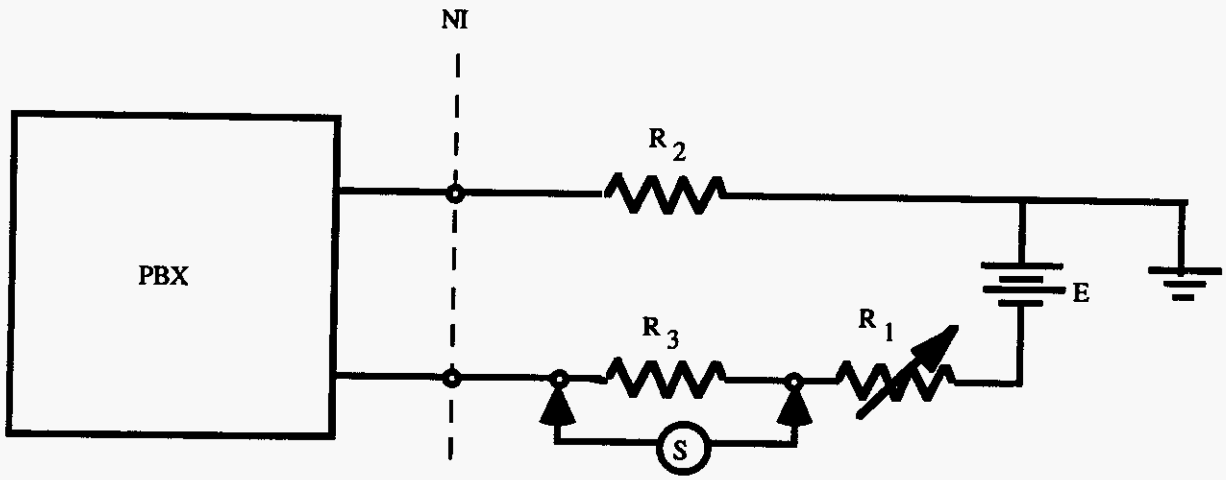
(b) An interdigital interval.

(c) The 700 ms interval immediately following the last pulse of a digit pulse train.

(4) DTMF pulses that might be generated along with dial pulses shall either:

(a) Have less power than -55 dBm in at least one tone.

(b) Be less than 23 ms in duration and separated by at least 45 ms.



E: 50 V ± 1%
R1: 0 - 1500 Ω
R2: 390Ω ± 1%
R3: 10Ω ± 1%
(S): Oscilloscope

Figure E1 - Dial Pulse Noninductive Test Circuit

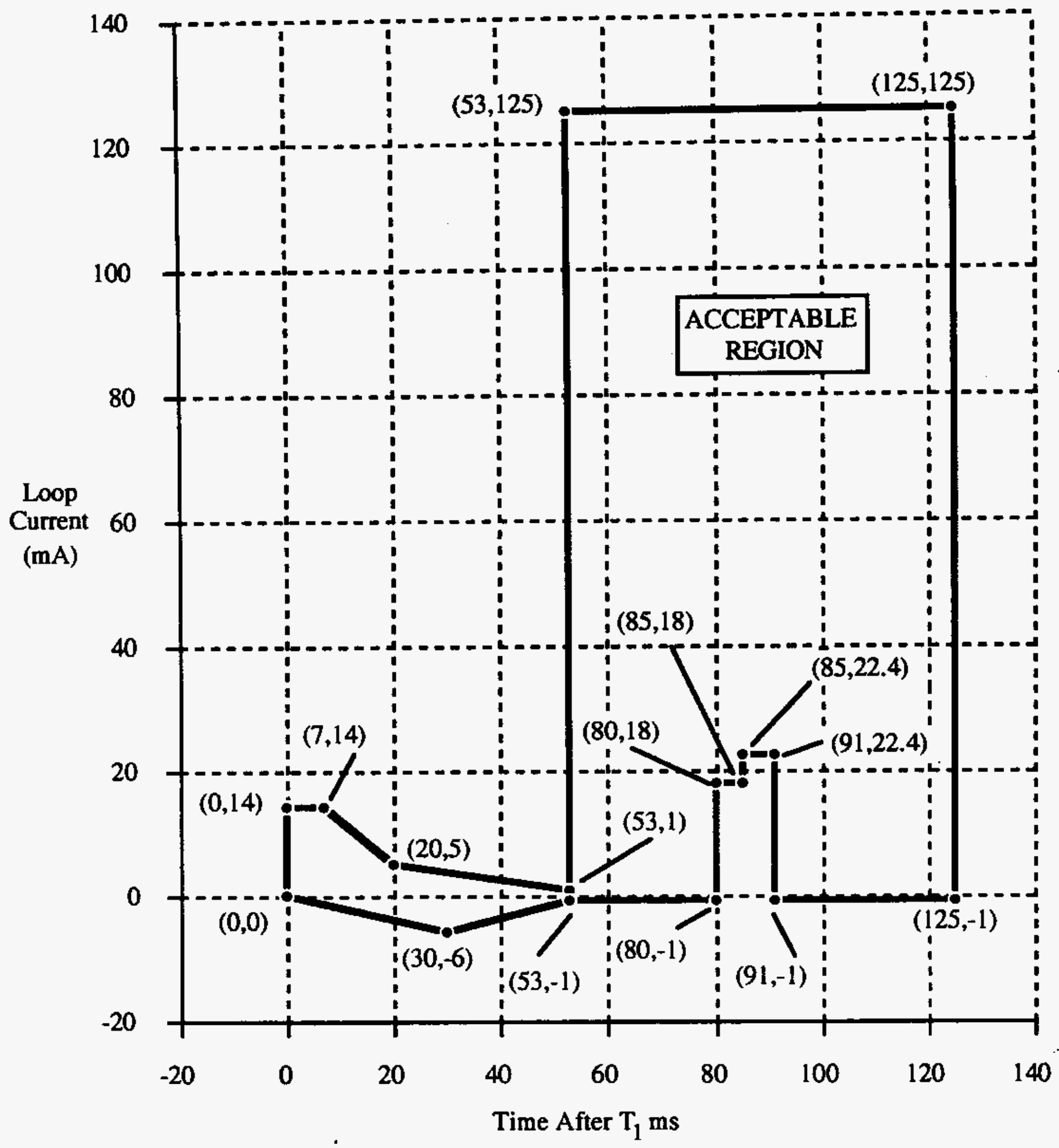
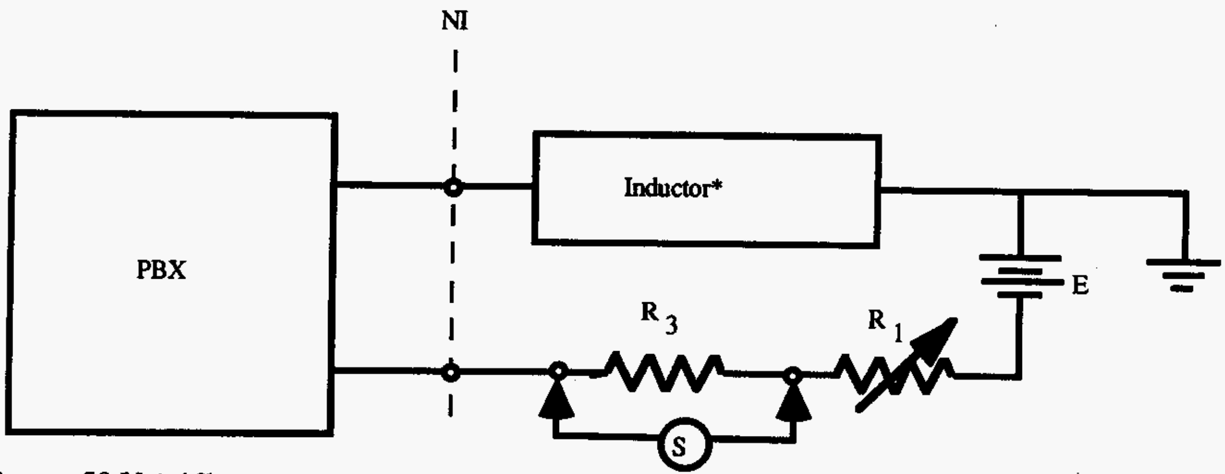


Figure E2 - Template for Noninductive Test Circuit



E: 50 V ± 1%
R1: 0 - 1500 Ω
R3: 10Ω ± 1%
S: Oscilloscope
* Inductor defined in Fig E5

Figure E3 - Dial Pulse Inductive Test Circuit

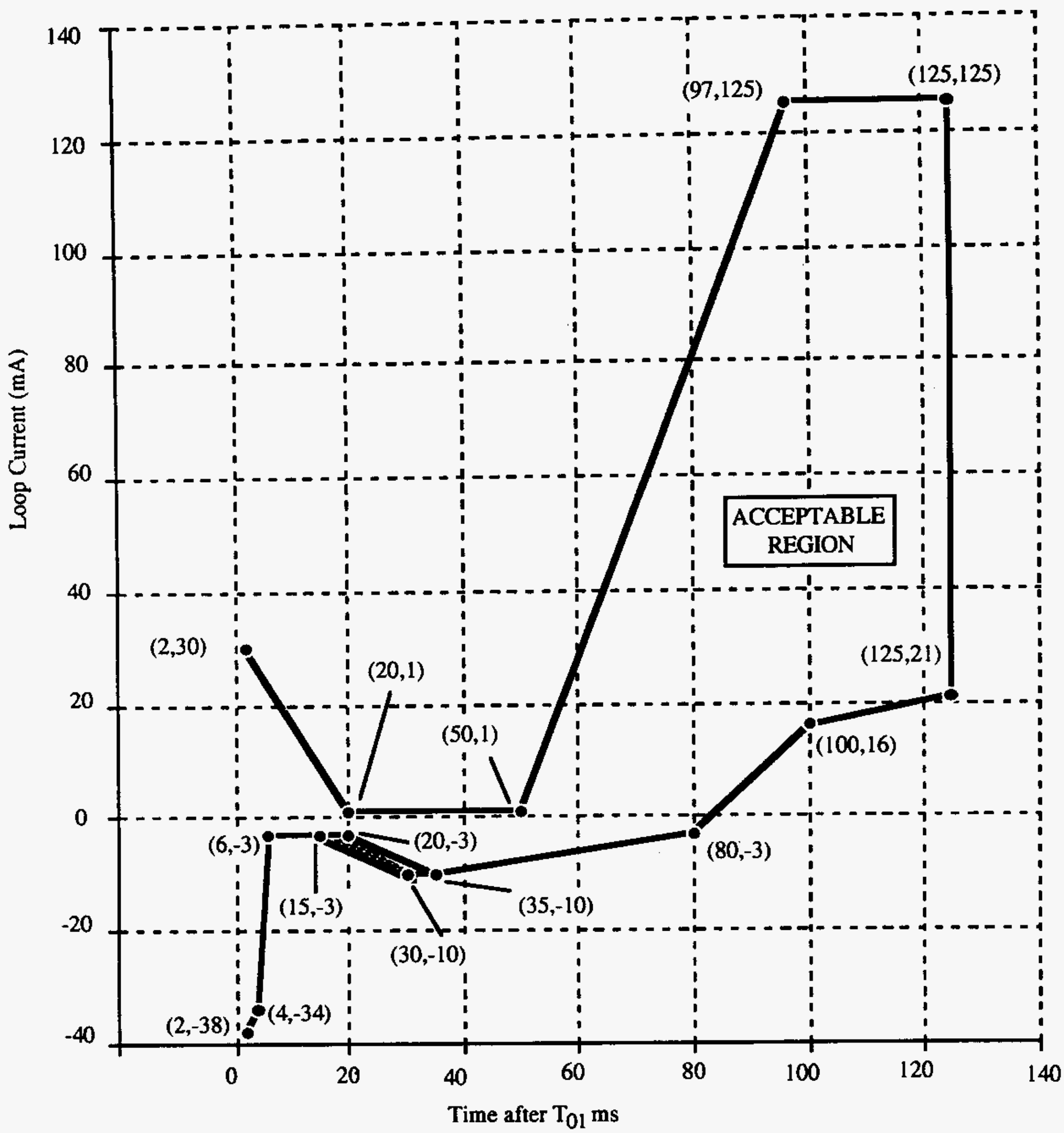
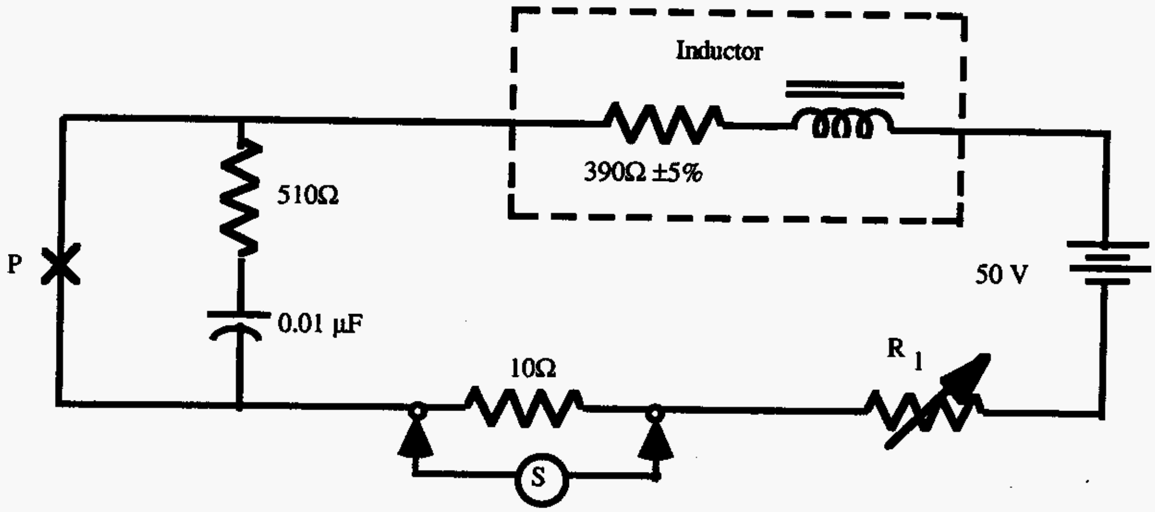


Figure E4 - Template for Inductive Dial Pulse Test



P: Mercury-wetted contacts; 75 ± 1 ms open, 50 ± 1 ms closed, continuous pulsing
R1: Adjust to 2100 Ω, 1270 Ω, or 100 Ω as specified below
(S): Oscilloscope

Tolerances are ± 1% except as noted.

During each loop closure, the current shall rise to within 5% of the values listed below:

Time From Start of Closure (ms)	Instantaneous Loop Current in mA		
	R1=2100 W	R1=1270 W	R1=100 W
2	7.0	7.9	8.5
5	10.6	12.1	14.0
10	14.0	17.2	24.5
15	16.1	20.9	35.0
20	17.3	23.5	45.0
25	18.2	25.5	56.0
30	18.8	27.0	67.0
35	19.1	28.0	76.5
40	19.3	28.7	86.0
45	19.5	29.1	92.0
50	19.6	29.3	96.0

Figure E5 - Inductor Specifications for Inductive DP Test

E3 Incoming Dial Pulse Signaling From Terminal Equipment

E3.1 General

The following criteria insure that PBX dial pulse receivers are compatible with dial pulses transmitted by terminal equipment (e.g., telephone sets) over expected loop lengths with various leakage and reactive conditions. Throughout these criteria, reference is made to the PBX manufacturer's specification of the maximum station conductor loop resistance (R) with which the PBX is intended to operate, and the number of remote terminal ringer equivalences (N) with which the PBX is specified to be compatible. These requirements are intended to assure acceptable performance provided the manufacturer's specified limitations are observed. R and N may be different for on-premises and off-premises applications. It is desirable that the manufacturer's specification of N be equal to 5, since this will insure that any registered remote terminal with which the PBX is compatible can be connected to the station interface. It is also desirable that the manufacturer's specification of station conductor loop resistance be at least 300 Ω for on-premises applications and at least 1300 Ω for off-premises applications.

E3.2 Loop Characteristics

Receivers shall properly count dial pulses generated by a pulsing contact in loops with the following characteristics:

(1) A loop with no external dc resistance; the pulsing contact shunted by an RC network of 0.5 μF capacitance in series with 100 to 600 Ω; the pulsing contact operated at speeds between 8 and 12 pulses per second with the percent break between 42 and 84.

(2) A loop with (R+300)-Ω series external dc resistance and no shunt resistance, capacitance or inductance. The pulsing contact is operated at speeds between 8 and 12 pulses per second with the percent break at 74.

(3) A loop with no series external dc resistance and with leak (shunt) resistance varying between 15,000 Ω and infinity. The pulsing contact is bridged with the parallel combination of up to N high impedance ringers[31], each in series with a 0.45-μF capacitor. The pulsing contact is operated at speeds between eight and twelve pulses per second and the percent break varied between 58 and 64. Speed, percent break, leakage, and number of bridged ringers are varied throughout the entire range.

E3.3 Dial Pulse Detection

E3.3.1 During the address signaling state (after sending dial tone but before the first dial pulse, during make intervals, during an interdigital interval, and after dial pulsing until such time as the dial pulse receiver is released), spurious breaks lasting 1 ms or less shall be ignored by the receiver.

E3.3.2 During the break interval, spurious makes of 1 ms or less shall be ignored by the receiver.

E3.3.3 The receiver shall properly count dial pulses with make-to-break transition times (contact arcing) of 0.2 ms or less.

E3.3.4 Rapid, repeated switching between make and break intervals lasting 3 ms or less after the initial break-to-make transition of any pulse shall be ignored by the receiver.

E3.3.5 The receiver shall properly count dial pulses with an interdigital time as low as 300 ms.

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31. If high impedance ringers are unavailable, each ringer may be simulated by the series combination of a 3650-ohm, 110-henry inductor and a 0.45-μF capacitor. The inductance should be essentially linear as defined by exponential current buildup during the application of a 36.5-V dc step voltage to the 3650-ohm, 110-henry inductor without the series capacitor.

E4 E&M Tie Trunk Dial Pulse Signaling

E4.1 Dial Pulse Sending

During dial pulse address signaling through the E&M trunk circuit, the PBX shall assure that:

(1) Address signaling consists of a sequence of alternate break and make intervals in response to PBX station or sender operation.

(2) Address signaling is transmitted on the M lead at a repetition rate of 8 to 11 pulses per second.

(3) The dial pulses are between 52 and 64 percent break.

(4) Each break interval plus the succeeding make interval (if any) and each break interval plus the preceding make interval (if any) is within the ranges of speed and percent break specified.

(5) When senderized operation is in use, the interdigital interval is between 600 ms and 3 seconds. (A maximum interval of 1 second and a minimum interval of 700 ms may be provided for dial pulsing to compatible equipment.)

(6) During break intervals of the pulse train –

(a) For Type I Signaling - the voltage between the M lead and the PBX ground does not exceed 1 V with the M lead connected through a 1000 (±1%)-Ω resistor to a -50±1-volt dc source (referenced to ground).

(b) For Type II Signaling - the M-SB loop contact is open, as described in 4.2.3.3.2.

(7) During make intervals of the pulse train –

(a) For Type I Signaling

1. The M lead is connected to a battery voltage of -42.5 to -56.5 V under no load.

2. The change in voltage between the M lead and ground does not exceed 5 V while a 0-to-85 mA dc current flows in the M lead.

(b) For Type II Signaling - the M-SB loop contact is closed, as described in 4.2.3.3.3(2).

(8) The total duration of short makes and breaks at the initiation of a make interval shall not exceed 3 ms.

(9) Spurious breaks other than those above (8) during any off-hook or make interval during the address signaling state (after dial tone but before dial pulsing, during a make interval, during an interdigital interval, and after dial pulsing through a period of time equivalent to an interdigital interval) shall not exceed 1 ms in duration.

(10) In the case of a mechanical contact, the duration of pulsing contact arcing at the initiation of a break interval shall not exceed 0.2 ms. Compliance with this criterion is determined by inserting the contact with its protective network into a resistive circuit with a potential of 50 V across the open contact.

(11) Spurious makes in the break interval of a dial pulse shall not occur.

E4.2 Dial Pulse Receiving

During receipt of dial pulse address signals by the E&M trunk circuit, the PBX shall assure that dial pulses with the following characteristics on the E lead are satisfactorily received:

Repetition rate:	8 to 12 pulses per second
Percent break:	42 to 84
Interdigital interval:	300 ms, minimum

The break intervals are characterized by the open-circuit conditions described in 4.2.3.2.2 for Type I signaling and 4.2.3.3.2 for Type II signaling.

The make intervals are characterized by the closed-circuit conditions described in 4.2.3.2.3 for Type I signaling and 4.2.3.3.3 for Type II signaling.

ANNEX F. PRIVATE NETWORK SYNCHRONIZATION PLANNING GUIDELINES

This annex is informative only and is not part of this standard.

F1 Hierarchical Synchronization

The hierarchical synchronization method, consisting of four stratum levels of clocks, has been selected for synchronizing the North American networks and is consistent with current industry standards (Ref A14). Fig F1 is an illustration of the hierarchical synchronization method.

In this hierarchical synchronization method, frequency references are transmitted between nodes. The design and layout of synchronization references are discussed in F3.

The highest level clock in the synchronization hierarchy is a Primary Reference Source (PRS) and all interconnecting digital synchronization networks need to be controlled by a PRS. A PRS is equipment that maintains a long-term frequency accuracy of 1x10-11 or better with optional verification to Universal Coordinated Time (UTC) and also meets current industry standards. This equipment may be a stratum 1 clock (e.g., Cesium standard) or maybe equipment directly controlled by standard UTC-derived frequency and time services (e.g., a LORAN-C or Global Positioning Satellite System (GPS) radio receiver). The LORAN-C and GPS signals themselves are controlled by Cesium standards which are not a part of the PRS, since they are physically removed from it. Since primary reference sources are stratum 1 devices or are traceable to stratum 1 devices, every digital synchronization network controlled by a PRS will have stratum 1 traceability.

Stratum 2 nodes form the second level of the synchronization hierarchy. Stratum 2 clocks can provide synchronization to other stratum 2 devices and/or stratum 3 devices (e.g., DCSs or digital end offices) and/or stratum 4 devices (e.g., channel banks, Digital Private Branch Exchanges (DPBXs) and remote switching modules.) Similarly, stratum 3 clocks can provide synchronization to other stratum 3 devices and/or to stratum 4 devices.

One attractive feature of hierarchical synchronization is that existing digital transmission facilities between digital switching nodes can be used for synchronization. For example, the basic 1.544 Mb/s line rate (the 8000-frame-per-second frame rate) of a Tl Carrier System can be used for this purpose without diminishing the traffic carrying capacity of that carrier system. Hence, no separate transmission facilities need to be dedicated for synchronization. However, synchronization interfaces between public and private networks need to be coordinated due to certain digital transmission facility characteristics (e.g., facility trouble history, pointer adjustments, and number of switching points).

Reliable operation is a necessary consideration for all parts of a telecommunications network. For this reason, the synchronization network includes primary and secondary (backup) synchronization facilities to each stratum 2 node, many stratum 3 nodes, and where applicable to stratum 4 nodes. In addition, each stratum 2 and 3 node is equipped with an internal clock that can bridge short disruptions of the synchronization references. This internal clock is normally locked to the synchronization references. When the synchronization reference is removed, the clock frequency is maintained at a rate determined by its stability, as specified in Ref 14.

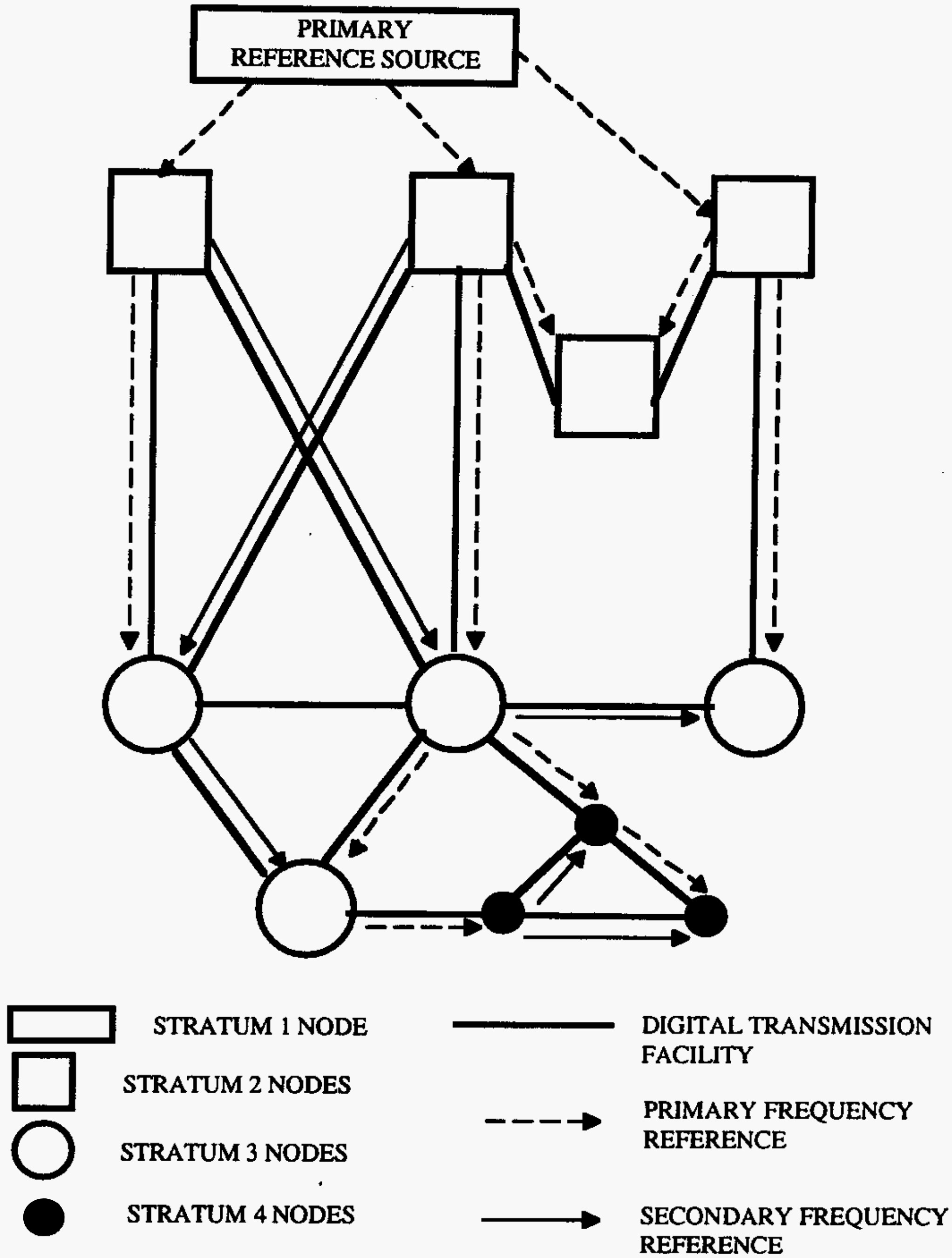

Figure F1 - Hierarchical Network Synchronization

F2 Overview Of Private Digital Networks

Private digital networks have a wide range of size and complexity. The smaller, less complex network may consist of a single DS1 line leased from a local Exchange Carrier or Interexchange Carrier (LEC/IEC), with terminal equipment located at the private network location. The larger, more complex networks may have small digital switching systems, digital cross-connect systems, digital multiplexers at private network locations, and multiple interfaces with several LEC/IECs. Many private networks also include digital facilities such as digital microwave and fiber systems.

No attempt is made in this annex to define how private digital networks need to be designed. The intent is to identify interface requirements that need to be met in order to provide quality digital service and to prevent negative impacts. Additionally, design considerations and engineering rules are provided as a basis for formulating a private digital network synchronization interface plan.

F3 Coordination And Design Of Private Digital Network Synchronization Plans

F3.1 Private Digital Network Owner Responsibilities

The owner of the private digital network has the ultimate responsibility for the design of that network. In order to design a private digital network synchronization plan, the owner needs to consider the impact of all digital equipment and interconnections within the private network. The LEC/IEC needs to provide certain information that will assist the owner with the design. The owner will also need information from the equipment vendors, e.g., clock stratum and equipment details, that will assist in the design.

For larger networks, the owner may choose to chair a meeting of all parties to discuss the design. The owner is responsible for performing tests on the synchronization network prior to service.

F3.2 LEC/IEC Responsibilities

When the private digital network interfaces with LEC/IEC digital networks, the LEC/IEC(s) need to advise the private network provider of the type of reference signal[32] that is available (i.e., PRS, stratum 2, stratum 3, or stratum 4).

F3.3 Vendor Responsibilities

The vendor(s) that provide the equipment for the private digital network need to provide the following:

(1) stratum level of clocks. If a clock is not stratifiable, then the vendor needs to provide:

- (a) pull-in range, hold-in range, minimum accuracy, and minimum stability;
- (b) holdover capability information;
- (c) application guidelines.

(2) number and format of loop timed references;

(3) number and format of external timing references;

(4) clock switching arrangements;

(5) timing options.

A tabular summary of equipment characteristics is provided in Table F1. This table summarizes equipment clock properties, functions and some comments about the applications of these properties.

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32. The type of Reference Signal is described in Ref A14.

Table F1 - Clock Properties and Functions

Property	Function	Comments
Pull-in Range	Maintain Synchronization	Ensures that clocks must lock to own or better stratum level.
Phase Buildout	Used to correct for phase differences between references when reference switching. Also used to filter out phase transients on timing references.	Prevents the propagation of errors from input timing lines to all output timing lines. Required for stratum 2, 3, 3ND and 4E.
Holdover	Provides a temporary improved accuracy over the clock's internal oscillator when all timing references are lost	Required for stratum 2,3 and 3ND.
Free Run	The clock's internal oscillator will be used to provide timing if all timing references are lost	Important only in rare case of long (>24 hour) loss of timing references in stratum 2, 3 and 3ND. More important in systems without holdover such as stratum 4 and 4E.
Dedicated Timing Ports	Used to derive timing from a dedicated synchronization signal. Data carried on this digital signal will be ignored by the dedicated timing port.	Required for stratum 2, 3 and 3ND.
Hardware Duplication	Used only during hardware failures.	Required for stratum 2 and 3 systems.

F3.4 Engineering Private Digital Network Synchronization Inter aces

For the purpose of this section, it is assumed that the private digital network will interface with other digital network elements in LEC/IEC synchronous networks, and in essence become an extension of the public network.

The following synchronization guidelines need to be applied to the design of a private digital network that interfaces with PRS-traceable LEC/IEC network elements:

(1) The private digital network needs to be hierarchical in nature as described in F1 and conform to the hierarchy of the connecting LEC/IEC(s).

(2) All clocks need to meet the stratum requirements in this standard.

(3) The private digital network needs to be traceable to a PRS.

(4) If the private digital network chooses to receive PRS-traceable timing from a source other than the LEC/IEC network, the private digital network will operate plesiochronously with the LEC/IEC network.

The following synchronization guidelines need to be applied to the design of a private digital network that interfaces with a non-PRS-traceable LEC/IEC network:

(1) If neither network has PRS traceability and the node clocks are of equal stratum levels, the private network needs to receive timing from the LEC/IEC network or if the node clocks are of unequal stratum levels, the lower stratum level (less accurate) clock needs to receive timing from the higher stratum level (more accurate) clock.

(2) If the LEC/IEC's clock does not have PRS traceability and the private network does, then the LEC/IEC can receive timing from the private digital network until such time as the LEC/IEC has traceability.

F3.5 Source of PRS-Traceable References

Private digital networks, when interconnected with PRS-traceable LEC/IEC network(s), need to be synchronized from a reference signal traceable to a PRS. Two methods may be employed to achieve PRS traceability. One method would be for the owner of the private network to provide a PRS, in which case the private network would operate plesiochronously with the LEC/IEC network(s). The second method would be for the private digital network to accept PRS-traceable timing from the LEC/IEC network(s).

The owner of the private digital network is responsible for deciding which method to employ. The decision needs ultimately to be based on the most cost effective and reliable method to enable the private digital network to meet all transmission and interface requirements.

F3.6 Synchronization Interface Considerations

There are fundamentally two architectures that may be used to pass timing across the interface between LEC/IEC and private digital networks. The first is for the private digital network to accept a PRS-traceable reference from an LEC/IEC at one location and to then provide timing references to all other private digital network locations over interconnecting facilities (see Fig F2). The second is for the private digital network to accept a PRS-traceable reference at each interface with an LEC/IEC (see Fig F3).

In method one, (Fig F2), the private network owner has control of the synchronization of his network, i.e., Location 1 is providing PRS-traceable references to Locations 2, 3, 4, and 5. From an administrative viewpoint, this looks good since there is only one set of PRS references between the LEC/IEC and the private digital network.

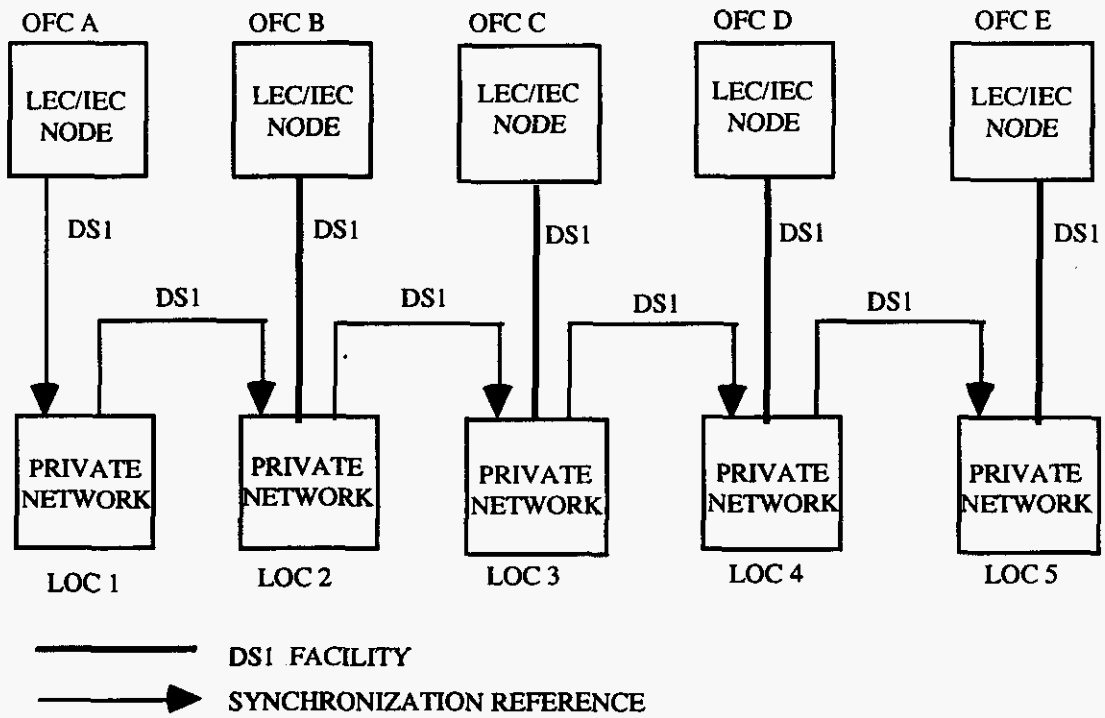

Figure F2 - Private Network Synchronization Reference at One Interface with a LEC/IEC

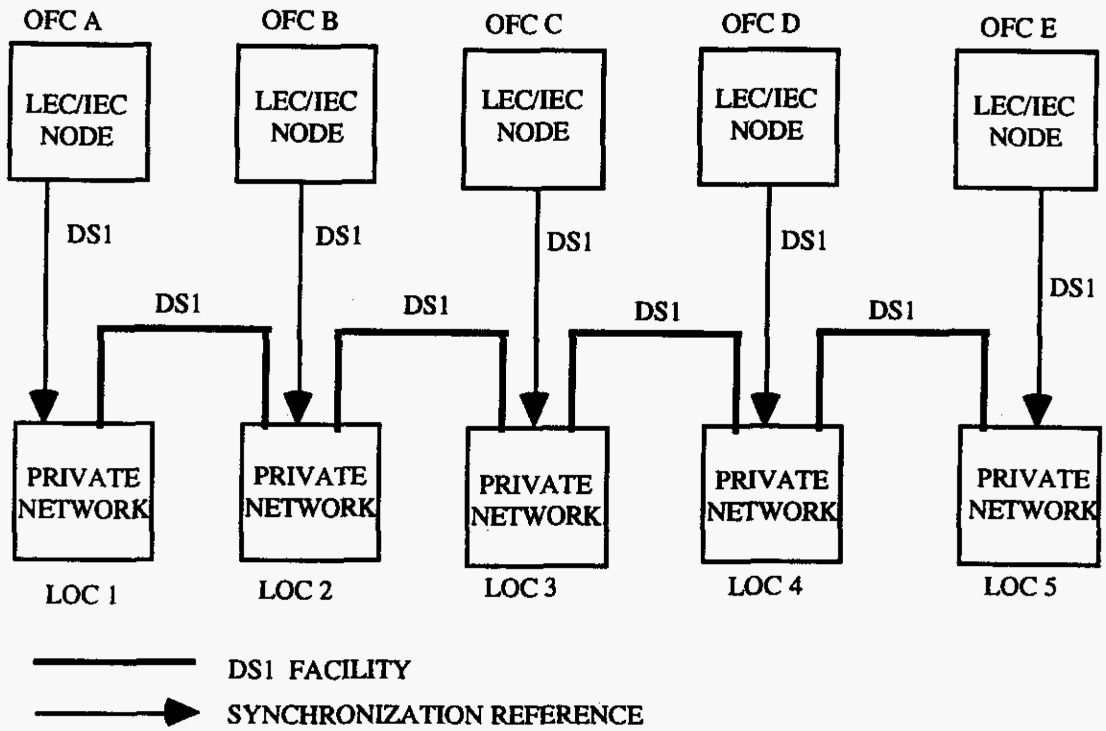

Figure F3 - Private Network Synchronization Reference at Each Interface with a LEC/IEC

However, from a technical and maintenance viewpoint, there are limitations. For example, a loss of the references at Location 1 would cause all private digital network locations to slip against the LEC/IEC network(s). This creates a trouble that is at best difficult to detect. Trouble reports may be generated at any office and maintenance forces may spend time looking for a trouble that may be in another office, state or company. Another weakness is the existence of multiple clocks and timing links in the private digital network timing chain. This daisy chain type of timing has two inherent weaknesses. One, the probability for failure is increased because of the additional links and clocks. Second, each clock and facility has the capability of adding jitter and wander, e.g., a DS1 signal transmitted from Location 5 may not meet the interface requirements for jitter or wander. Synchronous facilities of the future may cause other difficulties. Asynchronous facilities are transparent to timing from source to sink; i.e., the timing is passed unchanged from source to sink. Synchronous facilities could be re-timed by LEC/IEC network elements.

In the second method (Fig F3), PRS-traceable references are provided to the private digital network at each interface with an LEC/IEC. In this arrangement, the loss of a PRS-traceable reference would cause a minimum of troubles. For example, a loss of reference to Location 1 would cause slips only between Office A and Location 1, and between Locations 1 and 2.

Additionally, the slips against the LEC/IEC would occur at the same interface as the source of the trouble, making trouble location and subsequent repairs easier. The timing path(s) are shorter than method 1, thereby increasing reliability and reducing the level of jitter or wander.

F3.7 Intra/Inter Installation Synchronization Source

Fig F4 illustrates a private digital network with a mix of stratum 3 (DPBX, DCS, ACD) and stratum 4 (D Bank) clocks with multiple LEC/IEC interfaces and a mix of LEC/IEC and private digital network facilities.

Location 1 consists of one stratum 3 clock (the DPBX) and three stratum 4 clocks(the T1 MUX, the Automatic Call-Distributor (ACD) and the D Bank). Two methods could be employed to time the clocks at this location: (1) provide individual PRS-traceable references from the LEC/IEC to each of the clocks or (2) to time the stratum 3 clock from the LEC/IEC's PRS-traceable reference and then use that stratum 3 clock to time the other clocks at the location; i.e., apply the Building Integrated Timing Supply (BITS) concept[33]. Application of BITS would be the preferred method since the entire node would be synchronized to the controlling stratum 3 clock if the reference were interrupted. A second advantage to BITS is that there would only be one (rather than 3) interconnecting references to administer.

Also, in the example shown in Fig F4, there are private digital network-owned facilities between Locations 1, 2 and 3 which could be used to provide PRS-traceable references to Locations 2 and 3. However, it is recommended that the private digital network receive timing from the LEC/IEC whenever possible for the reasons described in F3.6.

F3.8 Avoidance of Timing Loops

Improper use of secondary timing references in the synchronization network can possibly create timing loops in the network. That is, a limed clock receives timing from itself via a chain of tuned clocks. Timing loops are to be avoided in digital networks. When a timing loop is formed, equipment clocks involved in the timing loop become unstable, and network performance can degrade beyond that which is obtained when all clocks are operating in the free run mode. The potential for loops exists when either primary or secondary reference signals are passed between clocks of the same stratum level and certain failure conditions exist. Fig F5(a) is a typical example of a possible timing loop in a private digital network. If references P1 and P2 fail, a timing loop would be formed when clocks 1 and 2 switch to their secondary references. A more appropriate design is shown in Fig F5(b).

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33. This concept is described in TA-NPL-000436, Digital Network Synchronization Plan (Ref A36).

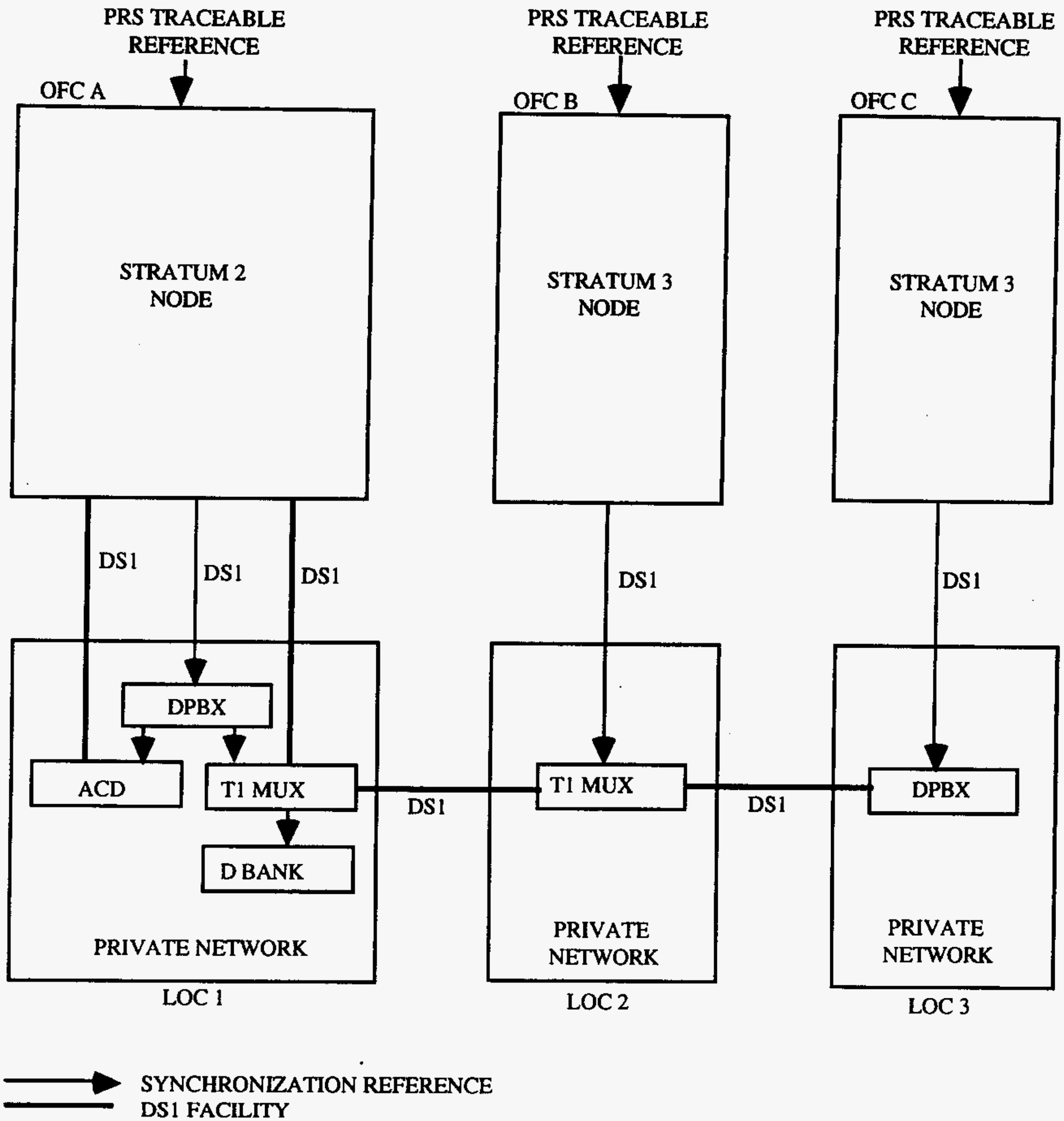
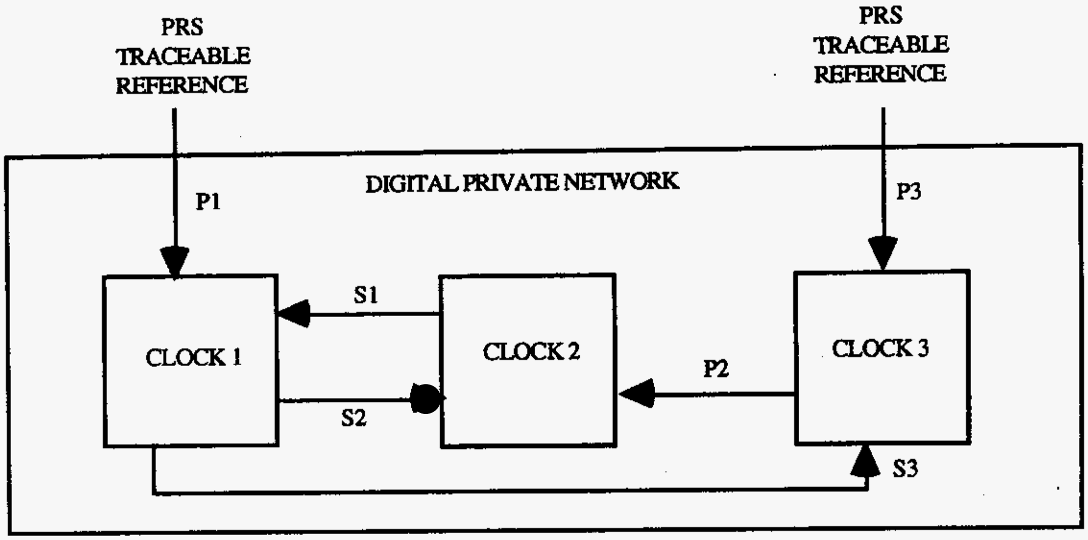
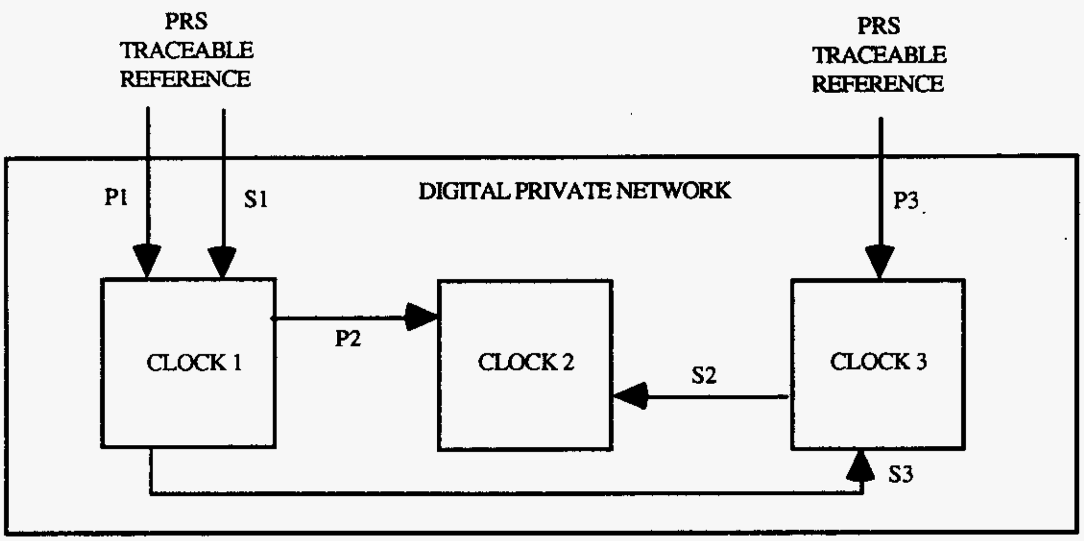


Figure F4 - Intra/Inter Private Digital Network Synchronization Reference Distribution



(a) Example of Timing Loop



(b) Correct Configuration

→ SYNCHRONIZATION REFERENCE
P(N): PRIMARY REFERENCE
S(N): SECONDARY REFERENCE

Figure F5 - Avoidance of Timing Loops

F4 Synchronization Network Operations

Operations include both the provisioning and maintenance of the digital synchronization network. Provisioning means engineering an appropriate configuration for the network and installing any particular equipment necessary to implement the configuration. Maintenance of the synchronization network is the primary focus of operations. These maintenance activities involve the detection of synchronization network failures and restoration of timing distribution.

F4.1 Installation Tests

Synchronized equipment (e.g., DPBXs, DCSs, D Banks, etc.) needs to be tested prior to cutover. The items to be tested may include:

(1) ability to synchronize to an eternal reference;
(2) ability to switch to a secondary reference;
(3) ability to manually switch from secondary back to primary;
(4) performance in the holdover mode (stratum 3 or higher);
(5) maintenance and operation interfaces;
(6) clock alarm, status, and control features.

F4.2 Detection of Network Failures

A failure means that there has been some disruption in the distribution of timing. In general, there are two ways of detecting a failure in the synchronization network. One method is to monitor the synchronization network equipment for failures, and the other method is to monitor the synchronized transmission facilities for slip impairments.

The synchronization network is generally composed of equipment and facilities that are primarily used to provide services. This equipment is usually monitored. If a digital transmission facility fails (or is degraded sufficiently in performance), alarms such as a Carrier Group Alarm (CGA) are generated. If a clock fails, a clock failure alarm is generated. However, total clock failure is unlikely because of redundancy in most designs. The more likely situation is that the clock is unable to receive timing from its primary link. In this case, it may generate an alarm so that it can be manually switched to its secondary reference, as it may switch automatically to the secondary reference and then generate an alarm. In either case, maintenance action is required to restore the primary reference.

In general, there are two ways of detecting slip impairments. One way is to monitor slips in the facility terminating equipment The other, less desirable way is the detection of trouble on individual circuits that indicate slips; e.g., a reduction in the throughput of a data line because of the excessive occurrence of slips.

A particularly important aid in detecting synchronization network failures is a thorough knowledge of the synchronization network. Adequate maps and records that show the layout of the private digital network synchronization need to be developed and maintained by the owner. These records need to include:

(1) source(s) of PRS-traceable reference;
(2) facilities used to carry primary and secondary reference;
(3) clock data, i.e., stratum level, manual or automatic switching, explanation of clock alarms and status indicators.

F4.3 Restoration

If the primary link for a clock has failed, timing can be restored by switching to the secondary reference for that clock. When a failed primary reference has been repaired, the active timing reference of the node needs to be switched back to the primary reference for reliability and redundancy (this restoration may be automatic or manual). If both the primary and secondary references for a clock have failed, timing to that clock cannot be restored unless a third link is made available by maintenance personnel or the primary or secondary references are repaired.

F5 Synchronized Private Network Examples

F5.1 High Level Concepts

There are some basic concepts which need to be considered when designing a synchronization plan for a private digital network. Synchronization plans need to be hierarchical; timing needs to always be passed from high stratum sources (stratum 1, stratum 2) to devices which have clocks of lower or equal stratum level. Stratum 1 traceable timing sources need to be used whenever possible, and timing sources need to be diverse whenever possible. The cascading of timing references through customer premises equipment (CPE) needs to be minimized, and timing loops need to be avoided as they will cause instability in the CPE clocks and result in large amounts of slips in the network. Two examples of private networks are provided in the next subsections which illustrate the application of the concepts that have been described

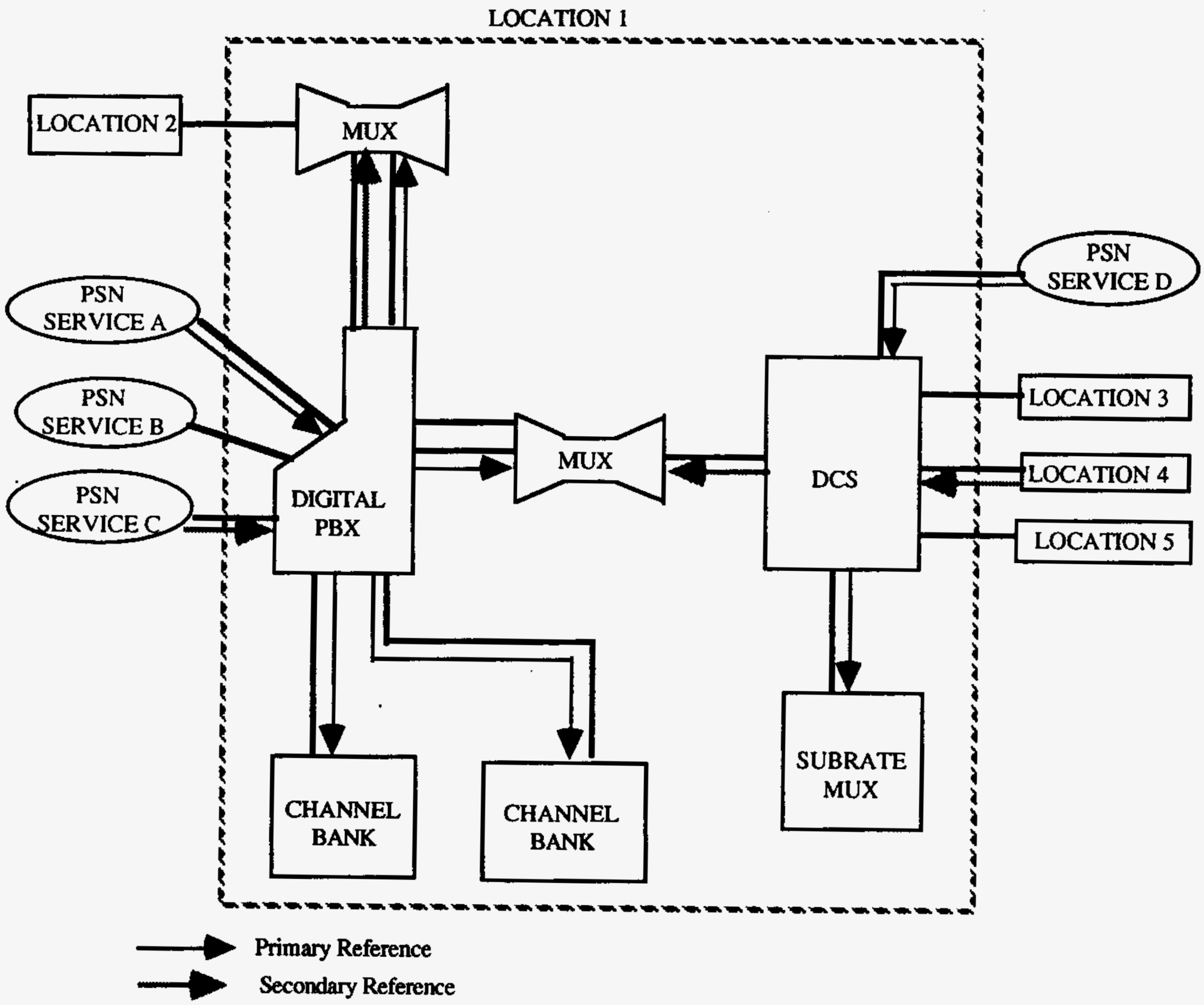


Figure F6 - Synchronized Private Network: Example 1

F5.2 Example 1

One location of a possible private digital network is illustrated in Fig F6. This location contains a digital PBX, channel banks, multiplexers (MUX), and a digital cross-connect system (DCS). In this example, the location is connected to four other locations as well as several public switched network (PSN) services. The public switched network services provide stratum 1 traceable timing which is utilized to provide primary and secondary timing references to the network location. Timing within the location is distributed in a manner which ensures hierarchical timing flow, minimization of the cascading of timing references, and the avoidance of timing loops.

F5.3 Example 2

Fig F7 shows a two-location private digital network consisting of a channel bank, digital PBXs, multiplexers (MUX), and echo cancelers. There is one stratum 1 traceable public switched network (PSN) service which is used to synchronize both locations through the existing stratum 4 CPE. Many small private networks will have limited connectivity to stratum 1 traceable timing sources. In these cases, the cascading of timing through multiple CPE may be unavoidable.

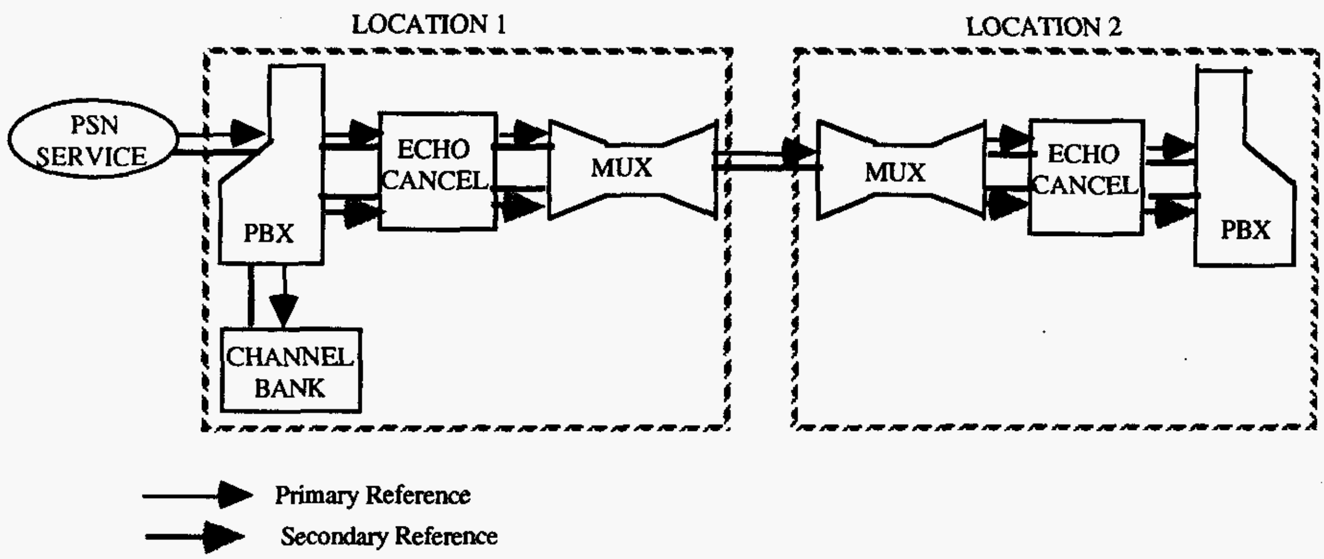


Figure F7 - Synchronized Private Network: Example 2

F6 Conclusion

The private digital network owner has the responsibility for the design, construction and testing of this synchronization network prior to the turn-up of service. Private digital networks, when interconnected with a PRS traceable network, need to be synchronized from a signal traceable to a PRS. Unless the private digital network has its own PRS, it is recommended that the private digital network accept PRS traceable timing from the LEC/IEC at all locations that have interfaces suitable for providing timing. This approach would likely minimize any negative impacts to both the private digital network and the LEC/IEC network(s).

INDEX

AT&T

How To Use Relay Services
In Pennsylvania

Pennsylvania Relay Service

Connecting People Who Are Deaf, Deaf-Blind, Hearing, Hard-of-Hearing And Speech-Disabled.

