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AT&T

R. Gerard Salemme
Vice President - Government Affairs

Suite 1000
1120 20th Street, N.W.
Washington, DC 20036
202 457-3118
FAX 202 457-3205

November 22, 1996

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

Ms. Regina Keeney
Chief, Common Carrier Bureau
Federal Communications Commission
1919 M Street, N.W.
Washington, DC 20554

Re: **Interstate Access Charge Reform**

Dear Ms. Keeney:

AT&T Corp. ("AT&T") makes the following recommendations as to the proper direction of access reform in anticipation of the Commission's forthcoming notice of proposed rulemaking on this issue.

What is wrong with the current system for access pricing?

Since the divestiture of the Bell System, switched access has been priced substantially above cost, purportedly to provide a necessary subsidy for basic local service.[1] AT&T estimates that interstate access charges collected annually from interexchange carriers are more than $11 billion higher than the actual economic

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[1] Some of these subsidies are built directly into the access charge structure, including the Carrier Common Line Charge ("CCLC"), the Residual Interconnection Charge ("RIC"), Long Term Support ("LTS"), and DEM Weighting ("DEM"). Others, such as the High Cost Fund ("HCF"), and the Lifeline and Link-Up programs, have the effect of raising interexchange carrier ("IXC") toll prices by imposing an additional charge on IXCs per presubscribed line.

cost of providing access, based on forward-looking economic cost studies.[2] Only about $4 billion of this amount is needed to subsidize the rates for local service in high cost areas, with the objective that universal service goals are met.[3] The remaining $7 billion represents a pure uneconomic subsidy to monopoly incumbent local exchange carriers ("ILECs"). This uneconomic subsidy exists because access is priced based on the embedded costs and other historical inefficiencies of local exchange carriers rather than economically efficient, forward-looking costs. Interstate switched access rates are inflated also because the ILECs' costs have been overallocated to the interstate jurisdiction for the avowed purpose of supporting universal service, and because those rates recovered from IXCs include retail costs (such as ILEC marketing expenses) and other costs unrelated to the provision of local exchange and access services. In addition, the ILECs have been able to realize excessive earnings from interstate access under price caps because of understated productivity factors.

By providing funding beyond what is required to sustain universal service, the existing access charge system not only encourages, and indeed rewards,

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[2] The $11.0 billion includes $10.5 billion representing the difference between the current nationwide average per-minute rate for interstate switched access for Tier 1 LECs and the forward-looking economic cost-based access per-minute rate currently estimated by the Hatfield model.

[3] The $4 billion includes $3.3 billion representing the amount by which the forward-looking economic costs for local service in high cost areas, based on current estimates from the Hatfield model, exceed an illustrative benchmark monthly rate of $20. It also assumes that this $3.3 billion amount will be funded by a new Universal Service Support Fund from interstate carriers' interstate revenues only (an issue which has yet to be decided). It further assumes that an additional $700 million of rural carrier support for LTS and DEM will be supported in the same manner. See Appendix B (Universal Service Reform). Accordingly, the full amount ($4 billion) should be reflected as an offset against the ILECs' interstate switched access revenues.

inefficiency, but it is profoundly anticompetitive. Problems associated with the current access charge system are widely recognized throughout the industry and include:

- ***Excessive access rates are anticompetitive as ILECs enter long distance markets.*** The excessive returns generated by today's access rates produce grave risks to competition in toll markets -- including predatory pricing -- to the extent that monopoly access providers integrate into those markets. They give incumbent LECs entering the long distance ("LD") market an artificial competitive advantage over IXCs by creating a "price squeeze" that puts long distance carriers at a disadvantage in competing with the ILECs. As long as IXCs are dependent on the ILECs for most of their switched access, they are burdened with artificially inflated access costs -- costs which the ILEC would not incur were it to provide LD service. This artificial cost advantage enables the ILECs to squeeze IXC margins via aggressive price reductions for LEC-provided LD service. Requirements that ILECs "impute" the price of access into their own costs of providing LD service do little to ameliorate this problem because the imputed price is not a real cost to the ILEC.

