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Mr. Steve C. Tribble, Director  
Division of Records and Reporting  
Florida Public Service Commission  
101 East Gaines Street  
Tallahassee, FL 32399-0850

Re: Docket No. 920260-TL

Dear Mr. Tribble:

Enclosed for filing in the above-referenced docket on behalf of MCI Telecommunications Corporation are the original and fifteen copies each of the direct testimony of Nina Cornell and Don Wood.

By copy of this letter, this testimony has been furnished to the parties on the attached service list.

Very truly yours,

*Richard D. Melson*

Richard D. Melson

- ACK  RDM/clh
- ATA  Enclosure
- ATL
- CLT
- CTD
- CTE
- ENG
- LEC
- LIN  (6 + Orig)
- OPC
- RCH
- SEC
- WAS
- OTH

**Cornell**  
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FP30-RECORDS/REPORTING

**Wood**  
DOCUMENT NUMBER-DATE  
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FP30-RECORDS/REPORTING

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing was sent by U.S. Mail this 8th day of November, 1993.

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**ORIGINAL  
FILE COPY**

**BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION**

**PREPARED DIRECT TESTIMONY OF**

**NINA W. CORNELL**

**ON BEHALF OF**

**MCI TELECOMMUNICATIONS CORPORATION**

**DOCKET NO. 920260-TL**

**NOVEMBER 8, 1993**

**DOCUMENT NUMBER-DATE**

**12051 NOV-83**

**FPSC-RECORDS/REPORTING**

1 Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

2

3 A. My name is Nina W. Cornell. My address is 1290 Wood River Road,  
4 Meeteetse, Wyoming 82433.

5

6 Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL  
7 BACKGROUND AND EXPERIENCE.

8

9 A. I am an economist in private practice, specializing in microeconomic analysis  
10 of regulatory and antitrust issues. Until late 1988, I was with the firm of  
11 Cornell, Pelcovits & Brenner Economists Inc., of which I was president.

12 Before entering private practice, I was Chief of the Office of Plans and  
13 Policy, Federal Communications Commission (FCC). As Chief of the Office  
14 of Plans and Policy, I served as chief economist to the Commission and  
15 participated in virtually all FCC agenda meetings.

16 Prior to being associated with the FCC, I was the Senior Staff  
17 Economist for regulatory, transportation, environmental, and health and safety  
18 issues for the Council of Economic Advisers (CEA). In this position I  
19 reported directly to Charles L. Schultze, Chairman of the Council.

20 Prior to being with the CEA, I was employed as an economist with the  
21 Council on Wage and Price Stability, where I served on the Task Force on  
22 Reform of Federal Energy Administration Regulations. Before joining the  
23 Federal Government, I spent four years at the Brookings Institution as a  
24 Research Associate. I am a graduate of Swarthmore College, and received my  
25 Ph.D. in Economics from the University of Illinois in 1972.

26

1 Q. HAVE YOU PUBLISHED ANY PAPERS ON TELECOMMUNICATIONS?

2

3 A. Yes. I have published a number of papers on the regulation of  
4 telecommunications as well as on other regulatory and natural resource issues.

5 A list of my publications is contained in my resume -- Exhibit NWC-1.

6

7 Q. HAVE YOU TESTIFIED BEFORE?

8

9 A. Yes. I have served as an expert witness in several court and a number of  
10 regulatory proceedings, particularly proceedings involving telecommunications  
11 issues. I have also testified before various committees of the US. Congress.

12 A list of my testimonies is also contained in my resume.

13

14 Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

15

16 A. My testimony responds to the testimony of Mr. David Denton. Specifically,  
17 my testimony addresses Mr. Denton's suggestion that the Florida Public  
18 Service Commission develop a "comprehensive structure that enables the  
19 FPSC to examine interrelated issues and develop appropriate integrated  
20 policy." (Denton testimony, page 31, line 24-page 32, line 2) I agree with his  
21 suggestion, and with his statement that, "An overall view cannot be obtained if  
22 each docket and the related issues are reviewed in isolation." (Denton  
23 testimony, page 32, lines 2-4) My testimony discusses what issues should be  
24 included in such a "structure," and why, in order to protect monopoly  
25 ratepayers and to promote fair competition for all providers of  
26 telecommunications services.

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Q. MR. DENTON APPEARS TO BASE MUCH OF HIS DISCUSSION OF THE NEED TO CONTINUE THE EXISTING INCENTIVE REGULATION PLAN ON GROWING COMPETITION. DOES COMPETITION BRING BENEFITS FOR CONSUMERS?

A. Yes, where it can be effective competition. Mr. Denton apparently agrees. On page 4 he claims that competition has benefited consumers (although on page 9 he classifies competition with one of the most destructive hurricanes in history). Effective competition in telecommunications is only possible, however, where there are adequate safeguards against abuse of the bottleneck monopoly of the local exchange carrier.

Q. DO YOU AGREE WITH MR. DENTON THAT SOUTHERN BELL IS FACING MASSIVE COMPETITION IN FLORIDA?

A. No. Mr. Denton's examples are all of possible future competition. Very little of his discussion is about actual competition. At the present time, the competition Southern Bell faces is largely either for some segments of intraLATA toll or for special access services. Due to the lack of 1+ presubscription, however, there is not competition for all of intraLATA toll. Because facilities take time to build, there is not competition for special access throughout Southern Bell's serving territory. There is also competitive rivalry in the provision of payphone services, and rivalry between PBXs and Centrex-type services. This rivalry is not full competition, however, at least in part because of a lack of nondiscrimination in the provision of bottleneck monopoly

1 functions to dependent competitors. Competition for basic local exchange,  
2 however, does not exist now and is at best only potential, not actual.

3  
4 Q. DO YOU BELIEVE THAT COMPETITION IS GOING TO COME FOR  
5 BASIC LOCAL EXCHANGE SERVICES?

6  
7 A. I do not know whether or not there will be competition for basic local exchange  
8 services, but even if it comes, it will come relatively slowly and it will carry  
9 with it a continuing need to regulate a bottleneck, namely interconnection. The  
10 various candidates discussed by Mr. Denton for competitive provision of basic  
11 local exchange service are all only potential sources of entry, each facing  
12 significant barriers at present that prevent it from even beginning to offer basic  
13 local exchange services. The first and most formidable barrier is the local  
14 exchange franchise. The second, and equally problematic barrier is the need to  
15 interconnect with the existing local exchange companies.