Pennsylvania Relay Service

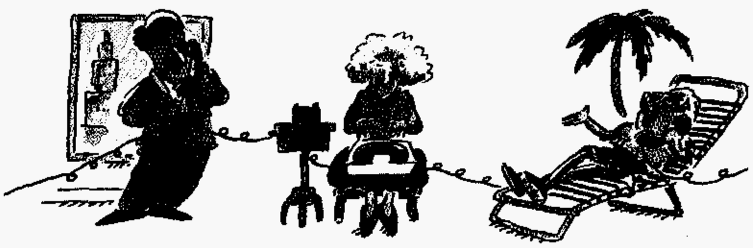
Pennsylvania Relay Service is operated under contract by AT&T. The Service relays conversations between people who use text telephones (TTYs) or telebraille (TB) and people who use standard telephones, 24 hours a day, every day. There is no charge to access Pennsylvania Relay Service.

How Relay Service Works:

A person who is deaf, hard-of-hearing or speech-disabled types his or her conversation using a TTY. A person who is deaf-blind may use either a TTY or TB. The message is relayed by a skilled Communications Assistant (CA) who reads it to the hearing person at the other end verbatim. The CA then relays the hearing person's exact spoken words by typing them back to the TTY user. Each call is handled in strict confidence.

To Use A TTY For A Relay Call:

1. Call Pennsylvania Relay Service at **1 800 654-5984.**
2. The Relay Center will send this message: "PA RC GA."
3. Type the area code and number you are calling, along with any calling instructions. Then type "GA."
4. Your call will be transferred to a CA whose identification number and gender ("M" or "F") will appear on your display.
5. If you want to make another relay call when you are done, don't hang up. The CA will be ready to place your call.



You can ask for voice carryover or hearing carryover service when you make a relay call on your TTY.

Voice Carryover (VCO)

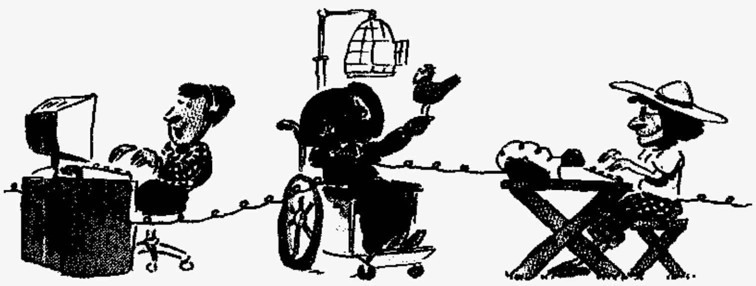
VCO is for a deaf or hard-of-hearing person (TTY user) who wants to speak instead of type. The deaf or hard-of-hearing person talks directly into the phone. The CA types the hearing person's response to the TTY user.

To use VCO:

1. Call Pennsylvania Relay Service at **1 800 654-5984.**
2. The Relay Center will send this message: "PA RC GA."
3. Type the area code and telephone number you are calling. Then type "VCO GA."
4. Your call will be transferred to a CA whose identification number and gender ("M" for male or "F" for female) will appear on your display. The CA will then type "VCO READY GA."
5. When the person you are calling answers, you can speak directly to him or her. Remember to say "Go Ahead" when you are ready for the person you are calling to respond. The CA will type his or her response.
6. If you want to make another relay call when you are done, don't hang up. The CA will be ready to place your call.

Hearing Carryover (HCO)

HCO is for a speech-disabled person who prefers listening to reading. The speech-disabled person types his or her responses for the CA to read to the standard telephone user.



Pennsylvania Relay Service

To use HCO:

1. Call Pennsylvania Relay Service at **1 800 654-5984.**
2. The Relay Center will send this message: "PA RC GA."
3. Type the area code and telephone number you are calling. Then type "HCO GA."
4. Your call will be transferred to a CA whose identification number and gender ("M" for male or "F" for female) will appear on your display. The CA will then type "HCO READY GA."
5. You will hear when the person you are calling answers. When you type what you want to say, be sure to end with "GA" so the person you are calling will know it's his or her turn to talk.
6. If you want to make another relay call when you are done, don't hang up. The CA will be ready to place your call.

To Use A Personal Computer (PC) For A Relay Call:

If you normally use a PC for TTY-to-TTY calls, you can use it for relay calls. Just follow the same instructions for using a TTY. Don't use a PC to call the Relay Center if you want to use VCO or HCO.

To interface with Pennsylvania Relay Service, you need to set up your PC as follows:

• Communications Mode	Asynchronous
• Baud Rate	300, 1200 or 2400
• Number of Data Bits	8
• Parity	No
• Number of Stop Bits	1
• X-ON X-OFF	Not Required

NOTE: Your PC should be set in half-duplex for 300 baud and full-duplex for 1200 and 2400 baud.

To Use A Voice Telephone For A Relay Call:

To talk with a person who is deaf, deaf-blind, hard-of-hearing or speech-disabled, just follow these easy steps:

1. Call Pennsylvania Relay Service at **1 800 654-5988.**
2. You will hear: "Pennsylvania Relay. CA #. Area code and number you are calling please."
3. Tell the CA the telephone number you want to call.
4. While your call is being relayed, talk as though speaking directly to the person you called. The CA will relay your conversation.
5. Each time you finish speaking, say "Go Ahead" to let the CA know you are ready for the TTY user's response.
6. If you want to make another relay call when you are done, don't hang up. The CA will be ready to place your call.

Billing Options

Collect calls

The person or business you are calling agrees to pay for your call.

- Tell the CA that you are making a collect call
- Give the telephone number you are calling
- Give your name

Calling card calls

You can charge a call to your telephone calling card. If you don't have a local telephone company calling card or AT&T Calling Card, please identify the company your call will be billed to.

- Give your calling card number
- Give the telephone number you are calling

Calls billed to a third party

You can bill your call to a telephone number that is different from the one you are using or calling. Someone will have to be available at the third number to accept the charges.

- Give the number you are charging the call to
- Give the telephone number you are calling
- Give your name

Person-to-person calls

If you call someone person-to-person and that person is not available, you will not be charged for the call. Person-to-person calls are operator assisted and will cost more.

- Tell the CA that you are making a person-to-person call
- Give the name of the person you are calling
- Give the telephone number you are calling
- Give your name

Calls from a public phone

Calls billed to another number or a calling card can be made from a public phone.

- Tell the CA the type of call you are making (collect, calling card, third-party billing, person-to-person) and give him or her the information needed to place the call

Confidentiality

Calls made through Pennsylvania Relay Service are strictly confidential. It is illegal for CAs to disclose any information from your conversation. No records of the contents of conversations are kept.

Emergency Calls

Pennsylvania Relay Service is not a substitute for 911 emergency services. However, if we receive an emergency call, we will do whatever we can to connect the caller to the emergency service needed. To make sure your emergency call is handled as quickly as possible, please call your local emergency service number directly.

Operator Services

For TTY-to-TTY calls, call AT&T Operator Services for the Deaf (OSD) at 1 800 855-1155 (TTY) if you:

- Have trouble getting through to a telephone number
- Need help placing a call because of a technical problem
- Need to get credit for a call you just placed because of a poor transmission, a wrong number or being disconnected
- Need Directory Assistance

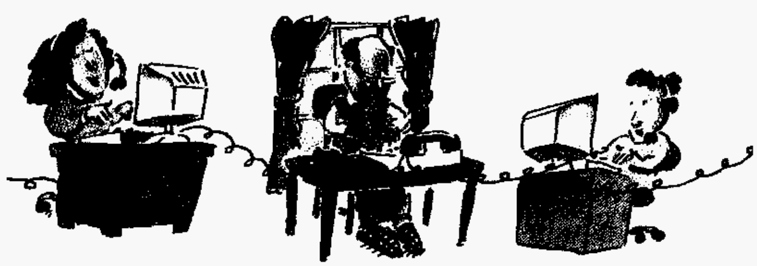
If You Have Questions Or Comments:

If you experience service problems or have comments about Pennsylvania Relay Service, please call the Consumer Hot Line number at:

1 800 682-8786 (TTY) • 1 800 682-8706 (Voice)

When you use the Consumer Hot Line regarding a call you have made, please have the following information ready:

- The CA number
- The time the call was made
- The date of the call



For More Information, Or To Request A Presentation/Demonstration, Write Or Call:

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Bridgewater, NJ 08807

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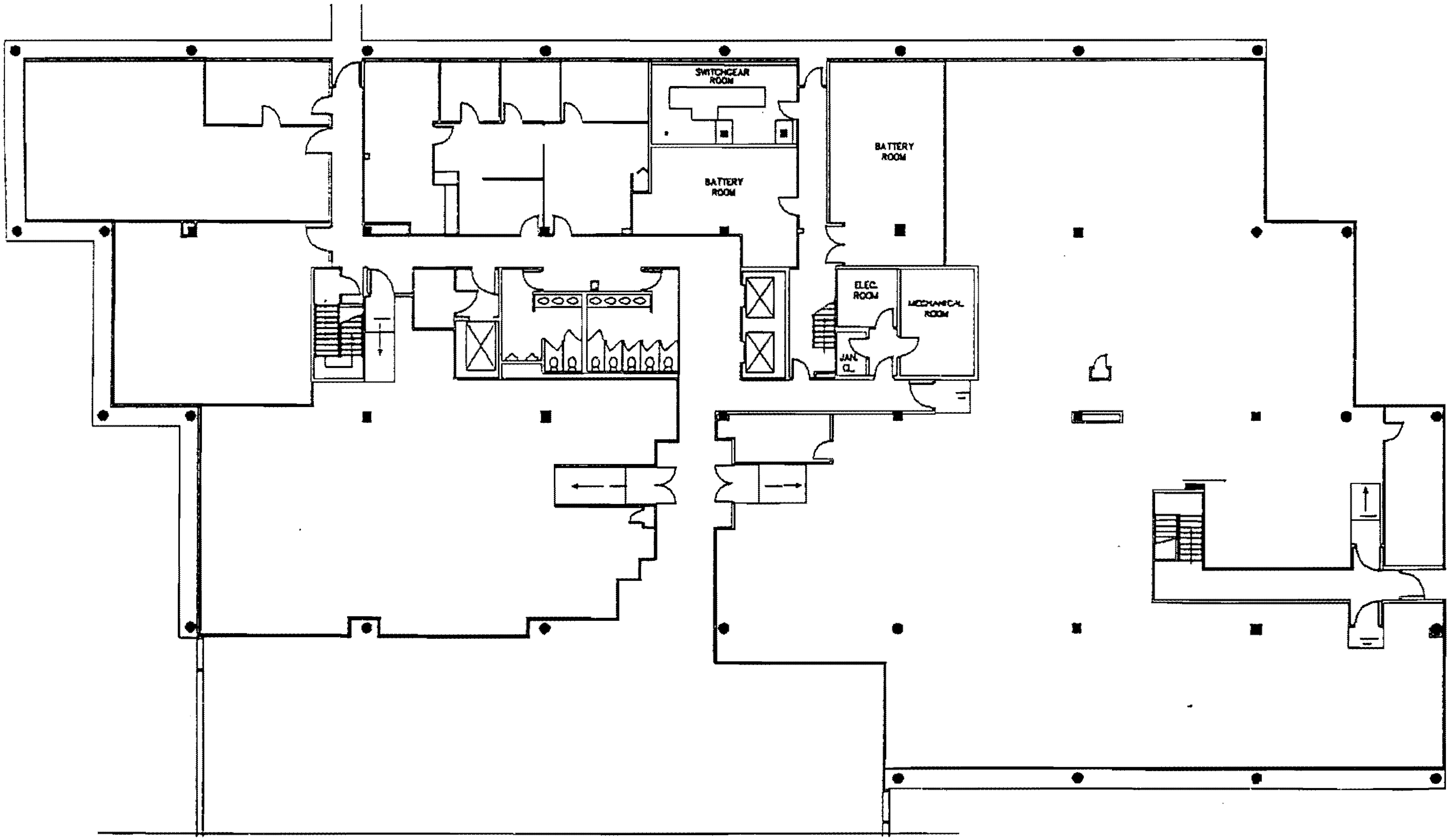

SECTION C

3. Public Entity Crimes Provision

Pursuant to Section 287.133, Florida Statutes, a person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity, and may not transact business with any public entity in excess of the threshold amount provided for in Florida Statute 287.017 for Category Two ($11,000) for a period of 36 months from the date of being placed on the convicted vendor list.

AT&T Response

AT&T understands and will comply.

4. *Financial Information*

To allow the FPSC to evaluate the financial responsibility of the bidding company, the following items shall be submitted with the proposal for the bidding company (and its parent company, if applicable):

1. *Audited Financial Statements (or a SEC 10K Report) for the most recent two (2) years, including at a minimum:*

    a) Statement of income and related earnings,

    b) cash flow statement,

    c) balance sheet, and,

    d) opinion concerning financial statements from an outside CPA;

AT&T Response

AT&T understands and will comply.

The documents following this page contain a-d.

a. See "Consolidated Statements of Income" in 1994 and 1995 annual reports.
b. See "Consolidated Statements of Cash Flows" in 1994 and 1995 annual reports.
c. See "Consolidated Balance Sheets" in 1994 and 1995 annual reports.
d. See "Report of Independent Auditors" in 1994 and 1995 annual reports; see "Report of Independent Auditors" in 1994 and 1995 10-K reports; and see Moody's ratings of AT&T debt.

2. *Primary Banking Source letter of reference.*

AT&T Response

AT&T understands and will comply.

Following the above items is a letter of reference from AT&T's Primary Banking Source. The original document can be found in the binder labeled **Original.**

FORM 10-K

SECURITIES AND EXCHANGE COMMISSION

WASHINGTON, DC 20549

(X) ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For The Fiscal Year Ended December 31, 1995

OR

( ) TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For The Transition Period From _________ to _________

Commission File Number 1-1105

AT&T CORP.

A NEW YORK CORPORATION	I.R.S. EMPLOYER NO. 13-4924710

32 Avenue of the Americas, New York, New York 10013-2412

Telephone Number 212-387-5400

Securities registered pursuant to Section 12(b) of the Act: See attached SCHEDULE A.

Securities registered pursuant to Section 12(g) of the Act: None.

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes....x.... No........

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ( )

At January 31, 1996, the aggregate market value of the voting stock held by non-affiliates was $ 106,686,856,743.

At January 31, 1996, 1,598,725,455 common shares were outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

(1) Portions of the registrant's annual report to security holders for the year ended December 31, 1995 (Part II)

(2) Portions of the registrant's definitive proxy statement dated February 27, 1996, issued in connection with the annual meeting of shareholders (Part III)

SCHEDULE A

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Common Shares (Par Value $1 Per Share)	New York, Boston, Chicago, Philadelphia and Pacific Stock Exchanges
Three Year 4-1/2% Notes, due February 15, 1996	New York Stock Exchange
Thirty-Four Year 4-3/8% Debentures, due October 1, 1996	
Thirty-Seven Year 4-3/4% Debentures, due June 1, 1998	
Thirty-Six Year 4-3/8% Debentures, due May 1, 1999	
Thirty-Three Year 6% Debentures, due August 1, 2000	
Thirty-Five Year 5-1/8% Debentures, due April 1, 2001	
Ten Year 7-1/8% Notes, due January 15, 2002	
Ten Year 6-3/4% Notes, due April 1, 2004	
Ten Year 7% Notes, due May 15, 2005	
Twelve Year 7-1/2% Notes, due June 1, 2006	
Twelve Year 7 -3/4% Notes, due March 1, 2007	
Thirty Year 8-1/8% Debentures, due January 15, 2022	
Medium Term Note 8.2% due February 15, 2005	
Thirty Year 8.35% Debentures, due January 15, 2025	
Thirty-Two Year 8-1/8% Debentures, due July 15, 2024	
Forty Year 8-5/8% Debentures, due December 1, 2031	

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Description

See page 11 for "Executive Officers of the Registrant."

ITEM 1. BUSINESS.

GENERAL

AT&T Corp. ("AT&T" or "Company") was incorporated in 1885 under the laws of the State of New York and has its principal executive offices at 32 Avenue of the Americas, New York, New York 10013-2412 (telephone number 212-387-5400). As used herein, "AT&T" and the "Company" refer to AT&T Corp., unless the context otherwise requires.

AT&T is currently a major participant in two industries: the global information movement and management industry and the financial services and leasing industry.

On September 20, 1995, AT&T announced a plan to separate (the "Separation") into three publicly-held stand-alone global companies that will each be focused on serving certain core businesses: communication services (to be carried on by the new AT&T, which will also include AT&T Universal Card Services Corp. ("AT&T Universal Card Services")), communications systems and technology (to be carried on by the newly formed Lucent Technologies Inc. ("Lucent")), and transaction-intensive computing (to be carried on by NCR Corporation ("NCR", formerly AT&T Global Information Solutions Company)). The new AT&T (other than AT&T Universal Card Services), Lucent and NCR are participants in the global information movement and management industry. The Separation is to be accomplished via spin-offs of Lucent and NCR to AT&T's shareholders, which in the case of Lucent will be preceded by a public offering of less than 20% of its shares. The decision to pursue the Separation was based on a comprehensive evaluation of business, economic, financial, public policy and technological factors with the goal to remove complexity from the businesses, minimize internal conflicts, and, otherwise, to improve the strategic position of each of the new companies. On September 20, 1995, AT&T also announced plans to pursue the public or private sale of its remaining interest in AT&T Capital Corporation ("AT&T Capital"), although AT&T cannot predict the timing or terms of any such transaction.

The Separation is targeted to be completed by the end of 1996, but remains subject to a number of conditions. These conditions include the receipt of a favorable tax ruling, other required approvals and the absence of events or developments that would have a material adverse impact on AT&T or its shareholders. On February 5, 1996, Lucent filed a registration statement with the Securities and Exchange Commission with respect to the proposed public offering of less than 20% of its shares.

For a discussion of the stand-alone results of each of the new AT&T, Lucent and NCR, see "Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations."

NEW AT&T CORP.

COMMUNICATIONS SERVICES GROUP

The Communications Services Group ("CSG") addresses the needs of large and small businesses, the Federal government, state and local governments and consumers for voice, data and video telecommunications services. Business units within this group provide regular and custom long distance communications services, including message telecommunications services ("MTS"), wide area telecommunications services ("WATS"), satellite transponder services, data transmission services, AT&T True Connections 500 services, toll-free or 800 services, 900 services, private line services, Software Defined Network services ("SDN"), integrated services digital network ("ISDN") technology based services, and electronic mail, electronic data interchanges and enhanced facsimile services. CSG introduced a variety of services this year, including AT&T WorldNet^{SM} Service, a service providing dedicated and dial-up access to the Internet; AT&T Network Notes, a network based workgroup service; AT&T NetWare Connect Services, a wide area network solution; and AT&T Business Network, an online service providing business news and information. CSG also provides special long distance services, including AT&T Calling Card services and special calling plans and the Company's domestic and international operators. AT&T provides communications services internationally, including transaction services, global networks, network management and value added network services (i.e., services offered over communications transmission facilities that employ computer processing applications) and sells and maintains submarine cable systems.

AT&T provides interstate and intrastate long distance telecommunications services throughout the continental United States and provides, or joins in providing with other carriers, telecommunications services to and from Alaska, Hawaii, Puerto Rico and the Virgin Islands and international telecommunications services to and from virtually all nations and territories around the world.

In the continental United States, AT&T provides long distance telecommunications services over its own network. Virtually all switched services are computer controlled and digitally switched and interconnected by a packet switched signaling network. Transmission facilities consist of approximately 2 billion circuit-miles using lightwave, satellite, wire and coaxial cable and microwave radio technology. International telecommunications services are provided via multiple international transoceanic submarine cable (primarily lightwave) systems and via international satellite and radio facilities.

AT&T Solutions, established in 1995, assists corporations in global network and computer management. AT&T Solutions designs, builds and operates corporate clients computer networks, designs software and manages data centers for its clients.

AT&T WIRELESS SERVICES

AT&T Wireless Services Inc. is the nation's largest cellular communications company and operates the fifth largest U.S. messaging service, serving more than 5 million customers in over 100 cities. The operations of AT&T Wireless Services Inc. were primarily previously conducted by McCaw Cellular Communications, Inc. ("McCaw"), which was merged with a special-purpose subsidiary of AT&T in September 1994. At that time, McCaw owned 52% of LIN Broadcasting Corporation ("LIN"). In September 1995, AT&T acquired the remaining 48% publicly-held interest in LIN at an aggregate price of approximately $3.3 billion.

In connection with the McCaw merger, AT&T, McCaw and the United States Department of Justice ("DOJ") agreed to enter into a proposed antitrust consent decree (the "Proposed Consent Decree") on July 15, 1994, which, when entered, would have settled a suit challenging the merger filed the same day by the DOJ in the United States District Court for the District of Columbia (the "court"). In February 1996, the Telecommunications Act of 1996 (the "Telecommunications Act") became law and effectively superseded the future operation of the Proposed Consent Decree. As a result, the conditions imposed by the Proposed Consent Decree on the operations of AT&T and McCaw will no longer apply.

On March 13, 1995, the Federal Communications Commission ("FCC") announced the conclusion of the broadband Personal Communications Services ("PCS") auction commenced on December 5, 1994. The auction involved a total of 99 PCS licenses in 51 Major Trading Areas ("MTAs") authorizing service on 30 MHZ of spectrum in the 1.8 GHz band. AT&T bid a total of $1.685 billion to win broadband PCS licenses covering 21 MTAs. AT&T is required to provide adequate service to at least one-third of the population in its licensed areas within five years of being licensed and two-thirds of the population in its licensed areas within ten years of being licensed. The licenses are granted for ten year terms from the original date of issuance and may be renewed by AT&T by meeting the FCC's renewal criteria and upon compliance with the FCC's renewal procedures.

AT&T UNIVERSAL CARD SERVICES

AT&T Universal Card Services began operations in early 1990. The AT&T Universal Card is a combined general-purpose consumer credit card and AT&T Calling Card that at year-end had receivables in excess of $14 billion in 1995, $12.3 billion in 1994, $9.2 billion in 1993, $6.6 billion in 1992, and $3.8 billion in 1991. The AT&T Universal Card is offered directly through AT&T Universal Financial Corp., a Utah industrial loan company, and Universal Bank, N.A., in Columbus, Georgia, which are both wholly owned by AT&T, and under an affinity relationship with Columbus Bank and Trust Company in Columbus, Georgia, a subsidiary of Synovus Financial Corp. AT&T Universal Card Services provides marketing and customer support for the AT&T Universal Card program and it purchases cardholder receivables generated by the AT&T Universal Card program.

Some seasonality exists in the consumer credit card industry, with a higher number of purchases occurring during the year-end holiday season. The Company believes that the AT&T Universal Card program is one of the top three or four bankcard/credit card programs, based on generally available industry information, and on the number of cardholder accounts in the United States.

REGULATION AND LEGISLATIVE DEVELOPMENTS

Telecommunications Act of 1996

The Telecommunications Act preempts state and local requirements which prohibit or have the effect of prohibiting an entity from providing telecommunications services. In addition, the Telecommunications Act requires incumbent local exchange carriers ("LECs"), including the Regional Bell Operating Companies ("RBOCs"), to implement a checklist of conditions that are designed to foster local exchange competition. These conditions include requiring incumbent LECs to provide to competing service providers (i) local exchange services for resale at wholesale rates, (ii) interconnection and access to unbundled network elements at any technically feasible point and at cost-based rates, (iii) number portability, (iv) dialing parity and (v) access to rights of way. Although the Telecommunications Act permits interexchange carriers and others to begin providing local exchange service at any time, negotiations with LECs over access and interconnection agreements and the adoption of implementing rules and regulations will be necessary before effective local exchange competition commences.

The Telecommunications Act also permits an RBOC to petition the FCC at any time for permission to provide interexchange services originating in any state in its region. The FCC cannot approve such a request unless (i) approval is consistent with the public interest, convenience and necessity; (ii) the FCC has consulted with the DOJ and given the DOJ's views substantial weight; (iii) the RBOC has implemented the Telecommunications Act checklist of conditions throughout such state; and (iv) either (A) the RBOC has entered into a binding interconnection agreement, approved by the relevant state, with one or more unaffiliated competing providers of telephone exchange service to residential and business subscribers which are offered either exclusively or predominantly over such competitors' own facilities, or (B) the RBOC has received no such requests for interconnection within the statutory prescribed time period. Once approved to provide interexchange services in a single in-region state, an RBOC is also permitted to begin manufacturing telecommunications equipment.

Furthermore, the Telecommunications Act permits immediate RBOC provision of interexchange services outside of their home service areas and certain incidental interexchange services in their home service areas, such as those provided in conjunction with commercial mobile and cellular services, information services, alarm monitoring and video and audio programming services within their home service area.

AT&T believes that the Telecommunications Act's provisions for the opening of local exchange markets to competitive entry are significant and that the restrictions placed on RBOC entry into in-region interexchange services should promote service competition in the RBOC's monopoly markets before RBOC provision of in-region interexchange services. Nonetheless, there is no assurance that, in the administration of the Telecommunications Act, the rules and regulations to be adopted will result in meaningful facilities-based competition prior to RBOC provision of in-region interexchange service.

To the extent that such implementing rules and regulations do not contain adequate provision for facilities-based local exchange competition, there is a substantial risk that AT&T and other interexchange service providers would be at a disadvantage to the RBOCs in the provision of local exchange services. In addition, regardless of provisions for facilities-based local exchange competition, the simultaneous entrance of seven RBOC competitors for interexchange services is likely to adversely affect AT&T's long-distance revenues and could adversely affect earnings. There is still a significant amount of uncertainty as to the extent, timing and impact on AT&T of the RBOCs entrance into interexchange services.

Similarly, the impact of AT&T's entrance into local services cannot reasonably be predicted. Notwithstanding the strong local entry provisions contained in the Telecommunications Act, various factors, including start-up costs associated with entering new markets, local conditions and obstacles, and the final form of implementing rules and regulations could adversely affect future revenues and earnings. Nevertheless, the Telecommunications Act, plus other public policy and technological changes, will likely open new markets for AT&T in different areas of communications services. AT&T's competitive strategy includes using its networking capabilities, respected brand name and other resources to take advantage of these new opportunities as they arise.

Proceedings are also pending before a number of state regulatory commissions, including New York, California and Illinois, concerning changes in the nature of the state regulation of telecommunication services and the removal of constraints on local service providers. The Telecommunications Act should require substantial changes to certain of these proceedings and provide more uniform opportunities for local entry throughout the nation.

At the time the Telecommunications Act was enacted, numerous significant matters were pending before the DOJ and the court concerning the Modification of Final Judgement of 1982 (the"MFJ"). Those pending matters included a motion to vacate the MFJ, a motion to allow Ameritech Corporation, subject to certain conditions and DOJ supervision, to provide interexchange services within certain LATA in its home service area after local competition is found to exist, and a motion to allow U S West, Inc. to provide interexchange services outside its home service area in conjunction with its planned out-of-region competitive local telephone services. Because the Telecommunications Act regulates the provisions of interexchange services by the RBOCs and thereby effectively superseded future operation of the MFJ, it is anticipated that continuing MFJ restrictions and pending waiver requests will be discontinued.

Regulation of Rates

AT&T is subject to the jurisdiction of the FCC with respect to interstate and international rates, lines and services, and other matters. For many years prior to July 1, 1989, the system of regulation used by the FCC for AT&T was rate-of-return regulation. Effective July 1, 1989, the FCC adopted a new system of regulating AT&T known as "price caps" under which AT&T's prices, rather than its earnings, were limited. On October 12, 1995, recognizing a decade of enormous change in the long distance market and finding that AT&T lacks market power in the interstate long distance market, the FCC reclassified AT&T as a "non-dominant" carrier for its domestic interstate services. As a result, AT&T is now subject to the same regulations as its long distance competitors for such services. Thus, AT&T is no longer subject to price cap regulation for these services, is able to file tariffs that are presumed lawful on one day's notice, and is free of other regulations and reporting requirements that apply only to dominant carriers.

Like its long distance competitors, AT&T remains subject to the statutory requirements of Title II of the Communications Act. It must offer service under rates, terms and conditions that are just, reasonable and not unreasonably discriminatory, it is subject to the FCC's complaint process, and it must give notice to the FCC and affected customers prior to discontinuance, reduction, or impairment of service. AT&T has also made certain commitments that address concerns that had been raised with regard to the potential impact of declaring AT&T to be non-dominant. These include: (i) a three-year rate assurance for low income and low usage residential users; (ii) a three year commitment to provide 5 days advance notice of any geographically specific tariff filing that departs from AT&T's traditional approach to geographic rate averaging for interstate residential direct dial services; (iii) a three-year limit on, and 5 days advance notice for, rate increases on 800 directory assistance and analog private line services; and (iv) commitments regarding the treatment of carriers that resell AT&T's services.

AT&T's international private line services have been classified as non-dominant for several years. AT&T's switched international services are subject to similar competitive challenges as its domestic services though AT&T has not received non-dominant treatment for those services. The FCC is considering a request by AT&T for non-dominant treatment of those services.

AT&T's intrastate telecommunications services are subject to regulation in many states by public service commissions or similar state authorities having regulatory power over intrastate rates, lines and services and other matters. The system of regulation used in many states, at least for some of AT&T's services, is rate-of-return regulation. In recent years, recognizing the competitive nature of AT&T's services, many states have adopted different systems of regulation, such as: complete removal of rate-of-return regulation, pricing flexibility rules for some or all of AT&T's services, price caps, and incentive regulation.

LUCENT TECHNOLOGIES INC.

Lucent is one of the world's leading designers, developers and manufacturers of telecommunications systems, software and products. Lucent is a global market leader in the sale of public telecommunications network systems, business communications systems and microelectronic components for communications applications. Further, Lucent is the largest supplier in the United States of telecommunications products for consumers. In addition, Lucent supports network operators and businesses with engineering, installation, maintenance and operations support services. Lucent's research and development activities are conducted through Bell Laboratories.

Lucent's systems enable network operators to provide wireline and wireless local, long-distance and international voice, data and video services. Lucent's networks include switching, transmission and cable systems packaged and customized with application software, operations support systems and associated professional services. Lucent's business systems are primarily customer premises-based telecommunications systems that enable businesses to communicate within and between locations. Lucent designs, develops and sells high-performance integrated circuits, electronic power systems and optoelectronic components for communications applications both for third parties and for incorporation into these microelectronic products as important components of its own systems and products. Lucent offers a wide range of communications products in the United States for consumers and small businesses, including corded, cordless and cellular telephones, telephone answering systems and related accessories.

NCR CORPORATION

NCR offers computing and communications solutions together to provide customers easy access to information and to each other. These solutions are comprised of computer products and systems, as well as software and professional services and support.

During the third quarter of 1995, NCR engaged in a strategic restructuring pursuant to which it would consolidate its lines of business operations, discontinue the manufacturing of personal computers, reduce the number of its employees and consolidate facilities throughout the U.S. and internationally. The plan is expected to be completed before the end of 1996.

NCR's primary focus after its restructuring is on three industries: financial, retail and communications. Key product lines include: Financial Systems, such as automated teller machines, image capture systems and financial processing systems; Decision Enabling Systems, such as commercial massively parallel processing and database systems; Platforms and Systems, including scalable multiprocessing systems, systems software and processing systems; Software Products, including groupware, messaging, and distributed computing middleware; Network Products, including networking tools and management systems such as OneVision℠ Network Management Solutions. The unit also has a fully integrated business, Systemedia, that provides business forms and media products. In addition, Worldwide Services provides comprehensive multi-vendor support and professional services.

AT&T CAPITAL CORPORATION

AT&T Capital is a full-service, diversified equipment leasing and finance company that operates in the United States, Canada, Europe, the Asia-Pacific region and Mexico. In August 1993, an initial public offering combined with a management stock offering took place, which totaled approximately 14 percent of AT&T Capital's common stock. As a result of the stock offerings, approximately 86 percent of the outstanding common stock of AT&T Capital (approximately 82% on a fully-diluted basis) is owned by AT&T indirectly through its wholly owned subsidiaries. On September 20, 1995, AT&T announced plans to pursue the public or private sale of its remaining 86% interest in AT&T Capital, although AT&T cannot predict the timing or terms of any such transaction.

AT&T Capital provides customized financing for AT&T's customers acquiring AT&T and associated equipment. AT&T Capital also provides financing in connection with general equipment used by AT&T entities and the AT&T employee vehicle leasing program. AT&T Capital's captive programs are dependent upon sales of products by AT&T and its affiliates and the continued acceptance of these products in the marketplace.

AT&T Capital also leases and finances non-AT&T equipment including office, manufacturing, data center and data processing and transportation equipment. Additionally, AT&T Capital provides inventory financing for equipment dealers and distributors, Small Business Administration lending, and asset management and remarketing services.

AT&T Capital's business is diversified by customer, customer type, equipment segments, geographic location of its customers and maturity of receivables. In 1994 and 1995, AT&T Capital expanded its international equipment leasing and financial services operations to customers in Europe, Hong Kong, Australia and Mexico.

COMPETITION

AT&T currently faces significant competition in the global information movement and management industry and expects that the level of competition will continue to increase. As public policy and technological changes occur, including those occasioned by the enactment of the Telecommunications Act, AT&T anticipates that new and different competitors will enter and expand their position in the communications services and equipment markets. These may include entrants from other segments of the telecommunications and information services industries and/or global competitors seeking to expand their market opportunities. Many such new competitors are likely to enter with a strong market presence, well recognized names and pre-existing direct customer relationships.

The financial services industry is also highly competitive. Participants in the industry compete through price (including the ability to control costs), risk management, innovation and customer service. Principal cost factors include the cost of funds, the cost of selling to or acquiring new end-user customers and vendors, and the cost of managing portfolios (including, for example, billing, collection, credit risk management and residual management).

SEGMENT, OPERATING REVENUE AND RESEARCH AND DEVELOPMENT EXPENSE INFORMATION

For information about the Company's industry and geographic segments, see Note 15 to the Consolidated Financial Statements. Such information is incorporated herein by reference pursuant to General Instruction G(2). For information about the consolidated operating revenues contributed by the Company's major classes of products and services and about consolidated research and development expenses, see revenue tables and descriptions on pages 24 through 27 and Consolidated Statements of Income on page 34 of the Company's annual report to security holders for the year ended December 31, 1995. Such information is incorporated herein by reference pursuant to General Instruction G(2).

EMPLOYEE RELATIONS

At December 31, 1995 AT&T employed approximately 300,000 persons in its operations, approximately 250,000 of whom are located domestically . On January 2, 1995, AT&T announced its intention to eliminate approximately 40,000 positions. See "Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations." About 38% of the domestically located employees of AT&T are represented by unions. Of those so represented, about 79% are represented by the Communications Workers of America ("CWA"), which is affiliated with the AFL-CIO; about 20% by the International Brotherhood of Electrical Workers ("IBEW"), which is also affiliated with the AFL-CIO; and the remainder by other unions. Labor agreements with most of these unions extend through May, 1998.

ENVIRONMENTAL MATTERS

The operations of the Company involve the release of materials to the environment that are subject to regulation under environmental protection laws. The Company is involved in a number of remedial actions to clean up hazardous wastes in accordance with the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA", or "Superfund"), the Resource Conservation and Recovery Act ("RCRA") and state environmental laws. Such statutes require that certain parties fund remedial actions regardless of fault. During 1995, as in prior years, the Company has been making capital expenditures for environmental control facilities. See "Item 3. Legal Proceedings."

An estimate of the costs of remedial actions or the amounts of capital expenditures for future periods is subject to a number of uncertainties including the following: the developing nature of administrative regulations being promulgated under CERCLA, RCRA and other environmental protection laws; the availability of other responsible parties at a site; the availability of information regarding conditions at potential sites; uncertainty as to how the laws and regulations may be applied to such sites; multiple choices and costs associated with diverse technologies that may be used in corrective actions at such sites; and the time periods (which may be quite lengthy) over which eventual remediation may occur. In the opinion of the Company's management, capital expenditures and expenses in connection with remedial actions to comply with the present environmental protection laws will not have a material effect upon the Company's future expenditures, annual consolidated financial statement or competitive position beyond that provided for at year-end.

ITEM 2. PROPERTIES.

The properties of AT&T consist primarily of plant and equipment used to provide long distance telecommunications services, manufacturing plants at which the Company's products and systems are produced and administrative office buildings.

Telecommunications plant and equipment consists of: central office equipment, including switching and transmission equipment; connecting lines (cables, wires, poles, conduits, etc.); land and buildings; and miscellaneous properties (work equipment, furniture, plant under construction, etc.). The majority of the connecting lines are on or under public roads, highways and streets and international and territorial waters. The remainder are on or under private property.

AT&T operates 96 manufacturing facilities located throughout the United States and abroad which at December 31, 1995, had a total of about 27 million square feet. Approximately 24 million square feet are in owned facilities and the remaining 3 million square feet are in leased premises. Some of the non-U.S. operations are operated through joint ventures with other parties. AT&T also operates a number of sales offices, service, repair and distribution centers, and other facilities, such as research and development laboratories.

AT&T continues to manage the deployment and utilization of its assets in order to meet its global growth objectives while at the same time ensuring that these assets are generating economic value added for the shareholder. AT&T will continue to manage its asset base consistent with globalization initiatives, marketplace forces, productivity growth and technology change.

A substantial number of the administrative offices of AT&T are in leased buildings. Substantially all of the important communications facilities are in buildings owned by AT&T or leased from the regional holding companies created at divestiture. Substantially all of the major manufacturing plants and major centers are in owned buildings. Many of the smaller facilities are in rented quarters. Most of the important buildings are on land held in fee, but a few are on land held under long-term leases.

On January 2, 1996, AT&T announced that it would take charges relating to the Separation, portions of which relate to asset impairment and facility closings. See "Item 7. Management's Discussion and Analysis of Financial Condition and Results of Operations."

ITEM 3. LEGAL PROCEEDINGS.

In the normal course of business, AT&T is subject to proceedings, lawsuits and other claims, including proceedings under government laws and regulations related to environmental and other matters. Such matters are subject to many uncertainties and outcomes are not predictable with assurance. Consequently, AT&T is unable to ascertain the ultimate aggregate amount of monetary liability or financial impact with respect to these matters at December 31, 1995. While these matters could affect operating results of any one quarter when resolved in future periods, it is management's opinion that after final disposition, any monetary liability or financial impact to AT&T beyond that provided for at year-end would not be material to AT&T's annual consolidated financial statements.

On February 14, 1996, Bell Atlantic Corporation and DSC Communications Corporation filed a complaint against AT&T and Lucent in the United States District Court for the Eastern District of Texas. The complaint alleges, among other things, that AT&T has monopolized or attempted to monopolize alleged markets for communications transmission equipment, related software and caller identification services. The complaint seeks injunctive relief and damages, after trebling, of approximately $3.5 billion. AT&T does not believe that the complaint has merit and intends to defend the lawsuit vigorously.

On July 31, 1991, the United States Environmental Protection Agency Region III issued a complaint pursuant to Section 3008a of the Resource Conservation and Recovery Act alleging violations of various waste management regulations at the Company's Richmond Works, Richmond, Virginia. The complaint seeks a total of $4,184,304 in penalties. The Company is contesting both liability and the penalties.

In addition, on July 31, 1991, the United States Environmental Protection Agency filed a civil complaint in the U.S. District Court for the Southern District of Illinois against the Company and nine other parties seeking enforcement of its CERCLA Section 106 cleanup order, issued in November 1990 for the NL Granite City Superfund site, Granite, Illinois, past costs, civil penalties of $25,000 per day and treble damages related to certain United States' costs. The Company is contesting liability.

During 1994, AT&T Nassau Metals Corporation ("Nassau"), a wholly owned subsidiary of AT&T, and the New York State Department of Environmental Conservation ("NYSDEC") were engaged in negotiations over a study and cleanup of the Nassau plant located on Richmond Valley Road in Staten Island, New York. During these negotiations, in June 1994, NYSDEC presented Nassau with a draft consent order which included not only provisions relating to site investigation and remediation but also a provision for payment of a $3.5 million penalty for alleged violations of hazardous waste management regulations. No formal proceeding has been commenced by NYSDEC. Nassau has denied most of the allegations and is also contesting the penalty. Negotiations and discussions are still continuing.

The foregoing environmental proceedings are not material to the consolidated financial statements or business of the Company and would not be reported but for Instruction 5 C. of Item 103 of Regulation S-K, which requires disclosure of such matters.

See also the discussion herein in Item 1. Business, for additional information about environmental matters.

ITEM 4. SUBMISSION OF MATTERS TO A VOTE OF SECURITY-HOLDERS.

No matter was submitted to a vote of security holders in the fourth quarter of the fiscal year covered by this report.

Executive Officers of the Registrant
(as of February 1, 1996)

Name	Age		Became AT&T Executive Officer On
Robert E. Allen*	61	Chairman of the Board and Chief Executive Officer	9-86
Harold W. Burlingame	55	Executive Vice President, Human Resources	9-86
Pier Carlo Falotti	53	President, AT&T International	1-96
Marilyn Laurie	56	Executive Vice President, Public Relations & Employee Information	2-87
Alex J. Mandl**	52	President and Chief Operating Officer	8-91
Gail J. McGovern	44	Executive Vice President, Business Markets Division	1-96
Richard W. Miller	55	Senior Executive Vice President and Chief Financial Officer	8-93
Joseph P. Nacchio	46	Executive Vice President, Consumer & Small Business Division	1-96
Lars Nyberg	44	Chief Executive Officer of NCR Corporation	6-95
John Petrillo	46	Executive Vice President, Strategy & New Service Innovation	1-96
Ron J. Ponder	52	Executive Vice President, Operations & Service Management and Chief Information Officer	1-96
Henry B. Schacht**	61	Chairman-designate and Chief Executive Officer of Lucent Technologies Inc.	2-96
John D. Zeglis	48	Senior Executive Vice President, Policy Development & Operations Support	9-86

*Member of the Board of Directors and Chairman of the Executive and Proxy Committees.
**Member of the Board of Directors.

All of the above executive officers have held high level managerial positions with AT&T or its affiliates for more than the past five years, except Messrs. Mandl, Miller, Falotti, Ponder, Nyberg and Schacht who have been officers or employees of AT&T since August 1, 1991, August 9, 1993, February 10, 1994, June 11, 1993, June 1, 1995 and January 1, 1996, respectively. Prior to joining AT&T, Mr. Mandl was Chairman and Chief Executive Officer of Sea-Land Service, Inc., an ocean transportation and distribution services company, for four years and prior thereto held executive positions at CSX Corporation. Prior to joining AT&T, Mr. Miller was with Wang Laboratories, Inc., a computer company, from 1989 through 1993, serving as President and Chief Operating Officer and later as Chairman, President and Chief Executive Officer. Mr. Falotti was President and Chief Executive Officer of the ASK Group, a software company, from 1992 to 1994 prior to joining AT&T. Prior to that, Mr. Falotti was President and Chief Executive

Officer of Digital Equipment Corporation Europe, a computer company. Prior to joining AT&T, Mr. Ponder was Executive Vice President and Chief Information Officer for Sprint Corporation, a telecommunications company, from 1991 to 1993 and prior to that Mr. Ponder was Chief Information Officer with the Federal Express Company, an express delivery company. Prior to joining AT&T, Mr. Nyberg was Chairman and Chief Executive Officer of Philips' Communications Systems Division of Philips Electronics NV, a telecommunications equipment company, from 1993 to 1995. From 1990 to 1993 he held other positions with Philips Electronics NV. Prior to joining AT&T, Mr. Schacht was Chairman of Cummins Engine Company, Inc., a manufacturer of diesel engines, from 1977 to 1995 and was Chief Executive Officer from 1973 to 1994.

Officers are not elected for a fixed term of office but hold office until their successors have been elected.

PART II

Items 5. through 8.

The information required by these items is included in pages 22 through 52 and on the inside back cover of the Company's annual report to security holders for the year ended December 31, 1995. The referenced pages of the Company's annual report to security holders have been filed as Exhibit 13 to this document. Such information is incorporated herein by reference, pursuant to General Instruction G(2).

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure.

There have been no changes in independent auditors and no disagreements with independent auditors on any matter of accounting principles or practices, financial statement disclosure, or auditing scope or procedure during the last two years.

PART III

Items 10. through 13.

Based upon its review of the reports furnished to the Company during and with respect to 1995 pursuant to Section 16(a) of the Securities Exchange Act of 1934, the Company notes that no Form 5 for 1995 has been filed to date by Richard A. McGinn, an Executive Vice President.

Information regarding executive officers required by Item 401 of Regulation S-K is furnished in a separate disclosure in Part I of this report because the Company did not furnish such information in its definitive proxy statement prepared in accordance with Schedule 14A.

The other information required by Items 10 through 13 is included in the Company's definitive proxy statement dated February 27, 1996, on page 6, the penultimate paragraph on page 7 through page 12 and on page 25 through page 42. Such information is incorporated herein by reference, pursuant to General Instruction G(3).

PART IV

Item 14. Exhibits, Financial Statement Schedules, and Reports on Form 8-K.

(a) Documents filed as a part of the report:

(1) Financial Statements:

(2) Financial Statement Schedules:

Separate financial statements of subsidiaries not consolidated and 50 percent or less owned persons are omitted since no such entity constitutes a "significant subsidiary" pursuant to the provisions of Regulation S-X, Article 3-09.

(3) Exhibits:

Exhibits identified in parentheses below, on file with the Securities and Exchange Commission ("SEC"), are incorporated herein by reference as exhibits hereto.

Exhibit Number	
(3)a	Restated Certificate of Incorporation of the registrant filed January 10, 1989, Certificate of Correction of the registrant filed June 8, 1989, Certificate of Change of the registrant filed March 18, 1992, Certificate of Amendment of the registrant filed June 1, 1992, and Certificate of Amendment of the registrant filed April 20, 1994. (Exhibit 4 to Registration Statement No. 333-00573).
(3)b	By-Laws of the registrant, as amended May 18, 1994 Exhibit (3)b to Form 10-K for 1994, File No. 1-1105).

*Incorporated herein by reference to the appropriate portions of the Company's annual report to security holders for the year ended December 31, 1995. (See Part II.)

Exhibit Number	
(4)	No instrument which defines the rights of holders of long term debt, of the registrant and all of its consolidated subsidiaries, is filed herewith pursuant to Regulation S-K, Item 601(b)(4)(iii)(A). Pursuant to this regulation, the registrant hereby agrees to furnish a copy of any such instrument to the SEC upon request.
(10)(i)1	Separation and Distribution Agreement by and among Lucent Technologies Inc., AT&T Corp. and NCR Corporation, dated as of February 1, 1996.
(10)(i)2	Tax Sharing Agreement by and among Lucent Technologies Inc., AT&T Corp. and NCR Corporation, dated as of February 1, 1996.
(10)(ii)(B)1	General Purchase Agreement by and between AT&T Corp. and Lucent Technologies Inc., dated February 1, 1996.
(10)(iii)(A)1	AT&T Short Term Incentive Plan as amended March, 1994 (Exhibit (10)(iii)(A)1 to Form 10-K for 1994, File No. 1-1105).
(10)(iii)(A)2	AT&T 1987 Long Term Incentive Program as amended July 17, 1989 (Exhibit (10)(iii)(A)2 to Form SE dated March 24, 1993, File No. 1-1105).
(10)(iii)(A)3	AT&T Senior Management Individual Life Insurance Program dated January 1, 1987 (Exhibit (10)(iii)(A)1 to Form SE, dated March 25, 1987, File No. 1-1105) and as revised December 1, 1994 (Exhibit (10)(iii)(A)3 to Form 10-K for 1994, File No. 1-1105).
(10)(iii)(A)4	AT&T Senior Management Long Term Disability and Survivor Protection Plan dated February 23, 1984 (Exhibit (10)(iii)(A)1 to Form SE, dated February 21, 1986, File No. 1-1105).
(10)(iii)(A)5	AT&T Senior Management Financial Counseling Program dated December 29, 1994 (Exhibit (10)(iii)(A)5 to Form 10-K for 1994, File No. 1-1105).
(10)(iii)(A)6	AT&T Deferred Compensation Plan for Non-Employee Directors, as amended December 15, 1993 (Exhibit (10)(iii)(A)6 to Form 10-K for 1993, File No. 1-1105).
(10)(iii)(A)7	AT&T Directors Individual Life Insurance Program dated January 1, 1987 (Exhibit (10)(iii)(A)3 to Form SE, dated March 25, 1987, File No. 1-1105).
(10)(iii)(A)8	AT&T Plan for Non-Employee Directors' Travel Accident Insurance (Exhibit (10)(iii)(A)8 to Form 10-K for 1990, File No. 1-1105).

Exhibit Number	
(10)(iii)(A)9	Extract from AT&T (formerly Bell System) Management Pension Plan regarding limitations on and payments of pension amounts which exceed the limitations contained in The Employee Retirement Income Security Act, with amendments effective October 1, 1985 (Exhibit (10)(iii)(A)2 to Form SE, dated February 21, 1986, File No. 1-1105).
(10)(iii)(A)10	AT&T Non-Qualified Pension Plan, (with amendments effective June 1, 1988) (Exhibit 10(iii)(A)10 to Form SE, dated March 26, 1990, File No. 1-1105).
(10)(iii)(A)11	AT&T Senior Management Incentive Award Deferral Plan, as amended January 20, 1994 and March 25, 1994 (Exhibit (10)(iii)(A)11 to Form 10-K for 1994, File No. 1-1105).
(10)(iii)(A)12	AT&T Mid-Career Hire Program revised effective January 1, 1988, including AT&T Mid-Career Pension Plan, as amended May 15, 1985 (Exhibit (10)(iii)(A)4 to Form SE, dated March 25, 1988, File No. 1-1105).
(10)(iii)(A)13	AT&T 1984 Stock Option Plan, as modified December 19, 1984 (Exhibit 10(t) to Form SE, dated February 27,1985, File No. 0-13247).
(10)(iii)(A)14	Form of Indemnification Contract for Officers and Directors (Exhibit (10)(iii)(A)6 to Form SE, dated March 25, 1987, File No. 1-1105).
(10)(iii)(A)15	Pension Plan for AT&T Non-Employee Directors revised February 20, 1989 (Exhibit (10)(iii)(A)(15) to Form 10-K for 1993, File No. 1-1105).
(10)(iii)(A)16	AT&T Senior Management Basic Life Insurance Program (Exhibit (10)(iii)(A)16 to Form 10-K for 1990, File No. 1-1105).
(10)(iii)(A)17	Form of AT&T Benefits Protection Trust Agreement (Exhibit (10)(iii)(A)17 to Form SE, dated March 25, 1992, File No. 1-1105).
(10)(iii)(A)18	Employment Agreement between American Telephone and Telegraph Company and Alex J. Mandl dated August 1, 1991 (Exhibit (10)(iii)(A) 18 to Form 10-K for 1993, File No. 1-1105).
(10)(iii)(A)19	Employment Agreement between American Telephone and Telegraph Company and Richard W. Miller dated August 9, 1993.
(12)	Computation of Ratio of Earnings to Fixed Charges.
(13)	Specified portions (pages 22 through 52 and the inside back cover) of the Company's Annual Report to security holders for the year ended December 31, 1995.

Exhibit Number	
(21)	List of subsidiaries of AT&T.
(23)	Consent of Coopers & Lybrand L.L.P.
(24)	Powers of Attorney executed by officers and directors who signed this report.
(27)	Financial Data Schedule.

AT&T will furnish, without charge, to a security holder upon request a copy of the annual report to security holders and the proxy statement, portions of which are incorporated herein by reference thereto. AT&T will furnish any other exhibit at cost.

(b) *Reports on Form 8-K:*

Form 8-K dated October 18, 1995 was filed pursuant to Item 5 (Other Events).

REPORT OF INDEPENDENT AUDITORS

To the Shareowners of AT&T Corp.:

Our report on the consolidated financial statements of AT&T Corp. and subsidiaries has been incorporated by reference in this Form 10-K from page 33 of the 1995 Annual Report to the Shareowners of AT&T Corp. In connection with our audits of such financial statements, we have also audited the related consolidated financial statement schedule listed in the index on page 13 of this Form 10-K.

In our opinion, the consolidated financial statement schedule referred to above, when considered in relation to the basic financial statements taken as a whole, presents fairly, in all material respects, the information required to be included therein.

As discussed in our report referred to above and in Note 3 to the consolidated financial statements, in 1993 the Company changed its methods of accounting for postretirement benefits, postemployment benefits and income taxes.

COOPERS & LYBRAND L.L.P.

1301 Avenue of the Americas
New York, New York
January 25, 1996

AT&T CORP.
AND ITS CONSOLIDATED SUBSIDIARIES

SCHEDULE II--VALUATION AND QUALIFYING ACCOUNTS

(Millions of Dollars)

COL. A	COL. B	COL. C		COL. D	COL. E
		Additions			
Description	Balance at Beginning of Period	(1) Charged to Costs and Expenses	(2) Charged to Other Accounts	Deductions(a)	Balance at End of Period
Year 1995					
Allowances for doubtful accounts (b)	$1,460	$2,378	$ 52(c)	$2,049	$1,841
Reserves related to business restructuring and facility consolidation (d)	$ 894	$4,444	$(83)	$ 478	$4,777
Deferred tax asset valuation allowance ...	$ 178	$ 293	$ --	$ 117	$ 354
Inventory valuation.....................	$ 763	$ 773(f)	$ --	$ 285	$1,251
Year 1994					
Allowances for doubtful accounts (b)	$1,225	$1,929	$ 59(c)	$1,753	$1,460
Reserves related to business restructuring, including force and facility consolidation (d)	$1,440	$ 34	$(115)	$ 465	$ 894
Deferred tax asset valuation allowance ...	$ 212	$ 41	$ --	$ 75	$ 178
Inventory valuation.....................	$ 669	$ 198	$ --	$ 104	$ 763

The Notes on Sheet 2 are an integral part of this Schedule.

AT&T CORP.
AND ITS CONSOLIDATED SUBSIDIARIES

SCHEDULE II--VALUATION AND QUALIFYING ACCOUNTS

(Millions of Dollars)

COL. A	COL. B	COL. C		COL. D	COL. E
		Additions			
Description	Balance at Beginning of Period	(1) Charged to Costs and Expenses	(2) Charged to Other Accounts	Deductions(a)	Balance at End of Period
Year 1993					
Allowances for doubtful accounts (b)	$1,013	$1,665	$66(c)	$1,519	$1,225
Reserves related to business restructuring, including force and facility consolidation (d)	$2,006	$ 416	$ 5	$ 987(e)	$1,440
Deferred tax asset valuation allowance ...	$ 212	$ --	$--	$ --	$ 212
Inventory valuation......................	$ 633	$ 141	$--	$ 105	$ 669

(a) Amounts written off as uncollectible, payments and reversals.
(b) Includes allowances for doubtful accounts on long-term receivables of $258, $209 and $185 in 1995, 1994 and 1993, respectively (included in Finance receivables in the Consolidated Balance Sheets).
(c) Amounts previously written off which were credited directly to this account when recovered.
(d) Included primarily in Other current liabilities and in Other liabilities in the Consolidated Balance Sheets.
(e) Upon adoption in 1993 of Statement of Financial Accounting Standards No. 112, "Employers' Accounting for Postemployment Benefits," $412 of business restructuring reserves established before 1993 were reclassified to postemployment benefit liabilities.
(f) Includes $631 of inventory write-downs associated with the 1995 restructuring and other charges.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

AT&T Corp.

By S. L. Prendergast
Vice President and Treasurer

February 27, 1996

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the date indicated.

Principal Executive Officer:

Robert E. Allen — Chairman of the Board

Principal Financial Officer:

Richard W. Miller — Senior Executive Vice President and Chief Financial Officer

Principal Accounting Officer:

Maureen B. Tart — Vice President and Controller

By S. L. Prendergast
(attorney-in-fact)*

February 27, 1996

Directors:

Robert E. Allen
Kenneth T. Derr
M. Kathryn Eickhoff
Philip M. Hawley
Carla A. Hills
Belton K. Johnson
Ralph S. Larsen
Drew Lewis
Alex J. Mandl
Donald F. McHenry
Victor A. Pelson
Donald S. Perkins
Michael I. Sovern
Franklin A. Thomas
Thomas H. Wyman

FORM 10-K

SECURITIES AND EXCHANGE COMMISSION

WASHINGTON, DC 20549

(X) ANNUAL REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For The Fiscal Year Ended December 31, 1994

OR

( ) TRANSITION REPORT PURSUANT TO SECTION 13 OR 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934

For The Transition Period From _________ to _________

Commission File Number 1-1105

AT&T CORP.

A NEW YORK CORPORATION	I.R.S. EMPLOYER NO. 13-4924710

32 Avenue of the Americas, New York, New York 10013-2412

Telephone Number 212-387-5400

Securities registered pursuant to Section 12(b) of the Act: See attached SCHEDULE A.

Securities registered pursuant to Section 12(g) of the Act: None.

Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes....x.... No........

Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K is not contained herein, and will not be contained, to the best of registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. ( )

At February 28, 1995, the aggregate market value of the voting stock held by non-affiliates was $81,379,399,770.

At February 28, 1995, 1,579,466,394 common shares were outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

(1) Portions of the registrant's annual report to security holders for the year ended December 31, 1994 (Part II)

(2) Portions of the registrant's definitive proxy statement dated February 28, 1995, issued in connection with the annual meeting of shareholders (Part III)

SCHEDULE A

Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Common Shares (Par Value $1 Per Share)	New York, Boston, Chicago, Philadelphia and Pacific Stock Exchanges
Two Year Fixed/Floating Rate Notes, due May 4, 1995	New York Stock Exchange
Three Year 4-1/2% Notes, due February 15, 1996	
Thirty-Four Year 4-3/8% Debentures, due October 1, 1996	
Thirty-Seven Year 4-3/4% Debentures, due June 1, 1998	
Thirty-Six Year 4-3/8% Debentures, due May 1, 1999	
Thirty-Three Year 6% Debentures, due August 1, 2000	
Thirty-Five Year 5-1/8% Debentures, due April 1, 2001	
Ten Year 7-1/8% Notes, due January 15, 2002	
Ten Year 6-3/4% Notes, due April 1, 2004	
Twelve Year 7-1/2% Notes, due June 1, 2006	
Thirty Year 8-1/8% Debentures, due January 15, 2022	
Thirty-Two Year 8-1/8% Debentures, due July 15, 2024	
Forty Year 8-5/8% Debentures, due December 1, 2031	

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PART II

Description

PART III

Description

PART IV

Description

See page 16 for "Executive Officers of the Registrant."

PART I

ITEM 1. BUSINESS.

GENERAL

AT&T Corp. ("AT&T" or "Company") was incorporated in 1885 under the laws of the State of New York and has its principal executive offices at 32 Avenue of the Americas, New York, New York 10013-2412 (telephone number 212-387-5400).

AT&T is a major participant in two industries: the global information movement and management industry and the financial services and leasing industry.

In the global information movement and management industry, AT&T is among the world's networking leaders, providing wireline and wireless communications services and products, communications products, network equipment, business information processing systems, and other systems, products and services that combine communication and computers, to business, consumers, telecommunications service providers and government agencies. Worldwide, AT&T's network handles more than 175 million voice, data, video and facsimile messages on an average business day. AT&T's operations in the financial services and leasing industry involve direct financing and finance leasing programs for AT&T and third party products, leasing products to customers under operating leases, as well as the general purpose credit card business.

GLOBAL INFORMATION MOVEMENT AND MANAGEMENT

To meet the needs of its customers and the demands of the complex and rapidly changing information movement and management industry, AT&T maintains business units that develop, engineer, market, and maintain telecommunications services and business units that develop, manufacture, market, provide, install and service information movement and management products and systems.

BUSINESS GROUPS

To better serve the needs of customers, AT&T's businesses are clustered into the Communications Services Group, AT&T Global Information Solutions Group, Multimedia Products Group and Network Systems Group.

o COMMUNICATIONS SERVICES GROUP

The Communications Services Group addresses the needs of large and small businesses, the Federal government, state and local governments and consumers for voice, data and image telecommunications services. Business units within this group provide regular and custom long distance communications services, including message telecommunications services ("MTS"), wide area telecommunications services ("WATS"), satellite transponder services, AT&T True Connections®500 services, toll-free or 800 services, 900 services, private line services, Software Defined Network services ("SDN"), integrated services digital network ("ISDN") technology based services, and electronic mail, electronic data interchanges and enhanced facsimile services through AT&T EasyLink®services. They also provide special long distance services, including AT&T Calling Card services and special calling plans and the Company's domestic and international operators. AT&T provides communications services internationally, including transaction services, global networks, network management and value added network services (i.e., services offered over communications transmission facilities that employ computer processing applications) and sells and maintains submarine cable systems.

