AT&T

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November 14, 1997

David Waddell
Executive Secretary
Tennessee Regulatory Authority
460 James Robertson Parkway
Nashville, Tennessee 37243

Re: ***Universal Service Generic Contested Case - Docket 97-00888***

Dear Mr. Waddell:

Please find enclosed for filing in the above-referenced docket AT&T's Response to Issue 16 of the Status Report of Technical Conference held on October 14.

Respectfully Submitted,

Jim Lamoureux

Jim Lamoureux

Encls.

Cc: All parties of record

BEFORE THE
TENNESSEE REGULATORY AUTHORITY
NASHVILLE, TENNESSEE

In Re:	)	
UNIVERSAL SERVICE GENERIC	)	
CONTESTED CASE	)	Docket No. 97-00888
	)	
	)	

AT&T 'S RESPONSE TO ISSUE 16 OF THE STATUS REPORT OF TECHNICAL CONFERENCE HELD ON OCTOBER 14, 1997

AT&T Communications of the South Central States, Inc. ("AT&T") hereby provides its Response to Issue 16 as requested in the October 16, 1997, Status Report of Technical Conference Held on October 14, 1997.

Phase II - Cost Issues

16. What cost model or method should be adopted to calculate needed universal service supports? (Likely to be contested) 5(a)(vii), 14b)(i), 14(b)(ii) Note: the word "method" is used to mean "algorithm(s) and input value(s)."

The Hatfield Model should be adopted to calculate needed universal service support in Tennessee. The Hatfield Model incorporates the most appropriate methodology and inputs for calculating universal service support. AT&T's responses to the sub-issues below describe the inputs and methodology used by the Hatfield Model in calculating universal service support.

a. What method should be used to population distributions within service areas.

The Hatfield Model should be used to calculate the cost of universal service support in Tennessee. To estimate the costs of the loop plant emanating outward from a wire center, it is vital to determine accurately the set of customers who are served by each wire center. Two general approaches may be followed: geographic and/or logical.

Earlier versions of the Hatfield Model (releases 2.1 and 2.2), used a geographic approach. Geographies (which were CBGs), were assumed to be served by the closest wire center in radial distance. This could have the result of some customers or geographies being assigned to wire centers, or to ILECs, that did not actually serve them.

Releases 3.0, 3.1 and 4.0 of the Hatfield Model use a logical approach that improved greatly upon the earlier geographical "closest distance" approach. Under this methodology, the actual NPA-NXXs of the telephone lines located in a CBG are examined to determine the identity of the wire center serving the most telephone lines in the CBG. This methodology eliminates the possibility that a CBG would be assigned to a wire center that did not actually provide significant service to that CBG. However, it remained possible that if more than one wire center actually served the CBG, some customers in the CBG would be assigned to a wire center that did not actually serve them.

The upcoming release of the Hatfield Model (version 5.0) will perform its analysis on a customer cluster level. To do this, it will use a combination of logical (NPA-NXX) and geographical (CB) mapping. Although the fact that wire center boundaries may split individual CBs suggests that logical NPA-NXX mapping is most appropriate, there are several reasons why Hatfield 5.0 will use geographical CB-based mapping in addition to an NPA-NXX analysis. The first is that a new data source from Business Location Research (BLR) has become available that provides wire center boundaries down to approximately the CB level. The second is that there can be CBs that lack any NPA-NXX information (either because they are empty or their data are incomplete). Third, complete reliance on NPA-NXXs can be misleading in the presence of FX lines, or customers receiving Centrex or ISDN service from a remote switch.

b. What method should be used to match a model's wire center line count to a LEC's existing wire center line count?

See Response to (a) above.

c. What method should be used to determine the proper outside plant mix (i.e., the fractions of aerial, underground, and buried cable) and associated materials and installation costs?

The following passages from the Hatfield Inputs Portfolio ("HIP") release 2.5 describe the inputs and methods used in the Hatfield Model to determine the materials and installation costs and the proper outside plant mix.

- COPPER DISTRIBUTION CABLE

Copper Distribution Cable, $/foot	
Cable Size	**Cost/foot (including engineering, installation, delivery and material)**
2400	$20.00
1800	$16.00
1200	$12.00
900	$10.00
600	$7.75
400	$6.00
200	$4.25
100	$2.50
50	$1.63
25	$1.19
12	$0.76
6	$0.63

Support: These costs reflect the use of 24-gauge copper distribution cable for cable sizes below 400 pairs, and 26-gauge copper distribution cable for cable sizes of 400 pairs and larger. Although 24-gauge copper is not required for transmission requirements within 18,000 feet of a digital central office with a 1,500 ohm limit, or a GR-303 integrated digital loop carrier system with a 1,500 ohm limit, a heavier gauge of copper is used in smaller cable sizes to prevent damage from craft handling wires in distribution terminals and pedestals. For cables of 400 pairs and larger, splices are normally enclosed in splice cases, and are not subject to wire handling problems.

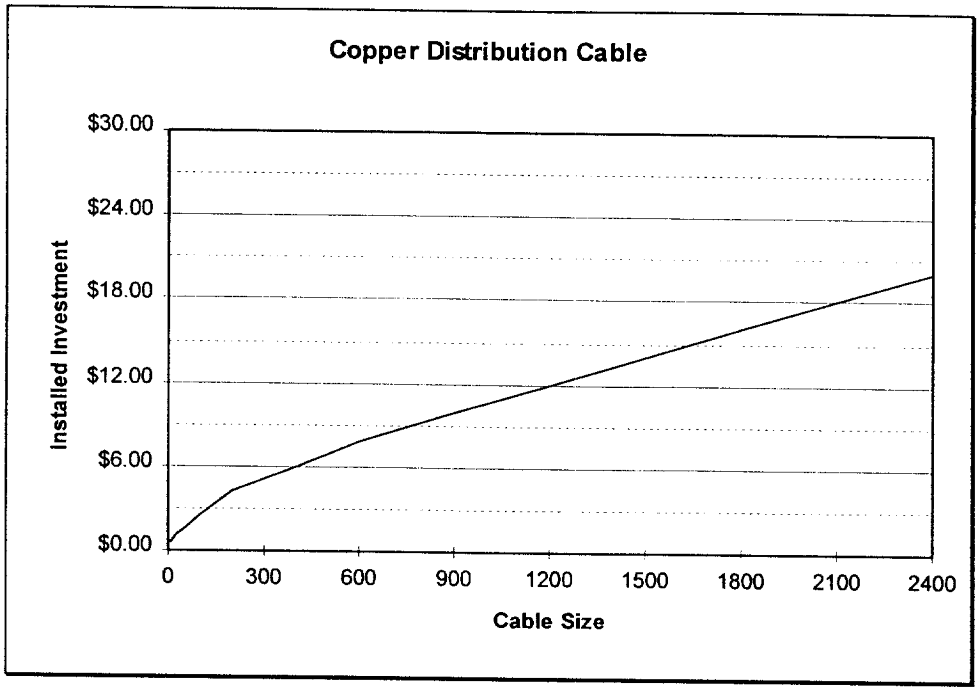
Cable below 400 Pairs: Outside plant planning engineers commonly assume that the cost of cable material can be represented as an a + bx straight line graph. In fact, Bellcore Planning tools, EFRAP I, EFRAP II, and LEIS:PLAN have the engineer develop such an a + bx equation to represent the cost of cable. As technology, manufacturing methods, and competition have advanced, the price of cable has been reduced. While in the past, the cost of copper cable was typically ($.50 + $.01 per pair) per foot, current costs are typically ($.30 + $.007 per pair) per foot.

In the opinion of expert outside plant engineers, material represents approximately 40% of the total installed cost. This is a widely used rule of thumb among outside plant engineers. Experience of outside plant experts used for developing the HM 3.1 includes writing and administering hundreds of outside plant "estimate cases" (large undertakings). Outside plant engineering experts have agreed that 40% material to total installed cost is a good approximation. Such expert opinions were also used to determine that the average engineering content for installed copper cable is 15% of the installed cost. The remaining 45% represents direct labor for placing and splicing cable, exclusive of the cost of splicing block terminals into the cable.[1]

Cable of 400 Pairs and Larger: As copper cable sizes become larger, engineering cost is based more and more on sheath feet, rather than cable size. The same is true for cable placing and splice set-up. Therefore the linear relationship between the number of copper pairs and installed cost is somewhat reduced. A review of many installed cable costs around the country were used by the engineering team to estimate the installed cost of copper cable for sizes of 400 pairs and larger.

[1] The formula would produce a material price of $.38/ft. for 12 pair 24 gauge cable, and $.34/ft. for 6 pair 24 gauge cable. An actual quote for materials was obtained at $.18/ft. for 12 pair 24 gauge cable, and $.12/ft. for 6 pair 24 gauge cable. The significant difference in material cost is perceived to be the result of the very small quantity of sheath required for 12 and 6 pair cables. Therefore, the formula generated material price was reduced by $.20 and $.22 for 12 and 6 pair cables respectively, but the engineering and labor components were retained at original formula levels, since neither would be affected by the reduction in material price.

The following chart represents the values used in the model.



- RISER CABLE

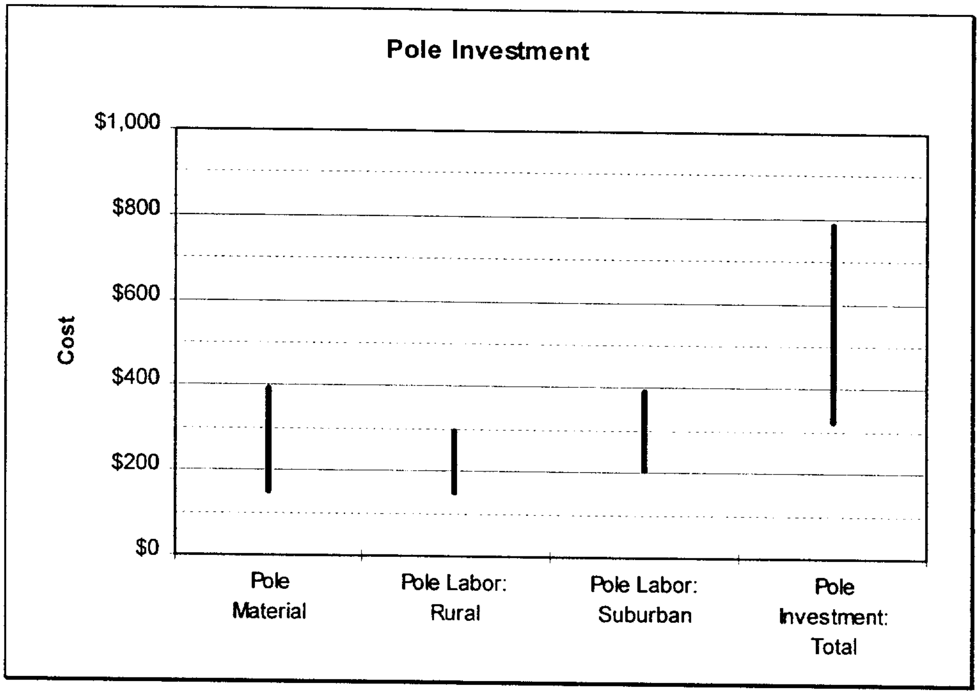
Riser Cable, $/foot	
Cable Size	**Cost/foot (including engineering, installation, delivery and material)**
2400	$20.00
1800	$16.00
1200	$12.00
900	$10.00
600	$7.75
400	$6.00
200	$4.25
100	$2.50
50	$1.63
25	$1.19
12	$0.76
6	$0.63

Support: Riser cable is assumed to cost the same per foot as equivalent-sized distribution cable.

