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November 13, 1997

K. David Waddell
Executive Secretary
Tennessee Regulatory Authority
460 James Robertson Parkway
Nashville, TN 37243-0505

Re: Universal Service Generic Contested Case
Docket No. 97-00888

Dear Mr. Waddell:

Pursuant to the Order of the Tennessee Regulatory Authority ("TRA") at its conference held on October 30, 1997, enclosed please find the original and thirteen (13) copies of information submitted by MCI Telecommunications Corporation in response to Issue 16, as set forth on the Universal Service Issues List adopted by the TRA in the above-captioned docket. As you will note, the information enclosed consists of the following (collectively, the "Documents"):

1. Comments of AT&T Corp. and MCI Telecommunications Corporation filed with the Federal Communications Commission ("FCC"), dated August 8, 1997 in the Matter of Federal-State Joint Board on Universal Service (CC Docket No. 96-45) and Forward-Looking Mechanism for High Cost Support for Non-Rural LECs (CC Docket No. 97-160);

2. Opposition filed by MCI Telecommunications Corporation dated August 18, 1997 filed with the FCC in CC Docket No. 96-45;

3. Comments of AT&T Corp. and MCI Telecommunications Corporation on Customer Location Issues dated September 2, 1997 filed with the FCC in CC Docket No. 96-45 and CC Docket No. 97-160;

4. Reply Comments of AT&T Corp. and MCI Telecommunications Corporation on Customer Location Issues dated September 10, 1997 filed with the FCC in CC Docket No. 96-45 and CC Docket No. 97-160;

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5. Comments of AT&T Corp. and MCI Telecommunications Corporation dated September 24, 1997 filed with the FCC in CC Docket No. 96-45 and CC Docket No. 97-160;

6. Reply Comments of AT&T Corp. and MCI Telecommunications Corporation dated October 3, 1997 filed with the FCC in CC Docket No. 96-45 and CC Docket No. 97-160; and

7. Comments of AT&T Corp. and MCI Telecommunications Corporation on Designated Input and Platform Issues dated October 17, 1997 filed with the FCC in CC Docket No. 96-45 and CC Docket No. 97-160.

8. Reply Comments of AT&T Corp. and MCI Telecommunications Corporation on Designated Input and Platform Issues dated October 27, 1997 filed with the FCC in CC Docket No. 96-45 and CC Docket No. 97-160.

The comments contained in the above-referenced and enclosed Documents address Issue 16 of the TRA Universal Service Issue List, as well as other Universal Service issues. MCI will be filing supplemental comments detailing specific portions of the above-referenced and enclosed Documents as such comments relate more particularly to Issue 16. Due to Universal Service hearings and preparation therefor occurring in other jurisdictions over the last several weeks, a more detailed summary responding particularly to Issue 16 is not available as of this required filing date. This supplemental filing will be made as soon as possible.

Very truly yours,

BOULT, CUMMINGS, CONNERS & BERRY, PLC

By: Jon Hastings
Jon E. Hastings

JEH/th

Enclosures

cc: All Parties of Record
Mickey Henry
Melba Reid

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OFFICE OF THE SECRETARY

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND
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August 8, 1997

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SUMMARY

The Hatfield Model best addresses the switch cost modeling issues raised in the FNPRM. As shown in Section I, the Commission has correctly concluded that an appropriate cost mechanism will account for cost differences among stand-alone, host and remote switches. The Hatfield Model appropriately captures these differences by basing its switching costs on actual ILEC purchasing practices, and hence the "market" view of the appropriate forward-looking switching mix. The Commission's alternate proposal of requiring cost models dynamically to optimize switch types at each wire center is unworkable and unlikely to produce measurable benefits.

Section II addresses switch capacity constraints. AT&T and MCI agree that an appropriately designed cost model will place multiple switches in a single wire center when one or more of a switch's capacity constraints are exceeded. The Hatfield Model adheres to this allocation rule and includes conservative capacity constraints.

In Section III, AT&T and MCI explain why it would be inappropriate to require cost models to reflect in nominal dollar terms the allegedly higher per line expenses associated with adding capacity to existing switches. ILECs have failed to provide verifiable data that such differences exist even in nominal terms, much less that there are significant differences in real dollar terms after accounting for the time value of money and the trend of declines in real prices for switching components. In any event, it would be improper to focus on the impact growth has on the cost of a single input or element, because for many other elements "growth" costs will be lower on a unit basis than "new" costs.

AT&T and MCI agree with the Commission that switching costs should be divided between port and non-port costs. As discussed in Section IV, that feature is already incorporated into the Hatfield Model, and evidence from existing cost studies confirms the reasonableness of the Hatfield Model's allocation factor.

Finally, in Section V, AT&T and MCI agree that it is critically important that a cost model produce forward-looking cost estimates for network elements necessary to provide interoffice trunking, signaling, and local tandem services, because the costs of those elements vary significantly between densely and sparsely populated areas. Only the Hatfield Model generates element prices at this requisite level of disaggregation.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND
MCI TELECOMMUNICATIONS CORPORATION

Pursuant to the Commission's Further Notice of Proposed Rulemaking,[1] AT&T Corp. ("AT&T") and MCI Telecommunications Corporation ("MCI") hereby submit their joint comments with respect to the designated issues concerning the selection of a forward-looking cost mechanism for use in determining the level of federal support for universal service in high cost areas. These comments specifically address issues related to switching costs and interoffice trunking, signaling, and local tandem investment as requested by the Commission in sections III.C.3 and III.C.4 of its FNPRM.[2]

[1] Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45, 97-160, Further Notice of Proposed Rulemaking (released July 18, 1997) ("FNPRM").

[2] AT&T and MCI will in accordance with the Notice address specific switching inputs in its separate cost model input comments and reply comments.

INTRODUCTORY STATEMENT

AT&T and MCI welcome the further opportunity to comment on the specific features, assumptions and computation processes that should characterize an appropriately designed forward-looking cost model for use in determining the level of federal universal service support in high cost areas. In this proceeding, AT&T and MCI will attempt to provide the Commission with as much detail as possible on the specific inputs and logic of the competing modeling approaches and proposals. It is important, however, that in this entirely proper focus on detail the parties not lose sight of the more general governing principles that distinguish an appropriate modeling approach from an inappropriate one.

In that regard, both the Commission and its staff and the Federal-State Joint Board on Universal Service have, over the course of the past year, enumerated a number of general principles that provide useful guides in evaluating specific modeling proposals and ultimately in selecting the best cost model. First and foremost, the model must estimate forward-looking economic cost.[3] As the Commission has repeatedly recognized, only that approach can simultaneously ensure full cost recovery and efficient investment, innovation, and entry, and thus the Commission should continue to reject attempts to "include sunk or historically incurred

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[3] See, e.g., FNPRM ¶ 1(federal universal service support will be 25% of "the difference between the forward-looking economic cost and the benchmark"); Staff Cost Model Analysis ¶ 9; Public Notice, Criteria for State-Conducted Economic Cost Studies, CC Docket 96-45 (released July 29, 1997) ("State Cost Study Criteria") ("Only long-run forward-looking economic cost may be included" in state universal service cost studies); Report and Order, Federal-State Joint Board on Universal Service, CC Docket No. 96-45 ¶ 224 (released May 8, 1997) ("USF Report and Order"); Recommended Decision, Federal-State Joint Board on Universal Service, CC Docket No. 96-45 ¶ 275 (released Nov. 8, 1996) ("Recommended USF Decision").

costs." The Use of Computer Models for Estimating Forward-Looking Economic Costs: A Staff Analysis, 1997 WL 10020 ¶ 9 (January 9, 1997) ("Staff Cost Model Analysis").

Second, the model must be open and verifiable and rely, where possible, on publicly available data.[4] Users should have the ability to examine not only the model's algorithms, but also detailed documentation on its operation. Third, the model must be both user adjustable and flexible enough to serve all local network modeling needs.[5] In this regard, the cost model must produce prices for all network elements necessary to provide traditional narrowband services and current quality levels.[6] Failure to provide prices at this disaggregate level "creates a 'bottleneck' that could prevent competitors from entering the market." Staff Cost Model Analysis ¶ 10. Further, without a wide range of adjustable inputs, a model cannot reliably identify high cost areas. And the model must be one of general applicability, not one, for example, that is dependent on the characteristics of manufacturer specific equipment. Although this list is by no means exhaustive, these fundamental principles should guide the Commission in its consideration of the much narrower issues that have been raised in this FNPRM.

Models are, of course, tools of estimation, and no model -- either a cost model or ILEC study -- can be expected to achieve absolute precision on all (or, indeed, any) fronts. AT&T and MCI are confident, however, that the Hatfield Model best achieves both the Commission's

[4] See, e.g., Staff Cost Model Analysis ¶ 15; State Cost Study Criteria ("The cost study or model and all underlying data, formulae, computations, and software associated with the model must be available to all interested parties for review and comment"); USF Report and Order ¶ 242 (criticizing BCPM for lack of support and openness).

[5] See, e.g., Staff Cost Model Analysis ¶ 16.

[6] See, e.g., State Cost Study Criteria; Staff Cost Model Analysis ¶ 10.

general cost model criteria and the more specific issues raised in the FNPRM. The Hatfield Model comes closest to the forward-looking, least cost engineering ideal by building a narrowband network from the bottom-up assuming the best available technology and current wire center locations. The Hatfield Model relies on available public information. In terms of narrowband network elements, the Hatfield Model prices the largest number of elements, and it is the only model that calculates cost estimates for the individual interoffice elements necessary to provide interoffice trunking, signaling, and local tandem services. And the Hatfield Model permits the user to adjust literally many hundreds of input values including the inputs that have been subjects of contention in this proceeding and in state arbitration proceedings.

The Hatfield Model also best comports with the Commission's tentative conclusions in the FNPRM. In particular, AT&T and MCI agree with the Commission that the selected model should capture the forward-looking costs of host, stand-alone, and remote switches -- as the Hatfield Model does. The Hatfield Model satisfies the constraint that a cost model locate multiple switches at a wire center whenever one or more capacity constraints are exceeded. The Hatfield Model's switch cost values are more than adequate to properly account for "growth" lines even assuming reliable evidence existed that such additions are significantly more expensive in real dollar terms (and it does not) and that including "costs" that should never be incurred by an efficient provider was consistent with the Commission's TELRIC approach (and it is not).

AT&T and MCI also support the Commission's tentative decision to allocate switching costs between port and non-port investment. Current data and ILEC cost studies indicate that the Hatfield Model allocation of 30% of switching costs to port investment is reasonable.

Finally, AT&T and MCI concur with the Commission that the selected cost model should calculate costs for the individual interoffice elements required for interoffice trunking, signaling, and local tandem services, and, as the Commission recognizes, only the Hatfield Model does so.

I. THE HATFIELD MODEL APPROPRIATELY CAPTURES THE DIFFERENT FORWARD-LOOKING COSTS OF HOST, STAND-ALONE, AND REMOTE SWITCHES.

In the Notice the Commission tentatively concluded that the chosen cost model "should include an algorithm that will place host switches in certain wire centers and remote switches in other wire centers." FNPRM ¶ 122. The Commission reached this conclusion based upon evidence that incumbent LECs are increasing their purchases of remote switches relative to their purchases of host switches, a practice the Commission correctly interprets as indicative of differences in the switching costs among host, stand-alone, and remote switches and the economies that may be obtainable by deploying an appropriate mix of switches. Id. ¶ 121. These three switch categories indisputably do exhibit different cost characteristics that may render one type more desirable in a specific wire center under particular circumstances. Hence, AT&T and MCI agree with the Commission that, to the extent reasonably practicable, the selected cost model should reflect the economies that are obtainable from use of an efficient mix of host, stand-alone, and remote switches -- and the Hatfield model advocated by AT&T and MCI appropriately does so.

In this regard, there are two possible approaches to modeling these switching cost characteristics. First, a cost model can, as the Hatfield Model does, rely on public data to construct a switching cost curve that reflects all available information about actual recent switch purchases, and hence the "market" view of the efficient forward-looking mix of different switch types. This market-based "averaging" approach is straightforward and verifiable, and, because it reflects market data and actual LEC purchasing practices without the biases that may infect "surveys" or more limited data sources, it is likely to produce a reasonably accurate estimate of actual forward-looking costs.

Second, a modeler could attempt, as the Notice suggests (FNPRM ¶ 122), to optimize dynamically the network switch configuration by calculating the most efficient switch for each wire center location given the type of switch at every other location. While such a dynamic approach might be ideal in theory, the enormous complexity of the simultaneous optimization calculations and the massive and elaborate data requirements would, in practice, render it both unworkable and unlikely to produce more accurate cost estimates.

As an initial matter, any such approach would require additional data regarding switch prices -- by manufacturer and switch type -- that simply is not available. Both requesting carriers and regulators, including the Commission, have long been frustrated by the unavailability of detailed data on switch prices even at the aggregate level, and by the unwillingness of incumbent LECs and switch manufacturers to provide such data in any usable or verifiable form.[7] In these circumstances, it is plainly unrealistic to assume the availability of the much more detailed cost information for every switch type that would be required to carry out a dynamic optimization process at the wire center level.

Further, even assuming its availability and accuracy, raw cost data could not simply be "entered" into an algorithm (again, assuming one could be written to account for all variables and

[7] See, e.g., Order, Federal-State Joint Board on Universal Service, CC Docket No. 96-45, DA 97-1433 (released July 9, 1997).

yield results in reasonable processing times, see, infra). Rather, assumptions (or additional calculations) would have to be made about the appropriate allocations of each host switch's processing time and equipment costs to the specific remote switches that are dependent on the host switch for particular functions. Again, because remotes only function with hosts from the same manufacturer, this would have to take place manufacturer-by-manufacturer, switch-type-by-switch-type.

Even if these imposing data hurdles could somehow be overcome, attempting to model the optimal, forward-looking mix of switch types would be extremely difficult, at best. The number and dependencies of the variables that would be required by the optimization algorithms is staggering. For example, a remote switch must be slaved to a host switch built by the same manufacturer. Hence, in order to determine the optimal switch type for a particular wire center, a dynamic algorithm must, at a minimum, account for the types of switches at other wire centers, the manufacturer, capacity, and capabilities of those switches, and the services the wire center being optimized must provide. The selection of a particular switch type for a wire center, however, impacts the optimal decision for every other wire center. In short, a dynamic algorithm must consider every factor that affects every wire center in order to allocate optimally a switch to a particular wire center. The simultaneous solution of the switch allocation algorithms for every wire center will be difficult, processor intensive, extremely sensitive to the underlying assumptions, and highly contentious. Even beyond these difficulties, the hypothetical algorithm would also need to decide whether or not to use a switch at a particular wire center at all. In many instances, a more efficient alternative would be simply to deploy Digital Loop Carrier

("DLC") equipment. This additional complexity would have a profound impact on the number of wire center equipment permutations.[8]

These difficulties cannot be overcome by looking to the embedded switch mix as a surrogate. Such an approach would plainly be inappropriate on a number of levels. Most fundamentally, relying on the embedded mix of switch types does not reflect the forward-looking optimal network configurations and therefore this approach would violate the core principle of the Commission's TELRIC methodology. For example, older remote switches have much smaller line capacities than newer ones and, therefore, a few years ago, ILECs would have installed more stand-alone switches. Today, remote switches have increased line capacity, and thus it would be more efficient to place a remote switch in some wire centers where the ILEC had previously located a stand-alone switch. For these and other reasons there is no reason to believe that the embedded network configuration reflects an efficient allocation of host, stand-alone, and remote switches from a forward-looking perspective. Indeed, the Commission in the Notice recognizes that the embedded switch mix does not comport with current purchasing practices. See FNPRM ¶ 121. There is certainly no reason to believe that substituting embedded mix assumptions for dynamic optimization -- which would not obviate the need to acquire currently unavailable data regarding switch prices -- would yield more accurate results than looking to LEC's current procurements of new switches for information about switch mix.

The Hatfield Model's reliance on a cost curve constructed using current ILEC purchasing characteristics avoids all the aforementioned difficulties. Specifically, the Hatfield Model reflects

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[8] Simple combinatorial mathematics suggests that literally billions of configurations would need to be tested.

different switching cost characteristics by relying on figures from the NBI Report which estimated industry average switching prices paid per line per year.[9] Using this data, two switching cost curves were developed, one curve for large buyers like the RBOCs and GTE, and another for smaller ILECs to represent the rates ILECs currently pay for switches. These cost curves, then, capture today's shifted emphasis from standalone to host/remote switches, as well as many other strategic factors considered by ILECs in their network designs. By focusing on the full spectrum of current purchases rather than the historic configuration, this approach greatly increases the likelihood that the Hatfield Model will yield accurate estimates of forward-looking economic costs.

II. THE HATFIELD MODEL APPROPRIATELY ASSIGNS MULTIPLE SWITCHES TO A WIRE CENTER WHENEVER ONE OR MORE CONSERVATIVE CAPACITY CONSTRAINTS ARE EXCEEDED.

The Commission has correctly concluded that the selected cost model "should assign more than one switch to a wire center" in those instances where any of a switch's capacity constraints are exceeded. The Hatfield Model explicitly accounts for switch capacity constraints including the number of lines (80,000), traffic capacity (1,800,000 busy-hour hundred call seconds for the largest switch), and processing capacity (600,000 busy-hour call attempts for the largest switch) – all through user adjustable inputs. See Hatfield Model Description at 47. The Hatfield Model proponents included these switching capacity constraints because the market -- and therefore switch manufacturers and purchasers -- have identified them as important. If any of the "capacity

[9] Northern Business Information Study: U.S. Central Office Equipment Market -- 1995 Database, McGraw-Hill, New York, 1996 ("NBI Report"). The Hatfield Model also relies on the ARMIS 43-07 and responses to the 1994 USF Notice of Inquiry data request for public line and data on average lines per switch. See Hatfield Model Description at 48.

limit[s] [are] exceeded, the model will compute the investment required for additional switches." Id. To the extent necessary, AT&T and MCI will address the specific default input values in their input comments. However, it is plain that the default constraints are very conservative given the actual capacities of currently deployed switches. For example, Nortel[10] advertises a busy hour call attempt capacity of 1,400,000 and Lucent[11] has switches supporting over 100,000 lines.

III. THE HATFIELD MODEL APPROPRIATELY ADDRESSES THE "GROWTH LINE" ISSUE.

The Commission has postponed comment on specific switching input prices until October 17, 1997 (FNPRM ¶ 141) at which time AT&T and MCI will discuss the switch cost and other input and assumption values used by the Hatfield Model as well as the positions taken by other parties to this proceeding.[12] Accordingly, AT&T and MCI will limit their comments here to the issue of "whether or not [to] incorporate the cost of growth lines into [its] switching cost estimate" (FNPRM ¶ 132).

AT&T and MCI do not believe any adjustments to incorporate supposed cost differences between "new" and "growth" lines are appropriate. First, contrary to ILEC claims, there are no reliable, verifiable, publicly available data that establish a significant per-line cost difference -- even in nominal dollar terms -- between new switch purchases and later purchases of additional

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[10] See Nortel's world-wide-web site at www.nortel.com.

[11] See Lucent's world-wide-web site at www.lucent.com.

[12] AT&T and MCI are currently evaluating the depreciation record-based data recently provided by the Commission and will comment on the appropriateness of relying on that data in this context when that evaluation is complete.

capacity for existing switches ("growth lines").[13] To the contrary, switch contract data reviewed by AT&T and MCI (which unfortunately remains proprietary) suggests that large ILEC switch contracts often reflect a single per-line price that encompasses both new and growth lines. And even where that is not so, it may simply reflect non-cost-based allocations by the parties to the contract, who, from a cost perspective, are concerned only with the total bottom-line purchase amount.[14]

But nominal dollar differences, even if they existed, would be irrelevant. Fundamental financial principles dictate that it would be patently inappropriate simply to lump together the nominal dollar costs of switches purchased today and switch capacity that might be purchased in the future. Put simply, even if an ILEC did agree to pay $100/line for growth lines in the same contract in which it paid $75 for new switch capacity, that ILEC's average cost/line in today's dollars (the time of modeling) could well remain $75 -- or even less -- given the time value of money and the fact that the "growth" lines are to be purchased, if at all, in the future. Indeed, if it were true that growth lines were significantly more expensive than new capacity, one might expect efficient ILECs to elect to pay prevailing prices for growth lines, rather than contracting in advance, given the long term downward trends in the prices of switch components (and the

[13] The "growth line" cost estimates provided by NBI, although clearly more reliable than the ILECs' unsubstantiated claims, are themselves problematic, because unlike the NBI estimates used in the Hatfield Model, the NBI "growth line" data are not sufficiently disaggregated to allow differentiation between large and small ILECs for comparison to corresponding "new" capacity costs.

[14] This is especially true given that ILECs may agree on growth line prices at the same time that they buy new switches. Thus the individual rate elements for growth lines in an aggregate contract can have no presumption of independent validity (but may instead reflect the ILEC's preferences for accounting or other purposes).

bargaining power the ILECs' continuing purchases give them with respect to switch manufacturers). The ILECs' claim that this does not happen is simply further evidence that there are no significant cost differences in real terms.

In any event, focusing on the "growth" costs of a single part of the network, while ignoring "growth" costs with respect to the remainder of the network would plainly be inappropriate. Even assuming that "growth" costs are higher in real dollar terms for switch capacity -- and there is no basis for any such assumption -- it is undeniable that precisely the opposite effect would be encountered with respect to "growth" costs for many other parts of the network (e.g., growth in loop plant is far cheaper than new on a unit basis). When coupled with the fact that the Hatfield Model makes very conservative capacity cost estimates that will tend to overstate switching costs, there is simply no justification for requiring upward "growth" line adjustments to cost estimates.

Finally, the Commission should not lose sight of the practical difficulties of obtaining reliable "growth" line cost data and appropriately accounting for the time value of money and real declines in switch capacity costs. In this regard, the "price" of various parties' proposals to scrap the Hatfield approach in favor of a hodgepodge of "surveys" and supposition on the grounds that the Hatfield Model curves do not perfectly account for all variables is the very reliability, verifiability and accuracy that the Commission, the states and industry participants have all recognized as critical.

IV. THE HATFIELD MODEL APPROPRIATELY INCLUDES A REASONABLE ALLOCATION OF PORT AND NON-PORT COSTS.

There can be little controversy over the Commission decision to divide switching costs between port and non-port costs. FNPRM ¶ 135. Precisely separating these costs presents significant difficulties, however, and any allocation necessarily will have some indeterminacy. Hence, it is critical that the Commission not adopt an allocation standard that exacerbates the problems with this separation process. In particular, consistent with the modeling principles discussed in the introductory statement, the selected mechanism should be manufacturer neutral. Failure to adhere to this maxim will render universal service subsidies sensitive to the particular mix of switching vendors. More importantly, under these circumstances vendor sensitivity of this type could be inconsistent with cost based pricing and therefore with forward-looking economic cost. The preferred approach in practice, then, is to allocate a reasonable portion of switching costs to the port. Currently, the Hatfield Model assigns 30% of total switch investment to the port, an allocation that has been supported by publicly available cost studies.[15]

The Commission has also decided that "all of the port cost and a percentage of the usage cost are costs of providing universal service." FNPRM ¶ 137. AT&T and MCI support this conclusion as well as the Commission's conclusion that local usage, as a percentage of other usage, should be allocated to universal service. Id. The Hatfield Model already employs exactly such an approach, separating switching costs associated with local traffic from other traffic on the basis of switching minutes, and then allocating the local traffic costs to universal service. Id. ¶ 134.

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[15] New York Study, Case 0657:94-C0095 & 91-C1174, Workpapers Part B at 93 (average 24% of line port); Massachusetts Study, 96-73/74: 96-75: 96-80/81: 96-83: 96-94 (filed Oct. 24, 1996) Workpaper Part B at 73 (average 43% of line port). The Commission has also sought comment "on whether alternative data sources are available for the purpose of estimating current cost...[and] how to obtain and use that information." FNPRM ¶ 136. The Hatfield Model currently relies on the best verifiable switching cost information as AT&T and MCI will demonstrate in their input comments to the Commission.

V. THE HATFIELD MODEL ACCURATELY DETERMINES THE COST OF THE SPECIFIC ELEMENTS NECESSARY TO PROVIDE INTEROFFICE TRUNKING, SIGNALING, AND LOCAL TANDEM SERVICES.

In its FNPRM, the Commission properly determined that the selected cost model should "calculate specific cost estimates for the interoffice elements" required to provide interoffice trunking, signaling, and local tandem services and that the Hatfield Model is the only model capable of producing "cost estimates at this level of specificity." FNPRM ¶ 141. Indeed, the Hatfield Model's flexibility and output specificity have allowed its proponents to demonstrate that the detailed modeling of these element costs is essential to an accurate assessment of universal service support because the cost of these elements varies significantly between densely and sparsely populated areas. In contrast, BCPM applies an overly simplistic multiplier to switching costs as a proxy for the cost of all of these services combined. Id. ¶ 140. In short, the Hatfield Model is the only reasonable choice with regard to interoffice investment cost estimation.

AT&T and MCI, of course, welcome suggestions on ways to improve the Hatfield Model's interoffice modeling. Contrary to ILEC statements, such refinements are quite likely to reduce, rather than inflate, overall cost estimates. For example, the Model assumes that interoffice traffic passes to other wire centers in proportion to their relative number of lines. In reality, more traffic is typically routed to closer wire centers, thereby reducing cost. The Hatfield Model also takes a conservative approach to the number of tandem switches and STPs.[16] For

[16] The Hatfield Model also uses the best verifiable input values for determining the costs of those elements used to provide interoffice trunking, signaling, and local tandem services. As requested by the Commission, these inputs will be discussed at length in AT&T and MCI's input comments. See FNPRM ¶ 141.

these and other reasons, the Hatfield Model's approach to the estimation of interoffice trunking, signaling, and local tandem costs is conservative.

CONCLUSION

For the foregoing reasons, the Commission should adopt the Hatfield Model approach to the switching issues raised in the Notice.

Respectfully submitted,

AT&T CORP.

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Attorney for MCI Telecommunications Corporation

August 8, 1997

CERTIFICATE OF SERVICE

I, Hagi Asfaw, do hereby certify that on this 8th day of August 1997, a copy of the foregoing "Comments of AT&T Corp. and MCI Telecommunications Corporation" was mailed by U. S. first class mail, postage prepaid, to the parties listed on the attached service list.

/s/ Hagi Asfaw
Hagi Asfaw

APPENDIX: SERVICE LIST

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Federal-State Joint Board on	)	CC Docket No. 96-45
Universal Service	)	
	)	

OPPOSITION

MCI TELECOMMUNICATIONS CORPORATION

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Dated: August 18, 1997

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SUMMARY

A number of incumbent local exchange carriers (ILECs) ask the Commission to reconsider its Universal Service Order because it does not guarantee the ILECs recovery of their booked costs and it does not guarantee them the same level of support as they receive today. Thus, petitioners argue that support based on forward looking economic cost and the Commission's transitional universal service measures will effect a taking; and that the Commission's cap on corporate expense and its treatment of DEM weighting and long term support-- namely, that these elements will be supported through the universal service fund and not access charges, and support will be portable-- will reduce their revenues. These arguments, however, fail because the Commission is not required to guarantee the ILECs recovery of their booked costs or a continuation of current revenues. Moreover, the Commission's decision with respect to the use of forward looking economic cost, weighted DEM, LTS and corporate expense, is entirely consistent with the Act's twin goals of ensuring universal service and competition. Accordingly, the Commission must deny these petitions.

The Commission should deny the petitions asking for reconsideration of its rules on support for newly-acquired exchanges. The Commission's order simply acts to prevent transitional support for rural telephone companies from becoming the impetus for the purchase and sale of exchanges.

The Commission should deny the request of the Puerto Rico Telephone Company (PRTC) for "special" treatment for non-rural carriers in insular areas. The PRTC has failed to

explain why a Tier 1 company in an insular area would not enjoy the same economies of scale and scope as a Tier 1 company in a non-insular area.

The Commission's treatment of support for carriers providing universal service services through unbundled network elements ensures fair support for the ILEC and competitive carrier and should not be reconsidered.

The Commission must deny the petition of the Alaska Public Utilities Commission which argues that the Commission should not dictate that federal support be used to reduce interstate access charges because to do otherwise would allow LECs to double recover for supported services-- once through the fund and once through interstate access charges.

Finally, the Commission should deny the petitions of a number of parties-- paging companies, private carriers, systems integrators, payphone providers, private satellite carriers, and non-profit agencies--requesting that they not have to pay into the fund. The Act requires all telecommunications carriers providing interstate telecommunications services to contribute to the fund, and equity requires that all entities that benefit from universal service should contribute to its maintenance.

OPPOSITION

MCI Telecommunications Corporation (MCI) hereby opposes the petitions for reconsideration of the Commission's Universal Service Order as discussed herein.

I. THE COMMISSION'S ORDER DOES NOT EFFECT A TAKING

The Rural Telephone Companies (RTCs) argue that the Universal Service Order will effect a taking because high cost support based on a forward-looking economic cost model will not permit them to recover their embedded investment. The RTCs also argue that the Commission's treatment of rural incumbent local exchange carriers (ILECs) during the interim period prior to the transition to forward looking costs results in an illegal taking without just compensation.[1] Specifically, the RTCs argue that the Commission's order prevents them from earning an 11.25% rate of return on their booked costs, the rate of return on interstate investment set by the Commission.

The RTCs reach this conclusion by misreading applicable Supreme Court precedent. According to the RTCs, Federal Power Comm'n v. Hope Natural Gas, establishes that "[a] rate is considered `confiscatory' if it is not `just and reasonable.'"[2] Since the Commission has concluded that an 11.25% rate of return is "just and reasonable," the RTCs reason, then any rate of return that falls below that number must be a taking.

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[1] RTCs Petition at 2-3.

[2] 320 U.S. 591, 602 (1944).

Neither Hope Natural Gas nor any other Supreme Court case, however, suggests that the rate of return that the Commission has deemed to be "just and reasonable" represents the constitutional minimum and that any rate of return that falls below that number is therefore confiscatory. What these cases do say is that the lowest rate that an agency can set under the "just and reasonable" statutory standard is one that is nonconfiscatory.[3] An agency, of course, is free to set "just and reasonable" rates well above the lowest possible nonconfiscatory rate.[4] It is thus absurd to contend that whatever rate an agency deems to be "just and reasonable" during a particular time period represents a constitutional floor.

Even if the Universal Service Order caused the RTCs to receive a rate of return that was considerably less than 11.25%, there would be no taking. As the Court held in Hope Natural Gas, "regulation does not insure that the [regulated] business shall produce net revenues.'"[5] Thus, any takings claim premised upon entitlement to a guaranteed profit -- let alone a takings claim premised upon entitlement to an 11.25% rate of return -- must fail.

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[3] FPC v. Natural Gas Pipeline Co., 315 U.S. 575, 585-866 (1942) ("By longstanding usage in the field of rate regulation, the 'lowest reasonable rate' is one which is not confiscatory in the constitutional sense"); see also Permian Basin Area Rate Cases, 390 U.S. 747, 770 (1968); Illinois Bell Tel. Co. v. FCC, 988 F.2d 1254, 1260 (D.C. Cir. 1993).

[4] Northwestern Public Serv. Co. v. Montana-Dakota Utilities Co., 341 U.S. 246, 251 (1950) ("Statutory reasonableness is an abstract quality represented by an area rather than a pinpoint. . . . To reduce the abstract concept of reasonableness to concrete expression in dollars and cents is the function of the Commission.").

[5] Hope Natural Gas, 320 U.S. at 603 (quoting Natural Gas Pipeline, 315 U.S. at 590); see also id. at 601 ("[t]he fact that the value is reduced does not mean that the regulation is invalid"); Market St. Ry. Co. v. Railroad Comm'n, 324 U.S. 548, 566 (1945) ("regulation does not assure that the regulated business make a profit"); Permian Basin Area Rate Cases, 390 U.S. 747, 769 (1968) ("[r]egulation may, consistently with the Constitution, limit stringently the return recovered on investment").

The correct standard for assessing whether a takings has been effected is whether the "overall impact of the rate order[] . . . jeopardize[s] the financial integrity of the compan[y], either by leaving [it] insufficient operating capital or by impeding [its] ability to raise future capital." [6] The RTCs cannot meet this stringent standard merely by alleging that their interstate access revenues will decrease.[7] The RTCs could demonstrate a taking only by showing that the Universal Service Order threatened the viability of their entire business, taking into account all inter- and intrastate operations and all lines of business. The RTCs have not even attempted to make such a showing.

In addition, the RTCs calculate their "rate of return" based upon their "booked costs." Indeed, the entire takings argument hinges upon the assumption that they are entitled to recovery of their booked costs. The RTCs' assertion that they are constitutionally entitled to recovery of all of their historical costs -- and that their rate of return must be set based upon their historical costs[8] -- flies in the face of decades of Supreme Court precedent. One need look no further than Duquesne Light Co. v. Barasch,[9] to confirm that regulated carriers are not entitled to recovery of

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[6] Duquesne Light Co. v. Barasch, 488 U.S. 299, 312 (1989).

[7] RTCs Petition at 6 (alleging that "a loss between 8.24% and 38.26% of total annual interstate average schedule settlements" establishes a taking).

[8] At least since the turn of the century, regulatory commissions have employed two basic systems for setting rates -- the historical cost approach and the "fair value" approach. See generally Alfred E. Kahn, The Economics of Regulation 35-41 (1988); Richard J. Pierce, Jr., "Public Utility Regulatory Takings: Should the Judiciary Attempt to Police the Political Institutions?," 77 Georgetown L.J. 2031, 2031 n. 5 (1989). Under the former, utilities receive a fair return on the actual amount of their prudent investments. Under the latter, they receive a fair return on the present value of their assets.

[9] 488 U.S. 299 (1989).

all historical costs. In Duquesne, the Supreme Court considered and dismissed a takings claim challenging the decision of a state regulatory agency to deny a regulated company the opportunity to recover substantial investments which were "prudent and reasonable when made" on the ground that they were no longer "used and useful in service to the public" -- that is, on the ground that they held no present value for consumers.[10] In doing so, the Court concluded that it was perfectly appropriate for rates to be set based upon the "actual present value of the assets employed in the public service" rather than upon their historical costs.[11] Further, the Supreme Court specifically rejected the argument that the Constitution mandates recovery of all historical costs or rates based upon historical costs.[12]

Indeed, for decades the Supreme Court has consistently upheld decisions to deny regulated companies recovery of all historical costs.[13] For example, in Market St Ry. Co. v. Railroad Comm'n,[14] the Supreme Court upheld a decision to set a rate of return based upon the $7.95 million present value of a regulated company's assets even though the "book value" of the property exceeded $41 million and the "historical reproduction cost" of the assets exceeded $25

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[10] Duquesne, 488 U.S. at 301.

[11] Duquesne Light Co., 488 U.S. at 308.

[12] See Duquesne Light Co., 488 U.S. at 315-16.

[13] See, e.g., Wisconsin v. Federal Power Comm'n, 373 U.S. 294, 309 (1963) (rejecting the argument that the "prudent investment, original cost [ratesetting] method" is the "sina qua non" of rate regulation); Denver Union Stock Yard Co. v. United States, 394 U.S. 470, 475 (1938) (holding that a company is constitutionally entitled to reimbursement only for property "used and useful" at the time); Galveston Elec. Co. v. Galveston, 258 U.S. 388, 395 (1922) (no taking as long as a rate is based on the "present reproduction value" of the asset).

[14] 324 U.S. 548, 564-67 (1945).

million. The Court affirmed the agency's decision to calculate the regulated company's rate of return based upon its present, rather than historical, value — thereby denying it recovery of all historical costs — on the ground that

> [T]he due process clause has never been held by this Court to require a commission to fix rates . . . on the historical valuation of a property whose history and current financial statements showed the value no longer to exist, or on an investment after it has vanished, even if once prudently made . . . . The due process clause has been applied to prevent governmental destruction of existing economic values. It has not and cannot be applied to insure values or to restore values that have been lost by the operation of economic forces.[15]

The only evidence the RTCs have produced to establish their losses are calculations based upon their "historical" or "book" costs. Given that the Supreme Court has long held that no regulated company is entitled to recovery of all historical costs or rates of return based upon book costs, the evidence produced by the RTCs -- even the evidence allegedly demonstrating that some carriers will receive "negative" interstate revenues on their book costs -- cannot be used to establish a takings claim. [16]

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[15] Market St. Ry., 324 U.S. at 567. Indeed, even when agencies set rates based upon the historical cost rather than the present value of the assets devoted to public service, only prudently incurred investments may be recouped. Duquesne Light Co., 488 U.S. at 309. Courts and agencies have further limited regulated utilities' recovery of historical costs to those that hold some present value to consumers. See, e.g., Natural Gas Pipeline Co. of America, 765 F.2d at 1157, 1163-64. As the D.C. Circuit has observed, "'Justice Brandeis' formula for ascertaining the rate base -- the amount of capital prudently invested -- was not to become the prevailing rule.' The general rule . . . is that expenditure of an item may be included in a public utility's rate base only when the item is 'used and useful' in providing service; that is, current rate payers should bear only legitimate costs of providing service to them." NEPCO Mun. Rate Com. v. FERC, 668 F.2d 1237, 1333 (1981) (citations omitted), cert. denied, 457 U.S. 1117 (1982).

[16] See Market St Ry. Co. v. Railroad Comm'n, 324 U.S. 548, 567 (1945) ("The owners of a property dedicated to the public service cannot be said to suffer injury if a rate is fixed . . .

The RTCs attempt to buttress their constitutional argument by asserting that the Universal Service Order unlawfully penalizes them "for making past investments in reliance on their ability to gain a fair return...".[17] Thus, the RTCs imply that their investments were based upon some specific promise or guarantee that the Universal Service Order is now abrogating. The RTCs' reliance argument is as flawed as their other takings arguments.

As a purely factual matter, the RTCs could not have relied upon a guarantee that they would recover all historical costs when making their investments because no such promise was ever made. As the Commission has observed, any claim by an incumbent telephone company to guaranteed recovery of all historical costs "would exceed the assurances that we or the states have provided [to the ILECs] in the past."[18] The RTCs' reliance argument is also foreclosed as a matter of law. The Supreme Court has held for decades that regulated companies are not entitled to recovery of all historical costs.[19]

When the RTCs' reliance argument is analyzed against this factual and legal backdrop, it is clear that there is simply no basis for their claim that they "relied" on some promise or assurance given by the states that they would be guaranteed recovery of all historical costs. The

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which will probably produce a fair return on the present fair value of their property").

[17] RTCs Petition at 7.

[18] In re Implementation of the Local Competition Provisions in the Telecommunications Act of 1996; Interconnection between Local Exchange Carriers and Commercial Mobile Radio Service Providers, FCC 96-325 at ¶ 706 (rel. Aug. 8, 1996).

[19] See Duquesne Light Co., 488 U.S. at 312-314 (concluding that requiring agencies to set rates based upon historical costs would "signal a retreat from 45 years of decisional law in this area"); supra pp. 4-6 & nn. 3 & 4.

RTCs have not pointed to any such promise in their filings, and decades of Supreme Court precedent refute its existence.

Nor can the RTCs claim that they are constitutionally entitled to maintenance of the regulatory status quo. The relationship between the ILECs and the government is a regulatory, not a contractual, relationship, and as such does not grant them a vested right in the maintenance of a particular regulatory scheme.[20] Indeed, even if the RTCs could produce a written contract explicitly outlining the "guarantee" on which they allegedly relied, the courts have long eschewed contractual agreements which "bind [the government] to ossify the law" and thus restrict the future exercise of legislative power.[21]

As shown above, the RTCs would not establish a constitutional takings claim even if they were able to demonstrate that the Universal Service Order threatened serious financial consequences for rural carriers. In fact, however, no such threat exists. In order to guard against such consequences, the Commission has afforded rural telephone companies years of subsidies

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[20] See Tennessee Elec. Power Co. v. Tennessee Valley Authority, 306 U.S. 118, 141 (1939) ("[t]he declaration of a specific policy creates no vested right to its maintenance in utilities then engaged in the business or thereafter embarking in it"); American Trucking Ass'n v. Atchison, Topeka and Santa Fe Ry. Co., 387 U.S. 397, 416 (1967) (agencies "are neither required nor supposed to regulate the present and the future within the inflexible limits of yesterday"); New York Cent. R.R. v. White, 243 U.S. 188, 198 (1917) ("No person has a vested interest in any rule of law entitling him to insist that it will remain unchanged for his benefit"); Rogers Truckline v. United States, 14 Cl. Ct. 108, 110-12 (1987) (a regulated carrier has no constitutionally protected property interest in an existing regulatory scheme); General Telephone Co. of the Southwest v. United States, 449 F.2d 846, 864 (5th Cir. 1971) ("[t]he property of regulated industries is held subject to such limitations as may reasonably be imposed upon it in the public interest and the courts have frequently recognized that new rules may abolish or modify pre-existing interests").

