BellSouth Telecommunications, Inc.
FPSC Docket 001305-TP
Jerry Kephart's Deposition
LATE-FILED EXHIBIT JK-2

Transmittal Cover Sheet for Jerry Kephart's Deposition LATE FILED EXHIBIT JK-2

WRITTEN GUIDELINES FOR USE OF DAML EQUIPMENT IN THE NETWORK.

Consisting of 16 pages

(PROPRIETARY)

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BELLSOUTH®

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subject: Deployment Directives for Digital AML Systems

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date: April 24, 2001

related letters: RL:00-12-002BT, RL:98-09-003BT, RL:98-09-002BT

other:

to: Attached Distribution List

entities: BellSouth Telecommunications, Inc.

from: Network Vice President - Technology Planning and Deployment, Science and Technology

description: Digital AML Deployment Directives

* * *

In an effort to provide alternative solutions necessary to meet continued increases in additional line demand, as well as to provide an additional facility relief alternative for slow growth areas, this letter transmits Deployment Directives for currently approved Digital Added Main Line carrier systems (DAMLs). In addition to the Terayon (RayChem) 2N1 and 4N1 systems, the ADC PG-Plus® DAML 6 line system is now also approved for integrated applications. These directives supersede RL: 98-09-003BT, which provided direction on the deployment of DAML devices. When used in a prudent fashion, DAML solutions offer attractive architecture alternatives to reduce costs in some situations, however DAMLs continue to be recommended as a last option in lieu of facility modifications, or relief authorizations that provide a more economical solution based on total facility requirements. It is also important to note that lines provisioned with DAMLs cannot be provisioned with ADSL. Attachment 3 of this document contains a one-page overview of the recommendations associated with DAML deployments.

Also note that the original Terayon DAML COT cards applied to some loops (all copper or integrated SLC96 circuits in particular) resulted in dramatic decreases in modem performance and a risk for customer dissatisfaction and complaints. BST has worked with Terayon to support a new card for the 2:1 COT systems that will not produce a significant impairment to the signal. These cards (V8) are undergoing final testing and should be available by the second quarter of this year. (A date for a V8 4:1 card has not yet been determined.) The newly approved ADC PG-Plus® DAML system is an integrated configuration for 6 POTs lines over a single cable pair, which also supports better modem speeds. Modem speed estimates for various DAML configurations are included as a summary on Table 1 in section 6.0.

We are providing this information to assist area teams in taking proactive steps to reduce overall costs and reduce the level of expenditures on copper. Questions or comments from your staff regarding these directives should be directed to Jim Jackson at (205) 977-5032 or Sherry Woodruff at (770) 493-3741.

Original signed by W. J. McNamara/for

Network Vice President - Technology Planning and Deployment, Science and Technology

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1.0 Directives

1.1 Introduction

DAMLs continue to provide alternative solutions necessary to meet increases in additional line demand, facility relief alternative for slow growth areas, and provide shorter response time intervals to meet critical service demands. It is important to note, however, that there can be economic penalties when used as a relief strategy without consideration for traditional reinforcements or relief options, particularly in areas of high growth. New cards for the Terayon 2:1 system and the newly approved ADC PG-Plus® integrated 6:1 DAML product will support better modem speeds, which have been a problem with other configurations on some customer loops.

1.1.1 Purpose

The purpose of this document is to discuss architecture options currently available in the approved DAML product line, and to identify various scenarios where DAMLs can help reduce overall costs.

1.1.2 Audience

The target audience for this letter is Loop Capacity Managers (LCMs), Outside Plant Engineering Managers, Service Advocacy Center (SAC) Specialists, Project Managers and Engineers.

1.1.3 Target Area

DAML use is applicable for the nine state area to provide an economic provisioning alternative or to meet critical service demands.

1.1.4 Time Frames

BellSouth is continuing to explore additional options for DAML technology, however the 2:1, 4:1, and the 6:1 configurations discussed in this document should be considered as relief alternatives currently available. The new Terayon V8 cards for improved modem speeds should be available 2qtr, 2001.

1.2 Implementation Plan

When deciding on relief strategies and options for DAML placements, it is important to understand the facility requirements for the entire route planning cycle. Short-term capital solutions should be weighed against long-term economics, customer service requirements, and budget restrictions. BellSouth continues to pursue enhancements to the Hands-off Assignment Logic (HAL) system that eliminate the manual handling previously required in the Address and Facility Inventory Group (AFIG) for 2:1 systems. Manual handling is still required in the AFIG and Recent Change Memory Administration Group (RCMAG) for those 2:1 Digital AML units not provisioned through HAL, i.e., when provisioned via Outside Plant Engineering (Service Order Advocacy Group) response to a PF'd ADL service order, or on a bulk basis for niche facility relief applications. Due to structural restrictions within the LFACS source code, which preclude the assignment of more than two telephone numbers to a given cable pair, all 4:1and 6:1 multi-line carrier systems must be administered as small digital loop carrier systems. Thus an Engineering Work Order will be required for all 4:1 and 6:1 system deployments.

1.2.1 Study Methodology / Current Products

Listed below are the configurations currently available in the DAML family.

2:1 DAML Family: Supplier-Terayon

- The Terayon Miniplex® Digital AML is a two-line digital subscriber carrier system that utilizes a single copper pair to provide two independent voice grade (POTS1) telephone service channels. The loop requires a non-loaded cable pair with no more than 6 KF of total bridged tap and must meet 1300 Ohms Resistance Design criteria, or in the case of DLE cards, Carrier Serving Area (CSA) Design criteria.
- The standard copper configuration consists of a CO shelf with line cards and remote Network Interface Device (NID) units. One COT shelf supports 18 systems and a 7 ft bay will accommodate 14 shelves. (The new V8 Central Office cards are compatible with the original shelf installations, and will resolve modem speed complaints.)
- The Digital Loop Electronics (DLE) configuration via SLC-96, SLC-5/SLC2000, or Marconi DISC*S consists of a DLE card at the carrier site and remote NID unit. The DLE channel units plug directly into their respective remote terminal channel banks and multiplex two adjacent channels onto one copper distribution pair, while interfacing with standard POTS channel units at the COT in a universal configuration, or directly

with the switch in an integrated configuration. Since DLE DAML channel units are plug-ins for DLC systems, there are no feeder relief opportunities associated with their deployment. However, the deployment of DLE DAML systems as a distribution relief alternative is addressed in Section 3.3.4. Methods and Procedures associated with Standard DAML and DLE DAML 2:1 systems are provided in RL:98-07-015BT.