- POLE INVESTMENT

Pole Investment	
Materials	$201
Labor	$216
Total	*$417*

Support: Pole investment is a function of the material and labor costs of placing a pole. Costs include periodic down-guys and anchors. Utility poles can be purchased and installed by employees of ILECs, but are frequently placed by contractors. Several sources revealed the following information on prices.

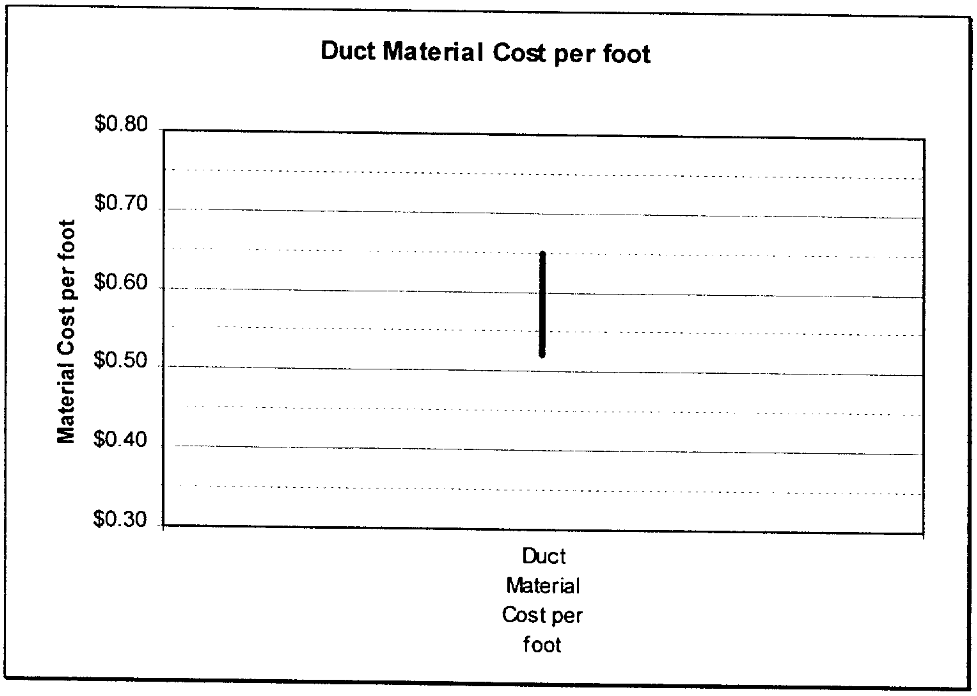


The exempt material load on direct labor includes ancillary material not considered by FCC Part 32 as a unit of plant. That includes items such as downguys and anchors that are already included in the pole placement labor cost. The steel strand run between poles is likewise an exempt material item, charged to the aerial cable account. The cost of steel strands is not included in the cost of poles; it is included in the installed cost of aerial cable.

- PVC PIPE

Material cost per foot of duct for 4" PVC	
4" PVC	$0.60

Support: Several suppliers were contacted for material prices. Results are shown below.



The labor to place conduit in trenches is included in the cost of the trench, not in the conduit cost.

Under the Model's assumptions, a relatively few copper cables serving short distances (e.g., less than 9,000 ft. feeder cable length), and one or more fiber cables to serve longer distances, will be needed. Since the number of cables in each of the four feeder routes is relatively small, the predominant cost is that of the trench, plus the material cost of a few additional 4" PVC conduit pipes. No additional allowance is necessary for stabilizing the conduit in the trench.

- INNERDUCT MATERIAL

Inner Duct Material Investment per foot
$0.30

Support: Innerduct might permit more than one fiber cable per 4" PVC conduit. The model adds investment whenever fiber overflow cables are required.

- FIBER FEEDER INVESTMENT

Fiber Feeder Investment, per foot	
Cable Size	**$/foot (u/g & aerial)**
216	$13.10
144	$9.50
96	$7.10
72	$5.90
60	$5.30
48	$4.70
36	$4.10
24	$3.50
18	$3.20
12	$2.90

Support: Outside plant planning engineers commonly assume that the cost of cable material can be represented as an a + bx straight line graph. In fact, Bellcore Planning tools, EFRAP I, EFRAP II, and LEIS:PLAN have the engineer develop such an a + bx equation to represent the cost of cable. As technology, manufacturing methods, and competition have advanced, the price of cable has been reduced. While in the past, the cost of fiber cable was typically ($.50 + $.10 per fiber) per foot, current costs are typically ($.30 + $.05 per fiber) per foot.

Splicing Engineering and Direct Labor are included in the cost of the Remote Terminal Installations, and the Central Office Installations, since field splicing is unnecessary with fiber cable pulls as long as 35,000 feet between splices.

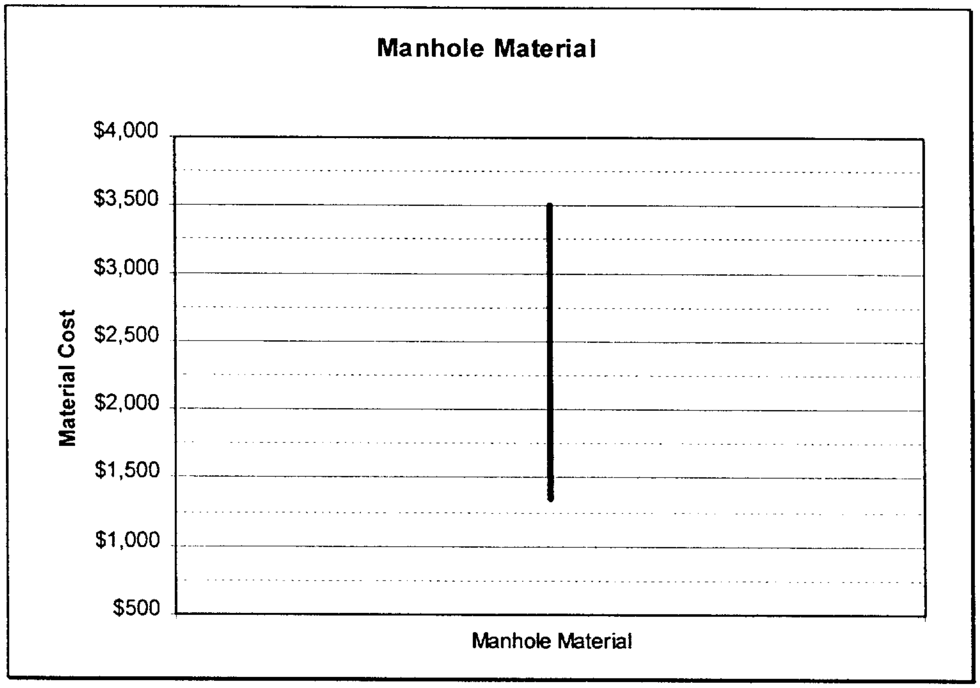
Placing Engineering and Direct Labor are estimated at $2.00 per foot, consisting of $0.50 in engineering per foot, plus $1.50 direct labor per foot. These estimates were provided by a team of Outside Plant Engineering and Construction experts.

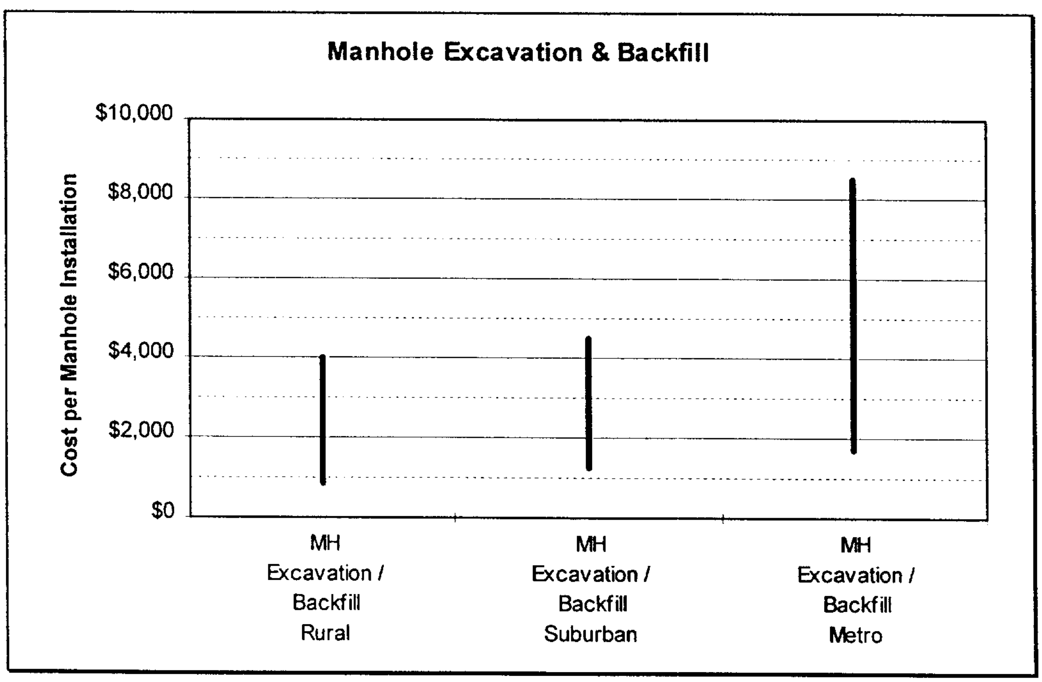
The following chart represents the default values used in the model.

- MANHOLE INVESTMENT – COPPER FEEDER

Copper Cable Manhole Investment						
Density Zone	**Materials**	**Frame & Cover**	**Site Delivery**	**Total Material**	**Excavation & Backfill**	**Total Installed Manhole**
0-5	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
5-100	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
100-200	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
200-650	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
650-850	$1,865	$350	$125	*$2,340*	$3,200	*$5,540*
850-2,550	$1,865	$350	$125	*$2,340*	$3,500	*$5,840*
2,550-5,000	$1,865	$350	$125	*$2,340*	$3,500	*$5,840*
5,000-10,000	$1,865	$350	$125	*$2,340*	$5,000	*$7,340*
10,000+	$1,865	$350	$125	*$2,340*	$5,000	*$7,340*

Support: Costs for various excavation methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries validated the opinions of outside plant experts and are revealed in the following charts.


Manhole Material
Material Cost
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
Manhole Material


Manhole Excavation & Backfill
Cost per Manhole Installation
$10,000
$8,000
$6,000
$4,000
$2,000
$0
MH Excavation / Backfill Rural
MH Excavation / Backfill Suburban
MH Excavation / Backfill Metro

- PULLBOX INVESTMENT – FIBER FEEDER

Fiber Pullbox Investment		
Density Zone	**Pullbox Materials**	**Pullbox Installation**
0-5	$280	$220
5-100	$280	$220
100-200	$280	$220
200-650	$280	$220
650-850	$280	$220
850-2,550	$280	$220
2,550-5,000	$280	$220
5,000-10,000	$280	$220
10,000+	$280	$220

Support: The information was received from a Vice President of PenCell Corporation at Supercom '96. He stated a price of approximately $280 for one of their larger boxes, without a large corporate purchase discount. Including installation, HM 4.0 uses a default value of $500.

d. What method should be used to determine drop lengths and associated costs?

- DROP DISTANCE

Definition: A copper 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. This parameter represents the average length of a drop wire in each of nine density zones.

Drop Distance by Density	
Density Zone	**Drop Distance, feet**
0-5	150
5-100	150
100-200	100
200-650	100
650-850	50
850-2,550	50
2,550-5,000	50
5,000-10,000	50
10,000+	50

Support: The Hatfield Model (HM) 4.0 assumes that drops are run from the front of the property line. House and building set-backs therefore determine drop length. Set-backs range from as low as 20 ft., in certain urban cases, to longer distances in more rural settings. While HM 4.0 assumes that lot sizes are twice as deep as they are wide, it is assumed that houses and buildings are normally placed towards the front of lots. Reasons for this include the cost of asphalt or cement driveways, unwillingness to remove snow from extremely long driveways in non-sunbelt areas, and the fact that private areas and gardens are usually situated in the backyard of a lot.