[21] United States v. Winstar Corp. 116 S. Ct. 2432, 2453-56 (1996) (plurality opinion) (surveying doctrines precluding agreements to limit the legislature's power to change the law).

that exceed those that could be justified by proper economic analysis. Thus, the Universal Service Order provides that rural companies will continue to receive support derived from the existing high cost, DEM and long-term support mechanisms. This support will continue until the Commission devises a forward-looking cost methodology for rural companies and for transitioning to that new methodology. For the next several years, then, rural telephone companies will continue to receive universal service support at substantially the levels they currently enjoy.

The RTCs complain that making universal service support and the recovery of local switching costs via DEM weighting portable, in lieu of being used to recover booked investment, has "immediate and adverse consequences" for the RTCs.[22] But this is a necessary consequence of the generous transition rules the Commission adopted for rural companies. As the Commission observed, it would unfairly skew competition to afford ILECs with subsidies based on the existing methods but limit CLECs to smaller, forward-looking compensation when they serve the very same customers.

The Commission allowed rural carriers to continue using existing support mechanisms for the immediate future as a *transitional* device, not based on a finding that rural ILECs were entitled to universal service support computed based upon booked costs. To the contrary, the Commission has ruled that rural carriers should (like all other carriers) eventually receive universal service support on a forward-looking cost basis. The Commission should not transform a limited (although generous) transition device into an entitlement to recovery of booked costs through the universal service fund.

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[22] RTCs Petition at 7.

Finally, the Commission has announced its intention to take up the issue of ILEC recovery of historic costs in a future proceeding in the Access Charge Reform docket.[23] If there is any basis to recover booked costs, the RTCs may establish it in the regulatory proceeding dedicated to that question.

II. THE TREATMENT OF DEM WEIGHTING AND LONG TERM SUPPORT

Some LECs take issue with the Commission's treatment of DEM weighting and Long Term Support (LTS) during the transition to the use of a forward looking cost methodology for determining universal service support. For example, the RTCs argue that it is arbitrary to treat DEM weighting payments as "subsidy" and to recover them through the Universal Service Fund USF).[24] Because DEM weighting is allegedly compensation for switching costs incurred to provide interstate access services, these parties argue, it should be recovered from interexchange carriers, "the entities that cause small ILECs to incur the lion's share of their switching costs."[25] Moreover, the RTCs argue that, by first changing the existing DEM weighting rules and eventually eliminating DEM weighting entirely, the Commission has created a subsidy program for IXCs by shifting costs away from them and onto the backs of all USF contributors.[26]

Contrary to these contentions, the Commission has not created a new subsidy. Consistent

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[23] In re Access Charge Reform; Price Cap Performance Review for Local Exchange Carriers; Transport Rate Structure and Pricing; End User Common Line Charges, FCC 97-158 at ¶ 14 (Access Charge Order).

[24] RTCs Petition at 12.

[25] RTCs Petition at 13.

[26] RTCs Petition at 13.

with the Act, the Commission has simply made an existing implicit subsidy, DEM weighting, explicit and portable. Even if DEM weighting does compensate small carriers for real costs incurred in providing access, they still constitute an implicit "subsidy" within the meaning of Section 254. That is, they are payments embedded in switched access charges that are designed to ensure that local customers in "high cost areas" "have access to telecommunications and information services . . . at rates that are reasonably comparable to rates charged for similar services in urban areas." Because DEM weighting payments are Section 254 subsidies, Congress has specifically directed that they be funded "on an equitable and nondiscriminatory basis" by "[e]very telecommunications carrier that provides interstate telecommunications services."[27]

United Utilities argues that the universal service order should be postponed until the Commission has completed the reform of its Part 36 jurisdictional cost separations rules.[28] United Utilities also urges the Commission to change the method by which it assigns costs to the interstate and intrastate jurisdictions from DEM weighting to SMOU (switched minutes of use).[29]

United Utilities' request that the Commission change the allocation from DEM to SMOU is not appropriately before the Commission in this proceeding. While the Commission has the authority to change the way in which subsidies are funded, a change in allocator (e.g., from DEM to SMOU) requires a Joint Board determination.

In addition, United Utilities' request to delay the implementation of the universal service order should be rejected, as it is simply an anticompetitive tactic aimed at prolonging its

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[27] Section 254(d).

[28] United Utilities Petition at 2.

[29] United Utilities Petition at 2-3.

monopoly status. The expressed goal of the Act is to promote competition in all telecommunications markets. The Commission's universal service order is a necessary component in fulfilling the goal of the Act, as it aims to make implicit subsidies explicit and portable. The new universal service rules do not significantly alter the amount of subsidies that ILECs will receive per customer. The primary difference is that support will come from the universal service fund-- not access charges. No economic reason, therefore, exists for the Commission to delay the implementation of the universal service order until after the Commission reforms its Part 36 separations rules.

The Commission also should dismiss the RTCs' argument that the new USF rules violate Section 254(b)(2) because the rule change will discourage investment in advanced telecommunications information services.[30] On the contrary, the Commission's rules replacing DEM weighting with USF support makes an implicit subsidy explicit and portable and, therefore, the new rules will spur competition. Competition, in turn, will lead to lower prices, more choice, greater innovation and alternative and more efficient information services.

The Western Alliance argues that the transfer of weighted DEM and long term support (LTS) to the USF may create a two-year lag in receipt of such support, with the result that support would not be "sufficient."[31] No time delay will ocurr from the transfer of weighted DEM and LTS to the USF. The Commission should, therefore, dismiss the Western Alliance's argument.

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[30] RTCs Petition at 15.

[31] Western Alliance Petition at 11.

III. THE TREATMENT OF CORPORATE EXPENSE IS NOT ABITRARY

Some LECs argue that it was arbitrary for the Commission to limit high-cost support payments for "corporate operations expenses" because, for example, the limit on support for corporate operations expenses will reduce their revenues.[32] The Commission's stated basis for limiting recovery of these costs was that they were "not directly related to the provision of subscriber loops and not necessary for the provision of universal service" and resulted not from the provision of essential telecommunications services, but "rather result from managerial priorities and discretionary spending."[33] The parties offer nothing to rebut the Commission's finding that corporate operation expenses are discretionary and not inherent to the provision of universal service. Accordingly, the limit on universal service support for these costs is plainly appropriate and the LECs should consider themselves fortunate that the Commission permitted any support for these costs. The Commission plainly did not act arbitrarily in limiting the recovery of these costs to 115 percent of the average corporate operations expenses for similarly sized companies.[34] For the same reason, a three year transition to the reduction in corporate expense operations, as requested by Fidelity Telephone Company, is not justified.[35]

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[32] RTCs Petition at 10-11; USTA Petition at 10; Alaska Telephone Association Petition at 2-3; Western Alliance Petition at 8-10.

[33] Universal Service Order, ¶ 283.

[34] Universal Service Order, 307. See also, Order on Reconsideration, Federal-State Joint Board on Universal Service, CC Docket No. 96-45, FCC 97-246 (rel. July 10, 1997) (modifying formula for reaching 115 percent cap for certain carriers).

[35] Fidelity Telephone Company Petition at 3-4.

IV. SUPPORT FOR ACQUIRED EXCHANGES

There is no merit to the LECs' argument that the Commission's rules on support for newly-acquired exchanges will discourage investment in rural telephone companies.[36] The Commission simply acted to prevent its transitional support for rural telephone companies from becoming the impetus for the purchase and sale of exchanges. Accordingly, the Commission held that for purchases occurring after the date of its order, the support afforded the exchange would not change depending on the rural or non-rural status of the purchaser.[37] This decision was reasonable.

V. INSULAR AREAS

Puerto Rico Telephone Company argues that carriers serving insular areas should be treated differently than carriers in non-insular areas. Specifically, PRTC contends that it should not be grouped with the Bell Operating Companies (BOCs) for modeling and transition purposes because it does not have the economies of scale or scope of a BOC.[38] The PRTC, however, fails to explain why a Tier 1 telephone company in an insular area would not enjoy the same economies of scale and scope-- which, for the most part, are an incidence of size-- as a Tier 1 telephone company in a non-insular area. In other words, although PRTC alleges that it has a low penetration rate, it serves enough customers and has sufficient revenue to qualify as a Tier 1 company. Accordingly, no rule change for non-rural carriers in insular areas is warranted.

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[36] Western Alliance Petition at 12-13; RTCs Petition at 21; USTA Petition at 7-8.

[37] Universal Service Order ¶ 308.

[38] Puerto Rico Telephone Company Petition at 7-12.

VI. UNES

Some petitioners ask the Commission to reconsider its decision concerning unbundled network elements (UNEs) and universal service support. For example, the Western Alliance argues that the Commission should not define UNEs as "owned" facilities for the purposes of determining carriers eligible to receive universal service and that doing so violates congressional intent to encourage rural infrastructure development.[39] Thus, the Alliance argues that only carriers that own all or substantially all of their own facilities should qualify for support. Similarly, US West argues that the incumbent LEC should get the support associated with an unbundled loop and the competitive LEC that purchases unbundled loops should benefit from support only indirectly as a result of the support-adjusted unbundled loop price they pay for the facility.[40]

The Commission was right in designating UNEs as the purchasing carrier's facility. In addition, carriers providing supported services solely through the use of UNEs can only receive support up to the UNE charge, and anything over this amount is remitted to the underlying carrier. In addition, the unbundled loop price fully compensates the ILEC for the cost of the underlying facility. Thus, carriers purchasing unbundled loops will not be overcompensated by the universal service fund.

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[39] Western Alliance Petition at 22-23.

[40] US West Petition at 15-19.

VII. USE OF UNIVERSAL SERVICE SUPPORT REVENUE

The Alaska Public Utilities Commission (PUC) argues that the Commission should not dictate that federal support be used to reduce interstate access charges.[41] Interstate access charges, however, must be reduced by the amount of federal universal service support received, because to do otherwise would allow LECs to double recover for supported services-- once through the fund and once through interstate access charges. There is no dispute that interstate access charges subsidize universal service. As those subsidies are provided explicitly through the fund, therefore, the implicit subsidy must be removed.

A number of petitioners also ask the Commission to reconsider its plan to fund only 25% of the high cost fund, arguing that it is not sufficient to maintain universal service.[42] Whatever amount federal support is ultimately, ILECs must be required to reduce interstate access charges by the amount of support received.

VIII. USE OF NATIONWIDE AVERAGE LOOP COST

The RTCs argue that adjusting the nationwide average loop cost for inflation would be unfair, noting that some carriers' costs have risen faster than the nationwide average loop cost, and that the USF was intended precisely to give these carriers support.[43] However, the carriers

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[41] Alaska PUC Petition at 9.

[42] RTCs Petition at 9; Alaska Telephone Association Petition at 1-5; Western Alliance Petition at 18-21; Rural Telephone Coalition Petition at 1-5; Arkansas Public Service Commission at 1-3; Wyoming Public Service Commission at 2-3; Vermont DPS Petition at 2-5; Alaska Public Utilities Commission Petition at 5-9; Texas Public Utility Commission Petition at 2.

[43] RTCs Petition at 22.

whose costs rise faster than inflation (i.e., the less efficient ones) will see their support go up under the Commission's order, while carriers whose cost grow slower (i.e., the relatively efficient ones) will see their support go down. This incentive to increased efficiency was cited by the Commission as a reason for its decision. The carriers it seeks to protect, whose costs rise by more than inflation, will actually see their support go up even with the cap.

IX. ENTITIES REQUIRED TO PAY FEDERAL SUPPORT

A number of petitioners-- including paging companies, private carriers, systems integrators, payphone providers, private satellite carriers, and non-profit agencies-- argue that it would be inequitable and anticompetitive to require them to pay federal universal service support.[44] The Act, however, requires that all telecommunications carriers providing interstate telecommunications services contribute to the fund. Moreover, equity requires that entities that benefit from universal service also should contribute to its maintenance. Accordingly, these petitions should be denied.

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[44] Ozark Telecom Petition at 3-5; Ad Hoc Telecommunications Users Committee Petition at 11-22; Information Technology Association of America Petition at 1-9; Iowas Telecommunications and Technology Commission Petition at 7-8; Columbia Communications Corporation Petition at 3-5.

X. CONCLUSION

Based on the foregoing, MCI respectfully requests that the Commission reject the petitions for reconsideration as specified herein.

Respectfully submitted,

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND
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SUMMARY

No cost model or LEC cost study will ever have the ability to exactly measure the cost of providing universal service. Consequently, it is important that the selected cost mechanism make the best possible use of the best available data and not create an artificial sense of accuracy or precision. This is especially true in the customer location context where some data sets cannot be disaggregated beyond the CBG level. Hence, AT&T and MCI demonstrate in Section I that the proposed BCPM approach of increasing granularity through an artificial grid cell approach is inferior to the proposed Hatfield method of creating clusters using actual customer geocoded data.

Section II expands on the Hatfield Model's constantly improving approach to customer location estimation. Hatfield 4.0 already vastly outpaces the BCPM by applying a clustering algorithm that can account for empty CBs, locate customers in towns or a variable number of population clusters, and determine the type of dwellings in which the customers live in a given CBG. Future Hatfield releases will employ geocoded data to more accurately account for customer location in two stages. The first involves estimating the number of clusters within a wire center service area, the size and location of those clusters, and the distance between customers in a cluster. This stage is a necessary and natural springboard for the next -- mapping individual customer locations to the specific cables that serve them. The BCPM's proponents appear not to even contemplate undertaking such a process. The forthcoming Hatfield release will incorporate the first stage to further improve its already accurate clustering algorithm while the Model's designers continue investigating the efficacy of strand mapping.

In Section III, AT&T and MCI demonstrate that embedded network loop lengths should not be used to verify a forward-looking cost model's cost estimates. An efficient basic telephone network may include loop lengths that are longer or shorter than those in the existing network. And to the extent that empirical verification plays any role in selecting a cost model, incumbent LECs should bear the burden of demonstrating why their numbers -- which they often cherry picked to highlight the greatest Hatfield discrepancies from historic investment or withheld altogether -- do not reflect inefficiencies or network capabilities unnecessary for universal service.

Section IV addresses the state members' concerns about the Hatfield Model's misassignment of CBGs to wire centers. Their examination focused on Hatfield 3.0, whereas Hatfield 4.0 almost always assigns a CBG to the wire center that actually provides that CBG's service. A few errors may still arise when the CBG is served by more than one wire center, but these should be obviated as the Hatfield Model transitions to an endogenous cluster-driven assignment.

In Section V, AT&T and MCI show that the Hatfield Model best accounts for a wire center's actual line count by using SIC codes to allow variation in the number of lines assigned per employee by business type, including special access lines, and normalizing line counts for non-ARMIS companies. Finally, AT&T and MCI show that arbitrarily limiting a model's closing factors to 10% appears not to be necessary to ensure accurate estimates of universal service costs.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND MCI TELECOMMUNICATIONS CORPORATION ON CUSTOMER LOCATION ISSUES

Pursuant to the Commission's Further Notice of Proposed Rulemaking,[1] AT&T Corp. ("AT&T") and MCI Telecommunications Corporation ("MCI") hereby submit their joint comments with respect to the designated issues concerning the selection of a forward-looking cost mechanism for use in determining the level of federal support for universal service in high cost areas. These comments address issues related to customer location as requested by the Commission in section III.C.1 of its FNPRM.

[1] Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45, 97-160, Further Notice of Proposed Rulemaking (released July 18, 1997) ("FNPRM").

INTRODUCTORY STATEMENT

No cost mechanism -- model or study -- will ever have the capacity to calculate exactly the cost of providing universal service.[2] Most fundamentally, significant input data limitations produce cost model output limitations. A good cost model then is one that makes the most of available (and reliable) input data -- basing outputs on that data and not purporting to generate outputs for which there is no underlying input data. The customer location issues on which the Commission seeks comment in this proceeding provide useful instruction on this fundamental principle and demonstrate yet additional bases to prefer the Hatfield Model, which is data-driven and continues to evolve and improve as more granular data are used and better algorithms are developed that can draw more accurate conclusions from these best available data.

As demonstrated below, the Benchmark Cost Proxy Model ("BCPM") falls short on each of the issues identified by the Commission. Notably, the current BCPM standard abstracts from any population clustering characteristics, instead favoring a simplistic and also cost-maximizing uniform distribution assumption. By contrast, the Hatfield Model has long recognized that a universal service cost mechanism must account for realistic population characteristics. Hence, each recent generation of the Model -- and future generations as well -- includes improved customer location estimation algorithms. Despite the BCPM's attempt now to catch up to the

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[2] Incumbent LEC "studies" face at least as many obstacles as cost models. For example, they invariably involve a set of approximations, assumptions, and algorithms for translating a limited data sample into a total estimate. In addition these "studies" start from an embedded network and therefore their proponents should bear the additional burden of demonstrating that they have accurately transformed embedded costs into forward-looking costs. Also, incumbent LEC studies are based on a network that uses embedded technology to provide services that are outside the scope of universal service, and their studies may assign the costs of such deployment to universal service.

Hatfield Model in this regard, it appears that the unreleased "new" BCPM, which may use a combination of CB, CBG, and "road" data, will still lag behind the Hatfield Model in every aspect related to customer location. Thus, the Hatfield Model is the only cost mechanism that promises to satisfy the Commission's tentative conclusions in this area.

I. GEOGRAPHIC UNIT AND COST ESTIMATE OUTPUT DISAGGREGATION SHOULD NOT EXCEED INPUT DATA DISAGGREGATION.

AT&T and MCI agree that "the size of the serving areas over which cost is calculated is an important element of platform design," and that a cost model should estimate and report costs at the finest level of detail (i) at which input data are available, and (ii) that is technically practical. FNPRM ¶¶ 39-40. The importance of these two constraints, particularly the reality of data limitations, cannot be overemphasized. The goal is "accurate cost estimates," and, as the Commission recognizes, any effort to report "costs" using "excessively small geographic units" that ignore data limitations not only does not advance that goal, but "creates a false sense of precision because the input data is still not disaggregated at that level." Id. ¶ 39. Furthermore, excessive disaggregation may overestimate universal service costs. In an efficient telephone network -- and presumably existing networks as well -- distribution and feeder are designed to service customers in groups, capitalizing on any clustering that exists. Even when no clustering exists, an efficient provider will still extend cables used to serve many customers as far as possible before separating them into individual wire pairs. Excessive disaggregation, however, may make customers artificially appear as singularities or in pairs, when in fact they are actually located in clusters than can be served more cost effectively.

Both the Hatfield Model and BCPM currently report costs at the Census Block Group ("CBG") level. That approach has a number of important benefits. First, a CBG is a relatively small unit, reflecting only approximately 400 households. Second, a wealth of relevant data are available disaggregated to the CBG level. And third, CBGs are not mere arbitrary constructs. Census Bureau census block ("CB") and CBG classifications and boundaries reflect to a certain degree natural geographic features and population clusters, and estimating and reporting costs at this level should therefore produce fewer "wide disparities in the cost of serving different customers in the same service area" (FNPRM ¶ 39) as compared to more arbitrary constructs such as grid cells. In short, CBs and CBGs may not be perfect geographic classifications, but they do reflect factors that have implications for engineering and telephony and are supported by the necessary input data.[3] A grid approach does not necessarily do so.

Below their CBG surfaces, however, the Hatfield Model and the BCPM are vastly different in their treatment of customer location. The Hatfield Model which in the past has used the most highly disaggregated data available, continues to follow a data-driven approach. Where insufficient data exists to justify moving to a smaller geographic unit per se, the Hatfield Model uses the data that are available to refine cost estimates at the CBG level. For example, as detailed below, Hatfield 4.0 adjusts cost estimates in rural CBGs with relatively large geographic areas with a population clustering mechanism that accounts for the empty space within each CBG. See FNPRM ¶ 42; infra at Section II (discussing both the current Hatfield algorithm and improvements that will be added). The Hatfield Model developers and sponsors continue to

[3] It appears that the new BCPM's grid cells will either exceed CBs in size or fall short. In any even, the information contained in CB or CBG boundaries will be jettisoned through the adoption of grid cells.

search for more disaggregated data that justify use of a smaller geographic unit (or further refinements at the CBG level).

By contrast, the BCPM developers appear to be following a process that models customer location under the false premise that increasing granularity is the same thing as enhancing accuracy. Specifically, the new BCPM will use an artificial grid cell approach that ignores that reducing geographical unit size is only useful to the extent that the corresponding input data can be further disaggregated.[4] Unfortunately, below the CB level data limitations frequently prohibit such disaggregation, forcing any cost model or study to ascribe many or all of the characteristics of the entire CB to the smaller geographic unit. But without good data to support this assumption, breaking the CB down into finer components adds nothing to a cost model's accuracy.[5] Thus, an algorithm employing an artificial grid will likely increase the complexity of the model without increasing its accuracy.

II. THE SELECTED COST MECHANISM SHOULD USE A CLUSTERING ALGORITHM.

AT&T and MCI agree that an <u>accurate</u> population clustering algorithm "would more accurately distribute customers within some CBGs and would consequently generate more

[4] AT&T and MCI have only had a viewgraph preview of the BCPM's future customer location algorithm. While the algorithm appears to incorporate some advances over the previous BCPM algorithm, it also has some very troubling aspects. In any event, it is impossible to meaningfully evaluate the new algorithm without a more thorough understanding of its logic. AT&T and MCI, then, will limit their comments to the current version of the BCPM and reserve the right to make further comments on the new model's customer location algorithm when it becomes available in operational form and with actual (not illustrative) data.

[5] While the new BCPM apparently will use road mileage within grids as an allocator for CB-level data, this methodology has not been specified completely, nor has it usefulness been verified.

accurate estimates of loop length and, therefore, of the cost of the outside plant" (FNPRM ¶ 44). In contrast to extreme presumptions underlying the current version of the BCPM, customers rarely are uniformly distributed within a CBG.[6] Instead, populations tend to form clusters, a characteristic that can significantly affect the amount of cable required to serve residential and business customers. See FNPRM ¶ 44. The Hatfield Model's developers have approached the issues of customer location and clustering in a series of progressive steps, with each additional level of complexity accepted only if it also increases the model's accuracy. First, the current version of the Hatfield Model and those predating it employ standard assumptions about population distributions to create customer clusters. Second, the next Hatfield release will use residence and business geocoded data to determine the number of clusters in a CBG, the size and location of those clusters, and the distance between customers within a cluster. This step is necessary for the third potential innovation, mapping individual cable strands to each customer location. As discussed below, strand mapping may ultimately prove unnecessary for accurate universal service cost estimation, but Hatfield's designers intend to investigate both the feasibility and desirability of adding this feature to their model. By contrast, the BCPM proponents -- by indicating that they will use block rather than point data -- are not proposing to develop a model that could incorporate strand mapping.[7]

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[6] See also FNPRM ¶ 41 ("Several commenters criticized the assumption, present in BCPM, that households are evenly distributed across a geographic unit. . . . At the proxy model workshops, a panelist provided several examples of specific locations where the uniform distribution assumption would cause significant errors. In addition, the panelist concluded that similar distortions exist in large regions of the country, and therefore, the uniform distribution assumption causes the model to overstate costs for many states").

[7] The proposed version of the BCPM will still rely on census block data that does not contain information regarding where customer lines are located relative to one another. The Hatfield (continued...)

Clearly, the Hatfield Model's proponents have been the leaders in developing better methods for modeling accurately the network costs that are sensitive to customer location. In response to the feedback received from the Commission and other industry participants, the Hatfield Model developers have already refined the customer location algorithm to better reflect actual population distributions within a CBG. For example, the area associated with CBs that do not have any population is removed so that networks are not engineered to serve empty space. See FNPRM ¶ 42. Indeed, as more refined data on customer clustering become available, they can be incorporated directly into the current version of the Hatfield Model because its degree of clustering is a user-adjustable parameter. Hatfield Model 4.0 Description at 27. Hatfield also applies standard assumptions about population distributions, placing large percentages of customers in either 2 or 4 "town" clusters depending on the amount of empty space in the CBG. See FNPRM ¶ 42; Hatfield Model 4.0 Description at 26. Further, Hatfield assigns customers to multi-unit dwellings and even high-rise buildings when census data and or high line density indicate that single-unit dwellings would be inadequate. See FNPRM ¶ 42; Hatfield Model 4.0 Description at 32-34.[8] The result has been a significant improvement in the accurate modeling of customer location.

AT&T and MCI, like the Commission, hope to go even further. See FNPRM ¶¶ 44, 46 (seeking comment on the availability of software capable of identifying customer locations "in all

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(...continued)
approach, on the other hand, will use geocoded data that allows the Model to determine the distances between customers and potentially to map individual cable strands to each customer location -- a technique that is impossible when relying on the BCPM's block data.

[8] This method -- unlike the BCPM -- preserves the overall size of the CBG and does not assume that all population is located in the center of the CBG.

CBs within a service territory" or of "geocod[ing] households").[9] Indeed, future releases of the Hatfield Model will incorporate geocoded data that locates exactly most customers. Such data can be used in two ways. Initially, geocoded data will provide important information on cluster characteristics, namely the number of clusters within a wire center service area, their geographic location, the size of the clusters, and distance between customers within the clusters.

Use of geocode data to determine cluster characteristics also provides a natural springboard for the second use of this data, mapping cable strands to each individual customer location. Translating actual customer locations into the individual cable strands that serve them is a difficult, but longer-term goal focus of the Hatfield Model necessitating not only much greater complexity and processor intensity, but also substantial revisions to other engineering aspects of a cost model. The Hatfield Model's developers are continuing to explore the feasibility and desirability of this approach. Whether or not actual strand mapping proves feasible and desirable, it is important to recognize, that accurately locating customers produces the greatest benefits (in accuracy) in sparsely populated areas. Consequently, the next release of Hatfield takes the necessary, but more tractable step of using these geocoded data to determine both the number of clusters in a wire center service area and their size and placement as well as to approximate the distance among customers within a cluster, instead of modeling a strand to each consumer. Early tests suggest that this method will be an excellent proxy for actual customer locations in the calculation of forward-looking costs, possibly accurate enough to render the complex modeling of

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[9] Geocoding refers to the process of identifying each customer by latitude and longitude. Although geocoding is no panacea -- for example, in some areas postal addresses are predominantly post office boxes -- these data, where available for a particular geography, can be used to improve the accuracy of locating customers.

a cable strand to each customer superfluous (particularly given the tremendous increase in complexity that would accompany a strand mapping approach).

Finally, as the Commission recognizes, FNPRM ¶ 44, it is important to distinguish between the accuracy of (i) cluster location relative to wire center, which drives feeder costs, and (ii) how customers are located within a cluster, which drives distribution costs. Feeder constitutes a relatively small part of universal service costs because each feeder route is just one cable, with one set of supporting structures. Moreover, any cost estimation error should be small in densely populated areas because the feeder cable is very short. Even for more rural areas, the improvement in accuracy gained by more precisely specifying customer locations may be modes, as placing feeder routes to terminate at CBG centroids already is likely to be a good approximation to optimal feeder placement. The more variable, and more important factor is how customers are clustered within a distribution area. If customers are tightly clustered, a relatively small amount of distribution plant is required, while uniform dispersion of customer locations over a large geographic area will require many more distribution cables of smaller size. The most important step in modeling customer location, therefore, is to develop an effective clustering algorithm. Hatfield is vastly superior to the BCPM in both respects. Further, the Hatfield Model not only does a much better job of locating customers, it continues to improve as new data become available and innovative methods are developed to utilize that data. Hatfield's evolutionary process will continue so long as the gains in accuracy outweigh the costs in complexity.

III. EMBEDDED NETWORK DATA CANNOT BE USED TO "VERIFY" LOOP LENGTHS.

The Commission seeks comment on whether it should look to embedded incumbent LEC data to "verify" the accuracy of the cost models' estimates of loop lengths. FNPRM ¶¶ 44-45. While such data might be instructive on a very broad range scale, they cannot clearly verify loop lengths. Such comparisons are inconsistent with the core principles of the Commission's TELRIC methodology in that variance from figures that reflect past incumbent LEC practices cannot prove or disprove the accuracy or inaccuracy of forward-looking cost estimates.

While the Commission's scorched node approach defines points of concentration from which to design an efficient forward-looking telephone network, loop lengths may not remain the same as in the embedded network. For example, increased reliance on efficient "double star" DLC network architectures may increase loop lengths in some instances as backhauls become more economical. Similarly, an existing local switch may not support Centrex, prompting the incumbent LEC to instead route some customers over much longer loops to a distant switch that does have Centrex capabilities -- but this cost should not be supported by universal service subsidies. Further, the existing network may include inefficient loop configurations that might have been to an incumbent LEC's advantage under a rate-of-return regulatory regime, but would not be desirable or profitable in a competitive environment. An efficiently designed basic telephone network, therefore, may produce loop lengths that differ (both longer and shorter) from those in the existing network.[10] For these reasons, a closer correlation between a proxy model's

[10] It would, however, be appropriate to validate approximated customer locations by comparing them with actual locations because customer location is not a product of historic plant investment. Indeed, customer location is the one feature of the existing network that unequivocally must remain the same regardless of the forward-looking mechanism employed, even scorched earth.

outputs and embedded loop lengths does not mean that that model is doing a better job of estimating universal service costs than another model.

Moreover, to the extent that embedded empirical evidence plays any role at all in the "verification" process, the burden plainly should be placed on the incumbent LECs to explain the derivation and source of their embedded numbers, and why these numbers might differ from efficient cost model calculations. In general, these companies have not been forthcoming with data that lies exclusively in their possession, and their "verification" criticisms are usually based on a cherry picking of Hatfield Model results that have the greatest discrepancy from historic investment.[11]

IV. THE HATFIELD MODEL CURRENTLY ASSIGNS A CBG TO THE SAME WIRE CENTER THAT ACTUALLY SERVES THAT CBG IN MOST INSTANCES AND WILL DO SO EVEN MORE ACCURATELY IN FUTURE RELEASES.

Cost modeling must address two potential sources of line count error. The first arises when the cost model assigns a CBG to the wrong wire center. Concerns about Hatfield's "assignment of CBGs to incorrect wire centers" (FNPRM ¶ 49), however, are misplaced. The cited state members' comments were based on their evaluation of Hatfield 3.0. Hatfield 4.0 is much more effective in assigning a CBG to the same wire center that actually provides it service in the existing network. Indeed, Hatfield's approach already uses the best available assignment method and the Model's designers continue to make improvements. They are currently implementing a new assignment algorithm that will further reduce any error by utilizing a

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[11] It appears that some of the incumbent LECs have responded positively to the Commission's data request (Universal Service Data Request in CC Docket 96-45, August 15, 1997) and have provided data that may prove useful. Others have chosen not to be so helpful in this process.

methodology that assigns an individual customer (not a CB or CBG) to a wire center based on the customer's actual telephone number when available -- not an arbitrary grid system. In those few instances, if any, where the Model continues to produce the incorrect assignment, the Model's designers would welcome any input as to how this state-of-the-art assignment methodology could be improved.

V. THE HATFIELD MODEL ACCOUNTS WELL FOR A WIRE CENTER'S ACTUAL LINE COUNT.

The second potential source of line count error arises when the number of lines in a geography is not accurately calculated. Hatfield 4.0 also does the best job in this respect. For example, Hatfield's line count algorithm is vastly superior to the BCPM's method of calculating business lines. The Hatfield Model employs SIC codes to allow variation among business types and the number of lines per employee.[12] The BCPM, on the other hand, simplistically and incorrectly assumes that the ratio of business lines per employee is the same throughout the state.[13] In other words, a travel agency would be assumed to have the same number of lines per employee as a manufacturing plant. In addition, as the Majority State Member Report

[12] The Commission expressly sought input on whether it "should assign business lines to geographic units by using commercially produced maps that give the coordinates of all businesses located in the U.S. along with their employment by standard industrial classification (SIC) code." FNPRM ¶ 53. AT&T and MCI agree that the selected cost mechanism should satisfy these criteria to the extent that the necessary data exists. Consequently, the current version of Hatfield already accounts for SIC codes, and the next version of Hatfield will incorporate business geocoded locations. Moreover, the Hatfield Model will utilize point data, while the BCPM will only rely on block data.

[13] This criticism is very ironic inasmuch as one of the BCPM's sponsors, U S WEST, harshly criticized earlier versions of the Hatfield Model because of this same model limitation. The BCPM sponsors have suggested that this is one of the models' current shortcomings that will be addressed in the BCPM's next release.

recognized, Hatfield "include[s] special access lines, but BCPM does not." FNPRM ¶ 51. Hatfield 4.0 has also made significant strides for small incumbent LECs -- it now normalizes line counts for non-ARMIS companies[14] -- and preliminary verification against Detailed Distribution Area Planning cable lengths indicates that Hatfield estimates ample cable to meet network requirements. In contrast, the BCPM appears to be substantially less accurate at estimating the necessary cable amounts.

Finally, AT&T and MCI question the state members' proposal that models should always "match within ten percent actual wire center line counts" (FNPRM ¶¶ 49, 53), even though the Hatfield Model generally does close within the 10 percent factor.[15] It is not clear what this requirement would accomplish. The Hatfield Model already includes a user adjustable line count normalization process to ensure that the cost estimate is for the actual number of lines served by a wire center -- if the incumbent LEC has made that information available.[16] A high closing factor used to perform this normalization does not indicate that costs have been affected. Possibly some state members are concerned that a wire center will be "missed" -- not assigned a CBG -- by the cost model and therefore a high closing factor indicates a line count error for which normalization will not correct the cost estimate. While a small number of wire centers may still be "missed," most usually fall into one of four categories: (i) de minimis in size; (ii) lacking any working lines;

[14] Hatfield 4.0 "[i]ncludes improved counts of lines served by certain small LECs based on data from USTA and RUS[.]" Hatfield 4.0 Model Description at 8.

[15] AT&T and MCI have no objection to providing closing factor results at a level of detail necessary for analysis.

[16] Normalization will be even more accurate in many areas now that a number of incumbent LECs have finally agreed to make their wire center line count information available.

(iii) so new that no customers have been identified as being served by that wire center; or (iv) do not actually constitute a public wire center. If it is shown that any "missed" wire centers are relevant to universal service cost calculations, the Hatfield Model will be modified to incorporate them.

In short, then, it is not clear that "[r]easonable estimates of lines at the wire center and study area level will allow [the Commission] to verify that the models' means of estimating line count leads to accurate results." FNPRM ¶ 53. Rather than establishing an arbitrary maximum closing factors with uncertain positive effects, the Commission should focus on obtaining line count data from those incumbent LECs who still refuse to provide this information and thereby ensure that the normalization routine in the selected cost model is as accurate as possible.

CONCLUSION

For the foregoing reasons, the Commission should adopt the evolving Hatfield Model approach to the customer location issues raised in the Notice.

Respectfully submitted,

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September 2, 1997

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I, Scott M. Bohannon, do hereby certify that on this 2nd day of September, 1997, I caused a copy of the foregoing Comments of AT&T Corp. and MCI Telecommunications Corporation on Customer Location Issues to be served upon each of the parties listed on the attached Service List by U.S. First Class mail, postage prepaid.

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

REPLY COMMENTS OF AT&T CORP. AND
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SUMMARY

The comments submitted on customer location issues clearly reveal that the selected cost mechanism should use actual customer locations wherever such data are available, an approach that has been embraced by Hatfield's designers, but eschewed by the BCPM sponsors. The comments also indicate that incumbent LECs already have extensive information on actual customer locations and line counts. The Commission should take the necessary steps to ensure the release of these data to model designers.

As AT&T and MCI discuss in Section I, a grid cell approach that refrains from using actual customer locations when they are available is unequivocally inferior to a methodology that uses such data. The BCPM's proposed approach -- which will not even be thoroughly described until after the customer location segment of proceeding has been completed -- apparently will employ a complex series of disaggregations and reaggregations of "microgrids," "subgrids," "subpartitioned subgrids," "partial grids," "macrogrids," and "ultimate grids." It is not at all clear that this iterative process adds any degree of accuracy. This is particularly true because the entire grid cell scheme is dependent upon the relationship between road mileage and customer location which has never been shown to exhibit any meaningful correlation.

Section II discusses the Hatfield Model's enhancements in its next release as well as the criticism that has been leveled at the model. Much of this criticism is irrelevant because it focuses on features and characteristics of Hatfield Model 3.1, not Hatfield Model 4.0. Moreover, most critics of the model assert that it would be better to use actual customer locations, instead of the current population distribution assumptions. Hatfield's designers agree. Consequently, the next release will use geocoded data to determine the number of clusters in a CBG, the size and location

of the clusters, and the distance between customers within a cluster. Hatfield's proponents also continue to investigate the efficacy of mapping individual strands to actual customer locations. In short, the BCPM sponsors have charted an inflexible course that relies on inferior data when superior data are readily available and possibly already in their possession.

The comments also reveal that actual loop lengths are not a useful measure for verifying cost models calculations. As AT&T and MCI demonstrate in Section III, the embedded figures are inconsistent with a forward-looking approach because any universal service telephone network today might be built with different loop lengths reflecting greater efficiencies, a different set of services, and technological enhancements. Moreover, the BCPM sponsors point out that only an average loop length is available for central offices. And this average is typically based on an inadequate sample. Hence, any comparison between actual loop lengths an this average figure would be unreliable and an improper comparison of apples and oranges.

Section IV reiterates that Hatfield provides the best method for assigning CBGs to wire centers. In forthcoming releases, its algorithm will be further improved by assigning customers (not CBGs, CBs, or "ultimate grids") to wire centers using actual telephone number data, thereby avoiding the problems inherent in the BCPM's "microgrid" approach.

Finally, in Section V, AT&T and MCI demonstrate that the Commission should focus on obtaining line count data from incumbent LECs, not establishing artificial closing factor limitations. Further, Hatfield already does a good job -- much better than the BCPM -- of accounting for actual line counts.

Before the
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Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

REPLY COMMENTS OF AT&T CORP. AND MCI TELECOMMUNICATIONS CORPORATION ON CUSTOMER LOCATION ISSUES

Pursuant to the Commission's Further Notice of Proposed Rulemaking,[1] AT&T Corp. ("AT&T") and MCI Telecommunications Corporation ("MCI") hereby submit their joint reply comments with respect to the customer location issues designated by the Commission in Section III.C.1 of the FNPRM that affect the selection of a forward-looking cost mechanism for use in determining the level of federal support for universal service in high cost areas.

INTRODUCTORY STATEMENT

The comments submitted on customer location reveal nearly universal agreement that the selected cost model should, to the extent practicable, account for actual customer locations in estimating universal service costs. And, as AT&T and MCI (at 6) explained in their initial

[1] Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45, 97-160, Further Notice of Proposed Rulemaking (released July 18, 1997) ("FNPRM").

comments, the next release of the Hatfield Model will incorporate geocoded data consistent with this objective. While some questions may remain regarding the optimal use of actual customer location data, there can be no doubt that a cost model that properly relies on geocoded data will be superior to one like the Benchmark Cost Proxy Model ("BCPM") that relies solely on some artificial grid cell-based methodology.