AT&T provides interstate and intrastate long distance telecommunications services throughout the continental United States and provides, or joins in providing with other carriers, interstate telecommunications services to and from Alaska, Hawaii, Puerto Rico and the Virgin Islands and international telecommunications services to and from virtually all nations and territories around the world.

In the continental United States, AT&T provides long distance telecommunications services over its own network. Virtually all switched services are computer controlled and digitally switched and interconnected by a packet switched signaling network. Transmission facilities consist of approximately 2 billion circuit-miles using lightwave, satellite, wire and coaxial cable and microwave radio technology. International telecommunications services are provided via multiple international transoceanic submarine cable (primarily lightwave) systems and via international satellite and radio facilities.

On March 13, 1995, the Federal Communications Commission ("FCC") announced the conclusion of the broadband Personal Communications Services ("PCS") auction commenced on December 5, 1994. The auction involved a total of 99 PCS licenses in 51 Major Trading Areas ("MTAs") authorizing service on 30 MHz of spectrum in the 1.8 GHz band. At the start of the auction, AT&T was eligible to bid in 30 MTAs. AT&T bid a total of $1.685 billion to win broadband PCS licenses covering 21 MTAs. AT&T must submit to the FCC an application for a broadband PCS license in each MTA where it has been declared the winning bidder. Other interested parties will have the opportunity to file petitions with the FCC commenting upon or challenging AT&T's applications. After a review of the applications and the conclusion of the public comment process, the FCC will determine whether there are any reasons precluding it from granting the licenses; if there are none, it will grant the licenses. AT&T is required to provide adequate service to at least one-third of the population in its licensed areas within five years of being licensed and two-thirds of the population in its licensed areas within ten years of being licensed. The licenses are granted for ten year terms from the original date of issuance and may be renewed by AT&T by meeting the FCC's renewal criteria and upon compliance with the FCC's renewal procedures. AT&T has submitted to the FCC a down payment equal to 20% of the 1.685 billion; the remainder is due within five business days after the grant of each license. Construction of the network to support these licenses will require substantial capital expenditure, the level of which is dependent on a number of factors which have not been determined.

AT&T Solutions is a new business unit established to assist corporations in global network and computer management. AT&T Solutions will design, build and operate corporate clients computer networks, design software and manage data centers for its clients.

o AT&T GLOBAL INFORMATION SOLUTIONS GROUP

AT&T Global Information Solutions ("AT&T GIS" formerly known as NCR Corporation) offers computing and communications solutions together to provide customers easy access to information and to each other. These solutions are comprised of computer products and systems, as well as software and professional services and support. AT&T GIS' primary focus is on six key industries: financial, retail, communications, consumer goods manufacturing, transportation and the public sector. Key product lines include: Financial Systems, such as automated teller machines, image capture systems and financial processing systems; Decision Enabling Systems, such as commercial massively parallel processing and database systems; Platform and Systems, including scalable multiprocessing systems, systems software and processing systems; Software Products, including groupware, messaging, and distributed computing middleware; Network Products, including networking tools and management systems such as OneVision®Network Management Solutions. The unit also has a fully integrated business, Systemedia, that provides business forms and media products. In addition, Worldwide Services provides comprehensive multi-vendor support and professional services.

o MULTIMEDIA PRODUCTS GROUP

The Multimedia Products Group addresses the equipment needs of large and emerging businesses, the Federal government, state and local governments, international distributors and consumers. Business units in this group offer products such as private branch exchanges ("PBXs") including the Definity* communications system, voice processing systems and voice messaging systems including the AUDIX®and Conversant®systems, video conferencing systems, installations, maintenance and repair services and other business communications systems, corded and cordless telephones, cellular telephones, answering systems, security systems, facsimile machines, modems, multiplexers, data transceivers, the Merlin®and Partner®communications systems, videophone, and imaging and personal communicator products.

The Multimedia Products Group also includes:

AT&T Ventures, an internal venture capital business. The mission of AT&T Ventures is to identify and nurture new markets for the application of AT&T-developed and other technologies. AT&T Ventures explores new businesses in markets not addressed by existing business units.

AT&T Microelectronics, a business unit that produces three broad categories of components: integrated circuits, photonics and other electronic components such as discrete components, power systems and printed wiring boards, which are included in most AT&T products and systems. Certain of these components and many other specially designed components are sold commercially to other companies.

o NETWORK SYSTEMS GROUP

The Network Systems Group includes business units that primarily manufacture, market, engineer, install and maintain switching systems, transmission systems, cable and wire products, cellular systems, and operations systems for AT&T, local exchange carriers, other carriers, private businesses, government agencies, foreign telephone administrations and others. Switching systems include the 5ESS® switch; transmission systems include lightwave and digital radio products, digital cross connect and multiplex products, and digital loop carrier products; cable and wire products include optical fiber, optical fiber cable and related apparatus; and operations systems include mechanized systems for managing telecommunications networks.

AT&T markets its services, products and systems throughout the United States. It also markets many of its services, products and systems outside of the United States.

The Company sells its services and products directly to all types of customers through its own direct sales force. The Company also sells certain of its products to distributors and other intermediaries who may resell these products to others. Some of the Company's services are also sold to businesses that resell them, usually in conjunction with other services, to others.

WIRELESS SERVICES (Merger With McCaw Cellular Communications, Inc.)

In September 1994, McCaw Cellular Communications, Inc. ("McCaw"), the nation's largest cellular communications company, became a wholly owned subsidiary of AT&T. McCaw has cellular operations in more than 100 cities and operates the sixth largest U.S. messaging service, serving more than 700,000 customers, and a digital air-to-ground telephone service for commercial airlines and corporate aircraft.

In connection with the merger, AT&T, McCaw and the United States entered into a proposed antitrust consent decree (the "Proposed Consent Decree") on July 15, 1994, which permitted the merger by settling a suit challenging the merger filed the same day by the United States in the United States District Court for the District of Columbia (the "court"). The Proposed Consent Decree imposes several conditions on the future operations of AT&T and McCaw.

These conditions include: (i) the maintenance of McCaw (and McCaw affiliates) as a subsidiary or entity separate from AT&T; (ii) requirements that McCaw cellular systems, within 21 months of the commencement of the action, cease providing interexchange services and provide customers of McCaw cellular systems with equal access to any interexchange carrier that offers service to the system; (iii) requirements that McCaw cellular systems provide to all interexchange carriers exchange access on an unbundled basis that is equal in type, quality, and price to that provided to AT&T; (iv) a prohibition on the sale by each of AT&T and McCaw of interexchange or local cellular services, respectively, at a price, term or discount that depends on whether the customer obtains both AT&T's interexchange and McCaw's local cellular services; (v) requirements that AT&T not discriminate in favor of McCaw in the way in which certain services and products are made available; (vi) restriction of the flow of certain non-public information between AT&T and McCaw relating to unaffiliated wireless system equipment customers of AT&T and unaffiliated wireless system equipment suppliers of McCaw; (vii) a requirement for AT&T to continue to provide technological and other support to its unaffiliated cellular system equipment customers; and (viii) a requirement that AT&T buy back any cellular system equipment sold to an unaffiliated cellular carrier if the United States determines AT&T has violated any of the provisions described in (v) through (vii) of this paragraph.

The requirements of the Antitrust Procedures and Penalties Act, 15 U.S.C. Section 16, must be complied with before the Proposed Consent Decree may be entered by the court. The requirements include: (i) filing with the court and publication of the Proposed Consent Decree and a competitive impact statement in the Federal Register at least 60 days prior to the effective date of the decree; (ii) an opportunity for the public to provide written comments and an opportunity for the United States to reply to such comments; and (iii) a determination by the court that the Proposed Consent Decree is in the public interest. Comments have been filed with the court by all interested parties and AT&T is awaiting the U.S. Department of Justice's ("DOJ") response to these comments. AT&T does not know when the court will act on this matter.

If the requirements of the Antitrust Procedures and Penalties Act are not complied with and court does not approve the Proposed Consent Decree, the suit brought by the United States challenging the merger could be revived, which may lead to a divestiture or further conditioning of the merger.

LIN Broadcasting Corporation

LIN Broadcasting Corporation ("LIN") is 52% owned by AT&T indirectly through McCaw. Under a private market value guarantee agreement (the "PMVG") between McCaw and LIN, a process began on January 1, 1995, to determine the private market value per share of LIN (the "Private Market Price") using independent appraisers. On March 7, 1995, the Private Market Price was determined to be $127.50 per share. McCaw will have 45 days from March 7, 1995, to decide whether to proceed with the acquisition of all the public shares at that price, subject to the approval of the LIN public shareholders. Based on the approximately 25 million shares of LIN held by the public, the total purchase price would be approximately $3.26 billion.

AT&T and McCaw have not decided if McCaw will offer to acquire LIN's public shares and must evaluate the final price. If McCaw does not proceed with an acquisition, the PMVG provides that McCaw will put LIN in its entirety up for sale under the direction of the LIN independent directors and subject to the approval of the LIN public shareholders. In connection with this matter, several purported class action suits have been filed against AT&T and others. See Item 3. Legal Proceedings.

INTERNATIONAL

The WorldPartners alliance was founded in 1993 by AT&T, Kokusai Denshin Denwa Company, Ltd of Japan and Singapore Telecommunications to provide multinational customers with a new level of seamless, high quality advanced telecommunications and related services around the globe, under the brand name WorldSource™ In 1994, Unisource N.V. (a joint venture of the Dutch, Swedish, Swiss and, it is expected, Spanish carriers in Europe) joined WorldPartners along with Telstra of Australia, Hong Kong Tel, Korea Telecom, and others. As of the end of 1994, WorldPartners included eleven members who will provide WorldSource Services to multinational customers covering more than two dozen countries in North America, Europe and Asia.

AT&T has numerous subsidiary companies and offices throughout the world. AT&T has implemented an international organizational structure, along regional lines, to complement the functional groups described above and to promote shared accountability between regional units and those groups. Three regional units, representing all AT&T businesses, are: Asia/Pacific, with headquarters in Hong Kong; Europe/Middle East/Africa, with headquarters in Brussels; and Caribbean/Latin America, with headquarters in Coral Gables, Florida.

AT&T has established a number of international alliances, ventures and manufacturing facilities, including the following:

Asia/Pacific Region

AT&T owns 60% of AT&T Taiwan Telecommunications Co., Ltd., a joint venture with the Taiwanese government and others in Taiwan which manufactures switching and transmission systems.

AT&T owns approximately 15% of United Fiber Optic Communications Inc., a venture with Pacific Electric Wire and Cable Ltd., Chiao Tung Bank and others in Taiwan which manufactures fiber cable and transmission equipment.

AT&T owns semiconductor assembly and test facilities in Singapore.

AT&T owns 80% of AT&T Software Japan, Ltd., a joint venture with Industrial Bank of Japan and Software Research Associates, which provides software development.

AT&T owns approximately 60% of AT&T Jens Corporation, a joint venture with 22 major Japanese companies which provides value added network services.

AT&T, through joint ventures, operates manufacturing facilities in the People's Republic of China for the production of copper and fiber cable, switching systems, and transmission equipment.

Europe/Middle East/Africa Region

AT&T owns AT&T ISTEL Limited, a United Kingdom based company, that manufactures software and provides software related services.

AT&T Network Systems International B.V. is a joint venture between AT&T, which indirectly owns approximately 94% of the equity, and Compagnia Telefonica Nacional de Espana, the national telephone company of Spain, which owns approximately 6%. It designs, develops, manufactures and markets Network Systems' products in Europe and elsewhere. In addition, the joint venture itself has established businesses and participates in joint ventures in a number of countries, including: the Netherlands, Belgium, the People's Republic of China, the Czech Republic, France, Germany, Ireland, Italy, Kazakhstan, Poland and the Russian Federation.

AT&T owns 19.5% of UTEL, a Ukrainian joint venture company with PTT Telecom and the Ukrainian State Committee of Communications, which provides services and products to improve Ukraine's domestic and international telecommunications services.

AT&T owns AT&T Wireless Communications Products Limited (formerly "Shaye Communications Limited"), a United Kingdom company engaged in research, development and marketing of products for the ultra low power, portable, radio-based telecommunications market.

AT&T owns in excess of 90% of Barphone S.A., a French company engaged principally in the development, design, manufacture and marketing of small PBXs and related equipment.

AT&T owns 50% of A/O Telmos, a Russian joint venture company with Moscow City Telephone Company which will own and operate a subscriber network in Moscow.

AT&T owns various controlling interests in joint ventures in the Czech Republic, Hungary, Poland and Slovakia which market key systems, PBXs, related equipment and other AT&T products.

AT&T owns AT&T Microelectronica de Espana S.A., a Spanish company which manufactures integrated circuits.

In addition, AT&T, through a joint venture, operates a manufacturing facility in Ireland.

Caribbean/Latin America Region

AT&T owns four companies in Mexico which manufacture microelectronics products, telephone answering machines, cordless telephones and corded telephones, and repair various items of AT&T's consumer products business unit.

AT&T owns 51% of AT&T Elecon Telesistemas C.A., a Venezuelan joint venture with Electroconductores, C.A., which manufactures copper cable for the Venezuelan market.

AT&T owns 5% of VenWorld Telecom, C.A., a Venezuelan joint venture company with GTE Venezuelan Telephone Incorporated and three Venezuelan corporations, which owns 40% of the Venezuelan Telephone Company, Compania Anonima Nacional Telefonos de Venezuela ("CANTV").

AT&T owns 49% of AT&T Network Systems do Brasil, S.A., a Brazilian joint venture with SID Telecommunicacoes e Controles, S.A. and Marcep, S.A. which manufactures and markets telephone switching systems.

AT&T owns 10% of Compania de Telefonas del Interior, S.A., a joint venture with GTE Mobile Communications International, Inc. and others which provides wireless telecommunication service in Argentina.

AT&T owns 35% of Jamaica Digiport International Limited, a joint venture with Cable & Wireless PLC and Telecommunications of Jamaica, Ltd. which provides certain telecommunications services in the free-trade zone, Montego Bay, Jamaica.

Canada

AT&T owns 22.5% of Unitel Communications Holdings, Inc., the sole shareholder of Unitel Communications, Inc., a Canadian long distance carrier.

AT&T BELL LABORATORIES

AT&T Bell Laboratories provides support to all business units. It designs and develops new products, systems, software and services, and carries out a broad program of fundamental research, to provide the technology base for AT&T's future.

AT&T Bell Laboratories has made significant contributions to information science and technology since its founding in 1925. These contributions include the invention of the transistor, the development of the nationwide microwave radio network, and the design and development of integrated circuits and many types of lasers. Areas of AT&T Bell Laboratories research and development work in recent years include lightwave transmission, which offers greater transmission capacity than other transmission systems; electronic switching technology, which enables faster call processing, increased reliability and reduced network costs; and microelectronics components, which bring the latest advantages of scale of integration to the full range of products offered by AT&T.

Other advances achieved by AT&T Bell Laboratories include: the development of the Karmarkar Algorithm, a mathematical optimization technique which is being applied to the efficient layout of AT&T's long distance telecommunications network; the development of optical amplifiers that dramatically increase the distance messages can be transmitted optically before they must be reamplified, and the invention of a self-electro optic effect device ("SEED") useful for optical storage, optical switching and optical logic, thus advancing the future of photonic technologies; the development of polysilicon memory structures widely used in dynamic random access memories ("DRAMS"); the development of speech recognizers which provide for the human control of complex systems with verbal commands; and improvements to AT&T's ACCUNET®T1.5 service (a wideband, all-digital, customer-dedicated service that combines voice, data and video communications) that permit customer control of reconfigurations.

AT&T Bell Laboratories also undertakes the architectural effort required to see that AT&T products can be integrated within a framework of national and international standards. An emphasis on use of the UNIX* Operating System, "C" language and other software suited to open architecture and easy connectivity facilitates this architectural effort. AT&T Bell Laboratories has also made significant contributions to the efficient coding of television pictures and to wireless communications technology.

In order to increase focus on customers and to create more responsive organizations, much of the AT&T Bell Laboratories systems engineering and development resource has been more formally aligned with business units. These organizations remain AT&T Bell Laboratories, but they receive day-to-day guidance from the business units they support.

COMPETITION, REGULATION AND LEGISLATION

Changing Competitive Environment

Communications services and products and information services and products today are provided, in significant part, by companies in different industries. Many of AT&T's competitors as well as participants in other segments of the communications and information industries are large companies which have substantial capital, technological and marketing resources. The business and competitive environment in the global information movement and management industry is changing, however, and will likely be reshaped by numerous forces, including customer preferences and needs, technological developments, increased competition and a reduction in domestic and foreign regulation. While it is difficult to predict the specific nature and pace of changes that might affect the business and competitive environment, AT&T anticipates that these changes will cause many major companies to expand into other segments of the communications and information industries. This may increase AT&T's ability to participate in the provision of a broader range of services with fewer regulatory constraints but result in increased competition in AT&T's existing markets.

Regulation of Rates

AT&T is subject to the jurisdiction of the FCC with respect to interstate and international rates, lines and services, and other matters. For many years prior to July 1, 1989, the system of regulation used by the FCC for AT&T was rate-of-return regulation. Effective July 1, 1989, the FCC adopted a new system of regulating AT&T known as "price caps" under which AT&T's prices, rather than its earnings, are limited. In a series of decisions, beginning in 1991, the FCC removed the vast majority of AT&T's business services from price caps regulation. Residential, 800 directory assistance and analog private line services, however, are still subject to such regulation.

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*Registered trademark of Novell, Inc.

The FCC's "price caps" system of regulation is designed to maximize the incentive for AT&T to increase productivity and lower costs and increases AT&T's flexibility to respond to market conditions. AT&T's price capped services are subject to price ceilings, defined by indices based on AT&T's price levels at the initiation of price cap regulation and adjusted annually to reflect changes in inflation and certain other costs of doing business. The price ceilings for services are also subject to a 3% annual decrease, which reflects a 2.5% productivity level that the FCC says AT&T has achieved historically plus an additional 0.5%. AT&T may raise prices of individual services, but must stay within the ceilings overall. Generally, AT&T is prohibited from raising or lowering the overall price of particular service categories by more than 5% annually.

In 1991, the FCC adopted an order in its "interexchange competition" proceeding (CC Docket No. 90-132), confirming that the interexchange market is largely competitive. As a result, the order streamlined the regulation of most AT&T outbound business services. In 1993, inbound 800 services were streamlined and, on January 12, 1995, streamlining was extended to services used by small business customers. These services are no longer subject to price cap regulation; AT&T can file tariff revisions for these services on 14 days' notice; and AT&T can offer individually negotiated contract-based rates for these services.

AT&T's intrastate telecommunications services are subject to regulation in many states by public service commissions or similar state authorities having regulatory power over intrastate rates, lines and services and other matters. The system of regulation used in many states, at least for some of AT&T's services, is rate-of-return regulation. In recent years, recognizing the competitive nature of AT&T's services, many states have adopted different systems of regulation, such as: complete removal of rate-of-return regulation, pricing flexibility rules for some or all of AT&T's services, price caps, and incentive regulation.

Legislation and Other Regulation

During 1994, a number of bills were introduced in Congress which would have permitted the Regional Bell Operating Companies (the "RBOCs") to offer long distance services under certain conditions and accelerated competition for local access and local phone services. While none of these bills was enacted, several key members of Congress announced plans to introduce new bills in the current session that would set conditions under which the RBOCs would be permitted to provide long distance services and manufacture equipment, and permit competition in local services. On March 23, 1995, the Senate Commerce Committee approved a telecommunications bill which establishes conditions relating to local competition an RBOC must meet before it can provide long distance service in the area in which it is the dominant provider of local exchange service but would permit the RBOC to provide long distance service elsewhere without satisfying these conditions. The bill would also permit RBOC entry into the manufacturing of telecommunications equipment when long distance entry is permitted. Proceedings are also pending before a number of state regulatory commissions, including New York, California and Illinois, concerning changes in the nature of the state regulation of telecommunication services and the removal of constraints on local service providers. AT&T has taken the position that because of the RBOCs' current monopoly position in providing local service, it is inappropriate for the RBOCs to receive relief from the restrictions on providing long distance service, manufacturing equipment and other regulatory constraints currently imposed on them until competition in local service has developed. In this regard, AT&T and a number of participants in the telecommunications industry have identified at least nine critical conditions necessary to create the potential for effective competition in the local service market, including the unbundling of basic network functions, interconnection to local network facilities and services, dialing parity and number portability. There is no certainty that any federal legislation will be passed, or if passed enacted into law, or state regulatory changes will be effected, or if enacted or effected, what form any such legislation or regulatory changes will take.

One state regulatory commission has taken regulatory action of the kind described above. In November 1994, the New York Public Service Commission approved the Open Market Plan of Rochester Telephone Company ("RTC"), pursuant to which RTC was granted additional pricing flexibility for certain local and toll services as part of a plan to permit other carriers to offer local and toll service, either independently or using some of RTC's facilities. The Open Market Plan did not satisfy all of the conditions AT&T has identified as a prerequisite to establishing competition in local services. In January 1995, AT&T filed a petition for reconsideration of the Open Market Plan based on its inability, as adopted, to foster local competition.

Competition; New Opportunities

AT&T currently faces significant competition in the provision of long distance service and AT&T expects that the level of competition in communications services will continue to increase. If regulatory, legislative or technological changes occur, AT&T anticipates that it will experience new and different competitors. These may include entrants from other segments of the telecommunications and information services industries seeking to expand their market opportunities. Such new competitors may enter with a strong market presence, well recognized names and pre-existing direct customer relationships. Depending on the timing and circumstances of, and any competitive inequities not addressed by regulatory or legislative conditions or restrictions on, their entry, AT&T's revenues and net income could be adversely affected in future years.

Some of the same regulatory and technological changes that AT&T anticipates will increase competition in its historic markets also are anticipated to open new markets for AT&T in different segments of communications services, end-to-end services, value-added services and multimedia services that AT&T can provide through its advanced, intelligent network. AT&T's competitive strategy includes positioning itself to best take advantage of these new opportunities through the use of its leading networking capabilities, respected brand name and other resources.

MFJ Activity

On July 6, 1994, four RBOCs (Bell Atlantic Corporation, BellSouth Corporation, NYNEX Corporation, and Southwestern Bell Corporation) filed a motion with U.S. District Court for the District of Columbia (the "District Court") to vacate the Modification of Final Judgment of 1982 ("MFJ") in its entirety, or, in the alternative, to remove the line of business restrictions. The MFJ currently forbids the RBOCs from providing long distance services and from manufacturing telecommunications equipment and customer premises equipment. The motion maintains that changed circumstances have obviated the need for the MFJ, that the local exchange is (or soon will be) competitive, that regulation can prevent anticompetitive abuse of the local exchange bottleneck, and that consumers and the nation will benefit from RBOC entry into the long distance services and equipment markets. The DOJ is currently investigating the motion. AT&T filed with the DOJ on December 7, 1994 its opposition to the motion. Bell Atlantic has since withdrawn its support for the motion. It is AT&T's position that the District Court and the Court of Appeals have previously rejected these claims, and nothing has changed since these rejections that could now justify elimination of the line-of-business restrictions and that the RBOCs retain the ability to use their local exchange monopolies to impede competition in long distance and equipment markets, and regulation cannot prevent anticompetitive behavior. Proceedings before the District Court are expected to begin in the third quarter of 1995.

Throughout the last two years, Ameritech Corporation has been pursuing its "Customers First" plan before the FCC, the DOJ, and, most recently, the Illinois Commerce Commission. That plan seeks to obtain relief from the MFJ's interLATA restriction in return for the implementation of certain conditions that could foster the development of local exchange competition. AT&T has been vigorously contesting Ameritech Corporation's plan in each jurisdiction, and has filed its own petition asking the Illinois Commerce Commission to implement all of the conditions needed to test the potential for local exchange competition, without any linkage to MFJ relief. The Illinois hearing examiners have released a proposed order that generally recognizes that certain conditions are necessary to implement local exchange competition.

FINANCIAL SERVICES AND LEASING

AT&T is a major participant in the financial services and leasing industry, with its operations conducted through AT&T Capital Corporation ("AT&T Capital"), a majority-owned subsidiary of AT&T, and AT&T Universal Card Services Corp. ("AT&T Universal Card Services"), a wholly owned subsidiary of AT&T.

o AT&T CAPITAL

In August 1993, an initial public offering combined with a management stock offering took place, which totaled approximately 14 percent of AT&T Capital's common stock. As a result of the stock offerings, approximately 86 percent of the outstanding common stock of AT&T Capital (approximately 82% on a fully-diluted basis) is owned by AT&T indirectly through subsidiaries.

AT&T Capital is a full-service, diversified equipment leasing and finance company that operates in the United States, Canada, Europe, the Asia-Pacific region and Mexico.

AT&T Capital works side by side with AT&T and its affiliates to provide customized financing for AT&T customers acquiring AT&T and associated equipment. AT&T Capital also provides: financing in connection with general equipment used by AT&T entities; the AT&T affiliate investment recovery program; and AT&T's employee vehicle leasing program. AT&T Capital's captive programs are dependent upon sales of products by AT&T and its affiliates and the continued acceptance of these products in the marketplace.

AT&T Capital also leases and finances non-AT&T equipment including office, manufacturing, data center and data processing and transportation equipment. Additionally, the Company provides inventory financing for equipment dealers and distributors, Small Business Administration lending, and asset management and remarketing services.

AT&T Capital's business is diversified by customer, customer type, equipment segments, geographic location of its customers and maturity of receivables.

In 1994 and January 1995, AT&T Capital expanded its international equipment leasing and financial services operations to customers in Canada, Europe, and Hong Kong and established operations in Australia and Mexico.

The equipment leasing and finance industry is highly competitive. Participants in the industry compete through price (including the ability to control costs), risk management, innovation and customer service. Principal cost factors include the cost of funds, the cost of selling to or acquiring new end-user customers and vendors, and the cost of managing portfolios (including, for example, billing, collection, credit risk management and residual management. There is no assurance as to the volume of financing opportunities that will be generated by sales or leases of equipment by AT&T and its affiliates.

In its leasing and financing operations and programs, AT&T Capital competes with captive or related leasing companies (such as General Electric Capital Corporation and IBM Credit Corporation), independent leasing companies (such as Comdisco, Inc.), certain banks engaged in leasing, lease brokers and investment banking firms that arrange for the financing of leased equipment, and manufacturers and vendors who lease their own products to customers. In addition, AT&T Capital competes with all banking and other financial institutions, manufacturers, vendors and others who extend or arrange credit for the acquisition of equipment and, in a sense, with the available cash resources of end-users (i.e., end-users may use their available cash resources to purchase equipment otherwise financeable by AT&T Capital). Many of the competitors of AT&T Capital are large companies that have substantial capital, technological and marketing resources; some of these competitors are significantly larger than AT&T Capital and have access to capital at a lower cost.

o AT&T UNIVERSAL CARD SERVICES

AT&T Universal Card Services began operations in early 1990. The AT&T Universal Card is a combined general-purpose consumer credit card and AT&T Calling Card that at year-end had receivables in the amount of $12.3 billion in 1994, $9.2 billion in 1993, $6.6 billion in 1992, $3.8 billion in 1991, and $1.6 billion in 1990. The AT&T Universal Card is offered directly through AT&T Universal Financial Corp., a Utah industrial loan company, and Universal Bank, N.A., in Columbus, Georgia, which are both wholly owned by AT&T, and under an affinity relationship with Columbus Bank and Trust Company in Columbus, Georgia, a subsidiary of Synovus Financial Corp. AT&T Universal Card Services provides marketing and customer support for the AT&T Universal Card program and it purchases cardholder receivables generated by the AT&T Universal Card program.

The consumer credit card industry is highly competitive and some seasonality exists, with a higher number of purchases occurring during the year-end holiday season. The Company believes that the AT&T Universal Card program is one of the top two or three bankcard/credit card programs, based on generally available industry information, and on the number of cardholder accounts in the United States.

SEGMENT, OPERATING REVENUE AND RESEARCH AND DEVELOPMENT EXPENSE INFORMATION

For information about the Company's industry and geographic segments, see Note 16 to the Consolidated Financial Statements. Such information is incorporated herein by reference pursuant to General Instruction G(2). For information about the consolidated operating revenues contributed by the Company's major classes of products and services and about consolidated research and development expenses, see revenue tables and descriptions on pages 22 through 26 and Consolidated Statements of Income on page 30 of the Company's annual report to security holders for the year ended December 31, 1994. Such information is incorporated herein by reference pursuant to General Instruction G(2).

EMPLOYEE RELATIONS

AT&T employs approximately 304,500 persons in its operations. About 35% of the employees of AT&T are represented by unions. Of those so represented about 80% are represented by the Communications Workers of America ("CWA"), which is affiliated with the AFL-CIO, about 19% by the International Brotherhood of Electrical Workers ("IBEW"), which is also affiliated with the AFL-CIO, and the remainder by other unions. Labor agreements with most of these unions extend through May 27, 1995. AT&T expects to commence negotiations in April 1995 with union representatives concerning these expiring agreements.

ENVIRONMENTAL MATTERS

The operations of the Company involve the release of materials to the environment that are subject to regulation under environmental protection laws. The Company is involved in a number of remedial actions to clean up hazardous wastes in accordance with the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA", or "Superfund"), the Resource Conservation and Recovery Act ("RCRA") and state environmental laws. Such statutes require that certain parties fund remedial actions regardless of fault. During 1994, as in prior years, the Company has been making capital expenditures for environmental control facilities.

An estimate of the costs of remedial actions or the amounts of capital expenditures for future periods is subject to a number of uncertainties including the following: the developing nature of administrative regulations being promulgated under CERCLA, RCRA and other environmental protection laws; the availability of other responsible parties at a site; the availability of information regarding conditions at potential sites; uncertainty as to how the laws and regulations may be applied to such sites; multiple choices and costs associated with diverse technologies that may be used in corrective actions at such sites; the eventual outcome of claims for insurance coverage; and the time periods (which may be quite lengthy) over which eventual remediation may occur. In the opinion of the Company's management, capital expenditures and expenses in connection with remedial actions to comply with the present environmental protection laws will not have a material effect upon the Company's future expenditures, annual consolidated financial statement or competitive position beyond that provided for at year-end.

ITEM 2. PROPERTIES.

The properties of AT&T consist primarily of plant and equipment used to provide long distance telecommunications services, manufacturing plants at which the Company's products and systems are produced and administrative office buildings.

Telecommunications plant and equipment consists of: central office equipment, including switching and transmission equipment; connecting lines (cables, wires, poles, conduits, etc.); land and buildings; and miscellaneous properties (work equipment, furniture, plant under construction, etc.). The majority of the connecting lines are on or under public roads, highways and streets and international and territorial waters. The remainder are on or under private property.

AT&T operates 92 manufacturing facilities located throughout the United States and abroad which at December 31, 1994, had a total of about 29 million square feet. Approximately 26 million square feet are in owned facilities and the remaining 3 million square feet are in leased premises. Some of the non-U.S. operations are operated through joint ventures with other parties (see the discussion of international alliances and ventures contained in Item 1. Business). AT&T also operates a number of sales offices, service, repair and distribution centers, and other facilities, such as research and development laboratories.

AT&T continues to manage the deployment and utilization of its assets in order to meet its global growth objectives while at the same time ensuring that these assets are generating economic value added for the shareholder. AT&T will continue to manage its asset base consistent with globalization initiatives, marketplace forces, productivity growth and technology change.

A substantial number of the administrative offices of AT&T are in leased buildings. Substantially all of the important communications facilities are in buildings owned by AT&T or leased from the regional holding companies created at divestiture. Substantially all of the major manufacturing plants and major centers are in owned buildings. Many of the smaller facilities are in rented quarters. Most of the important buildings are on land held in fee, but a few are on land held under long-term leases.

ITEM 3. LEGAL PROCEEDINGS.

In the normal course of business, AT&T is subject to proceedings, lawsuits and other claims, including proceedings under government laws and regulations related to environmental and other matters. Such matters are subject to many uncertainties and outcomes are not predictable with assurance. Consequently, AT&T is unable to ascertain the ultimate aggregate amount of monetary liability or financial impact with respect to these matters at December 31, 1994. While these matters could affect operating results of any one quarter when resolved in future periods, it is management's opinion that after final disposition, any monetary liability or financial impact to AT&T beyond that provided for at year-end would not be material to AT&T's annual consolidated financial statements.

In connection with the merger of AT&T and McCaw, the parties entered into a Proposed Consent Decree with the United States. For a discussion of the Proposed Consent Decree, see Item 1. Business.

On February 17, 1995, two purported class actions were filed in the Delaware Chancery Court entitled Fried v. MMM Holdings Inc., et al. (the "Fried Action") and Blake v. AT&T Corp., et al. (together with the Fried Action, the "Delaware Actions"). On February 21, 1995, a purported class action was filed in New York State Supreme Court against AT&T and its directors entitled Katz v. Robert E. Allen, et al. (the "New York Action"). The Delaware Actions allege that AT&T, among others, has violated its fiduciary duties, and one of the Delaware Actions alleges that AT&T, among others, has violated its obligations under the PMVG, in each case by virtue of, among other things, the McCaw Appraiser's view that the private market value of LIN as defined under the PMVG is $105 per share. The New York Action similarly alleges that AT&T and its directors have violated their fiduciary duties by virtue of, among other things, the McCaw Appraiser's determination under the PMVG. On March 3, 1995, plaintiffs in the Delaware Actions requested of the court that those actions be consolidated with two additional actions that have been filed in the Delaware Court of Chancery entitled Phillip Frank v. McCaw Cellular Communications, et. al. and H. Richard Dollinger v. MMM Holdings, Inc. Pursuant to the proposed order of consolidation, the complaint in the Fried Action would be designated as the complaint in the consolidated action. AT&T believes that the actions are without merit.

On July 31, 1991, the United States Environmental Protection Agency Region III issued a complaint pursuant to Section 3008a of the Resource Conservation and Recovery Act alleging violations of various waste management regulations at the Company's Richmond Works, Richmond, Virginia. The complaint seeks a total of $4,184,304 in penalties. The Company is contesting both liability and the penalties.

In addition, on July 31, 1991, the United States Environmental Protection Agency filed a civil complaint in the U.S. District Court for the Southern District of Illinois against the Company and nine other parties seeking enforcement of its CERCLA Section 106 cleanup order, issued in November 1990 for the NL Granite City Superfund site, Granite, Illinois, past costs, civil penalties of $25,000 per day and treble damages related to certain United States' costs. The Company is contesting liability.

On January 31, 1994, the Company pleaded guilty to a misdemeanor and paid a fine of $175,000 in connection with environmental violations at the Company's facilities in Reading, Pennsylvania.

During 1994, AT&T Nassau Metals Corporation ("Nassau"), a wholly owned subsidiary of AT&T, and the New York State Department of Environmental Conservation ("NYSDEC") were engaged in negotiations over a study and cleanup of the Nassau plant located on Richmond Valley Road in Staten Island, New York. During these negotiations, in June 1994, NYSDEC presented Nassau with a draft consent order which included not only provisions relating to site investigation and remediation but also a provision for payment of a $3.5 million penalty for alleged violations of hazardous waste management regulations. No formal proceeding has been commenced by NYSDEC. Nassau has denied most of the allegations and is also contesting the penalty. Negotiations and discussions are still continuing.

The foregoing environmental proceedings are not material to the consolidated financial statements or business of the Company and would not be reported but for Instruction 5 C. of Item 103 of Regulation S-K, which requires disclosure of such matters.

See also the discussion herein in Item 1. Business, for additional information about environmental matters.

ITEM 4. SUBMISSION OF MATTERS TO A VOTE OF SECURITY-HOLDERS.

No matter was submitted to a vote of security holders in the fourth quarter of the fiscal year covered by this report.

Executive Officers of the Registrant
(as of March 1, 1995)

Name	Age		Became AT&T Executive Officer on
Robert E. Allen*	60	Chairman of the Board and Chief Executive Officer	9-86
Richard S. Bodman	56	Senior Vice President, Corporate Strategy and Development	8-90
Harold W. Burlingame	54	Senior Vice President, Human Resources	9-86
Marilyn Laurie	55	Senior Vice President, Public Relations	2-87
Alex J. Mandl	51	Executive Vice President and Chief Executive Officer, Communications Services Group	8-91
William B. Marx, Jr.	55	Executive Vice President and Chief Executive Officer, Multimedia Products Group	7-89
Richard A. McGinn	48	Executive Vice President and Chief Executive Officer, Network Systems Group	10-94
Richard W. Miller	54	Executive Vice President and Chief Financial Officer	8-93
Victor A. Pelson**	57	Executive Vice President and Chairman Global Operations Team	3-89
Daniel C. Stanzione	49	President, AT&T Bell Laboratories	1-95
John D. Zeglis	47	Senior Vice President - General Counsel and Government Affairs	9-86

*Member of the Board of Directors and Chairman of the Executive and Proxy Committees.
**Member of the Board of Directors.

All of the above executive officers have held high level managerial positions with AT&T or its affiliates for more than the past five years, except Messrs. Bodman, Mandl and Miller who have been officers of AT&T since August 23, 1990, August 1, 1991 and August 9, 1993, respectively. Prior to joining AT&T, Mr. Bodman was President of Washington National Investment Corporation, an investment company, for more than five years. Prior to joining AT&T, Mr. Mandl was Chairman and Chief Executive Officer of Sea-Land Service, Inc., an ocean transportation and distribution services company, for four years and prior thereto held executive positions at CSX Corporation. Prior to joining AT&T, Mr. Miller was with Wang Laboratories, Inc. from 1989 through 1993, serving as President and Chief Operating Officer and later as Chairman, President and Chief Executive Officer.

Officers are not elected for a fixed term of office but hold office until their successors have been elected.

PART II

Items 5. through 8.

The information required by these items is included in pages 21 through 44 and on the inside back cover of the Company's annual report to security holders for the year ended December 31, 1994. The referenced pages of the Company's annual report to security holders have been filed as Exhibit 13 to this document. Such information is incorporated herein by reference, pursuant to General Instruction G(2).

Item 9. Changes in and Disagreements with Accountants on Accounting and Financial Disclosure.

There have been no changes in independent auditors and no disagreements with independent auditors on any matter of accounting principles or practices, financial statement disclosure, or auditing scope or procedure during the last two years.

PART III

Items 10. through 13.

Information regarding executive officers required by Item 401 of Regulation S-K is furnished in a separate disclosure in Part I of this report because the Company did not furnish such information in its definitive proxy statement prepared in accordance with Schedule 14A.

The other information required by Items 10 through 13 is included in the Company's definitive proxy statement dated February 28, 1995, on page 6, the first paragraph on page 7, the last paragraph on page 7 through page 13, and the last paragraph on page 24 through the first full paragraph on page 41. Such information is incorporated herein by reference, pursuant to General Instruction G(3).

PART IV

Item 14. Exhibits, Financial Statement Schedules, and Reports on Form 8-K.

(a) Documents filed as a part of the report:

(1) Financial Statements:

	Pages
Report of Management	*
Report of Independent Auditors	*
Statements:	
Consolidated Statements of Income	*
Consolidated Balance Sheets	*
Consolidated Statements of Cash Flows	*
Notes to Consolidated Financial Statements	*

*Incorporated herein by reference to the appropriate portions of the Company's annual report to security holders for the year ended December 31, 1994. (See Part II.)

(2) Financial Statement Schedules:

Separate financial statements of subsidiaries not consolidated and 50 percent or less owned persons are omitted since no such entity constitutes a "significant subsidiary" pursuant to the provisions of Regulation S-X, Article 3-09.

(3) Exhibits:

Exhibits identified in parentheses below, on file with the Securities and Exchange Commission ("SEC"), are incorporated herein by reference as exhibits hereto.

Exhibit Number	
(3)a	Restated Certificate of Incorporation of the registrant, dated January 10, 1989, Certificate of Change to Restated Certificate of Incorporation dated March 18, 1992, Certificate of Amendment to Restated Certificate of Incorporation dated June 1, 1992, and Certificate of Amendment to the Certificate of Incorporation dated April 20, 1994, (Exhibit 4B to Registration Statement No. 33-53765).
(3)b	By-Laws of the registrant, as amended May 18, 1994.
(4)	No instrument which defines the rights of holders of long term debt, of the registrant and all of its consolidated subsidiaries, is filed herewith pursuant to Regulation S-K, Item 601(b)(4)(iii)(A). Pursuant to this regulation, the registrant hereby agrees to furnish a copy of any such instrument to the SEC upon request.
(10)(iii)(A)1	AT&T Short Term Incentive Plan as amended March, 1994.
(10)(iii)(A)2	AT&T 1987 Long Term Incentive Program as amended July 17, 1989 (Exhibit (10)(iii)(A)2 to Form SE dated March 24, 1993, File No. 1-1105).
(10)(iii)(A)3	AT&T Senior Management Individual Life Insurance Program dated January 1, 1987 (Exhibit (10)(iii)(A)1 to Form SE, dated March 25, 1987, File No. 1-1105) and as revised December 1, 1994.

Exhibit Number	
(10)(iii)(A)4	AT&T Senior Management Long Term Disability and Survivor Protection Plan dated February 23, 1984 (Exhibit (10)(iii)(A)1 to Form SE, dated February 21, 1986, File No. 1-1105).
(10)(iii)(A)5	AT&T Senior Management Financial Counseling Program dated December 29, 1994.
(10)(iii)(A)6	AT&T Deferred Compensation Plan for Non-Employee Directors, as amended December 15, 1993 (Exhibit (10)(iii)(A)6 to Form 10-K for 1993, File No. 1-1105).
(10)(iii)(A)7	AT&T Directors Individual Life Insurance Program dated January 1, 1987 (Exhibit (10)(iii)(A)3 to Form SE, dated March 25, 1987, File No. 1-1105).
(10)(iii)(A)8	AT&T Plan for Non-Employee Directors' Travel Accident Insurance (Exhibit (10)(iii)(A)8 to Form 10-K for 1990, File No. 1-1105).
(10)(iii)(A)9	Extract from AT&T (formerly Bell System) Management Pension Plan regarding limitations on and payments of pension amounts which exceed the limitations contained in The Employee Retirement Income Security Act, with amendments effective October 1, 1985 (Exhibit (10)(iii)(A)2 to Form SE, dated February 21, 1986, File No. 1-1105).
(10)(iii)(A)10	AT&T Non-Qualified Pension Plan, (with amendments effective June 1, 1988) (Exhibit 10(iii)(A)10 to Form SE, dated March 26, 1990, File No. 1-1105).
(10)(iii)(A)11	AT&T Senior Management Incentive Award Deferral Plan, as amended January 20, 1994 and March 25, 1994.
(10)(iii)(A)12	AT&T Mid-Career Hire Program revised effective January 1, 1988, including AT&T Mid-Career Pension Plan, as amended May 15, 1985 (Exhibit (10)(iii)(A)4 to Form SE, dated March 25, 1988, File No. 1-1105).
(10)(iii)(A)13	AT&T 1984 Stock Option Plan, as modified December 19, 1984 (Exhibit 10(t) to Form SE, dated February 27, 1985, File No. 0-13247).
(10)(iii)(A)14	Form of Indemnification Contract for Officers and Directors (Exhibit (10)(iii)(A)6 to Form SE, dated March 25, 1987, File No. 1-1105).
(10)(iii)(A)15	Pension Plan for AT&T Non-Employee Directors revised February 20, 1989 (Exhibit (10)(iii)(A)(15) to Form 10-K for 1993, File No. 1-1105).

Exhibit Number	
(10)(iii)(A)16	AT&T Senior Management Basic Life Insurance Program (Exhibit (10)(iii)(A)16 to Form 10-K for 1990, File No. 1-1105).
(10)(iii)(A)17	Form of AT&T Benefits Protection Trust Agreement (Exhibit (10)(iii)(A)17 to Form SE, dated March 25, 1992, File No. 1-1105).
(10)(iii)(A)18	Employment Agreement between American Telephone and Telegraph Company and Alex J. Mandl dated August 1, 1991 (Exhibit (10)(iii)(A) 18 to Form 10-K for 1993, File No. 1-1105).
(12)	Computation of Ratio of Earnings to Fixed Charges.
(13)	Specified portions (pages 21 through 44 and the inside back cover) of the Company's Annual Report to security holders for the year ended December 31, 1994.
(21)	List of subsidiaries of AT&T.
(23)	Consent of Coopers & Lybrand L.L.P.
(24)a	Powers of Attorney executed by officers and directors who signed this report.
(24)b	Board of Directors' Resolution.
(27)	Financial Data Schedule.

AT&T will furnish, without charge, to a security holder upon request a copy of the annual report to security holders and the proxy statement, portions of which are incorporated herein by reference thereto. AT&T will furnish any other exhibit at cost.

(b) Reports on Form 8-K:

Forms 8-K dated October 26, 1994, December 8, 1994, December 13, 1994 and October 26, 1994, as amended (filed December 27, 1994).

REPORT OF INDEPENDENT AUDITORS

To the Shareowners of AT&T Corp.:

Our report on the consolidated financial statements of AT&T Corp. and subsidiaries has been incorporated by reference in this Form 10-K from page 29 of the 1994 Annual Report to the Shareowners of AT&T Corp. In connection with our audits of such financial statements, we have also audited the related consolidated financial statement schedules listed in the index on page 18 of this Form 10-K.

In our opinion, the consolidated financial statement schedules referred to above, when considered in relation to the basic financial statements taken as a whole, present fairly, in all material respects, the information required to be included therein.

As discussed in our report referred to above and in Note 2 to the consolidated financial statements, in 1993 the Company changed its methods of accounting for postretirement benefits, postemployment benefits and income taxes.

COOPERS & LYBRAND L.L.P.

1301 Avenue of the Americas
New York, New York
January 24, 1995

AT&T CORP.
AND ITS CONSOLIDATED SUBSIDIARIES

SCHEDULE II--VALUATION AND QUALIFYING ACCOUNTS

(Millions of Dollars)

COL. A	COL. B	COL. C		COL. D	COL. E
		Additions			
Description	Balance at Beginning of Period	(1) Charged to Costs and Expenses	(2) Charged to Other Accounts	Deductions (a)	Balance at End of Period
Year 1994					
Allowances for doubtful accounts (b)	$1,225	$1,929	$59	$1,753	$1,460
Reserves related to business restructuring and facility consolidation (d)	$1,440	$ (53)	$(28)	$ 465	$ 894
Deferred tax asset valuation allowance ...	$ 212	$ --	$(34)	$ --	$ 178
Year 1993					
Allowances for doubtful accounts (b)	$1,013	$1,665	$66(c)	$1,519	$1,225
Reserves related to business restructuring, including force and facility consolidation (d)	$2,006	$ 416	$ 5	$ 987(e)	$1,440
Deferred tax asset valuation allowance ...	$ 212	$ --	$--	$ --	$ 212

The Notes on Sheet 2 are an integral part of this Schedule.

AT&T CORP.
AND ITS CONSOLIDATED SUBSIDIARIES

SCHEDULE II--VALUATION AND QUALIFYING ACCOUNTS

(Millions of Dollars)

COL. A	COL. B	COL. C		COL. D	COL. E
		Additions			
Description	Balance at Beginning of Period	(1) Charged to Costs and Expenses	(2) Charged to Other Accounts	Deductions (a)	Balance at End of Period
Year 1992					
Allowances for doubtful accounts (b)	$1,049	$1,983	$31(c)	$2,050	$1,013
Reserves related to business restructuring, including force and facility consolidation (d)	$2,792	$ 64	$ 8	$ 858	$2,006

(a) Amounts written off as uncollectible, payments and reversals.
(b) Includes allowances for doubtful accounts on long-term receivables of $209, $185 and $153 in 1994, 1993 and 1992, respectively (included in Finance receivables in the Consolidated Balance Sheets).
(c) Amounts previously written off which were credited directly to this account when recovered.
(d) Included primarily in Other current liabilities and in Other liabilities in the Consolidated Balance Sheets.
(e) Upon adoption in 1993 of Statement of Financial Accounting Standards No. 112, "Employers' Accounting for Postemployment Benefits," $412 of business restructuring reserves established before 1993 were reclassified to postemployment benefit liabilities.

AT&T Corp.
AND ITS CONSOLIDATED SUBSIDIARIES

SCHEDULE IX - SHORT-TERM DEBT

(Millions of Dollars)

Col. A	Col. B			Col. C		
	Amount at December 31			Weighted Average Interest Rate		
	1994	1993	1992	1994	1993	1992
Notes Payable:						
Commercial Paper...	$10,777	$ 8,761	$ 6,053	4.7%	3.3%	3.8%
Other Notes.......	324	231	281	9.7%	10.0%	10.9%
Current Portion of long-term lease obligations.........	30	52	108			
Current portion of long-term debt......	2,535	2,019	1,249			
	$13,666	$11,063	$ 7,691			

	Amount for the Year					
	1994	1993	1992			
Average amounts of Notes Payable outstanding during the year..........	$ 8,400	$ 8,010	$ 5,117	4.6%(b)	3.7%(b)	4.4%(b)
Maximum amounts of Notes Payable at any month end during the year....	11,357	$ 9,959	$ 6,334			

NOTE: In future years, the information contained herein will be added to the Company's Consolidated Financial Statement Footnotes included in the Company's Annual Report to Shareowners.

(a) See Note (5) to the Consolidated Financial Statements
(b) Computed by dividing the average face amount of notes payable into the aggregate related interest expense.

SIGNATURES

Pursuant to the requirements of Section 13 or 15(d) of the Securities Exchange Act of 1934, the registrant has duly caused this report to be signed on its behalf by the undersigned, thereunto duly authorized.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

By S. L. Prendergast
Vice President and Treasurer

March 24, 1995

Pursuant to the requirements of the Securities Exchange Act of 1934, this report has been signed below by the following persons on behalf of the registrant and in the capacities and on the date indicated.

Principal Executive Officer:

Robert E. Allen	Chairman of the Board

Principal Financial Officer:

Richard W. Miller	Executive Vice President and Chief Financial Officer

Principal Accounting Officer:

Maureen B. Tart	Vice President and Controller

Directors:

Robert E. Allen
M. Kathryn Eickhoff
Walter Y. Elisha
Philip M. Hawley
Carla A. Hills
Belton K. Johnson
Drew Lewis
Donald F. McHenry
Victor A. Pelson
Donald S. Perkins
Henry B. Schacht
Michael I. Sovern
Franklin A. Thomas
Joseph D. Williams
Thomas H. Wyman

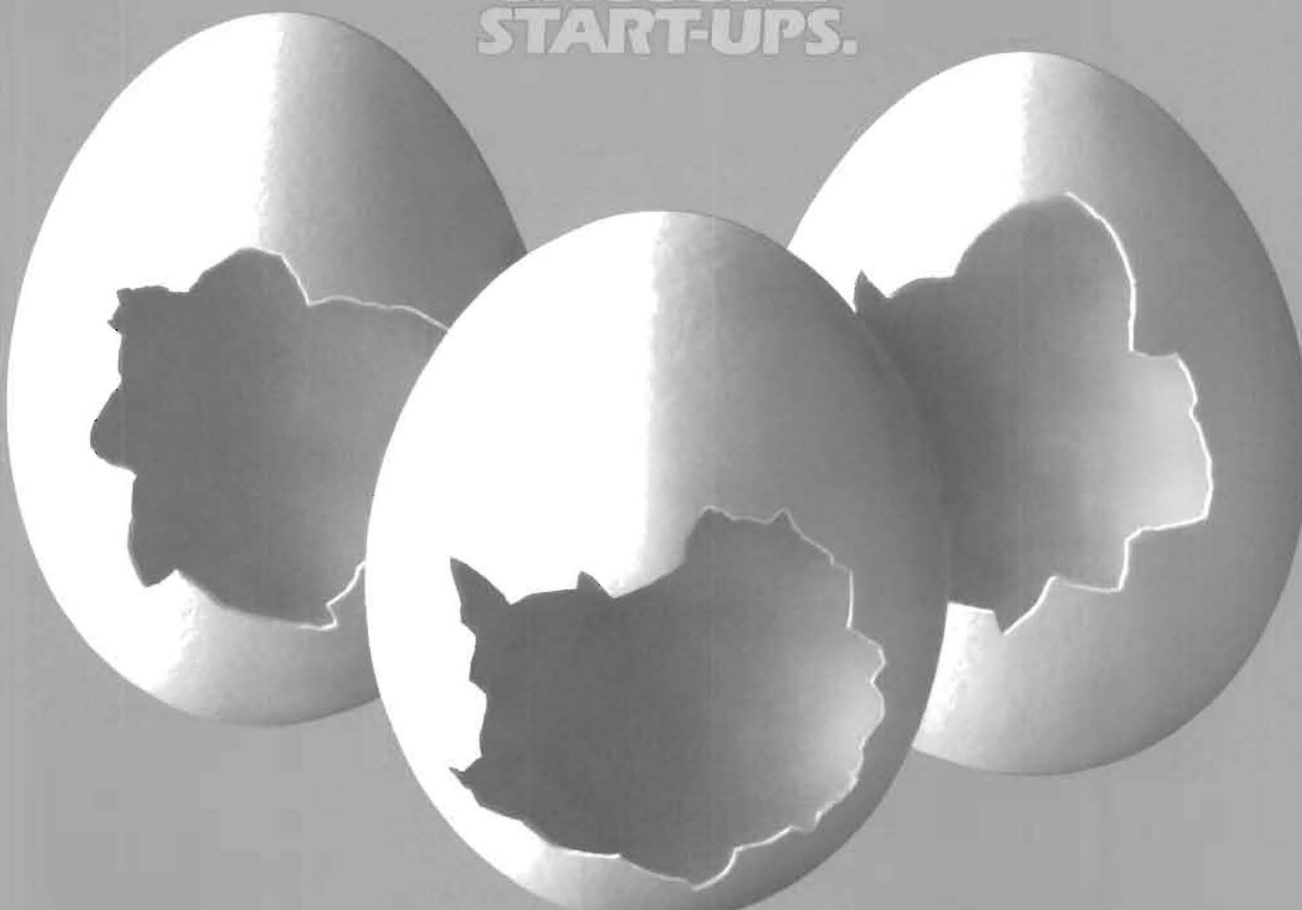
By S. L. Prendergast
(attorney-in-fact)*

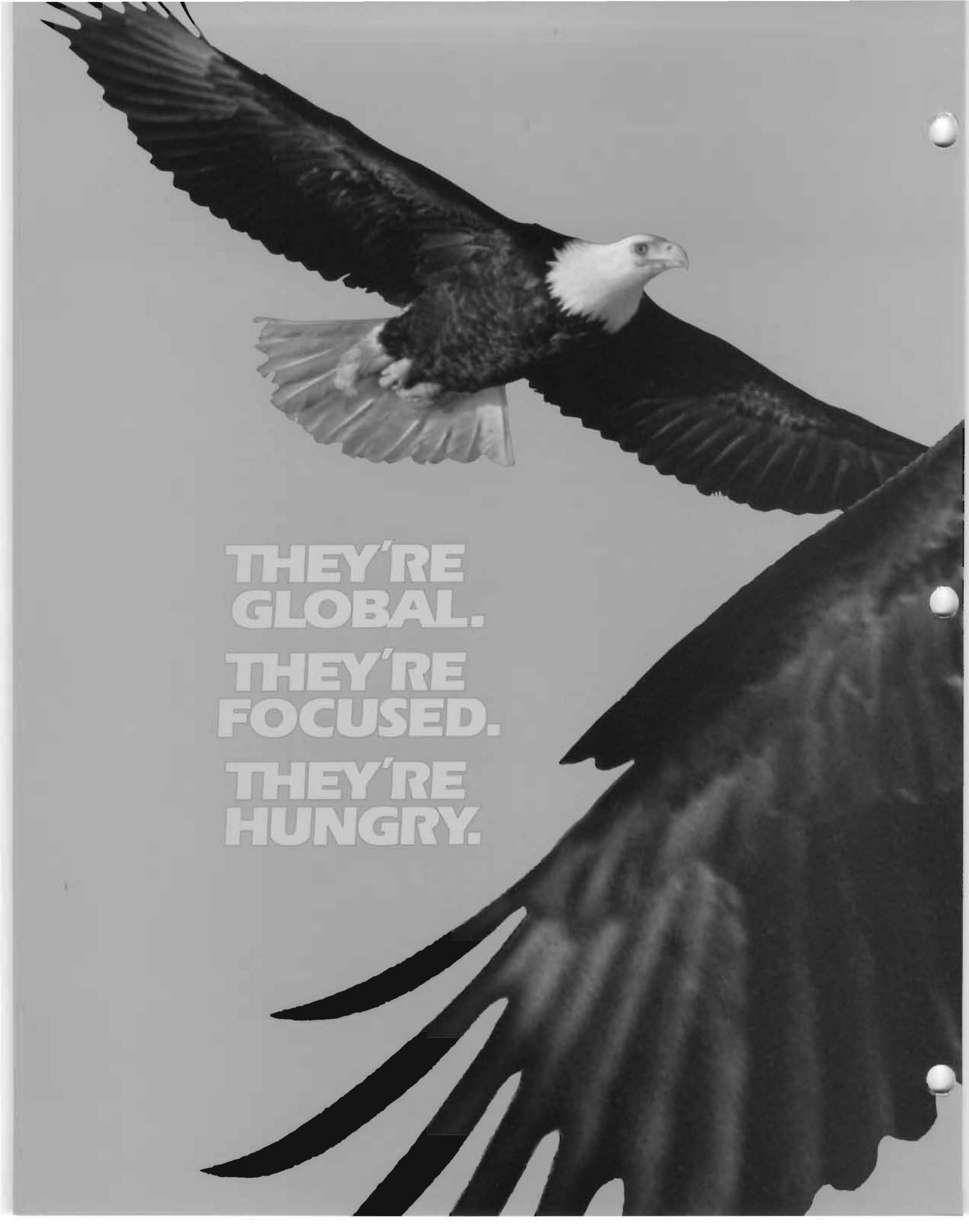
March 24, 1995

AT&T

1995 ANNUAL REPORT

WE'RE HATCHING THREE UNUSUAL START-UPS.




THEY'RE GLOBAL.
THEY'RE FOCUSED.
THEY'RE HUNGRY.

■ We are dedicated to being the world's best at bringing people together – giving them easy access to each other and to the information and services they want and need – anytime, anywhere.

The current integrated AT&T provides communications services and products, as well as network equipment and computer systems, to businesses, consumers, communications services providers and government agencies. Our Worldwide Intelligent Network carries more than 200 million voice, data, video and facsimile messages every business day. AT&T Bell Laboratories engages in basic research as well as product and service development. AT&T also offers a general-purpose credit card and financial and leasing services. We do business in some 200 countries.

1995 Financial Highlights

■ **REVENUES WERE AT RECORD LEVELS FOR 1995.**

■ **RESTRUCTURING AND OTHER CHARGES REDUCED NET INCOME BY $5 BILLION.**

■ **WE MADE STRATEGIC INVESTMENTS IN OUR FUTURE.**

DOLLARS IN MILLIONS (EXCEPT PER SHARE AMOUNTS)	1995	1994	PERCENT CHANGE
REVENUES			
Telecommunications services	**$ 47,277**	$ 44,600	6.0 %
Products and systems	**22,412**	21,161	5.9
Rentals and other services	**6,189**	6,216	(0.4)
Financial services and leasing	**3,731**	3,117	19.7
Total revenues	**$ 79,609**	$ 75,094	6.0 %
INCOME			
Operating income	**$ 1,215**	$ 7,949	(84.7)%
Net income	**139**	4,710	(97.1)
PER COMMON SHARE			
Net income	**$ .09**	$ 3.01	(97.0)%
Dividends declared	**1.32**	1.32	-
Stock price at end of year	**64.75**	50.25	28.9
OTHER INFORMATION			
Cash provided by operations	**$ 9,690**	$ 9,046	7.1 %
Cash used for investing activities	**11,953**	9,845	21.4
Total assets at year-end	**88,884**	79,262	12.1
Total employees at year-end	**299,300**	304,500	(1.7)

Contents

AT&T will separate into three stand-alone companies

each focused on a major segment of the growing global information industry. This restructuring is designed to make our businesses more responsive to customers and more agile competitors in their markets.

