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FPSC-RECORDS/REPORTING

POD No. 94
Attachment No. 1
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BELLSOUTH

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to: Assistant Vice Presidents with Responsibility for Planning, Budgeting, Economic Analysis, Comptrollers and Capital Recovery

entities: BellSouth Corporation, BellSouth Telecommunications, Inc.

from: Assistant Vice President - Finance and Human Services

description: Transmits current view of the BellSouth Region Telephone Plant Indexes (BSRTPI) and BSRTPI Forecasts through 2007.

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This letter transmits the 1998 version of the BellSouth Region Telephone Plant Index (BSRTPI). Included in the attachments are an overview of the major assumptions, the historical index by account, the forecast of percent cost change, and a comparison to other price indexes. This issue updates the historical indexes and forecasts sent October 23, 1997 in RL: 97-11-002BT.

The BellSouth Region Telephone Plant Indexes and Forecasts are meant solely for use by authorized BellSouth organizations responsible for planning, budgeting and economic analysis of telephone plant. The information contained herein should not be disclosed outside BellSouth or any of its subsidiaries except under written agreement.

Questions regarding this letter may be directed to Alan Lafourcade (205) 977-8846.

BK Tolbert

B. K. Tolbert
Assistant Vice President -
Finance and Human Services

Attachments

Almost 60 percent of BellSouth's expenditures on digital switches in 1997 were for Nortel equipment. Prices for those switches were basically unchanged from 1996. An additional 26 percent of expenditures were made on Lucent equipment. Lucent prices increased about 3.5%.

BellSouth's plans call for replacement of 15-20 large analog SPC switches per year between 1998 and 2003. Those switches will be replaced with current generation class 5 digital switches. Those purchases will be made at somewhat improved discounts over current prices. While the new discounts apply mainly to the switches being installed under the analog replacement program, those expenditures should have a large enough weight to keep the digital switch materials index on a flat to slightly declining trend in the near term.

A wholesale migration of voice to a packet-based system is not planned during this forecast period. A universal set of standards for voice over ATM has not been agreed upon and a substantial migration of voice to packet switching will not take place without those standards. The rapid growth in demand for data transport services will continue, and consequently, ATM switches or other packet options, such as IP-based technologies, will have an increasing impact on switch price trends during the latter half of the forecast period. Currently, ATM switches appear to be the switch of choice for the public networks but that equipment made up only a small percentage of BellSouth's switch expenditures in 1997. Prices for all packet switches will tend to be on a flat to downward trend as volume deployments increase during the forecast period.

Circuit – The circuit forecast is divided into analog, digital subscriber pair gain and other digital equipment. Throughout the forecast period the overall circuit account is weighted based on the relative expenditures of those three types in 1996. However, analog circuit was less than 2 percent of circuit in 1996 and has virtually no impact on the price trend during the forecast period. Based on 1996 weights slightly less than 60 percent of digital circuit expenditures were for subscriber pair gain equipment. The remaining weight is on the price trend for other, primarily interoffice, digital circuit. Actual expenditures may not match these distributions during the forecast period. Consequently, it is better to use the more detailed subaccounts than the circuit composite whenever possible.

Interoffice Circuit – Competitive pressures have prompted a rapid shift towards an optically based broadband interoffice network. Consequently, the deployment of SONET-based equipment has grown rapidly over the past few years. Prices for this equipment have been on a downward trend. In 1997, the prices paid to Lucent and Fujitsu for SONET equipment declined about 5 percent overall.

The forecast assumes a steadily growing share of SONET equipment in the other digital circuit account (primarily interoffice). SONET equipment is assumed to make up the majority of new circuit purchases during the next ten years. In addition, WDM equipment will become more prominently used in the network. DWDM equipment will begin to be deployed by BellSouth in its interoffice environment in late 1998. It will be deployed where it is more economical than placing additional fiber cable and in ATM switch locations where they will eliminate a number of SONET AD multiplexers. As prices drop, deployment of WDM equipment will expand. The demand for WDM equipment will probably put downward pressure on the prices for fiber cable and some of the SONET transmission equipment. Since BellSouth will continue to deploy a wider range of equipment types than the IXCs, this should help keep the price trend for its interoffice equipment on a downward path.

The steep decline in copper prices should, through escalation clauses, translate to declines in copper cable prices in 1998. Cable prices do not generally rise or fall by the same percent as raw copper prices because copper is only one of the inputs to cable production. However, since copper price declines have been substantial, this forecast calls for somewhat larger declines in cable prices in 1998 than did the previous forecast.

Fiber Optic Cable - BellSouth's fiber cable network totaled 2.3 million fiber miles in length at the end of 1997. New additions to the fiber network totaled 280 thousand fiber miles. This is down slightly from 1996's level of installation but still expanded the total network by over 10 percent. Overall the LECs and IXCs expanded their fiber networks by about 3.5 million fiber miles in 1997. The rapid increase of fiber deployment by telephone companies, Internet providers and CATV providers has pushed fiber demand up sharply in the past few years. The increased demand has prompted a significant expansion in fiber producing facilities. Corning is increasing its fiber producing capacity both by expanding its current facilities in Wilmington, NC and by building a new plant in Concord, NC. This second plant will be on stream in 1999, and combined with changes in the Wilmington plant, will more than double Corning's capacity. Alcatel and Lucent Technologies have also announced capacity expansions. BellSouth's fiber cable prices have been relatively flat but its fiber cable contracts call for 2 percent per year price declines between now and 2003.

Other Outside Plant Materials – After increasing almost 14 percent in 1995, BellSouth's conduit prices fell about 8 percent in 1996 and fell 1 percent in 1997. PVC prices, partly because of the fall in oil prices this year, have fallen steadily during 1998. While strong construction demand has partially offset those raw material cost declines, BellSouth's PVC pipe prices will probably show a decline in 1998.

Pole prices have been virtually unchanged for two years. However, environmental concerns in both the U.S. and Canada will continue to exert upward pressure on chemically–treated wood prices. Consequently, pole prices will probably increase faster than most other components of the TPI during the forecast period.

Wages – BellSouth signed a new union wage agreement in August 1998. That agreement called for wage increases of about 12.4 percent over 3 years or about 4 percent per year. While all of the details of this contract are not yet available, those base wage changes have been factored into the forecast for the 1998–2000 period.

BELLSOUTH TELECOMMUNICATIONS
HISTORICAL TELEPHONE PLANT INDEXES
ACCOUNTS ON A PART 32 USOA BASIS
1988=100

ACCOUNT NAME	ACCT #	FRC	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1/98
POLES	2411	1C	100.0	102.8	104.5	106.6	111.6	113.9	116.0	125.9	128.0	131.3	133.4
AERIAL CABLE	2421		100.0	111.7	110.6	113.6	104.9	104.6	99.1	107.5	109.7	111.6	114.8
COPPER		22C	100.0	113.6	112.8	116.1	105.9	106.3	101.4	111.5	114.0	116.1	120.3
OPTICAL		822C	100.0	92.0	89.8	91.1	90.2	86.1	77.2	75.4	76.2	76.8	76.1
U.G. CABLE	2422		100.0	101.8	99.1	100.5	95.8	93.2	85.2	88.9	89.9	89.9	90.4
COPPER		5C	100.0	110.3	107.9	109.8	100.2	101.3	96.2	107.3	109.0	108.8	112.5
OPTICAL		85C	100.0	90.9	88.2	89.2	87.9	82.5	72.6	70.3	70.9	71.0	70.0
BURIED CABLE	2423		100.0	108.7	108.3	112.4	105.4	103.7	102.1	107.2	109.4	112.5	114.5
COPPER		45C	100.0	110.4	110.0	114.4	106.2	105.1	104.1	110.0	112.2	115.6	118.1
OPTICAL		845C	100.0	94.5	93.7	95.4	95.7	90.6	86.2	86.6	88.4	89.7	89.7
SUBMARINE CABLE	2424		100.0	106.5	106.5	109.7	107.2	100.8	95.8	96.1	98.4	100.6	101.3
COPPER		6C	100.0	118.3	119.2	123.4	119.3	118.8	116.3	124.1	125.5	129.2	132.6
OPTICAL		86C	100.0	97.1	95.7	97.4	97.2	91.2	86.4	86.4	88.7	90.5	90.9
INBLDG NETWK CABLE	2426		100.0	114.4	113.3	116.8	103.6	105.5	99.8	107.6	110.8	108.7	110.7
COPPER		52C	100.0	114.9	113.9	117.5	103.9	106.4	101.1	109.8	113.2	110.8	113.0
OPTICAL		852C	100.0	96.2	93.8	95.1	94.1	89.3	79.1	76.6	77.8	79.1	79.0
CABLE COMPOSITE			100.0	108.7	107.7	111.1	104.0	102.6	99.2	105.0	107.0	109.4	111.5
COPPER			100.0	111.4	110.7	114.7	105.7	105.2	102.8	110.2	112.5	115.3	118.4
OPTICAL			100.0	92.6	90.7	92.0	91.4	86.5	79.3	78.4	79.4	80.2	79.6
CONDUIT SYSTEMS	2441	4C	100.0	96.8	95.6	93.9	93.9	83.9	87.9	95.7	96.6	98.7	100.5
OSP STRUCTURES			100.0	99.2	99.1	98.8	100.6	94.8	98.2	106.8	108.1	110.6	112.5
OSP COMPOSITE			100.0	107.6	106.7	109.7	103.6	101.6	99.1	105.3	107.2	109.6	111.7
TOTAL COMPOSITE			100.0	102.2	101.7	101.9	99.8	99.4	96.6	97.7	98.0	96.8	96.9

BELLSOUTH TELECOMMUNICATIONS
HISTORICAL TELEPHONE PLANT INDEXES
ACCOUNTS ON A PART 32 USOA BASIS
1988=100

ACCOUNT NAME	ACCT	FRC	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1/98
CIRCUIT-ANLG & DGTL	2232		100.0	100.3	99.9	102.5	100.6	103.1	100.2	98.6	96.7	96.2	96.0
ANALOG CIRCUIT		57C	100.0	102.4	104.8	108.9	111.0	112.7	116.6	118.2	119.3	124.3	126.8
MATERIAL (UNLOADED)			100.0	103.8	105.9	109.3	112.2	112.5	118.1	121.7	120.9	125.6	128.1
INSTALLATION			–	–	–	–	–	–	–	–	–	–	–
EQ SPEC			–	–	–	–	–	–	–	–	–	–	–
LOADED MATERIAL			100.0	102.2	104.5	109.7	111.9	113.4	117.4	119.5	120.5	125.7	128.2
TELCO LABOR COE			100.0	103.3	105.9	107.4	108.8	112.0	115.7	114.3	117.5	119.8	121.6
TELCO ENGINEERING			100.0	104.9	105.0	106.5	107.7	108.1	109.8	117.4	119.4	124.6	127.7
DIGITAL CIRCUIT X SPG		157C,357	100.0	99.1	99.2	98.1	98.7	100.8	96.1	92.6	90.6	87.7	87.3
MATERIAL (UNLOADED)			100.0	99.2	98.8	99.4	100.0	101.2	97.8	94.4	91.4	89.7	89.2
INSTALLATION			–	–	–	–	–	–	–	–	–	–	–
EQ SPEC			–	–	–	–	–	–	–	–	–	–	–
LOADED MATERIAL			100.0	98.8	98.8	97.6	98.2	100.2	95.2	91.4	89.2	86.2	85.7
TELCO LABOR COE			100.0	103.3	105.9	107.3	108.8	112.0	115.7	114.3	117.5	119.8	121.6
TELCO ENGINEERING			100.0	104.9	105.0	106.5	107.7	108.1	109.9	117.4	119.4	124.7	127.7
CIRCUIT-DIG. SUBPAIR GAIN		257C	100.0	100.7	99.8	104.9	100.8	103.8	101.8	101.4	99.4	100.5	100.3
MATERIAL (UNLOADED)			100.0	100.8	99.3	100.8	99.7	101.5	99.2	99.0	95.8	95.1	94.9
INSTALLATION			–	–	–	–	–	–	–	–	–	–	–
EQ SPEC			–	–	–	–	–	–	–	–	–	–	–
LOADED MATERIAL			100.0	100.5	99.3	104.7	100.1	103.1	100.8	100.2	98.0	99.0	98.7
TELCO LABOR COE			100.0	103.3	105.8	107.3	108.8	112.0	115.7	114.2	117.5	119.8	121.6
TELCO ENGINEERING			100.0	104.9	104.9	106.5	107.7	108.1	109.9	117.4	119.4	124.7	127.7
STATION APPARATUS	2311	318C	100.0	98.3	93.4	97.9	101.7	99.4	100.2	101.0	102.6	102.4	101.8
LARGE PBX	2341	258C	100.0	103.4	103.2	105.9	105.2	107.8	104.4	101.8	100.6	100.1	99.9
MATERIAL (UNLOADED)			100.0	100.6	99.6	100.8	100.4	102.0	99.3	97.5	94.5	93.4	93.1
LOADED MATERIAL			100.0	103.3	102.7	105.7	104.6	107.3	103.1	100.0	98.4	97.6	97.3
INSTALLATION (CONTRACT)			–	–	–	–	–	–	–	–	–	–	–
TELCO LABOR			100.0	103.3	105.9	107.4	108.9	112.1	115.8	114.4	117.6	119.9	121.7
TELCO ENGINEERING			100.0	104.9	105.0	106.5	107.7	108.1	109.8	117.4	119.4	124.6	127.7
PUBLIC TELEPHONES	2351	198C	100.0	99.7	99.0	99.5	98.9	101.5	101.6	103.0	103.8	104.5	105.2
MATERIAL			100.0	99.7	99.0	99.5	98.9	101.5	101.6	102.9	103.8	104.5	105.2
TELCO LABOR			100.0	103.3	105.9	107.5	108.9	112.1	115.8	114.4	117.6	119.9	121.7
CONTRACT LABOR			100.0	101.6	103.4	107.1	110.3	113.3	117.0	120.8	124.0	127.1	128.5
OTHER TERMINAL EQ.	2362	58C,858	100.0	101.2	101.1	102.4	102.6	104.6	103.7	102.2	100.2	99.7	99.8
MATERIAL			100.0	100.6	99.6	100.8	100.4	102.0	99.3	97.5	94.5	93.4	93.1
TELCO LABOR			100.0	103.3	105.8	107.3	108.8	112.0	115.7	114.2	117.5	119.7	121.6
TELCO ENGINEERING			100.0	104.9	105.0	106.5	107.7	108.1	109.9	117.4	119.4	124.7	127.7
CONTRACT LABOR			100.0	101.6	103.4	107.1	110.3	113.3	117.0	120.8	124.0	127.1	128.5

BELLSOUTH TELECOMMUNICATIONS
HISTORICAL TELEPHONE PLANT INDEXES
ACCOUNTS ON A PART 32 USOA BASIS
1988=100

ACCOUNT NAME	ACCT #	FRC	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1.98
SUB. CABLE-OPTICAL		86C	100.0	97.1	95.7	97.4	97.2	91.2	86.4	86.4	88.7	90.5	90.9
MATERIAL			100.0	84.5	80.8	81.6	79.3	71.1	57.7	53.6	53.6	52.8	51.4
TELCO LABOR			100.0	104.1	106.4	108.3	111.1	115.9	114.9	115.9	119.3	124.9	127.0
TELCO ENGINEERING			100.0	104.9	104.8	106.6	107.8	108.2	109.9	117.5	119.5	124.7	127.8
CONTRACT LABOR			100.0	102.0	104.2	107.0	109.9	105.1	106.6	109.4	113.1	116.4	117.7
INTRABLDG NW CABLE-COMPOSITE	2426		100.0	114.4	113.3	116.8	103.6	105.5	99.8	107.6	110.8	108.7	110.7
INTBLDG NW CABLE -COPPER		52C	100.0	114.9	113.9	117.5	103.9	106.4	101.1	109.8	113.2	110.8	113.0
MATERIAL			100.0	126.9	122.2	127.7	94.4	95.8	86.6	99.8	103.0	97.2	99.3
TELCO LABOR			100.0	104.1	106.4	108.4	111.2	116.0	115.0	116.0	119.5	125.0	127.1
TELCO ENGINEERING			100.0	104.9	104.9	106.5	107.8	108.2	109.9	117.5	119.4	124.7	127.8
CONTRACT LABOR			100.0	101.6	103.4	107.1	110.3	113.3	117.0	120.8	124.0	127.1	128.5
INTBLDG NW CABLE-OPTICAL		852C	100.0	96.2	93.8	95.1	94.1	89.3	79.1	76.6	77.8	79.1	79.0
MATERIAL			100.0	84.5	80.8	81.6	79.3	71.1	57.7	53.6	53.6	52.8	51.4
TELCO LABOR			100.0	104.1	106.6	108.9	111.7	116.6	115.5	116.6	120.0	125.6	127.7
TELCO ENGINEERING			100.0	104.9	104.8	106.6	107.8	108.2	109.9	117.5	119.5	124.7	127.8
CONTRACT LABOR			100.0	101.6	103.4	107.1	110.3	113.3	117.0	120.8	124.0	127.1	128.5
LE COMPOSITE			100.0	108.7	107.7	111.1	104.0	102.6	99.2	105.0	107.0	109.4	111.5
BLE-COPPER			100.0	111.3	110.7	114.7	105.7	105.2	102.8	110.2	112.5	115.3	118.4
CABLE-OPTICAL			100.0	92.5	90.7	92.0	91.4	86.5	79.3	78.4	79.4	80.2	79.6
AERIAL WIRE	2431		100.0	110.7	110.4	112.9	107.2	109.3	108.2	114.0	116.6	120.9	123.8
MATERIAL			100.0	126.9	122.2	127.7	97.5	94.3	83.5	101.6	103.3	102.3	108.3
TELCO LABOR			100.0	104.1	106.1	107.4	110.2	115.0	114.0	115.0	118.4	123.9	126.0
TELCO ENGINEERING			100.0	104.9	105.1	106.5	107.7	108.1	109.8	117.4	119.4	124.6	127.7
CONTRACT LABOR			100.0	101.6	103.4	107.1	110.3	113.3	117.0	120.8	124.0	127.1	128.5
CABLE & WIRE			100.0	108.7	107.8	111.2	104.0	102.6	99.2	105.1	107.1	109.4	111.6
OSP STRUCTURES			100.0	99.2	99.1	98.8	100.6	94.8	98.4	106.8	108.1	110.6	112.5
POLE LINES	2411	1C	100.0	102.8	104.5	106.6	111.6	113.9	116.6	125.9	128	131.3	133.4
MATERIAL			100.0	100.0	100.0	99.3	108.8	110.8	114.5	134.3	134.3	134	134
TELCO LABOR			100.0	104.1	106.4	108.3	111.1	115.9	114.9	115.9	119.4	124.9	127
TELCO ENGINEERING			100.0	104.9	105.0	106.5	107.7	108.1	109.9	117.4	119.4	124.6	127.7
CONTRACT LABOR			100.0	103.5	106.8	111.2	115.5	118.1	121.2	124.9	127.8	132.1	135
U.G. CONDUIT	2441	4C	100.0	96.8	95.6	93.9	93.9	83.9	87.9	95.7	96.6	98.7	100.5
MATERIAL			100.0	87.0	81.3	72.1	69.5	70.0	73.9	83.9	77	76.1	79.5
TELCO LABOR			100.0	104.1	106.4	108.5	111.3	116.1	115.1	116.1	119.6	125.1	127.2
TELCO ENGINEERING			100.0	104.9	104.9	106.5	107.8	108.2	109.9	117.5	119.4	124.7	127.8
CONTRACT LABOR			100.0	99.9	101.1	103.2	104.4	88.0	92.7	100.4	103.6	106.4	107.7

BELL SOUTH REGION - BUILDINGS SUBCOMPONENTS
1988 = 0

	1988	1/1/89	1989	1/1/90	1990	1/1/91	1991	1/1/92	1992	1/1/93	1993	1/94	1994	1/95	1995	1/96	1996	1/97	1997	1/98
GENL RQMT	100.0	100.0	104.0	104.0	108.1	108.1	112.2	112.2	116.3	116.3	120.1	120.1	123.5	123.5	126.8	128.2	130.8	131.8	134.8	136.5
SITEWORK	100.0	104.7	102.8	104.2	103.6	103.3	111.0	119.1	117.2	115.5	109.5	109.9	110.7	111.8	113.3	115.0	116.5	117.2	118.2	118.7
CONCRETE	100.0	103.3	99.1	98.7	98.6	98.8	99.3	100.8	99.1	97.7	88.6	89.3	91.4	92.7	95.6	97.4	99	99.9	101.7	103.1
MASONRY	100.0	102.3	96.3	97.3	97.2	98.3	98.6	100.0	100.5	101.6	100.5	101.0	101.5	102.5	104.2	105.8	108.3	109.9	110.6	111.4
METALS	100.0	109.7	106.9	109.2	111.2	113.8	113.7	114.3	112.0	110.1	115.6	113.3	114.8	116.8	121.1	126.1	130.4	134.3	136.8	139.4
WOOD&PLASTICS	100.0	103.5	98.9	97.9	98.0	98.7	98.2	99.6	99.8	99.7	98.2	97.3	99.5	101.3	99.4	99.1	99.2	100.3	101.5	101.6
THERM&MOIST PRO	100.0	102.4	102.9	106.8	107.2	108.3	106.5	105.4	110.0	115.0	113.8	114.7	114.5	113.7	115.6	117.6	124.6	130.2	131	132.2
DOORS&WINDOWS	100.0	105.4	100.1	100.6	100.8	101.8	101.1	101.7	101.8	101.9	115.4	116.5	118.7	120.6	123.0	125.9	127.5	129.1	130.5	131.4
FINISHES	100.0	90.1	93.7	95.1	96.7	98.7	98.6	99.8	99.5	99.7	98.6	98.1	100.6	102.7	100.6	101.0	100.1	101.5	100.1	98.9
SPECIALTIES	100.0	105.6	105.2	107.2	107.7	107.8	105.4	103.1	105.3	107.5	110.3	111.4	112.0	112.7	115.9	118.6	122	125.1	125.4	125.8
SPEC CONST	100.0	106.5	104.9	106.2	107.9	109.4	110.1	110.8	110.0	109.2	109.8	108.5	110.6	112.8	116.8	120.4	123.5	126.3	128.1	130.1
CONVEYING SYSTEMS	100.0	107.9	113.6	123.0	123.3	123.3	123.7	124.2	122.7	121.1	128.1	133.1	135.5	138.0	139.6	140.6	143.8	146.7	148.7	150.8
MECHANICAL	100.0	93.3	99.8	103.6	104.3	105.7	107.2	110.2	113.3	116.9	122.2	126.9	125.2	123.2	126.1	130.6	127.8	125.3	119.1	113.6
ELECTRICAL	100.0	102.0	100.2	100.2	100.6	102.6	103.5	105.8	114.0	122.4	124.4	127.6	131.3	134.4	137.5	141.6	139.8	139.6	138.8	139.1

RL: 98-11-002BT
Attachment B

BELLSOUTH TELECOMMUNICATIONS
FORECAST TELEPHONE PLANT INDEXES
ACCOUNT ON PART 32 USOA BASIS
OCTOBER 1998 FORECAST OF % COST CHANGE

ACCOUNT NAME	ACCT #	FRC	ACTUAL 1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008+
BUILDINGS	2121	10C	0.4	2	2	2	2	2	3	3	3	3	3	3
MOTOR VEHICLES	2112	40C	-1.0	-1	-1	1	1	1	1	1	1	1	1	1
AIRCRAFT	2113	140C	1.8	0	0	2	2	3	4	4	4	4	4	4
GARAGE WORK EQ	2115	340C	1.0	0	0	2	2	2	2	2	2	2	2	2
OTHER WORK EQ	2116	540C	1.7	2	2	2	2	2	2	2	2	2	2	2
FURNITURE	2122	30C	1.7	1	2	2	2	2	2	2	2	2	2	2
OFFICE EQUIPMENT	2123	430,718C	0.2	-1	0	0	0	1	1	1	1	1	1	1
OFF SUPPORT EQ			0.4	0	0	0	0	0	1	1	1	1	1	1
OTH COMM EQ			0.1	-1	-1	0	0	1	1	1	2	2	2	2
G.P. COMPUTERS	2124	530C	-19.3	-20	-19	-18	-17	-17	-16	-16	-16	-15	-15	-5
GEN EQ COMPOSITE			-12.8	-12	-11	-9	-7	-6	-5	-4	-3	-2	-2	0
ANALOG ELECTRONIC	2211	77C	-1.2	1	2	2	2	2	3	3	3	3	3	–
DIGITAL ELECTRONIC	2212	377C	-0.4	-2	-1	1	1	1	2	0	0	-1	-1	1
OPERATOR SYSTEMS	2220	117C	0.5	-3	-1	0	1	1	2	0	0	-1	-1	1
RADIO	2231	67C	0.4	0	0	0	0	0	0	0	0	0	1	1
CIRCUIT COMPOSITE	2232		-0.5	-3	-1	-1	-1	0	-1	-2	-2	-2	-2	0
ANALOG		57,457C	4.2	3	2	5	4	3	3	3	3	3	0	–
DIGITAL SPG		257C	1.1	-3	0	-2	0	0	0	-1	-2	-2	-2	0
OTHER DIGITAL		157,357C	-3.2	-3	-3	-1	-2	-2	-2	-2	-2	-2	-2	0
COE COMPOSITE			-0.5	-3	-1	-1	0	0	0	-1	-1	-1	-1	1
STATION APPARATUS	2311	318C	-0.2	-2	-1	-1	0	0	1	1	1	2	2	2
LARGE PBX	2341	258C	-0.5	-2	-2	-1	-1	0	0	-1	-1	-1	-1	1
PUBLIC TELEPHONES	2351	198C	0.7	1	1	1	1	1	1	1	1	1	1	1
OTH TERM EQ	2362	558,858C	-0.5	-1	-1	0	0	1	1	0	0	0	0	1
STATION COMPOSITE			-0.1	0	-1	0	0	0	1	0	0	0	0	1
ISP COMPOSITE			-0.5	-3	-1	-1	0	0	0	-1	-1	-1	-1	1

BELLSOUTH TELECOMMUNICATIONS
FORECAST TELEPHONE PLANT INDEXES
ACCOUNT ON PART 32 USOA BASIS
OCTOBER 1998 FORECAST OF % COST CHANGE

ACCOUNT NAME	ACCT #	FRC	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
BUILDINGS	2121	10C	122	124	126	129	132	136	140	144	148	152
MOTOR VEHICLES	2112	40C	116	115	116	117	118	119	120	121	122	123
AIRCRAFT	2113	140C	144	144	147	150	155	161	167	174	181	188
GARAGE WORK EQ	2115	340C	136	136	139	142	145	148	151	154	157	160
OTHER WORK EQ	2116	540C	130	133	136	139	142	145	148	151	154	157
FURNITURE	2122	30C	125	128	131	134	137	140	143	146	149	152
OFFICE EQUIPMENT	2123	430,718C	104	104	104	104	105	106	107	108	109	110
OFF SUPPORT EQ	2123.1		105	105	105	105	105	106	107	108	109	110
OFF COMM EQ	2123.2		105	104	104	104	105	106	107	109	111	113
G.P. COMPUTERS	2124	530C	26	21	17	14	12	10	8	7	6	5
GEN EQ COMPOSITE			47	42	38	35	33	31	30	29	28	27
ANALOG ELECTRONIC	2211	77C	121	123	125	128	131	135	139	143	147	151
DIGITAL ELECTRONIC	2212	377C	105	104	105	106	107	109	109	109	108	107
ERATOR SYSTEMS	2220	117C	98	97	97	98	99	101	101	101	100	99
DIO	2231	67C	124	124	124	124	124	124	124	124	124	125
CIRCUIT COMPOSITE	2232		93	92	91	90	90	89	87	85	83	81
ANALOG		57,457C	128	131	138	144	148	152	157	162	167	167
DIGITAL SPG		257C	98	98	96	96	96	96	95	93	91	89
OTHER DIGITAL		157,357C	85	82	81	79	77	75	74	73	72	71
COE COMPOSITE			99	98	97	97	97	97	96	95	94	93
STATION APPARATUS	2311	318C	100	99	98	98	98	99	100	101	103	105
LARGE PBX	2341	258C	98	96	95	94	94	94	93	92	91	90
PUBLIC TELEPHONES	2351	198C	106	107	108	109	110	111	112	113	114	115
OTH TERM EQ	2362	558,858C	99	98	98	98	99	100	100	100	100	100
STATION COMPOSITE			101	100	100	100	100	101	101	101	101	101
INSIDE PLANT COMP.			99	98	97	97	97	97	96	95	94	93

BELLSOUTH TELECOMMUNICATIONS TPI COMPONENTS
OCTOBER 1998 FORECAST

MATERIALS
(percentate changes)

	COPPER AERIAL CABLE	COPPER U.G. CABLE	COPPER BURIED CABLE	COPPER SUBMARINE CABLE	COPPER INTRBLDG CABLE	COMBINED COPPER CABLE	COMBINED OPTICAL CABLE	POLES	CONDUIT
1995	21.7	24.5	12.2	12.2	15.2	16.6	-7.1	17.3	13.5
1996	1.7	0.5	-0.9	-0.9	3.2	0.2	0.0	0.0	-8.2
1997	-1.0	-4.4	1.7	1.7	-5.6	0.1	-1.5	-0.2	-1.2
1998	-7.9	-8.0	-6.1	-6.5	-7.9	-7.0	-2.0	4.0	-7.0
1999	-3.6	-4.2	-2.4	-2.4	-3.6	-3.0	-2.0	2.7	-2.4
2000	5.1	5.4	5.5	5.5	5.1	5.3	-2.0	3.6	1.1
2001	4.1	3.2	2.3	4.2	4.1	3.0	-2.0	3.6	3.8
2002	3.2	2.9	2.3	2.3	3.2	2.7	-2.0	3.6	2.9
2003	3.0	2.3	2.1	2.3	3.0	2.5	-6.0	3.6	2.0
2004	2.2	1.8	1.6	1.9	2.2	1.9	-2.0	3.6	1.8
2005	2.2	1.9	1.7	1.9	2.2	1.9	-2.0	3.6	1.9
2006	2.5	2.3	1.9	2.1	2.5	2.1	-2.0	3.6	1.9
2007	2.7	2.5	2.0	2.3	2.7	2.3	-2.0	3.6	1.9

	UNLOADED RADIO	UNLOADED ANALOG CIRCUIT	UNLOADED DIGITAL SPG	UNLOADED OTHER DIG CIRCUIT	UNLOADED ANALOG ESS	UNLOADED DIGITAL ESS	UNLOADED OPERATOR SYSTEMS
1995	-1.7	3.0	-0.2	-3.5	1.9	2.0	2.0
1996	-3.1	-0.7	-3.2	-3.2	4.0	7.6	7.6
1997	0.0	3.9	-0.7	-1.9	-1.6	0.1	0.1
1998	-1.0	2.6	-3.3	-3.5	1.4	-2.6	-2.6
1999	-0.9	2.3	-0.3	-3.2	1.7	-1.0	-1.0
2000	-0.5	5.1	-2.3	-1.3	1.9	0.4	0.4
2001	-0.3	4.1	-0.7	-1.9	2.2	0.8	0.8
2002	-0.1	3.3	0.0	-1.9	2.3	0.9	0.9
2003	-0.1	3.0	-0.7	-2.1	2.5	1.5	1.5
2004	0.0	2.8	-1.9	-2.6	2.6	0.2	0.2
2005	0.1	2.8	-3.1	-2.6	2.7	-0.4	-0.4
2006	0.0	2.8	-2.4	-2.6	2.8	-1.2	-1.2
2007	0.0	2.7	-2.4	-2.6	2.9	-1.6	-1.6

BELLSOUTH TELECOMMUNICATIONS TPIs
OCTOBER 1998 FORECAST ASSUMPTIONS

	PRICE INDEX NONRESIDENTIAL STRUCTURES	CHAIN PRICE INDEX GDP	GDP 1992$	CAPITAL EQUIPMENT PPI	UNION WAGES	COPPER CATHODE PPI	PVC PPI	SEMICOND. PPI
1994	3.6	2.4	3.5	2.1	3.1	22.2	13.3	-0.9
1995	4.2	2.5	2.0	2.0	2.6	27.9	10.5	-7.0
1996	2.3	2.3	2.8	1.2	2.7	-21.5	-14.5	-8.1
1997	3.3	2.0	3.8	0.0	2.6	-2.9	4.7	-10.9
1998	2.5	1.2	3.3	-0.7	2.9	-26.3	-17.0	-9.5
1999	2.0	1.9	1.9	-0.2	3.2	-5.0	-1.5	-9.0
2000	1.9	2.3	2.6	1.2	3.4	3.5	1.0	-8.0
2001	2.1	2.3	2.3	1.4	3.5	8.0	6.0	-8.0
2002	1.9	2.3	2.3	1.3	3.5	5.0	4.0	-7.0
2003	2.0	2.3	2.4	1.5	3.5	2.5	3.0	-7.0
2004	2.0	2.3	2.5	1.6	3.5	2.5	2.5	-7.0
2005	2.2	2.3	2.5	1.6	3.5	3.0	2.6	-7.0
2006	2.2	2.3	2.5	1.5	3.7	3.5	2.6	-7.0
2007	2.2	2.3	2.4	1.5	3.7	3.5	2.6	-7.0

BELLSOUTH COMMUNICATIONS
TPI COMPARED TO OTHER PRICE INDEXES
1988=100

	TOTAL TPI	GDP DEFLATOR	CPI URBAN
1959	29.6	26.6	24.6
1960	29.6	27.1	25.0
1961	29.4	27.4	25.3
1962	29.2	27.8	25.5
1963	29.5	28.1	25.9
1964	29.8	28.5	26.2
1965	29.8	29.0	26.6
1966	30.4	29.8	27.4
1967	31.7	30.8	28.2
1968	33.5	32.2	29.4
1969	35.4	33.7	31.0
1970	37.7	35.5	32.8
1971	40.1	37.4	34.2
1972	42.7	38.9	35.3
1973	44.9	41.1	37.5
1974	50.6	44.7	41.7
1975	55.5	49.0	45.5
1976	59.9	51.8	48.1
1977	62.3	55.1	51.2
1978	64.8	59.2	55.1
1979	68.7	64.2	61.4
1980	72.3	70.2	69.7
1981	78.6	76.5	76.8
1982	85.1	81.4	81.6
1983	89.7	84.9	84.2
1984	94.2	88.2	87.8
1985	98.6	91.1	91.0
1986	99.9	93.6	92.6
1987	100.5	96.5	96.0
1988	100.0	100.0	100.0
1989	102.2	104.2	104.8
1990	101.7	108.7	110.5
1991	101.9	113.0	115.1
1992	99.8	116.1	118.6
1993	99.4	119.2	122.1
1994	96.6	122.1	125.3
1995	97.7	124.9	128.8
1996	98.0	127.2	132.6
1997	96.8	129.6	135.7

BELLSOUTH COMMUNICATIONS
TPI COMPARED TO OTHER PRICE INDEXES
PERCENT CHANGE

	TOTAL TPI	GDP DEFLATOR	CPI URBAN
1960	0.0	1.9	1.6
1961	-0.7	1.1	1.2
1962	-0.7	1.5	0.8
1963	1.0	1.1	1.6
1964	1.0	1.4	1.2
1965	0.0	1.8	1.5
1966	2.0	2.8	3.0
1967	4.3	3.4	2.9
1968	5.7	4.5	4.3
1969	5.7	4.7	5.4
1970	6.5	5.3	5.8
1971	6.4	5.4	4.3
1972	6.5	4.0	3.2
1973	5.2	5.7	6.2
1974	12.7	8.8	11.2
1975	9.7	9.6	9.1
1976	7.9	5.7	5.7
1977	4.0	6.4	6.4
1978	4.0	7.4	7.6
1979	6.0	8.4	11.4
1980	5.2	9.3	13.5
1981	8.7	9.0	10.2
1982	8.3	6.4	6.3
1983	5.4	4.3	3.2
1984	5.0	3.9	4.3
1985	4.7	3.3	3.6
1986	1.3	2.7	1.8
1987	0.6	3.1	3.7
1988	-0.5	3.6	4.2
1989	2.2	4.2	4.8
1990	-0.5	4.3	5.4
1991	0.2	4.0	4.2
1992	-2.1	2.7	3.0
1993	-0.4	2.7	3.0
1994	-2.8	2.4	2.6
1995	1.1	2.3	2.8
1996	0.3	1.8	3.0
1997	-1.2	1.9	2.3

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

AT&T'S 2ND REQUEST FOR PRODUCTION OF DOCUMENTS

POD NO. 32

PROPRIETARY

DECLASSIFIED

1

NUMBER OF VERTICAL SERVICE USOCs PER ACCOUNT

	OCTOBER				DECEMBER				DIFFERENCE		
STATE	APCC	CC	AP	Average	APCC	CC	AP	Average	APCC	CC	AP
AL	3.90	3.87	1.59	3.12	7.75	7.67	1.60	5.67	3.85	3.80	0.01
FL	6.97	4.69	2.27	4.64	9.01	8.22	2.22	6.48	2.04	3.53	(0.05)
GA	4.07	4.61	1.67	3.45	6.46	7.90	1.68	5.35	2.39	3.29	0.01
KY	3.31	3.94	1.25	2.83	6.86	7.97	1.18	5.34	3.55	4.03	(0.07)
LA	2.90	3.65	1.51	2.69	5.72	7.27	1.59	4.86	2.82	3.62	0.08
MS	2.71	3.43	*N/A*	3.07	5.63	7.54	*N/A*	6.59	2.92	4.11	*N/A*
NC	*N/A*	*N/A*	*N/A*	#DIV/0!	*N/A*	*N/A*	*N/A*	#DIV/0!	*N/A*	*N/A*	*N/A*
SC	4.24	5.14	1.61	3.66	6.97	8.04	1.39	5.47	2.73	2.90	(0.22)
TN	3.74	4.06	1.68	3.16	7.29	8.24	1.65	5.73	3.55	4.18	(0.03)
Region (Ave)	3.98	4.17	1.65	3.27	6.96	7.86	1.62	5.48			

FROM MkIS QUERY OF CUSTOMERS PURCHASING AN INTEGRATED PACKAGE ON A 'C' ORDER ONLY IN NOV 96

2

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

AT&T'S 2ND REQUEST FOR PRODUCTION OF DOCUMENTS

POD NO. 33

PROPRIETARY

4

	A	B	C
1	Florida		
2	Back-up for CLASS Modem Card Penetration		
3	Study Period: 2000-2002		
4			
5			
6	Item/Description	Source	Amount
7	**Lines per Office w/ CND**	Network	
8	Residence		12,000
9	Business		900
10			
11	**Percent Distribution**		
12	Residence		70%
13	Business		30%
14			
15	**Melded Input - Lines per Office**	Ln8*Ln12+Ln9*Ln13	8,699
16			
17	**Average Number of Lines per Office**	SCIS/MO Inputs	**16,191**
18			
19	**Penetration of CND**	Ln15/Ln17	**54%**

Number Portability
Calculation of DMS Vendor EF&I Investments

Residential

Workpaper: B2
State: All
Date: 11/29/98
Page: 1 of 1

LN	Description	Source	Amount
1	DMS Investment Calculations – Marginal		
2			
3	Investment Category		
4	A. Getting Started	MO1*IP1*RT33	$0.28
5	B. CCS		
6	C. Call		
7	D. Minmum Cost per Line		
8	E. Hardware		
9	F. Memory	(MP33*IT14+MD33*IT15)/IP2+MF33*IT16	$0.08
10	G. SSP Octet		
11	H. Total End Office (USOC: TNPRL)	LN4+LN9	$0.33
12	I. Investment per Additional Path	LN4+MF33*IT16	$0.28
13			
14	Model Office Outputs – Marginal	SCIS/MO BC836	
15	MO1 Investment per Msec		$0.00288
16			
17	User Input		
18	IP1 BH Calls per Line	Network Cost Group	1
19	IP2 Average RCF Lines per Office	StatMaster Extract	68
20			
21	SCIS/IN Database Items	SCIS/IN Tables	
22	IT14 Program Store Cost per Word		0.00207
23	IT15 Data Store Cost per Word		0.0081
24	IT16 Data Fill Cost per Word		0.0081
25	MD33 Data Store Memory Requirement		281
26	MF33 Data Fill Memory Requirement		8
27	MP33 Program Store Memory Requirement		1161
28	RT33 Realtime Requirement per RCF Call		9.70138
29			
30			
31	DMS Investment Calculations – Capacity		
32			
33	Investment Category		
34	A. Getting Started	MO1*IP1*RT33	$1.10
35	B. CCS		
36	C. Call		
37	D. Minmum Cost per Line		
38	E. Hardware		
39	F. Memory	(MP33*IT14+MD33*IT15)/IP2+MF33*IT16	$0.08
40	G. SSP Octet		
41	H. Total End Office (USOC: TNPRL)	LN34+LN39	$1.18
42	I. Investment per Additional Path	LN34+MF33*IT16	$1.13
43			
44	Model Office Outputs – Capacity	SCIS/MO BC836	
45	MO1 Investment per Msec		$0.40738
46			
47	User Input		
48	IP1 BH Calls per Line	Network Cost Group	1
49	IP2 Average RCF Lines per Office	StatMaster Extract	68
50			
51	SCIS/IN Database Items	SCIS/IN Tables	
52	IT14 Program Store Cost per Word		0.00207
53	IT15 Data Store Cost per Word		0.0081
54	IT16 Data Fill Cost per Word		0.0081
55	MD33 Data Store Memory Requirement		981
56	MF33 Data Fill Memory Requirement		8
57	MP33 Program Store Memory Requirement		1161
58	RT33 Realtime Requirement per RCF Call		9.70138
59			
60			

6

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

AT&T'S 2ND REQUEST FOR PRODUCTION OF DOCUMENTS

POD NO. 37

PROPRIETARY

8

BST Projection - (BOY)

a = 1988.5672
b = 0.456953

	FP Ratio	% Fiber	% Copper	HISTORICAL % Fiber	HISTORICAL % Copper
1981	0.01	0.5%	99.5%		
1982	0.01	0.9%	99.1%		
1983	0.02	1.5%	98.5%		
1984	0.03	2.6%	97.4%		
1985	0.05	4.5%	95.5%		
1986	0.08	7.7%	92.3%		
1987	0.15	12.8%	87.2%		
1988	0.26	20.6%	79.4%		
1989	0.46	31.4%	68.6%		
1990	0.81	44.7%	55.3%		
1991	1.42	58.7%	41.3%	81.56%	18.4%
1992	2.51	71.5%	28.5%	83.66%	16.3%
1993	4.43	81.6%	18.4%	85.26%	14.7%
1994	11.97	90.0%	10.0%	88.54%	11.46%
1995	18.91	94.0%	6.0%	92.56%	7.44%
1996	29.86	96.8%	3.2%	93.93%	6.07%
1997	47.15	97.9%	2.1%	96.44%	3.56%
1998	74.46	98.7%	1.3%	98.72%	1.28%
1999	117.60	99.2%	0.8%	99.12%	0.88%
2000	185.72	99.5%	0.5%		
2001	293.30	99.7%	0.3%		
2002	463.19	99.8%	0.2%		
2003	731.50	99.9%	0.1%		
2004	1155.22	99.9%	0.1%		
2005	1824.39	99.9%	0.1%		
2006	2881.17	100.0%	0.0%		

Development of IOF Metallic Cable Future Life Expectancy

BOY Year	% Fiber	% Copper	Survival Rate	Percent Of Pre-1998 Surviving Circuits
A	B	C = 1 - B	D	E[+1] = E * D
2000	99.5%	0.5%	63.45%	100.0%
2001	99.7%	0.3%	0.00%	63.4%
2002	100.0%	0.0%		0.0%

Future Life Expectancy: Sum(col-E)/E[1999] - 0.5 = 1.1 Years

9

BellSouth Feeder Cable

PRIVATE/PROPRIETARY

		Universe 1		Universe 2		Total				
		a=	1992.07317	a=	2004	2002.75362	2005			
		b=	0.461228	b=	0.4	0.521644	0.33			
		SR(b)=	58.60%	SR(b)=	49.18%					
					5.74	5.53				
A	B	C	D	E	F	G	H	I	J	K
BOY Year	Actual Fiber Penetration %	Projected Fiber Penetration %	Contribution to Total Substition Rate % Universe 1	Projected Fiber Penetration %	Contribution to Total Substition Rate % Universe 2	Projected Fiber Penetration % Total	Technological Obsolescence Rate %	Historical Mortality Rate %	Combined Mortality Rate %	Embedded Equipment Surviving %
1982		0.95%	0.19%	*-0.19%*	0.00%	0.19%				
1983		1.50%	0.29%	*-0.29%*	0.00%	0.29%				
1984		2.36%	0.46%	*-0.46%*	0.00%	0.46%				
1985		3.69%	0.72%	*-0.72%*	0.00%	0.72%				
1986		5.73%	1.12%	*-1.12%*	0.00%	1.12%				
1987		8.79%	1.71%	*-1.71%*	0.00%	1.71%				
1988		13.25%	2.58%	*-2.58%*	0.00%	2.58%				
1989		19.51%	3.80%	*-3.80%*	0.00%	3.80%				
1990		27.76%	5.41%	*-5.41%*	0.00%	5.41%				
1991	7.47%	37.87%	7.38%	*0.09%*	0.00%	7.38%				
1992	9.61%	49.16%	9.58%	*0.03%*	0.00%	9.58%	2.37%			
1993	11.49%	60.53%	11.80%	*-0.31%*	0.00%	11.80%	2.45%			
1994	14.04%	70.86%	13.81%	*0.23%*	0.18%	14.00%	2.49%			
1995	17.18%	79.41%	15.48%	*1.71%*	1.37%	16.85%	3.32%			
1996	19.49%	85.95%	16.75%	*2.74%*	2.20%	18.96%	2.53%			
1997	22.54%	90.66%	17.67%	*4.87%*	3.92%	21.59%	3.25%			
1998	25.83%	93.90%	18.30%	*7.53%*	6.06%	24.36%	3.54%			
1999	28.83%	96.06%	18.72%	11.92%	9.60%	28.32%	5.23%			
2000		97.48%	19.00%	16.80%	13.52%	32.52%	5.86%	1.40%	7.19%	100.00%
2001		98.40%	19.18%	23.15%	18.64%	37.81%	7.84%	1.51%	9.23%	92.81%
2002		98.98%	19.29%	31.00%	24.96%	44.25%	10.35%	1.63%	11.81%	84.24%
2003		99.36%	19.36%	40.13%	32.31%	51.67%	13.31%	1.74%	14.82%	74.29%
2004		99.59%	19.41%	50.00%	40.26%	59.67%	16.54%	1.86%	18.09%	63.28%
2005		99.74%	19.44%	59.87%	48.20%	67.64%	19.77%	1.99%	21.37%	51.83%
2006		99.84%	19.46%	69.00%	55.55%	75.01%	22.77%	2.12%	24.41%	40.76%
2007		99.90%	19.47%	76.85%	61.87%	81.34%	25.35%	2.26%	27.03%	30.81%
2008		99.94%	19.48%	83.20%	66.99%	86.46%	27.44%	2.39%	29.18%	22.48%
2009		99.96%	19.48%	88.08%	70.91%	90.40%	29.05%	2.54%	30.85%	15.92%
2010		99.97%	19.49%	91.68%	73.81%	93.30%	30.23%	2.69%	32.11%	11.01%
2011		99.98%	19.49%	94.27%	75.89%	95.38%	31.08%	2.84%	33.04%	7.47%
2012		99.99%	19.49%	96.08%	77.36%	96.84%	31.68%	2.84%	33.62%	5.00%
2013		99.99%	19.49%	97.34%	78.37%	97.86%	32.09%	2.84%	34.02%	3.32%
2014		100.00%	19.49%	98.20%	79.06%	98.55%	32.38%	2.84%	34.30%	2.19%
2015		100.00%	19.49%	98.79%	79.53%	99.02%	32.57%	2.84%	34.49%	1.44%
2016		100.00%	19.49%	99.18%	79.85%	99.34%	32.70%	2.84%	34.61%	0.94%
2017		100.00%	19.49%	99.45%	80.07%	99.56%	32.79%	2.84%	34.70%	0.62%
								Average Remaining Life =		**5.5**

BellSouth Distribution Cable

A	B	C	D	E	F	G	H	I	J
BOY Year	Projected Fiber Penetration %	Technological Obsolescence Rate % (due to Fiber)	Projected Wireless Penetration %	Projected Wireless Penetration % (adjusted for data growth)	Technological Obsolescence Rate % (due to Wireless)	Combined Technological Obs. Rate %	Historical Mortality Rate %	Combined Mortality Rate %	Embedded Equipment Surviving %
1998	0.35%	0.23%	0.00%	0.00%	0.00%	0.23%			
1999	0.58%	0.57%	1.00%	0.00%	0.00%	0.57%			
2000	1.14%	0.68%	2.00%	0.00%	0.00%	0.68%	1.37%	2.04%	100.00%
2001	1.81%	1.08%	5.00%	0.00%	0.00%	1.08%	1.53%	2.59%	97.96%
2002	2.87%	1.69%	9.00%	0.00%	0.00%	1.69%	1.69%	3.36%	95.43%
2003	4.51%	2.63%	14.00%	0.00%	0.00%	2.63%	1.86%	4.44%	92.23%
2004	7.03%	4.04%	19.00%	0.00%	0.00%	4.04%	2.03%	5.99%	88.13%
2005	10.78%	6.07%	24.00%	0.00%	0.00%	6.07%	2.20%	8.14%	82.85%
2006	16.20%	8.85%	30.00%	0.00%	1.00%	9.76%	2.38%	11.91%	76.11%
2007	23.61%	12.40%	35.00%	1.00%	1.01%	13.28%	2.56%	15.50%	67.05%
2008	33.08%	16.55%	40.00%	2.00%	3.06%	19.10%	2.74%	21.32%	56.65%
2009	44.16%	20.93%	46.00%	5.00%	5.26%	25.09%	2.92%	27.28%	44.58%
2010	55.84%	25.08%	51.00%	10.00%	4.44%	28.41%	3.11%	30.63%	32.42%
2011	66.92%	28.63%	55.00%	14.00%	3.49%	31.12%	3.30%	33.39%	22.49%
2012	76.39%	31.40%	60.00%	17.00%	3.61%	33.88%	3.49%	36.19%	14.98%
2013	83.80%	33.43%	64.00%	20.00%	3.75%	35.93%	3.69%	38.29%	9.56%
2014	89.22%	34.84%	68.00%	23.00%	3.90%	37.38%	3.89%	39.82%	5.90%
2015	92.97%	35.78%	71.00%	26.00%	4.05%	38.39%	4.09%	40.91%	3.55%
2016	95.49%	36.40%	74.00%	29.00%	2.82%	38.19%	4.30%	40.85%	2.10%
2017	97.13%	36.79%	77.00%	31.00%	2.90%	38.63%	4.51%	41.40%	1.24%
2018	98.19%	37.05%	80.00%	33.00%	2.99%	38.93%	4.73%	41.81%	0.73%
2019	98.86%	37.21%	82.00%	35.00%	1.54%	38.17%	4.94%	41.23%	0.42%
2020	99.28%	100.00%	82.00%	36.00%	0.00%	100.00%	5.16%	100.00%	0.25%
							Average Remaining Life =		**8.4**

Fiber Penetration in the Feeder

NOTE:
The Life estiamte of Analog Ckt eqpt is based on the demise of copper in the feeder. The life curves for feeder copper are shown here (end date of 2012).

A BOY Year	B Projected Fiber Penetration %	C Technological Obsolessence Rate %	D Historical Mortality Rate %	E Combined Mortality Rate %	F Embedded Equipment Surviving %
1982	0.19%	0			
1983	0.29%	0			
1984	0.46%	0			
1985	0.72%	0			
1986	1.12%	0			
1987	1.71%	0			
1988	2.58%	0			
1989	3.80%	0			
1990	5.41%	0			
1991	7.38%	0.00%			
1992	9.58%	2.37%			
1993	11.80%	2.45%			
1994	14.00%	2.49%			
1995	16.85%	3.32%			
1996	18.96%	2.53%			
1997	21.59%	3.25%			
1998	24.36%	3.54%			
1999	28.32%	5.23%			
2000	32.52%	5.86%	8.33%	13.70%	100.00%
2001	37.81%	7.84%	9.43%	16.53%	86.30%
2002	44.25%	10.35%	10.55%	19.81%	72.03%
2003	51.67%	13.31%	11.68%	23.44%	57.76%
2004	59.67%	16.54%	12.83%	27.25%	44.22%
2005	67.64%	19.77%	13.99%	31.00%	32.17%
2006	75.01%	22.77%	15.15%	34.47%	22.20%
2007	81.34%	25.35%	16.33%	37.54%	14.55%
2008	86.46%	27.44%	17.52%	40.15%	9.09%
2009	90.40%	29.05%	18.71%	42.32%	5.44%
2010	93.30%	30.23%	19.91%	44.12%	3.14%
2011	95.38%	31.08%	21.12%	45.64%	1.75%
2012	96.84%		22.32%		
2013	100.00%		23.54%		
			24.75%		
			25.97%		
			27.19%		

Average Remaining Life = 4.0

2

TECHNOLOGY: ANALOG / DIGITAL CONVERSION CIRCUIT EQUIPMENT
UNITS: (CIRCUITS)

YEAR	% SURVIVING BOY	[Dt] DISPLACEMENT TECHNOLOGICAL OBSOLESCENCE	[Dm] DISPLACEMENT NORMAL MORTALITY	[Dc] DISPLACEMENT COMBINED RATE	[Sc] SURVIVAL COMBINED RATE
		NOTE 1	NOTE 2		
1993					
1994					
1995					
1996					
1997	A	B	C	D	E
1998					
1999					
2000	100.0%	0.00%	8.33%	0.08326	0.91674
2001	91.7%	19.68%	9.43%	0.27254	0.72746
2002	66.7%	41.38%	10.55%	0.47566	0.52434
2003	35.0%	45.24%	11.68%	0.51639	0.48361
2004	16.9%	85.10%	12.83%	0.87013	0.12987
2005	2.2%	90.00%	13.99%	0.91399	0.08601
2006	0.0%	90.00%	15.15%	0.91515	0.08485

ARL = 2.6

* H = HISTORICAL
* E = ESTIMATED

NOTE 1: Displacement due to Technological Obsolescence is based on Analog Switching Life Analysis. However, some A/D eqpt will probably be left to serve spe

NOTE 2: Displacement due to Normal Mortality is based on Actuari Analysis (often called Historical Mortality Analysis) of the historical mortality data (i.e. investment and retirements year of placement) of the Circuit Other account.

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TECHNOLOGY: OTHER DIGITAL CIRCUIT EQUIPMENT
UNITS: (CIRCUITS)

1.

YEAR	BOY SURVIVORS	FIBER PENETRATION RATE	TECHNOLOGICAL OBSOLESENCE RATE **7 YEAR LAG**	% SURVIVING BOY	(Dm) DISPLACEMENT RATE	COMBINED RATE	% SURVIVING BOY	(Sm) SURVIVAL RATE
					NOTE 1			
		A	B	C	D	E	F	G
1992								
1993								
1994								
1995								
1996								
1997								
1998								
1999		28.32%						
2000		32.52%		100.0%	0.06616	6.62%	100.00%	0.93384
2001		37.81%		79.0%	0.07533	7.53%	93.38%	0.92467
2002		44.25%		71.6%	0.08458	8.46%	86.35%	0.91542
2003		51.67%		64.2%	0.09388	9.39%	79.05%	0.90612
2004		59.67%		57.0%	0.1033	10.33%	71.63%	0.89670
2005		67.64%		47.4%	0.1127	11.27%	64.23%	0.88730
2006		75.01%	5.23%	38.7%	0.1222	16.81%	56.99%	0.83187
2007		81.34%	5.86%	30.7%	0.1317	18.26%	47.41%	0.81738
2008		86.46%	7.84%	23.3%	0.1413	20.86%	38.75%	0.79138
2009		90.40%	10.35%	17.0%	0.1509	23.88%	30.67%	0.76119
2010		93.30%	13.31%	11.8%	0.1606	27.24%	23.34%	0.72764
2011		95.38%	16.54%	7.7%	0.1702	30.74%	16.98%	0.69258
2012			19.77%	4.8%	0.18	34.21%	11.76%	0.65788
2013			22.77%	2.9%	0.1897	37.42%	7.74%	0.62580
2014			25.35%	1.7%	0.1995	40.24%	4.84%	0.59756
2015			27.44%	0.0%	0.2093	42.63%	2.89%	0.57373
2016			29.05%	0.0%	0.2191	44.59%	1.66%	0.55408
2017			30.23%	0.0%	0.229	46.21%	0.92%	0.53792
2018			31.08%	0.0%	0.2388	47.54%	0.49%	0.52460
2019				0.0%	0.2487	24.87%	0.26%	0.00000
2020				0.0%	0.2585	25.85%	0.20%	0
2021					0.2684			
2022								
2023								
2024								
2025								
2026								
2027								
2028								
2029								
2030								

6.90

NOTE 1:
Displacement due to Normal Mortality is based on Actuarial Analysis (often called Historical Mortality Analysis) of the historical mortality data (i.e. investment and retirements by year of placement) of the Circuit Other account.

I

ASYNCHRONOUS OPTICAL CIRCUIT EQUIPMENT
(CIRCUITS)

YEAR	BOY SURVIVORS	% SURVIVING BOY	(Dt) DISPLACEMENT TECHNOLOGICAL OBSOLESCENCE	(Dm) DISPLACEMENT NORMAL MORTALITY	(Dc) DISPLACEMENT COMBINED RATE	(Sc) SURVIVAL COMBINED RATE
			NOTE 1	NOTE 2		
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000		100.0%	0.16866	0.03907	0.20114	0.79886
2001		79.9%	0.20467	0.04802	0.24287	0.75713
2002		60.5%	0.23798	0.05705	0.28145	0.71855
2003		43.5%	0.26638	0.06616	0.31492	0.68508
2004		29.8%	0.28899	0.07533	0.34255	0.65745
2005		19.6%	0.30601	0.08458	0.36470	0.63530
2006		12.4%	0.31829	0.09388	0.38229	0.61771
2007		7.7%	0.32689	0.1033	0.39643	0.60357
2008		4.6%	0.33279	0.1127	0.40798	0.59202
2009		0.0%	0.33677	0.1222	0.41782	0.58218
2010			0.33943	0.1317	0.42643	0.57357
				0.1413		1.00000
	ARL =	3.1		0.1509		1.00000
				0.1606		

NOTE 1:
Displacement due to Technological Obsolescence is based on Substitution Analysis of SONET for Asynchronous Optical Circuit Equipment with 3-year lag.

NOTE 2:
Displacement due to Normal Mortality is based on Actuarial Analysis (often called Historical Mortality Analysis) of the historical mortality data (i.e. investment and retirements by year of placement) of the Circuit Other account modified to account for the average age of async optical circuit equipment which differs from that of Circuit Other. Used a 3 year lag.

TECHNOLOGY: ASYNCHRONOUS OPTICAL CIRCUIT EQUIPMENT
UNITS: (CIRCUITS)

	ASYNC OPTICAL % of Optical (1999 ANALYSIS) (BOY) Q	SONET % of Optical (1999 ANALYSIS) (BOY) R	F-P RATIO (NEW/OLD) (1999 ANALYSIS) S	(Dt) DISPLACEMENT TECHNOLOGICAL OBSOLESCENCE (1999 ANALYSIS) T = 1 - (Q(+1) / Q)	(Dt) DISPLACEMENT TECHNOLOGICAL OBSOLESCENCE (1999 ANALYSIS) (3 YEAR LAG) U = T(-3)	IOF & Loop Actual % of Optical
SR =		66.1%				
a =		1998.1				
b =		0.4225196				
1991	95.26%	4.74%	0.0498	0.02433		
1992	92.94%	7.06%	0.0760	0.03580		
1993	89.61%	10.39%	0.1159	0.05179		6.27%
1994	84.97%	15.03%	0.1769	0.07324		10.72%
1995	78.75%	21.25%	0.2699	0.10051		31.55%
1996	70.83%	29.17%	0.4118	0.13297		36.94%
1997	61.41%	38.59%	0.6283	0.16866	0.07324	46.31%
1998	51.06%	48.94%	0.9586	0.20467	0.10051	56.49%
1999	40.61%	59.39%	1.4627	0.23798	0.13297	60.04%
2000	30.94%	69.06%	2.2318	0.26638	0.16866	
2001	22.70%	77.30%	3.4052	0.28899	0.20467	
2002	16.14%	83.86%	5.1957	0.30601	0.23798	
2003	11.20%	88.80%	7.9276	0.31829	0.26638	
2004	7.64%	92.36%	12.0959	0.32689	0.28899	
2005	5.14%	94.86%	18.4559	0.33279	0.30601	
2006	3.43%	96.57%	28.1601	0.33677	0.31829	
2007	2.27%	97.73%	42.9667	0.33943	0.32689	
2008	1.50%	98.50%	65.5586	0.34120	0.33279	
2009	0.99%	99.01%	100.0293	0.34236	0.33677	
2010	0.65%	99.35%	152.6249	1.00000	0.33943	
2011						
2012						
2013						
2014						
2015						
2016						
2017						
2018						
2019						
2020						

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BST
SONET IOF Equipment
Development of the Economic Life and the Average Remaining Life

1.01000E+00 = c
2.96920E-51 = g
3.18234E+00 = s

2015.0 = a
0.500000 = b
0.00% = sr

	Newly Placed Equipment		NG-SONET		SONET Equipment		
Year	Beginning of Period Surviving % A	Historical Mortality Rate % B	Penetration % C	Technological Obsolescence Rate % D	Historical Mortality Rate % E	Combined Mortality Rate % F	Embedded Surviving % G
2000	1.00000	0.58%	0.06%	0.04%	6.62%	6.65%	100.00%
2001	0.99420	1.73%	0.09%	0.06%	7.53%	7.59%	93.35%
2002	0.97700	2.88%	0.15%	0.10%	8.46%	8.55%	86.27%
2003	0.94888	4.02%	0.25%	0.16%	9.39%	9.53%	78.89%
2004	0.91070	5.17%	0.41%	0.26%	10.33%	10.57%	71.37%
2005	0.86364	6.31%	0.67%	0.43%	11.27%	11.65%	63.83%
2006	0.80916	7.45%	1.10%	0.71%	12.22%	12.84%	56.39%
2007	0.74890	8.58%	1.80%	1.15%	13.17%	14.17%	49.15%
2008	0.68462	9.72%	2.93%	1.87%	14.13%	15.73%	42.19%
2009	0.61809	10.85%	4.74%	2.98%	15.09%	17.62%	35.55%
2010	0.55105	11.97%	7.59%	4.69%	16.06%	20.00%	29.28%
2011	0.48507	13.10%	11.92%	7.18%	17.02%	22.98%	23.43%
2012	0.42153	14.22%	18.24%	10.58%	18.00%	26.68%	18.05%
2013	0.36160	15.34%	26.89%	14.86%	18.97%	31.01%	13.23%
2014	0.30614	16.45%	37.75%	19.67%	19.95%	35.70%	9.13%
2015	0.25578	17.56%	50.00%	24.49%	20.93%	40.30%	5.87%
2016	0.21087	18.67%	62.25%	28.76%	21.91%	44.37%	3.50%
2017	0.17151	19.77%	73.11%	32.17%	22.90%	47.70%	1.95%
2018	0.13761	20.87%	81.76%	34.66%	23.88%	50.26%	1.02%
2019	0.10889	21.96%	88.08%	36.36%	24.87%	52.19%	0.51%
2020	0.08498	23.05%	92.41%	37.48%	25.85%	53.64%	0.24%
2021	0.06539	24.13%	95.26%	38.19%	26.84%	54.78%	0.11%
2022	0.04961	25.21%	97.07%	0.00%	28.00%	100.00%	0.05%
2023	0.03710	100.00%	100.00%				
2024							
2025							
2026							
2027							
2028							
2029							
2030							
2031							
2032							
2033							
2034							
2035							
2036							
2037							
2038							
2039							
2040							

Average Remaining Life = 7.3

BST
Digital Switching - Analog Line Equipment (ALE)
Development of the Average Remaining Life

BOY Year	Projected IDLC Penetration % A	Technological Obsolescence Rate % B	Historical Mortality Rate % C	Combined Mortality Rate % D	Survivors % E
1998	19.46%	3.35%			
1999	22.16%	4.10%			
2000	25.35%	7.29%	6.62%	13.42%	100.00%
2001	30.79%	8.71%	7.53%	15.59%	86.58%
2002	36.82%	10.24%	8.46%	17.84%	73.08%
2003	43.29%	11.83%	9.39%	20.11%	60.05%
2004	50.00%	13.42%	10.33%	22.36%	47.97%
2005	56.71%	14.95%	11.27%	24.54%	37.25%
2006	63.18%	16.38%	12.22%	26.60%	28.11%
2007	69.21%	17.66%	13.17%	28.51%	20.63%
2008	74.65%	18.79%	14.13%	30.27%	14.75%
2009	79.41%	19.75%	15.09%	31.86%	10.29%
2010	83.48%	20.56%	16.06%	33.32%	7.01%
2011	86.88%	21.22%	17.02%	34.62%	4.67%
2012	89.66%	21.75%	18.00%	35.83%	3.06%
2013	91.91%	22.17%	18.97%	36.94%	1.96%
2014	93.70%	22.51%	19.95%	37.97%	1.24%
2015	95.12%	22.77%	20.93%	38.93%	0.77%
2016	96.23%		21.91%	21.91%	0.47%
2017	100.00%		22.90%	22.90%	0.37%
2018	100.00%		23.88%	23.88%	0.28%
2019	100.00%		24.87%	24.87%	0.21%
2020	100.00%		25.85%	25.85%	0.16%
2021	100.00%				

Average Remaining Life = 4.49

F

IDLC Actual %
5.78% 1
7.84% 1
9.96% 1
12.64% 1
15.11% 1
16.74% 1
18.28% 1
19.46% 1
22.16% 1

Historical Mortality Patterns of Digital Switching ALE

The historical mortality patterns are similar to that of general circuit equipment. They are derived from the best fit mortality curve to the 1989-1991 band of data. This band was chosen because it is the most recent band prior to the influence of significant technological substitutions. The best fit Gompertz-Makeham survivor curve is that shown; and its average life is 12.0 years.