16 Basic local exchange service is most valuable when the subscriber can  
17 reach all other subscribers. I have previously referred to this characteristic as  
18 ubiquity of reach. Any potential entrant into basic local exchange service will  
19 have to offer ubiquity of reach to be able to gain any subscribers at all.  
20 Because I do not believe it possible that any entrant could enter with a complete  
21 network in place that reached every current subscriber, and because I do not  
22 believe that even if an entrant did, all current subscribers would simultaneously  
23 drop their current local exchange service and sign up with the new supplier, all  
24 entrants will have to interconnect with the current local exchange providers.

25 The price that is set for this interconnection will determine whether or  
26 not there is any competition. If the price is too high, or if it applies only to the

1 entrant and not to the incumbent, any new services from firms such as cable  
2 television companies or possible PCS licensees will be confined to  
3 supplementary services, as is the case with cellular service today.

4  
5 Q. ARE THESE THE ONLY BARRIERS TO ENTRY BY ALTERNATIVE  
6 FORMS OF LOCAL EXCHANGE SERVICE PROVIDERS?

7  
8 A. No. There are additional barriers that make the various candidates less than  
9 sure bets to vie for basic local exchange service. PCS is not yet a service with  
10 licensees. To become a licensee, potential PCS providers are going to have to  
11 participate in a spectrum auction. If the payment for the licenses is too high,  
12 that service too may be limited to being a supplementary service, rather than a  
13 full substitute for current wire-line basic local exchange service. Cable  
14 television companies need to replace some plant in order for two-way  
15 transmissions not to distort or destroy the quality of television signals. This  
16 problem arises because of the very poor shielding built into television sets. As  
17 a result, they are very prone to interference that renders the program signals  
18 unwatchable. All of these problems are in addition to the two fundamental  
19 barriers I noted above. The result of all of them is to make it less than certain  
20 that any of these potential entrants ever becomes an actual entrant. It also  
21 makes it unlikely to occur soon or rapidly.

22 Southern Bell itself internally does not see PCS, at least, as posing any  
23 major threat. According to its 1993-1997 Network Strategic Plan, attached as  
24 Exhibit NWC-2, Southern Bell predicts only about a 1% displacement of  
25 regular telephone lines by PCS by the year 2000. It views PCS as more likely  
26 to affect the demand for additional lines, rather than as a replacement for basic

1 exchange service. Moreover, Southern Bell also recognizes the importance of  
2 interconnection. In a different document, a Southern Bell analyst notes that  
3 revenues from interconnection charges to PCS providers can "more than  
4 recover" any revenues lost due to the direct substitution of PCS for basic  
5 wireline exchange service.

6  
7 Q. DOES THIS MEAN THAT THE COMMISSION DOES NOT NEED TO  
8 DESIGN A REGULATORY STRUCTURE THAT ANTICIPATES  
9 COMPETITION?

10  
11 A. No, but the Commission should design a regulatory structure that appropriately  
12 responds to the competition that exists now and that is flexible enough to  
13 respond whether or not additional competition arises. This form of regulation  
14 needs attention not only to the array of issues that are covered in the other  
15 dockets listed by Mr. Denton, but also to a set of competitive safeguards about  
16 which Mr. Denton is totally silent. If the Commission were to adopt the  
17 appropriate safeguards, monopoly ratepayers would be protected no matter  
18 what the outcome of the competitive battles ahead -- if any. Those competitive  
19 battles, moreover, would be able to provide consumers the best possible  
20 benefits of allowing entry, including driving prices to cost (including the "cost"  
21 of any Commission-ordered contributions to monopoly services), facilitating  
22 the deployment of beneficial new technologies, and developing new services  
23 that respond to specific consumer needs.

24

1 Q. WHAT ARE THE DOCKETS LISTED BY MR. DENTON THAT NEED TO  
2 BE DECIDED WITHIN THE STRUCTURE MR. DENTON HAS  
3 RECOMMENDED?

4  
5 A. Mr. Denton listed three dockets that will have a significant impact on the state  
6 of telecommunications in Florida: expanded interconnection, 1+  
7 presubscription, and identification of competitive services and the appropriate  
8 regulation of these services. These dockets raise questions of where entry will  
9 be allowed, what kinds of pricing and service responses Southern Bell (and,  
10 presumably, other local exchange carriers) will be allowed to make, and how  
11 all of these changes will affect the remaining monopoly ratepayers.

12 I believe each of these dockets raises two additional underlying  
13 fundamental issues that are interrelated: the question of how to unbundle the  
14 functions of the local exchange carriers' networks, and how to establish prices  
15 for the core monopoly functions that exist today and those that will remain for  
16 some, I believe considerable, transition period. How the Commission decides  
17 these two fundamental underlying issues will determine what services will be  
18 available to the residents of Florida in the future, and at what price. The  
19 greatest degree of entry and possible competition can occur only if unbundling  
20 is required as an ongoing process and if there is strict nondiscrimination in the  
21 pricing of all bottleneck monopoly functions to all business users. The  
22 structure that Mr. Denton has recommended be adopted for deciding the three  
23 interrelated dockets that have been identified needs to make establishing an  
24 ongoing process for unbundling and adoption of a method for setting  
25 nondiscriminatory prices for those functions the starting point and the central  
26 focus of its attention.

1

2 Q. WHY IS UNBUNDLING AN MAJOR ISSUE UNDERLYING THE THREE  
3 DOCKETS THAT MR. DENTON IDENTIFIED?

4

5 A. Unbundling is a major issue underlying all three of the dockets identified by  
6 Mr. Denton because of a basic characteristic of telecommunications services.  
7 Services in telecommunications are whatever is offered under tariff (or price  
8 lists or contract). These services are in most cases bundled offerings that mix  
9 both bottleneck monopoly elements or functions and potentially competitive  
10 functions. The expanded interconnection docket deals directly with some  
11 unbundling, as the idea behind expanded interconnection is to allow other  
12 firms to offer potentially competitive functions and bundle them with some  
13 bottleneck monopoly elements provided by the local exchange companies.

14 More of this needs to take place, however, if the possible benefits of  
15 entry are to be realized in greater degree for telecommunications consumers in  
16 Florida. Those who think they have a better idea for a service or for  
17 technology need to be able to use whatever bottleneck monopoly elements that  
18 remain in the hands of the local exchange companies without having also to use  
19 elements that those other firms do not believe they want. Unbundling thus  
20 needs to occur not just as a one-time event, but as a process that potential  
21 entrants can use over time. If such a process is established correctly, more  
22 innovation in both technology and services can occur.