THE NEW AT&T

Consumer services

Business services

Wireless services

On-line services

International services

AT&T Laboratories

LUCENT TECHNOLOGIES

Network systems

Microelectronics

Business communications systems

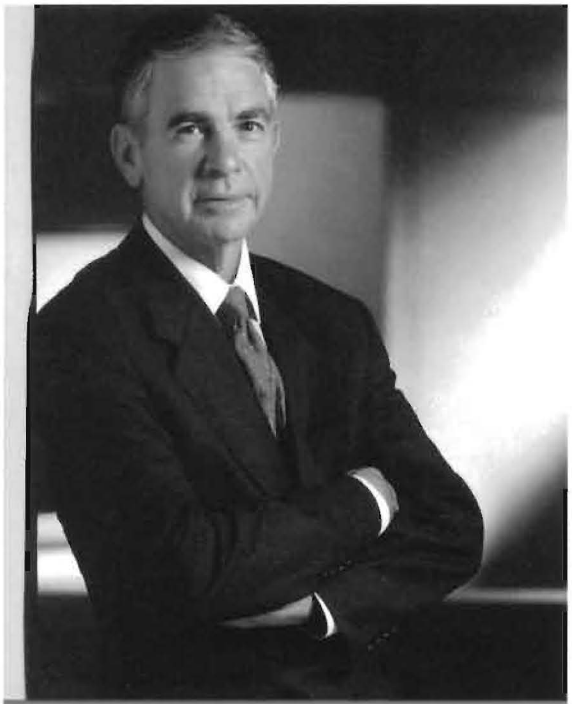
Consumer products

Bell Laboratories

NCR

Computer systems and services

It's a new world.



> "Plans in themselves don't create value. Action does. So we're moving quickly to put our restructuring plan into effect."
>
> ROBERT E. ALLEN, CHAIRMAN

It was a year of record sales. It was also a year when we took $5 billion in charges against earnings to prepare ourselves for the future.

It was a year that saw AT&T reap the benefits of the McCaw merger with a 39 percent increase in cellular customers and acquisition of key personal communications services licenses.

It was a year that saw us make the first forays into the $90 billion U.S. local services market and a year when we entered previously closed domestic service markets in the United Kingdom and India.

It was a year when we continued to globalize the business through communications infrastructure sales in China, the Philippines, Saudi Arabia and other countries.

It was a year when we opened a vital new dimension of our business by launching a series of Internet-based services.

But more than anything else, 1995 will be remembered for an announcement we made early on the morning of September 20.

That was the day we announced plans to separate AT&T into three independent, publicly held corporations.

The new AT&T will be focused on our core strength of communications services. The second company, Lucent Technologies, will offer communications systems and technology, and the third, NCR, will offer computer systems and services. We also announced our intent to sell AT&T Capital Corp., our financing and leasing arm.

Our decision to go this route reflects our determination to shape and lead the dramatic changes that have already begun in the worldwide market for communications and information services – a market that promises to double in size before we ring in the new century. It was, as well, a determination to act while our position is strong.

We operate in a global information industry grown used to a diet of constant change, where multibillion-dollar deals between once unthinkable partners have become almost commonplace.

1995 will be remembered for an announcement we made September 20.

But on September 20, even the most knowledgeable business journalists and financial analysts allowed themselves a moment of stunned surprise.

Then they got down to looking at the details of what we were doing and why.

We're reinventing AT&T...again.

By the close of that business day the financial markets had delivered an initial endorsement. AT&T's stock price jumped from $57-5/8 to $63-3/4. In other words, the stock market value of your company increased by $10 billion in one day. Thanks to a strong stock market and our initiative, our stock price closed at $64-3/4 as the year ended.

This investor reaction reflects confidence in the strategic thinking behind this restructuring. Three independent corporations will be able to go after the exploding opportunities of the industry faster than they could as parts of a much larger corporation.

The three new companies we'll launch at the end of the year will be free to pursue the best interests of their customers without bumping into each other in the marketplace. They are designed to be fast and focused, with a capital structure suited to their individual industries.

But let me reassure you, neither your board of directors nor I has lost sight of the fact that Wall Street's enthusiasm is for a plan. And plans in themselves don't create value. Action does. So we're moving quickly to put our restructuring plan into effect. Our actions are motivated by the creation of long-term value, not short-term surges in value.

We intend to do all of this in only 15 months. I am immensely proud of the job AT&T people are doing in keeping to a rigorous schedule as they move this complex process along. They understand that the changes we're making must be transparent to our customers. We cannot and will not in any way let up on our customer commitments or financial targets.

The value of your company increased by $10 billion in one day.

But our speed in moving ahead reflects the realities of a fast-changing world that won't wait for any company to catch up. Our decision to restructure was driven by seismic shifts in customer needs, technology and public policy.

Make no mistake about it, these are fundamental changes. They offer unprecedented new opportunities for us, but they also carry the threat of washing away any company that chooses to cling to the status quo and ignore the power of these changing conditions.

Technology is rapidly driving down the cost of basic communications and opening the door for widespread use of advanced information services, increasingly making use of the Internet. It's driving the need for new global alliances as well, putting us in direct competition with companies we barely knew about 10 years ago.

The new companies will be free to pursue the best interests of their customers.

Changes in public policy are beginning to open up monopoly telecommunications markets to competition, in the United States and many other parts of the world.

The cause of competition turned a major corner in February 1996 when the U.S. Congress passed its long-awaited telecommunications reform bill. This ends the local telephone companies' legally protected monopolies in local service and frees AT&T to enter the enormous, untapped local exchange markets. Conversely, Bell companies will be able to offer long distance service in their home territories when – and only when – their local monopolies are open to genuine competition. We'll be working closely with national and state regulatory agencies as they set rules for implementing the new law.

By prying open the local monopolies, this public policy change creates a competitive market for end-to-end services. Customers can choose winners and losers based on who offers the best services and prices. In that kind of arena, we're confident of our success.

Customers, large and small, will increasingly expect communications companies to provide combinations of services tailored to their individual needs at competitive prices. Those services will range from familiar long distance and local service to wireless communications, advanced information services and electronic commerce. We're preparing to be the leader in making this happen.

Each of the new companies we're creating will start life with the size and market presence to be a leader in this swirling information marketplace.

We've journeyed from the pioneering days of telephony...

The new AT&T communications services company represents a business with annual sales of about $51 billion. It will include all of our services businesses and be the world market leader on its first day in business.

Lucent Technologies, the new systems and technology company, includes Network Systems, Bell Labs and most of our equipment business. It expects to have $21 billion a year in sales to start. Details on the systems and technology company are contained in a registration statement filed February 5, 1996 with respect to the planned initial public offering of shares in that company.

The new computer company will be a trimmed down version of our current computer business. We've just changed the name back to NCR to capitalize on the global customer recognition that name holds. NCR can use that recognition to its advantage after the spin-off is complete.

Like many others in the computer industry, NCR has had some hard sledding over the past few years and I'm disappointed that we haven't been able to make this merger work. But this business, with $8 billion a year in sales, has an ambitious turnaround plan in place. It's our intention to spin this company off to our shareowners at the end of this year after taking appropriate steps to move NCR into a position of profitability.

We also plan to sell off our remaining interest in AT&T Capital Corporation. That company today is the largest publicly owned equipment leasing and financing company in the U.S. and is building a worldwide presence. We plan to continue to use AT&T Capital as a preferred supplier, as do the other new companies, but we'll use the proceeds from the sale to retire debt and otherwise invest in all three companies.

Each will start life with the size and market presence to be a leader.

You'll find profiles of each of the three new companies inside this annual report. I encourage you to take time to read them.

These companies will differ. But they will share a common heritage. Each company inherits a legacy of values from the AT&T we've all known over the years. Those values include a deep commitment to customers and dedication to quality principles.

We have always been committed to supporting our communities, as well. For example, we announced we would spend $150 million over the next five years to help America's schools make better use of information technology. The AT&T Learning Network will offer Internet access to every elementary and secondary school in America along with other forms of communications technology. We will also offer teachers technology mentors and support so they can use this technology effectively in teaching children.

The men and women of AT&T have made us the team to beat.

Perhaps most important, the three new companies share a history of looking to the values of Our Common Bond as a guide to doing business. One of those values is Respect for Individuals. We are making an intense effort to live that value now as we go through the difficult process of reducing our skilled and capable work force by about 40,000 jobs, or about 13 percent.

Every one of our businesses looked long and hard at staffing needs for the new companies. The employment levels we decided on represent the number of people needed to win in an increasingly competitive, cost-sensitive set of businesses.

Good and talented people will be leaving us because they are not a match for our future needs and size. That can't be helped. But we are making sure that these people are treated with respect and dignity. They will also have a package of financial benefits and support services to help them into new careers.

Major change always comes with some degree of sacrifice, and AT&T has been no stranger to major change over the last 15 years. Most of that change has been overwhelmingly positive.

The restructuring we're doing now has to be seen in the context of a continuing journey for AT&T that's brought us from the pioneering days of telephony into a new world of information technology. You don't make a journey of this magnitude without hitting some bumps along the way. And you certainly don't do it without making major changes.

In the 10-plus years since divestiture, we've converted from a predominantly analog to an all-digital network primed to capitalize on the

...into a new world of information technology.

emerging market for advanced services. We've taken a business that was exclusively domestic and made major strides in becoming a truly global corporation.

The men and women of AT&T have embraced the lessons of competition and made us the team to beat in some of the world's most competitive markets. As the trend towards competition opens up in new areas of the global telecommunications market, AT&T people around the world are ready to move in with enthusiasm and confidence.

We know there are no more important skills for us than continuously learning and rapidly adapting in this vibrant industry. In closing, I think it's worth pointing out that investors in AT&T have done well by our decade-plus of major changes since divestiture.

When you add in dividends and stock price increases, since January 1984 the value of your investment in AT&T has grown 19 percent annually on an average compounded basis. Not bad, but we're anxious to prove what we can do in the future.

As we prepare to launch the new AT&T, the past, to borrow a phrase, is prologue. Despite the pride we take in where we've been, our excitement comes from where we're going.

Robert E. Allen
Chairman
February 11, 1996

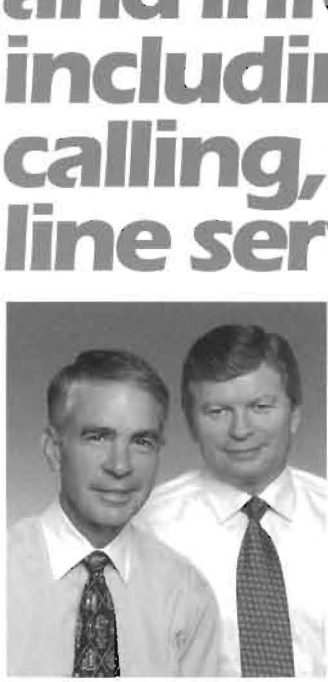
What to expect as an AT&T shareowner

■ As each of the new companies is spun off from AT&T you'll receive shares in that company. The companies are likely to be spun off at different points late in 1996. The number of shares you'll receive for each AT&T share you own has not yet been determined. Your current AT&T shares will then represent shares in the "new AT&T."

■ After the companies separate, future dividends will be declared by each company's board of directors. No one can predict their actions or commit them to a dividend policy. However, we understand your expectations as a shareowner and the importance of the dividend to you.

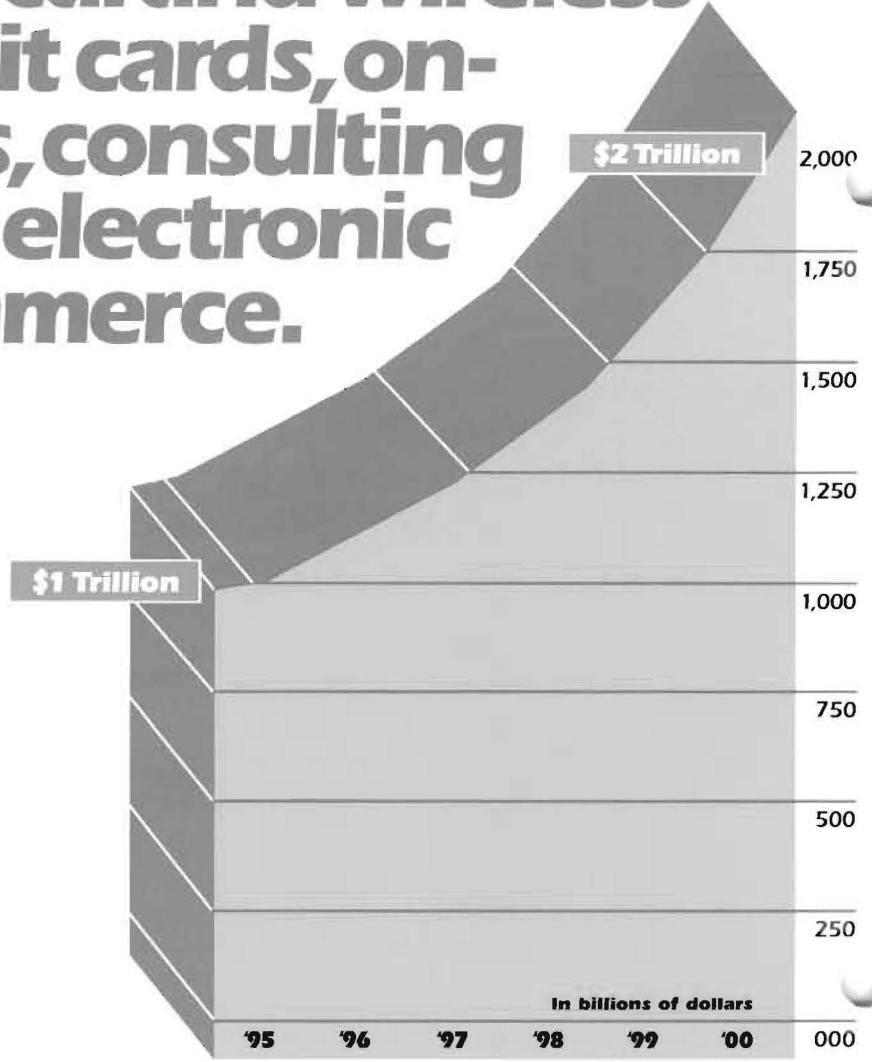
■ As 1996 progresses, we'll continue to report on developments in quarterly reports. We've also created a toll-free number you can call to hear updated information or to ask questions: 800 756-8500.

Our future is a long distance from long distance. We're moving to a full menu of communications and information services including local and wireless calling, credit cards, on-line services, consulting and electronic commerce.



BOB ALLEN, CHAIRMAN AND CHIEF EXECUTIVE OFFICER (LEFT)

ALEX MANDL, PRESIDENT AND CHIEF OPERATING OFFICER



Growth of the global communications and information services market: Estimated at $1 trillion in 1995, growing to $2 trillion by the year 2000.

1995 THE NEW AT&T*	
Revenues	$51 billion
Assets	$56 billion
Employees	127,000

*Revenues, assets and employees represent those the company would have shown at year-end had it existed as a separate company (see the Financial Review section for more details). The number of employees listed does not reflect the total impact of previously announced work force reductions.

KEY ASSETS

The world's most sophisticated network.

We continue to set – and quickly break – records for the number of calls handled by our network, and we complete those calls with better sound quality than anyone else. Our network is getting more useful to customers every day as we build in features like Internet access, dial-up videoconferencing and business collaboration tools.

A widely recognized and trusted brand.

AT&T tops *Advertising Age's* most recent list of the Top 200 Brands in the U.S. and leads the list of the 20 best companies identified by U.S. consumers in a recent Harris Poll. Recognition outside the U.S. is climbing steadily as we expand our presence.

A base of more than 90 million customers.

As we expand into new services like cellular and paging, electronic commerce and information access, we have the customer relationships, marketing channels and customer service capabilities to grow revenues cost-effectively.

A SAMPLE OF OUR SERVICES

FOR CONSUMERS

1 800 CALL ATT®
AT&T True Reach℠ International savings
AT&T True Reach℠ Savings on U.S. calling
AT&T Universal Card
Language Line® interpretation
Telecommunications Relay Service for the Deaf
True Choice® calling card
True Connections℠ 500 service
True Messages℠ voice messaging
True Ties® personal 800 service
USADirect® Service for calling back to the U.S.
World Connect® Service for travelers

FOR BUSINESSES

ACCUNET® private line digital services
AT&T Network Notes℠ applications hosting
AT&T WorldNet℠ Internet access services
AT&T WorldSource℠ global voice and data services
EasyLink Services® family of messaging services
InterSpan® data services
Megacom® services for large volumes of incoming and outgoing calls
MultiQuest® 900 Services
NetWare Connect Service℠ for connecting local area networks
Small Business Advantage volume calling plan
TeleConferencing Service
WorldWorx℠ voice, video and data teleconferencing

AT&T

The units described in this section will retain the AT&T brand after the restructuring is completed.

Business	Markets	
Consumer services	Provides interstate and intrastate long distance calling, voice-messaging and language translation services to 80 million U.S. consumers. The AT&T Universal Card, a combination credit and calling card, serves 22 million members.	
Business services	Offers interstate and intrastate long distance, data services and global messaging services to small and large businesses in the U.S. AT&T Solutions unit provides consulting, systems integration and outsourcing services, targeting a $50 billion market that's growing at double-digit rates annually.	
Wireless services	AT&T Wireless Services, formerly McCaw Cellular Communications, offers wireless telecommunications service in more than 100 cities. The unit also provides advanced messaging and wireless data services. It is expanding rapidly both in the U.S. and around the world.	
On-line services	According to many analysts, the Internet already connects 30 million users worldwide and their ranks are increasing 10 percent a month. Selling the tools to give consumers and businesses easy access to the information, entertainment and electronic commerce opportunities it offers is expected to spawn a $13 billion industry by the year 2000.	
International services	Offers international long distance to and from the U.S. and global communications services to travelers and multinational companies outside the U.S. Has a local presence in key markets around the world to capitalize on opportunities to provide communications services in countries that are opening their local markets to competition.	
AT&T Laboratories	AT&T Laboratories is being formed from the portion of Bell Laboratories that performs research and development supporting communications services and brings with it a heritage of innovation. Its staff of 1,200 will focus on network-based technologies to meet current and evolving customer needs for new services.	

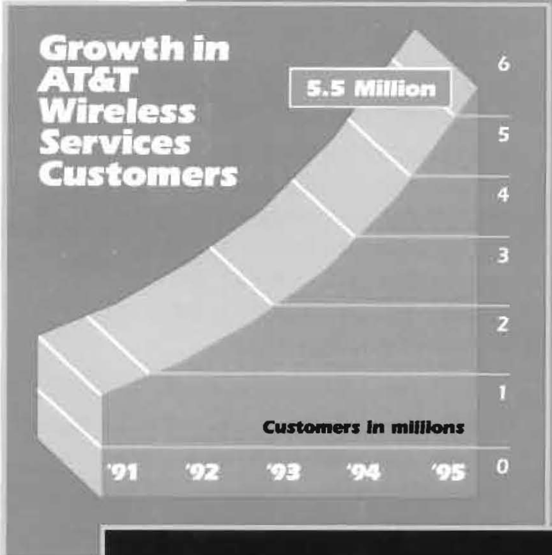
	Competitive strengths
Thanks to a patented Real Time Network Routing system, the AT&T network can automatically route calls around high-traffic areas or cable cuts, using any one of 134 possible routes.	■ Greater long distance market share than all other competitors. Long distance and credit card units won America's highest quality honor, the Malcolm Baldrige National Quality Award, in 1994 and 1992, respectively. Our highly skilled people handle four million customer interactions every day.
Many of our sales representatives operate from "virtual offices" so they can serve customers anytime, anywhere.	■ Rated #1 in eight of 10 service categories in 1995 CIT Research Ltd. study of 1,000 communications managers. Rated #1 in leased-line and packet-switching categories in *Data Communications International* survey of 4,500 readers worldwide.
Customers are calling for more wireless communications. More than 1.5 million new customers signed up for cellular and paging services from our wireless unit in 1995.	■ Doubled its wireless service area to more than 200 million potential customers in 1995 with acquisition of 21 personal communications services (PCS) licenses in U.S. Federal Communications Commission auction. Now covers 23 of the top 25 U.S. markets.
Through the AT&T Learning Network℠, we've pledged $150 million over the next five years to give U.S. schools access to the Internet and other services.	■ We developed much of the technology that makes the Internet possible and we're well positioned to bring its benefits to our 90 million customers. In 1995 we introduced services that offer information and entertainment content and easy dial-up and navigational tools. We can also help businesses set up electronic storefronts on the Internet.
AT&T USADirect® Service gives travelers and local residents in 25 countries the ability to reach an AT&T operator who speaks their language.	■ International calling agreements with 200 telecommunications companies worldwide. Ability to give travelers access to AT&T's network and billing in some 100 countries. In 1995 obtained a license to offer international services to business customers in the United Kingdom.
AT&T researchers have developed a system enabling people to browse the Internet's World Wide Web using spoken commands.	■ Focuses on basic research as well as on the application of technology to customer and business needs. Expertise spans a wide range of technologies including mathematics, computer science, software development, network analysis and design, and systems technologies that support existing and emerging services.

GROWTH OPPORTUNITIES

The wireless services market is growing steadily and we rank first in market share.

The global market for wireless services is about $40 billion today and is expected to reach $125 billion over the next decade. People want to call people, not places. They want access to the information superhighway in the palms of their hands. Our acquisition this year of 21 licenses to offer personal communications services (PCS) – wireless services at yet another radio frequency – extends our potential reach to more than 80 percent of the U.S. population.

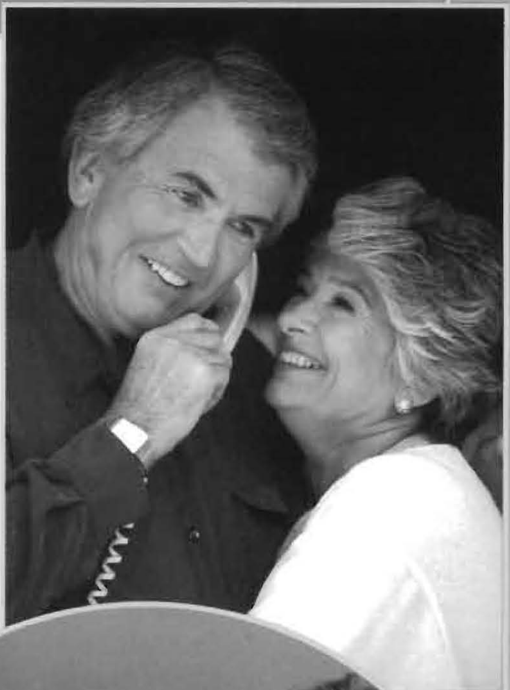
In 1995 we began marketing the wireless capabilities we acquired from McCaw Cellular Communications under the name AT&T Wireless Services.



The local telephone market represents a $90 billion growth opportunity.

Before long, customers throughout the U.S. will be able to choose a company to handle their local calls just as they now select one to complete their long distance calls. Our experience during the last two years in newly opened markets for local toll calls indicates that customers welcome competition. By the end of 1995, we had captured 15 percent of the business market for such calls.

In 1995 we announced our intent to offer local service, contingent upon the course of legislation and the economics of individual markets. We will offer local services either by reselling network capacity purchased from local providers or by building our own infrastructure.



We are uniquely positioned to make on-line services more accessible and useful to a wider audience.

Information and entertainment choices available electronically through the Internet and other computer networks are growing at a dizzying rate. Businesses and consumers are clamoring for time-saving navigational tools and for advancements that will make on-line information more secure and more interactive. Our technology expertise, corporate alliances and existing base of 90 million business and consumer customers position us to bring together a diversified group of information seekers and content providers.

In 1995 we launched AT&T Business Network, which serves up news and information from CNN, Dow Jones and others to small and home-based businesses; AT&T Easy World Wide Web Service, which provides hosting services; and Personal Online Services, which brings personalized and localized content services to consumers through the Internet.

The information services market outside the U.S. is expected to double to $2 trillion in the next 10 years.

The market for providing communications services to businesses outside the U.S. is strong and growing as multinational companies seek to do business as if all their operations resided at the same location. A number of countries are introducing competition for local services in response to customer demand for increased choices, improved quality and lower prices.

WorldPartners, the AT&T-sponsored alliance that offers global companies seamless communications services, extended its reach to 27 countries in 1995. We also expanded our global partnerships to pursue service opportunities in Brazil, India, Canada, Russia and Mexico.

Electronic commerce is changing the way businesses do business.

Financial markets already move $1 trillion a day using computer networks. Electronic payments are increasing 15 to 25 percent a year and the Internet is expected to handle more than $7 billion in on-line shopping transactions annually by the year 2000. We're helping businesses use our network as a delivery channel, create virtual stores on the Internet, and manage the security, customer service and billing challenges posed by such an environment.

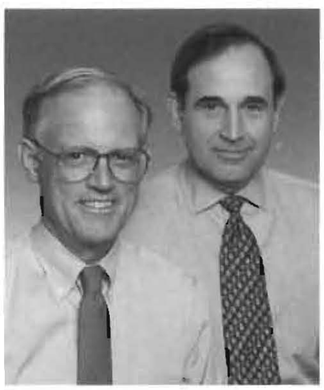
In 1995 we introduced tools to help businesses automate everything from handling information requests to managing ordering, payment and shipping processes. AT&T Universal Card Services is a recognized leader in electronic payments processing, transaction processing and customer service.

Customers want one-stop communications shopping and we can deliver a full line of services.

Consumer research indicates people want help managing their busy lives, support as they adopt new technologies, convenience in reaching others, and easy access to information and entertainment. We've reorganized to do just that, creating teams dedicated to specific customer segments. Their charge: identify more ways customers can benefit from their relationships with AT&T. Our reward: increased customer loyalty and greater network use.

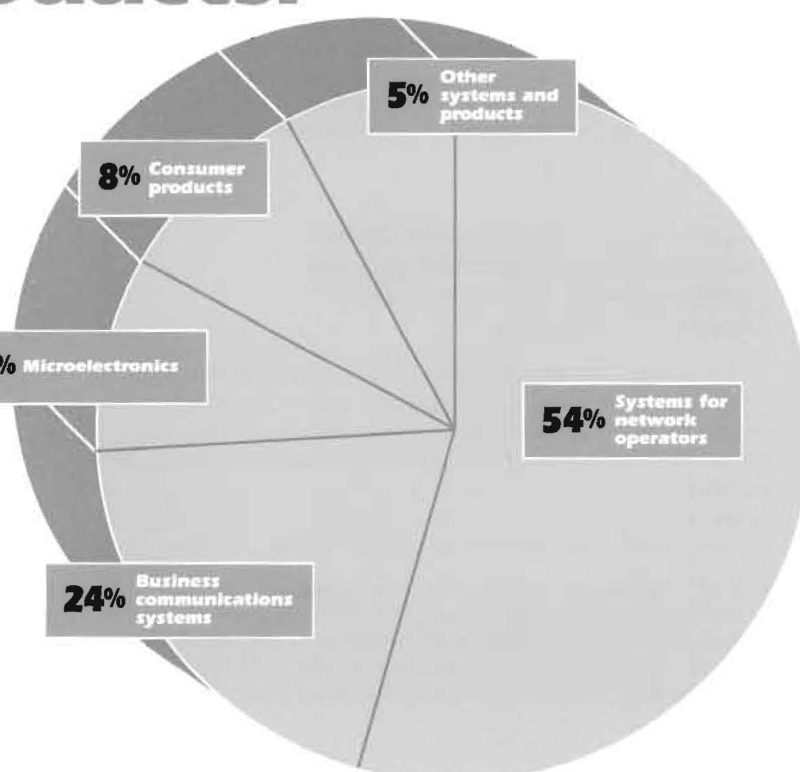
In 1995 we introduced a new one-stop shopping service for consumers that features a single customer service number–1 800 336-TRUE–for information on a variety of offers from paging services to electronic bill payment, as well as special pricing for our long distance customers.

Lucent Technologies is expected to emerge as a Fortune 40 company. It is one of the world's leading designers, developers and manufacturers of telecommunications systems, software and products.



HENRY SCHACHT, CHAIRMAN-DESIGNATE AND CHIEF EXECUTIVE OFFICER (LEFT)

RICHARD McGINN, PRESIDENT AND CHIEF OPERATING OFFICER



Sources of 1995 revenues

1995
LUCENT TECHNOLOGIES*

Revenues	**$21 billion**
Assets	**$20 billion**
Employees	**131,000**

**Revenues, assets and employees represent those the company would have shown at year-end had it existed as a separate company (see the Financial Review section for more details). The number of employees listed does not reflect the total impact of previously announced work force reductions.*

KEY ASSETS

Bell Laboratories, widely regarded as one of the world's foremost industrial research and development organizations.

Among its achievements since its inception in 1925: an average of one patent each business day, seven Nobel Prize winners, seven U.S. National Medals of Science and five National Medals of Technology. Its contributions include the transistor, the solar cell, the communications satellite, cellular telephony, electronic switching and the UNIX† operating system.

† Unix is a registered trademark licensed exclusively by Novell, Inc.

A global presence.

Lucent Technologies has offices or distributors in more than 90 countries or territories. Bell Labs has a presence in 13 countries.

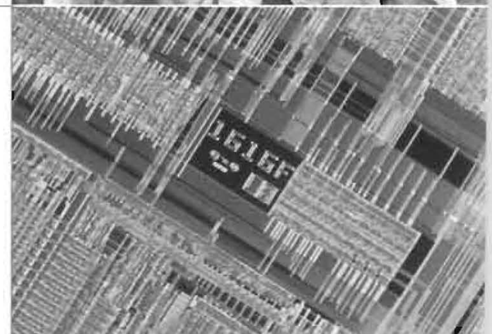
More than a hundred years of manufacturing experience.

During the past five years, our manufacturing practices have earned a Malcolm Baldrige National Quality Award, a Deming Prize and two Shingo Prizes for excellence in American manufacturing.

CORE MARKET	SHARE RANK
Switching	1 U.S.
Transmission	1 U.S.
Operations support software	1 World
Wireless networks	1 U.S.
Business communications	1 U.S.
Corded and cordless phones	1 U.S.
Answering systems	1 U.S.
Power supply systems	1 World
Digital signal processor chips	2 World

Lucent Technologies
Bell Labs Innovations

Our name was developed after extensive interviews with customers and other stakeholders. Lucent means "marked by clarity" or "glowing with light." The new logo is a bold, red, hand-drawn innovation ring.

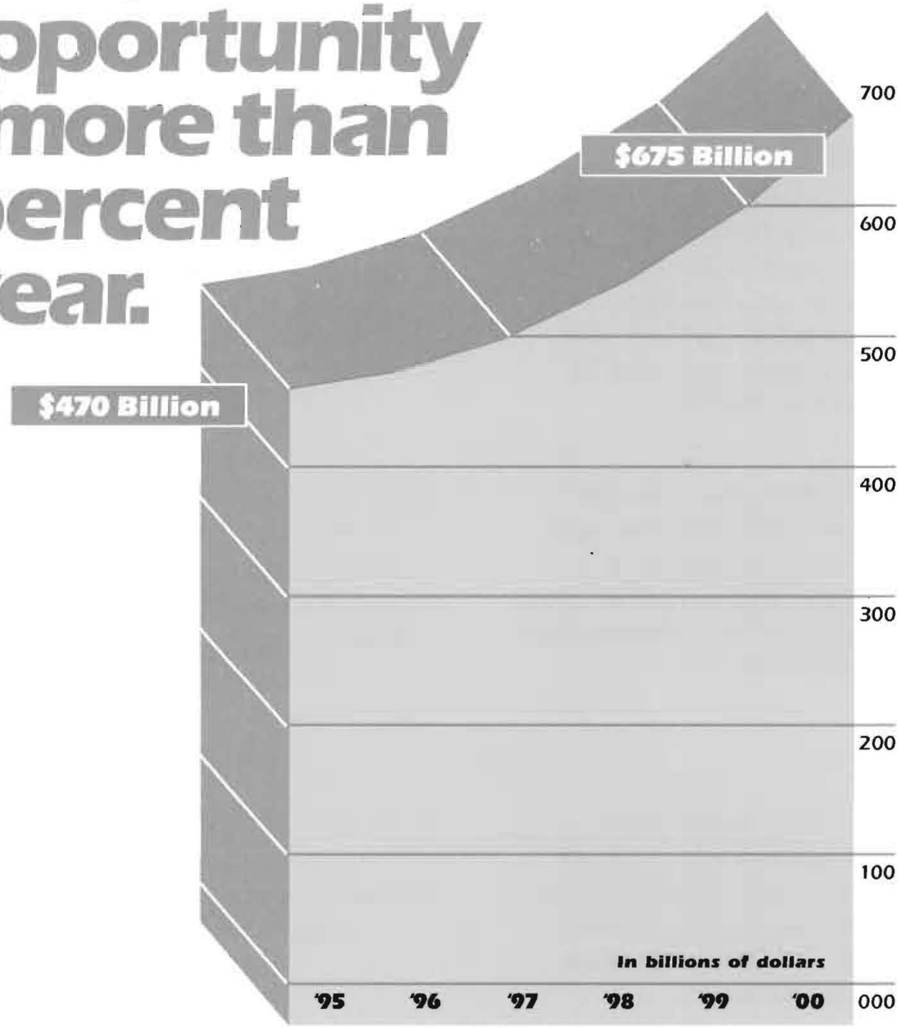
Business	Markets	
Network systems	Supplies network telecommunications systems, software and services to telephone companies around the world, the U.S. government, private communications network operators, cable companies and wireless service providers.	
Microelectronics	Produces high-performance integrated circuits, power systems and optoelectronic components for Lucent Technologies and other leading communications and computer manufacturers. During the last five years, sales to non-AT&T customers have shown double-digit growth rates.	
Business communications systems	Designs, manufactures, installs and services business telecommunications systems, including private branch exchanges, key systems, structured cabling and voice processing systems. Has provided engineering, installation, maintenance and support services to more than 1.5 million customer locations in more than 90 countries.	
Consumer products	Sells, services and leases telephones and other telecommunications devices through retailers representing 17,000 point-of-sale locations. Was the first in the industry to offer cordless telephones with 25-channel capability, which reduces interference. Sold 2.5 million Trimline® telephones in 1995. Offers a broad line of telephone answering systems and cellular products.	
Bell Laboratories	Focuses on several core technologies: software, digital signal processing, telecommunications networking technologies, microelectronics and photonics. Emphasizes areas offering Lucent Technologies' operating units a competitive advantage, such as increased transmission capacity, faster call processing, increased reliability and reduced network costs.	

Note: Rank orders listed refer to market share.

	Competitive strengths
This gaucho in Argentina's remote ranch lands now has access to telephone service, thanks to a wireless network that Network Systems played a key role in building.	■ Ranks #1 in U.S. public network infrastructure market, #2 worldwide. Flagship product, the 5ESS® 2000 Switch, has been installed in 49 countries and can provide any media–digital voice, data, video and wireless communications. According to data compiled in the U.S. Federal Communications Commission's Armis Report, it is the most reliable switch in the industry.
Microchips are the very heart of information age products and systems, and we offer a wide variety of standard, semi-custom and custom products.	■ At year-end 1995 the unit's microelectronics products were included in more than half the world's digital cellular phones. Has a research, design, manufacturing or sales presence in 15 countries to enable close design collaboration with customers.
Definity® Enterprise Communications Server phones for businesses, redesigned for European technical standards and aesthetics, roll off the manufacturing line in Saumur, France.	■ Offers a broad line of systems and products that can be integrated into a business's network and upgraded with new software releases. Intelligent diagnostic software built into systems and service centers around the world reduces system downtime and provides a key competitive advantage.
The Two-Line Personal Information Center 882 does double-duty as a phone and personal data organizer for home-based businesses.	■ For the nine months ended September 30, 1995, sold twice as many corded telephones, cordless telephones and telephone answering systems in the U.S. as any competitor in each category. Captured a 5 percent share of the market for cellular phones in the U.S. since entering the market in 1992 with innovations such as user-friendly, on-screen instructions, voice activation and circuitry that filters out background noise.
In 1995 a Bell Labs research team devised a way to reliably transmit compressed color still images over wireless channels.	■ Integrated with Lucent Technologies' operating units to speed innovation. Focuses on technologies critical to telecommunications: software, digital signal processing, networking technologies, microelectronics and photonics.

Our restructured computer unit, after a difficult year, is trimmer, more focused and primed to take on a $470 billion market opportunity growing more than 7 percent a year.

LARS NYBERG,
CHIEF EXECUTIVE
OFFICER



Growth of global markets for NCR-related computing systems and services: Estimated at $470 billion growing to $675 billion by the year 2000.

1995 NCR*	
Revenues	$8 billion
Assets	$5 billion
Employees	38,000

**Revenues, assets and employees represent those the company would have shown at year-end had it existed as a separate company (see the Financial Review section for more details). The company had significant 1995 losses and restructuring charges. The number of employees listed does not reflect the total impact of previously announced work force reductions.*

KEY ASSETS

A current customer base in 191 countries.

Our businesses are headquartered in Dayton, Ohio, Atlanta, Georgia, and London, but our people are based in 130 countries, giving us the ability to market and support our products and services around the world. More than half our revenues are generated outside the U.S.

Ability to leverage our leadership in key industries.

While we market our computer platforms across many industries, we're capitalizing on our long-standing relationships with customers in the financial, retail and communications industries. We are offering them total solutions, including a full range of professional and support services, building on our sales of automated teller machines, retail scanners, terminals and transaction-processing systems. As a result, they can better use information they collect to serve their customers.

Access to the research capabilities of Bell Laboratories.

We've signed a multi-year commercial agreement with Bell Labs for research to support several key technology areas. We will continue to invest in research and development at levels that are at or above industry averages.

A SAMPLE OF OUR CUSTOMERS

1-800-Flowers
Bank of America
Barnett Banks, Inc.

Blue Cross Blue Shield of Illinois
Commonwealth Bank of Australia
Delta Air Lines

Electronic Payments Services Inc.
Fidelity Investments
JCPenney

Japan Credit Bureau
MasterCard
Meijer, Inc.

Office Depot
Sainsbury Savacentre
W H Smith Ltd.

Wachovia Banks
Wal-Mart
Wells Fargo

NCR

AT&T Global Information Solutions changed its name back to NCR Corporation January 10, 1996, in anticipation of becoming an independent, publicly traded company.

GROWTH OPPORTUNITIES

We lead the market for high-end computer systems and services for data warehousing, transaction processing and decision support.

Businesses generate massive amounts of data – about customers, competitors and internal operations. We've developed the kind of sophisticated computer servers that can process large volumes of transactions and store, correlate and analyze huge amounts of information. In fact, we're the market share leader in commercial parallel processing systems that can perform many tasks simultaneously. We also rank first worldwide in data warehousing systems and UNIX commercial systems in the $100,000 to $1 million range.

Industry analysts widely applauded our 1995 introduction of the WorldMark® line of enterprise servers, which offer affordability, expandability, performance and investment protection.

The retail industry is increasing its spending on information technology and we're a leader in retail systems.

Retailers are expected to increase their investment in computer systems and services more than 8 percent a year over the next three years. We have a strong presence in the industry dating back over a century to our roots as the National Cash Register Company. Our scanners check out over 270 billion items a year around the world. In 1995 our estimated share of the market for slot-type scanners was more than 40 percent, and we had more than 20 percent of the world's market share for point-of-sale terminals.

The American Product Excellence Committee singled out our 7870 Bi-Optic Scanner/Scale for its 1995 Grand Award for Excellence in Product Design.

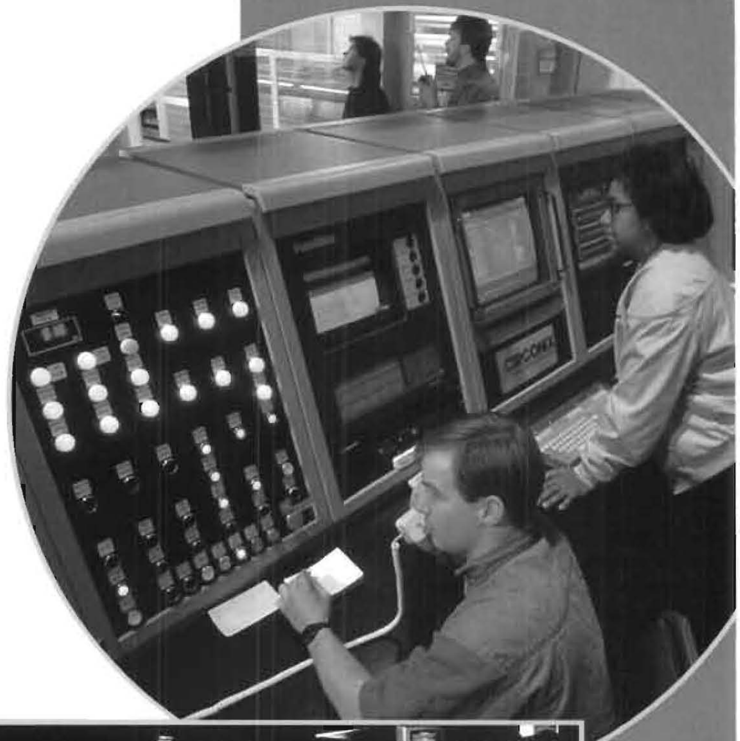
Our services business is easily outpacing the industry's 9 percent growth rate.

We have more than 20,000 service professionals in more than 1,100 locations around the globe. They're experts in helping global companies turn their information into actionable decisions and profitable results. We're recognized as an industry leader in data warehousing services, information technology architecture, project management, and network services solutions and support services that help businesses keep critical computer systems up and running.

In 1995 our services business grew 12 percent overall; professional services, 21 percent.

Our consumable media business is profitable and growing at a healthy clip.

Automated systems use huge quantities of labels, ribbons, paper rolls and custom-printed documents. Our Systemedia business operates 19 manufacturing facilities around the world that produce everything from thermal transfer ribbons and custom paper rolls to pressure-sensitive labels and ink ribbons. We're the market share leader in stock and paper rolls for point-of-sale retail terminals and automated teller machines (ATMs).



We brought new production facilities on line in 1995 to capitalize on the growing demand for thermal transfer ribbons used to print bar code labels, a market growing 18 percent a year.

The communications industry is expected to spend nearly $25 billion a year on information technology by 1997.

In the fast-paced, hotly contested communications industry, understanding customers is critical. We have considerable experience in designing combinations of systems and services to meet their needs. By putting to work our expertise in massively parallel processing and data warehousing, we're helping communications companies store and use customer calling records to better serve customers and to design customer acquisition and retention programs.

NCR teamed with Telstra, Australia's leading electronic communications and information services provider, on a system that gives customer service representatives quick access to calling, billing and service order information.

Financial institutions are looking for sophisticated systems to help them cut costs and enhance customer relationships, and we can fill the bill.

We're an established leader in the financial industry with a strong presence in more than 100 countries. About one-third of all automated teller machines installed throughout the world carry the company's brand. Our market share leadership in automated teller machines has served us well as we've moved into other transaction processing and commercial management areas. As banks look for creative ways to add value for consumers, we're helping them to tap into previously unmined consumer data and to design new banking services and delivery capabilities.

Around-the-clock availability of self-service devices like this ATM in Hong Kong is vital for banks striving to meet customers' financial services needs anytime, anywhere.

Our strategic restructuring will launch three new customer-focused companies.

A Discussion and Analysis of Our Results of Operations and Financial Condition

Record revenues in 1995 reflected growth in long distance and wireless communications services, increased sales of network telecommunications and business telephone systems and growth in financial services and leasing. Customer demand in the global information industry continues to rise, spurred by worldwide economic growth, technological advances and the declining relative cost of information technology.

Notwithstanding this revenue growth, after evaluating market conditions, including economic, financial, governmental and technological factors, we concluded that changes would be in the best interests of our stakeholders. On September 20, 1995 we announced our plan to separate AT&T Corp. (AT&T) into three independent, publicly held, global companies: communications services (which will retain the AT&T name), communications systems and technologies (which has been named Lucent Technologies Inc.) and transaction-intensive computing (formerly AT&T Global Information Solutions, now NCR Corporation). Our goal is to reduce the complexity of our operations making our businesses more competitive and responsive to customers by eliminating some strategic and internal conflicts. Separating into three independent companies will enhance our ability to focus on strategic businesses that add value to customers, to take advantage of new opportunities and to improve cost structures and operating efficiencies. We are planning an initial public offering of approximately 15% of Lucent Technologies Inc. (Lucent) common stock in the first half of 1996. We expect to distribute to our shareowners, subject to certain conditions, all of our remaining interest in Lucent and all of our interest in NCR Corporation (NCR) by the end of 1996. Also announced as part of the restructuring was our intent to pursue the sale of our remaining 86% interest in AT&T Capital Corporation (AT&T Capital). Our goal is to complete all of these actions by the end of 1996. However, our plan is subject to several conditions, including receipt of a favorable tax ruling, other required approvals, and the absence of events or developments that would cause the plan to have a material adverse impact on AT&T or its shareowners. We expect transactions associated with this plan to be tax-free to shareowners. Pages 31-32 of this report show summary financial information for the three separate companies.

In the fourth quarter of 1995, we recorded restructuring and other charges of approximately $6.2 billion before taxes primarily related to our plans to separate into three companies as described above. The charges reduced net income by approximately $4.2 billion, or $2.61 per share. As a result, net income for the year was $139 million, or $.09 per share. Excluding these charges, net income increased 16.6% in 1995 compared with 1994 to $5,492 million ($3.45 per share).

The charges cover plans to sell several businesses, including the AT&T Microelectronics Interconnect business and AT&T Paradyne. We also plan to close our 338 AT&T owned retail stores (the Phone Center Stores) by May 1996, to realign our consumer products distribution channels and to consolidate and reorganize corporate and business unit operations over the next two years. Accordingly, the fourth-quarter charges included separation costs for nearly 40,000 employees, of which about 24,000 were management and 16,000 were occupational. We expect 70% of all separations to be completed by the end of 1996, with the majority of the remainder being completed in 1997.

During the third quarter of 1995, we approved NCR's plans to refocus its business. The goal is to return NCR to profitability. Major aspects of the plan are to discontinue the manufacture of personal computers and their sale through reseller channels, to reduce the number of industry markets it serves and to consolidate facilities globally. NCR expects to complete these actions during 1996. As a result, in the third quarter of 1995, AT&T recorded charges of approximately $1.6 billion before taxes, which reduced net income by approximately $1.2 billion, or $0.74 per share.

The pretax total of the third and fourth quarter 1995 charges was recorded as $670 million in costs of telecommunications services, $1,676 million in costs of products and systems, $717 million in costs of rentals and other services, $6 million in costs of financial services

ELEVEN-YEAR SUMMARY OF SELECTED FINANCIAL DATA

AT&T Corp. and Subsidiaries (unaudited)

DOLLARS IN MILLIONS (EXCEPT PER SHARE AMOUNTS)

	1995*	1994	1993*	1992	1991*	1990	1989	1988*	1987	1986*	1985
Results of Operations											
Total revenues	**$79,609**	$75,094	$69,351	$66,647	$64,455	$63,228	$61,604	$62,067	$60,726	$61,975	$63,159
Research and development expenses	**3,718**	3,110	3,111	2,924	3,114	2,935	3,098	2,988	2,810	2,599	2,527
Operating income (loss)	**1,215**	7,949	6,498	6,529	1,428	5,358	4,751	(2,500)	4,071	974	3,561
Income (loss) before extraordinary item and cumulative effects of accounting changes	**139**	4,710	3,702	3,442	171	3,475	2,820	(1,527)	2,374	609	1,856
Net income (loss)	**139**	4,710	(5,906)	3,442	171	3,666	2,820	(1,527)	2,374	434	1,856
Earnings (loss) per common share before extraordinary item and cumulative effects of accounting changes	**0.09**	3.01	2.39	2.27	0.12	2.38	1.95	(1.06)	1.61	0.36	1.21
Earnings (loss) per common share	**0.09**	3.01	(3.82)	2.27	0.12	2.51	1.95	(1.06)	1.61	0.24	1.21
Dividends declared per common share	**1.32**	1.32	1.32	1.32	1.32	1.32	1.20	1.20	1.20	1.20	1.20
Assets and Capital											
Property, plant and equipment – net	**$22,264**	$21,279	$20,434	$20,209	$19,286	$18,906	$17,362	$16,793	$22,124	$22,247	$23,182
Total assets	**88,884**	79,262	69,393	66,104	62,071	57,036	45,228	41,945	45,583	44,305	44,824
Long-term debt including capital leases	**11,635**	11,358	11,802	14,166	13,682	14,579	10,116	10,172	9,060	8,234	8,104
Common shareowners' equity	**17,274**	17,921	13,374	20,313	17,973	17,928	15,727	13,694	16,913	15,849	16.945
Net capital expenditures	**5,997**	4,572	4,142	4,043	4,086	4,120	3,959	4,453	3,885	3,977	4,303
Other Information											
Operating income (loss) as a percentage of revenues	**1.5%**	10.6%	9.4%	9.8%	2.2%	8.5%	7.7%	(4.0)%	6.7%	1.6%	5.6%
Net income (loss) as a percentage of revenues	**0.2%**	6.3%	(8.5)%	5.2%	0.3%	5.8%	4.6%	(2.5)%	3.9%	0.7%	2.9%
Return on average common equity	**0.7%**	29.5%	(47.1)%	17.6%	0.9%	21.2%	19.1%	(8.9)%	14.3%	2.0%	10.6%
Data at year-end:											
Stock price per share	**$64.75**	$50.25	$52.50	$51.00	$39.125	$30.125	$45.50	$28.75	$27.00	$25.00	$25.00
Book value per common share	**$10.82**	$11.42	$ 8.65	$13.31	$12.05	$12.33	$10.92	$ 9.57	$11.87	$11.04	$11.73
Debt ratio	**62.0%**	58.3%	64.4%	53.1%	54.8%	53.5%	45.0%	45.8%	38.4%	39.6%	39.9%
Debt ratio excluding financial services	**44.3%**	34.1%	49.1%	40.8%	46.0%	47.6%	39.3%	42.2%	35.2%	37.6%	38.4%
Employees	**299,300**	304,500	317,700	319,000	322,300	333,400	343,000	367,400	366,200	379,900	400,400

*1995 DATA REFLECT $7.8 BILLION OF PRETAX BUSINESS RESTRUCTURING AND OTHER CHARGES.
1993 DATA REFLECT A $9.6 BILLION NET CHARGE FOR THREE ACCOUNTING CHANGES.
1991 DATA REFLECT $4.5 BILLION OF PRETAX BUSINESS RESTRUCTURING AND OTHER CHARGES.
1988 DATA REFLECT A $6.7 BILLION PRETAX CHARGE DUE TO ACCELERATED DIGITIZATION OF THE LONG DISTANCE NETWORK.
1986 DATA REFLECT $3.2 BILLION OF PRETAX CHARGES FOR BUSINESS RESTRUCTURING, AN ACCOUNTING CHANGE AND OTHER ITEMS.

and leasing, $4,359 million in selling, general and administrative expenses and $417 million in research and development expenses. If viewed by type of cost, the pretax charges reflect $3,417 million for employee separations and other related costs, $2,533 million for asset write-downs, $895 million for closing, selling and consolidating facilities and $1,000 million for other items. (See also Note 8 to the consolidated financial statements.)

In 1993 we provided $498 million before taxes for restructuring activities. These charges covered actions at NCR to reduce its workforce through early retirement and voluntary separation programs, actions at our telecommunications services units to centralize support services, actions to close plants that manufactured telecommunications network systems and actions to restructure operations that serviced the U.S. federal government. If viewed by type of cost, the charges reflect $235 million for employee separations and other related matters, $171 million for facility closings and $92 million for other related items. These charges were recorded as $13 million in costs of products and systems, $90 million in costs of other services, $373 million in selling, general and administrative expenses and $22 million in research and development expenses.

All parts of our business face substantial and intensifying competition. Product pricing and technology are under continual competitive pressure, and business and market conditions are changing rapidly. Our business leaders must continuously reassess their resource needs and redirect them as necessary to address market conditions and to reduce costs. Such steps can include the expansion of service offerings to provide larger bundles of services sought by customers. They can also include closing and consolidating facilities, disposing of assets, reducing the workforce or withdrawing from markets. Actions to enhance efficiency through continuous improvement are part of our commitment to quality.

The sections that follow describe our main revenue streams. Within these sections we describe the main service and product lines of the public companies that will emerge from our strategic restructuring.

AT&T versus S&P 500
Total shareowner return assuming reinvestment of dividends

Telecommunications Services

These revenues, which include traditional long distance, wireless services and other communications services, grew 6.0% in 1995 and 4.3% in 1994. The gains were mostly due to higher volumes, as the AT&T network handled a record 61.6 billion calls in 1995. Billed minutes for traditional, time-billed long distance services rose nearly 9.0% in 1995, compared with an increase of more than 7.5% in 1994 and about 5.5% in 1993. In particular, we saw volume growth in calling card, business inbound services and consumer international services.

Volume growth exceeds revenue growth because more customers are taking advantage of our many calling plans and promotions. However, the gap between revenues and volume growth narrowed in 1995 to 4%. This narrowing reflected less movement among calling plans by both business and residential customers and some targeted pricing actions.

The merger of AT&T and McCaw Cellular Communications, Inc. (McCaw) in 1994 and the acquisition of personal communications services (PCS) licenses in 1995 strengthened the competitive position of our communications services business. These initiatives will create new bundled offering opportunities, thereby enhancing our prospects for growth in revenues and earnings. The purchase of the minority owners' stake in LIN Broadcasting Corporation (LIN) in October 1995 gave us increased control of important cellular markets. AT&T now has the right to provide cellular services or PCS in 23 of the nation's top 25 markets. AT&T Wireless Services, formerly McCaw, is the leading U.S. provider of wireless communications services.

Total revenues from wireless services, which include cellular and messaging services, grew 28.3% to $2,926 million in 1995, from $2,280 million in 1994 and $1,760 million in 1993, mainly due to additional cellular service subscribers. Having met government conditions, in 1995 we were allowed to begin to jointly market long distance and cellular services. Thus far we've had a favorable response to this promotion. Cellular customers, reported on the same basis as consolidated wireless services revenues, increased to 3.9 million at year-end 1995, from 2.8 million in 1994 and 1.9 million in 1993. Cellular customers served by companies in which AT&T has or shares a controlling interest increased to 5.5 million at year-end 1995, from 4.0 million in 1994 and 3.0 million in 1993. Average revenue per subscriber declined in 1995 reflecting pricing pressures experienced by all cellular service providers, as well as lower average usage per subscriber atttributed to growth in subscribers for emergency and other personal use.

We also furthered our strategy of providing a broad package of telecommunications services by launching

AT&T branded on-line services, such as the AT&T Learning Network, the AT&T Business Network, AT&T Easy World Wide Web Service and Personal Online Services. These services provide dial-up and dedicated internet access, navigational tools and information directories, hosting and transaction services, and content.

In February 1996, the Telecommunications Act of 1996 (the "Telecommunications Act") became law. The Telecommunications Act preempts state and local requirements which prohibit or have the effect of prohibiting an entity from providing telecommunications services. In addition, the Telecommunications Act requires incumbent local exchange carriers (LECs), including the Regional Bell Operating Companies (RBOCs), to implement a checklist of conditions that are designed to foster local exchange competition. Although the Telecommunications Act permits interexchange carriers and others to begin providing local exchange service at any time, negotiations with LECs over access and interconnection agreements and the adoption of implementing rules and regulations will be necessary before effective local exchange competition commences.

The Telecommunications Act permits immediate RBOC provision of interexchange services outside of their home service areas and certain incidental interexchange services in their home service areas, such as those provided in conjunction with commercial mobile and cellular services. In addition, an RBOC is permitted to provide interexchange services originating in any state in its region upon receiving FCC approval, which is subject to a number of conditions, including that the RBOC has implemented the Telecommunications Act checklist of conditions throughout such state and, generally has entered into an interconnection agreement with a facilities-based competitor upon request. Once approved to provide interexchange services in a single in-region state, an RBOC is also permitted to begin manufacturing telecommunications equipment.

AT&T believes that the Telecommunications Act's provisions for the opening of local exchange markets to competitive entry are significant and that the restrictions placed on RBOC entry into in-region interexchange services should promote service competition in the RBOC's monopoly markets before RBOC provision of in-region interexchange services. Nonetheless, there is no assurance that, in the administration of the Telecommunications Act, the rules and regulations to be adopted will result in meaningful facilities-based competition prior to RBOC provision of in-region interexchange service.

To the extent that such implementing rules and regulations do not contain adequate provision for facilities-based local exchange competition, there is a substantial risk that AT&T and other interexchange service providers would be at a disadvantage to the RBOCs in the provision of local exchange services. In addition, regardless of provisions for facilities-based local exchange competition, the simultaneous entrance of seven RBOC competitors for interexchange services is likely to adversely affect AT&T's long-distance revenues and could adversely affect earnings. There is still a significant amount of uncertainty as to the extent, timing and impact on AT&T of the RBOCs entrance into interexchange services.

Similarly, the impact of AT&T's entrance into local services cannot reasonably be predicted. Notwithstanding the strong local entry provisions contained in the Telecommunications Act, various factors, including start-up costs associated with entering new markets, local conditions and obstacles and the final form of implementing rules and regulations, could adversely affect future revenues and earnings. Nevertheless, the legislation, plus other public policy and technological changes, will likely open new markets for AT&T in different areas of communications services. AT&T's competitive strategy includes using its networking capabilities, respected brand name and other resources to take advantage of these new opportunities as they arise.

The Pace of Change in the Global Information Industry

We must anticipate and react quickly to continuous and rapid changes in our markets. Technological developments create new markets, shorten product life cycles and hasten the convergence of different areas of the global information industry. The rapid growth, enormous size and global scope of this industry attract new entrants and encourage existing competitors to broaden their offerings. Alliances, joint ventures, mergers and acquisitions between market participants and regulatory and legislative decisions that affect these markets, further alter the competitive landscape.

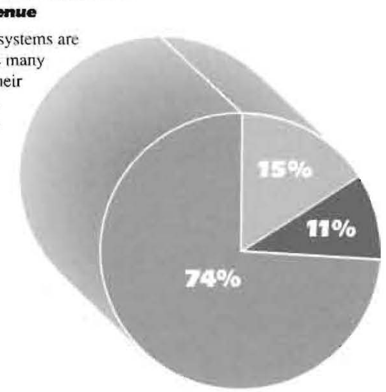
Current and potential competitors in telecommunications services include local telephone companies, other long distance carriers, cable companies, internet service providers, wireless service providers and other companies that offer network services. Other entrants from adjacent segments of the communications and information services industries, include providers of business information systems, systems integrators and companies outside the U.S. seeking to expand their markets. Some of these companies already have a strong market presence, brand recognition and existing direct customer relationships. All of these conditions contribute to substantial and intensifying competition.

Public policy changes including the Telecommunications Act are likely to bring not only increased competitive pressures, but may also open new markets to AT&T. Our strategy is to use our strong networking capabilities, a well-known and respected brand name and other strengths to capitalize on opportunities that arise.

Costs of telecommunications services include $670 million of restructuring and other charges in 1995. Excluding these charges, the gross margin percentage on telecommunications services rose to 44.9% in 1995 from 42.4% in 1994 and 39.9% in 1993. This upward trend is mainly the result of lower per-minute access costs – costs for reaching customers through local networks. The Federal Communications Commission (FCC) approved changes to the price-setting methodology for access costs, effective August 1995. These changes included a reduction in the maximum prices (price caps) local telephone companies can charge for connections. These price caps will be adjusted annually for inflation and changes in productivity. Additionally, the local telephone companies are required to use higher productivity factors in the future, which should lead to lower charges.

1995 Sources of Revenues
As percentages of total revenue

The markets for our products and systems are growing fastest outside the U.S. as many countries expand and modernize their telecommunications infrastructure. Global competition in telecommunications services is developing now and will likely accelerate.



International Revenues From operations located in other countries.

International Revenues From U.S. operations (international telecommunications services and exports)

U.S. Revenues

Products and Systems

Products and systems sales climbed 5.9% in 1995 and 18.1% in 1994, reflecting continued growth in sales both inside and outside of the United States.