ALE Technology

ALE circuit packs interface voice-grade analog loop channels with the Digital Switch. As the loop transitions to an integrated digital network, via Integrated Digital Loop Carrier (IDLE), the IDLC loop channel must interface with the switch via a DLE circuit pack; ALE packs are not compatible with an IDLC architecture. IDLC is rapidly replacing analog channels in the loop. As the IDLC substitution progresses, ALE circuit packs are, by necessity, replaced with DLE circuit packs. The IDLC substitution, therefore, is directly causing the technological obsolescence of Digital Switching ALE equipment. This technological substitution is reflected in the table.

As far back as 1992, surpluses of ALE equipment were documented in several central offices in Florida. Then, we predicted that DESS interim retirement levels would increase as a result of ALE obsolescence; subsequent history bares this out.

BST
Digital Switching - Digital Line Equipment (DLE)
Development of the Average Remaining Life

1.01000E+00 = c
2.96920E-51 = g
3.18234E+00 = s

Used in 1997 study
2014.5 = a
0.262364 = b
30.00% = sr

	Newly Placed DLE Equipment		TR303 Complient DLE		DLE Switching Equipment		
Year	Beginning of Period Surviving %	Historical Mortality Rate %	Penetration %	Technological Obsolessence Rate %	Historical Mortality Rate %	Combined Mortality Rate %	Embedded Surviving %
	A	B	C	D	E	F	G
2000	1.00000	0.58%	0.30%	0.60%	6.62%	7.17%	100.00%
2001	0.99420	1.73%	0.60%	1.21%	7.53%	8.65%	92.83%
2002	0.97700	2.88%	1.31%	2.43%	8.46%	10.67%	84.80%
2003	0.94888	4.02%	2.50%	4.31%	9.39%	13.28%	75.75%
2004	0.91070	5.17%	5.00%	7.31%	10.33%	16.86%	65.69%
2005	0.86364	6.31%	9.32%	12.14%	11.27%	22.01%	54.61%
2006	0.80916	7.45%	16.45%	19.49%	12.22%	29.28%	42.59%
2007	0.74890	8.58%	27.39%	29.79%	13.17%	38.96%	30.12%
2008	0.68462	9.72%	41.95%	42.65%	14.13%	50.64%	18.38%
2009	0.61809	10.85%	58.05%	56.58%	15.09%	62.99%	9.07%
2010	0.55105	11.97%	72.61%	69.55%	16.06%	74.26%	3.36%
2011	0.48507	13.10%	83.55%	80.01%	17.02%	83.21%	0.86%
2012	0.42153	14.22%	90.68%	87.52%	18.00%	89.55%	0.15%
2013	0.36160	15.34%	94.91%	92.48%	18.97%	93.68%	0.02%
2014	0.30614	16.45%	97.27%	95.56%	19.95%	96.22%	0.00%
2015	0.25578	17.56%	100.00%	97.42%	20.93%	97.73%	0.00%
2016	0.21087	18.67%	100.00%	98.51%	21.91%	98.61%	0.00%
2017	0.17151	19.77%	100.00%	100.00%	22.90%	99.77%	0.00%
2018	0.13761	20.87%	100.00%		23.88%	23.88%	0.00%
2019	0.10889	21.96%	100.00%		24.87%	24.87%	0.00%
2020	0.08498	23.05%	100.00%		25.85%	25.85%	0.00%
2021	0.06539	24.13%	100.00%		26.84%	26.84%	0.00%
2022	0.04961	25.21%	100.00%		27.82%	27.82%	0.00%
2023	0.03710	26.29%	100.00%		28.81%	28.81%	0.00%
2024	0.02735	27.36%	100.00%		29.79%	29.79%	0.00%
2025	0.01987	28.42%	100.00%		30.77%	30.77%	0.00%
2026	0.01422	29.48%	100.00%		31.75%	31.75%	0.00%
2027	0.01003	30.54%	100.00%		32.73%	32.73%	0.00%
2028	0.00697	31.59%	100.00%		33.71%	33.71%	
2029	0.00477	32.63%	100.00%		34.68%	34.68%	
2030	0.00321	33.67%	100.00%		35.65%	35.65%	
2031	0.00213	34.70%	100.00%		36.62%	36.62%	
2032	0.00139	35.73%	100.00%		37.59%		
2033	0.00089	36.75%	100.00%		38.55%		
2034	0.00057	37.76%	100.00%				
2035	0.00035	38.77%	100.00%				
2036	0.00022	39.77%	100.00%				
2037	0.00013	40.76%	100.00%				
2038	0.00008	100.00%					
2039							
	11:39448				Average Remaining Life = 5.3		

Notes:

Historical Mortality Patterns of Digital Switching DLE

The historical mortality patterns are similar to that of general circuit equipment. They are derived from the best fit mortality curve to the 1989-1991 band of data. This band was chosen because it is the most recent band prior to the influence of significant technological substitutions. The best fit Gompertz-Makeham survivor curve is that shown with an average life of 10 years.

TR-303 DLE Technology

Nearly all of the embedded DLE technology is TR-008 compliant and incompatible with the new TR-303 standards. Savings associated with TR-303 are substantial, and the substitution of TR-008 with TR-303 has already started.

Since there is very little empirical data on which to determine the rate of substitution, a conservative substitution model was chosen for these assets: The span of the substitution, i.e., from 1% to 99% penetration, is assumed to take 35 years, this equates to a substitution rate of 30 and an average technological life of 17.5 years. The substitution rate is similar to that of the Integrated Digital Loop Carrier substitution.

BST
Digital Switching - Trunk Interface Equipment (TIE)
Development of the Average Remaining Life

1.01000E+00 =c
2.96920E-51 =g
3.18234E+00 =s

from 1998 study
2016.5 =a
0.262364 =b
30.00% =sr

	Newly Placed DLE Equipment		SONET Complient TIE		TIE Switching Equipment		
Year	Beginning of Period Surviving %	Historical Mortality Rate %	Penetration %	Technological Obsolescence Rate %	Historical Mortality Rate %	Combined Mortality Rate %	Embedded Surviving %
	A	B	C	D	E	F	G
2000	1.00000	0.58%	7.06%	3.58%	6.62%	9.72%	1.00000
2001	0.99420	1.73%	10.39%	5.18%	7.53%	11.98%	90.28%
2002	0.97700	2.88%	15.03%	7.32%	8.46%	14.69%	79.46%
2003	0.94888	4.02%	21.25%	10.05%	9.39%	17.85%	67.79%
2004	0.91070	5.17%	29.17%	13.30%	10.33%	21.41%	55.69%
2005	0.86364	6.31%	38.59%	16.87%	11.27%	25.18%	43.76%
2006	0.80916	7.45%	48.94%	20.47%	12.22%	28.92%	32.74%
2007	0.74890	8.58%	59.39%	23.80%	13.17%	32.37%	23.27%
2008	0.68462	9.72%	69.06%	26.64%	14.13%	35.39%	15.74%
2009	0.61809	10.85%	77.30%	28.90%	15.09%	37.90%	10.17%
2010	0.55105	11.97%	83.86%	30.60%	16.06%	39.93%	6.32%
2011	0.48507	13.10%	88.80%	31.83%	17.02%	41.57%	3.79%
2012	0.42153	14.22%	92.36%	32.69%	18.00%	42.91%	2.22%
2013	0.36160	15.34%	94.86%	33.28%	18.97%	44.03%	1.27%
2014	0.30614	16.45%	96.57%	33.68%	19.95%	45.00%	0.71%
2015	0.25578	17.56%	97.73%	33.94%	20.93%	45.87%	0.39%
2016	0.21087	18.67%	98.50%	34.12%	21.91%	46.67%	0.21%
2017	0.17151	19.77%	99.01%	34.24%	22.90%	47.43%	0.11%
2018	0.13761	20.87%	99.35%	100.00%	23.88%	94.63%	0.06%
2019	0.10889	21.96%	100.00%	100.00%	24.87%	94.70%	0.00%
2020	0.08498	23.05%		100.00%	25.85%	94.76%	0.00%
2021	0.06539	24.13%		100.00%	26.84%	94.83%	0.00%
2022	0.04961	25.21%		100.00%	27.82%	94.90%	0.00%
2023	0.03710	26.29%		100.00%	28.81%	94.97%	0.00%
2024	0.02735	27.36%		100.00%	29.79%	95.04%	0.00%
2025	0.01987	28.42%		100.00%	30.77%	95.11%	0.00%
2026	0.01422	29.48%		100.00%	31.75%	95.18%	0.00%
2027	0.01003	30.54%		100.00%	32.73%	95.25%	0.00%
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2029	0.00477	32.63%			34.68%	34.68%	
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2034	0.00057	37.76%					
2035	0.00035	38.77%					
2036	0.00022	39.77%					
2037	0.00013	40.76%					
2038	0.00008	100.00%					
2039							

Average Remaining Life = 4.8

Notes:

Historical Mortality Patterns of Digital Switching TIE

The historical mortality patterns are similar to that of general circuit equipment. They are derived from the best fit mortality curve to the 1989-1991 band of data. This band was chosen because it is the most recent band prior to the influence of the SONET technological substitution. The best fit Gompertz-Makeham survivor curve is that shown; and its average life is 12.0 years.

SONET TIE Technology

Virtually all of the embedded TIE technology is non-SONET compliant, operating at the DS1 rate and incompatible with the new SONET standards.

Because of the huge advantages of SONET, the substitution for SONET in the IOF and Feeder portions of the network are proceeding at the fastest substitution rates experienced in our industry. It is therefore very likely that SONET will penetrate the DESS trunking multiplexes equally as fast.

Nonetheless, since there is very little empirical data specifically addressing DESS TIE equipment, a conservative substitution model was chosen for these assets. The span of the substitution chosen, i.e., from 1% to 99% penetration, is assumed to take 35 years, this equates to a substitution rate of 30; much less than the 75 substitution rate currently being experienced in the loop. The chosen substitution rate is similar to that of the Integrated Digital Loop Carrier, and has an average technological life of 17.5 years.

D

Subject: Exchange Area Transmission - Revised Resistance Design

SL: RL 83-04-013

type letter: Recommendation

date: April 1, 1983

distribution lists: NSV009, NSV001, NSV145

file no.
sl: RL 83-04-013
related letters: IL 80-01-360, RL 82-02-207
other: None

AT&T

American Telephone and
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Phone (201) 221-2000

to: Assistant Vice Presidents with Distribution Service and Network Services Planning Responsibilities

entitled companies/entities:

AT&T General Dept.	ABI
AMPS	Long Lines
AT&TI	Bell Labs
All BOC's	WECo

from: Director - Distribution Service
Director - Facilities Systems Engineering

description: Recommends the implementation of Revised Resistance Design (RRD) and elimination of Concentrated Range Extension with Gain (CREG) and Long Route Design (LRD) as options for loop relief.

* * *

The zones that were economic in the past for the implementation of CREG and LRD are now more economically relieved with Digital Loop Carrier (DLC). As a result, it is recommended that LRD and CREG not be considered as alternatives for future relief of a feeder route. Replacing these concepts is the Revised Resistance Design procedure that utilizes properly gauged and non-loaded wire plant up to 18 Kft, properly gauged and loaded wire plant from 18 Kft up to 24Kft, and the use of DLC beyond. These recommendations are consistent with current economics and reflect the concepts for positioning the local loop for digital capability as outlined in RL 82-02-207, Fundamental Subscriber Carrier Planning.

In addition to the elimination of CREG and LRD route relief options, RRD supersedes the existing RD plan referenced in Issue 4 of both BSP 902-115-100 and 902-115-101 and the Unified Loop Design Plan referenced in IL 80-01-360. These BSPs will be rewritten as Issue 5 to reflect the RRD changes with the new RRD worksheet, BS-1586 (attached), included in the latter BSP. There will be no further updates of existing BSPs on LRD or CREG. However, where LRD or CREG design is warranted for relief of existing LRD/CREG routes, the Universal Loop Design worksheet, BS-100, is recommended. The BS-100 worksheet should also be used to gauge distribution cable in carrier serving areas.

REVISED RESISTANCE DESIGN RULES

Application of Revised Resistance Design (RRD) rules is limited to loops 1500 ohms or less and 24 kft. or less including distribution. Refer to BSP 902-115-101 for further detail.

1. Loops 18 kft. or less (total length including bridged tap) must be designed to 1300 ohms or less (C.O. range permitting) and must be non-loaded.

2. Loops greater than 18 kft. and less than or equal to 24 kft. (total length including bridged tap) require standard H-88 loading* and may be designed to a maximum of 1500 ohms (C.O. range permitting).

3. Loops greater than 24 kft. should be designed using Digital Loop Carrier (DLC).

4. Bridged tap is limited to 6 kft. maximum.

5. No loaded bridged tap and no bridged tap between loads is permitted.

* Standard loading:

- minimum 2 loads
- C.O. end section 3000 ft.
- customer end section plus bridged tap a minimum 3000 ft. and maximum 12,000 ft.
- load coils spaced 6000 $\pm$ 120 ft. apart. For exceptions consult local transmission engineer.

NOTE: The lower bound of the shaded resistance bands of the Resistance Design Worksheet (BS-1586) represents 68 degrees F. The upper bound represents 100 degrees F.

OHMS PER KF AT 68 DEGREES F.

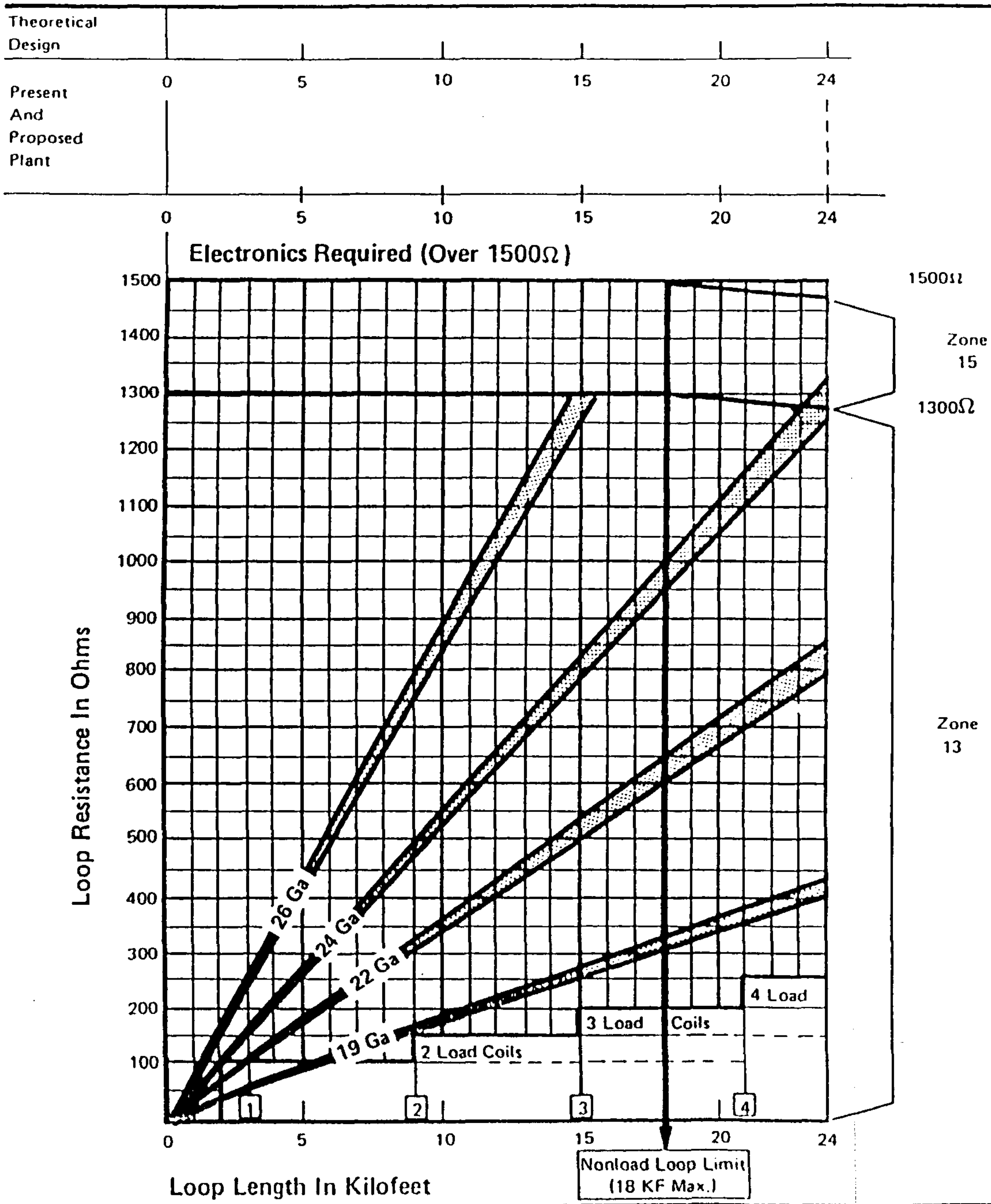
19 GA - 16.3 ohms
22 GA - 32.8 ohms
24 GA - 51.9 ohms
26 GA - 83.3 ohms

LOADING COIL

88 MH - 9 ohms each

Bell System

Resistance Design Worksheet



Revised Resistance Design Rules

Application of Revised Resistance Design (RRD) rules is limited to loops 1500 ohms or less and 24kft. or less including distribution. Refer to BSP 902-115-101 for further detail.

1. Loops 18kft. or less (total length including bridged tap) must be designed to 1300 ohms or less (C.O. range permitting) and must be nonloaded.
2. Loops greater than 18kft. and less than or equal to 24kft. (total length including bridged tap) require standard H-88 loading* and may be designed to a maximum of 1500 ohms (C.O. range permitting).
3. Loops greater than 24kft. should be designed using Digital Loop Carrier (DLC).
4. Bridged tap is limited to 6kft. maximum.
5. No loaded bridged tap and no bridged tap between loads is permitted.

* Standard loading:

- minimum 2 loads
- C.O. end section 3000 ft.
- customer end section plus bridged tap a minimum 3000 ft. and maximum 12,000 ft.
- load coils spaced 6000 ± 120 ft. apart. For exceptions consult local transmission engineer

NOTE: The lower bound of the shaded resistance bands represents 68 degrees F. The upper bound represents 100 degrees F.

Ohms Per KF At 68 Degrees F.

19 GA – 16.3 ohms
22 GA – 32.8 ohms
24 GA – 51.9 ohms
26 GA – 83.3 ohms

Loading Coil

88 MH – 9 ohms each

Central Office	Office Conductor Loop Limit
Type CO. Equipment	Proposed Resistance

Coin Line – Resistance Limit ________ Ohms

No. ________ Coin Lines Requiring Electronics Beyond ________ Feet

Loop ________________ Ft. Bridged Tap ________________ Ft.

☐ Loaded ☐ Non-Loaded

Project/Routine Job

Engineer

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Do not destroy

APPLICATION OF RESISTANCE DESIGN TO SUBSCRIBER LOOP PLANT

CONTENTS PAGE

1. GENERAL

1.01 This section describes the method by which the principles of Resistance Design are applied to the practical problem of designing customer loops. It is reissued to clarify and update Resistance Design methods.

1.02 Resistance Design is predicted upon controlling transmission losses by limiting the maximum conductor loop resistance. This is accomplished by observing the following Resistance Design Rules:

(1) Maximum conductor loop resistance of 1300 ohms (central office range permitting).

(2) Load all loops over 18 kft.

(3) Limit bridged tap on nonloaded loops to 6 kft or less.

(4) Limit end section plus bridged tap on loaded loops to 15 kft or less.

(5) Use only 500 sets beyond 10 kft.

(6) Design load spacing deviations normally within ± 120 ft.

(7) No bridged tap between load points.

(8) No loaded bridged taps.

1.03 Consistent application of all the above design rules will result in a distribution of loop losses that will result in satisfactory transmission to all customers.

2. DEFINITION OF TERMS

2.01 *Resistance Design Limit*—The maximum design value of outside plant conductor loop resistance to which the Resistance Design method is applicable. This value is set at 1300 ohms to control transmission losses.

2.02 *Resistance Design Boundary/Long Loop Boundary*—Both terms are synonymous with the boundary established as the furthest extension for applying the Resistance Design method.

2.03 *Resistance Design Area*—That area enclosed within the Resistance Design Boundary.

2.04 *Long Loop Area*—That area between the Resistance Design Boundary and all the exchange service area boundary.

2.05 *Office Supervision Limit*—That conductor loop resistance beyond which the operation of the central office relays or ferrods is uncertain.

2.06 *Office Design Limit*—The maximum resistance value to which the loop should be designed for a particular office. This will be the supervision limit for those offices with supervisory limits less than 1300 ohms. For offices with supervisory

: exceeding 1300 ohms, the Resistance Design L . of 1300 ohms is controlling.

2.07 *Design Loop*—The customer cable loop under study to which the Office Design Limit or Resistance Design Limit is applied in determining the proper gauge cable to use. It is normally the longest expected during the period of fill of the cable involved.

2.08 *Theoretical Design*—The cable makeup by gauge necessary in the Design Loop to just meet the Office Design Limit. It does not take into consideration any practical or economic considerations.

3. DETERMINATION OF RESISTANCE DESIGN BOUNDARY

3.01 A major decision that is to be made in the application of the Resistance Design method is that of establishing the Resistance Design Boundary. In other words, the point at which Resistance Design should stop and Long Loop Design begin. Basically, the Resistance Design concept should be applied to the bulk of the loops : e urban areas where the density and growth p .ntial are moderate to heavy. The Long Loop Design concept places emphasis on the treatment of individual loops, and, as such, is only intended for application to that small percentage of lines in sparsely settled areas where the design must be specialized to fit local conditions. The Long Loop Design procedures are outlined in Section 852-200-103.

3.02 From the preceding definition of the Resistance Design Boundary, it should be clear that this boundary is not fixed or static. The boundary should be changed to accommodate the changing conditions surrounding the distribution of the customers and our own plant. The Resistance Design Boundary should be re-evaluated using the guide lines listed for each outside plant project.

3.03 Figure 1 illustrates how offices with different supervisory ranges are affected differently by the 1300-ohm Resistance Design Limit. Office A represents those offices with supervisory limits less than 1300 ohms. With these offices it is generally more economical to select a cable gauge so that the densely settled areas are within the Office Design Limit. The present high cost of long equipment will not ordinarily prove economical to extend the supervisory ranges to 1300 ohms. In some situations it will be advisable to study the economies of coarser gauge cable versus long line equipment and finer gauge cable. All loops over 1300 ohms require additional transmission considerations as well as long line circuits for range extension as discussed in Section 852-200-103.

3.04 Office B does not present a problem because the Office Supervision Limit is the same as the Resistance Design Limit.

3.05 Office C represents the situation where the Office Supervision Limit is greater than the Resistance Design Limit. In such situations there is a tendency to stretch the Resistance Design Limit so that finer gauge cable may be used. Such design would result in substandard transmission, and it is the engineer's responsibility to assure that this does not occur.

3.06 The provision of dial long line equipment is dependent solely upon the supervision requirements of each office and not related to Resistance Design. Offices with supervision limits exceeding 1300 ohms may have some loops in the Long Loop Area (over 1300 ohms) that do not require dial long line circuit, but transmission for such loops will require study and treatment as detailed in Section 852-200-103.

4. DETERMINATION OF DESIGN LOOP

4.01 The length of the Design Loop is determined by the engineer based on his knowledge of the local service requirement and with the aid of the commerical forecast and other relevant data. It is normally the longest loop within the Resistance Design Area to be served by the cable being studied. In those cases, where cable is being proposed that will take care of future growth involving longer loops than those presently working in the cable, the Design Loop will be the longest loop anticipated to serve the new area during the period of fill of the cable. In these cases, the Design Loop may be referred to as the ultimate loop. Some cables may contain facilities that will be extended outside the Resistance Design Area. They should not control the gauging of the cable but should be studied on the basis of Long Loop Design.

4.02 Where the ultimate loop is longer than either the present or proposed loop, the Theoretical Design and gauge selection is based on this ultimate

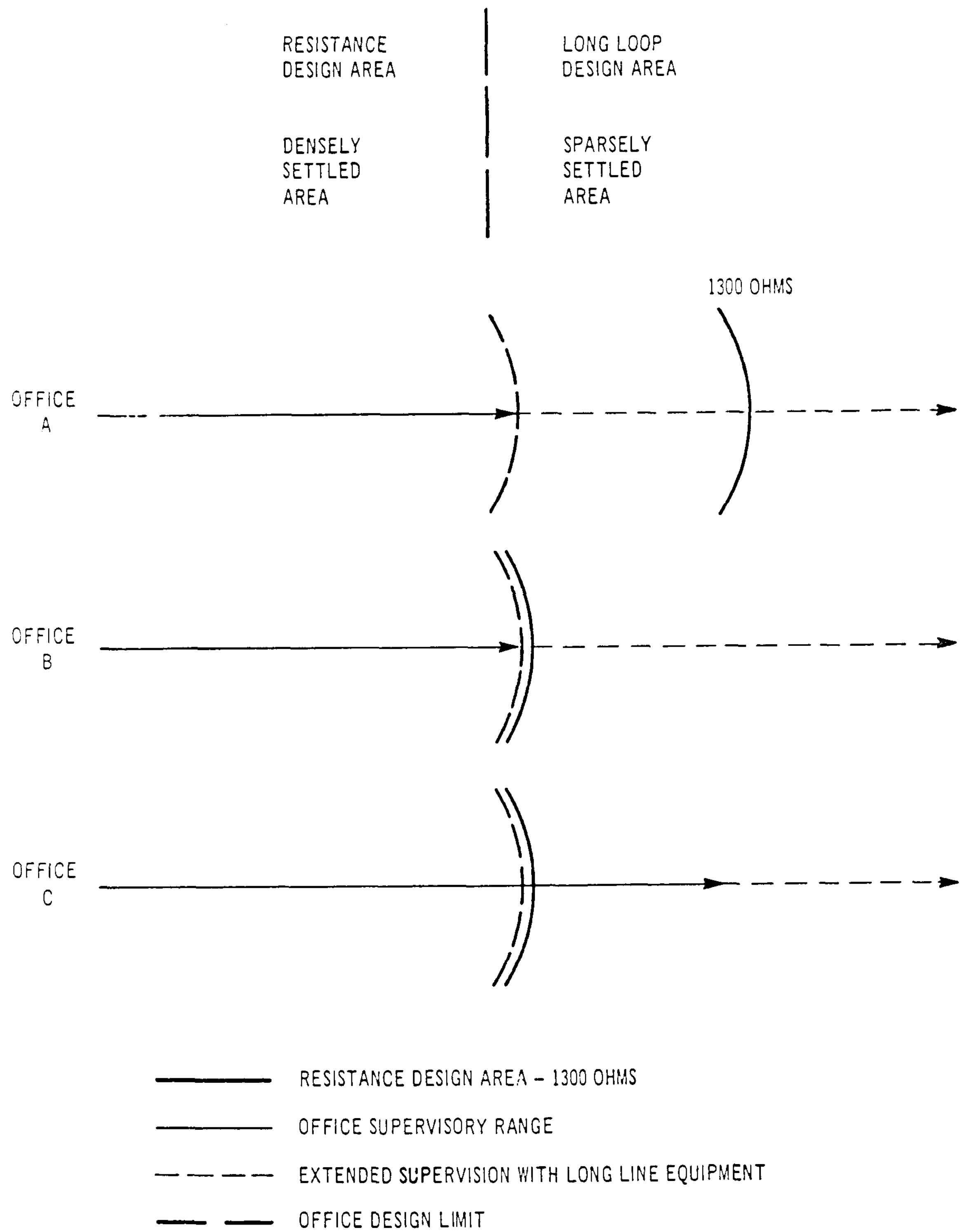

RESISTANCE
DESIGN AREA
LONG LOOP
DESIGN AREA
DENSELY
SETTLED
AREA
SPARSELY
SETTLED
AREA
1300 OHMS
OFFICE
A
OFFICE
B
OFFICE
C
RESISTANCE DESIGN AREA – 1300 OHMS
OFFICE SUPERVISORY RANGE
EXTENDED SUPERVISION WITH LONG LINE EQUIPMENT
OFFICE DESIGN LIMIT

Fig. 1

l However, the actual present and proposed ı :up should be shown on the Resistance Design Work Sheet. The ultimate length may be shown by a dotted line in the proposed design space (see Example 2 in 10.04).

4.03 In some cases there may be more than one design loop for a particular cable. When a major branching occurs before the gauge change point, each branch may have a different gauge requirement. Therefore, each branch should have a design loop, and each should be shown on a separate design work sheet.

5. GAUGE SELECTION

5.01 In order to determine what gauge cable or combination of gauges is required for any loop, the Theoretical Design should first be determined. This can be done easily with the use of form E5199 (Fig. 3). Having determined the length of the design loop and knowing the Office Design Limit, it is a simple matter of plotting to find the Theoretical Design. See the following C A for the step-by-step procedure.

Case A: Length of Design Loop is 20 kft and Office Design Limit is 1300 ohms. Find the Theoretical Design for this cable. On form E5199 (Fig. 2) find the intersection of the 20-kft line and the 1273-ohm (1300 ohms minus the allowance for load coils) line. This point is designated as point "A". Notice that it falls between the 26-gauge and the 24-gauge line. This immediately indicates that the Theorectial Design will consist of 24- and 26-gauge cable. Draw a line parallel to the line representing the coarser of the two gauges (in this case the 24-gauge cable line) passing through point "A" to where it intersects the finer gauge line (in this case the 26-gauge line). This point of intersection is designated point "B", the horizontal interval to the left of point "B" indicates the amount (8 kft) of the finer of the two gauges, or 26 gauge in this case, permissible in this loop. Therefore, the Theoretical Design for this 20-kft loop consists of 8 kft of the 26-gauge and 12 kft of the 24-gauge cable.

5.02 When more than one gauge is required in the Theoretical Design, the most economical design will result from the use of the two finest consecutive gauges, i.e., 26 and 24 or 24 and 22. It is advantageous to place the finer gauge cable closest to the office where a higher concentration of pairs is required.

5.03 Once the Theoretical Design is determined, actual plant conditions must be weighed to establish the point at which the actual change in gauge will be made. The following cases illustrate these conditions.

Case B: Consider the case where the theoretical gauge change point falls in the middle of a conduit section. The actual gauge change point is moved back to the first suitable manhole toward the CO or to a branch or change in feeder cable size.

Case C: The theoretical gauge change point is just beyond a major branching or a tapering of the main feeder cable. If it is within two or three sections, consideration should be given to making the gauge change point correspond with the branch or taper point.

The gauge change point should not be moved farther from the central office than it is on the Theoretical Design.

5.04 In some cases where duct space is at a premimum, as under rivers, streams, railroads, and highways, it may be advisable to undergauge a cable in order to get more pairs per duct. Where a cable is undergauged for this purpose, it is necessary that coaser gauge cable be provided in another part of the loop to compensate for the increased resistance caused by the undergauging.

6. BRIDGED TAP

6.01 Bridged tap is that portion of any cable pair that is not in the direct path between the telephone and the central office. It can be described electrically as any branch or extension of the cable pair in which no direct current will flow when a telephone connected to that pair is in use.

6.02 In considering the amount of bridged tap on any pair, it is found that its length will

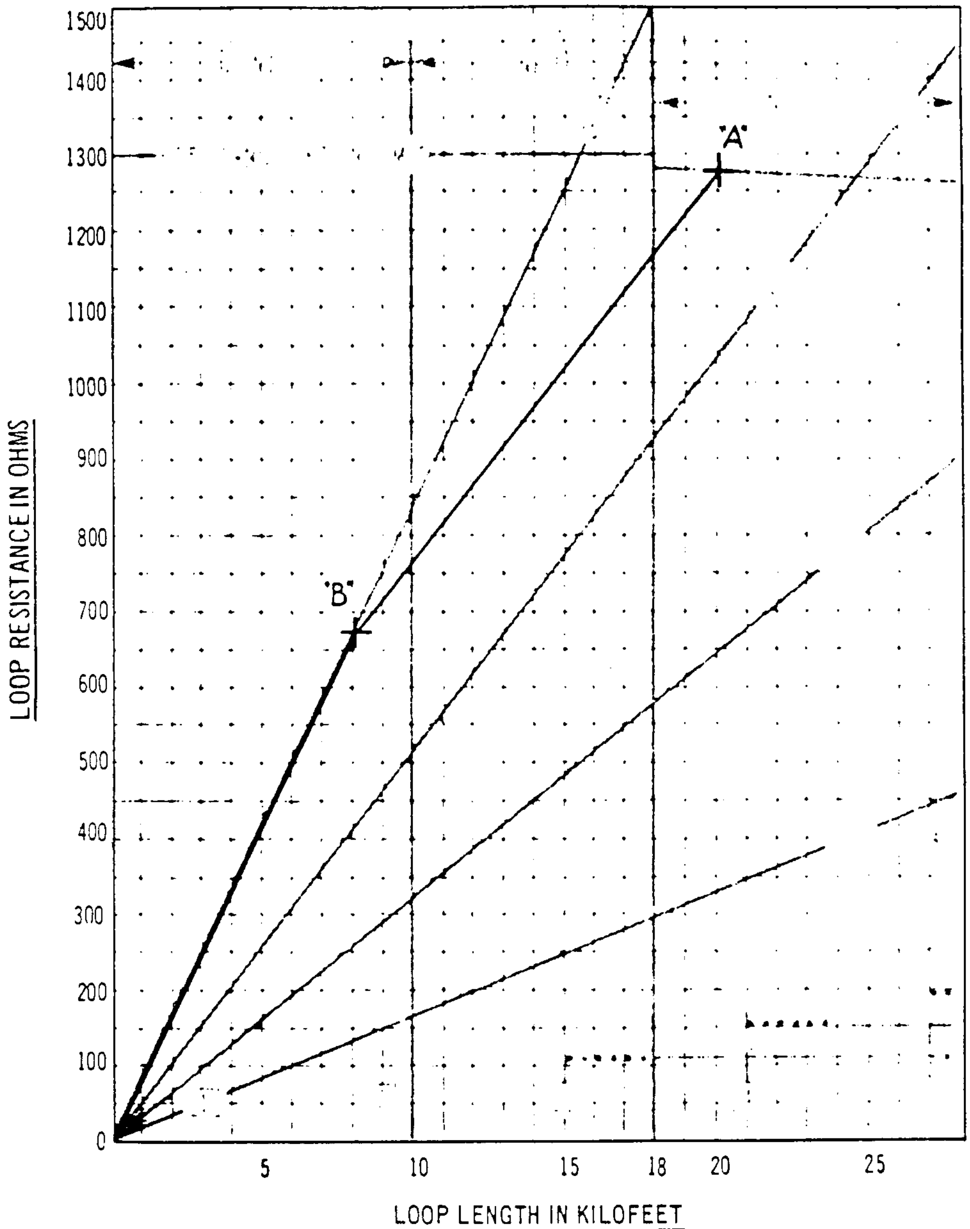


Fig. 2

depend on the terminal from which it is computed. Thus, in limiting the bridged tap to a maximum of 6000 feet for all telephones, it must be computed for the worst condition. This is normally the closest terminal to the central office as measured via the actual cable route. Therefore, for each work order, the closest terminal in each pair count must be checked and the bridged tap limited to 6000 feet. There must be no bridged tap between load coils nor any loaded bridged tap. Bridged tap is inefficient use of copper. While some bridged tap may be necessary, it is in the interest of both efficiency and transmission to reduce it to a minimum. PIC cable and ready-access terminals reduce the necessity for multiple appearances.

6.03 Bridge lifters have been developed to eliminate the effect of bridged tap and at the same time maintain the flexibility assoicated with the multipling of a pair. However, the use of these

·es, is limited by economic and some physical c ..acteristics. Where the use of these devices can be justified on an economic basis and all existing lines will work properly with bridge lifters, special administrative procedures must be set up to avoid any future problems due to their use in the outside plant. For more information on the use and the limitation of bridge lifters, see Section 852-215-100 and associated subsections.

7. LOADING AND LOADING SYSTEMS

7.01 All customer loops longer than 18 kft should be loaded. The maximum number of load coils consistent with the "H" spacing of every 6000 feet should be placed on a loop in order to conform to the desired transmission distribution.

7.02 All loading should be H88; however, it is not necessary to change existing H44 loading (44-millihenry coils spaced at nominal 6000-foot intervals) in primarily residential areas. All load coils on a pair must be of the same weight, i.e., all 88 millihenry or all 44 millihenry.

7.03 The spacing of load coils should be held as close as practicable to the 6000-foot interval. ..e objective in customer loop plant should be to place the load coils to within ±120 feet of the theoretical 6000 feet. Some economic or practical considerations may occasionally justify deviations up to ±500 feet, but each case should be weighed against its transmission shortcomings. Deviations in existing plant of up to ±500 feet are acceptable.

7.04 Although spacing deviations up to ±500 feet are not ordinarily detrimental to subscriber loop transmission, the increasing probability of subscriber loops being used for data, special services, and conversion to exchange trunks make it even more important that the loading be placed as accurately as practicable. It should be recognized that any liberties that are taken with the loading for economic or other reasons may require correction at a later date if a more critical service is placed upon the lines in question. Loading deviations over 120 feet should be taken on the short side so that they may be corrected at a later date, if necessary, by electrically building out.

7.05 The central office end section for each office should be determined locally with due .ideration given to the amount of office wiring involved. The recommended end section length should be listed in an appendix to this section. This first coil should be placed as close as is physically and economically possible to the recommended location, as this coil is the most critical as far as spacing is concerned.

7.06 The recommended customer end section including bridged tap is 3 to 12 kft. The length of the customer end section plus bridged tap may be computed from any terminal in a pair count as it will be the same for any terminal. To care for those cases where extensive multipling becomes necessary, an end section plus bridged tap limit of 15 kft is acceptable.

8. SELECTION OF STATION SETS AND ZONING

8.01 The proper selection of station sets is a vital part of Resistance Design. Transmission zones should be established to indicate where 500-type sets are required.

8.02 The area from the central office out to a cable length of 10 kft is designated as Transmission Zone 2. The 500-type sets may be used in this zone but are not required. The area beyond 10 kft is designated as Transmission Zone 5 and 500-type sets are required. For further information on zoning, see Section 852-205-100.

9. MISCELLANEOUS

9.01 Multiple Line Wire (MLW) is intended for use in those areas where growth is quite slow and limited. However, transmission characteristics of nonstabilized types vary appreciably with changes in the weather, so there are special rules that must be adhered to in Resistance Design Areas. For Resistance Design, 24- and 22-gauge MLW (urban wire) must be considered as equivalent to 26 and 24 gauges, respectively. The 19-gauge MLW (rural wire) can be considered the same as 19-gauge cable in Resistance Design, but the amount of the nonstabilized type used in the Resistance Design Area should be limited to 10 kft. For loops containing more than 10 kft of 19-gauge MLW outside the Resistance Design Area, long loop design should be used. Loading of MLW used in Resistance Design is the same as for cable. For further information on the use of MLW, see Section AG34.100.

9.02 Multiple Line Wire of the type that has been stabilized for wet and dry operation has the same characteristics as its equivalent gauge cable. Resistance Design methods can be used for it in the same manner as they are used for cable.

9.03 C Rural Wire is intended for use in areas where one or two pairs are sufficient to care for the area for an economic period. It has attenuation characteristics comparable to that of 19-gauge MLW. Therefore, all the design rules that apply to 19-gauge MLW also apply to C Rural Wire. When placing more than one wire in a span, the wires should be separated by at least 3 inches. This is due to the poor crosstalk characteristics of this nontwisted wire. For further information about the use of C Rural Wire, refer to Section AG34.200.

9.04 Open wire within the Resistance Design Area will eventually be replaced with cable and should be considered as such when gauging relief cable.

9.05 The use of a concentrator in the customer's loop plant does not alter the basic Resistance Design rules. However, different type units will have various signaling and control limits from the CO to the remote unit and from the remote unit to the customer's. Therefore, when a concentrator is being contemplated, the BSPs concerned with that particular type concentrator should be referred to for specific signaling, control, and supervisory requirements.

9.06 Nonstaggered twist (NST) cable does not satisfy present day crosstalk requirements for ordinary telephone service or balance and noise requirements for special service lines. It may, in general, be identified by the fact that it is either 22- or 24-gauge cable manufactured prior to 1921 or low capacity 19-gauge cable manufactured prior to 1910. NST cable should be identified and removed whenever an opportunity is presented. Where it will remain in plant for some time, use it only on nonloaded loops because the crosstalk is worse when the NST is loaded.

9.07 Facilities to a customer's location are occasionally provided over different routes. Where such conditions exist, the facilities over the two routes should be of similar losses so that transmission contrasts will not occur.

10. USE OF FORM E5199

10.01 The Resistance Design Work Sheet (form E5199) was developed to aid in the transmission design of customer loops. It can also be used for studies of customer loop where transmission is a consideration.

10.02 With each work order submitted for approval, a Resistance Design Work Sheet should be included for each separate branch feeder path involved. The only exception is when the cable loops involved can be served on all 26-gauge cable. In this case, a note on the engineer's drawing or key map to the effect that all loops are within the 26-gauge area and that the maximum amount of bridged tap is within 6000 feet will suffice.

10.03 The procedures for using form E5199 are outlined as follows:

(1) Determine the Office Design Limit for the office. (See local appendix on office resistance ranges.)

(2) Determine the Design Loop or Loops and their lengths.

(3) Find the Theoretical Design as described in 5.01 of this section and draw it out in the space provided at the top of form E5199.

(4) Draw out the makeup of the existing cable in the space provided on form E5199.

(5) Determine the actual gauge required in that portion of the cable being placed or activated on this job (see 5.03) and show the proposed layout in the space provided. Show any new cable being placed in heavy lines.

(6) Determine the loading requirement and show the points at which the loading is being placed on the proposed layout.

(7) Check the proposed distribution to see that no potential terminal location will create more than 6000 feet of bridged tap. Note which loop on the job has the greatest amount of bridged tap and indicate the amount in the space provided on form E5199.

10.04 Following are a few examples to illustrate the use of form E5199. Details as to the choice of the size of the cable and other outside p'-⁻t considerations are not covered here but will : und in the appropriate sections.

Example 1 (See Fig. 4)

In a metropolitan office, relief is needed in a cable from the CO out to a point 11,000 feet from the CO. From the CO to a point 3000 feet out, there are adequate spares in an existing 26-gauge cable, if 26 gauge will be adequate for this portion of the loop. The office has an Office Design Limit of 1300 ohms, having recently been converted from an office with a more restrictive signaling limit. In this example, the same routing will be used for existing and proposed plant, and 22,000 feet will be used as the longest loop.

(1) The Resistance Design Limit is 1300 ohms minus 27 ohms for load coils, or 1273 ohms.

(2) The Design Loop will be the longest loop served by this cable which is 22,000 feet.

(3) To determine the Theoretical Design, start from the point at which the 22-kft line intersects the Resistance Design Limit (approximately ?73 ohms at 22 kft because of the allowance r load coils) and draw a line parallel to the 24-gauge line intersecting the 26-gauge line (Line A—B). The Theoretical Design for this loop is then 4 kft of 26 gauge and 18 kft of 24 gauge.

(4) Now draw the existing cable layout which is as shown on form E5199 in Fig. 4.

(5) From the Theoretical Design, it can be seen that 26-gauge is adequate out to 4 kft, so the 26-gauge cable that is available to the 3.0-kft point can be used for this job. It is assumed in this instance that the 3.0-kft point is a major branching point. Therefore, the 3.0-kft point is selected as the actual gauge change point. If, however, 3.0 kft is not a logical cable change point, the 26-gauge cable should be extended as far toward 4 kft as practical. This job will then consist of placing 8 kft of 24-gauge cable between the 3.0-kft point and the 11.0-kft point. This is shown by the heavy line in the Proposed Plant space on form E5199 (Fig. 4).

(6) Since the Design Loop is greater than 18 kft, loading will be necessary. The number of pairs requiring loading will depend on the number of pairs having appearances beyond 18 kft. In this example, the existing loading is within the load spacing requirements so that the same locations may be used for placing the new load coils. The existing loading as well as the new loading is 88-millihenry coils, and the loading should be shown on both the "Present Plant" and the "Proposed Plant" layouts.

The end section plus a bridged tap will be the same at all terminals in which a given pair count appears, so it may be computed from any terminal. In this example, ***assume*** that the pair count that includes the Design Loop has the greatest end section plus bridged tap and assume that the Design Loop has 4.6 kft of bridged tap. Therefore, the end section (7320 feet) plus bridged tap (4600 feet) equals 11,920 feet. This figure is noted in the appropriate spot on the design work sheet.

(7) The distribution of all nonloaded pairs must be checked for bridged tap. The actual or potential terminal location which is closest to the central office in each pair count should be checked to make sure the bridged tap as computed from this point is less than 6000 feet. When this is computed, the appropriate box on the work sheet should be checked and the longest bridged tap should be noted. All bridged tap should also be checked to make sure that there is no bridged tap that includes any load coils or any bridged tap between load coils.

Example 2 (Fig. 5)

A new subdivision is being built, and the cables now feeding this area need relief. The office is a CDO with an Office Design Limit of 1000 ohms. The longest present loop in the area to be served by this cable is 23 kft; however, it is anticipated that within a year or two the service area of this cable will be extended out to include loops of 25.5 kft in length. Also assume that the new cable will go into conduit for the first 5.0 kft, with the remainder being buried construction.

(1) The Office Design Limit for this office is 1000 ohms.

(2) The Design Loop in this case is the longest loop ultimately to be served by this cable.

Even though these customers will not be served by the cable now, they will be during the life of the cable and it must be designed accordingly.

(3) Find the point of intersection of the 25.5-kft line and the 964-ohm (1000 ohms minus 36 ohms for 4 load coils) line. From this point ("A") draw a line parallel to the 22-gauge line to where it intersects ("B") the 24-gauge line. This then depicts the Theoretical Design of 7.4 kft of 24-gauge and 18.1 kft of 22-gauge cable. The Theoretical Design is transcribed into the space provided at the top of the work sheet.

(4) The existing loop is drawn out in the space provided, indicating the present loading as well as the gauge makeup. Even when the existing cable is being abandoned (we will not go into the possible re-use in place of this cable or whether it is removed in this section), it should be shown for comparison with the new for possible contrast problems.

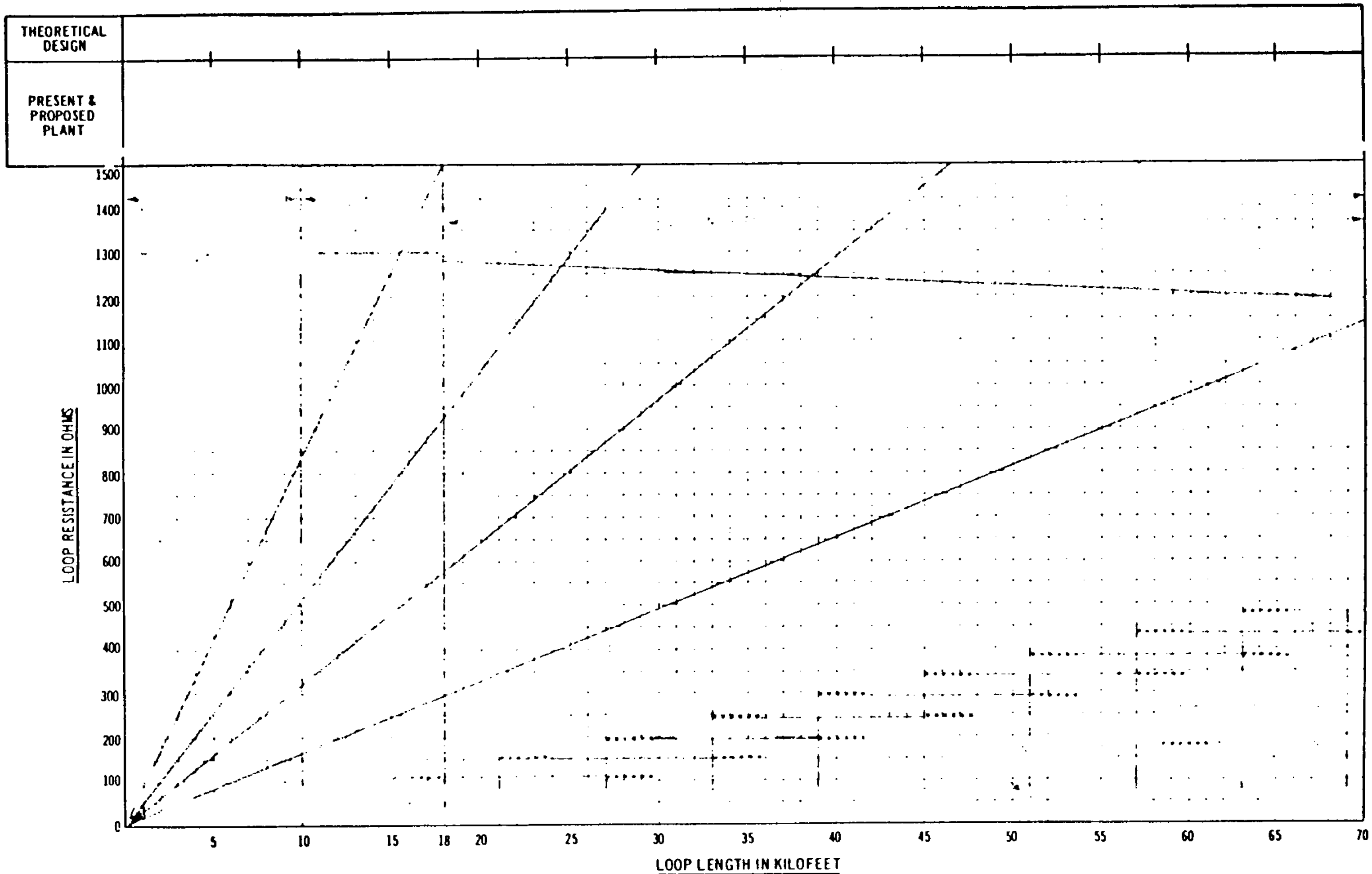
(5) In this example, it is assumed that the cable is buried beyond 5.0 kft so that the gauge change point is not dependent on manhole locations. It is further assumed that the cutting lengths of the cable work out so that the actual gauge required for this job is 24-gauge from the CO out to 7.4 kft and 22-gauge beyond that point. Note that if the cable was designed just to the 23.0 kft (line C-D) rather than to the ultimate length it would require 5.2 kft (difference between D and B) less 22-gauge cable. However, it would be impossible to extend this cable in the future without paralleling or replacing some part of it.

(6) All loops on this job are beyond 18 kft, so all loops will be loaded. The first point of loading will be placed in the same manhole that the existing loading is in, as this is within tolerance for underground loading. The second and third points will be at 6000-foot intervals. The existing load spacing can not be used as it is beyond the requirement. All customer end sections fall within 3 to 12 kft, so three load points are adequate. When the cable is extended to 25.5 kft, the fourth load coil will be placed on these long loops.

(7) Since there is no distribution before 18 kft, only a check for bridged tap between load coils or loaded bridged tap needs to be made.

E5199 (5-65)

RESISTANCE DESIGN WORK SHEET



EXCHANGE: ________

CENTRAL OFFICE: ________
WORK ORDER • ________
C.O. EQUIPMENT: ________

OFFICE
DESIGN LIMIT: (OUTSIDE PLANT) ________

PROPOSED RES. ________

L.L. EQUIP. REQUIRED
ON LINES BEYOND: ________ FT.
• OF L.L. CIR. NEEDED: ________

BRIDGED TAP

B.T. WITHIN 6000 FT. ☐ YES ☐ NO

LONGEST B.T.
ON THIS JOB: ________ FT.

LONGEST B.T. ON THIS
JOB (Non-Loaded Loops) ________ FT.

ENGINEER: ________ DATE ________

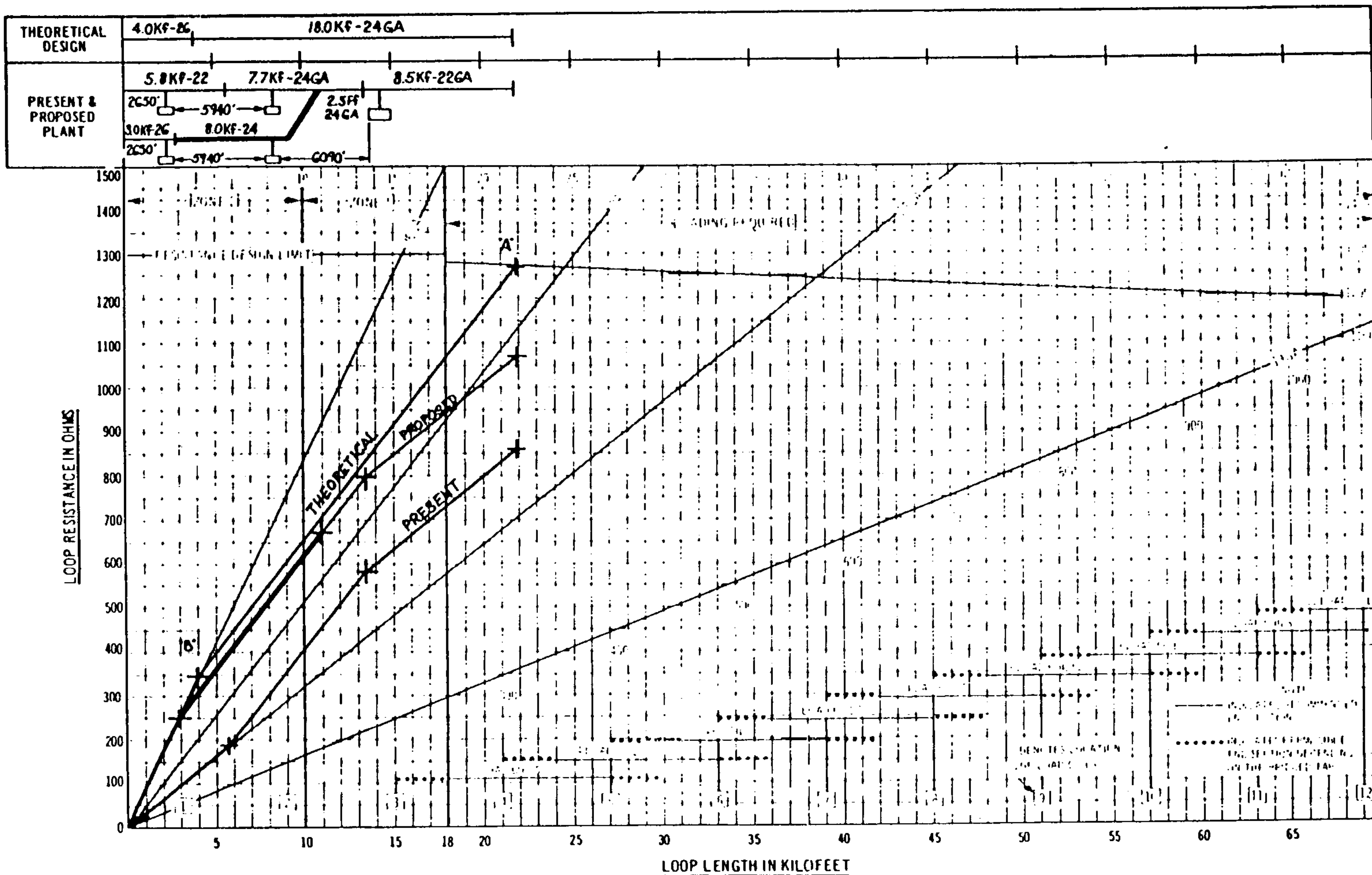
RULES FOR RESISTANCE DESIGN

1. RESISTANCE DESIGN LIMIT IS 1300 OHMS (C.O. EQUIP. PERMITTING)
2. LOAD ALL LOOPS OVER 18,000 FEET
3. CUSTOMER END SECTION PLUS BRIDGED TAP:
   MINIMUM – 3,000 FT.
   MAXIMUM – 15,000 FT.
   OPTIMUM – 3-12,000 FT.
4. LIMIT BRIDGED TAP TO 6,000 FT. FOR ANY STATION ON NON-LOADED LOOPS.
5. USE ONLY 500 TYPE SETS BEYOND 10KF
6. LOAD SPACING DEVIATIONS WITHIN ±120 FT. FOR EXCEPTIONS SEE 852-200-100/AG15.100
7. LIMIT MULTIPLE LINE WIRE TO LESS THAN 10,000 FT. FOR RESISTANCE DESIGN
8. NO BRIDGE TAPS BETWEEN LOAD COILS.
9. NO LOADED BRIDGED TAPS.

Fig. 3

E5199 (5-65)

RESISTANCE DESIGN WORK SHEET



EXCHANGE: ALPHA
CENTRAL OFFICE: MAIN
WORK ORDER • PROJ 805376
C.O. EQUIPMENT: #5X-BAR

OFFICE DESIGN LIMIT: (OUTSIDE PLANT) 1300~

PROPOSED RES. 1060~

L.L. EQUIP. REQUIRED ON LINES BEYOND: NOT APPLICABLE FT.
• OF L.L. CIR. NEEDED: NOT APPLICABLE

BRIDGED TAP

B.T. WITHIN 6000 FT. ☒ YES ☐ NO

LONGEST B.T. ON THIS JOB (Non-Loaded Loops) 4360 FT.

LONGEST B.T. + E.S. ON THIS JOB: 11,920 FT.

ENGINEER: J.J.J. Jr. DATE 3/27/64

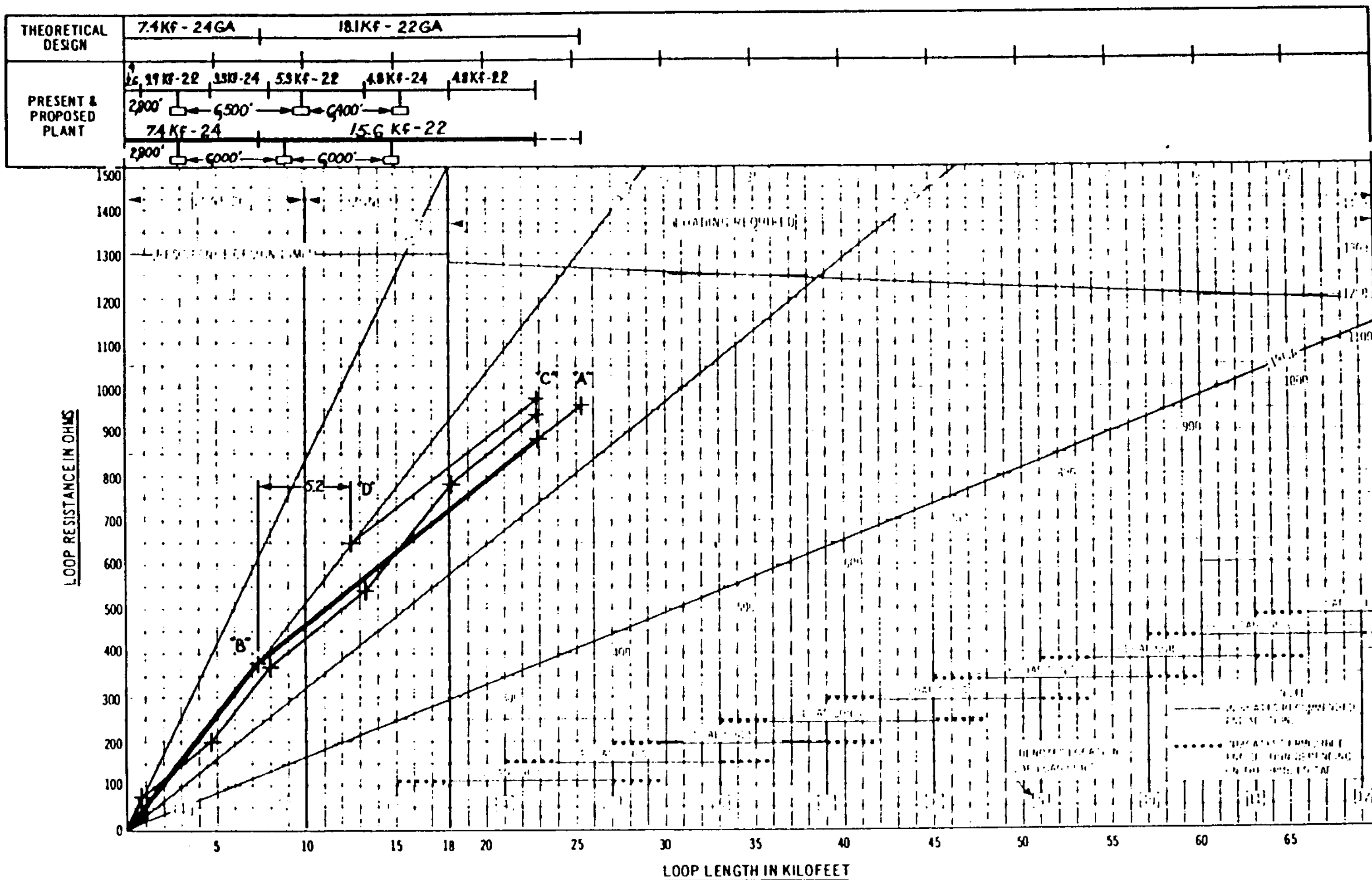
RULES FOR RESISTANCE DESIGN

1. RESISTANCE DESIGN LIMIT IS 1300 OHMS (C.O. EQUIP. PERMITTING)
2. LOAD ALL LOOPS OVER 18,000 FEET
3. CUSTOMER END SECTION PLUS BRIDGED TAP:
   MINIMUM – 3,000 FT.
   MAXIMUM – 15,000 FT.
   OPTIMUM – 3-12,000 FT.
4. LIMIT BRIDGED TAP TO 6,000 FT. FOR ANY STATION ON NON-LOADED LOOPS.
5. USE ONLY 500 TYPE SETS BEYOND 10KF
6. LOAD SPACING DEVIATIONS WITHIN ±120 FT. FOR EXCEPTIONS SEE 852-200-100/AG15.100
7. LIMIT MULTIPLE LINE WIRE TO LESS THAN 10,000 FT. FOR RESISTANCE DESIGN
8. NO BRIDGE TAPS BETWEEN LOAD COILS.
9. NO LOADED BRIDGED TAPS.