23 Mr. Denton refers to this at least indirectly in his discussion of  
24 deployment of the Advanced Intelligent Network (AIN) on pages 20-21. He  
25 claims that "deployment of AIN has the potential for expanding competition for  
26 end user services on Southern Bell's network." (Denton testimony, page 21,

1 lines 1-4) AIN could also have the potential of expanding competition for end  
2 users services using a combination of Southern Bell's and other suppliers'  
3 networks. This competition would bring greater benefits than would  
4 competition that can only use Southern Bell's network. To obtain these  
5 benefits, however, the deployment of AIN has to be accompanied by the  
6 unbundled availability of its various functions, rather than allowing Southern  
7 Bell to offer those functions only in more bundled ways.

8 1+ presubscription is also a kind of unbundling. Currently, the local  
9 exchange carriers bundle together 1+ presubscription with their own toll  
10 offering, not allowing any other firm to use that form of access for its  
11 customers. Requiring the local exchange carriers to unbundle and provide 1+  
12 presubscription to all carriers that want to use it to offer intraLATA toll services  
13 makes possible competition for medium and small toll users.

14 The example of 1+ presubscription demonstrates my earlier point that  
15 what services are truly competitive and what are not depends in part on the  
16 degree of unbundling that is adopted and on nondiscriminatory prices for those  
17 functions. Because 1+ presubscription is not available today in an unbundled  
18 form, effective competition for intraLATA MTS cannot exist. If the price  
19 charged for 1+ in an unbundled form is discriminatory, however, just  
20 unbundling it will not be sufficient to result in effective competition for MTS.  
21 Both requirements need to be met for effective competition to be able to  
22 develop. More broadly, no service that is a bundle of both bottleneck  
23 monopoly and potentially competitive functions is truly competitive unless the  
24 bottleneck monopoly elements are available to all who want them on an  
25 unbundled basis at nondiscriminatory prices.

26

1 Q. HOW SHOULD THE COMMISSION DETERMINE  
2 NONDISCRIMINATORY PRICES FOR THE BOTTLENECK MONOPOLY  
3 FUNCTIONS OF THE LOCAL EXCHANGE CARRIERS' NETWORKS?

4  
5 A. The Commission needs to require the local exchange carriers to determine its  
6 costs at the level of functions, not bundled services, and then use those cost  
7 results as the first input into setting prices. The Commission also needs to  
8 insist that whatever is charged to a business customer for a bottleneck  
9 monopoly function in one service, including when that function is unbundled  
10 and offered on a stand-alone basis, that the same price is covered in all bundled  
11 services using the same function used by any other business customers.

12  
13 Q. IS THIS FORM OF NONDISCRIMINATION YOU ARE TALKING  
14 ABOUT THE SAME AS WHAT HAS BEEN REFERRED TO AS THE  
15 BUILDING BLOCK APPROACH TO PRICING?

16  
17 A. Yes.

18  
19 Q. WHY IS NONDISCRIMINATION IN PRICING THE BOTTLENECK  
20 MONOPOLY FUNCTIONS TO ALL BUSINESS USERS REGARDLESS  
21 OF THE INTENDED USE SO IMPORTANT?

22  
23 A. This requirement is so important because only with nondiscrimination can new  
24 technology and new services develop in the most efficient way. Nobody can  
25 accurately predict the precise direction of future technological change or which  
26 services will turn out to be the most important for the economy in future years.

1           What is needed, therefore, is a pricing regime that allows new ideas to be  
2           tested without distortion. At least two distortions can occur with  
3           discriminatory pricing: energy better spent in testing new ideas is instead spent  
4           trying to make those ideas "fit" into a favored regulatory category in order to  
5           take advantage of discriminatorily favorable rates, or new ideas are not pursued  
6           because the rate they would face would clearly make them uneconomic. Both  
7           distortions reduce the possible benefits from telecommunications. Thus, if  
8           Florida's telecommunications users are to have the greatest benefits from new  
9           technologies and new services, it is very important that all users, or at least all  
10          business users, of any given bottleneck monopoly function pay the same price  
11          for that function, whether it is part of a bundled service or not.

12

13       Q.    YOU HAVE REPEATEDLY STRESSED THE NEED FOR PRICES TO ALL  
14           BUSINESS USERS TO BE NONDISCRIMINATORY. IS THE SAME  
15           REQUIREMENT NECESSARY FOR RESIDENTIAL USERS?

16

17       A.    Not at the present time, although if new technologies that could offer an  
18           alternative to the local exchange carrier do develop, some changes will be  
19           needed in the pricing of residential services as well. Currently, the  
20           Commission should take two steps. First, the Commission needs to determine  
21           what constitutes universal service. This should include a determination of  
22           what service level is the basic service that should be available as widely as  
23           possible and at affordable rates. Second, the Commission should require that  
24           the local exchange carrier determine correctly on the same unbundled basis the  
25           cost of providing the various functions that make up residential local exchange  
26           service and that would be required to provide what the Commission determines

1 to be the service required for universal service purposes. The costs for these  
2 two services then need to be compared with current rates to determine whether  
3 there is any subsidy or not or whether one would be needed.

4 If there is a subsidy, or if a subsidy is necessary in order to keep rates at  
5 the level the Commission believes is necessary for universal service, the  
6 Commission should explore how to move from having the subsidy, if any,  
7 administered by Southern Bell, to a system where the subsidy goes to those  
8 who need it directly. This would enable customers to use their "benefits" for  
9 any other service provider, should an alternative provider offer to enter. This  
10 change would also require that the mechanism for funding any necessary  
11 subsidy be collected in a broader way, not through unexamined internal rate  
12 designs of Southern Bell.

13  
14 Q. HOW SHOULD THE COMMISSION ESTABLISH A STRUCTURE TO  
15 MAKE DECISIONS ABOUT THE TWO FUNDAMENTAL ISSUES YOU  
16 HAVE IDENTIFIED AND THE THREE DOCKETS THAT MR. DENTON  
17 IDENTIFIED?

18  
19 A. The Commission should start by opening a proceeding that would determine  
20 what are the functions that should now be unbundled, and that would establish  
21 a procedure for allowing potential users to request further unbundling as new  
22 technologies and new service ideas require. This first proceeding should face a  
23 deadline for its completion, and should be a prerequisite for any further pricing  
24 flexibility for local exchange carriers.