Products and Systems

DOLLARS IN MILLIONS	1995	1994	1993
Revenues			
Telecommunications network products and systems	$10,665	$ 9,785	$ 8,345
Communications products and systems	4,899	4,494	3,692
Microelectronics products and other*	2,798	2,674	2,418
Computer products and systems	4,050	4,208	3,470
Products and systems	$22,412	$21,161	$17,925
Gross margin percentage	28.4%	37.3%	38.8%

*OTHER PRODUCT REVENUES ARE MAINLY FROM COMPUTING MEDIA THAT CUSTOMERS USE WITH AUTOMATED TELLER MACHINES AND RETAIL SCANNING EQUIPMENT, AND BUSINESS FORMS.

Most of the revenues from telecommunications network products and systems, communications products and systems, and microelectronics products are from units that will be a part of Lucent.

Revenues from telecommunications network products and systems rose 9.0% in 1995 and 17.3% in 1994. In both years we had higher sales both inside and outside of the United States. The growth outside of the U.S. was due primarily to increased sales to service providers. In the U.S. sales increased to independent telephone companies, cable companies and competitive access providers. About $243 million of the 1994 increase in revenues came from consolidating AG Communications Systems Corporation when we raised our ownership to 80%. Sales of switching and transmission equipment to local telephone companies declined in 1995. We believe that was due to delays in spending by those customers and recent legislative initiatives which caused reluctance to purchase from a potential competitor.

Sales outside of the U.S. of telecommunications network products and systems rose $730 million or 27.2% in 1995, led by strong sales in Saudi Arabia and China. Most systems and equipment for telecommunications networks are sold under contracts that produce revenues for several years. In 1994 we were awarded a $4 billion contract to build a fully digital communications network in Saudi Arabia. This contract will launch AT&T's GSM (global systems for mobile communications) offerings and is expected to be completed by the beginning of the next decade.

Revenues from sales of business communications products and systems rose 9.0% in 1995 and 21.7% in 1994. Sales of business communications equipment grew both inside and outside of the U.S. the last two years. In 1995 U.S. growth was largely due to increased sales of private branch exchanges (PBXs), including Definity® products and voice-processing systems. Sales of business communications products outside of the U.S. increased $89 million or 26.5% in 1995, led by increases in the United Kingdom, Canada and France. In 1994 we also had higher sales of Definity PBX products, partly reflecting upgrades to accommodate changes in the North American Numbering Plan and sales of Conversant® voice-processing products. Growth in sales outside the U.S. in 1994 reflected acquisitions in Europe and Latin America as well as higher demand.

Revenues from sales of consumer communications products declined in 1995 mainly because of competitive pricing pressures and an increasing proportion of lower-margin products. The decline was due to lower sales of corded telephones and telephone answering machines which was partially offset by higher sales of cordless and cellular phones. In 1994 revenues rose again primarily because of strong consumer sales of cellular and cordless phones. In 1995 we introduced three pagers, the first in a line that will include alphanumeric models in early 1996 and two-way pagers designed for eventual use with PCS. In January 1996 we announced our intention to close the 338 AT&T Phone Center Stores most of which will be closed by May 1996.

AT&T Submarine Systems, Inc. (Submarine Systems) supplies and constructs submarine cable systems and is a part of the communications services units. Revenues from these systems fall within the communications products and systems category. This unit had revenues of almost $900 million in 1995 which reflected growth of more than 14% over 1994. Revenues in 1994 increased almost 12% compared with 1993.

Revenues from sales of microelectronics components (including integrated circuits, digital signal processors and power systems) and other products grew 4.6% in 1995 and 10.6% in 1994. The growth occurred despite the sale of the NCR microelectronics unit in early 1995, which had 1994 revenues of $383 million. Most of the revenue increase in microelectronic components reflected increased sales of integrated circuits, both inside and outside of the United States.

NCR is responsible for the majority of our sales of computer products and systems. Revenues from these sales declined 3.7% in 1995 after rising 21.3% in 1994. The decline in revenues was primarily due to lower sales of personal computers and large systems. Price competition for personal computers was severe. Most personal computers from different manufacturers use the same or comparable microprocessors and software, leading customers to focus increasingly on price. This is one of the reasons that NCR is discontinuing the manufacture of personal computers. In 1994 we changed the end of the fiscal year from November to December for NCR operations outside of the United States. This was done to report essentially all of our operations on a calendar year. This change added $223 million in revenues ($113 million of product sales) and a marginal loss in 1994.

Cost of products and systems included $1,676 million in provisions for business restructuring and other charges in 1995 and $13 million in 1993. Apart from these provisions, the rise in cost of products and systems is mainly associated with the higher sales volumes. Excluding the charges, the gross margin percentage on products was 35.9% in 1995, compared with 37.3% in 1994 and 38.9% in 1993. The rising proportion of lower-margin products in the sales mix led to the margin decline in both years.

Rentals and Other Services

Revenues from rentals and other services for computer products and systems come primarily from NCR. The services are mainly professional services – such as designing solutions and systems for customers – and maintenance contracts.

Rentals and Other Services

DOLLARS IN MILLIONS	1995	1994	1993
Revenues			
Computer products and systems	**$2,841**	$ 2,818	$ 2,641
Communications products and systems services	**1,755**	1,680	1,457
Communications products and systems rentals	**795**	955	1,174
Other*	**798**	763	871
Rentals and other services	**$6,189**	$ 6,216	$ 6,143
Gross margin percentage	**33.8%**	47.1%	46.0%

*OTHER REVENUES ARE MAINLY FROM TELEMARKETING SERVICES, INFORMATION TECHNOLOGY SERVICES, FACILITY RENTALS AND LICENSES AND ROYALTIES.

Revenues from maintenance contracts for communications products grew as a result of increases in related sales. Rental revenues – from renting telephone sets or answering machines to consumers and PBX equipment to businesses – continued to decline and are expected to continue to decline in future years.

"Other" revenues are mainly from the activities of units that will remain with AT&T after our reorganization. An example is telemarketing services provided by AT&T American Transtech.

Provisions for business restructuring and other charges added $717 million to cost of rentals and other services in 1995 and $90 million in 1993. Excluding these charges, the gross margin percentage was 45.4% in 1995, compared with 47.1% in 1994 and 47.4% in 1993. This decline was due mainly to the shifting mix of revenues, particularly the declining proportion of high-margin rentals.

Financial Services and Leasing

These revenues come mainly from AT&T Universal Card Services (Universal Card) and AT&T Capital. As previously announced, AT&T intends to pursue the sale of AT&T Capital. Both revenues and earnings for these two companies continued to grow over the past two years because of their continued earning asset growth.

Financial Services and Leasing

DOLLARS IN MILLIONS	1995	1994	1993
Revenues			
AT&T Capital	**$ 1,577**	$ 1,384	$ 1,360
Universal Card	**2,250**	1,782	1,228
Eliminations, adjustments and other*	**(96)**	(49)	(84)
Financial services and leasing	**$ 3,731**	$ 3,117	$ 2,504
Gross margin percentage	**29.1%**	31.0%	31.7%
Universal Card Information:			
Total book and managed finance receivables	**$14,118**	$12,380	$ 9,154
Accounts in millions	**17.6**	15.1	11.7

*OTHER REVENUES ARE MAINLY FROM LEASE FINANCE ASSETS THAT AT&T RETAINED WHEN AT&T CAPITAL WAS REORGANIZED IN 1993 AS WELL AS THE ELIMINATION OF LEASE REVENUES FROM AT&T AFFILIATES.

The gross margin percentage for these services declined in 1995 due to competitive pricing pressures and to higher credit losses and fraud at Universal Card. In 1994 rising interest rates narrowed margins. Both Universal Card and AT&T Capital set reserves for losses based on experience, current delinquencies and the outlook for the economy.

The continuing growth of Universal Card is illustrated by its receivables and number of customer accounts. Universal Card's "book" and managed receivables, which include the $3.5 billion securitized in 1995, were $14.1 billion at December 31, 1995, up 14.0% from year-end 1994. Universal Card will retain the servicing and customer relationships of the credit card accounts that were securitized. Universal Card did not securitize receivables before 1995.

The intent to pursue the sale of AT&T Capital does not affect AT&T Capital's role as a provider of AT&T's customer financing pursuant to an operating agreement between AT&T and AT&T Capital. We expect that at the completion of the restructuring, AT&T Capital will retain its current operating agreements regarding its leasing arrangements with AT&T, Lucent and NCR. The sale of AT&T Capital also will not affect AT&T's unconditional guarantee of all of the AT&T Capital outstanding debt at the end of March 1993. The guaranteed debt amounted to $417 million at the end of 1995. AT&T Capital's debt issued subsequent to March 1993 relies on its own credit.

Operating Expenses

■ Selling, general and administrative expenses included $4,359 million of restructuring and other charges in 1995, $246 million of merger-related expenses in 1994 and $373 million of restructuring and other charges in 1993. Excluding these charges, such expenses were 26.1% of total revenues in 1995, compared with 25.8% in 1994 and 25.5% in 1993. Part of the 1995 increase was related to our response to competitive conditions and to our increased global presence, resulting in increased spending on sales and sales support efforts. We focused advertising expenditures on retaining and winning back residential customers of traditional long distance services and acquiring new cellular subscribers.

In 1994 expenses of $246 million related to the merger of AT&T and McCaw reduced net income by $187 million, or $0.12 per share. We accounted for the merger with McCaw as a pooling of interests. Therefore, we restated AT&T's financial statements to include McCaw's results in all periods before the merger.

Research and development expenditures are mainly for work on wireless systems technology, advanced communications services devices, and projects aimed at international growth. These expenses included $417 million of restructuring and other charges in 1995 and $22 million of such charges in 1993. Excluding those charges, research and development expenses were 4.1% of total revenues in 1995 and 4.1% in 1994 compared with 4.5% in 1993.

As required by changes in accounting standards, we adopted new methods of accounting for retiree benefits, postemployment benefits and income taxes in 1993. We recorded cumulative effects of accounting changes to reflect our financial statements at the position they would have been in if we had always used the new methods. As a result, we took a $9.6 billion after-tax charge which caused a reported net loss in 1993. The accounting changes did not affect cash flows.

Similar to other manufacturers, we use, dispose of and remove substances regulated under environmental protection laws. We have been named a potentially responsible party (PRP) at a number of Superfund sites. At most of these sites, our share of the costs is limited and other PRPs are expected to contribute to the cleanup costs. We regularly review potential cleanup costs and costs of compliance with environmental laws and regulations. We provide reserves for these potential costs and routinely review their adequacy. In addition, we forecast our expenses and capital expenditures for existing and planned compliance programs as part of our regular corporate planning process. We believe that cleanup costs and costs related to environmental proceedings and ongoing compliance with present laws will not have a material effect on our future expenditures, annual consolidated financial statements or competitive position beyond that provided for at year-end.

In October 1995 the Financial Accounting Standards Board (FASB) issued Statement of Financial Accounting Standards (SFAS) No. 123, "Accounting for Stock-Based Compensation." This standard establishes a fair value method for accounting for stock-based compensation plans either through recognition or disclosure. Upon adoption, which is required in 1996, we intend to disclose rather than record these computations. Adopting this standard will not affect our reported earnings, financial condition or cash flows.

In March 1995 the FASB issued SFAS No. 121, "Accounting for the Impairment of Long-Lived Assets and Long-Lived Assets to Be Disposed of." Although the standard does not require adoption until fiscal year 1996, we implemented it effective October 1, 1995. Under this standard, we consider whether we can recover our costs for impaired assets whenever events or changes in circumstances call that recovery into question. The adoption of this standard did not materially affect our reported earnings, financial condition or cash flows because this was essentially the same method we used in the past to measure and record asset impairments.

Our 1995 restructuring and other charges included recognition of asset impairments.

Other Income Statement Items

The majority of other income – net is from transactions, such as sales of assets, that are individually immaterial. In 1995 it reflects gains from selling the NCR microelectronics unit and several other properties. We also sold properties and recognized gains in 1994 but these were partially offset by losses on the shutdown of a subsidiary, EO Inc., and on the uninsured portion of a lost satellite. In 1993 we had a $217 million gain from exchanging our remaining 77% interest in UNIX System Laboratories, Inc. for stock in Novell, Inc. We subsequently recognized declines in the value of the Novell stock.

Also included in other income are earnings and losses from investments, increases in value of corporate-owned life insurance policies on officers, and minority owners' interests in the earnings or losses of subsidiaries. Before we redeemed the preferred stock of a subsidiary in mid-1994, we recorded the dividends on those shares as a charge against other income – net.

Interest expense increased slightly in 1995 compared with 1994 despite higher levels of average debt. This was due to lower average rates on long-term debt in 1995. The decline in interest expense in 1994 was mainly due to refinancing long-term debt at more favorable rates.

The effective income tax rate is the provision for income taxes as a percentage of income before taxes and cumulative effects of accounting changes. The effective tax rate of 85.1% for 1995 was impacted by the restructuring and other charges recognized. Excluding business restructuring and other charges, such as merger-related expenses from all three years, our effective tax rate was 37.5% in 1995, compared with 37.9% and 38.3%, in 1994 and 1993, respectively. The decline in 1994 compared with 1993 was mainly due to credits for foreign tax payments and the deferred tax effects of redeeming preferred stock. The effective tax rate in 1995 remained at essentially the same level as 1994 primarily due to lower state tax rates.

Cash Flows

Operating cash flow increased in both 1995 and 1994, mainly because of higher income before restructuring and other charges. About $160 million of the 1995 pretax charges for business restructuring and other related items required cash payments during the year. Another $4.4 billion of the pretax charges will also require future cash payments primarily in 1996 and 1997.

Most of our capital expenditures support telecommunications network services, providing for growth in calling volumes, the introduction of new technology and enhanced reliability.

Another large part of our investing activities is purchasing finance assets. Our investments in finance assets, which include credit card receivables, leases and equipment for rentals, fuel the growth in revenues and earnings from AT&T Capital and Universal Card.

The $1.68 billion purchase of PCS licenses in 1995 is intended to permit us to offer broadband PCS in 21 major trading areas. Additionally, in 1995 we completed the $3.3 billion acquisition of the minority owners' stake in LIN, a subsidiary of AT&T Wireless Services.

We will continue to make substantial investments in our communications services business. Notable plans include the buildout of PCS sites, preparing to provide local services in the U.S. and funding a variety of projects and joint ventures to offer telecommunications services in other countries.

We intend to conclude an agreement for 49% of a joint venture with Grupo Alfa to offer services in Mexico when that country opens to competition in 1997. We will supply our share of the investment up to $1 billion over the next four to six years. We also have a 40% stake in UniWorld, a joint venture with Unisource, that began operations in January 1996, providing services to multinational business customers in Europe. The venture was formed initially with about $200 million in assets, but may expand, partly because of possible entry into other markets.

Investing activities at Lucent focus on manufacturing and research and development. In 1995, we agreed to purchase part of the public network assets of N.V. Philips' Communications Systems division for approximately $260 million. This acquisition would give us products and an employee base to improve our access to cellular equipment markets in Europe, South America and Southeast Asia.

Competition in communications and computing is global and increasingly involves multinational firms and partners from different nations. We believe commitments of resources to expand globally are necessary for future growth. Although we reported operating losses for the past three years in our units outside of the U.S., we continue to believe that these operations and markets provide excellent opportunities for future revenues and earnings.

For all three years, operating cash flows covered capital expenditures and dividend payments. Operating cash also helped fund other investing activities such as our purchases of PCS licenses and the remaining 48% of LIN in 1995. We expect operating cash will continue covering capital expenditures and dividends in 1996.

The ratio of total debt to total capital (debt plus equity) increased to 62.0% at December 31, 1995, compared with 58.3% at December 31, 1994, mainly because of lower equity caused by the 1995 charges and the increase in debt associated with acquiring PCS licenses and the remaining interest in LIN. Most of our debt supports financial services and leasing operations. Excluding financial services and leasing operations and the impact of the restructuring and other charges taken in 1995, our debt ratio would have been 44.3% at December 31, 1995, compared with 34.1% at December 31, 1994.

AT&T has raised all necessary external financing through issuances of commercial paper and long-term debt, as well as asset-backed securities and equity. Additionally, we have unused available lines of credit totaling approximately $12.4 billion at December 31, 1995. We expect to be able to arrange any future needed financing using these same sources, with the timing of issue, principal amount and form depending on our needs and the prevailing market and economic conditions. Under a Master Trust, $3.5 billion of notes backed by Universal Card receivables were issued in 1995.

In 1995 our debt issuances were primarily to support our financial services and leasing businesses. Much of the financing activity in 1993 and 1994 was refinancing, generally to get lower rates, but sometimes to change maturities. In each of the past three years, we issued new shares of common stock in our shareowner and employee purchase plans. The dilution in earnings per share from new issuances for these plans was not material.

Our asset and liability management strategy for our financial services business is to match the average maturities of our borrowings with the average cash flows of our portfolio assets and to match floating-rate assets with floating-rate debt and fixed-rate assets with fixed-rate debt. Cash flow projections are based on assumptions about customer prepayments, refinancings and charge-offs that are derived from our past experience as well as current customer preferences, competitive market conditions, portfolio growth rates and our portfolio mix. We issue commercial paper and long-term notes and use interest rate swaps to achieve a matched portfolio position in our finance assets.

Foreign currency contracts and options are used to limit risks due to changing currency exchange rates. We do not speculate on interest rates or foreign currency rates. Instead, we seek to reduce the possible effects of fluctuations in these rates. This leads to more stable earnings in periods when these rates are changing.

The notional amounts of derivative contracts do not represent direct credit exposure or future cash requirements. Credit exposure is determined by the market value of derivative contracts that are in a gain position as well as the ability of the counterparties to perform its payment obligations under the agreements. We control credit risk of our derivative contracts through credit approvals, exposure limits and other monitoring procedures. There were no past due amounts related to our derivative contracts at December 31, 1995, nor have there been any charge-offs during the three years ended December 31, 1995.

We sell equity interests in AT&T subsidiaries only when opportunities or circumstances warrant. We have no current plans to sell material interests in subsidiaries beyond those announced and described previously.

Financial Condition, Including Liquidity

Our cash account includes funds to finance the day-to-day business and funds for pending transactions.

We turned over our inventory 3.1 times in 1995, compared with 3.2 times in 1994. This slight decline reflects higher levels of shipped but not invoiced inventory due to terms and conditions of large network contracts. Accounts receivable turned over an average of 5.7 times in 1995, compared with 6.0 times in 1994. The decrease in 1995 relates to lower turnover levels in our computer business, where revenues have been declining at a greater rate than the related receivables, as well as the impacts of some billing takebacks from the local telephone service carriers for our long distance service business.

The fair value of our pension plan assets is greater than our projected pension obligations. We record pension income when our expected return on plan assets plus amortization of the transition asset (created by our 1986 adoption of the current standard for pension accounting) is greater than the interest cost on our projected benefit obligation plus service cost for the year. Consequently, we continued to have pension income that added to our prepaid pension costs in 1995.

Higher payroll and benefit related liabilities and other liabilities are associated with the restructuring and other charges recorded in 1995.

Other aspects of our financial condition that relate closely to our investing and financing activities – such as finance receivables, plant, licensing costs and debt – have been discussed in the section on cash flows.

Strategic Restructuring

As announced in September 1995 and discussed elsewhere in this report, AT&T intends to implement a strategic restructuring to separate AT&T into three independent, publicly held, global companies. Our plans are subject to several conditions, including receipt of a favorable tax ruling, other required approvals, and the absence of events or developments that would have a material adverse impact on AT&T or its shareowners.

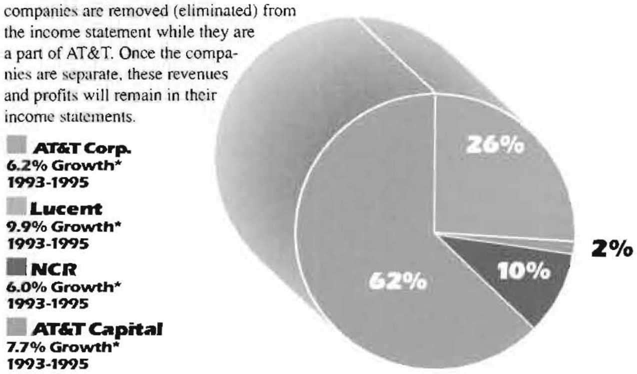
We plan an initial public offering of approximately a 15% interest in Lucent in the first half of 1996. By the end of 1996, AT&T intends, subject to certain conditions, to distribute its remaining interest in Lucent and its interest in NCR to AT&T's shareowners.

The following financial information for Lucent and NCR reflects those entities as if they had been operating as stand-alone companies in the periods presented. For example, sales to other entities of AT&T are included in revenues. Therefore, the sum of the entities' amounts do not equal consolidated AT&T's results of operations or financial condition.

The "As Adjusted" column for 1995, excludes the restructuring and other charges recorded in 1995 as discussed previously.

1995 Revenues for the four companies
Shown in percentages of the $82.8 billion total before eliminations

Revenues and profits from transactions between companies are removed (eliminated) from the income statement while they are a part of AT&T. Once the companies are separate, these revenues and profits will remain in their income statements.



*Compounded annual growth rate

Lucent Technologies Inc.

Lucent includes our businesses that develop, manufacture and service systems and software for telecommunications applications within the global telecommunications networking industry. These integrated systems enable network operators and business enterprises to connect, route, manage and store information between and within locations. They range in size from large global public telephone networks to small-business communications systems and support functions ranging from simple voice-only applications to complex multifunctional service offerings. Additionally, substantially all of Bell Laboratories is a part of this company.

The following table provides summary financial information for Lucent. It reflects the results of operations of the businesses transferred to Lucent from AT&T. As a result, the financial information has been derived from the financial statements of AT&T using the historical results of operations and historical basis of assets and liabilities of such businesses. Additionally, it includes certain assets, liabilities and expenses that were not historically recorded at the level of, but are primarily associated with, this business. We believe the assumptions underlying the financial information to be reasonable. However, the financial information may not necessarily reflect the results of operations or financial position of Lucent in the future, or what the results of operations or financial position would have been had Lucent been a separate, stand-alone entity during the periods presented.

Lucent Technologies Inc.

Dollars in millions	1995	1995 As Adjusted*	1994	1993
External revenues	$19,294	$19,294	$17,628	$15,767
Internal revenues	2,119	2,119	2,137	1,967
Total revenues	$21,413	$21,413	$19,765	$17,734
Gross margin	$ 8,468	$ 9,360	$ 8,428	$ 7,646
Operating expenses	9,468	7,559	7,457	6,977
Operating income	$ (1,000)	$ 1,801	$ 971	$ 669
Income before income taxes	$ (1,116)	$ 1,685	$ 854	$ 666
Total assets	$19,722	—	$17,340	$17,109

*As adjusted excludes the restructuring and other charges recorded in 1995.

The "internal revenues" in this table represent sales to other units of AT&T and its affiliates. They do not include any revenues from sales between operating units of Lucent, which will continue to be eliminated in consolidation. Most internal revenues are for network equipment sold to AT&T for the construction and maintenance of the AT&T Worldwide Intelligent Network, which will remain at AT&T.

As part of AT&T's strategic restructuring, Lucent underwent a comprehensive review of its operations. Approximately 23,000 of the total positions to be eliminated come from Lucent. Lucent intends to focus its investments on its core technologies, primarily through expanded and targeted research and development efforts. Consequently, Lucent will exit tangential product lines and markets, including AT&T Paradyne which manufactures certain data communications equipment and AT&T Microelectronics Interconnect products business which manufactures backplanes and printed circuit boards. Lucent's reorganization efforts also include plans to close all of its 338 Phone Center Stores, most of which will be closed by May 1996. As a result, Lucent recorded restructuring and other charges in 1995 of $2,801 million ($1,847 million after taxes). The pretax charges included $1,509 million for employee separations and other related items, $627 million for asset write-downs, $202 million for closing, selling and consolidating facilities and $463 million for other items.

NCR Corporation

We plan to make NCR a stand-alone business focused on transaction-intensive computing. The new strategy centers around more profitable products such as massively parallel computer processors, automated teller machines and retail scanning equipment. This direction also enhances the company's primary strategy which is to help businesses use new technology to collect and use information to enhance customer service. Although NCR is ceasing the manufacture of personal computers, it will continue to offer personal computers manufactured by others as part of its total solutions approach.

The following table provides summary financial information for NCR. It reflects the results of operations of the businesses to be transferred to NCR from AT&T. As a result, the financial information has been derived from the financial statements of AT&T using the historical results of operations and historical basis of assets and liabilities of such businesses. Additionally, it includes certain assets, liabilities and expenses that were not historically recorded at the level of, but are primarily associated with, this business. We believe the assumptions underlying the financial information to be reasonable. However, the financial information may not necessarily reflect the results of operations or financial position of NCR in the future, or what the results of operations or financial position would have been had NCR been a separate, stand-alone entity during the periods presented.

NCR Corporation

Dollars in millions	1995	1995 As Adjusted*	1994	1993
External revenues	**$ 7,531**	**$7,531**	$7,939	$6,879
Internal revenues	**631**	**631**	522	386
Total revenues	**$ 8,162**	**$8,162**	$8,461	$7,265
Gross margin	**$ 973**	**$1,904**	$2,671	$2,524
Operating expenses	**3,344**	**2,624**	2,773	2,805
Operating loss	**$(2,371)**	**$ (720)**	$ (102)	$ (281)
Income (loss) before income taxes	**$(2,354)**	**$ (703)**	$ 3	$ (264)
Total assets	**$ 5,181**	—	$6,006	$5,207

*As adjusted excludes the restructuring and other charges recorded in 1995.

The "internal revenues" in this table primarily represent sales of computer products to other units of AT&T and its affiliates.

NCR, as a result of continuing operating losses, has taken decisive action in 1995 to create a smaller, more focused business, concentrating on the three industries in which it has a leading position – retailing, financial and communications.

This resulted in restructuring and other charges in the third quarter of 1995, of approximately $1.6 billion before taxes ($1.2 billion after taxes). The pretax charges reflect $698 million for employee separations and other related costs, $564 million for asset write-downs, $196 million for closing, selling and consolidating facilities and $191 million for other items.

Ongoing AT&T

The ongoing business of AT&T will include communications services, wireless services, AT&T Solutions consulting services and our Universal Card business. Building on the skills from Bell Laboratories, we will also create an AT&T Laboratories unit that will continue research and development for the ongoing AT&T.

The following table provides summary financial information for the operations of AT&T that will remain with AT&T.

AT&T without Lucent, NCR and AT&T Capital

Dollars in millions	1995	1995 As Adjusted*	1994	1993
Total revenues	**$51,374**	**$51,374**	$48,315	$45,556
Gross margin	**$21,305**	**$22,395**	$20,052	$17,973
Operating expenses	**15,927**	**13,877**	12,421	11,259
Operating income	**$ 5,378**	**$ 8,518**	$ 7,631	$ 6,714
Income before income taxes	**$ 5,168**	**$ 8,308**	$ 7,289	$ 6,398
Total assets	**$55,603**	—	$49,167	$42,724

*As adjusted excludes the restructuring and other charges recorded in 1995.

The main differences between the information above and the consolidated AT&T results are the exclusion of Lucent, NCR and AT&T's interest in AT&T Capital.

The businesses that are part of the ongoing AT&T recorded restructuring and other charges of $3,140 million ($2,104 after taxes) in 1995 related to AT&T's plans to separate into three companies. The pretax charges cover consolidating and reorganizing numerous corporate and business unit operations during the next two years including force reductions of 17,000 positions as well as the write-down in value of some unnecessary network facilities, of nonstrategic wireless assets and some investments. The pretax charges cover $956 million for employee separations and other related items, $1,342 million for asset write-downs, $497 million for closing, selling and consolidating facilities and $345 million for other items. In connection with the plan to separate into three companies, AT&T, Lucent and NCR have entered into various agreements. These agreements generally provide for the separation and distribution of the operating assets and liabilities, and pension plan assets and liabilities, as well as tax sharing and allocation. Additionally, various interim services agreements provide for certain data processing services, telecommunications services and certain support services on specified terms.

In accordance with SEC rules and regulations, as uncertainties surrounding our plan to separate are cleared, we will provide more financial information. If you are interested in directly receiving this information as it is made public, it will be available by calling AT&T Shareowner Services toll-free at 1 800 348-8288.

Report of Management

Management is responsible for the preparation, integrity and objectivity of the financial statements and all other financial information included in this report. Management is also responsible for maintaining a system of internal controls as a fundamental requirement for the operational and financial integrity of results.

The financial statements which reflect the consolidated accounts of AT&T and subsidiaries and other financial information shown, were prepared in conformity with generally accepted accounting principles. Estimates included in the financial statements were based on judgments of qualified personnel.

To maintain its system of internal controls, management carefully selects key personnel and establishes the organizational structure to provide an appropriate division of responsibility. We believe it is essential to conduct business affairs in accordance with the highest ethical standards as set forth in the AT&T Code of Conduct. These guidelines and other informational programs are designed and used to ensure that policies, standards and managerial authorities are understood throughout the organization. Our internal auditors monitor compliance with the system of internal controls by means of an annual plan of internal audits. On an ongoing basis, the system of internal controls is reviewed, evaluated and revised as necessary in light of the results of constant management oversight, internal and independent audits, changes in AT&T's business and other conditions.

Management believes that the system of internal controls, taken as a whole, provides reasonable assurance that (1) financial records are adequate and can be relied upon to permit the preparation of financial statements in conformity with generally accepted accounting principles, and (2) access to assets occurs only in accordance with management's authorizations.

The Audit Committee of the Board of Directors, which is composed of directors who are not employees, meets periodically with management, the internal auditors and the independent auditors to review the manner in which these groups of individuals are performing their responsibilities and to carry out the Audit Committee's oversight role with respect to auditing, internal controls and financial reporting matters. Periodically, both the internal auditors and the independent auditors meet privately with the Audit Committee. These auditors also have access to the Audit Committee and its individual members at any time.

The financial statements in this annual report have been audited by Coopers & Lybrand L.L.P., Independent Auditors. Their audits were conducted in accordance with generally accepted auditing standards and include consideration of the internal control structure and selective tests of transactions. Their report follows.

Richard W. Miller
Executive Vice President,
Chief Financial Officer

R.E. Allen

Robert E. Allen
Chairman of the Board,
Chief Executive Officer

Report of Independent Auditors

To the Shareowners of AT&T Corp.:

We have audited the consolidated balance sheets of AT&T Corp. and subsidiaries (AT&T) at December 31, 1995 and 1994, and the related consolidated statements of income, changes in shareowners' equity, and cash flows for the years ended December 31, 1995, 1994 and 1993. These financial statements are the responsibility of AT&T's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the consolidated financial position of AT&T at December 31, 1995 and 1994, and the consolidated results of their operations, changes in their shareowners' equity and their cash flows for the years ended December 31, 1995, 1994 and 1993, in conformity with generally accepted accounting principles.

As discussed in Note 3 to the financial statements, in 1993 AT&T changed its methods of accounting for postretirement benefits, postemployment benefits and income taxes.

Coopers & Lybrand LLP

Coopers & Lybrand L.L.P.
1301 Avenue of the Americas
New York, New York
January 25, 1996

CONSOLIDATED STATEMENTS OF INCOME

AT&T Corp. and Subsidiaries, Years Ended December 31

DOLLARS IN MILLIONS (EXCEPT PER SHARE AMOUNTS)	1995	1994	1993
Sales and Revenues			
Telecommunications services	$47,277	$44,600	$42,779
Products and systems	22,412	21,161	17,925
Rentals and other services	6,189	6,216	6,143
Financial services and leasing	3,731	3,117	2,504
Total revenues	79,609	75,094	69,351
Costs			
Telecommunications services			
Access and other interconnection costs	17,618	17,797	17,772
Other costs	9,123	7,873	7,937
Total telecommunications services	26,741	25,670	25,709
Products and systems	16,045	13,273	10,966
Rentals and other services	4,098	3,287	3,319
Financial services and leasing	2,646	2,152	1,711
Total costs	49,530	44,382	41,705
Gross margin	30,079	30,712	27,646
Operating Expenses			
Selling, general and administrative expenses	25,146	19,653	18,037
Research and development expenses	3,718	3,110	3,111
Total operating expenses	28,864	22,763	21,148
Operating income	1,215	7,949	6,498
Other income -- net	458	293	546
Loss on sale of stock by subsidiary	—	—	9
Interest expense	738	724	1,032
Income before income taxes and cumulative effects of accounting changes	935	7,518	6,003
Provision for income taxes	796	2,808	2,301
Income before cumulative effects of accounting changes	139	4,710	3,702
Cumulative effects on prior years of changes in accounting for:			
Postretirement benefits (net of income tax benefit of $4,294)	—	—	(7,023)
Postemployment benefits (net of income tax benefit of $681)	—	—	(1,128)
Income taxes	—	—	(1,457)
Cumulative effects of accounting changes	—	—	(9,608)
Net Income (Loss)	$ 139	$ 4,710	$ (5,906)
Weighted average common shares outstanding (millions)	1,592	1,564	1,547
Per Common Share:			
Income before cumulative effects of accounting changes	$ 0.09	$ 3.01	$ 2.39
Cumulative effects of accounting changes	—	—	(6.21)
Net Income (Loss)	$ 0.09	$ 3.01	$ (3.82)

THE NOTES ON PAGES 38 THROUGH 50 ARE AN INTEGRAL PART OF THE CONSOLIDATED FINANCIAL STATEMENTS.

CONSOLIDATED BALANCE SHEETS

AT&T Corp. and Subsidiaries, At December 31

DOLLARS IN MILLIONS	1995	1994
Assets		
Cash and temporary cash investments	$ 908	$ 1,208
Receivables, less allowances of $1,583 and $1,251		
Accounts receivable	15,493	13,671
Finance receivables	13,782	14,952
Inventories	4,074	3,633
Deferred income taxes	4,460	3,030
Other current assets	792	1,117
Total current assets	39,509	37,611
Property, plant and equipment – net	22,264	21,279
Licensing costs, net of accumulated amortization of $743 and $613	8,056	4,251
Investments	3,885	2,708
Long-term finance receivables	5,389	4,513
Net investment in operating leases of finance subsidiaries	888	756
Prepaid pension costs	4,664	4,151
Other assets	4,229	3,993
Total assets	$88,884	$79,262
Liabilities		
Accounts payable	$ 7,071	$ 6,011
Payroll and benefit-related liabilities	6,256	4,105
Postretirement and postemployment benefit liabilities	405	1,029
Debt maturing within one year	16,589	13,666
Dividends payable	527	518
Other current liabilities	8,524	5,601
Total current liabilities	39,372	30,930
Long-term debt including capital leases	11,635	11,358
Long-term postretirement and postemployment benefit liabilities	8,908	8,754
Other long-term liabilities	5,170	4,285
Deferred income taxes	5,199	3,913
Unamortized investment tax credits	199	232
Other deferred credits	400	776
Total liabilities	70,883	60,248
Minority interests	727	1,093
Common Shareowners' Equity		
Common shares par value $1 per share Authorized shares: 2,000,000,000 Outstanding shares: 1,596,005,351 at December 31, 1995; 1,569,006,000 at December 31, 1994	1,596	1,569
Additional paid-in capital	16,614	15,825
Guaranteed ESOP obligation	(254)	(305)
Foreign currency translation adjustments	5	145
Retained earnings (deficit)	(687)	687
Total common shareowners' equity	17,274	17,921
Total liabilities and shareowners' equity	$88,884	$79,262

THE NOTES ON PAGES 38 THROUGH 50 ARE AN INTEGRAL PART OF THE CONSOLIDATED FINANCIAL STATEMENTS.

CONSOLIDATED STATEMENTS OF CHANGES IN SHAREOWNERS' EQUITY

AT&T Corp. and Subsidiaries, Years Ended December 31

DOLLARS IN MILLIONS	1995	1994	1993
Common shares			
Balance at beginning of year	$ 1,569	$ 1,547	$ 1,526
Shares issued:			
Under employee plans	13	11	6
Under shareowner plans	13	8	8
Other	1	3	7
Balance at end of year	1,596	1,569	1,547
Additional paid-in capital			
Balance at beginning of year	15,825	14,324	13,485
Shares issued:			
Under employee plans	602	538	183
Under shareowner plans	687	424	450
Other	31	133	208
Shares repurchased	(4)	(2)	(4)
Preferred stock redemption	—	408	—
Dividends declared	(527)	—	—
Other changes	—	—	2
Balance at end of year	16,614	15,825	14,324
Guaranteed ESOP obligation			
Balance at beginning of year	(305)	(355)	(407)
Amortization	51	50	52
Balance at end of year	(254)	(305)	(355)
Foreign currency translation adjustments			
Balance at beginning of year	145	(32)	65
Translation adjustments	(140)	177	(97)
Balance at end of year	5	145	(32)
Retained earnings (deficit)			
Balance at beginning of year	687	(2,110)	5,644
Net income	139	4,710	(5,906)
Dividends paid	(1,570)	(1,940)	(1,780)
Other changes	57	27	(68)
Balance at end of year	(687)	687	(2,110)
Total Shareowners' Equity	$17,274	$17,921	$13,374

THE NOTES ON PAGES 38 THROUGH 50 ARE AN INTEGRAL PART OF THE CONSOLIDATED FINANCIAL STATEMENTS.

In March 1990 we issued 13.4 million new shares of common stock in connection with the establishment of an ESOP feature for the nonmanagement savings plan. The shares are being allocated to plan participants over ten years commencing in July 1990 as contributions are made to the plan.

We have 100 million authorized shares of preferred stock at $1 par value. No preferred stock is currently issued or outstanding.

CONSOLIDATED STATEMENTS OF CASH FLOWS

AT&T Corp. and Subsidiaries, Years Ended December 31

DOLLARS IN MILLIONS	1995	1994	1993
Operating Activities			
Net income (loss)	$ 139	$ 4,710	$(5,906)
Adjustments to reconcile net income (loss) to net cash provided by operating activities:			
Restructuring and other charges	7,685	—	498
Cumulative effects of accounting changes	—	—	9,608
Depreciation and amortization	4,845	4,633	4,702
Provision for uncollectibles	2,378	1,929	1,665
Increase in accounts receivable	(3,386)	(2,673)	(2,211)
Increase in inventories	(1,206)	(394)	(594)
Increase (decrease) in accounts payable	1,043	1,125	(295)
Net decrease (increase) in other operating assets and liabilities	366	(793)	(1,579)
Other adjustments for noncash items – net	(2,174)	509	1,505
Net cash provided by operating activities	9,690	9,046	7,393
Investing Activities			
Capital expenditures, net of proceeds from sale or disposal of property, plant and equipment of $414, $354 and $198	(5,997)	(4,572)	(4,142)
Increase in finance assets, net of lease-related repayments of $3,960, $3,760 and $3,703	(3,785)	(5,315)	(4,222)
Cash proceeds from securitizations of finance receivables	3,747	303	586
Additions to licensing costs	(1,978)	(293)	(89)
Net increase in investments	(228)	(165)	(453)
(Acquisitions) dispositions, net of cash acquired	(3,355)	144	(228)
Other investing activities – net	(357)	53	(86)
Net cash used in investing activities	(11,953)	(9,845)	(8,634)
Financing Activities			
Proceeds from long-term debt issuances	5,504	6,134	4,386
Retirements of long-term debt	(4,519)	(5,637)	(5,879)
Issuance of common shares	1,214	973	1,053
Dividends paid	(2,088)	(1,870)	(1,774)
Increase in short-term borrowings – net	1,760	1,746	2,586
Other financing activities – net	87	(32)	25
Net cash provided by financing activities	1,958	1,314	397
Effect of exchange rate changes on cash	5	22	3
Net increase (decrease) in cash and temporary cash investments	(300)	537	(841)
Cash and temporary cash investments at beginning of year	1,208	671	1,512
Cash and temporary cash investments at end of year	$ 908	$ 1,208	$ 671

THE NOTES ON PAGES 38 THROUGH 50 ARE AN INTEGRAL PART OF THE CONSOLIDATED FINANCIAL STATEMENTS.

AT&T Corp. and Subsidiaries (AT&T)
(Dollars in Millions, except per share amounts)

1. Summary of Significant Accounting Policies

Consolidation

The consolidated financial statements include all majority-owned subsidiaries. Investments in which we exercise significant influence but which we do not control (generally a 20% – 50% ownership interest) are accounted for under the equity method of accounting. Generally, investments in which we have a less than 20% ownership interest are accounted for under the cost method of accounting. The fiscal year of most AT&T operations ends December 31.

Currency Translation

For operations outside of the U.S. that prepare financial statements in currencies other than the U.S. dollar, we translate income statement amounts at average exchange rates for the year, and we translate assets and liabilities at year-end exchange rates. We present these translation adjustments as a separate component of shareowners' equity.

Revenue Recognition

REVENUE FROM	BASIS OF RECOGNITION
Telecommunications Services	Minutes of traffic processed and contracted fees
Products and Systems	Percentage-of-completion method for most long-term contracts; upon performance of contractual obligations for others
Rentals and Other Services	Proportionately over contract periods or as services are performed
Financial Services and Leasing	Over the life of the finance receivables using the interest method, or straight-line over life of operating leases

Software Production Costs

Until technological feasibility is established, we expense the costs of developing computer software that we plan to sell, lease or otherwise market, as incurred. After that time, we capitalize the remaining software production costs and amortize them to costs over the estimated period of sales and revenues.

Advertising Costs

We expense costs of advertising as incurred. Advertising expense was $2,265, $2,219 and $1,665 in 1995, 1994 and 1993, respectively.

Investment Tax Credits

We amortize investment tax credits as a reduction to the provision for income taxes over the useful lives of the property that produced the credits.

Earnings Per Share

We use the weighted average number of shares of common stock and common stock equivalents outstanding during each period to compute earnings per common share. Common stock equivalents are stock options that we assume to be exercised for the purposes of this computation.

Temporary Cash Investments

We consider all highly liquid investments with original maturities of generally three months or less to be temporary cash investments.

Inventories

We state inventories at the lower of cost or market (i.e., net realizable value or replacement cost). Cost includes material, labor and manufacturing overhead. We determine cost principally on a first-in, first-out (FIFO) basis.

Property, Plant and Equipment

We state property, plant and equipment at cost and determine depreciation using either the group or unit method. The unit method is used primarily for laboratory equipment, large computer systems, and certain international earth stations and submarine cables. When we sell assets that were depreciated using the unit method, we include the gains or losses in operating results. The group method is used for most other depreciable assets. When we sell or retire plant that was depreciated using the group method, we deduct the original cost from the plant account and from accumulated depreciation.

We use accelerated depreciation methods for factory facilities and digital equipment used in the telecommunications network, except switching equipment placed in service before 1989 and certain high technology computer processing equipment. All other plant and equipment is depreciated on a straight-line basis.

Licensing Costs

Licensing costs are costs incurred to develop or acquire cellular, personal communication services (PCS) and messaging licenses. Generally, amortization begins with the commencement of service to customers and is computed using the straight-line method over a period of 40 years.

Goodwill

Goodwill is the excess of the purchase price over the fair value of net assets acquired in business combinations treated as purchases. We amortize goodwill on a straight-line basis over the periods benefited, principally in the range of 10 to 40 years. Goodwill is reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. If the sum of the expected future cash flows is less than the carrying amount of the asset, a loss is recognized.

Derivative Financial Instruments

We use various financial instruments, including derivative financial instruments, for purposes other than trading. We do not use derivative financial instruments for speculative purposes. Derivatives, used as part of our risk management strategy, must be designated at inception as a hedge and measured for effectiveness both at inception and on an ongoing basis. Gains and losses that do not qualify as hedges are recognized in other income or expense.

Use of Estimates

The preparation of financial statements in conformity with generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and revenues and expenses during the period reported. Actual results could differ from those estimates. Estimates are used when accounting for long-term contracts, allowance for doubtful accounts, inventory obsolescence, product warranty reserves, depreciation and amortization, employee benefit plans, taxes, restructuring reserves and contingencies.

Reclassifications

We reclassified certain amounts for previous years to conform with the 1995 presentation.

2. Restructuring of AT&T

On September 20, 1995, we announced a plan to separate AT&T into three independent, publicly held, global companies that will each focus on serving certain core businesses: communications services (AT&T), communications systems and technology (Lucent Technologies Inc.) and transaction-intensive computing (NCR Corporation). We are planning an initial public offering of approximately 15% of Lucent Technologies Inc. (Lucent) common stock in the first half of 1996 with our remaining interest in Lucent and NCR Corporation (NCR) being spun off to AT&T shareowners by the end of 1996. The plan also includes our intention to pursue the sale of our remaining interest in AT&T Capital Corporation (AT&T Capital) in 1996. Our plan is subject to several conditions, including receipt of a favorable tax ruling and other approvals, and the absence of events or developments that would have a material adverse impact on AT&T or its shareowners. In connection with the plan AT&T, Lucent and NCR have entered into various agreements. These agreements generally provide for the separation and distribution of the operating assets and liabilities and pension plan assets and liabilities, as well as tax sharing and allocation. Additionally, various interim service agreements provide for certain data processing services, telecommunication services and certain support services on specified terms.

3. Changes in Accounting Principles

Impairment of Long-Lived Assets

Effective October 1, 1995, we adopted Statement of Financial Accounting Standards (SFAS) No. 121, "Accounting for Impairment of Long-Lived Assets and for Long-Lived Assets to Be Disposed of." This standard requires that long-lived assets and certain identifiable intangibles held and used by an entity be reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount of an asset may not be recoverable. The adoption of this standard did not materially affect our reported earnings, financial condition or cash flows because this was essentially the same method we used in the past to measure and record asset impairments. Our 1995 restructuring and other charges included recognition of asset impairments.

Postretirement Benefits

We adopted SFAS No. 106, "Employers' Accounting for Postretirement Benefits Other Than Pensions," effective January 1, 1993. This standard requires us to accrue estimated future retiree benefits during the years employees are working and accumulating these benefits. Previously, we expensed health care benefits as claims were incurred and life insurance benefits as plans were funded.

In 1993, we recorded a one-time pretax charge for the unfunded portions of these liabilities of $11,317 ($7,023, or $4.54 per share, after taxes). Apart from these cumulative effects on prior years of the accounting change, this change in accounting had no material effect on net income and it does not affect cash flows.

Postemployment Benefits

We also adopted SFAS No. 112, "Employers' Accounting for Postemployment Benefits," effective January 1, 1993. Analogous to SFAS No. 106, this standard requires us to accrue for estimated future postemployment benefits, including separation payments, during the years employees are working and accumulating these benefits and for disability payments when the disabilities occur. Before this change in accounting, we recognized costs for separations when they were approved and disability benefits when they were paid.

We recorded a one-time pretax charge for the unprovided portion of these liabilities of $1,809 ($1,128, or $0.73 per share, after taxes). This change does not affect cash flows.

Income Taxes

We also adopted SFAS No. 109, "Accounting for Income Taxes," effective January 1, 1993. Among other provisions, this standard requires us to compute deferred tax amounts using the enacted corporate income tax rates for the years in which the taxes will be paid or refunds received.

The adoption of this standard reduced net income by $1,457 ($0.94 per share). Apart from these cumulative effects on prior years of the accounting change, this new accounting method had no material effect on net income in 1993. Unless Congress changes tax rates, we do not expect this change to affect net income materially in future periods. This change does not affect cash flows.

Stock-Based Compensation

In 1996 we will adopt SFAS No. 123, "Accounting for Stock-Based Compensation." This standard establishes a fair value method for accounting for stock-based compensation plans either through recognition or disclosure. We intend to adopt this standard by disclosing the pro forma net income and earnings per share amounts assuming the fair value method was adopted on January 1, 1995. The adoption of this standard will not impact our results of operations, financial position or cash flows.

4. Merger with McCaw Cellular Communications, Inc. (McCaw)

On September 19, 1994, AT&T merged with McCaw, now AT&T Wireless Services. As a result, 197.5 million shares of McCaw common stock were converted into shares of AT&T common stock. In addition, AT&T assumed 11.3 million McCaw stock options which were converted into AT&T stock options at the same exchange ratio. The merger was accounted for as a pooling of interests, and the consolidated financial statements were restated for all periods prior to the merger to include the accounts and operations of McCaw. Merger related expenses of $246 incurred in 1994 ($187 net of taxes) were reported as selling, general and administrative expenses.

5. Purchase of Remaining 48% of LIN Broadcasting

On October 3, 1995, we acquired the remaining 48% of LIN Broadcasting Corporation (LIN), now a wholly-owned subsidiary of AT&T Wireless Services, for a total purchase price of approximately $3.3 billion. The acquisition was accounted for using the purchase method. Accordingly, we allocated the purchase price to assets acquired and liabilities assumed based on their fair values. The allocations were $2.0 billion to licensing costs, $.9 billion to investments, $1.1 billion to goodwill and $.7 billion to deferred taxes. The goodwill and the licensing costs are being amortized on a straight-line basis over 35 years. The initial 52% interest of LIN was acquired by McCaw on March 1, 1990. Accordingly, the results of operations, assets and liabilities of LIN have been included in the consolidated financial statements since March 1, 1990.

6. Preferred Stock Redemption

On June 24, 1994, LCH Communications (LCH), a subsidiary of LIN Broadcasting Corporation, redeemed all $1.3 billion of its outstanding redeemable preferred stock held by Comcast Cellular Communications, Inc. in exchange for all of the capital stock of one of LCH's subsidiaries.

As a result of the redemption, we eliminated the net assets and recorded a gain on the sale of assets of $12 and a tax benefit of $74. The $784 difference between the book value of the preferred stock and the fair value of the assets exchanged was recorded as $408 of additional paid-in capital and $376 of minority interests.

7. Supplementary Financial Information

Supplementary Income Statement Information

	1995	1994	1993
Included in costs			
Amortization of software production costs	$ 365	$ 370	$ 359
Amortization of licensing costs	133	115	108
Cost of financial services and leasing			
Interest expense	$1,049	$ 725	$ 506
Depreciation, provision for losses and other	1,597	1,427	1,205
Total	$2,646	$2,152	$1,711
Included in selling, general and administrative expenses			
Amortization of goodwill	$ 128	$ 97	$ 89

	1995	1994	1993
Other income – net			
Interest income	$101	$ 72	$141
Royalties and dividends	74	30	59
Minority interests in earnings of subsidiaries	(73)	(64)	(9)
Miscellaneous – net	356	255	355
Total other income – net	$458	$293	$546

In June 1993, we sold our remaining 77% interest in UNIX System Laboratories, Inc. to Novell, Inc. (Novell) in exchange for approximately 3% of Novell's common stock. Our gain on the sale was $217. Between 1995 and 1994 we subsequently recognized a cumulative decline of $107 in the value of the stock of Novell.

	1995	1994	1993
Deducted from interest expense			
Capitalized interest	$121	$47	$72

Supplementary Balance Sheet Information

At December 31	1995	1994
Inventories		
Completed goods	$ 2,293	$ 2,022
Work in process and raw materials	1,781	1,611
Total inventories	$ 4,074	$ 3,633
Property, plant and equipment		
Land and improvements	$ 772	$ 761
Buildings and improvements	9,562	9,240
Machinery, electronic and other equipment	38,729	34,797
Total property, plant and equipment	49,063	44,798
Accumulated depreciation	(26,799)	(23,519)
Property, plant and equipment – net	$22,264	$21,279
Investments		
Accounted for by the equity method	$ 3,329	$ 2,314
Stated at cost or fair value	556	394
Total investments	$ 3,885	$ 2,708
Other assets		
Unamortized software production costs	$ 489	$ 483
Unamortized goodwill	1,735	1,007
Deferred charges	378	746
Other	1,627	1,757
Total other assets	$ 4,229	$ 3,993

Supplementary Cash Flow Information

	1995	1994	1993
Interest payments net of amounts capitalized	$1,691	$1,445	$1,728
Income tax payments	1,893	2,047	1,733

The following table displays the noncash items excluded from the consolidated statements of cash flows:

	1995	1994	1993
Machinery and equipment acquired under capital lease obligations	$ 41	$ 13	$ 15
Exchange of stock			
Net assets	$ —	$ 2	$ (43)
Investments	—	—	260
Licenses	32	134	96
Total	$ 32	$136	$ 313
Acquisition/Disposition activities			
Net receivables	$ (46)	$ 24	$ (19)
Inventories	72	(10)	(1)
Property, plant and equipment	(106)	3	(132)
Licensing costs	(1,960)	(79)	5
Accounts payable	1	(8)	7
Short-term and long-term debt	(450)	47	3
Other operating assets and liabilities – net	(866)	167	(91)
Net noncash items consolidated	(3,355)	144	(228)
Net cash (used for) received from acquisitions/dispositions	$(3,355)	$144	$(228)

8. Business Restructuring and Other Charges

In the fourth quarter of 1995, we recorded a pretax charge of $6,248 to cover restructuring costs of $5,336 and asset impairments and other charges of $912. Our fourth quarter charges include plans to restructure our consumer products business to implement major process improvements in how it designs, manufactures and distributes those products; consolidating and reorganizing numerous corporate and business unit operations during the next two years; and selling the AT&T Microelectronics Interconnect business and AT&T Paradyne. Accordingly, the fourth quarter restructure charge of $5,336 included the separation costs for nearly 40,000 employees, of which about 24,000 were management and 16,000 were occupational. As of December 31, 1995, approximately 7,400 management employees have accepted a voluntary severance package and will leave in early 1996. We expect 70% of all separations to be completed by the end of 1996 with the majority of the remaining separations being completed during 1997. The force reductions include about 10,000 corporate-wide staff jobs in functions such as information systems, human resources, financial operations, legal and public relations. The remaining separations will occur within the operating units of the ongoing AT&T and Lucent. The restructuring charge also included costs associated with early termination of building leases and asset write-downs as part of our plan to sell certain businesses and to restructure our operations.

In the third quarter of 1995, we approved the restructuring plans of NCR and recorded a pretax charge totaling $1,597 to cover restructuring costs of $1,547 and other charges of $50. NCR's plans include discontinuing the manufacture of personal computers, consolidating facilities globally, reducing industry markets served, as well as separating about 7,200 employees, including 3,200 in foreign locations. We expect to complete all NCR's restructuring plans by the end of 1996. As of December 31, 1995, about 4,900 employees have left NCR and the remainder will leave in 1996.

In 1993 we recorded a $498 pretax provision for business restructuring. Of the total provision, $227 was related to costs at NCR and $215 was for restructuring customer support functions for telecommunications services. The remainder of the provision consisted of $23 related to closing plants and $33 related to operations that service the U.S. federal government. The total 1993 provision of $498 was recorded as $13 in costs of products and systems, $90 in costs of other services, $373 in selling, general and administrative expenses and $22 in research and development expenses.

The following table displays a rollforward of the liabilities for business restructuring from December 31, 1993 to December 31, 1995:

Type of Cost	Dec. 31, 1993 Balance	1994 Additions	1994 Other	1994 Payments	Dec. 31, 1994 Balance
Employee separations	$ 356	$ 5	$ (52)	$(265)	$ 44
Facility closings	788	21	4	(172)	641
Other	296	8	(67)	(28)	209
Total	$1,440	$34	$(115)	$(465)	$894

Type of Cost	Dec. 31, 1994 Balance	1995 Additions	1995 Other	1995 Payments	Dec. 31, 1995 Balance
Employee separations	$ 44	**$2,712**	**$(22)**	**$(165)**	**$2,569**
Facility closings	641	**895**	**(51)**	**(227)**	**1,258**
Other	209	**837**	**(10)**	**(86)**	**950**
Total	$894	**$4,444**	**$(83)**	**$(478)**	**$4,777**

Other represents reversals of business restructuring reserves no longer required.

The December 31, 1993 business restructuring balance included reserves primarily for real estate, NCR and reengineering operator services. As of December 31, 1995, $469 of the $1,440 December 31, 1993 balance remained. This balance is related to excess space at some locations and is expected to be fully utilized over the remaining terms of the leases.

We believe that the liabilities for business restructuring of $4,777 at December 31, 1995 are adequate to complete our plans.

In 1995 in addition to recording restructuring liabilities of $4,444, asset impairments of $1,734 (which were credited directly to the related asset balances) and $705 of benefit plan losses were included in the total restructure costs of $6,883. Benefit plan losses relate to our pension and other employee benefit plans and primarily represent losses in the current year for actuarial changes that otherwise might have been amortized over future periods.

The fourth quarter charge also included $799 for writing down certain impaired assets, including the write-down in the value of some unnecessary network facilities, the write-down of nonstrategic wireless assets and the reduction in value of some investments. There were no assets to be disposed of or sold included in these write-downs. The third and fourth quarter charges also included $163 of other items, none of which individually exceed 1% of the total charge.

The pretax total of the third and fourth quarter charges of $7,845 for 1995 was recorded as $670 in costs of telecommunications services, $1,676 in costs of products and systems, $717 in costs of rentals and other services, $6 in costs of financial services and leasing, $4,359 in selling, general and administrative expenses and $417 in research and development expenses. If viewed by type of cost, the combined charges reflect $3,417 for employee separations and other related items; $2,533 for asset write-downs; $895 for closing, selling and consolidating facilities; and $1,000 for other items. The total combined charges reduced net income by $5,353 or $3.36 per share. Of the total combined charges, we have made cash payments of $160 as of December 31, 1995 and approximately $4.4 billion will result in payment of cash in the future. Approximately $3.3 billion related to noncash items.

9. Income Taxes

The following table shows the principal reasons for the difference between the effective tax rate and the United States federal statutory income tax rate:

	1995	1994	1993
U.S. federal statutory income tax rate	**35%**	35%	35%
Federal income tax at statutory rate	**$327**	$2,631	$2,101
Amortization of investment tax credits	**(36)**	(33)	(92)
State and local income taxes, net of federal income tax effect	**120**	296	287
Amortization of intangibles	**94**	20	24
Foreign rate differential	**106**	36	45
Taxes on repatriated and accumulated foreign income, net of tax credits	**194**	(71)	(20)
Research credits	**(58)**	(66)	(47)
Effect of tax rate change on deferred tax assets	**—**	—	(23)
Other differences – net	**49**	(5)	26
Provision for income taxes	**$796**	$2,808	$2,301
Effective income tax rate	**85.1%**	37.4%	38.3%

The 1995 effective tax rate is high primarily due to the foreign tax effects associated with the restructuring and other charges.

The U.S. and foreign components of income before income taxes and the provision for income taxes are presented in this table:

	1995	1994	1993
Income before income taxes			
United States	**$ 1,799**	$6,841	$5,705
Foreign	**(864)**	677	298
Total	**$ 935**	$7,518	$6,003
Provision for income taxes			
Current			
Federal	**$ 1,606**	$1,618	$ 925
State and local	**390**	300	206
Foreign	**212**	225	169
	$ 2,208	$2,143	$1,300
Deferred			
Federal	**$(1,023)**	$ 488	$ 910
State and local	**(205)**	155	212
Foreign	**(148)**	60	(41)
	$(1,376)	$ 703	$1,081
Deferred investment tax credits – net*	**(36)**	(38)	(80)
Provision for income taxes	**$ 796**	$2,808	$2,301

*Net of amortization of $36 in 1995, $33 in 1994 and $92 in 1993.

Deferred tax liabilities are taxes we expect to pay in future periods. Similarly, deferred tax assets are recorded for expected reductions in taxes payable in future periods.

Deferred taxes arise because of differences in the book and tax bases of certain assets and liabilities. Deferred tax liabilities and assets consist of the following:

	1995	1994
Long-term deferred income tax liabilities:		
Property, plant and equipment	**$6,981**	$5,872
Investments	**792**	343
Other	**1,568**	1,370
Total long-term deferred tax liabilities	**$9,341**	$7,585
Long-term deferred income tax assets:		
Business restructuring	**$ 853**	$ 479
Net operating loss/credit carryforwards	**410**	175
Employee pensions and other benefits – net	**2,353**	2,618
Reserves and allowances	**329**	141
Valuation allowance	**(293)**	(178)
Other	**490**	437
Total long-term deferred income tax assets	**$4,142**	$3,672
Net long-term deferred income tax liabilities	**$5,199**	$3,913
Current deferred income tax liabilities:		
Total current deferred income tax liabilities	**$ 210**	$ 110
Current deferred income tax assets:		
Business restructuring	**$ 763**	$ 99
Net operating loss/credit carryforwards	**61**	99
Employee pensions and other benefits	**1,546**	1,166
Reserves and allowances	**1,472**	1,126
Valuation allowance	**(61)**	—
Other	**889**	650
Total current deferred income tax assets	**$4,670**	$3,140
Net current deferred income tax assets	**$4,460**	$3,030

At December 31, 1995 we had net operating loss carryforwards (tax affected) for federal and state income tax purposes of $115 and $98, respectively, expiring through 2010. We also had foreign net operating loss carryforwards (tax affected) of $192, of which $145 has no expiration date, with the balance expiring by 2002. Federal and foreign tax credit carryforwards amounting to $65 also exist. The majority of these credits are not subject to expiration. We recorded a valuation allowance to reflect the estimated amount of deferred tax assets which, more likely than not, will not be realized.