Fig. 4

E-5199 (5-65)

RESISTANCE DESIGN WORK SHEET



EXCHANGE: EAST BAY
CENTRAL OFFICE: CENTRAL
WORK ORDER • PROJ 1000001
C.O. EQUIPMENT: SXS

OFFICE
DESIGN LIMIT: (OUTSIDE PLANT) 1000 ~

PROPOSED RES. 880 ~

L.L. EQUIP. REQUIRED ON LINES BEYOND: NOT APPLICABLE FT.
• OF L.L. CIR. NEEDED: NOT APPLICABLE

BRIDGED TAP

B.T. WITHIN 6000 FT. ☐ YES ☐ NO

LONGEST B.T. ON THIS JOB (Non-Loaded Loops) NOT APPLICABLE FT.

LONGEST B.T. + E.S. ON THIS JOB: 10,550 FT.

ENGINEER: R.L.M. DATE 3/27/64

RULES FOR RESISTANCE DESIGN

1. RESISTANCE DESIGN LIMIT IS 1300 OHMS (C.O. EQUIP. PERMITTING)
2. LOAD ALL LOOPS OVER 18,000 FEET
3. CUSTOMER END SECTION PLUS BRIDGED TAP:
   MINIMUM – 3,000 FT.
   MAXIMUM – 15,000 FT.
   OPTIMUM – 3-12,000 FT.
4. LIMIT BRIDGED TAP TO 6,000 FT. FOR ANY STATION ON NON-LOADED LOOPS.
5. USE ONLY 500 TYPE SETS BEYOND 10KF
6. LOAD SPACING DEVIATIONS WITHIN ± 120 FT. FOR EXCEPTIONS SEE 852-200-100/AG15.100
7. LIMIT MULTIPLE LINE WIRE TO LESS THAN 10,000 FT. FOR RESISTANCE DESIGN
8. NO BRIDGE TAPS BETWEEN LOAD COILS.
9. NO LOADED BRIDGED TAPS.

Fig. 5

APPLICATION OF RESISTANCE DESIGN TO SUBSCRIBER LOOP PLANT

1. GENERAL

1.001 This addendum supplements Section 902-115-101, Issue 4, and cancels Addendum 902-115-101SB, Issue B.

1.002 This addendum is issued to:

(a) state company policy for digital carrier deployment in loop plant.

(b) standardize the cable design temperature for all Areas in Southern Bell to:

1. 90 degrees fahrenheit for buried and underground plant.

2. 120 degrees fahrenheit for aerial plant.

(c) add the current transmission loss and slope objectives for Resistance Design of loops.

(d) change the Resistance Design Rules on bridged tap and end sections on loaded loops.

(e) change the Resistance Design Rules for non-loaded loops.

(f) add Forms E-5199SB, Resistance Design Work Sheets, and to delete Form BS-1586.

1.003 The following changes apply to Part 1 of this section.

1.01 - revised

1.02 - revised

1.03 - revised

1.01 This section states the digital carrier deployment strategy and describes the methods by which the principles of Resistance Design are applied to the practical problem of designing customer loops. For designing loops, 90 degrees fahrenheit for buried and underground plant and 120 degrees fahrenheit for aerial plant must be used.

1.02 For outside plant relief triggered by growth at 15 kilofeet and beyond, digital subscriber carrier is considered the standard facility. This will eliminate 22 and 24 gauge feeder relief with the exception of short extentions and bridging short gaps which must be designed using the criteria of this section. Carrier beyond 12 kilofeet is preferred facility in any central office with anticipated digital switching capability within the next five years, and also for routes where conduit is being triggered because of growth beyond 12 kilofeet. Loop electronics is also the preferred facility for feeder relief between eight and fifteen kilofeet to serve large concentration of special services.

1.03 Transmission design loss objectives for POTS customer loops are as follows:

(a) Limit 1000 Hz loss to 8.0 dB (not including CO wiring loss).

(b) Limit slope (2800 Hz loss minus 1000 Hz loss) to 7.5 dB.

These loss objectives are to be the controlling factors in following any design rules set forth. Resistance Design is predicated upon controlling transmission losses by limiting the maximum conductor loop resistance. This is accomplished by observing the following rules:

(1) Boundary of Resistance Design shall be the supervision limit of the office involved, up to a maximum of 1500 ohms.

(2) Limit bridged tap on nonloaded loops to 6 kf.

(3) Limit the length of non-loaded loops including bridged tap to 18.5 kf.

(4) Load all loops over 18 kf.

(5) Standard loading is H88.

(6) Minimum end section plus bridged tap for loaded loops is 3 kf.

(7) Maximum end section plus bridged tap for loaded loops is 12 kf.

(8) No bridged tap between load coils.

(9) No loaded bridged tap.

(10) Load spacing shall normally be 6000 feet ± 120 feet. Pairs with suspected deficient load sections should be examined by use of UNICCAP to evaluate the effect on transmission. With the pair open 3 kf beyond the last load coil and terminated in a precision network, the computed Echo Return Loss (ERL) at the central office against a precision network should be at least 25 dB. This criterion pertains equally to pairs with and without gain applied.

2. DETERMINATION OF RESISTANCE DESIGN BOUNDARY

The following changes apply to Part 2 of this section.

2.01 - revised

2.05 - revised

2.01 A major decision that is to be made in the application of the Resistance Design method is that of establishing the Resistance Design boundary. The introduction of digital subscriber carrier systems have resulted in a change to the economics of loop design. It is now often more economical to use subscriber carrier in suburban area as well as thinly populated rural areas. Recent cost studies dictate that loop electronics is the preferred facility for feeder relief at 15 kf and beyond. Thus the resistance design concept should be applied to all new loops below 15 kf. The resistance design boundaries already established should be followed for short extentions and to bridge small gaps in the existing network. Beyond the Resistance Design boundary, the design procedures are covered in the Section 902-200-XXX series on Long Route Design.

2.05 Office C represents the situation where the Office Supervision Limit is greater than the Resistance Design Limit. In such situations, there is a tendency to stretch the resistance design limit so that a finer gauge cable may be used. Such design would result in substandard transmission and it is the District Engineer's responsibility to assure that this does not occur on loops designed under Resistance Design rules. For No. 5 Crossbar and ESS offices under Long Route Design, see BSP 800-110-900SB for guidelines.

3. DETERMINATION OF LOOP DESIGN

The following changes apply to Part 3 of this section.

3.02 - revised

3.02 Where the ultimate loop length is longer than either the present or proposed loop, the theoretical design and gauge selection is based on this ultimate loop. However, the actual present and proposed makeup should be shown on the Resistance Design Worksheet, E5199-3SB (Figure 2).

4. GAUGE SELECTION

The following changes apply to Section 4.

Change form BS-1586 to E-5199-3SB.

5. BRIDGED TAP

The following changes apply to Section 5.

5.02 - revised

5.03 - revised

5.02 In considering the amount of bridged tap on any pair, it is found that its length will depend on the terminal from which it is computed. Thus in limiting the amount of bridged tap on non-loaded loops to a maximum of 6000 feet, it must be computed for the worst condition. This is normally the closest terminal to the central office as measured via the actual cable route. Therefore, for each work order, the closet terminal in each pair count must be checked and the bridged tap limited to 6000 feet. There must be no bridged tap between load coils nor any loaded bridged tap. On loaded loops, the minimum end section plus bridged tap is 3000 feet and the maximum is 12000 feet. It is in the interest of both customer trouble report reduction and transmission to keep "end section plus bridged tap" as near the minimum as practical.

5.03 Bridge lifters have been developed to eliminate the effect of bridged tap and at the same time maintain the flexibility associated with the "multipling" of a cable pair. However, the use of these devices is limited by economics and some physical characteristics. Where the use of these devices can be justified on an economic basis and all existing lines work properly with bridge lifters, special administrative procedures must be set up to avoid any future problems due to their use in outside plant. In addition, certain diode bridge lifters have been identified as causing noise problems on loops which have longitudinal ac voltages on the pairs. This type of bridge lifter shall not be used. For more information on the use and limitations of bridge lifters, see 902-815-150.

6. LOADING AND LOADING SYSTEMS

The following changes apply to Section 6.

6.01 - revised

6.06 - revised

6.01 All customer loops longer than 18 kf (18.5 kf including bridged tap) should be loaded. The maximum number of load coils consistent with "H" spacing of every 6000 feet should be placed on a loop in order to conform to the desired transmission distribution.

6.06 For loaded cables, the recommended customer end section including bridged tap is a minimum of 3 kf and a maximum of 12 kf. The length of the customer end section plus bridged tap may be computed from any terminal in a pair count as it will be the same for any terminal.

7. SELECTION OF STATION SETS AND ZONING

The following changes apply to Section 7.

7.01 - revised

7.02 - deleted

7.01 A new Resistance Zone, RZ10 has been established as an aid in the administration of zoning of subscriber loops. In the past, this segment of subscriber loops had no official designation. With the establishment of RZ10, all subscriber loops now fall within a designated zone. In addition, Resistance Zones have been defined for wire centers with a combination of two or more type switchers with terminations on the same MDF.

TABLE A

RESISTANCE ZONE BOUNDARIES

(Applicable to those wire centers which use 90 degree/120 degree fahrenheit design temperatures and can supervise on all lines to 1500 ohms.)

LOOP RESISTANCE • (OHMS)	RESISTANCE ZONE
0-1300	RZ 13
1301-1500	RZ 15
1501-2000	RZ 18
2001-2800	RZ 28
2801-3600	RZ 36

• This is the loop resistance of the cable pair between the Central Office Main Distribution Frame (MDF) and the terminal to which the customer drop wire connects.

TABLE B

RESISTANCE ZONE BOUNDARIES

(Applicable to those wire centers which use 68 degrees fahrenheit design temperatures.)

SXS OFFICE

LOOP RESISTANCE* (OHMS)	RESISTANCE ZONE
0-1000	RZ 10
1001-1240	RZ 13
1241-1525	RZ 16
1526-1910	RZ 18
1911-2670	RZ 28
2671-3440	RZ 36

5XB OFFICE **

LOOP RESISTANCE * (OHMS)	RESISTANCE ZONE
0-1240	RZ 13
1241-1470	RZ 16
1471-1910	RZ 18
1911-2670	RZ 28
2671-3440	RZ 36

5XB OR ESS AND SXS OFFICE ***

LOOP RESISTANCE * (OHMS)	RESISTANCE ZONE
0-1000	RZ 10
1001-1240	RZ 13
1241-1470	RZ 16
1471-1910	RZ 18
1911-2670	RZ 28
2671-3440	RZ 36

* This is the loop resistance of the cable pair between the Central Office Main Distribution Frame (MDF) and the terminal to which the customer drop wire connects.

** Consider rezoning only offices in which all lines do not supervise to at least 1500 ohms.

*** These resistance zones apply where SXS, and 5XB or ESS switchers are located in the same wire center and have pairs terminated on same MDF.

9. USE OF FORM E-5199

The following changes apply to Part 9.

9.01 - revised
9.02 - revised
9.03 - revised
9.04 - revised
9.05 - revised
9.06 - revised

9.01 A new Resistance Design work sheet has been developed to aid in transmission design of customer loops and replace Forms BS-1586, E-5199, E-5199-1SB, and E-5199-2SB. Form E-5199-3SB is to be used for loops to be designed using Resistance Design. This form uses cable design temperature of 90 degree fahrenheit for underground and buried plant and 120 degree fahrenheit for aerial plant. The factors used on this form are derived from UNICCAP. A shaded area in the range of 12.5 to 18.0 kf has been added to denote an area of special transmission concern. If the design loop falls in the shaded area, one of the following three options must be exercised:

(1) Use subscriber carrier.

(2) Limit bridge tap to 18.5 kf minus loop length.

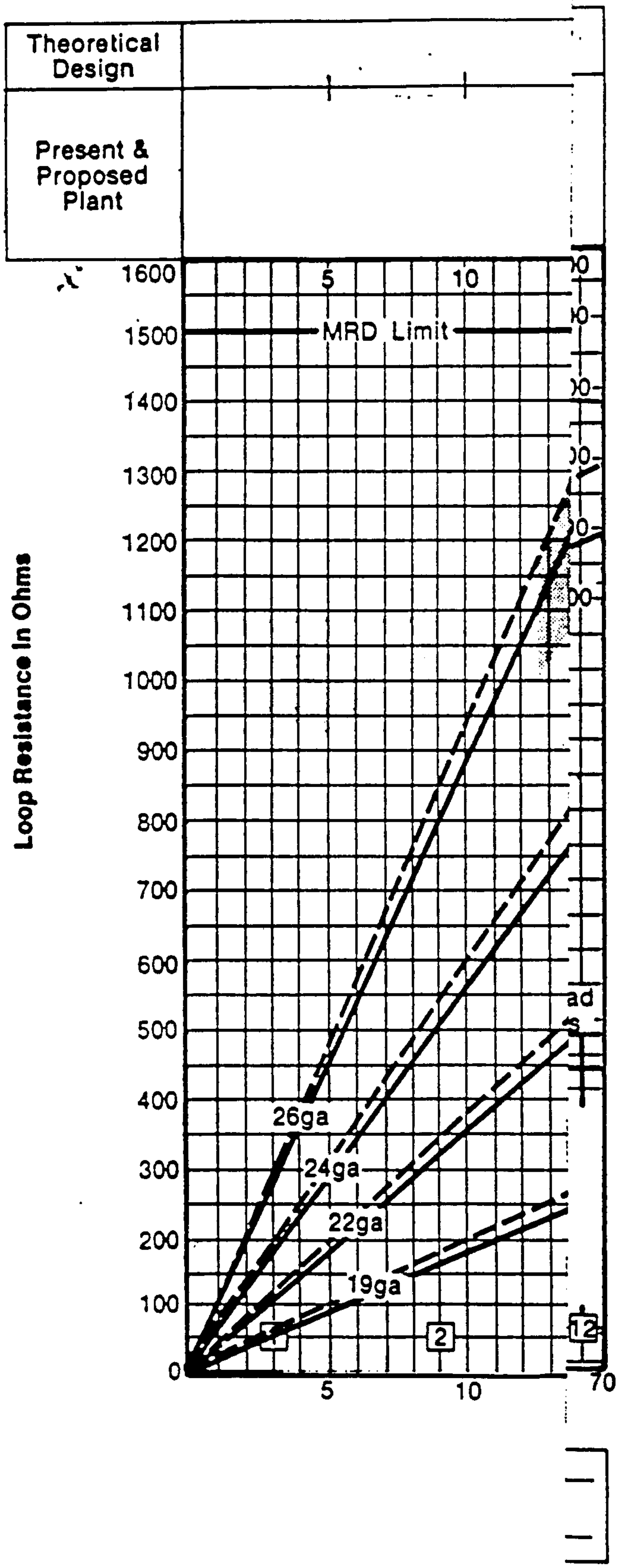
(3) Use coarser gauge.

9.02 thru 9.06 Change all references to the Southern Bell forms (Form E-5199-3SB).

Figures: The following changes apply to the figures in this section.

Figure 2 - replaced
Figure 3 - replaced
Figure 4 - replaced
Figure 5 - replaced

Form E-5199-3SB
(4-84)
Figure 1



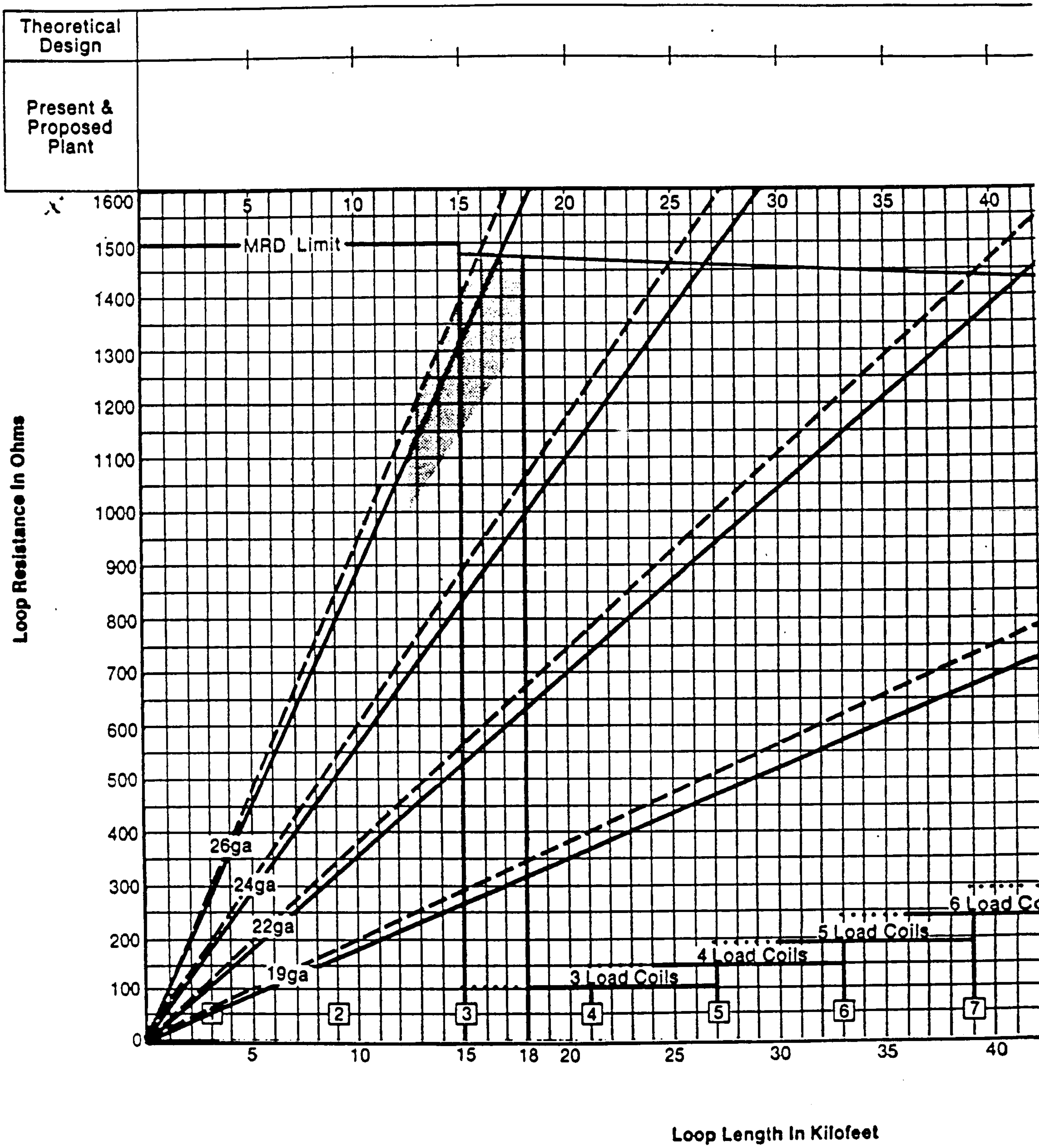
District________________
Wire Center________________
C.O. Equipment________________
Authorization #________________
C.O. Supervision Limit________________
Non Coin________________ohms
Proposed Res.________________ohms
Longest N.L. Loop & BT________________
Longest BT on NL Loop________________
Longest End Section & BT________________
Shortest End Section & BT________________
Engineer________________Date________
District Eng.________________Date________
Area Approval________________Date________

Rules for Modified Resistance Design

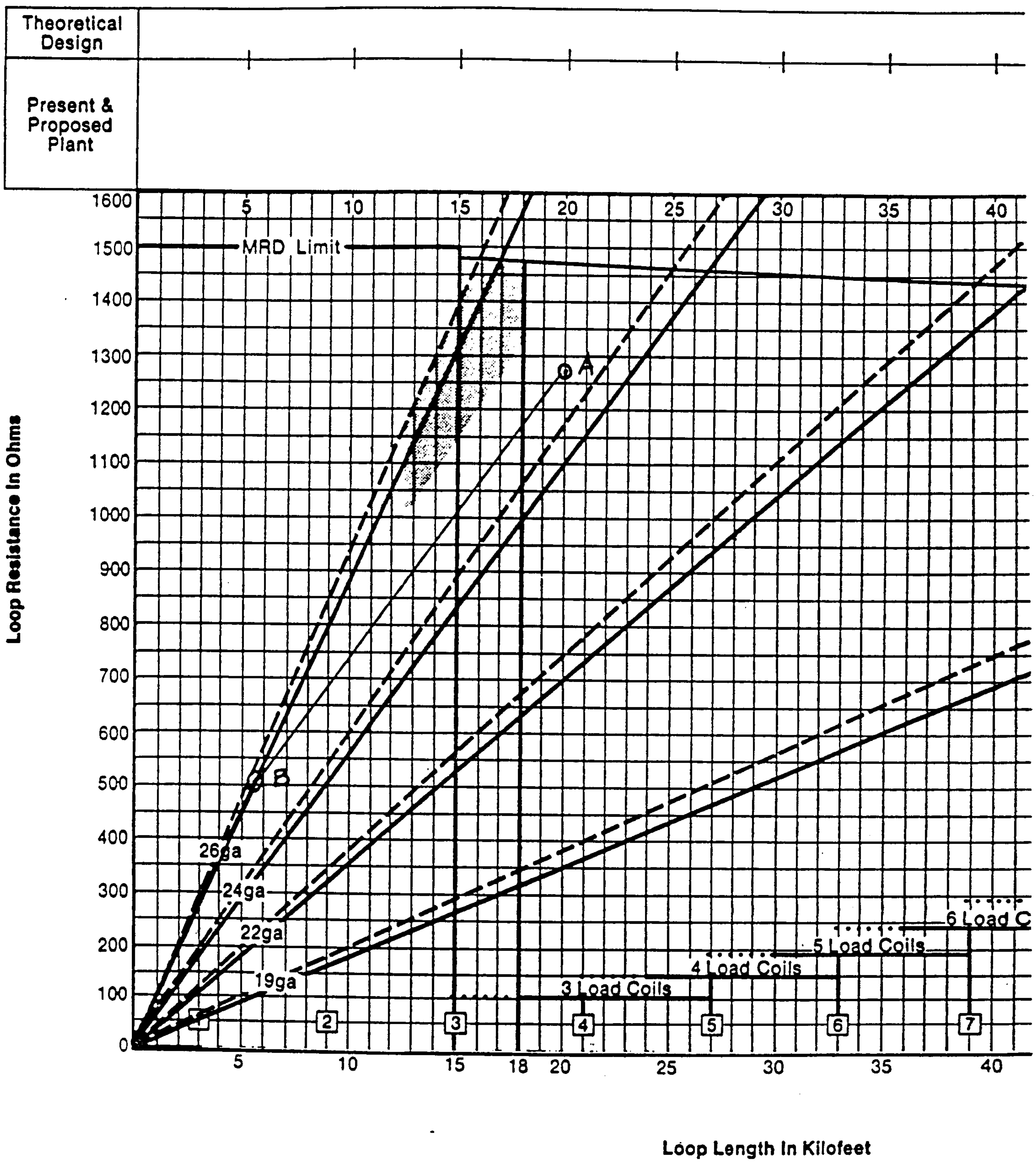
1. The boundary for Modified Resistance Design shall be 1500 ohms, C.O. equipment permitting.
2. Limit bridged tap on non-loaded loops to 6 KF.
3. Limit the length of non-loaded loops including bridge tap to 18.5 KF.
4. Load all loops over 18 Kf .
5. Standard loading is H88.
6. Minimum End Section plus Bridged Tap for loaded loops is 3 KF.
7. Maximum End Section plus Bridged Tap for loaded loops is 12 KF.
8. No Bridged Tap between load coils.
9. No loaded bridged tap.
10. Limit 1 KHZ loss to 8.0 DB.
11. Limit slope (2.8 KHZ-1 KHz loss) to 7.5 DB.

FIGURE 2

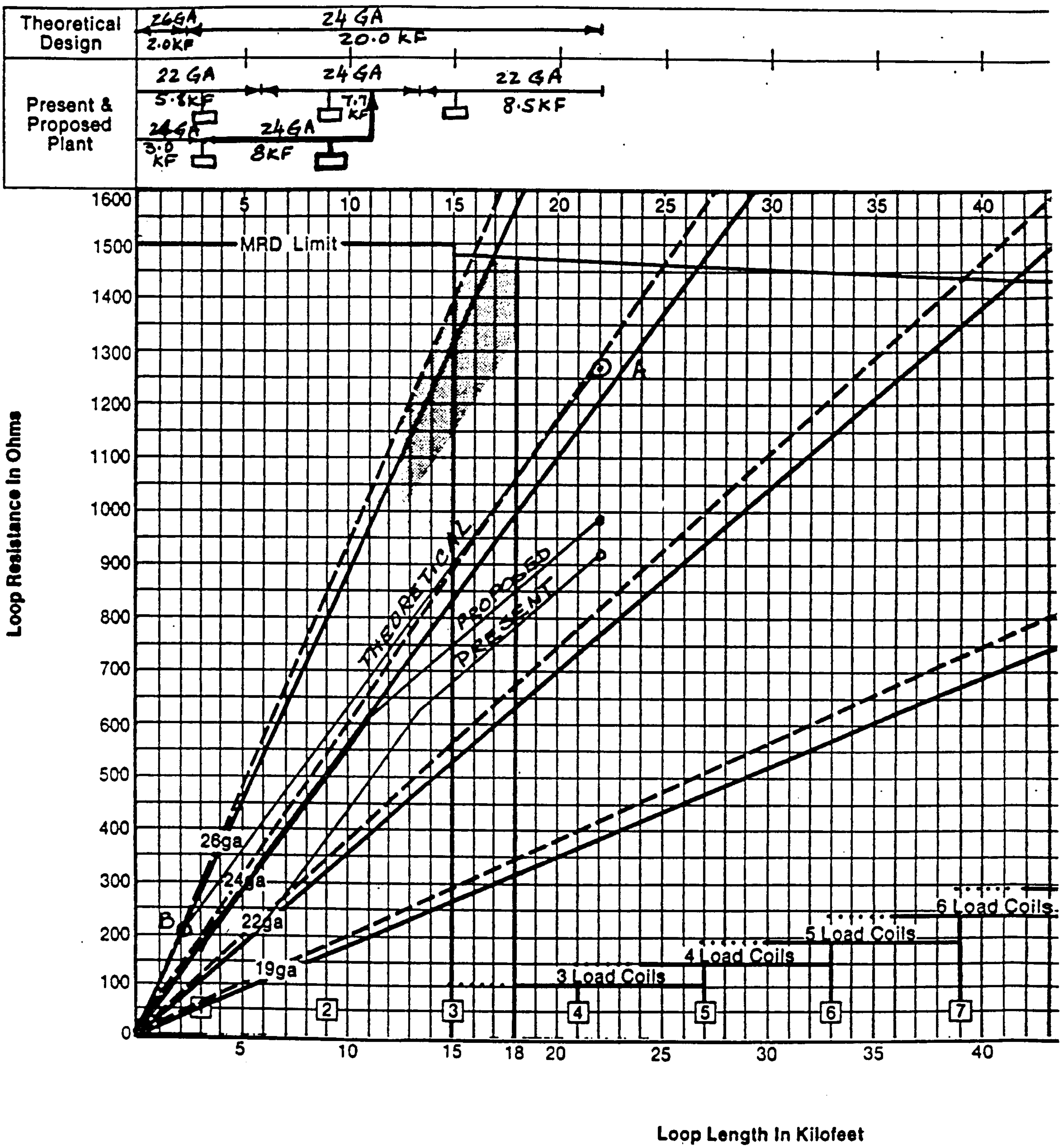
Modified Resistance Desig



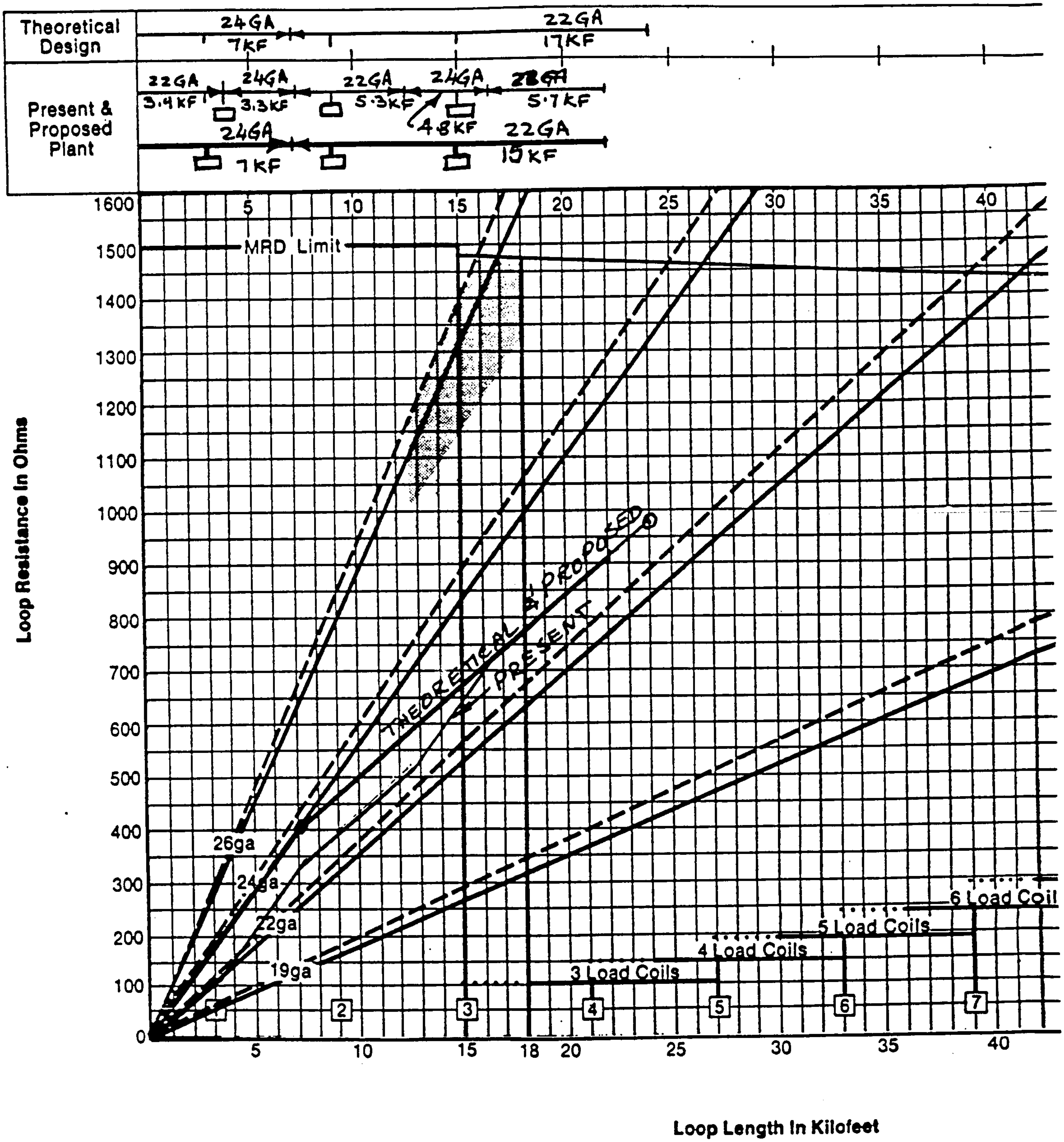
Modified Resistance Des



Modified Resistance Design



Modified Resistance Desigr



BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

RHYTHMS LINKS' FIRST REQUEST FOR PRODUCTIOON OF DOCUMENTS

POD NO. ____________

PROPRIETARY

DECLASSIFIED

BellSouth Telecommunications, Inc.
FPSC Dkt No. 990649-TP
Rhythms Links 1st Request for Production
Of Documents
May 19, 2000
Item No. 3
Attachment No. 9

INSTALLATION AND MAINTENANCE (I&M)
SPECIAL SERVICES INSTALLATION AND MAINTENANCE (SSIM)

APPLIES TO SL1, ISDN, ADSL, HDSL, UCL
NOT APPLICABLE TO ULM, LQSI

I&M

3/21/00 Conversation with re: Disconnect Worktimes

For SL1 and SL2 whole loops, there is no disconnect times for C&T or Travel.

For SL1 and SL2 subloops, there is time as follows:

20 minutes to process order
8 minutes to remove the cross-connect
19 minutes for order completion.

For add'l disconnect, there is only 8 minutes for the cross-connect removal.

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #2

TECHNICIAN TO X BOX AND/OR BCT OR LST LOCATION

Item Description: Travel time to Cross box and/or BCT or LST Location.

ACTIVITY PROFILE

Begins:

- When technician is ready to begin travel to cross box, pair change or BCT location

May Include:

- Checking vehicle for materials
- Actual driving time to cross box, pair change or BCT location

DOES NOT INCLUDE:

- Time spent on vehicle breakdowns
- Time spent resolving parts discrepancies
- Break or restroom time

Ends:

- When technician arrives at cross box, pair change or BCT location

NOTE: Often procedures dictate that the technician visit the customer's premises before performing these work operations. However, so that the study will be consistent across the region, please make estimates for this work operation as it is described above.

AVERAGE TIME PER OCCURRENCE

(Minutes)

	Item Number	Work Time
Travel from work ctr to the PXJ, BCT, RXJ, LST location (first order of the day)	2.01	27.00
Travel time from last job to the PXJ, RXJ, BCT, LST location	2.02	20.00

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #4

PLACE AND/OR PERFORM WORK PXJ, RXJ, BCT, LST AS REQUIRED

Item Description: Actual placement and/or removal of cross connect jumpers, performance of line and station transfer work, or breaking of connect through.

ACTIVITY PROFILE

Begins:

- On arrival at PXJ, RXJ, BCT or LST location

May Include:

- Set up time at job site preparing for work operation:
  - Tools, equipment
  - Ladder, placing
  - "Suiting up"
  - Opening/closing cross box, ped., terminal, etc.
- Performance of cross connect, LST or BCT work
- Coordination time
- "Dead time" waiting for assignments, frame, etc. while unable to do other work

DOES NOT INCLUDE:

- Vehicle breakdowns
- Initial travel to work location or trip to customer's premises
- Break or restroom time

AVG. TIME FOR THIS TASK = 32.00 Minutes

Ends:

- With PXJ, RXJ, BCT or LST being completed

AVERAGE TIME PER OCCURRENCE
(Minutes)

	Item Number	Work Time
PXJ	4.01	16.00
BCT/RXJ	4.02	28.00
LST	4.03	60.00

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #5

CHECK CONTINUITY AND/OR DIAL TONE

Item Description: Check loop pair(s) for continuity and/or dial tone before leaving cross box, LST, PXJ, RXJ, BCT location

ACTIVITY PROFILE

Begins:

- At completion of PXJ, RXJ, BCT, LST operation

May Include:

- Checking for loop continuity to serving central office
- Checking for dial tone and/or ring back as required

Ends:

- With continuity established and dial tone verified, or with failure to achieve the above results

DOES NOT INCLUDE:

- Trouble resolution time
- Break or restroom time

AVERAGE TIME PER OCCURRENCE
(Minutes)

Item Number	Work Time
5.00	15.00

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #6

TROUBLE RESOLUTION

Item Description: Attempt to resolve problems with continuity of the loop or lack of dial tone

ACTIVITY PROFILE

Begins:

- With failure to establish circuit continuity or get dial tone

May Include:

- Time spent testing through CAT or using test equipment
- Time spent on line with IMC or Central Office trying to resolve problem
- Time spent by technician to obtain new pair
- "Dead time" spent waiting for new assignments and not doing any other office work
- Time spent making repairs or making changes in facilities to resolve problem

DOES NOT INCLUDE:

- Break or restroom time
- Time spent on other activity while waiting for new pair assignments

Ends:

- With resolution of loop problems or decision to refer resolution of problem to other group and complete the order at another time

---

AVERAGE TIME PER OCCURRENCE
(Minutes)

Item Number	Work Time
6.00	45.00

3

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #11

ESTABLISH AND CONDUCT TEST FROM THE NI

Item Description: Time spent "hooking up" test equipment and performing operational test from the network interface

ACTIVITY PROFILE

Begins:

- With arrival of technician at customer premises or completion of drop and/or NI work if applicable

May Include:

- Time for "set up"
- Time to perform all necessary tests with CAT or test equipment
- Time spent storing test gear after use

Ends:

- With successful completion of tests or the need for trouble resolution

DOES NOT INCLUDE:

- Time for trouble resolution
- Break or restroom time

AVERAGE TIME PER OCCURRENCE
(Minutes)

Item Number	Work Time
11.00	20.00

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #12

TROUBLE RESOLUTION

Item Description: Time spent in trouble resolution following failure of test performed at the network interface

ACTIVITY PROFILE

Begins:

- With need to resolve problems which caused tests performed at the network interface to fail

May Include:

- All time spent resolving problems in:
  - Cable facilities
  - Drop, protector and/or NI
  - Network terminating wire
- Time spent testing with, or securing additional information from IMC or other centers in resolving problems or making corrections to records
- Travel time associated with trouble resolution

DOES NOT INCLUDE:

- Break or restroom time

Ends:

- With successful resolution of problem or decision to refer trouble to another group and to complete order later

---

AVERAGE TIME PER OCCURRENCE
(Minutes)

Item Number	Work Time
12.00	56.00

8/9/0

NETWORK INSTALLATION OUTSIDE WORK GROUP - BUSINESS (NIOWGB)

Item #16

TECHNICIAN COMPLETES SERVICE ORDER

Item Description: Technician closes out service order on CAT and/or on phone with the IMC

ACTIVITY PROFILE

Begins:

- When technician completes all physical work on order and is ready to begin close out procedure on CAT or with IMC

May Include:

- Placing call on CAT or to the IMC
- Entering close out information into CAT or relating that information to the IMC
- Calling IMC or other centers to correct records in connection with order
- Packing of gear, tools, etc.

DOES NOT INCLUDE:

- Time spent on CAT or on phone with IMC obtaining data on next job *

Ends:

- When the technician returns to truck and is ready to proceed with next job

* While the time the technician spends securing information on the next job is right in the middle of the time interval associated with this Item, it should not be considered part of this interval. It should be considered part of Item #1.

AVERAGE TIME PER OCCURRENCE
(Minutes)

Item Number	Work Time
16.00	19.00

MESSAGE
Subject: UCL/ADSL SSIM Worktimes
Creator:

Dated: 10-7-99 at 13:34
Contents: 2

SSIM

Item 1

TO:
BCC:

Item 2

this is my understanding of our phone conversation:

Both ADSL-Compatible Loops and 2-Wire Unbundled Copper Loops (designed circuit) should contain the same worktime for SSIM technician. This worktime is taken from the TOC study as follows:

AT THE CROSS-BOX
Place PXJ - 16 min.
Check continuity and/or dial tone - 15 min.
Trouble resolution/testing - 13.5 (45 min. 30% of the time)
These times total 44.5 minutes

AT CUSTOMER PREM.
Testing from NI - 20 min.
Trouble resolution/testing - 11.76 (56 min 21% of the time)
Service Order completion - 19 min.
These times total 50.76 min.

X 20 min
50 x time

TOTAL OF TIME AT CROSSBOX AND CUSTOMER PREM: 95.26 minutes.

Do you see anything above that should be modified/changed/added/deleted? No

These times include sending tones when qualifying pairs, checking for load coils and to see if there is bridge tap close to the customer. (Do these functions fall under testing?) Yes

Also, there is no disconnect time for either UNE. (What about equipment recovery?) No

Thanks for all your assistance.

Responses
provided
by

10/7/99

MESSAGE

Subject: SSIM Work Times

Creator:

Dated: 2/14/00 at 8:39

Contents: 2

Item 1

TO:

BCC:

Item 2

when gathering concurrences for SSIM worktimes, the subloop elements had not been fully developed. Adjustments were necessary due to the division of labor between feeder and distribution. For SSIM, we had received worktimes from , which lumped everything together for Connect & Test.

Using the TOC Study (the only documented reference I had), I came up with the following times. Please review and advise if any corrections are needed or if I have missed something:

FOR FEEDER, First & Addl Install:
Travel to crossbox: 20 min.
Service Order: Order receipt and analysis: 20 min.
Place cross-connect: 16 min.
Check continuity and dial tone: 15 min.
Trouble Resolution: 13.50 min. (45 min. 30% of the time)
Completion of Service Order: 19

First & Addl Disconnect:
Remove cross-connect: ~~16 min.?~~ 8 min
Completion of Service Order: 19 min.

FOR DISTRIBUTION, First & Addl Install:

Travel to cross-box (beginning of distribution): 20 min.
Travel from cross-box to premises (captured in Drop/NID)
Service Order: Order receipt and analysis: 20 min.
Connect & Test: Test from NID: 20 min.
Trouble Resolution: 11.76 min. (56 min 21% of the time)
Completion of Order: 19 min

20
11.76
19
51.76

Disconnect 1st and Addl: ~~Please advise~~.

For 4-wire elements, I have multiplied by 1.5 to capture the extra time necessary for 4-wire as opposed to 2-wire. Do you agree? Yes

What happens at the crossbox? Another "Place cross-connect" at 16 min? Yes
Where is continuity and dialtone checked?

Yes
add

I need a response ASAP.

Thx,

~~F8~~ 20
SSIM / IM

Dist.
test x box

D
x-box

BellSouth Telecommunications, Inc.
FPSC Dkt No. 990649-TP
Rhythms Links 1st Request for Production
Of Documents
May 19, 2000
Item No. 3
Attachment No. 14

HWD

APPROXIMATION SUMMARY FOR TELCORDIA INITIATIVES (NEW AND INCREMENTAL

NOTE: EXCLUDES ALL TELCORDIA RTU AND PROFESSIONAL SVS FEES, EDS, AND AC SUP

SECTION I: New PCs for Equipping Telcordia SIAC "Testers" at Atlanta BellSouth Center:

Item #	Budget Category	Item Description	Quantity	Unit Cost	Total
1	PC Capital	Desktop PC from APL	35	$2,000	$70,000
2	Data Comm Material Exp	Cables/IP addresses	35	$100	$3,500

Year 1 - Section I	Estimated Sub-Total Capital -	$70,000 PLUS	5% Contingency
Year 1 - Section I	Estimated Sub-Total Expense -	$3,500 PLUS	5% Contingency

SECTION II: New PCs for retooling LCSC target users presently w/ X-Terms:

Item #	Budget Category	Item Description	Quantity	Unit Cost	Total
1	PC Capital	Desktop PC from APL	350	$2,000	$700,000
2	Data Comm Capital	HW for new LAN Segments	2	$45,000	$90,000
3	Data Comm Material Exp	Misc. Material - LAN Segments	2	$14,000	$28,000
4	Data Comm Labor Exp	BCS Technician Labor costs	2	$6,000	$12,000

Year 1 - Section II	Estimated Sub-Total Capital -	$790,000 PLUS	5% Contingency
Year 1 - Section II	Estimated Sub-Total Expense -	$40,000 PLUS	5% Contingency

SECTION III: New Systems, not including Telcordia RTU and Prof. Services (ServiceGate COG, Delivery OM, S

Item #	Budget Category	Item Description	Quantity	Total
1	Capital/GPC	HP N4000	20	$4,600,000
3	Capital/GPC	Storage- GB	912	$456,000
4	RTU Soft Cap	HP Platform Svr SW	20	$440,000
5	RTU Soft Cap	3rd Party Sw - new servers	20	$1,399,266
6	Data Comm Mat'l Expense	Data Communications Circuits	80	$72,000

Note: Assumes that EDS will include HW ServiceGuard Install and Setup in support/expedite

($4,600,000 + $456,000 + $440,000 + $1,399,266)

captured by Operations.

($72,000 + $3,675)

Year 1 - Section III Only	**Estimated Sub-Total Capital -**	**$6,895,266 PLUS**	**20% Contingency**
Year 1- Section III Only	**Estimated Sub-Total Expense -**	**$75,675 PLUS**	**20% Contingency**
Year 1 - Section I, II, & III	**Estimated Capital -**	**$9,177,319**	($8,274,319 + $829,500 + $73,500)
Year 1 - Section I, II, & III	**Estimated Expense -**	**$132,810**	= ($90,810 + $42,000)
Year 2 - Section III COMPUTER HDW	Maintenance on Capital - 10%	$689,527	~ ($4,600,000 + $456,000) * .10 = $505,600
Year 2 - Section III DATA.COMM. RTU SOFTWARE	Maintenance on Expense Items	$132,810	~~$...~~ = ($440,000 + $1,399,266) * .10 → ~~$...~~ $132,810 = $183,927
Year 3 - Section III	Maintenance on Capital - 10%	$689,527	
Year 3 - Section III	Maintenance on Expense Items	$132,810	
Year 4 - Section III	Maintenance on Capital - 10%	$689,527	
Year 4 - Section III	Maintenance on Expense Items	$132,810	
Year 5 - Section III	Maintenance on Capital - 10%	$689,527	
Year 5 - Section III	Maintenance on Expense Items	$132,810	

($4,600,000 + $456,000 + $440,000 + $1,399,266)

captured by Operations. ($72,000 + $3,675)

Year 1 - Section III Only	**Estimated Sub-Total Capital -**	**$6,895,266 PLUS**	**20% Contingency**
Year 1- Section III Only	**Estimated Sub-Total Expense -**	**$75,675 PLUS**	**20% Contingency**
Year 1 - Section I, II, & III	**Estimated Capital -**	**$9,177,319** ($8,274,319 + $829,500 + $73,500)	
Year 1 - Section I, II, & III	**Estimated Expense -**	**$132,810** = ($90,810 + $42,000)	
Year 2 - Section III COMPUTER HDW	Maintenance on Capital - 10%	$689,527 - ($4,600,000 + $456,000) * .10 = $505,600	
Year 2 - Section III DATA.COMM.	Maintenance on Expense Items	$132,810 → $132,810	
~~RTU SOFTWARE~~		~~($440,000 + $1,399,266) * .10 = $183,927~~ SG	
Year 3 - Section III	Maintenance on Capital - 10%	$689,527	
Year 3 - Section III	Maintenance on Expense Items	$132,810	"
Year 4 - Section III	Maintenance on Capital - 10%	$689,527	"
Year 4 - Section III	Maintenance on Expense Items	$132,810	
Year 5 - Section III	Maintenance on Capital - 10%	$689,527	
Year 5 - Section III	Maintenance on Expense Items	$132,810	"

Superceded

←

INFRASTRUCTURE)

PORT COSTS

Assumption Notations:

Assumes BITs infra in place, IP addresses only needed

adjusted tot-> $73,500
adjusted tot-> $3,675

Assumption Notations:

Assumes 2 new LAN segment required at ATL location
Assumes 2 new LAN segment required at ATL location
Sys SW (HP UX, Process Mgr, JFS Online, Mirror UX, ServiceGuard)

adjusted tot-> $829,500
adjusted tot-> $42,000

erviceGate WSM, NCON, and Service Delivery):

Assumption Notations:

Assumes use of EMC shared storage platform ($500/GB)
Sys SW (HP UX, Process Mgr, JFS Online, Mirror UX, ServiceGuard)
From Telcordia Attachment I - Preliminary 3rd Party SW Requirements
4 BOSIP curcuits per server (service guard, primary/secondary app, backup/restore)

charges

adjusted tot	$8,274,319
adjusted tot	$90,810

SUMMARY FOR TELCORDIA INITIATIVES (NEW AND INCREMENTAL INFRASTRUCTURE)

SECTION II: New Systems support (ServiceGate COG, Delivery OM and ServiceGare WSM):

Item #	***Budget Category***	***Item Description***	***Quantity***	***Total***	***Assumption Notations:***
1	MidRge Install/Decomm	# installations	20	$6,000	One time charge
2	MidRge IIT	# Service Units installed	3628	$47,164	Monthly charge
3	MidRge Processing	# Service Units	3628	$50,792	Monthly charge times seven(7) months
4	Incremental Desktop	# of PCs or X-Terms	245	$17,150	Monthly charge
5	BCS Transport Labor	FTPs	9.75	$74,012	Monthly charge (2 mo.)
6	Fixed Price Expense	Service Guard HP Prof. Services	12	$408,000	Configure Svc Guard @$34,000 per Cluster
7	Other Expense	Server Expedite Charge	20	$342,000.00	Install 20 servers in 12 weeks
8	Other Expense	Expedite PC Installations	385	$30,000.00	350 PCs @LCSC & 35 @ BSC
9	Other Expense	HP expedite for Server setup	20	$42,000.00	One day setup of 20 N-Class Servers in the DCs
	Year 1	Estimated S $1,017,118	15% Risk $152,567	adjusted tot	$1,169,686
	Year 2	Server Ongoing Support	43536 SU	$609,504.00	Total anual Service Units
		Desktop Mtc	420	$28,980.00	
	Year 3	Server Ongoing Support	43536 SU	$609,504.00	Total anual Service Units
		Desktop Mtc	420	$28,560.00	
	Year 4	Server Ongoing Support	43536 SU	$609,504.00	Total anual Service Units
		Desktop Mtc	420	$28,560.00	
	Year 5	Server Ongoing Support	43536 SU	$631,272.00	Total anual Service Units
		Desktop Mtc	420	$28,140.00	

SUMMARY FOR TELCORDIA INITIATIVES (NEW AND INCREMENT

EDS

SECTION II: New Systems support (ServiceGate COG, Delivery OM and ServiceGare W

Item #	*Budget Category*	*Item Description*		*Quantity*
1	MidRge Install/Decomm	# installations		20
2	MidRge IIT	# Service Units installed		3628
3	MidRge Processing	# Service Units		3628
4	Incremental Desktop	# of PCs or X-Terms		245
5	BCS Transport Labor	FTPs		9.75
6	Fixed Price Expense	Service Guard HP Prof. Services		12
7	Other Expense	Server Expedite Charge		20
8	Other Expense	Expedite PC Installations		385
9	Other Expense	HP expedite for Server setup		20
	Year 1	Estimated S	$1,017,118	15% Risk
	Year 2	Server Ongoing Support		43536 SU
		Desktop Mtc		420
	Year 3	Server Ongoing Support		43536 SU
		Desktop Mtc		420
	Year 4	Server Ongoing Support		43536 SU
		Desktop Mtc		420
	Year 5	Server Ongoing Support		43536 SU
		Desktop Mtc		420

AL INFRASTRUCTURE)

SM):

	Total		Assumption Notations:
	$6,000		One time charge
	$47,164		Monthly charge
	$50,792		Monthly charge times seven(7) months
	$17,150		Monthly charge
	$74,012		Monthly charge (2 mo.)
	$408,000		Configure Svc Guard @$34,000 per Cluster
	$342,000.00		Install 20 servers in 12 weeks
	$30,000.00		350 PCs @LCSC & 35 @ BSC
	$42,000.00		One day setup of 20 N-Class Servers in the DCs
$152,567	adjusted tot	$1,169,686	
	$609,504.00	$14/Sv. unit.	Total anual Service Units
	$28,980.00	$69/desktop mtc.	
	$609,504.00		Total anual Service Units
	$28,560.00		
	$609,504.00		Total anual Service Units
	$28,560.00		
	$631,272.00		Total anual Service Units
	$28,140.00		

MESSAGE
Subject: Demand Infor for Loop Qual.
Sender:

Dated: 2 4.00 at 16:20
Contents: 2

Item 1

TO:

Item 2

The demand info for the loop qual is as follows:

2000	5,735,000
2001	11,678,100
2002	12,242,918
Total	29,656,018

These are annualized figures. Let me know if you have any questions.

Zanotti

Andersen Rates

Contract Year	Fixed FTP Billing Rate	Variable FTP Billing Rate	Monthly Fixed	Monthly Variable
2000	$179,500	$210,000	$14,958.33	$17,500.00
2001	$185,500	$214,500	$15,458.33	$17,875.00
2002	$191,500	$219,000	$15,958.33	$18,250.00
2003	$198,500	$223,500	$16,541.67	$18,625.00
2004	$205,500	$228,000	$17,125.00	$19,000.00

Jaunary 2000	1,100 Fixed x 14,958.33	16,454,166.67
	228 x 17,500.00	3,990,000.00
	Total Jan. 2000	20,444,166.67
	Average for Jan 2000	**15,394.70**

Note: AC Rates are subject to inflation in years after 2000, using ECI for White Collar, non-sales

Andersen Rates Inflated:

Contract Year	Fixed FTP Billing Rate	Variable FTP Billing Rate	Monthly Fixed	Monthly Variable
2000	$179,500	$210,000	$14,958.33	$17,500.00
2001	$189,988	$219,689	$15,832.31	$18,307.44
2002	$197,702	$226,093	$16,475.16	$18,841.05
2003	$206,568	$232,584	$17,214.01	$19,382.02
2004	$215,563	$239,165	$17,963.62	$19,930.44

Equivalent Andersen Hourly Rates:

Contract Year	Fixed Hourly Billing Rate	Variable Hrly Billing Rate
2000	$99.72	$116.67
2001	$105.55	$122.05
2002	$109.83	$125.61
2003	$114.76	$129.21
2004	$119.76	$132.87

ASSUMPTIONS:

1. **Andersen Inflated Sources:**
   a. Year 2000 =Year 2000 Annual Fee Per FTP
   b. Year 2001 =(Year 2001 Annual Fee Per FTP)*1.016064*1.008
   c. Year 2002 = (Year 2002 Annual Fee Per FTP)*1.016064*1.008*1.008
   d. Year 2003 = (Year 2003 Annual Fee Per FTP)*1.016064*1.008*1.008*1.008
   e. Year 2004 = (Year 2004 Annual Fee Per FTP)*1.016064*1.008*1.008*1.008*1.008
2. 1.106064 Inflation Factor used to restate fees stated in 1998 dollars as 2000 dollars.
3. 1.008 is the 1999 Inflation factor. Here we assumed the year over year inflation factor the same for each year as in 1999.
4. The Hourly Billing Rate equal 1 FTP annual Billing Rate divided by 1,800 annual hours.
5. Assumed 1 annual FTP equivalent to 1,800 hours which is 150 hours monthly times 12 months.

REVISED

2-7-00
pe

L.Q. portion only.

IT and NS ITS Information
2/4/00

Telcordia			
Application Software for TAG and Delivery OM. Interfaces for LFACS, CRIS, RSAG, CABS Maintenance Costs	5 to 7 Million 18% of Initial		Linda Tate Includes no Platform Costs Linda Tate
~~Network Services~~ IT Solutions Project Management		PG 58 Fully Loaded	Linda Tate

BST Labor

2000

– Telcordia RTU: $7M (?) × 3 =

2690/460c

– " " Maintenance:

$7M × .18 = $1,260,000 ~~x3~~

Software RTU

2-7-00
pe

L.Q. portion only.

IT and NS ITS Information
2/4/00

Other Cost Estimates	Costs	Other	Resources
Telcordia			
Application Software for TAG and Delivery OM. Interfaces for LFACS, CRIS, RSAG, CABS Maintenance Costs	5 to 7 Million 18% of Initial		Linda Tate Includes no Platform Costs Linda Tate
Network Services IT Solutions Project Management		PG 58 Fully Loaded	Linda Tate

BST Labor

– Telcordia RTU: 2000 \$7 M (?) × 3 = capitalize (amortize)

2690/4600

– " " Maintenance: \$7 M × .18 = \$1,260,000 per year Expense

Software RTU

PROPRIETARY
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Revised...

Cost Study Period

Loop Qualification Estimate

	Initial Install (2000)	2001	2002	2003	2004	2005	Notes
Andersen Labor in FTPs	355.5	156	108	108	108	108	Current AC rates are ~~$12,500~~ $17,500 per FTP
BellSouth BTSI Resources in Staff Months	24	6	6	6	6	6	Use JG59 pricing
	$17,500.00 [redacted]	$15,458.33	$15,958.33	16,541.67	$17,125.00		
Hardware: (see tab for details)							
Capital	$9,177,319	$689,527	$689,527	$689,587	$689,527	$689,527	Includes Soft Cap (See Hardware Sheet for breakout
Expense	$132,810	$132,810	$132,810	$132,810	$132,810	$132,810	
EDS (see tab for details)							
Expense Dollars	$1,169,686	$28,980	$28,980	$28,980	$28,980	$28,980	
Sevice Units		43536 SU	43536 SU	43536 SU	43536 SU	43536 SU	
BCS cost in FTPs	11						

variable based on FTP's

Use $609,504

~~11 x $12,500 = $137,500~~

$14,958.33

11 x $9,000/FTP =

Per

Pel

Loop Qualification Estimate

	Initial Install	2001	2002	2003	2004	2005	Notes
Andersen Labor in FTPs	355.5	156	108	108	108	108	Current AC rates are $12,500 per FTP
BellSouth BTSI Resources in Staff Months	24	6	6	6	6	6	Use JG59 pricing
Hardware: (see tab for details)							
Capital	$9,177,319	$689,527	$689,527	$689,587	$689,527	$689,527	Includes Soft Cap (See Hardware Sheet for breakout)
Expense	$132,810	$132,810	$132,810	$132,810	$132,810	$132,810	
EDS (see tab for details)							
Expense Dollars for Desktop Support	$1,169,686	$28,980	$28,980	$28,980	$28,980	$28,980	
Sevice Units (Server Support)		43536 SU	43536 SU	43536 SU	43536 SU	43536 SU	
BCS cost in FTPs	11						

variable based FTP's

multiply
x 12,500

$609,504

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COMPANIES EXCEPT UNDER WRITTEN AGREEMENT

PW

Loop Qualification Estimate

INPUT	Initial Install (2000)	2001	2002	2003	2004	2005	Notes
Andersen Labor in FTPs	355.5 (WR)	156 (R)	108 (R)	108 (R)	108 R	108	Current AC rates are $12,500 per FTP Remmy NVS.
INPUT BST LABOR BellSouth BTSI Resources in Staff Months	24	6	6	6	6	6	Use JG59 pricing Remmy NVS
Hardware: (see tab for details)							
Capital	$9,177,319	$689,527	$689,527	$689,587	$689,527	$689,527	Includes Soft Cap (See Hardware Sheet for breakout)
Expense	$132,810	$132,810	$132,810	$132,810	$132,810	$132,810	
See Sam's sheet							
EDS (see tab for details)							
Expense Dollars	$1,169,686	$28,980	$28,980	$28,980	$28,980	$28,980	
Sevice Units		43536 SU	43536 SU	43536 SU	43536 SU	43536 SU	
BCS cost in FTPs	11						

?

Revision

INVESTMENT
(Equipment)

PC's 633C: | 2000

I. New PC's for Equiping Telcordia SIAC Testers — $73,500

~~II. New PCs for retooling LCSC Target users (700,000 × 1.05 = 735,000) — 735,000~~

Midrange Computers 530C:

III. (4,600,000 + 456,000) × 1.20 — $6,067,200 ×3

I. Data Comm. Material Expense (3,500 × 1.05) — 3,675

~~II. " " " " (130,000 × 1.05) — 136,500~~

III. " " " " (72,000 × 1.05) — 75,675 × 3

RTU 2690 460C

III. HP & Third Party Server Software (440,000 + 1,399,266) × 1.2 — 2,207,119

~~III Software~~

HARDWARE MAINTENANCE

I, II & III

2001 2002 2003 2004

COMPUTER — $505,600 →

DATA COMMUNICATIONS — $132,810 →

INVESTMENT
(Equipment)

With no maintenance

PC's 633C: → 630C

	2000
I. New PC's for Equiping Telcordia SIAC Testers	$73,500
II. New PC's for retooling LCSC Target users (700,000 × 1.05 = 735,000)	735,000

* 3

Midrange Computers 630C:

III. (4,600,000 + 456,000) × ~~1.05~~ 1.20	$6,067,200
I. Data Comm. Material Expense (3,500 × 1.05)	3,675
II. " " " (130,000 × 1.05)	136,500
III. " " " " (72,000 × 1.05)	75,675

* ~~5~~ 3

RTU 2690 460C

III. HP & Third Party Server Software (440,000 + 1,399,266) × 1.2

2000 → 2,207,119 — Amortize over five years (2000-2002)

~~3,~~ III Software maintenance

2001 → 200[illegible]

$183,927 → $183,9[illegible]

HARDWARE MAINTENANCE

2001 2002 2003 2004 2[illegible]

I, II & III

Directly assign maint.

COMPUTER → $505,600 →

DATA COMMUNICATIONS → $132,810 →

Recurring Expense

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

RHYTHMS LINKS' FIRST REQUEST FOR PRODUCTIOON OF DOCUMENTS

POD NO. 14

PROPRIETARY

DECLASSIFIED

Subject: ***Evaluation of Bellcore Sapphyre™ Loop Qualification System - Progress report***

Date: June 17, 1998

S&T
SERVICE TECHNOLOGY INNOVATION
BELLSOUTH
SCIENCE & TECHNOLOGY

Authors:

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Evaluation of Bellcore Sapphyre™ ADSL Loop Qualification - Progress Report

The purpose of this one-page memo is to provide a Progress Report on the efforts underway in S&T to evaluate Bellcore's Sapphyre™ technology as a means of performing loop qualification for ADSL/Universal ADSL service. BellSouth is intent on developing a User-initiated Loop Qualification scheme as a part of ADSL service implementation. User initiated capability of loop qualification is viewed as a key ingredient in the deployment approach for Universal ADSL during 1999.