It should be noted that although exceptions to drop lengths may be observed, the model operates on average costs within density zones. The last nationwide study of actual loops produced results indicating that the average drop length is 73 feet.[2]

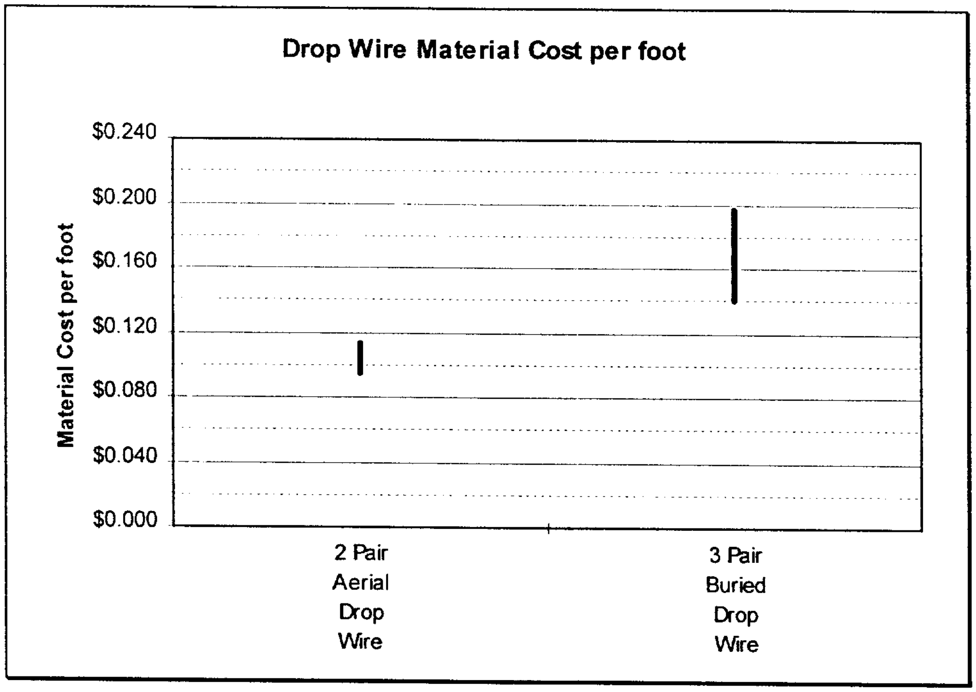
- DROP CABLE INVESTMENT, PER FOOT AND PAIRS PER WIRE

Definition: The investment per foot required for aerial and buried drop wire, and the number of pairs in each type of drop wire.

[2] Bellcore, *BOC Notes on the LEC Networks - 1994*, p. 12-9.

Drop Cable Investment, per foot		
	Material Cost Per foot	Pairs
Aerial	$0.095	2
Buried	$0.140	3

Support: Price quotes for material were received from several sources. Results were as follows:



e. What method should be used to determine structure sharing (e.g., poles, trenches, conduits)?

- BURIED DROP SHARING FRACTION

Definition: The fraction of buried drop cost that is assigned to the telephone company. The other portion of the cost is borne by other utilities.

Buried Drop Sharing Fraction	
Density Zone	**Fraction**
0-5	.50
5-100	.50
100-200	.50
200-650	.50
650-850	.50
850-2,550	.50
2,550-5,000	.50
5,000-10,000	.50
10,000+	.50

Support: Drop wires in new developments are most often placed in conjunction with other utilities to achieve cost sharing advantages, and to ensure that one service provider does not cut another's facilities during the trenching or plowing operation.

Conversations with architects and builders indicate that the builder will most often provide the trench at no cost, and frequently places electric, telephone, and cable television facilities into the trench if material is delivered on site. Research done in Arizona has indicated that developers not only provide trenches, but also provide small diameter PVC conduits across front property lines to facilitate placement of wires.

The Hatfield Model version 4.0 determines the sharing of buried drop structures based on density zones. It is the judgment of outside plant experts that buried drops will normally be used with buried distribution cable. Although many cases would result in three-way sharing of such structure, a conservative approach was used at 50% sharing.

- AERIAL AND BURIED DROP STRUCTURE FRACTIONS

Definition: The percentage of drops that are aerial and buried, respectively, as a function of CBG density zone.

Drop Structure Fractions		
Density Zone	**Aerial**	**Buried**
0-5	.25	.75
5-100	.25	.75
100-200	.25	.75
200-650	.30	.70
650-850	.30	.70
850-2,550	.30	.70
2,550-5,000	.30	.70
5,000-10,000	.60	.40
10,000+	.85	.15

Support: The Hatfield Model version 4.0 determines the use of distribution structures based on density zones. It is the judgment of outside plant experts that aerial drops will normally be used with aerial distribution cable and buried drops with buried and underground distribution cable. Therefore, the percentage of aerial drops equals the percentage of aerial distribution cable (see Section 2.5). The high percentage of aerial drops in the two most dense zones reflects the fact that such drops, if present at all, are extensions of riser cable, which is treated as aerial.

- COPPER FEEDER STRUCTURE FRACTIONS

Definition: The relative amounts of different structure types supporting copper feeder cable in each density zone. Aerial feeder cable is attached to telephone poles, buried cable is laid directly in the earth, and underground cable runs through underground conduit.

Copper Feeder Structure Fractions			
Density Zone	Aerial/Block Cable	Buried Cable	Underground Cable (calculated)
0-5	.50	.45	*.05*
5-100	.50	.45	*.05*
100-200	.50	.45	*.05*
200-650	.40	.40	*.20*
650-850	.30	.30	*.40*
850-2,550	.20	.20	*.60*
2,550-5,000	.15	.10	*.75*
5,000-10,000	.10	.05	*.85*
10,000+	.05	.05	*.90*

Support: ***{NOTE: Excerpts from the discussion in Section 2.5. [Distribution] are reproduced here for ease of use.}***

It is the opinion of outside plant engineering experts that density, measured in Access Lines per Square Mile, is a good determinant of structure type. That judgment is based on the fact that increasing density drives more placement in developed areas, and that as developed areas become more dense, placements will more likely occur under pavement conditions.

Aerial/Block Cable:

"The most common cable structure is still the pole line. Buried cable is now used wherever feasible, but pole lines remain an important structure in today's environment."[3]

Where an existing pole line is available, cable is normally placed on the existing poles. Abandoning an existing pole line in favor of buried plant is not usually done unless such buried plant provides a much less costly alternative.

Buried Cable:

Default values in HM 4.0 reflect an increasing trend toward use of buried cable. Since 1980, there has been an increase in the use of buried cable for several reasons. First,

[3] *BOC Notes on the LEC Networks - 1994*, Bellcore, p. 12-41.

before 1980, cables filled with water blocking compounds had not been perfected. Thus, prior to that time, buried cable was relatively expensive and unreliable. Second, reliable splice closures of the type required for buried facilities were not the norm. And third, the public now clearly desires more out-of-sight plant for both aesthetic and safety-related reasons.

Underground Cable:

Underground cable, conduit, and manholes are primarily used for feeder and interoffice transport cables, not for distribution cable. Any conduit runs short enough to not require a splicing chamber or manhole are classified to the aerial or buried cable account, respectively.

- FIBER FEEDER STRUCTURE FRACTIONS

Definition: The relative amounts of different structure types supporting fiber feeder cable in each density zone. Aerial feeder cable is attached to telephone poles, buried cable is laid directly in the earth, and underground cable runs through underground conduit.

Fiber Feeder Structure Fractions			
Density Zone	**Aerial/Block Cable**	**Buried Cable**	**Underground Cable (calculated)**
0-5	.35	.60	*.05*
5-100	.35	.60	*.05*
100-200	.35	.60	*.05*
200-650	.30	.60	*.10*
650-850	.30	.30	*.40*
850-2,550	.20	.20	*.60*
2,550-5,000	.15	.10	*.75*
5,000-10,000	.10	.05	*.85*
10,000+	.05	.05	*.90*

Support: ***{NOTE: Excerpts from the discussion in Section 2.5. [Distribution] are reproduced here for ease of use.}***

It is the opinion of outside plant engineering experts that density, measured in Access Lines per Square Mile, is a good determinant of structure type. That judgment is based on the fact that increasing density drives more placement in developed areas, and that as developed areas become more dense, placements will more likely occur under pavement conditions.

Aerial/Block Cable:

"The most common cable structure is still the pole line. Buried cable is now used wherever feasible, but pole lines remain an important structure in today's environment."[4]

Where an existing pole line is available, cable is normally placed on the existing poles. Abandoning an existing pole line in favor of buried plant is not usually done unless such buried plant provides a much less costly alternative.

Buried Cable:

Default values in HM 4.0 reflect an increasing trend toward use of buried cable. Since 1980, there has been an increase in the use of buried cable for several reasons. First, before 1980, cables filled with water blocking compounds had not been perfected. Thus, prior to that time, buried cable was relatively expensive and unreliable. Second, reliable splice closures of the type required for buried facilities were not the norm. And third, the public now clearly desires more out-of-sight plant for both aesthetic and safety-related reasons.

Underground Cable:

Underground cable, conduit, and manholes are primarily used for feeder and interoffice transport cables, not for distribution cable. Any conduit runs short enough to not require a splicing chamber or manhole are classified to the aerial or buried cable account, respectively.

f. What method should be used to determine the most economically efficient fiber-copper cross-over point?

- COPPER FEEDER MAXIMUM DISTANCE

Definition: The feeder length above which fiber feeder cable is used in lieu of copper cable.

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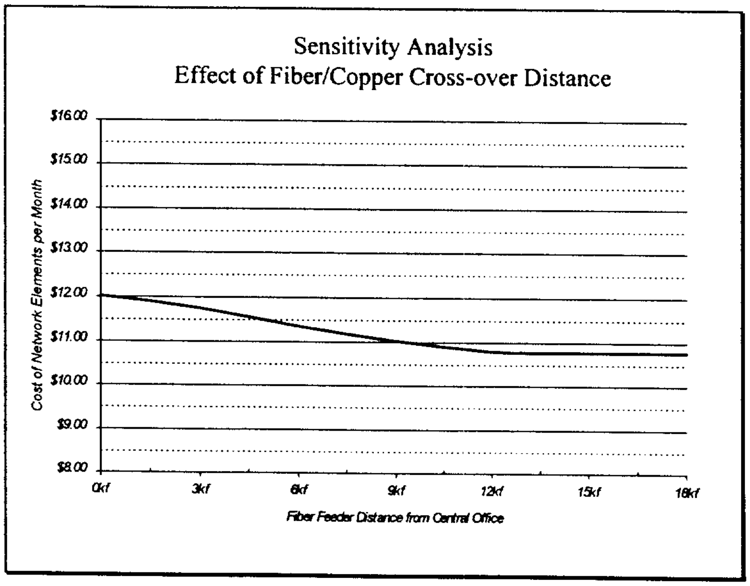
[4] *BOC Notes on the LEC Networks - 1994*, Bellcore, p. 12-41.

Copper Feeder Maximum Distance
9,000 feet

Support: The chart below depicts the result of multiple sensitivity runs of the Hatfield Model, wherein the only variable changed is the copper/fiber maximum distance point. Results indicate that Loop Costs per month drop off as the fiber/copper cross-over distance is increased. This reduction in monthly costs is purely a function of the investment carrying charges for the loop. Although there is a significant slope from an all fiber feeder at 0 kft. down to 9,000 feet, the curve is flat beyond 12,000 feet. Although HM 4.0 could reflect somewhat lower monthly costs by moving the copper feeder maximum distance point farther out, most Incumbent Local Exchange Carriers (ILECs) have adopted an engineering policy of placing fiber feeder at distances beyond 9,000 feet. Although significant savings in maintenance cost are likely to occur with the use of fiber and digital loop carrier over copper cable, HM 4.0 does not model those maintenance cost reductions. Therefore a conservative approach has been adopted in using fiber fed integrated digital loop carrier for all feeder cable greater than 9,000 feet in length.



g. What loop design standards, if any should be adopted for the cost model?