4:1 DAML: Supplier- Terayon

- The Terayon 4:1 DAML is a four-line subscriber system that utilizes a single copper pair to provide four independent voice grade (POTS1) telephone service channels. The standard 4:1 DAML requires a non-loaded cable pair with no more than 6 KF of total bridged tap and must meet 1300 Ohms Resistance Design criteria. Mid-span repeaters for 4:1 DAMLs were approved by RL:00-08-009BT to extend the range of the 4:1 DAML from 1300 ohms to 2100 ohms. See RL:00-08-007BT for M&Ps.
- The standard (non-repeatered) copper configuration for the 4:1 Carrier System consists of a Central Office shelf with line cards and a series of remote terminal alternatives. One CO shelf supports 18 systems and a 7 ft bay will accommodate a maximum of 10 shelves. It is strongly recommended that separate bays be dedicated to 2:1 and 4:1 systems because of powering, heat deflection, administrative, and derived pair wiring requirements. Remote terminal alternatives for the standard 4:1 include: 1) a standalone Outside Network Interface (ONI) device; 2) a snap on door configuration for existing Siecor 6-pair ONIs; 3) a version suitable for indoor applications; 4) a pedestal mounted configuration; and 5) a pole/strand mounted version. Fail-to-POTS (FTP) functionality is provided only in those remote terminal configurations designed for single customer premises applications, i.e., the standalone ONI, the snap on ONI door, and the indoor remote unit. Hence, if the DAML electronics fail, at least the primary service to the customer premise will remain in tact. Non Fail-to-POTS (NFTP) functionality is provided only in those remote terminal configurations designed for multiple customer premise applications, i.e. the pole/strand and pedestal mounted remote unit configurations. In these configurations, if the DAML electronics fail, all premises served by the 4:1 device are without service. This arrangement is similar to other "digital loop carrier" systems in the network today, in that none of the customers served by the 4:1 system would have service in the event of a system outage.
- The repeatered 4:1 systems are similar to the standard systems, but have different (repeater compatible) CO line cards and work only with Non-Fail to Copper (NFTC) remote units. These remote units are available in the pole/strand mount, the pedestal mount and the NFTC Indoor configurations only. There are two versions of the 4:1 repeater, the double wide 239 mechanics and the Super RT/NID version. (The 239-type repeater will not fit into the standard 819 type or single slot repeater cases. See RL:95-07-037BT, table 1, for approved housings for this type repeater.) Each 239 repeater will regenerate one pair.

6:1 DAML - Supplier ADC (PairGain)

- The ADC (formerly PairGain) PG-Plus™ DAML 6:1 integrated system employs a scaled rate HDSL (High bit rate Digital Subscriber Line) transmission over a single copper pair to deliver 6 full 64 kbs DS0 channels. This scaled HDSL is spectrally compatible with POTS, ISDN, DDS, full rate HDSL, and T1 systems that may already exist within the loop. Specific details for loop qualifications can be found in RL:00-12-002BT, but should utilize non-loaded cable pairs with typical ranges of 12.5 KF for 26GA, and 18KF for 24GA cable.
- The 6:1 PG-Plus® remote DAML units are supported by the PG-Flex ^{Plus}® Access Shelf that can also accommodate 24-line PG-Flex® RTs. Although a 4:1 DAML unit can also be supported, only the 6:1 unit has been approved in BellSouth to achieve adequate utilization on digital switch interfaces and per line cost objectives. One Access Shelf supports 16 dual integrated central office line units (DICOLUs) or 32 6:1 systems in an integrated configuration for a total of up to 192 channels per shelf. A maximum of 8 shelves can be installed in a 7-foot bay. Each shelf requires eight DS1s to support two TR008 mode 1 systems. Currently the only approved remote closures for the DAML units are an external Network interface Device (NID) and an indoor Remote Terminal Enclosure. Pole and pedestal mount enclosures are under development. The Access Shelf is currently approved for controlled environments only (i.e., Central Office applications, huts or CEVs). A pedestal mounted "half" access shelf with 8 slots is also under development.

2.0 Digital AML Costs

The equipment costs for the various DAML products in section 2.1 along with the administrative cost in section 2.2 are summarized for total system costs in section 2.3. Section 3.0 provides deployment recommendations based on these costs and are provided in a one-page overview in attachment 3.

2.1 Equipment Costs

2.1.1 2:1 DAML

DAML alternatives, when deployed as recommended in these directives, provide a viable means of meeting Additional Line (ADL) demand while also avoiding increased investmnets in copper and/or delays in meeting service activation requirements. The original Terayon DAML COT cards applied to some loops (all copper or integrated SLC96 circuits in particular) resulted in dramatic decreases in modem performance and a risk for customer dissatisfaction and complaints. BST has worked with Terayon to support a new card for the 2:1 COT systems that will not produce a significant impairment to the signal. These cards, referred to as "V8" for "version 8 " release, are undergoing final testing and should be available by the second quarter of this year.