Bellcore's Sapphyre technology is suggested to be capable of: a) detecting load coils in loops, b) detecting the presence of DLC in the loops, and c) predicting achievable ADSL data rates on the loops based on voice-band frequency response characteristics of a local loop.

An experiment was conducted to validate the basic claims of Bellcore technology. S&T supplied Bellcore the test data on voiceband frequency response for 21 test loops. The loops included some with loading coils, some with bridge-tap/loading coils, some with DLCs and some direct. Bellcore has run the test data through their algorithms and software. ***Bellcore Sapphyre™ was able to accurately detect load coils and DLC on 19 of the 21 test loops***. Bellcore's visual analysis accurately characterized 21 out of 21 test loops. This is very encouraging.

We now feel comfortable in proceeding with a **trial of Bellcore Sapphyre™ technology** in one or more metro areas within BellSouth territory to assess the suitability of Sapphyre as a solution for User-Initiated Loop Qualification. Clearly, the field trial will include a large number of diverse loops and will also test the ability of Sapphyre™ in predicting the achievable ADSL data rates and comparing Bellcore predicted rates with those achieved (for loops already with ADSL service). Stay tuned for updates......

****

A Novel Method For Estimating The Capacity Of A Local Loop

There is a significant need in the industry for a method to 'qualify' (pre-determine the capability) of a local loop for ADSL. At its simplest, qualification can mean whether the loop will support ADSL or not. In a broader sense, loop qualification attempts to estimate the 'capacity' of the loop, in terms of data rate.

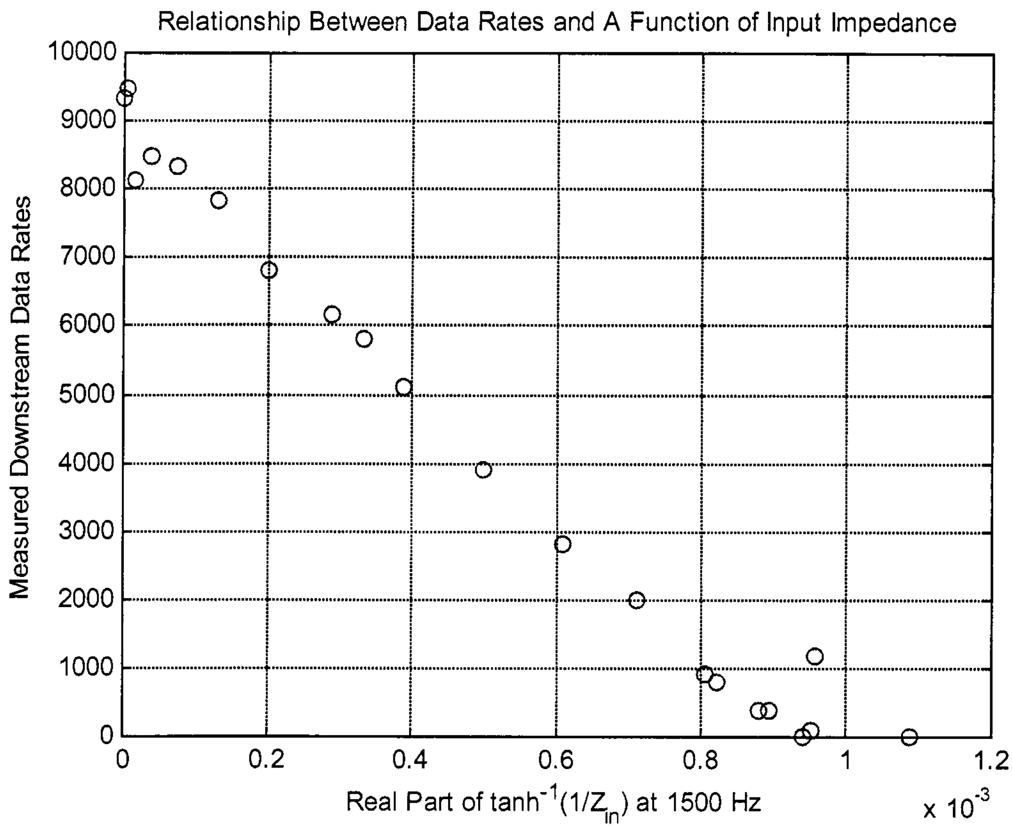
Attempts in the industry to identify capacity have been based on establishing concentric bands around a wire center. The idea is that customers within a band are all 'coded' to a particular upper limit, in terms of data rate. The bands are based on cable lengths and gauge, with some fairly large margins added. This method is quire costly, in that it involves not only the establishment of bands, but also the coding of all cable terminals with a band indicator.

The method envisioned here would obviate the need for such bands. Instead, a measurement of the input impedance of the existing cable pair serving the customer would be made, automatically, within the ordering process. This measurement could be made without human intervention, using automated test equipment accessing the pair via a Central Office's metallic test trunk. Alternatively, the measurement could be made in a variety of other test equipment.

It is well known that the input impedance of a cable pair, when opened at the other end, is a complex function of the cable circuit topology. Many devices, for instance, measure for the number and placement of load coils by measuring the magnitude of the input impedance as a function of frequency, within the voiceband. It is not widely known, however, that the input impedance (in the voiceband) can also be used to estimate the wideband loss of the cable pair. This is illustrated in the following graph, where the real part of the inverse hyperbolic tangent of the inverse of the input impedance (at 1500 Hz) is displayed against the data rate achieved across 22 different cable circuits.

There may be a potential here for intellectual property. One (possibly) novel idea is the estimation of data rate using input impedance. Another idea could be the extrapolation of input impedance (in the voiceband) to wideband data rates. Finally, we might want to seek intellectual property on the algorithms themselves. In that context, it should be noted that the problem of relating data rates to input impedance has a multi-valued solution, i.e., several algorithms could be developed besides the one shown here.

Gary Tennyson
(205) 985 6087


Relationship Between Data Rates and A Function of Input Impedance
Measured Downstream Data Rates
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
0.2
0.4
0.6
0.8
1
1.2
Real Part of tanh^-1(1/Z_in) at 1500 Hz
x 10^-3

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SCIENCE & TECHNOLOGY

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Memorandum for File

Notes on the Accuracy of MLT's Length Measurement

Abstract

Due to records inaccuracies encountered early in the deployment of ADSL, a decision was made to use MLT's length measurement as a pre-installation screening tool. The intent of the screen is to detect loops whose distances exceed the ADSL deployment limits and eliminate fruitless installation efforts. Comments from the field have been received suggesting that in many cases the loop seemed to be much shorter than portrayed by MLT. This paper examines the accuracy of MLT's length measurement.

MLT measures the length by measuring the capacitance from conductor(s) to ground. While the accuracy of the MLT capacitance measurement units appears to be excellent, the assumption of a fixed value of capacitance per unit length of cable is questionable. Three significant sources of error in MLT length measurements have been identified. In the worst case, they can contribute thousands of feet of additional 'apparent' length.

Approved	Title	Date
"Signed Original on File"	**Research Director**	

Distribution:

John Cahill
Sid Conley
Ken Hawkins
Bill McNamara
Jim Moore
Dirk Palenik
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Warren Norville
William Page
Rita Scherer
Roger Smith
Alan White

Background

The Mechanized Loop Testing (MLT) system displays a loop length measurement after testing a line. Due to records inaccuracies encountered early in the deployment of ADSL, a decision was made to use the length measurement as a pre-installation screening tool. The intent of the screen is to detect loops whose distances exceed the ADSL deployment limits and eliminate fruitless installation efforts.

Comments from the field have been received suggesting that, in some cases, the loop seemed to be much shorter than portrayed by MLT. Most instances were related in an anecdotal manner and could not be examined in detail. These comments resulted in an effort to understand the accuracy of MLT's loop length measurement. The results are documented here.

MLT's Length Measurement

Discussions with engineers at Lucent have provided some insight into the basic operation of MLT, which is described below.

After connecting to the line under test, the system performs ac and dc measurements [1] to develop a three-terminal model of the line, illustrated in Figure 1, below. Based on the measurements, and the LMOS line records, the MLT logic traverses a lengthy decision tree. Based on the decisions made, additional tests may be performed. The decision tree contains significant intellectual value and its details have not been disclosed. Fortunately, we are only interested in this basic test.

Note that this is a three-terminal model. None of the components can be measured directly using two-terminal devices. The two-terminal tip-to-ring resistance, for instance, is the circuit consisting of R_{TR} in parallel with the series combination of R_{TG} and R_{RG}. The components of the three-terminal model can, however, be determined from a series of two-terminal measurements. Similarly, the equivalent two-terminal readings can be derived from the three-terminal model.

This point is demonstrated by the MLT display itself. Resistances are displayed in three columns. One column, labeled "MLT: DC SIGNATURE" represents the dc resistances of the three-terminal model. The other column, labeled "CRAFT: DC SIGNATURE" represents the dc resistance that would be measured with a two-terminal ohmmeter. [2]

Note also that MLT measures voltages in each leg of the three-terminal network, but these are not shown here since they are not pertinent to the discussion.

[1] The dc measurements provide the values of the resistances. The ac measurement is an admittance measurement, which provides the value of the capacitances. Admittance is the inverse of impedance, i.e. the ratio of ac current to ac voltage. It is, in general, a complex number, having a magnitude and phase. After conversion to rectangular coordinates, the capacitance is easily derived, since the reactive component of the admittance = $2 \pi f C$. The frequency employed in MLT's admittance measurement is 24 Hz.

[2] A third column labeled "AC SIGNATURE" displays the inverse of the real part of admittance, i.e., the resistive component of the model, at 24 Hz. This parameter is used to detect ringers across the line.

MLT displays only the resistive values. The capacitances are not displayed. Instead, they are used to calculate two parameters — capacitance balance [3] and length. Length is calculated using the capacitance to ground measurements, assuming a fixed value of capacitance per unit length of cable. Length is not calculated using the tip-to-ring capacitance. [4] This is why the ADSL splitter adds little or no apparent length as measured by MLT. While the splitter has quite a bit of capacitance in the tip-to-ring path, it has virtually no capacitance to ground.

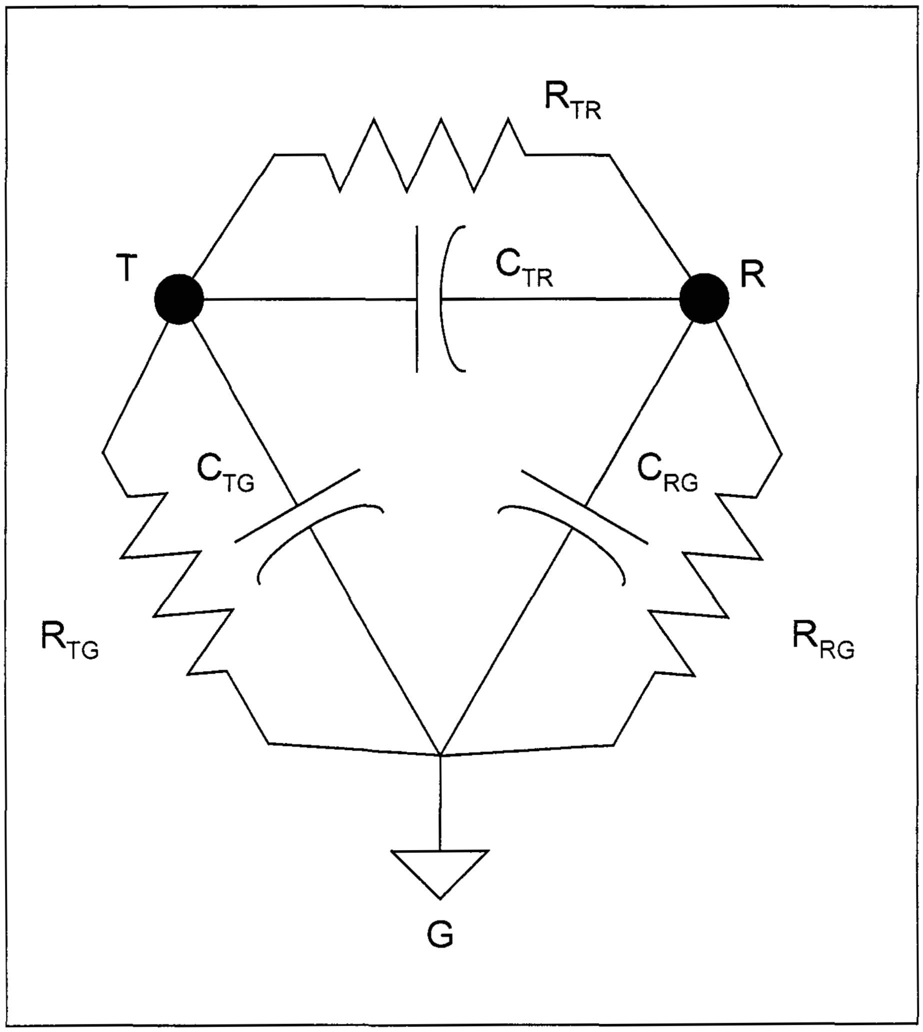


Figure 1, Three-terminal model assumed by MLT

[3] Capacitance balance is a measure of the similarity in the apparent length of the two conductors. A perfect loop has 100% capacitance balance. Below some threshold of capacitance balance (the value of which is apparently proprietary to Lucent) the MLT test is truncated.

[4] From today's vantage point, this seems counter-intuitive. The tip-to-ring capacitance (denoted mutual capacitance) is controlled in Bellcore cable specifications [1]. The capacitance to ground is not directly controlled.

Based on the method described above used by MLT to calculate the length, it can be seen that there are three factors contributing to it's accuracy [5]:

- The accuracy of the MLT measurement system itself,
- The capacitance to ground added via customer wiring and/or equipment
- The validity of the underlying assumption that the capacitance to ground is a single, fixed value.

Each of these factors have been examined in some detail.

The Accuracy of the MLT Measurement System Itself

MLT employs Precision Measurement Units (PMU's) to measure the admittance as described above. These units have been described by Lucent as being very accurate. In an attempt to verify this, measurements were made in the Alabaster CO and the Riverchase CO, both in Alabama. The Alabaster office is a Nortel DMS100. It has two PMU's and five No-Test Trunks (NTT's). The Riverchase office is a Lucent 5ESS with an integrated MLT system. It has two PMU's and eight DCTU's. (The basis for this acronym is not known, but these devices provide for dc connection between the integrated MLT system and the line under test.)

Artificial cable, representing fifteen-thousand feet of 26 AWG cable, with a telephone set across tip and ring, was used to test the accuracy of the measurement units. In both offices, an MLT supervisory terminal was employed to ensure that every combination of PMU and NTT (or DCTU) was used.

In the Alabaster CO, MLT reported from 15.1 to 15.2 kf in every case. In the Riverchase CO, the integrated MLT system reported from 14.5 to 14.6 kf in every case. Additionally, in the case of the integrated MLT system in the Riverchase CO, the MLT terminal displayed a note advising that the system may have up to 500 feet of error.

In summary, the accuracy of the MLT system itself appears to be very good.

The Capacitance to Ground Added Via Customer Wiring and/or Equipment

Reports have been received from the field that, in some cases, disconnecting the line at the Network Interface has removed up to 3,000 feet of length from MLT's length measurement. While this phenomena hasn't been verified, it seems plausible. In fact, an unofficial report from a survey done by Bell Atlantic in Pittsburgh, indicates that up to 2,000 feet of additional length can be contributed by inside equipment.

A conventional telephone set has no intentional path to ground and hence would add very little capacitance to ground. Other devices, though, could have significant capacitance to ground. Consider a voiceband modem. In an effort to meet FCC Part 15 requirements regarding emissions, it seems reasonable that a designer would add bypass capacitors to the telephone line terminals. Power strips with surge protection for both power and telephone circuits, also appear to be likely candidates for capacitance to ground.

---

[5] It should be understood that the length measurement furnished by MLT is the total working length, including bridge tap. In fact, given the measurement method described above, there is no way that MLT can distinguish inline cable from bridge tap. This is not considered an inaccuracy here, even though the effect of the bridge tap on ADSL can be significantly different than the additional inline length indicated by MLT.

The capacitance to ground, added by inside equipment, is a potentially significant source of error.

The Assumption That Capacitance to Ground Is a Single, Fixed Value

MLT assumes a value of 0.083 μF per mile for both C_{TG} and C_{RG}. A value of half that (or 0.0415 μF per mile) is assumed for C_{TR}. This yields a value of 0.083 μF per mile for the mutual capacitance, which consists of C_{TR} in parallel with the series combination of C_{TG} and C_{RG}. This assumption appears to be invalid in at least two cases, as described below.

Buried Air-Core PIC Cable

It is well known that the capacitance of wet PIC [6] cable is greater than that of dry cable, because the dielectric constant of water is greater than that of air. In fact, references [2] and [3] indicate that the mutual capacitance [7] of wet air-core PIC can be more than twice the value of dry cable. Similarly, reclaimed cable [8] has a greater capacitance, since the dielectric constant of the reclamation compound is greater than that of air. Reference [3] indicates that the capacitance of reclaimed cable is anywhere from 30% to 50% greater than that of the original dry cable. Either will obviously affect the accuracy of MLT length measurements; the value assumed by MLT is that of the dry cable.

The amount of buried air-core cable left in plant is not known. It is very likely, though, that what is left is either wet or has been pumped with reclamation compound. This could be a significant source of error if there is any buried air-core PIC cable in the loop under test. In the worst case, MLT may indicate that the cable is twice as long as it really is [9].

Filled Cable

Wet or reclaimed cable was thought to be the culprit on a loop in Alabaster, AL. This loop measured over 21 kf via MLT, but the records suggested that it was only about 15 kf in length. This loop serves a BST employee and it was selected as a 'test loop' for this effort.

Initially, two attempts were made by local technicians to find unrecorded bridge taps, but none were found. The MLT measurement accuracy was then tested, with results as described above. Thinking that wet or reclaimed cable might be involved, a loop makeup was obtained. In addition to the length and gauge data, usually furnished on makeups, this makeup included the core type and placement data, to determine if any of the cable was buried air-core PIC.

[6] PIC is an acronym for Polyethylene Insulated Cable. Any significant moisture in pulp cable renders the pulp insulation useless and results in a service outage.

[7] Since one-half of the mutual capacitance is contributed by the capacitance to ground, it is apparent that the capacitance to ground is also affected by the water.

[8] Reclaimed cable refers to buried air-core PIC cable that has been in service, and then injected with reclamation compound in an effort to mitigate the effects of water in the cable. The success of this procedure was never clear and reclamation efforts have been abandoned in favor of cable replacement.

[9] This particular error is not as troublesome as it might first appear. The attenuation of wet cable is also higher than that of dry cable. A loop appearing to be too long therefore, due to wet PIC cable, might also have too much loss to support ADSL, although its real loop length is acceptable. This effect is, unfortunately, not linear. The attenuation, particularly at the higher downstream ADSL frequencies, increases somewhat less than does the capacitance. [2]

None of the cable was buried air-core PIC, but a significant amount was filled cable.[10] Despite the higher dielectric constant of the filling compound, the mutual capacitance of filled cable is controlled to meet industry requirements [1] through the use of either thicker insulation or a different insulation material [4]. It was not known, however, if the capacitance to ground of filled cables was in line with the MLT assumptions, since there are no requirements pertaining to capacitance to ground.

To determine the capacitance to ground of filled cable, our supplier of Outside Plant copper cable, General Cable, was consulted. Mr. Guy Oligo of General Cable pulled a reel of 25-pair 24 AWG filled cable from the production line and measured the two-terminal capacitances (tip-to-ring, tip-to-ground, and ring-to-ground) on all 25 pairs [11]. His results are attached. In keeping with the convention of [5], the tip-to-ring capacitance is labeled C_{ab}, the tip-to-ground capacitance is labeled C_{ag}, and the ring-to-ground capacitance is labeled C_{bg}.

From the measured two-terminal capacitances, the values of the components of the three-terminal model are calculated in the attached spreadsheet. It can be seen that the mean value of the capacitance is ground is about 0.102 μF per mile, or about 21% higher than that assumed by MLT. It can also be seen that the standard deviation (a measure of the variation in the value about the mean) of the capacitance to ground is about 4 times that of the mutual capacitance.

While this is only one sample, it is strongly suggests that the capacitance to ground value assumed by MLT is at best a rough estimate. Since no measurements were made on air-core PIC cable, it's not even clear that the MLT assumptions are better for that type of cable.

In summary, based on the limited data at hand, it appears that the length measurement on filled cable is about 21% long.

Summary

MLT measures the length by measuring the capacitance from conductor(s) to ground. While the accuracy of the MLT measurement units appears to be excellent, the assumption of a fixed value of capacitance per unit length of cable is questionable. Three significant sources of error in MLT length measurements have been identified. They are as follows:

- Capacitance contributed by CPE, which could provide an increase in apparent length of a few thousand feet;
- Increased capacitance to ground in buried air-core PIC cable (arising from either water or reclamation compound), which could provide for several thousand feet of additional apparent length, in the worst case;
- The increased capacitance to ground arising from filling compound in buried filled cables, which appears to 'look' about 21% too long.

[10] Filled cable has a flooding compound injected into the cable core at the time of manufacture to slow or stop the intrusion of water into the core of the cable. Filled cables have been used in the buried plant since the early-to-mid 1970's.

[11] It should be noted that when measuring the capacitance of a pair, all of the other pairs in the cable are shorted. This convention complies with the governing cable measurement standard [5].

Acknowledgements

This work was initiated via comments and questions from Joe Clayburn, transmission engineer in the Alabama area. Joe also provided a great deal of assistance in measuring the 'test' loop in Alabaster. Melvin Elliott and Harry DeArman provided a great deal of assistance in measuring the accuracy of the MLT measurement units. Warren Norville (Manager – OSPE in the Birmingham district) provided the detailed loop makeup which, since it indicated a great deal of filled cable, initiated the investigation into to the higher capacitance of filled cable. Ken Hartsfield provided assistance and insight throughout this work.

References

[1] Bellcore, "Generic Requirements for Metallic Telecommunications Cables," TR-TSY-000241, Issue 2, June 1988

[2] J. A. Olszewski, V. W. Pehrson, H. Simon, "The Effects of Water in Plastic Insulated Cable," Proceedings of the International Wire and Cable Symposium, 1972

[3] S. Kaufman, R. Sabia, "Reclamation of Water-Logged Buried PIC Telephone Cable," Proceedings of the International Wire and Cable Symposium, 1972

[4] L. Jachimowicz, J. A. Olszewski, I. Kolodny, "Transmission Properties of Filled Thermoplastic Insulated Telephone Cables at Voice and Carrier Frequencies," International Conference on Communications, June 19-21, 1972, Philadelphia

[5] Standard Test Methods for Electrical Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable, ASTM D 4566 – 94

GENERAL CABLE COMPANY

MEASURED CAPACITANCE ON A 25/24 CABLE (ANMW)

CABLE LENGTH: 1010 ft.

Pair #	Cag+Cab (mFd/L)	Cbg+Cab (mFd/L)	Cag+Cbg (mFd/L)	Cab (mFd/L)	Cag (mFd/L)	Cbg (mFd/L)	Cm (mFd/L)	Cm (mFd/Mile)
1	25.6701	25.6505	37.5977	6.8615	18.8087	18.7891	16.2609	85.01
2	25.6957	25.7510	38.4341	6.5063	19.1894	19.2447	16.1148	84.24
3	25.8981	25.7609	38.9747	6.3422	19.5560	19.4188	16.0857	84.09
4	25.9559	26.0274	40.0237	5.9798	19.9761	20.0476	15.9857	83.57
5	25.6562	25.6941	38.6576	6.3464	19.3099	19.3478	16.0107	83.70
6	25.9778	25.9896	40.0747	5.9464	20.0315	20.0433	15.9650	83.46
7	25.8027	25.7179	38.9464	6.2871	19.5156	19.4308	16.0237	83.77
8	25.7600	25.7044	38.3505	6.5570	19.2031	19.1475	16.1446	84.40
9	26.1009	25.8749	39.5805	6.1977	19.9033	19.6773	16.0925	84.13
10	26.3030	26.0644	40.2316	6.0679	20.2351	19.9965	16.1254	84.30
11	25.7313	25.8571	38.6560	6.4662	19.2651	19.3909	16.1301	84.32
12	25.6584	25.6859	38.9260	6.2092	19.4493	19.4768	15.9406	83.33
13	25.8283	25.9627	39.8701	5.9605	19.8679	20.0023	15.9279	83.27
14	25.7202	25.4455	37.3133	6.9262	18.7940	18.5193	16.2540	84.97
15	25.9757	25.9128	40.1301	5.8792	20.0965	20.0336	15.9117	83.18
16	25.7774	25.7711	38.5765	6.4860	19.2914	19.2851	16.1301	84.32
17	25.5376	25.4569	37.6243	6.6851	18.8525	18.7718	16.0911	84.12
18	25.8607	25.7127	38.8658	6.3538	19.5069	19.3589	16.0701	84.01
19	25.8802	25.7220	38.9700	6.3161	19.5641	19.4059	16.0584	83.95
20	26.0147	25.9563	40.4104	5.7803	20.2344	20.1760	15.8829	83.03
21	25.8183	25.7039	38.2952	6.6135	19.2048	19.0904	16.1872	84.62
22	25.9624	25.9049	39.3668	6.2503	19.7122	19.6547	16.0919	84.12
23	25.9076	25.7982	38.1502	6.7778	19.1298	19.0204	16.3153	85.29
24	25.9812	25.7586	38.4470	6.6464	19.3348	19.1122	16.2578	84.99
25	26.1991	26.2315	40.4744	5.9781	20.2210	20.2534	16.0967	84.15

DIRECT READINGS:

AVERAGE MUTUAL CAPACIT/ 84.09

AVERAGE	25.83577
VARIANCE	0.032173
STD. DEV.	0.179367

Mutual Capacitance

Average	16.0858
Std. Dev.	0.114401

Capacitance to Ground

Average	19.4990
Std. Dev.	0.453998

GWO / 3/2

Ratio of Averages 1.212187

Background

The introduction of g.lite service has raised the issue of loop length limits again. Given that g.lite does not employ trellis coding, it is logical to expect that these products will not be capable of working on some of the longer loops that are currently supporting conventional ADSL, which does use trellis coding. Trellis coding provides some 4 dB of improvement in Signal to Noise Ratio, which should yield a little over one additional bit per tone.

This question of the appropriate loop limit was analyzed using both laboratory measurements and field data from the splitterless trial currently underway in Atlanta.

Trial Data

Apparently, there are about fifty-five customers currently on the splitterless trial in Atlanta. It should be noted that these customers are not using g.lite modems. They are using conventional Alcatel modems with trellis coding, and are thus enjoying slightly better performance than can be expected with g.lite.

The loop length, measured using MLT[1], was obtained for most of these accounts. For various reasons, this data was not available for all accounts. Data was available for forty-two accounts.

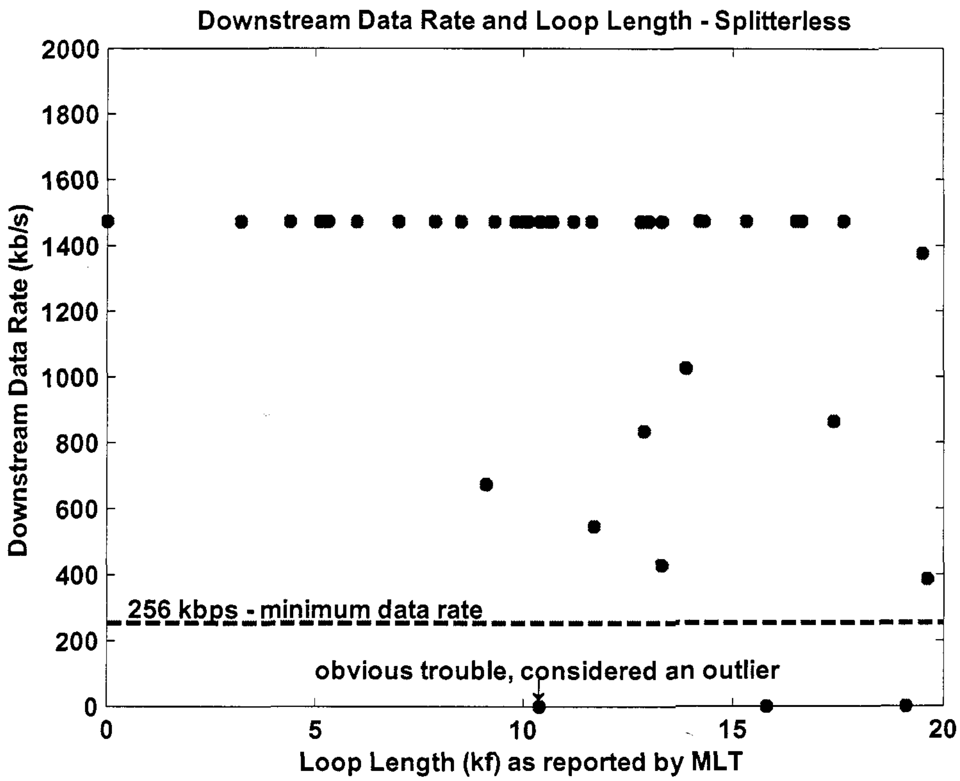
Analysis of Trial Data

We have attempted to install fifty-five customers in the trial. Three attempts have failed to synchronize. The downstream data rate was obtained for many of the remaining accounts. The data rate was obtained for thirty-seven accounts.

A scatter plot was created with data from those accounts where both the data rate (set to zero for failures) and loop length were available. The scatter plot is shown below.

---

[1] It should be recognized that MLT will generally report slightly longer loop lengths if filled cable is in the loop. This makes comparison between lab measurements and field data somewhat uncertain. Nevertheless, it appears that MLT will be used — at least initially — as a loop-screening tool.



As can be seen, most of these customers are working at 1.472 Mb/s, the maximum data rate allowed. Some are working at lower data rates, and some are working on fairly long loops. At first glance, it appears that one potential loop limit would be about 15.5 kilofeet[2]. It can also be seen that any loop limit that will eliminate fruitless installs (ones where the customer fails to synchronize) will also eliminate customers that would work. In fact, this data suggests that every fruitless install that we avoid will come at the cost of a few foregone customers.

To get a better feel for the distribution of customers by loop length, another chart was prepared, showing the cumulative distribution of working customers by loop length, using the same data from the Atlanta trial. The sample size here is slightly larger, as it includes customers that were known to be working, but whose specific data rates were not known. That chart is also shown below.

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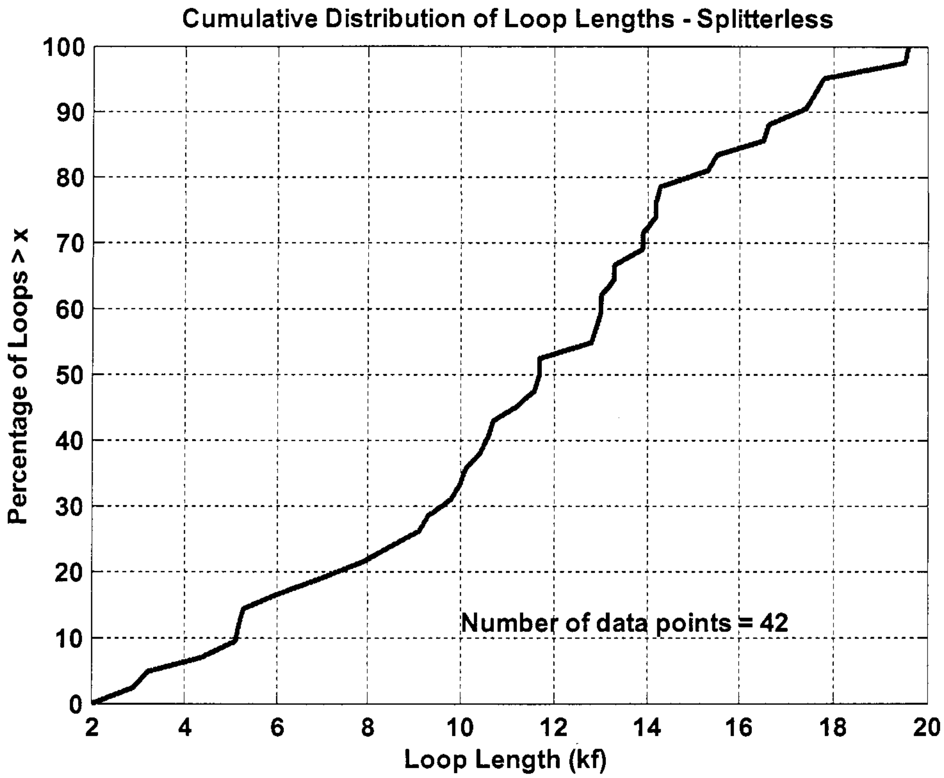
[2] It turns out, coincidentally, that 15.5 kf is also the maximum length of a solid 26 AWG cable permitted under Revised Resistance Design guidelines. In other words, the loop resistance of 15.5 kf of 26 AWG cable is about 1300 Ω.



A subtlety here deserves a comment. Most loop reach analyses are based on loop survey data. Conventionally, loop surveys of working telephone lines indicate that the density of customers (the slope of the line in the above chart) decreases as the distance from the C.O. increases. While the length data here includes bridge tap, it suggests that the distribution of ADSL customers is significantly different from that of working telephone lines.

Based on the suggested loop length limit of 15.5 kf, the size of the foregone market can be seen to be somewhat less than 20%.

Laboratory Measurements

In making laboratory measurements, two factors unique to splitterless operation need to be considered. The first is that inline filters, while fairly effective in isolating the deleterious effects of telephone sets, are not ideal. Some degradation can be expected, even with filters in place. Telephone sets impact splitterless ADSL via both Inter-Modulation Distortion (IMD) and low bridging impedance. The distribution of these impacts has not been well characterized. To approximate these impacts, an inline filter was bridged across the line with the telephone port shorted. This 'worst-case' bridging impedance is used to offset the fact that no IMD is present.

Another aspect of splitterless ADSL is that the ADSL line is exposed to all of the bridge tap introduced by the end-user's inside wire. To model this impact, we attempted to determine the worst-case length of bridge tap on a loop of about 15 kf.

It turns out that the worst-case length is almost exactly 500 feet[3]. The laboratory measurements, then, included both the inline filter (with the telephone port shorted) and 500 feet of bridge tap.

We have in the lab only one g.lite CPE product, and that is an experimental Alcatel product. We have attempted to secure g.lite CPE from both 3Com and Efficient Networks, but have been successful. Since it doesn't appear that g.lite CPE is readily available**, the immediate need was interpreted to be a loop deployment limit for splitterless ADSL, using conventional ADSL modems**.

Using the shorted filter and 500 feet of bridge tap, the in-line loop length was iterated until the minimum downstream data rate (256 kb/s) was achieved. Twenty-four DSL disturbers were assumed to be present. It turns out that 15 kf is the maximum length of in-line 26 AWG cable that can be tolerated. At this length, the effect of the bridge tap[4] is so pronounced that the noise can be removed, with no impact. A downstream data rate of 288 kb/s was obtained with this arrangement. The downstream data rate on 15 kf of 26 AWG cable, with no noise and no bridge tap is on the order of 1.6 Mb/s.

An inline length of 15 kf and a bridge tap of 500 feet yields a loop limit, when measured by MLT, of 15.5 kf.

Summary

Both the field data and laboratory measurements suggest a loop length limit (as measured by MLT) of 15.5 kf for splitterless ADSL. This loop length restriction is the result of the impact of bridge tap. It is independent of noise assumptions.

Coincidentally, this is also the maximum length of a solid 26 AWG loop allowed under Revised Resistance Design rules.

This loop limit applies to conventional ADSL modems, since performance data is only available for one g.lite modem. .

---

[3] It could be argued that practically no customers would have 500 feet of inside wire. This worst-case length is used, though, for the following reason. Since we don't have good insight into why this particular length is so problematic, it could be that the impact of several short stubs of inside wire — combined with some range of lengths of cable bridge tap — could be equally detrimental.

[4] These measurements were made using the new (ADNT-G) modems from Alcatel. Earlier implementations of Alcatel modems (ADNT-E) were known to perform even worse on longer loops with 500 feet of bridge tap. The new code released in the newer modems provided some improvement.

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Memorandum for File

A Comparison of MLT-reported Length Measurements to Record Data

Abstract

This provides an analysis of the difference between the loop length reported by MLT and the record loop length on forty-two ADSL loops in the Atlanta area. While the difference between the two seems to have a mean value of a few thousand feet, the wide variance in the distribution of the differences results in a significant number of loops that will exceed the 18 kf loop limit, using the existing 21 kf MLT screening limit.

A few potential screening limits are presented, with estimates at each point of the percentage of loops that will have record lengths exceeding 18 kf but will pass the screens. Given the wide variance of the distribution of the differences between MLT and the record length, any change in the MLT screening limit will — in addition to decreasing the number of unsuccessful installation attempts — also increase the number of 'false negatives', i.e. orders that falsely determined to be associated with loops greater than 18 kilofeet.

Approved	Title	Date
	Research Director	

Distribution:

Ken Hawkins
Jim Johnson
Bill McNamara
Stan Thompson
Chuck Yost
Susan Campbell
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Rita Scherer
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Background

ADSL loop lengths — which are defined here to include bridge tap — have been recommended to be limited to 18 kilofeet, which is also the Revised Resistance Design limit for non-loaded loops. Currently, ADSL installations involve the measurement of loop length using the Mechanized Loop Testing (MLT) system. In the installation of ADSL, an individual line is considered acceptable if it is 21 kf in length, or less. The difference between the two limits can be considered to arise from the inherent error in MLT's loop length measurement.[1] The MLT length measurement includes the effect of bridge tap.

In a previous paper, I outlined the sources of error in MLT's loop length measurement. While the sources of error— primarily the filling compound in buried cable — can contribute a great deal of error to an individual circuit, the impact across a number of circuits was not clear. This paper will examine the error across several circuits

Available Data

Data is available on a small number of ADSL circuits in the Atlanta area. This data contains the telephone number, achieved upstream and downstream data rates, and MLT-reported loop lengths for a number of 'splitterless' ADSL customers. Loop makeups were obtained on all of these customers from the Central and Suburban Atlanta districts. After combining all of the data, forty-two loops were found for which both loop makeups and MLT-reported length measurements were available.

It should be noted that there are really three lengths of interest; the 'true' length, the record length, and the MLT-reported length. We do not have access to the 'true' loop makeup [2], i.e., the length 'seen' by the actual ADSL system. Since the record length is the best data available, this analysis compares the MLT-reported lengths to the record lengths.

Graphical Presentation

A scatter plot of the MLT-reported loop lengths vs. the record loop lengths is shown in Figure 1, below. Again, both data sets include bridge tap.

---

[1] Literally, this isn't exactly true. Before the error in MLT's length measurement was well understood, several circuits were measured via MLT, after the ADSL was installed. Comparing the measured length to the record length seemed to suggest that 'the DSLAM added about 3,000 feet of apparent cable length.' The additional 3,000 feet was added to the 18 kf deployment limit, resulting in a 21 kf limit. Since then, we have demonstrated in the lab that the DSLAM 'adds' only the length of cable physically added to the circuit.

[2] The 'true' makeup can be closely approximated using the measured input impedance as a function of frequency with the far end open. The 'true' makeup is obtained by fitting the function — in an iterative manner — to cable makeups, starting with the record makeup, until a close match is found. The effort is very time-consuming, though, and cannot be used in any wide-scale manner. The 'true' length can be obtained from measurement of the differential (tip to ring) capacitance with the CPE disconnected, but still requires a double-ended test.

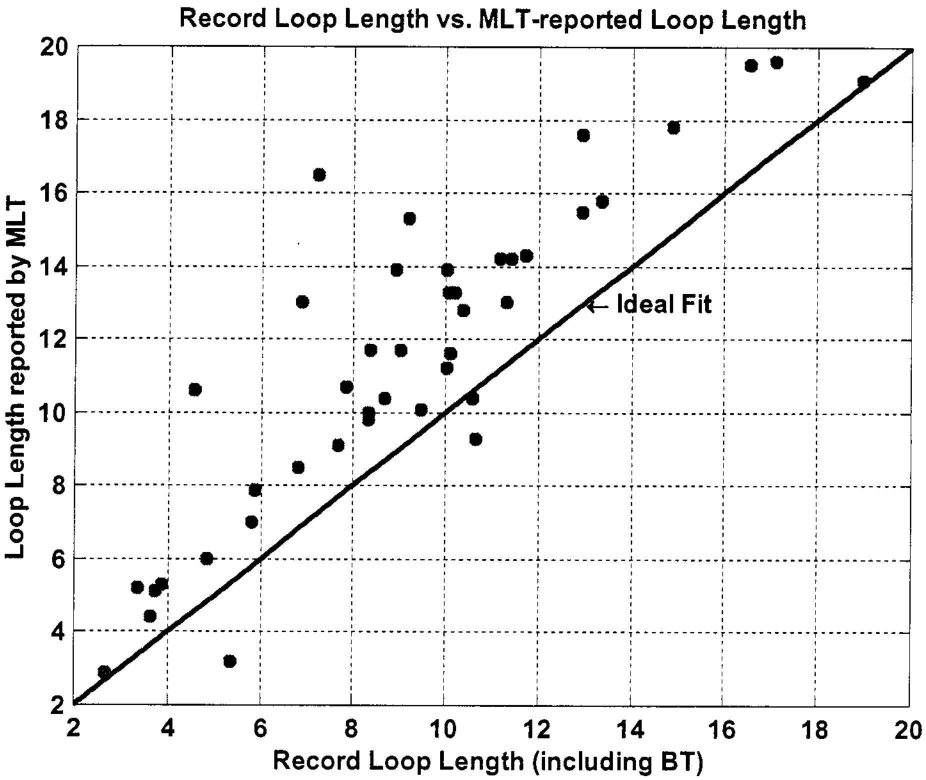
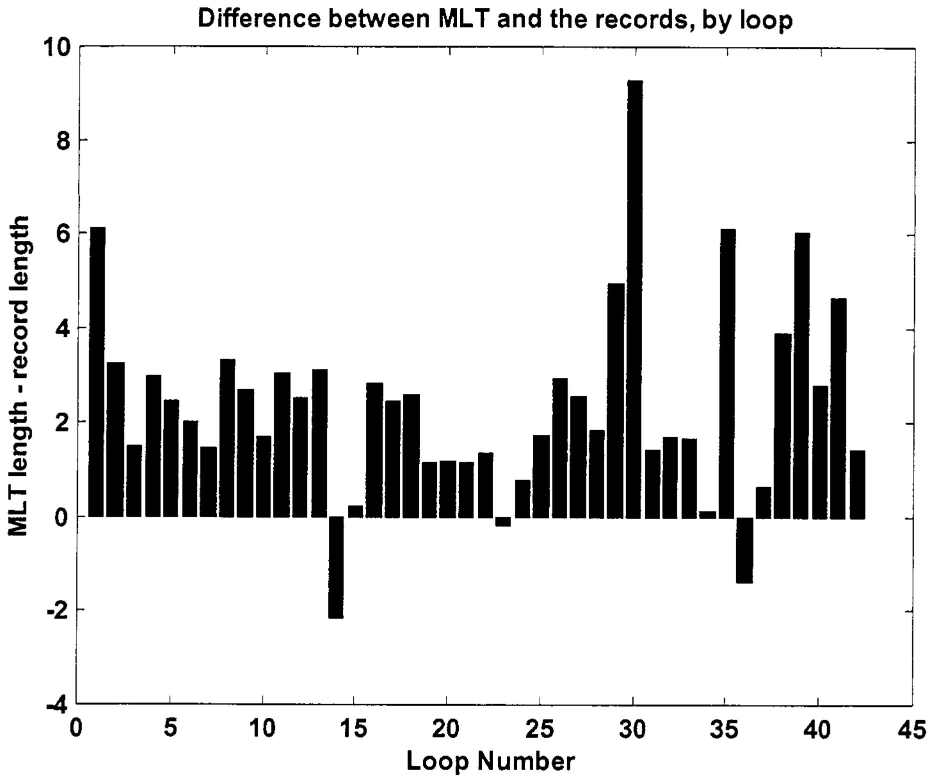


Figure 1

It can be seen that, in general, the MLT-reported values exceed the record lengths. The difference between the MLT-reported values and the record lengths are shown, for each of the forty-two loops, in Figure 2, below.



Difference between MLT and the records, by loop
MLT length - record length
10
8
6
4
2
0
-2
-4
0
5
10
15
20
25
30
35
40
45
Loop Number

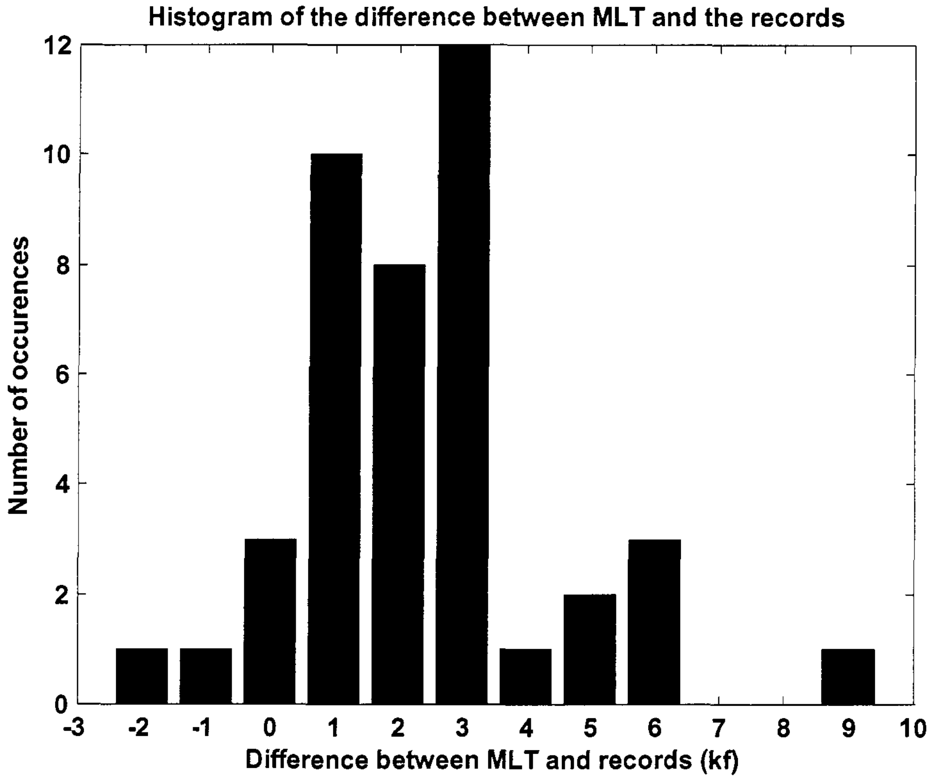


Figure 3

The histogram was constructed by 'binning' the differences into bins with 1,000 foot intervals. From this representation, the distribution has a mode (maximum value) at 3,000 feet. This could be viewed as justification for the difference between the 18 kf deployment limit and the 21 kf MLT 'screen.'

Analysis

The mean of the differences is about 2.4 kf. In practical terms, this tells us very little about the usefulness of the 21 kf MLT screening limit. The standard deviation, which describes the 'spread,' of the differences is slightly over 2.0 kf. The relatively large standard deviation does have some significance to loop screening. In order to use this parameter, though, something must be known about the 'shape' of the distribution. In Figure 4, below, the data is plotted on a normal probability plot. It can be seen that, between about 10% and about 90% probability, the data is roughly normally distributed. It's not known if the 'outliers' beyond these points are due to record errors, or if indicate that the data could be better fit to something other than a normal distribution.

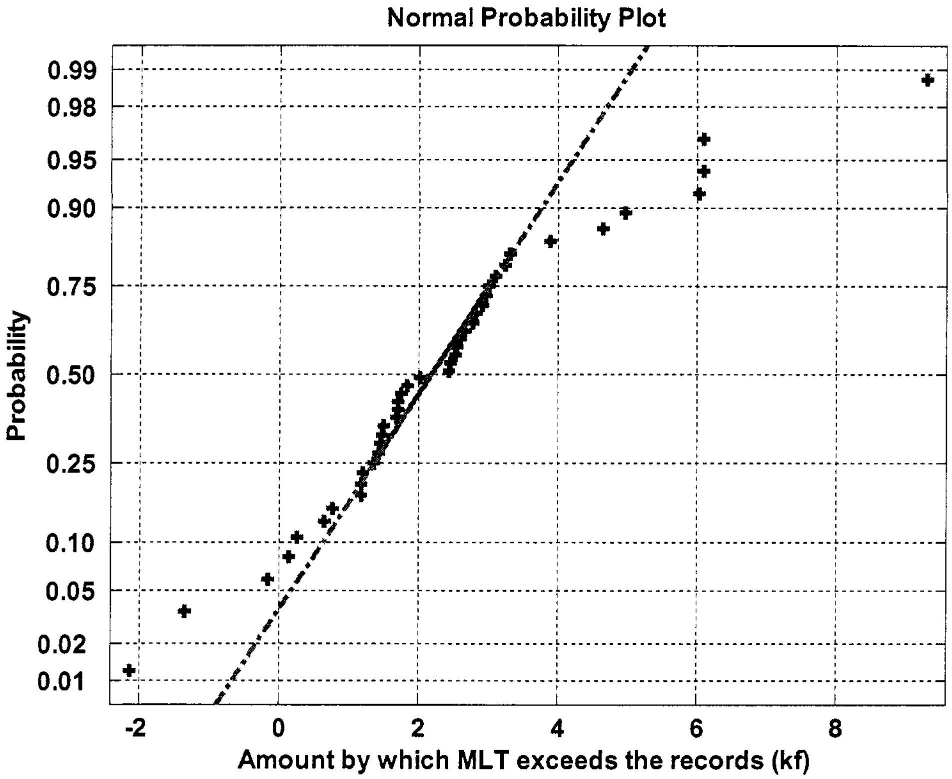


Figure 4

The MLT 'screening' limit of 21 kf is intended to ensure that the true loop length is less than 18 kf. This data suggests that the probability that MLT will exceed the record length by 3 kf or less is about 75%. Assuming MLT yields a length measurement of exactly 21 kf, then, there is approximately 75% probability that the record length is 18 kf or more.

With this distribution in hand, a more effective screening limits may be developed, if the objectives of the screen are limited to simply ensuring that the loop is less than 18 kf. If the objective is that no more than 25% of the loops that pass the screen shall have record lengths exceeding 18 kf, for instance, then the limit should be about 19.5 kf. If the stated objective is 10%, then the limit should be on the order of 18.5 kf. Given that a shorter distance screen will also disqualify many loops that are less than 18 kf — with the percentage of 'false negatives' increasing as the MLT limit is lowered — it's not clear that the objective of the screen can be stated this simply.

Acknowledgements

This work would not have been possible without the detailed loop makeups provided by Susan Campbell and Karen Simmons, in the Atlanta Suburban and Central districts, respectively.

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

RHYTHMS LINKS' FIRST REQUEST FOR PRODUCTIOON OF DOCUMENTS

POD NO. [illegible]

PROPRIETARY

DECLASSIFIED

ENCORE USER REQUIREMENTS FOR *MECHANIZATION OF LOOP MAKE-UP FOR CLEC XDSLS*

ENC7762.DOC
DOCUMENT VERSION 2.0
APRIL 28, 2000

Created: 12/06/1999
Revised: 4/28/2000

FEATURE DESCRIPTION

The mechanized Loop Make-Up Process for CLEC XDSL will provide Loop "Make-Up" detail to the requesting CLEC. The CLEC will use this information to determine if an end user's loop is capable of supporting their implementations of XDSL services.

Relative to CLEC XDSL service, the LM Scope includes the following:

a) Allowing CLECs' to request Loop Makeup detail on existing facilities, (Telephone Number or Circuit ID, - identified), when the facilities are owned by the submitting CLEC or BellSouth.
b) Allowing CLECs to request Loop Makeup detail on new/spare facilities owned by BellSouth.
c) Allowing CLECs to reserve new/spare facilities for a "standard" timeframe.
d) Allowing CLECs to cancel reservations for new / spare facilities within the standard timeframe.
e) Allowing CLECs to select or input a NC/NCI/SECNCI "codeset reference" that will be used to "fine tune" the facility types returned in the LM. (This "codeset reference" will NOT be used to "qualify (yes/no)" a facility. It will be used only to return a focused, abbreviated list of facilities that are a best match to meet the NC/NCI/SECNCI codes on the request.)

The CLEC XDSL pre-order LM transaction will allow the user to input / select :

a) A validated address and Telephone Number, (for requests involving existing facilities).
b) A validated address and Circuit Identifier, (for requests involving existing facilities).
c) A validated address only, (for requests involving new / spare facilities).
d) A NC / NCI / SECNCI codeset OR equivalent that identifies
   1) UNE ADSL 2-wire, ~~or~~
   2) UNE HDSL 2 or 4 wire service,
   3) UNE UCL-Short (2 or 4 wire)
   4) UNE UCL-Long (2 or 4 wire).
e) Up to ten (10) loops (quantity) for which Loop Make-Up detail is desired. (Applicable to New / Spare facilities only)

The LM process for CLEC XDSL shall respond with detailed information and functionality as specified in the Requirement section of this document.

USER REQUIREMENTS

Requirement #	Description
UR7762.0001	The user shall be able to identify and electronically submit a LM request for CLEC XDSL.
UR7762.0002	The User will receive a positive acknowledgement that the Loop Inquiry and / or reservation request has been completed.
UR7762.0003	The user shall receive common English "message detail" responses, as illustrated below: ▪ Account Information Not Found ▪ Address Not Found ▪ CC Not Valid ▪ CCNA Not Valid ▪ TN / Circuit Format Invalid ▪ TN / Circuit ID not found ▪ Insufficient Information To Process Query ▪ Invalid Input Combination (NC/NCI/SECNCI) ▪ Transaction Successful ▪ Not Authorized to access data. (Restricted Service. CLEC/ BST does not own / control the account) ▪ System Unavailable ▪ No Mechanized Information Available For This Request ▪ Not authorized to cancel Reservation request. (Not owner (CLEC) of the reservation).
UR7762.0004	The user shall have the ability to perform a preorder transaction to receive Loop Makeup detail for CLEC XDSL UNEs. (The user shall use this detail to evaluate if the loop is capable of supporting their specific XDSL or UCL service implementations.
UR7762.0005	The user shall utilize the Pre-order "address validation" process prior to submitting a request for Loop Qualification / Loop Makeup (LM).
UR7762.0006	The user shall have the data input for Telephone Number and Circuit ID, - FORMAT validated, based upon the following: ▪ Telephone Number : The format is valid if it conforms to rules associated with SOER – S&E, TN format 009. ▪ Circuit ID: The format is valid if it conforms to rules associated with SOER – S&E, CLS format 007 or CLT format 007.
UR7762.0007	If the user submission for LM involves an invalid Telephone Number, Circuit ID, and/or Address detail, the user shall receive a message. The message shall identify the invalid element(s) to the user.

UR7762.0008	As a part of the LM process for new/spare facilities, the user shall be able select / input a NC/NCI/SECNCI "codeset reference" that will be used to "fine tune" the facility types returned in the LM.
UR7762.0009	As a part of the LM interface for new/spare facilities, the user shall be notified that the input / selection of the codeset reference in UR7762.0008 above will be used only to return a focused, abbreviated list of facilities that are a best match to meet the NC/NCI/SECNCI codes on the request. The user shall be further notified that the use of the "codeset reference" should NOT be interpreted as an indication that the returned facilities are suitable or "qualifies" for any specific use.
UR7762.0010	For any given LM query, after initial data is input by the user (to initiate the query process), the user shall not be required to re-key valid data associated with sequential queries in the overall process.
UR7762.0012	In association with a given LM request, the user shall select / input data based upon the following rules : a) A validated address and Telephone Number OR a validated address and Circuit Identifier. (For requests involving existing facilities). b) A validated address only. (For requests involving new / spare facilities). c) A NC / NCI / SECNCI codeset OR equivalent that identifies: 1) UNE ADSL 2-wire, 2) UNE HDSL 2 wire service 3) UNE HDSL 4 wire service, 4) UNE Copper Loop – Short, 2 wire 5) UNE Copper Loop - Short , 4 wire 6) UNE Copper Loop –Long , 2 wire 7) UNE Copper Loop –Long , 4 wire (For new or existing requests.) d) The number of loops (quantity) for which Loop Make-Up detail is desired. (For New / Spare facilities only)
UR7762.0013	The user shall consider their request for LM as valid, when it conforms to one of the following scenarios: A) The request involves existing " working service" which is owned by the issuing CLEC or BST. Or B) The request involves new/ (BST spare) facilities. AND C) Involves a single premise address on any given Loop Make-up request.

UR7762.0014	If the user request for LM detail is associated with existing working service which is NOT owned by the issuing CLEC or BST, then the user shall receive a message. The message shall indicate that the submitting user is not authorized to receive the requested data for the specified account..
UR7762.0016	As a part of the LM process <u>for new/spare facilities</u>, the user shall be able to indicate up to ten (10) loops for which Make-up is desired.
UR7762.0017	As a part of the LM process <u>for new/spare facilities</u>, the user shall be able to reserve up to ten (10) loops for which Make-up is desired.
UR7762.0018	As a part of the LM process <u>for RESERVING new/spare facilities</u>, the user shall be notified that the facilities will be reserved for 4 days (96 hrs).
UR7762.0019	Not electronically supported for Phase 1. Restated as assumption. (5.7) to establish intent regarding future release.
UR7762.0020	Not electronically supported for Phase 1. Restated as assumption. (5.8) to establish intent regarding future release.

UR7762.0021	The users' response from the CLEC XDSL Loop Make-Up request shall include loop data currently available in the BST LFACs system, - based upon whether an individual loop conforms to service specific conditions listed in UR7762.0065 through UR7762.0070.
	
	This returned detail includes the list of items shown below in the LFACS Loop Data section, in addition to any items shown in the OTHER section, which are not implied / referenced by data in the LFACs section.
	
	<u>LFACS LOOP DATA Section</u>
	`LOOP{ Loop aggregate, 1 per loop`
	`LPSTAT [7] Status of assembled facility`
	`RTF [1] Receive/Transmit Indicator`
	`SSC [1] Single Subscriber Carrier Indicator`
	`FN{ Segment Aggregate, 1-9 per loop`
	`CA [10] Cable identifier`
	`PR [4] Pair Identifier`
	`ABP [4] Assignable Binding Post`
	`TEA [50] Terminal Identifier`
	
	`TRMED[9] Transmission Medium Type`
	`LMU{ Loop Makeup Aggregate, 1 per segment`
	`LMSTAT [40] Loop Makeup Status`
	`LUINT [2] Length Unit`
	`NLD [2] Load Point Number, Null if Non-loaded`
	`COIL [4] Load Coil Type`
	`ES [9] End Section`
	`LDSP [15][9] Load Spacing`
	`BO{ Build Out Aggregate, 1-2 per LMU`
	`BOCAP [5] Build Out Capacity`
	`BORES [5] Build Out Resistance`
	`BOOFF [9] Build Out Offset`
	`SPL{ Splice Section Aggregate, 1-10 times per LMU`
	`GA [7] Gauge`
	`LGTH [9] Length`
	`UBA [1] Type of cable`
	`CAPAC [5] Capacitance`

	`BTOFF [9] Bridge Tap Offset` <u>OTHER</u> Loop composition (Copper/Fiber etc.., length and wire gauge of each) Bridge taps (total kilofeet) Load coils (Presence) Pair gain devices DAML (Presence) Digital Loop Carrier (DLC) (Presence) Cross Box Identifier
UR7762.0022	As a result of a user LM request, if no loop Make-Up data is found, the user shall receive a message to that effect.
UR7762.0023	Collectively, the user shall be able to submit at least 4,000 LM requests per "busy hour".
UR7762.0024	The user shall receive an average response time of 2 seconds or less, per individual user initiated query associated with the LM.
UR7762.0025	As a result of a user LM request, if <u>any</u> loop make-up data is found, the user shall have the detail referenced in UR7762.0021, returned to them.
UR7762.0027	The users' response from the Loop Make-Up request shall identify (in common English terms) the specific element label, in conjunction with retrieved data values associated with a given element.
UR7762.0028	As a part of the LM process <u>for RESERVING new/spare facilities</u>, the user shall be able to cancel their own reservations.
UR7762.0029	If a user attempts to cancel a reservation which, was initiated by a different user, the user requesting the cancellation will receive a message. The message will indicate that the submitting user is not the owner of the reservation and are therefore not authorized to cancel the request.
UR7762.0030	The user shall NOT be allowed to reserve facilities that are currently reserved.
UR7762.0035	Not electronically supported for Phase 1. Rephrased as assumption. (5.6) to establish intent regarding future release.
UR7762.0041	In association with a user request for New/Spare loop reservations, the user shall receive a Facility Reservation Number (FRN). The FRN will be mechanically generated based upon the following format: CCCCZZZZZZZMMDDYYYY With C being the CLEC identified and Z being a per-reservation unique value.
UR7762.0065	User requests involving 2 or 4 wire Unbundled Copper Loops -<u>Short</u> (UCL-S), shall have facility data returned from LFACS which meet the following criteria

	(PER PAIR basis): ▪ The facility loop type/composition is COPPER ▪ The facility meets Resistance Design (RD) spec of 1300 Ohms or less ▪ The facility is non-loaded ▪ The total loop length is LESS than or equal to 18 kft ▪ Less than 6 kft of Bridged Tap is associated with the facility.
UR7762.0071	User requests involving 2 or 4 wire Unbundled Copper Loops -Long (UCL-L), shall have facility data returned from LFACS which meet the following criteria (PER PAIR basis): ▪ The facility loop type/composition is COPPER ▪ The facility may have up to 2800 Ohms of Resistance or less ▪ The total loop length is Greater than 18 kft ▪ Less than 12 kft of Bridged Tap is associated with the facility.
UR7762.0105	The user shall be able to print the FRN and results returned from a query.
UR7762.0110	FORMAT EXHIBITS

```
ID: CLS  - COMM. LANG. CIRCUIT ID-SERIAL NO.


     007  CLS DATA FORMAT INCORRECT!

          CLS DATA MUST APPEAR IN THE FOLLOWING FORMAT:

          /CLS 12.PLNT.123456.66.SB
          WHERE 12 = PREFIX (OPTIONAL) (1-2 ALPHANUMERICS)
          WHERE PL = SERVICE CODE (2 ALPHABETICS PRECEDED BY A PERIOD)
          WHERE NT = MODIFIER (2 ALPHABETICS OR 1 ALPHABETIC AND 1
                     ALPHANUMERIC)
          WHERE 123456 = SERIAL NUMBER (1-6 NUMERICS OF 1-999999
                         PRECEDED BY A PERIOD)
          WHERE 66 = SUFFIX (OPTIONAL) (1-3 NUMERICS OF 1-999 PRECEDED
                     BY A PERIOD)
          WHERE SB = ASSIGNING COMPANY IDENTIFICATION (2 OR 4
                     ALPHABETICS PRECEDED BY A PERIOD)

          NOTE 1:  THE ABSENCE OF THE SUFFIX DATA IS INDICATED BY 2
                   PERIODS BETWEEN THE SERIAL NUMBER AND THE ASSIGNING
                   COMPANY IDENTIFICATION.

                   EXAMPLE:  CLS 12.PLNT.123456..SB
          NOTE 2:  ON CABS ORDERS AND SOUTH CENTRAL BELL NON-CABS
                   ORDERS, THIS EDIT IS ONLY PERFORMED ON INWARD
                   (E,I,T OR X) AND RECAPPED ACTIVITY.

          NOTE 3:  WHEN THE SPECIAL ACTION INDICATOR IS D OR THE FIFTH
                   CHARACTER OF THE BASIC CLASS OF SERVICE IS Q, THE
                   ASSIGNING COMPANY IDENTIFICATION MAY APPEAR AS THREE
                   ALPHABETICS.

-------------------------------------------------------------


FID: CLT  - COMMON LANGUAGE CIRCUIT ID - TN FORMAT


     007  CLT DATA MUST BE FORMATTED AS FOLLOWS:

          /CLT 38.SBGS.404.477.3999.T22.123
          WHERE 38 = PREFIX (OPTIONAL) (1-2 ALPHANUMERICS)
          WHERE SB = SERVICE CODE (2 ALPHABETICS PRECEDED BY A PERIOD)
```

	WHERE GS = MODIFIER (2 ALPHANUMERICS OF AA-ZZ OR A1-Z9) WHERE 404 = NPA (3 NUMERICS PRECEDED BY A PERIOD) WHERE 477 = CENTRAL OFFICE (3 NUMERICS PRECEDED BY A PERIOD) WHERE 3999 = LINE NUMBER (4 NUMERICS PRECEDED BY A PERIOD) WHERE T22 = EXTENSION NUMBER/TRUNK CODE (OPTIONAL) (2-5 ALPHANUMERICS PRECEDED BY A PERIOD) WHERE 123 = SEGMENT NUMBER (OPTIONAL) (1-3 ALPHABETICS OR NUMERICS OF 1-999 OR A-ZZZ PRECEDED BY A PERIOD) -- FID: TN - TELEPHONE NUMBER 009 TN DATA FORMAT INCORRECT! TN MUST APPEAR ACCORDING TO ONE OF THE FOLLOWING FORMATS: A. I2 1FB /TN 101 555-1234-1235 WHERE 101 = NPA (3 NUMERICS) (OPTIONAL) WHERE 555 = NXX (3 NUMERICS) WHERE 1234 = LINE NUMBER - LOWER RANGE (4 NUMERICS) WHERE 1235 = LINE NUMBER - UPPER RANGE (4 NUMERICS) OR, B. I1 1FB /TN 101 555-1234 WHERE 101 = NPA (3 NUMERICS) (OPTIONAL) WHERE 555 = NXX (3 NUMERICS) WHERE 1234 = LINE NUMBER (4 NUMERICS) OR, C. I3 1FB /TN 205 555-1111, 4333, 5555 WHERE 205 = NPA (3 NUMERICS) (OPTIONAL) WHERE 555 = NXX (3 NUMERICS) WHERE 1111= LINE NUMBER (4 NUMERICS) WHERE 4333= LINE NUMBER IN A SERIES (OPTIONAL) WHERE 5555= LINE NUMBER IN A SERIES (OPTIONAL)

BELLSOUTH TELECOMMUNICATIONS, INC.