- GENERAL LOOP DESCRIPTION

The feeder portion of the loop terminates within the central office building, or "wire center." Copper cable feeder facilities terminate on the "vertical side" of the MDF (main distributing frame) in the wire center, and fiber optic feeder cable serving integrated digital loop carrier (IDLC) systems terminates on a fiber distribution frame in the wire center.

Copper feeder cable extends from the wire center to an SAI where it is cross-connected to copper distribution cables. If the feeder is fiber, it extends to a digital loop carrier (DLC) remote terminal (RT), where optical digital signals are demultiplexed and converted to analog signals. Individual circuits from the DLC are cross-connected to copper distribution cables at the adjacent SAI. Copper distribution cable extends from the SAI to the individual customer premises. At the distant end of these distribution cables, the local loop terminates at a network interface device, or NID, at the customer's premises.

Loop cables are supported by "structures." These structures may be underground conduit, poles, or trenches for buried cable and underground conduit. Underground cable is distinguished from buried cable in that underground cable is placed in conduit, while buried cable comes into direct contact with soil.[5]

- LOCAL LOOP COMPONENTS

(1) Network Interface Device

The NID is the demarcation point between the local carrier's network and the customer's inside wiring. 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 copper 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. The drop can be aerial or buried; generally it is aerial if the distribution cable is aerial, and buried if the distribution cable is buried or underground.

(3) Block Terminal

[5] Although the conduit supporting underground cable is always placed in a trench, buried cable may either be placed in a trench or be directly plowed into the earth.

The "block terminal" is the interface between the drop and the distribution cable. When aerial distribution cable is used, the block terminal is attached to a pole in the subscriber's backyard or at the edge of a road. A pedestal contains the block terminal when distribution cable is buried.

(4) Distribution Cable

Distribution cable runs between the block terminals and the SAI. In the Model, distribution cable connects the feeder cable with all customer premises within a Census Block Group (CBG). The model assumes that each CBG contains at least one SAI; limits on the capacity of an SAI and/or the distribution design assumed in particular CBGs may lead to multiple SAIs. Distribution structure components may consist of poles, trenches and conduit.[6]

(5) Conduit and Feeder Facilities

Feeder facilities constitute the transmission system between the SAI and the wire center. These facilities may consist of either pairs of copper wire or a DLC system that uses optical fiber cables as the transmission medium. In a DLC system, the analog signals for multiple individual lines are converted to a digital format and multiplexed into a composite digital bit stream. The Hatfield Model assumes that there is a standard (but user-adjustable) feeder distance beyond which optical feeder cable will be installed and DLC equipment will be used to serve subscribers.

Feeder structure components include poles, trenches and conduit. Manholes for copper feeder or pullboxes for fiber feeder 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. Pullboxes that are installed for underground fiber cable are normally farther apart than manholes used with copper cables, because the lightness and flexibility of fiber cable permits it to be pulled over longer distances than copper cable.

The costs of structure components normally are shared among several utilities, e.g., electric utilities, LECs, IXCs and cable television (CATV)

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[6] Because underground distribution exists only in the highest density zones where runs are relatively short, and because in such zones it commonly shares structure with feeder, distribution facilities typically do not include manholes.

operators. The amount of sharing may differ in different density zones and between feeder and current distribution.

h. What size(s) of digital loop carriers should the model incorporate?

High Density Environment

The forward looking DLC optimized for the high density environment is an integrated NGDLC compliant with BellCore Generic Requirements GR-303 which employs an optical fiber SONET OC-3 transport. This is a large capacity and highly efficient digital loop carrier for serving the high density environment. While products from different vendors, are available in a variety of sizes, HM4.0 uses typical digital loop carrier remote sizes which are the following:

672 DS0s
1344 DS0s
2016 DS0s

Low Density Environment

Similar to the high density environment, there are a wide variety of DLC products available for the low density environment.

HM4.0 uses the following sizes:

96 DS0s
192DS0s

Extreme Low Density

For extreme low density applications, HM4.0 employs T1 carrier extensions from either a High or Low Density DLC on copper pairs feeding small DLC remotes with a capacity of 24 DS0s.

For feeder runs that exceed the fiber threshold, one of two types of DLC equipment is selected. The first is designated "TR-303 DLC."[7] The second is designated "Low Density" DLC (which is also TR-303 compliant). The choice between these two types is determined on a CBG by CBG or quadrant by quadrant basis. If the number of lines is

[7] TR-303 (now GR-303; the term "TR-303" refers to earlier documents but is commonly used in the industry) is a Bellcore requirements document dealing with interfacing a DLC system with an end office switch.

below a threshold value, "low density" DLC is used; above that threshold, TR-303 DLC is assumed. The threshold is user-adjustable, with a default value of 384 lines.

The investment in DLC equipment, when it is used, is calculated in the Distribution Module. The parameters involved in this calculation are identified as Items B49 through B60 in Appendix B. For either type of DLC system, low density or TR-303, the investment is calculated based on user-adjustable amounts for site and powering (B49), for common equipment (B52 for an initial number of lines, B59 for each additional increment of lines, and B60 for the maximum number of increments), and channel units (B53 for the cost of a channel unit, B54 for the number of regular and payphone lines each channel unit can support). Other parameters in the range identified above specify items such as the number of fibers per RT, etc.

i. What wireless threshold, if any, should the model use?

The Hatfield Model does not incorporate wireless technology in its loop design so that advanced services can be accommodated on these facilities. For long loops, the Hatfield Model uses a T-1 on copper solution which permits basic rate ISDN and other high bit rate services to be provided. This approach is consistent with the FCC's requirements for universal service cost models as set forth in its May 7, 1997 Order (paragraph 250).

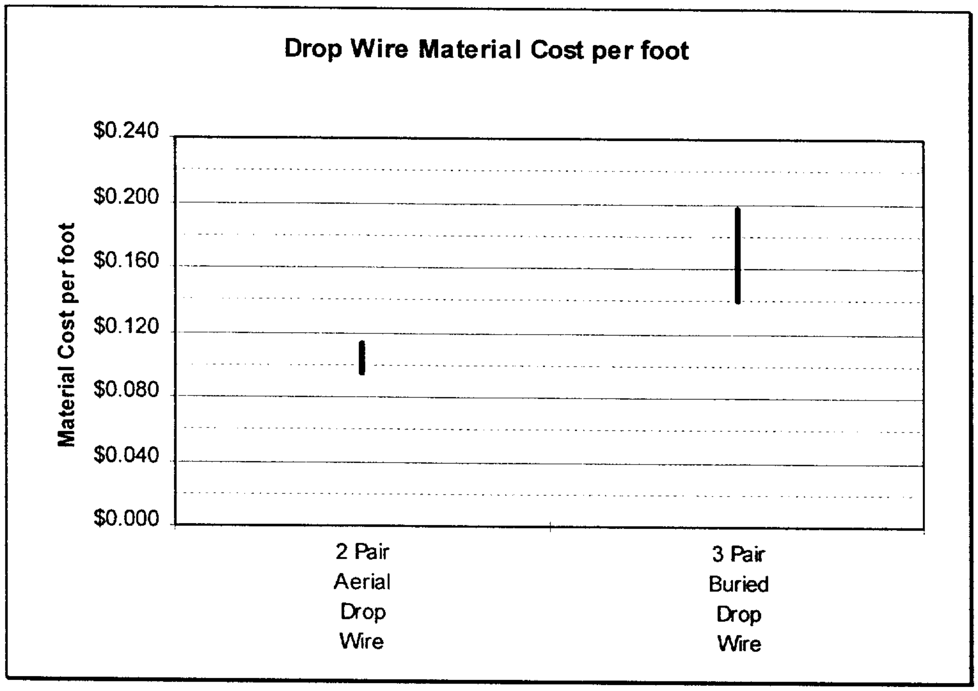
j. What method should be used to determine the materials and installation costs of manholes, poles, anchors, guys, aerial cable, building attachments?

- DROP CABLE INVESTMENT, PER FOOT AND PAIRS PER WIRE

Definition: The investment per foot required for aerial and buried drop wire, and the number of pairs in each type of drop wire.

Drop Cable Investment, per foot		
	Material Cost Per foot	**Pairs**
Aerial	\$0.095	2
Buried	\$0.140	3

Support: Price quotes for material were received from several sources. Results were as follows:



- RISER CABLE SIZE AND COST PER FOOT

Definition: The cost per foot of copper riser cable (cable inside high-rise buildings), as a function of cable size, including the costs of engineering, installation, and delivery, as well as the cable material itself.

Riser Cable, $/foot	
Cable Size	**Cost/foot (including engineering, installation, delivery and material)**
2400	$20.00
1800	$16.00
1200	$12.00
900	$10.00
600	$7.75
400	$6.00
200	$4.25
100	$2.50
50	$1.63
25	$1.19
12	$0.76
6	$0.63

Support: Riser cable is assumed to cost the same per foot as equivalent-sized distribution cable.

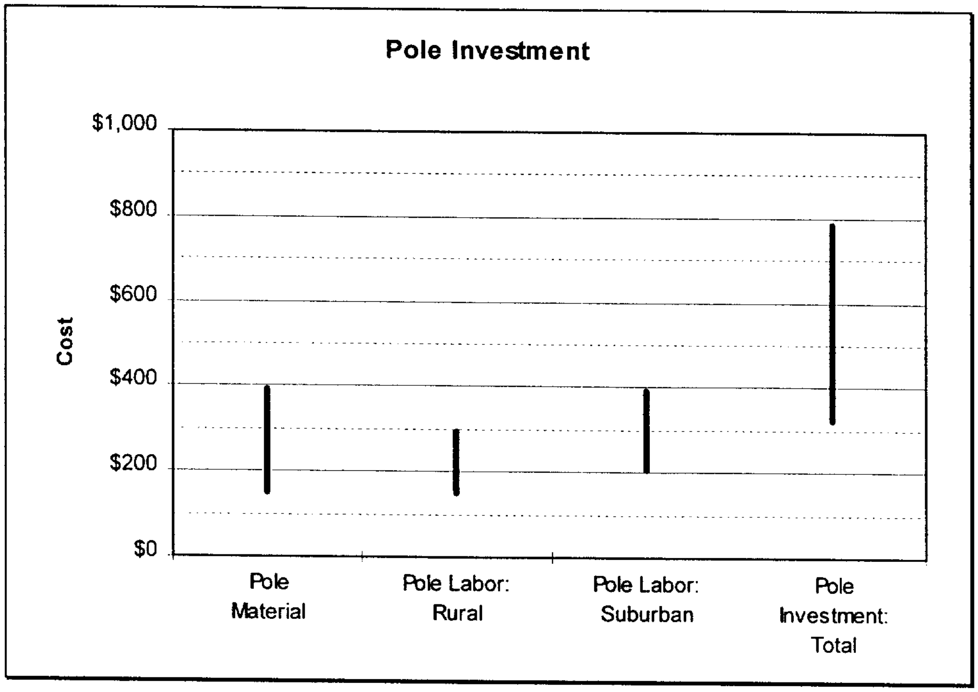
- COPPER FEEDER POLE INVESTMENT

Definition: The installed cost of a 40' Class 4 treated southern pine pole.

Pole Investment	
Materials	$201
Labor	$216
Total	*$417*

Support: ***{NOTE: The discussion in Section 2.4.1. [Distribution] is reproduced here for ease of use.}***

Pole investment is a function of the material and labor costs of placing a pole. Costs include periodic down-guys and anchors. Utility poles can be purchased and installed by employees of ILECs, but are frequently placed by contractors. Several sources revealed the following information on prices.