The customer location comments also reveal that a wealth of data has already been compiled on actual customer locations and line counts. See, e.g., Aliant (at 2) (BLR Data has compiled "with . . . 90% accuracy the latitude and longitude of household and businesses"); TDS at 12 ("some non-rural ILECs have developed data bases that will geo-code the households in their areas"). Most notably, some incumbent local exchange carriers ("LECs") refer to data that they already have in their possession. See, e.g., Ameritech at 6 (Ameritech has "the addresses where all of its customers' circuits terminate as well as the count of each circuit type . . . . Ameritech is geocoding these locations and has geo-coded a majority of them").[2] By utilizing this incumbent LEC data as well as other information already available, the actual location of most customers in the United States can be identified with a high level of accuracy. Clearly, then, the Commission has a tremendous opportunity to improve the ability of any cost mechanism to estimate accurately universal service costs -- it can take the necessary steps to ensure that this data will be available for use in the design and operation of the selected cost model.

[2] See also Ameritech at 8 ("Ameritech has line counts by [distribution areas]. . . .This information should be available in comparable operating systems of other non-rural companies"); Bell Atlantic at 1 ("The local exchange carriers have reliable data with which to assign customers and to count lines by wire center").

I. THE COMMENTS CLEARLY DEMONSTRATE THAT A GRID CELL APPROACH IS INFERIOR TO AN APPROACH INCORPORATING ACTUAL CUSTOMER LOCATIONS.

With the predictable exception of the BCPM's proponents, almost all of the other commenters recognize the tremendous improvements that relying on geocoded data will produce. See, e.g., Aliant at 2; Ameritech at 6 ("If [customer locations] are geocoded, then the actual dispersion of customers is known"); RUS at 2; TDS at 12. As TDS (at 13) notes, "[i]mproved information sources such as geo-coding would also facilitate better network design and modeling[.]" Even GTE (at 11-12), while claiming to endorse a grid cell approach, favors a cost mechanism that incorporates actual customer locations.[3] And as AT&T and MCI (at 6) have previously asserted, the next Hatfield release will use geocoded data in its customer locations algorithm wherever available. Of course, the model's designers could accelerate this enhancement process if the incumbent LECs were to produce the line count and customer location data that they have already compiled.

The BCPM "grid cell" approach is plainly inferior. AT&T and MCI (at 3) noted in their initial comments that a grid cell approach will merely add a false sense of accuracy unless the input data is capable of disaggregation beyond the CB level. See also Bell Atlantic, Attachment at 1; TDS at 9-10. The BCPM's proponents have failed to demonstrate that their grid cell methodology -- composed of "microgrids," "subgrids," "subpartitioned subgrids," "partial grids,"

[3] GTE (at 4-5) advocates "geo-cod[ing] random samples of locations and extrapolat[ing] [to] larger areas, such as grid cells." GTE (at 11) also incorrectly claims that geocoding cannot be conducted on a national scale. In fact, the level of inaccuracy that extrapolation would introduce is unnecessary in most areas because geocoded data is already available for most areas.

"macrogrids," and "ultimate grids" -- can overcome this limitation.[4] The reed upon which all of the new BCPM's disaggregation appears to be based is an unverified relation between road miles and customer lines. The BCPM's designers have charted a course inflexibly affixed to general and highly questionably assumptions about population distribution rather than turning to the superior actual customer location data currently available and very likely already in their possession. Most telling of all, they provide no justification for this decision except possibly administrative ease (BellSouth/Sprint/U S WEST at 15), an untenable position given the Hatfield Model designers' expressed intention to incorporate these data in the next release of their Model.

Unfortunately, the BCPM's proponents have provided only a cursory description of their enhancements and have indicated that detailed information will not be forthcoming until after the comment period on the customer location phase of this proceeding is completed. BellSouth/Sprint/U S WEST at 4. The BCPM sponsors do not even provide a guess when an actual operational version of the model with actual results will be available. However, even the cursory description, as discussed further below, reveals that the "enhanced" BCPM will not only have an absurd and pointless level of complexity, repeatedly disaggregating and reaggregating data without adding any additional accuracy, but also will invariably perform poorly in many rural areas that are the focus of universal service costing (see, e.g., RUS at 3).

Contrary to its proponents' claims, the BCPM's grid cell approach will not "locate customers where they really live" (BellSouth/Sprint/U S WEST at 19), but rather will build a

[4] GTE (at 4) claims that "[f]orecasted Census block data is publicly available and can easily be broken down to the grid cell level." GTE does not explain how this break down could be accomplished or that the data is in fact capable of further meaningful disaggregation.

house of cards based on many iterations of disaggregation and reaggregation. A ratio of road mileage to customer lines will apparently be used to estimate customer location. Id. at 10. This method of estimating customer location is at best inferior to using actual customer locations. The model's sponsors attempt to distract from this shortcoming by arguing that "[t]he enhanced BCPM recognizes that telephone plant engineers do not typically build plant on a customer by customer basis. . . . Thus, engineers recognize actual clustering of customers when implementing standard engineering practices that try to maximize the efficient use of plant, minimize the distribution portion of plant, and ensure adequate service quality." Id. at 5. What engineers do take into account in order to capitalize on these potential efficiencies, however, is actual customer location, not the method incorporated into the BCPM model or anything resembling it. Simply put, an engineer must first know where the customers are in order efficiently to deploy plant facilities that serve multiple customers because that is the goal, and not simply to deploy plant to keep roads company.

The BCPM's proposed assignment process appears to be entirely arbitrary and not to reflect actual population distribution characteristics. For example, if one-third of the road mileage in a CBG traverses a particular "microgrid," then one-third of the business lines and households are assigned to that microgrid. See BellSouth/Sprint/U S WEST at 10. But only those roads selected by the BCPM -- a list that they still have yet to provide (id. at n.6) even though their comments purport to demonstrate the types of results that the new version will produce -- are included, and they apparently do not account for the differences in population distributions that often arise along different roads in very small geographic areas. Some roads will attend industrial zones, others residential areas, and still others primarily retail or service oriented activities. And, of course, some roads will have a mix of one or more types -- or no telephone customers at all. Moreover, the greatest divergence in the relationship between actual customer location and road location is likely to arise in rural areas, exactly those regions the BCPM sponsors have wrongly claimed this algorithm will better address.[5] Furthermore, there has been no demonstration that road mileage tracks customer line counts any better than simpler measures such as area. Because the data does not reflect these and many other population variations, simply assigning customers to "micrograms" based on the amount of road mileage in each "microgrid" does not increase the accuracy of the cost modeling process and may well decrease accuracy.

This process is only exacerbated by the reaggregation process of "microgrids" into "larger grids as appropriate." BellSouth/Sprint/U S WEST at 10. But these larger grids are constrained by an overlay of "macrogrids" supposedly designed to prevent isolated "microgrids." Id. at 11. The "macrogrids," however, may require a series of partitions into "subgrids" that may continue until the "partitioned subgrid" becomes the size of the "microgrid." Id. at 12. But now, the circularity of the new BCPM's customer location algorithm becomes readily apparent. As its proponents attest, "[t]he ultimate grid size utilized essentially reflects the manner in which customers are clustered." Of course, the BCPM's "clustering" is no more than a product of the

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[5] A long road could easily cross several "microgrids" in a CBG. Presumably, each "microgrid" will have the same number of customer lines assigned to it so long as it is not empty. To a much greater extent than urban CBGs, rural CBGs might have the vast majority of their population in only one or two "microgrids." As a result, the same relative number of lines might be assigned to each "microgrid" in a rural CBG as in a urban CBG even though they could have very divergent population dispersements. See also RUS at 3 ("The BCPM's 'within 500 feet of a [public] road' assumption is more generally valid in rural areas served by RUS borrower LECs, but this assumption fails in such diverse areas as southwestern Texas and eastern Tennessee"); TDS at 10.

road assignment process used at the "microgrid" stage, a process which does not incorporate actual customer locations, and consequently cannot capture the actual manner in which customers are clustered. Indeed, one would suspect that the subpartitioning process would often produce exactly the type of uniform customer distribution across a set of grid cells (here "microgrid" cells) that the BCPM sponsors claim the grid process is designed to avoid, i.e., a uniform distribution of customers.[6]

In short, then, the new BCPM customer location process apparently will start by (i) disaggregating CB data by arbitrarily assigning business and residential lines to artificial "microgrids" based on road mileage, not telephony or network engineering criteria or any other characteristics of the data that exist at the "microgrid" level of detail, (ii) reaggregating the data in variably sized larger "grids" -- again, not based on telephony or network engineering criteria -- that cannot exceed the size of the "macrogrids," and (iii) partitioning the "macrogrid," if necessary, into "subgrids," "sub-partitioned subgrids," and sub-partitioned "sub-partitioned subgrids" until the "subgrid" size has the same number of household and business lines as the underlying "microgrids." Unfortunately, not even this tortured process will apparently prevent "small groups" of "microgrids" from being isolated, thereby forcing the model to arbitrarily assigned them to "those ultimate grids of equal or larger size, located closest to the road centroid." Id. at 12.[7] And, then, of course, there will also be "partial grids." Id.

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[6] In addition, because the BCPM "macrogrids" may be as large as 14,000 feet by 12,000 feet, a substantial amount of uncertainty may remain as to actual customer location.

[7] While the possibility that many "microgrids" may remain unassigned is problematic in and of itself, the fact that these "small groups" may actually exceed in size the nearest "ultimate grid" is even more alarming because it would appear that the algorithm might assign a large group of (continued...)

Unfortunately, the process will not stop there. The new BCPM will then apparently proceed to segment each "ultimate grid" into four quadrants and then combine them into a square distribution area based on the non-empty quadrants established. Id. After all these layers of disaggregation in "microgrids," reaggregation in "grids," disaggregation in "subgrids" and "ultimate grids," aggregation of isolated "microgrids" into "ultimate grids," disaggregation into quadrants, and finally reaggregation into square distribution areas, the BCPM's sponsors then make the incredible claim that this "approach provides a reasonable model of the required telecommunications network facilities[.]" Id. at 13.

II. UNLIKE THE BCPM, THE HATFIELD MODEL WILL ESTIMATE UNIVERSAL SERVICE COSTS BASED ON ACTUAL CUSTOMER LOCATIONS.

The comments clearly illustrate the desirability of using a clustering algorithm like that current employed by the Hatfield Model and especially like the one that the Model's designers have proposed. Aliant (at 3) suggests that "the model should have the capability to adjust a 'clustering factor' by individual wire centers[.]" While the Hatfield Model assumes a default 85% clustering factor, this factor is also user adjustable in Hatfield Model 4.0 on a CBG by CBG basis. And, as Aliant recognizes, this step would be unnecessary in all events if geocoded data are used. Id. The next Hatfield Model release will do just that in determining the number of clusters, the size and location of the clusters, and the distance between customers within a cluster.

(...continued)
"microgrids" to an "ultimate grid" that does not subtend the group. In other words, an "ultimate grid" may actually consist of noncontiguous geographic areas.

The Hatfield Model 4.0 applies mainstream population assumptions, including a clustering factor that can be adjusted by the user to better reflect actual clustering conditions if necessary. Most important of all, the Hatfield Model already does a superior job to the BCPM -- current or proposed -- of estimating universal service costs. Hatfield critics have attempted to distract the Commission by "cherry-picking" hypothetical diagrams of customer locations supposedly created by Hatfield and the BCPM, new and old, and comparing them to digitized satellite map data. See, e.g., BellSouth/Sprint/U S WEST, Attachment A). Even if these diagrams could provide useful information, they provide virtually no information on overall cost estimation performance. This is because they cannot capture accurately the distances between customers within clusters or the numbers of lines served at each location. As AT&T and MCI discussed in their initial comments (at 9), this factor drives distribution costs and has the greatest degree of variability.

Contrary to the BCPM sponsors' claims, the current Hatfield version 4.0 also reflects significant improvements in rural areas by using RUS and USTA data, Hatfield 4.0 Model Description at 8, and the next version of the Hatfield Model will reflect even more significant improvements.[8] Conceptually, clusters, or in some cases "superclusters," will replace the CBG as the unit of analysis in the Hatfield Model. These customer conglomerations will capture the most relevant factors for telephony, network engineering, and estimation of universal service costs,

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[8] Indetec has not demonstrated that the Model underestimates the route miles necessary to serve rural customers (BellSouth/Sprint/U S WEST, Attachment B) because the analysis is inherently flawed. For example, Indetec curiously chooses to discard a significant data point (Eagle Telecommunications) where Hatfield exceeds RUS mileage calculations -- choosing wishfully to dismiss it as erroneous RUS data -- even though inclusion of this data point would reverse Indetec's conclusions.

thereby obviating the need to rely on embedded incumbent LEC distribution areas (see, e.g., Ameritech at 3) or CBs (see, e.g., RUS at 2-4).[9]

The next release of the Hatfield Model will calculate costs based upon PNR's data which define clusters of customers based on geocoded customer locations. This identification is conducted on a wire center-by-wire center service area basis, without regard to CBG boundaries. Where the number of customers in a cluster does not reach a threshold value -- based on a reasonable engineering unit that can be adjusted by the user -- clusters are aggregated into "superclusters" containing a number of lines greater than or equal to the threshold value -- consistent with engineering and quality of service criteria. Superclusters are created because an efficient basic telephone network would use many of the same plant structures, such as SAIs, DLCs, and feeder cables to provide service to all customer within the supercluster. Where superclusters are formed, Hatfield calculates the amount of cable necessary to interconnect the clusters within the supercluster.

For each cluster or supercluster, the input data used in the Hatfield Model will include: (i) the wire center identification (CLLI), (ii) the centroid location (latitude and longitude), (iii) the omega angle, (iv) the alpha angle, (v) the radial distance from centroid to wire center, (vi) the

[9] Ameritech (at 6) claims that use of Bellcore's Loop Engineering Information System (LEIS) coupled with geocoded data would make clustering algorithms unnecessary. In fact, LEIS is primarily used in the Long Range Outside Plant Planning (LROPP) process for planning the feeder network which ends at the SAI, thereby estimating only feeder requirements -- not distribution costs. It also necessitates manual data population and updates by outside plant engineers, and it provides no audit trail that permits ready verification of the data's accuracy with the actual network. In addition, not all companies use BellCore's LEIS system fully, with some opting to exclude wire centers of less 5,000 lines. In short, LEIS is unreliable and, by ignoring distribution altogether, it has nothing to add to clustering or modeling customer location.

cluster or supercluster area, (vii) the cluster or supercluster density, (viii) the supercluster connecting cable length (if applicable), (ix) the CBG identification for CBGs containing the plurality of lines in the cluster, and (x) geological data, as well as (xi) total lines, (xii) business lines, (xiii) residence lines, (xiv) special access lines, (xv) public lines, (xvi) single-line businesses, (xvii) households in each of ten housing type categories, (xviii) firms, and (xiv) employees. In addition, a post-processing module will aggregate cluster-specific information to CBGs, aggregate wire center and density zone level information.

Almost all of the criticisms submitted in this proceeding of cost model customer location algorithms in general -- and certainly those leveled at the Hatfield Model -- will be addressed by these model enhancements.[10] For example, TDS (at 11) states that the selected model must "account reasonably precisely for variances" in determining cluster characteristics. Data sets that include actual customer location coupled with Hatfield's already extensive customer information will allow the Model to account for such variation. Similarly, the BCPM proponents' criticisms, which are generally misdirected and incorrect, will have no validity once geocoded data are

[10] GTE's criticism (at 6-9) are aimed almost entirely at Hatfield Model 3.1. Those allegations that have any validity whatsoever have either been addressed in Hatfield Model 4.0, will be resolved in the next Hatfield release which will incorporate geocoded data, or could be addressed, if necessary, through an adjustment by the user to the 85% clustering factor. Like GTE, RUS (at 2) and TDS (at 3) are also critical of the 85% clustering factor. Hatfield, however, has been specifically designed to allow the user to modify this value. Indeed, the Hatfield Model documentation has provided suggested alternative values for input on a state-by-state basis. Moreover, the next release of the Hatfield Model will obviate the need for this factor in most areas altogether because geocoded data will be used to accurately assess the distance between customers in a cluster, the size and location of a cluster, and the number of customers in an area.

incorporated.[11] And the next release of the Hatfield Model will also address PRTC's concerns (at 3) by using data for Puerto Rico where it is made available.

Although the Hatfield Model's designers believe that the next release of the model will be more than sufficient to accurately and satisfactorily estimate universal service costs, they continue to explore the desirability of modeling individual strands to each customer's location ("strand mapping"). This process would not replace clustering, but could increase the accuracy of determining distribution costs for a cluster or supercluster. It is unclear whether or not any gains in accuracy would justify the substantial increases in modeling complexity that would be required, particularly given that the next Hatfield release will already calculate the distance between customers in a cluster using geocoded data, the most important factor for determining distribution costs. Nevertheless, the Hatfield Model, unlike the BCPM (present or future) will have the potential to take this step.

The BCPM's sponsors ignore that any set of assumptions about customer location will invariably be inferior to the use of geocoded data in determining how many clusters to form, the size and location of the clusters, and the distance between customers in a cluster. In effect, BCPM's sponsors are advocating an inferior data set instead of the best available data on the indefensible basis that either set of data will have to be used in a clustering algorithm. Their

[11] The BCPM's sponsors (at 4) even mischaracterize the current version of the Hatfield Model, implying that Hatfield assumes a uniform dispersion of customers across a CBG, a limitation they claim will be overcome in the new BCPM. Hatfield, however, has already eliminated this restriction as far back as its 3.1 version and will continue implementing far reaching enhancements in the future.

adherence to this untenable position, then, merely reflects the inability of their model in its current form, or as proposed, to calculate costs using strand mapping.

III. THE COMMENTS REVEAL THAT ACTUAL LOOP LENGTHS ARE NOT USEFUL FOR VERIFYING COST MODEL ESTIMATES.

Despite the claims of Aliant (at 3) and TDS (at 11-12), the comments demonstrate that comparing a model's estimated loop lengths to the existing network's actual loop lengths would be inappropriate. Indeed, this is one area where all cost model proponents are in accord. See AT&T and MCI at 10-11; BellSouth/Sprint/U S WEST at 21-22. This "verification" methodology would not be useful because it is inconsistent with the estimation of forward-looking costs and, even if it was consistent with TELRIC, the comparison would not be statistically meaningful in most cases. First, under a forward-looking approach, variance from figures that reflect past incumbent LEC practices cannot prove or disprove the accuracy or inaccuracy of forward-looking cost estimates. In particular, loop lengths might be longer due to increased reliance on efficient "double star" DLC network architectures or shorter if the embedded loop routes some customers over much longer loops to a distant switch in order to receive Centrex service (a cost that should not be supported by universal service subsidies). And of course, the existing network may include inefficient loop configurations.

Second, as the BCPM sponsors correctly note, data on loop length for a central office is only available in an average format. BellSouth/Sprint/U S WEST at 21-22. Consequently, the comparison of the individual loop lengths at a wire center to the average central office length would be simply a comparison of apples and oranges. Even the average itself is typically based on a small statistical sample. AT&T and MCI agree, then, that this limitation makes it "questionable what value these loop statistics would have for high-cost support targeting." Id.

IV. THE HATFIELD MODEL EMPLOYS A "STATE-OF-THE-ART" MECHANISM FOR ASSIGNING A CBG TO A WIRE CENTER AND WILL ASSIGN THE ACTUAL CUSTOMER TO THE APPROPRIATE WIRE CENTER IN FUTURE RELEASES.

As AT&T and MCI (at 11) stressed in their initial comments, concerns about Hatfield's "assignment of CBGs to incorrect wire centers" (FNPRM ¶ 49) are misplaced. Past criticism has focused on Hatfield Model 3.0, whereas Hatfield 4.0 is much more effective in assigning a CBG to the same wire center that actually provides it service in the existing network. The Hatfield NPA-NXX approach using actual customer data is the best assignment method in existence and the Model's developers are already implementing a new algorithm that will further reduce any error. This forthcoming method will assign an individual customer (not a CB, CBG or "ultimate grid") to a wire center based on the customer's actual telephone number when available, thereby avoiding all of the difficulties as well as unreliable results inherent in the new BCPM's "microgrid" approach.

V. THE COMMENTS DEMONSTRATE THAT INCUMBENT LECS POSSESS LINE COUNT DATA THAT WOULD IMPROVE THE ACCURACY OF THE HATFIELD MODEL'S ALREADY HIGHLY ACCURATE LINE ASSIGNMENT ALGORITHM.

The comments confirm that incumbent LECs have line count data in their possession. The best approach, then, to improving the accuracy of cost model generated line counts is for the Commission to take the necessary steps to ensure that model designers have access to this information. In fact, the Hatfield Model presently has the capability to generate universal service cost estimates using the exact line counts released by the incumbent LECs. Nevertheless, some carriers continue in their efforts to restrict access to this information. GTE (at 13) for one wants the selected model "to use actual ILEC wire center count information" as submitted to the

Commission in response its universal service data request. At the same time, GTE (at 13-14) intends to restrict access to this data to the universal service fund administrator, a limitation that would prevent other model designers from making the most efficient use of this information. And then, protected by this veil of secrecy, GTE makes wholly unverifiable claims, including that GTE's Integrated Cost Model uses grid cells, CB data and GTE proprietary information "to render an exceptionally accurate picture" of customer locations. GTE at 4. Incumbent LECs can best demonstrate their commitment to providing affordable basic telephone service -- and validate such currently unsubstantiated claims -- by making line count information available to cost model developers. See Bell Atlantic (Attachment at 3) (suggesting that "the LECs can produce actual line counts by wire center. . .eliminat[ing] the need for 'closing factors' to reconcile estimated line counts based on CBGs or CBs with actual line counts").

Even without these data, the Hatfield Model already provides an excellent method for assigning CBGs to wire centers. Indeed, some commenters are suggesting improvements that the Hatfield Model already incorporates or that are being considered for future releases.[12] For example, WorldCom (at 5) has suggested that the selected cost model determine the number of business lines based on "the number of employees and SIC for each business[.]" In fact, this is exactly what the Hatfield Model already does.

Moreover, there is no cause for concern about the Hatfield Model's closing factors. With Hatfield 4.0, many new enhancements were implemented that reduce the closing factors and, more importantly, no commenters have demonstrated why the use of a closing factor has an

[12] RUS (at 4) and GTE (at 10) both examine Hatfield Model 3.1's line counts, providing criticism that is both misleading and in all events focused on an outdated version.

adverse impact on universal service cost estimates. Indeed, just the opposite is true. Closing factors ensure that the cost model incorporates the correct number of lines. Some commenters, however, misapprehend the use of closing factors. For example, TDS (at 14) questions the accuracy of network design or carrier pricing decisions made without 10% of the relevant data[,]" when in fact no available information is being neglected. The "closing factors" ensure that the model will account for each and every line and thereby calculate sufficient costs to guarantee that the network would not suffer any loss in quality. Similarly, there is no reason to worry about "missed" wire centers because it appears that most of these wire centers should not be included in a model of USF support.[13] If it can be shown that they do belong in a universal service cost model, Hatfield will incorporate them.

[13] AT&T and MCI (at 13-14) noted in the initial comments that these "missed" wire centers -- ones not assigned to a CBG -- are usually "(i) de minimis in size; (ii) lacking any working lines; (iii) so new that no customers have been identified as being served by that wire center; or (iv) do not actually constitute a public wire center."

CONCLUSION

For the foregoing reasons, the Commission should adopt the Hatfield Model approach to modeling customer location.

Respectfully submitted,

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September 10, 1997

CERTIFICATE OF SERVICE

I, Scott M. Bohannon, do hereby certify that on this 10th day of September, 1997, I caused a copy of the foregoing Reply Comments of AT&T Corp. and MCI Telecommunications Corporation to be served upon each of the parties listed on the attached Service List by U.S. First Class mail, postage prepaid.

/s/ Scott M. Bohannon

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RECEIPT

September 24, 1997

RECEIVED

SEP 24 1997

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

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

Re: **CC Docket No. 96-45; Federal-State Joint Board on Universal Service**
CC Docket No. 97-160; Forward-Looking Mechanism for High Cost Support for Non-Rural LECs

Dear Mr. Caton:

Enclosed herewith for filing are the original and four (4) copies of AT&T Corp.'s and MCI Telecommunications Corporation's Comments in the above-captioned proceeding.

Please acknowledge receipt by affixing an appropriate notation on the copy of the Comments furnished for such purpose and remit same to the bearer.

Sincerely yours,

Chris Frentrup

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MCI Telecommunications Corporation

Enclosure

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
	)	
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND
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September 24, 1997

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SUMMARY

The cost model used by the Commission to compute universal service support must reflect a network that is capable of providing the supported level of service, but does so most economically on a forward-looking basis, consistent with the Commission's quality requirements for supported universal service. The Commission has correctly concluded that the mix of plant will vary based on population density and on terrain characteristics. The Hatfield Model's outside plant algorithm reflects these characteristics, and the Hatfield Model sponsors are preparing further revisions that will allow the mix of plant used to vary based on the relative lifetime costs of the types of plant.

Similarly, the cost model should allow the costs to vary by density zone, with those density zones measured by lines per square mile to take account of all economies of scale in building a telephone network. However, costs should be assumed to vary by density zone only if there are sufficiently granular input data available by density zone. For example, data to determine the areas affected by climate conditions are unlikely to be available.

The structure sharing adopted in the universal service cost model should reflect the forward-looking opportunities for sharing, rather than the incumbent LECs' embedded base of sharing, because that level of sharing does not reflect the incentives that will be faced in a competitive environment. In addition, the cost model should embody a performance rather than a network standard, which will allow the network to use the most efficient design to provide supported services,

such as Hatfield's use of copper T-1 technology to provide service to distant customers in sparsely populated areas. Finally, the Commission can use a wireline model to estimate the cost of universal service for the present, without distorting the marketplace.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
	)	
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND MCI TELECOMMUNICATIONS CORPORATION

AT&T Corp. (AT&T) and MCI Telecommunications Corporation (MCI) hereby submit their comments regarding outside plant issues in the above-captioned docket.

I. INTRODUCTION

The cost of outside plant is the major component of the cost of local service, and thus of the total amount of universal service support. The cost model used by the Commission to compute universal service support must reflect a network that is capable of providing the supported level of service, but does so most economically on a forward-looking basis, consistent with the Commission's quality requirements for supported universal service. The Hatfield Model, with the revisions discussed infra, will meet these twin requirements. AT&T and MCI urge the Commission to adopt the approaches taken in the Hatfield Model.

II. THE MIX OF PLANT IN THE MODEL SHOULD REFLECT THE MOST ECONOMIC ALTERNATIVE, CONSISTENT WITH FORWARD-LOOKING NETWORK DESIGN PRACTICES (III.C.2.a. PLANT MIX)

Because the costs of installing aerial, buried, and underground cable and wire facilities vary so greatly, a prime determinant of the cost of any network is the relative proportions of these types of plant. The Hatfield Model properly reflects the differences in these types of costs, and will allow the user to select the mix of plant that is consistent with forward-looking network design practices.

The Commission has concluded that an efficient carrier will vary its plant mix according to the population density of an area.[1] The Hatfield Model currently allows the user to specify the plant mix by density zone, and has default values that vary by zone. For example, a company is likely to use more aerial or buried plant in the less densely populated zones, and more underground plant in more densely populated areas, due to relative costs and zoning requirements.

The Commission tentatively concludes that assignment of plant mix should also reflect terrain factors, and specifically that relatively more feeder and distribution cable should be assigned to aerial installation for all population density groups in wire centers characterized by "hard rock" conditions than in those wire

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1 See Federal-State Joint Board on Universal Service, CC Docket No. 96-45, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 97-160, Further Notice of Proposed Rulemaking, FCC 97-256, released July 18, 1997, (FNPRM) at para. 58. Plant mix refers to the percentages of plant which are aerial, buried, and underground.

centers with other terrain conditions.[2] AT&T and MCI agree that an efficient carrier will base its decision on whether to install aerial, buried, or underground cable on the relative costs of those types of installation, taking into consideration the different "first-cost" and maintenance expenses that are expected to result from the different choices.

The next release of the Hatfield model will incorporate an optimization process whereby the model will, by comparing the lifetime costs of aerial and buried plant, select a mix of these types of plant based on their relative cost. Specifically, the user will be able to input, by density zone, the percentage of plant which is underground, buried, and aerial, based on standard terrain conditions, and the percentages of aerial and buried plant which are "at risk" for shifting to the other type based on relative cost shifts that may arise from non-standard terrain conditions. Thus, for example, the user may specify that for a given density zone, standard terrain conditions will support 20 percent of plant being underground, 40 percent being buried, and 40 percent being aerial, with half of the aerial and buried available to be shifted to the lower cost alternative.[3] The exact percentage of "at-risk" plant in a particular geography that will be shifted will depend on the relative

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2 Ibid.

3 As currently envisioned, the model will not allow plant to be shifted into or out of the underground category, because the percentage of underground plant is primarily determined by factors other than terrain-related relative cost, such as the constraints of providing service in an urban environment, where aerial plant may be limited by law or regulation and buried plant is not desirable because of streets and sidewalks.

life cycle costs of aerial and buried plant, based on the terrain conditions of that geography. These relative costs will consider not only the cost of the initial plant installation, but also the life-cycle maintenance and other expenses of the types of plant. In addition, the percentage of plant actually shifted will depend on the degree to which the cost of buried plant exceeds aerial plant, e.g., a greater relative cost of buried plant will result in a greater portion of the "at-risk" buried plant shifted to aerial.

The Commission also suggests that climate conditions, such as the possibility that a hurricane will destroy aerial plant, may affect an efficient carrier's decision to deploy aerial plant.[4] It is not clear why susceptibility to any one type of climate condition, such as hurricanes, should receive special treatment, while susceptibility to other types, such as earthquakes, ice storms, wind storms, or extreme heat, are not assumed to affect costs. Thus, varying the type of plant used based on climatic conditions would be enormously complex, requiring the Commission to identify which conditions are relevant -- e.g., hurricanes, ice storms, wind storms, extreme heat, etc. -- and to determine which parts of the study area are affected -- e.g., how far inland is affected by hurricanes, how frequent ice storms must be before they affect the decision -- as well as the magnitude of the effect.[5]

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4 Ibid.

5 To the extent that the modeled LEC's ARMIS data reflect expense differences due to climate differences, the Hatfield Model will increase or

AT&T and MCI do not believe these conditions or areas can be readily identified or quantified with any accuracy. Given these data limitations, adding climate condition inputs is unlikely to produce more accurate cost estimates. Accordingly, AT&T and MCI do not recommend that the universal service cost model reflect this factor.

AT&T and MCI also agree with the Commission's finding that more recent installations of outside plant may more closely meet forward-looking criteria.[6] Because structures are generally long-lived plant, changes over time in types of structure take time to filter into the embedded base. The incumbent local exchange carriers' (LECs') embedded base of outside plant reflects decisions they have taken over the years, rather than the decisions a company would make today. Thus, their embedded base is unlikely to reflect the decisions a forward-looking efficient company would make today, or that a competitive firm would be able to reflect in its prices.

III. VARIATION IN COSTS BY DENSITY ZONE SHOULD REFLECT ACTUAL COST DIFFERENCES (III.C.2.b INSTALLATION AND CABLE COSTS)

The Hatfield Model, Release 4.0 (hereinafter, Hatfield 4.0) has revised the treatment of installation costs from the Hatfield Model, Release 3.1, consistently with the guidelines stated in the FNPRM. For instance, installation costs can be varied by terrain and density zones, and installation costs in difficult terrain are

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decrease maintenance costs consistent with these climate differences.

6 Id. at para. 59.

increased as the default, rather than installing longer cable to route around the difficult terrain.[7] Finally, Hatfield 4.0 includes costs per foot of conduit installation that vary by density zone.[8]

AT&T and MCI agree with the Commission's finding that density zones should be defined by lines per square mile rather than households per square mile, because the economies of scale that occur in a network depend more on the number of lines in place than on the number of households.[9] Households may differ greatly in their use of the telephone network, with some houses having no telephone service and others having several lines for voice, fax, and on-line services. In addition, relying solely on households per square mile may ignore the number of business lines in an area, and the resulting economies of scale that are available. Thus, lines per square mile is a more relevant measure of density than households per square mile.

The nine density zones used in Hatfield 4.0 accurately reflect cost differences.[10] In principle, the more zones used in a model the more accurate will be the costs estimated by the model. However, it is also true that increasing the number of zones in a model creates a need for increasingly granular zone-specific

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7 Id. at para. 65-66. Hatfield 4.0 also retains the option of adding cable to go around the difficult terrain if the modeler wishes.

8 Id. at para. 67.

9 Ibid.

10 Ibid.

input data. Thus, there is always a trade-off between the number of zones and the problems of getting accurate input data for the zones. Nine zones, as used in Hatfield 4.0, adequately capture the relevant differences in cost characteristics. There are zones which are primarily rural (0-5, 5-100, 100-200 lines per square mile, corresponding to lots of approximately 3 acres and more), primarily suburban (200-650, 650-850, and 850-2550 lines per square mile, corresponding to lots of between 3 and one quarter acres), and primarily urban (2,550-5,000, 5,000-10,000, and 10,000+ lines per square mile, corresponding to lots of less than a quarter acre). These zones are sufficiently granular, while simultaneously being broad enough to allow reasonable variations in input values to be specified.

The Commission seeks comment on how to calculate the forward-looking economic cost of conduit installation, specifically asking whether national statistical averages of contractor construction prices could be used.[11] Hatfield 4.0, as described in the Hatfield Inputs Portfolio provided as documentation with the model, relies on outside plant expert opinion, data from a book providing construction cost estimates,[12] and data on contractor bids that validate its estimates of conduit installation costs. These sources, which are based on recent conduit system installations, can be used to verify the reasonableness of default conduit placement costs used in the model.

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11 Id. at para. 67-8.

12 See Martin D. Kiley and Marques Allyn, eds., 1997 National Construction Estimator 45th Edition.

The Commission asks whether a labor cost variable should be included in the cost of installation, to reflect differences in labor costs for different regions of the country.[13] AT&T and MCI will address the extent to which labor costs should vary by region in their comments in the inputs portion of this proceeding. We note that the Hatfield model has the flexibility to allow such a regional adjustment, with a user-definable input which allows a different regional multiplier to be applied to the labor costs of plant installation.

Finally, the Commission tentatively concludes that material and installation costs should be separately identified in the model.[14] AT&T will revise the Hatfield Inputs Portfolio with the next release of the model to separately identify these costs.

IV. UNLESS BOTH CUSTOMER AND ROAD LOCATIONS ARE PRECISELY KNOWN, "ESTIMATED" DROP LENGTHS WILL LIKELY YIELD EXCESSIVE DROP LENGTH ESTIMATES (III.C.2.c DROPS)

The Commission asks whether drop lengths should be estimated, or assumed, and, if estimated, what the factors determining drop length should be.[15] AT&T and MCI believe it is more accurate to use assumed drop lengths, unless customer and road locations are precisely known. None of the cost models currently is engineering to the exact location of each house, i.e., neither model knows where within each lot the house lies or how much empty space, such as

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13 FNPRM at para. 68.

14 Ibid.

15 Id. at para. 74.

roads, parking lots, or greenways, is interspersed between houses. Thus, the Hatfield Model assumes that the drop length will vary by density zones, with the two least dense zones having average drop lengths of 150 feet, the next two zones having average drop lengths of 100 feet, and the remaining five zones having average drop lengths of 50 feet.

Since the model operates on average costs within density zones, no exact computation for the drop length of each house is necessary. In addition, since the models do not determine where each house is, there is no need (or capability) to determine drop lengths other than by averages. As documented in the Hatfield Inputs Portfolio, the latest publicly available network study that includes data on drop lengths found an average drop length of 73 feet.[16] This distance is consistent with the assumed drop lengths included as default values in the Hatfield model.

If the Commission nevertheless decides to estimate drop lengths, it must determine a number of relevant inputs before it can do so. In general, drop lengths are determined by building set-backs and lot depth. Thus, the model would have to determine the placement of houses within lots. AT&T and MCI believe that houses are usually placed closer to the front of the lot, for several reasons. First, people want bigger back than front yards, because most gardens and other private spaces are in back yards. Second, people for the most part do not want long driveways, both because of the cost of surfacing long driveways, and, in non-

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16 See Bellcore, BOC Notes on the LEC Networks - 1994, page 12-9.

Sunbelt areas, because of the problem of removing snow.

In addition to deciding these two issues to estimate the drop length, the Commission would have to determine the angle at which the drop meets the house. If, for example, a house is set on a lot that is 150 feet deep with 75 feet of road frontage, with the house set back 50 feet from the street,[17] the drop length would be 50 feet if the drop is perpendicular to the street, but could be as much as 62.5 feet if the drop runs from the corner of the lot to the middle of the lot, i.e., 50 feet from the street and 37.5 feet from the corner of the lot. In fact, if the drop were assumed to run from the corner of the lot to the house, the Commission would have to specify both the width of the house and how far back from the street the house is set in order to estimate the drop length.[18]

The Commission tentatively concludes that drop costs include installation, terminal, splice, and pedestal costs.[19] Hatfield 4.0 explicitly includes each of these items. Thus, the Hatfield model conforms to this conclusion of the Commission.

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17 This is an approximately quarter acre lot, twice as deep as it is wide, with the house set back one third of the depth of the lot.

18 This specification would have an even greater effect in rural areas. For example, a house placed in the middle of a square lot on a 200 acre farm would require a 3,300 foot drop. This exceeds by far the maximum recommended drop length of 700 feet. See AT&T Outside Plant Engineering Handbook, August 1994, p. 14-54 & p. 14-56.

19 FNPRM at para. 75.

V. STRUCTURE SHARING PERCENTAGES SHOULD REFLECT THE POTENTIAL FOR SHARING, NOT THE LECS' EMBEDDED PRACTICE (III.C.2.d STRUCTURE SHARING)

The Commission tentatively concludes in the FNPRM to adopt the BCPM's categories for installation activities and terrain categories.[20] This includes separate categories of cost for installations in normal soil, soft rock, and hard rock, which vary by density zone. For buried cable, the user can input costs separately for plowing, rocky plowing, trenching and backfilling, rocky trenching, backhoe trenching, hand digging trench, boring cable, pushing pipe and pulling cable, cutting and restoring asphalt; cutting and restoring concrete, and cutting and restoring sod. For underground cable, the user can input costs separately for trenching and backfilling, rocky trenching, backhoe trenching, hand digging trench, boring, cutting and restoring asphalt, cutting and restoring concrete, and cutting and restoring sod. Finally, for aerial cable, the user can input costs separately for poles and anchors and guys. For each of these cost categories, the user can input different values for feeder and distribution,[21] the cost per unit, the percent of installations in which the activity is used, and the percent assigned to the telephone company.

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20 Id. at para. 79

21 In many cases the default values used in the BCPM for feeder and distribution are the same.

This general methodology has been incorporated into Hatfield 4.0.[22] Based on the user inputs described supra, with the default values documented in the Hatfield Inputs Portfolio (which differ from those proffered by the BCPM's sponsors), Hatfield 4.0 computes a weighted average cost of installation.

At present, the Hatfield Model determines the cost for cable placements in hard rock and soft rock by applying multiplicative factors to the total excavation and restoral costs for normal soil. Because only excavation costs should be affected by the type of soil, the Hatfield Model sponsors are preparing a revision to the Hatfield model which will apply an additional factor only to excavation costs, not to restoral costs.

The Commission also tentatively concluded that 100% of buried and 66% of underground and aerial installation costs should be assigned to the telephone company.[23] The HM Sponsors believe this tentative conclusion is seriously wrong. At a minimum, it is inconsistent with record evidence cited by the Commission itself in the FNPRM, in which GTE states that it pays for 97.5% of buried plant, 95% to 99% of underground plant, and 57% to 61% of aerial plant in its territory.[24] In

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22 Because these costs vary by density zone, the same nine density zones will be used, to accurately reflect cost differences as discussed supra.