FPSC DKT NO 990649-TP

RHYTHMS LINKS' FIRST REQUEST FOR PRODUCTIOON OF DOCUMENTS

POD NO. 32

PROPRIETARY

DECLASSIFIED

BELLSOUTH

file code:	205.0200	**RL:98-09-019BT**
subject:	Loop Technology Deployment Directives	
type:	Deployment Directive	
date:	December 8, 1998	
distribution list:	See attached list	
related letters:	RL:96-09-026BT, RL:97-03-027BT, RL:97-11-017BT, RL:97-12-014BT RL:98-09-014BT, RL:98-09-003BT, RL:98-10-031BT	
to:	Network Vice Presidents - Network Operations Assistant Vice-Presidents - Network	
entities:	BellSouth Telecommunications, Inc.	
from:	D. A. Kettler, Executive Director/NVP – Science & Technology	
description:	1998 Issue of Loop Technology Deployment Directives	

* * *

This letter transmits the 1998 issue of the BellSouth Loop Technology Deployment Directives (LTDD). This document supersedes and updates all information previously contained in RL:96-09-026BT, the 1996 issue of the BellSouth Loop Technology Deployment Directives. It also incorporates provisions of previously issued directives or documents concerning loop technology deployment strategies, including:

RL:97-03-027BT	Loop Deployment Directives for ONU-12/24
RL:97-11-017BT	Update to Fiber Distribution Deployment Directives
RL:98-09-014BT	DS1 Technology Deployment Directives (update)
RL:98-09-003BT	Digital AML Deployment Directives
RL:98-09-025BT	Aerial Fiber Distribution Deployment Directive
RL:98-10-031BT	Alcatel (DSC) StarSpan Fiber-in-the-Loop (FITL) System Removal of Product from Approved Product List

These directives continue to reinforce a core BST strategy to maximize the deployment of fiber distribution to position the network for future services. Recent approvals of projects to replace existing feeder and distribution facilities in Atlanta and South Florida with a fiber distribution network to deliver integrated voice and broadband services have accentuated the importance of this strategy. Decisions regarding implementation of broadband services and facility replacements in other areas will be supported by separate business cases. In other new growth areas or extensive rehab situations, we must take advantage of every facility placement opportunity to ensure that deployment plans do not perpetuate the metallic distribution network, but maximize fiber distribution deployments in keeping with these directives. Deployment of fiber distribution with aerial facilities has recently been approved and fiber is now the first choice for all new facility placements, whether buried or aerial. We are continuing to work with our equipment vendors to introduce additional or enhanced products that will further reduce the cost of fiber distribution and provide broadband-ready features. Incremental costs of fiber distribution have been verified to be approximately $200/LU and budget requirements for forecasted deployment volumes for both buried and aerial facilities are included in the load-driven budgets. While the $200 incremental cost for fiber distribution should be coded to the FIBD program code, these expenditures are mapped to the load-driven growth budget. Although the DSC StarSpan was approved as a second fiber distribution system per RL:97-09-025BT, the acceleration of broadband deployment plans and the lack of progress in development of a viable data transport implementation have led to its removal from the approved products list per RL:98-10-031BT. A new broadband-ready fiber distribution product line is under development by DSC, now Alcatel, and we are continuing to work with them toward the introduction of that system. **However, until other vendor products are approved, RELTEC DISC*S fiber distribution components should be deployed in ALL qualifying locations, either requiring new HDTs or utilizing existing RELTEC HDTs, instead of the traditional copper distribution networks.**

Other issues that are addressed or updated by the 1998 Loop Technology Deployment Directives include small platform systems, ISDN provisioning and deployment, DAMLs and multi-line DAMLs, metallic distribution cable sizing/infrastructure limits, aerial fiber distribution, TR-303 system sizing and design, and loop planning issues identified in the recent field reviews. A summary of the major issues, including those listed and discussed above, immediately follows this letter. An updated copy of the directives, along with an executive summary, a checklist or job aid, and flowcharts are attached.

Questions or comments from your organization regarding these directives should be directed to Jim Jackson at (205) 977-5032 or Stan Fory at (205) 977-7158.

Original signed by D. A. Kettler

Attachments

DISTRIBUTION LIST FOR THE 1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES

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D. L. Estes

Interconnection
L. B. Shoemaker

SMU
E. L. May

Training
S. H. Snypp

Documentation *(2 copies)*

Summary of Major Issues and Changes

1. **Small Capacity NGDLC Cabinets**
The RELTEC DISC*S 192 Modular MESA cabinet e/w quad channel shelves and the DSC LSC-2001 fiber fed cabinets were recently approved per RL:98-03-030BT and RL:98-03-029BT, respectively. An RFP was also issued for T-1 or fiber fed small platform systems (up to 200 lines) and three products were selected by a vice-presidential team for testing and approval. A RELTEC MESA Sport cabinet with DISC*S common shelf and dual channel unit shelves will replace the DISC*S 192 Modular MESA cabinet in the RELTEC product line. Optional T-1, HDSL, OC-1, or OC-3 feeder can be utilized. The Alcatel/DSC LSC-2001 cabinet arrangement includes proposed software enhancements to provide Mode 2 and T-1 protection switching. Testing is scheduled for completion by YE98. New 52-type cabinets with optional T-1, HDSL, OC-1, or OC-3 feeder are proposed to support SLC-5 systems. While these systems do not have NGDLC TSI functionality, they do offer an economical arrangement for small demand sites. Furthermore, fiber distribution re-build projects in Atlanta and South Florida will likely provide substantial quantities of SLC-5 plug-ins for re-use in these applications. Product selection tables will be revised to reflect these new products which will displace small conventional DLC cabinets (51A, 2200, 80A) as the products of choice for many applications. Since the vendor pricing strategies for these products reflect significant reductions in getting started costs; this change in the directives will increase the variable cost of the network.

2. **ISDN Provisioning and Deployment**
Following direction and funding from the Consumer IBU, ISDN deployment directives (LTDD Section 3) have been updated to depend more heavily on service order driven deployments of Conklin or FITEL ISDN shelves in lieu of pro-active deployments of universal DLC or SLC-5 FP303. This change will increase the variable cost of the network.

3. **Customer DS1 Deployments**
New directives in RL:98-09-014BT approved 9/98 to reflect revised technology choices based on continued price decreases for HDSL. These directives have been incorporated into the decision processes for DS1 transport (LTDD Section 5). Additional changes will be made as other products are approved, such as OC-1 mini-cabinets for cell sites. Alcatel/DSC StarSpan may also be used to support customer DS1s, but long reach optics and local power options are yet to be tested. Funding for special treatment of specific sites approved by PCU/COU on a case-by-case basis.

4. **Digital AML (DAML) and Multi-line DAML**
A 2:1 Digital AML was introduced in 1994 and has been used to defer distribution relief. RL:98-09-003BT introduced directives for use of a 4:1 DAML to provide primarily distribution relief, but may also be useful for feeder relief in low growth situations. Small cable extensions in existing areas with a sufficiently sized backbone network are unlikely to be impacted by DAML technologies. These directives have been incorporated into the decision processes for narrowband facilities (LTDD Section 6). It is important to note that there are service limitations regarding modem speeds and future architectures, such as ADSL, but DAML equipment can provide effective transport for POTS-like services. Use of the DAML and multi-line DAML will increase the variable cost portion of the network and increase utilization of the network.

5. **Metallic Distribution Cable Sizing and Infrastructure Limits**
Distribution Cable Sizing Guidelines were issued in 1992 to provide design rules and sizing recommendations. However, major distribution deployments should utilize fiber distribution architectures. The 1998 release of the Loop Technology Deployment Directives (LTDD) has been updated to allow sizing for short metallic cable extensions to vary in order to balance short-term requirements with the existing backbone. More importantly, the 1998 LTDD reinforces the fiber distribution strategy by requiring that limits be established for

connection of new metallic cable extensions to the existing feeder/distribution infrastructure. This is to ensure that separate or sequential distribution cable placement decisions do not generate the need for additional infrastructure components to support yet more metallic distribution cable. This also ensures that new infrastructure placements are used to maximize the deployment of fiber distribution in new growth development areas.

6. **Aerial FITL**
Directives introducing the use of aerial cable placements to support fiber distribution deployments were provided by RL:98-09-025BT and have been incorporated into the new issue of the LTDD (see Section 6). The aerial cable arrangement uses the same ONU pedestal and electronics as in the buried cable arrangement. Typical designs serve 12 LUs from three 12-pair terminals subtended from a single ONU. Field or factory splicing arrangements can be utilized and taut sheath splicing techniques have been introduced by RL:98-10-001BT. Approximately 30% of new LUs in BellSouth require aerial facilities. Fiber distribution is now the first choice for all new facility placements, whether buried or aerial. See RL:98-09-026BT for engineering methods and procedures.

7. **Fiber Distribution with Integrated Broadband**
Projects to replace existing feeder and distribution facilities in Atlanta and South Florida with a fiber distribution network to deliver integrated voice and broadband services (also known as IFITL) have recently been approved. Decisions regarding implementation of broadband services and facility replacements in other areas will be supported by separate business cases that assess the competitive issues, broadband service revenues, and operations savings. These projects accentuate the importance of the fiber distribution deployment strategy in other growth areas, particularly the "next tier" metros. The 1998 LTDD outlines the need for coordination with BEI representatives regarding HDT node locations in targeted metros. In addition, distribution lengths should be maximized (up to 12 kft) for HDT nodes to ensure maximum utilization of broadband, as well as narrowband, HDT components. This will result in a lower percentage for fixed costs, as well as keep our overall costs down.

8. **DSC StarSpan**
The DSC StarSpan fiber distribution product was recently approved per RL:97-09-025BT and specific deployment directives were issued in RL:97-11-017BT. However, the acceleration of broadband deployment plans and the lack of progress in development of a viable data transport implementation have led to its removal from the approved product list per RL:98-10-031BT. A new broadband-ready fiber distribution product line is under development by DSC, now Alcatel, and we are continuing to work with them toward the introduction of that system. However, until other vendor products are approved, RELTEC DISC*S fiber distribution components should be deployed in ALL qualifying locations, either requiring new HDTs or utilizing existing RELTEC HDTs, instead of the traditional copper distribution networks. (See LTDD Section 6.)

9. **TR-303 System Sizing and Design**
Updated TR-303 deployment directives (RL:97-12-019BT) were previously issued to reflect approval of RELTEC TR-303 configurations and to confirm traffic parameters. In addition DSC TR-303 configurations have been approved for integration with a 5ESS (RL:98-08-017BT) and FOAs for integration with a DMS-100 are nearing completion. With these approvals, TR-303 is now the preferred choice for integration of system terminations in 5ESS and DMS-100 switches from both RELTEC and DSC NGDLC platforms. These issues have been incorporated into the 1998 LTDD (see Section 6, Table N4). Refinements have also been made to demand thresholds for small NGDLC system applications and adjustments have been made to DS1 parameters for some large systems based on recently completed traffic analyses (see RL:98-11-029BT). Deployment of TR-303 per these directives will lead to significant savings in both the switch and loop portions of the network. Incremental 1999 funding for initial TR-303 switching equipment is available through the BPTR303 change plan.

10. DSC and RELTEC Volume Pricing Contracts

Volume pricing contracts have been completed with both DSC and RELTEC. These contracts reflect substantially lower costs for cabinets and common plug-ins, resulting in a decrease in the fixed cost of the network. Although the new pricing arrangements do not introduce a major change in technology selections, they do allow more economical deployment of NGDLC/FITL architectures, particularly for certain "high volume" cabinet configurations. These will be used to refine product selection tables (see Section 6, Table N3).

11. Planning Review Issues

The updated LTDD also addresses several planning issues discovered during the field review activities in 1997, as well as our recent budget reviews. Some are related to the deployment of metallic and fiber distribution as discussed in item 5, or to relief alternatives and fiber infrastructure planning as discussed in the items 12 and 13. Other areas include reinforcement of fundamental planning principles as listed below.

a) Sectionalization of the network must be sufficient to allow identification of demand locations, cumulative demands, and relief alternatives. Old "rural" sections and allocation areas now overgrown with numerous connect points and cable branches or tapers can mask demand relationships, shortages, and plausible relief alternatives.
b) Official wire center demand forecasts and other documented extraordinary demand or service requirements, must be used to justify timing and sizing of all relief plans.
c) Relief plans must be implemented in context of an overall route plan and relief strategy, including effective use of existing facilities.
d) Area to be served by specific facilities, proposed or existing, should be known and documented.
e) While formal types of documentation are not required, "working" schematics, area maps, and/or other data tools are necessary to develop effective and efficient plans.

12. Development of Multiple Relief Alternatives

In keeping with findings from the recent field reviews, the 1998 LTDD reinforces the need to identify several relief alternatives, including minimum capital proposals. These should be assessed regarding budget impact, risks, timing, priorities, or other conditions to select the best alternative. However, all of these decisions would have to be made based on a disciplined planning process which must include the use of a forecast (tempered with extraordinary demand or service situations), assessment of route and service area interrelationships, and coordination with distribution plans. Critical decisions and deployment options should be identified for management review to finalize or revise budget and deployment plans. Furthermore, critical conditions for major projects should be reassessed prior to major expenditures.

13. Digital Line/Fiber Infrastructure Plan

Also in keeping with findings from the recent field reviews, the 1998 LTDD reinforces previous directives which outlined route/forecast-based long term planning for the digital line/fiber infrastructure, rather than nodal/event-based planning or deployments.

a) PCU/COU initiatives may trigger fiber facilities for specific services or customer sites, or to establish diversity or multi-CO routing.
b) Other near-term deployments should be based on forecasted demands.
c) Develop long term plans for loop diversity complete in conjunction with PCU/COU initiatives.
d) Group DS1 requirements into ADM ring node combinations and generally use OC-3.
e) Allocate 6 fibers per ADM ring, before and after diversity.
f) Ultimate requirements based on route forecast and sized for 6 fibers/1000 LUs or equiv. business lines plus specific PCU/COU needs.

14. Unbundled Loops

While there may be significant activity related to Unbundled Network Elements (or UNEs), those with the most impact on loop transport planning and provisioning are related to unbundled loops in which an CLEC offers services from their own switching network and requests use of BST's local loop network. However, the regional forecast for these types of circuits is less than 2% in 2002. These circuits will be provisioned much in the same way as non-switched or non-locally switched special services and will slightly increase the need for universal facility terminations. See Section 7 of LTDD. See RL:98-11-012BT for definitions and provisioning directives.

15. ATM Transport

There is also much interest in ensuring that emerging technologies, such as ATM transport, are utilized in all facility placements. However, until product designs and implementations mature, there are currently no viable substitutes for currently recommended SONET STM transport systems in the local loop. This is not to say that the transport of ATM-based services cannot be accomplished, since STM "envelopes" can be utilized. ATM service access multiplexers are expected to become available and be approved by the end of 1999 and are likely to first be applicable in high demand situations, such as a large business. As products are made available that match particular applications, then deployment directives will be issued or revised as appropriate.

16. High-speed Data via ADSL and FITL

Deployment of ADSL to provide high-speed data services has begun in seven metros: Atlanta, Birmingham, Charlotte, Ft. Lauderdale, Jacksonville, New Orleans, and Raleigh. These deployments are being planned and funded directly by a PCU/BBS initiative. Loop transport systems used to support these services beyond the limits of metallic feeder cable are generally separate from the systems used to transport telephony or other services. While this technology is being deployed to support these services via existing metallic distribution cable facilities, fiber distribution should continue to be deployed in new residential areas in keeping with these directives. High-speed data capabilities will be integrated into fiber distribution systems using additional or modified components. Specific directives regarding high-speed data using these technologies will be issued in 1999.

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
RL:98-09-019BT
EXECUTIVE SUMMARY

STRATEGIC INITIATIVES:

- Fiber cables will be the first choice for all new feeder cable placements and terminations. While there may be short extensions to utilize existing copper cable facilities, no new copper cables should be terminated at the central office.
- Next Generation Digital Loop Carrier (NGDLC) is the first choice vehicle for all new narrowband facility placements. These systems support both metallic and fiber distribution terminations and are an integral part of the emerging broadband/narrowband strategies.
- Fiber distribution, also known as Fiber-In-The-Loop (FITL), is the first choice architecture for all new residential developments requiring *either aerial or* buried distribution facilities. Our intent is to maximize FITL deployments and minimize copper distribution deployments.
- *Decisions regarding implementation of broadband services over existing or planned fiber distribution systems, as well as for facility replacements with fiber distribution delivering integrated voice and broadband services, will be supported by separate business cases.*

LOOP PLANNING:

- Existing facilities, including metallic cable, digital loop carrier, or high-speed fiber facilities, should be utilized to their fullest extent practical to satisfy current and forecasted demands.
- Proposed facility placements should be triggered by specific demand or replacement requirements and be coordinated with the overall long range requirements and current/fundamental plans for the entire route, wire center, and LATA. *Official wire center forecasts and other documented extraordinary demand or service requirements must be used to justify timing and sizing of relief plans.*
- Vacated metallic facilities made available by the transfer of existing lines to new facilities as required by feeder cable replacement activities (See Section 4) should be used to accommodate growth or other demand along the route.
- *Feeder and distribution deployment decisions must be coordinated to ensure that fiber distribution deployments are maximized. In new growth residential development areas, limits should be established for metallic distribution extensions to avoid placement and perpetuation of feeder and distribution infrastructure supporting metallic distribution.*
- *Several deployment alternatives should be identified for major deployment projects/jobs, including minimum capital proposals. Budget impact, risks, timing, priorities, and other conditions should be assessed to select the best alternatives.*

ISDN:

- Existing qualified facilities, including *non-loaded metallic cable* and Mode 1 universal carrier, should be used to satisfy ISDN demand.
- ISDN can be treated in a POTS-like manner when served via NGDLC systems using the large TR-303 interface.
- New facility placements should generally be selected and designed to accommodate demand for POTS and other tariffed special services. Costs for extraordinary changes in these new facility proposals required only to meet ISDN demand should be *funded via specific PCU/COU initiatives. With the availability of small ISDN-only systems, special assemblies will not be required and other systems will not be deployed to preposition for ISDN.*

FEEDER CABLE REPLACEMENTS:

- Within budget and manpower constraints, consider the placement of DLC or NGDLC growth facilities at the end of the metallic cable route, cutover existing metallic facilities, and use vacated pairs to provide relief facilities at growth sites closer to the central office. This cutover strategy will optimize the removal and retirement of metallic cable feeder facilities and should be targeted toward the replacement of those cables which carry the highest maintenance costs.
- Vacated pairs should be utilized where rearrangements, including placement of short sections of cable, can be performed on a planned basis such that entry into splices more than once in the 3-5 year planning period is avoided and additional stubbing is minimized.
- Where there is no forecasted demand for a vacated metallic facility during the next five years and no new metallic or DLC facilities are proposed along its route, then the vacant cable should be removed and retired.

CUSTOMER DS1s:

- Existing or planned multiplexer capacity, including those associated with NGDLC serving narrowband demand, should be utilized to support Customer DS1 demand.
- The most economical DS1 technology deployment alternative, including existing metallic cable, HDSL, OC-3, or new OC-1 and DS-2 Optical extensions, should be utilized to support Customer DS1 demand.
- Selected Customer DS1 sites, prioritized for implementation of fiber facilities by Legal, Regulatory, or a *PCU/*COU and funded by specific initiatives, should be served via the most economical fiber-based technology alternative, i.e. DS-2, OC-1, or OC-3. *Previous policies regarding the deployment of fiber facilities for all customer sites with six (6) or more DS1s are no longer in effect.*

NARROWBAND SERVICES:

- Minimize investments in metallic cable, conventional DLC systems, and associated equipment; maximize investments in NGDLC/FITL in anticipation of integrated broadband/narrowband systems.
- Minimize the placement of structures which will continue to require future placements of *conventional* DLC systems, such as SLC-5 or FDLC. New large cabinet sites should be satisfied with NGDLC/FITL in lieu of 80 *D/E*-type or 6200 cabinets. New 51*/52*-type *or 80A* cabinets for conventional DLC may be applicable for new *low to medium demand* sites, if the 5-year demand can be supported *and fiber distribution is not applicable. These may be particularly appropriate where development and demand have not yet warranted placement of NGDLC or FITL systems, such as low-growth rural wire centers. Small cabinet configurations for current NGDLC products have also been introduced for* use in these applications, *particularly where other activity has led to deployment of NGDLC systems.*
- Conventional DLC systems, such as SLC-5 and FDLC, should only be deployed in existing equipment housings which are incompatible with NGDLC or for new *low to medium demand* sites noted above.
- Service areas of existing DLC cabinets should be re-evaluated with deployment and relief plans for the entire route in order to serve primarily *areas with* existing distribution *plant* or *business* areas *(*not currently targeted for fiber distribution*)*. New cabinet placements along the route should be positioned and selected to allow maximum deployment of fiber distribution for new residential developments.
- Short sections of metallic cable may be placed to fill gaps in the feeder network and maximize the use of existing facilities, but should only be sized to meet the 3-5 yr. demand.
- Short extensions of *aerial or* buried metallic cable *for new residential development* may be placed to utilize previously designed distribution *infrastructure (backbone cable, cross-box,*

RT). However, these should generally be small-size cables serving limited numbers of living units *and should not be used to trigger or justify major expenditures in backbone distribution, cross-box or FDI, and feeder facilities.*

- Metallic distribution cable placements in areas not currently targeted for fiber distribution, such as business *areas, should* only be sized to support the 3-5 year demand. Backbone metallic distribution facilities should not be sized to support long term demand. Additional fiber distribution components to economically serve these applications are under development.
- *Digital Additional Main Line (DAML) equipment may be used to provide primarily distribution relief, but may also be useful for feeder relief in low growth situations. However, there are service limitations regarding modem speeds and future services. Small cable extensions in existing areas with a sufficiently sized backbone network are unlikely to be impacted by DAML technologies.*

DLC INTEGRATION AND SPECIAL SERVICES:

- *TR-303 is now the preferred choice for integration of system terminations in 5ESS and DMS-100 switches from both RELTEC and DSC NGDLC platforms.*
- Dedicated special service capacity should be established in each NGDLC node to allow grooming of special services *and unbundled loops* at the RT via electronic cross-connects. *Switch peripheral sidedoor capabilities should not be used to support special services transported via NGDLC.*
- *Unbundled loops are forecasted to represent only 2% of total lines by 2002 and should be provisioned in the loop network much like non-switched or non-locally switched special services.*

FIBER TRANSPORT AND LOOP DIVERSITY PLANNING:

- When new fiber facilities are needed to meet growth or replacement requirements, fiber placements should be planned to implement a fiber cable infrastructure sized for six fibers per 1000 households or equivalent business lines. Long range plans for completion of loop diversity should also be made.
- Specific plans for additional fibers or fiber cables, or for loop diversity routing should be funded through *PCU*/COU initiatives in targeted metros, wire centers, routes, or areas.
- Specific market areas and selected customer sites for implementation of multi-CO diversity should be qualified, prioritized, funded, and approved through *PCU*/COU initiatives for specific services, such as SmartPath.

Loop Transport Checklist/Job Aid: Auth.#__________ Date:__________ Initials:_____

RL:98-09-019BT. Changes from previous issue shown in green italics.

FUNDAMENTAL STRATEGIES (*"STOP"* on this checklist indicates potential inconsistency with the strategies)

- Maximize use of existing facilities to minimize capital requirements.
- *Identify several alternatives for major projects/jobs. Evaluate budget impact, risks, priorities to select best alternatives.*
- Place fiber as the first choice for new feeder transport facilities.
- Larger fiber cables/low-speed electronics are generally more economical than smaller cables/high-speed elect.
- Use NGDLC for feeder relief and significantly reduce SLC-5 and FDLC purchases.
- Coordinate loop and switch integration plans to maximize TR-303 for NGDLC and Mode 2 for DLC placements.
- Deploy fiber distribution in all new residential developments or major extensions. *Place limits on metallic dist. infrastructure.*
- Copper distribution cables should utilize the finest gauge to satisfy CSA and supervision limits (see RL:96-02-026BT).
- DAML is the last choice for distribution relief and only has niche applications for very slow growth feeder relief.

DISTRIBUTION CABLE PLACEMENTS

Fiber ☐ ➡ LUs/ONU < *5Bur/10Aer* ☐ ➡ [*Re-evaluate layout per Table N4/App 6-1*] [One Fbr/*8 LUs* +20% spares?] N ☐ ➡ ➡ [*Re-evaluate design per Table N4*] / Y ☐ OK
LUs/ONU >= *5Bur/10Aer* ☐ OK

Copper ☐ ➡ *Buried/Aerial* ☐ ➡ Residence ☐ ➡ ➡ [Req. Feeder, X-Box or Backbone Cables?] Y ☐ ➡ ➡ [STOP: Re-evaluate for fiber distribution] / N ☐ ⬇
Bldg Only ☐ OK Business ☐ ⬇

None ☐ OK [Size X-box and/or backbone dist. cable for 3-5 yr demand only.] [*Expected Demand Supported by Existing Infrastructure?*] N ☐ ⬆ / Y ☐ OK

FEEDER FACILITIES

Route Relief Plan Reviewed/Updated?
N ☐ ➡ ➡ [STOP: Review and update route facility inventory and relief plan]
Y ☐ OK

Vacant Copper Pairs Available Along Route?
Y ☐ ➡ ➡ [STOP: Review/revise route relief plan to utilize vacant copper pairs in route]
N ☐ OK

Fiber Cable/Mux Sizing and Usage
OC-*1*/3 ☐ OK For DS1 and DLC/NGDLC Transport
OC-12 ☐ ➡ *Generally to serve DS3 specials.*

Copper Pairs Available Via Cutover at Other CSA?
Y ☐ ➡ ➡ [STOP: Re-evaluate route plan to cutover lines at other CSA to provide relief.]
N ☐ OK

Fiber Cable Plans Coordinated With CMS/BBS Broadband Requirements and Budgets?
N ☐ ➡ [STOP: Review fiber cable sizing, routing, and usage to include CMS/BBS budgeted requirements.]
Y ☐ OK
N/A ☐ Not in targeted area.

RT HOUSING PLACEMENTS - See Table N3 for DLC/NGDLC/FITL product selection

51/52, or 80A ☐ ➡ [Will it satisfy the 5 yr RT demand?] Y ☐ ➡ [*Fiber Fed 80A or Other NGDLC in WC*] N ☐ ➡ ↘ / Y ☐ ↙ ; N ☐ ⬇
Hut, CEV, CEC ☐ OK
80 *D/E* or 6200 ☐ ➡ [STOP: Revise plans to place NGDLC/*FITL* housing]
LSC (LiteSpan) ☐ ➡ ➡ [*Supporting residential development growth?*] Y ☐ ⬆ / N ☐ OK
MESA (DISC*S) ☐ OK

[*Supporting residential development growth?*] N ☐ OK / Y ☐ ⬇ [STOP: *Re-evaluate plans* for NGDLC/*FITL* cabinet]

DLC/NGDLC SYSTEM PLACEMENTS (See **Table N3** for DLC/NGDLC product selection)

SLC-96	☐ ➡	**Copper distribution only**	**Only for existing cabinets wired for SLC96 or special situations.**
SLC-5	☐ ➡	**Copper distribution only**	**Only for 51-type,** *80A*, **or existing 80-type cabinets wired for SLC5.**
FDLC	☐ ➡	**Copper distribution only**	**Only for** *existing 2200 or* **6200 cabinets wired for FDLC**
DISC*S	☐ ➡	**Fiber or copper distribution**	**For new or existing huts, CEVs, CECs, or MESA cabinets.**
LiteSpan	☐ ➡	*Copper distribution only*	*Mode 1 only; DSC ADM only.* **New/exist. huts, CEVs, CECs, LSC cab.**

CO TERMINATIONS: SLC-96, SLC-5, FDLC

Universal ☐ ➡ ➡ ➡ [Digital Switch?] Y ☐ ➡ ➡ [To support specials?] Y ☐ ➡ [Sidedoor planned or available?] N ☐ OK / Y ☐ ⬇
Int. TR008 M1 ☐ >50% Bus. — Digital Switch? N ☐ OK — To support specials? N ☐ ⬇ — [Specials >5% of system capacity?] Y ☐ OK / N ☐ ⬇
Int. TR008 M2 ☐ >50% Bus.
Int. TR303 ☐ ➡ [Only for special ISDN applications (SLC-5) *coordinated with PCU/COU.*]

[STOP: Coordinate DLC and switch plans to maximize integration, including sidedoor.]

CO TERMINATIONS: DISC*S, LiteSpan

Int. TR008 M1 ☐ >50% Bus. ➡ [RT demand meets min. TR303 sizing? *See Table N4*] Y ☐ ↗ [TR303 planned or available?] Y ☐ ➡ [STOP: Revise plans to implement TR303] / N ☐ ⬇
Int. TR008 M2 ☐ >50% Bus. ➡ — RT demand meets min. TR303 sizing? N ☐ OK
[*TR008/TR303 terminations from large NGDLC exceed threshold in DMS100, 5ESS, EXM2000?*] N ☐ OK / Y ☐ ⬇
Universal ☐ ➡ ➡ ↘
Int. TR303 ☐ ⬇ [For Specials or ISDN only?] N ☐ ➡ ➡ / Y ☐ OK [Digital Switch?] Y ☐ ➡ ➡ / N ☐ OK [NGDLC plans coordinated with Switch Cap. Man.?] Y ☐ OK / N ☐ ⬇

[NOTE: See Table N4 for TR303 termination sizing, DS1 requirements, and CO thresholds] ⬅ ⬅ ⬅ ⬅ [STOP: Coordinate/*Review* NGDLC and switch plans to maximize integration and TR303]

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
RL:98-09-019BT

1.00 INTRODUCTION

1.01 UPDATE TO EXISTING LOOP GUIDELINES AND DIRECTIVES

This document supersedes and updates all information previously contained in *RL:96-09-026BT*, the *1996* issue of the BellSouth Loop Technology Deployment *Directives (LTDD). Changes* from the previous document are highlighted in *blue italics*. It also incorporates provisions of recently issued directives concerning loop technology deployment, including:

RL:97-03-027BT	*Loop Deployment Directives for ONU-12/24*
RL:97-11-017BT	*Update to Fiber Distribution Deployment Directives*
RL:98-09-014BT	*DS1 Technology Deployment Directives (update)*
RL:98-09-003BT	*Digital AML Deployment Directives*
RL:98-09-025BT	*Aerial Fiber Distribution Deployment Directive*
RL:98-10-031BT	*Alcatel (DSC) StarSpan Fiber-in-the-Loop (FITL) System Removal of Product from Approved Product List*

The Loop Technology Deployment Directives (LTDD) provide a comprehensive package of directives and recommendations regarding the deployment of loop technologies, including *planning fundamentals, metallic and fiber distribution,* fiber cable, loop diversity, SONET, ISDN, feeder cable replacement, metallic cable, and loop electronics. In keeping with the previous format, much of the discussion of alternatives, advantages and disadvantages, economic comparisons, technical details, strategic implications, etc., has been eliminated or summarized into tables. As reference, some of these details can be found in the deployment directives associated with specific issues. However, the directives and recommendations in this guideline supersede all those contained in the previous documents. Updates to specific sections, pages, or other parts of this document will be provided as appropriate to reflect changes in technologies, costs, and strategies. Study results and detailed discussions associated with the revised directives or recommendations will be provided under separate cover, if required.

1.02 STRATEGIC INITIATIVES

These directives *continue to* reinforce our core BST strategy to quickly move towards NGDLC and FITL which should be used to drive our loop deployments and which position the network for future services. The strategic initiatives related to these issues are listed below:

a. Fiber cables will be the first choice for all new feeder cable placements and terminations. While there may be short extensions to utilize existing copper cable facilities, no new copper cables should be terminated at the central office.

b. Next Generation Digital Loop Carrier (NGDLC) is the first choice vehicle for all new narrowband facility placements. These systems support both metallic and fiber distribution terminations and are an integral part of the emerging broadband/narrowband deployment plans.

c. Fiber distribution, also known as Fiber-In-The-Loop (FITL), is the first choice architecture for all new residential developments requiring *either aerial or* buried distribution facilities. Our intent is to maximize FITL deployments and minimize copper distribution deployments.

d. Feeder and distribution deployment decisions must be coordinated to ensure that fiber distribution deployments are maximized. In new growth development areas, limits should be established for metallic distribution extensions to avoid placement and perpetuation of *feeder and distribution infrastructure supporting metallic distribution.*

e. *Decisions regarding implementation of broadband services over existing or planned fiber distribution systems, as well as for facility replacements with fiber distribution delivering integrated voice and broadband services, will be supported by separate business cases.*

Recent approvals of projects to replace existing feeder and distribution facilities in Atlanta and South Florida with a fiber distribution network to deliver integrated voice and broadband services (also known as IFITL) have accentuated the importance of the fiber distribution deployment strategy. Decisions regarding implementation of broadband services and facility replacements in other areas will be supported by separate business cases. In other new growth areas or extensive rehab situations, we must take advantage of every facility placement opportunity to ensure that deployment plans do not perpetuate the metallic distribution network, but maximize fiber distribution deployments in keeping with these directives. Deployment of fiber distribution with aerial facilities has recently been approved and fiber is now the first choice for all new facility placements, whether buried or aerial. We are continuing to work with our equipment vendors to introduce additional or enhanced products that will further reduce the cost of fiber and provide broadband-ready features. Incremental costs of fiber distribution have been verified to be approximately $200/LU and budget requirements for forecasted deployment volumes of both buried and aerial facilities are included in the load-driven budgets. While the $200 incremental cost for fiber distribution should be coded to the FIBD program code, these expenditures are mapped to the load-driven growth budget. Although the DSC StarSpan was approved as a second fiber distribution system per RL:97-09-025BT, the acceleration of broadband deployment plans and the lack of progress in development of a viable data transport implementation have led the removal of DSC StarSpan from the approved product list per RL:98-10-031BT. A new broadband-ready fiber distribution product line is under development by DSC, now Alcatel, and we are continuing to work with them toward the introduction of that system. ***However, until other vendor products are approved, RELTEC DISC*S fiber distribution components should be deployed in ALL qualifying locations, either requiring new HDTs or utilizing existing RELTEC HDTs, instead of the traditional copper distribution networks.***

Purchases of *conventional DLC systems, such as* SLC-5 or FDLC, will *continue to* be limited to existing cabinets or *low-growth* RT sites per the deployment directives. *Two* small-platform NGDLC products *are being introduced* to provide better alternatives for *low-growth* sites.

Fundamental strategies and specific deployment directives or recommendations are outlined for each area of loop technology deployment in the following sections of this document.

1.03 RECOMMENDATIONS/FLOWCHARTS

A series of coordinated deployment recommendations and flowcharts were developed in the *previous directives* to facilitate the technology decision process for various aspects of the network. The *1998 LTDD* continues this format updated to reflect *specific issues that warrant changes from the previous document.* The directives, recommendations, and related issues are outlined in the following sections of this document for the topics listed below:

Although the loop planning and technology selection process is *often* complex, this consolidated/streamlined document contains some blanket or simplified recommendations in keeping with corporate strategies to reduce work content and to position the network for future services.

Associated flowcharts illustrate the critical decision factors, the sequence of decision points, and the coordination of the various network issues. Flowchart reference numbers are indicated in brackets **[ ]** for appropriate items. Flowchart boxes signify work activities, diamonds represent decision points or factors, circles designate significant inputs or outputs, and dashed lines indicate output feedback loops to previous sections. A myriad of different flowchart configurations can be created, but the main issue should be on whether an appropriate conclusion can be reached. Some seemingly obvious points are included to ensure that the flowcharts are complete and to redirect attention to some fundamentals that in some cases have been neglected. Although some decision points may appear more than once in different decision paths and one branch from each may lead to similar conclusions, the alternate branches may lead to different conclusions. Once the detailed directives and recommendations become familiar, these flowcharts can be used as a working summary.

As with the previous *documents*, these directives should be used for selecting the appropriate deployment solution, but should not be used to justify an unreasonable plan. Always use sound engineering judgment to select the most appropriate relief strategy, in keeping with overall corporate strategies documented in this letter. *Furthermore, relief plans must be implemented in context with an overall route plan and relief strategy.*

2.00 Loop Planning and Technology Selection

This section summarizes some of the steps involved in the loop planning process which should form the framework for the deployment decision process. These are highlighted by the "Loop Planning and Technology Selection" flowchart following this section.

The loop planning process should be guided by the following fundamental strategies:

a. Existing embedded facilities, including metallic cable, digital loop carrier systems, or high-speed fiber facilities, should be utilized to their fullest extent practical to satisfy current and forecasted demands.

b. Proposed facility placements should be triggered by specific demand or replacement requirements and be coordinated with the overall long range requirements and current/ fundamental plans for the entire route, wire center, and LATA. *Official wire center forecasts and other documented extraordinary demand or service requirements must be used to justify timing and sizing of relief plans.*

c. Vacated metallic facilities made available by the transfer of existing lines to new facilities as required by feeder cable replacement activities (See Section 4) should be used to accommodate growth or other demand along the route.

d. Feeder and distribution deployment decisions must be coordinated to ensure that fiber distribution deployments are maximized. In new growth residential development areas, limits should be established for metallic distribution extensions to avoid placement and perpetuation of feeder and distribution infrastructure supporting metallic distribution.

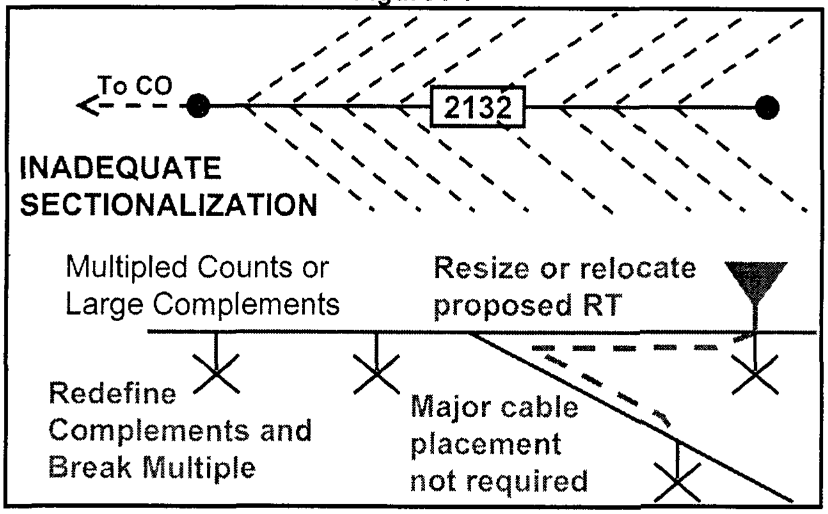
e. Several deployment alternatives should be identified for major deployment projects/jobs, including minimum capital proposals. Budget impact, risks, timing, priorities, and other conditions should be assessed to select the best overall route plan. Relief plans must be implemented in context with an overall route plan and relief strategy.

Deployment decisions derived in each section of this document will impact the planning process and deployment decisions in subsequent or even previous sections. These impacts are illustrated by the progressive flow of information to each section along the "Loop Planning" flowchart and the feedback of information to previous sections (dashed lines). For example, the impact of feeder cable replacement activities **[R000]** may result in additional metallic pairs being made available along the route closer to the central office (CO) than the replacement activity itself. These additional pairs can be used for narrowband relief **[N000]** or for ISDN demand **[R002 back to I000]**.

The following items in this section outline specific recommendations, critical factors, flow chart references, and other issues related to the loop planning and technology selection process.

*2.01 Obtain wire center and other PCU/COU market forecasts **[P100]**. Official wire center forecasts for all service types can be obtained via the LEAD module of LEIS. These should be used in establishing the forecasted demand for individual areas and routes. Also review and update loop network sectionalization. All major distribution connections, route branch points and major tapers, and remote electronics sites should be reflected. Old "rural" sections and allocation areas now overgrown with numerous connect points and cable branches or tapers can mask demand relationships, shortages, and plausible relief alternatives. Sectionalization must be sufficient to allow identification of demand locations, cumulative demands, and relief alternatives. An example of inadequate sectionalization is shown on Figure P1.*

Figure P1



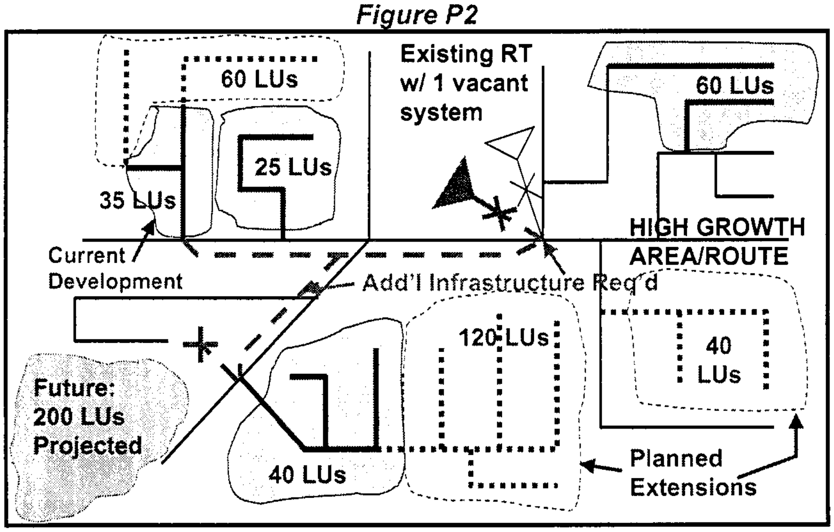
In metro and suburban areas, Distribution Areas (DAs) are the fundamental geographic building blocks for loop planning and administration. Each DA represents a collection of distribution service cables and terminals that are all considered or intended to have the same connect point to the network, usually a cross-connect box or large building terminal in the case of metallic distribution. Typical sizes included approximately 600 LUs or business lines and distribution loop lengths were typically short (3-6 kft). These should be created or changed as facilities are placed for new residential or business developments. Several DAs could be grouped into an Allocation Area (AA) for administering similarly designed metallic feeder pairs, or for administering large collections of feeder facilities that could not be easily divided due to multiple terminal appearances by the same pairs. These should also be changed as multiple is eliminated and as facilities are cutover to carrier. Rural Allocation Areas (RAAs) have been used to designate rural and fringe areas with no planned development. It also represents a collection of distribution service cables and terminals that are all considered or intended to have the same connect point to the network, usually a cross-connect box. Distribution loop lengths are typically longer (12 kft and longer) and demand varies widely. These should be deleted or changed as facilities are placed for additional growth or as DAs are created to administer new development areas.

Carrier Serving Areas (CSAs) were added to designate the collection of DAs served by a Remote Terminal (RT) location or locations. Total loop lengths from the RT are generally limited to 9 kft of 26 GA cable or 12 kft of 24 or 22 GA cable. Sometimes a CSA served a single DA, and other times, many DAs. Connect points for the DAs may or may not be collocated with the CSA. The CSA and its RT facilities may also become part of a larger Allocation Area or may become synonymous with a single Allocation Area. A CSA typically serves only one RAA because of the longer loop lengths. CSAs should be added or changed as new RT sites are added or as changes are made to the DA/AA/RAA configuration.

Prior to fiber distribution, the common denominator for all of these areas has been the metallic distribution cable. DAs and CSAs have been used much in the same way to support fiber distribution deployments to date. In this case, connect points for the DAs and supporting CSA are located at the same place, the TSI of the NGDLC/FITL platform. In some cases, both fiber distribution and metallic distribution are served from the same RT site, each serving different portions of the same CSA. However, maintaining the same CSA configuration created for metallic distribution to introduce fiber distribution may mask fiber distribution opportunities and may not optimize fiber distribution design for either *near-term deployments or for long-term broadband needs. Separate Fiber Service Areas (FSAs) may need to be identified as discussed in Section 2.02 below.*

2.02 *Identify areas with new residential development growth **[P110]**. These may include single large "named" developments with detailed master plans, as well as areas along old rural routes with a metro-sprawl development pattern of numerous small to medium-size developments. Separate or sequential decision processes regarding distribution and feeder placements for these areas can lead to exhaust of backbone and infrastructure as multiple distribution extensions or expansions are planned, engineered, and implemented. In order to avoid the perpetuation of a metallic distribution network and maximize fiber distribution deployments in keeping with the strategic initiatives in Section 1.02, limits should be established for metallic distribution additions to the existing infrastructure **[P120]**. For example, if the existing backbone, x-box, and/or RT housing can only accommodate demand for 60 more LUs, then distribution placements beyond this limit should be designed for fiber distribution, along planned infrastructure placements. Expected demand from LUs yet to be completed, but for which facilities have already been placed, should also be considered. An example of the impact of sequential distribution decisions on infrastructure placements is shown on Figure P2.*

Figure P2



*Distribution and infrastructure plans should be coordinated with engineering representatives or coordinates to identify new Fiber Service Areas (FSAs) for continued growth with fiber distribution facilities **[P130]**. An FSA is synonymous with a CSA for fiber distribution facilities. Since the distribution connection point is located with the HDT/RT equipment, the FSA would also be generally synonymous with a DA, similar to a CSA serving a single collocated DA. While there may be a need to identify multiple fiber DAs served by one FSA, these will be treated as one in the same for the discussions in this document. Boundaries for these areas do not need to match existing CSA boundaries and may in fact be interwoven with existing CSAs to serve a collection of non-adjacent new development tracts. Furthermore, previously designated boundaries of "existing metallic distribution areas" and supporting CSAs should be re-evaluated to encompass primarily the area for which most of the distribution facilities have been placed and for which planned extensions will not result in significant additions to the supporting infrastructure. Where practical, FSA boundaries should be extended to 12 kft of fiber and power cable to maximize the number LUs to be served from proposed or potential RT housings.*

2.03 Document existing & forecasted demands for DS0, DS1s, DS3s, and other broadband requirements for each DA, RAA, CSA, *and FSA* **[P100]**. Narrowband demands for each DA and RAA should represent the totals for that area, whether served by DLC or metallic cable. Demands for the CSA should represent the totals for the entire area to be served by the existing or potential RT site, not just the amount of demand served or to be served by NGDLC/DLC. *Obviously, demands for an FSA are all accommodated via NGDLC/FITL systems. Total demands for all service areas of a wire center should be reconciled to official wire center forecasts.* Differences between the planning forecast and *official* forecasts should be identified and fully documented, particularly for DS1, DS3, and other broadband service requirements. Deployments and expenditures based on these forecast differences should also be identified for each of the deployment decisions outlined in other sections of this document and in the budget documentation discussed later in this section.

2.04 If there is ISDN demand expected <=3 years **[I100]**, then see Section 3 and the associated flowchart of technology selection for ISDN demand **[I000]**. Since ISDN demand may lead to specialized facility treatments, these should be determined first and used to modify the PMO for other deployment decisions. For example, the capacity of carrier systems placed specifically to serve ISDN should be included in the total available NGDLC/FITL and DLC capacity to be utilized in that CSA; or the impact of cutover activities to provide existing metallic pairs for ISDN should be reflected in the number of carrier channels used at the cutover site and in the number of metallic pairs available at the ISDN site.

2.05 Determine cumulative route demands less channel shelf capacity of existing NGDLC/FITL and DLC systems utilized by growth requirements **[P200]**, including proposed placements for ISDN **[I000]**. Because of cable replacement and cut-over activities to be explored in later sections, it is important that potential uses for vacated capacity in existing metallic facilities be readily apparent prior to technology selection and allocation of existing spare facilities. Therefore, demand beyond the channel shelf capacity of existing NGDLC and DLC systems should be included in cumulative route demands in lieu of continued NGDLC/DLC placements at an existing RT housing or assumed new NGDLC/DLC placements at a new RT. Obviously, demands to be accommodated on existing or proposed fiber distribution facilities will be transported via NGDLC/FITL platforms and will not contribute to this "net" route demand.

2.06 If there are potential feeder cable replacements expected <=3 years **[R100]** due to maintenance or road move activities, then see Section 4 and the associated flowchart of technology selection for feeder cable replacements **[R000]**. If the facilities are to be replaced with NGDLC/DLC, then removal of feeder cable sections near the end of the route may make additional facilities available for growth at sites closer to the CO. Proposed NGDLC/DLC systems for facility replacements **[R001]** and/or vacated metallic pairs **[R002]** may also have an impact on technology decisions for ISDN demand **[I000]** as discussed in Section 3. Feeder cable replacement strategies may also be combined with distribution replacement plans to maximize deployment of fiber distribution facilities supported by NGDLC/FITL systems and migrate the network to support future services.

2.07 Determine total *feeder* facilities available along the route and for each DA, RAA, CSA, *and FSA* **[P300]**. These should include the impact of ISDN deployment plans and feeder cable replacement decisions. The result represents an adjusted PMO for technology selection of growth facilities. *Obviously, feeder facilities to support fiber distribution FSAs* *are not affected by this route assessment of available facilities since all FSA demand is served via NGDLC/FITL systems.*

2.08 If there are forecasted or existing customer DS1s <=3 years **[D100]**, then see Section 5 and the associated flowchart of technology selection for customer DS1s **[D000]**. Proposed fiber and mux placements for customer DS1s may have an impact not only on further decisions in the loop planning process, but also **[D001]** on technology decisions for feeder cable replacements **[R000]** as discussed in Section 4.

2.09 Compare demands for narrowband services to available facilities at each DA, RAA, *FSA,* and along route **[P400]**. As discussed in item 2.03 above, it is important that demand beyond the channel shelf capacity of existing NGDLC and DLC systems be allocated to the route, and not arbitrarily credited to assumed continued NGDLC/DLC placements at an existing RT or assumed new NGDLC/DLC placements at a potential RT. This will ensure that metallic facilities vacated by the removal of feeder cable sections further out the route due to feeder cable replacements or cutover decisions will be fully utilized. Obviously, demands to be accommodated on existing or proposed fiber distribution facilities will be transported via NGDLC/FITL platforms and cannot be satisfied by existing metallic facilities. Deployment plans should be optimized to obtain maximum utilization of existing metallic facilities in areas not targeted for fiber distribution deployments, such as existing distribution areas *or* business areas, as well as to maximize deployments of fiber distribution. *"Existing distribution areas" are primarily those for which most of the distribution facilities have been placed and planned extensions will not result in significant additions to the supporting infrastructure. These should not include large tracts of vacant land with anticipated development. See Section 2.02*

2.10 If *relief for narrowband feeder or distribution* is required at a DA, RAA, *or FSA* <=3 yrs **[N100]**, then see Section 6 and the associated flowchart of technology selection for narrowband services **[N000]**. Alternatives for narrowband services include the use and/or deployment *of* NGDLC/FITL, conventional DLC in some cases, *Digital Added Main Line (DAML),* and short extensions of metallic cable facilities. The impact of integration and special service issues will also be considered (Section 7), as well as DS1 trunking options for the DLC alternatives. Proposed fiber and mux placements for narrowband relief **[N001]** may impact technology selection or deployment plans for customer DS1s **[D000]** as discussed in Section 5 and/or feeder cable replacements **[R000]** as discussed in Section 4. Proposed NGDLC/FITL, DLC, or short extensions of metallic cable placements for narrowband relief **[N001]** may impact technology selection or deployment plans for feeder cable replacements **[R000]** as discussed in Section 4 and/or ISDN demand **[I000]** as discussed in Section 3.

2.11 Determine cumulative DS1/DS3 demand for fiber transport and identify mux sites **[P500]**. These should include not only those demands generated by deployment plans for ISDN, cable replacement, customer DS1, NGDLC/FITL, and conventional DLC, but also those generated by business broadband requirements, such as LightGate, SmartRing, and Native Mode LAN Interface (NMLI). Previous loop planning and technology selection decisions only include the type of transport and the amount of demand (DS1s) to be included on the fiber network.

2.12 If there are fiber cable and/or lightwave electronics placements required <=3 yrs **[F100]**, then see Section 8 and the associated flowchart of fiber transport and loop diversity planning **[F000]**. This process will examine fiber routing for loop or multi-CO diversity, ADM ring groupings, and cumulative or ultimate fiber requirements. Fiber sizing for specific cable placements will be handled in subsequent planning steps.

2.13 *If there are no cable or equipment placements required within 3 years, then d*ocument long range deployment plans for each route, wire center, or LATA ***[P690]*** *to reflect future fiber cable placements and metallic cable extensions, potential feeder cable removals or retirements, and future system placements and RT sites.*

2.14 If there are cable, equipment, and/or switch termination placements required <=3 years ***[P600]****, see Tables P1 and P2 at the end of this section for cable and equipment sizing/timing criteria* ***[P610]*** *and review deployment alternatives for major projects/jobs, including minimum capital proposals* ***[P620]****. Assess budget impact, market/demand risks, timing, priorities, and other conditions to select the best overall plan* ***[P630].*** *Critical decisions and deployment options, particularly those with a wide disparity in budget impact, should be reviewed with the management for approval, informally during planning activities and/or formally during route reviews* ***[P640]****.*

2.15 *Finalize* project/job proposals and document budget requirements ***[P650]****. Also document long range deployment plans for the route wire center, and/or LATA based on approved project proposals* ***[P690]****. These should include:*

a. Proposed fiber cable placements
b. Proposed metallic cable extensions
c. Establishment of new NGDLC/FITL or conventional DLC sites
d. Deployment of additional NGDLC/FITL or DLC systems
e. Switch termination requirements for narrowband facilities, including TR-008, TR-303, and universal systems, as well as dedicated special service systems.
f. Serving CO fiber and ADM ring configurations
g. Multi-CO fiber and ADM ring configurations
h. Metallic feeder cable removals/retirements

2.16 Prepare forecasts of facility placements to interdepartmental work groups ***[P660]****.* Of particular importance is the forecast of facility terminations at the local serving switch including:

a. [Metallic cable terminations eliminated]
b. Universal or special service carrier terminations
c. Integrated carrier terminations - TR-008 (Mode 1, Mode 2, protection DS1 requirements)
d. Integrated carrier terminations - TR-303 (# systems, # lines)
e. Sidedoor/hairpin requirements for integrated carrier systems

2.17 *Critical conditions for major projects should be reassessed prior to major expenditures to ensure that placements are still required and are consistent with current budget and market situations* ***[P670]****.*

TABLE P1
CABLE SIZING/TIMING CRITERIA

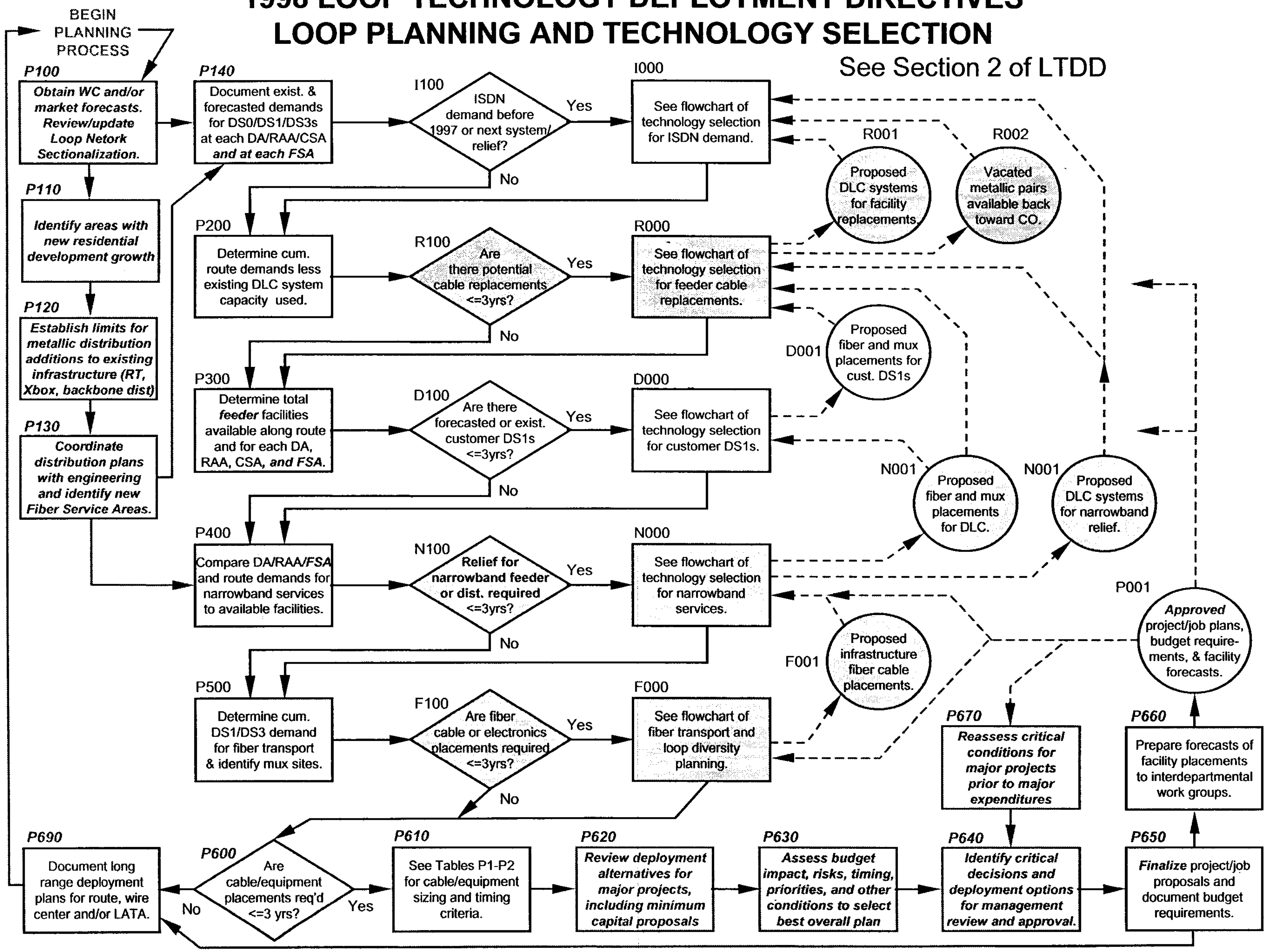
FEEDER CABLE	Metallic	Extensions Only	3-5 year demand (See Section 6)
	Fiber	Minimum:	5 year demand for forecasted lightwave electronics requirements (minimum of 12 fibers in metro areas)
		Maximum:	15 year ultimate demand (6 fibers per 1000 LUs or equivalent business lines)
DISTRIBUTION CABLE	Metallic	Residential	Ultimate demand (extensions only) *for 3-5 year development. Size balanced with existing infrastructure. (See Section 6)*
		Business	3-5 year demand
	Fiber	Res. (buried)	*Maximum of* 1 fiber per ONU *or one fiber per 8 LUs at service pedestal location +* 20% spare *(above requirement)*
	Power	Res. (buried)	One 22-ga. pair (0-6 kft *buried or 0-5.7 kft aerial*) or two 22-ga. pairs (6-12 kft *buried or 5.7-11.3 kft aerial*) per ONU *or fiber required* + 20% spare *(above requirement)*
BUILDING ENTRANCE	Fiber	Minimum	12 fibers

TABLE P2
EQUIPMENT SIZING/TIMING CRITERIA

DIGITAL LOOP CARRIER	SLC-5/FDLC	NGDLC	FITL
Cabinet Housing	3-5 year demand	***10 year*** demand (Growth+Cutover)	***10 year*** demand (Growth+Cutover)
HW Channel Banks in cabinets	2 year demand	2 year demand	2 year demand
HW Channel Banks - in huts/CEVs	1 year demand	1 year demand	1 year demand
Common plug-ins	1 year demand	1 year demand	1 year demand
Pre-provisioned Channel Units	1 year demand	1 year demand	1 year demand (Max. 1 line/LU)
Optical Network Units (ONUs)	Not Applicable	Not Applicable	1 year demand
SONET MULTIPLEXERS			
Add Drop Multiplexer Rings	ADM RT	10 year demand for ADM node	
	ADM COT/Ring	Sum of total 10 yr demand for ADM RTs <=75% COT/Ring capacity; Maximum of 8 ADM RTs per ADM ring	
Point-to-Point Systems	COT/RT	2 year demand for RT node	

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
LOOP PLANNING AND TECHNOLOGY SELECTION

See Section 2 of LTDD



3.00 TECHNOLOGY SELECTION FOR ISDN DEMAND

This section summarizes the decision process and deployment directives and recommendations for satisfying ISDN demand requirements. These are highlighted by the "Technology Selection for ISDN Demand" flowchart following this section.

