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October 8, 1996

BY HAND DELIVERY

Ms. Blanca Bayo, Director
Division of Records and Reporting
Room 110, Easley Building
Florida Public Service Commission
2540 Shumard Oak Blvd.
Tallahassee, Florida 32399-0850

Re: Docket No. 961169-TP

Dear Ms. Bayo:

Enclosed are an original and fifteen copies of the Direct Testimony of Dr. Marvin H. Kahn, the Direct Testimony of Richard Robertson and the Direct Testimony of C. William Stipe, III on behalf of American Communications Services, Inc. in the above-referenced docket.

Please indicate receipt of this document by stamping the enclosed extra copy of this letter.

Thank you for your assistance in this matter.

Sincerely,

Floyd R. Self

FRS/amb
Enclosures
cc: James Falvey, Esq.
Parties of Record

Kahn 10778-96
Robertson 10779-96
Stipe 10780-96

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a true and correct copy of the Direct Testimony of Dr. Marvin H. Kahn, the Direct Testimony of Richard Robertson, and the Direct Testimony of C. William Stipe, III on behalf of American Communications Services, Inc. in Docket No. 961169-TP has been furnished by Hand Delivery (*) and/or Overnight Delivery (**) on this 8th day of October, 1996 to the following parties of record:

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961169

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

TESTIMONY OF

MARVIN H. KAHN

ON BEHALF OF

AMERICAN COMMUNICATIONS SERVICES, INC.

Docket No. 961169-TP

October 8, 1996

TESTIMONY OF

DR. MARVIN H. KAHN

I. QUALIFICATIONS

Q. PLEASE STATE YOUR NAME, POSITION AND BUSINESS ADDRESS.

A. My name is Marvin H. Kahn. I am a Senior Economist and a founding principal of Exeter Associates, Inc. Our offices are located at 12510 Prosperity Drive, Silver Spring, Maryland 20904.

Q. PLEASE REVIEW YOUR BACKGROUND AND QUALIFICATIONS.

A. I am an economist specializing in public utility regulation, energy, communications and antitrust analysis. My primary research interest is in the application of microeconomic principles to public policy issues. Over the last several years, my interests have turned most specifically to matters regarding the regulation of firms operating simultaneously in competitive and non-competitive markets. Particular issues addressed include the unbundling of services, the effects of imposing line of business restrictions on regulated firms, assessments of alternative regulatory structures, and matters regarding cost allocation and rate design.

In addition to my consulting experiences, I taught economics or lectured at the University of Tennessee, the University of Missouri in St. Louis, Washington University in St. Louis, at Merrimac College and at The Johns Hopkins University. I served as a senior economist with the Institute of Defense Analysis and the Mitre Corporation, both not-for-profit Federal Contract Research Centers in the Washington, D.C. metropolitan area. I also served as a senior staff economist with an Ad Hoc Committee of the U.S. House Committee on Currency and Banking, focusing on energy and employment issues.

I am a graduate of Ohio Northern University and hold a Ph.D. in Economics from Washington University in St. Louis.

Q. HAVE YOU TESTIFIED BEFORE REGULATORY AGENCIES ON MATTERS DEALING WITH TELECOMMUNICATIONS?

A. Yes. I have served as an expert witness on matters regarding telecommunications before commissions in over 20 jurisdictions in this country and Canada. I have also undertaken research and prepared reports on ratemaking issues for the U.S. Postal Service, the National Association of State Utility Consumer Advocates (NASUCA), the Federal Communications Commission (FCC) and the National Regulatory Research Institute (NRRI).

Q. HAVE YOU TESTIFIED ON ISSUES RELATED TO LOCAL COMPETITION?

A. Yes. I have testified on local competition issues in California, Louisiana, Tennessee, Kentucky, Texas, Pennsylvania, Delaware and West Virginia. Directly or indirectly, all of these testimonies involved the issue of appropriate pricing for unbundled telecommunications network elements.

II. PURPOSE AND SUMMARY OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. I have been asked by American Communications Services, Inc. (ACSI) to address the economic and ratemaking principles that underlie the pricing of unbundled network elements. Specifically, I have been asked to address the appropriate methodology for pricing unbundled local loops, one that is consistent with the Telecommunications Act of 1996 (1996 Act or Act) and with the promotion of meaningful and effective competition in the market for local exchange services. ACSI has also asked me to address the principles underlying the development of reciprocal compensation for mutual traffic exchange, and the establishment of appropriate non-recurring charges for telephone number portability.

Q. WHAT OBJECTIVES ARE IMPORTANT IN DETERMINING THE APPROPRIATE RATES FOR NETWORK ELEMENTS?

A. The 1996 Act established a vehicle to allow meaningful and effective competition to develop in the markets for local exchange services. Currently in the telephone industry, competition does not prevail. The incumbent local exchange carriers (ILECs), including GTE Florida, Inc. (GTE), still hold a monopoly or near monopoly on most of their telecommunications services and elements; thus, regulatory oversight is still required to ensure the competitive outcome. Where competition prevails, market forces naturally drive prices toward cost and the result is economic efficiency. Hence, a key objective of any pricing policy is to obtain the competitive outcome.

Adherence to economic pricing principles is important in achieving the competitive outcome. The methodology used to determine the price ILECs charge for use of their facilities must send the correct price signals, encourage the entry of efficient competitors, promote efficient make-buy decisions, and allow consumers to benefit from an increase in competitive activity, including lower retail prices and a diversity of service choices.

Q. WHAT ARE YOUR RECOMMENDATIONS REGARDING THE APPROPRIATE METHODOLOGY FOR DEVELOPING RATES FOR UNBUNDLED ELEMENTS?

A. Prices in a competitive market are based on forward-looking, market-oriented costs. To achieve this competitive market outcome, prices for network elements should be developed based on two criteria. The first is a measure of forward-looking, direct costs. The total service long run incremental cost (TSLRIC) method when focusing on services and the total element long run incremental cost (TELRIC) method when focusing on network elements are thus the appropriate standards for achieving the desired results. The second input is a mark-up over TSLRIC/TELRIC to permit recovery of forward-looking, efficiently incurred joint and common costs. As I describe below, I propose that this mark-up not be based on the ILECs' accounting records, but rather limited to what ILECs elect by their own activities in competitive markets. This is the best approach for ensuring the efficient level of entry, efficient production of end user services, competitively determined end user prices and the avoidance of anticompetitive behavior by ILECs. Since the markup is limited to that which does prevail in the ILECs' more competitive markets, it is reasonable by market standards.

Under the 1996 Act, determinations by a state commission whether the rates for interconnection and network elements are just and reasonable if the rate is based on cost (determined without reference to a rate-of-return or other rate-based proceeding).[1] The rate may include a reasonable profit.[2] A TSLRIC/TELRIC-based rate is a cost-based rate which is determined without reference to a rate-or-return or other rate-based proceeding. A mark-up over direct cost limited to a level determined by competitive market forces permits a reasonable profit. Thus, the approach outlined above is both economically sound and satisfies the pricing standards of the Act.

In addition, the rates charged for network elements and bundled services must be priced in a manner that prevents uncompetitive price

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[1] Section 252(d)(1)(A).

[2] Section 252(d)(1)(B).

squeezes. A price squeeze occurs whenever the combined price of the unbundled components and bottleneck services (such as number portability and directory assistance) equals or exceeds the price of the bundled function to the end user. While a price squeeze is always a matter of competitive concern, pricing of bundled services and functions is not addressed in this testimony.

In summary, this approach is consistent with the FCC's ruling on interconnection interpreting Section 252(d)(1) of the 1996 Act.[3] Because the TSLRIC studies are for network elements, the FCC calls them Total Element Long Run Incremental Costs (TELRIC) as we do throughout the remainder of this testimony. Under the First Report and Order, prices are to be set at TELRIC plus a "reasonable share of forward-looking joint and common costs." Section IV of my testimony discusses the mark-up in greater detail.

Q. WHAT RATES DO YOU RECOMMEND FOR UNBUNDLED LOOPS?

A. GTE did not provide cost studies to ACSI during negotiations. Therefore, GTE's version of TELRIC or TSLRIC for network elements and data necessary to develop a cost-based, competitive mark-up are not available. In the absence of such data, I recommend using the best cost

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[3] First Report and Order, in the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, Released August 8, 1996 (First Report and Order).

information currently available to the extent it is also consistent with the approach outlined above.

Q. WHAT IS THE BEST COST-BASED ALTERNATIVE AVAILABLE?

A. The best TELRIC alternative (at this time) for estimating reasonable TELRIC data uses the updated Hatfield Model.[4] This model produces TELRIC data by density zone (six density zones) for each state. The model is forward looking and takes into consideration population demographics, geology, network architecture and technology. The cost estimates for Florida, both statewide and by density zone, are provided in Exhibit 1 to my testimony.[5] GTE has not provided cost studies which could be used to determine or evaluate TELRIC estimates or a competitive mark-up. In the absence of GTE sponsored TELRIC studies completed within two months. I recommend setting interim rates based on the TELRIC estimates developed in the Hatfield Model. Further, the Commission should order GTE to provide the information necessary to estimate the mark-up on GTE's more competitive services and to provide GTE cost studies or other data which the Commission determines to be

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[4] Hatfield Model, Version 2.2, Release 2, by Hatfield Associates, Inc., attached to an <u>ex parte</u> filed by AT&T Corp. on September 10, 1996, in CC Docket No. 96-45.

[5] The Hatfield Results in Florida are based on BellSouth data, but it is our opinion that the resulsts are reasonably applicable to GTE's operations in Florida.

necessary to evaluate and verify the Model's TELRIC estimates. The interim rates should remain in effect until GTE's TELRIC-cost-based rates are effective, which should occur no later than six months from now.

Q. HOW IS THE REMAINDER OF YOUR TESTIMONY STRUCTURED?

A. Section III addresses economic efficiency goals and explains the role of pricing in achieving those goals. In Section IV, I discuss the FCC's First Report and Order, which implements Sections 251 and 252 of the Telecommunications Act of 1996 (Act). I focus on various parts of the First Report and Order that pertain to network element costs and prices. This section also discusses a cost-based pricing methodology for achieving the competitive outcome and explains why a TELRIC methodology best satisfies the criteria for efficient pricing. GTE has not provided any cost studies or estimates of cost. Section V discusses appropriate compensation mechanisms for transport and termination cost recovery. Section VI compares the theoretical pricing methodology discussed in Section IV with the proxy cost model developed by Hatfield Associates, Inc. to estimate TELRIC for network elements. Section VII discusses the FCC requirements that rates for interim number portability be competitively neutral.

III. EFFICIENCY GOALS

Q. WHAT OBJECTIVES ARE IMPORTANT IN DETERMINING THE APPROPRIATE PRICES FOR NETWORK ELEMENTS?

A. A key objective of the 1996 Act is a structure that allows the entry of both facilities-based and resale carriers into the local service market to promote effective competition. The pricing of unbundled network elements is one of the critical components of any open market policy, as reflected in new Sections 251(c)(3) and 252(d)(1) of the Communications Act of 1934 adopted by the 1996 Act.

With this in mind, the goal should be to structure a competitive outcome. A competitive outcome requires efficiency in production and pricing. Efficient pricing, in turn, requires that price reflect the cost of the good or service in question which means that rational choices by producers and consumers are encouraged. Production, entry and consumption decisions are each influenced by pricing, or at least potentially so. Only when prices reflect costs will the market yield the optimal quantity or combination of those goods and services valued by society at the minimum resource cost to society. Adherence to economic costing principles is important in achieving the competitive outcome and requires the use of reasonable, accurate measures of cost.

Q. WHAT EFFICIENCY RESULTS CAN BE ANTICIPATED FROM A PRICING POLICY CONSISTENT WITH COMPETITIVELY FUNCTIONING MARKETS?

A. In a market structured so that no one firm can dictate price or quantity, the market yields important efficiencies. Relevant aspects of these efficiencies are referred to as operational and allocative.

Operational efficiencies result when the lowest cost method of production is selected. Competition acts to ensure this result, as entry and exit occur freely. New entrants are not required to use the same technology as does the incumbent, but are free to select among all available technologies and adopt lower cost methods of production. As market price is often forced downward with an increase in supply and, in particular, with an increase in lower cost supply, incumbents are forced to become more efficient, lose market share or cease production altogether.

Allocative efficiencies result when resources are channeled into the production of those goods and services that are valued more highly than are the resources consumed in the production process. As long as market price covers the additional cost of production, the unit will be produced in a competitive market. Since resources are limited, it is in society's interest that resources are used in a manner that maximizes the value of that produced from those resources. A competitive market allocates resources efficiently, i.e., to the goods and services valued most highly.

Q. WILL THE EFFICIENCIES JUST DESCRIBED INURE TO THE BENEFIT OF CONSUMERS?

A. There is no question that meaningful competition will create benefits for consumers. What is less clear, unfortunately, is when or even whether the successful emergence of competition can be expected in the various markets for local services. There are generally two factors to consider.

First, it must be recognized that properties which allow the ILECs' monopoly control to remain for some network elements may delay the competitive entry. The Commission should establish rates to allow the benefits of a competitive outcome to be realized by consumers well before full facilities-based competition emerges for all elements and in all areas of the local service market. Otherwise, the benefits of competition could be delayed indefinitely given the tremendous practical and economic obstacles involved in replicating more than a negligible portion of the incumbent LEC's network.

Second, the Commission pricing rules must guard against anticompetitive pricing behavior by the ILEC. This is assured if a competitive norm or competitive outcome serves as the basis for pricing all non-competitive network elements. For instance, if the competitive outcome is emulated, the relationship between price and cost will be the same for competitive and non-competitive elements alike. Further, through the application of nondiscrimination obligations and imputation principles, the ILEC will "pay" the same for all non-competitive network elements set by tariff or arbitration as its competitors. Under these conditions, price squeezes and other forms of anti-competitive conduct will be deterred.

In short, the pricing policy designed to promote competition must recognize that competition is not likely to evolve evenly or with equal success for all network elements or in all areas of the state. The policy should be designed to provide the benefits of competition in the end use market to consumers, even before the successful emergence of that competition. In fact, the policy should be structured to create these benefits in the end use market for consumers, even if competition for each network element never emerges.

Q. WHY IS A TOTAL SERVICE OF TOTAL ELEMENT LONG RUN INCREMENTAL COST METHODOLOGY BETTER SUITED THAN OTHER COSTING METHODOLOGIES TO PROMOTING COMPETITION?

A. Prices should be set to recover incremental, forward-looking costs, not the firm's historically incurred embedded costs or revenue requirements. Pricing based on TSLRIC or TELRIC results in several market benefits. First, entrants have a continuous stream of make-buy decisions. Prices based on forward-looking cost will provide the correct signals on which to base decisions regarding facilities based investment and market entry. Second, cost-based pricing identifies the low cost supplier in any market, affecting decisions among alternative providers of a given product or service. Finally, cost-based prices permit efficient decisions in choosing among different goods.

Pricing based on embedded costs or revenue requirements cannot provide these benefits. Further, such pricing requires that the firm has -- and that it exercises -- a certain degree of market power. Market power permits the ILEC to engage in anticompetitive conduct by allocating costs to non-competitive network elements. This will provide a "cost basis" to raise the prices for those non-competitive network elements, removing the need to recover these costs from competitive network elements.

Q. TO WHAT EXTENT IS UNBUNDLING OF NETWORK ELEMENTS NECESSARY FOR THE EFFICIENCY GOALS TO BE MET?

A. Without the availability of unbundled network elements, entry into the local exchange market is severely restricted and in some circumstances would be impossible. It is for this reason that the Act specifically requires incumbents to provide nondiscriminatory access to network elements on an unbundled basis at any technically feasible point.[6] Further, to facilitate competition, network elements must be available in a manner such that new entrants are not forced to take and pay for elements that are not needed by that entrant in the provision of the local service, and are not denied access to key elements needed to ensure quality provision on a par with the ILEC's services. If new entrants are forced to buy unneeded elements in order to get others (if elements are not sufficiently unbundled), they will incur unnecessary costs which will deter efficient entry. Similarly, if access is denied to certain elements needed to ensure equal quality service, efficient entry will be deterred. The Act not only requires access to unbundled elements, it requires that unbundled elements be available in a manner that allows requesting carriers to choose the desired combination of those elements to provide the services they choose to the extent technically feasible.[7]

The network elements at issue in this arbitration are loops. The loop is the component of local service, i.e., the circuit or channel, by which the LEC provides transport between the end user premise and the LEC wire center. These communications channels or circuits may be provided as 2-wire or 4-wire copper pairs, as radio frequencies or as channels on a high-capacity feeder/distribution facility.

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[6] Section 251(c)(3).

[7] Ibid.

Further unbundling, for example, unbundling at the sub-loop level, is technically feasible, albeit ACSI is not asking for such further unbundling at this time. The FCC has concluded that unbundling of local loops is feasible[8] and that further unbundling of local loops may be appropriate.[9] In addition, the FCC has identified local and tandem switches (including all software features provided by switches) as one of seven separate unbundled network elements; and, apparently, left additional unbundling requirements up to the states.[10] Competition is enhanced by allowing the degree of unbundling requested by ACSI.

Q. DOES COMPETITION REQUIRE THE AVAILABILITY OF UNBUNDLED LOOPS AT COST-BASED RATES?

A. Yes. Physical replication of the loop by facilities-based carriers could not occur in the relatively near future; such massive investment would take time, if it occurred at all. Currently, GTE has a virtual monopoly on loop elements, which, in turn, are necessary for facilities-based competition to occur. Without access to the unbundled loop, and specifically access at economically feasible rates, entry will not occur and the objective of promoting efficient facilities-based entry will not be met. Lack of access to unbundled loops at cost-based rates would

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[8] First Report and Order, ¶ 377.

[9] First Report and Order, ¶ 391.

[10] First Report and Order, ¶ 366.

perpetuate the entry barriers in the local exchange market. Such entry barriers are inefficient from an economic perspective and clearly inconsistent with the 1996 Act.

IV. APPROPRIATE METHODOLOGY FOR PRICING UNBUNDLED ELEMENTS

Q. WHAT IS THE APPROPRIATE METHODOLOGY FOR ACHIEVING THE EFFICIENCY GOALS DESCRIBED IN SECTION III OF YOUR TESTIMONY?

A. Rates based on a TSLRIC/TELRIC methodology give the appropriate signals to carriers and consumers, ensure efficient entry into the market, and promote efficient utilization of the telecommunications network. As pointed out above (Section III), in a competitive market, prices are driven toward market-oriented, incremental costs over the long term. Thus, the rates for unbundled network elements should be based on a long run incremental cost methodology. TELRIC is just such a cost methodology.

Q. WHY IS TELRIC THE PROPER MEASURE OF THE COST OF NETWORK ELEMENTS?

A. Using TELRIC will result in prices for network elements reflecting forward-looking, efficiently incurred costs. It is appropriate that the TELRIC be forward looking. Efficient decisions regarding market entry, exit and expansion are based on forward-looking comparisons of expected revenues and expected costs. For correct price signals to promote efficient market activity, forward-looking costs should be used.

The appropriate cost study is long run in nature, i.e., it is based on a time horizon long enough to allow entry or exit to occur and/or for substantial changes in capacity or technology to occur. All costs affected by any of these decisions (entry, exit, capacity expansion or technology adoption) are variable. A properly structured incremental cost study should therefore include forward-looking capital costs, and the preponderance of all expenses should be viewed as variable, i.e., joint and common costs should amount to a relatively small fraction of total costs.

The relevant increment of demand to estimate network element costs is the total demand by all users, including the incumbent. Hence, the "total service" (or total element) designation. ILECs realize economies of scale. Focusing on any volume of output smaller than the total volume realized may result in higher per unit costs than are actually realized.

Further, the incremental cost calculation is intended to capture the added cost from producing or the cost avoided from discontinuing the service, assuming all other ILEC outputs remain unchanged. The incremental cost of a port is calculated assuming no change in the volume of loops and the incremental cost of loops is calculated assuming no change in the volume of ports. Since all else is held constant, the calculations focus exclusively on the cost of the unbundled network element.

Q. PLEASE SUMMARIZE THE FCC'S RULING REGARDING THE COSTING METHODOLOGY FOR PRICING UNBUNDLED LOOPS.

A. The FCC adopted specific requirements in its First Report and Order governing the methodology to be used in developing cost-based rates for interconnection and unbundled elements, including unbundled loops. The general pricing standard requires that rates be established on the basis of a forward-looking economic cost-based pricing methodology. The forward-looking economic cost of an element is defined in the First Report and Order as the sum of:

(1) the total element long-run incremental cost of the element (TELRIC), and

(2) a reasonable allocation of forward-looking joint and common costs.[11]

TELRIC is the forward-looking cost over the long run of the total quantity of the facilities and functions that are directly attributable to, or reasonably identifiable as incremental to, an element, given the incumbent LEC's provision of other elements. TELRIC and the term total service long run incremental cost (TSLRIC) are identical

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[11] First Report and Order, Appendix B-Final Rules, § 51.505(d).

conceptually. The term TELRIC is used by the FCC in applying the concept to the costing and pricing of network elements.

The FCC also required states to establish different rates for unbundled loop elements in at least three defined geographic areas within the state to reflect geographic cost differences.[12] In the event that state commissions do not have cost information available which meets the forward-looking economic cost criteria, the FCC produced a statewide average ceiling proxy at or below which unbundled loops can be priced on an interim basis.

Q. DID THE FCC IMPOSE CERTAIN REQUIREMENTS REGARDING THE CONSTRUCT OF A TELRIC STUDY?

A. Yes. The FCC recognized the importance of each of these considerations. The FCC required that the study be long-run (First Report and Order, ¶ 677), incremental (id., ¶ 675), forward-looking (id., ¶ 675) and that it focus on elements and not the underlying services (id., ¶ 678).

The FCC also established requirements in terms of what was not to be included in a TELRIC. The factors not to be considered in calculating TELRIC estimates are:[13]

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[12] Id. § 51.507(f).

[13] First Report and Order, Appendix B-Final Rules § 51.505.

(1) Embedded costs. As noted, the intent is to include forward looking incremental costs only.

(2) Retail costs. These are costs associated with the provision of services, not network elements.