23 Id. at para. 80-1.

24 Id. at fn. 118, citing GTE Model comments at 72. These data should be considered an upper limit of the assignment to the telephone company, because they reflect the embedded base of a LEC whose plant was largely installed while under a regime of rate-of-return regulation, rather than the forward-looking efficient level of sharing that will exist as local exchange markets become more competitive.

addition, the claim that no sharing of buried plant is possible is refuted by the ex parte evidence recently filed by AT&T and MCI, which showed that cable plows do in fact bury more than one cable simultaneously.[25] That this sharing occurs is further supported by the deposition of U S West witness Genie Cervarich in Washington State, in which she stated, "Power is plowing in and we're going in the plow with them."[26] It also ignores the evidence, cited in the Hatfield Inputs Portfolio, that builders often provide trenching in new sub-divisions for use by cable, electric, and telephone companies, to facilitate placement of wires and to minimize cable cuts.[27] In this case, the telephone company pays none of the cost of trenching. Finally, it ignores the statement by Anchorage Telephone Utility that it shares trench space with two local electric companies.[28]

Given all of this evidence, it is clear that the cost model should not assign 100 percent of buried costs to the telephone company. At a minimum, the

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25 See Ex Parte Letter from Chris Frentrup, MCI, to William F. Caton, September 18, 1997, CC Docket Nos. 96-45 and 97-160.

26 See Deposition of Genie Cervarich, 4-18-97, at page 41, in Pricing Proceeding for Interconnection, Unbundled Elements, Transportation and Termination, and Resale, Docket Nos. UT-960369, UT-960370, and UT-960371.

27 See Hatfield Inputs Portfolio, August 1, 1997 edition, page 16 and Appendix B, pages 131-132, attached to Ex Parte Letter from Richard N. Clarke, AT&T, to William F. Caton, August 5, 1997, CC Docket No. 97-160 (Hatfield Inputs Portfolio).

28 See Request for Partial Waiver of Data Submission, CC Docket No. 96-45, filed by Anchorage Telephone Utility, August 8, 1997. ATU states that it is billed for 45 percent of the trenches.

Commission should first examine the LECs' written engineering policies to determine how much sharing of buried plant they are currently attempting to achieve in new installations. This should indicate the minimum sharing of buried plant that is possible on a forward-looking basis.

Similarly, the assumption that 66% of aerial cable cost is borne by the telephone company is inconsistent with several sources cited in the Hatfield Inputs Portfolio,[29] i.e., (1) New York Telephone reports that almost 63 percent of its pole inventory is jointly owned;[30] (2) in the same proceeding, Niagara Mohawk Power Company reported that 58 percent of its pole inventory was jointly owned;[31] and, (3) financial statements of the Southern California Joint Pole Committee indicate that telephone companies hold approximately 50 percent of all pole units.[32]

In addition, this conclusion ignores the likelihood that carriers will face greater incentives to share structure costs in the future, as they must lower their costs in order to compete.

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29 Hatfield Inputs Portfolio at 130.

30 New York Telephone's Response to Interrogatory of January 22, 1997, Case 95-C-0341: Pole Attachments, State of New York Public Service Commission, January 27, 1997.

31 Direct Panel Testimony of Richard Wolf, Clay T. Whitehead, Donald Fiscella, David Peacock and Dr. Miles Bidwell on Behalf of the Electric Utilities, Case 95-C-0341: Pole Attachments, State of New York Public Service Commission, January 27, 1997. These experts also predicted that sharing of poles among six attachers would not be uncommon.

32 "Statement of Joint Pole Units and Annual Pole Unit Changes by Regular Members", Monthly Financial Statements of the Southern California Joint Pole Committee, October, 1996.

The sharing percentages adopted in the model should reflect forward-looking opportunities. The incumbent LECs' current level of sharing represents merely the minimum that is achievable. In fact, sharing should rise, both because of the greater incentives to reduce costs and because of the increase in the number of entities with whom to share structure costs. Finally, a number of jurisdictions have adopted requirements that any carrier who wishes to dig up a street to lay cable must notify other parties, and any carriers that do not lay cable at that time are prohibited from opening that street again for a period of time.

VI. THE MODEL'S LOOP DESIGN SHOULD REPRESENT THE MOST EFFICIENT METHOD OF PROVIDING THE SPECIFIED SERVICES (III.C.2.e LOOP DESIGN)

One significant difference between the Hatfield model and the BCPM has been in their respective approaches to distribution and feeder design. While both rely on similar configurations of feeder plant extending from central offices, tapering down to sub-feeder and distribution plant, the BCPM overbuilds its network to be capable of providing services far more elaborate than those meeting the Commission's specifications for supported universal services. The Hatfield model, on the other hand, uses a network design that is fully capable of providing the level of service required by the Commission, without over-building the network to provide services beyond those for which support is intended.

a. THE COMMISSION SHOULD ADOPT A PERFORMANCE RATHER THAN A NETWORK STANDARD (III.C.2.e.(1) & (2) FIBER-COPPER CROSSOVER POINT & LOOP STANDARDS)

The Commission asks whether it should specify a network standard that the models should meet, such as the Revised Resistance Design (RRD) or Carrier Serving Area (CSA) standards, or whether it should specify a performance standard, and let the model select the network standard which will meet that performance standard.[33] AT&T and MCI support the use of a performance standard.

To build a cost model, the modelers must first know what level of service the network is intended to provide. The Commission has specified the performance standard it desires -- a network that can provide voice grade service, but which is also capable of supporting advanced services.[34] The cost model it adopts in this proceeding should be able to meet this standard at the lowest cost. Thus, the Commission need not specify a particular network standard, as that would limit the ability to use the most efficient alternative, or require the Commission to revisit its choice of model, should a new network standard become available in the future.

If the Commission does decide to specify a network rather than a performance standard, it should select the standard that will be able to meet its adopted performance standard in the most efficient manner possible. Of the two standards the Commission proposes in the FNPRM, the RRD standard will be the lower cost methodology to supply services up to at least the level of ISDN-BRI

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33 FNPRM at para. 89.

34 See Federal-State Joint Board on Universal Service, CC Docket No. 96-45, *Report and Order*, FCC 97-157, released May 8, 1997, (USF Order) at para. 250, criterion 1.

digital subscriber loops, and will not require excessive use of digital loop carrier. Furthermore, it will not allow cross-subsidization of a network capable of providing additional services, such as video dial tone, by a universal service fund that is intended to ensure that all people in the United States have access to a reasonably priced telephone line capable of supporting advanced services.[35]

b. THE COMMISSION SHOULD ADOPT HATFIELD 4.0'S DESIGN FOR DISTRIBUTION AND FEEDER (III.C.2.e(3) DIGITAL LOOP CARRIERS)

The BCPM over-engineers its network by placing fiber further out into the network than is necessary or cost-effective to provide quality service, thus requiring placement of excessive numbers of digital loop carriers (DLCs) in the network. This vastly inflates the cost of providing universal service. The approach in Hatfield 4.0 is preferable, because it uses a more economic mix of fiber and copper, thus minimizing the number of required DLCs. Hatfield 4.0 extends fiber feeder to the center of the Census Block Group (CBG)[36] if the feeder is greater than 9 kilofeet,

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35 The Commission also tentatively concludes that substituting increased use of optical fiber to restrict copper loops to a maximum of 18 kilofeet is preferable to using load coils. FNPRM at para. 87. Although Hatfield 4.0 no longer includes load coils in its network design, AT&T and MCI note that they do not believe that loops with load coils are incapable of supporting high-speed modems, as the Commission indicated in its decision. In fact, the Commission has not addressed an ex parte filed by AT&T which provided data from an independent modem testing laboratory that demonstrated that loops with load coils would in fact be capable of supporting high-speed modems. See Ex Parte Letter from Richard N. Clarke, AT&T, to William F. Caton, April 8, 1997, CC Docket Nos. 96-45 and 96-262.

36 The next release of Hatfield will engineer outside plant based on clusters of customers rather than CBGs. Fiber will always be extended to the cluster

or if total copper feeder plus distribution is greater than 18 kilofeet. From the center of the CBG, copper distribution of greater than 18 kilofeet will cause the Hatfield model to extend fiber to the center of quadrants in the CBG. From there, any distribution that extends greater than 18 kilofeet is provided over digital T-1 on copper, with repeaters as necessary, attached to 24-line DLCs.

The Hatfield model sponsors examined the use of High bit-rate Digital Subscriber Line (HDSL) over copper as a solution to the problem of long copper loops, and determined that this technology was not cost-effective for universal service, because it requires costly repeaters every 12 kilofeet.[37] Furthermore, for loops which extend more than 36 kilofeet, HDSL would require the use of dual HDSL terminals, because repeaters are unable to boost the signal to acceptable levels at those distances. Thus, Hatfield's copper T-1 technology represents the most economical method of provisioning digital quality service to distant customers in those rare cases (much less than 1 percent of total loops) in which the copper portion of loops exceeds 18 kilofeet.

The Commission also seeks comment on whether more than two sizes of DLC should be used, especially DLCs smaller than are assumed by either model.

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if the distance criteria discussed in the text are met. In addition, the model will compare the cost of fiber and copper in all areas, and use the lower cost option.

37 HDSL systems appear to be optimized toward the delivery of channels to individual subscribers that are much higher in bandwidth (e.g., 384 kbps, 768 kbps, or 1536 kbps) than the typical 64 kbps voice grade digital channel.

Hatfield 4.0 uses DLC remote terminals of eight sizes.[38] It also allows the user to input the line threshold at which the model installs a larger size fiber-fed DLC, so the model can accommodate any size DLC that is available.[39] Our information also indicates that the capacity of small DLCs can be increased in modular fashion without greatly changing the cost per line. Finally, the DLCs used by the Hatfield model allow a longer, more economical reach on copper distribution loops because they transmit against resistances up to 1500 ohms.[40] The DLCs specified in the BCPM will not do so, because they appear to mistakenly assume a 900 ohms limit, which triggers the placement of far more fiber-fed DLC remote terminals.

VII. BASING UNIVERSAL SERVICE SUPPORT ON A WIRELINE MODEL FOR THE PRESENT WILL NOT DISTORT FUNDING (III.C.2.f WIRELESS THRESHOLD)

The Commission asks several questions regarding the use of wireless or other technology as an alternative. Specifically, it asks (1) whether any loop with more than $10,000 investment, as reflected in the BCPM, could be more

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38 DLC Remote Terminal increments are in maximum line sizes of 2016, 1344, 672, 384, 288, 192, 96, (all fiber fed) and 24 (copper T-1 fed).

39 The default value in Hatfield 4.0 of 384 lines to trigger the larger 672-line DLC is based on a calculation of the most cost effective break-even point. Up to that user-specified breakpoint, the Hatfield Model adds lines to the DLC in 96 line increments.

40 See, e.g., DSC Communications Litespan-2000 Specifications for POTS cards: "Up to 224 lines per channel bank, 4 lines per POTS card, Loop Resistance of 1930 ohms (including set)." Subtracting 430 ohms from this for the assumed station resistance (cf. Bellcore, BOC Notes on the LEC Networks - 1994, page 7-67) leaves 1500 ohms.

economically served by a wireless system;[41] (2) whether the cost of wireless loops can be estimated;[42] (3) whether basing universal service support on the costs of wireline technology alone would be consistent with the requirement that support be technology neutral;[43], and (4) whether the cost model adopted in this proceeding should model the cost of other technologies as well, such as microwave and satellite.[44]

AT&T and MCI agree that, in principle, the cost model should reflect all technological alternatives, selecting the lowest-cost option to compute universal service support. However, to be done correctly, such a model would require development of cost models for each technology, rather than the simple $10,000 cap on investment assumed in the BCPM. For example, because there is a large fixed cost component of wireless systems, the size of the customer base served by a wireless system will have an effect on the per-customer cost. In addition, any alternative technology modeled would have to be engineered so that it would be capable of achieving the level of service required to receive universal service support, e.g., wireless services would have to be capable of supporting the same

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41 FNPRM at para. 98.

42 Id. at para. 99.

43 Id. at para. 101.

44 Id. at para. 102.

advanced services as the wireline network.[45]

Considering the amount of time it has taken to develop a cost model for wireline service, it is unlikely that the Commission could resolve all issues of model structure and inputs for conventional wireless service, much less for other alternatives such as microwave or satellite in the amount of time available. For the foreseeable future, supported services are more likely to be provided by wireline technologies, with alternative technologies being used only if they prove to be lower cost. Thus, using a wireline-only model for the time being is unlikely significantly to distort the market. The Commission should work on determining models for alternative technologies, but for now can use the wireline model without a cap.

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45 Typically, wireless services deployed on a large scale overseas as an alternative to wireline service support only a fraction of the calling volumes per line handled by the typical United States wireline network.

VIII. CONCLUSION

For the reasons stated herein, the Commission should adopt the Hatfield Model's approach to determining outside plant placement.

Respectfully submitted,

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September 24, 1997

STATEMENT OF VERIFICATION

I have read the foregoing and, to the best of my knowledge, information, and belief, there is good ground to support it, and it is not interposed for delay. I verify under penalty of perjury that the foregoing is true and correct. Executed on September 24, 1997.

Chris Frentrup

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CERTIFICATE OF SERVICE

I, Carolyn McTaw, do hereby certify that on this 24th day of September, 1997, I caused a copy of the foregoing Comments of AT&T Corp. and MCI Telecommunications Corporation to be served upon each of the parties listed on the attached Service List by U.S. First Class mail, postage prepaid.

Carolyn McTaw

Carolyn McTaw

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10/3/97

RECEIPT

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OCT - 3 1997

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

October 3, 1997

Mr. William F. Caton
Secretary
Federal Communications Commission
Room 222
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Washington, D.C. 20554

Re: **CC Docket No. 96-45; Federal-State Joint Board on Universal Service
CC Docket No. 97-160; Forward-Looking Mechanism for High Cost Support for Non-Rural LECs**

Dear Mr. Caton:

Enclosed herewith for filing are the original and four (4) copies of **AT&T Corp.'s and MCI Telecommunications Corporation's Reply** Comments in the above-captioned proceeding.

Please acknowledge receipt by affixing an appropriate notation on the copy of the Comments furnished for such purpose and remit same to the bearer.

Sincerely yours,

Chris Frentrup

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Enclosure

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
	)	
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

REPLY COMMENTS OF AT&T CORP. AND
MCI TELECOMMUNICATIONS CORPORATION

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SUMMARY

Any cost model used to set universal service support should be based on forward-looking criteria, rather than on the local exchange carriers' embedded network. The mix of aerial, buried, and underground plant, and the level of structure sharing with other utilities, should reflect the forward-looking opportunities for these factors, not the LECs' historical deployment.

Distribution and feeder plant are correctly modeled in Hatfield. Even though there is no explicit matching of outside plant to the road network, the Hatfield Model does not under-estimate either the amount of plant or the cost of placing that plant. Similarly, the Hatfield model's assumed drop lengths are reasonable. Estimation of drop lengths would require determination of lot shape and size and placement of the house within the lot, which would require either a tremendous amount of site-specific data or would itself require assumptions about these factors. Thus, the Hatfield Model's approach of assuming drop lengths is a reasonable procedure that is sufficiently flexible for all modeling needs.

Finally, the Hatfield Model installs copper T-1 technology to serve distant customers that otherwise would be served by loops containing more than 18 kilofeet of copper. This technology is the most efficient technology to provide a voice-grade network capable of supporting advanced services. The Hatfield Model correctly engineers its network to incorporate this forward-looking technology, and includes all necessary equipment.

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REPLY COMMENTS OF AT&T CORP. AND
MCI TELECOMMUNICATIONS CORPORATION

AT&T Corp. ("AT&T") and MCI Telecommunications Corporation ("MCI") hereby submit their reply comments regarding outside plant issues in the above-captioned docket.

I. INTRODUCTION

In our initial comments concerning outside plant, AT&T and MCI stated that an appropriate cost model should reflect the forward-looking design of the network required to provide the services that will receive universal service support, i.e., a voice grade network that is capable of supporting advanced services. To meet this requirement, an appropriate cost model would use a plant mix that varies by lines density of the area served and by relative cost of the different types of plant in the terrain of the served area. However, the incumbent local exchange carriers' (LECs') existing mix of types of plant is unlikely to reflect these forward-looking criteria, and should not be used to determine the mix of plant for the cost model. Furthermore, the drop lengths used in the model should be assumed rather than estimated, because this method can assure sufficient accuracy and because precise information about the locations of houses, roads, and empty areas is not available.

The amount of structure sharing used in the model should also reflect forward-looking criteria. The degree of sharing in the incumbent LECs' embedded network reflects merely the sharing decisions made by the LECs when they were faced with the incentives of a monopoly environment. It will substantially understate the forward-looking sharing, given both the increase in incentives to share structures in order to cut costs as competition grows, and the increase in the number of parties with whom to share structure. Finally, the Hatfield Model's use of copper T-1 technology to provision digital quality service to those few distant customers that would otherwise be served by loops containing more than 18 kilofeet of copper is the most economically efficient method of meeting the performance standard that the Commission has adopted for universal service.

In their comments, several parties have questioned these conclusions, or have otherwise claimed that the network as designed in the Hatfield Model is flawed in some manner. We discuss these issues infra.

II. THE MIX OF PLANT IN THE MODEL SHOULD BE BASED ON FORWARD-LOOKING CRITERIA, NOT THE INCUMBENT LOCAL EXCHANGE CARRIERS' EMBEDDED MIX (III.C.2.a. PLANT MIX)

The Hatfield Model allows the user to specify the mix of buried, aerial, and underground plant by density zone. In addition, the Hatfield Model sponsors are developing a method by which the amount of buried and aerial plant can be varied based on terrain factors, such as hard or soft rock. The mix of aerial and buried plant will be determined by the "life cycle" costs (which includes both the "first-cost" and maintenance costs) of the two types of plant, with the model selecting the type of plant based on their relative cost.

Ameritech claims that there are several factors that affect plant mix beyond terrain and population density. Since the incumbent LECs' embedded plant mix is the response to all these factors, Ameritech argues, the embedded plant mix should be considered the forward-looking mix. AT&T and MCI do not agree. The LECs' embedded mix, because it represents decisions they have made over several years, does not represent the decisions that would be made today by a company that is providing the services that will receive universal service support. The Hatfield Model's approach, whereby the relative cost of placing aerial and buried plant will be the prime determinant of the mix, is preferable to an approach that relies solely on the LEC's historical practices.

III. THE HATFIELD MODEL'S TREE AND BRANCH ROUTING OF DISTRIBUTION AND FEEDER ACCURATELY ESTIMATES THE AMOUNT OF PLANT (III.C.2.b INSTALLATION AND CABLE COSTS)

The Rural Utilities Service (RUS) claims that any cost model must reflect the fact that outside plant is placed along roads.[1] Any placement of plant, especially in rural areas, that goes anywhere but in a public right of way will face higher costs

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[1] See Comments of Rural Utilities Service at 2.

for the purchase of that right of way than are currently reflected in the models, the RUS states.

The Hatfield Model sponsors acknowledge that outside plant will typically be placed along roads. However, roads typically head directly toward population clusters. Furthermore, the current Hatfield algorithm for computed feeder and distribution distances, which assumes that feeder plant leaves the central office at the four cardinal points of the V&H compass, and then branches out in a tree and branch structure to reach individual homes, likely overstates the plant that would be placed if the model explicitly followed the roads. In addition, since the Hatfield Model also uses rectilinear routing of cable from the Serving Area Interface to the home, the distribution network should likewise be overstated.[2]

IV. HATFIELD'S ASSUMED DROP LENGTHS ARE REASONABLE (III.C.2.c DROPS)

Since house, road, and empty area locations are not precisely known, the Hatfield Model uses assumed drop lengths, which vary by density zones.[3] Because neither BCPM nor Hatfield determine accurately the amount of empty area in particular customer locations, or where houses are in relation to the roads, there

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2 Rectilinear routing implies a route-to-air distance multiplier of $4/\pi \approx 1.27$.

3 The two least dense zones have user-adjustable average drop lengths of 150 feet, the next two zones have average drop lengths of 100 feet, and the remaining five zones have average drop lengths of 50 feet.

is no need (or capability) to determine drop lengths other than by averages.[4] Ameritech also states that the use of assumed rather than estimated drop lengths is appropriate.[5]

The BCPM Sponsors claim that Hatfield's assumed drop lengths are too short, specifically claiming that an assumed drop of 150 feet on a 3-acre in town lot is too short.[6] No evidence is offered to support this claim. In fact, a 3-acre (130,680 square foot) lot which is twice as deep as it is wide, as is assumed in the Hatfield Model, would be approximately 256 feet wide by 512 feet deep. Given that houses are usually placed closer to the front of the property, especially in towns as assumed here, a 150 foot drop cable is not too short. Indeed, if the setback from the street were fully one third of the depth of the lot, the house would be only 170 feet from the road. Furthermore, setbacks in towns rarely are so high. Thus, Hatfield's assumed drop lengths are not unreasonably short, as the BCPM sponsors claim.

Similarly GTE claims the Hatfield Model's drop lengths are too short, noting that the 1993 New Hampshire Incremental Cost Study by New England Telephone

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4 As explained in our comments, in addition to knowing amount of area held "empty" for parks, interstates, etc. in a service area, estimating drop lengths would require specification of the lot size and shape, the location of the house within the lot, the width of the house, the point on the street from which the drop enters the lot, and the point on the house where the drop is terminated.

5 See Comments of Ameritech at 8.

6 See Comments of Sprint, BellSouth, and US West at 14.

Company estimated an average drop length of 125 feet in that state, rather than the 87 foot average in the Hatfield Model, and claiming that the Hatfield Model's average drop length is 64 feet, whereas the most recent nationwide study of drop lengths gives an average of 73 feet.[7] The estimate of a 125 foot average drop length cited by GTE is not supported in the cost study; it is simply asserted.[8] In addition, 64 feet is the average drop length in Bell Operating Company (BOC) territories in the Hatfield model. In non-BOC territories, the average is 92 feet, giving a total nationwide average of 70 feet. Thus, the Hatfield Model's average drop length is very close to the nationwide average. In any case, the Hatfield Model's default drop lengths are a user-adjustable input, and their accuracy does not change the fact that estimating drop lengths will require either a great deal more data than is currently in the models, or will itself require assumptions about lot shape and size, and location of the lot on the house. Thus, the "estimated" drop lengths in BCPM are not based on actual drop lengths, but are simply the result of assumptions regarding these factors.

V. STRUCTURE SHARING PERCENTAGES SHOULD REFLECT THE POTENTIAL FOR SHARING, NOT THE LECS' EMBEDDED PRACTICE (III.C.2.d STRUCTURE SHARING)

The Commission tentatively concluded that 100% of buried and 66% of underground and aerial installation costs should be assigned to the telephone

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7 See Comments of GTE at 6.

8 "The typical drop wire is 125 feet in length." New Hampshire Incremental Cost Study, p. 27 (emphasis added).

company. Several parties supported this conclusion, claiming that sharing of plowing is not done,[9] that sharing is less likely to occur in rural areas,[10] or that sharing of buried structure requires utilities to coordinate their placement of plant.[11]

In our previous comments on this issue, AT&T and MCI cited extensive record evidence that in fact there is substantial sharing of all types of plant, including buried.[12] That evidence shows that most telephone companies today are overcoming the purported difficulties of coordinating their placement of buried plant.[13] As we stated in our comments, the sharing percentages adopted in the model should reflect forward-looking opportunities and incentives to share.

The incumbent LECs' current level of sharing represents merely the sharing that occurred when the LECs faced a monopoly environment. As the Florida PSC notes, there should be more sharing of structure in the future.[14] In fact, sharing should rise in all areas, rural as well as urban, both because of the greater incentives to reduce costs and because of the increase in the number of entities

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9 See Comments of Florida PSC at 7.

10 See Comments of Rural Utilities Service at 5-6.

11 See Comments of Sprint, BellSouth, and US West at 15-16; GTE at 8.

12 This evidence included, inter alia, a photograph of a cable plow placing simultaneously two cable sheaths.

13 As the attached article shows, buried structure sharing is practiced by utilities - even if monopoly telephone companies choose not to avail their ratepayers of its potential cost savings. See Attachment A.

14 See Comments of Florida PSC at 8.

with whom to share structure costs.

Moreover, the Telecommunications Act of 1996 explicitly contemplates the sharing of outside plant structures. The Act modified § 224 of the Communications Act to require attachers to pay for two-thirds of the non-usable space on poles, ducts, conduits, and rights-of-way. 47 U.S.C. § 224(e). This requirement, then, implies that Congress believed three parties on average would be using an incumbent LEC's outside plant structures and provides compensation for use of these structures under this assumption. If the selected cost model assumes no cost sharing or even that only two parties share these structures, incumbent LEC's will over-recover the costs of these structures. The efficient level of compensation will arise if an efficient level of structure sharing is built into the selected cost mechanism and the Commission ensures that its cost model requirements are consistent with § 224 of the Communications Act.

VI. THE COMMISSION SHOULD ADOPT A PERFORMANCE RATHER THAN A NETWORK STANDARD (III.C.2.e.(1) & (2) FIBER-COPPER CROSSOVER POINT & LOOP STANDARDS)

In their comments, AT&T and MCI supported the use of a performance standard rather than a network standard, because doing so would allow the cost model to reflect the most economically efficient way of providing a desired level of service. Aliant also supports this approach.[15] However, GTE urges the

15 See Aliant Comments at 4.

Commission to adopt the Carrier Serving Area (CSA) network standard.[16] While noting that an 18,000 foot copper loop, as allowed under the Revised Resistance Design (RRD) rules, will support the provision of some advanced services, GTE claims that "at least one commercially available 1.544 mbps high density subscriber line ("HDSL") product constrain[s] copper loops to 12,000 feet of 24-gauge cable or 9000 feet of 26-gauge cable." Because this limitation is similar to the limitation imposed in the CSA standard, GTE argues, CSA should be selected as the network standard.

As a threshold matter, it should be recognized that CSA is a planning "concept", not a standard.[17] Furthermore, GTE is incorrect on two counts. First, while it may be true, as GTE claims, that one commercially available HDSL product has this constraint, HDSL is available for longer loops. Second, the Commission has determined that the network to be reflected in the cost model for universal service support is a network capable of providing voice grade service while allowing provision of advanced services. If the LECs are deploying a network that provides service above that level, then the extra-capability services supported by that more advanced network are the cost-causers of that additional network performance.

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16 See GTE Comments at 11-12.

17 See Bellcore, Telecommunications Transmission Engineering, 1990, p. 94; Bellcore, BOC Notes on the LEC Networks - 1994, p. 12-5, and; AT&T Outside Plant Engineering Handbook, August 1994, p. 13-1. These sources still advocate the use of Rural Allocation Areas where appropriate, rather than CSA.

The Universal Service Fund should not be increased so that the LECs will be able to receive a subsidy to provide additional services, such as video dial tone, which are beyond the level of service intended to be subsidized. As GTE itself acknowledges, an 18,000 foot copper loop will support advanced services. The Commission should not require the network for the cost model to be designed to a specification that exceeds the level needed to provide the services it has decided require universal service support.

Two other parties make claims concerning the design of copper loops that are incorrect. First, the BCPM sponsors claim that, "[g]iven the mix of services provided by telephone companies, 12,000 feet is the electrical limitation of 26 gage [sic] copper".[18] The current mix of services provided by telephone companies is irrelevant to the design of the network for the universal service cost model. The service to be subsidized is voice grade service, provided over a network capable of supporting advanced services. As the BCPM sponsors acknowledge, use of copper at lengths of up to 18,000 feet will be possible, without requiring the use of load coils.[19] Thus, the use of these long copper loops will provide the level of service which the universal service fund is intended to support.

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18 See Comments of Sprint, BellSouth, and US West at 15-16; GTE at 16 (emphasis added).

19 Ibid. The Commission determined that the use of load coils would prevent the use of modems. AT&T and MCI have filed evidence, cited in our comments at footnote 35, that loops with load coils will support high-speed modems.

Second, Bell Atlantic claims that underground copper requires splicing every 600 feet, and that therefore the Hatfield Model's default assumption of 2000 feet between pullboxes is excessive.[20] The 2000 foot distance between pullboxes applies only to fiber feeder. For copper feeder, the Hatfield Model 4.0 uses manholes, which are spaced between 400 and 800 feet apart, depending on population density. The maximum length of 4200 pair cable on a standard 420 Type reel is 931 feet. Thus, Bell Atlantic's claim that 600 feet is the maximum distance possible between splices on copper cable is incorrect.

VII. THE HATFIELD MODEL'S COPPER T-1 TECHNOLOGY IS THE MOST EFFICIENT DESIGN FOR A NETWORK THAT PROVIDES THE SERVICES THAT ARE ELIGIBLE FOR UNIVERSAL SERVICE SUPPORT (III.C.2.e(3) DIGITAL LOOP CARRIERS)

The Hatfield Model uses copper T-1 technology to provide digital quality service to distant customers in those rare cases (much less than 1 percent of total loops) in which the copper portion of loops exceeds 18 kilofeet. Some parties claim that this T-1 technology is not the forward-looking method of providing service to these distant customers.[21]

Before deciding to use copper T-1 technology, the Hatfield sponsors examined various alternatives to serve those long loops, including use of fiber-fed Digital Loop Carriers (DLCs), HDSL, and copper T-1s. Based on that analysis,

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20 See Comments of Bell Atlantic at 4-5.

21 See Comments of Sprint, BellSouth, and US West at 17; GTE at 10; Rural Utilities Service at 4.

Hatfield's designers determined that copper T-1 technology was the most economically efficient option for provisioning the services to receive universal service support. Therefore, copper T-1 technology should be used in the cost model regardless of what companies are currently installing, i.e., if companies are installing some other, higher cost technology that is not needed for a network that can provide voice grade service while being capable of supporting advanced services, the universal service fund should not be used to subsidize that market decision by the LECs.

GTE claims that the Hatfield Model's T-1 loop design is technically flawed in two respects: (1) repeaters are placed every 6000 feet, while the maximum allowable distance for 24- and 26-gauge cable is 5000 and 4000 feet, respectively; and; (2) Hatfield's use of up to 12 repeater segments results in a cumulative line span resistance of 11,251 ohms, whereas the maximum line span resistance for T-1 is 8,456 ohms.[22]

These two claims are incorrect. While sources differ slightly on the maximum allowable cable loss at 772 kHz (from 31dB to 35dB), the standard normally used by outside plant engineers is 32dB of loss between repeaters. A 24 gauge buried filled cable has a standard loss of 5.0 dB/kilofoot, and aerial air core cable has a standard loss of 5.8 dB/kilofoot.[23] Since the Hatfield Model defaults to

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22 See Comments of GTE at 10.

23 AT&T Outside Plant Engineering Handbook, August 1994, p. 5-14

75% buried and 25% aerial in the three lowest density zones where this situation will be encountered, an average repeater spacing of 6,000 ft. is appropriate (32dB/{.75 x 5.0 + .25 x 5.8}= 6,154 feet).

GTE's statement that the maximum T-1 "line span" resistance is 11,251 ohms is nonsensical. The maximum T-1 distance in the Hatfield Model is 12 18,000 foot segments, or 216,000 feet. Using 24-gauge wire pairs, the total cable resistance is about 5,545 ohms, not 11,251 ohms as GTE claims. The Hatfield Model sponsors can only assume that GTE is attempting to refer to resistance as it pertains to line powering of the repeaters. What GTE has failed to note is the fact that the 24-line T-1 digital loop carriers used in the Hatfield Model are spaced at 36 kilofoot intervals, and are supplied with commercial power. This would result in a maximum copper line distance of 18 kilofeet with resistance of 934 ohms from the powering T-1 DLC source to the farthest repeater from that source.[24]

GTE also claims that the Hatfield Model leaves out several pieces of equipment necessary for provisioning DLCs. First, they claim the model incorrectly excludes the use of controlled environmental vaults (CEVs) for DLCs.[25] The Hatfield Model excludes CEVs because they are not necessary for modern DLC electronic equipment. Use of air-conditioned CEVs was necessary only for early fiber optic multiplexers, the lasers in which presented a problem of heat dissipation

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24 Powering of T-1 repeaters from both directions is common in interoffice design, and has been adopted by the Hatfield modelers.

25 See Comments of GTE at 13.

and burn-out. As laser technology has developed, air conditioning is no longer necessary to protect the lasers from overheating. In fact, DLCs are routinely installed today without the use of CEVs, and so there is no need to include a CEV in the model.

Second, GTE claims that neither the Hatfield Model nor the BCPM uses small (12 to 96 line) fiber-fed DLCs.[26] In fact, the Hatfield Model does use small DLCs, of an initial potential capacity of up to 96 lines. However, it equips these DLCs only with the number of line cards needed to meet the expected demand. Due to the efficiencies and expandability of such an arrangement, the small DLCs installed in the Hatfield Model represent the most economically efficient use of DLCs, when computed on a life-cycle cost basis.[27]

Third, GTE claims that the demultiplexing arrangement used on the Hatfield Model's integrated DLC (IDLC) loops is not yet commercially available, nor has the industry reached consensus on how it should be implemented.[28] GTE is incorrect. The technology used in the Hatfield Model is based on Bellcore generic requirements GR-303 for Integrated Digital Loop Carrier. It is commercially available, it is the forward-looking technology, and it is the technology all LECs are currently deploying on a forward-looking basis.

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26 Ibid.

27 In addition to the use of these small fiber-fed DLCs, copper T-1 fed 24-line DLCs are also used as a cost effective measure on long loops.

28 See Comments of GTE at 13-14.

Finally, GTE states that hand-off at the DS-0 level, as required in some interconnection arrangements, may require the use of some universal DLC (UDLC) in IDLC central office terminals. According to GTE, the Hatfield Model inappropriately excludes the common and per-channel costs associated with this combined IDLC/UDLC configuration. The Commission has already found that it is technically feasible to unbundle IDLC-delivered loops.[29] Thus, there is no need to have combined IDLC/UDLC configurations, as GTE avers.

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[29] See Implementation of the Local Competition Provisions of the Telecommunications Act of 1996, CC Docket No. 96-98, First Report and Order, 11 FCC Rcd 15499, 15692 (para. 384)(1996).

VIII. CONCLUSION

For the reasons stated herein, the Commission should adopt the Hatfield Model's approach to determining outside plant placement.

Respectfully submitted,

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October 3, 1997

<u>**STATEMENT OF VERIFICATION**</u>

I have read the foregoing and, to the best of my knowledge, information, and belief, there is good ground to support it, and it is not interposed for delay. I verify under penalty of perjury that the foregoing is true and correct. Executed on October 3, 1997.

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ATTACHMENT A

Business Plus

DAILY CAMERA Monday, September 29, 1997 SECTION D

MARTY CAIVANO / Daily Camera

Steve Young, construction manager at Rugby Row Condominiums, 3663 Iris Ave. in Boulder, shows exposed phone wires slithering through the condo development spearheaded by his brother, Mark Young.

Telephone troubles

■ With its service record, can US West compete?

By TOM LOCKE
Camera Business Writer

Competition is gradually making its way into local phone service in Boulder County. Is US West ready?

Not according to Mark Young. He's about halfway through developing 12 new condominiums at 3663 Iris Ave. in Boulder, and his project is served by tangles of phone wires that are lying on the ground, tied to a fence and wrapped around trees.

He has been battling for 2½ years with US West to resolve the problem, which arose when representatives from US West failed to show up to join other utilities in laying their lines through a common ditch. The ditch eventually had to be covered, and US West has refused to uncover it to bury its phone lines. So lines snake through the development and get cut about once a week by construction equipment, Young says.

It's not a typical US West installation, but Young believes his problems are indicative of something fundamentally awry with the telephone giant, something that may prove damaging as it tries to respond to new competition.

"The bureaucracy that I've had to

See PUC / Page 12

From Page 1

deal with there suggests that they'll be slow to respond," says Young. If a competitor comes along that will provide alternative service, he says he'll switch, even if it costs more for service.

"I would go with a competitor right now because of the way I've been treated there," he says.

A recently released consumer assistance summary by the Colorado Public Utilities Commission shows that the Englewood-based telephone company has improved its service in Colorado over the last several years, dramatically in some instances. But the numbers also show that U S West continues to have a significant problem with customer service.

And Boulder County has more than its fair share of the problem. "Held-orders" — orders for new phone service not provided when the customer requested it — are one measure of customer service, and Boulder County had a per capita held-order rate for the fiscal year ending June 30 that was nearly twice the rate for the state as a whole.

Dian Callaghan, administrative director of the Office of Consumer Counsel, the state consumer advocacy agency, said Boulder County had 91 of of the state's 765 held-orders for new service last fiscal year. That's about 12 percent of the state's held-orders, while Boulder County's population of 256,000 is 6.5 percent of the state's population.

Numbers prepared for the Daily Camera by the PUC show that, for the fiscal year ending June 30, consumer contacts with the PUC were more than 10 times higher for U S West than for electric and natural gas provider Public Service Company of Colorado (see chart). Contacts for U S West totaled 361 in the county, compared with 29 for Public Service, and a city-by-city breakdown shows the large difference to be uniform across all cities.

In addition, only 16 percent of contacts concerning U S West were attributed to informational requests, as opposed to objections about rates or services. Of the Public Service total, 52 percent of the contacts in Boulder County were informational.

U S West spokesman David Beigie emphasizes that the telecommunications industry is a fast-changing arena, so a comparison with Public Service may not be justified. U S West has to keep up with demand for second or third lines, new features, data transfer and other complexities that make comparisons with other utilities difficult, he says.

In addition, U S West has 2.3 million access lines in Colorado, he says, and total customer objections to rates and services "are a very small percentage of our customer base." For fiscal 1997, statewide objections totaled 2,448, or about 0.1 percent of total customers.

That may seem small, unless you're one of the people falling in that percentage.

Take Marcia Greiner, president of Lafayette-based Our Kids Ltd., a maker of sidewalk chalk and other creative playthings for kids.

On April 4, she was told by a U S West representative that the phones at her new 28,000-square-foot Lafayette building at 1400 Overlook Drive were ready. An April Fool's Day notification would have been more appropriate, because when she moved her business she found that the phone lines weren't installed.

On hold

When she tried to find out what happened she: was put on hold for 25 minutes at a time; was continually shuffled around without getting her concerns met, questions answered, or calls returned; and finally was able to get service only after complaining to the PUC.

She figures her out-of-pocket damages for the lack of phone service — including extra rent at her old spot, cellular phone use, and driving — at $5,000 to $7,000. If a competitive service were available to her, she says, she would switch "in a heartbeat, with gleeful joy."

But U S West can point to some significant improvement in certain areas of measuring service quality. One is the column of the new PUC summary that displays service complaints that are "not in compliance" with state regulations. Those "not in compliance" complaints dropped by more than three-quarters between fiscal year 1996 and fiscal year 1997, from 1,714 to 454 (see chart).

And U S West spokesman Beigie points to the company's decline in held-service orders. Those numbers declined by 50 percent between the end of calendar 1995 and the end of calendar 1996, he says, and the company will post further improvement in 1997. He says they show that "our service has improved significantly over last year, and even more so over the past few years."

Bruce Smith, director of the PUC, also emphasizes US West progress over time. "Over the last eight months to a year, we've seen some improvements," he says.

After re-engineering efforts cutting thousands of jobs were instituted in 1994, U S West's service quality problems accelerated. Eventually the problems led to a "show-cause" order, the initial stage of an investigation, and the investigation led to U S West's paying $5.3 million in reparations because of poor service quality. The 1995 payments went to grants for health, medical, telecommunications and education projects.

Last fall, the PUC began a similar process by sending U S West a show-cause letter spurred by poor service quality. But after the company presented evidence of improvement in service, the PUC decided in the spring not to follow with a show-cause order. The PUC's Smith stresses that move as evidence the PUC has become more satisfied with U S West's improvement in complying with service quality rules.

But does compliance with rules tell the most accurate story? Not according to Consumer Counsel's Callaghan. From the consumer's point of view, the more appropriate category to measure is "objections to rates or services," she says, because it "really says how satisfied consumers are with services they are receiving."

In that area, U S West is clearly suffering (see chart). The 2,448 Colorado objections to US West rates or service for fiscal 1997 were down by only 27, or 1.1 percent, from fiscal 1996. And the latest numbers show that total objections are six times higher than the objections recorded five years earlier, in fiscal 1992.

U S West's Beigie says the latest numbers may have been boosted by people objecting to U S West's failed request for a rate rebalancing that included a $3 monthly increase in residential service.

But Callaghan points out that contacts concerning rate filings or rates totaled only 47, or 2 percent of the 2,448 contacts. In comparison, 49 percent of all objections recorded against U S West were for either held orders, which totaled 765, or repair complaints, which totaled 434.