Technology selection for ISDN demand should be guided by the following fundamental strategies:

a. Existing qualified facilities, including *non-loaded metallic cable* and Mode 1 universal carrier, should be used to satisfy ISDN demand.

b. ISDN can be treated in a POTS like manner as Next Generation Digital Loop Carrier (NGDLC) systems, using the large TR-303 interface, become the standard transport facility for all narrowband demand, including ISDN. Small TR-303 (96-line) systems, *such as SLC-5 FP-303,* should only be proposed when required to meet specific ISDN demand *in conjunction with other* narrowband relief plans. *These small systems will generally be limited to 5ESS switch capacity specifically set-up for small TR-303 systems and each system deployment must be coordinated with Switch Capacity Management and PCU/COU representatives.*

c. New facility placements should generally be selected and designed to accommodate demand for POTS and other tariffed special services. Costs for extraordinary changes in these new facility proposals required only to meet ISDN demand should *be funded via specific PCU/COU initiatives. With the availability of small ISDN-only systems, such as the FITEL or Conklin mini-shelf, special assemblies will not be required and other systems will not be deployed to preposition for ISDN. Furthermore, the ADTRAN "Total Reach" DSL can extend the loop length for ISDN provisioning via non-loaded pairs.* See Table I1 for a list of provisioning or deployment alternatives. Items 1-9 reflect *alternatives* discussed in this section and are generally funded through normal growth budgets, *except for the ISDN mini-banks and DSL repeater plug-ins. These components are funded by the PCU/COU and are generally placed on a service-order basis. Items* 10-20 represent *alternatives that* would generally require additional funding. *Most of these options have been eliminated in favor of the mini-shelf arrangement.*

As previously discussed, ISDN demand may lead to specialized facility treatments and therefore these should be determined first and used to modify the PMO for other deployment decisions. For example, the capacity of carrier systems placed specifically to serve ISDN should be included in the total available NGDLC/FITL and DLC capacity to be utilized in that CSA; or the impact of cutover activities to provide existing metallic pairs for ISDN should be reflected in the number of carrier channels used at the cutover site and in the number of metallic pairs available at the ISDN site.

The following items in this section outline specific directives and recommendations, critical factors, flow chart references, and other issues related to technology selection for ISDN demand.

3.01 If there is **NO** ISDN demand expected within 3 years **[I100]**, then go back to Section 2 and the associated flowchart of loop planning and technology selection to continue the loop deployment decision process **[P200]**.

3.02 *TR-303 has been approved for the RELTEC NGDLC/FITL systems with both the 5ESS and DMS-100. TR-303 has also been approved for the Alcatel/DSC NGDLC system with the 5ESS and approval is pending with the DMS-100. The deployment of large platform TR-303 interfaces supporting widely deployed NGDLC systems will allow ISDN to be provisioned in a more POTS-like manner and will eliminate virtually all unique facility requirements to serve ISDN for new system placements. See Section 6 and 7 for* *discussion of TR-303 deployment decisions and parameters. Other* NGDLC/FITL or DLC alternatives for ISDN using the BRITE card implementation cannot be integrated. See Tables S1-S4 in Section 7 for service capabilities for various carrier system and switch types. *SLC-5 FP303 is available for TR-303 integration with a No.5ESS, but system size is* limited to 96 lines. These arrangements are generally not cost effective for low ISDN demands and should only be considered when ISDN demand is known or imminent *and only in coordination with specific PCU/COU funding. Furthermore,* deployment of *these small* systems to satisfy a forecast for unidentified ISDN demand should be avoided. This means that narrowband facility placements triggered by forecasted demand should be based on requirements for POTS and services other than ISDN.

3.03 Planning for TR-303 switch capacity must be done in conjunction with switch process planners and equipment engineering to ensure appropriate quantities of TR-303 and TR-008 interfaces are ordered, installed, and utilized. TR-303 *has been approved for the RELTEC* NGDLC/FITL *platform with both the 5ESS and DMS-100. TR-303 has also been approved for the Alcatel/DSC NGDLC system with the 5ESS and approval is pending with the DMS-100. These platforms allow the large system terminations, typically 175-672 lines (see Section 6). Planning* for this capability should reflect the increasing penetration of these NGDLC platforms in loop deployment plans. *SLC-5 FP303 is available* for *TR-303* integration *with a* No.5ESS, *but* ISDN is the primary driver for the establishment of *these 96-line* systems. Associated switch capacity consists of an IDCU peripheral(s) on an ISDN equipped switch module *specifically designed for these small 96-line systems.* This switch capacity should be utilized to respond to firm or immediate ISDN demand as discussed in the following paragraphs. However, the economics for this serving arrangement are very sensitive to actual ISDN demand and, as previously discussed, the deployment of small TR-303 systems to satisfy a forecast for unidentified ISDN demand should be avoided. Due to its significant costs, the deployment and use of TR-303 switch capacity designed for these small systems *must be coordinated with Switch Capacity Management and IBU representatives.*

*3.04 Existing ISDN-only systems, such as the FITEL and Conklin mini-shelves, would be the first choice for serving ISDN **[I150]**. These are obviously not applicable for areas served with fiber distribution facilities and NGDLC/FITL systems.*

3.05 Existing TR-303 systems with available capacity or NGDLC systems with large TR-303 interfaces planned for other relief **[I200]** should be used to provide integrated access for ISDN **[I210]** and other narrowband demand *when sufficient capacity is not available on existing ISDN-only systems **[I150]**.* Existing TR-303 systems may have been placed for previous ISDN demand or NGDLC systems e/w a large TR-303 interface may be proposed for feeder cable replacement activities **[R002]** as discussed in Section 4 or for other narrowband relief **[N001]** as discussed in Section 6. With TR-303, ISDN can be provisioned and planned in a POTS-like manner. Once the TR-303 system is established, the economics of providing ISDN over digital loop carrier or metallic based facilities is much the same as that for POTS. Obviously, the number of TR-303 systems in service will be small during the near term. To ensure maximum utilization of dedicated TR-303 switch capacity, these already available or planned systems should be the first choice for providing ISDN. Other TR-303 considerations in the following sections are driven by ISDN demand.

3.06 If *qualified,* non-loaded metallic pairs are available for ISDN demands **[I300]**, then plan to use DSLs on existing pairs to serve ISDN **[I310]** where *existing ISDN-only systems are not available **[I150]** and* existing/planned TR-303 systems are not available **[I200]**.

Metallic pairs may be made available by feeder cable replacement activities **[R001]** as discussed in Section 4 or by proposed metallic cable extensions for ISDN and other narrowband relief **[N001]** as discussed in Section 6. Metallic pairs may also be made available by transferring working lines to carrier facilities at another site and reusing the vacated metallic pairs for ISDN demand <=18 kft. In some cases, load coils are to be removed from the metallic pairs to support other services *or have already been removed to support previous ISDN efforts. Existing apparatus cases may also be available to support DSL mid-span repeaters.* See Section 3.12 and item #9 in Table I1 concerning removal of load coils to specifically support ISDN. Nevertheless, in most situations, the use of metallic pairs is the first choice over *other system deployments or modifications* until large platform TR-303 systems become more widely deployed for other demand (see 3.02). *Use of these existing non-loaded pairs may also include the placement of mid-span repeaters in existing apparatus cases or "Total Reach" DSLs. Both of these are funded by the PCU/COU and placed on a service order basis.*

3.07 Where NGDLC/FITL systems are deployed or planned **[I400]**, but *existing ISDN-only systems are not available **[I150]**,* TR-303 capability is not available in the switch or approved **[I200]**, and non-loaded metallic pairs **[I300]** are not available, BRITE (3 DS0) channel units should be used to serve ISDN demand via NGDLC capacity dedicated to special services, usually connected to an NGDLC COT channel shelf **[I410]**. The NGDLC TSI will allow electronic cross-connects or assignments to be made from any channel *on a channel shelf or ONU* to any *channel* of any "virtual RT" terminated on the NGDLC common shelf, including TR-008 Mode 1, Mode 2, and universal. In this way, ISDN lines can be field groomed along with NS/NLS special services to a separate facility from those carrying integrated switched services. Options to connect the DS1s for these NGDLC special service "virtual RTs" to D-4 systems and/or Digital Cross-connect Systems (DCS) *have been approved for the RELTEC system and M&Ps are nearing completion for the DSC/Alcatel system.* Current *RELTEC* FITL components do not support *ISDN via* TR-303 and therefore must always utilize the BRITE arrangement to support ISDN.

3.08 Where a new Mode 1 or Mode 2 *conventional* IDLC system is required for other growth or replacement facilities, modify planned system configuration to TR-303 to serve ISDN demand **[I540]** when all of the following conditions are met:

a. TR-303 is approved for proposed IDLC systems with the serving digital switch **[I530]**.

b. TR-303 switch capacity for small TR-303 systems is available or planned **[I510]** to meet service and/or system installation dates. *This should generally be limited to existing 5ESS IDCU capacity specifically set-up for small (96-line) TR-303 systems. Additional switch capacity for small TR-303 systems would require additional funding from PCU/COU. Each system termination should be coordinated with switch capacity management and approved by PCU/COU.*

*c. Capacity is insufficient in existing ISDN-only systems **[I150]**.*

d. Existing TR-303 systems are not available and NGDLC/large TR-303 are not planned for other relief **[I200]**.

e. Metallic pairs are not available or planned for loops <18 kft **[I300]**.

f. NGDLC systems are not existing or planned **[I400]** to support ISDN via dedicated special service capacity

3.09 If there is a *non-concentrated* (Mode 1 TR-008 *or SLC-5 FPC*) universal system available or planned for other relief **[I560]** at the serving RT, then BRITE (3 DS0) channel unit plug-ins may be used to serve ISDN ***[I570]*** where *existing ISDN-only systems* ***[I150]***, existing/planned TR-303 systems **[I200]**, metallic pairs **[I300]**, and NGDLC **[I400]** are not available. These systems may be made available by proposed DLC placements for feeder cable replacement activities **[R002]** as discussed in Section 4 or for other narrowband relief **[N001]** as discussed in Section 6, particularly where required for special services (see Section 7). Capacity in an existing Mode 1 universal system may also be made available by transferring working lines to other carrier or metallic facilities and reusing the vacated channel capacity for ISDN demand.

Utilize available *non-concentrated universal* system capacity with BRITE plug-ins to serve ISDN **[*I570*]** if the following conditions are met:

a. Firm or known ISDN demand is <= ten (10) BRIs per year **[I550]**. (This is not a physical limit, but an economic one if other options are available.)

AND EITHER

b. No TR-303 switch capacity is available or planned to meet service and/or system installation dates **[I510]**.

OR

c. No new IDLC system placements are required to meet other growth or facility replacements **[I520]** or TR-303 arrangements are not approved for proposed IDLC systems with the serving digital switch **[I530]**

3.10 Where there are no systems available or planned for other relief to serve ISDN **[*I150,* I200, I400, I510-I530, I560]** and non-loaded metallic pairs **[I300]** are not available, then special treatment of new or existing facilities for ISDN should be deferred **[I590]** if there is no firm or immediate demand for ISDN **[I580]**. Conversion of existing facilities or placement of new facilities to position the network for ISDN may be funded through *PCU/*COU initiatives in targeted areas. See Table I1 for a list of additional ISDN deployment alternatives beyond those funded by normal growth budgets..

3.11 If other options are not readily available, integrated Mode 1 systems may provide limited ISDN service capability via the sidedoor arrangement of some digital switch peripherals **[I650/I660]**. Both the No.5ESS IDCU and the DMS-100 SMS support ISDN via sidedoor. To minimize the economic impact of sidedoor provisioning on total switch costs, 96-line system capacities should be limited to only 2-3 ISDN BRIs or 5 special services, with the remainder of the capacity utilized for switched services. An existing Mode 1 system integrated to a switch peripheral which does not support sidedoor, such as the DCLU, *should not generally* be transferred to a sidedoor peripheral in order to accommodate ISDN.

3.12 Convert an existing IDLC system to TR-303 (e.g., SLC-5 Mode 1 or Mode 2 to FP303) to serve ISDN demand **[I640]** when there are no systems available or planned for other relief to serve ISDN **[*I150,* I200, I400, I510-I530, I560, *I650*]**, metallic pairs **[I300]** are not available, and all of the following conditions are met:

a. A TR-303 arrangement is approved for the existing IDLC system with the serving digital switch **[I630]**.

b. TR-303 switch capacity is available or planned **[I620]** to meet service and/or system installation dates. *This should generally be limited to existing IDCU capacity specifically set-up for small (96-line) TR-303 systems. Additional switch capacity for small TR-303 systems would require additional funding from PCU/COU. Each* *system termination should be coordinated with switch capacity management and approved by PCU/COU.*

c. Firm or immediate ISDN demand **[I580]** and expected demand is <= ten (10) BRIs per year **[I550]**.

3.13 *Place a FITEL or Conklin mini-shelf to support ISDN **[I1750]** when there are no systems available or planned for other relief to serve ISDN **[I200, I400, I510-I530, I560, I620-I630, I650]**, metallic pairs **[I300]** are not available, and all of the following conditions are met:*

*a. Existing or planned DLC housing capacity is available **[I740]**.*

*b. Firm or immediate ISDN demand **[I580]** and expected demand is <= eight (8) BRIs per year **[I700]**.*

All mini-shelf electronics expenditures are funded by the PCU/COU.

3.14 If loaded metallic pairs are available for loop lengths consistent with Table A **[I710]**, then ISDN demands may be served by removing load coils and using DSLs *or "Total Reach" DSLs* **[I730]**. *The "Total Reach" DSL also requires a remote unit at the customer NID. Load coils may also be removed to serve ISDN via DSL mid-span repeaters in **existing** apparatus cases only (see Table B). No new apparatus cases should be placed. "Total Reach" DSLs and mid-span repeater plug-ins are funded by the PCU/COU.* Metallic pairs may be made available by feeder cable replacement activities **[R001]** as discussed in Section 4 or by proposed metallic cable extensions for ISDN and other narrowband relief **[N001]** as discussed in Section 6. Metallic pairs may also be made available by transferring working lines to carrier facilities at another site and reusing the vacated metallic pairs for ISDN demand. See Section 3.05 and item #2 in Table I1 concerning use of non-loaded pairs to support ISDN.

This alternative should be utilized where there are no TR-303 or NGDLC systems available or planned for other relief to serve ISDN **[I200, I400, I510-I530]**, unloaded metallic pairs **[I300]** are not available, and either:

a. Expected ISDN demand > 10 BRIs per year **[I610]**

OR:

b. System options for ISDN demands <= 10 BRIs per year are not available, including Mode 1 universal systems **[I560]**, existing IDLC for conversion to TR-303 **[*I620*-I630]**, existing Mode 1 integrated systems using sidedoor **[*I650*]**, *or FITEL/Conklin mini-shelf **[I740]**.*

3.15 Firm or immediate ISDN demand (such as an existing or pending order) must be referred to the special assembly process *[I720]*, if none of the system options discussed above are available and non-loaded or unloaded metallic pairs are not available. See Table I1 for a list of additional ISDN deployment alternatives beyond those funded by normal growth budgets as described in this section. These include *apparatus cases for* mid-span repeaters, Mode 2 to Mode 1 conversions, or placement of separate transport systems for ISDN. Some of these options may also be funded through *PCU/*COU initiatives in targeted areas.

TABLE I1
ISDN DEPLOYMENT ALTERNATIVES
(IN RELATIVE ORDER OF ECONOMIC PRIORITY)

Alt. No.	CURRENT LOOP ALTERNATIVES TO SERVE ISDN #1-9 FUNDED THRU NORMAL GROWTH BUDGETS	SWITCH TYPE SM2000	5ESS	D100	1AESS
0.	*Utilize existing Conklin or FITEL mini-shelf*	***Yes - Universal Application***			
1.	**Utilize existing *TR-303 system* or planned NGDLC e/w TR-303 interface.** May include advancement of planned placements.	**Yes**	**Yes**	**Yes**	**NA**
2.	**Utilize existing *non-loaded* qualified metallic pairs (*See Tables A & B*).** May include cutover of POTS services to other existing or new growth facility. ***May also include mid-span repeater in existing apparatus case only.***	***Yes - Universal Application Mid-span repeaters or "Total Reach" DSLs funded by PCU/COU on service order basis.***			
3.	**Field-groom ISDN lines to COT via existing or planned NGDLC e/w TR-008 interface.** May include advancement of planned placements.	**Yes** (Existing only)	**Yes**	**Yes**	**Yes** (Univ. Only)
4.	**Modify planned integrated SLC-5 Mode 1 or Mode 2 system to SLC-5 FP303 and integrate ISDN lines.** May include placement of additional/separate TR-303 system if additional ISDN demand requires additional capacity. May also include advancement of planned placements.	**Yes** ***WCs per PCU/ COU (Note1)***	**No**	**NA**	**NA**
	Note: If ISDN demand >10 BRIs/yr, skip to Alternative #9.				
5.	**Utilize vacant capacity in existing or planned Mode 1 universal system.** May include advancement of planned placements. May also include cutover of POTS services to other existing or new growth facility (Demand <=10 BRIs/yr).	**Yes**	**Yes**	**Yes**	**Yes**
6.	**Utilize vacant capacity in existing or planned Mode 1 integrated system on IDCU via sidedoor to D4 system.** Should be limited to only a few (2-3) per system for permanent demand; Limited only by available IDCU DS-1 capacity for temporary demand.	**Yes** *~~(Existing Only)~~*	**Yes**	***No*** *No longer support-ed by vendor*	**NA**
7.	**Convert/re-terminate existing integrated SLC-5 Mode 1 or Mode 2 system to SLC-5 FP303 and integrate ISDN lines.** May include cutover of POTS services to existing facility, such as loaded pairs. Slot restrictions eliminated. (ISDN demand <=10 BRIs/yr)	**Yes** ***WCs per PCU/ COU (Note1)***	**No**	**NA**	**NA**
8.	**Reterminate existing Mode 1 integrated from DCLU to IDCU and utilize sidedoor to D4 for ISDN.** Should be limited to only a few (2-3) per system for permanent demand; Limited only by available IDCU DS-1 capacity for temporary demand.	***No longer recommended. Place Conklin or FITL mini-shelf per item 8A.***			
8A	***Place Conklin or FITEL mini-shelf in existing or planned conventional DLC site..*** *(Demand <= 8 BRIs/yr)*	***Yes - Universal Application To be funded by PCU/COU and placed on a service order basis***			
9*A*.	**Unload existing metallic pairs to create qualified facility (see table A).** May include cutover of POTS services to other existing or new growth facility.	***Yes - Universal Application***			
9B.	***Unload existing metallic pairs and place mid-span repeaters in existing apparatus cases (see table B).*** *May include cutover of POTS services to other existing or new growth facility.*	***Yes - Universal Application Mid-span repeaters to be funded by PCU/COU and placed on service order basis.***			
9C.	***Unload existing metallic pairs and use ADTRAN "Total Reach" DSL (see table A).*** *May include cutover of POTS services to other existing or new growth facility.*	***Yes - Universal Application "Total Reach DSLs to be funded by PCU/COU and placed on service-order basis.***			

Note 1: *SLC-5 FP303 should be deployed only in WCs specifically identified by PCU/COU and must be coordinated with Switch Capacity Management and IBU representatives. Generally limited to existing IDCU/SM2000 capacity specifically designed for small platform (96-line) systems.*

TABLE I1
ISDN DEPLOYMENT ALTERNATIVES
(IN RELATIVE ORDER OF ECONOMIC PRIORITY)

Alt. No.	CURRENT LOOP ALTERNATIVES TO SERVE ISDN #10-20 Funded Thru Special Assembly or PCU/COU	SWITCH TYPE SM2000	5ESS	D100	1AESS
10.	**Unload metallic pairs,** ***install apparatus cases,*** **and deploy mid-span repeaters (see table B).**	*No longer recommended. Use ADTRAN "Total Reach" DSL (#9C).*			
	Note: If ISDN demand >10 BRIs/yr, skip to Alternative #20.				
11.	**Modify planned Mode 2 universal system to Mode 1 universal.** May include advancement of planned placements. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
12.	**Convert existing Mode 2 universal system to Mode 1 universal system.** May include cutover of existing POTS lines to other facilities, such as loaded pairs. (<=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
13.	**Place ADTRAN BR1/8 ISDN/T1 Terminal Shelf in hut/CEV.** Not hardened. Requires one-time approval for site or metro. No prot. switching - max. 8 BRIs. (demand<=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
14.	**Modify planned Mode 2 integrated system to Mode 1 integrated on IDCU and utilize sidedoor to D4 for ISDN.** Should be limited to only a few (2-3) per system for permanent demand; Limited only by available IDCU DS-1 capacity for temporary demand. May include advancement of planned placements. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
15.	**Modify planned Mode 1 integrated system to Mode 1 universal system.** May include advancement of planned placements. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
16.	**Convert existing Mode 2 integrated system with vacant capacity to Mode 1 integrated on IDCU and utilize sidedoor to D4 for ISDN.** Should be limited to only a few (2-3) per system for permanent demand; Limited only by available IDCU DS-1 capacity for temporary demand. May include cutover of existing POTS lines to other vacant facility, such as loaded metallic pairs. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
17.	**Modify planned Mode 2 integrated system to Mode 1 universal system.** May include advancement of planned placements. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
18.	**Convert existing Mode 1 integrated system to Mode 1 universal system.** May include cutover of POTS services to other existing facility. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
19.	**Convert existing Mode 2 integrated system to Mode 1 universal system.** May include cutover of POTS services to other existing facility. (ISDN demand <=10 BRIs/yr)	*No longer recommended. Place Conklin or FITL mini-shelf per item 8A.*			
20.	**Place new TR-303/Mode 1 universal system for ISDN.** (For ISDN only, see #2 or #5 for other growth placements)	**Yes** *Note 1*	**Yes**	**Yes**	**Yes**

Note 1: *SLC-5 FP303 should be deployed only in WCs specifically identified by PCU/COU and must be coordinated with Switch Capacity Management and IBU representatives. Generally limited to existing IDCU/SM2000 capacity specifically designed for small platform (96-line) systems.*

TABLE A Maximum Length for ISDN on Non-Loaded Pair					TABLE B Maximum Length for ISDN on Non-Loaded Pair with Mid-Span Repeater			
	Standard DSL		*"Total Reach" DSL*					
Cable Gauge	Loss (db/kft)	Max. Cust. Loop (kft)	***Loss (db/kft)***	***Max. Cust. Loop (kft)***	Cable Gauge	Loss (db/kft)	Max.Dist. to Rptr (kft)	Max. Cust. Loop (kft)
26	2.8	14.9	***2.22***	***23.4***	26	2.8	NA	NA
24	2.0	21.0	***1.66***	***31.3***	24	2.0	19.0	38.0
22	1.39	30.2	***1.19***	***43.6***	22	1.39	27.3	54.6

"Total Reach" DSL also requires Remote Unit at customer NID.

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
TECHNOLOGY SELECTION FOR ISDN DEMAND

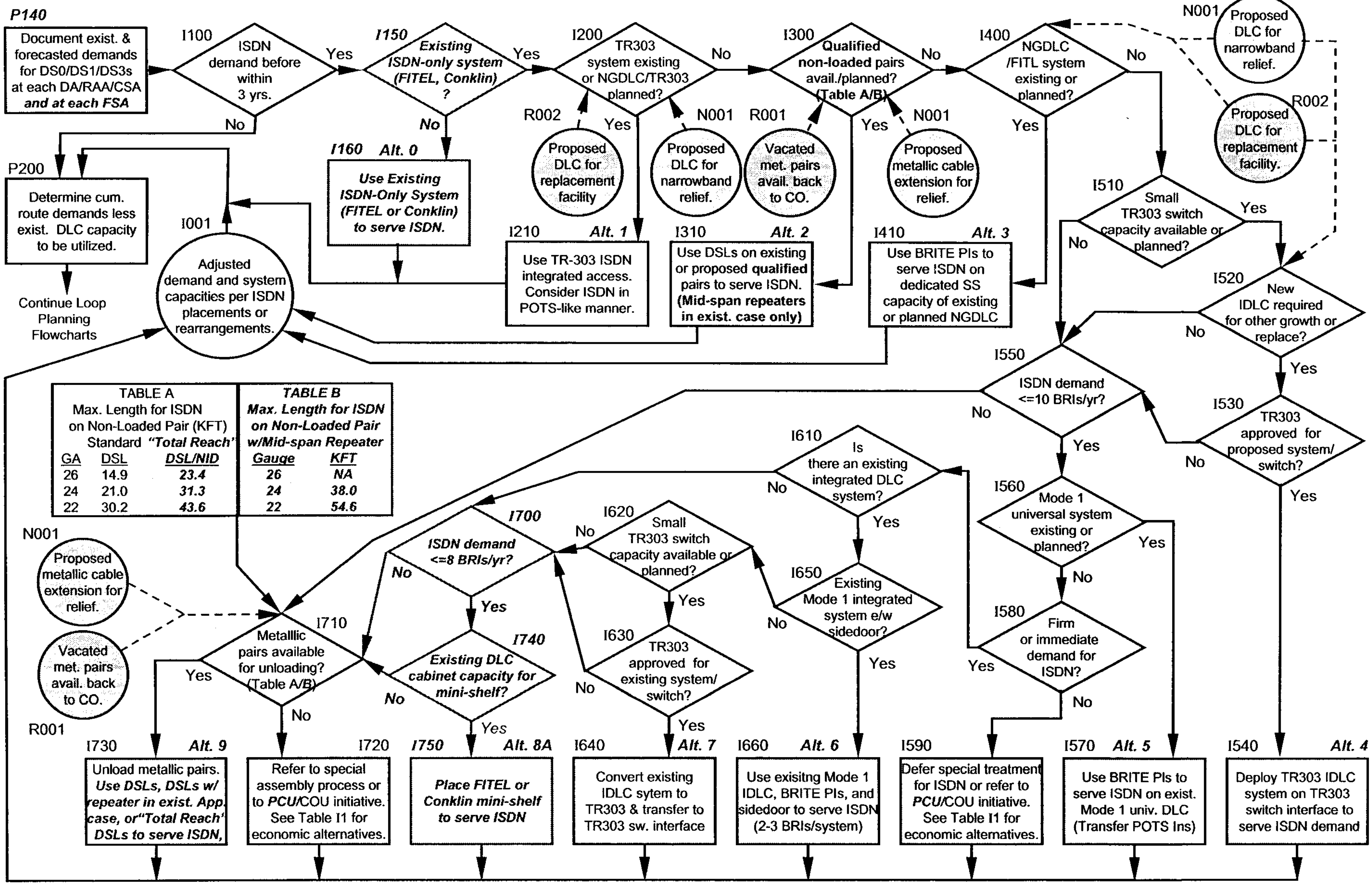


TABLE A Max. Length for ISDN on Non-Loaded Pair (KFT) Standard *"Total Reach"*			*TABLE B Max. Length for ISDN on Non-Loaded Pair w/Mid-span Repeater*	
GA	DSL	*DSL/NID*	*Gauge*	*KFT*
26	14.9	*23.4*	*26*	*NA*
24	21.0	*31.3*	*24*	*38.0*
22	30.2	*43.6*	*22*	*54.6*

See Section 3 of LTDD

4.00 TECHNOLOGY SELECTION FOR FEEDER CABLE REPLACEMENTS

This section summarizes the decision process and deployment recommendations for feeder cable replacements, primarily driven by maintenance and road move activities. The decision process and recommendations are represented by the "Technology Selection for Feeder Cable Replacements" flowchart following this section.

Technology selection for feeder cable replacements should be guided by the following fundamental strategies:

a. When digital loop carrier systems are deployed to replace facilities impacted by the removal of a feeder cable section, the resulting vacant metallic facilities should be made available for other requirements along the route nearer to the central office. Obviously, demands to be accommodated on existing or proposed fiber distribution facilities will be transported via NGDLC/FITL platforms and cannot be satisfied by existing metallic facilities. Deployment plans should be optimized to obtain maximum utilization of existing metallic facilities in areas not targeted for fiber distribution deployments, such as existing distribution areas, business areas, or those to be served by aerial facilities, as well as to maximize deployments of fiber distribution. Feeder cable replacement strategies may also be combined with distribution replacement plans to maximize deployment of fiber distribution facilities supported by NGDLC/FITL systems and migrate the network to support future services.

b. Within budget and manpower constraints, consider the placement of DLC or NGDLC growth facilities at the end of the metallic cable route, cutover existing metallic facilities, and use vacated pairs to provide relief facilities at growth sites closer to the central office. This cutover strategy will optimize the removal and retirement of metallic cable feeder facilities and should be targeted toward the replacement of those cables which carry the highest maintenance costs. Since metallic facilities of less than 8 kft total loop length may be used to provide emerging broadband services, using this cutover strategy in conjunction with the placement of NGDLC growth systems may also be effective in providing growth facilities for short loops while positioning both growth and cutover sites for future broadband demands. Specific cable sections should be prioritized for cutover based on service history, budget and manpower constraints, and other fundamental plans.

c. Vacated pairs should be utilized where rearrangements, including placement of short sections of cable, can be economically and practically implemented to serve other areas of the route. These rearrangements should be performed on a planned basis such that entry into splices more than once in the 3-5 year planning period is avoided and additional cable stubbing is minimized.

d. Where there is no forecasted demand for a vacated metallic facility during the next five years and no new metallic or DLC facilities are proposed along its route, then the vacant cable should be removed and retired.

e. *Several deployment alternatives for major replacement projects/jobs should be identified, including minimum capital proposals. Budget impact, risks, timing, priorities, and other conditions should be assessed to select the best alternatives.*

The results of technology selections in this section will be used to adjust the total facilities available along a route, resulting in an adjusted PMO for technology decisions in subsequent sections, particularly for narrowband services.

The following items in this section outline specific recommendations, critical factors, flow chart references, and other issues related to technology selection for feeder cable replacements.

4.01 Non-discretionary cable replacements **[R200]** due to catastrophic damage and/or safety hazards **[R210]** should generally be replaced with metallic cable to expedite restoration **[R211]**. All other feeder cable replacements should be evaluated in the context of the fundamental plan for an entire facility route or wire center area.

4.02 Discretionary replacements **[R200]** of high maintenance cost feeder cable sections should be identified and prioritized through the Outside Plant Improvement or FAP (Facility Analysis Plan) Steering Committee **[R300]**.

4.03 Replacements of metallic feeder cable sections where the "Copper Replacement" alternative costs less than $100 per **working** line **[R220]**, should be replaced with copper **[R211]**. This threshold represents an absolute minimum DLC costs which must be exceeded by the "Cable Replacement" alternative before a "Carrier Replacement" alternative should even be considered. Any metallic cable replacements should be sized to meet only the 3-5 year demand.

4.04 Deleted.

4.05 If 4.03 does not apply, replacement alternatives should be evaluated to determine the most appropriate replacement strategy **[R241]**. Factors which should be considered include:

a. Trouble history of the end-to-end metallic feeder facility (not just the replacement section in question)
b. Plans to provide growth facilities in the route
c. The incremental impact of the fiber/electronics placements required to support the "Carrier Replacement" alternative
d. Manpower and budget constraints
e. Cutover costs
f. Condition and maintenance history of distribution cable facilities served by feeder section.
g. Potential re-use of vacated metallic pairs along the route back to the CO.

Where plans exist to provide carrier facilities for growth in the route, consider repositioning and accelerating the growth facilities. Planned carrier may be placed at a site beyond the feeder section in question, allowing cutover of working lines, reuse of metallic pairs at the original growth site, and retirement of the metallic feeder section. This approach optimizes the retirement of the metallic facilities by eliminating the long segments of small cross-section feeder cables which typically have higher trouble occurrences. Evaluation of some of these alternatives may be simple and lead to obvious conclusions. For example, planned growth facilities may be sufficient to allow repositioning to a single site to permit the feeder cable replacement. However, for more complex route scenarios with multiple sites affected by the feeder cable replacement, a more comprehensive evaluation is required with results supported by documentation which includes the factors discussed above.

Regarding the factor of distribution facilities, feeder cable replacement strategies may also be combined with distribution replacement plans to maximize deployment of fiber distribution facilities supported by NGDLC/FITL systems and migrate the network to support future services. Regarding the re-use potential of vacated metallic pairs, demands to be accommodated on existing or proposed fiber distribution facilities will be transported via NGDLC/FITL platforms and cannot be satisfied by re-claimed metallic facilities. As already discussed, deployment plans should be optimized to obtain maximum utilization of existing metallic facilities in areas not targeted for fiber distribution deployments, such as existing distribution areas, business areas, or those to be served by aerial facilities, as well as to maximize deployments of fiber distribution.

If a "Carrier Replacement" alternative is selected, the vacated metallic facilities should be made available for use at sites closer to the central office as noted in the strategies defined at the beginning of this section. If a "Copper Replacement" alternative is selected, metallic cable replacements should be sized to meet only the 3-5 year demand.

4.06 Implementing fiber infrastructure and/or loop diversity in an area does not provide a trigger for metallic cable replacement. These efforts typically involve the placement of additional fiber sheath, without necessarily involving any cutover. An appropriate trigger for metallic cable replacements (road move, high maintenance cost, customer needs, etc.) must exist and the recommendations in this section must be applied to ensure the selection of the most appropriate replacement alternative.

4.07 Existing viable metallic cable pairs which are made vacant by cutover to carrier facilities triggered by a cable replacement should be made available for use at sites closer to the central office to defer capital expenditures required for growth triggered facilities. **[R001]**

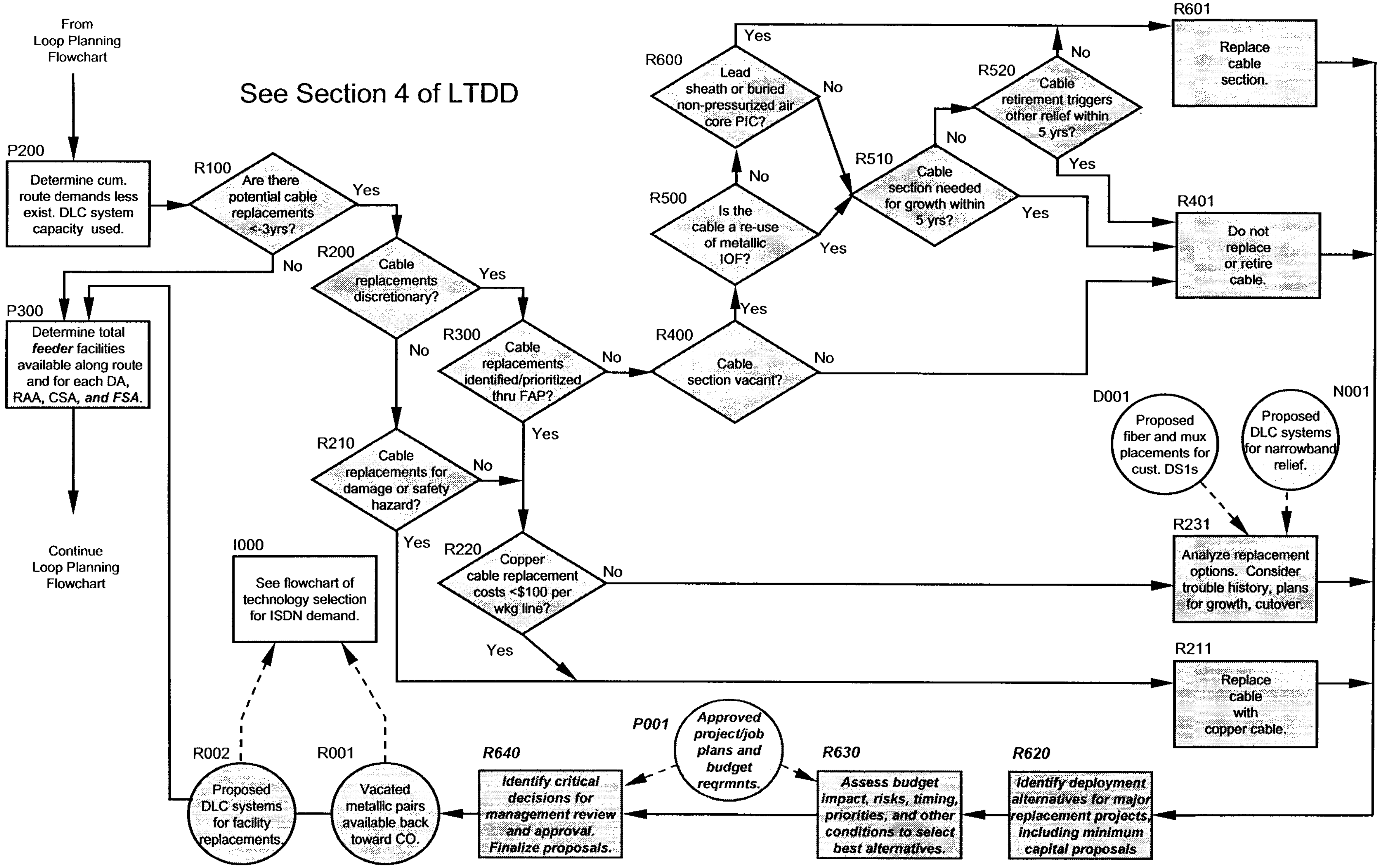
4.08 Vacant metallic cable sections not needed in the OSP feeder route for growth within five years **[R510]** can be retired **[R601]**, provided their retirement does not trigger the need for some other relief project within the same five year timeframe. **[R520]**

4.09 No study is required to support the retirement of vacant lead sheath or vacant buried non-pressurized air core pic cable **[R600/R601]**, even when needed for growth if, based on sound engineering judgment, they should not be reused. However, at this time, there is no justification for a blanket policy for the retirement of lead sheath or buried air core pic cables. The Loop Improvement process is designed to systematically remove and retire the worst performing facilities, regardless of the type of facility. It should be noted that any extraordinary costs associated with special care of these types of facilities should be included in the evaluation discussed in Section 4.05.

4.10 There is not sufficient data to support a blanket retirement policy for vacated interoffice cables. These facilities should be considered for reuse in the feeder network, particularly to provide DS1 transport for digital loop carrier sites, as well as for DS1 customer sites with low DS1 demand (see Section 5). With the exception of Metropolitan Area Trunk (MAT) cables, represented by "MCRC" and "MCRH" cable codes, and those situations identified in Sections 4.08 and 4.09, justification is required to support the retirement of vacated metallic interoffice cables **[R500]**. The intent of this reuse opportunity is to defer unnecessary expenditures and effectively utilize limited resources in high priority areas **[R401]**.

4.11 Several deployment alternatives for major replacement projects/jobs should be identified, including minimum capital proposals ***[R620]****. Assess budget impact, market/demand risks, timing, priorities, and other conditions to select the best alternatives* ***[R630]****. Critical decisions and deployment options, particularly those with a wide disparity in budget* *impact, should be reviewed with the management for approval, informally during planning activities and/or formally during route reviews **[R640]**.*

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
TECHNOLOGY SELECTION FOR FEEDER CABLE REPLACEMENTS



5.00 TECHNOLOGY SELECTION FOR CUSTOMER DS1s

This section summarizes the decision process and deployment recommendations for providing customer DS1 facilities. This *update reflects changes to these recommendations and related issues* in keeping with the provisions of *RL:98-09-014BT*, "DS1 Technology Deployment Directives". *The primary drivers for these changes have been the continued decline in HDSL pricing and the introduction of additional products for cell site and other DS1 applications.* These directives and recommendations are summarized in Table D1 and highlighted by the "Technology Selection for Customer DS1s" flowchart at the end of this section.

Technology selection for customer DS1s should be guided by the following fundamental strategies:

a. Existing or planned multiplexer capacity, including those associated with NGDLC serving narrowband demand, should be utilized to support Customer DS1 demand.

b. The most economical DS1 technology deployment alternative, including existing metallic cable, HDSL, OC-3, or new OC-1 and DS-2 Optical extensions, should be utilized to support Customer DS1 demand.

c. Selected Customer DS1 sites, prioritized for implementation of fiber facilities by Legal, Regulatory, or *PCU*/COU and funded by specific initiatives, should be served via the most economical fiber-based technology alternative, i.e. DS-2, OC-1, or OC-3. *Previous policies regarding the deployment of fiber facilities for all customer sites with six (6) or more DS1s are no longer in effect.*

d. Several deployment alternatives for major customer DS1 projects/jobs should be identified, including minimum capital proposals. Budget impact, risks, timing, priorities, and other conditions should be assessed to select the best alternatives.

While the results of technology selections in this section will impact technology decisions in subsequent sections, the deployment of fiber based facilities to serve DS1 demand does not dictate the deployment of narrowband electronics for growth or for facility replacement.

The following items in this section outline specific directives and recommendations, flow chart references, and other issues related to technology selection for customer DS1s.

5.01 The technology selection recommendations detailed above are based primarily on three deployment parameters; the availability of existing equipment, the distance from the CO/RT/closest location with existing DS1 service facilities, and the 5-year DS1 demand at the customer location. However, where fiber facilities are mandated by Legal, Regulatory, or *PCU*/COU initiative, and the appropriate funding has been allocated, deployment decisions should follow the recommendations provided under Scenario 4 of Table D1 **[D400/*D410*]**.

An interdepartmental team consisting of representatives from BellSouth Technology Directives, BellSouth Business Systems (BBS), InterConnection Services (ICS), and the Product Commercialization Unit (PCU), fully examined competitive revenue issues impacting DS1 technology deployments. As a result, the team elected to cancel BST's 1993 6-DS1 fiber facility deployment strategy. That policy is no longer in effect, even in the major metro areas. However, there is funding allocated annually (in BPLPMOD) for the conversion of metallic DS1 sites to fiber facilities, and in some cases provide facility diversity. Representatives from Science & Technology – Technology Directives, Network Operations – Infrastructure Planning, Interconnection Services, and BBS, meet periodically to identify high priority locations throughout the Region. The objective of the team is the identification of targeted customer locations requiring fiber-based facility *architectures to meet customer requirements. They also secure the appropriate funding levels to effectively treat these locations.*

As a matter of record, of the more than 50,000 customer DS1 locations in BellSouth as of June 1998, 62% have only one (1) DS1 and only 7% have six (6) or more DS1s. Interestingly, 76% of the customer DS1 sites with six (6) or more DS1s are already served via fiber facilities.

5.02 BellSouth approved OC-3 ADM alternatives include the Fujitsu FLM-150® and the Lucent DDM-2000®. Since the recommendations shown above incorporate in-plant costs associated with each of these devices, any decision to deploy a specific multiplexer should be governed by the vendor selection criteria for an individual turf area. Obviously, at Customer DS1 demand sites where existing multiplexer capacity is available, that capacity should be utilized **(D310)**. This includes sites where DS1 demand can be served by an existing or planned fiber-fed NGDLC system supporting narrowband demand. OC-3 ADMs are also the appropriate deployment alternative for 5-year DS1 demands of greater than 28 **[D710]**. In addition, for maintenance purposes, when excess multiplexer capacity exists at a demand site, cutover of metallic Customer and DLC DS1s is an attractive economic alternative. For the purpose of this decision, excess capacity is defined as the availability of multiplexer facilities, both at the C.O. and at the site, which could be utilized and still not advance the exhaust of the equipment within a five year relief interval.

5.03 The OC-1 optical extension alternative referenced in this section is the Lucent FiberReach® product which has the capability of providing up to 28 DS1s. This particular OC-1 device has been found technically suitable and M&Ps *are available. However, there remain Operations Systems (OS) issues, specifically regarding Bellcore template support for a number of OSs (TIRKS, NMA, NSDB, ITS, etc.), that must be resolved. Bellcore funding has been allocated in 1999 BellSouth budgets to ensure the full support of the FiberReach® OC-1 multiplexer during early 1999.* The FiberReach® OC-1 is designed to be optically extended in a ring configuration from the Lucent DDM-2000® OC-3 Multiplexer, located either in the C.O. or at a Remote Terminal. OC-1 rings extended from an OC-3 multiplexer located at the switch are similar in cost to those rings that would be extended from existing field OC-3 nodes. Therefore, the technology selection results shown in this directive are applicable to either network architecture alternative.

Obviously, we *do not* recommend placing an additional field OC-3 node on an existing ring specifically to host a new OC-1 ring for DS1 demand. This would result in incurring the costs of a new OC-3 field node, a new OC-1 field ring, and the allocated cost of the existing OC-3 CO node. The Loop Capacity Manager would have to evaluate a specific customer location to determine what other demands in the area could utilize the capacity of either a new OC-1 or OC-3 ring. If demand in the area is substantial enough to justify an OC-3 ring (> 28 DS1s), then an OC-3 deployment would be more appropriate. Otherwise, the OC-1 ring is less expensive and would be the appropriate alternative **[D820, D830, D910, or D920]**. For those situations where an OC-1 device has been recommended, yet is not applicable due to the lack of penetration of the DDM-2000® multiplexer, an OC-3 ADM should be deployed.

5.04 The DS-2 optical extension alternative referenced in this directive **[D910 or D920]** is the Fujitsu FLM-6® product which has the capability of providing 4 *protected* DS1s. This particular DS-2 device has been *approved* and M&Ps *are available*. The FLM-6 is designed to be optically extended in a point-to-point configuration from a Fujitsu FLM-150® OC-3 Multiplexer, located either in the C.O. or at a Remote Terminal.

5.05 The HDSL alternative referenced in this directive **[D820, D830, or D910]** is reflective of the PairGain HiGain® HDSL device. *However, a recent field trial of Adtran HDSL equipment also proved to be very successful. Final lab evaluations of specific Adtran HDSL software applications are near completion, and final approval as an alternate HDSL supplier is expected soon.* The deployment of HDSL is always contingent on CSA design limitations, but is typically 9 - 12 Kft, depending on cable gauge. However, an HDSL Doubler device is now approved and available which extends the potential service area to roughly twice that of standard HDSL. Again, like standard HDSL, the deployment of the HDSL Doubler is always contingent on CSA design limitations relative to each span of the Doubler. *Furthermore, an HDSL arrangement with four (4) "doublers" is under evaluation that will support much longer customer loop lengths.* Regardless of the architecture alternative, HDSL has proven to be a very robust DS1 deployment alternative, particularly in response to short interval *customer* service requirements, as well as with respect to DS1 trouble report rates. *Also see Table D1.*

5.06 With the *technical* evolution *and declining cost* of HDSL, *along with* BellSouth's emphasis on fiber feeder deployments and the increasing availability of optical extension devices, the repeatered metallic T1 alternative has progressively fewer attractive deployment opportunities. The *most favorable* deployment opportunities for this alternative occur where there are existing apparatus cases, with repeater plug-in capacity, and no extraordinary provisioning/maintenance costs, i.e. blowing manholes, wet cable, bridged tap removal, etc. *Other applications for T-1 include short metallic extensions from the CO or RT mux, as well as longer metallic extensions beyond the current reach of HDSLs and HDSL doublers. Even these options will be displaced as HDSL pricing continues to decline and as longer reach HDSL arrangements are introduced.*

5.07 Metallic T1 field repeaters are typically not required to serve DS1 demands within approximately 1500' of the CO or RT, *although a T-1 plug-in is required at the CO or RT.* Therefore, direct metallic facilities are recommended for all DS1 demand levels at locations within 1500' of the C.O. or R.T. where metallic pairs can be accessed without terminating additional copper cables on the mainframe **[D610]**. *This includes placement of short sections of metallic cable.*

5.08 *While* T1 Maintenance Switch*es are* not *currently* recommended for *widespread regional* deployment, *BellSouth has approved for deployment a manual TI Maintenance Switch, as well as an Automatic Protection Switch. Due to the relatively high incremental costs associated with the switch and the supporting DS1 facility, these* devices should only be deployed on a limited basis for specifically troublesome Customer DS1 locations with appropriate approvals from *PCU/*COU, Loop Capacity Management, and Network Operations organizations. *Since 60% of all Customer DS1 sites within BellSouth have only 1 DS1, deployment of a maintenance switch to these types of locations would more than double the costs (on a per DS1 basis) of provisioning service to these locations.*

5.09 The costs associated with remote test access and performance monitoring for Customer DS1s are addressed in either the Growth driven (formerly Steady State) portion of the MDP budget process, or in the BPTMOD New Platform initiative. As of June *1998*, approximately *98%* of the non-switched DS1s were equipped with PM and RTA and BPTMOD includes funding in *1999* for the limited growth in those offices expected to exceed the threshold guideline to provide PM/RTA in offices with 10 or more Customer DS1s.

As for PM at the customer premise via an intelligent Network Interface Unit (NIU), *BellSouth had previously implemented a policy to deploy intelligent NIUs with PM capability, i.e. the ADA Remote Module. As information, BellSouth has also approved non-PM NIUs for application directly behind fiber multiplexers, which have DS1 cards with PM capability. These non-PM NIUs are available at a much lower cost than their PM counterparts and their application behind multiplexers saves the corporation significant capital dollars, not only from a reduced price perspective, but also through the elimination of redundant capability.* Questions concerning DS1 fault management issues should be referred to Terry Catt of the *Science & Technology* - Technology Directives staff at (205) 977-7160.

5.10 The majority of new *customer* DS1s in the loop being deployed on metallic facilities are on HDSL as opposed to repeatered T1 lines. Hence, the deployment of addressable line repeaters (ADLR) will be minimal, i.e., only for those DS1s that are not being deployed via HDSL or fiber. It is **NOT** recommended that the embedded base of metallic DS1s be retrofitted with ADLRs. In addition, every embedded circuit that is retrofitted with ADLRs would have to be redesigned because the ADLRs have a different resistance than non-addressable line repeaters. Again, questions concerning DS1 fault management issues should be referred to Terry Catt of the *Science & Technology* - Technology Directives staff at (205) 977-7160.

5.11 There has been a great deal of interest in the DS1 deployment capabilities of FITL ONUs. Currently approved *RELTEC* fiber distribution components *provide limited* support *of* Customer DS1 services*:* a single DS1 from each ONU along with DS0 services. *Furthermore, fiber distribution deployments are currently targeted toward residential areas for delivery of high-speed data and other broadband services that will exclude the delivery of a DS1 optically via the current product. The DSC StarSpan ONU can deliver up to 6 DS1s per ONU, but StarSpan HDTs are no longer approved for deployment in remote carrier sites for residential areas. FITL ONU* deployment to meet Customer DS1 demand will be restricted to sites where an existing FITL infrastructure (HDTs, either in the C.O. or in the field, and fiber) is in place or is planned to satisfy primarily DS0 demand. The deployment of Next Generation Digital Loop Carrier (NGDLC) HDTs and FITL ONUs should be based solely on narrowband service demands and should not be triggered by Customer DS1 requirements. *However, a locally powered ONU arrangement is being tested for the StarSpan product line that may be useful in cell site arrangements discussed below. Additional directives will be issued as appropriate.*

5.12 There has also been a great deal of interest in the deployment of fiber facilities to cell sites across the Region. Our economic analysis efforts in recent years have repeatedly concluded that the costs associated with deploying fiber facilities to small DS1 demand cell sites make it infeasible to deploy such facilities on any sort of widespread basis. There are unique cell site locations, specifically those with high numbers of DS1s or with repeated chronic trouble reports that would justify the placement of fiber facilities. However, those opportunities are rare.

In an effort to meet what appears to be an increasing desire in the Wireless market to have fiber facilities deployed to cell sites, an Interdepartmental Team of BellSouth representatives has been investigating the feasibility of an Enhanced Private Line Local Channel DS1 service that would require fiber facilities, but also include a price increase over current tariffed DS1 services. Pending specific customer feedback and analysis of the total anticipated costs, this Enhanced Private Line Local Channel Service could be offered in early 1999.

There is also a technical trial under way of the Raychem Cellu-Light® cabinet for fiber to the cell site applications. This low cost cabinet is capable of housing either a pair of Fujitsu FLM-6® multiplexers, or a single Lucent FiberReach® multiplexer, but unlike other multiplexer arrangements, both DC power for the optical equipment and emergency power will be provided by the cell tower owner. An alternative arrangement for these cell sites may be provided by a variation of the StarSpan product line. Locally powered ONUs and long reach optical units hosted from a CO-based HDT arrangement are under evaluation. As field trials and evaluations are completed, specific deployment directives will be provided as appropriate.

5.13 Several deployment alternatives for major customer DS1 projects/jobs should be identified, including minimum capital proposals ***[D620].*** *Assess budget impact, market/demand risks, timing, priorities, and other conditions to select the best alternative* ***[D630].*** *Critical decisions and deployment options, particularly those with a wide disparity in budget impact, should be reviewed with the management for approval, informally during planning activities and/or formally during route reviews* ***[D640].***

TABLE D1
DS1 TECHNOLOGY DEPLOYMENT DIRECTIVES
Deployment Scenario Descriptions

Scenario 1
No existing facilities are available within 1500' of the customer DS1 demand location.

Scenario 2
Customer DS1 demand location where T-1 facilities have exhausted and:

a. Existing Metallic Cable facilities are available within 1500' of *Customer DS1 location*
b. Existing Metallic Cable and Fiber Cable facilities are available within 1500'
c. Existing Fiber Cable, but no existing Metallic Cable, available within 1500'

Scenario 3
Existing customer DS1 location where multiplexer capacity is planned or exists to accommodate projected DS1 demand.

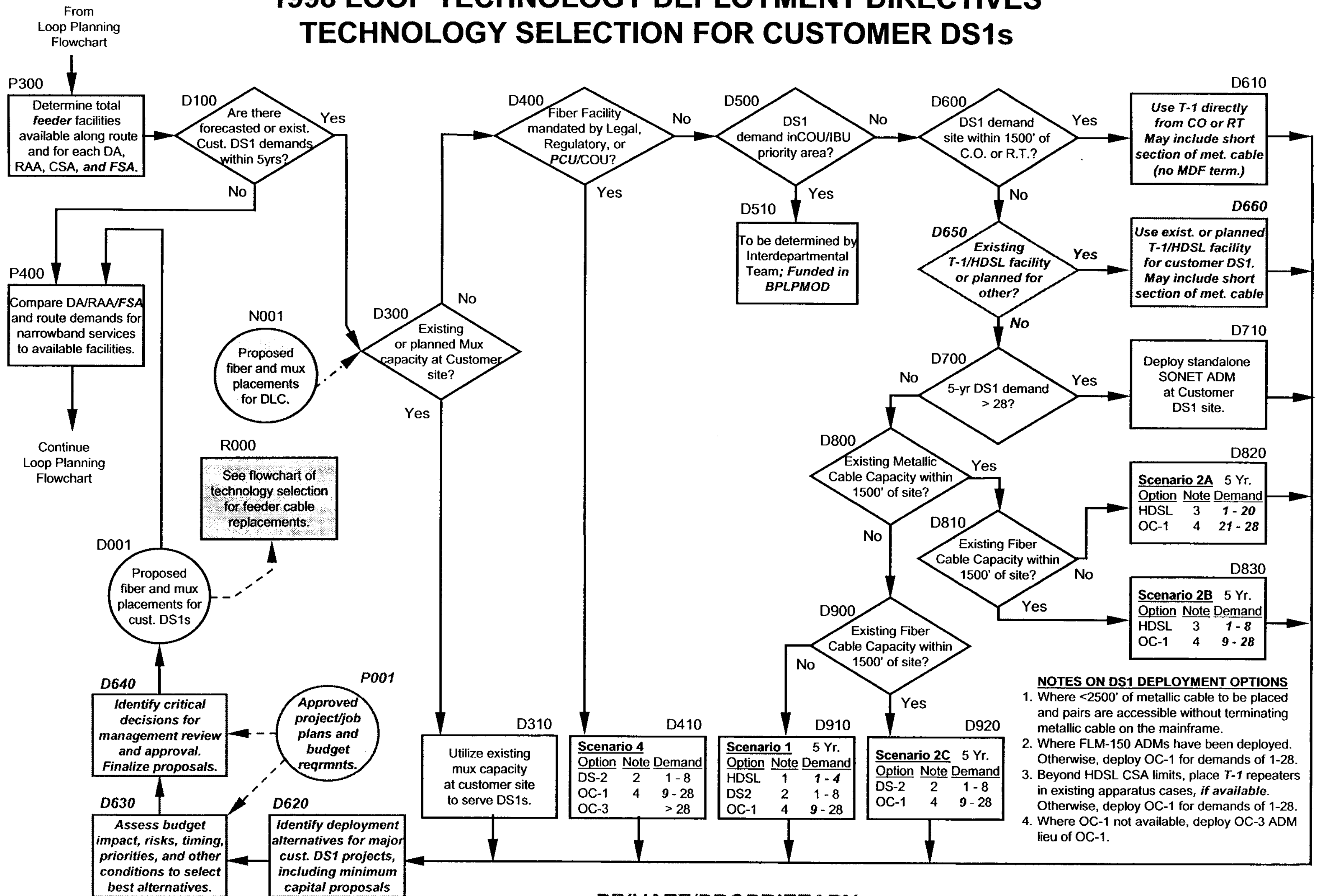
Scenario 4
Customer DS1 demand location where no fiber or multiplexer facilities exist, however, fiber/mux facilities are mandated by Legal, Regulatory, or Marketing commitments, i.e. Fiber to Cell Site commitments to Wireless Carriers in some areas, and incremental funding has been provided.

DS1 Technology Deployment Recommendations

Scenario	Technology	5-Year DS1 Demand
1 (within 1500' of CO or RT)	Direct Metallic Cable[1]	All
1 (< 2500' metallic cable to be placed)	HDSL[1]	*1 - 4*
1 or 2c	DS-2 Optical Extension[2]	1 - 8
1 or 2c	OC-1 Optical Extension Ring[4]	9 - 28
1 or 2c	OC-3 ADM Ring	> 28
2a (within 1500' of CO or RT)	Direct Metallic Cable	All
2a	HDSL[3]	1 - 20
2a	OC-1 Optical Extension Ring[4]	21 - 28
2a	OC-3 ADM Ring	> 28
2b (within 1500' of CO or RT)	Direct Metallic Cable	All
2b	HDSL[3]	*1 - 8*
2b	OC-1 Optical Extension Ring[4]	*9 - 28*
2b	OC-3 ADM Ring	> 28
3	Use Existing Mux Capacity	All
4	DS-2 Optical Extension[2]	1 - 8
4	OC-1 Optical Extension Ring[4]	9 - 28
4	OC-3 ADM Ring	> 28

Note 1: Where pairs are accessible without terminating additional metallic cables on the mainframe.
Note 2: Where Fujitsu FLM-150® ADMs have been deployed. Otherwise, deploy OC-1 Optical Extension Rings for demands of 1 - 28.
Note 3: Beyond HDSL Doubler or HDSL CSA limits, place repeaters in existing apparatus cases. Otherwise, deploy OC-1 Optical Extension Rings for demands of 1 - 28.
Note 4: Where the OC-1 alternative is not available, deploy an OC-3 ADM.

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
TECHNOLOGY SELECTION FOR CUSTOMER DS1s



6.00 TECHNOLOGY SELECTION FOR NARROWBAND SERVICES

This section outlines the decision process and deployment directives and recommendations for satisfying narrowband service requirements. (See Section 3 for treatment of ISDN demand and Section 5 for treatment of customer DS1s.) Deployment alternatives evaluated in this section include *distribution cable,* metallic *feeder* cable, *Digital Added Main Line (DAML),* conventional digital loop carrier (DLC), Next Generation Digital Loop Carrier (NGDLC), and NGDLC e/w fiber distribution networks, also known as Fiber-In-The-Loop (FITL). A summary of directives and recommendations is provided by the "Technology Selection for Narrowband Services" flowchart at the end of this section.

Technology deployments for narrowband services should be guided by the following fundamental strategies:

a. Next Generation Digital Loop Carrier (NGDLC) is the first choice vehicle for all new narrowband facility placements. These systems support both metallic and fiber distribution terminations and are an integral part of the emerging broadband/narrowband deployment plans. NGDLC is more economical than conventional DLC systems over a wide range of deployment applications, demand volumes, and service mixes.

b. Fiber distribution, also known as Fiber-In-The-Loop (FITL), is the first choice architecture for all new residential developments requiring *either aerial or* buried distribution facilities. The intent is to maximize FITL deployments and minimize copper distribution deployments.

c. Fiber cables will be the first choice for all new feeder cable placements and terminations. While there may be short extensions to utilize existing copper cable facilities, no new copper cables should be terminated at the central office.

d. Feeder and distribution deployment decisions must be coordinated to ensure that fiber distribution deployments are maximized. In new growth residential development areas, limits should be established for metallic distribution extensions to avoid placement and perpetuation of feeder and distribution infrastructure supporting metallic distribution.

e. Decisions regarding implementation of broadband services over existing or planned fiber distribution systems, as well as for facility replacements with fiber distribution delivering integrated voice and broadband services, will be supported by separate business cases.

f. Minimize investments in metallic cable, conventional DLC systems, and associated equipment; maximize investments in NGDLC/FITL in anticipation of integrated broadband/narrowband systems.

g. Existing narrowband facilities, including metallic feeder cable and conventional DLC systems, should be utilized to their fullest extent practical to satisfy current and/or forecasted demands. Short sections of metallic cable may be placed to fill gaps in the feeder network and maximize the use of existing narrowband facilities, but should only be sized to meet the 3-5 year demand.

h. Minimize the placement of structures which will continue to require future placements of *conventional* DLC systems, such as SLC-5 or FDLC. New large cabinet sites should be satisfied with NGDLC/FITL in lieu of 80 *D/E*-type or 6200 cabinets. New 51/52-type *or 80A* cabinets for conventional DLC may be applicable for new *low to medium demand* sites, if the 5 year demand can be supported *and fiber distribution is not applicable. These may be particularly appropriate where development and demand have not yet warranted placement of other NGDLC or FITL systems, such as low-growth rural wire centers. Small cabinet configurations for current NGDLC products have also been introduced for* use in these applications, *particularly where other activity has led to deployment of NGDLC systems. NGDLC alternatives are also more economical than 80A configurations where fiber feeder is proposed or planned. Substantial quantities of SLC-5* *plug-ins and other components may be made available from fiber distribution re-build initiatives and should be utilized to the fullest extent possible to meet applicable deployments.*

i. Conventional DLC systems, such as SLC-5 and FDLC, should only be deployed in existing equipment housings which are incompatible with NGDLC systems or for new *low to medium demand* sites as noted above. *Substantial quantities of SLC-5 plug-ins may be made available from fiber distribution re-build initiatives and should be utilized to the fullest extent possible to meet applicable deployments.*

j. Service areas of existing DLC cabinets should be re-evaluated with deployment and relief plans for the entire route in order to serve primarily *areas with* existing distribution *plant* or *business* areas *(*not currently targeted for fiber distribution*)*. New cabinet placements along the route should be positioned and selected to allow maximum deployment of fiber distribution for new residential developments.

k. Short extensions of *aerial or* buried metallic cable *for new residential development* may be placed to utilize previously designed distribution *infrastructure (backbone cable, cross-box, RT). However, these* should generally be small-size cables serving limited numbers of living units *and should not be used to trigger or justify major expenditures in backbone distribution, cross-box or FDI, and feeder facilities.*

l. Metallic distribution cable placements in areas not currently targeted for fiber distribution, such as business *areas, should* only be sized to support the 3-5 year demand. Backbone metallic distribution facilities should not be sized to support long term demand. Additional fiber distribution components to economically serve these applications are under development.

m. *Digital Additional Main Line (DAML) equipment may be used to provide primarily distribution relief, but may also be useful for feeder relief in low growth situations. However, there are service limitations regarding modem speeds and future services. Small cable extensions in existing areas with a sufficiently sized backbone network are unlikely to be impacted by DAML technologies.*

n. *Several deployment alternatives for major narrowband relief projects/jobs should be identified, including minimum capital proposals. Budget impact, risks, timing, priorities, and other conditions should be assessed to select the best alternatives.*

The following items in this section outline specific directives, recommendations, critical factors, flow chart references, and other issues related to technology selection for narrowband services.