25 In this first proceeding, all of the functions -- building blocks -- of the  
26 networks of the local exchange carriers should be separately identified. This

1 process should build upon the work already done in Oregon, where a  
2 workshop has determined categories and subcategories of building blocks, or  
3 functions. As modern telecommunications networks are very similar, the  
4 Oregon determinations should be easily adaptable to Florida.

5 The local exchange carriers, or at a minimum the larger local exchange  
6 carriers, should then be required to develop the ability to determine the costs of  
7 these functions at the level of the function. This means that the studies should  
8 look at the costs to the local exchange carrier of supplying the total quantity of  
9 each function, without regard to the services in which those functions are used.  
10 This also should not be as large a task as it may sound. U S WEST in Oregon  
11 was able to start from its existing cost models to develop costs for most of the  
12 categories and subcategories of building blocks that were identified, despite  
13 needing to make two types of changes to those models: 1) they had to change  
14 from looking at service-specific costs to looking at function-specific costs; and  
15 2) they also had to look at the costs of the entire quantity of what they were  
16 studying, rather than just at a small increase over existing levels.

17 In addition to identifying all of the functions of the local exchange  
18 company networks, the proceeding should result in a determination of how  
19 much unbundling will become available within a specified period of time, and  
20 it should have a process for continuing unbundling. That process should give  
21 other firms the ability to request additional unbundling, with the final arbiter if  
22 the local exchange carriers say no being the Commission. The process should  
23 require the local exchange companies to bear the burden of proving that the  
24 requested degree of unbundling is not technically feasible, rather than putting  
25 the reverse burden on the party requesting the further unbundling.

26

1 Q. YOU HAVE REFERRED TO THE EXPERIENCE IN OREGON AND HAVE  
2 SAID THAT THE TASKS YOU HAVE LISTED WOULD NOT BE HARD,  
3 GIVEN THAT THE LECS IN FLORIDA COULD START FROM THE  
4 RESULTS IN OREGON. IS IT NOT THE CASE THAT THE OREGON  
5 PROCEEDING TOOK THREE YEARS JUST TO GET TO ITS PRESENT  
6 STATE?

7  
8 A. Yes and no. The Oregon workshops took three years to get to the results that  
9 were released last summer, but more than a year was spent in various parties  
10 repeating old positions before the group began to try to identify the building  
11 blocks themselves. Once that step was taken, then the costing work could  
12 begin. I think it more accurate that the cost work took somewhere between one  
13 and two years to look at all of the categories and subcategories of building  
14 blocks for which U S WEST produced cost estimates.

15  
16 Q. YOU SAID EARLIER IN CONNECTION WITH POSSIBLE LOCAL  
17 EXCHANGE COMPETITION THAT THE PRICE OF  
18 INTERCONNECTION COULD BE USED TO PREVENT ANY EFFECTIVE  
19 ENTRY INTO A SERVICE. WOULD THAT SAME PROBLEM NOT  
20 EXIST FOR THOSE WHO REQUEST UNBUNDLED FUNCTIONS?

21  
22 A. Yes. That is why the initial proceeding needs to go on to phase two, namely  
23 determining how monopoly functions will be priced and insisting on  
24 nondiscrimination among all business users. If the Commission were to  
25 implement the building block approach to pricing in this phase, some of the  
26 problems would be at least partially met. For the functions that exist now, the

1 building block approach would establish prices that could be used if the same  
2 functions were unbundled. This would make the process move more quickly  
3 over time, allowing faster introduction of new technologies into the market  
4 where consumers could have the final say over what services they want and  
5 how and who should provide them.

6 As the local exchange carriers introduce new technologies into their  
7 networks, the new functions they make possible, or the new cost relationships  
8 that new technology creates, would need to be determined. It is important to  
9 note that this process would be needed no matter how the Commission  
10 approaches pricing. If the Commission were to adopt the building block  
11 approach, however, the local exchange carriers would already know the basic  
12 policy guidelines that would apply: strict nondiscrimination among at least  
13 business users, and prices that are based on the economic costs of providing  
14 the entire quantity of the functions in question.

15

16 Q. DOES THIS CONCLUDE YOUR TESTIMONY?

17

18 A. Yes.

BIOGRAPHY

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EXPERIENCE

- 10/88-Present Private consultant. Microeconomic consulting, primarily in fields of telecommunications, antitrust, broadcasting, and environmental economics.
- 2/82 - 10/88 President: Cornell, Pelcovits & Brenner Economists Inc. Microeconomic consulting, primarily in fields of telecommunications, broadcasting, environmental, and antitrust economics. Assignments have included serving as an expert witness before State and Canadian regulatory agencies on many emerging issues in telecommunications such as: the appropriate structure of access charges to interexchange companies; the public interest benefits of competition and of resale; the need to separate the unregulated from the regulated activities of telephone companies; appropriate telephone costing methodology, market rules, and industry structure; the proper costing of Centrex service; the setting of appropriate prices for the sale of embedded terminal equipment; and the appropriate application of cost and demand studies to the design of telephone tariffs; assisting in the cross examination of opposing witnesses and preparation of information requests; sponsoring cellular tariffs in cellular applications to the FCC; and testifying before Congressional committees on the economics of home taping, copyright, and the First Sale Doctrine.
- 3/81 - 2/82 Vice President: Owen, Cornell, Greenhalgh & Myslinski Economists Inc. Microeconomic consulting in telecommunications, broadcasting, environmental, and antitrust economics. Assignments included serving as expert witness in court cases, including U.S. v. AT&T, and before the Public Service Commission of the State of Florida on the public interest benefits of competition in long haul services and of resale, and on standards for access charges for competitors; assisting in preparation of depositions and cross examination of opposing witnesses; preparing an analysis of the economic impact of the broadcasting regulations on the video industry; preparing a cost-benefit analysis of proposed water pollution control regulations for the steel industry and defending it before EPA.
- 5/78 - 2/81 Chief: Office of Plans and Policy, Federal Communications Commission. Responsible for proposing policy and directing medium and long-range planning for the Commission. During this period, developed an in-house economics capability and functioned as chief economist for the Commission, sat at all Commission meetings, and advised the Commissioners on economic policy issues and alternatives. Directed a staff of 28-35 of mixed disciplines, mainly economics and engineering. Projects of the Office covered such topics as appropriate regulation for common carriers, including involvement in developing a new cost manual, further extensions of resale to switched intercity services, appropriate instances to require separate subsidiaries, and proper regulatory treatment of non-dominant common carriers; direct broadcast satellites; public coast stations; and radio; appropriate policies to achieve an improved UHF TV service; children's television; and how to improve spectrum management.