- ***Excessive access rates are economically inefficient.*** Because current access rates far exceed economic cost, they are economically inefficient, resulting in distortion of both usage of long distance services and IXC choice of access arrangements. Usage of long distance service is suppressed because artificially high access rates inflate the cost of long distance services. For instance, customers have an incentive to avoid high access costs by placing calls over the Internet. This artificial alternative is made possible by the "exemption" from inflated access charges enjoyed by Internet and other enhanced service providers -- an exemption that would not be justified or appropriate if access charges recovered only the economic cost of access. IXCs' choice of access arrangements is also distorted because inflated switched access charges provide incentives to substitute alternatives, such as special access or CAP-provided access, to connect with high volume customers, even where they are less efficient.

- ***Excessive access rates are associated with numerous forms of discriminatory treatment* based on artificial distinctions among categories of customers.** Switched access customers pay much more than special access customers for use of the same facilities, and they also

pay more than purchasers of unbundled network elements. Interstate access rates frequently differ from intrastate interLATA access rates, which in turn may differ from intraLATA access charges. Long distance telephony over the Internet usually escapes access charges entirely.[4] Switched and special access, interstate and intrastate access, purchasers of access, interconnecting local carriers and purchasers of unbundled elements all make similar use of the ILEC network and therefore these various components should be priced similarly, in an economically rational manner.

How should carrier access be priced?

In order to foster competitive markets for local service and exchange access, as well as interexchange services, access prices must be set at economically efficient levels. Carrier access should be priced in exactly the same manner as unbundled network elements and interconnection based on forward-looking economic cost. Access pricing should be determined by examining the incremental costs of satisfying access demand, which uses the same components associated with interconnection, transport and termination, i.e., switching, interoffice transport and signaling. A model, such as the Hatfield model, which accurately measures the forward-looking economic costs of serving the total demand for these components, should be used to establish access prices at economically efficient levels.[5] Only when access is priced in this manner will the ability of ILECs to engage in price squeezes, to discriminate against other carriers in local, access and interexchange markets, and to introduce other competitive distortions in those markets be halted.

Cost-based pricing of access, moreover, is required by related statutory requirements that interconnection and unbundled elements (identical to access) be priced at cost and that subsidies from non-

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[4] Once switched access is reformed, as suggested herein, enhanced service providers should also be required to pay access.

[5] See Appendix A (Use of the Hatfield Model to Develop Forward-looking Economic Costs of Exchange Access).

competitive services to competitive ones be eliminated.[6] Assuming proper funding of legitimate universal service objectives, there is no permissible basis for additional subsidies in access.

Pricing of access at forward-looking economic cost means that IXCs pay only for the switching, signaling and transport elements used in access. It thus requires immediate elimination of the CCLC and RIC.

Loop costs should be excluded from carrier access charges because the loop is not an incremental cost of providing access. Loop costs should thus be recovered from the end-user and, to the extent that support for universal service is required, it will be provided via the new universal service support mechanism. Loop costs currently recovered from switched access via the CCLC amount to approximately $4 billion annually.

The RIC, which represents approximately $3 billion in annual revenues, should also be eliminated. The RIC has never been associated with any specific underlying cost of providing access. It is basically a contribution element that was established to maintain LEC revenues at their historical levels when the local transport component of switched access was restructured at the end of 1993. The U.S. Court of Appeals for the District of Columbia Circuit has ruled that unless the FCC can find that the RIC is cost-justified -- a finding that is squarely at odds with prior Commission decisions -- that charge must be eliminated.[7]

Transitional Issues

The revenues collected from pricing of access at forwarding-looking economic cost will be less than the current revenues from access. Part of the difference will be recovered through the new Universal Service

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[6] Sections 251(c)(2), (c)(3); 252(d)(1); 254(k) of the Telecommunications Act of 1996, P.L. 104-104, 110 Stat. 56 (1996), to be codified as 47 U.S.C. §§ 251(c)(2), (c)(3); 252(d)(1); 254(k).

[7] Competitive Telecommunications Association v. FCC, 87 F.3d 522 (D.C. Cir. 1996).