The deployment of DAML systems, particularly as a niche facility relief alternative, should be considered only after comparing the total costs of DAML deployments to the costs of currently acceptable methods of providing facility relief. The current in-plant equipment cost of standard 2:1 DAML systems is approximately $550, the 2:1 DLE DAML for SLC-96 and SLC-5 installed per line equipment cost is approximately $581, and Marconi DISC*S DLC system applications are approximately $641 per line gained. The new improved 2:1 V8 CO line cards will be more expensive at approximately $720, but will satisfy modem speed complaints. Standard (all copper) 2:1 DAML system cost is comprised of fully allocated in-plant equipment cost for the C.O. shelf, power supply, rack and test assembly, wiring, etc. (~$151), as well as the in-plant equipment cost of the 2:1 C.O. line card (~$169 for the current standard, $339 for the new V8 cards) and remote 2:1 Door RT unit (~$230). The 2:1 DLE DAML in-plant equipment costs are comprised solely of a 2:1 DLE channel unit (~$351 for SLC-96 and SLC-5 or ~$411 for Marconi DISC*S) and a remote 2:1 DooRT unit (~$230).

2.1.2 4:1 DAML

Standard (Non-repeatered) 4:1 DAML Systems

The current in-plant equipment costs of the standard 4:1 DAML multi-line systems varies by type of remote configuration deployed. For each 4:1 multi-line system application, the total system cost is comprised of the fully allocated in-plant equipment cost for the C.O. shelf, power supply, rack and test assembly, wiring, etc. (~$216), as well as the in-plant equipment cost of the 4:1 C.O. line card (~$397) and the in-plant equipment cost of the specific remote configuration required. The approximate in-plant equipment costs of the various remote configurations are as follows:

- Standalone Outside Network Interface (ONI) device ~ $514
- Snap on door configuration (DooRT) for existing Siecor 6-pair ONIs ~ $472
- A version suitable for indoor applications ~ $476
- Pedestal mounted configuration ~ $599
- Pole/strand mounted configuration ~ $551

Hence, the total standard 4:1 multi-line carrier in-plant system equipment costs range from a low of $1085 for the Door and Indoor RT configurations, to a high of $1212 for the pedestal mounted configuration. On a per line basis, these totals equate to a range of $362 to $404 per line gained (4:1 systems utilize one line to provide 4 lines, thus a net gain of 3 lines per system).

Repeatered 4:1 DAML Systems

The repeatered option adds significant cost to the 4:1 application. For each 4:1 multi-line system application, the total system cost is comprised of the fully allocated in-plant equipment cost for the C.O. shelf, power supply, rack and test assembly, wiring, etc. (~$216), as well as the in-plant equipment cost of the 4:1 C.O. line card (~$454), the repeater and housing ($834) and the in-plant equipment cost of the specific remote configuration required. The approximate in-plant equipment costs and the various remote configurations are as follows:

- A version suitable for indoor applications ~ $526

- Pedestal mounted configuration ~ $599
- Pole/strand mounted configuration ~ $551

Thus, the total repeatered 4:1 multi-line carrier in-plant equipment costs range from a low of $2030 for the Indoor RT configurations, to a high of $2103 for the pedestal mounted configuration. On a per line basis, these totals equate to a range of $677 to $701 per line gained. (Costs for the 4:1 systems will increase if we elect to pursue the V8 modem solution with Terayon, however the usage at this point does not suggest that we will pursue this feature in the near term.)

2.1.3 6:1 DAML

The current in plant equipment costs for the integrated ADC PG-Plus™ 6:1 DAML systems are estimated since final MBOS pricing is not yet available. The estimate is comprised of fully allocated in-plant equipment cost for the C.O. installation and commons cards, (~$222), as well as the in-plant allocated equipment cost of the 6:1 C.O. line cards ($236) and the RT cards ($1168) for a total system cost of $1626. A Network Interface Device (NID) and an indoor Remote Terminal Enclosure are available, with other remote configurations still under investigation. On a per line basis, the costs equate to approximately $325 per line gained (6:1 systems utilize one line to provide 6 lines, thus a net gain of 5 lines per system).

2.2 Administrative Costs

When provisioned through the service order process via HAL, neither Standard nor DLE 2:1 DAML deployments add any significant work content to the Additional Line provisioning process. However, when provisioned by Outside Plant Engineering (Service Order Advocacy Group) response to a PF'd ADL service order, there are incremental manual handling requirements in the AFIG and RCMAG. For analysis purposes, these manual handling requirements translate into a cost of approximately $35 per 2:1 DAML provisioned on a service order basis without the aide of the HAL system, and approximately $20 per 2:1 DAML system deployed on a bulk basis as a niche facility relief alternative. For ADL disconnects involving 2:1 DAML, regardless of how they were provisioned, the AFIG manual handling requirements translate to a cost of approximately $20 per 2:1 Digital AML.

The 4:1 and 6:1 DAML systems, unlike the 2:1 systems, must be administered as a small digital loop carrier system. Thus an Engineering Work Order will be required for **all** 4:1 or 6:1 system deployments. Please refer to the M&Ps for full details (RL:98-09-002BT for the 4:1, and RL:00-12-002BT for the 6:1). For analysis purposes, the EWO will result in AFIG and RCMAG manual handling requirements, which translate into a cost of approximately $50 per 4:1 and $60 per 6:1 DAML system deployed. This approximation is based on the estimated time required for administration in the AFIG and RCMAG. Hence, the total estimated costs of provisioning on a per line **gained** basis ranges from $378 to $421 for standard 4:1 systems, from $693 to $718 for the repeatered 4:1 systems, and approximately $337 for the 6:1 systems, depending on the remote unit configuration deployed.