- 2/77 - 5/78 Senior Staff Economist: Council of Economic Advisors. Covered all areas of regulation except energy for the Council. Some major areas of activity were development of the regulatory analysis requirement in Executive Order 12044; the Regulatory Analysis Review Group; development of policy on various EPA activities such as prevention of significant deterioration of air quality; beverage container deposit legislation; revisions to the Clean Air, and the Clean Water Acts; minerals policy; and carcinogen regulation; also amendments of the laws governing civil aviation, trucking and communications.
- 6/76 - 2/77 Senior Economist: Council on Wage and Price Stability. Worked on energy issues. Major activity was as lead economist on the Presidential Task Force on Reform of Federal Energy Administration Regulation.
- 8/72 - 4/76 Research Associate: The Brookings Institution. First two years were in Foreign Policy Studies working as the economist on an interdisciplinary study on international institutions for managing oceans, outerspace, and weather modification. Last two years were in Economic Studies working with Charles L. Schultze on energy policy and working on safety and health regulation.
- 9/65 - 6/67 Teaching Assistant: Department of Economics, University of Illinois at Urbana-Champaign.

## PUBLICATIONS

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##### Canadian Radio-television and Telecommunications Commission:

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##### Alaska Public Utilities Commission

- In the Matter of Consideration of Regulations Governing the Market Structure for Intrastate Interexchange Telecommunications Service, Docket No. R-90-1, 6/5/90.

##### Arizona Corporation Commission:

- In the Matter of the Application of the Mountain States Telephone and Telegraph Company, a Colorado Corporation, for a Hearing to Determine the Earnings of the Company, the Fair Value of the Company for Ratemaking Purposes, to Fix a Just and Reasonable Rate of Return Thereon, and to Approve Rate Schedules Designed to Develop Such Return, Docket No. E-1051-84-100, and In the Matter of the Mountain States Telephone & Telegraph Company Filing New Tariff Pages for Approval by the Commission, Which Introduce Access Services, Docket No. E-1051-83-293, 8/23/85.
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##### Arkansas Public Service Commission:

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##### Public Utilities Commission of California:

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**Public Utilities Commission, State of Colorado:**

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- In Re: Application of Mountain States Telephone and Telegraph Company, D/B/A, U S West Communications, Inc., for Approval of a Five Year Plan for Rate and Service Regulation and for a Shared Earnings Program, Docket No. 90A-655T, 10/28/91.
- In Re: Investigation and Suspension of Proposed Changes in Tariffs Filed by the Mountain States Telephone and Telegraph Company, d/b/a U S West Communications, Inc., in Advice Letter No. 2173, Docket No. 90S-544T, 7/23/91, 7/25/91.
- In Re: Rules Prescribing the Provision of Certain Services within Open Network Architecture, Docket No. 90R-512T, 11/26/90.
- In Re: Investigation of IntraLATA Interexchange Telecommunications Markets in the State of Colorado, Docket No. 89I-082T, 2/22/90.
- Investigation and Suspension of Proposed Changes and Additions to Exchanges in Network Services Tariff—Telephone, Mountain States Telephone and Telegraph Company, Denver, Colorado 80202, I & S Docket No. 1766, 11/29/88.
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- DPUC Investigation into Competition for Intrastate Interexchange Telecommunications Service, Docket No. 85-06-04, 4/2-3/86 and 5/29-30/86.
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- In re: Review of Southern Bell Telephone and Telegraph Company's Capital Recovery Position, Docket No. 890256-TL, 3/29/90.
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- In re: Intrastate Access Charges for Toll Use of Local Exchange Services, Docket No. 820537-TP, 9/14/83.
- In re: Petition of MCI Telecommunications Corporation for a Certificate of Public Convenience and Necessity, Docket No. 820450-TP, 3/21/83.
- In the Matter of: Resale of Wide Area Telephone Service and Message Toll Service, Docket No. 1 810239-TP, 1/22/82.
- Application of Microtel, Inc. for a Certificate to Construct and Operate a Microwave System, Docket No. 800333-TP, 11/5/81.

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- Application of MCI to Provide Intrastate Toll Service, Docket No. 3446-U, 2/29/84 (Direct testimony only).

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#### Iowa Utilities Board

- In re: IntraLATA Presubscription, Discounted Access Charges, and Imputed Access Charges, Docket No. INU-90-1, 8/13/90.
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#### Public Service Commission of the Commonwealth of Kentucky

- In the Matter of An Inquiry into IntraLATA Toll Competition, an Appropriate Compensation Scheme for Completion of IntraLATA Calls by Interexchange Carriers, and WATS Jurisdictionality, Administrative Case No. 323, 12/13/89, 10/29/90.

#### Louisiana Public Service Commission

- In the Matter of Investigation of the Revenue Requirements, Rate Structures, Charges, Services, Rate of Return and Construction Program of South Central Bell Telephone Company of its Louisiana Intrastate Operations, the Appropriate Level of Access Charges, and All Matters Relevant to the Rates and Service Rendered by the Company, Docket No. U-17949-B (Generic Phase), 12/10/90 and 5/8/91.
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Public Service Commission of Maryland:

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Public Service Commission of the State of Michigan:

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- In the Matter of the Investigation into the Revenue Requirements and Rate Spread of Pacific Northwest Bell Telephone Company, dba U S West Communications, Docket No. UT 85, 6/8/89.
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- South Central Bell Telephone Company v. Southeastern Telecommunications, Inc. and Intercall, Inc. TPSC Docket No. U-82-7167 (on resale), 7/3/82 and 7/7/82.

**Public Utilities Commission of Texas:**

- Complaint of Intellicall, Inc Against Private Coin Phone Rates and Practices of Southwestern Bell Telephone Company; Complaint of Advanced Telecom Systems, Inc., Against Private Coin Phone Rates and Practices of Southwestern Bell Telephone Company; Complaint of Intellicall, et al. Against Private Coin Phone Rates and Practices of Southwestern Bell Telephone Company; Application of Southwestern Bell Telephone Company to Revise its Private Coin Service Tariff, Docket Nos. 7122, 7123, 7124, 7152, 6/29-30/87 (Deposition - case subsequently settled.)
- In re: Petition of the PUC of Texas for an Inquiry Concerning the Effects of the Modified Final Judgment and the Access Charge Order upon Southwestern Bell Telephone Company and the Independent Telephone Companies of Texas, Docket No. 5113, 11/8/83.
- In the Matter of the Petition of Southwestern Bell Telephone Company for Authority to Change its Rates, Docket No. 4545, 11/3/82.