The exempt material load on direct labor includes ancillary material not considered by FCC Part 32 as a unit of plant. That includes items such as downguys and anchors that are already included in the pole placement labor cost. The steel strand run between poles is likewise an exempt material item, charged to the aerial cable account. The cost of steel strands is not included in the cost of poles; it is included in the installed cost of aerial cable.

- COPPER FEEDER MANHOLE SPACING, FEET

Definition: The distance, in feet, between manholes for copper feeder cable.

Copper Feeder Manhole Spacing, feet	
Density Zone	**Distance between manholes, ft.**
0-5	800
5-100	800
100-200	800
200-650	800
650-850	600
850-2,550	600
2,550-5,000	600
5,000-10,000	400
10,000+	400

Support: "The length of a conduit section is based on several factors, including the location of intersecting conduits and ancillary equipment such as repeaters or loading coils, the length of cable reels, pulling tension, and physical obstructions. Pulling tension is determined by the weight of the cable, the coefficient of friction, and the geometry of the duct run. Plastic conduit has a lower coefficient of friction than does concrete or fiberglass conduit and thus allows longer cable pulls. Conduit sections typically range from 350 to 700 ft in length."[8]

The higher density zones reflect reduced distances between manholes to provide transition points for changing types of sheaths and the increased number of branch points.

Maximum distances between manholes is also a function of the longest amount of cable that can be placed on a normal cable reel. Although larger reels are available, the common type 420 reel supports over 800 feet of 4200 pair cable[9], the largest used by the Hatfield Model. Therefore the longest distance between manholes used for copper cable is 800 feet.

- MANHOLE INVESTMENT – COPPER FEEDER

Definition: The installed cost of a prefabricated concrete manhole, including backfill and restoration. All the non-italicized costs in the following table are separately adjustable.

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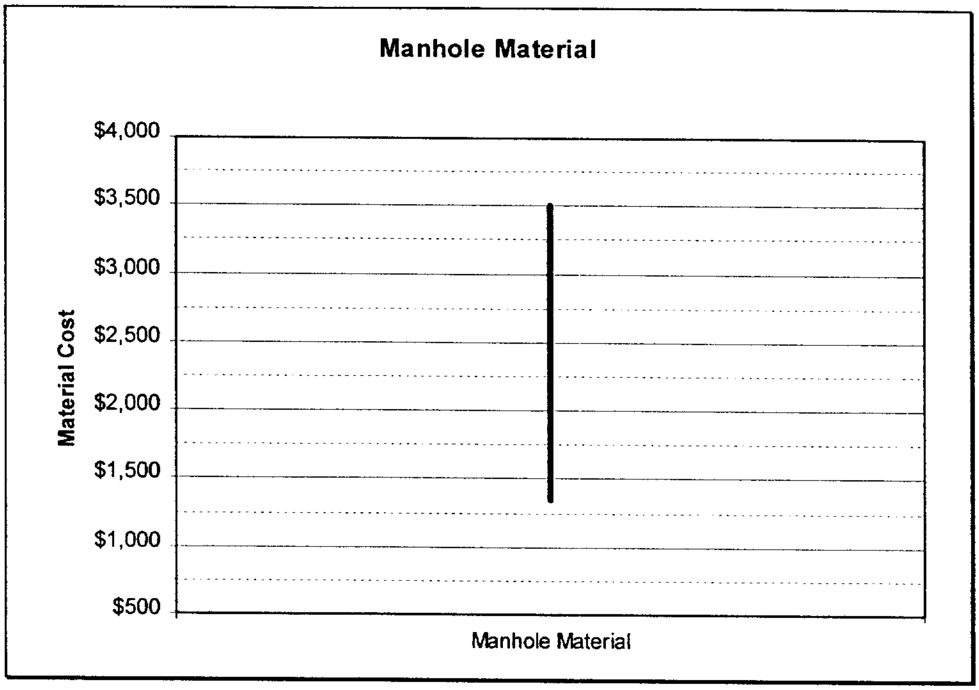
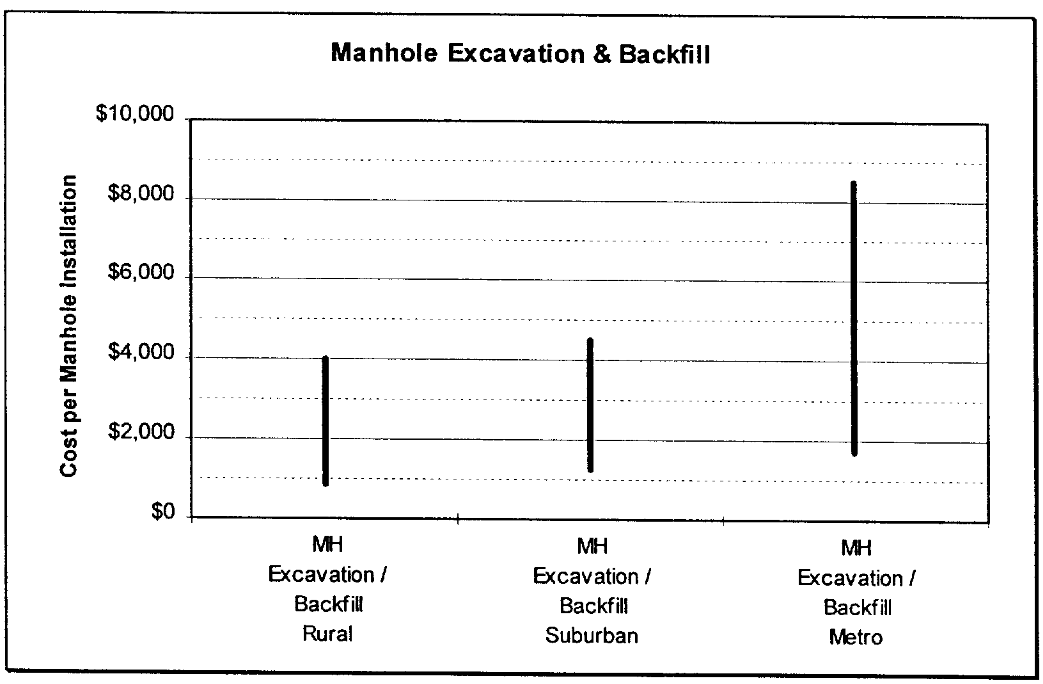
[8] Bellcore, *BOC Notes on the LEC Networks - 1994*, p. 12-42
[9] AT&T, *Outside Plant Systems*, pp. 1-7.

Copper Cable Manhole Investment						
Density Zone	**Materials**	**Frame & Cover**	**Site Delivery**	**Total Material**	**Excavation & Backfill**	**Total Installed Manhole**
0-5	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
5-100	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
100-200	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
200-650	$1,865	$350	$125	*$2,340*	$2,800	*$5,140*
650-850	$1,865	$350	$125	*$2,340*	$3,200	*$5,540*
850-2,550	$1,865	$350	$125	*$2,340*	$3,500	*$5,840*
2,550-5,000	$1,865	$350	$125	*$2,340*	$3,500	*$5,840*
5,000-10,000	$1,865	$350	$125	*$2,340*	$5,000	*$7,340*
10,000+	$1,865	$350	$125	*$2,340*	$5,000	*$7,340*

Support: Costs for various excavation methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries validated the opinions of outside plant experts and are revealed in the following charts.





building attachments - 2.1 (see response to 16 k)
poles - 2.4.1 (included in response to 16 c)

k. What method should be used to determine NID costs?

The NID is the device at the customers' premises within which the drop wire terminates, and which is the point of subscriber demarcation. The NID investment is calculated as the cost of the NID case plus the product of the protection block cost per line and the number of lines terminated.

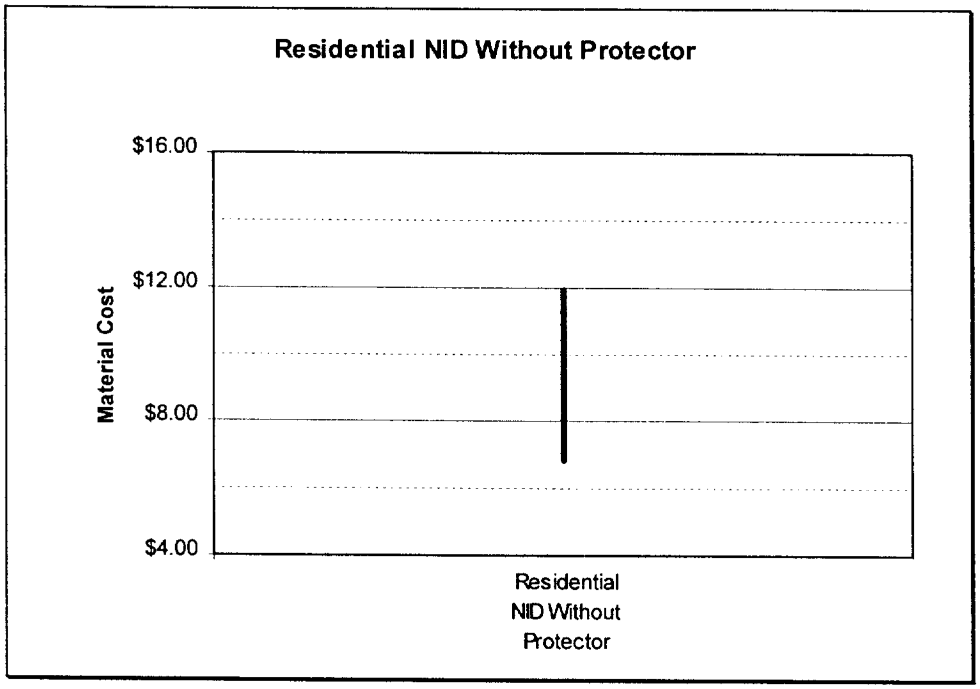
NID Materials and Installation	
	Cost
Residential NID case, no protector	$10.00
Residential NID basic labor	$15.00
Installed NID case	*$25.00*
Maximum lines per res. NID	6
Protection block, per line	$4.00
Business NID case, no protector	$25.00
Business NID basic labor	$15.00
Installed NID case	*$40.00*
Protection block, per line	$4.00

Support:

Residential NID Cost without Protector:

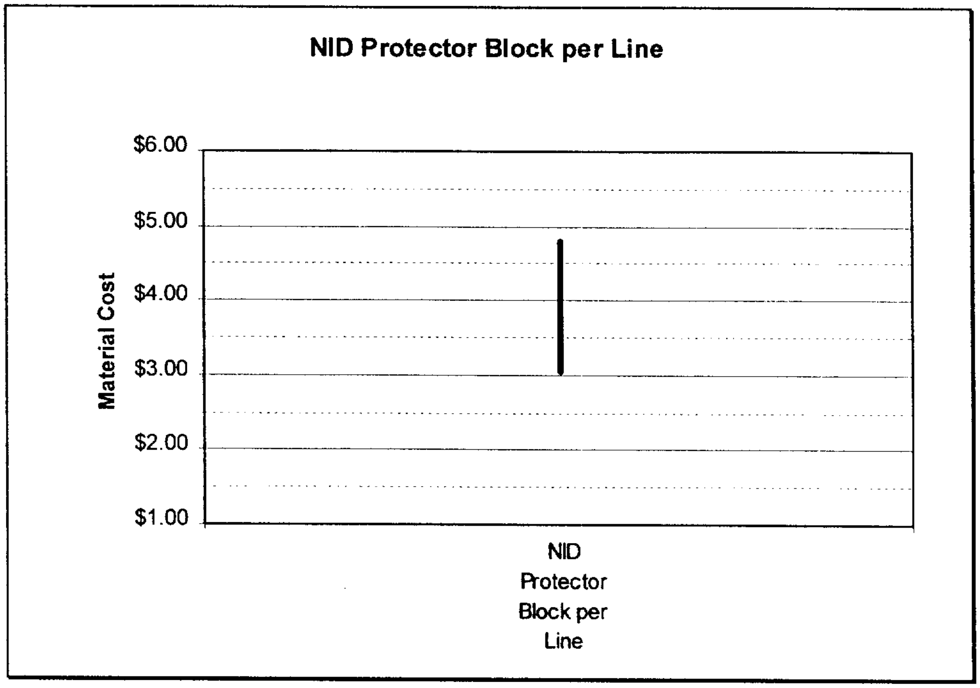
The labor estimate assumes a crew installing network interface devices throughout a neighborhood or CBG (in coordination with the installation of drops, terminals, and distribution cables). A work time of 25 minutes was used, based on the opinion of a team of outside plant experts. A loaded labor rate of $35 per hour excludes exempt material loadings which normally include the material cost of the NID and Drops. A residential NID shell has capacity for two protectors.