2.3 Total System Costs

Combining the total in-plant equipment costs (capital) detailed in Section 2.1 with the administrative costs (expense) detailed in Section 2.2, results in the following total (capital and expense) system costs, on a **per line gained** basis, for the various DAML configurations available to BellSouth:

2.3.1 2:1 DAML

- Standard 2:1 system / new 2:1 V8 system
  - with service order flow-thru via HAL ~ $550 standard / $720 using V8
  - with manual handling on a PF'd service order basis ~ $585 standard / $755 using V8
  - with manual handling on a bulk basis for niche relief ~ $570 standard / $740 using V8

- DLE 2:1 system (SLC-96 or SLC-5 plugs)
  - with service order flow-thru via HAL ~ $581
  - with manual handling on a PF'd service order basis ~ $616
  - with manual handling on bulk basis for niche relief ~ $601

- DLE 2:1 system (Marconi DISC*S plugs)
  - with service order flow-thru via HAL ~ $641
  - with manual handling on a PF'd service order basis ~ $676

  with manual handling on bulk basis for niche relief ~ $661

2.3.2 4:1 DAML 4:1 standard system / repeatered 4:1 system
- with standalone Outside Network Interface (ONI) device ~ $392 standard
- with Snap on door (Door RT) for existing Siecor 6-pair ONIs ~ $378 standard
- for indoor applications ~ $380 standard / $693 repeatered
- in pedestal mounted configurations ~ $420 standard / $718 repeatered
- in pole/strand mounted configurations ~ $404 standard / $701 repeatered

2.3.3 6:1 DAML 6:1 system (ADC PG-Plus® integrated DAML application)
- with Network Interface Device (NID) or indoor Remote Terminal Enclosure (estimate) ~$337

3.0 Digital AML Deployment Directives

The total costs discussed above, on a per line gained basis, are used to develop the following directives.

3.1 Residence Additional Line Applications

3.1.1 Miniplex®2:1 System Residence Additional Line Applications

The deployment of 2:1 DAML, in lieu of an Engineering Work Order (EWO), to provide **single** Additional Line service remains economically attractive. Although the new V8 cards are more expensive than the standard 2:1 cards, they will result in increased modem performance, which has been a major service complaint. The DLE 2:1 solutions may also provide options at distances that would prohibit a COT system due to loop length. *Considering all costs and administrative impacts*, 2:1 DAML provides BellSouth a viable **single** ADL service provisioning alternative where all of the following conditions have been met:

a) The Outside Plant Engineer, or HAL in a mechanized application, has determined 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), and Break Over-age Connect-Throughs (BCTs). On a weighted average basis, using current Facility Mod data and accepted LATIS Cost Factors from the Outside Plant Engineering Support Staff, these alternatives cost approximately from $43 to $93 per occurrence. Clearly, when compared to the $581 to $720 cost of the DLE 2:1 or new V8 COT 2:1 DAML systems, each of these facility modification alternatives offers a significant economic and administrative advantage over DAML deployments.
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 Section 4 of the DAML M&Ps (RL:98-07-015BT).

Note that COT 2:1 DAML systems are generally NOT an economical feeder facility relief alternative, however, there are niche applications for facility relief (see Section 3.3). Obviously, since the DLE 2:1 DAML channel units are plug-ins for DLC systems, there are no feeder relief opportunities associated with their deployments. Hence, the use of DLE 2:1 DAML systems is restricted to the provisioning of ADL service orders requiring distribution facilities at residential or small business locations served by their own ONI. Regardless of the application, for either Standard or DLE two-line DAML systems, both the primary and additional lines must be assigned to the same address. Furthermore, to avoid the complexities of having multiple ONIs at a given address, not to mention the cost penalties of having multiple 2:1 ONIs as opposed to a 4:1 ONI, there should be no more than one 2:1 DAML remote unit deployed to a residential or small business location.

3.1.2 Miniplex® 4:1 Multi-line Carrier System Residence Additional Line Applications

The standalone ONI, the DooRT, and the indoor remote terminal configurations are all designed to serve Additional Line demand locations. By providing 4 voice grade circuits over a single copper pair, they are ideal for residence locations requiring more than a single additional line. Obviously, due to the higher first cost of the 4:1 systems relative to the Miniplex®[R] 2:1 systems, if the demand at a given residence location is only 2 lines, the lower cost 2:1 system should be deployed. *However, in those locations where 3 – 4 lines are* required, the 4:1 system is ideal. Although the repeatered version of the 4:1 will add significant costs to provision, it will offer an extended service range, which may also provide economic solutions when compared to traditional facility relief reinforcement jobs. As with the Miniplex® 2:1 systems, the 4:1 system is a viable ADL service provisioning alternative only where all of the following conditions have been met:

a) The Outside Plant Engineer has determined that all other possible Facility Modification service resolution alternatives have been exhausted, i.e., Line and Station Transfers (LSTs), Wired Out of Limits (WOLs), Clear Defective Pairs (CDPs), and Break Over-age Connect-Throughs (BCTs). On a weighted average basis, using current Facility Mod data and accepted LATIS Cost Factors from the Outside Plant Engineering Support Staff, these alternatives cost approximately from $43 to $93 per occurrence. Clearly, when compared to the per line costs of DAML systems (see Section 2.3), each of these facility modification alternatives offers a significant economic and administrative advantage over DAML deployments.
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 for standard DAMLs in Section 9 of M&P RL:98-09-002BT, and section 5 of M&P RL00-08-007BT for repeatered DAML systems.

Recall that all 4:1 systems require an EWO. Therefore, they cannot be implemented via the service order assignment process. As such, any ADL service order assigned mechanically on a flow-through basis will be provisioned via 2:1 DAML equipment. However, the majority of ADL service orders are PF'd to Outside Plant Engineering for facility assignment. The Loop Capacity Manager should always use sound engineering judgment regarding the demand for multiple additional lines at a given location when evaluating which DAML alternative to recommend.

The pedestal mounted and pole/strand mounted remote unit versions of the 4:1 system are not designed for Additional Line applications. *Instead, they are designed for niche facility relief applications.* Additional details are provided in Section 3.3.