**Utah Public Service Commission:**

- In the Matter of the Request of U S WEST Communications Inc. for an Increase in its Rates and Charges, Docket No. 94-049-05, 2/1/93.
- In the Matter of the Application of U S West Communications for Approval of an Incentive Regulation Plan, Docket No. 90-049-03, and In the Matter of the Investigation into the Reasonableness of the Rates and Charges of U S West Communications, Docket No. 90-049-06, 3/7/91.
- In the Matter of Mountain States Telephone and Telegraph Company, Case No. 88-049-07, 5/24/89.

**Vermont Public Service Board:**

- Investigation of Proposed Second Vermont Telecommunications Agreement, Docket No. 5540, 2/14/92.
- Joint Petition of New England Telephone and Telegraph Company and the Vermont Department of Public Service Requesting Approval of the Vermont Telecommunications Agreement of October 14, 1987, Docket No. 5252, 5/2-3/88.

**Virginia State Corporation Commission:**

- Ex Parte, in re: Investigation to Consider the Impact of Modified Final Judgment in United States v. American Telephone & Telegraph Company, Civil Nos. 74-1698 and 82-0192, 552 F. Supp. 131 (D.D.C. 1972) and In the Matter of MTS and WATS Market Structure, FCC Docket No. 78-72 (Feb. 28, 1983) on the Provision of Toll Service in Virginia, Case No. PUC830020, 9/10-11/86.
- Petition of AT&T Communications of Virginia for Authority to Set Rates and Charges Pursuant to 1 of the Code of Virginia, Virginia Case No. PUC 840023, 7/30-31/84.
- Application of MCI Telecommunications of Virginia for a certificate of public convenience and necessity to provide inter-LATA, inter-exchange telecommunications service and to have rates established on competitive factors, Virginia Case No. PUC 840022, 7/27/84.

**Washington Utilities and Transportation Commission:**

- Northwest Payphone Association, et al. v. U S WEST Communications, Inc., Docket UT-920174, 2/2/93.
- Washington Utilities and Transportation Commission, Complainant, vs. U. S. West Communications, Respondent, Docket Nos. UT-911488, UT-911490, and UT-920252, 9/28-29/92, 2/9/93.
- In the Matter of Pacific Northwest Bell D/B/A U S West Communications Petition for an Alternative Form of Regulation, Docket No. U-89-3245-P, 11-28-89.
- Washington Utilities and Transportation Commission vs. Pacific Northwest Bell Telephone Company, Docket No. U-87-1083-T, 3-7-88.
- In the Matter of the Petition of AT&T Communications of the Pacific Northwest, Inc. for Classification as a Competitive Telecommunications Company, Cause No. U-86-113, 4/6/87.
- Washington Utilities and Transportation Commission, Complainant, vs. Pacific Northwest Bell Telephone Company, Petitioner and Respondent, Consolidated Cause Nos. U-86-34, U-86-35, U-86-36, U-86-86, U-86-90, 12/14-17/86, 2/9/87.
- In the Matter of the Petition of MCI Telecommunications Corporation for Classification as a Competitive Telecommunications Company, Cause No. U-86-79, 9/2-3/86.
- Washington Utilities and Transportation Commission v. Pacific Northwest Bell Telephone Company et al., Cause No. U-85-23 et al., 4/29/86.

**West Virginia Public Service Commission:**

- Case Nos. 85-259-T-SC, et al., 1/27/86, 2/18/86.
- Case Nos. 85-282-T-GI and 85-022-T-P, 10/29/85.
- Case No. 83-259-T-SC, 11/1/83.

**Public Service Commission, State of Wisconsin:**

- Investigation of Intrastate Interexchange Access Charges and Related IntraLATA and InterLATA Compensation Matters, Docket No. 05-R-5, Part C, 2/2/87.
- Investigation of Application of MCI Telecommunications Corporation for Certificate of Public Convenience and Necessity to Offer Intrastate Toll Services (Petition for Interim InterLATA Authority), Docket No. 3258-NC-1, 10/29/84.
- In the Matter of: Proposed Tariff of Wisconsin Telephone Company for Centrex-CO Rate Stability, Docket No. 6720-TR-35, 3/15/83.

**Public Service Commission, State of Wyoming**

- In the Matter of a General Inquiry by the Public Service Commission into the Telecommunications Needs and Capabilities in Wyoming, General Order No. 67, 8/12/93.
- In the Matter of the Joint Application of U S West Communications, Inc. and Tri County Telephone Association, Inc., for Authority for U S West to Sell to Tri County the Following Telephone Exchanges, I.E., Lovell, Meeteetse, Greybull, Frannie and Basin, and for a Transfer of Requisite Certificate Authority, Docket No. 70000-TA-93-150 and Docket No. 70011-TA-93-8, 8/12/93; 9/30/93; 10/1/93.

## TESTIMONY — US CONGRESS

Before the:

- House Judiciary Committee, Subcommittee on Courts, Civil Liberties, and the Administration of Justice, 10/27/83, [Economic Impacts of Repeal of the First Sale Doctrine for Audio-visual Works].
- Senate Committee on the Judiciary, Subcommittee on Patents, Copyrights and Trademarks, 10/25/83 [Home Taping of Audio and Video Works].
- Senate Committee on the Judiciary, Subcommittee on Patents, Copyrights and Trademarks, 4/29/83, [Economic Impacts of repealing the First Sale Doctrine for audio-visual Works].
- House Committee on the Judiciary, Subcommittee on Courts, Civil Liberties and the Administration of Justice, 9/22/82, Copyright Aspects of Home Audio Taping].
- Senate Committee on the Judiciary, 4/21/82, [Copyright Aspects of Home Videotaping].
- House Committee on the Judiciary, Subcommittee on Courts, Civil Liberties and the Administration of Justice, 4/13/82, [Copyright Aspects of Home Videotaping].
- Senate Committee on the Judiciary, 7/23/81, [Monopolization and competition in the Telecommunications Industry: Duties of the FCC under S.898].
- House Committee on Energy and Commerce, Subcommittee on Telecommunications, Consumer Protection, and Finance, 5/27/81, [Status of Competition and Deregulation in the Telecommunications Industry: Local Distribution].
- Senate Committee on Government Affairs, Subcommittee on Oversight of Government Management, 10/10/79, [FCC Compliance with Executive Order 12044].
- House Committee on Interstate and Foreign Commerce, Subcommittee on Communications, 6/6/79, [Communications Act of 1979].
- Senate Committee on Commerce, Science and Transportation, Subcommittee on Communications, 6/18/79, [Spectrum Management].