(3) Opportunity costs. These are revenues that the incumbent would have received from the sale of services rather than the sale of the underlying network elements.

(4) Revenues to subsidize other services. Rates for network elements are to be based on their own costs only.

Q. WHAT ARE THE REQUIREMENTS IN THE FIRST REPORT AND ORDER WITH REGARD TO RETAIL COSTS IN THE CONTEXT OF MEASURING THE TELRIC OF UNBUNDLED NETWORK ELEMENTS?

A. Retail costs may not be considered in a calculation of the forward-looking economic cost of an element. Retail costs are defined by the FCC for the purposes of implementing Section 251(c)(4) of the 1996 Act, which requires incumbent LECs to offer *services* at wholesale rates. Nonetheless, the FCC definition of retail related expenses for purpose of establishing a wholesale rate is instructive for understanding some of the costs that should be excluded from TELRIC. Under the FCC definition, retail-related costs include the costs of marketing, billing, collection and other costs associated with offering retail telecommunications services to subscribers who are not telecommunications carriers.[14]

Q. WHAT OTHER COSTS SHOULD BE CONSIDERED AS RETAIL RELATED AND EXCLUDED FROM COST STUDIES FOR UNBUNDLED ELEMENTS?

A. The FCC identified a series of administrative expenses as retail related. These include product management, product advertising and customer services.[15] Costs for support facilities associated with each of these functions, and the depreciation, return and taxes pertaining to those facilities should also be avoided.

Q. DID THE FCC IDENTIFY ANY MAINTENANCE EXPENSES AS BEING AVOIDED IN THE CONTEXT OF ITS AVOIDED COST STUDY ANALYSIS RELATED TO WHOLESALE RATES?

A. No. But retail costs avoided in the context of service resale are only a subset of the expenses avoided in the context of unbundled loop elements. In resale, the end user service continues to be provisioned by the local exchange company and only the retail functions are provided by the reseller. In the context of unbundled elements, on the other hand, entirely different considerations come into play, as the unbundled

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[14] First Report and Order, Appendix B-Final Rules, § 51.505(d)(2).

[15] Id. ¶ 917.

exchange service because once these facilities are installed to provide one service they are able to provide the other at no additional cost. By contrast, the network elements, as we have defined them, largely correspond to distinct network facilities. *Therefore, the amount of joint and common costs that must be allocated among separate offerings is likely to be much smaller using a TELRIC methodology rather than a TSLRIC approach that measures the costs of conventional services.*

First Report and Order, ¶ 678 (emphasis added).

There is no reason to assume that lower joint and common costs are necessarily mapped into an increase in the *direct* costs of providing a network element. Instead, because certain activities associated with the production of services may be unnecessary in the production of elements, direct costs may not increase and may even be reduced as well.

Q. WHAT IS YOUR OVERALL CONCLUSION ON THE RELATIONSHIP OF TELRIC VS. TSLRIC?

A. The only way to determine the relationship in a given situation is to have both studies completed. There is no theoretical relationship between them that can assure that TELRIC will always stand in the same position (i.e., be higher or lower) vis-a-vis TSLRIC. As I have explained, TELRIC may well be less than TSLRIC. However, until such time as GTE can complete TELRIC studies, only interim rates less than or equal to the FCC's proxies can be established.

Q. PLEASE EXPLAIN THE ECONOMIC CIRCUMSTANCES WHICH GOVERN THE NEED FOR A MARK-UP OVER DIRECT COSTS.

A. In economic terms, when a firm is characterized by economies of scale or scope, its cost structure is such that incremental costs will generally be less than average costs. Thus, even in a highly competitive market, the price charged by firms with this cost structure will exceed the marginal or incremental costs, if the firm is to recover its costs in total, i.e., if the firm is to remain in business. It is generally accepted that the telephone industry is characterized by scale and scope economies. This will lead to various costs being joint and common. Therefore, the total costs of the firm operating in this industry will exceed the direct costs, and the rates charged must generally exceed the sum of the direct costs. This is true whether the services or network elements in question are competitive or monopolistic.

Q. WHY IS A LIMIT TO THE MARK-UP APPLIED TO NETWORK ELEMENTS APPROPRIATE?

A. There are at least four reasons why a limit to the mark-up should be applied. First, by applying the competitive mark-up to all elements, non-competitive elements are treated as if they were competitive. This allows the benefits of competition to be realized even before actual competition emerges. This also keeps the ILEC from using revenues from non-competitive elements to finance strategic pricing responses in competitive markets.

Second, this produces non-discriminatory rates, consistent with the requirements of the 1996 Act. Sections 251 and 252 require that rates for interconnection and network elements be cost-based and non-discriminatory. Discrimination results whenever price differentials are not cost-based, that is, whenever mark-ups differ.

Third, by not limiting the mark-up, the ILEC is able to recover a large, if not virtually unlimited, volume of shared and common costs in prices charged for monopoly elements. As such, it has no incentive to accurately classify costs as direct as opposed to shared or common in TSLRIC/TELRIC studies. Misclassifying costs as shared or common will reduce price floors and maximize pricing flexibility, improving the ILEC's position in competitive markets without any change in the level of costs incurred. On the other hand, if the extent to which monopoly service elements can bear a mark-up is limited, there is less opportunity to recover these costs through pricing of monopoly services and there is less incentive to misassign these costs as shared or common. To be sure, the ILEC can still misassign costs and can still reduce prices selectively. However, the ability to recover the costs misassigned is substantially limited and, therefore, the incentive to do so is reduced. The result is a general incentive to increase the proportion of costs subject to direct attribution. Further, putting shared and common costs at risk by limiting the mark-up will also provide the ILEC with greater operational incentives to minimize these shared and common costs.

Finally, this will limit the prices that ILEC can charge competitors. The ILEC has a clear incentive to charge competitors high prices. High prices provide a financial advantage to ILECs by increasing their margins relative to their competitors. Limiting the mark-up to the competitive norm establishes a reasonable mark-up, while minimizing overcharging.

Q. HOW DO YOU PROPOSE THAT THE RELEVANT MARK-UP FOR NETWORK ELEMENTS BE ESTABLISHED?

A. A mark-up over direct costs is appropriate to recover forward-looking joint and common costs. Since a competitive environment would limit the mark-up to a level needed to fully recover only efficiently incurred, forward-looking joint and common costs, it would be reasonable that the mark-up be limited to (1) an amount no greater than the ratio of efficiently incurred joint and common costs to direct costs, or (2) that realized on GTE's competitive services, whichever is lower. To do otherwise will allow the ILEC to recover monopoly rents by overpricing these essential, monopoly network elements.

A primary issue with regard to the provision of network elements is the "make-buy" decision. Many of the potential entrants have the option of either functioning as a reseller (buying unbundled components from the LECs) or, alternatively, becoming a facilities-based provider (using their own network). Setting the mark-up at other than what would be expected to exist in a competitive market could well result in incorrect price signals and inefficient investment. Because the goal, however, is to promote efficient entry through proper pricing policy, restricting that mark-up to the competitive market norm, appears to be an appropriate economic and regulatory policy.

Q. WHAT CRITERIA HAS THE FCC ESTABLISHED FOR DETERMINING THAT MARK-UP?

A. The FCC set two general criteria for the mark-up over TELRIC. First, it required a mark-up to allow for the recovery of forward-looking joint and common costs. At the same time, the FCC required that the mark-up be consistent with the behavior in competitive markets[16] and be

[16] Id. ¶ 679.

limited to a "reasonable allocation" of "forward-looking" costs.[17] Forward-looking common costs are defined as economic costs efficiently incurred in providing a group of elements or services (which may include all elements or services offered by the LEC that cannot be attributed directly to an individual element or service.[18] In determining what is a "reasonable" allocation the FCC imposes two criteria on the allocation of common costs.[19]

(1) The sum of TELRIC plus the "reasonable" allocation of common cost cannot exceed the stand-alone cost of producing the element, and

(2) The sum of the allocations for all elements and service excluding retail costs) should not exceed the total forward-looking common costs attributable to operating the incumbent LEC's total network.

One reasonable allocation method mentioned in the First Report and Order is to allocate common costs using a fixed allocator, such as a certain percentage mark-up over the directly attributable forward-looking costs. Another reasonable allocation method proposed by the FCC would be to allocate only a relatively small share of common costs to

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[17] Id. ¶ 682.

[18] Id., Appendix B-Final Rules, § 51.505(c).

[19] Id. ¶ 698.

certain critical network elements, such as the local loop and collocation, since these are facilities that are the most difficult for competitors to duplicate,[20] i.e., those facing the greatest barriers to entry. An allocation of common costs on that basis ensures that the price of network elements that are subject to the least competition are not "artificially inflated by a large allocation of common costs."[21]

Q. WHAT IS YOUR RECOMMENDATION FOR ESTABLISHING THIS MARK-UP OVER TELRIC?

A. As I explain in greater detail below, I propose that the Commission establish a mark-up for unbundled local loops that is no greater than the mark-up which the ILEC realizes on its competitive network services.

Q. IS YOUR PROPOSAL FOR A MARK-UP IN THE PRICING OF UNBUNDLED LOOPS CONSISTENT WITH THE ACT AND THE FIRST REPORT AND ORDER?

A. Yes. A competitive based mark-up provides a market surrogate for the extent to which joint and common cost can be recovered through prices of competitively provided services and elements. For the same reasons as explained in my testimony, the FCC required a mark-up over costs, TELRIC in this instance. Second, the FCC limited the mark-up to a

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[20] Id. ¶ 696. The FCC refers to facilities such as the loop as bottleneck facilities in this paragraph.

[21] Id.

"reasonable level." The mark-up proposed in my testimony, which would be limited to the mark-up accepted by the ILEC on its most competitive services, is consistent with the FCC mandated limits. A mark-up limit defined as the voluntarily accepted return on a competitive service is consistent with the criteria which limits the allocation of common costs to that which could be earned on a stand alone basis and because it is competitively determined, it restricts the total or "sum of the allocation" for all elements to the total of forward-looking common costs less retail costs.

Q. HOW WOULD THE MARK-UP ON COMPETITIVE SERVICES BE DETERMINED OR MEASURED?

A. The purpose of the mark-up is to capture the competitive outcome in the pricing of network elements. By mark-up, I mean the difference between the rate charged for an element (or service) and the TSLRIC/TELRIC of the element (or service). The determination of a mark-up should be based on comparable, competitive transactions and it must recognize that the tariff rate is not always the relevant figure to use.

GTE's services are subject to various degrees of market competition. The intent here is to identify the mark-up consistent with an actively competitive market. Consequently, the focus should be on those elements or services provided by GTE that are subject to more competition, rather than an average of all services provided. Services subject to a greater degree of competition (than basic local exchange or even MTS services) include, for example, Centrex, and 800 service.

Further, it must be recognized that rates established historically have been designed to allow GTE to fully recover its revenue requirement. Rates for many of the services that are less elastic have been set at levels necessary to accomplish this recovery. If competition successfully emerges in these markets, rates for many of these services are likely to fall. Consequently, in the interest of capturing a competitively inspired mark-up, it is inappropriate to take the average of all services, but instead the focus should be on competitive market operations and the market pricing of GTE's more competitive activities, i.e., on the revenues realized under specific market-type contracts negotiated by GTE.

Q. YOU INDICATED THAT TARIFFS MAY NOT ALWAYS BE THE RELEVANT SOURCE OF PRICING INFORMATION. WHY IS THAT?

A. The ILECs typically have had contracting capability for some time now. This allows an ILEC to price off-tariff in especially competitive market conditions. With this, rates covered by contracts can be at discounts off of the tariffed rate.

Q. IS THERE ANY EVIDENCE ON THE EXTENT OF THE MARK-UP NECESSARY TO RECOVER EFFICIENTLY INCURRED JOINT AND COMMON COSTS?

A. While none has been presented by GTE in this jurisdiction in the context of negotiations, other available data point to a mark-up in the 10-15 percent range.

Q. ON WHAT DO YOU BASE THE INFORMATION REGARDING OTHER AVAILABLE DATA?

A. I have performed an analysis of the more competitive contracts for two ILECs in California. An analysis of contracts entered into by GTE and Pacific Bell in California for their competitive Centrex offering points to mark-ups of up to 15 percent. Comparing the Centrex contract revenues with Pacific Bell's estimate of TSLRIC (as filed with the California Commission in the cost study proceedings) provides a median mark-up of approximately 15 percent. The mark-ups obtained by GTE were generally lower.[22]

A mark-up of that same magnitude over TSLRIC has been identified by Bell Atlantic Pennsylvania.[23]

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[22] R.93-04-003, I.93-04-002, Rebuttal Testimony of Dr. Marvin H. Kahn (Revised), July 25, 1996, Tables III and IV.

[23] Opinion and Order, short form, Application of MFS Intelenet of Pennsylvania, Inc., Docket No. A-310203F002, et al., page 13.

Q. COULD THE PSC RELY ON GTE'S COMMON COSTS PER BOOK FOR THE MEASURE OF THIS MARK-UP?

A. Only with caution. Note that the intent of the markup is to permit the incumbent LEC an opportunity to recover forward-looking, economically efficient joint and common costs. These are not necessarily the same as the incumbent LEC's booked expenses, or stated differently its embedded level of such expenses. This is the same position as expressed by the FCC (First Report and Order, ¶ 705):

> Rather, we reiterate that the prices for the interconnection and network elements critical to the development of a competitive local exchange should be based on the procompetition, forward-looking, economic costs of those elements, which may be higher or lower than historical costs.

The determination of economically relevant, forward-looking expenses would require the consideration of elements such as the following:

(1) The incumbent LEC clearly takes the position that virtually all aspects of its operations on a forward-looking basis will differ and differ materially from its recent operations, even from its current operations, i.e., those in 1995 or 1996. Among other things, the incumbent LEC has even greater pressures to become "lean and mean" than it had before. Hence, to blindly rely on historical data on

operations and cost levels as the basis for any forward-looking estimate is not only incorrect, but in this case a guarantee of inflated rates for monopoly services.

(2) When attempting to project a level of expenses, it is appropriate to adjust current levels of efficiently incurred expenses for anticipated future events. Rates of inflation may act as a reasonable surrogate for increases in labor expenses, which are the primary factor affecting these common costs. On the other hand, the experience with the telephone industry in general, and the ILECs in particular, indicates that the cost of producing any good or service tomorrow will be less than what it is today. This is not because labor costs are going down, but rather because productivity improvements are outpacing any increase in expenses incurred. All available evidence, including that prepared by ILECs, points to a continuation in this trend.

(3) The costs must be adjusted to reflect the portion allocated to retail operations.

Q. DOESN'T ALLOWING A MARK-UP ON ESSENTIAL MONOPOLY ELEMENTS PROVIDE GTE AN ADVANTAGE OVER ANY ENTRANT THAT MUST TAKE SERVICE FROM GTE TO COMPETE?

A. In part, it may. The mark-up provides GTE cash flow from any profit that may be realized. On the other hand, it is for reasons such as this that I am suggesting that the mark-up be restricted to no more than a competitively determined level. In this manner whatever profit realized is no more than what could be expected from a competitive activity.

Q. IS YOUR PROPOSED APPROACH TO PRICING NETWORK ELEMENTS CONSISTENT WITH THE 1996 ACT?

A. Yes. Section 251(c)(3) requires that incumbent LECs provide "non-discriminatory access to network elements on an unbundled basis . . . on rates, terms and conditions that are just, reasonable and non-discriminatory." Section 252(d)(1)(B) provides that determinations by a state commission are just and reasonable if those rates are:

(i) based on the cost (determined without reference to a rate-of-return or other rate-based proceeding) of providing the interconnection or network element (whichever is applicable);

(ii) nondiscriminatory; and

(iii) may include a reasonable profit.

These conditions clearly proscribe the use of the embedded or fully-allocated cost methodology of traditional regulation, which is based on the historical and actual costs incurred, in setting cost-based rates for network elements. A long-run incremental cost methodology does not rely on historical, embedded costs and is, therefore, consistent with the 1996 Act. In addition, rates based on a competitive mark-up are nondiscriminatory; reassured by Section 252(i) of the Act which requires an ILEC to make available any interconnection, service or network element provided under any agreement approved by a state commission on the same terms and conditions. With my proposal, competitive and non-competitive elements are each priced according to identical standards.

Q. UNDER SECTION 252(d)(1)(B) OF THE ACT, A COST-BASED RATE FOR NETWORK ELEMENTS MAY INCLUDE A REASONABLE PROFIT. IS YOUR APPROACH CONSISTENT WITH THIS PROVISION?

A. Yes. The Act does not define "reasonable profit." However, few would disagree that a mark-up over direct costs equal to that which would prevail in a competitive market is reasonable. In a competitive market, the achievable mark-up over cost will be disciplined by competition in the market and held to a reasonable level. Attempts to maintain excessive mark-ups over price will invite entry into a competitive market, driving prices down and reducing mark-ups or profits to what economists sometimes call a normal level. Restricting the mark-up on monopoly elements to a competitive level ensures that the element will earn only a normal profit and that the mark-up will not exceed a reasonable level.

Q. YOU MENTIONED THE FCC PROXY CEILING. PLEASE EXPLAIN WHAT THAT NUMBER IS AND HOW THE FCC PROPOSED THAT THE NUMBER BE USED.

A. As noted, the FCC required that rates for unbundled elements must be cost based. The FCC established proxy rates for specific network elements to be used on an interim in the event that the necessary cost data are not available at an arbitration. These proxies take the form of rate ranges or, for some elements, such as the loop, a ceiling. The default proxies established by the FCC serve merely as presumptive rate ceilings.

States may set rates above the price ceiling only if the state commission has given full and fair effect to cost data based on the methodology prescribed in the First Report and Order, i.e., a properly structured TELRIC.

Q. HOW DO THE COST ESTIMATES PRODUCED BY THE HATFIELD MODEL COMPARE WITH THE FCC ESTABLISHED PROXIES?

A. As noted, the Hatfield Model assigns a portion of joint and common costs to each network element. Even with this, the current updated Hatfield cost estimates are below the FCC estimates. Exhibit 2 provides a comparison of the FCC proxy and the current updated Hatfield estimates on a statewide basis.

Q. GEOGRAPHIC DE-AVERAGING IS REQUIRED BY THE FCC. WHY IS GEOGRAPHIC DE-AVERAGING OF COSTS OF IMPORTANCE?

A. A primary goal in establishing prices for unbundled loop elements is to achieve a competitive market outcome in the provision of these elements. In that regard, price signals to market participants should provide the correct information to guide efficient decisions with regard to market entry and exit and also with regard to facility make/buy decisions. For these decisions to be efficient, the price must accurately reflect the cost of providing such facilities.

Service and element cost studies and engineering analyses all point to the fact that the cost of providing unbundled loop elements will vary across the state. For efficient price signals to result to carriers utilizing the elements to provide services, the cost calculation should reflect these differences. Hence, loop costs must be geographically de-averaged. To be economically relevant, the zones selected for the de-averaged areas must be consistent with the cost differences.

Q. ON WHAT BASIS DOES ACSI PROPOSE DE-AVERAGING?

A. ACSI proposes that either three or six density zones be established based upon lines per square mile. This is the method used in the Hatfield Model. The boundaries of each area for establishing the density within the Hatfield Model are defined by Census Block Groups, but alternative groupings are possible. The density of lines in a given area bears a strong correlation to the cost of installing and providing local loops in an area. Accordingly, this method meets the criteria of the defining zones based on cost differences.

Further, de-averaged rates must conform with the FCC proxy ceilings. For purposes of determining whether de-averaged rates for unbundled loop elements comply with the proxy cost ceiling those actual, geographically de-averaged rates must be less than or equal to the FCC proxy when combined on a weighted-average basis,[24] depending on the record before them.

Q. ARE GROUPING LOOPS BY LOCAL EXCHANGE A REASONABLE METHOD OF PROVIDING DISAGGREGATED COSTS?

A. Not necessarily. Disaggregating loop costs by local exchange simply is a method of establishing prices consistent with the Company's current marketing and pricing practices. This results in marketing practices determining the costing procedures, rather than costing similarities determining pricing practices.

Further, prices established in this manner would likely be inefficient. The purpose of geographic de-averaging is to group loops in a manner that minimizes the variation in cost across the geographic de-

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[24] First Report and Order, Appendix B-Final Rules, § 51.513(b).

averaged groups. The goal is to establish geographic de-averaging in a manner that groups loops with similar cost characteristics together and puts loops with different cost characteristics in different categories. If this is done successfully, averaging will not distort the underlying differences in costs. De-averaging structured on any basis designed to meet the Company's marketing and pricing considerations would not be based upon differences in costs incurred in provisioning unbundled loop elements. As a result, the price signals generated from such rates would not be consistent with efficient price signals in the manner that those signals affect entry/exit or make/buy decisions, and would not be consistent with forward-looking economic costs.

Q. HAVE YOU ANY RECOMMENDATIONS REGARDING THE COST BASED DE-AVERAGING OF RATES?

A. Yes. One option available to the Commission is to use the Commission approved, properly structured TELRIC to establish such rates. In the absence of cost data provided by GTE, I recommend that the Hatfield data serve as the basis of such geographically rates. Data from the most recent Hatfield Model for Florida, displayed on a geographically de-averaged basis, are included in Exhibit 2.

Exhibit 2 displays the use of the Hatfield results for both six and three geographically de-averaged density zones. These figures are based on the weighted average of the combined zones. For simplicity, to develop a three-zone result, I combined the two most dense, the two middle, and the two least dense zones in the Hatfield Model which adopted six density zones. It may be appropriate in particular circumstances to combine zones differently.

Q. WHAT ARE NON-RECURRING CHARGES?

A. Non-recurring charges (NRCs) are the charges which an ILEC assesses to recover the one-time or non-recurring costs associated with establishing, moving and/or changing the service received by a particular customer. Typically, NRCs consist of multiple elements which include charges for activities such as service orders, central office line connections and premise visits.

Q. HOW SHOULD THE NON-RECURRING COSTS ASSOCIATED WITH ESTABLISHING, MOVING OR CHANGING THE SERVICE RECEIVED BY A CUSTOMER OF ACSI OR ANOTHER COMPETITOR BE RECOVERED BY GTE?