10. Leases

As Lessor

We provide financing on sales of our products and those of other companies, primarily through AT&T Capital, and lease our products to customers under sales-type leases. This table displays our net investment in direct financing and sales-type leases that are primarily included in finance receivables:

At December 31	1995	1994
Minimum lease payments receivable	$ 6,699	$5,414
Estimated unguaranteed residual values	731	593
Unearned income	(1,189)	(1,006)
Allowance for credit losses	(166)	(127)
Net investment	$ 6,075	$4,874

This table shows the scheduled maturities for our $6,699 minimum lease payments receivable on these leases at December 31, 1995:

1996	1997	1998	1999	2000	Later Years
$2,574	$1,868	$1,164	$637	$254	$202

We lease airplanes, energy-producing facilities and transportation equipment under leveraged leases having original terms ranging from 10 to 30 years, expiring in various years from 1996 through 2026. Leveraged leases are included in finance receivables on the balance sheet. This table shows our net investment in leveraged leases:

At December 31	1995	1994
Rentals receivable (net of principal and interest on nonrecourse notes)	$ 885	$ 967
Estimated unguaranteed residual values	787	781
Unearned income	(396)	(472)
Allowance for credit losses	(34)	(30)
Investment in leveraged leases	1,242	1,246
Deferred taxes	(1,189)	(1,066)
Net investment	$ 53	$ 180

We lease assets to others through operating leases, the majority of which are cancelable. Assets under operating leases, other than those owned by our finance subsidiaries, are included in property, plant and equipment. This table shows our net investment in operating leases:

At December 31	1995	1994
Machinery, electronic and other equipment	$1,902	$ 1,391
Buildings and land	800	738
Less: Accumulated depreciation	(1,142)	(817)
Net investment	$1,560	$ 1,312

This table shows the $1,030 of future minimum rentals receivable under noncancelable operating leases at December 31, 1995:

1996	1997	1998	1999	2000	Later Years
$384	$224	$127	$60	$35	$200

As Lessee

We lease land, buildings and equipment through contracts that expire in various years through 2026. Our rental expense under operating leases was $1,088 in 1995, $1,098 in 1994 and $1,095 in 1993. The table below shows our future minimum lease payments due under noncancelable leases at December 31, 1995. Such payments total $2,796 for operating leases. The total of minimum rentals to be received in the future under noncancelable subleases related to operating leases as of December 31, 1995 was $586.

1996	1997	1998	1999	2000	Later Years
$546	$461	$360	$293	$238	$898

11. Debt Obligations

Debt Maturing Within One Year

The following table displays the details of debt maturing within one year:

Amount	1995	1994	1993
Commercial paper	$12,829	$10,777	$ 8,761
Long-term debentures and notes	3,236	2,535	2,019
Long-term lease obligations	36	30	52
Other	488	324	231
Total debt maturing within one year	$16,589	$13,666	$11,063
Weighted Average Interest Rate (a)			
Commercial paper	6.0%	4.7%	3.3%
Long-term debt	7.1%	9.7%	10.0%
Average Short-Term Debt Outstanding During the Year			
Amounts	$10,016	$ 8,400	$ 8,010
Weighted average interest rate (a)	6.1%	4.6%	3.7%
Maximum amount of short-term debt at any month end during the year	$13,489	$11,357	$ 9,959

(a) Computed by dividing the average face amount of debt into the aggregate related interest expense.

A consortium of lenders provides revolving credit facilities of $9.5 billion to AT&T and $2.0 billion to AT&T Capital. These credit facilities were unused at December 31, 1995. Both AT&T and AT&T Capital also maintain lines of credit with different consortiums of primarily foreign banks totaling approximately $340 and $1,035, respectively. At December 31, 1995, $304 and $638, respectively, of these foreign lines of credit were unused. The credit facilities, as described above, are intended for general corporate purposes, which include support for AT&T's and AT&T Capital's commercial paper.

Long-term Obligations

This table shows the outstanding long-term debt obligations at December 31:

INTEREST RATES (b)	MATURITIES	1995	1994
Debentures			
4 3/8% to 4 3/4%	1996–1999	$ 750	$ 750
5 1/8% to 7 1/8%	2000–2001	500	500
8 1/8% to 9%	1996–2031	1,999	1,700
Notes			
4 1/4% to 7 3/4%	1995–2025	8,091	6,291
7 4/5% to 8 19/20%	1995–2025	1,397	348
9% to 13%	1995–2020	178	373
Variable rate	1995–2054	1,249	3,187
		14,164	13,149
Long-term lease obligations		166	105
Other		1,140	1,062
Less: Unamortized discount – net		75	69
Total long-term obligations		15,395	14,247
Less: Amounts maturing within one year		3,760	2,889
Net long-term obligations		$11,635	$11,358

(b) NOTE THAT THE ACTUAL INTEREST PAID ON OUR DEBT OBLIGATIONS MAY HAVE DIFFERED FROM THE STATED AMOUNT DUE TO OUR ENTERING INTO INTEREST RATE SWAP CONTRACTS TO MANAGE OUR EXPOSURE TO INTEREST RATE RISK AND OUR STRATEGY TO REDUCE FINANCE COSTS.

This table shows the maturities, at December 31, 1995, of the $15,395 in total long-term obligations:

1996	1997	1998	1999	2000	LATER YEARS
$3,760	$2,071	$1,709	$1,527	$779	$5,549

12. Employee Benefit Plans

Pension Plans

We sponsor noncontributory defined benefit plans covering the majority of our employees. Benefits for management employees are principally based on career-average pay. Benefits for occupational employees are not directly related to pay.

Pension contributions are principally determined using the aggregate cost method and are primarily made to trust funds held for the sole benefit of plan participants. We compute pension cost using the projected unit credit method and assumed a long-term rate of return on plan assets of 9.0% in 1995, 1994 and 1993.

Pension cost includes the following components:

	1995	1994	1993
Service cost – benefits earned during the period	$ 570	$ 669	$ 536
Interest cost on projected benefit obligation	2,551	2,400	2,294
Amortization of unrecognized prior service costs	280	230	251
Credit for expected return on plan assets*	(3,318)	(3,260)	(3,110)
Amortization of transition asset	(500)	(501)	(500)
Charges for special pension options	213	—	74
Net pension credit	$ (204)	$ (462)	$ (455)

*THE ACTUAL RETURN ON PLAN ASSETS WAS $9,484 IN 1995, $582 IN 1994 AND $5,068 IN 1993.

The net pension credit of $204 in 1995 was reduced by a one-time charge of $213 for early retirement options and curtailments.

This table shows the funded status of the defined benefit plans:

AT DECEMBER 31	1995	1994
Actuarial present value of accumulated benefit obligation, including vested benefits of $32,726 and $26,338, respectively	$36,052	$28,801
Plan assets at fair value	$47,634	$40,131
Less: Actuarial present value of projected benefit obligation	37,989	30,125
Excess of assets over projected benefit obligation	9,645	10,006
Unrecognized prior service costs	2,297	2,319
Unrecognized transition asset	(2,961)	(3,460)
Unrecognized net gain	(4,528)	(4,928)
Net minimum liability of nonqualified plans	(166)	(103)
Prepaid pension costs	$ 4,287	$ 3,834

We used these rates and assumptions to calculate the projected benefit obligation:

AT DECEMBER 31	1995	1994
Weighted-average discount rate	7.0%	8.7%
Rate of increase in future compensation levels	5.0%	5.0%

The prepaid pension costs shown above are net of pension liabilities for plans where accumulated plan benefits exceed assets. Such liabilities are included in other liabilities in the consolidated balance sheets.

We are amortizing over approximately 15.9 years the unrecognized transition asset related to our 1986 adoption of SFAS No. 87, "Employers' Accounting for Pensions." We amortize prior service costs primarily on a straight-line basis over the average remaining service period of active employees. Our plan assets consist primarily of listed stocks (including $259 and $216 of AT&T common stock at December 31, 1995 and 1994, respectively), corporate and governmental debt, real estate investments, and cash and cash equivalents.

Savings Plans

We sponsor savings plans for the majority of our employees. The plans allow employees to contribute a portion of their pretax and/or after-tax income in accordance with specified guidelines. We match a percentage of the employee contributions up to certain limits. Our contributions amounted to $408 in 1995, $357 in 1994 and $351 in 1993.

13. Postretirement Benefits

Our benefit plans for retirees include health care benefits, life insurance coverage and telephone concessions. This table shows the components of the net postretirement benefit cost:

	1995	1994
Service cost – benefits earned during the period	**$ 98**	$ 108
Interest cost on accumulated postretirement benefit obligation	**888**	852
Expected return on plan assets*	**(298)**	(243)
Amortization of unrecognized prior service costs	**67**	14
Amortization of net loss (gain)	**(14)**	1
Charge for special options	**11**	—
Net postretirement benefit cost	**$752**	$ 732

*The actual return on plan assets was $962 in 1995 and ($30) in 1994.

We had approximately 146,700 retirees in 1995, 144,900 in 1994 and 142,200 in 1993.

Our plan assets consist primarily of listed stocks, corporate and governmental debt, cash and cash equivalents, and life insurance contracts. The following table shows the funded status of our postretirement benefit plans reconciled with the amounts recognized in the consolidated balance sheets:

At December 31	**1995**	1994
Accumulated postretirement benefit obligation:		
Retirees	**$ 8,250**	$ 7,476
Fully eligible active plan participants	**1,453**	822
Other active plan participants	**2,869**	1,751
Accumulated postretirement benefit obligation	**12,572**	10,049
Plan assets at fair value	**4,704**	3,291
Unfunded postretirement obligation	**7,868**	6,758
Less:		
Unrecognized prior service costs	**771**	(46)
Unrecognized net (gain) loss	**(292)**	(1,012)
Accrued postretirement benefit obligation	**$ 7,389**	$ 7,816

We made these assumptions in valuing our postretirement benefit obligation at December 31:

	1995	1994
Weighted-average discount rate	**7.0%**	8.8%
Expected long-term rate of return on plan assets	**9.0%**	9.0%
Assumed rate of increase in the per capita cost of covered health care benefits	**6.1%**	8.6%

We assumed that the growth in the per capita cost of covered health care benefits (the health care cost trend rate) would gradually decline after 1995 to 4.9% by the year 2005 and then remain level. This assumption greatly affects the amounts reported. To illustrate, increasing the assumed trend rate by 1% in each year would raise our accumulated postretirement benefit obligation at December 31, 1995 by $646 and our 1995 postretirement benefit costs by $53.

14. Stock Options

In our Long-Term Incentive Program, we grant stock options, stock appreciation rights (SARs), either in tandem with stock options or free-standing, and other awards. On January 1 of each year, 0.6% of the outstanding shares of our common stock become available for grant. The exercise price of any stock option is equal to or greater than the stock price when the option is granted. When granted in tandem, exercise of an option or SAR cancels the other to the extent of such exercise. Before our mergers with McCaw, NCR and Teradata, and our purchase of LIN, stock options were granted under the separate stock option plans of those companies. No new options can be granted under those plans.

Option transactions are shown below:

Number of Shares	**1995**	1994	1993
Balance at January 1	**40,284,801**	38,011,478	36,777,098
Options granted	**13,276,698**	5,803,142	7,261,355
Options assumed in purchase of LIN	**3,381,869**	—	—
Options and SARs exercised	**(8,181,161)**	(2,498,132)	(5,766,132)
Average price	**$29.39**	$25.04	$23.93
Options forfeited	**(1,073,142)**	(1,031,687)	(260,843)
At December 31:			
Options outstanding	**47,689,065**	40,284,801	38,011,478
Average price	**$43.21**	$36.61	$33.52
Options exercisable	**28,775,262**	28,010,381	24,063,837
Shares available for grant	**17,524,180**	22,014,728	25,264,307

During 1995, 154,887 SARs were exercised and no SARs were granted. At December 31, 1995, 685,897 SARs remained unexercised and all of these were exercisable.

15. Segment Information

Industry Segments

Our operations in the global information movement and management industry involve providing wireline and wireless telecommunications services, business information processing systems, and other systems, products and services that combine communications and computers. Our operations in the financial services and leasing industry involve direct financing and finance leasing programs for our products and the products of other companies, leasing products to customers under operating leases and being in the general-purpose credit card business. Miscellaneous other activities, including the distribution of computer equipment through retail outlets, in the aggregate, represent less than 10% of revenues, operating income and identifiable assets and are included in the information movement and management segment. Revenues between industry segments are not material.

	1995	1994	1993
Revenues			
Information movement and management	**$75,878**	$71,977	$66,847
Financial services and leasing	**3,731**	3,117	2,504
	$79,609	$75,094	$69,351
Operating income (loss)			
Information movement and management	**$ 1,519**	$ 8,107	$ 6,769
Financial services and leasing	**486**	394	339
Corporate and nonoperating	**(1,070)**	(983)	(1,105)
Income before income taxes	**$ 935**	$ 7,518	$ 6,003
Assets			
Information movement and management	**$66,155**	$56,551	$51,971
Financial services and leasing	**21,368**	21,462	17,033
Corporate assets	**1,839**	1,714	1,104
Eliminations	**(478)**	(465)	(715)
	$88,884	$79,262	$69,393
Depreciation and amortization			
Information movement and management	**$ 4,405**	$ 4,193	$ 4,271
Financial services and leasing	**440**	440	431
Capital expenditures			
Information movement and management	**$ 5,853**	$ 4,244	$ 3,839
Financial services and leasing	**144**	328	303
Total liabilities			
Financial services and leasing	**$19,072**	$19,463	$15,329

Geographic Segments

Transfers between geographic areas are on terms and conditions comparable with sales to external customers. The methods followed in developing the geographic area data require the use of estimation techniques and do not take into account the extent to which product development, manufacturing and marketing depend upon each other. Thus the information may not be indicative of results if the geographic areas were independent organizations.

	1995	1994	1993
Revenues – external customers			
United States	**$70,896**	$67,769	$63,775
Other geographic areas	**8,713**	7,325	5,576
	$79,609	$75,094	$69,351
Transfers between geographic areas (eliminated in consolidation)			
United States	**$ 1,378**	$ 1,679	$ 1,374
Other geographic areas	**1,221**	1,291	1,125
	$ 2,599	$ 2,970	$ 2,499
Operating income (loss)			
United States	**$ 3,792**	$ 8,651	$ 7,355
Other geographic areas	**(1,787)**	(150)	(247)
Corporate and nonoperating	**(1,070)**	(983)	(1,105)
Income before income taxes	**$ 935**	$ 7,518	$ 6,003
Assets			
United States	**$76,624**	$69,718	$63,194
Other geographic areas	**12,085**	9,361	6,901
Corporate assets	**1,839**	1,714	1,104
Eliminations	**(1,664)**	(1,531)	(1,806)
	$88,884	$79,262	$69,393

Data on other geographic areas pertain to operations that are located outside of the U.S. Our revenues from all international activities, including those in the table, international telecommunications services and exports, provided 26.2% of consolidated revenues in 1995, 25.2% in 1994 and 24.4% in 1993.

Corporate assets are principally cash and temporary cash investments.

Concentrations

As of December 31, 1995, we are not aware of any significant concentration of business transacted with a particular customer, supplier or lender that could, if suddenly eliminated, severely impact our operations. We also do not have a concentration of available sources of supply materials, labor, services, licenses or other rights that could, if suddenly eliminated, severely impact our operations.

16. Contingencies

In the normal course of business we are subject to proceedings, lawsuits and other claims, including proceedings under laws and regulations related to environmental and other matters. Such matters are subject to many uncertainties, and outcomes are not predictable with assurance. Consequently, we are unable to ascertain the ultimate aggregate amount of monetary liability or financial impact with respect to these matters at December 31, 1995. These matters could affect the operating results of any one quarter when resolved in future periods. However, we believe that after final disposition, any monetary liability or financial impact to us beyond that provided for at year-end would not be material to our annual consolidated financial statements.

AT&T and Lucent have entered into an agreement pursuant to which AT&T and affiliates will purchase from Lucent products and services totaling at least $3,000 cumulatively for the calendar years 1996, 1997 and 1998.

17. Financial Instruments

In the normal course of business we use various financial instruments, including derivative financial instruments, for purposes other than trading. We do not use derivative financial instruments for speculative purposes. These instruments include commitments to extend credit, letters of credit, guarantees of debt, interest rate swap agreements and foreign currency exchange contracts. Interest rate swap agreements and foreign currency exchange contracts are used to mitigate interest rate and foreign currency exposures. Collateral is generally not required for these types of instruments.

By their nature all such instruments involve risk, including the credit risk of nonperformance by counterparties, and our maximum potential loss may exceed the amount recognized in our balance sheet. However, at December 31, 1995 and 1994, in management's opinion there was no significant risk of loss in the event of nonperformance of the counterparties to these financial instruments. We control our exposure to credit risk through credit approvals, credit limits and monitoring procedures and we believe that our reserves for losses are adequate. We do not have any significant exposure to any individual customer or counterparty, nor do we have any major concentration of credit risk related to any financial instruments.

Commitments to Extend Credit

We participate in the general-purpose credit card business through AT&T Universal Card Services Corp., a wholly-owned subsidiary. We purchase essentially all cardholder receivables under an agreement with the Universal Bank, a subsidiary of Synovus Financial Corporation, which issues the cards. The unused portion of available credit was approximately $72,179 at December 31, 1995 and $75,445 at December 31, 1994. This represents the receivables we would need to purchase if all Universal Card accounts were used up to their full credit limits. The potential risk of loss associated with, and the estimated fair value of, the unused credit lines is not considered to be significant.

Letters of Credit

Letters of credit are purchased guarantees that ensure our performance or payment to third parties in accordance with specified terms and conditions.

Guarantees of Debt

From time to time, we guarantee the financing for product purchases by customers outside the U.S., and the debt of certain unconsolidated joint ventures.

Interest Rate Swap Agreements

We enter into interest rate swaps to manage our exposure to changes in interest rates and to lower our overall costs of financing. We enter into swap agreements to manage the fixed/floating mix of our debt portfolio in order to reduce aggregate risk to interest rate movements. Interest rate swaps also allow us to raise funds at floating rates and effectively swap them into fixed rates that are lower than those available to us if fixed-rate borrowings were made directly. These agreements involve the exchange of floating-rate for fixed-rate payments or fixed-rate for floating-rate payments without the exchange of the underlying principal amount. Fixed interest rate payments are at rates ranging from 4.68% to 11.59%. Floating-rate payments are based on rates tied to prime, LIBOR or U.S. Treasury bills. Interest rate differentials paid or received under these swap contracts are recognized over the life of the contracts as adjustments to the effective yield of the underlying debt. If we terminate a swap agreement, the gain or loss is recorded as an adjustment to the basis of the underlying asset or liability and amortized over the remaining life.

The following table indicates the types of swaps in use at December 31, 1995 and 1994 and their weighted average interest rates. Average variable rates are those in effect at the reporting date and may change significantly over the lives of the contracts.

	1995	1994
Fixed to variable swaps – notional amount	$1,657	$ 746
Average receive rate	6.46%	6.82%
Average pay rate	5.63%	5.91%
Variable to fixed swaps – notional amount	$2,896	$3,677
Average pay rate	6.23%	5.56%
Average receive rate	5.83%	6.11%

The weighted average remaining terms of the swap contracts are 5 years for both 1995 and 1994.

Foreign Exchange

We enter into foreign currency exchange contracts, including forward, option and swap contracts, to manage our exposure to changes in currency exchange rates, principally Canadian dollars, Deutsche marks, pounds sterling and Japanese yen. Some of the contracts involve the exchange of two foreign currencies, according to the local needs of foreign subsidiaries. The use of these derivative financial instruments allows us to reduce our exposure to the risk that the eventual dollar net cash inflows and outflows, resulting from the sale of products to foreign customers and purchases from foreign suppliers, will be adversely affected by changes in exchange rates. Our foreign exchange contracts are designated for firmly committed or forecasted purchases and sales. These transactions are generally expected to occur in less than one year. For firmly committed sales and purchases, gains and losses are deferred in other current assets and liabilities. These deferred gains and losses are recognized as adjustments to the underlying hedged transactions when the future sales and purchases are recognized, or immediately if the commitment is cancelled. Gains or losses on foreign exchange contracts that are designated for forecasted transactions are recognized in other income as the exchange rates change. Amounts deferred relating to firm commitments at December 31, 1995 and 1994, were unrealized gains of $9 and $4, respectively, and unrealized losses of $7 and $10, respectively.

Fair Values of Financial Instruments Including Derivative Financial Instruments

The tables below show the valuation methods and the carrying or notional amounts and estimated fair values of material financial instruments. The notional amounts represent agreed upon amounts on which calculations of dollars to be exchanged are based. They do not represent amounts exchanged by the parties and, therefore, are not a measure of our exposure. Our exposure is limited to the fair value of the contracts with a positive fair value plus interest receivable, if any, at the reporting date.

FINANCIAL INSTRUMENT	VALUATION METHOD
Universal Card finance receivables	Carrying amounts. These accrue interest at a prime-based rate.
Other finance receivables excluding leases	Future cash flows discounted at market rates.
Debt excluding capital leases	Market quotes or based on rates available to us for debt with similar terms and maturities.
Letters of credit	Fees paid to obtain the obligations.
Guarantees of debt	Costs to terminate agreements.
Interest rate swap agreements	Gains or losses to terminate agreements.
Interest rate cap agreements	Costs to obtain agreements.
Foreign exchange contracts	Market quotes.

	1995		1994	
	Carrying Amount	**Fair Value**	Carrying Amount	Fair Value
On balance sheet instruments				
Assets:				
Finance receivables other than leases	**$12,064**	**$12,108**	$13,553	$13,528
Liabilities:				
Debt excluding capital leases	**28,058**	**28,717**	24,919	24,449

	1995	1994
	Contract/ Notional Amount	Contract/ Notional Amount
Derivatives and off balance sheet instruments		
Interest rate swap agreements	**$4,553**	$4,423
Interest rate cap agreements	**—**	1,333
Foreign exchange:		
Forward contracts	**3,260**	3,068
Swap contracts	**756**	340
Option contracts	**22**	—
Letters of credit	**919**	834
Guarantees of debt	**731**	518

	1995			
	Carrying Amount		**Fair Value**	
	Asset	**Liability**	**Asset**	**Liability**
Derivatives and off balance sheet instruments				
Interest rate swap agreements	**$12**	**$ 8**	**$65**	**$99**
Foreign exchange:				
Forward contracts	**44**	**46**	**29**	**48**
Swap contracts	**1**	**10**	**7**	**66**
Letters of credit	**—**	**—**	**2**	**—**

	1994			
	Carrying Amount		Fair Value	
	Asset	Liability	Asset	Liability
Derivatives and off balance sheet instruments				
Interest rate swap agreements	$ 9	$ 2	$142	$27
Interest rate cap agreements	2	—	2	—
Foreign exchange:				
Forward contracts	37	39	44	61
Swap contracts	—	5	16	6
Letters of credit	—	—	2	—

Securitization of Receivables

For the years ended December 31, 1995, 1994 and 1993, we securitized portions of our short-term and long-term finance receivable portfolios amounting to $3,575, $259 and $562, with proceeds received of $3,579, $288 and $649, respectively. We continue to service these accounts for the purchasers. At December 31, 1995 and 1994, $4,059 and $853, respectively, of receivables previously securitized remained outstanding. Our maximum exposure under limited recourse provisions, in the unlikely event that all such receivables became uncollectible, amounted to $255 at December 31, 1995 and $353 at December 31, 1994. We have recorded a liability for the amount that we expect to reimburse to the purchasers.

18. AT&T Credit Holdings, Inc.

In connection with a March 31, 1993 legal restructuring of AT&T Capital Holdings, Inc. (formerly AT&T Capital Corporation), we issued a direct, full and unconditional guarantee of all the outstanding public debt of AT&T Credit Holdings, Inc. (formerly AT&T Credit Corporation). At December 31, 1995, $417 of the guaranteed debt remained outstanding.

AT&T Credit Holdings, Inc. holds the majority of AT&T's investment in AT&T Capital and the lease finance assets of the former AT&T Credit Corporation. The table below shows summarized consolidated financial information for AT&T Credit Holdings, Inc. The summarized financial information includes transactions with AT&T that are eliminated in consolidation.

	1995	1994	1993
Total revenue	$ 1,762	$1,437	$1,432
Interest expense	422	302	284
Selling, general and administrative expense	444	387	329
Income before cumulative effect of change in accounting	119	92	70
Cumulative effect on prior years of change in accounting for income taxes (SFAS No. 109)	—	—	22
Net income	$ 119	$ 92	$ 48
Finance receivables	$ 9,111	$7,726	
Net investment in operating lease assets	1,118	903	
Total assets	11,061	9,468	
Total debt	7,028	5,682	
Total liabilities	9,750	8,299	
Minority interest	299	270	
Total shareowners' equity	$ 1,012	$ 899	

19. Sale of Stock by Subsidiary

In August 1993, AT&T Capital sold 5,750,000 shares of common stock in an initial public offering and approximately 850,000 shares of common stock in a management offering. The shares sold represented approximately 14% of the shares outstanding, decreasing our ownership to 86%. The shares were sold at $21.50 per share, yielding net proceeds of $115 excluding $18 of recourse loans attributable to the management offering. Because of these loans, we recorded a $9 loss on the sale in 1993.

The plan announced on September 20, 1995 includes our intent to sell our remaining 86% interest in AT&T Capital either to another company or through a public offering. While the sale requires changes to certain existing agreements between AT&T and AT&T Capital, we expect the sale to be completed by the end of 1996. The recourse loans attributable to the management offering will become due and payable upon disposition of our remaining interest.

20. Quarterly Information (unaudited)

	First	Second	Third	Fourth
1995				
Total revenues	$18,262	$19,512	$19,704	$22,131
Gross margin	7,545	8,144	7,361	7,029
Net income (loss)	1,198	1,355	262	(2,676)
Per common share:				
Net income (loss)	.76	.85	.16	(1.67)
Dividends declared	.33	.33	.33	.33
Stock price*:				
High	53 1/4	53 3/4	66 3/8	68 1/2
Low	47 5/8	47 7/8	51 3/8	60 1/4
Quarter-end close	51 3/4	53	65 3/4	64 3/4
1994				
Total revenues	$17,097	$18,238	$18,649	$21,110
Gross margin	6,952	7,390	7,747	8,623
Net income	1,074	1,248	1,050	1,338
Per common share:				
Net income	.69	.80	.67	.85
Dividends declared	.33	.33	.33	.33
Stock price*:				
High	57 1/8	57 1/8	55 7/8	55 1/4
Low	50 5/8	49 1/2	52 1/2	47 1/4
Quarter-end close	51 1/4	53 3/8	54	50 1/4

*Stock prices obtained from the Composite Tape.

In the fourth quarter of 1995, we recorded $6,248 of charges which reduced net income by $4,181 or $2.61 per share.

In the third quarter of 1995, we recorded $1,597 of charges at NCR which reduced net income by $1,172 or $0.74 per share.

In the third quarter of 1994, we recorded $227 of costs ($169 net of taxes or 11 cents per share) related to the McCaw merger primarily consisting of legal and investment banking fees and bonus pool funding.

BOARD OF DIRECTORS

ROBERT E. ALLEN, 60
Chairman of the Board and Chief Executive Officer of AT&T since 1988. Director since 1984.6,8

KENNETH T. DERR, 59
Chairman and Chief Executive Officer of Chevron Corporation, an international oil company. Elected to Board in 1995.

M. KATHRYN EICKHOFF, 56
President of Eickhoff Economics Inc., a business consulting firm. Elected to Board in 1987.1,5

WALTER Y. ELISHA, 63
Chairman and Chief Executive Officer of Spring Industries, Inc., a textile manufacturing firm. Director since 1987.2,4,7

PHILIP M. HAWLEY, 70
Retired Chairman and Chief Executive Officer of Broadway Stores, Inc. (formerly Carter Hawley Hale Stores, Inc.), department stores. Director since 1982.2,3,4

CARLA A. HILLS,* 61
Chairman and Chief Executive Officer of Hills & Company international consulting firm and former U.S. Trade Representative. Elected to Board in 1993.1,2,5

BELTON K. JOHNSON, 66
Former owner of Chaparrosa Ranch. Chairman of Belton K. Johnson Interests. Director since 1974.3,5,6,8

RALPH S. LARSEN, 57
Chairman and Chief Executive Officer of Johnson & Johnson, a diversified health care company. Elected to Board in 1995.

DREW LEWIS,* 64
Chairman and Chief Executive Officer of Union Pacific Corporation, a rail transportation, natural resources and trucking company. Elected to Board in 1989.1,2,5

ALEX J. MANDL, 52
President and Chief Operating Officer of the new AT&T. Served as Chief Financial Officer of AT&T and Group Head of AT&T Communications Services since joining the company in 1991. Elected to Board in 1996.

DONALD F. McHENRY, 59
President of IRC Group, international relations consultants; educator and former U.S. Ambassador to the United Nations. Director since 1986.3,7

VICTOR A. PELSON, 58
Chairman of AT&T Global Operations Team and Executive Vice President of AT&T. Elected to Board in 1993.5

DONALD S. PERKINS,* 68
Retired Chairman, Jewel Companies, Inc. Director since 1979.2,3,6,7,8

HENRY B. SCHACHT,† 61
Chairman of the Executive Committee and former Chief Executive Officer of Cummins Engine Company, Inc., manufacturer of diesel engines. Elected to Board in 1981.1,5

MICHAEL I. SOVERN, 64
President Emeritus and Chancellor Kent Professor of Law at Columbia University. Director since 1984.1,4

FRANKLIN A. THOMAS,* 61
President of The Ford Foundation. Elected to Board in 1988.1,2,5

JOSEPH D. WILLIAMS, 69
Retired Chairman and Chief Executive Officer of Warner-Lambert Company, a pharmaceutical, health care and consumer products company. Director since 1984.4,6,7

THOMAS H. WYMAN, 66
Chairman of S. G. Warburg & Co. Inc., investment bankers. Director since 1981.2,4,7

Our thanks and best wishes to Philip Hawley and Vic Pelson, who will retire March 1996.

* Expected to join the Board of Lucent Technologies.

†Will resign to become Chairman and CEO of Lucent Technologies coincident with the company's Initial Public Offering.

1. Audit Committee
2. Committee on Directors
3. Committee on Employee Benefits
4. Compensation Committee
5. Corporate Public Policy Committee
6. Executive Committee
7. Finance Committee
8. Proxy Committee

1995 MANAGEMENT EXECUTIVE COMMITTEE

The Management Executive Committee of the integrated AT&T was dissolved as 1995 ended and new leadership teams were formed. Our thanks and best wishes to those officers who went on to other assignments in the new operating units (indicated on page 52), as well as to John Mayo, who retired in February 1995 as President of AT&T Bell Laboratories; Vic Pelson, who will retire in March; and Dick Bodman, who will retire in April to become Managing General Partner of a new AT&T venture capital fund.

NEW LEADERSHIP TEAMS

AT&T

ROBERT E. ALLEN*
Chairman and Chief Executive Officer.1,2

ALEX J. MANDL*
President and Chief Operating Officer.1,2

HARRY BENNETT
Vice President and General Manager and Acting Head - Local Services

HAROLD W. BURLINGAME*
Executive Vice President - Human Resources.2

PIER CARLO FALOTTI
President - AT&T International and AT&T Europe.2

STEVEN W. HOOPER
President and Chief Executive Officer - AT&T Wireless Services

DAVID K. HUNT
President and Chief Executive Officer - AT&T Universal Card Services

FRANK IANNA
Vice President and General Manager - Network and Computing Services Division

MARILYN LAURIE*
Executive Vice President - Public Relations and Employee Information.2

GAIL J. McGOVERN
Executive Vice President - Business Markets Division.2

VICTOR E. MILLAR
President and Chief Executive Officer - AT&T Solutions

RICHARD W. MILLER*
Senior Executive Vice President and Chief Financial Officer.1,2

JOSEPH P. NACCHIO
Executive Vice President - Consumer and Small Business Division.2

JOHN C. PETRILLO
Executive Vice President - Strategy and New Offer Development. 2

RON J. PONDER
Executive Vice President - Operations and Service Management and Chief Information Officer.2

JOHN D. ZEGLIS*
General Counsel and Senior Executive Vice President - Policy Development and Operations Support.1,2

Other officers:

S. LAWRENCE PRENDERGAST
Vice President and Treasurer

MAUREEN B. TART
Vice President and Controller

MARILYN J. WASSER
Vice President - Law and Secretary

1. Chairman's Office
2. Executive Policy Council

LUCENT TECHNOLOGIES

HENRY B. SCHACHT
Chairman-designate and Chief Executive Officer

RICHARD A. McGINN*
President and Chief Operating Officer and Director-designate

CURTIS R. ARTIS
Senior Vice President - Human Resources

JAMES K. BREWINGTON
President - Network Systems Product Realization

GERALD J. BUTTERS
President - Network Systems North American Region

JOSEPH S. COLSON, JR.
President - Network Systems AT&T Customer Business Unit

CURTIS J. CRAWFORD
President - Microelectronics

CARLETON S. FIORINA
Executive Vice President - Corporate Operations

KATHLEEN M. FITZGERALD
Senior Vice President - Public Relations and Investor Relations

WILLIAM B. MARX JR.*
Senior Executive Vice President

ARUN N. NETRAVALI
Vice President - Research, Bell Laboratories

WILLIAM T. O'SHEA*
President - Network Systems International Regions and Professional Services

DONALD K. PETERSON
Executive Vice President and Chief Financial Officer

RICHARD J. RAWSON
Senior Vice President and General Counsel

PATRICIA F. RUSSO
President - Business Communications Systems

DANIEL C. STANZIONE*
President - Bell Laboratories and President - Network Systems

NCR

LARS NYBERG*
Chief Executive Officer

RAYMOND G. CARLIN
Senior Vice President - The Americas Region

ROBERT R. CARPENTER
Senior Vice President - Worldwide Services

ROBERT A. DAVIS
Senior Vice President - Quality and Reengineering

WILLIAM J. EISENMAN
Senior Vice President - Computer Systems Group

DANIEL J. ENNEKING
Senior Vice President - Systemedia Group

RICHARD H. EVANS
Senior Vice President - Global Human Resources

ANTHONY E. FANO
Senior Vice President - Retail Systems Group

RONALD L. FOWINKLE
Senior Vice President and Chief Information Officer

JOHN L. GIERING
Senior Vice President and Chief Financial Officer

JONATHAN S. HOAK
Senior Vice President and General Counsel

PER-OLOF LOOF
Senior Vice President - Financial Systems Group

DENNIS A. ROBERSON
Senior Vice President and Chief Technical Officer

JOSE LUIS SOLLA
Senior Vice President - Europe, Middle East/Africa Region

HIDEAKI TAKAHASHI
Senior Vice President - Asia/Pacific Region

MICHAEL P. TARPEY
Senior Vice President - Public Relations

*Former member AT&T Management Executive Committee

INVESTOR INFORMATION

CORPORATE HEADQUARTERS

AT&T
32 Avenue of the Americas
New York, NY 10013-2412

Internet users can access information on AT&T and its products and services at: http://www.att.com/.

ANNUAL MEETING

The 111th Annual Shareowners Meeting will convene at 9:30 a.m. Wednesday, April 17, 1996, at the James L. Knight International Center in the Convention Center in Miami, Florida.

SHAREOWNER SERVICES

Questions about stock-related matters should be directed to AT&T's shareowner services and transfer agent, First Chicago Trust Co. of NY:

AT&T
c/o First Chicago Trust Co. of NY
P.O. Box 2575
Jersey City, NJ 07303-2575
800 348-8288

Shareholders with e-mail addresses can send inquiries electronically. First Chicago Trust's Internet address is fctc@attmail.com. AT&T Mail Service subscribers should address inquiries to !fctc.

Persons outside the U.S. may call collect to 201 324-0293.

Persons using a telecommunications device for the deaf (TDD) or a teletypewriter (TTY) may call: 800 822-2794.

The First Chicago Trust address to which banks and brokers may deliver certificates for transfer is 14 Wall Street in New York City.

To hear information or ask questions about AT&T's restructuring, call our special toll-free number: 800 756-8500.

DIVIDEND REINVESTMENT

The Dividend Reinvestment and Stock Purchase Plan provides owners of common stock a convenient way to purchase additional shares. You may write or call First Chicago Trust for a prospectus and enrollment form.

STOCK DATA

AT&T (ticker symbol "T") is listed on the New York Stock Exchange, as well as on the Boston, Midwest, Pacific and Philadelphia exchanges in the U.S., and on stock exchanges in Brussels, London, Paris, Geneva and Tokyo.

Shareowners of record as of December 29, 1995: 2,190,940.

PUBLICATIONS

AT&T's annual report to the Securities and Exchange Commission, Form 10-K, is available without charge by writing or calling First Chicago Trust Co.

The following publications are available by writing or calling the sources indicated:

AT&T Capital Corporation
Annual Report and/or Form 10-K:
Corporate Communications
44 Whippany Road
Morristown, NJ 07962-1983
800 235-4288 or 201 397-3000

AT&T Foundation Report
Room 3100
1301 Avenue of the Americas
New York, NY 10019-1035

AT&T and the Environment
Department AR
131 Morristown Road
Room B1220
Basking Ridge, NJ 07920-1650

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AT&T

32 Avenue of the Americas
New York, NY 10013-2412
212 387-5400

Our Common Bond

We commit to these values to guide our decisions and behavior

Respect for Individuals

We treat each other with respect and dignity, valuing individual and cultural differences. We communicate frequently and with candor, listening to each other regardless of level or position. Recognizing that exceptional quality begins with people, we give individuals the authority to use their capabilities to the fullest to satisfy their customers. Our environment supports personal growth and continuous learning for all AT&T people.

Dedication to Helping Customers

We truly care for each customer. We build enduring relationships by understanding and anticipating our customers' needs and by serving them better each time than the time before. AT&T customers can count on us to consistently deliver superior products and services that help them achieve their personal or business goals.

Highest Standards of Integrity

We are honest and ethical in all our business dealings, starting with how we treat each other. We keep our promises and admit our mistakes. Our personal conduct ensures that AT&T's name is always worthy of trust.

Innovation

We believe innovation is the engine that will keep us vital and growing. Our culture embraces creativity, seeks different perspectives and risks pursuing new opportunities. We create and rapidly convert technology into products and services, constantly searching for new ways to make technology more useful to customers.

Teamwork

We encourage and reward both individual and team achievements. We freely join with colleagues across organizational boundaries to advance the interests of customers and shareowners. Our team spirit extends to being responsible and caring partners in the communities where we live and work.

By living these values, AT&T aspires to set a standard of excellence worldwide that will reward our shareowners, our customers, and all AT&T people.

AT&T 1994 Annual Report

With 5% of the $1.5 trillion global information industry, AT&T is a small fish with lots of room  to grow.

AT&T 1994

THE WORLD'S NETWORKING LEADER

We are dedicated to being the world's best at bringing people together–giving them easy access to each other and to the information and services they want and need–anytime, anywhere.

AT&T provides communications services and products, as well as network equipment and computer systems, to businesses, consumers, communications services providers and government agencies. Our Worldwide Intelligent Network carries more than 175 million voice, data, video and facsimile messages every business day. AT&T Bell Laboratories engages in basic research as well as product and service development. AT&T also offers a general-purpose credit card and financial and leasing services. We do business in some 200 countries.

- **Revenues grew at the best rate since we became the new AT&T, to a record $75.1 billion.** Products and systems sales were the major sources of that growth, with telecommunications services showing the strongest increase in nine years and financial services continuing double-digit gains.

- **Our operating income, net income and earnings per share all rose,** after restating prior years for the merger with McCaw. Not only did this merger add to our revenues and earnings, it also makes us a leader in wireless services.

- **The company continued to have strong cash flow.** This helps fund dividends and research and development. It also helps pay for investments to fuel our future growth, such as network improvements, financial assets and international expansion.

1994 Highlights

Dollars in millions (except per share amounts)	1994	1993	Percent Change
Revenues			
Telecommunications Services	**$ 43,425**	$ 41,623	4.3%
Products and Systems	**21,161**	17,925	18.1
Rentals and Other Services	**7,391**	7,299	1.3
Financial Services and Leasing	**3,117**	2,504	24.5
Total Revenues	**$ 75,094**	$ 69,351	8.3%
Income			
Operating Income	**$ 8,030**	$ 6,568	22.3%
Income before Accounting Changes	**4,710**	3,702	27.2
Accounting Changes	**-**	(9,608)	-
Net Income (Loss)	**4,710**	(5,906)	-
Per Common Share			
Income before Accounting Changes	**$ 3.01**	$ 2.39	25.8%
Accounting Changes	**-**	(6.21)	-
Net Income (Loss)	**3.01**	(3.82)	-
Dividends Declared	**1.32**	1.32	-
Stock Price at Year-End	**50.25**	52.50	(4.3)
Other Information			
Cash Provided by Operations	**$ 8,956**	$ 7,424	20.6%
Cash Used for Investing Activities	**9,755**	8,665	12.6
Total Assets at Year-End	**79,262**	69,393	14.2
Total Employees at Year-End	**304,500**	317,700	(4.2)

At AT&T, our core strength is our ability to build and manage networks that deliver services of value to customers.

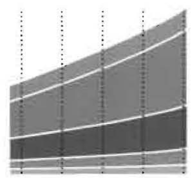
Our business is based on building long-term, multi-faceted relationships with customers who can increasingly look to AT&T for their communications and information needs.

The AT&T Worldwide Intelligent Network is the world's most advanced and reliable. It is central to our ability to connect people with people and people with information.

But our network does not stand alone. It is enhanced by what we uniquely offer: a business that combines communications, computing and network products and systems.

Networking is becoming increasingly vital in managing all aspects of people's personal and business lives. In fact, it is at the very heart of what has become a new global information industry. This report outlines our growth opportunities in this new industry and describes how we are well positioned to capitalize on them.

Contents



Principal photographer: Frank Moscati

We're taking the lead in creating a world where smart networks connect to smart devices, giving people easy access to each other and to the advanced information services that will enrich the way they live, work and play.

Dear Shareowners

If you're like most readers of the AT&T annual report, you're holding a printed copy in your hand right now.

But you could also be sitting at a computer screen, looking at this report in electronic form — as well as browsing through other information about AT&T on the Internet.

Offering our report electronically is just one example of how the powerful combination of communications and computing is changing lifestyles and raising expectations of customers all over the world.

AT&T intends to meet those expectations.

I am confident because I am so proud of the job being done by AT&T people (more than 300,000 of them). By serving customers well, they have delivered our most profitable year since we became the "new AT&T" in 1984, satisfying analysts' expectations and producing record revenues at the same time.

The eddies and hurricanes swirling through our industry today provide us with opportunities on a scale that few, if any, companies have had before.

Earnings per share were $3.01; margins were higher at 41 percent; and top-line revenue growth was $5.7 billion. In fact, that revenue growth alone exceeded the annual revenues of 80 percent of the companies in the 1994 *Fortune* 500 listing. We also arranged sales of more than $1 billion in assets that were not a strategic fit with our mission.

This financial performance wasn't rewarded by the stock market in 1994, but we believe the fundamentals are sound and the market will respond accordingly.

You'll see in this annual report some major efforts in 1994 to make sure that AT&T is up to the job ahead. We made key alliances with other leading companies in the communications industry and in the related industries now converging in the marketplace for information technology. Each of these partnerships will leverage the intelligence in our network with the intelligence in customer devices to create powerful and unique services for our customers. AT&T WorldWorx™ Solutions, for example, enables teams of people at locations all over the world to see and talk with each other on their various desktop computers while sharing files in real time.

We completed the merger with McCaw Cellular Communications, positioning AT&T for leadership in wireless services, the fastest growing segment of our industry.

Supported by the R&D leadership of AT&T Bell Laboratories, we introduced many new products and services that speak to the needs of a society on the go. We became the first company to offer 500 service, for example, which gives mobile consumers and corporate road warriors a "follow me anywhere" phone number they can keep for life.

In a tough competitive environment, we showed our mettle. In different segments of communications services, we regained or held market share — helped immensely by our "True" campaign. We increased share in our equipment businesses — and won major infrastructure contracts in the United States, China, Saudi Arabia and other countries.

We were buoyed by winning America's highest quality award for the third time, and this year we won Japan's most prestigious award for quality as well. The diversity of our workforce and leadership team was also improved, strengthening our ability to meet the needs of an increasingly diverse customer base.

Perhaps the best measure of quality is the ability to deliver customer satisfaction — again and again and again. As we sharpen our focus on customers, AT&T is taking on the intensity of an Olympic training camp. In world-class competition, there is no substitute for constant improvement.

Looking ahead, we see a number of challenges.

We have important work to do in knocking down internal barriers and making it easier for customers to get the full benefit of all of AT&T's capabilities.

More and more consumers and businesses are looking for someone who can combine services and equipment into communications offers that really meet their lifestyle or management needs. So we must marshal all of our resources to serve customers well in two ways: First, with products and services on a stand-alone basis. And second, with packaged or integrated offers — customized to specific consumer segments or the complex needs of businesses.

Along with the challenges posed by our familiar competitors, we face nontraditional competition from new entrants in the highly dynamic information market. This double-edged competition makes it essential to hold down costs and offer competitive pricing, while not letting up on continuous innovation.

We also still have a lot to learn about managing the complex outside partnerships that are essential to our future. Not all these ventures will work (bumps and detours are part of the Information Superhighway), but we must forge alliances around the world to stimulate our own thinking and enhance our ability to meet emerging customer needs with increasingly better products and services.

We're proud of how far our globalization effort has come, but AT&T people recognize that there's also a good deal yet to learn about operating a truly global business.

Finally, it is critically important that we make our voice heard on the public policy front. In America, that means requiring real competition for local telephone service before permitting the local telephone monopolies to enter the highly competitive long distance market. In other countries, we must press for the right to compete with the same freedom competitors from those nations enjoy in the United States.

So the future won't lack for challenges. But the eddies and hurricanes swirling through our industry today provide us with opportunities on a scale that few, if any, companies have had before.

AT&T is smack in the middle of an emerging global information industry that's advancing at breakneck speed. This is a $1.5 trillion industry today with every prospect of doubling in size early in the new century.

As the cover of this report emphasizes, we have plenty of room to grow. We're going after that growth with a

strategy built around AT&T's strength as the world's networking leader. We're taking the lead in creating a world where smart networks connect to smart devices, giving people easy access to each other and to the advanced information services that will enrich the way they live, work and play.

No other company on earth has AT&T's potential to lead this market and to grow long-term value for shareowners and customers at the same time. We won't do it without the help of strategic partners, and we certainly won't do it without competition.

But we will do it.

Robert E. Allen
Chairman
February 9, 1995

The world is shrinking. Information is exploding. Industries are converging. Opportunities are emerging. Networking is at the very heart of the new global information industry. And it's what we do best.

Growth Opportunities

Think back just three years ago. Unless you were an academic or a computer hacker, chances are you had never heard of the worldwide computer network known as the Internet. And you weren't tired of references to the Information Superhighway because no one was talking about that either.

A lot has happened. More trans-Atlantic telecommunications circuits were added in the past three years than in all previous history. The Internet now connects some 25 million people worldwide. Electronic mail, voice mail and portable phones have become everyday staples for many.

At the same time, half the world is still waiting to make its first phone call, and the waiting period for a phone line in some countries is 10 years.

The good news is that many of them may not be waiting much longer. Developing countries now recognize the indisputable links between communications capability and economic development.

What has so many people excited is that this new industry is worth well over $1 trillion today and it's growing 8 to 10 percent annually.

What does all this mean to the shareowners and employees of AT&T? In a word, *opportunity*.

As technologies and industries converge to meet expanding demand for everything from portable communications to information services to interactive entertainment, what is emerging is a new "global information industry."

What has so many people excited is that this new industry is estimated to be worth well over $1 trillion today and it's growing 8 to 10 percent annually.

What has us at AT&T excited is our good fortune to be at the very heart of this convergence, which gives us the ability to greatly expand our current 5 percent share of the global markets created.

As the distinctions between communications and computing have blurred, we have carved out a leadership position in networking, combining the best of both technologies to benefit customers in new ways.

As computers, phones, TVs and fax machines merge to produce intelligent hybrids like home "information appliances," multimedia systems and personal digital assistants, we have expertise in virtually all the technologies employed.

As the world clamors for everything from basic telecommunications to palm-held information devices to home shopping, we offer a full range of supporting products and services — from integrated circuits to switching systems, and from voice and data communications to audio processing and messaging systems.

We also have considerable expertise in software, the enabling technology behind many "information age" products and services. One out of every 10 AT&T people is engaged in software development.

Besides technical expertise, we have the skills to provide customized, integrated offers — either alone or in concert with partners attracted by the strength of our brand, the power of our technology and the skills of our people.

Not that there aren't challenges. Growth opportunities have a way of attracting formidable competitors.

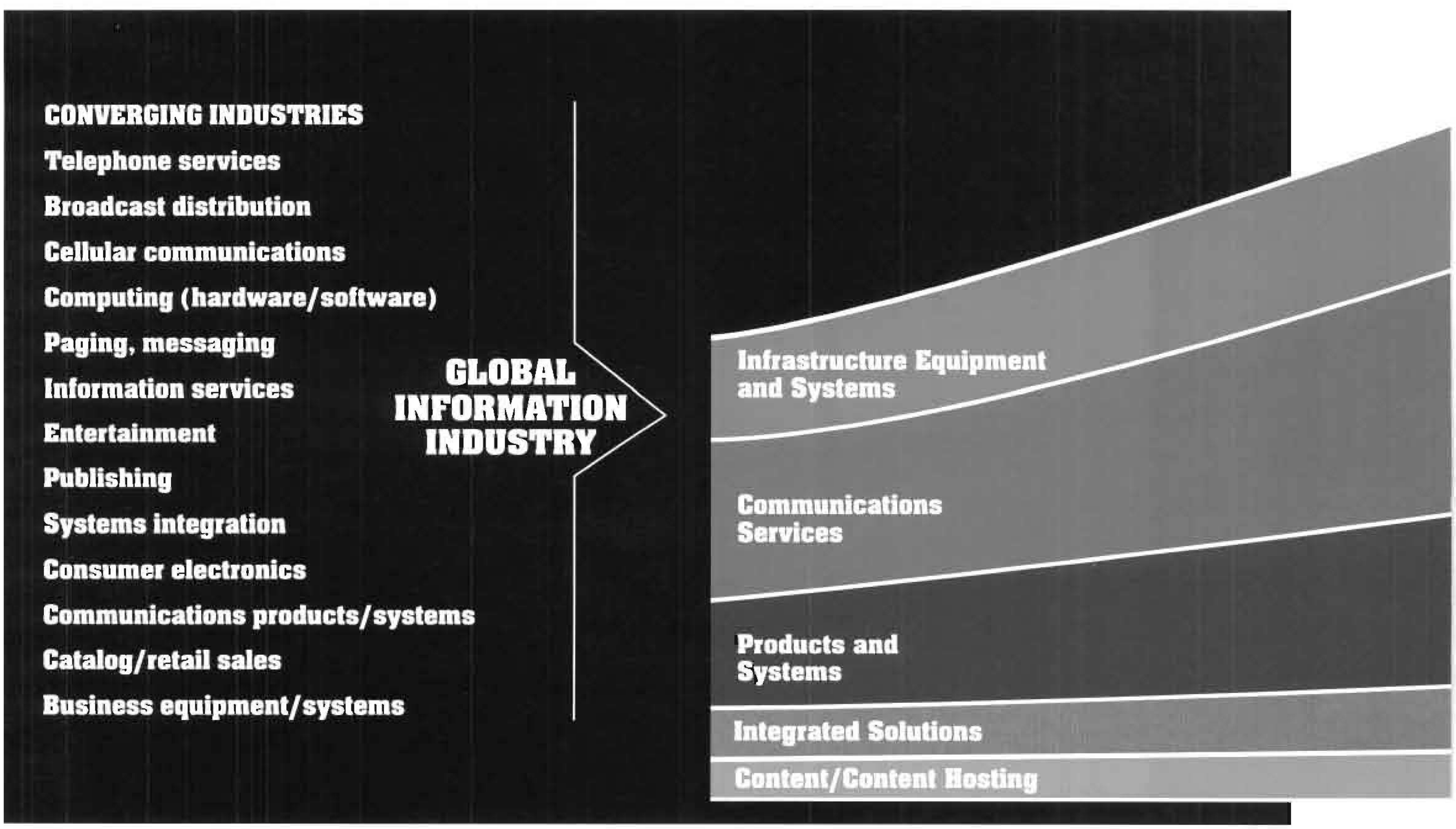
We can't predict exactly how the information industry will evolve, but we know that the breadth of our participation greatly increases our chances to capitalize on its growth.

The New Global Information Industry

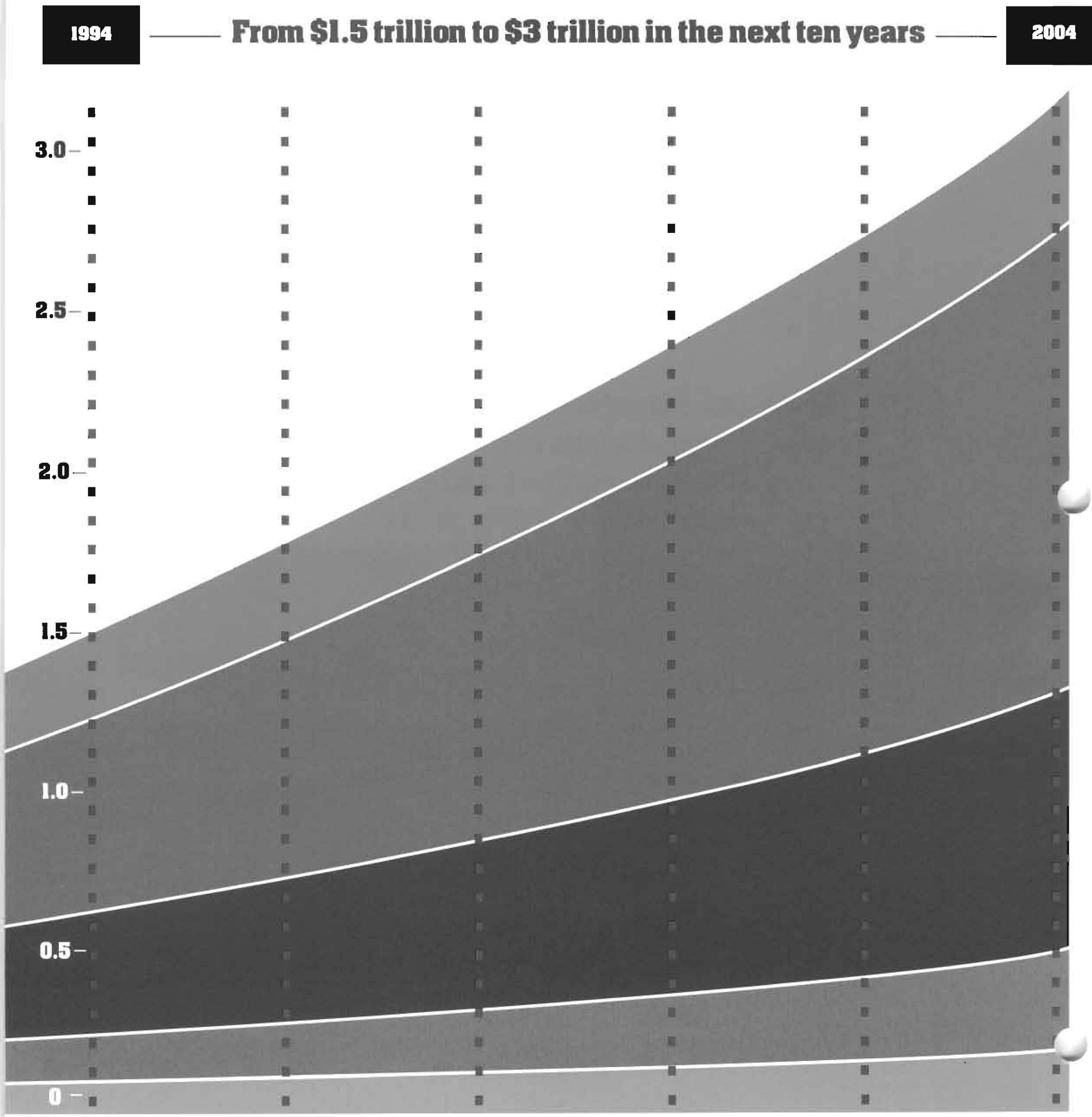
"As technologies and industries converge, what is emerging is a new 'global information industry.' The new marketplace will no longer be divided along current sectoral lines. There may not be cable companies or phone companies or computer companies, as such.... There will be information conduits, information providers, information appliances and information consumers."

—U.S. Vice President Al Gore

Here's one way of looking at some of the developing markets in the new global information industry and AT&T's opportunities within them.



Turn the page to see how these market trends might affect you.



1994
From $1.5 trillion to $3 trillion in the next ten years
2004
3.0
2.5
2.0
1.5
1.0
0.5
0

Growth Markets

'94 Market Size/ Annual Growth*	Market Drivers	AT&T's Role	Some Key Players
Infrastructure Equipment and Systems **$150 billion / 9%**	Expansion and modernization of global networks, new telecommunications providers, demand for multimedia and other new capabilities.	Hardware, software and systems integration supporting global networking of voice, data and video. Includes microelectronics, switching, transmission, wireless, satellite and operating systems; massively parallel and scalable computing; database management; fiber optics and applications software.	AT&T Alcatel Ericsson Intel Motorola NEC Northern Telecom Siemens
Communications Services **$750 billion / 7%**	Demand for comprehensive packaged offers, mobile communications and information sharing; increased traffic; reduced regulation.	Traditional and emerging voice, data and video communications services. Includes U.S. and international long distance; mobile, air-to-ground, paging, messaging, voice processing, language interpretation and interactive voice, data and video services; electronic mail and electronic data interchange.	AT&T British Telecommunications Cable companies Local telephone companies MCI NTT Sprint
Products and Systems **$400 billion / 7%**	Need for easy-to-use, multi-use, "smart" communications and computing devices offering access to new services.	Communications, computing and other equipment for consumers and businesses worldwide. Includes corded, cordless and cellular communications devices; multimedia personal computers; desktop videoconferencing systems; answering, audio processing and messaging equipment; modems; and retail, financial and other business systems.	AT&T Apple Compaq Hewlett-Packard IBM Matsushita Motorola Sony
Integrated Solutions **$100 billion / 12%**	Increasing time and cost pressures on businesses, growing sophistication and interdependence of communications and computing networks.	Systems integration, network management, transaction-management and other end-to-end solutions and professional services that bring together the benefits of numerous technologies for customers so that they can concentrate on their businesses.	AT&T Andersen Consulting EDS IBM
Content/Content Hosting **$50 billion / 12%**	Global demand for entertainment, home shopping, home banking and on-line access to information.	Development and management of interface systems and software that help people navigate a wide variety of information and entertainment choices from content providers.	AT&T Cable companies Local telephone companies Matsushita Microsoft The News Corporation Sony Time Warner

*compound annual growth rate

Growth Initiatives

Infrastructure Equipment and Systems

Time Warner, Bell Atlantic, Southern New England Telephone, GTE and others chose AT&T as prime contractor for their expansions into new technologies and new markets. AT&T broke ground on Pacific Bell's multibillion-dollar network upgrade.

AT&T provided the equipment for an ultra-high-speed voice, data, and video communications link between China and Hong Kong — and signed a long-term partnership agreement with China worth $500 million over the next five years. We plan to double our workforce in China in the next two years.

Communications Services

The McCaw merger positioned AT&T as the largest wireless service provider in the U.S. McCaw's subscriber base grew dramatically in 1994.