"U S West's service is improving, but it still needs a lot of work, especially in the area of repair and held-orders," says Callaghan. There has been "some improvement in both held-service and repairs, but the number of complaints is still way too high."

Some of those complaints came from Kevin Wenzel, director of network operations for Louisville-based Internet service provider privatel LLC. "It's pretty much where you have to complain to the PUC to get it installed on time," he says.

His company put in an order for a high-speed, high-capacity "T-1" line to connect to the Internet backbone in July of last year. Installation was to be in September, and by Novem-

Boulder County

Boulder County consumer contacts with the Colorado Public Utilities Commission concerning U S West and Public Service Co.

Fiscal year ending June 30, 1997

	U S West	Public Service
Boulder	185	22
Longmont	67	4
Louisville/Superior	39	1
Lafayette	19	2
Lyons/Nederland	32	0
Niwot	19	0
Total	361	29

Note: Of the above customer contacts, three for US West and four for Public Service are designated as objections to rate filings. Of the total 361 U S West contacts, 58 (16 percent) were information rather than objection calls. Of the total 29 Public Service contacts, 15 (52 percent) were attributed to information rather than objections.

Source: Colorado Public Utilities Commission

Colorado

Colorado PUC Consumer Assistance Summary - fiscal years 1991-92 through 1996-97
US West numbers only — statewide

Fiscal Years Ending June 30	Consumer Contacts	Utility in Compliance	Utility not in Compliance	Objections to Rates or Services
1997	3,501	not avail.	454	2,448
1996	4,940	41	1,714	2,475
1995	4,838	223	2,143	1,913
1994	3,126	347	810	1,127
1993	2,609	427	695	625
1992	2,235	121	474	401

Note: Fiscal years are for July 1 through June 30.
Source: Colorado Public Utilities Commission

ber Wenzel was complaining to the PUC that the line hadn't been installed. The next month privateI finally got its line.

But by that time, the company had lost three or four potential customers who mentioned the lack of a back-up line as a reason they opted not to choose privateI. They might have brought in $200 to $1,000 a month in business, Wenzel says.

In another instance, he noticed that he was getting usage out of only 16 of 24 lines in a "hunt group," in which calls were supposed to be automatically routed to unoccupied lines. After two days of inquiries, U S West finally admitted that its local switch was not capable of hunting past 16 lines, he says. Customers were getting busy signals as they tried to access the Internet through privateI, Wenzel started getting a "little freaked," and the problem was finally fixed — after a complaint to the PUC.

Now, privateI is getting most of its services through Englewood-based ICG Communications Inc.

"ICG has been a lot better to work with," Wenzel says. It's not perfect, he adds, but service is superior, and pricing is "worlds better" than U S West in all but one category — "frame relay" transport of data.

New competition

PUC spokesman Terry Bote says ICG is one of four providers in Colorado that have received full approval from the PUC. The other three are New York-based Teleport Communications Group Inc., which in January became the first competitor to offer local dial-tone service in Boulder-Denver; MCImetro, a subsidiary of Washington, D.C.-based MCI Telecommunications Corp.; and Cedar Rapids, Iowa-based McCloud USA, which hasn't started service yet.

More than a dozen other companies have received operating certificates but haven't finalized pricing, so they're not yet permitted to operate.

Cindy Schonhaut, spokeswoman for ICG, says her company is concentrating on business service. It technically offers residential service by reselling U S West service, but it is not marketing it. She says ICG offers better quality, lower prices and better service than U S West, but it faces an uphill battle against the entrenched giant.

MCImetro is offering local service to large and medium-sized businesses in Boulder and Denver but has not yet started residential service. For a Boulder business to use the service, it would need to lease a high-capacity line to Denver to connect with MCI's switch and fiber-optic rings there. Typically, a business would need at least 20 lines to make that change from US West economical, says Bill Levis, director of public policy for MCImetro in Denver.

MCI is touting its customer service advantages over U S West, including a single person to contact about problems and single billing for long distance, local, Internet access, wireless and data services. It also trumpets its 24-hour-a-day, seven-day-a-week customer service. Those advantages have been paying off in the 25 markets in the country where it offers local service, says spokesman Steve McAbee. Since January, its minutes of local calls per day have increased seven-fold, from 2 million to 14 million, he says.

MCI has been delayed in offering local service to Colorado residents and small businesses because of problems in the interface with U S West. It wants computer-to-computer communication with U S West for switching customers and hopes US West will have that capability by the end of this year.

TCG, which is 31 percent owned by cable TV company Tele-Communications Inc., also offers competitive service in Boulder County, concentrating on the business market.

In November, McCloud USA will begin offering resale of U S West service to businesses and residents in Pueblo, Fort Collins, Greeley and Loveland. Key to its marketing will be the inclusion of three free features — three-way calling, call transfer and consultation hold — in its local service. McCloud will expand to Boulder some time next year, says spokesman Justin Saylor.

Jumping ship

As competition accelerates, US West's main advantage will be customer inertia, says Terry Parrish, strategist for Communications Technology Management, a Berthoud-based telecommunications advisory firm. But there are those who will switch.

"I think most of the people tell me that, when they get the chance to go to Jones Telephone, they'll jump ship," Parrish says. "Whenever I get the chance, I certainly will."

He projects that U S West might have less than half of the total market share for local phone service in its territory in 10 years. "I just think people are tremendously frustrated by the past performance of US West," he says.

What has caused U S West's customer-service problems?

Parrish blames it on the company's recent history of re-engineering and layoffs, first announced in 1993. "When your quality of service is so low, and they opt to lay off people when their quality of service is so bad, that tells me they are more interested in profit than quality of service," says Parrish.

Callaghan also emphasizes the recent cuts. "They re-engineered and downsized while demand increased for phone service," she said.

Those huge shifts translated into problems for certain customers, some of whom are still not happy. Condo developer Young continues to live with his own small battle on Iris Avenue. The ditch that Public Service dug continues to be occupied only by gas, electric and cable TV lines. Young's own condo has five lines, and U S West has been out to fix them twice in the last month.

At one point, he almost relented. He was about to pay the $600 to $800 necessary to open up the trench. But U S West told him it would not guaranteee a date to show up, so he refused to sign a contract.

"I decided to dig in my heels and not put in the trench," he says.

Not too long ago, he got a promising call from a U S West representative in Phoenix. The rep checked things out and then called Young back. U S West would open the ditch and put in the service in two weeks. Eureka. "I was touting it as quite a victory," Young says.

But the man promised installation in two weeks. That was more than three weeks ago. No one has appeared. ■

CERTIFICATE OF SERVICE

I, Carolyn McTaw, do hereby certify that on this 3rd day of October, 1997, I caused a copy of the foregoing Comments of AT&T Corp. and MCI Telecommunications Corporation to be served upon each of the parties listed on the attached Service List by U.S. First Class mail, postage prepaid.

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Before the
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In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
	)	
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

COMMENTS OF AT&T CORP. AND MCI TELECOMMUNICATIONS CORPORATION ON DESIGNATED INPUT AND PLATFORM ISSUES

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October 17, 1997

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SUMMARY

Unlike the BCPM, the Hatfield Model is open and verifiable, and AT&T and MCI have already demonstrated the superiority of Hatfield's algorithms to the Commission. The following comments further illustrate that the input values employed by Hatfield's designers are reasonable and forward-looking. Consequently, the Commission should adopt the Hatfield Model and not attempt to created a hybrid cost mechanism that would depend on the cooperation of rival model designers and require a tremendous effort to overcome the inevitable software difficulties.

AT&T and MCI show in Section II that the Hatfield Model adopts accurate forward-looking values for a host of distribution and feeder inputs. The current version of the Model already uses accurate values for outside plant mix, feeder and distribution material and installation costs, drop costs, structure sharing, DLC costs, manhole costs, pole material and installation costs, NID costs, SAI costs, and cable fill factors. The next release of the Model will use a dynamic structure allocation process and other improvements that will further enhance the efficiency of the outside plant mix and allow for more economic determinations about which structures are shared, under what conditions, and how costs are impacted by factors such as terrain. Furthermore, because of the stability of universal service demand, the Commission may wish to increase the default cable fill factors which were set conservatively for UNE cost determination and may be inappropriately low for universal service cost estimates.

Section III revisits the switching, interoffice, trunking, signaling, and local tandem service issues discussed in the first round of comments. AT&T and MCI demonstrate that the switch capacity constraints reflect actual switch capacities and that the Hatfield switch cost curve is the best estimate of switch prices actually paid by incumbent LECs. They also show that (i) switch

costs should not include alleged "growth line" costs, (ii) 30% of switch investment should be allocated to the port until the Commission makes a final determination pursuant to its Access Charge Reform Order, and (iii) the interoffice trunking, signaling, and local tandem service inputs are conservative and permit the user wide latitude to make any necessary adjustments.

As Section IV demonstrates, the Hatfield Model uses weighted averages of the Commission's asset lives. It would be inappropriate to shorten those lives because they reflect all anticipations of the competition that may be faced by incumbent LECs. Moreover, any more rapid technological obsolescence that does occur will most likely reflect broadband initiatives, not forward-looking narrowband technologies. Competition may actually increase asset lives for basic telephone assets because service providers will have increased incentives to earn the greatest profit from the network components they have already deployed.

AT&T and MCI show in Section V that the Hatfield Model estimates the expenses an efficient universal service provider would incur. Most of the Model's calculation use historic incumbent LEC data as a starting point for determining forward-looking costs. For example, GSF expenses are estimating by determining the ratio between investment in a particular GSF account and total network investment. These same ratios are then applied to the forward-looking, universal service network investment as determined by the Hatfield Model in order to calculate the expenses in that account that an efficient universal service provider would be likely to incur. Similar techniques are used to estimate plant specific, plant non-specific, customer service, and corporate operations expenses.

Then in Section VI, AT&T and MCI demonstrate that the more expedient approach to completing the forward-looking model development process initially is to avoid annual adjustments for inflation and productivity. Instead, the selected cost mechanism should be rerun periodically with adjustments made to any of the input values that have changed in the interim. Given the high productivity gains the Commission has found in other proceedings and the fact that the cost of capital assumes anticipated inflation, this approach will ensure more than sufficient compensation for incumbent LECs as well as incent local service providers to lower their costs and earn higher profits until the model is reassessed.

Section VII explores the importance of defining universal service support areas as coincident with the areas used to price unbundled network elements. If these areas are not the same, service providers will be given an incentive to cherry-pick some customers and avoid serving others altogether. For example, if the universal service area encompasses more than one UNE pricing area, service providers may not want to serve high cost customers. At the same time, if a UNE pricing area encompasses more than one universal service support area, then service providers may not find it desirable to serve low cost customers. In addition, if the universal service support area is too large, the universal service mechanism will become a barrier to entry rather than a method of providing affordable basic telephone service. If a state defines an unnecessarily large universal service support area, the Commission should adopt smaller support areas such as those contained in the Hatfield Model to minimize anticompetitive consequences.

Finally, in Section VIII, AT&T and MCI urge the Commission to adopt a local usage component of universal service that is technologically neutral. If, on the other hand, the local usage requirement is set too high, some technologies like wireless may be unable to provide universal service thereby reducing consumer choice and undermining competition.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

**COMMENTS OF AT&T CORP. AND
MCI TELECOMMUNICATIONS CORPORATION
ON DESIGNATED INPUT AND PLATFORM ISSUES**

Pursuant to the Commission's Further Notice of Proposed Rulemaking,[1] AT&T Corp. ("AT&T") and MCI Telecommunications Corporation ("MCI") hereby submit their joint comments with respect to the designated issues concerning various input values and the remaining aspects of platform design. These comments address Sections III.B.3, III.C, III.D, IV and V as directed by the Commission in its Notice.

INTRODUCTORY STATEMENT

As AT&T and MCI demonstrate in these comments, the Hatfield Model uses verifiable, reasonable, forward-looking input values in estimating universal service costs. In fact, the default values included in Hatfield err on the side of cost inclusion rather than exclusion. For example,

[1] Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45, 97-160, Further Notice of Proposed Rulemaking (released July 18, 1997) ("FNPRM").

the Model's designers adopted span lengths between distribution poles that are shorter, and therefore more costly, than the spans incumbent local exchange carriers ("LECs") typically achieve. Similarly, for cable fill factors the default values were chosen principally for unbundled network element cost estimation, not calculation of universal service costs. Pricing unbundled network elements requires allowance for less stable demand, which occasions somewhat lower cable fill factors and higher expenses than for universal service. As a result, the Commission may find it justifiable to increase the cable fill factor input values to model the lower costs associated with the provision of universal service.

Despite the superiority of Hatfield's inputs to those of any other model or study, AT&T and MCI do not believe that input values alone are sufficient to select between the BCPM and Hatfield. Users can adjust the inputs. What users cannot change, however, are the algorithms and assumptions that underlie a model. Hatfield's designers have continually improved the Model's platform characteristics, particularly in response to feedback received from the Commission. As much as possible, they have constructed the Model to allow examination by industry participants of its algorithms and explore how universal service costs are estimated.

By contrast, the BCPM sponsors continue to rely on proprietary information. And the model's documentation has been insufficient to determine what input values are used, much less why they were selected. The BCPM sponsors have made claims about future versions of their model, but many details are vague and the model is not yet delivered. Thus, the parties in this proceeding have been forced to comment on the February 1997 version of the BCPM presently available or draw tentative conclusions based on sponsor descriptions of the next version that may bear little similarity to the existing one. This potential lack of similarity, nevertheless, does not guarantee that the new release will be any better than the current one at estimating forward-looking costs. What is certain about the BCPM is that it will attempt to cling to embedded network characteristics and remain largely a black box dependent on proprietary information. Hatfield's flexibility, openness, modularity, and forward-looking design make it the superior choice.

I. ATTEMPTING TO COMBINE ASPECTS OF THE HATFIELD AND THE BCPM MODELS COULD PRESENT SIGNIFICANT DIFFICULTIES AND WOULD BE INFERIOR TO USE OF THE HATFIELD MODEL ALONE.

The Commission has asked parties to comment on the ramifications of combining features of the Hatfield Model and the BCPM. FNPRM ¶ 37. AT&T and MCI strongly believe that adoption of the Hatfield Model would be far superior to adopting some hybrid version of the two models. As AT&T and MCI have demonstrated in the preceding rounds of comments, the Hatfield Model is superior to the BCPM in every important respect identified by the Commission in the Notice, including customer location, outside plant cost, loop design and switching and interoffice cost estimation. Moreover, ordering a hybrid model would be a very risky strategy. As the parties and the Commission have witnessed over the past two years, the difficulties associated with complex cost modeling are not limited to defining engineering and other parameters on paper. Rather, very significant difficulties often lie in designing, programming and testing reliable, flexible, and easy-to-use model software. It is unclear precisely how much work would be required to patch various aspects of the two models together, but it would be substantial. And because it would be difficult to achieve full cooperation among model developers until after the Commission makes its model choice, the "hybrid" approach could delay significantly the universal service costing process.[2] Finally, there is in all events little to be gained by combining given that the Hatfield Model has been demonstrated to produce the BCPM results by adjusting a number of its significant input values.[3] In contrast, the developers of the BCPM appear to have been unable to demonstrate similar flexibility in their model. Accordingly, if the Commission nonetheless adopts the combination approach, it should avail itself of the open, modular design of the Hatfield Model and use it as the primary vehicle for universal service cost calculation.

II. THE HATFIELD MODEL ADOPTS REASONABLE, FORWARD-LOOKING DISTRIBUTION AND FEEDER DEFAULT VALUES.

A. Outside Plant Mix Inputs

The Hatfield Model allows the user to specify separately the percentages of aerial, buried and underground plant for both distribution and feeder plant by density zone. The default percentages for both types of plant are supported in the Hatfield Inputs Portfolio ("HIP") that was filed as documentation with the original Hatfield Model Release 4.0 and is also attached to this filing as an appendix.[4] The default distribution plant mix reflects the increasing use of buried plant in new subdivisions due to the improved waterproof-cladding of cable, the greater reliability of

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[2] Furthermore, because both the Hatfield Model and the BCPM have been submitted in state proceedings, their developers may be hesitant to combine them unless state regulators follow a similar course of action.

[3] See Letter from Richard N. Clarke to William F. Caton, Ex Parte Presentation - Universal Service: CC Dockent No. 96-45, Access Reform: CC Docket No. 96-262, filed April 1, 1997.

[4] See Letter from Richard N. Clarke to William F. Caton, Ex Parte Presentation - Proxy Cost Models, CC Docket No. 97-160, filed August 5, 1997.

splice closures for buried plant, and the aesthetic and safety reasons for the community preference of buried plant. In the two densest urban zones the Hatfield Model 4.0 assumes a higher proportion of both Intrabuilding Network Cable and of cable attached to the outsides of buildings. For these reasons, the percentage of "aerial cable" for distribution increases in those two zones. The mix of feeder plant also reflects the increasing use of buried plant. However, since feeder plant is not normally attached to the outside of buildings but is terminated at an indoor Serving Area Interface ("SAI"), the percentage of aerial feeder cable falls, and the percent of underground cable rises, in the densest urban zones.

To date, the Hatfield Model has relied solely on these user-variable inputs that do not vary by local terrain characteristics to determine the plant mix. However, as the Commission notes, an efficient carrier should base its decision on whether to install aerial, buried, or underground cable on the relative costs of those types of installation, including the different "first-cost" and maintenance expenses that are expected to result from the different choices. As AT&T and MCI noted in their previous comments, the next release of the Hatfield Model will incorporate an optimization process whereby the model will, by comparing the lifetime costs of aerial and buried plant, and adjust the selected mix of these types of plant toward the plant type that displays a lower relative cost. The user will be able to input, by density zone, the percentage of plant which should be underground, buried, and aerial, assuming typical terrain conditions, and the percentages of aerial and buried plant which are "at risk" for shifting to the other type based on relative cost shifts that may arise from atypical terrain conditions.[5] The exact percentage of "at-

[5]As currently envisioned, the model will not allow plant to be shifted into or out of the underground category, because the percentage of underground plant is primarily determined by factors other than terrain-related relative cost, such as the constraints of providing service in an (continued. . .)

risk" plant in a particular geography that will be shifted will then depend flexibly on the relative life cycle costs of aerial and buried plant in the terrain conditions of that geography.

B. Feeder and Distribution Inputs

Hatfield Model 4.0 already meets the Commission's criteria for computation of material and installation costs for feeder and distribution plant. Specifically, installation costs can be varied by terrain and density zones, and installation costs in difficult terrain are increased, rather than installing longer cable to route around the difficult terrain as in previous versions of the Hatfield Model.[6] Finally, Hatfield Model 4.0 includes costs per foot of conduit installation that vary by density zone. Support for the default input values for materials and installation costs is contained in the HIP. HIP at 9-67.

The Commission asks whether national statistical averages of construction prices can be used to verify installation costs, and whether a labor cost variable should be included in determining these costs. In support of the default values used, the HIP cites public sources for data on contractor prices, which contain tables of state specific adjustment factors.[7] The Hatfield Model contains a labor adjustment factor which set to one by default, but could be populated by a

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(. . . continued)
urban environment, where aerial plant may be limited by law or regulation and buried plant is not desirable because of streets and sidewalks.

[6] Hatfield Model 4.0 also retains the option of adding cable to go around the difficult terrain if the modeler wishes.

[7] HIP at 30-32., citing Martin D. Kiley and Marques Allyn, eds., 1997 National Construction Estimator 45th Edition, pp. 12-15, and Square Foot Costs, 18th Annual Edition, R.S. Means Company, Inc., 1996, p. 429-433. These factors show that labor rates vary by state, with the most expensive state having labor costs almost two and a half times the labor costs in the least expensive state.

table of variable adjustments. That factor applies to the labor component of the installation of buried cable, conduit, manholes, fiber pullboxes, copper and fiber cable, Service Area Interfaces, Network Interface Devices ("NIDs"), and drops.

Finally, as the Commission tentatively concluded, the basic costs of the cable for aerial, buried, and underground installations do not differ significantly. The only differences in cost of these three types are a buried copper cable sheath multiplier to reflect the cost of water blocking compound, and the different costs of the installation of the cable.[8] These differences are reflected in the default values in the Hatfield Model.

C. Drop Costs

Hatfield Model 4.0 computes drop costs based on assumed drop lengths (that vary by density zone), and includes separate estimates for installation, terminal, splice and pedestal costs. Hatfield also assumes the use of both buried and aerial drops, which should be in the same proportion as buried and aerial distribution cable, with the costs of burying drops being shared with other utilities.[9] Documentation for the default values of all these variables is contained in the HIP.[10]

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[8] The Hatfield Model does provide for a cost multiplier on buried cable to reflect water-proofing.

[9] This sharing of buried drops also subsumes the instances in which the LEC bears none of the cost for the structure. This situation is quite common in new developments, where the developer will typically dig a trench for all drops - electric, telephone, and cable - to avoid the risk of these three cutting each others' cables. In such a case, the telephone company bears <u>none</u> of the cost of burying the drop. Conservatively, Hatfield Model 4.0 assumes that, on average, the telephone company bears half the cost of burying a drop.

[10] <u>See</u> HIP at 13-18.

D. Structure Sharing

In the last round of comments, AT&T and MCI addressed the type and degree of structure sharing that would be undertaken by an efficient local service provider in a competitive market. AT&T and MCI Comments at 11-15 (filed Sep. 24, 1997); AT&T and MCI Reply Comments at 6-8 (filed Oct. 3, 1997). Congress and municipalities increasingly believe that structure sharing will or should become ubiquitous. The Telecommunications Act of 1996 envisioned at least three parties sharing poles, conduit, and rights-of-way. 47 U.S.C. § 224(e)(2) (allocating two-thirds of unusable space costs to attachers and one-third to the structure owner). Similarly, more and more municipalities are requiring utilities and telecommunications companies to share structures. See, e.g., "Policy Relating to Grants of Location for New Conduit Network for the Provision of Commercial Telecommunications Services," Public Improvement Commission of the City of Boston (April 28, 1994). Thus, Hatfield's assumption that incumbent LECs will share structures with at least two other parties is reasonable -- indeed, necessary to prevent overcompensation.[11]

E. DLC Costs

As the Commission notes, the costs of digital loop carriers ("DLCs") differ significantly between the Hatfield Model and the BCPM. The price of DLC equipment included in Hatfield Model 4.0 is based on the expert opinion of outside plant engineers with extensive experience in

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[11] Although the Telecommunications Act anticipates the sharing of conduit (i.e., different utilities place or purchase innerduct within a single conduit tube, see Implementation of Section 703(e) of the Telecommunications Act of 1996, Amendment of the Commission's Rules and Policies Governing Pole Attachments, CS Docket No. 97-151, Notice of Proposed Rulemaking ¶ 38 (released August 12, 1997)), the Hatfield Model assumes that only the trench is shared and that utilities each place separate conduit tubes.

contracting for DLCs In addition, the Hatfield Model designers provided the Commission staff with a list of DLC vendors to confirm the prices used in the model.[12]

The Hatfield Model designers believe that the costs of DLC reflected in the BCPM significantly overstate the true costs. For example, the BCPM uses DLC capacities much greater than that actually required. Moreover, it is the Hatfield Model designers' understanding that DLCs are priced significantly lower if they are bought as a preassembled bundle, rather than as separate components.[13] The prices used as defaults in Hatfield Model 4.0 correctly reflect this bundled price.

F. Manhole Costs

The default manhole costs incorporated in the Hatfield Model and the BCPM are substantially similar, with the Hatfield cost -- which, unlike the BCPM's cost, includes materials, delivery, excavation, and backfill -- being slightly higher. The Hatfield Model's estimate is based on information from contractors who routinely perform this type of work for telephone companies and from other printed sources, as documented in the HIP.[14] There is substantial variation in prices obtained, and the Hatfield designers have taken a conservative approach in default values

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[12] See Letter from Chris Frentrup, MCI, to William F. Caton, Secretary - FCC, CC Docket Nos. 96-45 and 97-160, dated August 19, 1997.

[13] The bundle includes, among other components, the cabinet, multiplexer, digital loop carrier, battery backup, and power supply.

[14] See HIP at 65.

within the range of such prices For example, although estimates of manhole excavation and backfill costs ranged from $1,700 to $8,500, a default of $5,000 was recommended.[15]

AT&T and MCI note that the Hatfield Model assigns manhole costs at the same rate as the costs for conduit trenching, except that Hatfield assumes one less party is sharing the manhole costs (presumably the electric utility).[16] However, in some areas, such as New York City, the telephone company does not own the manholes. Instead, it leases space in manholes that may be shared with several other utilities, from another party.[17] Thus, the current treatment of manholes in the Hatfield Model assigns a conservatively high amount of manhole costs to the telephone company.

G. Pole Material And Installation Costs.

The Hatfield Model produces the most reasonable estimates of forward-looking pole material and installation costs by using material and installation input values that have been confirmed by multiple sources and by conservatively placing poles closer together in many instances than is strictly necessary. See FNPRM ¶ 110. The Hatfield Model's $201 default material cost, for example, reflects a 40 foot Class 4 southern pine utility pole, a very common pole type deployed in the United States and is supported by a survey of multiple pole suppliers

[15] In light of the relatively minor effect that manhole costs have on overall loop costs, determining manhole costs based on either the Hatfield Model or the BCPM default values should make little difference in the total cost of the local loop.

[16] In other words, if the model has three parties sharing trenching expenses, it will assume that two parties share manhole costs.

[17] In New York City, for instance, the manholes in downtown Manhattan are all owned by the Empire City Subway Company, and New York Telephone leases space. Of course, Empire City Subway Company is a wholly owned subsidiary of New York Telephone, but it is operated as a separate entity and this leasing arrangement is not unique to Manhattan.

and industry sources. See HIP at 22 Indeed, $201 is, if anything, conservatively high, given that 35 foot poles are appropriate in certain circumstances -- as the Commission has long recognized and recently reaffirmed. See Implementation of Section 703(e) of the Telecommunications Act of 1996, Amendment of the Commission's Rules and Policies Governing Pole Attachments, CS Docket No. 97-151, Notice of Proposed Rulemaking (released August 12, 1997) (discussing the Commission's current presumption of a 37.5 foot average pole height).

Hatfield Model 4.0's default installation cost value of $216.00 also falls well within the range of labor costs provided by outside sources. See HIP at 22. Incumbent LECs have also submitted data to the Commission that demonstrates the reasonableness (and, in fact, the conservativeness) of the Hatfield defaults.[18] And US WEST has quoted an average installed cost per pole of $266,[19] compared to the Hatfield default of $417.

Further, the Hatfield default installation cost value reflects composite labor costs that include miscellaneous equipment, including guys and anchors (normally referred to as the exempt material load on labor).[20] For that reason, it would not be appropriate to inflate the $216 value with additional guy and anchor costs. Nor is there anything to be gained from accounting for guy

[18] For example, pursuant to the Commission's data request in CC Docket No. 96-45, DA 97-1433, GTE submitted a material plus installation cost of $385.21 for Alabama and similar values in other states (Sep. 12, 1997 Response of GTE at Main5, p. 4) and SBC and PacBell submitted an installed pole cost of $244.82 in Kansas. (Sep. 12, 1997 Response of Nevada Bell, et. al. at 3).

[19] 1996 Consolidated Cost Docket Nos. U-2428-96-417 (AT&T), U-3175-96-479 (MCI), et. al. at 9 (Supplemental Rebuttal Testimony of Ms. Geraldine G. Santos-Rach, Exhibit 1, Nov. 15, 1996).

[20] Exempt material loadings on labor are computed by performing periodic studies to calculate the amount of hardware used that is not classified discretely as a "unit of plant" for regulatory accounting.

and anchor costs separately from other labor and installation costs. See FNPRM ¶ 111. The frequency with which guys and anchors must be installed does not follow a formula that is systematically influenced by terrain, density, or other observable factors. Rather, it depends upon many factors and typically must be left to the judgment of field personnel. Because no party has proposed an accurate and administratively feasible method to estimate guy and anchor costs that vary on a wire center or other basis, separately identifying these costs would add complexity without any benefit in increased accuracy.

The Commission should also require the selected cost mechanism to use pole separation distances at least as long as those currently employed by the Hatfield Model. See FNPRM ¶ 112. Hatfield uses a range of distances from 250 feet in less densely populated areas to 150 feet in the most populated ones. Actual span lengths often extend 400 feet or more, producing much lower plant and maintenance costs, particularly in rural areas. Thus, if the Commission believes that any adjustment should be made to the Hatfield Model's treatment of pole investment, it should be an increase in the distance between poles in more rural areas.[21]

Finally, the next release of the Hatfield Model will include different pole installation costs for various terrain types. These costs will be calculated as part of the Model's dynamic structure allocation process.

H. Network Interface Costs

In the Hatfield Model, the cost of the NID is shown separately for the protection block and the NID itself. In addition, the cost of the NID is different for residence and business,

[21] In fact, if the selected cost mechanism assumes less structure sharing than the default level assumed in the Hatfield Model, the pole investment algorithm should significantly increase the amount of spacing because their would be fewer utilities on the poles.

primarily because of the different number of protectors that can be installed for the two types The default input prices were based on price quotes received from several sources, as documented in the HIP.[22]

I. Serving Area Interface Costs

The SAI is the physical interface point between distribution and feeder cable. The Hatfield Model has separate indoor and outdoor SAI costs that vary by the size of the SAI, as determined by the number of pairs, both feeder and distribution, that the SAI serves. Indoor SAIs are used in buildings and consist of simple terminations, or punch down blocks, and lightning protection where required. The equipment is typically mounted on a plywood backboard, and located in common space within a customer's building. Outdoor SAIs are more expensive, because they must be housed in steel cabinets to protect the cross connects from being exposed to water. Support for the default SAI costs used in the Hatfield Model 4.0 are provided in the HIP.[23]

J. Cable Fill Factors

As the Commission has noted, the Hatfield Model and the BCPM developers largely agree on the appropriate cable sizing fill factor defaults that the Commission should adopt in the selected cost mechanism. FNPRM ¶ 118-19. The only significant area of contention is the lower bound fill factor used in the least dense areas. There, the BCPM's 40% figure plainly is unreasonably low -- an efficient universal service provider certainly would use higher cable sizing fill factors, especially given that cable modularity produces lower actual utilization levels.[24]

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[22] See HIP at 9-12.

[23] See HIP at 46.

[24] The effects of modularity on cable fill factors are most pronounced for small cables.

Indeed, even the 50% default utilized in the Hatfield Model is likely too low First, as explained in the Hatfield Input Binder, the model's cable sizing algorithm invariably produces effective fill factors that are lower than the input value maximums (in some cases, much lower). Moreover, the Hatfield Model fill factor inputs reflect the lower fills necessary to accommodate the varying demands for residential second lines (the capacity for which the network owner places without knowing which specific customers will demand multiple lines) and for multiple business lines. Universal service, however, does not include residential second line or multiple business line service. Thus, the Commission may find it quite appropriate to increase fill factors above the Hatfield Model's default cable fill factors when determining universal service subsidies.

III. HATFIELD'S DESIGNERS ADOPTED REASONABLE, FORWARD-LOOKING SWITCHING, INTEROFFICE TRANSMISSION, AND SIGNALING PARAMETERS

A. Switch Capacity Constraints

As the Commission has noted, the Hatfield Model explicitly accounts for switch capacity constraints including the number of lines (80,000), traffic capacity (1,800,000 busy-hour hundred call seconds for the largest switch), and processing capacity (600,000 busy-hour call attempts for the largest switch) -- all through user adjustable inputs. See Hatfield Model Description at 47. The Hatfield Model proponents included these switching capacity constraints because switch purchasers and switch manufacturers have identified them as important, and if any of the "capacity limit[s] [are] exceeded, the model will compute the investment required for additional switches." Id. As AT&T and MCI stated in their August 8, 1997 Comments (at 10), it is plain that the default constraints are very conservative given the reported actual capacities of currently deployed switches. For example, Nortel advertises a busy hour call attempt capacity of 1,400,000[25] and Lucent has switches supporting over 100,000 lines.[26] While the user is free to make adjustments to these capacity constraints, the only justifiable changes would be increases from the Hatfield Model default values.

B. Switch Costs

The Commission has "tentatively conclude[d] that the selected mechanism should incorporate the Commission staff's estimates of switching costs because these estimates are based on filings with the Commission that record actual incumbent LEC switch purchases." FNPRM ¶ 132. AT&T and MCI agree that actual incumbent LEC switch purchase prices -- not list prices -- should form the basis for switching costs in the selected cost mechanism. As AT&T and MCI have repeatedly stressed, an approach that reflects market data and actual LEC purchasing practices without the biases that may infect proprietary "surveys" or more limited data sources is much more likely to produce a reasonably accurate estimate of forward-looking costs.

AT&T and MCI believe that the Northern Business Information ("NBI") data reflected in the Hatfield Model provides the best available estimate of forward-looking switching costs. Although the Commission staff's costs are not very different than those used in the Hatfield Model -- and either set of switching cost inputs, properly applied, produces relatively similar switching cost outputs -- staff's data set appears to include switch costs beyond those for Class 5 switches and may reflect more of the upward bias on switching cost inherent in the pre-1996 Act

[25] See Nortel's world-wide-web site at www.nortel.com.

[26] See Lucent's world-wide-web site at www.lucent.com.

regime, which often rewarded unnecessarily large capital investments, or at least encouraged incumbent LECs to present a skewed portrait of their switching expenditures to the Commission.

The Hatfield Model avoids this inflationary bias to the extent possible by relying on figures reported from a neutral source, NBI, which estimated industry average switching prices paid per line per year.[27] This data set has several advantages, most notably that it encompasses data from a broader range of companies than those reported to the Commission and focuses on the prices for Class 5 switches. By including purchases for many incumbent LECs in many different states and diverse geographic areas, the NBI Report better reflects the forward-looking purchasing practices of local service providers.[28] Using this data, two switching cost curves were developed, one curve for large buyers like the RBOCs and GTE, and another for smaller incumbent LECs. Because they rely on a broad range of recent incumbent LEC purchases and reflect the differences in purchasing power between large and small purchasers, these curves reasonably represent the rates incumbent LECs currently pay for switches -- and thus provide the best available estimate of forward-looking switching costs.[29] By contrast, switch cost "surveys" and similar approaches that

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[27] Northern Business Information Study: U.S. Central Office Equipment Market -- 1995 Database, McGraw-Hill, New York, 1996 ("NBI Report"). The Hatfield Model also relies on the ARMIS 43-07 and responses to the 1994 USF Notice of Inquiry data request for public line and data on average lines per switch. See Hatfield Model Description at 48.

[28] If the NBI Report only relied on a single incumbent LEC, a single state, or one type of geographic area, then the criticism that has been leveled by its detractors might be justified. By relying on many incumbent LECs in many different areas, the data set captures the purchasing practices of incumbent LECs who have different network configurations and are at different stages of network modernization. This feature of the data set minimizes to the extent possible the impact of inefficiencies in any particular incumbent LECs' embedded network configurations on forward-looking estimates and is clearly superior to any model that is dependent on historic switch deployments.

[29] AT&T and MCI have previously explained that these cost curves also capture the shifting emphasis from standalone to host/remote switches, as well as many other strategic factors

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rely on a subset of prices some incumbent LECs claim to have paid may reflect selective disclosures or not reveal the full set of terms that were part of the purchase agreement.[30]

Further, to the extent that cost models are required to identify switches as host, remote, and stand-alone, the Commission must ensure that the costs for each switch category reflect verifiable, contract based prices -- not "costs" that have been "processed" through a proprietary and unaudited model such as SCIS.[31] And, in all events, the Hatfield Model's NBI data-based cost curves should be used as check -- the selected cost mechanism should not rely on a switching configuration and set of switching cost inputs whose weighted average deviates significantly from Hatfield's existing cost curve (or the Commission staff's switching cost estimations).

Finally, as AT&T and MCI explained in their August 8, 1997 Comments (at 10-12), the selected cost mechanism should not incorporate supposed cost differences between "new" and "growth" lines.[32] As a threshold matter, publicly available data that establish per-line cost

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considered by incumbent LECs in their switch purchases. AT&T and MCI Comments at 9 (filed August 8, 1997). By focusing on the full spectrum of current Class 5 switch purchases rather than the historic configuration, this approach greatly increases the likelihood that the Hatfield Model will yield accurate estimates of forward-looking economic costs.

[30] For example, an incumbent LEC might enter into multiple agreements simultaneously with a switch manufacturer where one agreement covers switches whose cost will be reported to the Commission and the other agreements cover additional switches. The "price" in the first agreement could be inflated, however, with an unreasonable share of the related equipment and services, including repair and maintenance, because the switch manufacturer and the switch purchaser would only be concerned with the total price for all of the agreements. This is just one example of how the switching "costs" selectively presented to the Commission could reflect an upward bias.

[31] If data become publicly available as to the prices incumbent LECs actually paid for switches, the Hatfield's designers will incorporate that data into their model.

[32] As AT&T and MCI have previously explained, focusing on the "growth" costs of a single part of the network, while ignoring "growth" costs with respect to the remainder of the network
(continued. . .)

differences between new switch purchases and later purchases of additional capacity for existing switches ("growth lines") and quantities of these purchases is sketchy.[33] By contrast, switch contract data reviewed by AT&T and MCI (which unfortunately still remains proprietary) suggests that large incumbent LEC switch contracts often reflect a single per-line price that encompasses both new and growth lines. And even where that is not so, it may simply reflect non-cost-based allocations by the parties to the contract, who, from a cost perspective, are concerned only with the total bottom-line purchase amount.[34]

AT&T and MCI have also explained that nominal dollar differences, even if they existed, would be irrelevant. AT&T and MCI Comments at 11-12 (filed August 8, 1997). Simply lumping together the nominal dollar costs of switches purchased today and switch capacity that might be purchased in the future would violate fundamental financial principles. Put simply, even

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would plainly be inappropriate. AT&T and MCI Comments at 12 (filed August 8, 1997). Even assuming that "growth" costs are higher in real dollar terms for switch capacity -- and there is no basis for any such assumption -- it is undeniable that precisely the opposite effect would be encountered with respect to "growth" costs for many other parts of the network (e.g., growth in loop plant is far cheaper than new on a unit basis). When coupled with the fact that the Hatfield Model makes conservative capacity cost estimates that will tend to overstate switching costs, there is simply no justification for requiring upward adjustments to cost estimates for "growth" lines.

[33] The "growth line" cost estimates provided by NBI, although clearly more reliable than the incumbent LECs' unsubstantiated claims, are themselves problematic, because unlike the NBI estimates used in the Hatfield Model, the NBI "growth line" data are not sufficiently disaggregated to allow differentiation between large and small incumbent LECs for comparison to corresponding "new" capacity costs. Furthermore, the data do not appear to be available to indicate whether significant number of lines are bought at "growth" prices.

[34] This is especially true given that incumbent LECs may agree on growth line prices at the same time that they buy new switches. Thus the individual rate elements for growth lines in an aggregate contract can have no presumption of independent validity (but may instead reflect the incumbent LEC's preferences for accounting or other purposes).

if an incumbent LEC did agree to pay $100/line for growth lines in the same contract in which it paid $75 for new switch capacity, that incumbent LEC's average cost/line in <u>today's</u> dollars (the time of modeling) could well remain $75 -- or even less -- given the time value of money and the fact that the "growth" lines are to be purchased, if at all, in the future. Indeed, if it were true that growth lines were significantly more expensive than new capacity, efficient incumbent LECs would often elect to pay prevailing prices for growth lines, rather than contracting in advance, given the long term downward trends in the prices of switch components (and the bargaining power the incumbent LECs' continuing purchases give them with respect to switch manufacturers). The incumbent LECs' claim that this does not happen simply supports the conclusion that there are no significant cost differences in real terms.

Moreover, the Commission must recognize the practical difficulties of obtaining reliable "growth" line cost data and appropriately accounting for the time value of money and real declines in switch capacity costs. The reliability, verifiability, and accuracy of the Hatfield approach should not be supplanted with a hodgepodge of "surveys" and supposition. In the event, however, that the Commission decides to separately identify growth lines and can obtain verifiable estimates of their costs and quantities, these costs must be discounted to current dollars according to the date it is expected they will be installed. In addition, the selected cost mechanism must include the number of growth lines in the denominator of per line cost calculations to ensure that new lines do not subsidize capacity expansion.