A. The NRCs which GTE is allowed to charge ACSI to establish, move, or change service for a customer of ACSI should not exceed the charges which would apply if GTE was establishing, moving or changing service for a customer which it was serving directly.[25] Moreover, the NRCs

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[25] Non-recurring charges associated with interim telephone number portability are discussed below separately in Section VII.

assessed should be limited to only the charges applicable to those activities specifically required by ACSI or another competitor.

Q. CAN YOU PROVIDE EXAMPLES OF THE TYPES OF NRCS WHICH SHOULD APPLY BASED ON NRCS ASSESSED TODAY?

A. Yes. One example of a situation where GTE would assess NRCs today would involve the situation where ACSI requests that service be established to a new customer which is not currently served by GTE. In that case, ACSI is effectively acting as the customer's agent and the NRCs which apply should be the same as those which apply if the customer was connecting directly to GTE. This might include service order and central office line connection or similar charges. Of course, if ACSI will be responsible for activities at the customer's premises, GTE should not be entitled to assess premise visit charges for that purpose.

A second example of a situation where NRCs could apply would involve an existing customer of GTE changing to a new location. In this case, the only non-recurring costs involved would be those associated with changing the cross-connect from GTE's switch to ACSI's node. In situations such as this, the appropriate NRC would be comparable to the NRC which applies when customers switch from GTE to ACSI. If GTE does not have a specific NRC in place for changing local service providers, an appropriate level for the NRC would be the secondary service charge applicable to a new customer or a customer move to a new location.

Q. YOU INDICATED PREVIOUSLY THAT THE NRCS ASSESSED TO ACSI SHOULD NOT EXCEED THE CHARGES WHICH WOULD APPLY IF THE ILEC WAS PERFORMING THE NON-RECURRING ACTIVITY FOR ITS OWN DIRECT CUSTOMER. WOULD THAT CHARGE NECESSARILY BE THE SAME THAT GTE CHARGES ITS OWN CUSTOMER?

A. No. In developing their NRCs, ILECs often include the costs of sales and marketing activities which are not directly attributable to establishing service to a customer and setting up the necessary customer records. Instead, these costs are associated with marketing additional "value-added" services. ACSI and other competitors will be responsible for and will incur their own costs to market value-added services to their customers. Therefore, to the extent that costs for these types of sales and marketing activities have been included in GTE's NRCs, ACSI and other competitors should receive a discount to exclude these costs.

V. <u>TRANSPORT AND TERMINATION</u>

Q. WHAT PRICING METHODOLOGY OR METHODOLOGIES ARE APPROPRIATE FOR ESTABLISHING TRANSPORT AND TERMINATION CHARGES?

A. Under Section 252(d)(2) of the 1996 Act, the terms and conditions for transport and termination of traffic are just and reasonable if (1) they provide for the mutual and reciprocal recovery of costs, and (2) costs are determined on the basis of a reasonable approximation of the additional costs of terminating calls. The Act does not preclude arrangements that waive mutual recovery, such as bill-and-keep arrangements (Section 252(d)(2)(B)). Indeed, the FCC in its First Report and Order stated that bill-and-keep is an appropriate reciprocal compensation mechanism where traffic exchanged between the two carriers is balanced and the network functions are equivalent. As stated in the testimony of Richard Robertson, ACSI expects traffic to be balanced. Bill Stipe's testimony explains that the network functions of ACSI's and GTE's network in transporting and terminating calls originating on the others' networks will be equivalent.

Where a state commission chooses not to adopt bill-and-keep in an arbitration, TSLRIC would be the appropriate costing methodology under the Act for estimating such charges.

Both approaches -- bill and keep, and TSLRIC-based charges -- promote competition by ensuring that the ILECs, with their greater market power, do not charge excessive rates for termination and transportation. However, where traffic is balanced, bill-and-keep is more efficient because it avoids the administrative costs associated with traffic measurement.

Q. HAVE OTHER STATES ADOPTED BILL-AND-KEEP ARRANGEMENTS?

A. Yes. Washington adopted bill-and-keep for reciprocal compensation as an interim measure. Arizona, Florida, California, Connecticut and Oregon have also adopted bill-and-keep for specified periods of one to two (1-2) years. Other states, such as Delaware, are considering bill-and-keep in the establishment of interim rules on local competition.

Q. IF THE COMMISSION DOES NOT ORDER A BILL-AND-KEEP ARRANGEMENT, HOW SHOULD COMPENSATION BE DETERMINED?

A. If the Commission does not order a bill-and-keep mechanism, it should require charges determined in accordance with TELRIC, as discussed above. Where TELRIC studies are not yet available, rates should be established using the default proxies established in the First Report and Order. Specifically, the FCC set a range of 0.2 to 0.4 cents per minute where traffic is terminated at the end office, and an additional charge not to exceed 0.15 cents per minute where the traffic is terminated at the tandem. Appropriate rates, if the proxies must be used on an interim basis, are attached to ACSI's Petition. These were established using the results for end office and tandem switching from the Hatfield Model.

VI. DEVELOPMENT OF COST-BASED RATES IN THE ABSENCE OF GTE DATA

Q. HAS GTE PROVIDED TELRIC STUDIES TO USE TO DEVELOP COST-BASED PRICES FOR UNBUNDLED NETWORK ELEMENTS?

A. No. GTE has not provided cost-studies which could be used to determine reliable TELRIC estimates. Thus, it was necessary to turn to alternative sources of cost information to develop cost-based rates.

Q. WHAT SOURCE OF DATA DID YOU USE AS AN ALTERNATIVE?

A. I would use TELRIC estimates developed by Hatfield Associates, Inc. (Hatfield Model) to set rates for these elements on an interim basis. The Hatfield Model is a widely known model of network costs. In addition the model is based on publicly available data, which allows it to be subject to detailed review and analysis, and updated when appropriate.

Q. DOES THE HATFIELD MODEL PERMIT THE CALCULATION OF TELRICS THAT ARE CONSISTENT WITH YOUR PROPOSED APPROACH?

A. Yes. The model uses a TELRIC methodology that is forward-looking, and includes the entire demand for each network element. The TELRIC measure used in the model is based on the costs of an efficient, cost-minimizing entrant into the local service market.[26] The model assumes (1) a high quality network that incorporates copper distribution loops with copper and fiber feeder, digital switching, SS7 signaling and all fiber interoffice transport; (2) network capacity sufficient to serve all narrow band switched and dedicated local demand, intraLATA toll and access service demand in the region examined; and (3) the provision of all basic network elements needed for local service. In addition, the model reflects ILEC specific geographic and demographic differences that may affect cost. A summary of TSLRIC pricing rules and standards employed in the model is provided in Exhibit 1 hereto.

We relied upon Hatfield Version 2.2, Release 2. This is the most recent version of the model. The numeric results of the Hatfield Model most recently submitted to the FCC are also presented in Exhibit 1.

Q. GENERALLY, HOW IS THE HATFIELD MODEL CONDUCTED?

A. The Hatfield Model is primarily an engineering model, which is used to design a local network subject to various rules and constraints. The network is designed to meet demands for local and toll services, including both switched and dedicated access. The end product of this

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[26] That is, the costs of assets that are optimally configured, sized and operated.

analysis can be costs for individual services or, as is the case here, cost by network element.

One of the strengths of the Hatfield Model was its reliance on the detailed census block data. This information can be drawn upon to obtain cost estimates not only at the census block group, but can also be aggregated to obtain cost estimates at the wire center level, the LATA, the state, across regions and nationwide. In addition, other aggregations, such as by "density zones" are also possible. Finally, these data are based on census blocks nationwide, which permits direct comparisons of costs across companies within a state, as well as across states.

Q. ARE THERE ANY CHARACTERISTICS SPECIFIC TO THE HATFIELD MODEL THAT DISTINGUISH IT FROM ILEC CONDUCTED TELRIC STUDIES WITH WHICH YOU ARE FAMILIAR?

A. Yes. As indicated, the Hatfield Model represents an attempt to construct the cost of a local network for the provision of local and toll narrowband services. In this manner, the model focuses on the minimum cost, most efficient network for that limited purpose, rather than the cost incurred based upon the infrastructure currently in place by the ILECs for whatever combination of commercial interests may be driving that entity.[27] For instance, while the model assumes fiber facilities are used in both the interoffice and feeder network, it is premised on only copper facilities used in the loop distribution system.[28] In this manner, the costing procedures in the Hatfield Model do not require cost allocations to deal with those network facilities which are not needed to provide local service, but which are necessary to provide various strategic services such as high-speed data or video.

The Hatfield Model is driven by current demand levels for local and toll services. The network is sized to meet both local and toll requirements for business and residential customers (including second line residential demands), plus the growth of these services over time. In this manner, a network is modeled that is efficiently sized to meet the demands of these customers, but not the demands for other strategic services whose evolvement is both risky and possibly distant. Spare capacity is required in this analysis, but not to meet potential strategic service demands.

As noted, the Hatfield Model draws from the census block data base. This sets it apart from the typical ILEC TSLRIC study, which tends to be both state and purpose specific. By that, I mean that the cost studies are developed individually for each state and based upon the

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[27] Hatfield Model, pp. 1-2.

[28] Id., page 16.

specific requirements at hand. Cost studies may be developed at the wire center level, at other times by exchange, or at other times utilizing statewide averages. Therefore, comparisons of costs across these studies, as well as across space and time, are most difficult. With the Hatfield Model, such comparisons are both possible and, in fact, are promoted by the study authors.

Q. THE HATFIELD MODEL HAS BEEN CRITICIZED AS PROVIDING INEFFICIENT OR INACCURATE ESTIMATES OF COSTS FOR LESS DENSELY POPULATED AREAS. HOW HAVE YOU DEALT WITH THIS?

A. For the purposes at hand, that criticism is not limiting.

One of the difficulties in any technique that draws on data that is widely applicable is that the accuracy of the analysis in any individual specific circumstance may be limited. The inaccuracies or inefficiencies of the calculation procedure are typically greatest the further one goes from the median, or average, of the distribution of outcomes. With regard to the data used in the Hatfield Model, the inaccuracies in the calculation procedure have been claimed to exist primarily with regard to cost estimates in census block groups with the lowest population densities. While there may be a large number of such census block groups, they tend to include but a small portion of the total number of subscribers and therefore have a limited impact on the calculated results.

More importantly, for the purposes at hand, our data requirements do not focus on the costs in these tail blocks of the distribution, but rather for those geographic areas that are among the more densely populated. Consequently, to the extent that the criticisms are accurate, they have little impact on the cost information that we are drawing upon.

Q. HAVE YOU ANALYZED THE HATFIELD MODEL AND ITS UNDERLYING ASSUMPTIONS?

A. Yes. At this juncture, I have reviewed the model and its assumptions in order to gain a complete understanding of its construction and its operations. In this manner, I have been able to identify the differences between the Hatfield Model's approach to obtaining cost estimates and those typically used by ILECs in their study procedures. As indicated earlier, GTE has not provided any TSLRIC information to this point. It is my expectation that such information will be forthcoming and a detailed review of that analysis will be conducted.

Q. HOW CAN THE OUTPUTS OF THE HATFIELD MODEL BE USED TO SET RATES FOR UNBUNDLED LOOPS?

A. The outputs of the Hatfield Model are TELRIC estimates. These estimates should be marked up by an appropriate factor for the recovery of efficiently incurred shared and common costs. The appropriate mark-up can be estimated either through a detailed examination of GTE's costs or, alternatively, as I have suggested in Section V by assessing the mark-up which GTE has elected in the context of pricing its most competitive service offerings.

The difficulty faced by the Commission in either of these instances is that the data necessary to construct the mark-up are within GTE's control. Consequently, the ability to calculate this mark-up must await the availability and the examination of those data. It is my understanding that ACSI is seeking those data through discovery.

Q. IN THE EVENT THAT THE NECESSARY DATA TO EFFICIENTLY ESTIMATE AN APPROPRIATE MARK-UP IS NOT AVAILABLE, WHAT ARE YOUR RECOMMENDATIONS?

A. Since the information necessary is within the control of GTE, it is my recommendation that a default mark-up be established that increases the likelihood that the necessary information would become available. Simply stated, I would recommend that no mark-up be established unless or until the information necessary to construct the appropriate mark-up has been made available for review.

Q. YOU NOTED THAT GTE DID NOT PROVIDE ITS TSLRIC/TELRIC FOR YOUR REVIEW. IF THAT WERE TO BE MADE AVAILABLE ON A TIMELY BASIS, WOULD YOU USE THE RESULTS OF THAT ANALYSIS IN PLACE OF THE HATFIELD MODEL?

A. That is not clear. It is my understanding that ACSI is requesting copies of GTE's TSLRIC and TELRIC studies. Upon receipt of that cost study information on a timely basis, it will be reviewed and a decision will be made as to its applicability in terms of establishing rates in this proceeding. At that time, I will comment on whether GTE's study should be adopted, modified and adopted, or simply rejected. At this juncture, I offer no observation.

VII. TELEPHONE NUMBER PORTABILITY

Q. HAS THE FCC PRESCRIBED GUIDELINES THAT INCUMBENT LECS AND STATE COMMISSIONS MUST FOLLOW WHEN ESTABLISHING INTERIM NUMBER PORTABILITY RATES?

A. Yes. The FCC, in its First Report and Order in CC Docket No. 95-116 ("TNP Order"),[29] noted that customers would be reluctant to change service providers in the absence of service provider number portability, resulting in depressed demand for services provided by new entrants.[30] The FCC required incumbent LECs to provide interim number portability pursuant to currently available methods, and established a schedule for the implementation of long-term number portability consistent with FCC-adopted performance criteria. The FCC, however, went beyond merely requiring the implementation of number portability. The FCC adopted pricing requirements designed to ensure that the costs of currently available measures are borne by all telecommunications carriers on a competitively neutral basis.

Q. HOW HAS THE FCC DEFINED "COMPETITIVELY NEUTRAL"?

A. The FCC explained in its TNP Order that it

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[29] In the Matter of Telephone Number Portability, First Report and Order and Further Notice of Proposed Rulemaking, 11 F.C.C. Rcd. 8352 (1996).

[30] Id. ¶ 31.

> interpret[s] "on a competitively neutral basis" to mean that the cost of number portability borne by each carrier does not affect significantly any carrier's ability to compete with other carriers for customers in the marketplace.[31]

Q. WHAT CRITERIA DID THE FCC PROVIDE FOR SETTING RATE LEVELS FOR INTERIM NUMBER PORTABILITY?

A. Congress, the FCC noted, by requiring "competitively neutral" recovery,[32] directed the FCC to make cost recovery secondary to promoting entry. The FCC noted that regulators should depart from cost causation principles if necessary to permit new entrants to compete with incumbent LECs.[33] Accordingly, the FCC articulated two guidelines the State commissions must follow in establishing or approving an interim number portability cost recovery mechanism.

- The mechanism should not give one service provider an appreciable, incremental cost advantage over another service provider when both compete for a specific subscriber. [34]

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[31] TNP Order, ¶ 131.

[32] 47 U.S.C. § 251(e)(2).

[33] TNP Order, ¶ 131.

[34] Id., ¶ 132.

- The mechanism should not have a disparate effect on the ability of competing service providers to earn normal returns on their investment.[35]

The FCC explained further that a cost recovery mechanism based upon the relative market shares of an incumbent LEC and its competitors (e.g., based on revenues or lines) would be consistent with its criteria:

> This approach does not disparately affect the incremental cost of winning a specific customer or group of customers, because a LEC with a small share of the market's revenue would pay a percentage of the incremental cost of number portability that will be small enough to have no appreciable affect on the new entrant's ability to compete for that customer.

Q. DOES ANY ASPECT OF THE GTE PROPOSAL FOR INTERIM NUMBER PORTABILITY CHARGES VIOLATE THE FCC'S "COMPETITIVELY NEUTRAL" REQUIREMENTS?

A. Yes. GTE proposes a non-recurring charge for interim number portability which appears to violate the first guideline. The FCC explained that a cost recovery mechanism that imposes the entire incremental cost of currently available number portability would violate

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[35] Id. ¶ 135.

this criterion.[36] The imposition of a non-recurring charge on a new entrant that is designed to recover all of GTE's non-recurring costs when a customer moves to ACSI and decides to retain its number is inconsistent with the FCC's "competitively neutral" guidelines.

Q. WHAT IS YOUR RECOMMENDATION REGARDING NONRECURRING CHARGES FOR TELEPHONE NUMBER PORTABILITY?

A. The Arbitrator should require GTE to limit the charge to a level that is consistent with the "competitively neutral" mandates of the First Report and Order. In general, this requires that the charge be something less than the full incremental cost (i.e., less than 100 percent of the reasonably determined measure of the cost of provision). The FCC discusses four methods for assessing the "percent" or proportion of the cost borne by the various market participants which it considered consistent with the "competitively neutral" guidelines.[37] The FCC found that any of these methods for assessing the percentage of costs to each market participant satisfied the two criteria for competitive neutrality. These methods are based on different measures of market participation, such as number of lines or met revenues, and should yield a percentage assessment consistent with the competitive neutrality guidelines.

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[36] TNP Order, ¶ 134.

[37] First Report and Order, ¶ 136.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

DOCKET NO. 961169-TP
WITNESS: KAHN
EXHIBIT NO. ______ (MHK-1)
CONSISTS OF 62 PAGES

ITS

AT&T

Suite 1000
1120 20th Street, N.W
Washington, DC 20036
202 457-381C

September 10, 1996

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, DC 20554

RE: Ex Parte Presentation
CC Docket No. 96-45

Dear Mr. Caton:

At the request of the Commission staff, AT&T and MCI are submitting further outputs and documentation of the Hatfield Model, Version 2.2, Release 2 for calculating the economic cost of basic local service and of network elements. Attached to this filing are the following items.

1. *Written documentation of the Hatfield Model, Version 2.2, Release 2.* This documentation both updates the documentation of Release 1 of the Model that was filed with AT&T's Comments and Reply Comments in CC Docket No. 96-98 on May 16 and 30, 1996, respectively. Included as an appendix to this documentation is a user's manual for operation of the model via its automated interface.
2. *Paper copies of the Unit Cost and Universal Service sheets* from the Expense Module of the Hatfield Model, Version 2.2, Release 2 for all 49 BOC plus SNET study areas.
3. *A CD-ROM* that expands upon the CD-ROM that AT&T and MCI filed with the Commission in this Docket on August 27 by containing not only electronic copies of the Hatfield and BCM-PLUS modules and state/BOC templates, but also electronic copies of the model's documentation and expense modules that have already been run for each of the 49 BOC plus SNET study areas. As indicated in the model's documentation, operation of the Hatfield Model requires an IBM-compatible PC operating under Microsoft Windows 95 or Windows NT. To facilitate analysis of much of the model, the pre-run expense modules may be examined, and what-ifs run, with as little as 8 Meg. of RAM.

Two copies of this Notice and its attachments are being submitted to the Secretary of the FCC in accordance with Section 1.1206(a)(1) of the Commission's rules. Copies of the CD-ROM will be available through the ITS, the Commission's copy contractor.

Sincerely,

R. N. Clarke/HH

Richard N. Clarke

Attachments

cc: Federal-State Joint Board and Staff w/ CD-ROM
John Morabito
Kathleen Levitz
James Schlichting
Gregory Rosston
Anthony Bush
Robert Loube w/ CD-ROM
Bill Sharkey w/ CD-ROM
Doron Fertig w/ CD-ROM

I. INTRODUCTION

A. OVERVIEW

The Hatfield Model has been developed by Hatfield Associates, Inc. (HAI), of Boulder, Colorado, at the request of AT&T and MCI. Its purposes are: 1) to estimate the forward-looking economic cost of unbundled network elements referenced in § 252(d)(1)(A) and (B) of the Telecommunications Act of 1996 based on Total Element Long Run Incremental Cost (TELRIC) principles;[1] and 2) in a separate calculation using consistent procedures and input data, to estimate the forward-looking economic cost of the basic local telephone service that is the target of universal service funding mechanisms.[2]

B. EVOLUTION OF THE HATFIELD MODEL

The original version of the Hatfield Model was developed to produce estimates of the TSLRIC of basic local telephone service as part of an examination of the cost of universal service. This original model was a "greenfield" model in that it assumed all network facilities would be built without consideration given to the location of existing wire centers or transmission routes. When the original Benchmark Cost Model (BCM1)[3] became available, HAI revised the original Hatfield Model to incorporate certain loop investment data produced by BCM1. As a result, the Hatfield Model became a "scorched node"

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1 TELRIC is the term used by the Federal Communications Commission to refer to the total service long run incremental cost (TSLRIC) of unbundled network elements.

2 The definition of basic universal service used in the model includes the following functional components:

- single-line, single-party access to the first point of switching in a local exchange network;
- usage within a local exchange area;
- touch tone capability;
- a white pages directory listing; and
- access to 911 services, operator services, directory assistance, and telecommunications relay service for the hearing-impaired.

Excluded from this definition are many other local telephone company services, such as toll calling, interexchange carrier access, custom calling and CLASS[SM] features, and private line services, although the existence of such services is taken into account in developing the cost estimates for unbundled elements.

3 The Benchmark Cost Model is a model of basic local telephone service developed by MCI, NYNEX, Sprint, and U S WEST.

model that developed efficient, forward-looking network investments and costs for basic universal service based on existing wire center locations. Thus, this new version of the Hatfield Model combined results from BCM1's loop modeling (based on actual population distributions) with the extensive wire center and interoffice calculations from the earlier Hatfield Model.

Early in 1996, an expanded version of earlier Hatfield Models, referred to as the Hatfield Model, Version 2.2, Release 1, was developed to estimate the costs for unbundled network elements. It was submitted to the Federal Communications Commission (FCC) in CC Docket No. 96-98 on May 16 and 30, 1996, accompanied by descriptive documentation.[4] On July 3, 1996, this model was placed into the record of CC Docket No. 96-45 to assist the Commission in determining the economic costs of universal service.[5]

The Hatfield Model, Version 2.2, Release 2 (hereafter HM2.2.2), described in this document, estimates the efficient, forward-looking economic cost of both unbundled network elements and basic local telephone service. This release incorporates a number of enhancements over earlier versions.[6] HM2.2.2 derives certain of its inputs and methods from the BCM-PLUS model. The BCM-PLUS model is a derivative of BCM1 that has been developed for and is copyrighted by MCI Telecommunications Corporation.[7] Furthermore, because populated data workfiles now accompany HM2.2.2, Release 2 executes more quickly than Release 1, and without required user intervention.