WorldPartners, the AT&T-supported alliance that offers global companies seamless communications services, extended its direct reach to 26 countries. Signing on were three partners of Unisource — a consortium of Dutch, Swedish and Swiss telephone companies — plus others in Australia, Hong Kong, Korea and New Zealand.

Products and Systems

The Vistium™ Personal Video System 1200, half the price of similar products, hit the market just as the desktop conferencing market heated up. Demand for such systems is so high the software is standard on AT&T Globalyst™ personal computers.

Integrated Solutions

AT&T and Delta Air Lines formed TransQuest Information Solutions, a joint venture to develop computing and communications services such as electronic ticketing for the airline industry. Estimated venture revenues from Delta alone are $2.8 billion over 10 years.

Content/Content Hosting

AT&T formed a new unit to offer a family of interactive electronic services such as home entertainment and access to on-line information from publishers and other content providers.

Revenues for network systems outside the U.S. grew 20 percent in 1994. AT&T won the largest telecommunications contract ever awarded outside the U.S. — $4 billion in Saudi Arabia — and, in Argentina, the largest cellular contract ever awarded outside the U.S.

AT&T supported videoconferencing with a new microchip that boosts quality and global reach — at half the price of the chip it replaces. Sales of electronic components were up overall, with sharp growth outside the U.S.

AT&T WorldPlus® Service gives global travelers hassle-free communications in more than 45 countries — a toll-free number to tap into local and international calling, speed dialing, messaging, interpretation and information services.

AT&T launched an aggressive campaign in 43 states to compete in the $16 billion market for local toll calls. Our share of the consumer market alone more than doubled by year end.

WorldWorx™ Solutions delivers "video dial tone" using the AT&T network. People can now plug in a variety of computer systems and communicate face to face while sharing data in real time.

The AT&T TV Information Center works with your television to serve up local traffic and weather, sports scores, stock quotes, electronic banking and telephone answering services at a fraction of the cost of a personal computer.

Another new "intelligent device"(left) was designed for the growing legions of home-office workers. The Two-Line Personal Information Center 882 has built-in caller identification, speakerphone, calendar and personal directory features, helping customers put all their contacts and reminders at their fingertips.

Rover, the UK's top automobile producer, began managing its distribution network with an AT&T on-line tracking system. Linking manufacturing plants, distributors and dealers in regional hubs cut inventory levels by 40 percent and reduced delivery times.

Great Western Bank, the world's seventh largest savings institution, chose AT&T to design and manage its entire data network. The deal, worth $160 million over seven years, will give Great Western a more reliable network so it can serve its customers better and more cost-effectively.

AT&T entered the business market for on-line services by buying the Interchange Online Network from publisher Ziff Communications. It's one way AT&T intends to provide open and intelligent hosting networks so information providers and software companies can offer products and services electronically.

ImagiNation Network, the premier on-line interactive game network, joined the AT&T family. Its growing subscriber base includes physically challenged people who "get together" regularly to play bridge and newlyweds who met while playing chess.

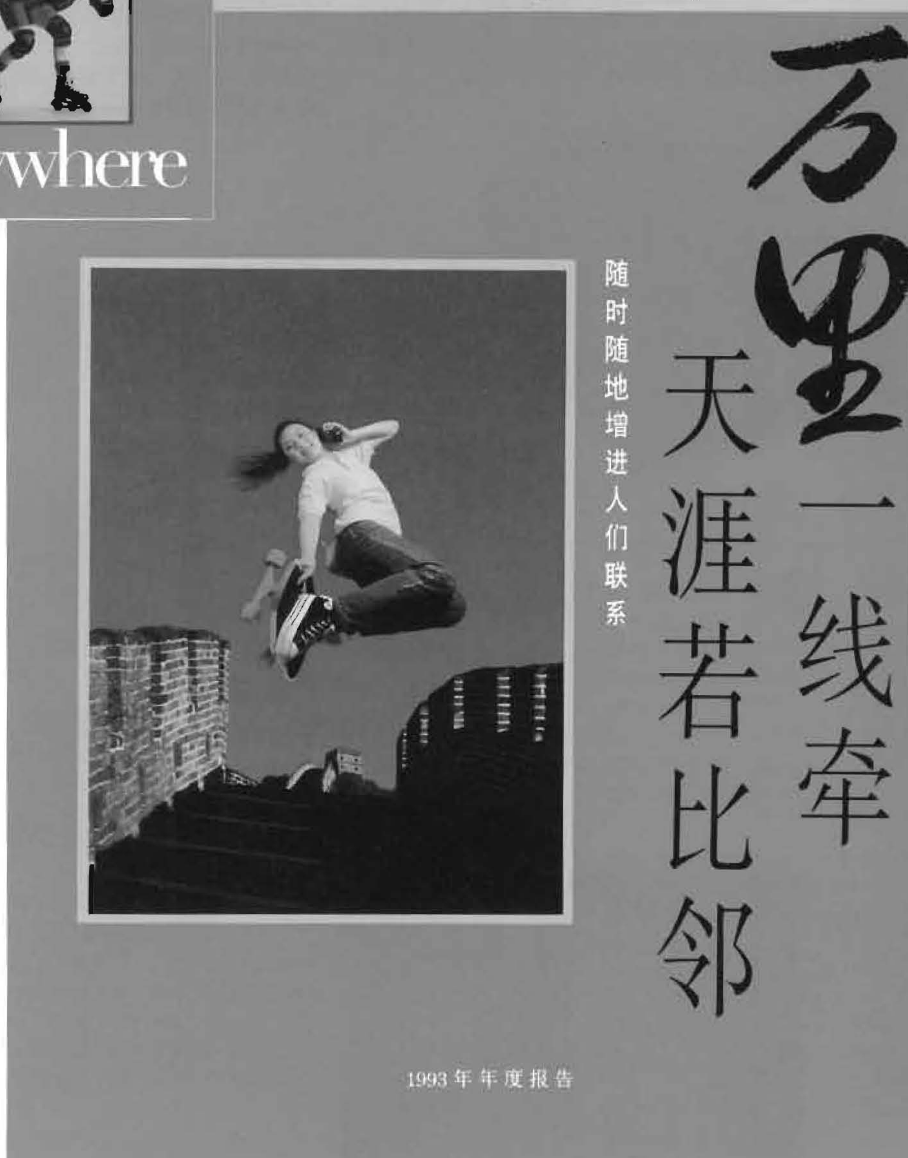
Year in Review

Some growth opportunities in the global information age may be new, but we're capitalizing on them by focusing on proven strategies: dedication to customers, quality, global expansion, innovation—and alliances with partners who can help us turn opportunities into successful products and services.

And while we're doing all that, we're also looking for ways to cut costs and speed product and service delivery.

Our commitment to growth is evident in our most widely publicized 1994 accomplishment, our merger with McCaw, as well as in other highlights of the year.

But the global information industry is doing more than providing growth opportunities for AT&T. It's changing the way we all live, work and learn—for the better.



The Chinese version of last year's annual report, showing a young woman skateboarding at the Great Wall, speaks volumes about how we're globalizing and bringing people together — *anytime, anywhere*. China is the world's largest undeveloped telephone market. AT&T is one of China's largest telecommunications suppliers.

Growth through Wireless Expansion

More than 17,000 new customers sign up for cellular service each day. Two out of every three new phone numbers are assigned to wireless customers.

What people clearly want today is the freedom to communicate with people, not places. The growth in wireless services tells the tale.

The cellular phone industry chalked up its 10 millionth customer in 1992, its ninth year in existence, making it one of the fastest growing consumer electronics product industries in history. Then it went on to double that base less than two years later.

Who better to capitalize on that growth than the combined forces of the leading wireless provider, McCaw Cellular Communications, and AT&T. The merger, completed in September, has a host of benefits.

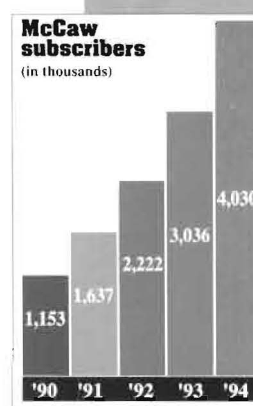
Greater sales and service firepower through the brand recognition and resources of AT&T. More innovative products and services by combining McCaw's expertise with that of AT&T Bell Laboratories. And, eventually, one-stop shopping for both wired and wireless communications.

During 1994, our new cellular unit not only grew its revenues by more than 30 percent, it expanded the number of customers served by high-quality digital service. In November it announced its first AT&T-branded product, the first wireless data receiver with a graphic display.

In January of 1995, it introduced the nation's first wireless caller identification feature, allowing customers to use their cellular phone more selectively by screening incoming calls.

One reason the merger has gone so smoothly is that both companies not only share the same commitment to growth, they share the same focus on customers, quality and innovation and the same philosophy about being open to new ideas that give people control of their communications.

McCaw's subscriber base has been increasing well over 30 percent for the last few years and shows no signs of abating.




WALKER

The doctor will see you now

By the time the ambulance arrived at Atlanta's Grady Hospital, the patient's injury was already diagnosed and a surgical team was prepped and ready in a third-floor operating room.

That's because he'd already been "seen" by a physician at the hospital, thanks to AT&T Picasso™ Phone images transmitted by paramedics from the accident site to the emergency room.

The scene pictured is simulated, but situations like it have become commonplace at several hospitals where Emory University is conducting clinical trials.

Sending such images over regular phone lines used to be cumbersome and expensive, and images were poor. The Picasso Phone is changing all that. It even works over cellular networks.

Specialists in urban areas can now examine medical images of patients miles away, instantly, advising local physicians on treatment without leaving their offices.

Doctors can make "virtual house calls" with the help of medical assistants equipped with portable systems. Soon medical records may routinely shuttle from physician to physician across phone lines, speeding treatment and cutting costs.

Some estimate that broad use of telemedicine could slash $36 billion annually from the U.S. health care bill alone.

Growth through Customer Focus

Revenues grew more than 8 percent during 1994, a good indication that we're addressing customers' needs in highly competitive markets.

Strip away the strategic and marketing complexities and one fundamental truth remains: The key to a growing business is giving customers what they want — and need.

Contributing to our success in 1994 were revamped consumer long distance offers first announced in the closing days of 1993. Customers told us they wanted simple plans. We gave them simple plans. The result: Combined enrollment in AT&T True USA℠ Savings and AT&T True Rewards℠ programs topped 31 million in 1994, making them the most successful long distance promotions in history.

Business customers told us network reliability and performance were critical to their success. Making the most of our strong suit, we introduced the industry's first comprehensive set of guarantees for voice and fax services.

Many countries the world over looking for world-class telecommunications systems at competitive prices found what they wanted at AT&T. As one securities analyst noted, we have become the preferred supplier to the world.

While buoyed by revenue growth across all of our major business groups, we weren't lulled into complacency. Our Global Information Solutions, Network Systems and Business Communications Services units redesigned their operations around customer-focused teams. Those teams are charged with understanding the needs of specific customer groups and delivering products, services and integrated solutions that meet those needs.

Not satisfied with its phenomenal success in the credit card arena, Universal Card Services introduced the Something Extra℠ program. It's the first program in the industry to reward cardmembers every month whether they make new purchases or choose to pay off purchases over time.

Customer service representatives like John Lee were hard pressed to keep up with demand for our redesigned long distance offers. We ended the year with a net gain of a million residential customers.


AT&T
AT&T

A world of opportunity

Two years ago, the Czech Republic didn't even have a stock market. Today, thanks to AT&T's DEFINITY® private phone switch and CONVERSANT® interactive voice technology, Lubomir Pužej's customers can get around-the-clock stock quotes and buy and sell stocks by phone.

Like Pužej, of Prague's Harvard Capital and Consulting Company, businesses and countries worldwide are skipping entire stages of technological and economic development. They're finding that optical fiber, digital switches and wireless transmission systems offer shortcuts to prosperity.

The fast-growing Moscow suburb of Mitino leapfrogged from 300 telephone lines to 30,000 in 1994 by installing a state-of-the-art AT&T 5ESS® switch. Now Irina Osipenkova won't have to wait years for a telephone.

Argentina found the quickest and most cost-effective way to supply service to 100 rural towns and enhance business communications with the rest of the world was to invest in a cellular network using AT&T equipment. Latin America's $10 billion telecommunications infrastructure equipment market is one of the fastest growing in the world.

Growth through Quality

AT&T is the only company to receive America's highest quality award three times.

While our attention was riveted on customers, our efforts did not go unnoticed by independent experts with a trained eye for quality and customer satisfaction. Our consumer long distance unit received America's highest honor for quality in 1994, the Malcolm Baldrige National Quality Award. In 1992, AT&T Universal Card Services and AT&T Transmission Systems scored an unprecedented double win.

Our integrated circuit plant in Florida garnered yet another honor, the Shingo Prize for excellence in American manufacturing.

The Republic of China singled out AT&T Taiwan Telecommunications as the winner of its National Quality Award for achievements in quality business practices and management.

To top things off, AT&T snared top honors in all categories of *Data Communications* magazine's annual survey of long distance data services customers. *PC World* magazine rated AT&T Global Information Solutions "best" in personal computer reliability and service support. And AT&T walked off with nine Enterprise Technology Awards from *Network World* readers.

Not only did our consumer long distance unit win the Malcolm Baldrige National Quality Award in 1994, AT&T Power Systems became the first American manufacturing company to win Japan's top quality honor, the prestigious Deming Prize.

Growth through Globalization

Revenues from operations outside the U.S. grew more than 31 percent in 1994. We now have more than 50,000 employees outside the U.S.

Many of our growth opportunities lie outside the United States. We're well positioned to take advantage of them, having made good progress in our globalization efforts during 1994.

Nations are privatizing and modernizing their network infrastructures because such investment is recognized as a springboard to economic growth in the highly competitive global marketplace.

continued on page 17

Have phone, will travel

Rhonda Brown is a woman on the move. And she doesn't make a move without her cellular phone.

A review judge with the Washington State Employment Security Department, she can enjoy son Averill's swimming lesson and still keep tabs on her home office in Tacoma and state offices 40 miles away in Lacey.

Brown, who has a muscle and nerve disorder, depends on cellular service for security. She also finds it and other "anytime, anywhere" communications advancements help her manage her busy professional and personal lives.

She's not alone. More and more people are working at home — and on the road — thanks to cellular phones, fax machines, electronic mail and other communications tools.

A third of the U.S. adult workforce aged 18 or over now work at home at least some of the time. Industry-wide, the work-at-home market generated $23 billion in long distance calling alone in 1994.

AT&T offers an array of products and services to meet the needs of this burgeoning market.

We're responding by providing many of the necessary building blocks.

Three years ago, our Global Business Communications Systems unit offered products in 15 countries. Now it sells systems in nearly 90 countries and has doubled its sales outside the United States every year for the past three years.

In 1994 we also devised a way to deliver consumer products efficiently in an international marketplace. Instead of redesigning devices to meet the technical standards in each country, we developed the first phone containing new AT&T integrated circuitry that can be reprogrammed easily to meet any national standard.

We're also making headway on the services front. Case in point: We announced plans to form a joint venture with Grupo Alfa, a leading Mexican business consortium, to deliver communications services in Mexico. Mexico's telecommunications market is expected to expand rapidly as it triples its telephone lines by the year 2000.

Bell Labs' Bob Tkach and Andy Chraplyvy set a new world's record for lightwave transmission, sending the equivalent of 5 million simultaneous phone calls over a single pair of optical fibers. That's 100 times more than any existing commercial system.

Growth through Innovation

AT&T Bell Laboratories, our world-renowned research arm, churned out its 25,000th patent during the year. That's virtually a patent a day since its inception in 1925.

You can launch a company with one good idea, but at AT&T we understand that long-term success requires dedication to continual innovation. In our case, that means constantly searching for new technology and new ways to make technology more useful to customers.

Bell Labs is a key participant in a research and development effort to build and test a high-speed optical communications network that would enable low-cost delivery of such services as interactive town meetings and on-line shopping.

But Bell Labs doesn't have a monopoly on innovation at AT&T. It's something we strive for in the introduction of every product and service and in the design of every manufacturing process or customer service procedure.

It's evident in the AT&T Paradyne® Dataport® 2001 modem. Cited in *Popular Science* magazine's 1994 "Best of What's

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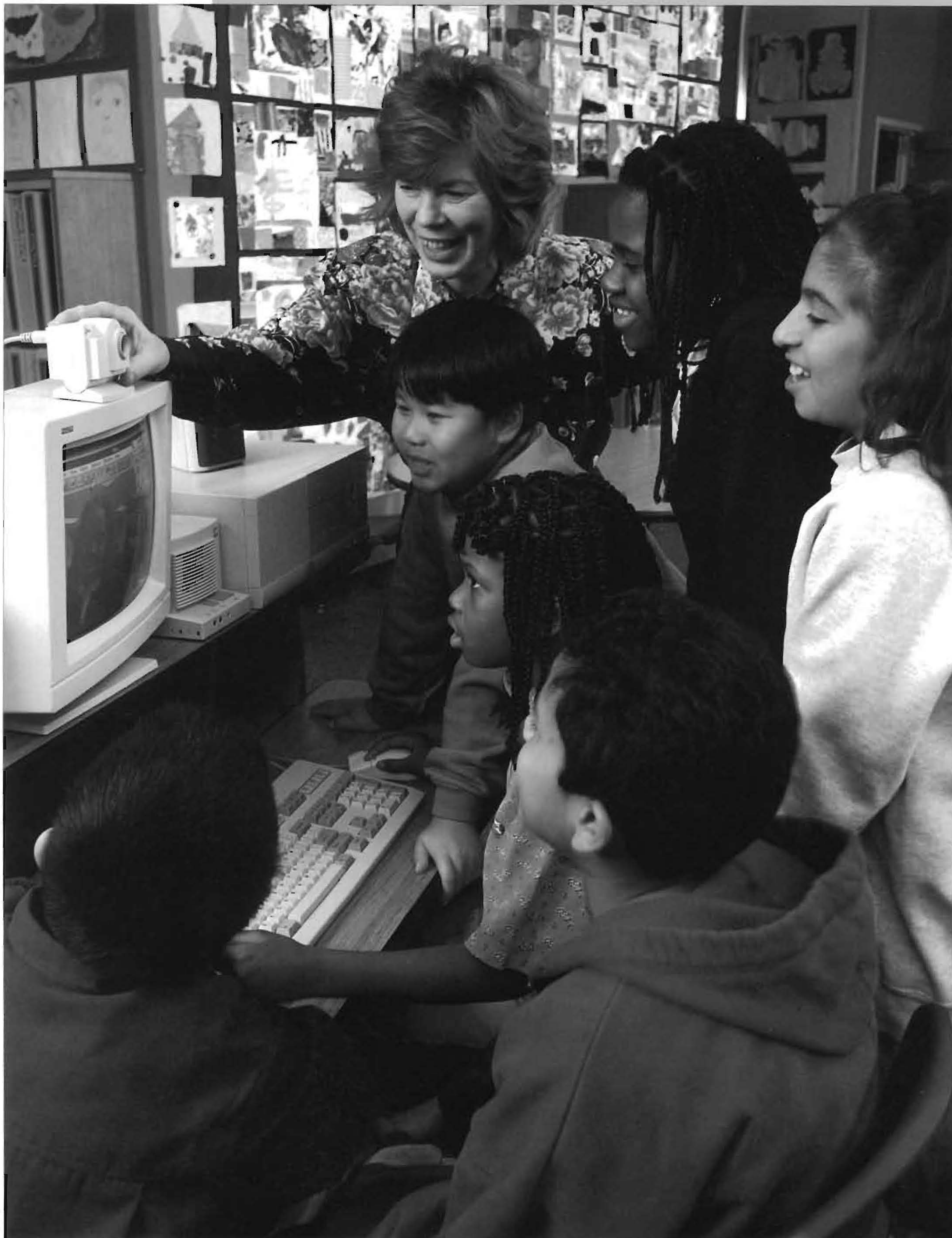


Room with a view

Students traditionally turn toward a window when they want a glimpse of the outside world. Fourth-graders at San Francisco's Bryant Elementary School turn to their AT&T Vistium™ Personal Video Systems.

As participants in "Education First," a school networking initiative sponsored by Pacific Bell, they're linked to 11 other California schools and the county library. Thanks to AT&T multimedia technology and equipment, they can videoconference and share information simultaneously.

This means that when teacher Virginia Davis assigns a book report on dinosaurs, the local librarian can host an on-screen tour of the library's card catalog and tantalize them with full-color, full-motion images of Tyrannosaurus rex. Soon they'll use AT&T-provided software to explore the worldwide Internet computer network.

We've seen the benefits of distance learning in a variety of AT&T-sponsored projects using electronic mail networks: Physically disabled Tennessee teens who can be "just kids" when communicating electronically. Native American students in Montana sharing their Crow heritage with peers in Germany.

Networking has the power to bring down classroom walls and open endless possibilities.

New" issue, it splits a single telephone line into two virtual channels to carry voice and data.

You can even find it in services like AT&T Talking Package Service. Thanks to a creative application of our voice-messaging technology, customers can deliver a personal message, pre-recorded on the AT&T network, to a loved one along with a birthday gift.

Even when an innovation like the AT&T EO 440 Personal Communicator doesn't meet our expectations in the marketplace, it yields valuable insights about customers and technology—insights that form the foundation for the next generation of innovation.

Network Notes℠ makes Lotus Development Corporation's Lotus Notes® computer data-sharing capabilities available on the AT&T network. This means that businesses like Egghead Software can make their catalogs available to AT&T network users, increasing information channels and potential sales.

Growth through Alliances

Our brand power and our experience with corporate alliances serve us well, putting us in a position to attract good partners and forge solid relationships.

Rapid-fire technological and business developments require us to be flexible and fleet of foot. Sometimes the quickest and most cost-effective way to respond is to link our expertise to that of like-minded partners.

Among the many alliances we struck in 1994, several in particular illustrate the value of such relationships in serving customer needs.

We formed the Versit Partnership with Apple, IBM and Siemens to better link computer and telephone systems so people can exchange information and communicate using a variety of devices.

Building on software from other providers, we launched AT&T OneVision™ Network Management Solutions. The open-systems design approach makes it possible for businesses to manage their phone and data systems as one.

Capitalizing on the burgeoning market for interactive services such as movies on demand, in 1994 we also formed a joint venture with visual-computing innovator Silicon Graphics. Together we're developing software and equipment for companies interested in providing interactive services to homes and businesses.

We Keep Our Word

One reason we're confident we can succeed in the global information age is that we know how to set ambitious goals and make good on them. Our financial results are evident on the following pages. Here are some other goals we set for ourselves and how we have performed against them. As a result of our progress against these goals, we begin 1995 in a better position to serve customers and the communities in which we live and work.

Reduce reportable toxic air emissions 95 percent by year-end 1995.

As 1994 began, our toxic air emissions worldwide were 92 percent lower than when we established our goal in 1987. We also met our commitment to phase out ozone-depleting chlorofluorocarbon (CFC) emissions from manufacturing operations — 19 months ahead of schedule.

Recycle 60 percent of our paper by year-end 1994 and reduce our use of paper 15 percent from 1990 levels.

We exceeded our goal before 1994, recycling 63 percent of our waste paper (48 million pounds) and reducing our use of paper by 28 percent.

Improve the diversity profile of our workforce to better serve the needs of our diverse customer base.

Some 35 percent of management employees hired in 1994 were women, and 28 percent, minorities. The representation of these groups in the officer ranks is also up sharply: 12 percent are now women and nearly 10 percent are minorities.

Increase our purchases from U.S. businesses owned by minorities and women by 10 percent.

We surpassed our goal, increasing such purchases by 34 percent while deriving additional sales and savings benefits from these relationships.

Increase our support of community organizations and projects outside the United States in areas where AT&T has a major presence.

In 1994, the AT&T Foundation increased its grants outside the United States by 66 percent, providing $1.3 million to nonprofit and charitable groups in the areas of education, health and human services, and the arts. Worldwide, the Foundation has awarded some $329 million in grants since its inception in 1984. In addition, the AT&T University Equipment Donation Program has supplied $287 million in AT&T computer equipment to colleges and universities since 1984.

Communities are improving early childhood services thanks to an AT&T Foundation-funded project that applies quality principles honed in business.

The merger of AT&T and McCaw is the best and quickest way for the two companies to take advantage of developing opportunities in a dynamic industry.

Financial Section

A Discussion and Analysis of Our Results and Operations

The merger was one of the most important events of 1994 for us. Shareowners now own a stronger AT&T with even better prospects for growth in revenues and earnings. Our customers will choose from a wider array of services.

Though completed, the merger remains subject to legal reviews. In addition, under the terms of a proposed antitrust consent decree between AT&T and McCaw and the United States, the operations of AT&T and McCaw are subject to several conditions, including keeping McCaw as a separate business with its own officers and employees. After McCaw provides equal access connections to other long distance carriers, McCaw may use the AT&T brand on McCaw's cellular services, and AT&T may jointly market AT&T's long distance and McCaw's cellular services, and provide customers with a single bill for both. For the most part, these restrictions merely confirm commitments we made when we announced our merger plans and they do nothing to alter the fundamental logic or economics of the merger.

Operating now as the wireless unit of AT&T, McCaw is the leading U.S. provider of wireless communications services, which include cellular, messaging, data transmission and air-to-ground services. McCaw has cellular operations in more than 100 cities. In most markets McCaw offers its services under the brand name Cellular One®. McCaw also operates the sixth largest U.S. messaging service, serving more than 700,000 customers, and a digital air-to-ground telephone service for commercial airlines and corporate aircraft.

AT&T's Strong Financial Performance

Accelerating revenue growth in products and services, aided by effective cost and expense controls, boosted earnings to another record in 1994. The climate for growth improved this past year because of better economic conditions, and changes in technology and world trade that spurred demand for network services as well as new networks. We look forward to continued growth in revenues and earnings in 1995.

Our financial performance was also strong in 1992 and 1993. Our performance met growth targets despite the less favorable business and economic environment. In 1993 we also had to adopt new accounting methods. Because new

In 1994 we achieved revenue growth that matches the 8–10% annual growth of the global information industry as a whole.

rules apply to all U.S. companies, we changed our accounting for retiree benefits, postemployment benefits and income taxes. The net $9.6 billion after-tax charge to bring our financial statements in line with the new accounting methods caused us to report a net loss for that year. But those accounting changes do not affect cash flows; they only change the expenses we report.

In our accounting for *retiree benefits,* we estimate and book expenses during the years employees are working and accumulating future benefits. When we used the former "pay-as-you-go" accounting, we simply booked our contributions to trust funds for life insurance benefits and the actual claims for benefits such as health care and telephone concessions as they occurred.

Our accounting for *postemployment benefits,* including payments for separations and disabilities, is very similar to the accounting for retiree benefits. We book expenses for future separations during the years employees are working and accumulating service with the company and for disability benefits when the disabilities occur. In the former accounting method, we booked expenses for separations when we approved them and for disabilities when we made payments. Compared with 1992, this change increased our costs and expenses by $301 million in 1993, which reduced earnings $171 million, or $0.11 per share.

Our accounting for *income taxes* uses the enacted tax rates to compute both deferred and current income taxes. Using our former method, we held deferred tax assets and liabilities at their original values even when Congress changed the tax rates.

An Overview of Our Business Operations

Our main business is meeting the communications and computing needs of our customers by using networks to move and manage information. We divide the revenues and costs of this business into three categories on our income statement: *telecommunications services, products and systems,* and *rentals and other services.* AT&T Capital Corporation (AT&T Capital) and AT&T Universal Card Services Corp. (Universal Card) are partners with our communications and computing business units as well as innovators in the financial services industry. We include their revenues and costs in a separate category on our income statement: *financial services and leasing.*

Competition in communications and computing is global and increasingly involves multinational firms and partners from different nations. To increase our global presence, we are hiring, building facilities and investing outside the U.S. We believe these commitments of resources are necessary to be successful in these markets. However, the economies of Europe and Japan were very weak in 1992 and 1993, and we restructured some operations in those areas. For these reasons we reported operating losses, in total, for the past three years in our units outside the U.S. Nevertheless, we continue to believe that these operations and markets provide excellent opportunities for future growth in revenues and earnings.

All our business units face stiff competition. Prices and technology are under continual pressure. Such market conditions make the ongoing need for cost controls even more urgent. Managers must continuously assess their resource needs and consider further steps to reduce costs, which could include consolidating facilities, disposing of assets, reducing workforce or withdrawing from markets.

In 1993 one of our business units, AT&T Global Information Solutions Company, offered an early retirement program and a voluntary separation program to its U.S.-based employees. About 2,200 employees accepted the early retirement offer, and the total workforce at the unit has declined by more than 10% since year-end 1993. We also provided reserves in 1993 to restructure and centralize support services for telecommunications services and for other restructuring activities. In total we provided $498 million before taxes in 1993 for restructuring activities.

At year-end 1994 reserves for all restructuring activities amounted to about $900 million, most of which relates to net lease payments to be made over the life of the related leases. We believe the balance of reserves is adequate for the completion of planned activities to improve efficiency as part of our commitment to meet intense competition.

Like other manufacturers, we use, dispose of and clean up substances that are regulated under environmental protection laws. We also have been named a potentially responsible party (PRP) at a number of Superfund sites. At most of these sites, our share is very limited and there are other PRPs who can be expected to contribute to the cleanup costs. We review potential cleanup costs and costs of compliance with environmental laws and regulations regularly. Using engineering estimates of total cleanup costs, we estimate our potential liability for all currently and previously owned properties where some cleanup may be required, including each Superfund site where we are named a PRP. We provide reserves for these potential costs and regularly review the adequacy of our reserves. In addition, we forecast our expenses and capital expenditures for existing and planned compliance programs as part of our regular corporate planning process. Despite these procedures, it is very difficult to estimate the future impact of actions regarding environmental matters, including potential liabilities. However, we believe that cleanup costs and costs related to environmental proceedings and ongoing compliance with present laws will not have a material effect on our future expenditures, annual consolidated financial statements or competitive position beyond that provided for at year-end.

Many of our employees are represented by unions. In 1995 we will negotiate new labor agreements because the 1992 contracts are due to expire on May 27.

Telecommunications Services

These revenues, which include wireless services revenues, grew 4.3% in 1994 and 1.6% in 1993. Volume growth, caused by market share gains among residential customers, strong demand from business customers, new cellular customers and the improved economy, fueled the faster growth in 1994.

Wireless services revenues, including cellular, messaging and air-to-ground services revenues, grew to $2,280 million in 1994 from $1,760 million in 1993 and $1,387 million in 1992, primarily because of the added traffic coming from new customers. Cellular customers served by companies in which AT&T has or shares a controlling interest increased to 4.0 million at year-end 1994, from 3.0 million at the end of 1993 and 2.2 million at the end of 1992.

Billed minutes for switched long distance services rose more than 7.5% in 1994 compared with 5.5% in 1993. Volume growth exceeds revenue growth because many customers are selecting higher-value, lower-priced

Reporting on the Merger

To complete the merger, McCaw's owners exchanged their McCaw stock for 197.5 million shares of newly issued AT&T stock. At the market closing price for AT&T stock on September 19, the official day of the merger, that exchange was worth about $11.5 billion.

We accounted for the merger as a pooling of interests. That means we combined the financial statements for the two companies. We did, however, take out the business between the companies just as we remove dealings between other AT&T units. Now all our financial information shows combined amounts as if we had always been one company.

Eleven-Year Summary of Selected Financial Data

(unaudited)
AT&T Corp. and Subsidiaries

Dollars in millions (except per share amounts)

	1994	1993*	1992	1991*	1990	1989	1988*	1987	1986*	1985	1984
Results of Operations											
Total revenues	**$75,094**	$69,351	$66,647	$64,455	$63,228	$61,604	$62,067	$60,726	$61,975	$63,159	$60,326
Research and development expenses	**3,110**	3,111	2,924	3,114	2,935	3,098	2,988	2,810	2,599	2,527	2,477
Operating income (loss)	**8,030**	6,568	6,628	1,570	5,622	4,931	(2,381)	4,164	978	3,562	2,825
Income (loss) before extraordinary item and cumulative effects of accounting changes	**4,710**	3,702	3,442	171	3,475	2,820	(1,527)	2,374	609	1,856	1,712
Net income (loss)	**4,710**	(5,906)	3,442	171	3,666	2,820	(1,527)	2,374	434	1,856	1,712
Earnings (loss) per common share before extraordinary item and cumulative effects of accounting changes	**3.01**	2.39	2.27	0.12	2.38	1.95	(1.06)	1.61	0.36	1.21	1.14
Earnings (loss) per common share	**3.01**	(3.82)	2.27	0.12	2.51	1.95	(1.06)	1.61	0.24	1.21	1.14
Dividends declared per common share	**1.32**	1.32	1.32	1.32	1.32	1.20	1.20	1.20	1.20	1.20	1.20
Assets and Capital											
Property, plant and equipment–net	**$22,035**	$21,015	$20,798	$19,887	$19,536	$17,653	$16,886	$22,159	$22,247	$23,182	$22,180
Total assets	**79,262**	69,393	66,104	62,071	57,036	45,228	41,945	45,583	44,305	44,824	43,461
Long-term debt including capital leases	**11,358**	11,802	14,166	13,682	14,579	10,116	10,172	9,060	8,234	8,104	8,963
Common shareowners' equity	**17,921**	13,374	20,313	17,973	17,928	15,727	13,694	16,913	15,849	16,945	15,852
Net capital expenditures	**4,853**	4,296	4,328	4,376	4,369	4,162	4,528	3,936	3,977	4,303	3,685
Other Information											
Operating income (loss) as a percentage of revenues	**10.7%**	9.5%	10.0%	2.4%	8.9%	8.0%	(3.8)%	6.9%	1.6%	5.6%	4.7%
Net income (loss) as a percentage of revenues	**6.3%**	(8.5)%	5.2%	0.3%	5.8%	4.6%	(2.5)%	3.9%	0.7%	2.9%	2.8%
Return on average common equity	**29.5%**	(47.1)%	17.6%	0.9%	21.2%	19.1%	(8.9)%	14.3%	2.0%	10.6%	10.4%
Data at year-end:											
Stock price per share	**$50.25**	$52.50	$51.00	$39.125	$30.125	$45.50	$28.75	$27.00	$25.00	$25.00	$19.50
Book value per common share	**$11.42**	$ 8.65	$13.31	$12.05	$12.33	$10.92	$ 9.57	$11.87	$11.04	$11.73	$11.19
Debt ratio	**58.3%**	64.4%	53.1%	54.8%	53.5%	45.0%	45.8%	38.4%	39.6%	39.9%	42.0%
Debt ratio excluding financial services	**34.1%**	49.1%	40.8%	46.0%	47.6%	39.3%	42.2%	35.2%	37.6%	38.4%	41.7%
Employees	**304,500**	317,700	319,000	322,300	333,400	343,000	367,400	366,200	379,900	400,400	427,800

*1993 data reflect a $9.6 billion net charge for three accounting changes.
1991 data reflect $4.5 billion of business restructuring and other charges.
1988 data reflect a $6.7 billion charge due to accelerated digitization of the long distance network.
1986 data reflect $3.2 billion of charges for business restructuring, an accounting change and other items.

services made possible by our increasing efficiency. Although we raised prices on basic services over the past two years, the shift in the mix of services that customers selected reduced average per-minute revenues in 1994 and 1993.

AT&T True USA℠ Savings and AT&T True Rewards℠ offer savings and other benefits to residential customers based on their calling volumes. We also rolled out AT&T *TrueVoice*® service, a patented technology to improve the sound quality on calls placed within the continental U.S. and Canada. Other offers and calling plans now share this theme of offering customers true value. These efforts helped us retain and win back residential customers in 1994, allowing us to recapture some market share for the first time since the breakup of the Bell System in 1984.

We expect continuing strong volume growth in 1995, leading to further growth in telecommunications services revenues. Several of our initiatives will enhance future network capabilities for communications and computing. For example, since late 1994, Network Notes℠ has enabled customers to access applications and information hosted on the AT&T network that are compatible with the popular Notes groupware software from Lotus Development Corp. Beginning in 1995, Netware Connect℠ services, based on popular networking software from Novell, Inc., will enable users to link computers or use computer-based services through the AT&T network. Through our relationship with Xerox Corp., users will be able to store and transmit high-quality production documents through our network. Our WorldWorx℠ service, developed in cooperation with several major equipment vendors, will permit interactive, multipoint video and data calls. Customers using our PersonaLink℠ service may program "intelligent agents" to sort through, retrieve and monitor desired information on networks.

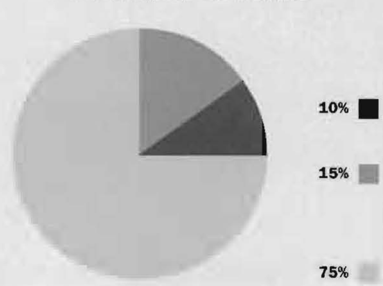
Total cost of telecommunications services declined both years despite higher volumes, in part because of reduced prices for connecting customers through local networks. In addition, we improved our efficiency in network operations, engineering and operator services. With lower costs and higher revenues, the gross margin percentage rose to 41.8% in 1994 from 39.0% in 1993 and 37.2% in 1992.

Products and Systems

Expansion abroad and into new customer segments, improved global economic conditions and major contract wins raised sales by 18.1% in 1994 and 8.1% in 1993 despite stiff price competition. Sales outside the U.S. grew at a faster rate than U.S. sales and were responsible for more than half the growth both years. We expect sales under major contracts and the continuing economic recovery outside the U.S. in 1995 to pave the way for further growth in revenues.

1994 Sources of Revenue

As Percentages of Total Revenues



Markets and competition in the information industry are increasingly global in scope. Some of the fastest growing markets are outside the U.S.

Revenues from sales of telecommunications network products and systems grew 17.3% in 1994 and 8.5% in 1993. The 1994 increase reflected higher sales across this product line, particularly in switching and transmission systems and wireless products. About $243 million of switching revenues in 1994 came from consolidating A.G. Communication Systems Corporation because AT&T raised its ownership to 80%. The 1993 increase came chiefly from higher sales of wireless products, switching equipment and operations systems. For the last two years, sales grew both inside and outside the U.S.

Spotlight on Some Trends in Telecommunications Services

Competition is changing.

As we look ahead, along with growing opportunities, we see more direct competition for AT&T coming from local telephone, long distance, cable television, wireless and other companies that offer network services. AT&T, as a supplier of networking systems, services and products, will be a supplier as well as a customer and competitor of these firms. There may also be other entrants from the communications and information services industries, such as providers of information systems, who will offer basic or integrated services.

Customers and competitors – present and future – are making acquisitions, merging, and forming joint ventures and alliances to expand their geographic reach, enter new markets and gain scale. Some of the largest cable TV companies, such as Tele-Communications Inc. (TCI) and Time Warner Inc., are clustering cable systems. Cables have more capacity than current phone lines, suiting them for multimedia use. Bell Atlantic Corporation, Nynex Corporation, U S West, Inc. and Airtouch Communications Corp. formed an alliance of their cellular operations to gain a national presence and bid against AT&T and others for radio licenses to provide personal communications services. These licenses are being auctioned by the Federal Communications Commission to get as many as seven wireless competitors in each territory. Sprint Corporation (Sprint), which already competes in local phone service, long distance and cellular markets, is forming a joint venture with cable companies TCI, Comcast Corp. and Cox Enterprises, Inc. to expand its presence in both local and wireless markets.

Several bills were introduced in Congress last year which would have accelerated competition for local access and phone services and permitted the Regional Bell Operating Companies (RBOCs) to offer long distance services under certain conditions. Although none of these bills was enacted, several key members of Congress have introduced or announced plans to introduce new bills during 1995 that would permit competition in local services and set conditions under which the RBOCs would be permitted to offer long distance services and manufacture equipment.

Products and Systems

Dollars in millions	**1994**	1993	1992
Revenues			
Telecommunications network products and systems	**$ 9,785**	$ 8,345	$ 7,691
Computer products and systems	**4,208**	3,470	3,358
Communications products and systems	**4,494**	3,692	3,279
Microelectronics products, special-design products for U.S. government, and other*	**2,674**	2,418	2,251
Products and systems	**$21,161**	$17,925	$16,579
Gross margin percentage	**37.3%**	38.8%	39.8%

*"Other" is composed principally of media, predominantly for use with automated teller machines and point-of-sale equipment, and business forms.

AT&T was selected for several large projects for network products and systems over the past two years that we believe will lead to many sales opportunities in the years ahead. Pacific Bell and Bell Atlantic Corporation chose AT&T as the major equipment supplier and systems integrator for planned multimedia networks. These two projects alone could generate up to $10 billion in revenues for AT&T over the next seven years. AT&T was also awarded major contracts by other U.S. telephone and cable companies, including Southern New England Telephone Corp. and Time Warner, Inc. Outside the U.S., AT&T won a $4 billion contract with Saudi Arabia and signed a long-term system support agreement, worth about $500 million over five years, with China's Guangdong province government agencies.

Revenues from sales of computer products and systems grew 21.3% in 1994 and 3.3% in 1993. The growth came mainly from higher U.S. sales of workstations, automated teller machines, and mid-range and high-end systems for enterprise-wide computing. Price competition for this product line is very fierce, particularly for personal computers, so revenue growth has lagged behind the gains in volumes. We changed the end of the fiscal year for certain operations located outside the U.S. to December from November in 1994 to report essentially all of our operations on a calendar year. This added $223 million in revenues and a marginal loss in income in 1994. About $113 million of these revenues were from sales of computer products and systems.

Revenues from sales of communications products and systems rose 21.7% in 1994 and 12.6% in 1993. More than half this growth in both years came from higher sales of business communications products and systems. We also had higher sales of consumer communications products—particularly cellular phones—submarine cables and data communications equipment. AT&T Submarine Systems, Inc. and a partner were awarded a $1.2 billion contract to supply and construct the 17,000-mile Fiber Optic Link Around the Globe (FLAG) cable system. This system is scheduled to be completed during 1997. We will manage the entire marine installation and also supply network management equipment.

In total, revenues from sales of microelectronics products, special-design products for the federal government, and other products and systems grew 10.6% in 1994 and 7.4% in 1993. Growth in both years came mainly from higher sales of microelectronics components and power systems to equipment manufacturers outside the U.S. Sales of media and business forms rose slightly in 1994, but were steady in 1993. Because of reduced defense spending by the U.S. government, sales of special-design products, such as secure phones, declined both years.

We sold several smaller operating units in 1994 and arranged to sell NCR Microelectronics and are negotiating to sell a copper cable unit in early 1995. These sales will reduce our revenues, as well as our costs and expenses, by about $1 billion a year. Most of the revenues related to product sales, about half in the microelectronics products category.

The increase in cost of products and systems is mainly associated with the higher sales volumes both years. The declining gross margin percentage reflects pricing pressures and a changing product sales mix.

Some of the RBOCs are also seeking this same kind of permission through the courts. They requested relief from the decree that broke up the Bell System – the Modification of Final Judgment of 1982 – including provisions that bar the RBOCs from offering long distance services and manufacturing equipment. We believe the RBOCs must face real competition for their local business before getting the permission they seek. Absent local competition they could use their bottleneck control over connections to customers to disadvantage competitors.

It is not possible to predict the timing, course and circumstances of changes that may come from technology, new alliances, regulation and legislation. We set a high priority on anticipating these changes and positioning AT&T for future success. However, depending on their exact nature and timing, such changes could affect our future revenues and earnings adversely.

Competition will be global, as legal monopolies disappear in other countries.

Mexico will open to competition beginning in late 1996. We are working with Grupo Alfa to plan a joint venture to compete there. Other U.S. companies – including MCI Communications Corp. (MCI), Sprint and GTE Corporation – have or plan alliances with Mexican companies to compete in telecommunications services.

The European Union is scheduled to be open fully to competition beginning in 1998, but some changes are coming sooner. At year-end 1994 we were granted a license to provide switched voice and data services and private lines within the United Kingdom (U.K.) and to resell services between the U.K. and other countries. To better serve multinational businesses in Europe, we plan a joint venture with the Unisource consortium founded by PTT Telecom Netherlands, Swiss Telecom PTT and Telia of Sweden. Telefónica de España will also become a member. The new joint venture would then replace Unisource as the European partner in the AT&T-sponsored WorldPartners seamless global services alliance begun in 1993. British Telecommunications plc (BT) took a 20% stake in MCI in 1994, and they jointly formed a venture to compete in this same market sector.

Germany's Deutsche Telekom AG and France Telecom each seek approval to buy a 10% stake in Sprint, securing entry to the U.S. market similar to that of BT. We oppose their plans because the French and German telecommunications services markets remain fundamentally closed.

Rentals and Other Services

These revenues grew the last three years. The growth in 1994 came mainly from communications equipment maintenance contracts and professional services for computer products and systems. In 1993 we saw higher revenues from newer telecommunications services, such as network management and satellite services, which individually generate small revenue streams. In both years these increases more than offset the continuing, expected decline in communications equipment rentals.

Rentals and Other Services

Dollars in millions	1994	1993	1992
Revenues			
Computer products and systems	**$2,818**	$2,641	$2,742
Communications products and systems rentals	**955**	1,174	1,409
Communications products and systems services	**1,680**	1,457	1,375
Other*	**1,938**	2,027	1,680
Rentals and other services	**$7,391**	$7,299	$7,206
Gross margin percentage	**50.9%**	51.2%	53.3%

*"Other" is composed principally of global messaging and electronic mail services, telemarketing services, information technology services and facility rentals.

The shift in revenue mix from rentals to lower-margin services reduced the gross margin percentage. Also, provisions for business restructuring added $90 million to cost of rentals and other services in 1993.

Financial Services and Leasing

These revenues rose 24.5% in 1994 and 32.2% in 1993. Both Universal Card and AT&T Capital contributed to the growth by profitably expanding their portfolios of earning assets. We expect continuing growth in these revenues, earnings and assets in 1995.

Financial Services and Leasing

In millions	1994	1993	1992
Revenues			
AT&T Capital	**$ 1,384**	$ 1,360	$ 1,266
Universal Card	**1,782**	1,228	831
Eliminations, adjustments and other*	**(49)**	(84)	(203)
Financial services and leasing	**$ 3,117**	$ 2,504	$ 1,894
Gross margin percentage	**31.0%**	31.7%	30.8%
Universal Card Information:			
Finance receivables	**$12,380**	$ 9,154	$ 6,606
Accounts	**15.1**	11.7	10.3

*"Other" is composed principally of revenues from certain lease finance assets AT&T retained when AT&T Capital was reorganized.

Universal Card rose to fourth in its industry in 1994 measured by cardmember receivables. During the year it began its Something Extra℠ program, which offers customers rewards for outstanding balances as well as new purchases. Other promotions have convinced customers to transfer balances from the credit card accounts held with competitors. These programs and our highly regarded customer service contributed to the 35.2% increase in outstanding cardholder receivables in 1994 and 38.6% increase in 1993. We set reserves for losses based on experience and the future outlook for the economy.

AT&T Capital completed an initial public offering of its common stock in August 1993, emerging as the largest publicly owned equipment leasing and financing company in the U.S. AT&T still owns about 86% of the stock, so AT&T Capital is still fully consolidated in our financial statements. AT&T Capital limits its exposure to credit risks by diversifying its business across customers, geographic locations and lease maturities. It determines its allowance for credit losses by analyzing previous experience on losses, current delinquencies, and present and future economic conditions. We unconditionally guaranteed all of AT&T Capital's debt outstanding at the end of March 1993. Since then, all AT&T Capital debt has been issued using its own credit. This change makes AT&T Capital financially independent and permits us to focus on the financing needs of our main business.

The growth in cost of financial services and leasing over the last two years is associated mostly with the growth in financing activity. The improved gross margin percentage in 1993 mainly reflects the maturation of the credit card receivables portfolio. Lower interest rates in 1993 also contributed to the margin improvement that year, but rising interest rates in 1994 narrowed our margins.

By 1995 we must change our accounting on loans to customers. Under new rules we must compute the present value of principal and interest payments for troubled loans that may not be fully repaid. Our current methods do not require present value calculations, but we do not expect this change to affect our costs materially.

Operating Expenses

Selling, general and administrative expenses increased 8.9% in 1994 and 8.0% in 1993, largely because of spending for advertising and promotions, and for sales and sales support activities. We focused particularly on retaining and winning back residential customers of telecommunications services and acquiring new cellular customers. We expect marketing expenses will continue to grow because of competitive conditions. The 1993 total also includes $373 million in provisions for business restructuring activities, and the 1994 total includes $246 million of expenses related to the merger of AT&T and McCaw.

Research and development expenses were level in 1994 but increased 6.4% in 1993. The higher spending of the last two years was mainly for work on cellular technology, advanced communications services and devices, and projects aimed at international growth.

Other Income Statement Items

Other income – net depends mostly on our cash balance, investments and joint ventures, and sales of assets. We also deducted dividends on preferred stock of a subsidiary in other income before we redeemed this stock in mid-1994.

Interest income declined over the past two years, and in 1993 we saw a decline in income related to investments and joint ventures. Material pretax gains and losses also affected other income – net:

- In 1994 there were no material transactions. Asset sales and various other immaterial gains more than offset losses from the shutdown of EO Inc. and the uninsured portion of a lost telecommunications satellite.
- In 1993 we had a $217 million gain when we exchanged our remaining 77% interest in UNIX System Laboratories, Inc. for stock in Novell, Inc.
- Because of declines in its market value, we wrote down our investment in Compagnie Industriali Riunite S.p.A. by $68 million in 1992. We sold our remaining interest in that investment in 1993 for a slight gain.

Interest expense declined over the past two years because of benefits from refinancing long-term debt at favorable rates. Reduced requirements for contingent liabilities also contributed about half the decline in 1993.

The provisions for income taxes increased the past two years mainly because of higher "book income," that is, the income before income taxes and cumulative effects of accounting changes. The effective tax rate declined to 37.3% in 1994, from 38.3% in 1993 and 39.0% in 1992, due to credits for foreign tax payments and the effect on deferred taxes from redeeming preferred stock. These benefits were somewhat offset by the nondeductibility of some merger-related expenses.

Congress increased the federal statutory tax rate to 35% in August 1993 and made the change retroactive to January 1, 1993. We recognized a $23 million benefit from adjusting our net deferred tax assets for the new rate. However, this benefit was more than offset by the increase in income taxes due to the new rate.

Total Assets, Working Capital and Liquidity

We raised our cash balance in 1994 so we could act quickly on new opportunities outside the U.S. and because of some pending reinvestments in projects. However, we continue to target a cash balance of about $800 million. The higher cash balance as well as higher inventories and receivables, which are primarily associated with the growth in revenues, boosted net working capital to $6.7 billion at the end of 1994 from $4.3 billion at the end of 1993.

We turned over our inventory 3.4 times in 1994, the same turnover rate as 1993. Accounts receivable for our communications and computing business were outstanding an average of 56.4 days in 1994, about the same as in 1993.

Net property, plant and equipment and net licensing costs rose because of normal purchasing activity.

A 52%-owned subsidiary of McCaw, LIN Broadcasting Corporation (LIN), exchanged its investment in the A Block Philadelphia cellular system for all the outstanding redeemable preferred stock of one of its subsidiaries. In addition, AT&T sold its remaining 20% interest in Italtel S.p.A back to STET S.p.A., the Italian government's telecommunications holding company. These transactions led to a decline in investments during the year.

We also changed the way we report and account for investments in equity securities that have readily determinable fair values and in all debt securities. Starting in 1994 we account for the fair values of these securities rather than our original investment. This change did not affect our earnings or financial position materially.

The fair value of our pension plan assets is greater than our projected pension obligations. We record pension income when our expected return on plan assets plus amortization of the transition asset (created by our 1986 adoption of the current standard for pension accounting) is greater than the interest cost on our projected benefit obligation plus service cost for the year. Consequently, we had pension income that added to our prepaid pension costs in 1994.

The increase in other assets mainly reflects the advanced purchase of rewards, such as frequent flyer miles and merchandise certificates to be given to consumers who earn sufficient points to claim them under our calling plans. At the same time, we accrued a liability for the unredeemed points earned under our calling plans, which led to higher other current liabilities.

Higher accounts payable and payroll and benefit-related liabilities are mainly due to increases in the associated expenses and benefit costs.

We issued more debt in 1994, mainly short-term financing, for financial services and for higher inventories and receivables.

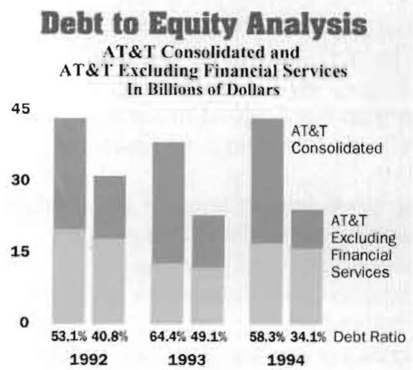
Contributions to trusts for retiree benefits led to the decline in related liabilities. We redeemed all of LIN's outstanding preferred stock, which increased additional paid-in capital and minority interests.

Operating cash flows increased in 1994 mainly because of higher income. The decline in 1993 was mainly due to working capital requirements such as inventories and accounts receivable. For the three years operating cash flows covered our additions to property, plant and equipment and dividend payments. We expect operating cash flows to continue covering usual capital expenditures and dividends in 1995. However, as discussed in the next section, we may have broader capital requirements in 1995 which may require additional external financing.

Investing Activities

Most of our capital expenditures support telecommunications network services, providing for growth in traffic, modernization and enhanced reliability. Other capital additions include the equipment and facilities used in leasing operations, manufacturing, and research and development. We expect our net capital expenditures to continue rising in 1995.

We plan substantial investments to expand and enhance our cellular network in 1995. We are also bidding on broad-band personal communication services (PCS) radio licenses to provide wireless telephone service in 30 of 51 major trading areas in the U.S. The Federal Communications Commission (FCC) auction began on December 5, 1994. It is not possible to predict the outcome of the auction or the amounts successful bidders will be required to



Most of AT&T's debt supports our financial services. Our long-term goal is a 30% debt ratio for AT&T excluding financial services. We are currently above that ratio because of McCaw's capital structure and our heavy investment program to take advantage of current opportunities and build a stronger AT&T for the future. Accounting changes reduced our equity in 1993.

pay in order to win licenses as about 30 companies have made deposits and are eligible for bidding. In the event AT&T is successful in obtaining one or more licenses, substantial expenditures could be required for the licenses and for constructing associated systems.

Under an agreement between McCaw and LIN, a process, using third party appraisers, began on January 1, 1995 to determine the private market value per share of LIN. The private market value is the price per share, including control premium, that an unrelated third party would pay if it were to acquire all the outstanding shares of LIN, including the shares held by McCaw, in an arm's-length transaction and assuming LIN was being sold in a manner designed to attract all possible participants and to maximize shareholder value. After the price is determined, McCaw will have 45 days to decide whether to proceed with the acquisition of all the public shares at that price, subject to the approval of the LIN public shareholders. AT&T and McCaw have not made any decision as to whether McCaw should proceed with an acquisition of the LIN public shares. If the private market price is set at a level that AT&T and McCaw believe is reasonable, AT&T and McCaw expect that McCaw would seek to proceed with an acquisition. Any such acquisition would involve a substantial capital expenditure. If the private market price is set at a level that AT&T and McCaw believe is not reasonable, AT&T and McCaw expect that McCaw would not proceed with an acquisition. If McCaw does not proceed with an acquisition, the agreement provides that McCaw will put LIN in its entirety up for sale under the direction of the LIN independent directors.

In 1994 we agreed to acquire Alascom, one of Alaska's long distance companies, for $290 million. This agreement is subject to approval by the Alaska Public Utilities Commission and the FCC.

We also plan substantial expenditures to increase our presence outside the U.S. in 1995. For example, we signed a memorandum of understanding in 1994 with Grupo Alfa, a leading Mexican company, to explore the feasibility of a joint venture to compete in telecommunications services in Mexico when the market is opened to competition beginning in late 1996. The capital requirements of such a joint venture are not currently known, but we estimate that as much as $1 billion of capital might be required over a 4- to 6-year period. Our share of the joint venture would be 49%. We also signed an agreement in principle with Unisource, a consortium of European telecommunications companies, to form a joint venture to compete in Europe, meeting the communications needs of multinational business customers. Our ownership of the venture would be 40%. At the formation, the venture would have $200 million of assets, but these assets and our investment would be likely to grow.

We also signed a broad set of business agreements in 1994 with the People's Republic of China to provide technologies, products and services to modernize its telecommunications infrastructure. Those agreements call for us to invest more than $150 million over two years.

Our investments in finance receivables, particularly credit card receivables, are required to support further growth in revenues and earnings from our financial services businesses.

Financing Activities and Capitalization

Capital requirements due to the growth of our financial services and leasing business will continue to grow in 1995.

Much of the financing activity shown on our cash flows statement relates to refinancing activities. For example, in 1992 and 1993 we took advantage of favorable levels of interest rates to extend debt maturities by refinancing a substantial amount of long-term debt. In 1994 we refinanced McCaw's debt.

In the normal course of our business, we use certain derivative financial instruments, mainly interest rate contracts and foreign currency exchange rate contracts for purposes other than trading. The interest rate contracts allow us to limit the effects of changing interest rates and protect our margins on existing transactions. The foreign currency contracts and options allow us to manage our exposure to changing currency exchange rates. We design our credit policies to limit the risks of dealing with other parties to these instruments. In our view, the risks to AT&T from our use of these derivative financial instruments are small and our benefits include more stable earnings in periods when interest rates or currency exchange rates are changing.

For the past three years we have issued new shares of common stock in our shareowner and employee plans. The dilution in earnings per share from these new issuances was not material.

We sell equity interests in AT&T subsidiaries only when opportunities or circumstances warrant. We have no current plans to sell material interests in subsidiaries.

The ratio of total debt and preferred stock to total capital (total debt, preferred stock and equity) declined to 58.3% at December 31, 1994, compared with 64.4% at December 31, 1993, primarily because of higher equity from 1994 earnings. Excluding financial services and leasing operations, the debt ratio declined to 34.1% at December 31, 1994, compared with 49.1% at December 31, 1993.

Report of Management

Management is responsible for the preparation, integrity and objectivity of the financial statements and all other financial information included in this report. Management is also responsible for maintaining a system of internal controls as a fundamental requirement for the operational and financial integrity of results.

The financial statements, which reflect the consolidated accounts of AT&T and subsidiaries, and other financial information shown were prepared in conformity with generally accepted accounting principles. Estimates included in the financial statements were based on judgments of qualified personnel.

To maintain its system of internal controls, management carefully selects key personnel and establishes the organizational structure to provide an appropriate division of responsibility. We believe it is essential to conduct business affairs in accordance with the highest ethical standards as set forth in the AT&T Code of Conduct. These guidelines and other informational programs are designed and used to ensure that policies, standards and managerial authorities are understood throughout the organization. Our internal auditors monitor compliance with the system of internal controls by means of an annual plan of internal audits. On an ongoing basis, the system of internal controls is reviewed, evaluated and revised as necessary in light of the results of constant management oversight, internal and independent audits, changes in AT&T's business and other conditions.

Management believes that the system of internal controls, taken as a whole, provides reasonable assurance that (1) financial records are adequate and can be relied upon to permit the preparation of financial statements in conformity with generally accepted accounting principles, and (2) access to assets occurs only in accordance with management's authorizations.

The Audit Committee of the Board of Directors, which is composed of directors who are not employees, meets periodically with management, the internal auditors and the independent auditors to review the manner in which these groups of individuals are performing their responsibilities and to carry out the Audit Committee's oversight role with respect to auditing, internal controls and financial reporting matters. Periodically, both the internal auditors and the independent auditors meet privately with the Audit Committee. These auditors also have access to the Audit Committee and its individual members at any time.

The financial statements in this annual report have been audited by Coopers & Lybrand, L.L.P., Independent Auditors. Their audits were conducted in accordance with generally accepted auditing standards and include consideration of the internal control structure and selective tests of transactions. Their report follows.