Fund.[8] Other components of the difference are addressed by identifying and eliminating from access the retail expenses not associated with the provision of access services ($900 million)[9] and adopting a higher 8.8% productivity factor ($500 million) within the current price cap review proceeding.[10]

The immediate elimination of any residual amount not recovered in access rates set at forward-looking economic cost would best serve the public interest by substantially reducing long distance prices, as well as increasing efficiency and providing the correct price signals to customers. Contrary to what some ILECs may claim, a decision to limit an ILEC's recovery to the true economic value of its facilities -- i.e., rates based on the most efficient, least-cost means

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8 See Appendix B (Universal Service Reform). Universal service will be funded through a competitively neutral funding mechanism, which the FCC will establish based on the Joint Board's recommendations in CC Docket 96-45. Under the new universal service fund mechanism the requirement for subsidies in high cost areas will be established based on a proxy model of forward-looking economically efficient costs, and all interstate telecommunications carriers (not just IXCs) will contribute to universal service support. In addition, the subsidy associated with any subscriber line will become available to whichever eligible carrier wins the local customer. This new universal service support mechanism will displace the need for subsidies that are currently recovered through the existing access charge regime to support high cost areas and low-income consumers. It will also provide for any new funding that is needed to support discounts for eligible schools, libraries and rural health care providers.

9 See Appendix C (Inappropriate Retail Expense in Interstate Switched Carrier Access).

10 In its March 1, 1996 Reply Comments in CC Docket 94-1 (pp. 38-40), AT&T proposed X-Factor options of 7.8% and 8.8% for the LECs' interstate services.

of providing the services or functionalities in question -- implicates no constitutional concerns.[11]

To the extent the Commission nonetheless decides to allow recovery of a portion of this residual amount for an interim period, the burden of this recovery cannot be borne solely by IXCs. Rather, if it is to be recovered at all, the residual cost must be funded in a competitively neutral manner. This could be accomplished by placing the residual in a fund, to which all carriers contribute and from which any carrier that provides local service to the end-user customer would be able to draw a pro rata per-line portion. The fund should then be phased out over a reasonably short period, such as three years. If, however, the ILEC enters the long distance market before then, the residual should be eliminated in its entirety in its region, with sufficient notice to give IXCs an opportunity to develop marketing plans to flow through the reductions to their customers when ILEC entry occurs.

Regulation of Access

The price cap system that regulates the interstate access prices of Tier 1 LECs should be retained. Elimination of the CCLC and RIC elements will require appropriate modifications of the Common Line and Trunking baskets. Continued price cap regulation will avoid the need for annual forward-looking economic cost studies to recalibrate the price of access to assure that LEC access rates continue over time to reflect their underlying costs. Although there will be significant access reductions initially because of cost-based pricing, ongoing reductions are likely to be required. Continued growth in LEC productivity and stimulation of access demand as toll prices are reduced and competition takes root in local markets will result in significant cost reductions which should be reflected in lower access prices. Price cap regulation with an appropriate productivity offset (X-Factor) will ensure that access prices continue to match underlying cost.

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[11] As the Supreme Court has observed, the Fifth Amendment has only been applied "to prevent the governmental destruction of existing economic values." Market St. Ry. Co. v. Railroad Comm'n of the State of California, 324 U.S. 548, 567 (1945) (emphasis added).

AT&T urges the Commission to take prompt action to reform the interstate access charge regime and thereby help make possible the realization of the 1996 Telecommunication Act's procompetitive goals. Unless subsidies and price discrimination are eliminated from access, these objectives cannot be achieved.

Very truly yours,

Gary Salamone/Be

Enclosures

cc: Larry Atlas
Lauren Belvin
James Casserly
Daniel Gonzalez
Richard Metzger
John Nakahata

Appendices

Appendix A:	Use of the Hatfield Model to Develop Forward-Looking Economic Costs of Exchange Access
Appendix B:	Universal Service Reform
Appendix C:	Inappropriate Retail Expense in Interstate Switched Carrier Access

Cardinal

Appendix A

Use of the Hatfield Model to Develop Forward-looking Economic Costs of Exchange Access

The purpose of this paper is to briefly describe how the Hatfield model can be used to calculate the Forward-looking Economic Cost (FLEC) of exchange access. For a complete discussion of the structure and operation of the Hatfield model, see Attachment 1.