## TESTIMONY — COURT CASES

- Clear Communications Limited v. Telecom Corporation of New Zealand Limited, et al., High Court of New Zealand, Wellington Registry, 6/24-26/92, 9/11/92.
- United States Football League, et al., v. National Football League, et al., United States District Court Southern District of New York, 84 Civ. 7484 (PKL), 6/17-19/86.
- International Telemeter Corporation v. Hamlin International Corporation, U.S. District Court - Western District of Washington, No. C76-487, 9/9-10/81.
- U.S. v. AT&T, U.S. District Court for the District of Columbia, Civil Action No. 74-1698, 6/19/81.

## TESTIMONY — ARBITRATIONS

- In the Matter of An Arbitration Before the Right Honourable Sir Duncan McMullin Between Clear Communications Limited, Plaintiff, and Telecom Corporation of New Zealand Limited, Telecom Auckland Limited, Telecom Central Limited, Telecom Wellington Limited and Telecom South Limited, Defendants, 6/24/93.

## FILINGS — FCC

"Accounting Separations: A Contradiction in Terms," with Michael D. Pelcovits, Appendix I to Reply Comments of Lee Enterprises, Incorporated, Before the FCC, January 21, 1986, in CC Docket No. 85-229 (Third Computer Inquiry), Attachment to the Written Testimony of Robert D. Ross, President, Call-It Co., Before the Subcommittee on Telecommunications, Consumer Protection & Finance, March 13 Hearing to Examine the Competitive Status of the Bell Operating Companies: Diversification and Its Impact upon Consumers.

## EDUCATION

Ph. D. (Economics), University of Illinois at Urbana-Champaign, June 1972. *Doctoral Dissertation: "The Role of the Nobility in Agricultural Change in Russia During the Reign of Catherine II"*.

M.A. (Economics), University of Illinois at Urbana-Champaign, June 1967.

A.B. (Economics), Swarthmore College, Swarthmore, Pennsylvania, June 1964.

## AWARDS

1978-79 Harold and Margaret Sprout Award for the outstanding study on international ecological or environmental affairs.

## PROFESSIONAL ASSOCIATION

*American Economic Association*

## OTHER ACTIVITIES

1986-1988: Representative of the American Economic Association on the Executive Committee of the Consortium of Social Science Associations

1986-1988: Ex Officio Member, American Economic Association Committee on Economic Statistics

## PERSONAL

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Boston, Massachusetts

EXHIBIT NO. 16

DOCKET NO.: 920385-TL

WITNESS: H.E. GRAY, JR.

PARTY: SOUTHERN BELL

DESCRIPTION:

RESPONSES TO STAFF'S FIRST SET OF PRODUCTION OF DOCUMENTS  
(VOLUME 2)

1. SWITCHING TECHNOLOGY ASSUMPTIONS (06611-06612) PAGE 1
2. 1993-1997 NETWORK STRATEGIC PLAN (06613-06621) PAGE 3

PROFFERING PARTY: STAFF

I.D. # HEG-5

AGW / 9-17-91

**SWITCHING TECHNOLOGY ASSUMPTIONS**

**Technology Assumptions for 1992:**

Replacement of analog ESS switches (AESS's) with current generation digital machines will continue. Significant economic benefits will continue to be realized thru the direct integration of the new digital switch with digital loop carrier (DLC) systems and digital interoffice trunking facilities. Replacement will also be driven by customer demand for switched digital services such as digital ESSX.

About 194 1AESS switches will still be in service at year end.

Digital switches will continue to be enhanced to provide new service features and improved architectural capabilities.

Selective replacement of some DMS-10's and RSU's will continue.

The first broadband ATM switch will be trialed in an overlay island arrangement. Interworking will not be available between the ATM switch fabric and the co-located narrowband machine.

**Technology Assumptions for 1993:**

Accelerated deployment of standard NISDN.

About 171 1AESS switches will remain in service at year end.

First AIN Release 0 services to be offered.

Standards for BISDN architecture will be published in late 1993 or early 1994 allowing vendors to finalize their switch design.

**Technology Assumptions for 1994:**

About 145 1AESS switches will remain in service at year end.

**Technology Assumptions for 1995 thru 2000:**

About 112 1AESS switches will still be in service at the end of 1995 declining to about 44 at year end 2000.

Deployment will begin in 1995 of broadband ATM switches with standard access and interworking protocols.

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-2-

**Technology Assumptions for 2001 thru 2005:**

All analog ESS machines will be displaced by year end 2003.

Photonic (non-electronic) switch fabrics will become generally available during this period.

**Technology Assumptions for 2005+:**

The life cycle cost of a multiple rate switch fabric will become less than that of an arrangement consisting of several single rate fabrics.

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1993-1997 NETWORK STRATEGIC PLAN

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Page 1

7.0000 Assumptions

The Network Strategic Plan is predicated upon the assumption that certain events or conditions will exist in the network. The following Technology Assumptions, provided by the Technology Forecasting Group in Network Strategic Planning, identifies significant assumptions for the coming years regarding primarily transport and switching equipment.

Note that some of these are sensitive to the RBOCs receiving regulatory relief from information services provisioning. Also, there is no ruling to what extent, if any, BellSouth Telecommunications will be allowed to participate in PCS. In later years, PCS's competitive impact on our local loop may aid in the push for deregulation.

Additional assumptions, particularly those associated with a specific product or service, may be found in the Telecommunications Investment Programs (TIPs). Significant assumptions summarized by year include the following:

7.1000 Technology Assumptions

7.1100 Technology Assumptions for 1992:

SWITCHING:

- Demand for many currently unidentified services including those delivered over broadband architectures will become more evident.
- \* General agreement will be reached on standards for the BISDN access protocol.
- \* In field trial configurations non-standard BISDN architectures will begin to emerge.
- \* New systems, such as ITS and NMA will be in the early stages of deployment to support network operations and testing.
- \* Large Operation Support Systems (i.e., LMOS, TIRKS, and FACS), with a high embedded cost will continue to be the mainstay of Network Operations. Enhancements to these systems will be required for both support of new services and justifiable efficiency improvements.
- The FCC may approve ATV Standards for broadcasting to homes.
- The Operational/Environmental and End-office Switch Replacement portions of our Network Survivability program will be completed.
- BellSouth will have the capability to record 100% of Usage Based Pricing for businesses.