C. Port And Usage Costs

The Commission has correctly concluded that "all of the port cost and a percentage of the usage cost are costs of providing universal service." <u>FNPRM</u> ¶ 137. Precisely separating these costs presents significant difficulties, however, and any allocation necessarily will have some indeterminacy. Hence, as AT&T and MCI have previously urged, it is critical that the Commission not adopt an allocation standard that exacerbates the problems with this separation process. AT&T and MCI Comments at 12-13 (filed August 8, 1997). Most importantly, the selected mechanism should be manufacturer neutral thereby preventing universal service subsidies from becoming sensitive to the particular mix of switching vendors, encouraging uneconomic decision-making in switch purchases, and violating forward-looking economic principles. The Hatfield Model adopts a better approach of assigning 30% of total switch investment to the port, an allocation that has been supported by publicly available cost studies.[35] If the Commission determines pursuant to its Access Charge Reform Order that a different percentage allocation is appropriate, then the Hatfield Model can be adjusted accordingly. See FNPRM ¶ 135.

AT&T and MCI also support the Commission's tentative conclusion that "all of the port cost and a percentage of the usage cost are costs of providing universal service" and that local usage, as a percentage of other usage, should be allocated to universal service. FNPRM ¶ 137. The Hatfield Model already employs exactly such an approach, determining the cost of local usage based upon the level of local usage in a study-area. Id. ¶ 134.

D. Interoffice Trunking, Signaling, and Local Tandem Service Inputs

As the Commission properly recognized, the Hatfield Model is the only cost mechanism that currently calculates separate costs for the network elements used to provide interoffice

[35] New York Study, Case 0657:94-C0095 & 91-C1174, Workpapers Part B at 93 (average 24% of line port); Massachusetts Study, 96-73/74: 96-75: 96-80/81: 96-83: 96-94 (filed Oct. 24, 1996) Workpaper Part B at 73 (average 43% of line port).

trunking, signaling, and local tandem services. FNPRM ¶ 141.[36] In addition, as AT&T and MCI have repeatedly demonstrated, the Model uses conservative platform characteristics to ensure the universal service costs are not underestimated. And the Model allows the user to exercise significant control over this estimation algorithm by including over 60 user adjustable input values. The HIP references the publicly available data and engineering and network design justifications supporting the reasonableness of these input values. HIP at 68-104. AT&T and MCI will respond to specific criticisms of these values, if any, in their reply comments.

IV. THE HATFIELD MODEL USES FORWARD-LOOKING ASSET LIVES.

The Hatfield Model incorporates a weighted average of the Commission's asset lives as determined in a three-party review process including the relevant state commission, the incumbent LEC, and the Commission. See HIP at 106. In general, the depreciation lives prescribed by the Commission are forward-looking and fully appropriate for use in TELRIC cost studies. Over a decade ago the Commission directed its staff to put less emphasis on historic data in estimating projection lives, instead directing that prescribed depreciation lives should reflect "company plans, technological developments, and other future oriented analysis." Report on Telephone Indus. Depreciation, FCC Tax and Capital/Expense Policy, Accounting and Audits Division, at 3 (April 15, 1987). In this regard the Commission has stated that in prescribing life ranges, it would rely on "statistical studies of the most recently prescribed factors. These statistical studies required detailed analysis of each carrier's most recent retirement patterns, the carrier's plans, and the

[36] The BCPM sponsors have promised to include this feature in a new version of their model, but they have yet to demonstrate satisfactorily that they can deliver on this promise.

current technological developments and trends." Simplification of the Depreciation Prescription Process, CC Docket No. 92-296, at 6 (May 4, 1995). As such, the lives prescribed by the Commission assure forward-looking capital recovery.

Indeed, the Commission recently reaffirmed that its prescribed lives are forward-looking in its Second Report and Order in the Price Cap Performance Review, CC Docket No. 94-1 (May 21, 1997). There, the Commission expressly rejected claims by incumbent LECs that the Commission's prescribed lives did not provide for economic depreciation rates:

> [T]here is no sound basis in the record in this proceeding for determining whether and to what extent our depreciation rates differ from economic depreciation rates. . .[U]nder our recently established streamlined procedures for determining LEC depreciation rates, incumbent LECs have considerable influence and some discretion in setting their specific depreciation rates. Commentors in this proceeding have not persuaded us that the depreciation rates we have currently prescribed do not reflect the LECs' depreciation costs.

Id. ¶ 63 (emphasis added).

Contrary to the assertion of some incumbent LECs (see FNPRM ¶ 151), asset lives should not be shortened in response to speculative forecasts of possible future competitive pressures. Such asset lives already incorporate best anticipations about such pressures. Indeed, before any such adjustment could be justified, an incumbent LEC would need to demonstrate that it is, in fact, facing significant facilities-based competition that renders part of its plant economically unusable. No incumbent LEC has done so or conceivably could do so. There is no significant local competition in most areas of the country today, and it remains uncertain when and even whether significant facilities-based competition will occur in many areas, including the rural and high cost areas most relevant for universal service purposes. And even if a few customers are lost to exclusively facilities-based competitors, growth in customer demand will almost certainly the increase in auxiliary equipment and personnel that support a larger switch's operation will necessitate more space. Moreover, larger switches will be most common in urban areas where, even if the building size were not to increase, the cost per foot of wire center space most likely would be significantly higher.

VI. UNIVERSAL SERVICE COSTS SHOULD NOT BE ADJUSTED ANNUALLY FOR INFLATION AND PRODUCTIVITY OFFSETS.

The Commission has sought comment on the best method of adjusting universal service costs over time. FNPRM ¶ 173. AT&T and MCI believe that, initially, periodic reassessment of costs is superior to annual adjustments based on inflation and productivity offsets. The obstacles to developing a universal service cost mechanism have already proven formidable and would only be exacerbated by attempts to properly address these additional factors. The cost model selected should be a model of forward-looking network practice and, until the technology used in networks changes significantly, variations in cost can be determined by simply adjusting the inputs to reflect changes in conditions and then rerunning the model. Productivity gains and inflation will be captured if the inputs are appropriately adjusted.

In addition to simplicity, this approach would have the added benefit of incenting incumbent and competitive LECs to find more efficient means of providing basic telephone services.[42] It is also a very conservative approach given that (i) the cost of capital in the models is

[42] Like price cap regulation, fixed universal service costs provide incentives for local service providers to develop more cost effective methods of serving customers because the providers will be allowed to keep the profits from these gains until the universal service costs are reassessed. If the period between reassessments is too long, however, customers will be unnecessarily delayed from enjoying the benefits of these productivity gains.

a nominal cost of capital incorporating anticipated inflation and (ii) the Commission has found annual productivity gains in local telecommunications in the 6.5% range.[43]

VII. UNIVERSAL SERVICE SUPPORT AREAS SHOULD BE COINCIDENT WITH THE AREAS USED TO PRICE UNBUNDLED NETWORK ELEMENTS.

The Commission has sought comment on what geographic area should be used to calculate cost support. FNPRM ¶ 176. In order to promote efficient local telephone service competition, the Universal Service Fund should provide support for the same geographic unit used to price unbundled network elements. The correspondence between these two units of measurement is more important than their size.[44] If universal service subsidies are provided for an area larger than the UNE pricing area, local service providers may not find it profitable to serve high cost areas. On the other hand, universal service areas smaller than the UNE pricing area may discourage service to low cost areas.

For example, consider two contiguous areas that have a single UNE "platform" cost of $15. In fact, if these UNE costs had been calculated separately for each area, they would have cost $20 in the first area and $10 in the second. If the Commission determines that the affordability benchmark is $12 and that the universal service area is coincident with the UNE pricing area, entrants would receive a $3 subsidy ($15-$12) for each customer they serve in either

[43] See Price Cap Performance Review for Local Exchange Carriers, Access Charge Reform, "Fourth Report and Order in CC Docket No. 94-1 and Second Report and Order in CC Docket No. 96-262," CC Docket Nos. 94-1, 96-262 ¶ 1 (released May 21, 1997).

[44] AT&T and MCI have discussed in their previous comments the inherent difficulties in using smaller and smaller geographic units to determine universal service costs. See AT&T and MCI Comments at 3-5 (filed Sep. 2, 1997). In this regard, it is critical that the selected cost mechanism not demand more accuracy than the available data can reveal.

area. If, on the other hand, the Commission established separate universal service support payments for each area, entrants would have no incentive to serve customers in the lower cost area because it would cost $15 per customer (the UNE rate), and they would not receive any subsidy ($10 is less than the affordability benchmark of $12) above the $12 retail rate. Similarly, if the same two areas are subject to separate UNE charges of $10 and $20 but are part of a single universal service area with a cost of $15, no entrant will serve the high cost area, because the $20 UNE charge less a $3 subsidy ($15 - $12) exceeds the retail rate of $12 by $5.

In all events, the Commission must ensure that no universal service support area is so large that it constitutes a barrier to entry, rather than a mechanism for ensuring affordable basic telephone service. If, for example, a state defines its universal service area as the state's entire geographic area, the Commission should instead use smaller support areas such as the zones provided by the Hatfield Model.

VIII. THE LOCAL USAGE REQUIREMENT ADOPTED IN THIS PROCEEDING SHOULD BE TECHNOLOGY NEUTRAL AND GIVE SUPPORTED USERS THE SAME INCENTIVES AS NON-SUPPORTED USERS.

The Commission has tentatively concluded that universal service should include a minimum local usage component. FNPRM ¶ 178. The Commission must ensure, however, that any minimum local usage requirement for universal service is technologically neutral. For example, if local service requirements are set too high, carriers using other technologies such as wireless or possibly cable telephony may be economically foreclosed from providing universal service, thereby undermining the Commission's commitment to providing consumer choice among a wide range of competing carriers and technologies.[45] In addition, the amount of local usage that should be included in the definition of universal service should be lower than current average usage levels, which reflect services such as multiple line business services that should not receive universal service support. Finally, if the free usage level is set too high, customers who receive universal service support will not face the same incentives to choose an efficient level of usage as non-supported customers who must pay per minute or per call charges associated with their telephone calls.

---

[45] For example, Bell Atlantic's recommendation of a 500 minute per month local usage component (see FRPRM ¶ 281) might preclude wireless service providers or other technologies that exhibit relatively low fixed costs, but high usage costs, from competing for universal service customers -- even when their overall costs for certain customers are lower. This would deny customers the opportunity to determine that a wireless, mobile offering at a lower usage level is as or more valuable to them than a wireline offering with higher usage levels.

CONCLUSION

For the foregoing reasons, the Commission should adopt the evolving Hatfield Model approach to the designated issues raised in the Notice.

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Hatfield Model

Release 4.0

Inputs Portfolio

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August 1, 1997

Hatfield Model Release 4.0 Inputs Portfolio

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1. OVERVIEW

This draft document contains descriptions of the user-adjustable inputs to the Hatfield Model, version 4.0 ("HM4.0"), the default values assigned to the inputs, and the rationales and supporting evidence for these default values. The inputs and assumptions in HM4.0 are based on information in publicly available documents, expert engineering judgment, or price quotes from suppliers and contractors.

Prices of telecommunications equipment and materials are notoriously difficult to obtain from manufacturers and large sales organizations. Although salespeople will occasionally provide "ballpark" prices, they will do so only informally and with the caveat that they may not be quoted and the company's identity must be concealed. It is very nearly impossible to obtain written, and hence "citable," price quotations, even for "list" prices, from vendors of equipment, cable and wire, and other items that are used in the telecommunications infrastructure. Part of the reason for this is that the vendors have long-standing relationships with the principal users of such equipment, the incumbent local exchange carriers ("ILECs"), and they apparently believe that public disclosure of any prices, list or discounted, might jeopardize these relationships. Further, they may fear retaliation by the ILECs if they were to provide pricing explicitly for use in cost models such as HM4.0.[1] The HM4.0 developers thus have often been forced to rely on informal discussions with vendor representatives and personal experience in purchasing or recommending such equipment and materials. Nevertheless, a great deal of experience and expertise in the industry underlies the estimates, where they were necessary to augment explicit, publicly-available information.

This document contains a number of graphs that illustrate a range of prices for particular kinds of telecommunications equipment. The information contained in these graphs was gathered to validate the opinions of outside plant experts who used their collective industry knowledge and experience to estimate the costs of particular items.

This document will continue to evolve as more documented sources are found to support the input values and assumptions.

Organization of Material:
Material is generally organized in this binder in the same order as default values appear in Model Input screens in the Hatfield Model.

[1] See, for example, "U S West to Suppliers: Back Us or Lose Business," *Inter@ctive Week*, September 16, 1996.

2. DISTRIBUTION

2.1 Network Interface Device (NID)

Definition: The investment in the components of the network interface device (NID), 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.

Default Values:

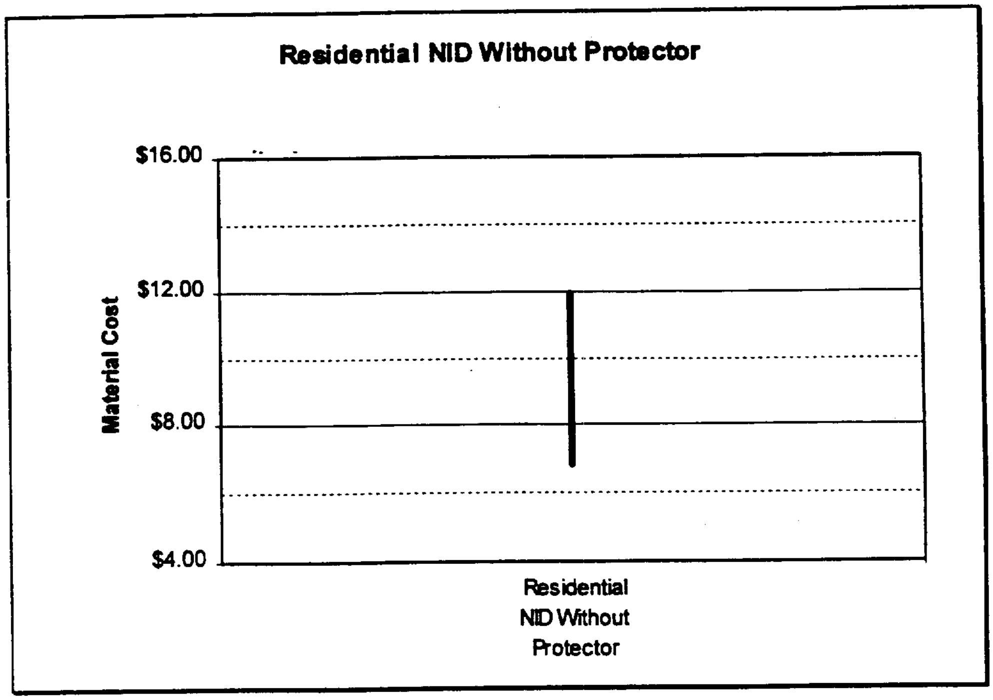
NID Materials and Installation	
	Cost
Residential NID case, no protector	$10.00
Residential NID basic labor	$15.00
Installed NID case	*$25.00*
Maximum lines per res. NID	6
Protection block, per line	$4.00
Business NID case, no protector	$25.00
Business NID basic labor	$15.00
Installed NID case	*$40.00*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

Support:

Residential NID Cost without Protector:

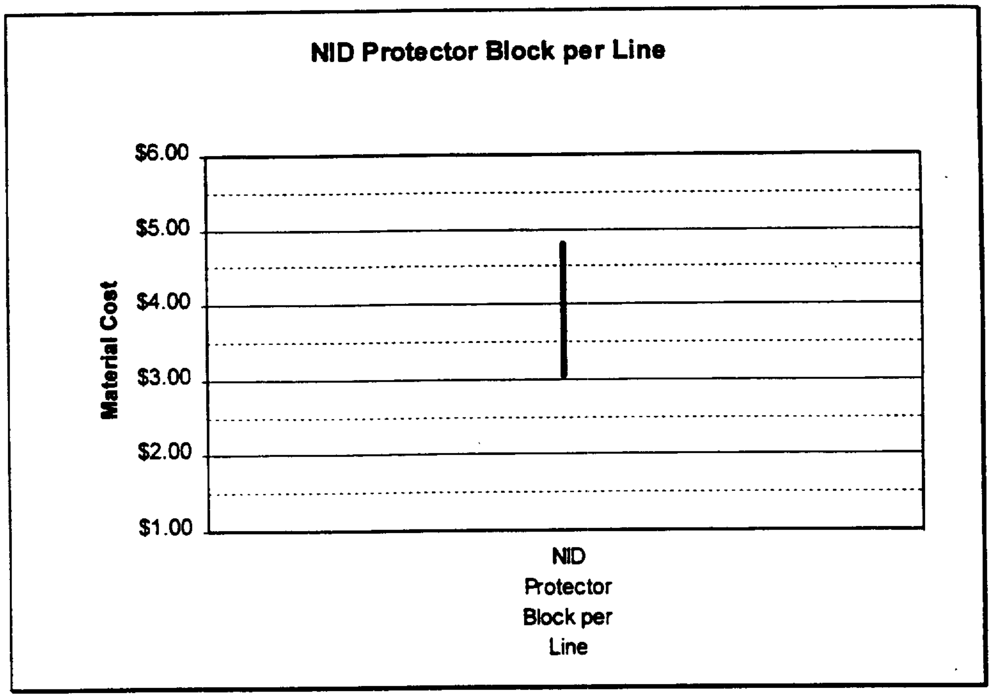
The labor estimate assumes a crew installing network interface devices throughout a neighborhood or CBG (in coordination with the installation of drops, terminals, and distribution cables). A work time of 25 minutes was used, based on the opinion of a team of outside plant experts. A loaded labor rate 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
Material Cost
$16.00
$12.00
$8.00
$4.00
Residential
NID Without
Protector

NID Protection Block per Line:

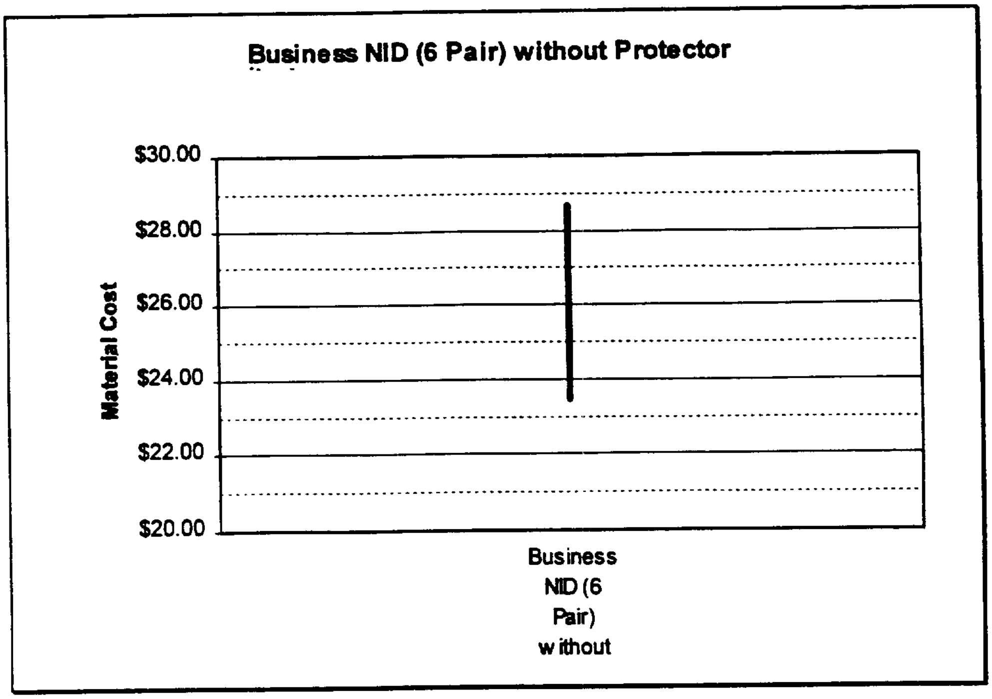
Price quotes for material were received from several sources. Results were as follows:



Business NID - No Protector:

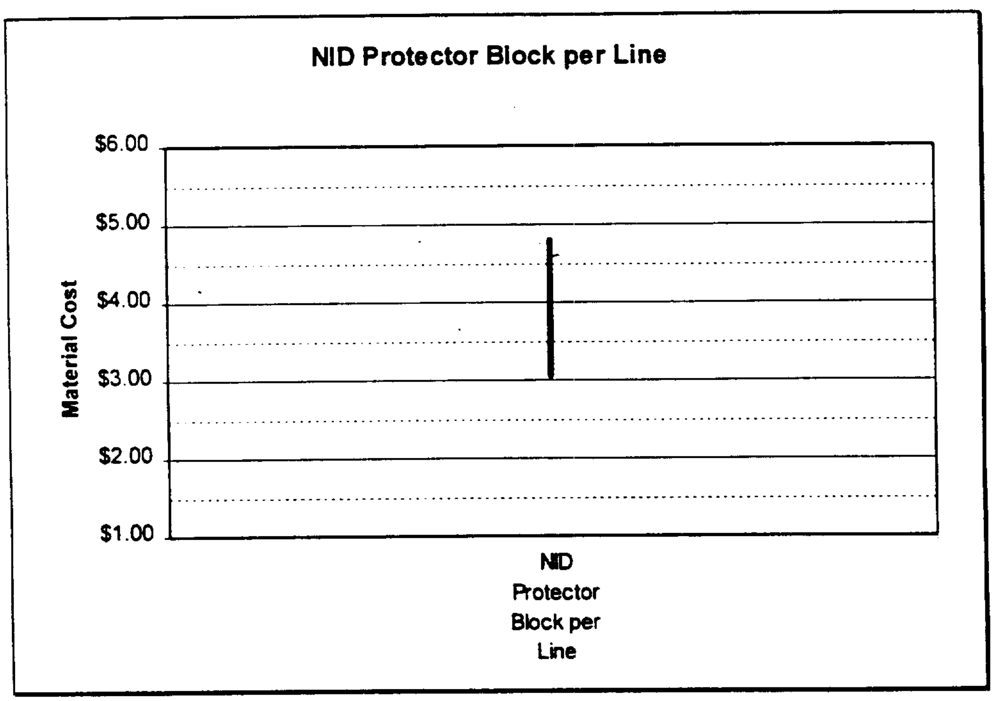
The labor estimate assumes a crew installing network interface devices throughout a neighborhood or CBG (in coordination with the installation of drops, terminals, and distribution cables). A work time of 25 minutes was used, based on the opinion of a team of outside plant experts. A loaded labor rate 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:



2.2. DROP

2.2.1. 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.

Default Values:

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]

2.2.2. Drop Placement, Aerial and Buried

Definition: The total placement cost by density zone of an aerial drop wire, and the cost per foot for buried drop cable placement, respectively.

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

Default Values:

Drop Placement, Aerial & Buried		
Density Zone	Aerial, total	Buried, per foot
0-5	$23.33	$0.60
5-100	$23.33	$0.60
100-200	$17.50	$0.60
200-650	$17.50	$0.60
650-850	$11.67	$0.60
850-2,550	$11.67	$0.60
2,550-5,000	$11.67	$0.75
5,000-10,000	$11.67	$1.50
10,000+	$11.67	$5.00

Support:

Aerial Drop Placement:

The opinions of expert outside plant engineers and estimators were used to project the amount of time necessary to attach a drop wire clamp at a utility pole, string the drop, and attach a drop wire clamp at the house or building. Labor to terminate the drop at the NID and the Block Terminal is included in the NID and Block Terminal investments respectively.

The labor estimate assumes a crew installing aerial drop wires throughout a neighborhood or CBG (in coordination with the installation of NIDs, terminals, and distribution cables), and consists of 10 minutes per drop plus 10 minutes for each 50 ft. of drop strung. The loaded labor rate excludes exempt material loadings which normally include the material cost of the Aerial Drop Wire.

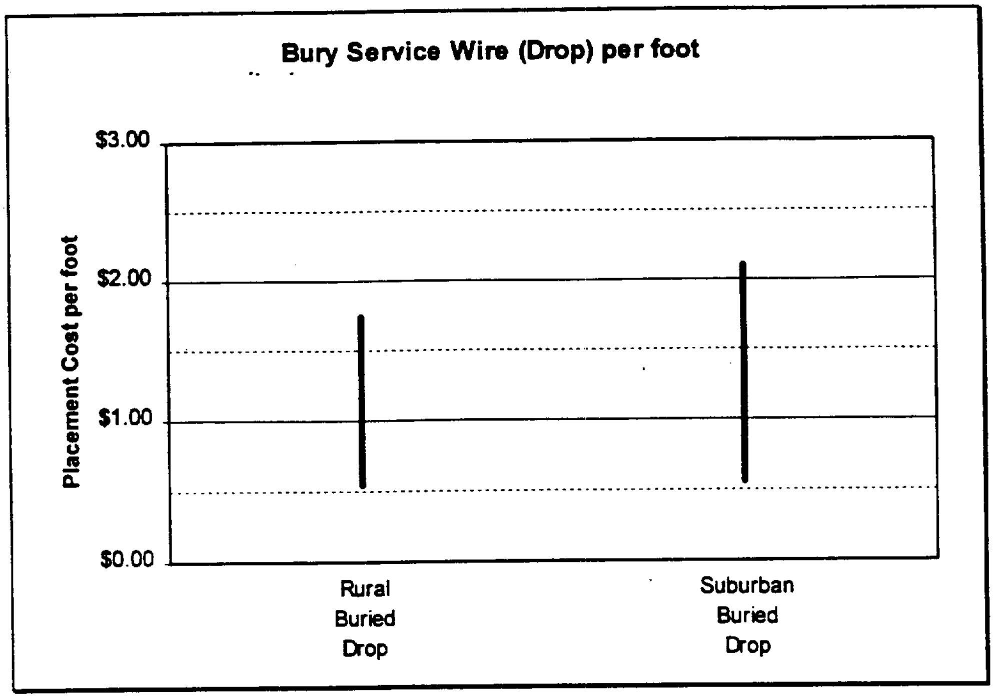
Aerial Drop Placement				
Density Zone	Aerial Drop Length (ft.)	Installation Time (min.)	Direct Loaded Labor Rate $/hr.	Aerial Total
0-5	150	40	$35	$23.33
5-100	150	40	$35	$23.33
100-200	100	30	$35	$17.50
200-650	100	30	$35	$17.50
650-850	50	20	$35	$11.67
850-2,550	50	20	$35	$11.67
2,550-5,000	50	20	$35	$11.67
5,000-10,000	50	20	$35	$11.67
10,000+	50	20	$35	$11.67

Buried Drop Placement

The contract labor estimate is based on a crew installing buried drop wires throughout a neighborhood or CBG (in coordination with the installation of NIDs, terminals, and distribution cables).

Of the many quotes that were received for suburban and rural buried drop placement, several of them price buried drop placement at the HM 4.0 default values. Because buried drops are rare in urban areas, the expert opinion of outside plant experts was used in lieu of verifiable forward looking alternatives from public sources or ILECs.

Price quotes for contractor placement of buried drop wire were as follows:



Of the many price quotes received there were several at the default value. Because buried drops are rare in urban areas, the expert opinion of outside plant experts was used in lieu of verifiable forward looking alternatives from public sources or ILECs.

2.2.3. 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.

Default Values:

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.

2.2.4. Aerial and Buried Drop Structure Fractions

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

Default Values:

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.

2.2.5. Average Lines per Business Location

Definition: The average number of business lines per business location, used to calculate NID and drop cost. This parameter should be set the same as 5.4.15.

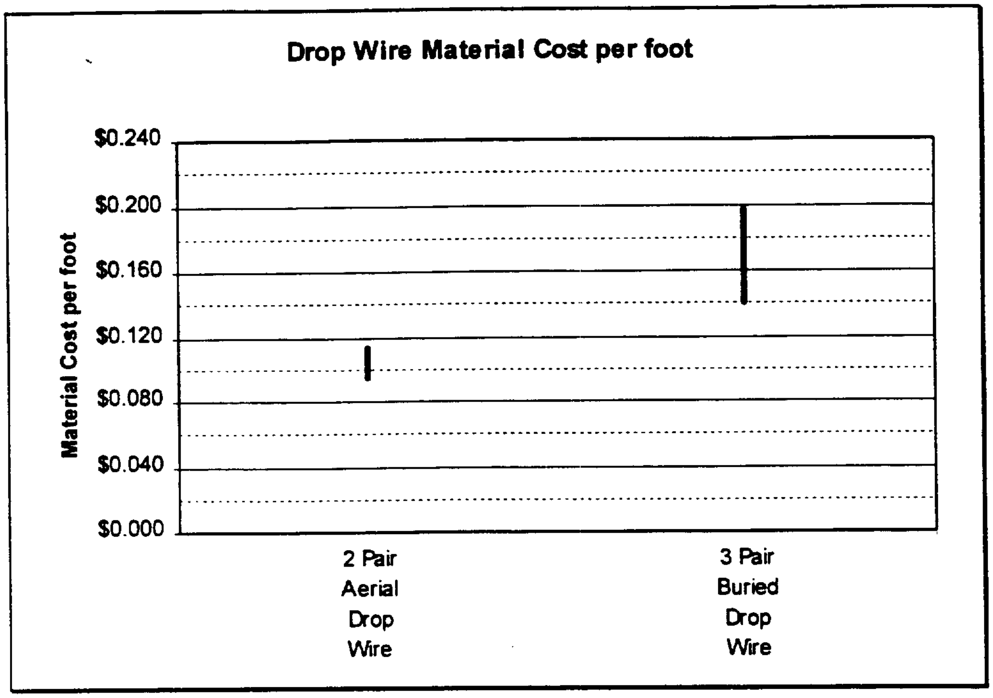
Default Value:

Number of Lines per Business Location
4

Default Values:

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:



2.3 CABLE AND RISER INVESTMENT

2.3.1. Distribution Cable Sizes

Definition: Distribution plant connects feeder plant, normally terminated at a Serving Area Interface (SAI), to the customer's block terminal. "Distribution network design requires more distribution pairs than feeder pairs, so distribution cables are more numerous, but smaller in cross section, than feeder cables."[3] The Hatfield Model default values represent the array of distribution cable sizes assumed to be available for placement in the network.

Default Values:

Cable Sizes
2400
1800
1200
900
600
400
200
100
50
25
12
6

Support: These are cable sizes typically available to, and used by, telephone companies. Although three additional sizes of distribution cable (2100 pair, 1500 pair, and 300 pair cable) can be used, the industry has largely abandoned use of those sizes in favor of reduced, simplified inventory.

2.3.2. Distribution Cable, Cost per Foot

Definition: The cost per foot of copper distribution cable, as a function of cable size, including the costs of engineering, installation, and delivery, as well as the cable material itself.

[3] Bellcore, *Telecommunications Transmission Engineering*, 1990, p. 91.

Default Values:

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.

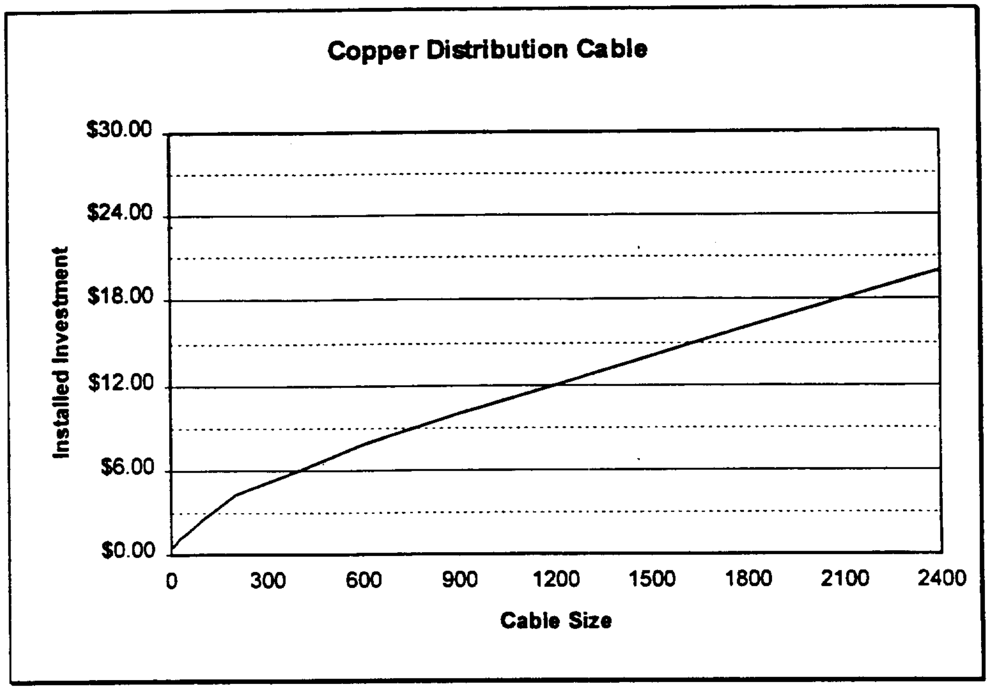
In the opinion of expert outside plant engineers, material represents approximately 40% of the total installed cost. This is a widely used rule of thumb among outside plant engineers. Experience of outside plant experts used for developing the HM 3.1 includes writing and administering hundreds of outside 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.[4]

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

[4] 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 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.

The following chart represents the values used in the model.



2.3.3. 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.

Default Values:

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.

2.4. POLES AND CONDUIT

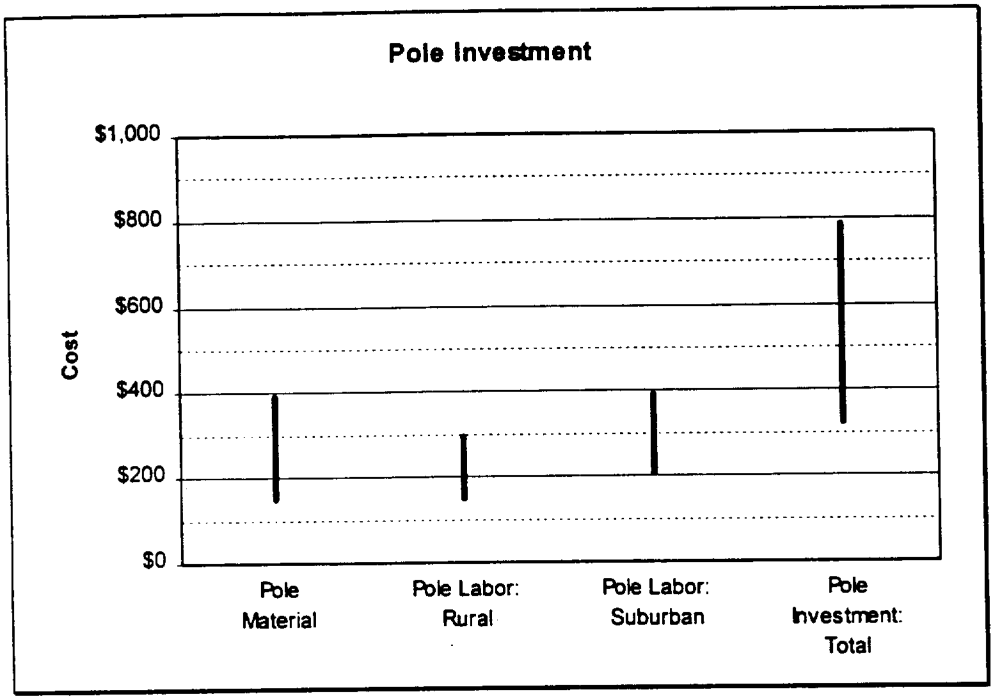
2.4.1. Pole Investment

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

Default Values:

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.

2.4.2. Buried Copper Cable Sheath Multiplier (feeder and distribution)

Definition: The additional cost of the filling compound used in buried cable to protect the cable from moisture, expressed as a multiplier of the cost of non-filled cable.

Default Value:

Buried Copper Cable Sheath Multiplier	
Multiplier	1.04

Support: Filled cable is designed to minimize moisture penetration in buried plant. This factor accounts for the extra material cost incurred by using a more expensive type of cable designed specifically for buried application.

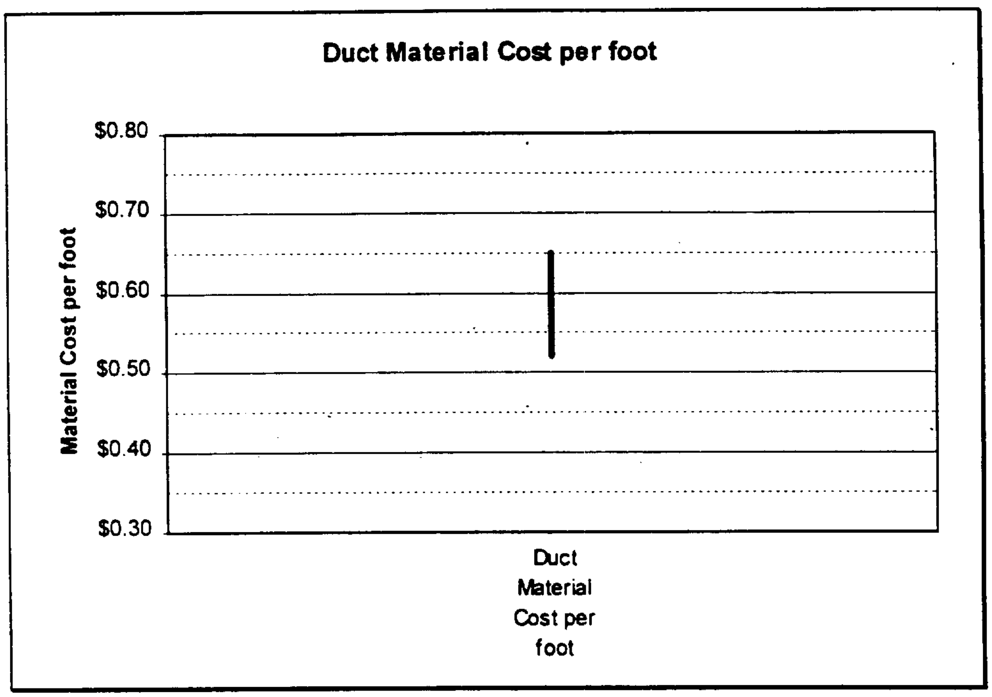
2.4.3. Conduit Material Investment per Foot

Definition: Material cost per foot of 4" PVC pipe.

Default Values:

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.

2.4.4. Spare Tubes per Route

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

Default Value:

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."[5] Version 4.0 of the Hatfield Model provides one spare maintenance duct (as a default) in each conduit run.

2.4.5. Regional Labor Adjustment Factor

Definition: A factor that adjusts the labor cost portion of certain investments to account for regional differences in the availability of trained labor, union contracts, and cost of living factors.

Default Value:

Regional Labor Adjustment Factor	
Factor	1.0

Support: Different areas of the country are known to experience variations in wages paid to technicians, depending on availability of trained labor, union contracts, and cost of living factors. The adjustment applies only to that portion of installed costs pertaining to salaries. It does not apply to loading factors such as exempt material, construction machinery, motor vehicles, leases and rentals of special tools and work equipment, welfare, pension, unemployment insurance, workers compensation insurance, liability insurance, general contractor overheads, subcontractor overheads, and taxable and non-taxable fringe benefits.

The regional adjustment factor is applied to the model as follows. For heavy construction of outside plant cable, the model assumes a fully loaded direct labor cost of $55.00 per hour for a placing or splicing technician who receives pay of $20 per hour. For copper feeder and copper distribution cable, the Hatfield Model assumes that this fully loaded direct labor component accounts for 45% of the investment.

Because $20 is 36.4% of the fully loaded $55 per hour figure, the effect of the Regional Labor Adjustment Factor is .364 x .45, or 16.4% of the installed cost of copper cable. Therefore, the labor adjustment factor is applied to 16.4% of the installed cost of copper cable.

The labor adjustment factor also applies to pole labor, NID installation, conduit and buried placement, and drop installation. In the feeder plant, the factor applies to manhole and pullbox installation as well as to cable and other structure components.