Price quotes for material were received from several sources. Results were as follows:


Residential NID Without Protector
$16.00
$12.00
$8.00
$4.00
Material Cost
Residential
NID Without
Protector

NID Protection Block per Line:

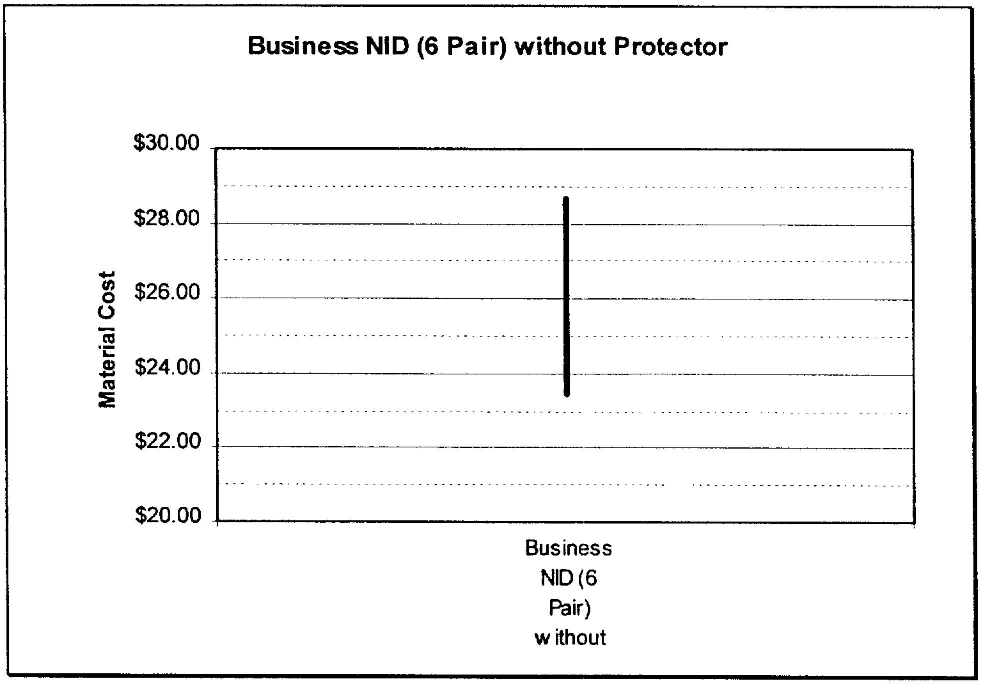
Price quotes for material were received from several sources. Results were as follows:



Business NID - No Protector:

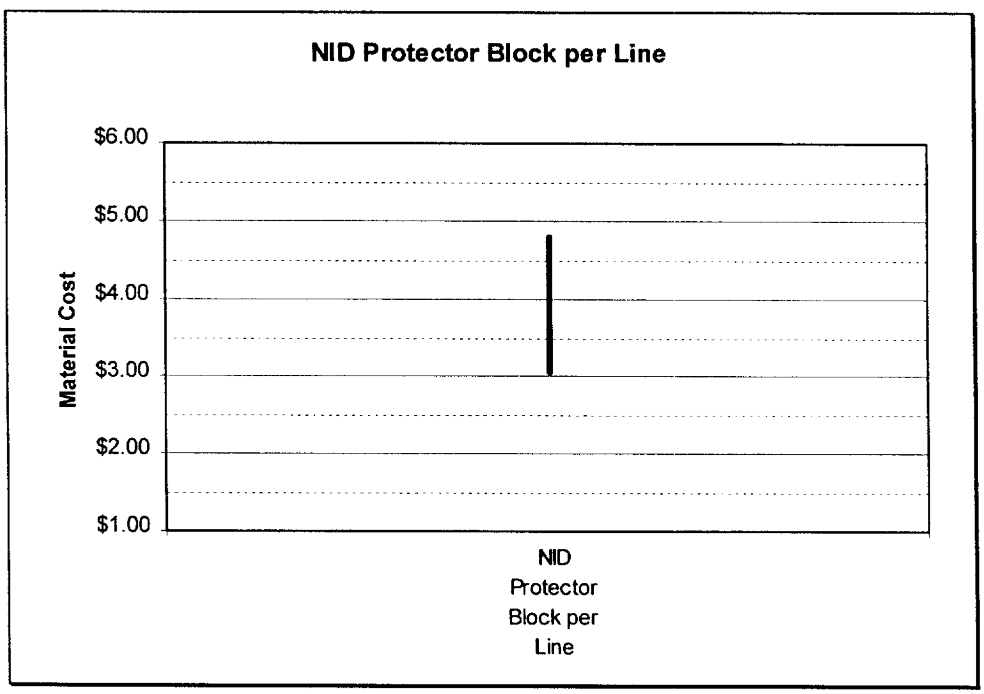
The labor estimate assumes a crew installing network interface devices throughout a neighborhood or CBG (in coordination with the installation of drops, terminals, and distribution cables). A work time of 25 minutes was used, based on the opinion of a team of outside plant experts. A loaded labor rate of $35 per hour excludes exempt material loadings which normally include the material cost of the NID and Drops. A business NID shell has capacity for six protectors.

Price quotes for material were received from several sources. Results were as follows:



NID Protection Block per Line:

Price quotes for material were received from several sources. Results were as follows:



I. What method should be used to determine the cost of investment and installation of service area interfaces?

The SAI in each CBG serves as an interface between the feeder and distribution facilities. Each SAI consists of a cabinet, including suitable physical mounting, and a simple passive cross connect. In the case of fiber feeder there is an adjacent DLC remote terminal.. SAI investment is determined by the number of distribution and feeder pairs required to be served. The model equips multiple SAIs if the pair requirement exceeds the maximum SAI capacity.

Urban areas normally have feeder cable running directly into the basement of large buildings, rather than interfacing at an SAI outside of the building. In such cases, the SAI, located in the building, is significantly less expensive than the outdoor SAI. This type of interface consists of a plywood backboard and inexpensive "punch-down blocks," rather than the heavy steel weatherproof outside terminals found in less urban areas.

The Distribution Module sizes and calculates the investment in the SAIs required in each CBG based on the number of distribution and feeder pairs required and the urban/non-urban characteristic of the CBG. The pertinent input parameter for the SAI is identified as B34 in Appendix B. It is the installed investment in an SAI, stated as a function of the number of distribution and feeder pairs served by the SAI. The model equips each CBG, or individual quadrants within a CBG if DLC remote terminals are extended to the quadrants, with one or more SAIs. The number required is determined by comparing the total line demand to 7,200, which is the maximum number of pairs that can be supported by a single SAI. HM 4.0 differentiates between outdoor and indoor SAIs, the former being the normal case, and the latter being used when a CBG is identified as a high-rise building.

A given CBG is served by either fiber feeder or copper feeder. Fiber feeder is used where the total main feeder plus subfeeder length exceeds a user-defined threshold whose default value is 9,000 feet. For feeder runs that exceed the fiber threshold, one of two types of DLC equipment is selected. The first is designated "TR-303 DLC."[10] The second is designated "Low Density" DLC (which is also TR-303 compliant). The choice between these two types is determined on a CBG by CBG or quadrant by quadrant basis. If the number of lines is below a threshold value, "low density" DLC is used; above that threshold, TR-303 DLC is assumed. The threshold is user-adjustable, with a default value of 384 lines.

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[10] TR-303 (now GR-303; the term "TR-303" refers to earlier documents but is commonly used in the industry) is a Bellcore requirements document dealing with interfacing a DLC system with an end office switch.

The investment in DLC equipment, when it is used, is calculated in the Distribution Module. The parameters involved in this calculation are identified as Items B49 through B60 in Appendix B. For either type of DLC system, low density or TR-303, the investment is calculated based on user-adjustable amounts for site and powering (B49), for common equipment (B52 for an initial number of lines, B59 for each additional increment of lines, and B60 for the maximum number of increments), and channel units (B53 for the cost of a channel unit, B54 for the number of regular and payphone lines each channel unit can support). Other parameters in the range identified above specify items such as the number of fibers per RT, etc.

m. What method should be used to determine cable fill and utilization factors?

- SPARE TUBES PER ROUTE

Definition: The number of spare tubes (i.e., conduit) placed per route.

Spare Tubes per Route	
# Spare Tubes	1

Support: "A major advantage of using conduits is the ability to reuse cable spaces without costly excavation by removing smaller, older cables and replacing them with larger cables or fiber facilities. Some companies reserve vacant ducts for maintenance purposes."[11] Version 4.0 of the Hatfield Model provides one spare maintenance duct (as a default) in each conduit run.

- DISTRIBUTION CABLE FILL FACTORS

Definition: The Hatfield Model uses the distribution cable fill factor input to calculate the size of cable needed to serve a given quantity of demand. HM 4.0 divides the number of pairs required in a distribution cable by this factor to determine the minimum number of pairs required, then uses the next larger available size cable.

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[11] *BOC Notes on the LEC Networks - 1994*, Bellcore, p. 12-42.

Distribution Cable Fill Factors	
Density Zone	**Fill Factors**
0-5	.50
5-100	.55
100-200	.55
200-650	.60
650-850	.65
850-2,550	.70
2,550-5,000	.75
5,000-10,000	.75
10,000+	.75

Support: In determining appropriate cable size, an outside plant engineer is more interested in a sufficient number of administrative spares than in the percent fill ratio. The appropriate "target" distribution cable fill factor, therefore, will vary depending upon the size of cable. For example, 75% fill in a 2400 pair cable provides 600 spares. However, 50% spare in a 6 pair cable provides only 3 spares. Since smaller cables are used in lower density zones, Distribution Cable Fill Factors in HM 4.0 are lower in the lowest density zones to account for this effect.

In general, the level of spare capacity provided by default values in HM 4.0 is sufficient to meet current demand plus some amount of growth. Because the model calculates the unit loop investment cost as the total loop investment (including spare capacity), divided by the current loop demand, the resulting unit costs are a conservatively high estimate of the economic cost of meeting current loop demand. This occurs because, in reality, some of the spare distribution plant can and will be used to satisfy additional loop demand in the future, without causing any additional investment cost, thus a larger number of customers will pay for the cable over time. In this sense, the HM 4.0 default values for the distribution cable fill factors are conservatively low from an economic costing standpoint.

- FILL FACTORS
    - Copper Feeder Cable Fill Factors

Definition: The spare capacity in a feeder cable, calculated as the ratio of the number of assigned pairs to the total number of available pairs in the cable.