6.01 If *relief for narrowband feeder or distribution* is required for any DA, RAA*, or FSA* during the three year planning period **[N100]**, then see Section 7 and the associated flowchart to preview or evaluate integration and special service considerations **[N110]** prior to technology selections for narrowband services. Otherwise, return to Section 2 and proceed with the loop planning process **[P500]**.

6.02 FITL systems should be deployed **[N230]** as the first choice architecture for all new residential developments ***[N200]*** requiring *either aerial or* buried distribution facilities. If there are major expenditures required for distribution cable, backbone distribution, and/or feeder facilities (particularly housing) during the planning period ***[N220]***, then *fiber distribution facilities should be deployed.* This may also apply to areas requiring complete replacement of distribution facilities using buried cable when combined with feeder cable replacement strategies (see Section 4). *Obviously, fiber distribution should continue to be deployed to support new residential development growth in existing Fiber Service Areas* ***[N215]****.* See Table N1 at the end of this section for deployment considerations and design requirements. Also see *Appendix 6-1* for discussions of FITL deployment applications. It is important that the sizing *criteria and* design requirements in Table N1 be followed to maximize utilization and minimize costs for FITL deployments to ensure that deployment is economical and that funding based on these factors is adequate.

*The DSC StarSpan fiber distribution product was recently approved per RL:97-09-025BT and specific deployment directives were issued in RL:97-11-017BT. However, the acceleration of broadband deployment plans and the lack of progress in development of a viable data transport implementation have led to its removal from the approved products list per RL:98-10-031BT. A new broadband-ready fiber distribution product line is under development by DSC, now Alcatel, and we are continuing to work with them toward the introduction of that system. However, until other vendor products are approved, RELTEC DISC*S fiber distribution components should be deployed in ALL qualifying locations, either requiring new HDTs or utilizing existing RELTEC HDTs, instead of the traditional copper distribution networks. Additional optical shelves and ONUs can be added to accommodate growth requirements from existing DSC StarSpan HDTs, but no additional HDTs should be placed. Design parameters specific to these limited StarSpan ONU deployments are outlined in RL:97-11-017BT.*

6.03 If *there is new residential development growth* ***[N200]*** *in metallic distribution areas* ***[N215]*** *with no major expenditures required* ***[N220]****, then short metallic distribution cable extensions may be appropriate. However, if the existing infrastructure cannot support the capacity or anticipated demand from the metallic distribution cable extension* ***[N225]****, then existing service areas* should be *re-configured* to allow maximum deployment of fiber distribution for new residential developments, as previously discussed **[N240]**. *Where short metallic distribution cable extensions can be supported by the existing infrastructure* ***[N225]****, cable placements should only be sized to support the 3-5 year development, balanced with the existing infrastructure. For example, an extension to serve the last 30 LUs along a distribution leg may utilize 50 to 100 pairs depending on available pairs, previous backbone design, and other anticipated development.*

6.04 *If there are other metallic distribution relief requirements, such as for business or rural areas,* placements should only be sized to support the 3-5 year demand and backbone facilities should not be sized to support long term demand.

6.05 If vacant metallic pairs are available at the DA/RAA or along the route **[N310]** and 6.02 does not apply, then energize vacant pairs into service area through existing cable or the placement of short cable sections to fill feeder gaps **[N320]**. *Any cable placements should only be sized to support the 3-5 year demand or to balance with available feeder facilities.* Metallic pairs may be made available by feeder cable replacement activities (Section 4) or by proposed metallic cable extensions for ISDN (Section 3). Metallic pairs may also be made available by transferring working lines to carrier facilities at another site and reusing the vacated metallic pairs for growth (to be discussed later in this section). As discussed in the fundamental strategies at the beginning of this section, **NO** new copper cables should be terminated at the central office. *The use of DAMLs to defer distribution relief* ***[N325]*** *may also impact the need for additional metallic feeder pairs (see 6.06).*

6.06 *If relief is required for slow growth metallic distribution or feeder* ***[N315]****, then consider the use of Digital Added Main Line (DAML) equipment to defer relief* ***[N325]****. DAML equipment is used primarily for distribution relief, but a 4:1 DAML may also be useful for feeder relief in low growth situations. See Table N2 for conditions. Small cable extensions in existing areas with a sufficiently sized backbone network are unlikely to be* *impacted by DAML technologies. It is important to note that there are service limitations regarding modem speeds and future services, such as ADSL, but DAML equipment can provide effective transport for POTS-like services.*

6.07 If vacant DLC/NGDLC system capacity is available at the CSA **[N330]** and 6.02, *6.05, and 6.06* do not apply *or satisfy relief requirements*, then energize vacant derived pairs into service area through existing cable or the placement of short cable sections to fill feeder gaps **[N340]**. DLC system capacity may be available because derived pairs were not energized into a cross-connect box or service area. Derived pairs may also be available in another service area served by the same CSA where expected demand has not been realized. Transfer of some lines may be required to allow a full compliment of derived pairs to be re-routed to the growth area. In some cases, system hardwire components are in place but the common plug-ins have not been placed and the system has not been turned up for service.

6.08 As previously discussed in the fundamental strategies for this section, NGDLC is the first choice vehicle for all new narrowband facility placements. When 6.02 *and 6.05-6.07* do not apply *or satisfy relief requirements*, propose new or additional NGDLC systems and/or channel shelves for all new facility requirements. These NGDLC systems should generally be placed at the growth sites with an existing compatible housing **[N410/N420/N430]** or with a new housing **[N560]**, except as noted below.

a. Within budget and manpower constraints and where pairs are available **[N440]**, consider the placement of NGDLC growth facilities at or near the end of the metallic cable route, cutover existing metallic facilities, and use vacated pairs to provide relief facilities at growth sites closer to the CO **[N450]**. This cutover strategy will maximize the removal and retirement of metallic cable feeder facilities (See Section 4). When combined with the deployment of NGDLC, this cutover strategy may be particularly effective in providing growth facilities for loops <= 8 kft in total loop length. Since metallic facilities for these short loops may be readily used to provide emerging broadband services, cutover to NGDLC can position both growth and cutover sites for future broadband demands.

b. Conventional DLC placements specified in *6.09* below.

6.09 Conventional DLC systems, such as SLC-5 and FDLC, should only be deployed in existing equipment housings which are incompatible with NGDLC systems or for new small sites as noted below. *However, small NGDLC cabinet configurations have recently been introduced for both the Alcatel (DSC) LiteSpan and RELTEC DISC*S systems and should be considered first choice for these applications, particularly where other NGDLC deployments have already been made or planned.*

a. Place additional DLC systems and channels in vacant *non-NGDLC* housing space at growth site, if available **[*N410*/N420/N530]**. In keeping with the fiber distribution strategy, service areas of existing DLC cabinets should be re-evaluated with deployment and relief plans for the entire route in order to serve primarily existing distribution areas or areas not currently targeted for fiber distribution. New cabinet placements along the route should be positioned and selected to allow maximum deployment of fiber distribution for new residential developments.

b. If vacant housing space is not available at the growth site **[N410]** but metallic pairs are available for cutover at another carrier site **[N540]**, place additional DLC systems and channels at the other carrier site, cutover POTS lines, and reuse pairs at the growth site **[N570]** only if the cutover activity does not trigger a new housing, mux, or fiber placement within two years **[N550]**.

c. New conventional DLC systems and equipment housing at the growth site may be proposed for *low or medium demand* sites **[N560],** if the 5 year demand can be supported by a small/*medium* cabinet (51/52-type *or 80A)*, and only when the options above are not available *and fiber distribution is not applicable*. New large cabinet sites should be satisfied with NGDLC/FITL in lieu of 80-type or 6200 cabinets. *These may be particularly appropriate where development and demand have not yet warranted placement of other NGDLC or FITL systems, such as low-growth rural wire centers.*

6.10 See Table N3 at the end of this section for selection of NGDLC/FITL/DLC system products and configuration. *While the product with the lowest equipment price for various demands and configurations is shown on this table, product selection is also affected by other factors, including other system deployment and the existing network configuration. Also see* Table N4 for selection of TR-303 termination configurations ***[N700]***. *TR-303 is now the preferred choice for integration of system terminations in 5ESS and DMS-100 switches from both RELTEC and DSC NGDLC platforms. See Section 7 for more discussion. Where TR-303 is not applicable or available, Mode 2 system terminations should be proposed to support systems providing primarily residential services. However, Mode 2 is not yet approved for the DSC LiteSpan and other systems should be proposed for these applications.*

6.11 Utilize existing mux capacity (or planned for other demand) for DS1 transport for proposed *NGDLC/*DLC **[N810]** if available **[N800]**. *Existing mux capacity may be available in an existing hut or CEV accommodating the growth systems or in a collocated RT housing.*

6.12 Where existing multiplexer capacity is not available **[N800]** but fiber cable facilities have been established or triggered for other sites and include fibers allocated for use at the *NGDLC/*DLC deployment site ***[N820]***, then propose deployment of a SONET ADM **[N830]** consistent with the fiber planning recommendations in Section 8. *See Table N3 for approved transport options. Use an OC-1 system, if available, only if it can meet the 10-15 demand at the RT site. The OC-1 FiberReach can be configured as an ADM ring or point-to-point extension from a DDM-2000 ADM ring RT node or as a separate ADM ring from a DDM-2000 COT.*

6.13 Where existing multiplexer capacity is not available **[N800]** and fiber cable facilities have not been established or triggered **[N820]**, use existing T-1 *or HDSL* facilities with existing apparatus cases for DS1 transport for proposed *NGDLC/*DLC **[N850]** if available **[N840]**. This issue should generally not apply to NGDLC or FITL. *See Table N3 for approved transport options.*

6.14 Where existing mux capacity **[N800]**, fiber facilities **[N820]**, and existing T-1 *or HDSL* facilities are not available **[N840]**, and existing metallic pairs are not available or cannot be conditioned for T-1 **[N860]**, then fiber cable and multiplexer placements should be triggered for *NGDLC/*DLC transport **[N880]**. *Where metallic pairs can be conditioned for HDSLs **[N860]** and the RT sites requiring DS1 support are within HDSL range, then HDSL can be used economically from a multiplexer hub or the CO for up to 20 DS1s during the 5-yr planning period. Standard HDSL units that can use up to two doublers for a maximum range of 36 kft are available for SLC-5 systems and for RELTEC via a Wescom HDRS. "Hi-Gain" HDSL units are pending approval and can use up to four* *"doublers" for a maximum range of 60 kft. These will be compatible with the Wescom HDRS but there are currently no plans for units to fit directly in other systems.* Where existing metallic pairs can be conditioned for T-1 *beyond HDSL limits* **[N860]**, then see Chart N5 at the end of this section for an economic screening tool of immediate fiber facility placement versus extraordinary T-1 costs **[N865]**. Other detailed analysis may also be appropriate. Low speed lightwave options, such as OC-1, *make* fiber placement more attractive, but *HDSL has also made metallic transport more attractive where existing pairs are available.*

a. Where fiber cable placement is economic now **[N870]**, then fiber cable and multiplexer placements should be triggered for *NGDLC/*DLC transport **[N880]**.

b. Where fiber cable placement is not economic now **[N870]**, then condition existing pairs from an existing multiplexer hub or CO for *NGDLC/*DLC transport **[N890]**.

6.15 When proposing new housing installations for loop electronics, consider maximizing the area to be served in order to minimize the total number of housing sites and their associated maintenance and emergency powering requirements. Considerations when determining housing type/size and area to be served should include:

a. Total 10-15 year demand (growth + cutover)
b. CSA design limits for metallic distribution (9 kft of 26 gauge cable or 12 kft of 24/22 gauge cable)
c. Powering limits for fiber distribution (see Table N1)
d. Housing costs for cabinet, hut, or CEV.
e. Right-of-way or land costs and availability
f. Implementation of integrated broadband services via FITL, also known as IFITL. High common costs for broadband service components at HDT require maximum sharing in order to minimize unit costs.

*6.16 Several deployment alternatives for major narrowband relief projects/jobs should be identified, including minimum capital proposals **[N620]**. Assess budget impact, market/demand risks, timing, priorities, and other conditions to select the best alternatives **[N630]**. Critical decisions and deployment options, particularly those with a wide disparity in budget impact, should be reviewed with the management for approval, informally during planning activities and/or formally during route reviews **[N640]**.*

TABLE N1
FITL DEPLOYMENT CONSIDERATIONS AND DESIGN REQUIREMENTS

This table has been updated to reflect directives concerning the ONU-12/24 per RL:97-03-027BT and concerning aerial fiber distribution per RL:98-09-025BT.

Unless other facilities have already been placed, fiber distribution will be the first choice architecture for all new residential developments requiring *either aerial or* buried distribution facilities. Generally, any new single family or multi-family residential development or expansion which would have previously required major expenditures for DLC-based feeder facilities, RT housing, cross-connect box, and/or backbone distribution cable under a copper distribution plan is now a candidate for fiber distribution. Copper distribution cable should still be deployed only to satisfy small cable extensions connecting to existing appropriately designed backbone distribution cables and associated cross-connect box and feeder facilities. As directed in *Section 6.00a*, NGDLC *is the first choice for* all new feeder facility *placements*, except as noted *by 6.00h*, and may be configured to support metallic distribution, fiber distribution, or both. While an NGDLC installation may include metallic distribution channels to serve existing metallic distribution facilities or new metallic distribution facilities in aerial or business applications, NGDLC/FITL components and fiber cable facilities should be placed for all new residential developments to be served by the NGDLC site. RELTEC DISC*S fiber distribution components should be deployed in ALL qualifying locations, *either requiring new HDTs or utilizing existing RELTEC HDTs,* instead of traditional copper distribution facilities. See *Appendix 6-1* for detailed discussion of FITL applications and designs.

FITL design requirements are summarized below. These are not meant to prohibit your deployments in any way, but should be used to ensure cost effective designs.

1) *The RELTEC ONU-12/24 for fiber distribution was approved by RL:97-02-032BT to provide increased capacity over the previously deployed ONU-12. The ONU-12/24 is now the standard product for all new ONU placements and replacements. ONU-12/24s should be configured in the 12 line mode when serving eight living units or less. This will ensure maximum utilization of the current HDT optical channel shelf (OCS) design. Otherwise, HDT capacity is consumed at twice the rate required by the demand. The ONU can be upgraded to 24 DS0s at a later date if required by demand by simply moving the fiber jumper to an OIU configured for 24 DS0s (this also changes the facility count of the ONU terminal). When serving more than eight living units, as for multi-family developments, the ONU should be configured to operate in the 24 line mode.*

   Utilizing the new ONU-12/24, new buried fiber distribution layouts should generally be designed to achieve an average of 6-8 LUs per ONU across each district. Each ONU-12/24 may serve as many as 16 living-units in some multi-family or zero lot-line types of developments, displacing two ONU-12s under the previous design. Single family applications should continue to typically be designed to serve 6-8 LUs/ONU, since the number of LUs served from each ONU is often controlled by the drop length which should still be generally limited to 500'. However, designs of 4 LUs/ONU to accommodate above average line usage can now be discontinued in favor of designs serving 6-8 LUs/ONU, but ONUs may need to be configured for 24-lines. Since ONU channels are not dedicated to each living unit, capacity can be assigned on a service order basis to accommodate second line and/or special service demand. Therefore, two or three lines of ONU capacity are not required for every living unit even though some living units may require two or three lines.

   For joint trench arrangements with the power companies, ONUs are generally placed at the same locations as the power transformers. The number of living units served from each ONU in this arrangement will vary with each development and with each service pedestal grouping. Typical joint trench applications result in designs with averages of 4.3 to 7.8 living units per ONU with some transformer/ONU locations serving as few as 2-3 and other locations serving as many as 8-9 living units. *The ONU-12/24 will simplify the joint trench plans by allowing one ONU (configured for 24 lines) at pedestal locations serving more than 8 living units, in lieu of two ONU-12s in the previous design.*

Aerial cable applications use the same ONU pedestal and electronics as in the buried environment. Optimal designs serve 12 LUs from three 12-pair terminals subtended from a single ONU.

2) *Although the ONU-12/24 has increased capacity over the previously deployed ONU-12, fiber cable sizing should remain the same in order to position the network for future services.* Fiber distribution cables should be sized to provide the maximum of one fiber per ONU or one fiber for each 8 living units (two for 9-16 living units) at each service pedestal location. Each fiber cable sheath should also include 20% additional fibers (above the requirement) or a minimum of two spare fibers in any sheath. Generally, 10 ONUs *(each serving 8 LUs or less)* can be served from a 12-fiber cable and 4 ONUs from a 6-fiber cable. Where practical, one spare fiber should be spliced all the way from the HDT to the end of each fiber distribution cable. *The additional fibers beyond those required to support the deployed ONUs should not be connectorized. Although a practical plan should be used to make spare fibers available throughout the distribution network, backbone distribution cables should not be upsized to energize spare fibers in all side legs, end sections, or fiber drops.* When working lines exceed the capacity of an existing ONU, these spare fibers should be used to activate an additional ONU. Spare fibers may also be used to accommodate maintenance situations.

3) *Power cable sizing, routing, and splicing should generally parallel that for the fiber cables. For service locations within 6kft (5.7 kft for aerial) of the HDT, power cables should be sized to provide one 22-gauge pair for each ONU plus one 22-gauge pair for each service pedestal location serving more than 8 living units. Two power pairs should be dedicated for each fiber allocated to service locations that fall between 6-12kft (5.7-11.3 kft for aerial) from the HDT.* Power cables should also include 20% spare pairs above the ONU requirement. The HDT should be centrally located as much as possible to minimize powering requirements and costs.

4) *For buried applications,* fiber and power cables should generally placed on one side of a street with ONUs positioned on both sides. *Composite fiber/power cable should generally be used for all applications.* Use of composite fiber/power drops with pre-terminated fiber connectors should be maximized to eliminate field or factory splices for ONUs, such as those at the end of a cable run or those across the street from the primary cable placements. These drops should contain two power pairs and two fibers with a pre-terminated fiber connector on only one fiber. *For aerial applications, fiber and power cables may be separate or in a composite sheath, depending on placement issues. Either factory or field splicing of the aerial fiber and power cable is generally accomplished on the strand and taut sheath splicing techniques have been introduced by RL:98-10-001BT. Composite fiber/power drops extended to ONUs at the base of the pole or at the end of the cable route. These should contain two fibers with a pre-terminated fiber connector on only one fiber. Since ONUs for aerial applications will generally be serving more than 8 LUs, both fibers in the fiber drop will generally be spliced to the fiber cable. See item 2 for more discussion. Also see RL:98-09-026BT for engineering methods and procedures.*

5) Branch and taper splices should be minimized. *For buried cable applications,* fiber cables routed through ONU pedestals should be limited to *48* fibers. *In addition, buried fiber cable extensions up to 12 fibers, such as those to serve future phases of developments, should now be spliced in the ONU pedestal.* Handholes should be used only to meet special situations. Fusion splicing is the only approved splicing method for FITL installations. Fusion welding is also recommended for emergency restorations, but FiberLok splicing may

be used for emergency restorations if fusion splicers are not available. FiberLoks used for emergency restoration will be considered permanent.

6) Placement depths and cable marker signs or tape for *buried* fiber distribution cable should be the same as those intended for a metallic distribution cable placement.

7) Joint trenching, Factory Installed Terminating System (FITS), and other cost reduction and labor-saving steps should be used for fiber distribution in the same manner being used today for metallic distribution.

8) For joint trench arrangements with power company facilities, service drops should be placed in the same manner and timeframe as power company service drops.

9) For FITS or factory/shop spliced fiber and power cables, fiber/power drops to ONU pedestals along the fiber cable route should include only one fiber. To accommodate a future cable extension, fiber and power cables should be terminated and spliced in the last ONU pedestal. It should be noted that pre-term fiber distribution cables will limit access to spare fibers and power pairs for maintenance and unanticipated demand.

10) There is no change in existing policies regarding conduit placements to accommodate special circumstances. In general, conduit should not be placed along with fiber or other distribution facilities.

11) NGDLC platforms for fiber distribution may be supported by fiber feeder transport via integrated or stand-alone multiplexers or by T-1 copper feeder transport.

12) Use pre-CT assignments for fiber distribution facilities in the same manner as for metallic distribution, usually for multi-family or fast build-out single family applications. Otherwise, channel units should be placed and electronic cross-connects implemented via PIPSO/service order activities. Until an automated system can be implemented, electronic cross-connects must be made by technicians using a craft interface device at the ONU, HDT, or COT, or via Supervisory System at CO.

13) TR-008, TR-303, and/or universal system terminations at the CO should be sized and implemented per the NGDLC and TR-303 Loop Deployment Directives (RL:95-03-028BT).

14) As Consumer Multimedia Services (CMS) plans are finalized, additional CMS facilities may be placed with the fiber distribution in targeted areas. These CMS facilities will be designed and construction performed by a CMS organization. Funding and coordination for these additional facilities will be provided by the CMS IBU.

TABLE N2
Summary of Digital AML Directives per RL:98-09-003BT

Primary Application
Utilize Raychem Miniplex[R] 2:1 systems for single line ADL Service Orders in lieu of an EWO, and Raychem Miniplex[R] 4:1 systems at households or small businesses where 3-4 lines are required.

Deploy Digital AML where

a) *Loop Capacity Management (Service Order Advocacy Group or Outside Plant Engineer), or HAL in a mechanized application, determines that all other possible Facility Modification service alternatives have been exhausted, i.e., Line and Station Transfers (LSTs), Wired Out of Limits (WOLs), Clear Defective Pairs (CDPs), Break Over-age Connect-Throughs (BCTs), and purging of invalid Quickserves and CTs.*
b) *No pending relief job authorization can be advanced, completed or coordinated with the ADL order to provide facilities in time to meet the expected service activation date.*
c) *The primary line to the service location meets the Loop Qualification Criteria set forth in Digital AML M&Ps (Section 4 of RL:98-07-015BT for 2:1 Systems or Section 9 of RL:98-09-002BT for 4:1 Systems).*

Niche Applications
Raychem 4:1 Digital AML systems on a Bulk Basis as a Facility Relief Alternative is typically a last choice option due to the higher per line costs for this equipment as compared to other conventional alternatives. However, there are economically attractive niche applications under the following conditions:

Conditions

a) *Loop Capacity Management (Service Order Advocacy Group, Outside Plant Planner or Engineer) has determined that all other traditional Facility Modification alternatives, i.e. LSTs, WOLs, BCTs, CDPs, as well as the purging of invalid Quickserves and CTs, will not be sufficient to defer facility relief authorizations and their associated capital expenditures by at least 1 year.*
b) *There are enough ADLs currently served by the crossbox, or in the Distribution Area, such that placement of 4:1 Digital AML single premise remote units, i.e. standalone ONI, DooRT, or indoor configurations, would facilitate "mining" of enough feeder and/or distribution pairs to meet the anticipated 3-5 year demand.*
c) *Enough existing line demand must be accumulated at given pole or pedestal locations to justify the placement of 4:1 Digital AML multiple customer premise units for cutover to facilitate the "mining" of feeder and/or distribution pairs to meet the anticipated 3-5 year demand.*
d) *The drops serving the individual living units beyond the 4:1 multiple customer premises remote units, i.e. pole/strand or pedestal mounted, must not exceed the length recommended in the M&Ps (RL:98-09-002BT).*
e) *The ultimate loops (F1 and F2) potentially served by 4:1 Digital AML systems, or the distribution loops (F2) in a DLE 2:1 Digital AML configuration, do not exceed the Loop Qualification Criteria defined in the Digital AML M&Ps (Section 4 of RL:98-07-015BT for 2:1 Systems or Section 9 of RL:98-09-002BT for 4:1 Systems).*

Deploy	*Where*	*and*	*Growth Rate*
4:1 Digital AML Systems	*Feeder **and** Distribution Relief Required*		*Any*
4:1 Digital AML Systems	*Feeder Relief req'd in slow growth area where DLC proposed in existing cabinet*		*<= 10 lines/year*
4:1 Digital AML Systems	*Feeder Relief req'd in slow growth area where DLC and new cabinet proposed*		*<= 22 lines/year*
4:1 Digital AML Systems	*Feeder Relief req'd in slow growth area where short section metallic cable placements proposed*		*<= 24 lines/year*
4:1 Digital AML Systems	*Distribution Relief req'd in slow growth area where metallic cable placement proposed*	*<= 8 lines/year*	
2:1 DLE Digital AML	*Distribution Relief req'd in slow growth area where metallic cable placement proposed*		*<= 6 lines/year*

Subject	*Subject Matter Expert*	*Telephone Number*
Deployment Strategy	*Sherry Woodruff*	*1-770-493-3741*
Outside Plant Engineering	*Dennis Grau*	*1-615-214-4609*
Installation & Maintenance	*W. P. Beverly*	*1-205-977-2985*
Procurement	*Neil Shattles*	*1-404-420-6089*
AFIG Inventory Issues	*Rick Haggard*	*1-205-977-3251*
AFIG Service Order Processing	*Rhonda Hannon-Holland*	*1-615-214-4570*

TABLE N3 - NGDLC/DLC PRODUCT SELECTION

NGDLC/FITL Product Avail:	DSC LiteSpan	RELTEC DISC*S
Feeder Transport Interfaces:		
• DS1 via External Mux	*Under evaluation*	Approved
• *T-1*	*Under evaluation*	*Approved via HDRS*
• *HDSL*	*Not Approved*	*Approved via HDRS*
• *SONET ADM Ring: OC-1*	*Not Available*	*Approved via FiberReach*
• SONET ADM Ring*: OC-3*	*Approved*	*Approved via DDM2000/FLM150*
Distribution Interfaces:		
• Metallic Distribution	Approved	Approved
• Fiber Distribution	*Existing HDTs Only*	Approved
Switch Interfaces:		
• Universal	Approved	Approved
• TR-008 Mode 1	Approved	Approved
• TR-008 Mode 2	Under evaluation	Approved
• TR-303 Single VRT	*Approved for 5ESS* *Pending Approval for DMS-100*	*Approved for 5ESS & DMS-100* *Under evaluation for EWSD*
• TR-303 Multi-VRT	Under development	Under development
RT Cabinets:		
• *192 to 448* lines	*LSC-2001 copper-fed (192 or 384 lns)* LSC-2001 *fiber-fed* (448 lns) *approved*	*MESA Sport (288lns) approved* MESA 2 (384 lns) approved
• Up to 1344 lines	LSC- 2030 *Approved*	MESA-4 approved
• Up to 2016 lines	CEC 2000 approved	MESA-6 approved CEC-2000 *Approved*
• CPE Cabinet	Under Development *Awaiting resolution of EMI issues.*	Under Development *Awaiting resolution of EMI issues*

NGDLC Product Selection:		10 Yr. Demand	Metallic Distribution	Fiber Distribution[5]
• *Cabinet*	*T-1 feeder*	*<=192 Lns*	*DSC Litespan[1,2] (RELTEC DISC*S)[3]*	*RELTEC DISC*S*
		193-288 Lns	*RELTEC DISC*S[4]*	*RELTEC DISC*S*
		>288 Lns	*DSC LiteSpan[1,2] or RELTEC DISC*S*	*RELTEC DISC*S*
• *Cabinet*	*Existing Mux*	*<=192 Lns*	*DSC Litespan[1,2] (RELTEC DISC*S)[3]*	*RELTEC DISC*S*
		193-288 Lns	*RELTEC DISC*S[4]*	*RELTEC DISC*S*
		289-672 Lns	*DSC LiteSpan[1,2] or RELTEC DISC*S*	*RELTEC DISC*S*
		>672 Lns	*RELTEC DISC*S[4] (DSC LiteSpan)[1,2,6]*	*RELTEC DISC*S*
• *Cabinet*	*Fiber -Fed*	*Any Lns*	*DSC Litespan[2] or RELTEC DISC*S*	*RELTEC DISC*S*
• *Frame:*	*Existing Mux*	*All Lns*	*RELTEC DISC*S[4] (DSC LiteSpan)[1,2,7]*	*RELTEC DISC*S*
• *Frame:*	*Fiber Fed*	*0-672 Lns*	*DSC LiteSpan[2,4]*	*RELTEC DISC*S*
	Fiber Fed	*>672 Lns*	*DSC LiteSpan[2] or RELTEC DISC*S*	*RELTEC DISC*S*

*Note 1: Pending approval of T-1/DS1-feeder for DSC LiteSpan, otherwise deploy RELTEC DISC*S.*
*Note 2: For residential applications, assumes the approval of Mode 2 for DSC LiteSpan, or use of TR-303. Otherwise, deploy RELTEC DISC*S.*
*Note 3: RELTEC DISC*S configuration is also economically viable where RELTEC DISC*S COT is existing or planned to support other applications.*
Note 4: Listed NGDLC configuration has a savings of 10% or more over other NGDLC alternatives.
*Note 5: RELTEC DISC*S is the only system approved to support fiber distribution.*
*Note 6: For TR-303, cost difference for DSC LiteSpan over RELTEC DISC*S is less than $20/line.*
*Note 7: For TR-303, cost difference for DSC LiteSpan over RELTEC DISC*S is less than $10/line.*

NGDLC Configuration (CO system terminations):	
• TR-303 equipped switches	TR-303 system termination (see Table N4) Universal or D4 COT system for specials
• All other *digital* switches	Mode 1 for system demand >50% business Mode 2 for system demand <50% business Universal or D4 COT system for specials

NGDLC Sizing Criteria:

• Channel Banks & Commons	1-2 year demand
• Channel Unit Plug-ins	Installed via PIPSO
• TR-008 System Terminations	1-2 year demand
• TR-303 System Terminations	See Table N4

DLC Deployment Criteria: Only to meet *new* small demand s*ites* or to fill existing cabinets

• DLC Product Selection:	SLC-5 or FDLC	
• DLC Configuration:	System demand >50% business:	Mode 1
	System demand <50% business:	Mode 2
• DLC Sizing Criteria:	Channel Banks & Commons:	1-2 year demand
	Channel Unit Plug-ins:	Installed via PIPSO

TABLE N4
TR-303 NGDLC DESIGN PARAMETERS

Next Generation Digital Loop Carrier is a transport platform which can support multiple CO system terminations, including TR-008, TR-303, universal, and D4, as virtual RTs. Each virtual RT is recognized by the digital switch and/or operations systems as a single system entity and is independent from the metallic and/or fiber distribution capacities terminated on the NGDLC platform. The timeslot interchange (TSI) capability allows electronic mapping of services from the distribution facilities to the virtual RTs to provide efficient utilization of feeder facilities and enable cost-effective field grooming of special services. Although an NGDLC site may initially be implemented with TR-008, subsequent facility relief may include a TR-303 system termination

A TR-303 system termination can range in size from 48 to 2048 lines and can be supported by 2 to 28 DS1s. However, to avoid over-allocation of costly near-term switch capacities, TR-303 system terminations supported by an NGDLC platform should generally be sized to meet the two year demand to be served by the NGDLC. Furthermore, the number of DS1s required to support the TR-303 system termination should be determined by anticipated traffic requirements. Although some concerns are often raised regarding concentration of services on loop facilities, TR-303 allows this concentration to be effectively moved from the switch peripheral to the loop facilities on a similarly large facility. Rather than uniquely engineer each TR-303 system termination, the following tables should be used to size the initial TR-303 system termination at each NGDLC platform. *See RL:98-11-029BT for TR-303 traffic analysis.*

TR-303 Initial System Terminations

Virtual RT Forecast (Lns)		TR-303 System Termination Size (Lns) (2)		DS1 Requirements (3)		
				<50% Business		>=50%
2 Year Demand	5 Year Demand	5ESS(4)	DMS100(5)	*<5 CCS*	*>=5 CCS*	Bus.
97-175	***<=192***	175	N/A(1)	2	3 ***(192 lns)***	3
97-175	***>192***	288	288	3	***4***	4
176-288	Any	288	288	3	***4***	4
289-384	Any	384	384	4	***5***	5
385-480	Any	480	480	5	***5***	6
481-576	Any	576	576	***6***	***6***	7
577-672	Any	672	672	***7***	***7***	8
>672	Contact your switch capacity manager to determine TR-303 design parameters.					

Note 1: If a potential system termination does not have a forecasted growth greater than 192 lines in ***5 years***, then it is not normally a candidate for TR-303.

Note 2: If the ultimate system forecast is known and the recommended initial system termination is within 96 lines of the ultimate, then the initial system termination should instead by sized for the ultimate demand.

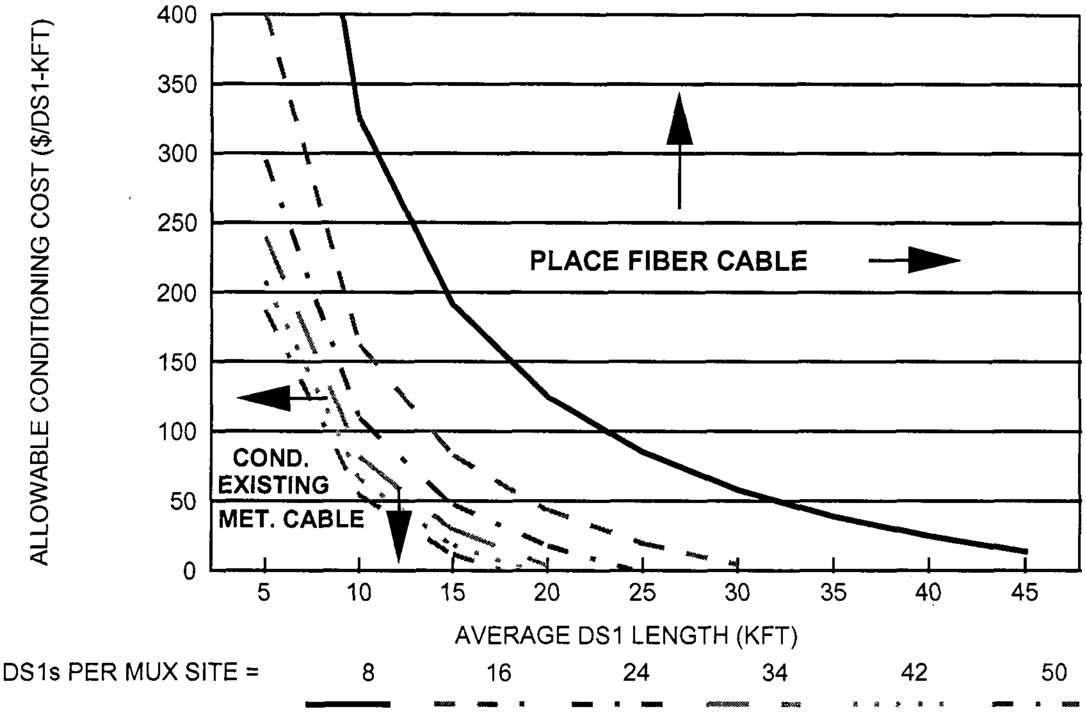
Note 3: For switches ***that have a*** ABSBH digital CCS/NAL of 5.0 or greater, the ***higher*** DS1 requirements ***should be used for*** virtual RTs with <50% business demand. In this special case, the 3 DS-1s for the smallest termination are sufficient to support 192 lines rather than only 175 lines.

Note 4: Deploy TR-303 in 5ESS if capacity terminated >=400 lines per year for 7 years.

Note 5: Deploy TR-303 in DMS-100 only if capacity terminated >=1440 lines over 7 years.

Subsequent feeder relief for the NGDLC platform beyond the initial TR-303 system termination *should be accomplished by adding DS1s and increasing system size as first choice, or by establishing* another system termination and virtual RT. *The first is most likely in a DMS-100 since the ESMA peripheral is generally system limited, rather than DS1 or line limited.* Because the unit cost for TR-303 terminations decreases with system size, dramatically for the DMS-100, a cut-over strategy as discussed in Section 6 may be particularly effective when relief facilities can be provided via TR-303 system terminations. *TR-303 systems will be monitored for potential blocking by Network Information Warehouse (NIW) and reports on systems requiring potential treatment or with excess DS1s will be forwarded to Loop Capacity Management. Additional DS1s are reserved on switch peripherals for treatment of high traffic RTs* or the system size may be re-defined. *Also see RL:98-11-029BT for further discussion.*

CHART N5
EXTRAORDINARY T-1 LINE COST LIMIT



NOTES ON CHART N5

1. Locate potential multiplexer locations for fiber project.
2. Develop forecast of DS1 requirements for each multiplexer site and calculate average number of DS1s per MUX site.
3. Calculate the total DS1KFT which would be provided over the length of a potential fiber cable plan. Multiply each DS1 requirement by the portion of its length to be served by fiber facilities.
4. Calculate the Average DS1 Length = (Total DS1KFT)/(Total No. of DS1s).
5. Estimate the extraordinary costs for the route associated with conditioning existing metallic cable to provide the total DS1s. Calculate extraordinary costs per DS1KFT and compare to chart.
6. Alternately, the chart indicates the limit of conditioning costs and or extraordinary expenditures (per DS1KFT) for that particular route This unit value multiplied by the total DS1KFT indicates the total extraordinary cost limit for the route.

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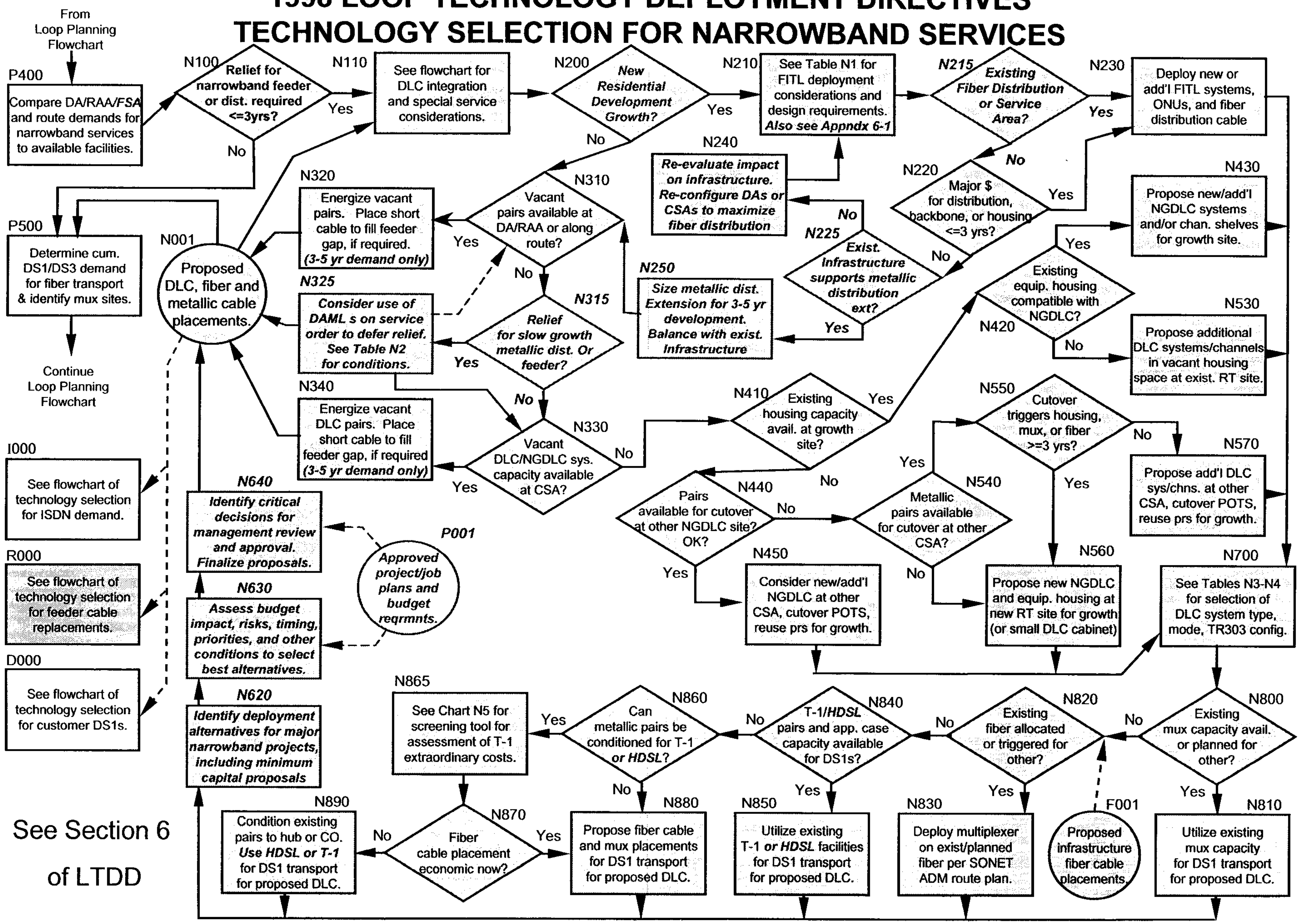


7.00 DLC INTEGRATION AND SPECIAL SERVICE CONSIDERATIONS

DLC integration and special service considerations are explored in this section in order to determine the type of DLC system terminations to be considered for carrier deployments to serve switched services, as well as non-switched (NS) or non-locally switched (NLS) special services. These considerations should be reviewed prior to making technology decisions regarding narrowband services and confirmed when proposed narrowband placements have been determined. A summary of directives and recommendations is provided by the "DLC Integration and Special Services Consideration" flowchart at the end of this section.

DLC system terminations may include universal arrangements (UDLC) *and* integrated arrangements (IDLC), TR-008 or TR-303. An NGDLC/FITL system is a large capacity carrier platform which can utilize a time slot interchanger and software control to establish multiple "virtual" system terminations, TR-008, TR-303, and/or universal, in order to efficiently utilize transport and switch interface facilities. One (or more) of these "virtual" systems may be a dedicated special service system terminated as UDLC on an NGDLC COT channel unit shelf or as an Integrated Network Access (INA) system on a Digital Crossconnect System (DCS). All of these system terminations appear as "virtual RTs" in the remote NGDLC common shelf and are not directly associated with any channel shelf capacity. Electronic cross-connects or assignments are used to associate a specific channel from the channel shelves or ONUs to a particular line termination from the CO. This is a major advantage for NGDLC platforms over conventional DLC systems since it eliminates the need to dedicate RT channel shelf capacity to universal or special service arrangements. From a central office perspective, establishment of additional "virtual" system terminations is the same as the termination of a new conventional DLC system with hardwired channel capacity, even though it simply utilizes existing common shelf capacity. Therefore, for discussion in this section, the term "system" will apply to the unit of carrier capacity terminated at the CO whether associated with a conventional DLC system or a *virtual RT termination on an* NGDLC/FITL system.

DLC integration and special service considerations should be guided by the following fundamental strategies:

a. *TR-303 is now the preferred choice for integration of system terminations in 5ESS and DMS-100 switches from both RELTEC and DSC NGDLC platforms. RL:97-12-019BT updated TR-303 deployment directives to reflect approval of RELTEC TR-303 configurations with the 5ESS and DMS-100. RL:98-08-017BT approves Alcatel (DSC) TR-303 configurations with the 5ESS and FOAs for integration with the DMS-100 are nearing completion. While TR-303 provides significant long-term savings, incremental 1999 funding for initial TR-303 switching equipment is available through the BPTR303 change plan.*

b. Dedicated special service capacity should be established in each NGDLC node to allow grooming of special services *and unbundled loops* at the RT via electronic cross-connects. *Switch peripheral sidedoor capabilities should not be used to support special services transported via NGDLC.*

c. Where TR-303 is not yet installed or available, TR-008 integration of new carrier system placements with a digital switch should be maximized. Both the RELTEC DISC*S and DSC LiteSpan NGDLC systems have been approved for TR-008 integration with the No.5ESS and DMS-100. *Both systems have also been successfully integrated with the EWSD, but full* interoperability testing *has not been completed.*

d. Unbundled loops are forecasted to represent only 2% of total lines by 2002 and should be provisioned in the loop network much like non-switched or non-locally switched special services. See RL:98-11-012BT for definitions and provisioning directives.

The following items in this section outline specific recommendations, critical factors, flow chart references, and other issues related to DLC integration and special service considerations.

7.01 Where growth requirements do not include NS/NLS special services within 3 years **[S100]**, then *propose* new TR-008 or TR-303 integrated carrier systems **[S140/S150]** or universal systems **[S160]** to serve switched services. Where NGDLC/FITL systems are being deployed **[S120]**, *TR-303 integration planning should be coordinated and/or reviewed with the Switch Capacity Manager **[S125]**. Using the sizes recommended in Table N4 or equivalent TR-008 system terminations anticipated from existing and planned NGDLC platforms, determine the total system capacity to be terminated for the wire center. Assuming a need for switch relief, initial deployment of TR-303 switch components is economical if system capacity to be terminated in 7 years totals 1440 lines or more for a DMS-100 or averages 400 lines or more per year for a 5ESS. Only planned or potential "large system" terminations from an NGDLC site that qualify per Table N4 should be included. Where the two-year demand is 96 lines or less, such as for small NGDLC cabinet sites, a TR-008 system termination is recommended and should not be included in the total. After coordination with switch planning, if* large TR-303 interface capacity is available or planned at the switch **[S130]**, then TR-303 integrated system terminations should be proposed **[S140]**. Otherwise, proposed integrated systems must utilize a TR-008 termination **[S150]**, *but TR-303 deployment plans should continue to be reviewed if NGDLC systems are planned and deployed.*

7.02 Where growth requirements do include NS/NLS special services*, including unbundled loops,* then see Tables S1-S4 at the end of this section for a summary of service capabilities for various system configurations **[S190]**.

7.03 Where available, use an existing *universal or* dedicated special service system to serve NS/NLS specials, *including unbundled loops* **[S200/S210]**. *POTS lines may be transferred to other existing or proposed integrated facilities to accommodate the additional NS/NLS specials on the universal system.* As discussed in 7.00, a dedicated special service system *is always* available as part of an NGDLC and/or FITL system platform. Consider or propose additional carrier systems to serve switched services per 7.01.

7.04 Use vacant, existing, or proposed metallic pairs to serve NS/NLS specials*, including unbundled loops* **[S400/S410]** where an existing *universal or* dedicated special service system is not available **[S200]** and a new DLC system is not required for other growth or replacement **[S300]**. These metallic pairs may be made available by cable replacement activities (Section 4), the placement of new metallic facilities, or by cutover activity to DLC at the farthest CSAs for growth along the route. Existing metallic pairs serving the CSA may also be made available by transferring POTS lines to other existing or proposed integrated facilities to accommodate the additional NS/NLS specials on the metallic pairs.

7.05 For applications in which NGDLC/FITL-based systems are not existing or planned **[S700]**, propose a new dedicated carrier system to serve NS/NLS specials*, including unbundled loops,* **[S510]** where a new system is required for other growth or replacement **[S300]** and growth forecast >24 NS/NLS specials in 3 yrs **[S500]**. Consider or propose additional carrier systems to serve switched services per 7.01.

7.06 For applications utilizing conventional DLC systems **[S700]** per the directives in Section 6, propose one universal carrier system to serve SS/POTS mix and consider additional universal systems if required **[S610]** when <u>all</u> of the following conditions are met:

a. Capacity is not available in an existing *universal or* dedicated special service system **[S200]**.

b. New systems are required for other growth or replacement facilities **[S300]**.

c. Growth forecast <=24 NS/NLS specials*, including unbundled loops,* in three years **[S500]**.

d. Digital switch is not existing or planned **[S600]** to meet the system service date.

7.07 In keeping with previous directives and as documented in Section 6 of this document, NGDLC and FITL are the first choice for new facility placements. Where NGDLC or FITL systems can be deployed **[S700]**, *TR-303 integration planning should be coordinated and/or reviewed with the Switch Capacity Manager **[S125]**. Using the sizes recommended in Table N4 or equivalent TR-008 system terminations anticipated from existing and planned NGDLC platforms, determine the total system capacity to be terminated for the wire center. Assuming a need for switch relief, initial deployment of TR-303 switch components is economical if system capacity to be terminated in 7 years totals 1440 lines or more for a DMS-100 or averages 400 lines or more per year for a 5ESS. Only planned or potential "large system" terminations from an NGDLC site that qualify per Table N4 should be included. Where the two-year demand is 96 lines or less, such as for small NGDLC cabinet sites, a TR-008 system termination is recommended and should not be included in the total. After coordination with switch planning, if* large TR-303 interfaces are available or planned at the switch **[S730]** to meet the required system service date, then propose TR-303 integrated system terminations to serve all switched services, including ISDN **[S740]**. If large TR-303 interfaces will not be available **[S730]** for a digital switch **[S710]**, then propose TR-008 integrated system terminations to serve all switched services, except ISDN **[S750]**, *but TR-303 deployment plans should continue to be reviewed if NGDLC systems are planned and deployed.* In both cases, dedicated NGDLC COT capacity or SS system should be proposed to serve NS/NLS specials, *including unbundled loops* **[S720]**. For placements not associated with a digital switch, universal NGDLC COT channel shelf capacity must be placed to serve both switched and non-switched services **[S760]**.

7.08 For applications utilizing conventional DLC systems **[S700]** per the directives in Section 6, propose one universal carrier system to serve SS/POTS mix and consider additional TR-008 integrated systems for switched services if required **[S880]** when <u>all</u> of the *conditions below are met. A limited number of POTS lines should be cutover to subsequent integrated system placements to allow capacity for additional special services on the initial universal system.*

a. Capacity is not available in an existing *universal or* dedicated special service system **[S200]**.

b. New systems are required for other growth or replacement facilities **[S300]**.

c. Growth forecast <=24 NS/NLS specials*, including unbundled loops,* in three years **[S500]**.

d. Digital switch is existing or planned **[S600]** to meet required service date but sidedoor or hairpin capability is not **[S800]**.

e. No other facility is available to serve NS/NLS specials **[S870]**, including vacant or existing metallic pairs suitable for specials as discussed in 7.04 or existing universal carrier systems. POTS lines may be transferred to other existing or proposed integrated facilities to accommodate the additional NS/NLS specials on the metallic pairs or universal system.

7.09 For applications utilizing conventional DLC systems **[S700]** per the directives in Section 6, use other existing facilities, where available, to serve NS/NLS specials and consider TR-008 integrated carrier for switched services **[S830]** when <u>all</u> of the following conditions are met.

a. Capacity is not available in an existing dedicated special service system or UDLC system **[S200]**.

b. New systems are required for other growth or replacement facilities **[S300]**.

c. Growth forecast <=24 NS/NLS specials, *including unbundled loops,* in three years **[S500]**.

d. Digital switch is existing or planned to meet required service date **[S600]** and either sidedoor or hairpin capability is not available or planned to meet the required service date **[S800]** or existing No.5ESS DCLU capacity is available **[S810]**.

Other available facilities to serve NS/NLS specials **[S820/S870]** include vacant or existing metallic pairs suitable for specials as discussed in 7.04, existing UDLC systems, or existing IDLC systems with sidedoor or hairpin capability. POTS lines may be transferred to other existing or proposed integrated facilities to accommodate the additional NS/NLS specials on the special service facility.

7.10 Where sidedoor or hairpin capability is available on all switch/carrier peripherals of a digital switch **[S800]**, then NS/NLS specials may be easily integrated via TR-008 system terminations. These include the DMS-100 and new No.5ESS switches e/w with IDCU only. If so, consider/propose TR-008 integrated carrier system(s) to serve all narrowband demand **[S860]** when NGDLC cannot be deployed **[S700]**. If NS/NLS special service demand, *including unbundled loops,* >5% of system capacity **[S840]**, then review system and switch peripheral traffic requirements (current and forecasted) and consider a dedicated special service system, if required **[S850]**.

7.11 For No.5ESS switches equipped with available IDCUs **[S800]** and DCLUs **[S800]** and no other facility is available to serve NS/NLS special services **[S820]** as discussed in 7.09 above, propose TR-008 integrated carrier with sidedoor or hairpin for POTS/SS mix **[S860]**. Consider additional TR-008 integrated systems without sidedoor or hairpin capabilities for other switched services, if required. If NS/NLS special service demand, *including unbundled loops,* >5% of system capacity **[S820]**, then review system and switch peripheral traffic requirements (current and forecasted) and consider a dedicated special service system, if required **[S850]**.

7.12 The loop and switch *capacity managers* should jointly plan the use and placement of switch peripheral capacity for TR-008 and TR-303 terminations in order to maximize the integration of carrier facilities.

7.13 *NGDLC/FITL systems require* termination of a DS1 at a CO node to access the embedded operations channel for communication with *operations systems and should utilize associated* channel shelf *capacity* as the first choice for serving NS/NLS special services, *including unbundled loops,* in lieu of sidedoor or hairpin facilities.

TABLE S1
SERVICE CAPABILITIES - UNIVERSAL CARRIER

This table provides a summary of service capabilities for universal carrier systems. See RL:93-12-008BT for more details.

	UNIVERSAL CARRIER SYSTEM TYPE (COT/RT)							
Service Type	SLC96 / SLC96	SLC96 / SLC5B	SLC5C / SLC5C	FDLC / FDLC	SLC96 / FDLC	DMS1U / DMS1U	DISC*S / DISC*S	LS2000 / LS2000
POTS	Y	Y	Y	Y	Y	Y	Y	Y
OPX	Y	Y	Y	Y	Y	Y	Y	Y
Coin	Y	Y	Y	Y	Y	N	Y	Y
ESSX	Y	Y	Y	Y	Y	Y	Y	Y
Locally Switched Services	Y	Y	Y	Y	Y	Y	Y	Y
FX	Y	Y	Y	Y	Y	Y	Y	Y
Private Line	Y	Y	Y	Y	Y	Y	Y	Y
Synchronet								
<=56 kbps	Y	Y	Y	Y	Y	Y	Y	Y
64 kbps	Y	Y	Y	N	N	N	Y	Y
Accupulse								
2-Wire	Y	N	N	N	N	N	Y	Y
4-Wire	Y	Y	Y	Y	Y	Y	Y	Y
ISDN (BRI)	Y	Y	N	Y	Y	N	Y	Y
P-Phone	Y	Y	Y	N	N	Y	Y	Y
DDCS	Y	N	N	N	N	N	N	N
DOV	N	N	N	N	N	N	N	N

TABLE S2
SERVICE CAPABILITIES - INTEGRATED CARRIER/NO. 5ESS

This table provides a summary of service capabilities for integrated carrier systems with a No.5ESS. See RL:93-12-008BT for more details.

	INTEGRATED CARRIER SYSTEM TYPE FOR NO.5ESS							
	TR-008 Mode 1 or Mode 2						TR-303[3]	
Service Type	SLC96	SLC5B	FDLC	DMS1U	DISC*S	LS2000	DISC*S	LS2000
POTS	Y	Y	Y	NA[1]	Y	Y	Y	Y
OPX	N	N	N	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
Coin	Y	Y	Y	NA[1]	Y	Y	Y	Y
ESSX	Y	Y	Y	NA[1]	Y	Y	Y	Y
Locally Switched Services	Y	Y	Y	NA[1]	Y	Y	Y	Y
FX	Y/SD	Y/SD	Y/SD	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
Private Line	Y/SD	Y/SD	Y/SD	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
Synchronet								
<=56 kbps	Y/SD	Y/SD	Y/SD	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
64 kbps	Y/SD	Y/SD	N	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
Accupulse								
2-Wire	Y/SD	N	N	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
4-Wire	Y/SD	Y/SD	Y/SD	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
ISDN (BRI)								
Local CO	Y/SD	Y/SD	Y/SD	NA[1]	NA[2]	NA[2]	Y	Y
Foreign CO	Y/SD	Y/SD	Y/SD	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
P-Phone	N	N	N	NA[1]	NA[2]	NA[2]	NA[2]	NA[2]
DDCS	N	N	N	NA[1]	N	N	N	N
DOV	N	N	N	NA[1]	N	N	N	N

N = RT channel unit not available for this service or service cannot be technically provided.
Y = RT channel unit is available and service provided directly via integrated switch termination.
Y/SD = RT channel unit is available, but service provided via sidedoor arrangement.

Note 1: DMS-1 Urban systems cannot be integrated to No.5ESS.
Note 2: These services to be groomed at NGDLC RT and routed to universal COT terminations.

TABLE S3
SERVICE CAPABILITIES - INTEGRATED CARRIER/DMS-100

This table provides a summary of service capabilities for integrated carrier systems with a DMS-100. See RL:93-12-008BT for more details.

	INTEGRATED CARRIER SYSTEM TYPE FOR DMS-100							
	TR-008 Mode 1 or Mode 2						TR-303[3]	
Service Type	SLC96	SLC5B	FDLC	DMS1U	DISC*S	LS2000	DISC*S	LS2000
POTS	Y	Y	Y	Y	Y	Y	Y	Y
OPX	N	N	N	N	NA[2]	NA[2]	NA[2]	NA[2]
Coin	Y	Y	Y	N	Y	Y	Y	Y
ESSX	Y	Y	Y	Y	Y	Y	Y	Y
Locally Switched Services	Y	Y	Y	Y	Y	Y	Y	Y
FX	Y/SD	Y/SD	Y/SD	Y/SD	NA[2]	NA[2]	NA[2]	NA[2]
Private Line	Y/SD	Y/SD	Y/SD	Y/SD	NA[2]	NA[2]	NA[2]	NA[2]
Synchronet								
<=56 kbps	Y/SD	Y/SD	Y/SD	Y/SD	NA[2]	NA[2]	NA[2]	NA[2]
64 kbps	Y/SD	Y/SD	N	N	NA[2]	NA[2]	NA[2]	NA[2]
Accupulse								
2-Wire	Y/SD	N	N	N	NA[2]	NA[2]	NA[2]	NA[2]
4-Wire	Y/SD	Y/SD	Y/SD	Y/SD	NA[2]	NA[2]	NA[2]	NA[2]
ISDN (BRI)								
Local CO	Y/SD	Y/SD	Y/SD	N	NA[2]	NA[2]	Y	Y
Foreign CO	Y/SD	Y/SD	Y/SD	N	NA[2]	NA[2]	NA[2]	NA[2]
P-Phone	N	N	N	N	NA[2]	NA[2]	NA[2]	NA[2]
DDCS	N	N	N	N	N	N	N	N
DOV	N	N	N	N	N	N	N	N

N = RT channel unit not available for this service or service cannot be technically provided.
Y = RT channel unit is available and service provided directly via integrated switch termination.
Y/SD = RT channel unit is available, but service provided via sidedoor arrangement.

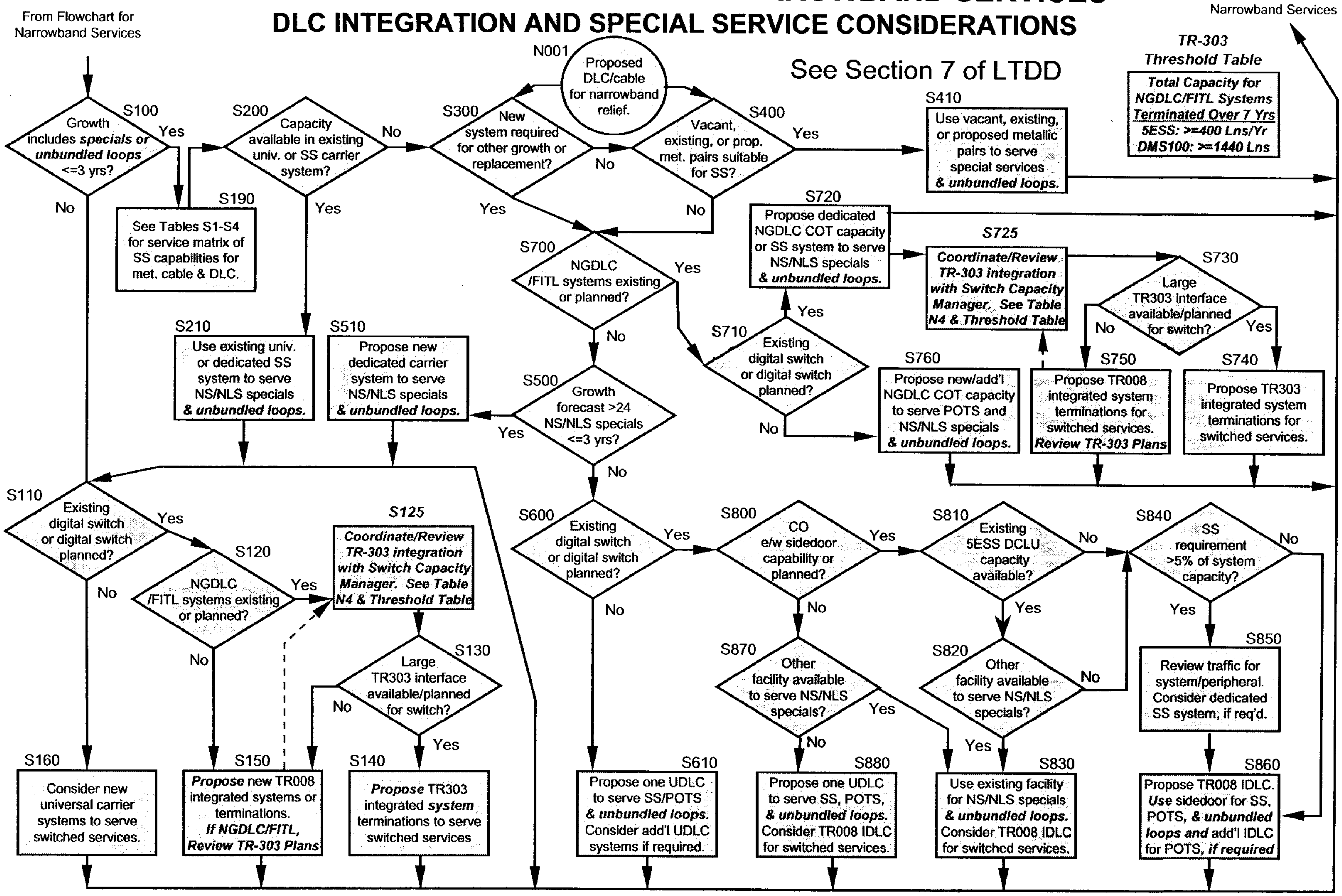
Note 1: DMS-1 Urban systems cannot be integrated to No.5ESS.
Note 2: These services to be groomed at NGDLC RT and routed to universal COT terminations.

TABLE S4
SERVICE CAPABILITIES - METALLIC CABLE

This table provides a summary of metallic cable service capabilities. See RL:93-12-008BT for more details.