The Hatfield Model comprises several workbook files in Microsoft Excel 7.0 for Windows 95 or Windows NT. An automated front end interface permits the user to select the study area to be modeled and to enter any desired user-adjustable input assumptions. The entire model will then execute without any required user intervention.[8] Although AT&T and MCI typically have run

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4 See, Appendix E of the *Comments* of AT&T in CC Docket No. 96-98, In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, and Appendix D of AT&T's *Reply Comments*. In the same proceeding, MCI submitted results based on an earlier "greenfield" version of the Model as Attachment 1 to its *Comments*.

5 Ex parte submission of L. Sawicki, MCI.

6 Appendix A to this documentation contains a summary of the differences between Release 1 and Release 2 of Version 2.2 of the Hatfield Model.

7 On July 3, 1996, Sprint Corporation and U S WEST presented version 2 of the BCM (BCM2) to the FCC. NYNEX and MCI are not sponsors of BCM2. A careful review by HAI indicates that all of BCM2's relevant enhancements over BCM1 are already present in the Hatfield Model. Furthermore, the Hatfield Model has important attributes and capabilities that are not available in the BCM2.

8 Documentation of this automated user interface is provided in Appendix B.

HM2.2.2 for 49 continental U.S. study areas (Bell Operating Companies "BOCs" plus Southern New England Telephone Company), it may be run for any Tier 1 study area.[9]

C. PURPOSE OF THIS DOCUMENT

This document describes: 1) the structure and operation of HM2.2.2. and 2) inputs to the model, emphasizing those that can be changed by the user and their default values. It should be emphasized that the model provides a large number of inputs that can be altered by the user. However, the default values for these inputs are believed to be appropriate based on the experience and engineering judgment of HAI personnel and other subject matter experts.

II. STRUCTURE OF THE MODEL

A. GENERAL NETWORK COMPONENTS DESCRIPTION

This section describes generally the network components modeled in HM2.2.2. Figures 1, 2 and 3 depict the relationships among the network components discussed in the following sections.

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[9] AT&T has retained telecommunications consultants from the Deloitte & Touche Consulting Group (and not Deloitte & Touche, LLP as might have been inferred from the prior reference to "Deloitte & Touche" in footnote 7 of AT&T's August 9, 1996 *Further Comments* in CC Docket No. 96-45), to provide additional Hatfield support. Deloitte & Touche Consulting Group personnel have: (1) provided analytical support to Hatfield and AT&T personnel; (2) assisted with data entry, results interpretation, and version and release testing; and (3) worked to improve the Hatfield Model's user interfaces, as well as to identify other areas for improvement with regard to the operation of the model.

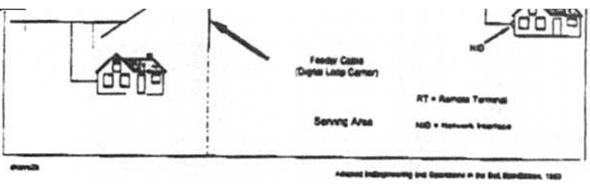

Figure 1 Loop components

a) General loop description

The local loop begins at a physical demarcation frame within the central office building (wire center). Copper cable feeder facilities terminate on the vertical side of the main distributing frame (MDF) in the wire center. Fiber optic feeder cable serving integrated digital loop carrier terminates on a fiber distribution frame in the wire center. At its distant end, the local loop terminates at the Network Interface Device (NID) at the customer's premises.

Loop cables are supported by "structures." These "structures" may be underground conduit, poles, or trenches for buried cable. Underground cable is distinguished from buried cable in that underground cable is placed in conduit, while buried cable comes into direct contact with soil.[10]

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10 While the conduit supporting underground cable is placed in a trench, buried cable may either be placed in a trench or be directly plowed into the earth.

6

b) Local Loop Components

(1) NID

The demarcation point between the local carrier's network and the customer's inside wiring is known as the Network Interface Device (NID). This device terminates the drop wire and is an access point that may be used to isolate trouble between the carrier's network and the customer's premises wiring.

(2) Drop

A drop wire extends from the NID at the customer's premises to the block terminal at the distribution cable that runs along the street or the lot line.

(3) Block Terminal

The block terminal is the interface between the drop and the distribution cable. With aerial distribution cable, the block terminal is attached to a pole in the subscriber's backyard or at the edge of a road. If the distribution cable is buried, then the block terminal is contained within a pedestal.

(4) Distribution Cable

Distribution cable runs from each of the block terminals to the Serving Area Interface (SAI), also called a "cross box" or Serving Area Concept (SAC) box or connection. Distribution cable connects the feeder cable with all customer premises within a Census Block Group (CBG). The model assumes that each CBG contains one SAI, and that the SAI is placed one quarter of the way into the CBG. Distribution structure components may consist of poles, trenches and conduit. Manholes normally are not used in distribution facilities.

(5) Feeder facilities

Feeder cable may be copper wires or optical fibers. Feeder cables extend from the wire center to the SAIs. The Hatfield Model assumes that there is a standard feeder distance beyond which optical feeder cable will be installed and Digital Loop Carrier (DLC) equipment will be used to serve subscribers.

Feeder structure components also include poles, trenches and conduit. Manholes are also normally installed in conjunction with underground feeder cable. Manhole spacing is a function of population density and the type of feeder cable used. Manholes installed for underground fiber cable are normally farther apart than are manholes used with copper cables because the lightness and flexibility of fiber cable permits it to be pulled over longer lengths than copper cable. The costs of structure components are normally shared among at least three utilities, e.g., electric utilities, local exchange companies (LECs) and cable television (CATV) operators.

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2. Interoffice network description

This section describes generally network components at the wire center and interoffice level. Figures 2 and 3 illustrate the relationships among the components described below.

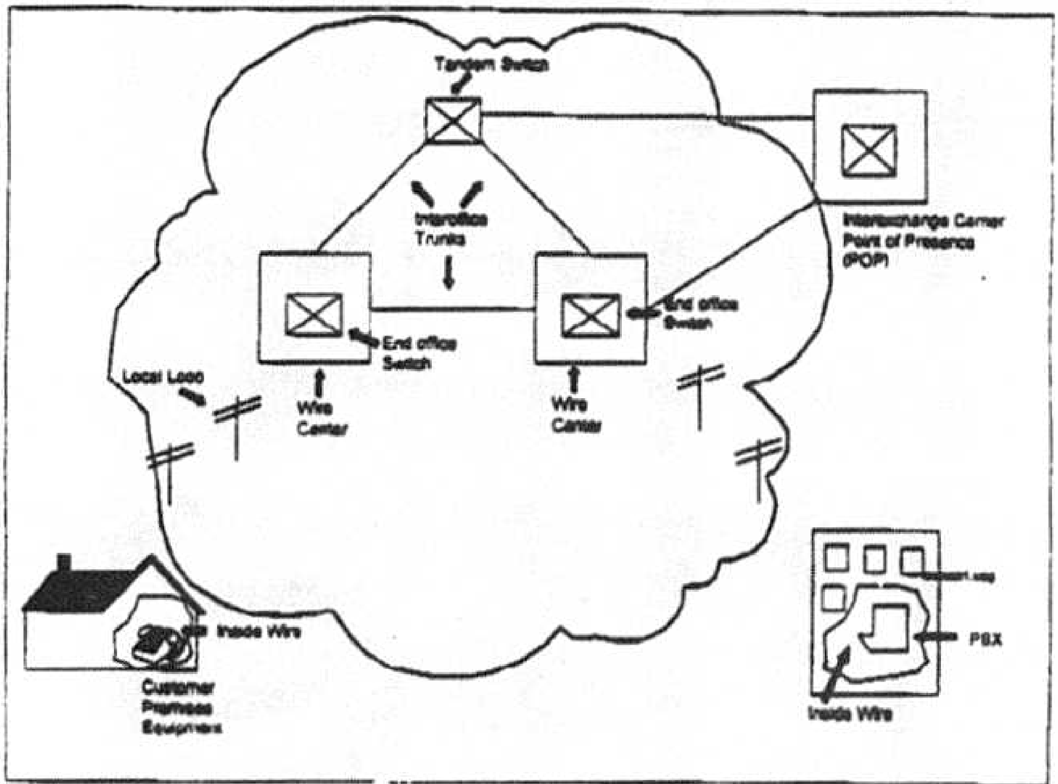

Figure 2 Interoffice network

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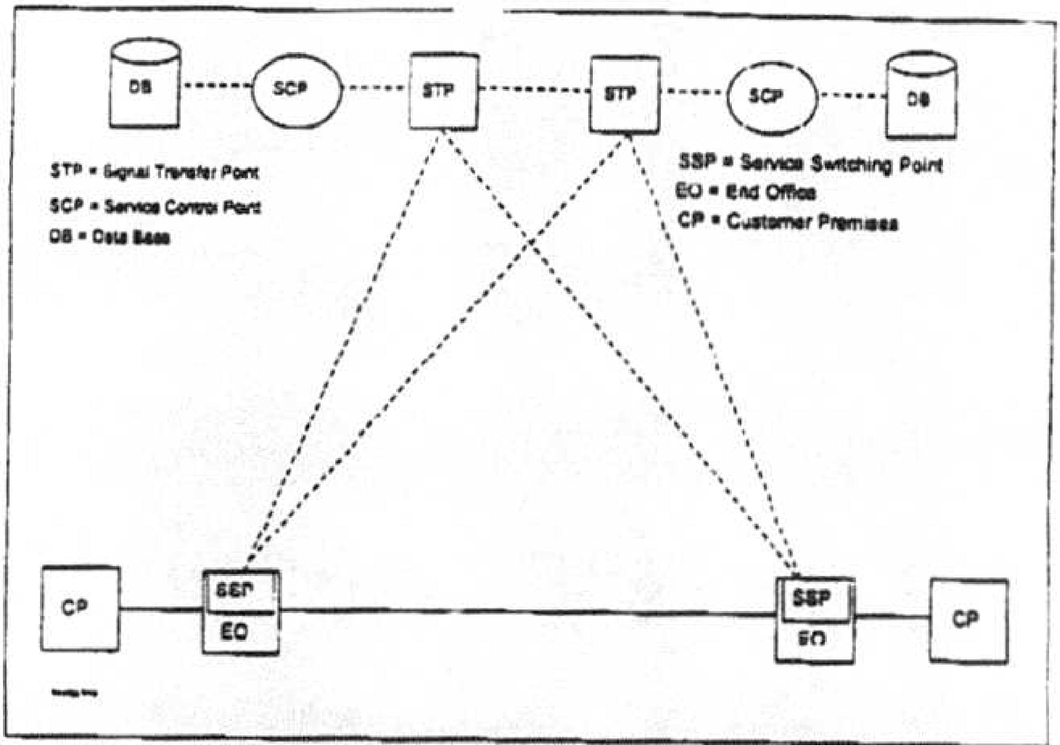

Figure 3 Signaling network components

a) Wire center

The wire center is a location from which local feeder routes emanate. A wire center normally contains at least one End Office (EO) switch and also may contain a tandem office, a Signal Transfer Point (STP), an operator tandem, or any combination of these facilities. Wire center physical facilities include a building, power and air conditioning systems, separate rooms housing switches, transmission equipment, distributing frames and entrance facilities for interoffice and loop cables.

b) End office switch

The end office switch provides dial tone to the switched access lines it serves. It also provides connections to other end offices via direct trunks, to tandem switches via tandem trunks, and to operator tandems via operator trunks. The model computes the numbers of trunks for each route according to input traffic assumptions and the breakdown of business, residential, and public access lines served by each end office switch.

c) Tandem switch

Tandem switches interconnect end office switches via tandem trunks. These trunks provide an alternate route for traffic between end offices when direct routes are unavailable. The tandem also may route access traffic between end offices and interexchange carriers' (IXC's) points of presence (POPs). Tandem switching functions often are performed by switches that also perform end office functions.

d) Signal transfer point

STPs route signaling messages between switching and control entities in a Signaling System 7 (SS7) network via signaling links between STPs and SS7-compatible end offices and tandems (called Service Switching Points "SSPs") as well as Service Control Points (SCPs). STPs are equipped in mated pairs, with at least one pair in each LATA.

e) Service switching points

SSPs are SS7-compatible end office or tandem switches. They communicate with each other and with SCPs through signaling links, which are 56 kbps dedicated circuits connecting SSPs with the mated STP pair serving the LATA.

f) Service control points

SCPs are databases residing in an SS7 network that contain various types of information such as IXC identification or routing instructions for 800 numbers in regional 800 databases and customer line information in Line Information Databases (LIDB).

B. OVERVIEW OF MODEL ORGANIZATION

Figure 4 shows the relationships among the various modules contained within HM2.2.2. An overview of each component module follows.

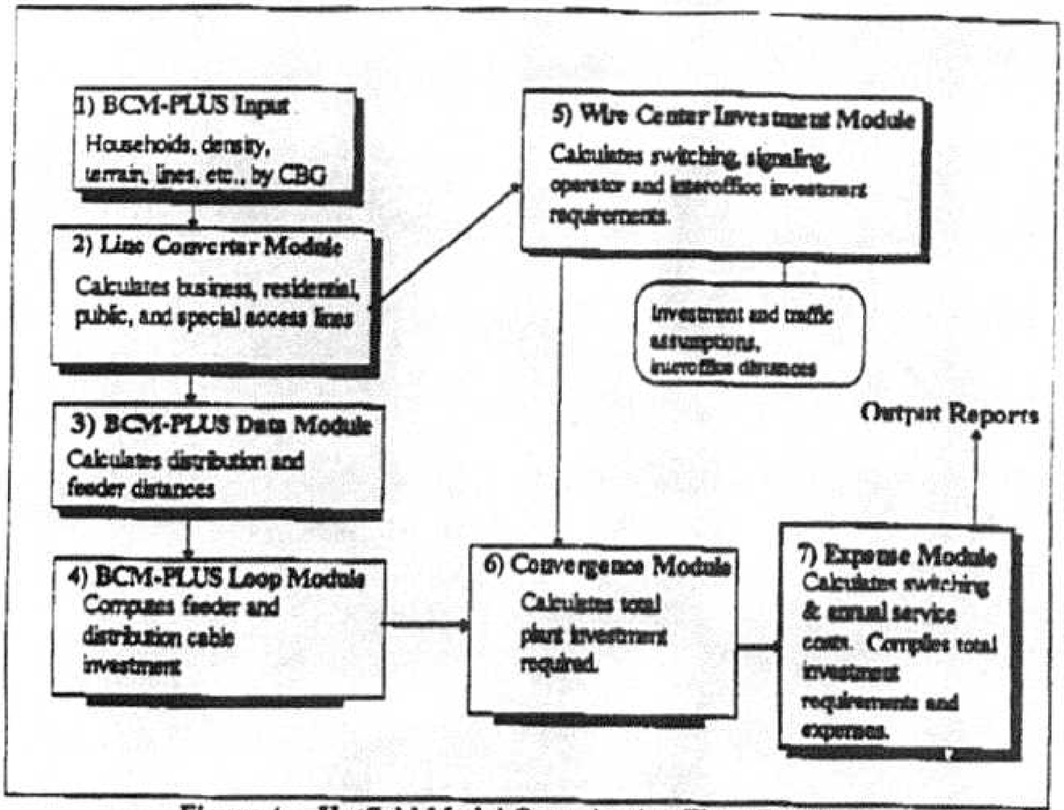

Figure 4 Hatfield Model Organization Flow Chart

1. BCM-PLUS loop input data file

The BCM-PLUS input data for the model generally consist of the original BCM state-by-state worksheets filed with the FCC.[11] The input household counts in each CBG (which in BCM1 were derived from 1990 Census Bureau data) have been replaced with 1995 household counts estimated from more recent Census Bureau data. As the following section discusses, HM2.2.2 modifies these BCM-PLUS data in several significant ways.

2. Line Converter Module

The model calculates all network costs on a per line basis, thus it must first determine the total access lines of all types within each CBG. The Line Converter Module transforms the Census data included in the BCM-PLUS input data files (which contain only household counts for each CBG) into total line counts by

[11] These data are for all states except Alaska. While the pertinent data for Alaska are included with BCM2, the BCM2 sponsors have placed more restrictive terms in the BCM2 license agreement that prohibit the use of these data for modeling use here.

customer type. The Line Converter Module performs this function while recognizing that residential subscriber penetration is less than 100%, that some residences contain second lines, and that business, public, and special access lines need also to be added. The module adds these latter line types based on other of its input data that indicate the number of business employees in each CBG. These line number calculations, which are performed on a CBG by CBG basis, are also required to accord with the number of lines that the incumbent LEC (ILEC) reports for the study area in ARMIS.

3. BCM-PLUS Data Module

The Data Module computes the distribution and feeder cable lengths necessary to serve each CBG and determines facilities placement difficulty according to geological parameters included in the BCM-PLUS input data.

4. BCM-PLUS Loop Module

The Loop Module estimates cable investments in each CBG according to the distribution and feeder lengths calculated in the Data Module. The module selects either fiber or copper feeder cable according to a user-adjustable parameter that specifies the feeder distance beyond which fiber is to be installed. The module then determines the size of copper or fiber cable required to serve each CBG according to user-adjustable maximum engineered fill levels for each population density range. Once the module has determined the required types and sizes of cable, it computes the total investment in feeder and distribution cables.[12]

5. Wire Center Module

The Wire Center Module computes investment in wire centers, switching (including end offices, tandems, and operator tandems), signaling, and interoffice transmission facilities. It uses line totals by type across all CBGs served by the wire center, along with user-adjustable traffic inputs, to estimate required switching capacities.

The model determines switching and interoffice capacity sufficient to serve all demand in the service area studied. HM2.2.2 derives its switch investment estimates by using data on typical per-line prices paid by BOCs, GTE and other independents,[13] and data from Table 2.10 of the FCC's *Statistics of Communications Common Carriers*, which provides the average number of access lines served by existing LEC switches.

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12 A later module, the Convergence Module, adds investment for placement and "structure" (conduit, poles, trenching, and manholes), as well as other components, including SAIs, terminals, splices, subscriber drops and NIDs.

13 See *U.S. Central Office Equipment Market – 1994*, McGraw-Hill.

6. Convergence Module

The Convergence Module combines output of the Loop Module (loop cable investments) with that of the Wire Center Module (per-line wire center and interoffice investments). The Convergence Module also adds investment in SAIs, buried, underground and aerial cable placement, terminals and splices, drop wires, NIDs, and structure components including poles, conduit, and manholes. Output from this module contains total investment for all plant categories by density range.

7. Expense Module

The Expense Module uses output from the Convergence Module to produce monthly costs of Unbundled Network Elements (UNEs) and basic local service. These costs include the annual user cost of capital for network investment (e.g., depreciation, return, and tax on return), network operating and maintenance expenses, and other per-line expenses incurred by ILECs in the provision of local service and UNEs. This module uses investment, revenue and expense data relationships that are available from ILEC ARMIS reports and allows the user to set different economic lives for various plant categories as well as adjust capital structure parameters.

C. MODULE DESCRIPTIONS

1. BCM-PLUS Input Data File

BCM-PLUS includes input data files organized by state. Each state file contains a list of that state's CBGs. CBGs are assumed to be served from the nearest existing wire center.[14] Each CBG appears as a separate record in a Microsoft Excel 7.0 spreadsheet, and each record includes a set of geometric parameters describing the physical relationship (distance and direction) between the center of the CBG and the wire center serving it. The data also contain certain geological parameters associated with the CBG that indicate bedrock depth, bedrock hardness, and soil type.[15] The input data file also contains the estimated number of households in each CBG as of 1995.

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14 Because wire centers are associated with specific telephone companies, the model may be run on a company-specific basis.

15 Studies of the effects of these parameters on the estimate of placement difficulty show that the parameters affect overall results only slightly. The HM2.2.2 Convergence Module produces much more accurate estimates of placement investment with user-adjustable inputs than did the original BCM with its undocumented input assumptions. As noted in the text, however, HM2.2.2 increases (continued)

2. Line converter module

a) Overview

HM2.2.2 engineers loop facilities for residence, business, public and special access lines. As shown in Figure 5, the Line Converter Module calculates total access line counts for each CBG, as well as overall line totals for use in the BCM-PLUS Data Module and the Wire Center Investment Module. The Line Converter Module replaces the household count in each CBG with estimated total access lines, including business, public, special access, and first and second residential lines. This allows the BCM-PLUS Loop Module to calculate the sizes of feeder and distribution cables required to serve the existing demand.

b) Description of inputs and assumptions

The Line Converter module uses access line demand data from the Operating Data Reports, ARMIS 43-08, submitted to the FCC annually by all Tier 1 LECs.[16] HM2.2.2 thus incorporates the following data.

- Residential access lines, both analog and digital. These totals measure all residential switched access lines, including flat rate (1FR) and measured rate (1MR) service.[17]
- Business access lines, including analog single line, analog multiline and digital. These totals include flat rate business (1FB) and measured rate business (1MB) single lines, PBX trunks, Centrex lines, hotel/motel long distance trunks and multi-line semi-public lines.[18]
- Special access lines, including analog and digital. These totals include dedicated lines connecting end users' premises to an IXC POP, but do not include intraLATA private lines.[19]

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feeder and distribution cable lengths in the presence of shallow bedrock or rocky soil types for routing of facilities around areas with difficult placement conditions.

16 See, Reporting Requirements for Certain Class A and Tier 1 Telephone Companies (Parts 31, 43, 67 and 69 of the FCC's Rules), CC Docket No. 86-182, 2 FCC Rcd 5770 (1987) (ARMIS Order), modified on recon., 3 FCC Rcd. 6375 (1988). Tier 1 LECs are those with more than $100 million in annual revenues from regulated services. This includes over 50 carriers.

17 Revision of ARMIS USOA Report (FCC Report 43-02) for Tier 1 Telephone Companies and Annual Report Form M, AAD 92-46, DA 92-1405, released October 16, 1992, Appendix C, at FCC Report 43-08 - Report Definition for Table S-3, page 2.