Copper Feeder Cable Fill Factors	
Density Zone	**Fill Factors**
0-5	.65
5-100	.75
100-200	.80
200-650	.80
650-850	.80
850-2,550	.80
2,550-5,000	.80
5,000-10,000	.80
10,000+	.80

Support: ***{NOTE: The discussion in Section 2.6.1. [Distribution] is reproduced here for ease of use.}***

In determining appropriate cable size, an outside plant engineer is more interested in a sufficient number of administrative spares than in the percent fill ratio. The appropriate "target" distribution cable fill factor, therefore, will vary depending upon the size of cable. For example, 75% fill in a 2400 pair cable provides 600 spares. However, 50% spare in a 6 pair cable provides only 3 spares. Since smaller cables are used in lower density zones, Distribution Cable Fill Factors in HM 4.0 are lower in the lowest density zones to account for this effect.

In general, the level of spare capacity provided by default values in HM 4.0 is sufficient to meet current demand plus some amount of growth. Because the model calculates the unit loop investment cost as the total loop investment (including spare capacity), divided by the current loop demand, the resulting unit costs are a conservatively high estimate of the economic cost of meeting current loop demand. This occurs because, in reality, some of the spare distribution plant can and will be used to satisfy additional loop demand in the future, without causing any additional investment cost, thus a larger number of customers will pay for the cable over time. In this sense, the HM 4.0 default values for the distribution cable fill factors are conservatively low from an economic costing standpoint.

- Fiber Feeder Cable Fill Factor

Definition: Maximum fraction of fiber strands in a cable that are available to be used.

Fiber Feeder Fill Factor	
Density Zone	**Fill Factor**
0-5	1.00
5-100	1.00
100-200	1.00
200-650	1.00
650-850	1.00
850-2,550	1.00
2,550-5,000	1.00
5,000-10,000	1.00
10,000+	1.00

Support: Standard fiber optic multiplexers operate on 4 fibers. One fiber each is assigned to primary optical transmit, primary optical receive, redundant optical transmit, and redundant optical receive. Since the fiber optic multiplexers used by HM 4.0 have 100 percent redundancy, and do not reuse fibers in the loop, there is no reason to divide the number of fibers needed by a fill factor, prior to sizing the fiber cable to the next larger available size.

n. What method should be used to determine the mix of host, stand-alone, and remote switches?

- END OFFICE SWITCHES

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

- TANDEM SWITCHES

Tandem switches interconnect end office switches via common trunks, and may also provide connections to IXC POPs via dedicated trunks. Common trunks also provide alternatives to direct routes for traffic between end offices. Tandem switching functions often are performed by switches that also perform end office functions. At a minimum, tandems normally are located in wire centers that also house end office switches.

- INTEROFFICE TRANSMISSION FACILITIES

Interoffice transmission facilities carry the trunks that connect end offices to each other and to tandem switches. The signaling links in a SS7 signaling network are also normally carried over these interoffice facilities.

Consistent with the evolving practice, interoffice transmission facilities are predominantly optical fiber systems that carry signals in Synchronous Optical Network (SONET) format. Efficient practice also prescribes the use of a fiber optic ring configuration to link switches, except for switches that serve few lines or that are remote from other switches. This provides a redundant path between any two switches, and the potential for substantial cost savings relative to more traditional point-to-point facilities.

- SIGNAL TRANSFER POINTS

STPs route signaling messages between switching and control entities in a Signaling System 7 (SS7) network. Signaling links connect STPs and Service Switching Points (SSPs). STPs are equipped in mated pairs, with at least one pair in each Local Access Transport Area (LATA).

- SERVICE SWITCHING POINTS AND SIGNALING LINKS

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

In release 5.0 of the Hatfield Model, the model will cost separately hosts, remotes and stand-alones.

- investment apportionment among wire centers in host/remote configuration
    - capacity constraints specific to switch types
    - increased trunk and signaling capacity at host office.

o. What switch capacity constraints, if any, should the model employ?

- SWITCH REAL-TIME LIMIT

Definition: The maximum number of busy hour call attempts (BHCA) a switch can handle. If the model determines that the load on a processor, calculated as the number of busy hour call attempts times the processor feature load multiplier, exceeds the switch real time limit multiplied by the switch maximum processor occupancy, it will add a switch to the wire center.

Switch Real-time limit, BHCA	
Lines Served	**BHCA**
1-1,000	10,000
1,000-10,000	50,000
10,000-40,000	200,000
40,000+	600,000

Support: Industry experience and expertise of Hatfield Associates. These numbers are well within the range of the BHCA limitations NORTEL supplies in its Web site.[12]

Busy Hour Call Attempt Limits from Northern Telecom Internet Site	
Processor Series	**BHCA**
SuperNode Series 10	200,000
SuperNode Series 20	440,000
SuperNode Series 30	660,000
SuperNode Series 40	800,000
SuperNode Series 50 (RISC)	1,200,000
SuperNode Series 60 (RISC)	1,400,000 (burst mode)

[12] http://www.nortel.com

- SWITCH TRAFFIC LIMIT, BHCCS

Definition: The maximum amount of traffic, measured in hundreds of call seconds (CCS), the switch can carry in the busy hour (BH).

If the model determines that the offered traffic load on an end office switching network exceeds the traffic limit, it will add a switch.

Lines	Busy Hour CCS
1-1,000	30,000
1,000-10,000	150,000
10,000-40,000	600,000
40,000+	1,800,000

Support: Values selected to be consistent with BHCA limit assuming an average holding time of five minutes.

- SWITCH MAXIMUM EQUIPPED LINE SIZE

Definition: The maximum number of lines plus trunk ports that a typical digital switching machine can support.

Switch Maximum Equipped Line Size
80,000

Support: This is a conservative assumption based on industry common knowledge and the Lucent Technologies web site.[13] The site states that the 5ESS-2000 can provide service for "up to as many as 100,000 lines but can be engineered even larger." The

[13] See Lucent's Web site at http://www.lucent.com/netsys/5ESS/5esswtch.html

Hatfield Model lowers the 100,000 to 80,000, or 80 percent, recognizing that planners will not typically assume the full capacity of the switch can be used.

- SWITCH PORT ADMINISTRATIVE FILL

Definition: The percent of lines in a switch that are assigned to subscribers compared to the total equipped lines in a switch.

Switch Port Administrative Fill
0.98

Support: Industry experience and expertise of Hatfield Associates in conjunction with subject matter experts.

- SWITCH MAXIMUM PROCESSOR OCCUPANCY

Definition: The fraction of total capacity (measured in busy hour call attempts, BHCA) an end office switch is allowed to carry before the model adds another switch.

Switch Maximum Processor Occupancy
0.90

Support: Bell Communications Research, *LATA Switching Systems Generic Requirements*, Section 17: Traffic Capacity and Environment, TR-TSY-000517, Issue 3, March 1989, figure 17.5-1, p. 17-24.

p. What method should be used to determine switching investment costs?

AT&T has indicated to the FCC that basic service should include local usage, and the Hatfield Model USF costs are calculated in that fashion. USF costs for these elements are shown on the USF output sheet for the Hatfield Model. Therefore, follow the Hatfield methodology for end office switching, as detailed in the formula in cell D23 on the USF output sheet, to determine how end office switching costs are allocated for basic service. As the formulae indicate, the UNE cost is the starting point for this calculation.

q. What method should be used to determine the portion of total interoffice trunking, signaling, and local tandem costs to be attributed to universal service?

AT&T has indicated to the FCC that basic service should include local usage, and the Hatfield Model USF costs are calculated in that fashion. USF costs for these elements are shown on the USF output sheet. Therefore, follow the Hatfield methodology for signaling, as detailed in the formula in cell D24 and for transport in cell D25 on the USF output sheet, to determine how signaling and transport costs were allocated for basic service. As the formulae indicate, the UNE cost is the starting point for both of these calculations.

r. What method should be used to determine costs of general support facilities (e.g., vehicles, land, buildings)?

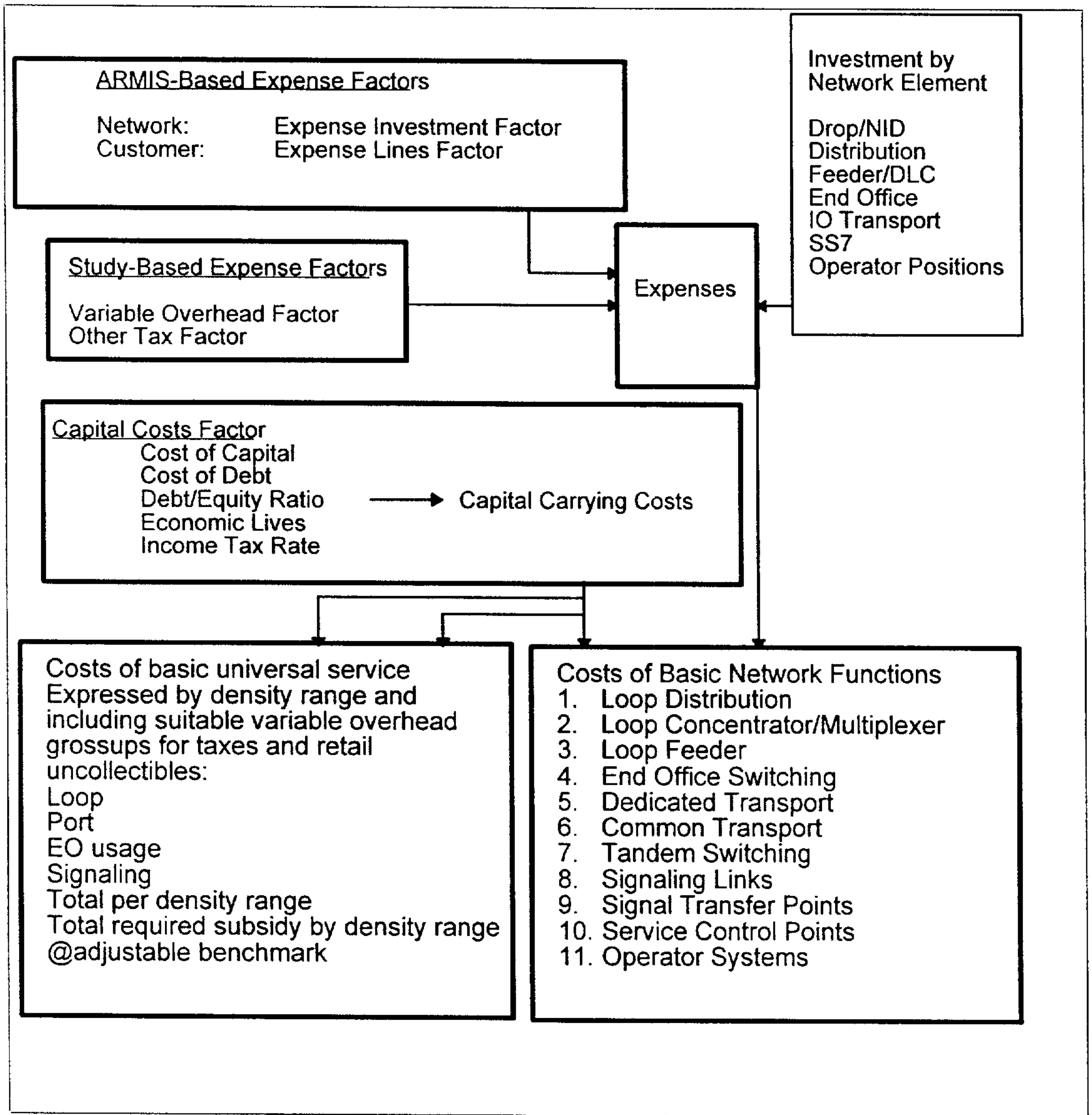
The Hatfield Model calculates investments for furniture, office equipment, general purpose computers, buildings, motor vehicles, garage work equipment, and other work equipment. The Model uses actual 1995 company investments to determine the ratio of investments in the above categories to total investment. The ratio is then multiplied by the network investment estimated by the Model to produce the investment in general support equipment. The recurring costs -- capital carrying costs and operating expenses -- of these items are then calculated from the investments in the same fashion as the recurring costs for other network components. A portion of general support costs is assigned to customer operations and corporate operations according to the proportion of operating expense in these categories to total operating expense reported in the ARMIS data. The remainder of costs is then assigned directly to UNEs.

s. What method should be used to determine the economic depreciation rate of assets?