While the Hatfield model develops forward-looking economic costs for eleven unbundled network elements (UNEs), only seven of the usage-sensitive UNEs are used in the provision of exchange access:

- End Office Switching
- Dedicated Transport
- Common Transport
- Tandem Switching
- Signaling Links
- Signal Transfer Point
- Service Control Point

Because the UNE structure closely maps to existing access rate elements, FLEC pricing of access is relatively straightforward. There are significant differences, however, in the methodology of FLEC pricing as compared to traditional embedded, separated costing of access. Namely, FLEC relies on:

- Total expected demand for the element
- Forward-looking technology
- Existing wire center topology
- Forward-looking cost of capital
- Economic depreciation
- Plus a reasonable allocation of forward-looking common costs

In addition, it is important to note that because FLEC pricing involves economic costs, no jurisdictional distinctions are made between interstate and state minutes of use. In Hatfield, an end office switching minute is an end office switching minute; an inter-office circuit is an inter-office circuit. Thus, under FLEC one would expect that the rates for usage of the same network element would be the same regardless of the jurisdictional nature of the usage.

Common Line

While Hatfield produces FLEC costs for the local loop, no portion of these costs is included in a FLEC price for exchange access. FLEC only considers the additional cost to the ILEC of providing the element. ILEC provision of exchange access requires no additional loop costs.

Local Switching

Hatfield produces unit costs for the End Office Switching UNE in two components: line ports and usage. For access costing purposes, the line port component of End Office Switching does not apply to exchange access.[1] However, Hatfield's unit cost for the usage component of End Office Switching, i.e., end office switching per minute, is functionally identical to the Local Switching rate element in current access tariffs. This component is directly available in the "Unit Cost" tab of the Hatfield expense module.

Tandem Switching

Tandem Switching costs per minute are provided in Hatfield and are no different than Tandem Switching for exchange access. The Tandem Switching cost is provided in the "Unit Cost" tab of the Hatfield expense module.

Transport

Hatfield provides separate unit costs for common transport links and dedicated transport links in the "Unit Costs" tab of the expense module. Common transport is provided as a per-minute per leg cost, while dedicated transport is computed per DS-0 equivalent per month. The DS-0 equivalent trunk cost calculated in Hatfield is based on an assumption of OC-12 inter-office facilities. Dedicated transport costs for DS-1 and DS-3 are also available in Hatfield in the "Cost Detail" tab of the expense module.

A difference between Hatfield and today's access transport rate structure is the fact that Hatfield develops the costs based on how transport is actually provided. That is, Hatfield includes facilities from the LEC's wire center that serves an IXC's POP to a tandem switch in its development of dedicated transport facilities rather than assigning these costs to common transport.

Signaling

The Hatfield model provides signaling unit costs as follows:

D Links	Per link per month	Cost Details Tab
STP	Per signaling message	Unit Costs Tab
SCP	Per signaling message	Unit Costs Tab

If this degree of unbundling is not required in access rates, these costs could be converted to per minute rates for inclusion in the Tandem and End Office Switching access rate elements.

[1] As for loops, line ports represent a flat cost required for exchange service and thus are not an additional cost to the ILEC of providing exchange access.

Appendix A
Attachment 1

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

TABLE OF CONTENTS

I. INTRODUCTION 1
A. OVERVIEW 1
B. EVOLUTION OF THE HATFIELD MODEL 1
C. PURPOSE OF THIS DOCUMENT 3
II. STRUCTURE OF THE MODEL 3
A. GENERAL NETWORK COMPONENTS DESCRIPTION 3
1. Loop description 4
2. Interoffice network description 6
B. OVERVIEW OF MODEL ORGANIZATION 8
1. BCM-PLUS loop input data file 9
2. Line Converter Module 9
3. BCM-PLUS Data Module 10
4. BCM-PLUS Loop Module 10
5. Wire Center Module 10
6. Convergence Module 11
7. Expense Module 11
C. MODULE DESCRIPTIONS 11
1. BCM-PLUS Input Data File 11
2. Line converter module 12
3. BCM-PLUS Data module 14
4. BCM-PLUS Loop Module 15
5. Wire Center Investment Module 21
6. Convergence module 28
7. Expense Module 32
III. SUMMARY 40

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

APPENDIX B Instruction Manual

APPENDIX C Default Values of User-Adjustable Inputs

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" model that developed

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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℠ 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.

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 HM2.2.2

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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.

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.

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.