18 *Id.* at 1-2.

19 *Id.* at 2-3.

- Public access lines, which include lines associated with coin (public and semi-public) phones, but exclude customer owned pay telephone lines.[20]

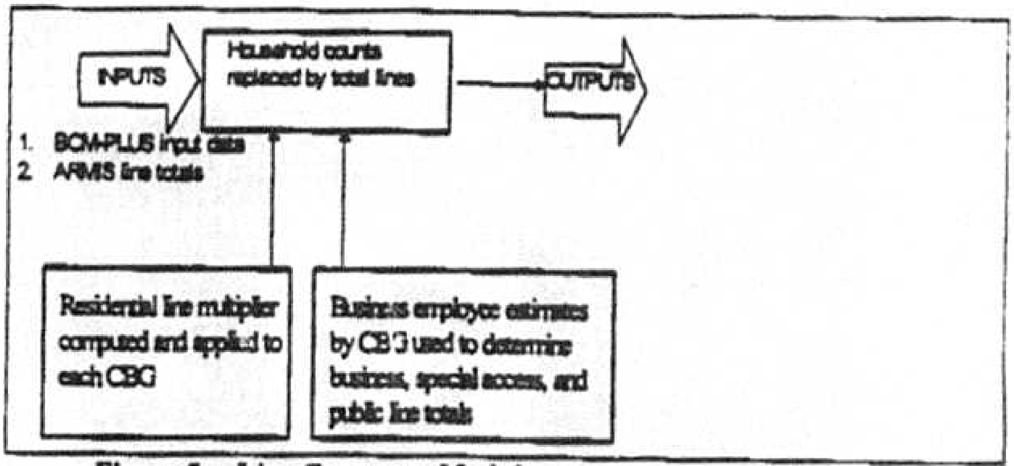

Figure 5 Line Converter Module

c) Explanation of calculations

In order to estimate loop plant investment properly, the model must consider the demand for all services, *e.g.*, business, first and second residential, special access and public access lines, within each CBG. Presumably, these service-specific demand data are known to the ILECs at a wire center or finer level. But because the ILECs have declared these data to be proprietary, absent Commission directive they are not available for incorporation into HM2.2.2.[21]

The Line Converter Module uses ARMIS access line data to assist in estimating total line counts per CBG. To compute residential lines in each CBG, the module multiplies the household count by the ratio of total reported residential access lines to total households. This accounts for total household penetration and multiple residential lines via a single average factor. The module similarly computes business lines in each CBG by multiplying the number of business employees in each CBG by the ratio of total reported business lines to total employees in the study area. Special access and public line calculations also are

20 *Id.* at 2.

21 Some BOCs, notably the Southwestern Bell companies, formerly published this information for use by their interexchange carrier customers, but the practice apparently has been discontinued. See, Southwestern Bell, *Interexchange Customer Information Handbook*, Volume IV (End Office Profile), 1987.

based on business employee counts because both services are closely associated with businesses.

d) Description of module outputs and connection to next module

The primary output from the Line Converter Module is the Input Data File -- with household counts in each CBG replaced by total residential, business, special access and public lines. The other data in the Input Data File pass through the module unchanged for eventual use by both the BCM-PLUS Data Module and the Wire Center Module.

3. BCM-PLUS Data module

a) Overview

The BCM-PLUS Data Module uses Line Converter Module output to calculate feeder, subfeeder, and distribution cable lengths. The BCM-PLUS Data Module uses the distance between each CBG and its serving wire center, and the area of each CBG, to estimate feeder and distribution cable lengths. In areas of increased placement difficulty, generally those CBGs with shallow bedrock (within one foot of the surface) or having rocky (*e.g.*, "bouldery") soil types, the Data Module increases the calculated feeder and distribution distances to allow for routing of facilities around these rocky conditions.

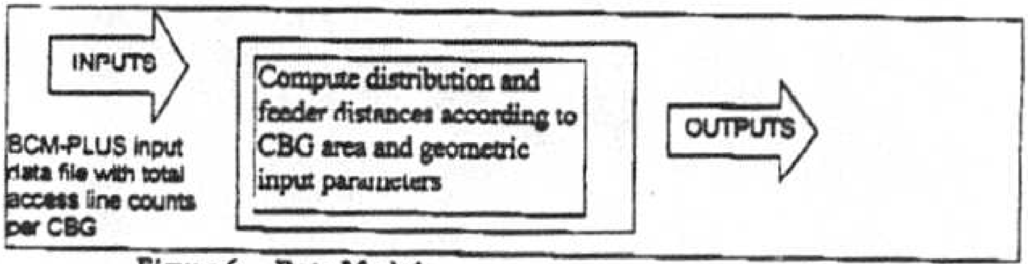

Figure 6 Data Module

b) Description of inputs and assumptions

The Data Module bases its loop length calculations on the following assumptions.

- Feeder cable extends from the wire center to an SAI located midway between the edge and the center of the CBG.
- There are four main feeder routes that leave each wire center, with sub-feeder routes placed at 90 degree angles from the main feeder routes.
- Customer premises are spaced uniformly across a CBG.

- Distribution cables extend from the SAI within the CBG to terminals serving several customers' premises.
- A variable number of equal-length distribution cables serve each CBG. The area of the CBG determines the length of each cable, and the CBG line density determines the number of cables.

A more detailed description of the model's feeder route design is contained in the documentation to Release 1.[22]

c) Explanation of calculations

Distribution Distance – BCM-PLUS uses geometric relationships to calculate distribution distances. The distribution distance is the average distance between a customer premises and the SAI. The module calculates the average distribution distance within a CBG to equal 0.625 times the length of one side of the CBG.

SAI placement – The Data Module adds sufficient feeder cable to place the SAI at a point midway between the CBG boundary and its center. This approach comports with telephone company outside plant engineering practices.

d) Outputs

The output of the BCM-PLUS Data Module includes total line counts per CBG, along with feeder and distribution cable lengths. Other parameters include "cable multipliers" used in a previous version to estimate combined placement investment. Because HM2.2.2 calculates separately cable placement and structure investments, these values are not used by BCM-PLUS.

4. BCM-PLUS Loop Module

This section discusses inputs and calculations in the BCM-PLUS Loop Module.

a) Module overview

The BCM-PLUS Loop Module estimates loop cable facilities investment for HM2.2.2. The Loop Module employs a "bottoms-up" network design process that uses forward-looking loop plant engineering and planning practices, publicly-available information on component prices, and least-cost cable sizing algorithms to estimate the outside plant investment appropriate to a TELRIC-based analysis.

22 See, note 4, *infra*

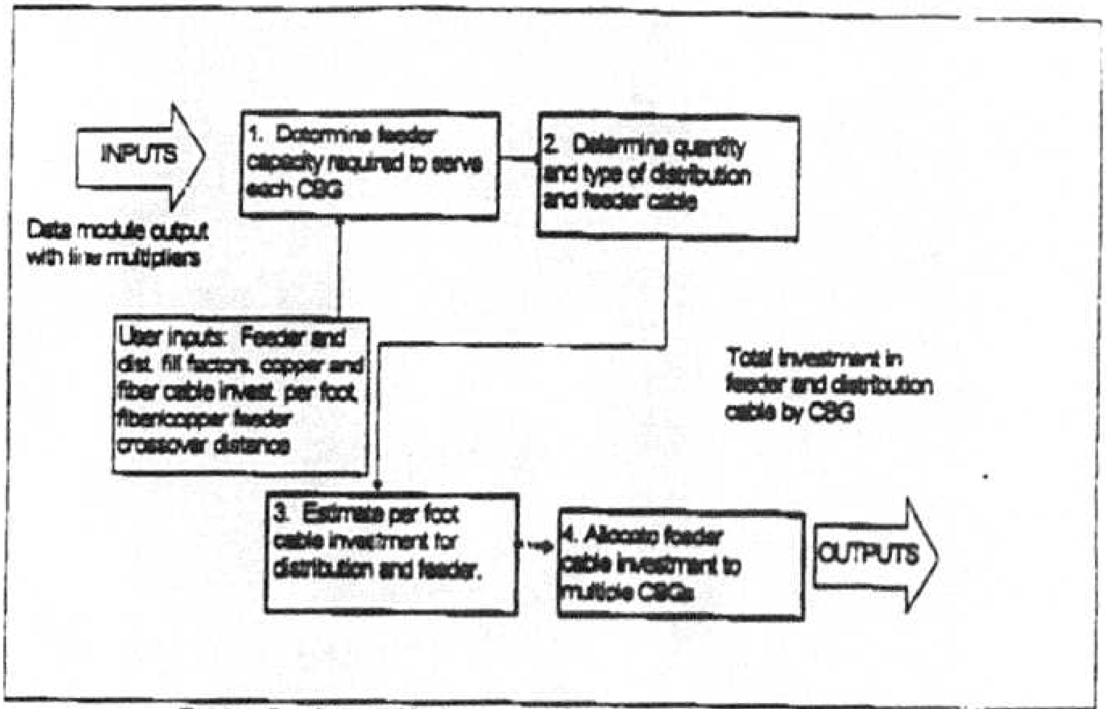

Figure 7 BCM-PLUS Loop Module

b) Description of inputs and assumptions

Inputs to the Loop Module include the per-foot investment cost for copper and fiber cable, the distance at which fiber feeder cable is installed, the number of DS-0s that can be carried on a single fiber, and the number of fibers required to feed a DLC remote terminal. There are separate per-unit investment tables for distribution, copper feeder, and fiber feeder cables. These tables show the assumed per-foot investment for cables having different cross sections. The default numbers in these tables assume discounted cable materials prices, along with per-unit costs for installation, engineering, and delivery.

c) Inputs derived from the Data Module

The following outputs from the Data Module are used as inputs by the Loop Module.

Feeder and Distribution Distances – These are the feeder, sub-feeder and distribution lengths calculated for each CBG. The main feeder distance (called the "B" distance in the model) for each CBG is expressed as the incremental distance from the CBG to the CBG served by that feeder that is the next closest to the wire center (the "B segment" length). The formula used to develop B segment length is to first match the CBG with all others served by the same wire center and within the same quadrant (*i.e.*, on the same main feeder route). The module then calculates the B segment length for each CBG by subtracting from its total B length the total B length associated with the next CBG closer to the wire center. Segmentation of the main feeder in this way allows the Loop Module to simulate the tapering of cable facilities along the feeder route.

The model also computes a "subfeeder" distance (called the "A" distance within the model) which is the distance from the main feeder route to the SAI in CBGs that are not astride the main feeder route.

d) User Specified Inputs

Because the Loop Module simulates the "bottoms up" development of a network, it requires several inputs specifying the type and purchase price for copper distribution cable and copper and fiber feeder cable, as well as maximum engineered cable fill factors that vary by density range. Because the actual prices paid for these components may vary from carrier to carrier, these values may be adjusted, if appropriate, by the user. The model, however, contains HAI's best estimates as default values for cable investment per foot and cable fill factors. These default values for fill factors and cable investment per foot are as follows:

Density (lines/sq. mi.)	Feeder fill	Distribution fill
0 - 5	0.65	0.50
25 - 200	0.75	0.55
200 - 650	0.80	0.60
650 - 850	0.80	0.65
850 - 2550	0.80	0.70
> 2550	0.80	0.75

Fiber feeder cable investment per foot (including engineering, delivery and installation)	
Fiber cable size(strands)	Investment per foot
12	$2.90
18	$3.20
24	$3.50
36	$4.10
48	$4.70
60	$5.30
72	$5.90
96	$7.10
144	$9.50
216	$13.10

Copper feeder cable investment per foot (including engineering, delivery and installation)	
Pairs in sheath	Investment per foot
100	$2.50
200	$4.25
400	$7.75
600	$11.25
900	$16.50
1200	$21.75
1800	$32.25
2400	$42.75
3000	$53.25
3600	$63.75
4200	$74.25

Distribution cable investment per foot (including engineering, delivery and installation)	
Copper cable sizes	Investment per foot
25	$1.19
50	$1.63
100	$2.50
200	$4.25
400	$7.75
600	$11.25
900	$16.50
1200	$21.75
1800	$32.25
2400	$42.75
3600	$63.75

Other user inputs are discussed in the feeder plant section below.

e) Distribution plant

This section examines components of the distribution facilities. The model assumes that all distribution cables serving a CBG are of equal length. The number of distribution cables per CBG varies by density range as shown below.

Density (lines/sq. mi.)	Number of cables
0 - 5	2
5 - 200	4
200 - 650	4
650 - 850	4
850 - 2,550	6
> 2550	8

The larger number of cables serving higher density CBGs reflects the fact that households will tend to be distributed more uniformly across densely populated CBGs than across less dense CBGs. In addition, customer premises plot sizes will be smaller. Lower numbers of cables serving lower density CBGs reflect the fact that customer premises will either be concentrated along a few roads, or clustered in towns rather than being distributed uniformly.

Mix of aerial and underground plant for distribution – Distribution cables typically connect with the feeder network at one or more SAIs and run along streets within a defined area. Distribution plant may be aerial (carried on poles), underground (placed in conduit), or buried (plowed directly in the ground or placed in a trench without conduit). The proportions of aerial, underground and buried cable are user-adjustable variables set in the Convergence Module.

Unit Costs for Distribution Cable – The default cable investment figures shown in the preceding table include discounted materials prices, engineering, delivery to the site, and placement or installation.[23] These costs are added to other loop investments in the Convergence Module, described later.)

Fill Factors for Distribution Cable – The Loop Module permits users to input values specifying the maximum engineered level of plant utilization or "fill" for distribution and feeder cable.[24] Engineered cable fills are always less than 100% in practice, with some spare pairs necessary to accommodate unforeseen growth, breakage and line administration.

The effective fill factors achieved by the Hatfield Model are even lower than the engineered fill factors because the model requires that the next larger available cable size be installed to accommodate the engineered fill.

f) Feeder plant

Feeder cables extend along any of four routes from the wire center to one or more points where they are cross-connected to the distribution network. Depending on required feeder capacity, distance or economics may dictate that feeder be provisioned using various sizes of copper cabling, or fiber cables in conjunction with DLC systems. The Loop Module assumes that a CBG will be served with fiber-fed DLC equipment whenever the feeder length exceeds a user-adjustable threshold value (the default is 9,000 feet); otherwise it assumes copper feeder cable.

The user may specify the number of fibers assigned per DLC remote terminal. The default value is four. Similarly, the number of equivalent voice circuits (DS-0s) that may be carried on this fiber may be set by the user. The default value is 2016, or 3 DS-3s.

23 Placement investment consists of pulling underground cable through conduit and mounting aerial cable on poles. It should not be confused with the actual "structure" investment in poles, conduit and manholes, or in the installation of structure components.

24 A cable fill factor represents the ratio of working lines (measured in terms of voice grade equivalent channels or copper wire pairs) to minimum installed line capacity.

Mix of aerial and underground plant for feeder -- These values are set in the Convergence Module, as they are for distribution cable.

g) Explanation of calculations

The Loop Module's calculations include the following:

- Selection of copper or fiber feeder cable to serve each CBG according to the user-adjustable threshold feeder distance (default is 9,000 ft).
- Sizing of main feeder segments to accommodate the cumulative capacity requirements along the route.
- Determination of the type and quantity of feeder facilities and distribution cables to meet each CBG's capacity requirements.

Applying unit investment costs to estimate total investment in loop cables -- The fundamental feeder length calculations, including the sharing of feeder sheath by multiple CBGs lying on a common route, are essentially unchanged from those described in the Release 1 documentation. The BCM-PLUS Data Module does, however, extend the SAI location into each CBG halfway to its center.

The BCM-PLUS Loop Module computes distribution cable lengths as 0.625 times the length of a side of the CBG. The number of cables serving a CBG varies according to the CBG's density range, as described in the Data Module discussion above. The Loop Module sizes the distribution cables according to the specified fill factor and number of cables in each CBG.

h) Description of model outputs

The Loop Module produces total investment by CBG for distribution and feeder cable. The Loop Module's "costing" worksheet contains these investments and is sent to the Convergence Module to determine overall network investment.

5. Wire Center Investment Module

a) Overview

This Module produces network investment estimates in the following categories:

Switching and wire center investment -- This category includes investment in local and tandem switches, along with associated investments in wire center facilities, including buildings, land, power systems and distributing frames.

Signaling network investment – This includes investment in STPs, SCPs and signaling links.

Transport investment – This category consists of investment in transmission systems supporting local interoffice (tandem and direct) trunks, intraLATA toll trunks (tandem and direct) and access trunks (tandem and direct). The model also separately calculates investment in operator trunks.

Operator Systems investment – This includes investments in operator systems positions and operator tandems. The module allows the operator positions to be located at a distance from the operator tandem.

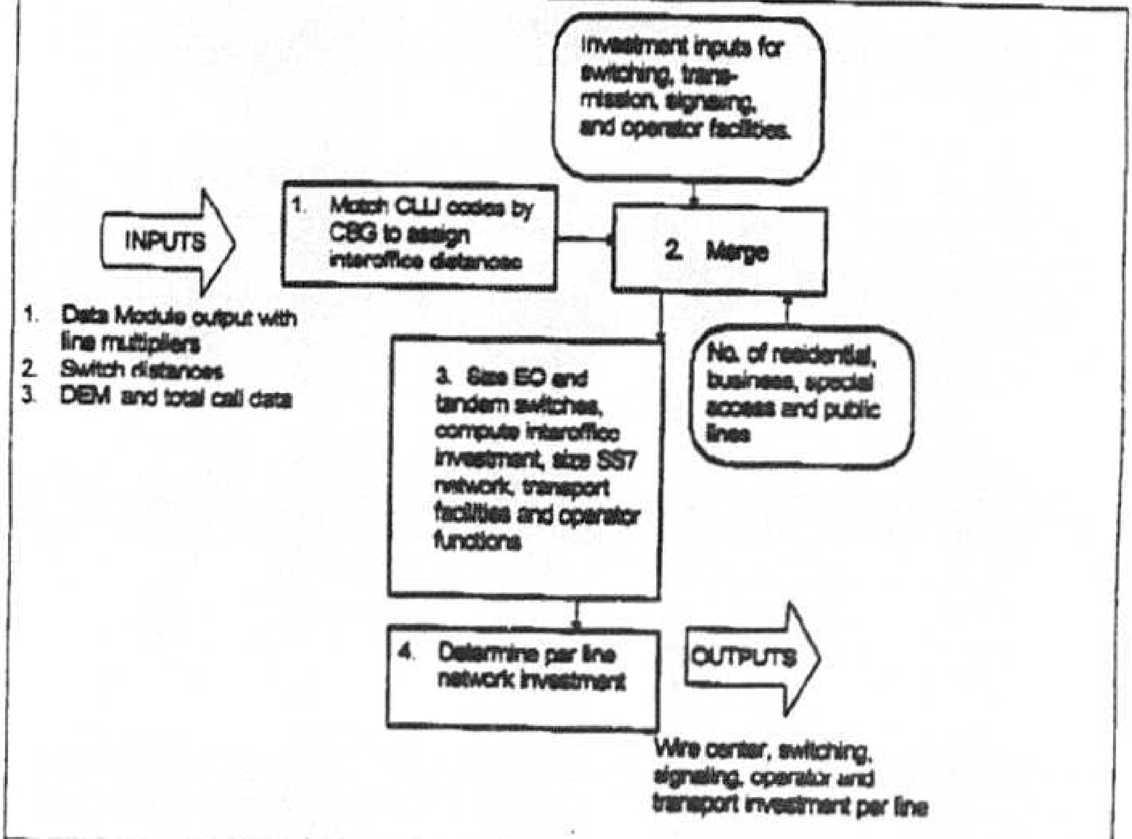

Figure 8 Wire Center Module

b) Description of inputs and assumptions

For the wire center module to compute required switching and transmission investments, it must have as inputs total line counts for each wire center, interoffice distances, traffic peakedness assumptions, as well as inputs describing the distribution of total traffic among local intraoffice, local interoffice, intraLATA toll, interexchange access and operator services. This module takes as data inputs overall line counts obtained from the Line Converter Module and interoffice distances for the calculation of transmission facilities investment.[25]

There are many user-adjustable input assumptions in the Wire Center module. The following sections discuss these assumptions, and Appendix C includes additional tables showing all of the default values for the module's input parameters.

c) Traffic assumptions

Many of the calculations in the Wire Center module rely on traffic assumptions suggested in Bellcore documents.[26] These inputs, which the user may alter, assume 1.3 busy hour call attempts (BHCA) per residential line and 3.5 BHCA per business line. Total busy hour usage is then determined based on published Dial Equipment Minutes (DEM) information. Other inputs, which may be changed by the user, specify the fraction of traffic that is interoffice, the fraction of traffic that flows to operator services, the local fraction of overall traffic, as well as breakdowns between direct-routed and tandem-routed local, intraLATA toll, and access traffic. Appendix C contains tables showing the default settings for these parameters.

d) Explanation of calculations

The following sections describe the calculations used to generate investments associated with switching, wire centers, interoffice transport, signaling and operator systems functions.

(1) Switching investment calculations

The Module places at least one end office switch in each wire center. It sizes the switches placed in the wire center by adding up all the switched lines in the CBGs served by the wire center, then compares this line total to the maximum allowable switch line size. This parameter is user-adjustable, but its default setting is at 100,000 lines with a fill factor of 0.80, yielding a maximum effective switch line size of 80,000. By default, the model will equip the wire center with a single switch if the number of switched access lines served by the wire center is no greater than 80,000. If a wire center serves 90,000 lines, the model will

25 The HM2.2.2 includes a set of interoffice distance calculations produced from wire center location information from Bellcore's Local Exchange Routing Guide (LERG). Because AT&T has now gained a site license for use of these data, users of the Hatfield Model no longer need to obtain their own copies of the LERG.

26 Bell Communications Research, *LATA Switching Systems Generic Requirements, Section 17: Traffic Capacity and Environment*, TR-TSY-000517, Issue 3, March 1989.

compute the investment required for two 45,000 line switches.[27] The wire center module also compares the BHCA produced by the mix of lines served by each switch with a user-adjustable processor capacity (default set at a maximum of 600,000 BHCA) to determine whether the switch is line-limited or processor real-time-limited.