AT&T proposes using the FCC prescribed projection lives and future net salvage percents contained in its Parameter Report. The FCC has been prescribing state-specific, forward-looking economic projection lives for over a decade. The rise in LEC reserve levels from 18.7% in 1980 to 47.1% in 1996 provides empirical evidence of the forward-looking nature of the FCC prescription. Similarly, for instance, BellSouth's reserve level in Tennessee has risen from 37.3% in 1990 to 45.4% in 1996. The projection lives prescribed by the FCC for BellSouth are currently also prescribed by the TRA, and are consistent with the FCC's Universal Service guidelines.

t. What method should be used to determine plant specific (e.g., equipment and maintenance), non--plant-specific (e.g., engineering, network operations), customer service (e.g., marketing and billing), and corporate (e.g., legal and accounting) expense factors?

The expense module in the Hatfield Model receives from the other modules all the network investments, by type of network component necessary to provide UNEs, basic universal service and network interconnection and carrier access in each study area. The Expense Module estimates the capital carrying costs associated with the investments as well as the costs of operating this network. Capital carrying costs include depreciation, return on the debt and equity investment required to build the network and a gross-up to pay for the income taxes imposed on equity returns. Network-related operating expenses include maintenance and network operations. Non-network-related operating expenses include customer operations expenses, general support expenses, other taxes, uncollectibles and variable overhead expenses.



Estimating forward-looking capital carrying costs is relatively straight-forward. The FCC and state regulators have developed standard practices that are based on sound economics to perform this function. The model calculates annual capital cost for each UNE component based on plant investment for that component from the relevant investment modules, the return to the net asset, an income tax gross-up on the equity component of the return, and the expected service life adjusted for net salvage value (depreciation) of the component. Each of these elements of the capital carrying cost estimate is discussed below.

The weighted average cost of capital (return) is built up from several components. A 45/55 debt/equity ratio is assumed, with a cost of debt of 7.7 percent and a cost of equity of 11.9 percent, for an overall weighted average cost of capital of 10.01 percent.[14] The equity component of the return is subject to federal, state and local income tax. As a consequence, it is necessary to increase the pre-tax return dollars, so that the after-tax return is equal to the assumed cost of capital. An assumed combined 39.25 percent federal, state and local income tax (FSLIT) rate was used to "gross up" return dollars to achieve this result.

The model assumes straight-line depreciation and calculates return on investment, tax gross-up and depreciation expenses annually on the mid-year value of the investment. Because capital carrying costs are levelized, substitution of nonlinear or accelerated depreciation schedules for straight-line depreciation would have almost no net effect on calculated annual capital carrying costs (aside from favorable tax effects). Default values for the service lives of the 23 categories of equipment used in the Model are based on their average projection lives adjusted for net salvage value as determined by the three-way meetings (FCC, State Commission, LEC) for 76 LEC study areas including all of the RBOCs, SNET, Cincinnati Bell, and numerous GTE and United companies. The table below shows the plant categories, their economic lives, their percent net salvage value, and the resulting adjusted projection lives upon which depreciation is based.

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14 This assumed cost of capital is conservatively high. Current financial analyses show LEC cost of capital to range between 9 and 10 percent. See, AT&T ex parte filing of February 12, 1997, "Estimating the Cost of Capital of Local Telephone Companies for the Provision of Network Elements," by Bradford Cornell, September, 1996.

Service Lives for Various Plant Categories

Account	USOA Category	Economic Lives	Net Salvage Percent	Adjusted Projection Lives (years)
2112	Motor Vehicles	8.24	11.21%	9.28
2115	Garage Work Equipment	12.22	-10.71%	11.04
2116	Other Work Equipment	13.04	3.21%	13.47
2121	Buildings	46.93	1.87%	47.82
2122	Furniture	15.92	6.88%	17.10
2123.1	Office Support Equipment	10.78	6.91%	11.58
2123.2	Company Comm Equipment	7.40	3.76%	7.69
2124	Computers	6.12	3.73%	6.36
2212	Digital Switching	16.17	2.97%	16.66
2220	Operator Systems	9.41	-0.82%	9.33
2232.2	Digital Circuit Equipment	10.24	-1.69%	10.07
2351	Public Telephone	7.60	7.97%	8.26
	NID, SAI			Calculated
2411	Poles	30.25	-89.98%	15.92
2421-m	Aerial Cable - Metallic	20.61	-23.03%	16.75
2421-nm	Aerial Cable - Non-Metallic	26.14	-17.53%	22.24
2	Underground -	2	-	21.14

422-m	Metallic	5.00	18.26%	
2	Underground - Non-	2	-	23.08
422-nm	Metallic	6.45	14.58%	
2	Buried - Metallic	2	-	19.90
423-m		1.57	8.39%	
2	Buried - Non-	2	-	23.86
423-nm	Metallic	5.91	08.58%	
2	Intrabuilding -	1	-	15.71
426-m	Metallic	8.18	15.74%	
2	Intrabuilding - Non-	2	-	23.62
426-nm	Metallic	6.11	10.52%	
2	Conduit Systems	5	-	50.92
441		6.19	10.34%	
	Average Metallic			Calcula
	Cable			ted

Return is earned only on net capital, but because depreciation results in a declining value of plant in each year, the return amount declines over the service life of the plant. To ensure that a meaningful long run capital carrying cost is calculated, the return amount is levelized over the assumed life of the investment using net present value factors. An annual capital carrying charge factor is developed for economic depreciation lives from 1 to 80 years. (*see*, "CCCFactor" worksheet in the Expense Module). These factors (which are also disaggregated into their depreciation, return and tax components) are then applied to investment in each plant category (with interpolation to account for fractional year values for economic life) to determine the annual capital carrying cost for each plant category.

Estimating LEC operating costs is more difficult than estimating capital costs. Few publicly available forward-looking cost studies are available from the ILECs. Consequently, many of the operating cost estimates developed here must rely on relationships to and within historical ILEC cost information as a point of departure for estimating forward-looking operating costs. While certain of these costs are closely linked to the number of lines provided by the ILEC, other categories of operating expenses are related more closely to the levels of their related investments. For this reason, the Expense Module develops factors for numerous expense categories and applies these factors both against investment levels and demand quantities (as appropriate) generated by previous modules.

The operating expenses can be divided into two categories -- network related and non-network related. Network-related expenses include the cost of operating and maintaining the network, while non-network expenses include customer operations and variable overhead.

The cost categories contained in the FCC's Uniform System of Accounts ("USOA") are used as the point of departure for estimating the operating expenses associated with providing UNEs, basic universal service and carrier access and interconnection. The major expense categories in the USOA are Plant Specific Operations Expense, Plant Non-Specific Operations Expense, Customer Operations Expense and Corporate Operations Expense. The first two are network-related, the latter are not.

LECs report historical expense information for each of these major categories through the FCC's ARMIS program. The ARMIS data used in the Expense Module include investment and operating expenses and revenues for a given local carrier and state. As noted above, forward-looking expense information for these categories is not publicly available from the ILECs. A variety of approaches are used to estimate the forward-looking expenses.

The two major categories under which network-related expenses are reported by the ILECs are plant-specific operations expenses and non plant-specific operations expenses. The plant-specific expenses are primarily maintenance expenses. Certain expenses, particularly those for network maintenance, are functions of their associated capital investments. The Expense Module estimates these from historic expense ratios calculated from balance sheet and expense account information reported in each carrier's ARMIS report. These expense ratios are applied to the investments developed by the Distribution, Feeder, and Switching and Interoffice Modules to derive associated operating expense amounts. The ARMIS information used to perform these functions is contained in the "ARMIS Inputs" worksheet, and the expense factors are computed in the "'95 Actuals" worksheet of the Expense Module.

Other expenses, such as network operations, vary more directly with the number of lines provisioned by the ILEC rather than its capital investment. Thus, expenses for these elements are calculated in proportion to the number of access lines supported.

The Expense Module estimates direct network-related expenses for all of the UNEs. These operating expenses are added to the annual capital carrying cost to determine the total expenses associated with 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 applied to 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 equipment; these values derive from a New England Telephone cost study.[15] The Module similarly computes a forward-looking Network Operations value based on the corresponding ARMIS value. The total Network Operations expense is strongly line-dependent. The model thus computes this expense as a per-line additive value based on the reported total Network Operations expense divided by the number of access lines and deducting 50 percent of the resulting quotient to produce a forward-looking estimate.

The Expense Module assigns non-network related expenses to each density range, census block group, or wire center (depending on the unit of analysis chosen) based on the proportion of direct expenses (network expenses and capital carrying costs) for that unit of analysis to total expenses in each category. Each of these expenses is described below:

Variable support -- Certain costs that vary with the size of the firm, and therefore do not meet the economic definition of a pure overhead, are often included under the classification of General and Administrative expenses by ILECs. For example, if a LEC did not provide loops, it would be a much smaller company, and would therefore have lower overhead costs. Some of these costs are nonetheless attributed to overhead under current ILEC accounting procedures. Therefore, the model includes a portion of these "overhead" costs in the TSLRIC estimates.

Such variable support expenses for LECs currently 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 10.4 percent variable support

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[15] New England Telephone, 1993 New Hampshire Incremental Cost Study, Provided in Compliance with New Hampshire Public Utility Commission Order Number 20, 082, Docket 89-010/85-185, March 11, 1991.

factor to the total costs estimated for unbundled network elements, as well as basic local service.

Uncollectible 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, with the retail factor applied to basic local telephone service monthly costs and the wholesale factor used in the calculation of UNE costs.

u. In which cases is it appropriate to allocate costs between the provision of universal service and all other services?

Universal Service Fund Outputs (USF Sheet)

The calculation of costs for basic local service is based on the costs of the UNEs constituting this service. These are the loop, switch line port, local minute portions of end office and tandem switching, transport facilities for local traffic, and the local portions of signaling costs.[16] In addition, costs associated with retail uncollectibles, variable overheads, and certain other expenses required for basic local service, such as billing and bill inquiry, directory listings, and number portability costs, are included. No operator services or SCP costs are included. The model user has the ability to select dynamically the portions of non-traffic-sensitive UNEs to be included in the supported basic local service.

The USF report in the expense module then compares the monthly cost per line used at residence or business intensity in each density range, CBG or wire center to user-adjustable "benchmark" monthly costs for local service (which includes the End User Common Line charge). If the cost exceeds the associated "benchmark," the model accumulates the total required annual support relative to stated benchmarks according to the number of primary residence lines, secondary residence lines, single line business lines, multiline business lines, or public lines in each density range, CBG, or wire center (depending on the unit of analysis).

v. In cases where it is appropriate, what method should be used to allocate costs between the provision of universal service and all other services?

See response to "u".

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[16] On an optional basis, the usage sensitive cost of switched access use can be included as well.

w. What, if any, local usage component should be included in universal service support?

A limited amount of local usage should be included.

x. What is the proper cost and percentage of equity?

<u>BellSouth</u>
Cost of equity - 11.02%
Percent of equity - 60%

<u>Citizens</u>
Cost of equity - 11.9%
Percent of equity - 55%

<u>United</u>
Cost of equity - 11.9%
Percent of equity - 55%

y. What is the proper cost of debt?

BellSouth
Cost of debt - 7.06%
Percent of debt - 40%

Citizens
Cost of equity - 11.9%
Percent of equity - 55%

United
Cost of equity - 11.9%
Percent of equity - 55%

Respectfully submitted,

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