1. Loop description

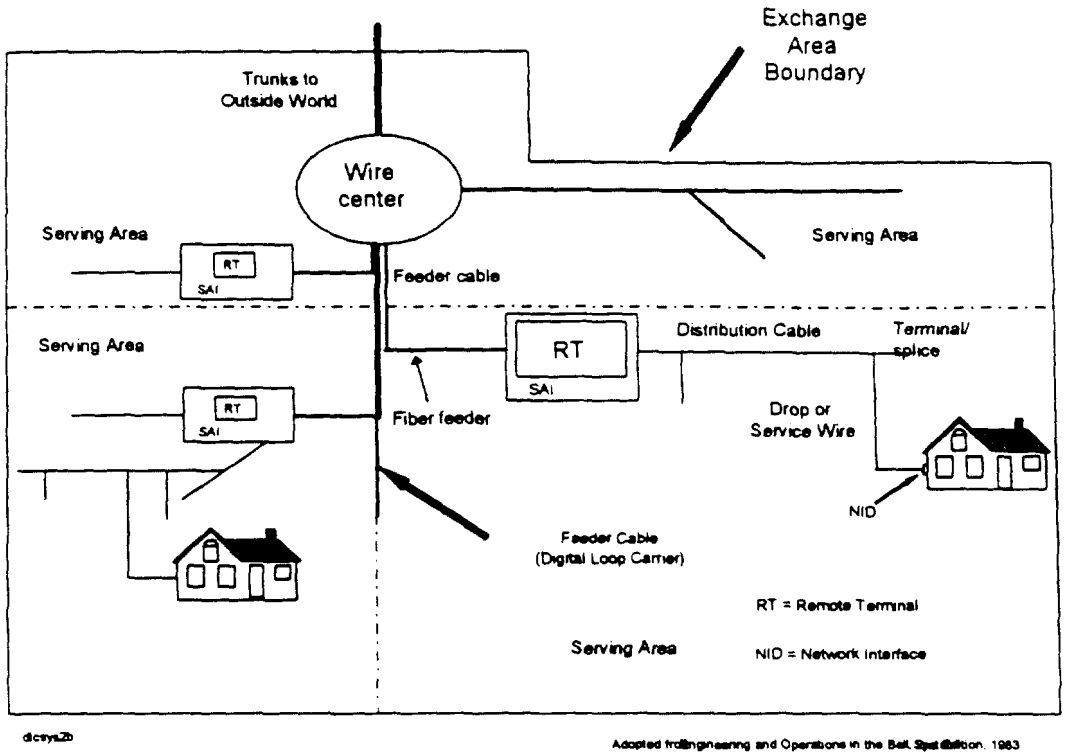

Figure 1 Loop components

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]

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.

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.

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.