3.1.3 ADC PG-Plus® 6:1 Integrated Carrier System Residence Additional Line Applications:

The 6:1 indoor Remote Terminal Enclosure and the Network Interface Device (NID) primary applications are for single locations requiring Additional Lines. By providing 6 voice grade circuits over a single copper pair, they are ideal for residence locations requiring 5 to 6 additional lines. Obviously, due to the higher first cost of the 6:1 system relative to the Miniplex® 4:1 system, if the demand at a given location is only 4 lines, the lower cost 4:1 system should be deployed. (Approximately $1085 for the 4:1 and $1626 for the 6:1.) In addition, the 6:1 system must be installed in an integrated central office and reasonable system utilization may be difficult to achieve and maintain for this application alone. Section 3.3 discusses niche relief applications for the 6:1 DAMLs, and may provide additional system utilization opportunities once additional remote mountings for poles and pedestals are provided. As with the other DAML systems, the 6:1 system is a viable ADL provisioning alternative only where all of the following conditions have been met:

a) The Outside Plant Engineer has determined that all other possible Facility Mod service resolution alternatives have been exhausted, i.e., Line and Station Transfers (LSTs), Wired Out of Limits (WOLs), Clear Defective Pairs (CDPs), and Break Over-age Connect-Throughs (BCTs). On a weighted average basis, using current Facility Mod data and accepted LATIS Cost Factors from the Outside Plant Engineering Support Staff, these alternatives cost approximately from $43 to $93 per occurrence. Clearly,

when compared to the per line costs of DAML systems (see Section 2.3), each of these alternatives offer significant economic and administrative advantage over DAML deployments.

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 Section 6 of the PG-Plus® DAML M&Ps (RL:00-12-002BT)

3.2 Business Back-Up^{R} Line and Additional Business Line Applications

Back-Up^{R} Line is a measured Additional Line service targeted at Small Business customers with peak calling periods. While DAMLs may appear to be an attractive alternative for Back-Up^{R} Line service, the following issues should be considered prior to deploying a DAML system to a business location:

a) There are relatively few business locations served by their own ONI, thus restricting the opportunities to deploy either the Terayon DooRT (ONI door version) or standalone ONI version DAML devices. The 4:1 or 6:1 systems, in an indoor remote unit configuration, may be applicable in some specific cases.
b) Business locations typically involve more volatile or unpredictable additional line growth patterns. Digital AML, even the 6:1 system, may not be the appropriate deployment vehicle, either economically or practically, for locations where significant additional line growth potential exists.
c) Since HAL processes a limited array of business (1FB) orders, the manual handling requirements in the AFIG and RCMAG associated with Additional Business Lines would be incurred with every 2:1 DAML deployed, and an EWO would be required for any 4:1or 6:1 system deployment.
d) All 2:1 DAML systems, most 4:1 systems, (i.e., standalone ONI, snap on door, or indoor remote unit configurations), and the current 6:1 systems must be assigned and deployed to the same exact address as the primary line, including suite or unit numbers typically prevalent in Small Business locations. For example, a DAML system assigned and deployed to the same general address as a primary line (i.e., 2800 Main St.), but to an incorrect suite or unit number, would create significant confusion in the AFIG office and in LFACS records. This confusion could ultimately lead to extended service maintenance and repair intervals.

3.3 Facility Relief Applications

As stated earlier, DAML systems are generally not an economical long-term facility relief alternative when compared to our currently available feeder and distribution relief alternatives. However, there are niche applications where DAML systems deployed on a bulk basis should be considered. When deployed on a bulk basis, the 4:1 systems and /or 6:1 DAML systems are the recommended configurations for most niche facility relief, due to the per line equipment cost advantages relative to the 2:1 system applications. (While pole and pedestal mounts are not currently available for the 6:1, they are expected later this year, and considered for this application. Also note that the 6:1 application is limited to integrated central offices.) In considering these niche applications, the following conditions are all required:

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 and/ or 6:1 DAML 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 DAML multiple customer premise units for cutover to facilitate the "mining" of feeder

and/or distribution pairs to meet the anticipated 3-5 year demand. (Pole / pedestal mounts have also been requested for the 6:1, and, when available, will also be a consideration to serve multiple customer locations in order to mine facilities for a 3-5 year demand.)

d) The drops serving the individual living units beyond the 4:1 multiple customer premise 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 and 6:1 DAML systems, or the distribution loops (F2) in a DLE 2:1 DAML configuration, do not exceed the Loop Qualification Criteria defined in the DAML M&Ps (Section 4 of RL:98-07-015BT for 2:1 Systems, Section 9 of RL:98-09-002BT for 4:1 standard systems, Section 5 of RL:00-08-00BT for repeatered 4:1 systems, and Section 6 of RL:00-12-002BT for the 6:1 systems.).

3.3.1 DAML Systems for Feeder and Distribution Facility Relief

As noted in Section 2.3, the total in-plant costs of 4:1 standard DAML systems range from $378 to $420 and the 6:1 systems are approximately $337 per line gained. Hence, deployment of 4:1 or 6:1 DAML systems as a facility relief alternative, **where traditional feeder *and* distribution facility relief can be deferred**, is always economically attractive. There are no currently available feeder (NGDLC, Conventional DLC, Metallic Cable, etc.) or single family residential distribution (Metallic cable, Fiber Distribution, etc.) relief alternatives, which **in combination**, can be implemented on a per line basis for less than the per line cost of 4:1/ 6:1 DAML systems.

As noted earlier, since 2:1 DLE Digital AML channel units are plug-ins for SLC-96, SLC Series 5, or Marconi DISC*S systems, there are no feeder relief opportunities associated with their deployment. The deployment of 2:1 DLE Digital AML systems as a distribution relief alternative is addressed in Section 3.3.4 below.

3.3.2 DAML Systems for Feeder Facility Relief

While not generally an economical feeder facility relief alternative, there are limited scenarios where DAML deployments can be economically attractive. Again, with each deployment of a 4:1 or 6:1 DAML system for facility relief comes a manual handling requirement in the AFIG and RCMAG. Therefore, their deployments should be carefully considered. At the fully allocated cost, DAML systems deployed for bulk recovery of feeder facilities are more expensive over the long run than our typical feeder facility relief alternatives (i.e., NGDLC, Conventional DLC, short sections of Metallic Cable reinforcement, etc.) Please refer to the latest edition of the Loop Technology Deployment Directives (RL:01-03-001BT), for appropriate feeder relief alternatives. However, for **slow growth areas** (as defined in the following sections), the deployment of 4:1 or 6:1 DAML systems for feeder facility relief can be more cost effective than incurring the higher first costs associated with other feeder facility relief alternatives.