Once the model determines the end office switch line size, it calculates the required investment per line from an investment function that relates per-line switching investment to switch line size. The data defining this function were obtained from a publicly-available study of the central office equipment market published annually by McGraw-Hill.[28] This study shows the average investment per new line of digital switching paid by BOCs to be $102, and by independents to be $235, in 1995.[29] The model combined these figures with average BOC (11,200) and independent (2,761) switch line sizes derived from data published in the FCC's *Statistics of Communications Common Carriers*, along with information on much larger switches obtained from switch manufacturers to develop the complete investment function.[30] The above per-line investment figures are for the entire end office switch, including trunk ports. These investment figures are then reduced by $16 per line to remove trunk port investment that will be accounted for in the module's trunk calculations. Figure 9 shows the resulting investment curve.

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27 If multiple switches are required in the wire center, they are sized equally to allow for maximum growth on both switches.

28 Northern Business Information study: *U.S. Central Office Equipment Market – 1995*, McGraw-Hill.

29 These per-line average prices represent investments over all types of switching, including remote switching systems, hosts, and stand-alone end office switches. Through this scaling, the switching investment curve thus represents automatically the cost of the average profile of remote, host, and stand-alone applications of end office switches.

30 Federal Communications Commission, *Statistics of Communications Common Carriers*, Tables 2.3 and 2.4, 1994 edition.

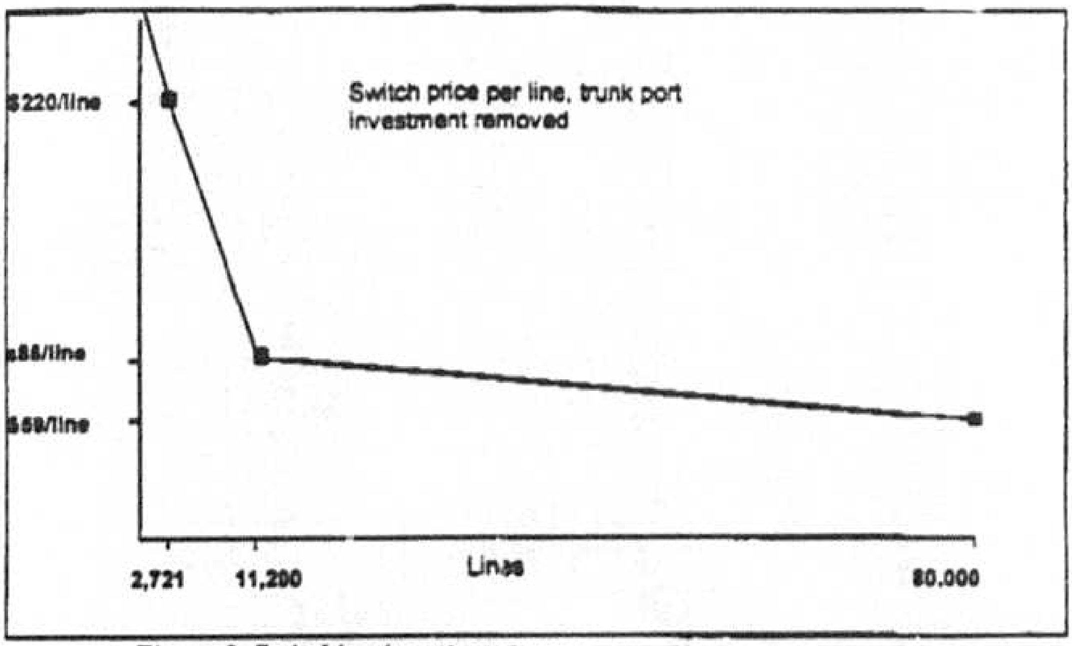


Figure 9 Switching investment curve

The wire center module uses existing tandem and end office wire center locations for computing interoffice transmission investments. A preprocessing step, relying on licensed LERG data, produces end office-to-tandem, end office-to-STP, tandem-to-STP, and STP-to-STP distances in a table that then is used by the module to estimate interoffice transmission facility investments. The module computes investments for end office and tandem "A" signaling links, "C" signaling links between the STPs in a mated pair, and it estimates investments in "D" signaling link segments that an interconnecting carrier such as an IXC may lease from the ILEC.

Tandem and operator tandem switching investments are computed according to assumptions contained in an AT&T report on interexchange capacity expansion costs filed with the FCC.[31] The investment calculation assigns a price to switch "common equipment," switching matrix and control structure, and adds to these amounts the investment in trunk interfaces. The numbers of trunks and their related investments, are derived from the transport calculations described below. The module recognizes that a significant fraction of local tandems also perform end office switching functions, and the inputs allow the user to vary the

31 AT&T, "An Updated study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," filed with the FCC in CC Docket No. 79-252, April 24, 1995 ("AT&T Capacity Cost Study").

sharing of tandem common equipment with end office use. The default sharing value is 40%.

Wire center investments required to support end office and tandem switches are based on assumptions regarding the size of room required to house a switch (for end offices, this size varies according to the line sizes of the switch), construction costs, lot sizes, land acquisition costs and investment in power systems and distributing frames. The default values are shown in Appendix C.

The model computes required wire center investments separately for each switch. For wire centers housing multiple end office switches, the wire center investment calculation adds switch rooms to house each additional switch. Tandem wire center calculations assume the maximum switch room size, and further assume the tandem will reside in a wire center that contains at least one end office switch.

(2) Transport calculations

The traffic and routing assumptions listed above, along with the total mix of access lines served by each switch, form the basis for the model's transport calculations. The model determines the overall breakdown of traffic per subscriber according to the traffic assumptions and computes the numbers of trunks required to carry this traffic. These calculations are based on the fractions of total traffic assumed for interoffice, local direct routing, local tandem routing, intraLATA direct and tandem routing and access direct and tandem routing. These traffic fractions are applied to the total traffic generated in each wire center according to the mix of business and residential lines and appropriate per-line offered load assumptions. These trunk loading assumptions include a user-adjustable maximum trunk utilization of 27.5 CCS in the busy hour.[32]

The distance preprocessing calculations estimate interoffice distances using existing wire center and tandem locations. The calculation assumes rectilinear routing between end offices and tandems, and between switches and STPs. The resulting distances are greater than if they were calculated as airline mileage.

Average direct-route distances for local, intraLATA and access traffic are set as user-definable inputs. It is not possible to compute these values from wire center locations because existing exchange area definitions determine whether routes will carry local, intraLATA toll, or access traffic. In addition, the locations of IXC POPs may not be publicly available. Because of these factors, the default

[32] The 27.5 CCS value is based on an AT&T estimate of maximum per trunk utilization. See, AT&T Capacity Cost Study.

distances for direct transport are 10 miles for local routes, 25 miles for intraLATA routes, and 15 miles for access routes. The user may alter these values.

The model contains explicit transport facilities investment calculations to produce both termination and per-mile investments, each expressed per DS-0 (a 64 kbps voice-equivalent circuit). The assumptions underlying these calculations include the facilities capacity expressed at a default SONET transmission rate of OC-12, multiplexer installed price per end, regenerator spacing and investment, buried/underground/aerial composition, manhole spacing and investment, pole spacing and investment, along with ancillary investments such as splicing, optical patch panels, and "pigtail" (short connectorized fibers between strands in the cable and the optical patch panel) investment. Interoffice investment calculations also include a "sharing" factor that accounts for the sharing of structure used by feeder and interoffice facilities. This eliminates double-counting of structure between feeder and interoffice routes. The amount of sharing, expressed as a percentage of interoffice route miles, is a user-adjustable input. The default value is 25%.

(3) Tandem switch calculations

The module scales the investment in tandem switch common equipment according to the total number of tandem trunks computed for the study area. By doing so, it thus avoids equipping maximum-capacity tandems whenever a LATA is served by multiple tandems. The calculations also recognize that a significant fraction of tandems in practice are "Class 4/5" offices that serve both tandem and end office functions. A sharing fraction may be set by the user to reflect the incidence of such dual-purpose switches.

(4) Signaling network calculations

The Wire Center Module uses the preprocessed interoffice distances to compute signaling link investment for end office and tandem A links, C links between the STPs in a mated pair, and D link segments. The investment per link-mile is the same as the computed per-DS-0 investment described above.

The model always equips at least two signaling links per switch. It also computes required SS7 message traffic according to the call type and traffic assumptions described earlier. User inputs define the number and length of ISDN User Part (ISUP) messages required for interoffice call control. Default values are six messages per interoffice call attempt with twenty-five octets per message. These values are those assumed in the AT&T Capacity Cost Study.

Other inputs define the number and length of Transaction Capabilities Application Part (TCAP) messages required for database lookups, along with the percentage of calls requiring TCAP message generation. Default values, also obtained from the AT&T Capacity Cost Study, are two messages per transaction, at 100 octets per message, and 10% of all calls requiring TCAP generation. If the message traffic from a given switch exceeds the link capacity (also user-adjustable and set at 56 kbps and 40% occupancy as default values), the model will add links to carry the computed message load. The total link distance calculation includes all the links required by a given switch.

STP capacity is expressed as the total number of signaling links each STP in a mated pair can terminate (default value is 720 with an 80% fill factor). The maximum investment per STP pair is set at $5 million, and may be changed by the user. These default values derive from the AT&T Capacity Cost Study. The STP calculation scales this investment based on the number of links the model requires to be engineered for the study area.

SCP investment is expressed in terms of dollars of investment per transaction per second. The transaction calculation is based on the fraction of calls requiring TCAP message generation. The total TCAP message rate in each LATA is then used to determine the total SCP investment. The default SCP investment is $20,000 per transaction per second and is based on a number reported in the AT&T Capacity Cost Study.

(5) Operator systems calculations

Operator tandem and trunk requirements are based on the operator traffic fraction inserted by the user into the model and on the overall maximum trunk occupancy value of 27.5 CCS discussed above. Operator tandem investment assumptions are the same as for local tandems.

Operator positions are assumed to be based on current personal computer terminal technology. The default operator position investment is $3500. The Model includes assumptions for maximum operator "occupancy" expressed in CCS. The default assumption is that each position can be in service 27.5/36 of the busy hour. This value is related to the maximum trunk occupancy assumption described above. Also, because many operator services traditionally handled by human operators may now be served by announcement sets and voice response systems, the model includes a "human intervention" factor that reflects the fraction of calls that require human operator assistance. The default factor is 10, which is believed to be a conservative estimate. (A factor of ten implies that one out of ten calls will require human intervention).

6. Convergence module

The Convergence Module combines the loop cable investments produced by BCM-PLUS with the wire center, switching, transport, signaling and operator systems investments calculated by the Wire Center Investment Module. The output of the Convergence Module is the complete collection of network investments stated by density range for use by the Expense module.

The module adds structure investment to the loop cable investments produced by the Loop Module based directly on the number of sheath miles of cable to be installed. The previous version of the Hatfield Model relied on BCM estimates of loop structure components which were calculated by applying "cable multipliers" to loop cable investment. The cable multipliers produced estimates of structure that varied directly with cable investment. In some cases, the structure estimates per unit length were unacceptably low. The multiplier approach also improperly made structure investment a function of cable materials price discounts.

In Release 2, the Convergence Module includes user-defined inputs for conduit investment, pole investment and spacing, manhole investment and spacing, trenching and direct burial investment, and breakdowns of aerial, buried, and underground cable. Although the Loop Module cable investment inputs include values for aerial and underground cable, where buried cable is required the Convergence Module adds an incremental amount per foot to represent the increased investment in armoring that is characteristic of cable intended to be directly buried. The default assumptions, which vary by density range, appear in Appendix C. There are separate sets of default inputs for distribution, copper feeder and fiber feeder facilities.[33]

The following tables display the default values for structure type:

Distribution Structure			
Density Range	Aerial Fraction	Buried Fraction	Underground Fraction
0 - 5	0.50	0.50	-
5 - 200	0.50	0.50	-
200 - 650	0.50	0.50	-
650 - 850	0.50	0.50	-
850 - 2550	0.40	0.50	0.10
> 2550	0.65	0.05	0.30

33 The HM2.2.2 Convergence Module still performs certain loop-related calculations. These were originally included in this module to correct deficiencies in the initial BCM loop calculations. HAI has chosen to keep these additional calculations in the Convergence Module even after the incorporation of BCM-PLUS into HM2.2.2.

Copper Feeder Structure			
Density	Aerial Fraction	Buried Fraction	Underground Fraction
0 - 5	0.50	0.45	0.05
5 - 200	0.50	0.45	0.05
200 - 650	0.50	0.45	0.05
650 - 850	0.40	0.40	0.20
850 - 2550	0.10	0.10	0.80
> 2550	0.05	0.05	0.90

Fiber Feeder Structure			
Density Range	Aerial Fraction	Buried Fraction	Underground Fraction
0 - 5	0.35	0.60	0.05
5 - 200	0.35	0.60	0.05
200 - 650	0.35	0.60	0.05
650 - 850	0.20	0.60	0.20
850 - 2550	0.10	0.10	0.80
> 2550	0.05	0.05	0.90

The Convergence Module adds several components to the loop cable investments produced by the Loop Module: NIDs, SAIs, terminals and subscriber drops. The drop and terminal/splice values are added for each line directly. The model computes one NID per household and one NID for every four (a user-adjustable value) business lines. The default per-unit investments are $30 for the NID (obtained from discussions with subject matter experts); $40 for the drop (taken from the New England Telephone Incremental Cost Study[34]), and $35 for the terminal and splice.

The SAI investments depend on whether copper or fiber feeder cable feeds a particular CBG. If the feeder cable is copper, the SAI is a simple cross-connect arrangement. This arrangement's investment is obtained from a table listing SAI installed prices by total lines served. For optical feeder cable, the SAI consists of an optical patch panel for connecting the cable to the remote terminal, along with an associated cross-connect for connecting the subscriber loops to the analog side of the remote terminal. Investment assumptions for both types of SAIs include engineering, a housing, and site preparation, along with common equipment and

[34] NYNEX, 1993 New Hampshire Incremental Cost Study

per-line investments in channel units. A separate fill factor applies to the number of lines served by each set of common equipment.

Structure investment (*i.e.*, poles, conduit, trenches, and manholes) generally are shared among utilities, typically LECs, CATV operators, electric utilities, and others, including competitive access providers (CAPs) and IXCs. To the extent that several utilities may place cables in common trenches, conduits or on common poles, it is appropriate to share the costs of these structure items among them. Because the Convergence Module reports investments in different structure separately to the Expense Module, the user may select the fraction of each type of distribution and feeder structure investment that should be assigned to local telephone service.

The Convergence Module also adds investment for integrated DLC equipment. Inputs include site and power, common equipment, and per-line investment in channel units. The module allows two types of DLC equipment as described in the Release 1 documentation: TR-303-compatible SLC®-2000 equipment, used in all but the lowest density zone, and proprietary equipment manufactured by Advanced Fibre Communications, a California company, in the 0-5 lines per square mile range.

The Convergence Module produces investments in the following categories for each of the six density ranges:

- Distribution (aerial, buried, and underground copper cable and associated structure)
- Concentration (DLC remote terminal and associated investment in power, site preparation, and housing)
- Feeder (aerial, buried and underground fiber and copper feeder cable and associated structure)
- Switching (end office and tandem switching investment)
- Wire center (end office and tandem wire center investment)
- Operator services (operator tandem switching, tandem wire center, trunks and operator positions)
- Transport (common and dedicated)
- STPs
- SCPs
- Signaling links
- NID, drop, terminal and splice, and SAI

In addition, the Convergence Module output sheet summarizes line and trunk counts, and passes other parameters, such as tandem routing fractions and DEMs, to the Expense Module. Line counts include residential, business, special access and public access lines, and the module also reports households in each density range.

7. Expense Module

a) Overview

The Expense Module provides per-line and per-month cost summaries for each unbundled network element defined by the model, and for basic universal service. It does so by calculating capital carrying cost, operating expenses, network operation expenses, and attributable support expenses for each of eleven UNEs plus public telephone terminal equipment.

The Expense Module uses the output of the Convergence Module to capitalize the investments needed for each UNE and the per-line investments for basic universal service. The module requires investment, revenue and expense data reported by individual LECs in their annual ARMIS reports. The Module's other required inputs are capital structure parameters (e.g., debt/equity ratio, costs of debt and equity) as well as the total network investment produced by the Convergence Module.

The Expense Module uses ARMIS data to calculate several expense-to-investment ratios to be applied to the investments in different plant categories as computed by the model. It also uses estimates of LEC revenues, tax rates, costs of debt and equity and economic service lives for various types of network equipment.

This section describes the inputs and assumptions of the Expense Module, including ARMIS data, capital structure parameters and expense factors built into the module. It also explains the calculations used to determine capital costs and operating expenses.

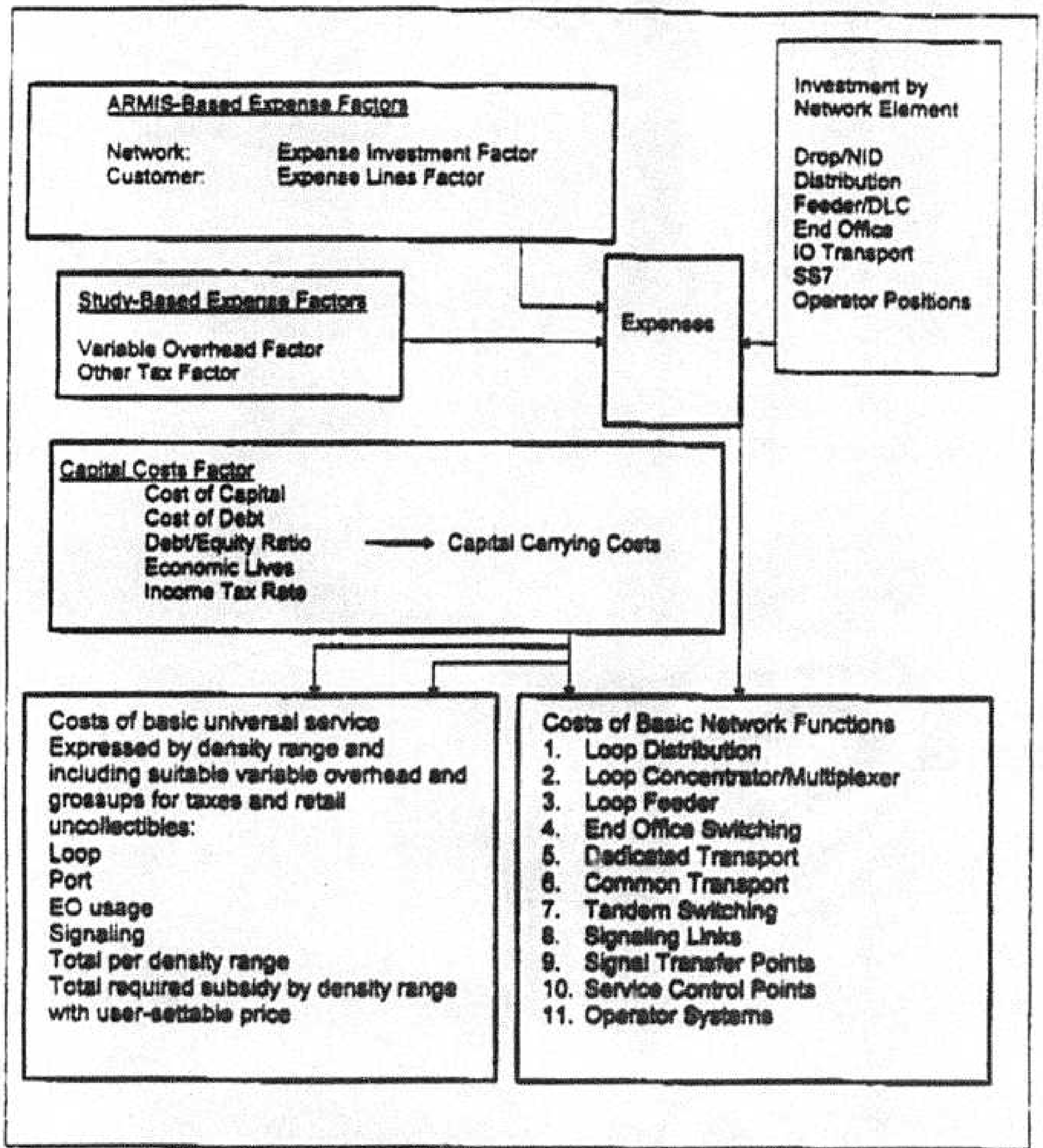


Figure 10 Expense Module

b) Description of inputs and assumptions

(1) ARMIS data

The ARMIS data used in the Expense Module include investment and operating expenses and revenues for a given local carrier and state. These data are used to derive the total investments, expenses and revenues for each UNE. The investment, expense and revenue categories are listed below, and described in detail in the Calculations section.

(a) plant specific operations
- end office and tandem switching -- digital switching, operator systems
- transmission -- circuit equipment, transmission
- information origination and termination -- public telephone, terminal equipment
- cable and wire facilities -- poles, cable, conduit

(b) plant non-specific operations
- provisioning
- power
- plant operations
- network administration
- testing
- general support equipment -- land, buildings, vehicles, furniture, office and other equipment

In addition, ARMIS data include local network service revenues by the following categories:
- access revenue -- end user, switched and special access revenue
- basic service revenue
- long distance network revenue

(c) Capital structure parameters

The Expense Module requires capital structure parameters to calculate the carrier's Weighted Average Cost of Capital (WACC), which is a discount factor used to calculate capitalized costs of UNEs and basic local service. Parameters required are for the carrier's debt/equity ratio, cost of debt, and cost of equity.

(d) Factors built into the expense module

The module uses a number of ratios and factors to calculate monthly per-line loop and annual switching costs. These factors are explained in detail in the Calculations section.

(e) Other user inputs

There are several explicit user inputs to the Expense Module, including economic lives by plant category, variable overhead factor, forward-looking Network Operations expense reduction factor, similar forward-looking expense factors for switching and circuit equipment, other taxes (principally franchise fees), and structure assignment factors. The model uses the latter to assign structure investment to telephone subscribers. Generally, plant structure (conduit, poles, and trenches) will be shared by several service providers. The structure assignment parameters in the Expense Module allow the user to vary the amount of structure investment for aerial, underground, and buried feeder and distribution facilities assigned to telephone users. The default value is 0.33 for all categories.