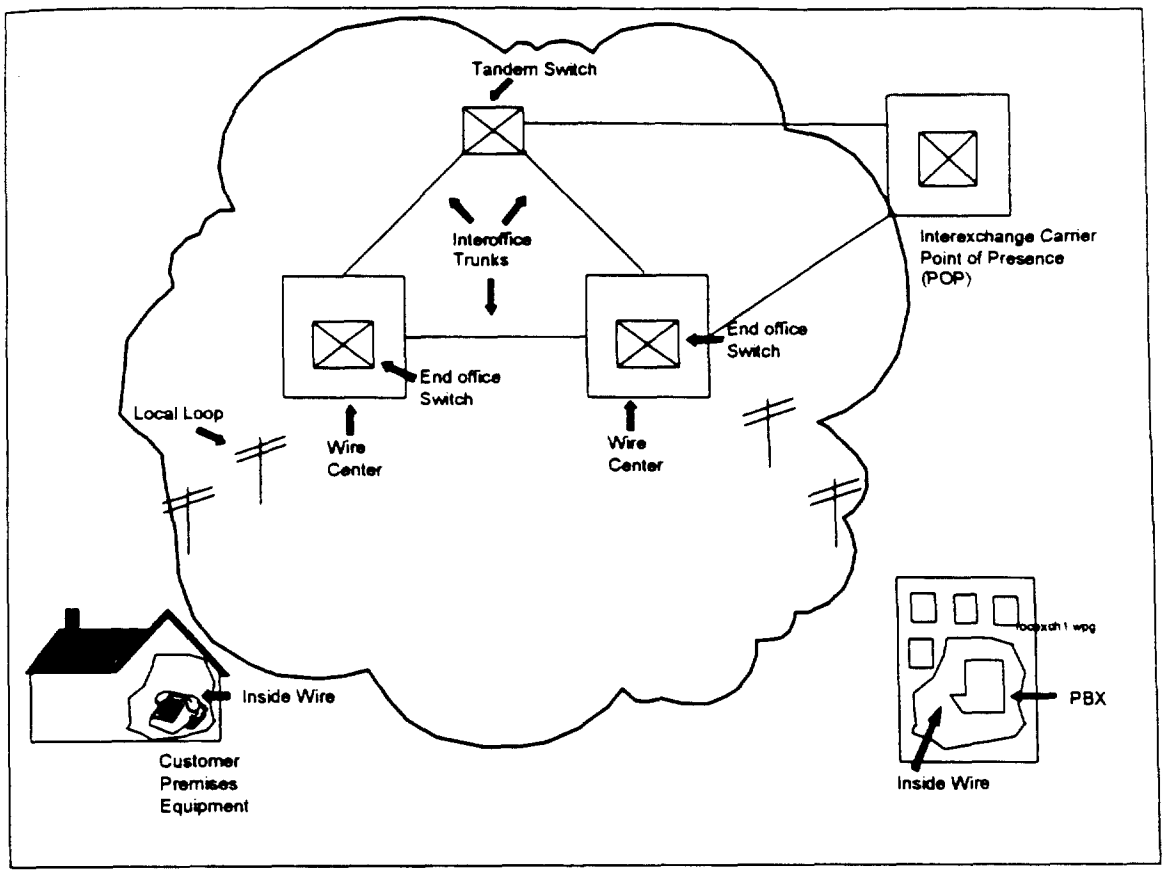

Figure 2 Interoffice network

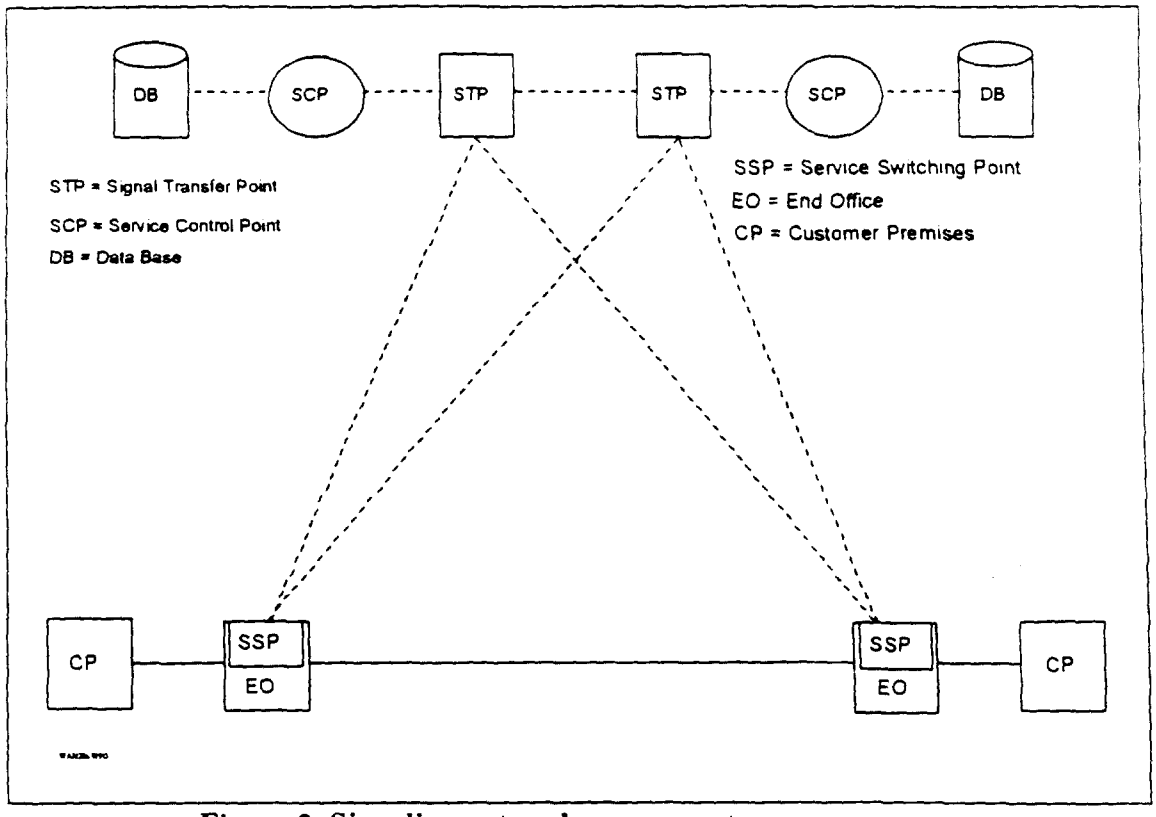

Figure 3 Signaling network components

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.