The following scenarios are provided as comparisons between feeder facility relief alternatives for slow growth areas and DAML systems:

- Installation of conventional DLC systems, such as SLC-96 (least desirable), SLC Series 5, and FDLC in existing cabinets compared to DAML relief:
  - Standard 4:1 DAML systems are an economically viable relief alternative for **growth rates of up to 8 lines per year**
  - Repeatered 4:1 DAML systems are an economically viable relief alternative for **growth rates up to 5 lines per year.**
  - 6:1 integrated PG Plus systems are an economically viable relief alternative **for growth rates up to 6 lines per year.**

- Installation of a small remote cabinet (such as a 52 type) with conventional DLC systems fed by copper T1s, or with an OC1 mux, compared to DAML relief:
  - Standard 4:1 DAML systems are an economically viable relief alternative for **growth rates of up to 17 lines per year**
  - Repeatered 4:1 DAML systems are an economically viable relief alternative for **growth rates up to 10 lines per year.**
  - 6:1 integrated PG Plus systems are an economically viable relief alternative **for growth rates up to 19 lines per year**

- Short cross-sections of metallic cable placement (not C.O. terminations) to make feeder pairs available to a crossbox compared to DAML relief:
  - Standard 4:1 DAML systems are an economically viable relief alternative for **growth rates of up to 26 lines per year**
  - Repeatered 4:1 DAML systems are an economically viable relief alternative for **growth rates up to 15 lines per year.**
  - 6:1 integrated PG Plus systems are an economically viable relief alternative **for growth rates up to 28 lines per year**

In all cases, conditions a) through e) set forth in Section 3.3 must be met in order to consider DAML deployments as a feeder facility relief alternative.

3.3.3 DAML Systems for Distribution Facility Relief

Utilizing DAML systems, on a bulk basis via EWO, is also generally not an economically attractive distribution facility relief alternative when compared to placing short sections of metallic distribution relief cable. DAML systems deployed for bulk recovery of distribution facilities are more expensive over the long run than our typical facility relief alternatives, **except in slow growth areas.**

The following comparisons are provided between placing short sections of metallic distribution cable and DAML systems for distribution facility relief:

- Standard 4:1 DAML systems are an economically viable relief alternative for **growth rates of up to 10 lines per year**
- Repeatered 4:1 DAML systems are an economically viable relief alternative for **growth rates up to 6 lines per year.**
- 6:1 integrated PG Plus systems are an economically viable relief alternative **for growth rates up to 8 lines per year.**

Again, before considering DAML systems for distribution facility relief alternatives, the conditions set forth in Section 3.3 must be met.

3.3.4 Digital Loop Electronics (DLE) 2:1 DAML Systems for Distribution Facility Relief

The economics associated with utilizing 2:1 DLE DAML systems (i.e., UDC-CU96, MP-CU5, or CU-R channel units in SLC-96, SLC Series 5, or Marconi DISC*S systems, respectively, combined with a 2:1 DAML remote unit at the residence ADL location), for distribution facility relief are not as attractive as the economics for 4:1 or 6:1 DAML systems. As noted earlier, on a per line gained basis, the cost for 2:1 DLE DAML systems (from $581 for SLC-96 and SLC-5 to $676 for Marconi DISC*S) is higher than the 4:1 Standard DAML alternative. However, having channel units at the DLC Remote Terminal which constitute the "office end" of the DLE Digital AML loop, as opposed to the C.O. equipment (shelves, power supplies, fuse panels, line cards, etc.) required for the CO DAML configurations, offers a time value of money benefit that offsets some of the per line cost penalty. Additionally, there are opportunities for distribution relief that are beyond the non-loaded cable pair loop qualification criteria of the 4:1 system, that possibly could be addressed with the

deployment of a 2:1 DAML from an existing SLC-96, SLC-5, or Marconi DISC*S remote terminal out in the network.

Therefore, similar conclusions can be drawn for DLE 2:1 DAMLs that were established for the DAML systems in the previous section. Utilizing DLE 2:1 DAML on a bulk basis via EWO is also generally not an economically attractive distribution facility relief alternative when compared to placing metallic distribution relief cables, **except in slow growth areas**. In analyzing the initial and subsequent costs of DLE 2:1 DAML versus metallic distribution facility relief, DLE 2:1 DAML proves to be a viable economic alternative only when the growth rate is **not greater than 6 lines per year**. Again, before considering DLE 2:1 DAML as a distribution facility relief alternative, the conditions set forth in Section 3.3 must be met.

Considering the relatively low utilization typically associated with our existing metallic distribution (F2) facilities, as well as the potential impact of local competition (particularly facility based competition as opposed to resale), there could be strategic advantages associated with deploying DAML facilities in lieu of distribution facility relief to meet ADL demand. Specifically, the opportunity to reuse DAML components following ADL disconnect provides a strategically attractive alternative to potentially stranded facilities that would have otherwise been placed to meet ADL demand. The Loop Capacity Manager should always use sound engineering judgment when evaluating these distribution relief alternatives.

4.0 Special Considerations

There are a number of other factors that may affect the DAML deployment decisions. Among those factors would be the ability to effectively perform low cost facility modifications, i.e., LSTs, WOLs, CDPs, or BCTs. The costs associated with performing facility modifications to make available the facilities required to meet an impending ADL service request and/or resolve an existing facility shortfall, are generally much less than the installed per line cost of a DAML system. For example, there could be opportunities to perform a facility mod at one distribution terminal to make facilities available in another distribution terminal from which the ADL service request may be served. HAL has been designed to perform logic of this nature, however, on ADL orders that are PF'd (Pending Facilities) to Loop Capacity Management (Service Order Advocacy Group or Outside Plant Engineer), care must be taken to examine these alternatives. In those situations where extenuating circumstances exist, i.e., buried encapsulated plant, any extraordinary costs associated with these types of facility mods may make the use of a DAML system an attractive alternative.