Contract labor is used for buried trenching, conduit trenching, and manhole/pullbox excavation. Contract labor (vs. equipment + other charges) is 25% of total contractor cost. Direct salaries are 50% of the "labor & benefits" cost. The fraction of investment that represents labor cost for these items, and is, therefore,

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

subject to the regional labor adjustment factor, is 0.25 times 0.50, or 0.125 of the trenching and excavation costs.

Once the adjustment factors are determined in this fashion, the factor is multiplied by the corresponding unit cost to determine the amount of investment affected by the adjustment. This amount is then multiplied by the specific regional labor adjustment factor to determine the modified investment. For instance, if buried installation trenching per foot is normally $1.77, the adjustment factor of 0.125 applied to this amount is $.2213. If the regional adjustment was 1.07 (e.g., California), the increased installation cost is .07 times $.2213, or $.015.

Application of Regional Labor Adjustment Factor on Buried Installation			
Density Zone	Buried Installation per Foot	Labor Content Affected	Investment Affected per Foot
0-5	$1.77	0.125	$0.2213
5-100	$1.77	0.125	$0.2213
100-200	$1.77	0.125	$0.2213
200-650	$1.93	0.125	$0.2413
650-850	$2.17	0.125	$0.2713
850-2,550	$3.54	0.125	$0.4425
2,550-5,000	$4.27	0.125	$0.5338
5,000-10,000	$13.00	0.125	$1.6250
10,000+	$45.00	0.125	$5.6250

Application of Regional Labor Adjustment Factor on Conduit Installation			
Density Zone	Conduit Installation per Foot	Labor Content Affected	Investment Affected per Foot
0-5	$10.29	0.125	$1.2863
5-100	$10.29	0.125	$1.2863
100-200	$10.29	0.125	$1.2863
200-650	$11.35	0.125	$1.4188
650-850	$11.38	0.125	$1.4225
850-2,550	$16.40	0.125	$2.0500
2,550-5,000	$21.60	0.125	$2.7000
5,000-10,000	$50.10	0.125	$6.2625
10,000+	$75.00	0.125	$9.3750

Application of Regional Labor Adjustment Factor on Manhole Installation			
Density Zone	Manhole Excavation & Backfill	Labor Content Affected	Investment Affected per Manhole
0-5	$2,800	0.125	$350
5-100	$2,800	0.125	$350
100-200	$2,800	0.125	$350
200-650	$2,800	0.125	$350
650-850	$3,200	0.125	$400
850-2,550	$3,500	0.125	$438
2,550-5,000	$3,500	0.125	$438
5,000-10,000	$5,000	0.125	$625
10,000+	$5,000	0.125	$625

Application of Regional Labor Adjustment Factor on Fiber Pullbox Installation			
Density Zone	Pullbox Excavation & Backfill	Labor Content Affected	Investment Affected per Pullbox
0-5	$220	0.125	$27.50
5-100	$220	0.125	$27.50
100-200	$220	0.125	$27.50
200-650	$220	0.125	$27.50
650-850	$220	0.125	$27.50
850-2,550	$220	0.125	$27.50
2,550-5,000	$220	0.125	$27.50
5,000-10,000	$220	0.125	$27.50
10,000+	$220	0.125	$27.50

Application of Regional Labor Adjustment Factor on Copper Distribution Cable Installation			
Copper Distribution Cable Size	Installed Copper Distribution Cost	Labor Content Affected	Investment Affected per Foot
2,400	$20.00	0.164	$3.28
1,800	$16.00	0.164	$2.62
1,200	$12.00	0.164	$1.97
900	$10.00	0.164	$1.64
600	$7.75	0.164	$1.27
400	$6.00	0.164	$0.98
200	$4.25	0.164	$0.70
100	$2.50	0.164	$0.41
50	$1.63	0.164	$0.27
25	$1.19	0.164	$0.20
12	$.76	0.201	$0.15
6	$.63	0.219	$0.14

Application of Regional Labor Adjustment Factor on Copper Feeder Cable Installation			
Copper Feeder Cable Size	Installed Copper Feeder Cost	Labor Content Affected	Investment Affected per Foot
4,200	$29.00	0.164	$4.76
3,600	$26.00	0.164	$4.26
3,000	$23.00	0.164	$3.77
2,400	$20.00	0.164	$3.28
1,800	$16.00	0.164	$2.62
1,200	$12.00	0.164	$1.97
900	$10.00	0.164	$1.64
600	$7.75	0.164	$1.27
400	$6.00	0.164	$0.98
200	$4.25	0.164	$0.70
100	$2.50	0.164	$0.41

Application of Regional Labor Adjustment Factor on Fiber Feeder Cable Installation				
Fiber Feeder Cable Size	Installed Fiber Feeder Cost	Labor Content Affected	Factor	Investment Affected per Foot
216	$13.10	$2.00	0.364	$0.73
144	$9.50	$2.00	0.364	$0.73
96	$7.10	$2.00	0.364	$0.73
72	$5.90	$2.00	0.364	$0.73
60	$5.30	$2.00	0.364	$0.73
48	$4.70	$2.00	0.364	$0.73
36	$4.10	$2.00	0.364	$0.73
24	$3.50	$2.00	0.364	$0.73
18	$3.20	$2.00	0.364	$0.73
12	$2.90	$2.00	0.364	$0.73

Application of Regional Labor Adjustment Factor on Outdoor SAI Installation			
Outdoor SAI Total Pairs Terminated	Installed Outdoor SAI	Labor Content Affected	Investment Affected per Outdoor SAI
7,200	$4,469	0.164	$733
5,400	$3,569	0.164	$585
3,600	$2,610	0.164	$428
2,700	$2,028	0.164	$333
1,800	$1,500	0.164	$246
1,200	$1,071	0.164	$176
900	$902	0.164	$148
600	$642	0.164	$105
300	$300	0.164	$49
150	$250	0.164	$41
50	$250	0.164	$41

Application of Regional Labor Adjustment Factor on Indoor SAI Installation			
Indoor SAI Distribution Cable Size	Installed Indoor SAI	Labor Content Affected	Investment Affected per Indoor SAI
7,200	$1,052	0.164	$733
5,400	$864	0.164	$585
3,600	$576	0.164	$428
2,700	$432	0.164	$333
1,800	$288	0.164	$246
1,200	$192	0.164	$176
900	$96	0.164	$148
600	$48	0.164	$105
300	$48	0.164	$49
150	$48	0.164	$.41
50	$48	0.201	$41

Telco Installation & Repair labor (Drop & NID installation): Regional Labor Adjustment Factor applies to $20 of the $35 loaded labor rate (exclusive of exempt material loadings).

Application of Regional Labor Adjustment Factor on NID Installation			
Type of NID	NID Basic Labor	Labor Content Affected	Investment Affected per NID
Residence	$15.00	0.571	$8.57
Business	$15.00	0.571	$8.57

Application of Regional Labor Adjustment Factor on Aerial Drop Installation			
Density Zone	Installed Aerial Drop	Labor Content Affected	Investment Affected per Drop
0-5	$23.33	0.571	$13.33
5-100	$23.33	0.571	$13.33
100-200	$17.50	0.571	$10.00
200-650	$17.50	0.571	$10.00
650-850	$11.67	0.571	$6.67
850-2,550	$11.67	0.571	$6.67
2,550-5,000	$11.67	0.571	$6.67
5,000-10,000	$11.67	0.571	$6.67
10,000+	$11.67	0.571	$6.67

Application of Regional Labor Adjustment Factor on Buried Drop Installation			
Density Zone	Installed Buried Drop per Foot	Labor Content Affected	Investment Affected per Drop
0-5	$0.75	0.125	$0.094
5-100	$0.75	0.125	$0.094
100-200	$0.75	0.125	$0.094
200-650	$0.75	0.125	$0.094
650-850	$0.75	0.125	$0.094
850-2,550	$0.75	0.125	$0.094
2,550-5,000	$1.13	0.125	$0.141
5,000-10,000	$1.50	0.125	$0.188
10,000+	$5.00	0.125	$0.625

The following chart shows recommended default values for each state.

Regional Labor Adjustment Factor:

Direct Labor costs vary among regions in the United States. A variety of sources can be used for labor adjustment factors.[6] The following statewide labor adjustment factor indexes can be used as default values:

[6] See, for example, Square Foot Costs, 18th Annual Edition, R.S. Means Company, Inc., 1996, p.429-433.

State	Factor[7]
Alaska	1.25
Hawaii	1.22
Massachusetts	1.09
California	1.07
Michigan	1.01
New York	1.00
New Jersey	1.00
Rhode Island	1.00
Illinois	1.00
Minnesota	0.99
Connecticut	0.98
Pennsylvania	0.97
Nevada	0.95
Washington (State)	0.92
Oregon	0.92
Delaware	0.92
Indiana	0.92
Missouri	0.90
Maryland	0.89
New Hampshire	0.86
Montana	0.85
West Virginia	0.84
Ohio	0.83
Wisconsin	0.83
Arizona	0.81
Colorado	0.77
New Mexico	0.76
Vermont	0.75
Iowa	0.74
North Dakota	0.74
Idaho	0.73
Maine	0.73
Kentucky	0.73
Louisiana	0.72
Kansas	0.71
Utah	0.71
Tennessee	0.70
Oklahoma	0.69
Florida	0.68
Virginia	0.67
Nebraska	0.65
Texas	0.65
South Dakota	0.64
Georgia	0.62

[7] Martin D. Kiley and Marques Allyn, eds., *1997 National Construction Estimator 45th Edition*, pp. 12-15. [Normalized for New York State as 1.00]

State	Factor[7]
Arkansas	0.61
Wyoming	0.60
Alabama	0.58
Mississippi	0.58
South Carolina	0.55
North Carolina	0.51

2.5. BURIED, AERIAL, AND UNDERGROUND PLACEMENT FRACTION

Definition: Outside plant structure refers to the set of facilities that support, house, guide, or otherwise protect distribution and feeder cable. There are three types of structure: aerial, buried, and underground.

a) Aerial Structure

Aerial structure includes poles and associated hardware.[8] Pole investment is a function of the material and labor costs of placing a pole. A user-adjustable input adjusts the labor component of poles investment to local conditions. The Hatfield Model computes the total investment in aerial distribution and feeder structure within a CBG by evaluating relevant parameters, including the distance between poles, the investment in the pole itself, the total cable sheath mileage, and the fraction of aerial structure along the route.

Poles are assumed to be 40 foot Class 4 poles. The spacing between poles for aerial cable is fixed within a given density range, but may vary between density ranges.

b) Buried Structure

Buried structure consists of trenches. The additional cost for protective sheathing and waterproof filling of buried cable is a fixed amount per foot in the case of fiber cable, and is a multiplier of cable cost in the case of copper cable.[9] The total investment in buried structure is a function of total route mileage, the fraction of buried structure, investment in protective sheathing and filling and the density-range-specific cost of trenching.

c) Underground Structure

Underground structure consists of conduit and, for feeder plant, manholes and pullboxes. Manholes are used in conjunction with copper cable routes; pullboxes are used with fiber cable. The total investment in a manhole varies by density zone, and is a function of the following investments: materials, frame and cover, excavation, backfill, and site delivery. Investment in fiber pullboxes is a function of materials and labor. Underground cables are housed in conduit facilities that extend between manholes or pullboxes. The total investment in underground structure is a function of total route mileage, the fraction of underground structure, investment in conduit manholes, and pullboxes, and the cost of trenching needed to hold the conduit.

In each line density range, there may be a mixture of aerial, buried, and underground structure. For example, in downtown urban areas it is frequently necessary to install cable in underground conduit systems, while rural areas may consist almost exclusively of aerial or direct-buried plant.

Users can adjust the mix of aerial, underground and buried cable assumed within the Hatfield model. These settings may be made separately by density zone for fiber feeder, copper feeder, and copper distribution cables.

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[8] In the two highest density zones, aerial structure is also assumed to consist of intrabuilding riser cable and "block cable" attached to buildings. In HM 4.0, this "aerial" structure does not include poles.

[9] The default values for sheathing are an additive \$.20 per foot for fiber and a multiplier of 1.04 for copper. The different treatment reflects the fact that the outside dimension of fiber cable is essentially constant for different strand numbers, while the dimension of copper cable increases with the number of pairs it contains.

Default Values:

Distribution Cable Structure Fractions			
Density Zone	Aerial/Block Cable	Buried Cable	Underground Cable (calculated)
0-5	.25	.75	0
5-100	.25	.75	0
100-200	.25	.75	0
200-650	.30	.70	0
650-850	.30	.70	0
850-2,550	.30	.70	0
2,550-5,000	.30	.65	.05
5,000-10,000	.60	.35	.05
10,000+	.85	.05	.10

Support: 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."[10]

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.

HM 4.0 accounts for drop wire separately. Cable attached to the [out]sides of buildings, normally found in higher density areas, are also appropriately classified to the aerial cable account. To facilitate modeling, HM 4.0 reasonably includes Intrabuilding Network Cable under its treatment of aerial cable.

Therefore, the default percentages above 2,550 lines per square mile indicate a growing amount of block and intrabuilding cable, rather than cable placed on pole lines (although existing joint use pole lines are also more prevalent in older, more dense neighborhoods built prior to 1980).

Buried Cable:

Default values in HM 4.0 reflect an increasing trend toward use of buried cable in new subdivisions. Since 1980, new subdivisions have usually been served with 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. Contacts with telephone outside plant engineers, architects and property developers in several states confirm that in new subdivisions, builders typically not only prefer buried plant that is capable of accommodating multiple uses, but they usually dig the trenches at their own expense and place power, telephone, and CATV cables in the trenches, if the utilities are willing to supply the materials. Thus, many buried structures are available to the LEC at no charge, although the Model does not reflect such savings, since it is uncertain.

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

Underground Cable:

Underground cable, conduit, and manholes are primarily used for feeder and interoffice transport cables, not for distribution cable. Distribution plant in congested, extensively paved, high density areas usually runs only a short distance underground from the SAI to the block terminal, thus it requires no intermediate splicing chambers. In high density residential, distribution cables are frequently run from pole lines, under a street and back up onto a pole line, or from buried plant, under a street and back to a buried cable run. Such conduit runs are short enough to not require a splicing chamber or manhole and are therefore classified to the aerial or buried cable account, respectively.

There may be rare exceptions where distribution cable from a SAI is so long that it requires an underground splicing chamber (manhole). Sometimes feeder cable will be extended, via a lateral, into a SAI, and distribution pairs in the same feeder stub will run back into the same manhole for further routing to aerial or buried structures down a street. In those cases, manholes and conduit were placed for feeder cable and have already been accounted for in the cost of feeder plant structure. Therefore it is unnecessary to double count such manholes and conduit when used occasionally for the routing of a distribution backbone cable.

In a "campus environment," where underground structure is used, it is owned and operated by the owner of the campus and not the ILEC. The cable is treated as Intrabuilding Network Cable between buildings on one customer's premises, and the cost of such cable is not included in the model.

2.6. CABLE FILL AND POLE SPACING

2.6.1. 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.

Default Values:

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.

2.6.2. Distribution Pole Spacing

Definition: Spacing between poles supporting aerial distribution cable.

Default Values:

Distribution Pole Spacing	
Density Zone	**Spacing**
0-5	250
5-100	250
100-200	200
200-650	200
650-850	175
850-2,550	175
2,550-5,000	150
5,000-10,000	150
10,000+	150

Support: Distances between poles are longer in more rural areas for a several reasons. Poles are usually placed on property boundaries, and at each side of road intersections (unless cable is run below the road surface in conduit). Property boundaries tend to be farther apart in less dense areas, and road intersections are also farther apart.

Depending on the weight of the cable, and the generally accepted guideline that sag should not exceed 10 feet at mid-span, while still maintaining appropriate clearances as designated by the National Electric Safety Code, very long spans between poles may be achieved. This length may be as great as 1,500 feet using heavy gauge strand and very light cable, or may be shorter for heavier cables.[11] In practice, much shorter span distances are employed, usually 400 feet or less.

"...where conditions permit, open wire spans can approach 400 feet in length with practical assurance that the lines will withstand any combination of weather condition. Longer spans mean savings in construction costs and a net reduction in over-all plant investment, including fewer poles to buy, smaller quantity of pole hardware required, and less construction time. The use of long spans also means a reduction in maintenance expense."[12]

[11] Bellcore, *Clearance for Aerial Cable and Guys in Light, Medium and Heavy Loading Areas, (BR 627-070-015), Issue 1*, 1987.
see also, Bellcore, *Clearances for Aerial Plant, (BR 918-117-090), Issue 5*, 1987.
see also, Bellcore, *Long Span Construction (BR 627-370-XXX)*, date unk.

[12] Lee, Frank E., *Outside Plant, abc of the Telephone Series, Volume 4*, abc TeleTraining, Inc., Geneva, IL, 1987, p. 41.

2.7. GEOLOGY AND POPULATION CLUSTERS

2.7.1. Distribution Distance Multiplier, Difficult Terrain

Definition: The amount of extra distance required to route distribution and feeder cable around difficult soil conditions, expressed as a multiplier of the distance calculated for normal situations.

Default Value:

Distribution Distance Multiplier, Difficult Terrain
1.0

Support: HM 4.0 treats difficult buried cable placement in rock conditions using five parameters: 1) Distribution Distance Multiplier, Difficult Terrain; 2) Surface Texture Multiplier; 3) Rock Depth Threshold, inches; 4) Hard Rock Placement Multiplier; and 5) Soft Rock Placement Multiplier. The last three of these pertain to the effect of bedrock close to the surface – see Section 2.7.2 through 2.7.5. The first pertains to difficult soil conditions such as the presence of boulders.

While the typical response to difficult soil conditions is often to simply route cable around those conditions, which could be reflected in this parameter, HM 4.0 instead treats the effect of difficult soil conditions as a multiplier of placement cost - see Parameter 6.5, Surface Texture Multiplier. Therefore. the distribution distance multiplier is set to 1.0.

2.7.2. Rock Depth Threshold, Inches

Definition: The depth of bedrock, less than which (that is, closer to the surface) additional costs are incurred for placing distribution or feeder cable. The depth of bedrock is provided by USGS data for each CBG.

Default Value:

Rock Depth Threshold, Inches
24 inches

Support: Cable is normally placed at a minimum depth of 24 inches. Where USGS data indicates the presence of rock closer to the surface, HM 4.0 imposes additional costs.

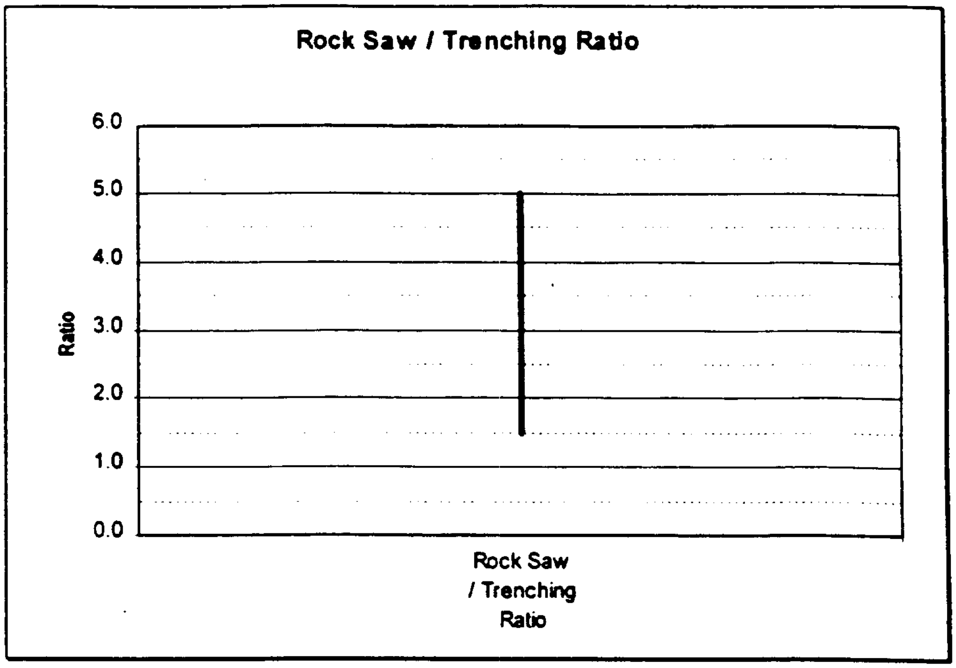
2.7.3. Hard Rock Placement Multiplier

Definition: The increased cost required to place distribution or feeder cable in bedrock classified as hard, when it is within the rock depth threshold of the surface, expressed as a multiplier of normal installation cost per foot.

Default Value:

Hard Rock Placement Multiplier
3.5

Support: A rock saw is used whenever hard rock must be excavated. Information received from independent contractors who perform this type of work is reflected below. Hard rock costs are reflected at the top of the scale.



2.7.4. Soft Rock Placement Multiplier

Definition: The increased cost required to place distribution or feeder cable in bedrock classified as soft, when it is within the rock depth threshold of the surface, expressed as a multiplier of normal installation cost per foot.

Default Value:

Soft Rock Placement Multiplier
2.0

Support: A rock saw or tractor-mounted ripper is used whenever soft rock must be excavated. Information received from independent contractors who perform this type of work is reflected in the figure in section 2.7.3. Soft rock costs are reflected at the lower end of the scale.

2.7.5. Sidewalk / Street Fraction

Definition: The fraction of small, urban CBGs that are streets and sidewalks, used in the comparison of occupied CBG area with number of lines to identify cases where high rise buildings are present. To qualify as a small urban CBG, the total land area must be less than .03 square miles and the line density must exceed 30,000 lines per square mile.

Default Value:

Sidewalk / Street Fraction
.20

Support: The sidewalk/street fraction is computed using a .03 square mile (836,352 square feet) CBG, the largest CBG to which it applies. This densely urban CBG is assumed to be square, which means each side of the CBG is approximately 915 feet long. As a result, the roads and sidewalks running around the outside of such a CBG would cover a total land area of approximately 165,000 square feet (915 feet per side times 4 sides times (15 foot wide sidewalk + .5 times 60 foot wide street), or 20 percent of the CBG's total area. The remaining 80 percent, or non-sidewalk/street land area, is occupied by buildings.

2.7.6. Local RT (per Cluster) Thresholds – Maximum Total Distance

Definition: The maximum potential distribution length, in feet, above which Remote Terminals are located at the center of each cluster, rather than at the center of the CBG, in order to reduce the remaining distribution length.

Default Value:

Local RT (per cluster) Thresholds Maximum Total Distance
18,000 ft.

Support: The default value was chosen to be consistent with the minimum distance at which long loop treatment is usually required.[13]

2.7.7. Town Factor

Definition: The fraction of business and residential customers that are assumed to be located in clusters, as opposed to surrounding areas, for those rural population cases in which the model determines that such clustering is likely. The rural clustering assumption is made for all CBGs falling in the lowest three line density zones, and all other CBGs whose fraction of empty area is greater than 50 percent. The default value is equal to one minus the fraction of rural population that is located on farms, averaged across the U.S.

Default Value:

Town Factor
.85

Support: Derived from data in the *Statistical Abstract of the United States, 1995*. Using rural population (table 44), farm data (table 1105), and 4 pops per farm, town factors are computed as one minus the fraction of rural population that is located on farms (i.e., town factor (state) = 1 – (number of farms * 4 pops per farm) / rural pops). A table containing the computed town factor for each state is provided below.

State	Rural Pop (1,000)[14]	Farms[15] (1,000)	Farm Pop	Town Factor

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

State	Rural Pop (1,000)[14]	Farms[15] (1,000)	Farm Pop	Town Factor
Alabama	1,601	47	188,000	0.8826
Alaska	179	1	4,000	0.9776
Arizona	458	8	32,000	0.9302
Arkansas	1,093	47	188,000	0.8279
California	2,189	85	340,000	0.8447
Colorado	579	27	108,000	0.8134
Connecticut	686	4	16,000	0.9767
Delaware	180	3	12,000	0.9332
Florida	1,971	41	164,000	0.9168
Georgia	2,381	48	192,000	0.9194
Hawaii	122	5	20,000	0.8361
Idaho	429	22	88,000	0.7946
Illinois	1,762	83	332,000	0.8116
Indiana	1,946	68	272,000	0.8602
Iowa	1,094	104	416,000	0.6196
Kansas	765	69	276,000	0.6392
Kentucky	1,775	93	372,000	0.7904
Louisiana	1,348	32	128,000	0.9051
Maine	680	7	28,000	0.9588
Maryland	893	15	60,000	0.9328
Massachusetts	947	7	28,000	0.9704
Michigan	2,739	54	216,000	0.9212
Minnesota	1,319	89	356,000	0.7300
Mississippi	1,362	40	160,000	0.8826
Missouri	1,601	108	432,000	0.7302
Montana	379	25	100,000	0.7363
Nebraska	534	57	228,000	0.5734
Nevada	140	3	12,000	0.9145
New Hampshire	544	3	12,000	0.9779
New Jersey	820	8	32,000	0.9610
New Mexico	409	14	56,000	0.8632
New York	2,826	39	156,000	0.9448
North Carolina	3,291	62	248,000	0.9246
North Dakota	298	34	136,000	0.5443
Ohio	2,808	84	336,000	0.8803
Oklahoma	1,015	70	280,000	0.7243
Oregon	839	37	148,000	0.8236
Pennsylvania	3,693	53	212,000	0.9426
Rhode Island	140	1	4,000	0.9714
South Carolina	1,581	25	100,000	0.9368
South Dakota	348	35	140,000	0.5978
Tennessee	1,907	89	356,000	0.8133
Texas	3,352	186	744,000	0.7780
Utah	224	13	52,000	0.7676

[14] Rural population counts are from the Statistical Abstract, 1995, table 44. For the definition of rural population, see the Statistical Abstract, p.4.

[15] Farm counts from Statistical Abstract, 1995, table 1105 (4 pops/farm). Farms are defined as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.

State	Rural Pop (1,000)[14]	Farms[15] (1,000)	Farm Pop	Town Factor
Vermont	382	7	28,000	0.9266
Virginia	1,894	46	184,000	0.9028
Washington	1,149	37	148,000	0.8712
West Virginia	1,145	21	84,000	0.9267
Wisconsin	1,680	80	320,000	0.8095
Wyoming	159	9	36,000	0.7735

2.7.8. Maximum Lot Size, Acres

Definition: The maximum effective lot size allowed in a non-rural CBG, above which it is assumed that the population is clustered into areas whose effective lot size is the default value (that is, there is a cap on the amount of land each subscriber occupies).

Default Value:

Maximum Lot Size
3.0 acres

Support: Based on observations that subdivisions, towns, or other areas where a grid distribution structure is used rarely consist of plots greater than 3 acres.

2.7.9. Town Lot Size, Acres

Definition: The assumed lot size– including common areas such as streets and parks -- of subscribers residing in rural population clusters.

Default Value:

Town Lot Size
3.0 acres

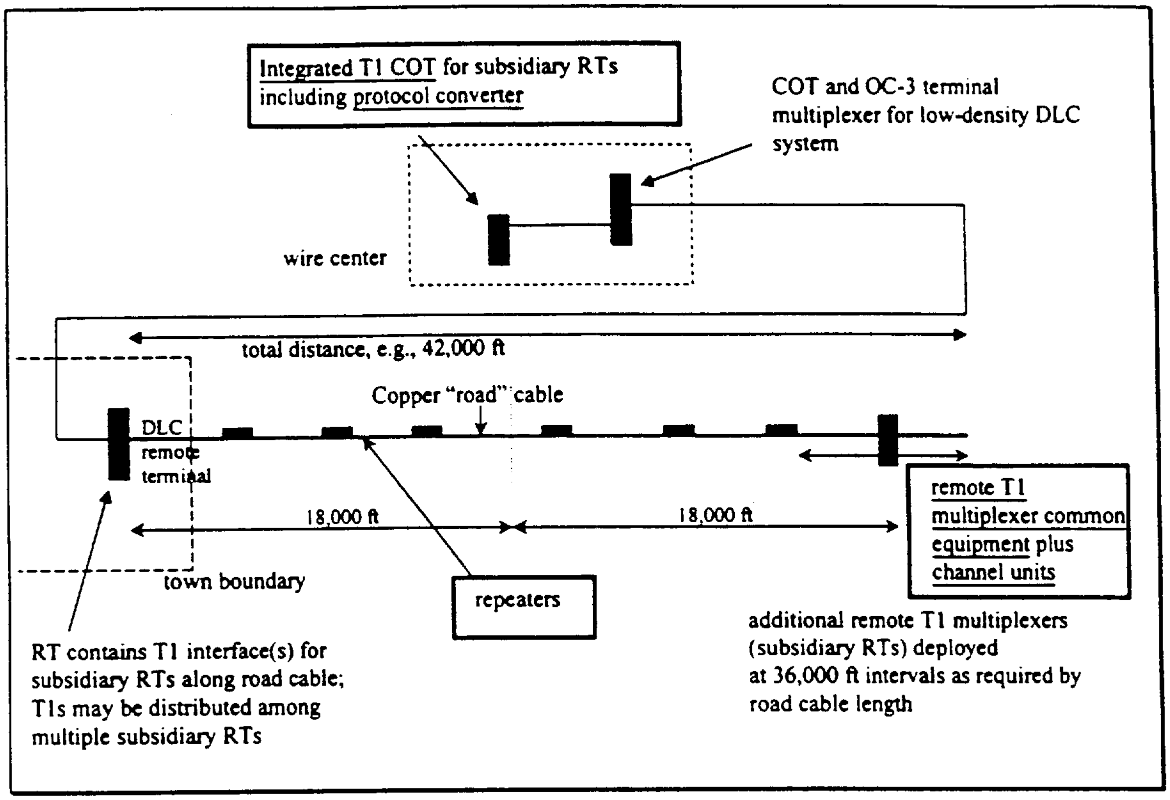
Support: For clustering in rural areas the model calculates total cluster area as the sum of individual lot sizes. Larger lot sizes thus produce more distribution cable in this case. Assuming three acre lot sizes within a cluster yields a conservatively high cost estimate.

2.8. LONG LOOP INVESTMENTS

General:

HM 4.0 extends fiber fed Integrated Digital Loop Carrier (IDLC) deep into the loop. Even if feeder cable is shorter than the Copper Feeder Maximum Distance, if the total length of copper is greater than 18,000 feet, HM 4.0 places fiber and IDLC into the quadrants of the CBG using either GR-303 or Low Density DLC. An additional test is performed to determine if the copper distribution cable is still longer than 18,000 feet. If it is, HM 4.0 calls for use of T1 on copper to feed small Digital Loop Carrier sites (maximum of 24 lines per T1) with repeaters as necessary.

The T1 system has a number of components described in parameters 2.8.1. through 2.8.5. The relationship among these components is shown in the following figure.



2.8.1. T1 Repeater Investments, Installed

Definition: The investment per T1 repeater, including electronics, housing, and installation, for T1 extension of loops longer than 18,000 ft.

Default Value:

Repeater Investment, Installed
$300

Support: The cost of a line powered T1 repeater was estimated by a team of experienced outside plant experts with extensive experience in purchasing such units, and arranging for their installation. The equipment portion of this investment is based on supplier information less discount.

2.8.2. Integrated T1 COT, Installed

Definition: The installed Central Office Terminal (COT) investment per road cable required to terminate the copper fed T1 DLC connection serving subscribers along roads longer than 18,000 ft.

Default Value:

Integrated COT, Installed
$4,400

Support: The cost of an initial increment of this type of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts who were in contact with vendors of appropriate small size IDLC equipment suitable for extending bandwidth on conditioned copper pairs. The equipment portion of this investment is based on supplier information less discount.

2.8.3. Remote T1 Multiplexer Common Equipment Investment, Installed

Definition: The installed investment per T1 fed Subsidiary Remote Terminal, including the T1 interface in the DLC RT, used to serve subscribers along road cables longer than 18,000 ft.

Default Value:

Remote Mux Common Equip, Installed
$5,510

Support: The cost of an initial increment of this type of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts who were in contact with vendors of appropriate small size IDLC equipment suitable for extending bandwidth on conditioned copper pairs. The equipment portion of this investment is based on supplier information less discount.

2.8.4. T1 Channel Unit Investment per Subscriber

Definition: The investment per line in POTS channel units installed in T1 fed Subsidiary RTs serving subscribers located along roads longer than 18,000 ft.

Default Value:

Channel Unit Investment per Subscriber
$125

Support: The cost of appropriate line cards used for this type of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts who were in contact with vendors of appropriate small size IDLC equipment suitable for extending bandwidth on conditioned copper pairs. The equipment portion of this investment is based on supplier information less discount.

2.8.5. COT Investment per T1 RT, Installed

Definition: The installed investment per T1 fed Subsidiary RT in protocol conversion equipment for interfacing with the integrated COT.

Default Value:

COT Investment per RT, Installed
$1,265

Support: The cost of an initial increment of this type of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts who were in contact with vendors of appropriate small size IDLC equipment suitable for extending bandwidth on conditioned copper pairs. The equipment portion of this investment is based on supplier information less discount.

2.9. SAI INVESTMENT

Definition: The installed investment in the Serving Area interface (SAI) that acts as the physical interface point between distribution and feeder cable.

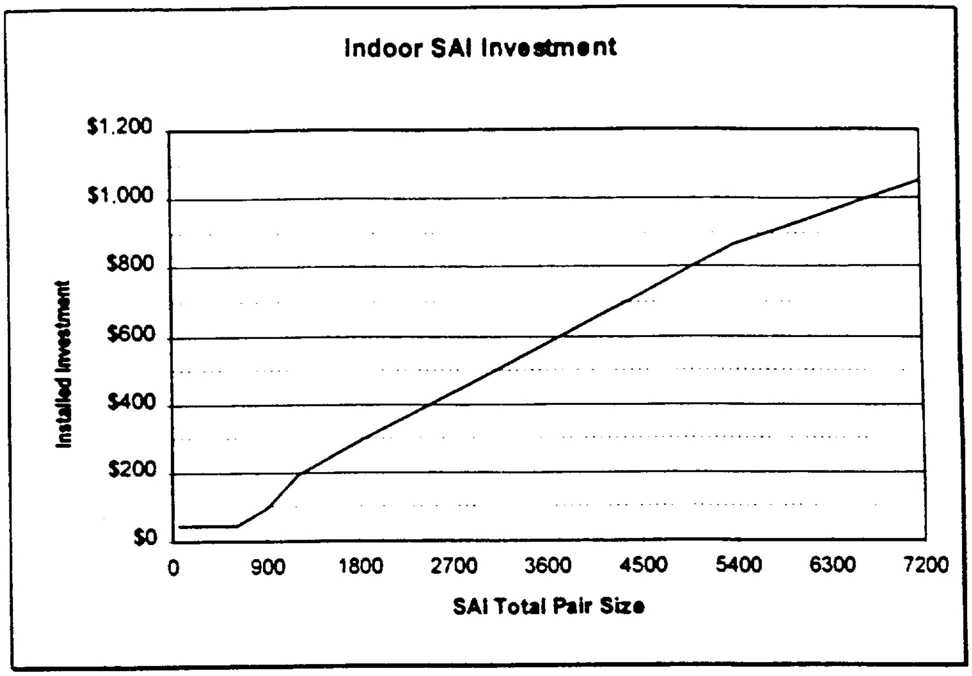
Default Values:

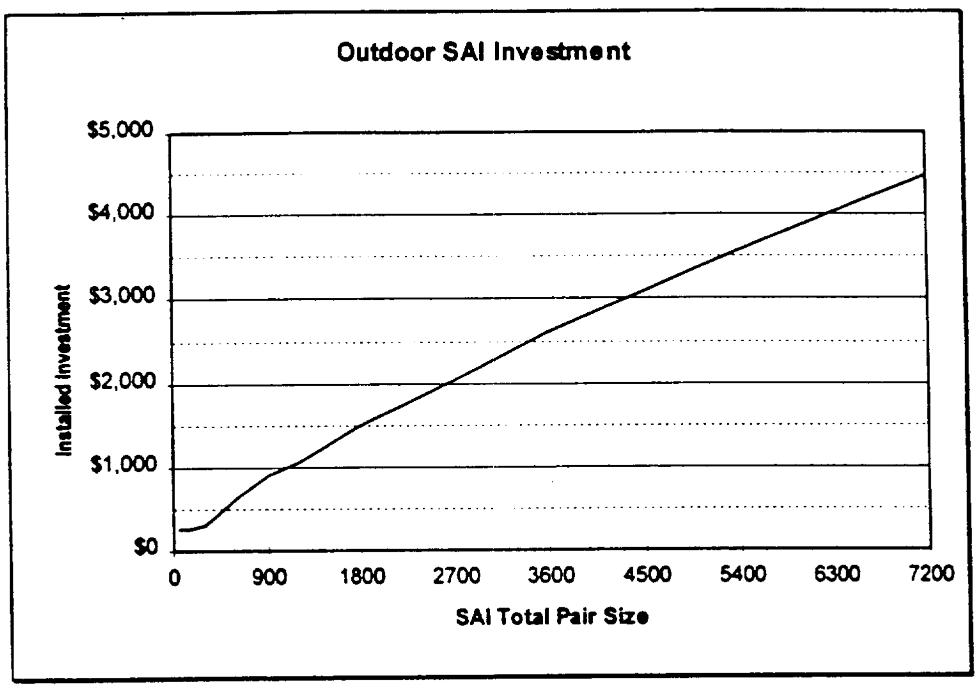
SAI Investment		
SAI Size	**Indoor SAI**	**Outdoor SAI**
7200	$3,456	$10,000
5400	$2,592	$8,200
3600	$1,728	$6,000
2400	$1,152	$4,300
1800	$864	$3,400
1200	$576	$2,400
900	$432	$1,900
600	$288	$1,400
400	$192	$1,000
200	$96	$600
100	$48	$350
50	$48	$250

Support: Indoor Serving Area Interfaces are used in buildings, and consist of simple terminations, or punch down blocks, and lightning protection where required. Equipment is normally mounted on a plywood backboard in common space. Outdoor Serving Area Interfaces are more expensive, requiring steel cabinets that protect the cross connection terminations from the direct effects of water. Both indoor and outdoor SAI investments are a function of the total number of pairs, both Feeder and Distribution, that the SAI terminates.

The total number of pairs terminated in the SAI is computed as follows. a) The number of Feeder Pair terminations provided is equal to 1.5 times the number of households plus the number of business, special access, and public lines required. b) The number of Distribution Pair terminations provided is equal to 2.0 time the number of households plus the number of business, special access, and public lines required.

Prices are the opinion of a group of Engineering Experts.


Indoor SAI Investment
$1,200
$1,000
$800
$600
$400
$200
$0
Installed Investment
0
900
1800
2700
3600
4500
5400
6300
7200
SAI Total Pair Size


Outdoor SAI Investment
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Installed Investment
0
900
1800
2700
3600
4500
5400
6300
7200
SAI Total Pair Size

2.10. DEDICATED CIRCUIT INPUTS

2.10.1. Percentage of Dedicated Circuits

Definition: The fractions of total circuits included in the count of total private line and special access circuits that are DS-0 and DS-1 circuits, respectively. The fraction of DS-3 and higher capacity circuits is calculated by the model as (1 minus fraction DS-0 minus fraction DS-1). The equivalence between the three circuit types -- that is, DS-0, DS-1, and DS-3 -- and wire pairs is expressed in Section 2.10.2.

Default Values:

Percentage of Dedicated Circuits	
DS-0	DS-1
100%	0%

Support: These parameters provide the breakdown of reported dedicated circuits into voice-grade equivalents and DS-0s, DS-1s, and DS-3s. The default database values for dedicated circuits represent special access voice-grade and DS-0 equivalents as reported in ARMIS 43-08. Thus, the default input values are 100 percent for DS-0/voice grade, and 0 percent for DS-1 and DS-3.

2.10.2. Pairs per Dedicated Circuit

Definition: Factor expressing the number of wire pairs required per dedicated circuit classification.

Default Values:

Pairs per Dedicated Circuit		
DS-0	DS-1	DS-3
1	2	56

Support: A DS-1 bit stream on copper requires one transmit pair and one receive pair. Although a DS-3 signal can only be transmitted on fiber or coax, the bit stream carries the equivalent of 28 DS-1's. Since a DS-1 requires 2 pairs, a DS-3 is represented in HM 4.0 as requiring 28 times 2 pairs, or a total of 56 pairs. While many DS-0s are provided on 4-wire circuits, the model conservatively assumes only one pair per DS-0.