	METALLIC CABLE SERVICE PARAMETERS			
Service Type	OK?	Loading	Loss Limit	Res. Limit
POTS	Y	Any	8 db @ 1 kHz	1300 ohms
OPX	Y	Any	See RL:93-12-008BT	1300 ohms
Coin	Y	Any	8 db @ 1 kHz	1300 ohms
ESSX	Y	Any	8 db @ 1 kHz	1300 ohms
Locally Switched Services	Y	Any	See RL:93-12-008BT	1300 ohms
FX	Y	Any	See RL:93-12-008BT	1300 ohms
Private Line	Y	Any	See RL:93-12-008BT	1300 ohms
Synchronet	Y	Non-Loaded	See RL:93-12-008BT	NA
Accupulse	Y	Non-Loaded	See RL:93-12-008BT	NA
ISDN (BRI)	Y	Non-Loaded	See RL:93-12-008BT	1300 ohms
P-Phone	Y	Non-Loaded	See RL:93-12-008BT	1300 ohms
DDCS	Y	Non-Loaded	See RL:93-12-008BT	1300 ohms
DOV	Y	Non-Loaded	See RL:93-12-008BT	1300 ohms
ISDN (PRI)	Y	Non-Loaded	T-1 or HDSL See RL:93-12-008BT	
MegaLink	Y	Non-Loaded	T-1 or HDSL See RL:93-12-008BT	

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
TECHNOLOGY SELECTION FOR NARROWBAND SERVICES
DLC INTEGRATION AND SPECIAL SERVICE CONSIDERATIONS



8.00 FIBER TRANSPORT AND LOOP DIVERSITY PLANNING

Planning and deployment decisions in the previous sections generated deployment plans for ISDN, cable replacement, customer DS1, and narrowband DLC. These plans include only the type of transport, the amount of demand (DS1s) to be included on the fiber network, and placements of multiplexers; and together with business broadband requirements (>=DS3s), cumulative DS1/DS3 demand for fiber transport can be determined and mux sites identified (P500). This section will examine fiber routing for loop or multi-CO diversity, ADM ring groupings, and cumulative or ultimate fiber requirements. Fiber sizing for specific placements will be handled in subsequent planning steps (See Section 2). A summary of directives and recommendations is provided by the "Fiber Transport and Loop Diversity Planning" flowchart at the end of this section

Planning and deployments for fiber transport and loop diversity should be guided by the following fundamental strategies:

a. When new fiber facilities are needed to meet growth or replacement requirements, fiber placements should be planned to implement a fiber cable infrastructure sized for six fibers per 1000 households or equivalent business lines. Long range plans for completion of loop diversity should also be made.

b. Specific plans for additional fibers or fiber cables, or for loop diversity routing should be funded through *PCU*/COU initiatives in targeted metros, wire centers, routes, or areas.

c. Specific market areas and selected customer sites for implementation of multi-CO diversity should be qualified, prioritized, funded, and approved through *PCU*/COU initiatives for specific services, such as SmartPath.

d. Several deployment alternatives for major fiber projects/jobs should be identified, including minimum capital proposals. Budget impact, risks, timing, priorities, and other conditions should be assessed to select the best alternative.

The following items in this section outline specific directives, recommendations, critical factors, flow chart references, and other issues related to fiber transport and loop diversity planning.

8.01 If there are fiber cable and/or lightwave electronics placements required <=3 yrs **[F100]**, then fiber routing, total fiber requirements, and ADM arrangements must be determined. If the cumulative DS1/DS3 fiber transport requirements **[P500]** can be met by existing fiber and multiplexers, then no immediate deployment decisions must be made and the planning process can continue with documentation of other deployments and preparation of projects, budgets, and forecasts. However, even if there are no immediate deployment needs, an updated view of the long term requirements for the fiber infrastructure is fundamental for development of long range plans and coordination with current projects and budgets.

8.02 Strategic service areas and/or wire centers **[F110]** should be identified and prioritized per specific *PCU*/COU initiatives to direct the use of limited resources in the near term development of the fiber cable infrastructure and loop diversity. Current priorities may direct the application of these initiatives to the entire local calling area of some areas or to a smaller set of wire centers or even feeder route areas.

8.03 If a wire center or feeder route area is a priority area for *PCU*/COU initiatives **[F120]**, then near-term requirements for fiber sizing and diversity routing should be identified **[F130]**. These initiatives primarily apply only to the fiber cable placements and electronics for specific services or customer sites and should generally not be used to direct the deployment of digital loop carrier, which is primarily a narrowband facility. Technology selections for narrowband services are discussed in Section 6 of this document. In addition, the deployment of lightwave electronics will continue to be triggered by specific demand requirements.

8.04 If the wire center or feeder route area is not currently a priority area for *PCU/*COU initiatives **[F120]**, then near-term deployments for fiber cable and associated electronics will primarily be planned based on conventional planning methodologies; placements will be triggered by growth, modernization, and replacement needs; sizing may be based on forecasted demands for services; and special treatments such as broadband fiber sizing and loop diversity must be evaluated to determine need for re-prioritization and funding. This evaluation may include analysis of placement costs and revenues generated or protected. A reallocation of resources to meet these additional requirements should be approved by the *PCU/*COU and the *Network Vice President* -Network Operations.

8.05 Some wire centers or service areas have also been identified for implementation of services, such as SmartPath or SmartRing, which will require multi-CO diversity for the fiber transport network. These areas should be identified, prioritized, budgeted, and approved by specific *PCU/*COU initiatives in conjunction with Service Product Teams **[F400]**. See RL:94-01-048BT for more information regarding selection of wire centers or service areas.

8.06 For wire centers, routes, service areas, or customer sites that are targeted for multi-CO treatment **[F410]**, fiber routing and sizing for some loop/interoffice facilities will be planned to accommodate and stimulate services such as SmartPath. For other feeder sites in these wire centers and for wire centers not designated for this treatment, then loop diversity fiber routing should be planned in conjunction with long term strategies and deployments.

8.07 Customer sites for SmartPath or other multi-CO services should be identified, qualified, and prioritized by the *PCU/*COUs **[F420]** in conjunction with Service Product Teams for specific services. Previous recommendations targeted customer sites with >=6 DS1s (existing or pending) within some priority areas. Currently, customer sites are being qualified and selected by the *PCU/*COU for multi-CO treatment based on specific deployment costs and revenue potential. See RL:94-01-048BT for more information regarding customer site selection.

8.08 Plan multi-CO fiber routing for all selected SmartPath or other multi-CO sites **[F430]**. Near-term facility placements should also be planned for the selected/approved sites. Previous administrative issues regarding assignment of DS1 crossconnects in multiple wire centers have been resolved and facilities for local switched services can be included in the multi-CO transport system. This planning step should establish only the geographic routing of new fiber cable placements and the designated transmission paths for each existing and future multiplexer site.

8.09 Develop or update long term plans for loop diversity fiber routing for all other mux sites **[F510/F440]**. As with multi-CO fiber routing, this planning step should only establish the geographic routing of required fiber cable placements and the designated transmission paths for each existing and future multiplexer site. While multi-CO routing to implement loop diversity may be appropriate in some cases, it is generally not economical or practical. Where multi-CO fiber routing is selected to implement loop diversity, loop capacity requirements may be routed through interoffice transport systems in lieu of additional fiber placements. Completion of loop diversity should be accomplished in conjunction with *PCU/*COU fiber infrastructure initiatives and long term deployment plans. (See "OSPE Loop Diversity/Survivability Application Guideline" for engineering methods and procedures.)

8.10 Multiplexer sites are to be prioritized for implementation of loop diversity and/or multi-CO diversity **[F520]** in keeping with priorities of the *PCU/*COU initiatives and long term deployment plans.

8.11 In general, plan for deployment of OC-3 multiplexers to meet relief requirements which include DS1s. OC12 systems may be more economical when serving only DS3 demand. Identify multiplexer groupings for ADM rings or point-to-point applications **[F530]** to meet the 10 year requirement of DS1s/DS3s at the multiplexer site. When planning ADM ring groupings, the sum of the total ten year demands for the ADM RTs should not exceed 75% of the ADM ring capacity. Actual use may obviously exceed 75% utilization, but this assumption should be applied when planning the initial implementation of an ADM ring or adding an ADM node to an existing ADM ring in order to balance adequate utilization and forecast uncertainties with the complexities of re-design and re-configuration of the ADM rings. In some cases, multiple OC-3 point-to-point systems may be required to meet demand at a single site. Remember that loop and/or multi-CO diversity are not synonymous with ADM rings and may be applied to both ADM ring and point-to-point multiplexer arrangements. Conversely, the use of ADM rings does not infer diversity routing.

8.12 Demand currently served by multimode systems in all areas should be included in the total capacity to be served by single mode systems at the next relief activity. Cutover and removal of the existing multimode systems should be prioritized as local resources allow. Fiber cable requirements and placements will be sized to accommodate removal of multimode cable (see 8.16).

8.13 Determine cumulative demands for fibers and identify fiber cable shortages **[F540]**. Cumulative demands should be based on the allocation of six (6) fibers per existing or future ADM ring or point-to-point system. Both before and after diversity is established, six fibers should be allocated or assigned for each ADM ring and point-to-point system. With diversity, three fibers should be allocated or assigned from each path. When comparing cumulative fiber requirements to existing fiber facilities, do not include multimode fibers in existing totals if replacement of the associated lightwave multiplexers is planned within the 3 year planning period as triggered by relief requirements (see 8.12). These cumulative fiber requirements are primarily used to identify fiber cable sections with shortages within the 3 year construction period and to allocate or assign existing fiber facilities, not to size fiber cable placements.

8.14 For all routes and areas, determine total existing and 10-15 year forecast of living units and business lines (DS0, DS1, DS3, etc.) along each feeder route and their cumulative totals to be served by each existing or future fiber route/ring **[F550]**. These will be used to determine ultimate fiber requirements. Fiber cable placement plans should be balanced to meet a ten year demand from the projected year of completion for the infrastructure in that route or area. Therefore, requirements for initial fiber cable placements may need to be based on a longer forecast with subsequent placements balanced to match the requirements and forecast period of the initial placements. These forecasts and sizing of the fiber infrastructure should be reevaluated as fiber cable placements are proposed in subsequent years.

8.15 Determine ultimate requirements for the fiber feeder network sized for 6 fibers per 1000 living units or equivalent business lines (DS0=1, DS1=24, DS3=672, etc.) **[F560]**, consistent with diversity fiber routing requirements (see 8.08 and 8.09). Where the number of residential living units cannot be readily obtained, the total number of residence access lines may be used a surrogate. Existing and proposed/ future single mode fiber cables will be used to meet this ultimate requirement. A route example showing the application of ultimate fiber sizing is shown by Figure F1.

8.16 Fiber cable placements in all areas should be sized to accommodate the cutover of demand from existing multimode facilities. This is not a one for one fiber replacement since capacities for new single mode lightwave multiplexer are higher than those for multimode. See Section 8.12.

8.17 Fiber cable placements should be implemented in conjunction with any proposed *PCU/*COU fiber cable initiatives and loop or multi-CO diversity, as well as with long range deployment plans **[F570]**. Feeder sections with facility shortages within the 3 year planning period will obviously be high priorities for near-term deployments and funding. Deployments in other sections should be scheduled within budget and resource limitations. In some cases, cable placements required to meet ultimate requirements may exceed the capacity of a maximum size fiber cable. If so, then consideration should be given to the placement of one sheath to meet a minimum five year requirement and future sheath placement(s) to meet the ultimate requirements.

*8.18 Several deployment alternatives for major fiber projects/jobs should be identified, including minimum capital proposals **[F620]**. Assess budget impact, market/demand risks, timing, priorities, and other conditions to select the best alternatives **[F630]**. Critical decisions and deployment options, particularly those with a wide disparity in budget impact, should be reviewed with the management for approval, informally during planning activities and/or formally during route reviews **[F640]**.*

8.19 Funding for both near-term proposals and long-term plans for the fiber initiatives and loop or multi-CO diversity should be verified with the *PCU/*COU **[F580]**.

8.20 For wire center or feeder route areas which have not been prioritized **[F120]** for near-term deployment of fiber infrastructure initiatives per the *PCU/*COUs (see Section 8.04), the demands of concentrated business areas or near-term competitive business strategies **[F200]** may prompt a reevaluation of strategic area priorities. The following steps should be included in this reevaluation process:

a. Identify potential service area for near-term treatment of loop diversity and/or fiber infrastructure placements **[F210]**.

b. Identify major customer locations and obtain revenue reports and forecasts **[F220]**.

c. Evaluate costs and revenue impacts for fiber infrastructure and/or diversity alternatives **[F230]**.

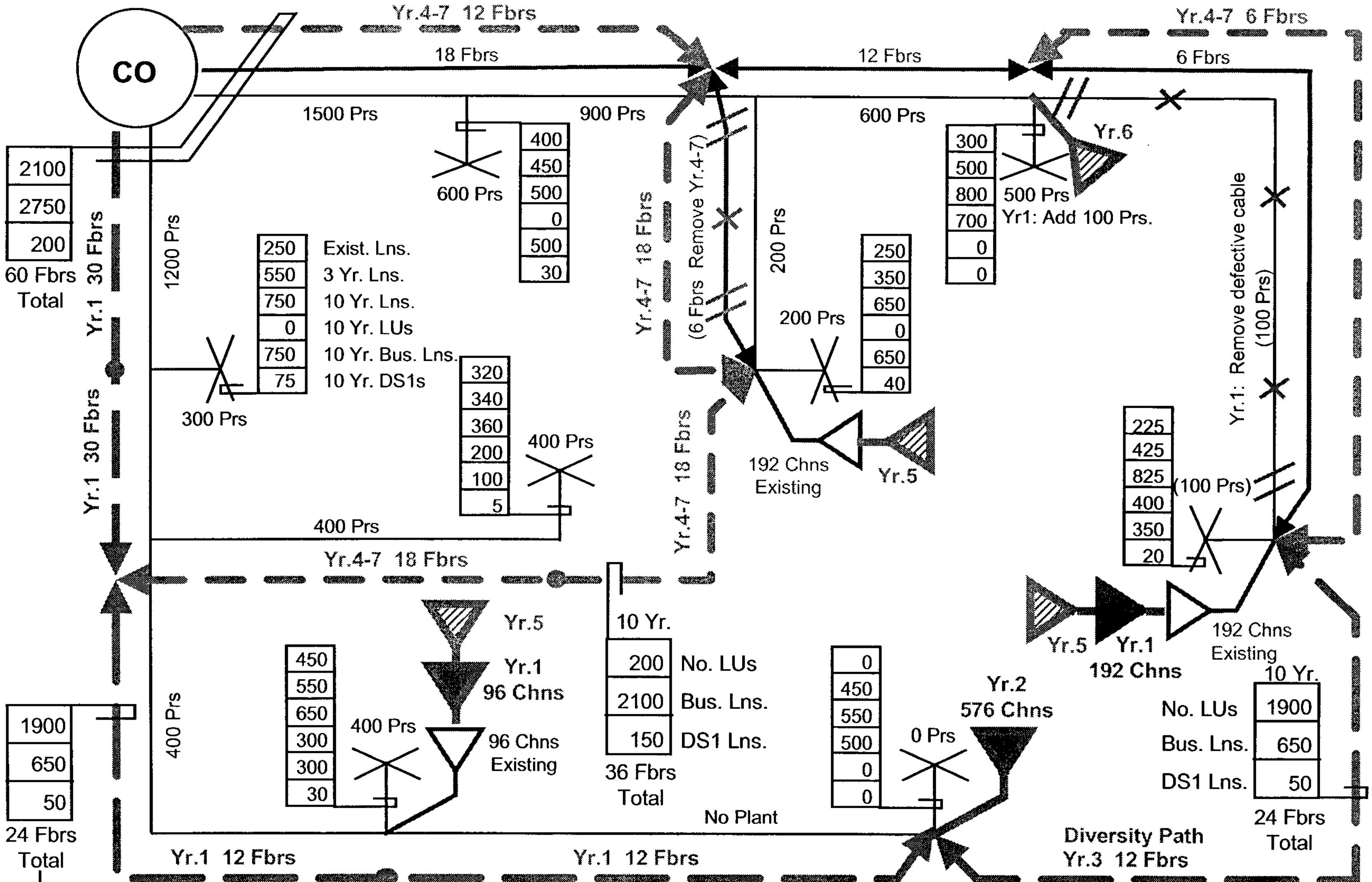
d. Document proposals and funding requirements for review by *PCU/*COUs **[F240]**.

8.21 As with all fiber cable placements, fiber branch and entry splices should be planned and all fibers should be spliced and made ready for service to meet unanticipated demands and position the network for implementation of *PCU*/COU initiatives and strategies. In the case of ribbon cables, the sheath should be opened, designated fibers prepared, and splice case installed at all planned fiber entry points to avoid damage to working fibers in the ribbon when additional work is done. In general, ribbon cables should be used for cable sizes >=36 fibers. Multi-fiber splicing methods should generally be used for these sizes as well. Splicing methods are reviewed in RL:94-01-011BT.

8.22 Joint loop and interoffice cables should be considered if both have requirement triggers within the 3-5 year timeframes.

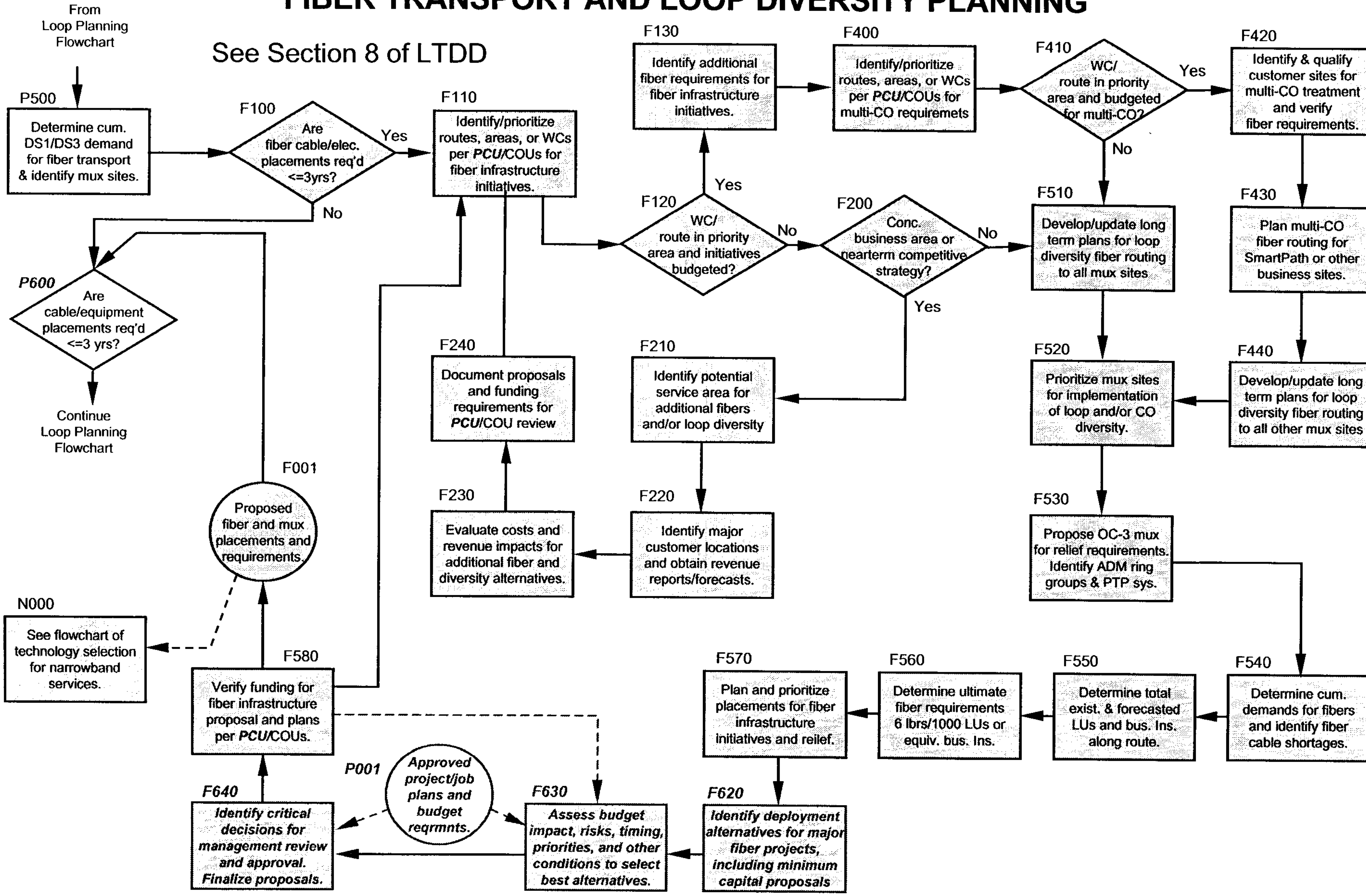
1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES

FIGURE F1 - FIBER FEEDER SIZING - ROUTE EXAMPLE



Sample Fiber Sizing Calaculation: 6 Fbrs X (1900 LUs + 650 Bus. Lns. + (50 DS1s X 24 DS0s/DS1))/1000 = 24 Fbrs
Note that with loop diversity, 12 fibers are in one path and 12 in the other.

1998 LOOP TECHNOLOGY DEPLOYMENT DIRECTIVES
FIBER TRANSPORT AND LOOP DIVERSITY PLANNING

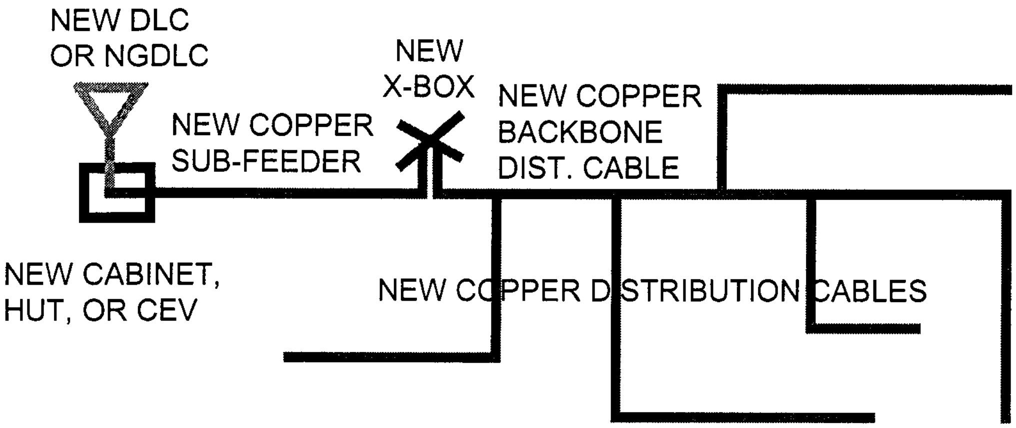


APPENDIX 6-1

FITL APPLICATIONS

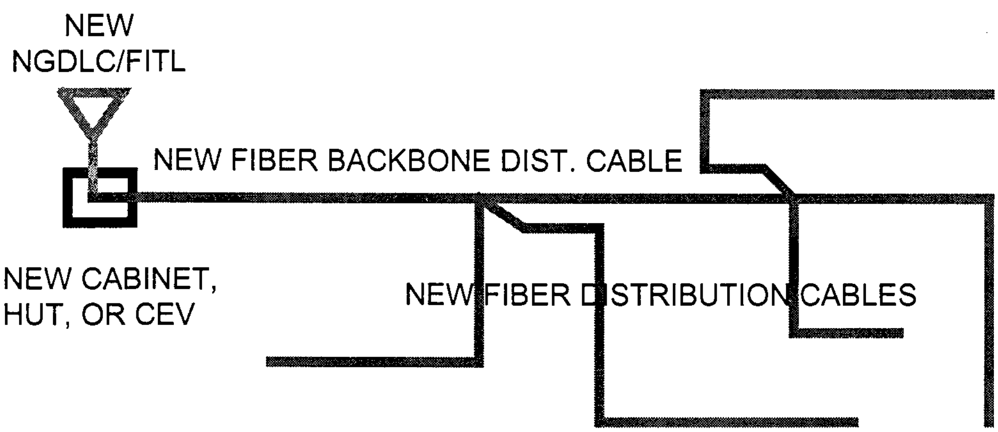
ALL NEW FACILITIES

Conventional Copper Plan:



This situation is an obvious candidate for fiber distribution since all RT and cable facilities must be placed.

New Fiber Plan:



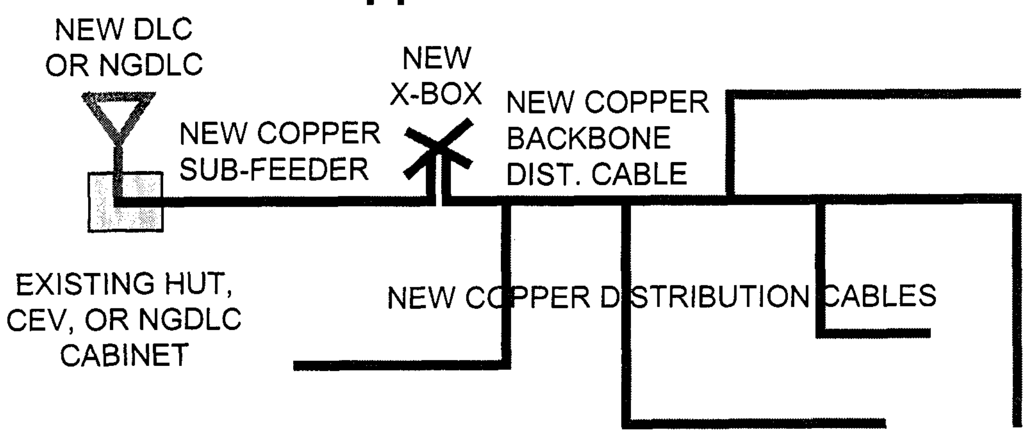
Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

FITL APPLICATIONS

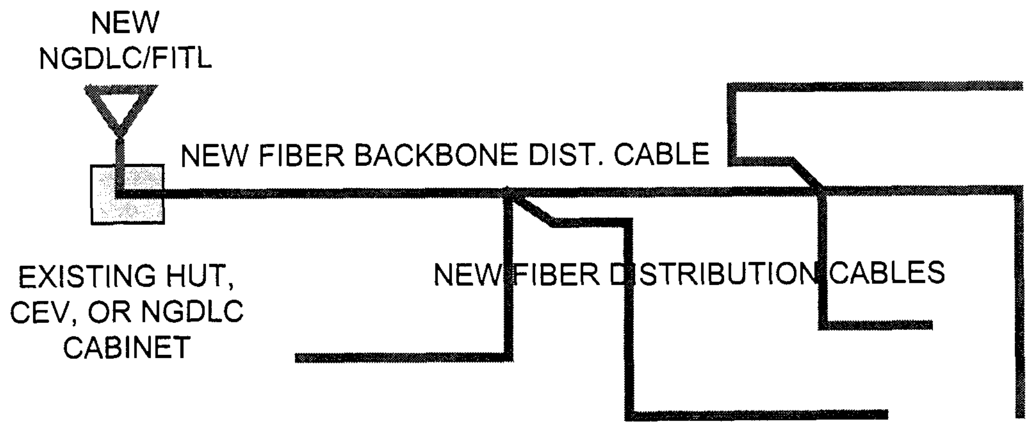
EXISTING HUT, NEW CABLE FACILITIES

Conventional Copper Plan:



This situation is similar to the "all new facilities" situation. Since an existing hut or CEV can accommodate NGDLC/FITL products and all RT electronics and cable facilities must be placed, it is an obvious candidate for fiber distribution .

New Fiber Plan:



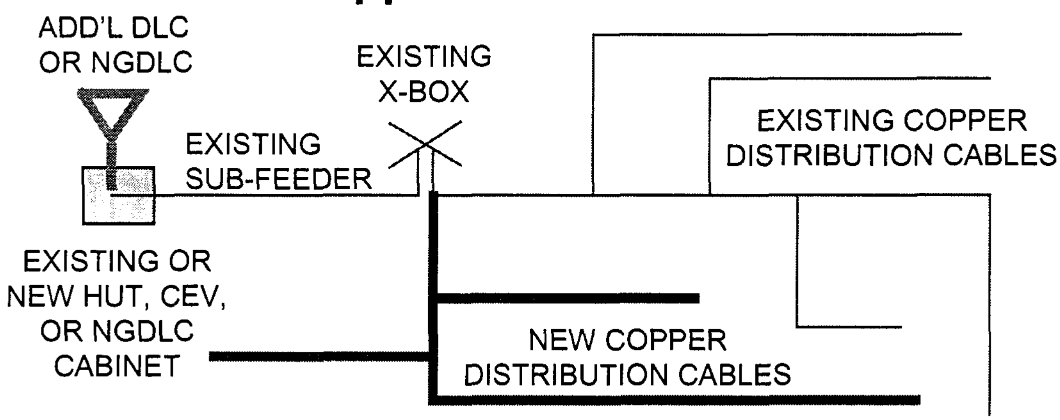
Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

FITL APPLICATIONS

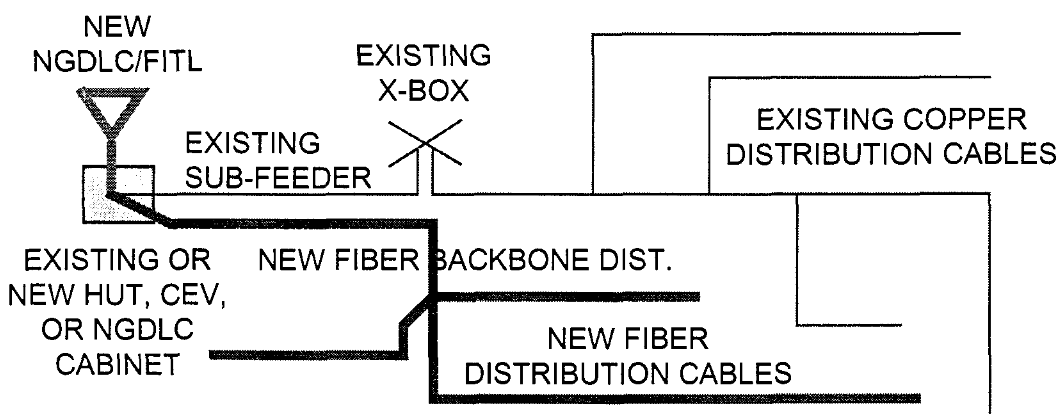
EXISTING HUT, SUB-FEEDER, AND X-BOX

Conventional Copper Plan:



Although a cross-connect box and a short length of sub-feeder exist, these may not be sufficient to exclude this situation as a candidate for fiber distribution. Since the existing housing can accommodate NGDLC/FITL products and there are significant volumes of distribution cable to be placed, only the short length of fiber distribution backbone is required to complete the fiber distribution plan.

New Fiber Plan:

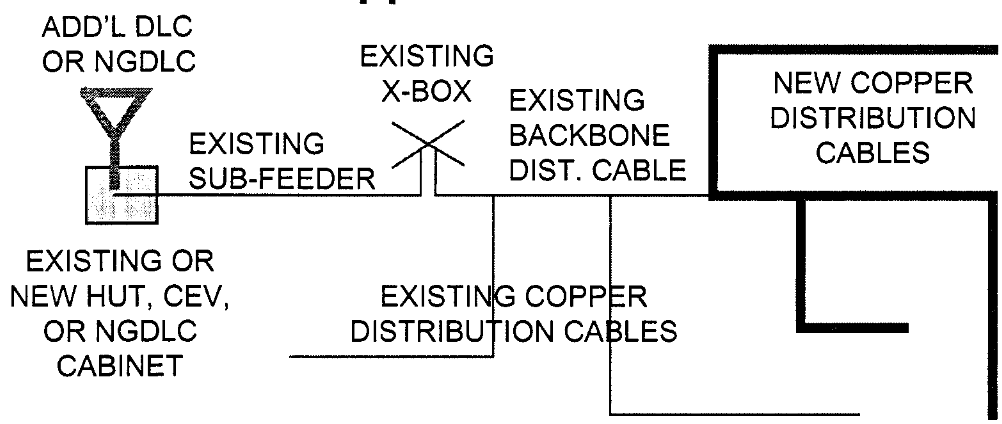


Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

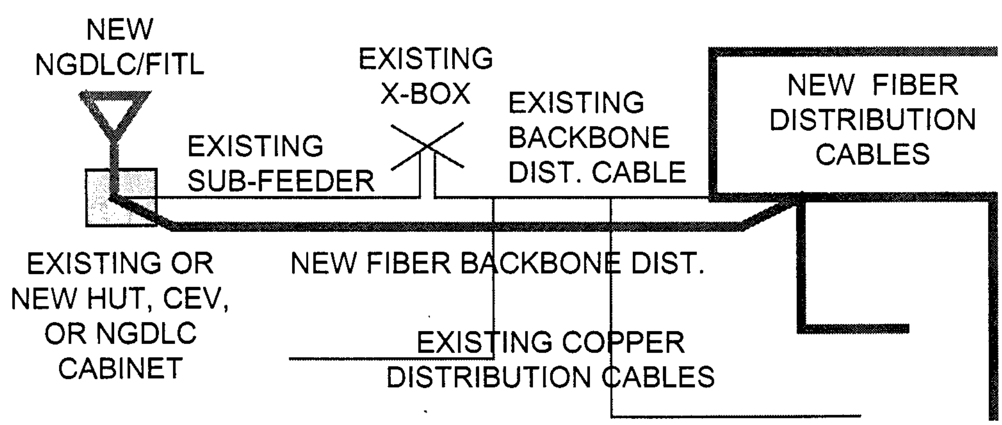
FITL APPLICATIONS
EXISTING HUT & BACKBONE DISTRIBUTION

Conventional Copper Plan:



Although some of the cable facilities exist, short distances of sub-feeder and/or backbone distribution may not be sufficient to exclude this situation as candidate for fiber distribution. Since the existing housing can accommodate NGDLC/FITL products there are still significant volumes of distribution cable to be placed, only the length of fiber distribution backbone is required to complete the fiber distribution plan.

New Fiber Plan:



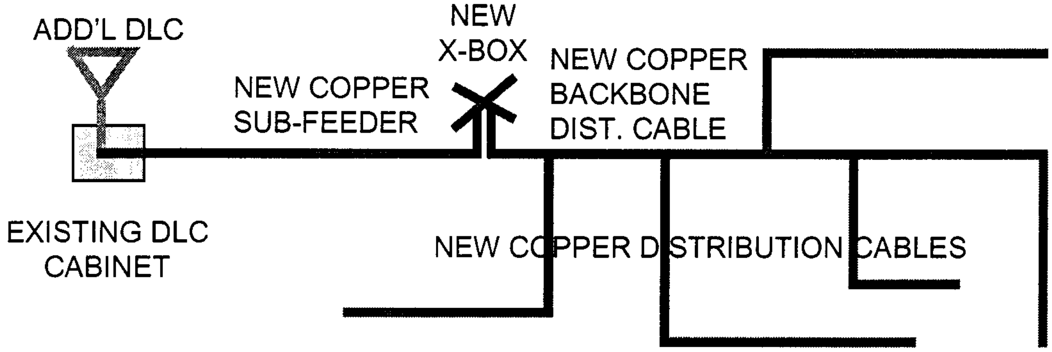
Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

FITL APPLICATIONS

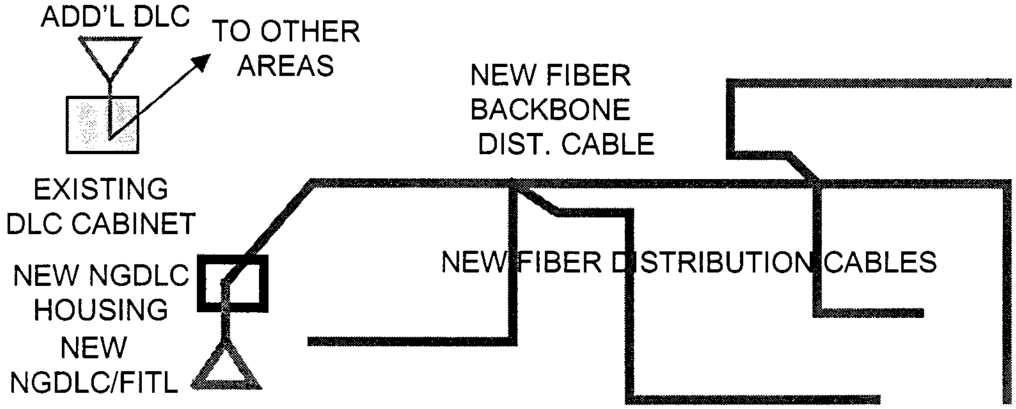
EXIST. DLC CABINET, NEW CABLE FACILITIES

Conventional Copper Plan:



If vacant capacities in the existing DLC cabinet are insufficient to accommodate expected demand or can be utilized for other applications during the planning period, such as existing distribution areas, then this situation will become the same as the "all new facilities" situation and is also a candidate for fiber distribution . Similar opportunities may also be available for DLC cabinet applications with existing sub-feeder and/or backbone distribution.

New Fiber Plan:



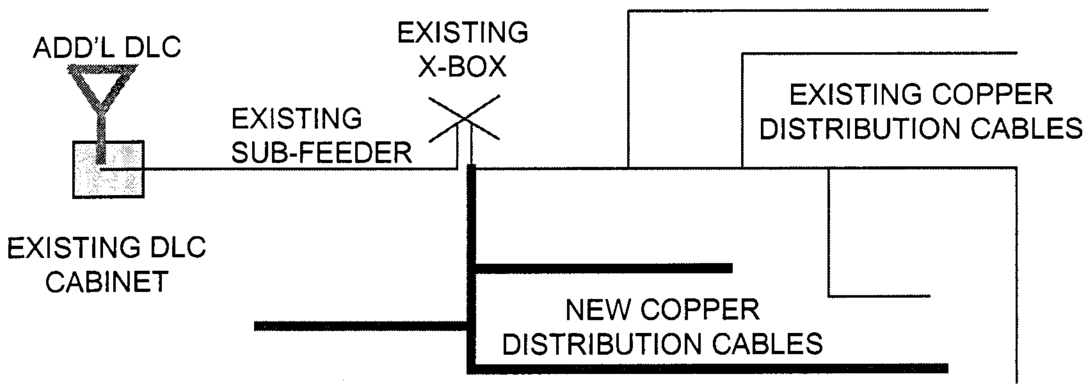
Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

FITL APPLICATIONS

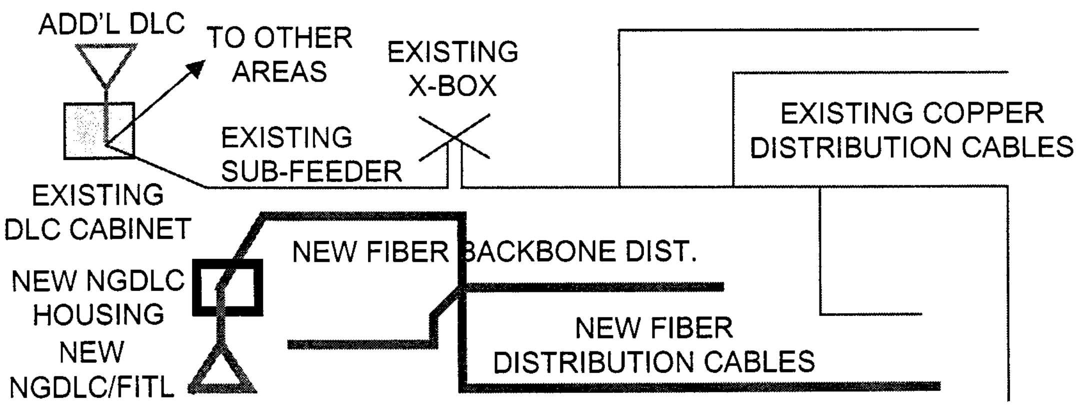
EXIST. DLC CABINET, SUB-FEEDER, & X-BOX

Conventional Copper Plan:



Although a cross-connect box and a short length of sub-feeder exist, these may not be sufficient to exclude this situation as a candidate for fiber distribution. If vacant capacities in the existing DLC cabinet are insufficient to accommodate expected demand or can be utilized for other applications during the planning period, such as existing distribution areas, then this situation may also be a candidate for fiber distribution.

New Fiber Plan:

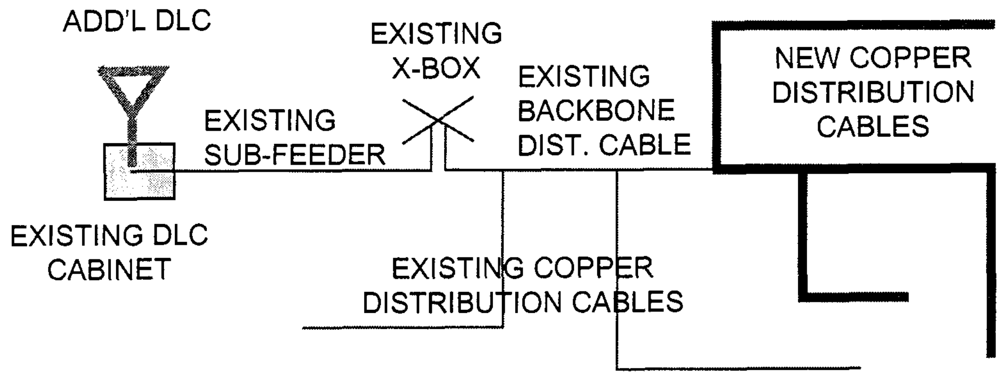


Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

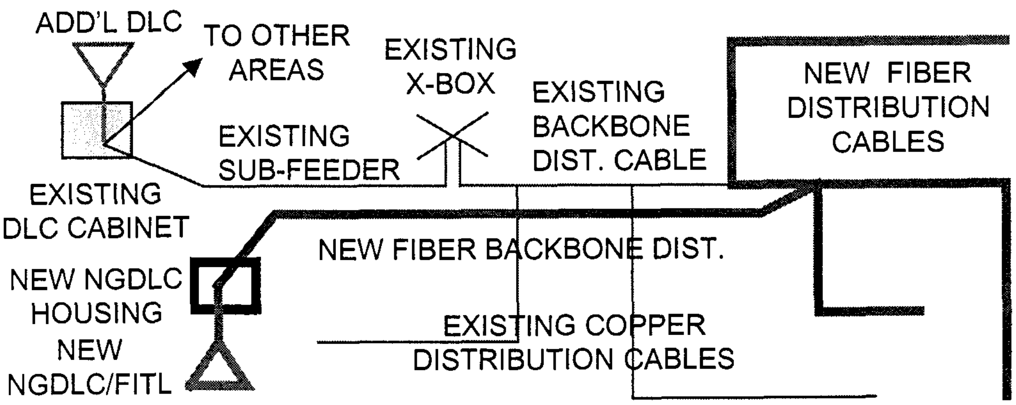
FITL APPLICATIONS
EXIST. DLC CABINET & BACKBONE DIST.

Conventional Copper Plan:



Although some of the cable facilities exist, short distances of sub-feeder and/or backbone distribution may not be sufficient to exclude this situation as candidate for fiber distribution. If vacant capacities in the existing DLC cabinet are insufficient to accommodate expected demand or can be utilized for other applications during the planning period, such as existing distribution areas, then this situation may also be a candidate for fiber distribution.

New Fiber Plan:



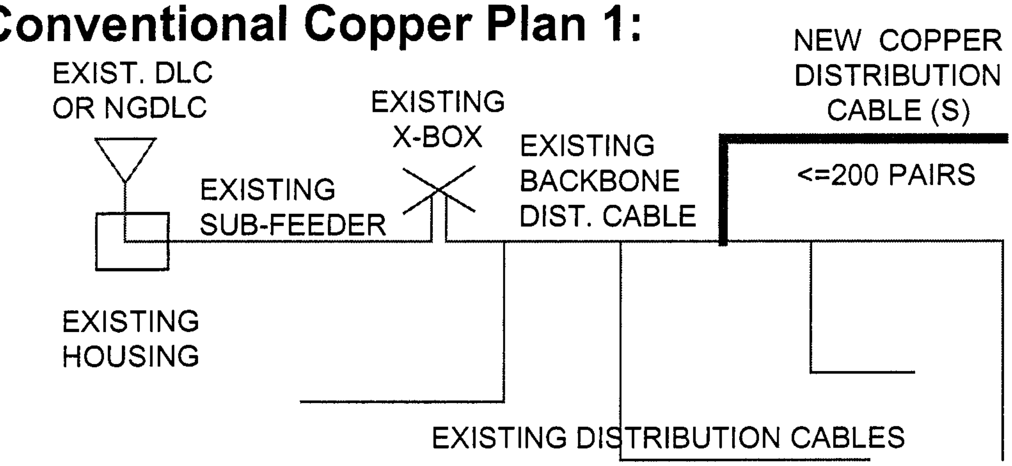
Note: Fiber distribution cable layouts do not necessarily match those of traditional copper cable designs regarding cable routing, no. of splices, and terminal locations.

APPENDIX 6-1 (continued)

FITL APPLICATIONS

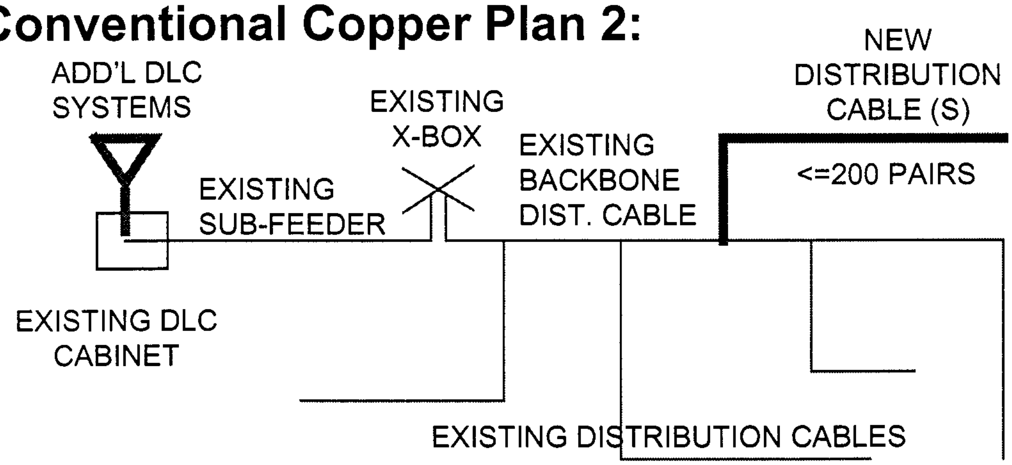
DISTRIBUTION CABLE EXTENSIONS

Conventional Copper Plan 1:



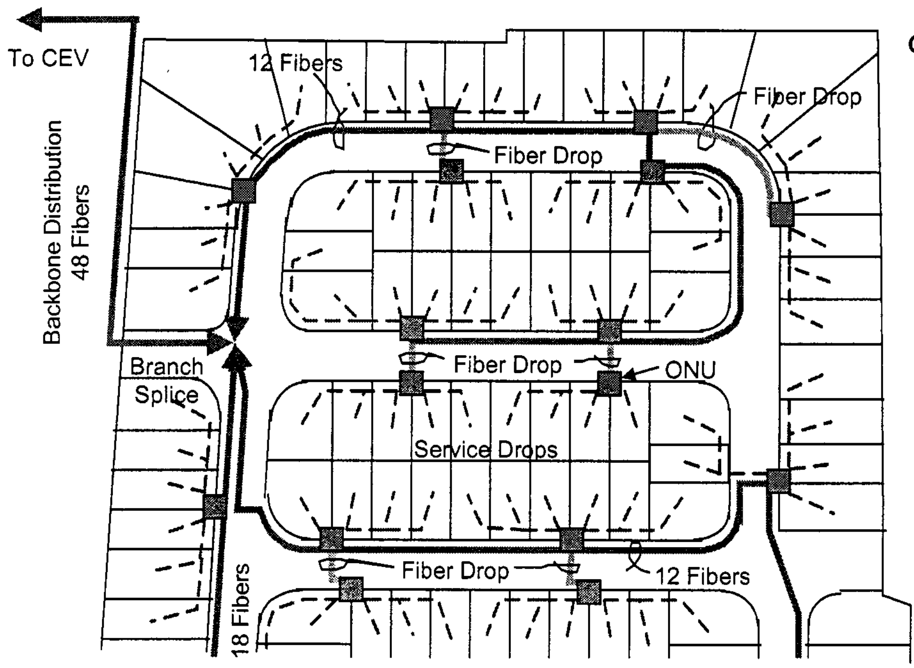
This situation is NOT a good candidate for fiber distribution since most of the required loop facilities are already in place.

Conventional Copper Plan 2:



Although additional DLC systems may be required, this situation is NOT a good candidate for fiber distribution since the existing DLC cabinet cannot accommodate NGDLC/FITL products and most of the other required loop facilities are already in place. The existing DLC cabinet must be of sufficient size to accommodate the 3-5 year demand.

APPENDIX 6-1 (continued)
FITL DESIGNS/LAYOUTS
SINGLE FAMILY DEVELOPMENT



CYPRESS COVE
FITL FOA SITE
MARGATE, FL

TOTALS
195 Living Units
34 ONUs
5.7 LUs/ONU

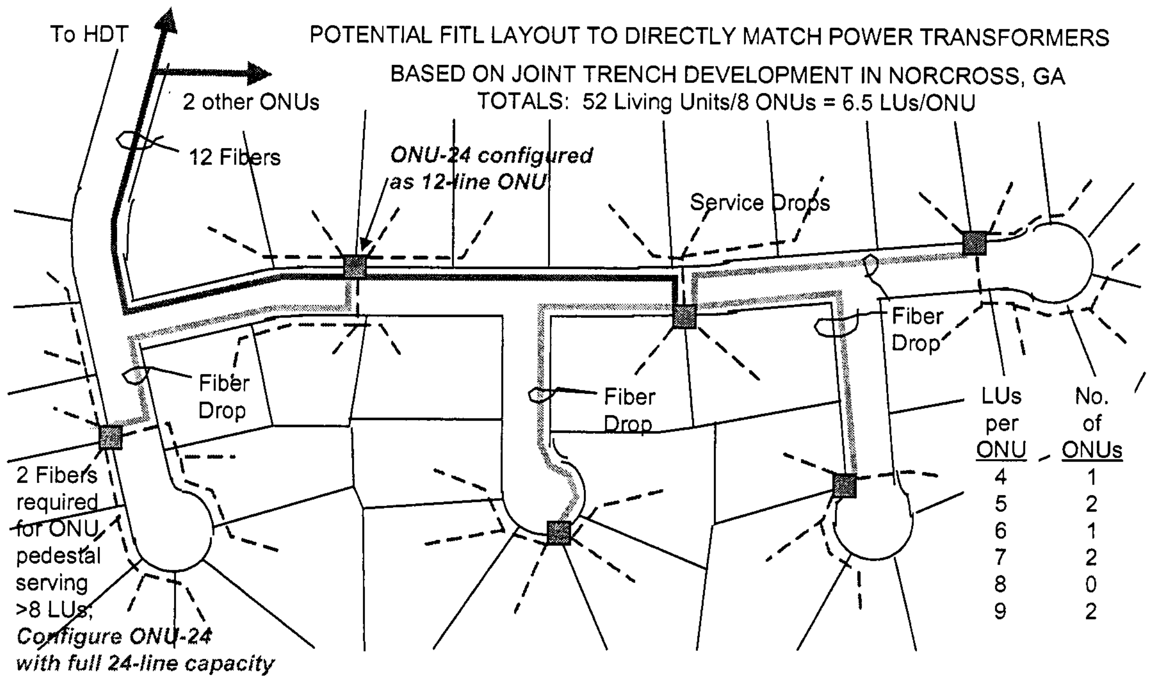
LUs per ONU	No. of ONUs
4	4
5	5
6	22
7	3

1 Fiber required at each ONU pedestal; *ONU-24s configured as 12-line ONU.*

APPENDIX 6-1 (continued)

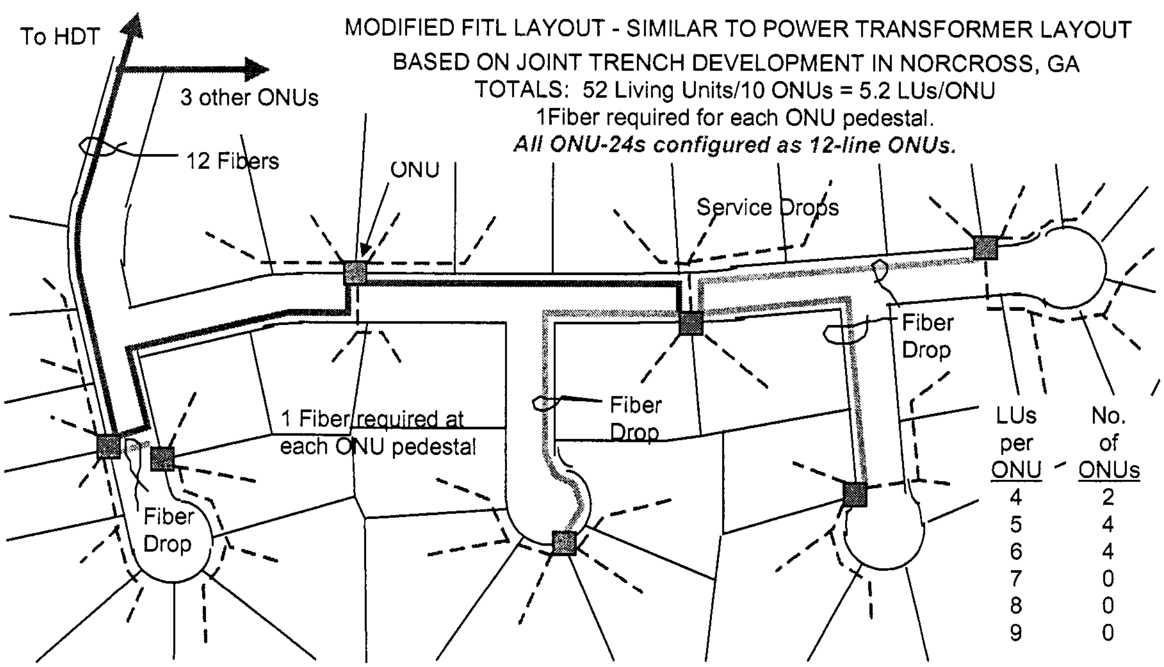
FITL DESIGNS/LAYOUTS

SINGLE FAMILY/JOINT TRENCH ARRANGEMENT



FITL DESIGNS/LAYOUTS

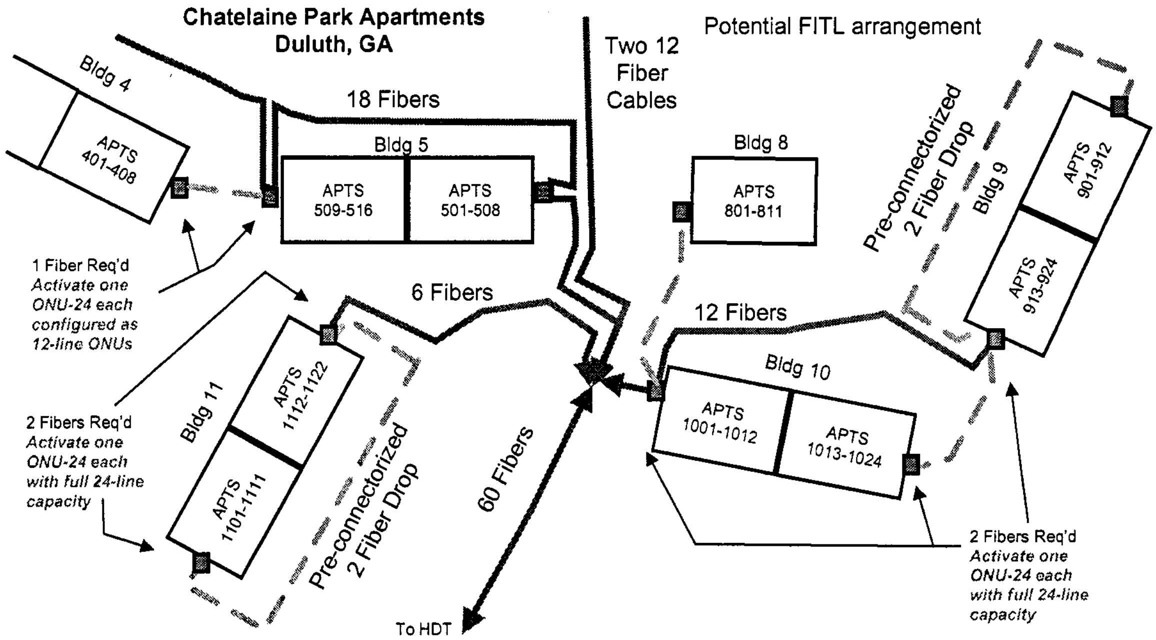
SINGLE FAMILY/MODIFIED JOINT TRENCH ARRANGEMENT



APPENDIX 6-1 (continued)

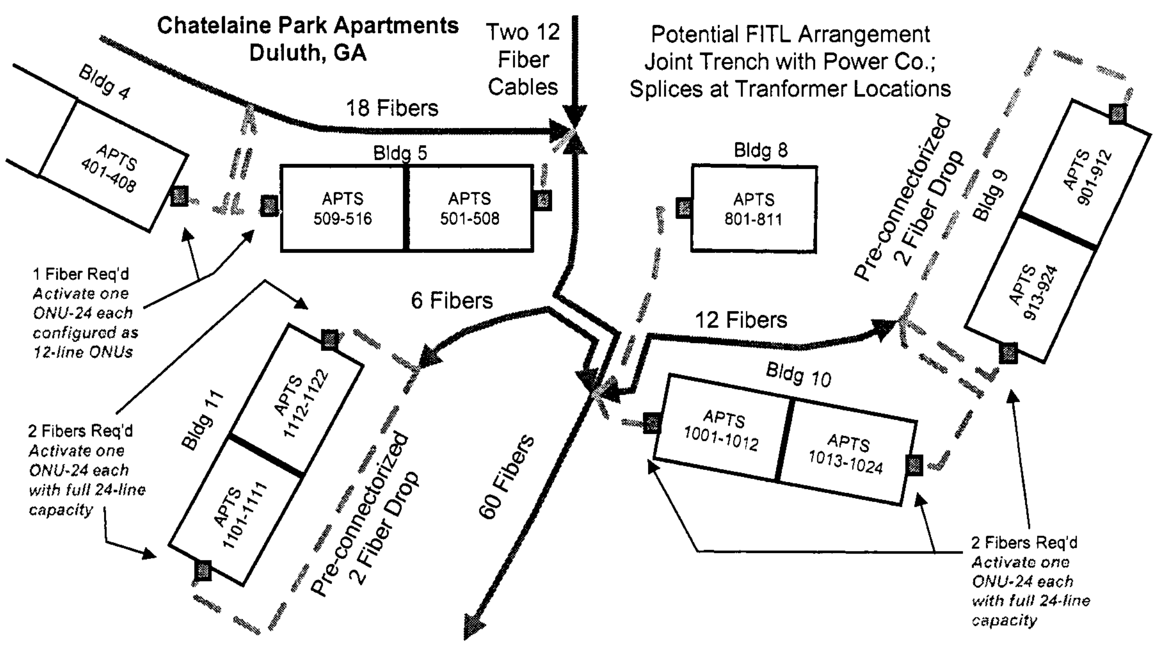
FITL DESIGNS/ LAYOUTS

MULTI-FAMILY DEVELOPMENT



FITL DESIGNS/ LAYOUTS

MULTI-FAMILY/JOINT TRENCH ARRANGEMENT



BELLSOUTH TELECOMMUNICATIONS, INC.

27

FPSC DKT NO 990649-TP

AT&T'S 2ND REQUEST FOR PRODUCTION OF DOCUMENTS

POD NO. 33

PROPRIETARY

DECLASSIFIED

	A	B	C
1	Florida		
2	Back-up for CLASS Modem Card Penetration		
3	Study Period: 2000-2002		
4			
5			
6	Item/Description	Source	Amount
7	**Lines per Office w/ CND**	Network	
8	Residence		12,000
9	Business		900
10			
11	**Percent Distribution**		
12	Residence		70%
13	Business		30%
14			
15	**Melded Input - Lines per Office**	Ln8*Ln12+Ln9*Ln13	8,699
16			
17	**Average Number of Lines per Office**	SCIS/MO Inputs	16,191
18			
19	**Penetration of CND**	Ln15/Ln17	**54%**

Number Portability
Calculation of DMS Vendor EFSI Investments

Residential

Workpaper: 52
State: All
Date: 11/29/96
Page: 1 of 1

LN	Description	Source	Amount
1	**DMS Investment Calculations -- Marginal**		
2			
3	**Investment Category**		
4	A. Getting Started	MO1*IP1*RT33	$0.25
5	B. CCS		
6	C. Call		
7	D. Minmum Cost per Line		
8	E. Hardware		
9	F. Memory	(MP33*IT14+MD33*IT15)/IP2+MF33*IT16	$0.08
10	G. SSP Octet		
11	H. Total End Office (USOC: TNPRL)	LN4+LN9	$0.33
12	I. Investment per Additional Path	LN4+MF33*IT16	$0.28
13			
14	**Model Office Outputs -- Marginal**	SCIS/MO BC836	
15	MO1 Investment per Msec		$0.09288
16			
17	**User Input**		
18	IP1 BH Calls per Line	Network Cost Group	1
19	IP2 Average RCF Lines per Office	StatMaster Extract	65
20			
21	**SCIS/IN Database Items**	SCIS/IN Tables	
22	IT14 Program Store Cost per Word		0.00207
23	IT15 Data Store Cost per Word		0.0031
24	IT16 Data Fill Cost per Word		0.0031
25	MD33 Data Store Memory Requirement		281
26	MF33 Data Fill Memory Requirement		9
27	MP33 Program Store Memory Requirement		1161
28	RT33 Realtime Requirement per RCF Call		2.70138
29			
30			
31	**DMS Investment Calculations -- Capacity**		
32			
33	**Investment Category**		
34	A. Getting Started	MO1*IP1*RT33	$1.10
35	B. CCS		
36	C. Call		
37	D. Minmum Cost per Line		
38	E. Hardware		
39	F. Memory	(MP33*IT14+MD33*IT15)/IP2+MF33*IT16	$0.08
40	G. SSP Octet		
41	H. Total End Office (USOC: TNPRL)	LN34+LN39	$1.18
42	I. Investment per Additional Path	LN34+MF33*IT16	$1.13
43			
44	**Model Office Outputs -- Capacity**	SCIS/MO BC836	
45	MO1 Investment per Msec		$0.40738
46			
47	**User Input**		
48	IP1 BH Calls per Line	Network Cost Group	1
49	IP2 Average RCF Lines per Office	StatMaster Extract	65
50			
51	**SCIS/IN Database Items**	SCIS/IN Tables	
52	IT14 Program Store Cost per Word		0.00207
53	IT15 Data Store Cost per Word		0.0031
54	IT16 Data Fill Cost per Word		0.0031
55	MD33 Data Store Memory Requirement		281
56	MF33 Data Fill Memory Requirement		9
57	MP33 Program Store Memory Requirement		1161
58	RT33 Realtime Requirement per RCF Call		2.70138
59			
60			