The costs associated with the development and implementation of an EWO to provide traditional facility relief will generally exceed the installed cost of a single 2:1 DAML system. In situations where an EWO would be required to support a small number of ADL service requests, the DAML deployment option is the preferred alternative. However, if the Loop Capacity Manager anticipates that a large number of ADL service requests will occur at a particular location, or along a particular route, traditional facility reinforcement methods may be more applicable. This scenario would theoretically appear more likely in the volatile additional business line environment. Regardless of the situation, the deployment of DAML systems should be done only after comparing its cost to the cost of other facility relief alternatives. Section 3.3 provides some niche applications for DAML systems as facility relief alternatives, however the Loop Capacity Manager should always use sound engineering judgment when evaluating these options. OSPE RL: 99-11-015BT contains information on DAML recovery procedures to insure that opportunities for additional savings are examined at the district level.

5.0 Restrictions

5.1 Services Supported by DAML Systems

All BellSouth approved DAML systems will support basic (POTS1) service, including all CLASS^{R} services, FAX and modem lines, CALLER ID, Enhanced CALLER ID, MemoryCall^{R}, and future Utility Telemetry Service and pose no spectral compatibility issues with ADSL circuits. However, they will not support WatchAlert^{R} service (presently only being offered in Florida) or ISDN, nor will any service porvided on a

DAML system allow ADSL on the same cable pair. (The ADC PG-Plus DAML system will support ISDN, but those cards are not approved BellSouth).

5.2 Transmission Requirements

DAML systems in 2:1, standard 4:1 or 6:1 COT configurations over metallic feeder and distribution facilities, or in DLE 2:1 configurations over metallic distribution facilities behind SLC-96, SLC Series 5, or Marconi DISC*S, are restricted to 2-wire 1300 ohm Resistance Design loops within the non-loaded range (total non-DLC loop length not to exceed 18 Kft). (Mid-span repeaters for 4:1 DAMLs were approved by RL:00-08-009BT to extend the range of the 4:1 DAML from 1300 ohms to 2100 ohms.) The loop includes all segments of cable and bridged taps connected to serve a customer premise, including segments in the C.O. and on the customer premise. Refer to the M&Ps (Section 4 of RL:98-07-015BT for 2:1 Systems, Section 9 of RL:98-09-002BT for standard 4:1 systems, section 5 of RL:00-08-007BT for repeatered 4:1 systems, and section 6 of RL:00-12-002BT for 6:1 systems) for the Loop Qualification Criteria before deploying DAML systems.

5.3 Specific Restrictions for Various DAML Alternatives

The DLE 2:1 DAML channel units generally provide the same features as Standard (Copper Only) 2:1 DAML devices. However, the following exceptions do apply:

a) DLE 2:1 DAML channel units **do not** have a Fail-to-POTS option. In the event of a failure of a DAML component in a Standard (Copper only) 2:1 DAML configuration, the Fail-to-POTS feature allows the residence primary line to remain intact. However, in a DLE 2:1 DAML configuration, where the primary and additional lines serve from the same channel unit, the Fail-to-POTS feature is not achievable.
b) The DLE DAML channel units use programmable signatures in the MLT system to achieve testability. Unique VER codes are returned to the tester to indicate a DAML system. Refer to RL:98-07-015BT for more details.

Additionally, by design, there are distinct differences in the technical attributes and capabilities associated with each remote terminal alternative. For example,

- Fail-to-POTS (FTP) functionality is provided only in those remote terminal configurations designed for single customer premises applications, i.e., the standalone ONI, the snap on ONI door, and the indoor remote unit. Hence, if the Digital AML electronics fail, at least the primary service to the customer's premises will remain intact.
- Non Fail-to-POTS (Non-FTP) functionality is provided only in those remote terminal configurations designed for multiple customer premises applications, i.e., the pole/strand and pedestal mounted remote unit configurations. In these configurations, if the DAML electronics fail, all premises served by the device are without service. This arrangement is similar to other "digital loop carrier" systems in the network today, in that none of the customers served by the DAML system would have service in the event of a system outage.

Furthermore, drop side MLT capabilities are provided for the non-FTP remote unit configurations. Drop side test capabilities are required in these applications to assist in the isolation of customer troubles that might occur in the customer drops beyond the system remote unit.

6.0 Strategic Implications

Generally, the deployment of copper 2:1, 4:1, 6:1 or DLE 2:1 DAML systems, either on an ADL service order basis or on a bulk basis via EWO, should be restricted to areas where distribution (F2) facilities have exhausted. Niche applications for DAML deployment as a distribution relief alternative are described in Sections 3.3.3 and 3.3.4. Similarly, while DAML systems are not generally an economical feeder facility relief alternative, there are niche applications that are justified (see Sections 3.3.1 and 3.3.2). Refer to RL:01-03-001 BT, the 2001 Issue of the Loop Technology Deployment Directives due out during 2Q01 for those facility

relief alternatives that have been identified as strategically and economically beneficial for BST. For the purposes of this application, direct underground facilities to a service location (no F2 component) are considered distribution facilities.

Conversely, when considering the relatively low utilization of our existing metallic distribution (F2) facilities and the potential impact of local competition, particularly facility based competition as opposed to resale, there are strategic advantages associated with deploying DAML facilities in specific situations for additional line demand. Specifically, the opportunity to reuse DAML components following ADL disconnect provides a strategically attractive alternative to potentially stranded facilities that would have otherwise been placed to meet ADL demand.

Also note that the use of DAML equipment can affect customer modem performance, and restricts the cable pair from ADSL service. Modem speed is related to the various ways in which DAML equipment can be deployed, i.e., the number of A/D and D/A conversions caused by DAML equipment in the customer's local loop. Since there is no effective method of determining how customers will use their telephone facilities, it is important to consider whether choices are available to deploy DAML technology that will impact modem performance. For example, if a customer is currently working on a universal DLE system and DAML use is planned, consider the use of a DLE DAML in ISLC-5 or IDISC*S systems, if those choices exist.