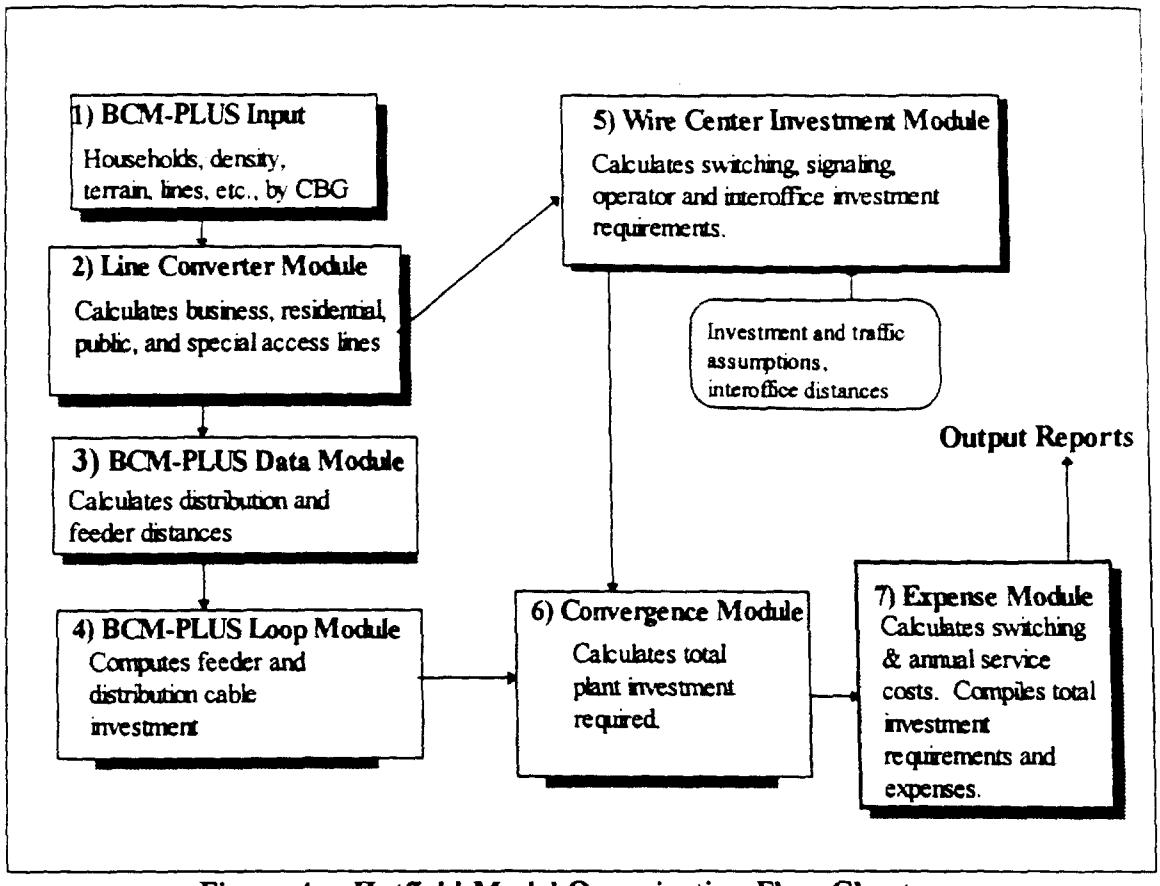

Figure 4 Hatfield Model Organization Flow Chart

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 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.