Other user inputs include an explicit value for the monthly cost per line for local number portability (set at a default of $0.25/line/month), a quantity used in estimating basic local service monthly costs. There is also a monthly factor of $1.22 per line that accounts for bill generation and bill inquiries relating to basic local service. The model includes a value for the NID's annual maintenance expense, the default is $3.00 per NID. There is an input for carrier-to-carrier customer expense, set at $1.56 per line per year, which is used in the determination of UNE costs. This default value derives from Tier 1 LEC expenses for servicing the access accounts of their IXC customers reported in ARMIS 43-04 for 1995.

Appendix C shows all user inputs to the Expense Module.

c) Explanation of calculations

The Expense Module is driven primarily by the calculated annual capital cost and operating expenses of the carrier(s) under study. All costs are summarized for each of the eleven UNEs. The algorithms used to determine these amounts are described below.

(1) Capital costs

The model calculates annual capital cost for each UNE based on the net plant investment, the expected service life (depreciation), the return on the net asset and the grossed-up income tax on the return of the net asset. The model assumes straight-line depreciation and assumes that cash flows are in arrears (*i.e.*, return from assets, tax gross-ups and depreciation are applied at the end of each year).

The WACC, the capital structure, and the cost of debt and equity must be provided for the modeled entity. Based on these data, the model calculates the investments required for each UNE. The model then determines the appropriate levelized monthly cost of these investments based on the economic lives for each of the UNEs.

(2) Operating Expenses - General

Operating expenses are derived from historic expense factors which are calculated from balance sheet and expense account information reported in carriers' ARMIS reports. These expense factors are applied to the investments developed by the Hatfield Model to determine associated operating expense amounts.

Certain expenses, particularly those for network maintenance, are strongly related to their associated capital investments. The Expense Module estimates these expenses using factors computed from the carrier's ARMIS reports. Other expenses, such as network operations, vary directly with the number of lines provisioned rather than with capital investment. Expenses for these elements are scaled by the number of access lines supported. Uncollectibles expense is calculated as a percentage of revenues.

(3) Network-Related Expenses and Expense Factors

The Expense Module assigns network-related expenses to each of eleven UNEs, plus public telephone terminal equipment. The module also assigns the cost of capital, expenses, total investment and attributable support expense to each UNE.

These network and non-network operating expenses are added to annual capital costs to determine the total economic cost of each UNE. Each network-related expense is described below:

Network Support – This category includes the expenses associated with motor vehicles, aircraft, special purpose vehicles, garage and other work equipment.

Central Office Switching – This includes end office and tandem switching, as well as equipment expenses.

Central Office Transmission – This includes circuit equipment expenses associated with transport investment.

Cable and Wire – This category includes expenses associated with poles, aerial cable, underground/buried cable and conduit systems. This expense varies directly with capital investment.

Network Operations – The Network Operations category includes power, provisioning, engineering and network administration expenses.

The Expense Module uses specific forward-looking expense factors for digital switching and for central office transmission. These values derive from the New England Telephone Incremental Cost Study. The module similarly computes forward-looking Network Operations expenses based on corresponding ARMIS-reported expenses. Because total Network Operations expense is strongly line-dependent, the model computes this expense as a per-line additive value based on ARMIS-reported total Network Operations expense divided by the number of access lines, then deducting 30% of this quotient to produce a forward-looking estimate.[35]

(4) Non-network-related operating expenses and expense factors

The Expense Module assigns non-network related expenses to each density range based on its proportion to total expenses in each category. Each of these expenses is described below.

Variable support – Historical variable support expenses for LECs are substantially higher than those of similar service industries operating in more competitive environments. Based on studies of these variable support expenses in competitive industries, such as the interexchange industry, the model applies a conservative 10% variable support factor to the total costs estimated for UNEs as well as basic local service.

General Support Equipment – The module calculates investments for furniture, office equipment and general purpose computers. The Model uses actual 1995 company investments to determine the ratio of investments in the above categories to total investment. The ratio is then multiplied by the network investment estimated by the Model to produce the investment in general support equipment. The recurring costs of these items are then calculated in the same way as recurring costs for network investment.

(5) Revenues

Revenues are used to calculate the uncollectibles factor. This factor is a ratio of uncollectibles expense to adjusted net revenue. The module computes both retail and wholesale uncollectibles factors. The retail factor is applied to basic local telephone service monthly costs and the wholesale factor used in the calculation of UNE costs.

d) Outputs of the Expense Module

The Expense Module displays results in a series of reports which depict detailed investments and expenses for each UNE for each density range, summarized investments and expenses for all UNEs, unit costs by UNE and total

35 Although forecasting forward-looking expenses is difficult, there is evidence that the 30% reduction from currently reported per-line Network Operations expense is conservative. Testimony before the California Public Utilities Commission (Testimony of R. L. Scholl, Universal Service Proxy Cost Models, April 17, 1996, p. 11) states that Pacific Bell's forward-looking Network Operations expenses are 55% less than current per-line values computed from Pacific Bell's 1994 ARMIS data.

annual and monthly network costs, as well as basic local service costs per household.

(1) Unbundled Network Elements outputs

The Hatfield Model produces cost estimates for eleven UNEs, plus public telephone terminal equipment. These UNEs represent an unbundling of the local exchange network into discrete functions, which can be used singly or in any combination to furnish services. The UNEs are described below and their interrelationships are illustrated in Figure 11.

Loop Distribution -- The individual communications channel originating from the DLC remote terminal or SAI and terminating at the customer's premises. In the Hatfield Model, this UNE also includes the investments in NID, drop and terminal/splice.

Loop Concentrator/Multiplexer -- The DLC remote terminal at which individual subscriber traffic is multiplexed and connected to loop distribution for termination at the customer's premises. The Hatfield Model includes DLC equipment and SAI investment in this UNE.

Loop Feeder -- The facilities on which subscriber traffic is carried from the line side of the end office switch to the DLC remote terminal or SAI. The UNE includes copper feeder and fiber feeder cable, plus associated structure investments (poles, conduit, etc.)

End Office Switching -- The facility connecting lines to lines, or lines to trunks. The end office represents the first point of switching. As modeled in the Hatfield Model, this UNE includes the end office switching machine investments and associated wire center costs, including distributing frames, power, land and building investments.

Operator Systems -- The systems that process and record special toll calls, public telephone toll calls, and other types of calls requiring operator assistance, as well as Directory Assistance. The investments identified in the Hatfield Model for the Operator Systems UNE include the operator position equipment, operator tandem (including required subscriber databases), wire center and operator trunks.

Dedicated Transport -- The full-period, bandwidth-specific interoffice transmission path between LEC wire centers or between LEC wire centers and an IXC POP. It provides the ability to offer individual and/or multiplexed switched and special services circuits between switches. Interoffice transport investments that provide dedicated transport are assigned to this UNE.

Common Transport -- A trunk between two switching systems on which traffic is commingled to include LEC traffic as well as traffic to and from other local or interexchange carriers. These trunks may originate at an end office and terminate at a tandem switch or at another end office. Interoffice transport investments that provide common transport are assigned to this UNE.

Tandem Switching -- The facility that provides the function of connecting trunks to trunks for the purpose of completing interoffice calls. Similar types of investments as are included in the End Office Switching UNE are also reflected in the Tandem Switching UNE.

Signaling Links -- Transmission facilities in a signaling network that carry all out-of-band signaling traffic between end office and tandem switches and STPs, between STPs, and between STPs and SCPs. Signaling link investment developed by the Hatfield Model and assigned to this UNE.

Signal Transfer Point -- This facility provides the function of routing TCAP and ISUP messages between network nodes (end offices, tandems and SCPs). The model estimates STP investment and assigns it to this UNE.

Service Control Point -- The node in the signaling network to which requests for call handling information (*e.g.*, translations for local number portability) are directed and processed. The SCP contains service logic and customer specific information required to process individual requests. The model estimates SCP investment and assigns it to this UNE.

(2) Universal Service Fund Outputs

The calculation of costs for basic local service is based on the costs of the UNEs constituting this service. These are the loop, local portions of end office and tandem switching, transport facilities for local traffic, and the local portions of signaling investment. No operator services or SCP investments are included. In addition, these UNE cost elements are adjusted to accommodate other items such as retail uncollectibles rather than wholesale uncollectibles. Finally, certain retail expenses required by basic local service, such as billing and bill inquiry, directory listings, number portability costs, etc. are added.

For illustrative purposes, the USF sheet in the expense module compares the monthly cost per line in each density range to a user-adjustable "affordable" monthly price for local service (which include the End User Common Line charge). If the cost exceeds the "affordable" price, the model accumulates the total required annual subsidy at the stated price level according to the number of households in each density range.

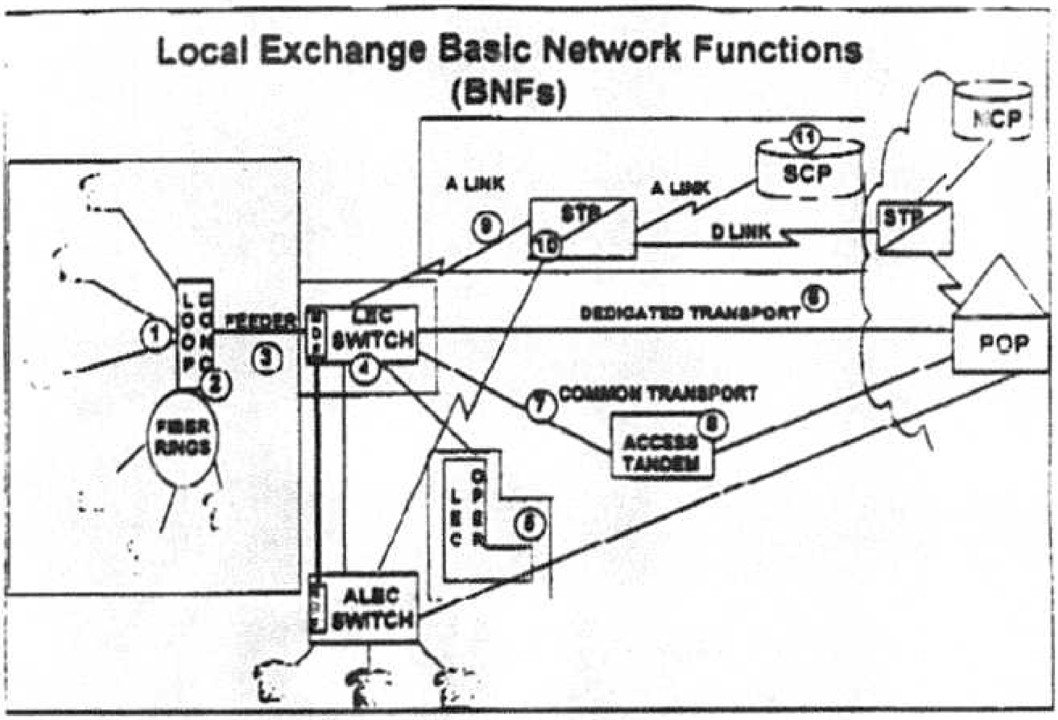


Figure 11 Local Exchange Network Elements

III. SUMMARY

In its Version 2.2, Release 2 formulation, the Hatfield Model estimates reliably and consistently both the forward-looking economic cost of unbundled local exchange network elements and the forward-looking economic cost of basic local telephone service. Because both of these calculations are performed in adherence to TELRIC/TSLRIC principles, Hatfield Model cost estimates provide an accurate basis for the efficient pricing of unbundled network elements and the calculation of efficient universal service funding requirements.

HM2.2.2's methodology is transparent, and it uses public source data for its inputs. These default input values represent the developers' best judgments of efficient, forward-looking engineering and economic practices. But, because many of these inputs are adjustable, users of HM2.2.2 can use the model's automated interface to model directly and simply any desired alternative scenario.

Appendix A

Summary of Changes Between Releases 1 and 2 of the Hatfield Model, Version 2.2

This document describes changes made to the Hatfield Model Version 2.2 between Release 1 and Release 2. The discussions refer specifically to changes incorporated in Release 2 that modify the updated Release 1 version as filed publicly with the FCC on May 30, 1996.

A Benchmark Cost Model (BCM) derivative work called BCM-PLUS has been developed for and copyrighted by MCI Telecommunications Corporation and incorporated into the Release 2 version of the Hatfield Model (which, in this description, is known as HM2.2.2, for Hatfield Model Version 2.2 Release 2). HM2.2.2 also includes an automated user interface with dialog boxes that allow the user to change options and adjust inputs. The interface automates the running of the model as well.

BCM-PLUS Modules

Data module

1. Input and output sheets include an additional column containing business line counts per census block group (CBG).

2. Feeder and distribution distances are increased by 20% in the presence of rocky terrain to accommodate routing of facilities around difficult placement conditions.

3. Feeder length calculation modified to place SAI inside CBG by one-fourth the length of a CBG side.

Loop module

1. The distance at which fiber feeder is assumed is now user-adjustable. In the original BCM, the model assumed fiber feeder cables for total loop lengths of 12,000 ft or greater. In the new version, the calculation is based on total feeder length, and the threshold distance may be adjusted by the user to any value. The default setting is 9,000 ft.

2. The DS-0 capacity per fiber is now adjustable with a default value of 2016 (equivalent to 3 DS-3s). In the original version, the model included a fixed capacity of 672 DS-0s (1 DS-3) per fiber.

3. The number of fibers required per digital loop carrier remote terminal is now adjustable. The default setting is four fibers, which is the same as the value fixed in the original BCM.

4. Lookup tables for optical feeder cable investment now allow user adjustment of cable sizes. The default maximum cable size is now 216 fibers. In the first BCM version, the maximum cross sections for optical and copper fiber and distribution cables were fixed. Also, fiber and copper cable investments per unit length have been adjusted to include engineering, delivery, and installation in addition to material investment. The original BCM did not include installation, engineering, and delivery in this table. The default distribution cable investment table now includes 25-pair cable.

5. The module now computes varying numbers of distribution cables according to density range to accommodate different population distributions in high and low density ranges.

6. Density ranges are now expressed in terms of lines per square mile instead of households per square mile.

Hatfield Model modules

Line Multiplier (now Line Converter) Module:

1. The original Line Multiplier Module used user-specified line multipliers that varied by density range to estimate total residential, business, special access, and public lines. The new Line Converter module applies uniform multipliers to all CBGs to compute residential access lines in each density zone. The business, special access, and public line calculations are based on data that estimate the number of business employees in each CBG. All line totals are computed to match those shown in the ILEC's most recent ARMIS 43-08 reports.

2. The input data contains estimated 1995 household counts per CBG in place of the 1990 counts in the original BCM data.

3. The module computes CBG density in terms of lines, instead of households, per square mile.

Wire Center Investment Module

1. The module removes previous double-counting of trunk ports by reducing the input per-line switching investment by $16 per line, because the model separately calculates the investment in trunk ports for the switches in each wire center and adds the total trunk port investment to the total switching investment in each wire center.

2. STP size is now scaled by the number of A links in the study area; the model previously equipped maximum-capacity STPs in all cases.

3. The module now computes Signaling System 7 C and D link investments, where it previously calculated only A link investments.

4. The transmission facilities investment, expressed as investment per DS-0-mile, is now calculated explicitly for each of the following routes:

common (tandem)
local direct
intra LATA direct
IXC switched access direct
special access

The calculations allow separate user assumptions for optical patch panels, optical multiplexers, regenerator investment and spacing, installation costs, mix of buried/underground/aerial plant, and manhole and pole spacing and installation.

5. The module eliminates double counting of structure costs typically shared between interoffice and feeder facilities.

6. The model now contains reconciled usage calculations between the Expense Module and Wire Center Investment Module.

7. Operator services positions may now be remote from the operator tandem. The user may select the distance; the default value is zero.

8. The module now includes tandem-to-POP switched access direct transport facilities.

9. The end office capacity limits now include entries for switch traffic; they previously included line and processor real-time limits. There are also separate holding time multipliers for business and residence lines to allow users to compute the effects of increased holding time on costs.

10. The module now uses pre-processed interoffice distance data derived from end office, tandem, and STP locations listed in the Local Exchange Routing Guide. This facilitates the running of the model.

Convergence Module

1. The module now separately computes structure costs for aerial, buried, and underground facilities, including poles, conduit, trenching, and manholes. The model independently treats underground and buried cable. The new version eliminates previous double counting of terminals and splices. All structure factors, including the mix of aerial, buried, and underground distribution and feeder facilities are user definable.

2. Digital loop carrier investment is now computed from "ground up." The calculation includes site, housing, power, engineering, common equipment (including multiplexing at the wire center), and line cards.

3. The new version corrects a previous calculation error in local direct and local tandem trunk investment.

4. Default settings eliminate optical multiplexers from the Serving Area Interface. Sufficient fiber capacity exists to allow dedicated fibers to serve each remote terminal, as is consistent with current practices.

Expense Module

1. The module allows economic lives of up to 50 years to be input, (previous maximum permitted life was 32 years).

2. Consistent with the new structure calculations and incorporation of separate underground and buried facilities inputs, the model now calculates separate expense factors for the following network components:

Aerial cable
Underground cable
Buried cable
Poles
Manholes
Conduit

Previously, only aerial and underground factors were calculated.

3. Double counting of DLC terminations and end office line circuits is eliminated.

4. Trunk port costs can now be estimated per DS-0 or per minute.

5. Default user inputs for cost of debt, equity, and debt/equity ratio have been changed.

6. Separate uncollectibles rates for retail and carrier-to-carrier are specified.

7. The module eliminates a previous triple counting of NID (other terminal equipment) investment.

8. Drops are now computed per household rather than per line basis.

9. Dedicated trunking calculations have been reconciled between the Expense Module and the Wire Center Investment Module.

10. IXC switched access and local interconnection unit costs have been added to a new "Cost Detail" worksheet in the Expense Module.

11. NID expenses are now based on ARMIS-reported regulated expense per line (other terminal account); they previously included all "other terminal" expenses and, as a result, overstated NID maintenance expenses.

12. A user-definable carrier-to-carrier customer service expense has been added. Its default value is set at $1.56/line/year -- based on ARMIS 43-04 data on current ILEC expense in serving IXC's access accounts.

13. The new version includes a NID monthly cost calculation in the "Cost Detail" worksheet.

14. Structure sharing fractions have been expanded to allow the user to set independent parameters for aerial, buried, and underground distribution and feeder structure. Default values are 0.33 for all categories.

15. The module now contains a Universal Service Module with the following features:

Network cost built up from UNEs

Network Operations factored to reflect local service only

Local number portability costs have been added as a user input; with a default setting of $0.25 per line per month.

Instruction Manual

Hatfield Model Version 2.2, Release 2

Automated Interface

I. GETTING STARTED

A. SYSTEM REQUIREMENTS

The Hatfield Model (HM) Automated Interface requires the following minimum PC system components to run properly:

- Pentium 133 MHz processor or higher
- 128 MB RAM or more
- CD-ROM drive
- Microsoft Windows 95 or Windows NT operating system
- Microsoft Excel version 7.0

B. TERMINOLOGY

The following terminology is used in this documentation when referring to the Hatfield Model and its components:

HM Modules: The HM Modules are the six functional Excel files which comprise the HM. They are Line Converter, Data Master, Loop Master, Wire Center, Convergence, and Expense.

HM Interface: The user interface to the Hatfield model, which is contained in the Excel file HM Interface.xls. (Figure 1 shows what the HM Interface looks like.)

Workfile: A workfile is an Excel file created by the HM which contains state-specific HM data and outputs, and can reflect user-specified input parameters. Although the workfile is created by the HM, the user must provide a filename.

Data Template: The data template is a special workfile which contains the default inputs for each state. Data templates use a filename convention which looks like: AZ_rboc__tmplt.xls. Data templates should not be modified by HM users.

C. DIRECTORY STRUCTURE

The HM Interface assumes a basic directory structure as follows:

- HM modules should be stored in C:\hatfield modules
- HM data templates should be stored in C:\hatfield templates

The HM Interface allows users to specify which directories the HM components reside in by selecting 'HM Tools/Set Up Paths and Directories', but it is recommended that the default settings be used.

CD-ROM users should ensure that the paths and filenames point to the appropriate CD-ROM drive (e.g., D:\).

II. RUNNING THE HATFIELD MODEL

D. CREATING A NEW WORKFILE

- Select 'HM Tools/New HM Workfile...'
- Select the appropriate state from the dialog box.
- Select 'HM Tools/Save HM Workfile...' to give the workfile a unique name.
- Press 'GO!'
- Save Expense Module when HM is done calculating
- Select 'HM Tools/Close HM Workfile...' when finished

E. MODIFYING AN EXISTING WORKFILE

Once a workfile has been created, it can be modified to reflect different input parameters. To modify an existing workfile:

- Select 'HM Tools/Open HM Workfile...'
- Modify inputs as necessary, using process described below
- Press 'GO!'
- Save Expense Module when HM is done calculating
- Select 'HM Tools/Close HM Workfile...' when finished

F. CHANGING USER INPUTS

The HM contains several hundred user-adjustable parameters, each of which can be easily modified using the HM Interface. To change a user input, open the appropriate workfile, and select the desired category of inputs from the 'HM Inputs' menu. A dialog box will appear, in which alternative inputs may be specified. (See Figure 2.) If the workfile is saved, the alternative inputs will be saved with it. However, default inputs can always be restored by clicking the 'Reset Defaults' button on the input dialog box.

G. TROUBLESHOOTING

- If the HM Interface displays 'Cannot find file...' errors, ensure that the paths and filenames are correctly specified in the 'HM Tools/Set Paths and Filenames...' menu.
- In the unlikely event that the HM crashes, it is always best to restart.