Richard W. Miller
Executive Vice President,
Chief Financial Officer

R.E. Allen

Robert E. Allen
Chairman of the Board,
Chief Executive Officer

Report of Independent Auditors

To the Shareowners of AT&T Corp.:

We have audited the consolidated balance sheets of AT&T Corp. and subsidiaries (AT&T) at December 31, 1994 and 1993, and the related consolidated statements of income and cash flows for the years ended December 31, 1994, 1993 and 1992. These financial statements are the responsibility of AT&T's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with generally accepted auditing standards. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the consolidated financial position of AT&T at December 31, 1994 and 1993, and the consolidated results of their operations and their cash flows for the years ended December 31, 1994, 1993 and 1992, in conformity with generally accepted accounting principles.

As discussed in Note 2 to the financial statements, in 1993 AT&T changed its methods of accounting for postretirement benefits, postemployment benefits and income taxes.

Coopers & Lybrand LLP

1301 Avenue of the Americas
New York, New York
January 24, 1995

Consolidated Statements of Income

AT&T Corp. and Subsidiaries, Years Ended December 31

Dollars in millions (except per share amounts)	**1994**	1993	1992
Sales and Revenues			
Telecommunications services	**$43,425**	$41,623	$40,968
Products and systems	**21,161**	17,925	16,579
Rentals and other services	**7,391**	7,299	7,206
Financial services and leasing	**3,117**	2,504	1,894
Total revenues	**75,094**	69,351	66,647
Costs			
Telecommunications services			
Access and other interconnection costs	**17,797**	17,772	18,186
Other costs	**7,466**	7,623	7,553
Total telecommunications services	**25,263**	25,395	25,739
Products and systems	**13,273**	10,966	9,976
Rentals and other services	**3,629**	3,563	3,366
Financial services and leasing	**2,152**	1,711	1,310
Total costs	**44,317**	41,635	40,391
Gross margin	**30,777**	27,716	26,256
Operating Expenses			
Selling, general and administrative expenses	**19,637**	18,037	16,704
Research and development expenses	**3,110**	3,111	2,924
Total operating expenses	**22,747**	21,148	19,628
Operating income	**8,030**	6,568	6,628
Other income – net	**236**	476	163
Loss on sale of stock by subsidiary	—	9	—
Interest expense	**748**	1,032	1,153
Income before income taxes and cumulative effects of accounting changes	**7,518**	6,003	5,638
Provision for income taxes	**2,808**	2,301	2,196
Income before cumulative effects of accounting changes	**4,710**	3,702	3,442
Cumulative effects on prior years of changes in accounting for:			
Postretirement benefits (net of income tax benefit of $4,294)	—	(7,023)	—
Postemployment benefits (net of income tax benefit of $681)	—	(1,128)	—
Income taxes	—	(1,457)	—
Cumulative effects of accounting changes	—	(9,608)	—
Net Income (Loss)	**$ 4,710**	$ (5,906)	$ 3,442
Weighted average common shares outstanding (millions)	**1,564**	1,547	1,519
Per Common Share:			
Income before cumulative effects of accounting changes	**$ 3.01**	$ 2.39	$ 2.27
Cumulative effects of accounting changes	—	(6.21)	—
Net Income (Loss)	**$ 3.01**	$ (3.82)	$ 2.27

The notes on pages 33 through 43 are an integral part of the consolidated financial statements.

Consolidated Balance Sheets

AT&T Corp. and Subsidiaries at December 31

Dollars in millions (except per share amount)	1994	1993
Assets		
Cash and temporary cash investments	$ 1,208	$ 671
Receivables, less allowances of $1,251 and $1,040		
Accounts receivable	13,671	12,294
Finance receivables	14,952	11,370
Inventories	3,633	3,222
Deferred income taxes	3,030	2,079
Other current assets	1,117	732
Total current assets	37,611	30,368
Property, plant and equipment – net	22,035	21,015
Licensing costs – net	4,251	3,995
Investments	2,708	3,060
Finance receivables	4,513	3,815
Prepaid pension costs	4,151	3,575
Other assets	3,993	3,565
Total assets	$79,262	$69,393
Liabilities and Deferred Credits		
Accounts payable	$ 6,011	$ 4,853
Payroll and benefit-related liabilities	4,105	3,802
Postretirement and postemployment benefit liabilities	1,029	1,301
Debt maturing within one year	13,666	11,063
Dividends payable	518	448
Other current liabilities	5,601	4,587
Total current liabilities	30,930	26,054
Long-term debt including capital leases	11,358	11,802
Postretirement and postemployment benefit liabilities	8,754	9,083
Other liabilities	4,285	4,363
Deferred income taxes	3,913	2,231
Unamortized investment tax credits	232	270
Other deferred credits	776	263
Total liabilities and deferred credits	60,248	54,066
Minority interests	1,093	648
Redeemable preferred stock	—	1,305
Common Shareowners' Equity		
Common shares par value $1 per share	1,569	1,547
Authorized shares: 2,000,000,000		
Outstanding shares: 1,569,006,000 at December 31, 1994;		
1,546,518,000 at December 31, 1993		
Additional paid-in capital	15,825	14,324
Guaranteed ESOP obligation	(305)	(355)
Foreign currency translation adjustments	145	(32)
Retained earnings (deficit)	687	(2,110)
Total common shareowners' equity	17,921	13,374
Total liabilities and shareowners' equity	$79,262	$69,393

The notes on pages 33 through 43 are an integral part of the consolidated financial statements.

Consolidated Statements of Cash Flows

AT&T Corp. and Subsidiaries, Years Ended December 31

Dollars in millions	1994	1993	1992
Operating Activities			
Net income (loss)	**$ 4,710**	$(5,906)	$ 3,442
Adjustments to reconcile net income to net cash provided by operating activities:			
Cumulative effects of accounting changes	—	9,608	—
Depreciation and licensing cost amortization	**4,039**	4,082	3,825
Provision for uncollectibles	**1,929**	1,665	1,983
(Increase) in accounts receivable	**(2,672)**	(2,211)	(1,577)
(Increase) decrease in inventories	**(392)**	(444)	549
Increase (decrease) in accounts payable	**1,125**	(295)	46
Net (increase) decrease in other operating assets and liabilities	**(356)**	(1,272)	(1,595)
Other adjustments for noncash items – net	**573**	2,197	1,363
Net cash provided by operating activities	**8,956**	7,424	8,036
Investing Activities			
Capital expenditures net of proceeds from sale or disposal of property, plant and equipment of $451, $241 and $250	**(4,853)**	(4,296)	(4,328)
Increase in finance receivables, net of lease-related repayments of $3,384, $3,512 and $3,316	**(4,616)**	(3,484)	(3,878)
Net (increase) decrease in investments	**(159)**	(453)	33
Acquisitions, net of cash acquired	**144**	(228)	(308)
Other investing activities – net	**(271)**	(204)	(125)
Net cash used in investing activities	**(9,755)**	(8,665)	(8,606)
Financing Activities			
Proceeds from long-term debt issuance	**6,134**	4,386	3,368
Retirements of long-term debt	**(5,637)**	(5,879)	(3,732)
Issuance of common shares	**976**	1,053	703
Dividends paid	**(1,870)**	(1,774)	(1,748)
Increase in short-term borrowings – net	**1,747**	2,586	1,341
Other financing activities – net	**(36)**	25	(162)
Net cash provided by (used in) financing activities	**1,314**	397	(230)
Effect of exchange rate changes on cash	**22**	3	26
Net increase (decrease) in cash and temporary cash investments	**537**	(841)	(774)
Cash and temporary cash investments at beginning of year	**671**	1,512	2,286
Cash and temporary cash investments at end of year	**$ 1,208**	$ 671	$ 1,512

The notes on pages 33 through 43 are an integral part of the consolidated financial statements.

1. Summary of Significant Accounting Policies

Consolidation

Ownership of affiliates	*Accounting method*
More than 50%	Fully consolidated
20% to 50%	Equity method
Less than 20%	Cost method

The fiscal year of essentially all AT&T operations ends December 31.

Currency Translation

For operations outside of the U.S. that prepare financial statements in currencies other than the U.S. dollar, we translate income statement amounts at average exchange rates for the year, and we translate assets and liabilities at year-end exchange rates. We show these translation adjustments as a separate component of shareowners' equity.

Revenue Recognition

Revenue from	*Basis of recognition*
Telecommunications Services	Minutes of traffic processed and contracted fees
Products and Systems	Upon performance of contractual obligations
Rentals and Other Services	Proportionately over contract period or as services are performed
Financial Services and Leasing	Over the life of the finance receivables using the interest method, or straight-line over life of operating lease

Software Production Costs

Until technological feasibility is established, we expense as incurred the costs of developing computer software that we plan to sell, lease or otherwise market. After that time, we capitalize the remaining software production costs and amortize them to costs over the estimated period of sales and revenues.

Interest Expense

Interest expense is the interest on short-term and long-term debt and accrued liabilities, excluding the interest related to our financial services operations, which is included in cost of financial services and leasing, and net of interest capitalized in connection with construction.

Investment Tax Credits

For financial reporting purposes, we amortize investment tax credits as a reduction to the provision for income taxes over the useful lives of the property that produced the credits.

Earnings per Share

We use the weighted average number of shares of common stock and common stock equivalents outstanding during each period to compute earnings per common share. Common stock equivalents are stock options that we assume to be exercised for the purposes of this computation.

Temporary Cash Investments

We consider temporary cash investments to be cash equivalents for cash flow reporting purposes. They are highly liquid and have original maturities generally of three months or less.

Inventories

We state inventories at the lower of cost or market. We determine cost principally on a first-in, first-out (FIFO) basis.

Property, Plant and Equipment

We state property, plant and equipment at cost and determine depreciation using either the group or unit method. The unit method is used primarily for factory facilities, laboratory equipment, large computer systems, and certain international earth stations and submarine cables. The group method is used for most other depreciable assets. When we sell assets that were depreciated using the unit method, we include the gains or losses in operating results. When we sell or retire plant that was depreciated using the group method, we deduct the original cost from the plant account and from accumulated depreciation.

We use accelerated depreciation methods for factory facilities and digital equipment used in the telecommunications network, except switching equipment placed in service before 1989. All other plant and equipment is depreciated on a straight-line basis.

In our wireless services unit, depreciation is computed using the straight-line method over the estimated useful lives of the assets, which are generally 10 to 12 years for cellular, 2 to 12 years for messaging, 3 to 12 years for air-to-ground and 3 to 5 years for other equipment. Leasehold improvements are amortized using the straight-line method over the terms of the leases.

Licensing Costs

Licensing costs represent costs incurred to develop or acquire cellular and messaging licenses. Generally, amortization begins with the commencement of service to customers and is computed using the straight-line method over a period of 40 years.

Goodwill

Goodwill is the difference between the purchase price and the fair value of net assets acquired in business combinations treated as purchases. We amortize goodwill on a straight-line basis over the periods benefited, principally in the range of 10 to 40 years.

Reclassifications

We reclassified certain amounts for previous years to conform with the 1994 presentation.

2. Changes in Accounting Principles

Postretirement Benefits

We adopted Statement of Financial Accounting Standards (SFAS) No. 106, "Employers' Accounting for Postretirement Benefits Other Than Pensions," effective January 1, 1993. This standard requires us to accrue estimated future retiree benefits during the years employees are working and accumulating these benefits. Previously, we expensed health care benefits as claims were incurred and life insurance benefits as plans were funded.

We also reimburse the divested regional Bell companies for a portion of their costs to provide health care benefits, increases in pensions and other benefits to predivestiture retirees under the terms of the Divestiture Plan of Reorganization. Through 1992 we expensed these reimbursements as incurred.

We recorded a one-time pretax charge for the unfunded portions of these liabilities of $11,317 million ($7,023 million or $4.54 per share after taxes). Apart from these cumulative effects on prior years of the accounting change, our change in accounting had no material effect on net income and it does not affect cash flows.

Postemployment Benefits

We also adopted SFAS No. 112, "Employers' Accounting for Postemployment Benefits," effective January 1, 1993. Analogous to SFAS No. 106, this standard requires us to accrue for estimated future postemployment benefits, including separation payments, during the years employees are working and accumulating these benefits, and for disability payments when the disabilities occur. Before this change in accounting, we recognized costs for separations when they were approved and disability benefits when they were paid.

We recorded a one-time pretax charge for the unprovided portion of these liabilities of $1,809 million ($1,128 million or $0.73 per share after taxes). The change in accounting reduced operating income by $301 million and net income by $171 million ($0.11 per share) in 1993. This change does not affect cash flows.

Income Taxes

We also adopted SFAS No. 109, "Accounting for Income Taxes," effective January 1, 1993. Among other provisions, this standard requires us to compute deferred tax amounts using the enacted corporate income tax rates for the years in which the taxes will be paid or refunds received. Before 1993 our deferred tax accounts reflected the rates in effect when we made the deferrals.

The adoption of this standard reduced net income by $1,457 million ($0.94 per share) as a result of deferred liabilities that were created by McCaw Cellular Communications, Inc. acquisitions prior to the merger. Apart from these cumulative effects on prior years of the accounting change, the new accounting method had no material effect on net income in 1993. Unless Congress changes tax rates, we do not expect this change to affect net income materially in future periods. This change does not affect cash flows.

3. Prospective Accounting Changes

Impaired Loans

In 1995 we must adopt SFAS No. 114, "Accounting by Creditors for Impairment of a Loan." This standard requires us to compute present values for impaired loans when determining our allowances for credit losses. We do not expect this new standard to affect net income materially at or after adoption, and it will not affect cash flows.

4. Merger with McCaw Cellular Communications, Inc. (McCaw)

On September 19, 1994, AT&T merged with McCaw. As a result, 197.5 million shares of McCaw common stock were converted into shares of AT&T common stock at an exchange ratio of one share of AT&T common stock for each McCaw share. In addition, AT&T assumed 11.3 million McCaw stock options which were converted into AT&T stock options at the same exchange ratio, resulting in 11.3 million additional AT&T stock options at an average exercise price of $27.43. The merger was accounted for as a pooling of interests, and the consolidated financial statements were restated for all periods prior to the merger to include the accounts and operations of McCaw. Intercompany transactions prior to 1994 were not eliminated due to immateriality. Merger-related expenses of $246 million incurred in 1994 ($187 million net of taxes) were reported as selling, general and administrative expenses. Certain reclassifications were made to McCaw's accounts to conform to AT&T's presentation. Premerger operating results of the companies in the current presentation were:

Dollars in millions	**Nine Months Ended September 30, 1994**	Year Ended December 31, 1993	1992
Sales and Revenues			
AT&T	**$52,178**	$67,156	$64,904
McCaw	**2,062**	2,195	1,743
Eliminations	**(256)**	—	—
Total	**$53,984**	$69,351	$66,647
Net Income (Loss)			
AT&T	**$ 3,431**	$ (3,794)	$ 3,807
McCaw	**34**	(2,112)*	(365)
Eliminations	**(93)**	—	—
Total	**$ 3,372**	$ (5,906)	$ 3,442

*Includes a charge of $45 million previously reported as an extraordinary item for the early redemption of debt.

5. Supplementary Financial Information

Supplementary Income Statement Information

Dollars in millions	1994	1993	1992
Included in costs			
Amortization of software production costs	$ 370	$ 359	$ 315
Amortization of licensing costs	115	108	105
Cost of financial services and leasing			
Interest expense	$ 725	$ 506	$ 485
Depreciation, provision for losses, etc.	1,427	1,205	825
Cost of financial services and leasing	$2,152	$1,711	$1,310
Included in selling, general and administrative expenses			
Amortization of goodwill	$ 97	$ 89	$ 80
Other income – net			
Interest income	$ 80	$ 141	$ 167
Royalties and dividends	30	59	48
Minority interests in earnings of subsidiaries	(64)	(9)	40
Miscellaneous – net	190	285	(92)
Other income – net	$ 236	$ 476	$ 163
Deducted from interest expense			
Capitalized interest	$ 47	$ 72	$ 62

Supplementary Balance Sheet Information

Dollars in millions at December 31	1994	1993
Inventories		
Completed goods	$ 2,022	$ 1,927
Work in process and raw materials	1,611	1,295
Inventories	$ 3,633	$ 3,222
Property, plant and equipment		
Land and improvements	$ 761	$ 757
Buildings and improvements	9,240	8,608
Machinery, electronic and other equipment	35,981	33,930
Total property, plant and equipment	45,982	43,295
Less: Accumulated depreciation	23,947	22,280
Property, plant and equipment – net	$22,035	$21,015
Investments		
Accounted for by the equity method	$ 2,314	$ 2,603
Stated at cost or fair value	394	457
Investments	$ 2,708	$ 3,060
Other assets		
Unamortized software production costs	$ 483	$ 499
Unamortized goodwill	1,007	1,359
Deferred charges	746	270
Other	1,757	1,437
Other assets	$ 3,993	$ 3,565
Debt maturing within one year		
Commercial paper	$10,777	$ 8,761
Long-term debt	2,535	2,019
Long-term lease obligations	30	52
Other	324	231
Debt maturing within one year	$13,666	$11,063

Supplementary Cash Flow Information

Dollars in millions	1994	1993	1992
Interest payments net of amounts capitalized	$1,280	$1,640	$1,510
Income tax payments	2,047	1,733	727

The following table displays the non-cash items excluded from the consolidated statements of cash flows:

Dollars in millions	1994	1993	1992
Machinery and equipment acquired under capital lease obligations	$ 13	$ 15	$ 60
Exchange of stock			
Net assets	$ 2	$ (43)	—
Investments	—	260	—
Licenses	134	96	—
	$ 136	$ 313	—
Acquisition activities			
Net receivables	$ 24	$ (19)	$ (131)
Inventories	(10)	(1)	(48)
Property, plant and equipment	3	(132)	(82)
Licensing costs	(79)	5	(75)
Accounts payable	(8)	7	37
Short-term and long-term debt	47	3	93
Other operating assets and liabilities – net	167	(91)	(102)
Net non-cash items consolidated	144	(228)	(308)
Net cash received from (used for) acquisitions	$ 144	$ (228)	$ (308)

6. Business Restructuring and Other Charges

Our $498 million in provisions for business restructuring in 1993 covered $227 million of costs at AT&T Global Information Solutions (including, in millions, $137 for special termination benefits, $43 for closing facilities, $18 for employee relocation, $19 for contractual obligations and $10 for other related expenses). We also provided $215 million for restructuring customer support functions for telecommunications services (including, in millions, $55 for employee relocation, $25 for outplacement costs, $30 for legal matters, and $105 for closing facilities, lease terminations and asset abandonments associated with centralizing support services). The remaining provisions consist of $23 million related to closing plants for manufacturing telecommunications network systems, and $33 million for employee relocation, outplacement services and legal liabilities related to restructuring operations that service the U.S. federal government. These amounts were recorded as $13 million in costs of products and systems, $90 million as costs of other services, $373 million as selling, general and administrative expenses and $22 million as research and development expenses.

We believe that the balance of reserves for business restructuring activities, $894 million at December 31, 1994, is adequate for the completion of those activities.

7. Other Income – Net

In June 1993 we sold our remaining 77% interest in UNIX System Laboratories, Inc. to Novell, Inc. (Novell) in exchange for approximately 3% of Novell's common stock. Our gain on the sale was $217 million.

We sold our remaining interest in Compagnie Industriali Riunite S.p.A. in 1993 for a slight gain. We reduced the carrying value of that investment by $68 million in 1992 because of a sustained decline in its market value.

8. Sale of Stock by Subsidiary

In August 1993 AT&T Capital Corporation (AT&T Capital) sold 5,750,000 shares of common stock in an initial public offering and approximately 850,000 shares of common stock in a management offering. That was about 14% of the shares outstanding, so our ownership is now about 86%. The shares were sold at $21.50 per share, yielding net proceeds of $115 million excluding $18 million of recourse loans attributable to the management offering. Because of these loans, we recorded a $9 million loss on the sale. When the loans are collected by the year 2000, we expect to report a net $6 million gain from this sale of stock.

9. Income Taxes

This table shows the principal reasons for the difference between the effective tax rate and the United States federal statutory income tax rate:

Dollars in millions	**1994**	1993	1992
U.S. Federal statutory income tax rate	**35%**	35%	34%
Federal income tax at statutory rate	**$2,631**	$2,101	$1,917
Amortization of investment tax credits	**(33)**	(92)	(221)
State and local income taxes, net of federal income tax effect	**296**	287	243
Amortization of intangibles	**20**	24	110
Foreign rate differential	**36**	45	75
Taxes on repatriated and accumulated foreign income, net of tax credits	**(71)**	(20)	67
Research credits	**(66)**	(47)	(18)
Capital loss carryforward	—	—	(13)
Effect of tax rate change on deferred tax assets	—	(23)	—
Other differences – net	**(5)**	26	36
Provision for income taxes	**$2,808**	$2,301	$2,196
Effective income tax rate	**37.3%**	38.3%	39.0%

The U.S. and foreign components of income before income taxes and the provision for income taxes are presented in this table:

Dollars in millions	**1994**	1993	1992
Income before income taxes			
United States	**$6,841**	$5,705	$5,308
Foreign	**677**	298	330
	$7,518	$6,003	$5,638
Provision for income taxes			
Current			
Federal	**$1,618**	$ 925	$ 533
State and local	**300**	206	142
Foreign	**225**	169	215
	$2,143	$1,300	$ 890
Deferred			
Federal	**$ 488**	$ 910	$1,384
State and local	**155**	212	225
Foreign	**60**	(41)	(85)
	$ 703	$1,081	$1,524
Deferred investment tax credits–net*	**(38)**	(80)	(218)
Provision for income taxes	**$2,808**	$2,301	$2,196

*Net of amortization of $33 in 1994, $92 in 1993 and $221 in 1992.

Deferred tax liabilities are taxes we expect to pay in future periods. Similarly, deferred tax assets are taxes we expect to get refunded in future periods. Deferred taxes arise because of differences in the book and tax bases of certain assets and liabilities.

Deferred tax liabilities (assets) consist of the following:

Dollars in millions	1994	1993
Long-term deferred income tax liabilities:		
Property, plant and equipment	**$5,964**	$5,620
Other	**1,713**	964
Total long-term deferred tax liabilities	**$7,677**	$6,584
Long-term deferred income tax assets:		
Business restructuring	**$ 479**	$ 476
Credit carryforwards	**166**	425
Employee pensions and other benefits–net	**2,618**	3,348
Reserves and allowances	**141**	142
Unamortized investment tax credits	**92**	119
Valuation allowance	**(178)**	(212)
Other	**446**	55
Total long-term deferred income tax assets	**$3,764**	$4,353
Net long-term deferred income tax liabilities	**$3,913**	$2,231
Current deferred income tax liabilities:		
Other	**$ 110**	$ 93
Total current deferred income tax liabilities	**$ 110**	$ 93
Current deferred income tax assets:		
Business restructuring	**$ 99**	$ 191
Credit carryforwards	**99**	—
Employee pensions and other benefits	**1,166**	850
Reserves and allowances	**1,126**	907
Other	**650**	224
Total current deferred income tax assets	**$3,140**	$2,172
Net current deferred income tax assets	**$3,030**	$2,079

This table shows the principal sources of deferred taxes in 1992:

Dollars in millions	1992
Property, plant and equipment	$ 992
Business restructuring charges	218
Employee pensions and other benefits	234
Reserves and allowances	108
Other timing differences – net	(28)
Deferred income taxes	$1,524

10. Leases

As Lessor

We provide financing on sales of our products and those of other companies and lease our products to customers under sales-type leases. This table displays our net investment in direct financing and sales-type leases:

Dollars in millions at December 31	1994	1993
Minimum lease payments receivable	**$ 5,414**	$4,226
Estimated unguaranteed residual values	**593**	543
Unearned income	**(1,006)**	(797)
Allowance for credit losses	**(127)**	(110)
Net investment	**$ 4,874**	$3,862

This table shows the scheduled maturities for our $5,414 million minimum lease payments receivable on these leases at December 31, 1994:

1995	1996	1997	1998	1999	Later Years
$1,689	$1,402	$1,143	$659	$309	$212

We lease airplanes, energy-producing facilities and transportation equipment under leveraged leases having original terms ranging from 10 to 30 years, expiring in various years from 1995 through 2025.

This table shows our net investment in leveraged leases:

Dollars in millions at December 31	1994	1993
Rentals receivable (net of principal and interest on nonrecourse notes)	**$ 967**	$1,010
Estimated residual value of leased property	**781**	782
Unearned and deferred income	**(472)**	(537)
Allowance for credit losses	**(30)**	(22)
Investment in leveraged leases	**1,246**	1,233
Deferred taxes	**(1,066)**	(994)
Net investment	**$ 180**	$ 239

We lease land, buildings and equipment to others through operating leases, the majority of which are cancelable. This table shows our net investment in operating leases:

Dollars in millions at December 31	1994	1993
Assets leased to others	**$2,129**	$2,694
Less: Accumulated depreciation	**817**	1,230
Net investment	**$1,312**	$1,464

This table shows the $977 million of future minimum rentals receivable under noncancelable operating leases at December 31, 1994:

1995	1996	1997	1998	1999	Later Years
$354	$201	$104	$46	$32	$240

As Lessee

We lease land, buildings and equipment through contracts that expire in various years through 2025. Our rental expense under operating leases, in millions, was $1,098 in 1994, $1,095 in 1993 and $1,168 in 1992. The table below shows our future minimum lease payments due under noncancelable leases at December 31, 1994. Such payments total $2,968 million for operating leases. The net present value of such payments on capital leases was $105 million after deducting estimated executory costs of $1 million and imputed interest of $15 million.

	1995	1996	1997	1998	1999	Later Years
Operating leases	$579	$445	$370	$301	$250	$1,023
Capital leases	52	30	21	10	5	3
Minimum lease payments	$631	$475	$391	$311	$255	$1,026

11. Shareowners' Equity

Dollars in millions	Common Shares	Additional Paid-in Capital	Foreign Currency Translation Adjustments	Retained Earnings (Deficit)
At December 31, 1991	$1,491	$12,670	$158	$4,116
1992				
Net income	—	—	—	3,442
Dividends declared	—	—	—	(1,759)
Shares issued:				
Under employee plans	14	307	—	—
Under shareowner plans	10	402	—	—
Other	—	2	—	—
For merger with Teradata	11	103	—	—
Teradata balance recorded	—	—	—	(178)
Shares repurchased	—	(2)	—	
Translation adjustments	—	—	(93)	—
Other changes	—	3	—	23
At December 31, 1992	1,526	13,485	65	5,644
1993				
Net income	—	—	—	(5,906)
Dividends declared	—	—	—	(1,780)
Shares issued:				
Under employee plans	6	183	—	—
Under shareowner plans	8	450	—	—
Other	7	208	—	—
Shares repurchased	—	(4)	—	—
Translation adjustments	—	—	(97)	—
Other changes	—	2	—	(68)
At December 31, 1993	1,547	14,324	(32)	(2,110)
1994				
Net income	—	—	—	**4,710**
Dividends declared	—	—	—	**(1,940)**
Shares issued:				
Under employee plans	**11**	**538**	—	—
Under shareowner plans	**8**	**424**	—	—
To acquire licenses	**3**	**133**	—	—
Shares repurchased	—	**(2)**	—	—
Preferred stock redemption	—	**408**	—	—
Translation adjustments	—	—	**177**	—
Other changes	—	—	—	**27**
At December 31, 1994	**$1,569**	**$15,825**	**$145**	**$ 687**

In 1992 we recorded the retained earnings of Teradata Corporation (Teradata) as of January 1, after making adjustments associated with the merger. In September 1991 NCR Corporation (NCR) issued 6.3 million shares of NCR common stock in connection with the merger with AT&T. The shares were converted into approximately 17.9 million shares of our common stock upon consummation of the merger.

In March 1990 we issued 13.4 million new shares of common stock in connection with the establishment of an ESOP feature for the nonmanagement savings plan. The shares are being allocated to plan participants over ten years commencing in July 1990 as contributions are made to the plan.

We have 100 million authorized shares of preferred stock at $1 par value. No preferred stock is currently issued or outstanding.

12. Long-term Debt Obligations

This table shows the outstanding long-term debt obligations in millions at December 31:

Interest Rates	Maturities	1994	1993
Debentures			
$4\frac{3}{8}\%$ to $4\frac{3}{4}\%$	1996–1999	**$ 750**	$ 750
$5\frac{1}{8}\%$ to 6%	2000–2001	**500**	500
8% to 9%	2008–2031	**1,700**	1,676
Notes			
$4\frac{1}{4}\%$ to $7\frac{3}{4}\%$	1995–2009	**6,291**	3,605
$7\frac{4}{5}\%$ to $8\frac{19}{20}\%$	1995–2004	**348**	445
9% to 13%	1995–2020	**373**	616
Variable rate	1995–2054	**3,187**	6,072
		13,149	13,664
Long-term lease obligations		**105**	163
Other		**739**	89
Less: Unamortized discount–net		**69**	43
		13,924	13,873
Less: Amounts maturing within one year		**2,566**	2,071
Total long-term obligations		**$11,358**	$11,802

This table shows the maturities, at December 31, 1994, of the $13,149 million in debentures and notes:

1995	1996	1997	1998	1999	Later Years
$2,535	$2,115	$1,197	$1,288	$1,396	$4,618

A consortium of lenders provides revolving credit facilities of $7 billion to AT&T and $2 billion to AT&T Capital. These facilities are intended for general corporate purposes, which include support for AT&T's and AT&T Capital's commercial paper. They were unused at December 31, 1994.

13. Employee Benefit Plans

Pension Plans

We sponsor noncontributory defined benefit plans covering the majority of our employees. Benefits for management employees are principally based on career-average pay. Benefits for occupational employees are not directly pay-related.

Pension contributions are principally determined using the aggregate cost method and are primarily made to trust funds held for the sole benefit of plan participants. We compute pension cost using the projected unit credit method and assumed a long-term rate of return on plan assets of 9.0% in 1994, 1993 and 1992.

Pension cost includes the following components:

Dollars in millions	1994	1993	1992
Service cost – benefits earned during the period	**$ 669**	$ 536	$ 452
Interest cost on projected benefit obligation	**2,400**	2,294	2,225
Amortization of unrecognized prior service costs	**230**	251	346
Credit for expected return on plan assets*	**(3,260)**	(3,110)	(2,973)
Amortization of transition asset	**(501)**	(500)	(502)
Charges for special pension options	**—**	74	11
Net pension cost (credit)	**$ (462)**	$ (455)	$ (441)

*The actual return on plan assets was $601 in 1994, $5,068 in 1993 and $2,153 in 1992.

This table shows the funded status of the defined benefit plans:

Dollars in millions at December 31	1994	1993
Actuarial present value of accumulated benefit obligation, including vested benefits of $26,315 and $28,027, respectively	**$28,778**	$30,804
Plan assets at fair value	**$40,150**	$41,291
Less: Actuarial present value of projected benefit obligation	**30,090**	32,495
Excess of assets over projected benefit obligation	**10,060**	8,796
Unrecognized prior service costs	**2,319**	2,052
Unrecognized transition asset	**(3,460)**	(3,960)
Unrecognized net gain	**(4,982)**	(3,504)
Net minimum liability of nonqualified plans	**(93)**	(122)
Prepaid pension costs	**$ 3,844**	$ 3,262

We used these rates and assumptions to calculate the projected benefit obligation:

At December 31	1994	1993
Weighted-average discount rate	**8.7%**	7.5%
Rate of increase in future compensation levels	**5.0%**	5.0%

The prepaid pension costs shown above are net of pension liabilities for plans where accumulated plan benefits exceed assets. Such liabilities are included in other liabilities in the consolidated balance sheets.

We are amortizing over approximately 15.9 years the unrecognized transition asset related to our 1986 adoption of SFAS No. 87, "Employers' Accounting for Pensions." We amortize prior service costs primarily on a straight-line basis over the average remaining service period of active employees. Our plan assets consist primarily of listed stocks (including $216 million and $378 million of AT&T common stock at December 31, 1994 and 1993, respectively), corporate and governmental debt, real estate investments, and cash and cash equivalents.

Savings Plans

We sponsor savings plans for the majority of our employees. The plans allow employees to contribute a portion of their pretax and/or after-tax income in accordance with specified guidelines. We match a percentage of the employee contributions up to certain limits. Our contributions in millions amounted to $357 in 1994, $351 in 1993 and $334 in 1992.

14. Postretirement Benefits

Our benefit plans for retirees include health care benefits, life insurance coverage and telephone concessions. This table shows the components of the net postretirement benefit cost:

Dollars in millions	1994	1993
Service cost – benefits earned during the period	**$108**	$ 95
Interest cost on accumulated postretirement benefit obligation	**852**	868
Expected return on plan assets*	**(242)**	(180)
Amortization of unrecognized prior service costs	**14**	29
Charge for special options	**—**	29
Net postretirement benefit cost	**$732**	$841

*The actual return on plan assets was $(30) in 1994, and $243 in 1993.

We did not restate our 1992 financial statements to reflect the change in accounting for retiree benefits. This table shows our actual postretirement benefit costs on a pay-as-you-go basis in 1992:

Dollars in millions	1992
Cost of health care benefits for retirees	$532
Cost of life insurance benefits for retirees	3
Cost of telephone concessions and other benefits	39
Payments to regional Bell companies for predivestiture retirees	145
Postretirement benefit cost	$719

We had approximately 144,900 retirees in 1994, 142,200 in 1993 and 141,200 in 1992.

Our plan assets consist primarily of listed stocks, corporate and governmental debt, cash and cash equivalents and life insurance contracts. This table shows the funded status of our postretirement benefit plans reconciled with the amounts recognized in the consolidated balance sheet:

Dollars in millions at December 31	1994	1993
Accumulated postretirement benefit obligation:		
Retirees	**$ 7,861**	$ 8,912
Fully eligible active plan participants	**822**	885
Other active plan participants	**1,745**	2,084
Accumulated postretirement benefit obligation	**10,428**	11,881
Plan assets at fair value	**3,291**	2,918
Unfunded postretirement obligation	**7,137**	8,963
Less:		
Unrecognized prior service cost	**(46)**	210
Unrecognized net (gain) loss	**(633)**	558
Accrued postretirement benefit obligation	**$ 7,816**	$ 8,195

We made these assumptions in valuing our postretirement benefit obligation at December 31:

	1994	1993
Weighted-average discount rate	**8.8%**	7.5%
Expected long-term rate of return on plan assets	**9.0%**	9.0%
Assumed rate of increase in the per capita cost of covered health care benefits	**8.6%**	9.4%

We assumed that the growth in the per capita cost of covered health care benefits (the health care cost trend rate) would gradually decline after 1994 to 5.7% by the year 2021 and then remain level. This assumption greatly affects the amounts reported. To illustrate, increasing the assumed trend rate by 1% in each year would raise our accumulated postretirement benefit obligation at December 31, 1994 by $577 million and our 1994 postretirement benefit costs by $58 million.

15. Stock Options

In our Long-Term Incentive Program, we grant stock options, stock appreciation rights (SARs), either in tandem with stock options or free-standing, and other awards. On January 1 of each year, 0.6% of the outstanding shares of our common stock become available for grant. The exercise price of any stock option is equal to or greater than the stock price when the option is granted. When granted in tandem, exercise of an option or SAR cancels the other to the extent of such exercise. Before our mergers with McCaw, NCR and Teradata, stock options were granted under the separate stock option plans of those companies. No new options can be granted under those plans. Option transactions are shown below:

Number of Shares	1994	1993	1992
Balance at January 1	**38,011,478**	36,777,098	37,267,956
Options assumed in merger with Teradata	—	—	1,848,642
Options granted	**5,803,142**	7,261,355	7,580,568
Options and SARs exercised	**(2,498,132)**	(5,766,132)	(9,504,536)
Average price	**$25.04**	$23.93	$13.66
Options forfeited	**(1,031,687)**	(260,843)	(415,532)
At December 31:			
Options outstanding	**40,284,801**	38,011,478	36,777,098
Average price	**$36.61**	$33.52	$28.53
Options exercisable	**28,010,381**	24,063,837	23,759,421
Shares available for grant	**22,014,728**	25,264,307	22,614,535

During 1994, 41,300 SARs were exercised and no SARs were granted. At December 31, 1994, 881,385 SARs remained unexercised and all of these were exercisable.

16. Segment Information

Industry Segments

Our operations in the global information movement and management industry involve providing wireline and wireless telecommunications services, business information processing systems, and other systems, products and services that combine communications and computers. Our operations in the financial services and leasing industry involve direct financing and finance leasing programs for our products and the products of other companies, leasing products to customers under operating leases and being in the general-purpose credit card business. Miscellaneous other activities, including the distribution of computer equipment through retail outlets, in the aggregate, represent less than 10% of revenues, operating income and identifiable assets and are included in the information movement and management segment. Revenues between industry segments are not material.

Dollars in millions	1994	1993	1992
Revenues			
Information movement and management	**$71,977**	$66,847	$64,753
Financial services and leasing	**3,117**	2,504	1,894
	$75,094	$69,351	$66,647
Operating income			
Information movement and management	**$ 8,188**	$ 6,839	$ 7,200
Financial services and leasing	**394**	339	193
Corporate and nonoperating	**(1,064)**	(1,175)	(1,755)
Income before income taxes	**$ 7,518**	$ 6,003	$ 5,638
Assets			
Information movement and management	**$56,551**	$51,971	$50,661
Financial services and leasing	**21,462**	17,033	14,003
Corporate assets	**1,714**	1,104	1,849
Eliminations	**(465)**	(715)	(409)
	$79,262	$69,393	$66,104
Depreciation and amortization			
Information movement and management	**$ 4,193**	$ 4,271	$ 4,046
Financial services and leasing	**440**	431	352
Capital expenditures			
Information movement and management	**$ 4,237**	$ 3,831	$ 3,710
Financial services and leasing	**609**	457	633
Total liabilities			
Financial services and leasing	**$19,463**	$15,329	$12,250

Geographic Segments

Transfers between geographic areas are on terms and conditions comparable with sales to external customers. The methods followed in developing the geographic area data require the use of estimation techniques and do not take into account the extent to which product development, manufacturing and marketing depend upon each other. Thus the information may not be indicative of results if the geographic areas were independent organizations.

Dollars in millions	1994	1993	1992
Revenues – external customers			
United States	**$67,769**	$63,775	$60,977
Other geographic areas	**7,325**	5,576	5,670
	$75,094	$69,351	$66,647
Transfers between geographic areas (eliminated in consolidation)			
United States	**$ 1,679**	$ 1,374	$ 1,077
Other geographic areas	**1,291**	1,125	911
	$ 2,970	$ 2,499	$ 1,988
Operating income (loss)			
United States	**$ 8,732**	$ 7,425	$ 7,441
Other geographic areas	**(150)**	(247)	(48)
Corporate and nonoperating	**(1,064)**	(1,175)	(1,755)
Income before income taxes	**$ 7,518**	$ 6,003	$ 5,638
Assets			
United States	**$69,718**	$63,194	$60,409
Other geographic areas	**9,361**	6,901	5,373
Corporate assets	**1,714**	1,104	1,849
Eliminations	**(1,531)**	(1,806)	(1,527)
	$79,262	$69,393	$66,104

Data on other geographic areas pertain to operations that are located outside of the U.S. Our revenues from all international activities, including those in the table, international telecommunications services and exports, provided 25.2% of consolidated revenues in 1994.

Business restructuring and other charges were taken primarily in the information movement and management segment and the U.S. geographic area. Corporate assets are principally cash and temporary cash investments.

17. Financial Instruments

In the normal course of business we use various financial instruments, including derivative financial instruments, for purposes other than trading. These instruments include commitments to extend credit, letters of credit, guarantees of debt, interest rate swap and cap agreements, and foreign currency exchange contracts. By their nature all such instruments involve risk, including the credit risk of nonperformance by counterparties, and our maximum potential loss may exceed the amount recognized in our balance sheet. As is customary for these types of instruments, we usually do not require collateral or other security from other parties to these instruments. However, because we control our exposure to credit risk through credit approvals, credit limits and monitoring procedures, we believe that our reserves for losses are adequate.

Commitments to Extend Credit

We participate in the general-purpose credit card business through AT&T Universal Card Services Corp., a wholly owned subsidiary. We purchase essentially all cardholder receivables under an agreement with the Universal Bank, a subsidiary of Synovus Financial Corporation, which issues the cards. At December 31, the unused portion of available credit was approximately $75,445 million in 1994 and $64,864 million in 1993. This represents the receivables we would need to purchase if all Universal Card accounts were used up to their full credit limits. The potential risk of loss associated with, and the estimated fair values of, the unused credit lines are not considered to be significant.

Letters of Credit

Letters of credit are purchased guarantees that ensure our performance or payment to third parties in accordance with specified terms and conditions.

Guarantees of Debt

From time to time, we guarantee the financing for product purchases by customers outside the U.S., and the debt of certain unconsolidated joint ventures.

Interest Rate Swap and Cap Agreements

We enter into interest rate contracts to manage our exposure to changes in interest rates and lower our overall costs of financing. We enter into swap agreements to manage the fixed/floating mix of our debt portfolio to reduce aggregate risk to interest rate movements. These agreements involve the exchange of floating rate for fixed rate payments without the exchange of the underlying principal amount. Fixed interest rate payments are at rates ranging from 3.8% to 8.2%. Floating rate payments are based on rates tied to prime, LIBOR or U.S. Treasury bills. Interest rate differentials paid or received under these swap contracts are recognized over the life of the contracts as adjustments to the effective yield of the underlying debt.

We pay premiums for cap agreements to protect us from rising interest rates on our floating rate debt. There is no market risk of loss beyond the premiums paid, which are amortized over the life of the agreement. The weighted average remaining term of the agreements is 5 years for swap contracts and 2 years for caps.

Foreign Exchange

We enter into foreign currency exchange contracts, including forward, option and swap contracts, to manage our exposure to changes in currency exchange rates, principally Canadian dollars, Deutsche marks, pounds sterling and Japanese yen. The use of derivative financial instruments allows us to reduce our exposure to the risk that the eventual dollar net cash inflows resulting from the sale of products to foreign customers and purchases from foreign suppliers will be adversely affected by changes in exchange rates. Our foreign exchange contracts almost entirely hedge firmly committed purchases and sales. These transactions are generally expected to occur in less than one year. Deferred gains and losses are recognized when the future sales or purchases are recognized or immediately if the commitment is canceled. At December 31, 1994, deferred unrealized gains, based on dealer quoted prices, were $51 million and deferred unrealized losses were $55 million.

Fair Values of Financial Instruments Including Derivative Financial Instruments

The tables below show the valuation methods and the carrying or notional amounts and estimated fair values of material financial instruments held or issued for purposes other than trading:

Financial instrument	*Valuation method*
Universal Card finance receivables	Carrying amounts. These accrue interest at a prime-based rate.
All other finance receivables	Future cash flows discounted at market rates.
Debt excluding capital leases	Market quotes or based on rates available to us for debt with similar terms and maturities.
Letters of credit	Fees paid to obtain the obligations.
Guarantees of debt	Costs to terminate agreements.
Interest rate swap agreements	Net gains or losses to terminate agreements.
Interest rate cap agreements	Costs to obtain agreements.
Foreign exchange contracts	Market quotes.

Dollars in millions	**1994**		1993	
	Carrying Amount	**Fair Value**	Carrying Amount	Fair Value
On balance sheet				
Assets:				
Finance receivables other than leases	**$13,553**	**$13,528**	$10,320	$10,337
Liabilities:				
Debt excluding capital leases	**24,920**	**24,449**	22,702	23,032
	Contract/ Notional Amount	**Fair Value**	Contract/ Notional Amount	Fair Value
Off balance sheet				
Interest rate swap agreements	**$4,423**	**$115**	$3,835	$(37)
Interest rate cap agreements	**1,333**	**2**	1,640	4
Foreign exchange:				
Forward contracts	**1,573**	**(17)**	783	(3)
Swap contracts	**340**	**10**	361	5
Purchased option contracts	**—**	**—**	41	1
Letters of credit	**834**	**2**	680	—
Guarantees of debt	**423**	**—**	455	—

18. Contingencies

In the normal course of business we are subject to proceedings, lawsuits and other claims, including proceedings under government laws and regulations related to environmental and other matters. Such matters are subject to many uncertainties, and outcomes are not predictable with assurance. Consequently, we are unable to ascertain the ultimate aggregate amount of monetary liability or financial impact with respect to these matters at December 31, 1994. While these matters could affect the operating results of any one quarter when resolved in future periods, we believe that after final disposition, any monetary liability or financial impact to us beyond that provided for at year-end would not be material to our annual consolidated financial statements.

19. AT&T Credit Holdings, Inc.

In connection with a March 31, 1993, legal restructuring of AT&T Capital Holdings, Inc. (formerly AT&T Capital Corporation), we issued a direct, full and unconditional guarantee of all the outstanding public debt of AT&T Credit Holdings, Inc. (formerly AT&T Credit Corporation).

AT&T Credit Holdings, Inc. holds the majority of AT&T's investment in AT&T Capital and the lease finance assets of the former AT&T Credit Corporation. The table below shows summarized consolidated financial information for AT&T Credit Holdings, Inc., which consolidates the accounts of AT&T Capital. The summarized financial information includes transactions with AT&T that are eliminated in consolidation.

Dollars in millions	**1994**	1993	1992
Total revenue	**$1,437**	$1,432	$1,351
Interest expense	**302**	284	293
Selling, general and administrative expense	**387**	329	309
Income before cumulative effect of change in accounting	**92**	70	100
Cumulative effect on prior years of change in accounting for income taxes (SFAS No. 109)	**—**	22	—
Net income	**92**	48	100
Finance receivables	**$7,726**	$6,220	
Net investment in operating lease assets	**903**	978	
Total assets	**9,468**	7,886	
Total debt	**5,682**	4,639	
Total liabilities	**8,299**	6,867	
Minority interest	**270**	251	
Total shareowners' equity	**899**	768	

In some cases, AT&T Capital securitizes finance receivables, subject to limited recourse provisions. In the unlikely event that all such receivables had become uncollectible and subject to recourse, our exposure was $353 million at December 31, 1994 and $347 million at December 31, 1993. We record liabilities for the amounts we expect to actually reimburse.

20. Preferred Stock Redemption

On June 24, 1994, LCH Communications (LCH), a subsidiary of LIN Broadcasting Corporation (LIN), redeemed all $1.3 billion of its outstanding redeemable preferred stock held by Comcast Cellular Communications, Inc. in exchange for all of the capital stock of one of LCH's subsidiaries.

As a result of the redemption, we eliminated the net assets and recorded a gain on the sale of assets of $12 million and a tax benefit of $74 million. The $784 million difference between the book value of the preferred stock and the fair value of the assets exchanged was recorded as $408 million of additional paid-in capital and $376 million of minority interests.

21. Private Market Value Guarantee

Under the Private Market Value Guarantee (PMVG) between McCaw and its 52%-owned subsidiary, LIN, a process began on January 1, 1995, to determine the private market price per share of LIN. The private market value is defined as the price per share, including control premium, that an unrelated third party would pay if it were to acquire all the outstanding shares of LIN, including the shares held by McCaw, in an arm's-length transaction and assuming that LIN was being sold in a manner to attract all possible participants and to maximize shareholder value. Using that definition, the private market value is being determined by Morgan Stanley & Co. Incorporated, designated as McCaw's appraiser, and by Lehman Brothers Inc. and Bear, Stearns & Co., designated jointly as the LIN independent directors' appraiser, and if necessary by a third party appraiser. After the price is determined, McCaw will have 45 days to decide whether to proceed with the acquisition of all the public shares of LIN at that price, subject to the approval of the LIN public shareholders, or to put LIN in its entirety up for sale under the direction of the LIN independent directors. Such a sale would also be subject to approval by the LIN public shareholders.

22. Quarterly Information (unaudited)

Dollars in millions (except per share amounts)	First	Second	Third	Fourth
1994				
Total revenues	**$17,097**	**$18,238**	**$18,649**	**$21,110**
Gross margin	**6,967**	**7,406**	**7,765**	**8,639**
Net income	**1,074**	**1,248**	**1,050**	**1,338**
Per common share:				
Net income	**.69**	**.80**	**.67**	**.85**
Dividends declared	**.33**	**.33**	**.33**	**.33**
Stock price*:				
High	**57 1/8**	**57 1/8**	**55 7/8**	**55 1/4**
Low	**50 5/8**	**49 1/2**	**52 1/2**	**47 1/4**
Quarter-end close	**51 1/4**	**53 3/8**	**54**	**50 1/4**
1993				
Total revenues	$16,199	$16,857	$17,225	$19,070
Gross margin	6,491	6,785	6,941	7,499
Income before cumulative effects of accounting changes	922	982	1,022	776
Net income (loss)	(8,686)	982	1,022	776
Per common share:				
Income before cumulative effects of accounting changes	.60	.64	.66	.50
Net income (loss)	(5.65)	.64	.66	.50
Dividends declared	.33	.33	.33	.33
Stock price*:				
High	59 1/8	63 7/8	65	61 3/8
Low	50 1/8	53 3/4	57 3/8	52
Quarter-end close	56 3/4	63	58 7/8	52 1/2

*Stock prices obtained from the Composite Tape.

The number of weighted average shares outstanding increases as we issue new common shares for employee plans, shareowner plans and other purposes. For this reason, the sum of quarterly earnings per common share may not be the same as earnings per common share for the year, and the per share effects of unusual items in a quarter may differ from the per share effects of those same items for the year.

In the third quarter of 1994, we recorded $227 million of costs ($169 million net of taxes) related to the McCaw merger primarily consisting of legal and investment banking fees and bonus pool funding.

In the second quarter of 1993, we recorded $278 million in provisions for business restructuring activities. The effect of these provisions was offset by the $217 million gain from selling UNIX System Laboratories, Inc. and other miscellaneous credits. In the fourth quarter of 1993, we recorded a $190 million provision for business restructuring at AT&T Global Information Solutions Company, which reduced net income by $119 million ($0.08 per share).

Board of Directors

Robert E. Allen, 59
Chairman of the Board and Chief Executive Officer of AT&T since 1988. Director since 1984. 6,8

M. Kathryn Eickhoff, 55
President of Eickhoff Economics Inc., a business consulting firm. Elected to Board in 1987. 1,5

Walter Y. Elisha, 62
Chairman and Chief Executive Officer of Springs Industries, Inc., a textile manufacturing firm. Director since 1987. 2,4,7

Philip M. Hawley, 69
Retired Chairman and Chief Executive Officer of Broadway Stores, Inc. (formerly Carter Hawley Hale Stores, Inc.), department stores. Director since 1982. 2,3,4

Carla A. Hills, 60
Chairman and Chief Executive Officer of Hills & Company consulting firm and former U.S. Trade Representative. Elected to Board in 1993. 1,2,5

Belton K. Johnson, 65
Former owner of Chaparrosa Ranch. Chairman of Belton K. Johnson Interests. Director since 1974. 3,5,6,8

Drew Lewis, 63
Chairman and Chief Executive Officer of Union Pacific Corporation, a rail transportation, natural resources and trucking company. Elected to Board in 1989. 1,2,5

Donald F. McHenry, 58
President of IRC Group, international relations consultants; educator and former U.S. Ambassador to the United Nations. Director since 1986. 3,7

Victor A. Pelson, 57
Chairman of AT&T Global Operations Team and Executive Vice President of AT&T. Elected to Board in 1993. 5

Donald S. Perkins, 67
Chairman of Kmart Corp., mass merchandise retailer. Director since 1979. 2,3,6,7,8

Henry B. Schacht, 60
Chairman and former Chief Executive Officer of Cummins Engine Company, Inc., manufacturer of diesel engines. Elected to Board in 1981. 1,5

Michael I. Sovern, 63
President Emeritus and Chancellor Kent Professor of Law at Columbia University. Director since 1984. 1,4

Franklin A. Thomas, 60
President of The Ford Foundation. Elected to Board in 1988. 1,2,5

Joseph D. Williams, 68
Retired Chairman and Chief Executive Officer of Warner-Lambert Company, a pharmaceutical, health care and consumer products company. Director since 1984. 4,6,7

Thomas H. Wyman, 65
Chairman of S. G. Warburg & Co. Inc., investment bankers. Director since 1981. 2,4,7

1. Audit Committee
2. Committee on Directors
3. Committee on Employee Benefits
4. Compensation Committee
5. Corporate Public Policy Committee
6. Executive Committee
7. Finance Committee
8. Proxy Committee

Management Executive Committee

Robert E. Allen, 59
Chairman of the Board and Chief Executive Officer since 1988. During 37-year AT&T career, has been chairman of Chesapeake and Potomac Telephone Companies, AT&T chief financial officer, chairman and CEO of AT&T Information Systems, and president and chief operating officer of AT&T.

Richard S. Bodman, 56
Senior Vice President of Corporate Strategy and Development since 1990. Previously president of Washington National Investment Corporation and CEO of Comsat General Corporation. Also held positions at E.I. du Pont de Nemours & Company, in the federal government and at Touche Ross & Company.

Harold W. Burlingame, 54
Senior Vice President of Human Resources since 1987. During 33-year AT&T career, has been vice president of public relations for AT&T Information Systems and senior vice president of public relations for the corporation.

Marilyn Laurie, 55
Senior Vice President of Public Relations and Employee Information since 1987. Chairman of the AT&T Foundation. Headed public relations at AT&T Bell Laboratories and AT&T Communications. A nationally recognized environmentalist, she joined AT&T in 1971.

Alex J. Mandl*, 51
Executive Vice President and Chief Executive Officer of Communications Services since 1993. Joined AT&T in 1991 as chief financial officer. Formerly chairman and CEO of Sea-Land Service, Inc. Held senior positions at CSX Corporation and Boise Cascade Corporation.

William B. Marx, Jr.*, 55
Executive Vice President and Chief Executive Officer, Multimedia Products, since 1994. Also responsible for worldwide purchasing operations, global manufacturing planning and AT&T Microelectronics. Held executive positions in several AT&T units since joining the company in 1961, most recently as Chief Executive Officer of AT&T Network Systems from 1989 to 1994.

John S. Mayo†, 64
President of AT&T Bell Laboratories since 1991. Joined AT&T in 1955. Headed product development at AT&T Network Systems and was senior vice president for network systems and network services at Bell Labs. Recipient of the National Medal of Technology for role in providing the technological foundation for Information Age communications.

Richard A. McGinn*, 48
Executive Vice President and Chief Executive Officer of Network Systems since 1994. During 25-year AT&T career, has been a regional director for AT&T International, president of AT&T Computer Systems, and president and chief operating officer of Network Systems.

Richard W. Miller*, 54
Executive Vice President and Chief Financial Officer since 1993. Formerly chairman and CEO of Wang Laboratories, Inc., senior vice president and general manager for consumer electronics at General Electric Company and chief financial officer for RCA.

William T. O'Shea*, 47
Interim Executive Vice President and Chief Executive Officer of AT&T Global Information Systems following the departure of Jerre L. Stead. Has spent more than 20 years in development, marketing and sales of information systems since joining AT&T Bell Laboratories in 1972. Currently senior vice president for worldwide marketing of AT&T Global Information Solutions.

Victor A. Pelson*, 57
Executive Vice President and Chairman of the Global Operations Team since 1993. Responsible for the effectiveness of AT&T's operations worldwide. Joined AT&T in 1959 as an engineer. Named head of Communications Services Group in 1989. Has held executive positions in virtually every part of the company.

John D. Zeglis, 47
Senior Vice President–General Counsel and Government Affairs since 1986 and 1989, respectively. Joined AT&T in 1984. Formerly a partner at the law firm of Sidley & Austin.

*Also a member of the Global Operations Team.

†Daniel C. Stanzione, president of AT&T Network Systems' Global Public Networks unit, will succeed Dr. Mayo upon his retirement February 28, 1995.

The Management Executive Committee leads the development and implementation of AT&T's mission, values and strategic intent, while the Global Operations Team is responsible for the effectiveness of AT&T's operations worldwide.

Our thanks and best wishes to three Management Executive Committee members who left the company. Sam Willcoxon retired as Group Executive of AT&T and President of the Telephone Pioneers of America. Jerre Stead, Chief Executive Officer of AT&T Global Information Systems, left to become Chief Executive Officer of Legent Corp., and Robert Kavner, Chief Executive Officer of AT&T Multimedia Products and Services, joined Creative Artists Agency.

Maureen B. Tart, 39
Vice President and Controller

S. Lawrence Prendergast, 53
Vice President and Treasurer

Marilyn J. Wasser, 39
Vice President–Law and Secretary

General Information

GENERAL QUESTIONS
General questions or comments about AT&T may be addressed to the office of Vice President–Law and Secretary at:

AT&T Corporate Headquarters
32 Avenue of the Americas
Room 2420E
New York, NY 10013-2412

FORM 10-K
Form 10-K (AT&T's annual report to the Securities and Exchange Commission) is available without charge from AT&T's shareowner services agent, First Chicago Trust Co., at the address shown at right.

OTHER REPORTS
AT&T Capital Corporation's annual report and Form 10-K are available without charge by calling 1 800 235-4288 or 201 397-3000, or writing:

AT&T Capital Corporation
Corporate Communications
44 Whippany Road
Morristown, NJ 07962-1983

AT&T Foundation Report
Department BR
P.O. Box 45284
Jacksonville, FL 32232-5284

AT&T and the Environment
Department AR
131 Morristown Road
Room B1336
Basking Ridge, NJ 07920-1650

Helpful Information for Investors

SHAREOWNER SERVICES
First Chicago Trust Co., our shareowner services and transfer agent, will be happy to answer questions about your account and help you with transactions. You may call them toll-free at: 1 800 348-8288.

Persons using a telecommunications device for the deaf (TDD) or a teletypewriter (TTY) may call: 1 800 822-2794.

From outside the United States, call us collect at: 201 324-0293.

Our mailing address is:
AT&T
c/o First Chicago Trust Co. of NY
P.O. Box 2575
Jersey City, NJ 07303-2575

The First Chicago Trust address to which banks and brokers may deliver certificates for transfer is 14 Wall Street in New York City.

DIVIDEND REINVESTMENT
The Dividend Reinvestment and Stock Purchase Plan provides owners of common stock a convenient way to purchase additional shares. If interested, please call or write First Chicago Trust for a prospectus and enrollment form.

INVESTOR RELATIONS
Security analysts and other members of the professional financial community are invited to contact AT&T Corporate Investor Relations with questions. Call 1 800 972-0784.

STOCK DATA
AT&T is listed on the New York Stock Exchange (ticker symbol "T"). AT&T also is listed on the Boston, Midwest, Pacific and Philadelphia stock exchanges in the U.S., and on stock exchanges in Brussels, London, Paris, Geneva and Tokyo.

Shareowners of record (as of December 30, 1994): 2,302,327

1995 ANNUAL MEETING
The 110th Annual Shareowners Meeting will be held 9:30 a.m., Wednesday, April 19, 1995, at the Washington State Convention and Trade Center in Seattle.

INFORMATION VIA INTERNET
Internet World Wide Web users can access information on AT&T and its products and services through the following Universal Resource Locator address: http://www.att.com/.

Shareowners with an e-mail address can send account inquiries electronically to our transfer agent, First Chicago Trust Co. The Internet address is fctc@attmail.com. AT&T Mail Service subscribers should address inquiries to !fctc.

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AT&T

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New York, NY 10013-2412
212 387-5400

Our Common Bond

We commit to these values to guide our decisions and behavior

Respect for Individuals: We treat each other with respect and dignity, valuing individual and cultural differences. We communicate frequently and with candor, listening to each other regardless of level or position. Recognizing that exceptional quality begins with people, we give individuals the authority to use their capabilities to the fullest to satisfy their customers. Our environment supports personal growth and continuous learning for all AT&T people. **Dedication to Helping Customers:** We truly care for each customer. We build enduring relationships by understanding and anticipating our customers' needs and by serving them better each time than the time before. AT&T customers can count on us to consistently deliver superior products and services that help them achieve their personal or business goals. **Highest Standards of Integrity:** We are honest and ethical in all our business dealings, starting with how we treat each other. We keep our promises and admit our mistakes. Our personal conduct ensures that AT&T's name is always worthy of trust. **Innovation:** We believe innovation is the engine that will keep us vital and growing. Our culture embraces creativity, seeks different perspectives and risks pursuing new opportunities. We create and rapidly convert technology into products and services, constantly searching for new ways to make technology more useful to customers. **Teamwork:** We encourage and reward both individual and team achievements. We freely join with colleagues across organizational boundaries to advance the interests of customers and shareowners. Our team spirit extends to being responsible and caring partners in the communities where we live and work. **By living these values, AT&T aspires to set a standard of excellence worldwide that will reward our shareowners, our customers, and all AT&T people.** ■