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Analog switches will still make up a significant portion of the switch network. Digital replacements will continue as strategic and economic plans prove them feasible.

- Digital switches will continue to be enhanced to provide new service features and improved architectural capabilities.

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Page 2

- The first broadband ATM switch will be field trialed using an overlay island arrangement. Interworking will not be available at this time between the ATM switch fabric and the collocated narrowband machine.
- Basic-Rate ISDN service, provided in conjunction with ESSX service, will continue to be attractive primarily to large businesses.
- Basic-Rate ISDN will be offered to single line (non-ESSX) customers.
- Volume deployment of Primary-Rate ISDN will begin; aimed at providing network access for PBXs.

TRANSPORT:

- DS3/DS1 and SONET based digital cross connect systems will be available.
- 64 clear channel capability and CCS required for ISDN will be available.
- Synchronous add/drop multiplexers based on the SONET standard will be available and hardened for an Outside Plant environment.
- Agreement will be reached on the channel rates for BISDN.
- SONET standards should be defined; essentially all but operational systems standards will be done in 1991.
- Fiber optic systems capable of 2 Gb/s speeds will be commercially available.
- More integration of transport with switching elements will continue to occur.
- SONET deployment will begin early in the year in the IOF and feeder.
- Many SONET products will be introduced on the market, but the operational systems lag may limit their usage.
- The development of Standards, as well as technical guidelines, will be under way for BellSouth's CCS7 interconnection to other networks, including IC's, independent telephone companies, private networks, other RBOCs and cellular carriers, providing for improved network connection and enhancing the value of services offered to our customers.

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Nina W. Cornell

Docket No. 920260-TL

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- Price parity, for fiber-to-the-curb deployment, between the average copper and fiber optic costs will be realized late 1992 or early 1993 for niche markets only.

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**WIRELESS:**

- \* Personal Communications Service (PCS) will begin to appear in niche markets.
- Standardization of PCS issues: CDMA/TDMA (code division multiple access and time division multiple access) decision for North America, global spectrum allocation meeting, and protocols for interconnecting networks decisions expected.
- \* BellSouth involved in wireless field trials; wireless ESSX and CT-2 (PCN) equipment.

7.1200 Technology Assumptions for 1993:

**SWITCHING:**

- Area Number Calling (ANC) or Calling Name Delivery, the first SCP (service control point)-based AIN service making use of TR-402 capabilities, also referred to as AIN Release 0 services, will be offered.
- Widespread deployment of standard NISDN will begin.
- \* Standards for BISDN architecture will be published in late 1993 or early 1994 allowing vendors to finalize their switch design.

**TRANSPORT:**

- Synchronous add/drop multiplexers and SONET based DCSSs will offer the capability to automatically shift bandwidth in the network, more economically adding flexibility and reliability; if operating systems can be upgraded.
- If trends continue fiber optic systems capable of 5 Gb/s speeds will be commercially available.
- Virtually an all-digital interoffice facility network will be achieved.
- Fiber in the distribution loop will become more competitive with copper to the customer premise for general deployment.
- SONET will be rapidly penetrating the transport network, both loop and IOF, and will be approaching 5% by year end.

**WIRELESS:**

- Tariff for CCS7 Interconnection to Cellular networks.

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7.1300 Technology Assumptions for 1994:

SWITCHING:

- The first versions of evolved digital switches utilizing AIN control architecture will become available, possibly as hybrids or adjuncts to existing switches.
- The Statewide Access Tandem Facility Diversity portion of the Network Survivability Program will be completed.
- Continue to replace analog switches with digital switches based on strategic plans and economic implications.
- AIN will become increasingly available, AIN Release 0.1 deployment.

TRANSPORT:

- SONET penetration into the transport network will exceed 10% by end of year.

WIRELESS:

- AIN services offered in support of cellular networks.

7.1400 Technology Assumptions for 1995:

SWITCHING:

- The Facility Diversity for Critical Major Metropolitan Areas portion of the Network Survivability Program will be completed.
- Switch conversion to the North American Numbering Plan (NANP) interchangeable codes will be complete.
- AIN Release 0.2 deployment.
- As the ISDN evolution progresses, it will continue to receive wider acceptance from both business and residential customers.

TRANSPORT:

- SONET penetration into the transport network will approach 20% by end of year.

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As demand for AIN services increases, the amount of signaling traffic will increase, which may result in the need to increase the transmission rate of CCS7 links to 384 Kb/s or 1.5 Mb/s.

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## 1993-1997 NETWORK STRATEGIC PLAN

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## WIRELESS:

- FCC decision on spectrum allocation results in PCS services offerings in "island" environments initially.

## 7.1500 Technology Assumptions for 1995 TO 2000:

## SWITCHING:

- AIN Control of BISDN services will provide supplementary services.
- BISDN services will be deployed to residential subscribers via ATM technology over new carrier transport systems.
- Deployment will begin in 1995 of broadband ATM switches with standard access and interworking protocols.

## TRANSPORT:

- Virtually all distribution growth will be on fiber optic rather than metallic cable by 2000.
- Virtually an all-fiber interoffice facility network will be achieved by year 2000.
- SONET penetration into the transport network will exceed 70% by end of the century.

## WIRELESS:

- PCS expected to replace 1% of POTS lines in service. However, it is expected to have a greater impact on second line growth.
- PCS interconnection expected to allow extensive coverage.

## 7.1600 Technology Assumptions for BEYOND 2000:

## SWITCHING:

- All analog switches will be replaced by digital switches shortly into the twenty-first century.
- Photonic (non-electronic) switch fabrics should be generally available during this period.
- The life cycle cost of a multiple rate switch fabric will become less than that of an arrangement consisting of several single rate fabrics.

## TRANSPORT:

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**1993-1997 NETWORK STRATEGIC PLAN**

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**Page 5a**

- SONET penetration into the transport network will be virtually all SONET around 2007.
- Virtually all feeder metallic facilities will be displaced with fiber by 2005.

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