Please refer to the Table 1 for comparative average modem speed results using copper, DLC, and DAML Systems. The use of DAMLs on facilities consisting of SLC-5, Universal SLC-96 or integrated DISCUS will not significantly change the modem speed of the existing loop. Modem speed can be inhibited when DAML systems are placed on existing copper loops or ISLC-96 lines. This chart is provided as information, and while not intended to alter DAML deployment strategies, may outline preferred solutions where options are available.

Table 1

Modem Speed Comparisons

*ISLC-96 POTS	48.1 kb/s avg
*ISLC-96 DAML	29.0 kb/s avg
*ISLC-5 POTS	49.2 kb/s avg
*ISLC-5 DAML	46.4 kb/s avg
#ISLC- 5 & DISC*S DAML	45.6 kb/s or higher
#USLC-96 POTS	21.6 - 28.8 kb/s
#USLC-96 DAML	21.6 - 28.8 kb/s
#USLC-5 POTS	21.6 - 31.2 kb/s
#USLC-5 DAML	21.6 - 31.2 kb/s
#Copper 2N1 DAML	21.6 - 31.2 kb/s
#Copper 2N1 DAML - new V8 cards	42.6 - 46.6 kb/s
#Terayon 4N1	Up to 33.6 kb/s
#Terayon 4N1 repeatered version	Up to 33.6 kb/s
# ADC PG-Plus® 8:1 DAML	45.6 kb/s or higher
# All copper facility V.34 - downstream connect speeds	19.2 - 33.6 kb/s
# All copper facility V.90 - downstream connect speeds	28.8 - 53.3 kb/s

Notes:
*For these tests, the connection was made through a 5E switch to a collocated access server in the TASTA switch lab. The DAML lines were built out with 16 kef of 26gauge cable.
Supplier data

7.0 REFERENCES

1. RL:00-12-002BT, OSPE M&Ps for PG-PLUS® DAML Systems
2. RL:00-10-019BT, Product announcement letter for ADC PG FlexPlus® DAML equipment
3. RL:00-08-007BT OSPE M&Ps for Terayon Miniplex® Repeatered 4:1 DAML Systems
4. RL:98-08-021BT, Product Approval Letter for Raychem Miniplex® 4N1 High-Speed Digital Subscriber Loop Carrier System
5. RL:98-09-002BT, Outside Plant Engineering Methods and Procedures for the Raychem Miniplex® 4N1 Multiline carrier System
6. RL:98-07-015BT, Outside Plant Engineering Methods and Procedures for Raychem Miniplex® DAML Systems
7. RL:97-01-012BT, Product Approval Letter for Raychem Digital AML Channel Unit for SLC Series 5 DLC System Remote Terminal
8. RL:96-07-012BT, Product Approval Letter for Raychem Digital AML Channel Unit for SLC 96 DLC System Remote Terminal
9. UG-AFIG-001BT, Section II, Tab 19, Issue A, FACS Methods and Procedures Users Guide, "Pair Gain (PG) Digital Added Main Line (DAML) FACS Service Order Assignment Procedures."
10. RL:95-07-033BT, Product Approval Letter for the Raychem Miniplex® Digital AML Door RT unit.
11. RL:95-02-018BT, Digital AML Monitor Report User Guide.
12. RL:94-10-030BT, Product Approval for the Raychem Miniplex® Digital AML Systems.

Summary of Digital AML Directives

Customer Premise Applications

Utilize Terayon Miniplex® 2:1 systems for single line ADL Service Orders in lieu of an EWO, Terayon Miniplex® 4:1 systems at households or small businesses where 3-4 lines are required, and ADC PG-Plus® 6:1 integrated system where 4- 5 lines are required, and where appropriate system utilization can be achieved.

Deploy Digital AML as a last choice option 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, Section 9 of RL:98-09-002BT for standard 4:1 systems, section 5 of RL:00-08-007BT for repeatered 4:1 systems, and section 6 of RL:00-12-002BT for 6:1 systems).

Facility Relief Applications

DAML 4:1 and 6:1 systems on a Bulk Basis as a Facility Relief Alternative are typically last choice options 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:

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 or 6:1 DAML 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 DAML multiple customer premise units for cutover to facilitate the "mining" of feeder and/or distribution pairs to meet the anticipated 3-5 year demand. (It is anticipated that pole and pedestal mounts for the 6:1 systems will be available at a later date.)

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 for standard and RL:00-08-007BT for repeatered systems).

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 DAML M&Ps (Section 4 of RL:98-07-015BT for 2:1 Systems, Section 9 of RL:98-09-002BT for standard 4:1 systems, section 5 of RL:00-08-007BT for repeatered 4:1 systems, and section 6 of RL:00-12-002BT for 6:1 systems).

DEPLOYMENT SELECTION TABLE

FACILITY RELIEF APPLICATION	4:1 non-repeatered	*4:1 Repeatered*	*6:1 Integrated*	*2:1 DLE*
	DEPLOY DAMLs WHERE GROWTH RATE IS:			
Feeder and Distribution Relief Required	=Any	*=Any*	*=Any*	Not Applicable
Feeder Relief req'd in slow growth area where DLC proposed in existing cabinet	*<= 8 lines/year*	*<= 5 lines/year*	*<= 6 lines/year*	Not Applicable
Feeder Relief req'd in slow growth area where DLC and new cabinet proposed	*<= 17 lines/year*	*<= 10 lines/year*	*<=19 lines/year*	Not Applicable
Feeder Relief req'd in slow growth area where short section metallic cable placements proposed	*<= 26 lines/year*	*<= 15 lines/year*	*<= 28 lines/year*	Not Applicable
Distribution Relief req'd in slow growth area where metallic cable placement proposed	*<= 10 lines/year*	*<= 6 lines/year*	*<= 8 lines/year*	<= 6 lines/year

Note: particular loop conditions may dictate only one viable option. For example, universal offices obviously will not have the 6:1 integrated system options, or loop lengths may dictate a repeatered solution. Where both the 6:1 and standard 4:1 options exist, growth rates of 14 lines or more per year for the 3-5 year window are slightly less expensive with the 6:1 systems.