Figure 1: HM Interface

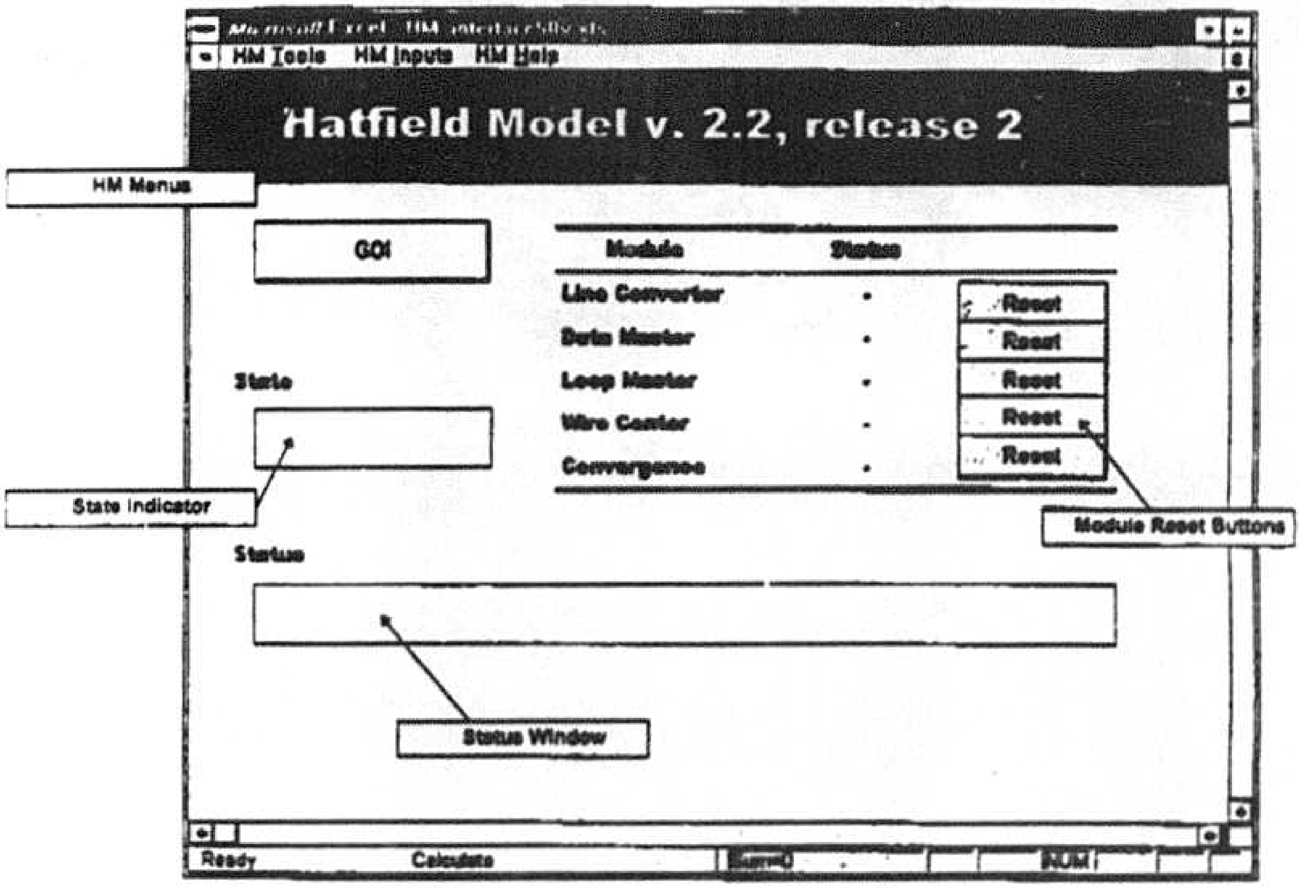
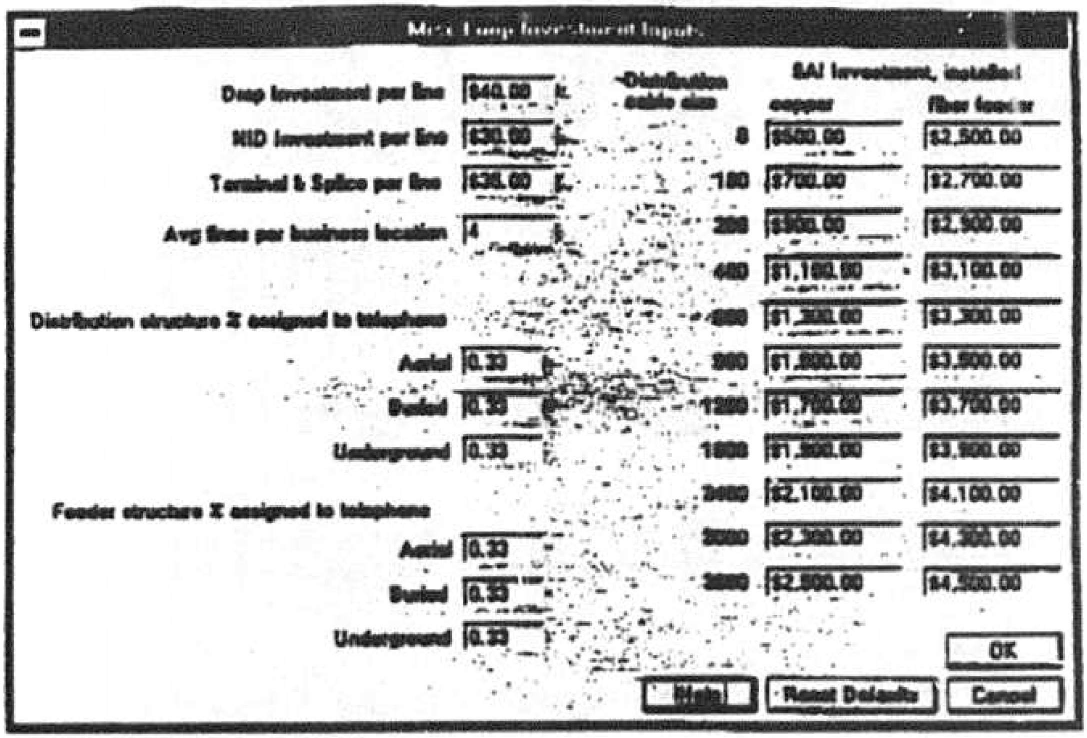


Figure 2: Sample User Input Dialog Box



BCM-PLUS Loop Module Inputs

Cable fill factors

density	Feeder	Distribution
0	0.65	0.5
5	0.75	0.55
200	0.8	0.6
650	0.8	0.65
850	0.8	0.7
2550	0.8	0.75

DS-0s per fiber		Fibers per RT
DLC case	2016	4
AFC case	2016	4

Fiber feeder distance threshold, ft

9,000

Fiber feeder cable inv per foot

Cable Size	u/g	aerial
216	$ 13.10	$ 13.10
144	$ 9.50	$ 9.50
96	$ 7.10	$ 7.10
72	$ 5.90	$ 5.90
60	$ 5.30	$ 5.30
48	$ 4.70	$ 4.70
36	$ 4.10	$ 4.10
24	$ 3.50	$ 3.50
18	$ 3.20	$ 3.20
12	$ 2.90	$ 2.90

Distribution cable inv per ft

Cable Size	u/g	aerial
3600	$ 63.75	$ 63.75
3000	$ 53.25	$ 53.25
2400	$ 42.75	$ 42.75
1800	$ 32.25	$ 32.25
1200	$ 21.75	$ 21.75
900	$ 16.50	$ 16.50
600	$ 11.25	$ 11.25
400	$ 7.75	$ 7.75
200	$ 4.25	$ 4.25
100	$ 2.50	$ 2.50
50	$ 1.63	$ 1.63
25	$ 1.19	$ 1.19

Copper feeder cable inv per ft

Cable Size	u/g	aerial
4200	$ 74.25	$ 74.25
3600	$ 63.75	$ 63.75
3000	$ 53.25	$ 53.25
2400	$ 42.75	$ 42.75
1800	$ 32.25	$ 32.25
1200	$ 21.75	$ 21.75
900	$ 16.50	$ 16.50
600	$ 11.25	$ 11.25
400	$ 7.75	$ 7.75
200	$ 4.25	$ 4.25
100	$ 2.50	$ 2.50

Wire Center Investment Module Inputs

EO switching and traffic parameters

switch real-time limit, BHCA

lines	limit
1	10,000
1,000	50,000
10,000	200,000
40,000	600,000

switch traffic limit, BHCCS

lines	limit
1	10,000
1,000	50,000
10,000	500,000
40,000	1,000,000

switch maximum line size		100,000
switch max line fill		0.80
switch max processor occupancy		0.90
processor feature loading multiplier		1.00
switch installation multiplier		1.1

Interoffice parameters

operator traffic fraction		0.02
total interoffice traffic fraction		0.65
direct-routed fraction of local interoffice		0.98

Transmission parameters

maximum trunk occupancy, CCS		27.5
trunk port, per end	$	100.00
average direct route distance, miles		10
average trunk usage fraction		0.3

Tandem switching parameters

real time limit, BHCA		1,500,000
port limit, trunks		120,000
common equipment investment	$	1,000,000
maximum trunk fill		0.8
maximum real time occupancy		0.9
common equipment intercept factor		0.25

switch price/line size references

switch price per line, less trunk circuits @	$	220.00	$	85.00	$	59.00
switch line size		2,782		11,200		80,000

BH fraction of daily usage	0.10
Annual to daily usage reduction factor	270
residential holding time multiplier	1.0
business holding time multiplier	1.0

(offered load assumed for afternoon busy hour)

call attempts/BH

residential	1.3
business	3.5

Signaling parameters

STP link capacity		720
STP maximum fill		0.8
STP investment, per pair, fully equipped	$	5,000,000
STP common equipment investment, per pair	$	1,000,000
link termination, both ends	$	900
signaling link bit rate		56,000
link occupancy		0.4
C link cross section		24
ISUP messages per interoffice BHCA		6
ISUP message length, bytes		25
TCAP messages per transaction		2
TCAP message length, bytes		100
fraction of BHCA requiring TCAP		0.10
SCP investment/transaction/second	$	20,000

Wire Center Investment Module Inputs

Operator position parameters

investment per position	$	3,500
maximum utilization per position, CCS		27
operator intervention factor		10
operator position remote distance, mi		0

Wire center parameters

lot size, multiplier of switch room size	2
tandem/EO wire center common factor	0.40

Power and frame investment

served lines in wire center		sum of power and frame
0	$	10,000
1,000	$	20,000
5,000	$	40,000
25,000	$	100,000
60,000	$	500,000

Switch room size table

switch size, lines	floor area required
0	500
1,000	1,800
5,000	2,600
25,000	5,000
60,000	[illegible]

Construction costs, per sq ft

switch size, lines		construction, $/sq ft
0	$	75
1,000	$	85
5,000	$	100
25,000	$	125
60,000	$	150

Land price, per sq ft

lines in wire center		price/sq ft
0	$	5.00
1,000	$	7.50
5,000	$	10.00
25,000	$	15.00
60,000	$	20.00

Public telephone, per station $ 1,200

Toll traffic inputs

local call attempts	
call completion factor	0.70
intraLATA calls completed	
interLATA intrastate calls completed	
interLATA interstate calls completed	
local DEMs, thousands	
intrastate DEMs, thousands	
interstate DEMs, thousands	
tandem-routed fraction of total intraLATA traffic	0.2
average direct intraLATA route distance, mi	25
tandem-routed fraction of total interLATA traffic	0.2
average direct access route distance, mi	15

Interoffice transport investment			Unit Cost
Terminal Investment			
Number of fibers			24
FOT capacity, DS-3s			12
FOT fill			0.80
FOT, installed		$	43,000
Pigtails		$	60
Panel		$	1,000
EF&I, per hour		$	65
Medium Investment			
Fraction of structure assigned to telephone			0.33
Fraction of structure shared with feeder			0.25
Distance, mi			41
Regenerator spacing, mi			40
Regenerator investment, installed		$	15,000
Fiber cable inv/ft		$	2.00
Placement		$	2.00
Splice spacing,ft			20,000
Splice cost		$	15.00
Trenching/ft		$	45.00
Resurfacing/ft		$	10.00
Conduit/ft		$	4.00
Number of tubes			2
Manhole spacing			1,000
Manhole inv per manhole		$	5,000
Total Conduit			
Buried installation/ft		$	5.00
Pole inv		$	450
Pole spacing			150
Weighting			
	underground		0.3500
	buried		0.5000
	aerial		0.1500

Convergence Module Inputs

drop investment per line	$	40
NID investment per line	$	30
terminal and splice per line	$	35
average lines per business location		4

Distribution cable size	SAI investment (installed) copper feeder		fiber feeder	
0	$	600.00	$	2,500.00
100	$	700.00	$	2,700.00
200	$	900.00	$	2,900.00
400	$	1,100.00	$	3,100.00
600	$	1,300.00	$	3,300.00
900	$	1,500.00	$	3,500.00
1200	$	1,700.00	$	3,700.00
1800	$	1,900.00	$	3,900.00
2400	$	2,100.00	$	4,100.00
3000	$	2,300.00	$	4,300.00
3600	$	2,500.00	$	4,500.00

Digital loop carrier inputs

BCM "DLC" (TR-303)

site, housing, and power per RT	$	3,000
maximum lines		672
RT fill factor		0.90
common equipment investment	$	42,000
channel unit investment per line	$	75

BCM "AFC"

site, housing, and power per RT	$	2,500
maximum lines		100
RT fill factor		0.90
common equipment investment	$	10,000
channel unit investment per line	$	150

Convergence Module Inputs

Distribution structure inputs

density range limit	aerial fraction	buried fraction	underground fraction	buried installation/foot	conduit installation/foot
0	0.50	0.50	-	$ 2.00	$ 25.00
5	0.50	0.50	-	$ 2.00	$ 25.00
200	0.50	0.50	-	$ 2.00	$ 25.00
650	0.50	0.50	-	$ 3.00	$ 25.00
850	0.40	0.50	0.10	$ 3.00	$ 45.00
2550	0.65	0.05	0.30	$ 20.00	$ 70.00

pole spacing, feet	150	
pole investment	$ 450	
conduit investment per foot	$ 1.00	w/o trenching
manhole investment, per manhole	$ 3,000	
buried cable armoring multiplier	1.10	

Feeder structure inputs

Copper

density range limit	aerial fraction	buried fraction	underground fraction	manhole spacing, f	buried installation/foot	conduit installation/foot
0	0.50	0.45	0.05	800	$ 2.00	$ 25.00
5	0.50	0.45	0.05	800	$ 2.00	$ 25.00
200	0.50	0.45	0.05	800	$ 2.00	$ 25.00
650	0.40	0.40	0.20	800	$ 3.00	$ 25.00
850	0.10	0.10	0.80	800	$ 3.00	$ 45.00
2550	0.05	0.05	0.90	400	$ 25.00	$ 75.00

pole spacing, feet	150	
pole investment	$ 450	
conduit investment per foot	$ 1.00	w/o trenching
manhole investment, per manhole	$ 3,000	
buried cable armoring multiplier, Cu	1.10	

Fiber

density range limit	aerial fraction	buried fraction	underground fraction	manhole spacing, f	buried installation/foot	conduit installation/foot
0	0.35	0.60	0.05	2000	$ 2.00	$ 25.00
5	0.35	0.60	0.05	2000	$ 2.00	$ 25.00
200	0.35	0.60	0.05	2000	$ 2.00	$ 25.00
650	0.20	0.60	0.20	2000	$ 3.00	$ 25.00
850	0.10	0.10	0.80	2000	$ 3.00	$ 45.00
2550	0.05	0.05	0.90	2000	$ 20.00	$ 70.00

Buried cable armoring per foot, fiber $ 0.20

Expense Module Inputs

Debt fraction		0.45
Cost of Debt		0.077
Cost of Equity		0.119
corporate overhead factor		0.100
other taxes factor		0.050
operating state and local income tax factor		0.010
billing/bill inquiry per line per month	$	1.22
directory listing per line per month	$	0.15
service order processing fraction of 6623		0.346
forward-looking network operations factor		0.700
alternative CO switching factor		0.0269
alternative circuit equipment factor		0.0153
EO traffic-sensitive fraction		0.70
per-line monthly LNP cost	$	0.25
Carrier-carrier customer service, per line per year	$	1.56
NID expense per line per year	$	3.00
DS-0/DS-1 crossover		24
DS-1/DS-3 crossover		28
Switch line circuit offset per DLC line	$	35.00

economic life and tax inputs

tax rate	0.40
economic life -- 50 years maximum	
loop distribution	20
loop feeder	20
loop concentrator	10
end office switching	14.3
wire center	37
tandem switching	14.3
OS investment	8
transport facilities	19
STP	14
SCP	14
links	19
public telephones	9
general support	7

Structure fraction assigned to telephone

distribution	
aerial	0.33
underground	0.33
buried	0.33
feeder	
aerial	0.33
underground	0.33
buried	0.33

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Model Description

Hatfield Model

Version 2.2, Release 2

Hatfield Associates, Inc.
International Telecommunications Consultants
737 29th Street, Suite 200
Boulder, Colorado 80303

September 4, 1996

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COST OF NETWORK ELEMENTS

Florida — BELLSOUTH TELECOMM INC - FL

A. Loop elements

	0 - 5 lines/sq mi	5 - 200 lines/sq mi	200 - 650 lines/sq mi	650 - 850 lines/sq mi	850 - 2550 lines/sq mi	> 2550 lines/sq mi	Totals
Loop Distribution (including NID)							
Annual Cost	$ 7,032,926	$ 85,494,760	$ 59,178,675	$ 18,432,785	$ 113,120,314	$ 205,134,510	4929560078
Unit Cost/month	$ 67.84	$ 20.17	$ 10.26	$ 7.67	$ 6.18	$ 5.26	6.0625185[illegible]
Loop Concentration							
Annual Cost	$ 742,373	$ 16,184,868	$ 19,591,423	$ 8,271,186	$ 55,706,573	$ 79,018,657	1794738[illegible]
Unit Cost/month	$ 6.59	$ 3.92	$ 3.40	$ 3.38	$ 2.94	$ 2.02	2.545013[illegible]
Loop Feeder							
Annual Cost	$ 865,073	$ 9,808,200	$ 9,060,622	$ 3,628,497	$ 43,610,988	$ 98,805,390	1056807751
Unit Cost/month	$ 8.56	$ 2.32	$ 1.57	$ 1.49	$ 2.30	$ 2.53	2.3701[illegible]
Total Loop							
Annual Cost	$ 9,330,371	$ 111,786,823	$ 87,830,721	$ 30,272,468	$ 218,436,871	$ 382,864,667	838'188118
Unit Cost/month	$ 82.80	$ 26.91	$ 16.22	$ 12.44	$ 11.43	$ 9.76	11.[illegible]
Total lines	9,391	344,802	460,863	202,704	1,578,173	3,259,031	5874804
Total lines served by DLC	6,742	318,276	382,100	167,493	1,047,816	1,460,788	3375012.482

		Annual Cost	Units			Unit Cost	
End office switching	$	221,081,784					
1. Port	$	66,904,635	5,459,485	switched lines	$	1.02	per line/month
2. Usage	$	155,177,249	93,536,345,880	minutes	$	0.0017	per minute
Signaling network elements	$	7,953,978					
1. Links	$	113,138	512	links	$	18.41	per link per month
2. STP	$	3,884,071	72,348,209,841	TCAP + ISUP messages	$	0.00005	per signaling message
3. SCP	$	3,956,770	4,977,684,600	TCAP messages	$	0.00079	per signaling message
Transport network elements							
1. Dedicated	$	50,727,404	936,146	trunks	$	4.24	per DS 0 equivalent/month
Switched	$	29,620,213	532,827		$	0.00042	per minute
Special	$	21,107,191	416,319				
2. Common	$	4,871,549	6,869,374,354	minutes	$	0.00074	per minute per leg (orig or term)
3. Tandem switch	$	7,082,332	5,730,067,671	minutes	$	0.0012	per minute
Operator systems	$	7,376,405					
Public Telephone	$	3,181,476	n/a				
Total	$	1,137,803,064					
Total cost of switched network elements	$	18.14	per line/month				

8/16/00

Basic local service

monthly costs per line

Florida

BELLSOUTH TELECOMM INC - FL

Network costs	0 - 5 lines/sq mi	5 - 200 lines/sq mi	200 - 650 lines/sq mi	650 - 850 lines/sq mi	850 - 2550 lines/sq mi	> 2550 lines/sq mi	Weighted Average	
Loop	84.42	27.68	15.87	12.81	11.74	10.02	12.19	
Port	1.03	1.03	1.03	1.03	1.33	1.03	1.03	
End office usage	1.43	1.43	1.43	1.43	1.43	1.43	1.43	
Signaling	0.04	0.04	0.04	0.04	0.04	0.04	0.04	
Transport	0.08	0.08	0.08	0.08	0.08	0.08	0.08	
Billing/bill inquiries	1.44	1.44	1.44	1.44	1.44	1.44	1.44	
Directory listing	0.18	0.18	0.18	0.18	0.18	0.18	0.18	
LNP expense (when available)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
Total monthly cost per line (assumes LNP available)	88.91	37.08	20.18	17.30	16.22	14.50	16.98 wtd by hh	
Total lines	8,391	344,082	408,883	382,704	1,670,133	3,260,631	6,074,884	
Total households	6,434	222,460	301,030	123,878	928,727	1,668,787	3,237,218	
Annual Subsidy @ 20.00	5,320,084	32,193,613	553,274	0	0	0	38,066,970	

Model release date: 8/20/96

Assumed direct monthly per line costs:

billing/bill inquiries	1.22
directory listing	0.15
local number portability	0.25

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Hatfield Unbundled Loop Results by Density Zone including Statewide Average Florida

Density Zone (lines/sq. mi.)	Six Density Zones Proposed Rate/Month ($)
0-5	82.80
5-200	26.91
200-650	15.22
650-850	12.44
850-2550	11.43
>2550	9.79

	Three Density Zone Proposed Rate/Month ($)
0-200	28.39
200-850	14.40
>850	10.33

	Statewide Average Loop Rate/Month ($)
Proposed Statewide Weighted Average	11.89
FCC Proxy Ceiling	13.68

Sources:

(1) Hatfield Model Version 2.2, Release 2, submitted by AT&T on September 10, 1996, as an Ex Parte Presentation to the FCC in CC Docket No. 96-45.

(2) First Report and Order, Released August 8, 1996, In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, CC Docket No. 96-98, Appendix D, "State Proxy Ceilings for the Local Loop."