3. FEEDER INPUT PARAMETERS

3.1. COPPER PLACEMENT

3.1.1. 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.

Default Values:

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."[16]

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.

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

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.

3.1.2. Copper Feeder Manhole Spacing, Feet

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

Default Values:

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."[17]

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[18], the largest used by the Hatfield Model. Therefore the longest distance between manholes used for copper cable is 800 feet.

3.1.3. Copper Feeder Pole Spacing, Feet

Definition: Spacing between poles supporting aerial copper feeder cable.

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

[18] AT&T, *Outside Plant Systems*, pp. 1-7.

Default Values:

Copper Feeder Pole Spacing	
Density Zone	**Spacing, ft.**
0-5	250
5-100	250
100-200	200
200-650	200
650-850	175
850-2,550	175
2,550-5,000	150
5,000-10,000	150
10,000+	150

Support: *{NOTE: The discussion in Section 2.6.2. [Distribution] is reproduced here for ease of use.}*

Distances between poles are longer in more rural areas for a several reasons. Poles are usually placed on property boundaries, and at each side of road intersections (unless cable is run below the road surface in conduit). Property boundaries tend to be farther apart in less dense areas, and road intersections are also farther apart.

Depending on the weight of the cable, and the generally accepted guideline that sag should not exceed 10 feet at mid-span, while still maintaining appropriate clearances as designated by the National Electric Safety Code, very long spans between poles may be achieved. This length may be as great as 1,500 feet using heavy gauge strand and very light cable, or may be shorter for heavier cables.[19] In practice, much shorter span distances are employed, usually 400 feet or less.

"...where conditions permit, open wire spans can approach 400 feet in length with practical assurance that the lines will withstand any combination of weather condition. Longer spans mean savings in construction costs and a net reduction in over-all plant investment, including fewer poles to buy, smaller quantity of pole hardware required, and less construction time. The use of long spans also means a reduction in maintenance expense."[20]

3.1.4. Copper Feeder Pole Investment

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

[19] Bellcore, *Clearance for Aerial Cable and Guys in Light, Medium and Heavy Loading Areas, (BR 627-070-015), Issue 1*, 1987.
see also, Bellcore, *Clearances for Aerial Plant, (BR 918-117-090), Issue 5*, 1987.
see also, Bellcore, *Long Span Construction (BR 627-370-XXX)*, date unk.

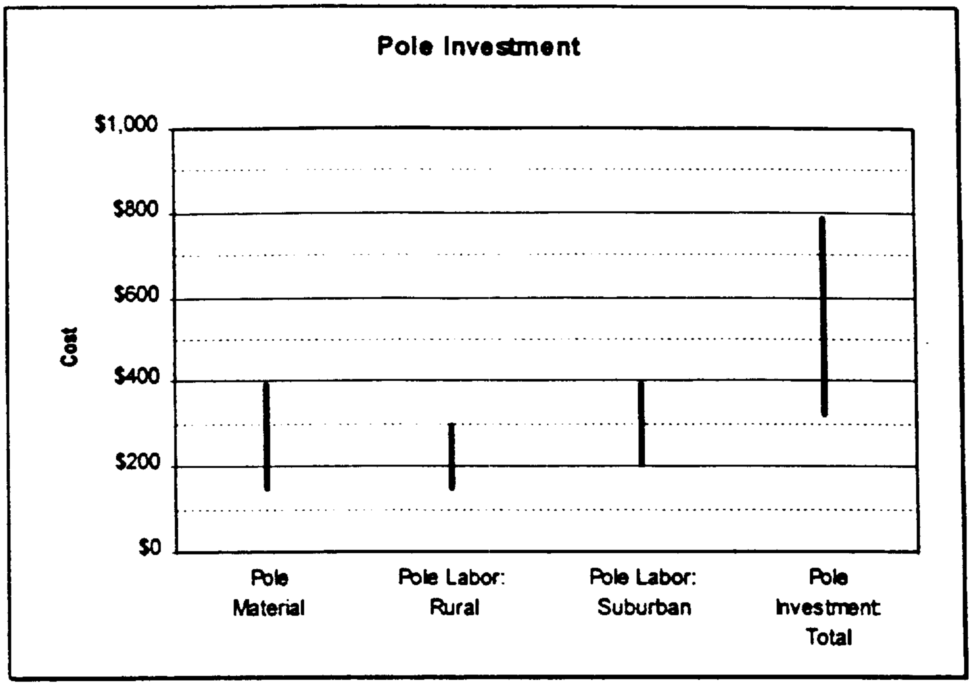
[20] Lee, Frank E., *Outside Plant, abc of the Telephone Series, Volume 4*, abc TeleTraining, Inc., Geneva, IL, 1987, p. 41.

Default Values:

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.

3.1.5. Innerduct Material Investment per Foot

Definition: Material cost per foot of innerduct.

Default Value:

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.

3.2. FIBER PLACEMENT

3.2.1. 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.

Default Values:

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."[21]

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.

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

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.

3.2.2. Fiber Feeder Pullbox Spacing, Feet

Definition: The distance, in feet, between pullboxes for underground fiber feeder cable.

Default Values:

Fiber Feeder Pullbox Spacing, feet	
Density Zone	**Distance between pullboxes, ft.**
0-5	2,000
5-100	2,000
100-200	2,000
200-650	2,000
650-850	2,000
850-2,550	2,000
2,550-5,000	2,000
5,000-10,000	2,000
10,000+	2,000

Support: Unlike copper manhole spacing, the spacing for fiber pullboxes is based on the practice of coiling spare fiber (slack) within pullboxes to facilitate repair in the event the cable is cut or otherwise impacted. Fiber feeder pullbox spacing is not a function of the cable reel lengths, but rather a function of length of cable placed. The standard practice during the cable placement process is to provide for 5 percent excess cable to facilitate subsurface relocation, lessen potential damage from impact on cable, or provide for ease of cable splicing when cable is cut or damaged.[22] It is common practice for outside plant engineers to require approximately 2 slack boxes per mile.

3.2.3. Buried Fiber Sheath Addition, per Foot

Definition: The cost of dual sheathing for additional mechanical protection of buried fiber feeder cable.

Default Value:

Buried Fiber Sheath Addition, per foot
$0.20 / ft.

Support: Incremental cost for mechanical sheath protection on fiber optic cable is a constant per foot, rather than the ratio factor used for copper cable, because fiber sheath is approximately ½ inch in diameter, regardless of the number of fiber strands contained in the sheath. The incremental per foot cost was estimated by a team of experienced outside plant experts who have purchased millions of feet of fiber optic cable.

[22] *Cable Construction Manual, 4th Edition*, CommScope, p. 75.

3.3. FILL FACTORS

3.3.1. 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.

Default Values:

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.

3.3.2. Fiber Feeder Cable Fill Factor

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

Default Values:

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.

3.4. CABLE COSTS

3.4.1. Copper Feeder Cable, Cost per Foot

Definition: The investment per foot in copper feeder cable, engineering, installation, and delivery.

Default Values:

Copper Feeder Investment, per foot	
Cable Size	**$/foot (u/g & aerial)**
4200	$29.00
3600	$26.00
3000	$23.00
2400	$20.00
1800	$16.00
1200	$12.00
900	$10.00
600	$7.75
400	$6.00
200	$4.25
100	$2.50

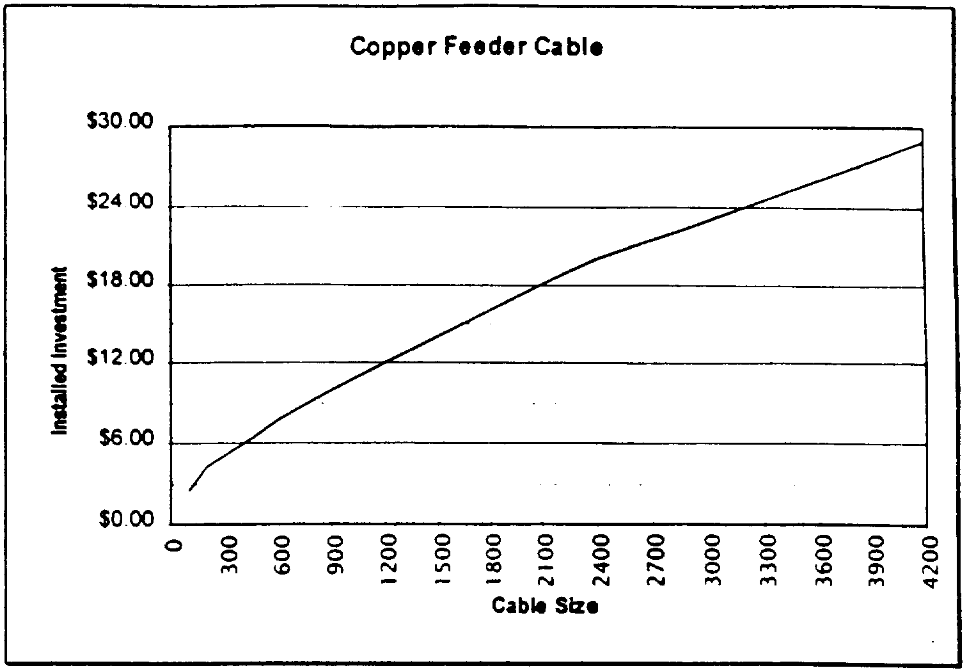
Support: These costs reflect the use of 24-gauge copper feeder cable for cable sizes below 400 pairs, and 26-gauge copper feeder cable for cable sizes of 400 pairs and larger. Although 24-gauge copper is not required for transmission requirements within 18,000 feet of a digital central office with a 1,500 ohm limit, a heavier gauge of copper is used in smaller cable sizes to prevent damage from craft handling wires in pedestals where wires may be exposed, rather than sealed in splice cases. 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.

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.

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



3.4.2. Fiber Feeder Cable, Cost per Foot

Definition: The investment per foot in fiber feeder cable, engineering, installation, and delivery.

Default Values:

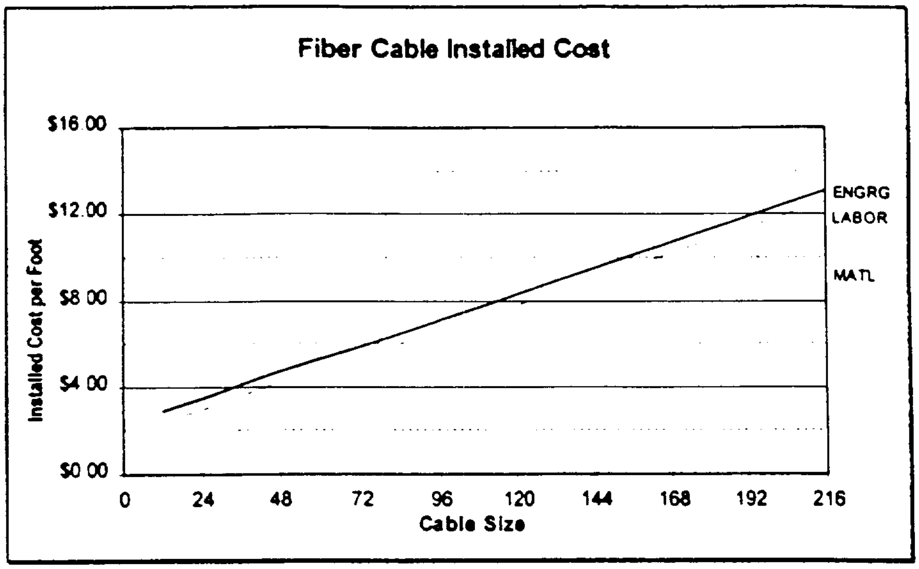
Fiber Feeder Investment, per foot	
Cable Size	**$/foot (u/g & aerial)**
216	$13.10
144	$9.50
96	$7.10
72	$5.90
60	$5.30
48	$4.70
36	$4.10
24	$3.50
18	$3.20
12	$2.90

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.



3.5. DLC EQUIPMENT

3.5.1. DLC Site and Power per Remote Terminal

Definition: The investment in site preparation and power for the remote terminal of a Digital Loop Carrier (DLC) system.

Default Values:

Remote Terminal Site and Power	
GR-303 DLC	Low Density DLC
\$3,000	\$2,500

Support: The incremental per site cost was estimated by a team of outside plant experts with extensive experience in contracting for remote terminal site installations. Low Density DLC requires less space than the higher density GR-303 DLC.

3.5.2. Maximum Line Size per Remote Terminal

Definition: The maximum number of lines supported by the initial line module of a remote terminal.

Default Values:

Maximum Line Increment per Remote Terminal	
GR-303 DLC	Low density DLC
672	96

Support: The standard increment for large fiber optic multiplexers is an OC-3 multiplexer equipped to operate at the OC-1 rate of approximately 50 Mbps. This basic unit provides 28 DS-1s, which can carry 24 DS-0 POTS circuits each. This equates to 672 POTS lines. Although GR-303 allows other concentrations. this is the most common standard used by multiple vendors of Integrated Digital Loop Carrier Systems.

A variety of low density digital loop carrier systems exist in the market today. The HM 4.0 utilizes an integrated configuration, whereby several 96 line Remote Terminal units can home on a standard OC-3 based terminal. Several of these can be used before moving to the larger 672 line system.

3.5.3. Remote Terminal Fill Factor

Definition: The line unit fill factor in a DLC remote terminal, that is, the ratio of lines served by a DLC remote terminal to the number of line units equipped in the remote terminal.

Default Values:

Remote Terminal Fill Factors	
GR-303 DLC	Low Density DLC
.90	.90

Support: The most expensive part of integrated digital loop carrier provisioning is the digital to analog conversion that takes place in the Remote Terminal line card. This expensive card (HM4.0 defaults to \$310 per 4 line card) calls for stringent inventory control on the part of the ILEC. Also, fill factors are largely a function of the time frame needed to provide incremental additions. Since line cards are a highly portable asset, facility relief can be provided by dispatching a technician with line cards, rather than engaging in a several month long copper cable feeder addition. Therefore high fill rates should be the norm for an efficient provider using forward looking technology.

3.5.4. DLC Initial Common Equipment Investment

Definition: The cost of all common equipment and housing in the remote terminal, as well as the fiber optics multiplexer required at the CO end, for the initial line module of the DLC system (assumes integrated digital loop carrier (IDLC)).

Default Values:

Remote Terminal Initial Common Equipment Investment	
GR-303 DLC	Low Density DLC
$66,000	$13,000

Support: The cost of an initial increment of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts with extensive experience in contracting for remote terminal site installations. Low Density DLC requires less initial investment.

3.5.5. DLC Channel Unit Investment

Definition: The investment in channel units required in the remote terminal of the DLC system.

Default Values:

GR-303 and low density DLC channel unit investment per unit	
POTS Channel Unit	Coin Channel Unit
$310	$250

Support: The cost of individual POTS Channel Unit Cards was estimated by a team of experienced outside plant experts with extensive experience in contracting for DLC channel units.

3.5.6. DLC Lines per Channel Unit

Definition: The number of lines that can be supported on a single DLC channel unit.

Default Values:

GR-303 and low density DLC Lines per channel unit	
POTS	Coin
4	2

Support: This is the common configuration for all major market leaders in this technology.

3.5.7. Low Density DLC to GR-303 DLC Cutover

Definition: The threshold number of lines served, above which the GR-303 DLC will be used.

Default Value:

Low Density DLC to GR-303 DLC Cutover
384 lines

Support: An analysis of initial costs reveals that 4 Low Density DLC units, at 96 lines each, are more cost effective than a single large IDLC unit with a capacity of 672 lines. Beyond 4 Low Density DLC units, the larger unit is less costly.

3.5.8. Fiber Strands per Remote Terminal

Definition: The number of fibers connected to each DLC remote terminal, including one for upstream transmission, one for downstream transmission, and two for redundancy.

Default Values:

Fibers per Remote Terminal	
GR-303 DLC	Low density DLC
4	4

Support: All standard fiber optic multiplexers manufactured for at least the past 15 years have used this configuration, which includes a 100 percent hot standby backup for the transmit and receive paths. This configuration is common knowledge in the industry.

3.5.9. Optical Patch Panel

Definition: The investment required for each optical patch panel associated with a DLC remote terminal.

Default Values:

Optical Patch Panel	
GR-303 DLC	Low density DLC
$1,000	$1,000

Support: The cost for an installed fiber optic patch panel, including splicing of the fibers to pigtails, was estimated by a team of experienced outside plant experts with extensive experience in contracting for optical patch panels. A fiber optic patch panel contains no electronic, nor moving parts, but allows for the physical cross connection of fiber pigtails.

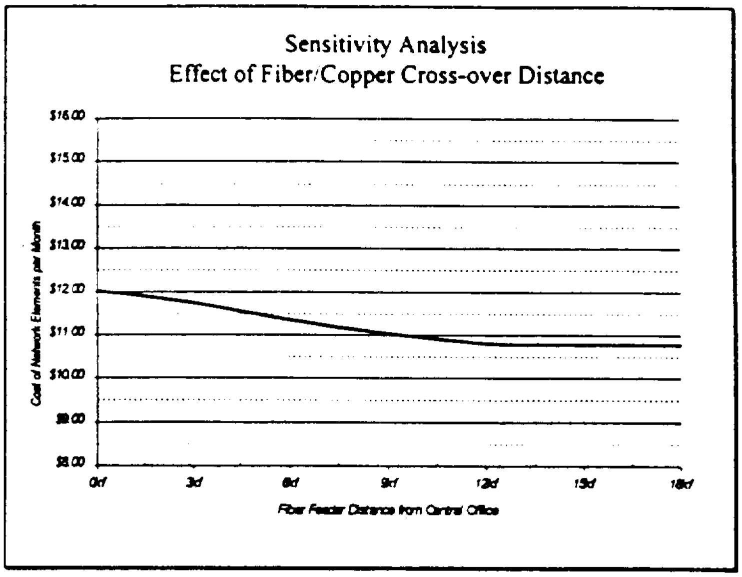
3.5.10. Copper Feeder Maximum Distance, Feet

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

Default Value:

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.



3.5.11. Common Equipment Investment per Additional Line Increment

Definition: The cost of the common equipment required to add a line module in a remote terminal.

Default Values:

Common Equipment Investment per Additional Line Increment	
672	96
$18,500	$11,000

Support: The cost of an additional increment of Integrated Digital Loop Electronics was estimated by a team of experienced outside plant experts with extensive experience in contracting for remote terminal site installations. Low Density DLC requires less initial investment.

3.5.12. Maximum Number of Additional Line Modules per Remote Terminal

Definition: The number of line modules (in increments of 672 or 96 lines) that can be added to a remote terminal.

Default Values:

Max. # Add. Line Modules/RT	
GR-303 DLC	Low density DLC
2	1

Support: A standard OC-3 multiplexed site can provide up to 3 OC-1 systems, each at 672 lines. The Hatfield Model allows for adding 2 additional Common Equipment Investment modules to an initial 672 line system, and 1 additional Common Equipment Investment modules to an initial 96 line system.

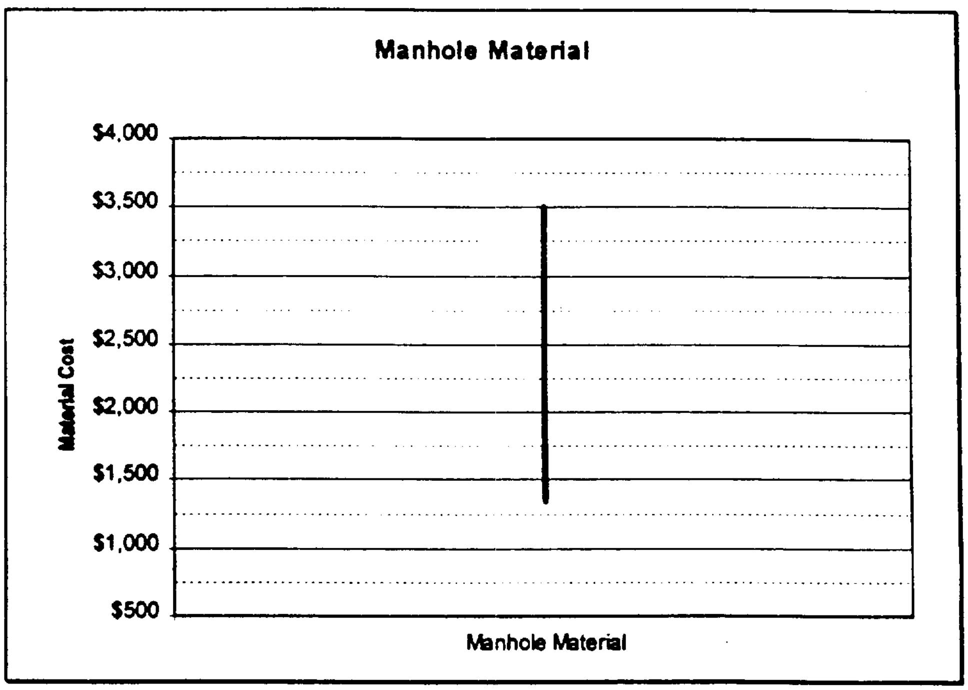
3.6. MANHOLE INVESTMENT – COPPER FEEDER

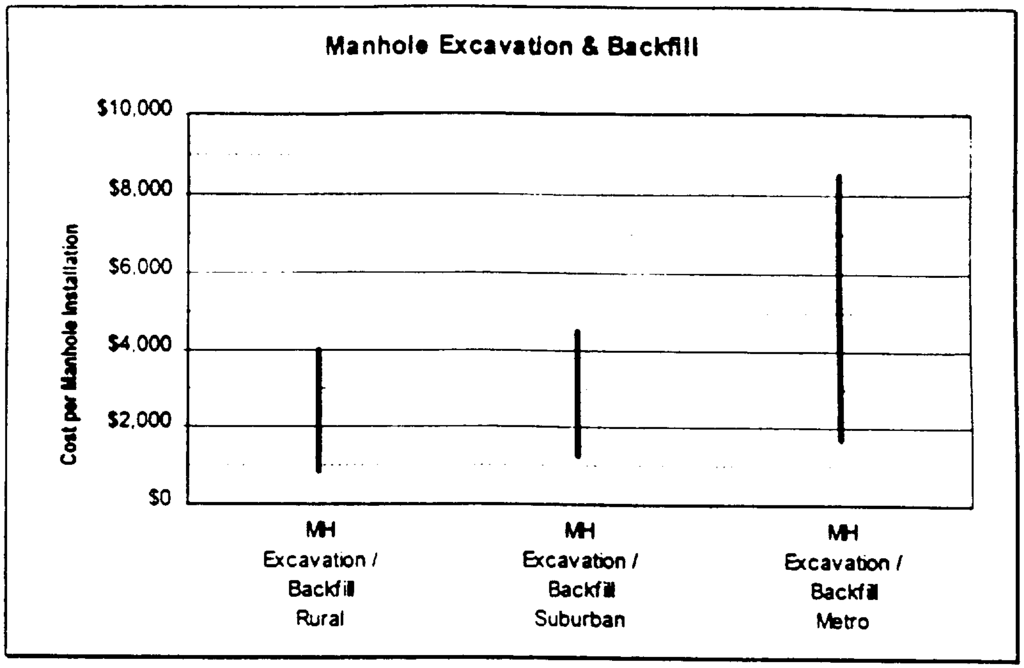
Definition: The installed cost of a prefabricated concrete manhole, including backfill and restoration. All the non-italicized costs in the following table are separately adjustable.

Default Values:

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

3.7. PULLBOX INVESTMENT – FIBER FEEDER

Definition: The investment per fiber pullbox in the feeder portion of the network.

Default Values:

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.

4. SWITCHING AND INTEROFFICE TRANSMISSION PARAMETERS

4.1. END OFFICE SWITCHING

4.1.1. Switch Real-Time Limit, BHCA

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.

Default Values:

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.[23]

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)

4.1.2. 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.

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

Default Values:

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.

4.1.3. Switch Maximum Equipped Line Size

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

Default Value:

Switch Maximum Equipped Line Size
80,000

Support: This is a conservative assumption based on industry common knowledge and the Lucent Technologies web site.[24] 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 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.

4.1.4. 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.

Default Value:

Switch Port Administrative Fill
0.98

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

4.1.5. 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.

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

Default Value:

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.

4.1.6. MDF/Protector Investment per Line

Definition: The Main Distribution Frame investment, including protector, required to terminate one line. According to Lucent's Web site, a main distribution frame is "a framework used to cross-connect outside plant cable pairs to central office switching equipment, but also carrier facility equipment such as Office Repeater Bays and SLC[R] Carrier Central Office Terminals. The MDF is usually used to provide protection and test access to the outside plant cable pairs."

Default Value:

MDF/Protector Investment per Line
$12.00

Support: This price was obtained by Telecom Visions, Inc., a consulting firm that assisted in the preparation of this Input Portfolio,, from a major manufacturer of MDF frames and protectors. A review of this price with information available in various proceedings indicates that this is a competitive investment cost.

4.1.7. Analog Line Circuit Offset for DLC Lines, per Line

Definition: The reduction in per line switch investment resulting from the fact that line cards are not required in both the switch and remote terminal for DLC-served lines.

Default Value:

Analog Line Circuit Offset for DLC Lines
$5.00 per line

Support: This is a Hatfield Associates estimate, which is used in lieu of forward looking alternatives from public sources or ILECs. It is based on consultations with AT&T and MCI subject matter experts.

4.1.8. Switch Installation Multiplier

Definition: The telephone company investment in switch engineering and installation activities, expressed as a multiplier of the switch investment.

Default Value:

Switch Installation Multiplier
1.10

Support: The 10% factor used in the Hatfield model was derived based on the following information: Bell Atlantic ONA filing (FCC Docket 92-91) on February 13, 1992, showed a range of engineering factors for the different Bell Atlantic states between .08 and .108. The SBC ONA filing (FCC Docket 92-91) on May 18, 1992, showed a range of engineering and plant labor factors added together between .0879 and .1288. The 10% incremental-based factor is a fairly conservative estimate, given the ranges filed by two RBOCs using traditional ARMIS-based embedded cost factor development.

4.1.9. End Office Switching Investment Constant Term

Definition: The value of the constant ("B") appearing in the function that calculates the per line switching investment as a function of switch line size, expressed separately for BOCs and large independents (ICOs), on the one hand, and for small ICOs, on the other hand. The function is cost per line = A ln X + B, where X is the number of lines.

Default Values:

End Office Switching Investment Constant Term	
BOC & Large ICO	Small ICO
$242.73	$416.11

Support: The switching cost surveys were developed using typical per-line prices paid by BOCs, GTE and other independents as reported in the Northern Business Information (NBI) publication, "U.S., Central Office Equipment Market: 1995 Database," compared to switch size and data from the ARMIS 43-07 report.[25] See, Hatfield Model Release 4.0 Model Description, p. 47-50.

4.1.10. End Office Switching Investment Slope Term

Definition: The constant multiplying the log function ("A" in the function shown in parameter 4.1.9.) in the EO switching investment function.

Default Value:

EO Switching Investment Slope Term
-14.922

Support: The switching cost surveys were developed using typical per-line prices paid by BOCs, GTE and other independents as reported in the Northern Business Information (NBI) publication, "U.S., Central Office Equipment Market: 1995 Database," compared to switch size and data from the ARMIS 43-07 report.[26] See, Hatfield Model Release 4.0 Model Description, p. 47-50.

4.1.11. Processor Feature Loading Multiplier

Definition: The amount by which the load on a processor exceeds the load associated with ordinary telephone calls, due to the presence of vertical features, Centrex, etc., expressed as a multiplier of nominal load.

[25] Northern Business Information study: U.S. Central Office Equipment Market – 1995, McGraw-Hill, New York, 1996.

Default Value: 1.20 for business line percentage up to the variable business penetration rate, increasing linearly above that rate to a final value of 2.00 for 100% business lines.

Support: This is a Hatfield Associates estimate of the impact of switch features typically utilized by businesses on switch processor load. The assumption is that business lines typically invoke more features and services. Therefore, business lines affect processor real time loading more than residential lines. It is based on consultations with AT&T and MCI subject matter experts.

4.1.12. Business Penetration Ratio

Definition: The ratio of business lines to total switched lines at which the processor feature loading multiplier is assumed to reach the "heavy business" value of 2.

Default Value:

Business Penetration Ratio
0.30

Support: This is a Hatfield Associates estimate of the point at which the number of business lines will cause the 20 percent processor load addition. It is based on consultations with AT&T and MCI subject matter experts.

4.2. WIRE CENTER

4.2.1. Lot Size, Multiplier of Switch Room Size

Definition: The multiplier of switch room size to arrive at total lot size to accommodate building and parking requirements.

Default Value:

Lot Size, Multiplier of Switch Room Size
2.0

Support: This is a Hatfield Associates estimate.

4.2.2. Tandem/EO Wire Center Common Factor

Definition: The percentage of tandem switches that are also end office switches. This accounts for the fact that tandems and end offices are often located together, and is employed to avoid double counting of switch common equipment and wire center investment in these instances.

Default Value:

Tandem/EO Wire Center Common Factor
0.4

Support: This is a conservatively low estimate of the number of shared-use switches based on Local Exchange Routing Guide (LERG) data.

4.2.3. Power Investment

Definition: The wire center investment required for rectifiers, battery strings, back-up generators and various distributing frames, as a function of switch line size.

Default Values:

Lines	Investment Required
0	$5,000
1000	$10,000
5000	$20,000
25,000	$50,000
50,000	$250,000

Support: This is a Hatfield Associates Estimate.

4.2.4. Switch Room Size

Definition: The area in square feet required to house a switch and its related equipment.

Default Values:

Switch Room Size	
Lines	**Sq. Feet of Floor Space Required**
0	500
1,000	1,000
5,000	2,000
25,000	5,000
50,000	10,000

Support: Industry experience and expertise of Hatfield Associates along with information taken from manufacturer product literature (e.g., Nortel DMS-500 Planner and 5ESS Switch Information Guide). Furthermore, these values are supported by discussions over the years with personnel from LECs and competitive access providers who are familiar with the size of switch rooms through installing switches and/or acquiring space for network switches.

4.2.5. Construction Costs, per Square Foot

Definition: The costs of construction of a wire center building. Although cost per square foot generally decreases as building size increases, the construction cost per square foot is assumed to increase with the number of lines served to account for higher prices typically associated with greater population densities where larger switches tend to be located.

Default Values:

Construction Costs per sq. ft.	
Lines	**Cost/sq. ft.**
0	$75
1,000	$85
5,000	$100
25,000	$125
50,000	$150

Support: This is a Hatfield Associates estimate.

4.2.6. Land Price, per Square Foot

Definition: The land price associated with a wire center. Land cost per square foot increases with the number of lines served to account for higher prices typically associated with greater population densities where larger switches are located.

Default Values:

Lines	Price/sq. ft.
0	$5.00
1,000	$7.50
5,000	$10.00
25,000	$15.00
50,000	$20.00

Support: This is a Hatfield Associates estimate.

4.3. TRAFFIC PARAMETERS

4.3.1. Local Call Attempts

Definition : The number of yearly local call attempts, as reported to the FCC.

Default Value: Taken from ARMIS reports for the LEC being studied.

Support: ARMIS report 43-08. For non-Tier I LECs, the default value is the average per line local call attempt value for all ICOs reporting to ARMIS.

4.3.2. Call Completion Fraction

Definition: The percentage of call attempts that result in a completed call. By this definition, calls that result in a busy signal, no answer, or network blockage are all considered incomplete.

Default Value:

Call Completion Fraction
0.7

Support: Bell Communications Research, *LATA Switching Systems Generic Requirements*, Section 17: Traffic Capacity and Environment, TR-TSY-000517, Issue 3, March 1989. This number is a composite of the results shown in table 17.6-B.

4.3.3. IntraLATA Calls Completed

Definition : The number of yearly intraLATA completed call attempts, as reported to the FCC.

Default Value: Taken from ARMIS reports for the LEC being studied.

Support: ARMIS report 43-08. For non-Tier I LECs, the default value is the average per line IntraLATA calls completed value for all ICOs reporting to ARMIS.

4.3.4. InterLATA Intrastate Calls Completed

Definition : The number of yearly interLATA intrastate completed call attempts, as reported to the FCC.

Default Value: Taken from ARMIS reports for the LEC being studied.

Support: ARMIS report 43-08. For non-Tier I LECs, the default value is the average per line interLATA intrastate calls completed value for all ICOs reporting to ARMIS.

4.3.5. InterLATA Interstate Calls Completed

Definition : The number of yearly interLATA interstate completed call attempts, as reported to the FCC.

Default Value: Taken from ARMIS reports for the LEC being studied.

Support: ARMIS report 43-08. For non-Tier I LECs, the default value is the average per line interLATA interstate calls completed value for all ICOs reporting to ARMIS.

4.3.6. Local DEMs, Thousands

Definition : The number of yearly local Dial Equipment Minutes (DEMs), as reported to the FCC.

Default Value: Taken from FCC reports for the LEC being studied.

Support: See FCC Monitoring Report, Docket No. 87-339, May 1995, Table 4.15.

4.3.7. Intrastate DEMs, Thousands

Definition : The number of yearly intrastate DEMs, as reported to the FCC.

Default Value: Taken from FCC reports for the LEC being studied.

Support: See FCC Monitoring Report, Docket No. 87-339, May 1995, Table 4.16.

4.3.8. Interstate DEMs, Thousands

Definition : The number of yearly interstate DEMs, as reported to the FCC.

Default Value: Taken from FCC reports for the LEC being studied.

Support: See FCC Monitoring Report, Docket No. 87-339, May 1995, Table 4.17.

4.3.9. Local Business/Residential DEMs Ratio

Definition: The ratio of local Business DEMs per line to local Residential DEMs per line

Default Value:

Local Bus / Res DEMs Ratio
1.1

Support: This is a Hatfield Associates estimate, based on consultations with AT&T and MCI subject matter experts.

4.3.10. Intrastate Business/Residential DEMs

Definition: The ratio of intrastate Business DEMs per line to intrastate Residential DEMs per line

Default Value:

Intrastate Bus / Res DEMs Ratio
2

Support: This is a Hatfield Associates estimate, based on consultations with AT&T and MCI subject matter experts.

4.3.11. Interstate Business/Residential DEMs

Definition: The ratio of interstate Business DEMs per line to interstate Residential DEMs per line

Default Value:

Interstate Bus / Res DEMs Ratio
3

Support: This is a Hatfield Associates estimate, based on consultations with AT&T and MCI subject matter experts.

4.3.12. Busy Hour Fraction of Daily Usage

Definition: The percentage of daily usage that occurs during the busy hour.

Default Value:

Busy Hour Fraction of Daily Usage
0.10

Support: AT&T Capacity Cost Study.[27]

4.3.13. Annual to Daily Usage Reduction Factor

Definition: The effective number of business days in a year, used to concentrate annual usage into a fewer number of days as a step in determining busy hour usage.

Default Value:

Annual to Daily Usage Reduction Factor
270

Support: The AT&T Capacity Cost Study uses an annual to daily usage reduction factor of 264 days.[28]

[27] Blake, V.A., Flynn, P.V., Jennings, F.B., AT&T Bell Laboratories, "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," June 20, 1990, p.10. Filed in CC Docket No. 90-132.

[28] Ibid.

4.3.14. Holding Time Multipliers, Residential/Business

Definition: The potential modification to the average call "holding time" (i.e., duration) to reflect Internet use or other causes, expressed as a multiplier of the holding time associated with ordinary residential or business telephone calls.

Default Values:

Holding time multipliers	
Residential	**Business**
1.0	1.0

Support: The purpose of this parameter is to allow users to study the impact of increasing the offered load on the network. The default value of 1 means the load is that estimated from DEMs.

4.3.15. Call Attempts, Busy Hour (BHCA), Residential/Business

Definition: The number of call attempts originated per residential and business subscriber during the busy hour.

Default Values:

Busy Hour Call Attempts	
Residential	**Business**
1.3	3.5

Support: Bell Communications Research, *LATA Switching Systems Generic Requirements*, Section 17: Traffic Capacity and Environment, TR-TSY-000517, Issue 3, March 1989. This number is a composite of the results shown in table 17.6 C-G.

4.4. INTEROFFICE INVESTMENT

4.4.1. Transmission Terminal Investment

Definition: The investment in 1) the fully-equipped add-drop multiplexer (ADM) that extracts inserts signals into OC-48 fiber rings, and are needed in each wire center to connect the wire center to the interoffice fiber ring; and 2) the fully-equipped OC-3 DS-1 multiplexers required to interface to the OC-48 ADM and to provide point to point circuits between tandem switches and end offices not connected directly to a fiber ring. The "Investment per 7 DS-1" figure is the amount by which the investment in OC-3s is reduced for each unit of 7 DS-1s below full capacity of the OC-3. See the figure in Appendix A.

Default Values:

Transmission Terminal Investment			
OC-48 ADM, Installed		OC-3/DS-1 Terminal Multiplexer, Installed	Investment per 7 DS-1s
48 DS-3s	12 DS-3s	84 DS-1s	
$50,000	$40,000	$26,000	$500

Support: Industry experience and expertise of Hatfield Associates, supplemented by consultations with telecommunications equipment suppliers.

4.4.2. Number of Fibers

Definition: The assumed fiber cross-section, or number of fibers in a cable, in the interoffice fiber ring and point to point network.

Default Value:

Number of Fibers
24

Support: The default value is consistent with common practices within the telecommunications industry and reflects the engineering judgment of Hatfield Model developers.

4.4.3. Pigtails

Definition: The cost of the short fiber connectors that attach the interoffice ring fibers to the wire center transmission equipment via a patch panel.

Default Value:

Pigtails
$60 each

Support: A public source estimates the cost of pigtails at $75.00 per fiber. See, Reed, David P., Residential Fiber Optic Networks and Engineering and Economic Analysis, Artech House, Inc., 1992, p.93. The lower amount reflects Hatfield Associates' estimate of price trends since that figure was published.

4.4.4 Optical Distribution Panel

Definition: The cost of the physical fiber patch panel used to connect 24 fibers to the transmission equipment.

Default Value:

Optical Distribution Panel
$1,000

Support: The cost for an installed fiber optic patch panel, including splicing of the fibers to pigtails, was estimated by a team of experienced outside plant experts who have contracted for such installations. A fiber optic patch panel contains no electronic, nor moving parts, but allows for the physical cross connection of fiber pigtails.

4.4.5. EF&I, per Hour

Definition: The per-hour cost for the "engineered, furnished, and installed" activities for equipment in each wire center associated with the interoffice fiber ring, such as the "pigtails" and patch panels to which the transmission equipment is connected.

Default Value:

EF&I
$55 per hour

Support: This is a fully loaded labor rate used for the most sophisticated technicians. It includes basic wages and benefits, Social Security, Relief & Pensions, management supervision, overtime, exempt material and motor vehicle loadings. This value was estimated by a team of experienced outside plant experts.

4.4.6. EF&I, Units

Definition: The number of hours required to install the equipment associated with the interoffice transmission system (see EF&I, per hour, above) in a wire center.

Default Value:

EF&I, units
32 hours

Support: This amount of labor was estimated by a team of experienced engineering experts. It includes the labor hours to install and test the transport equipment involved in interoffice facilities.

4.4.7. Regenerator Investment, Installed

Definition: The installed cost of an OC-48 optical regenerator.

Default Value:

Regenerator Investment, Installed
$15,000

Support: This approximation was obtained from a representative of a major fiber optic multiplexer manufacturer at Supercom '96, in June 1996 in Dallas, Texas.

4.4.8. Regenerator Spacing, Miles

Definition: The distance between digital signal regenerators in the interoffice fiber optics transmission system.

Default Value:

Regenerator Spacing
40 miles

Support: Based on field experience of maximum distance before fiber regeneration is necessary. This number is conservatively low compared to Fujitsu product literature, which indicates a maximum regenerator spacing of 110km, or approximately 69 miles[29] (with post- and pre-amp).

4.4.9. Channel Bank Investment, per 24 Lines

Definition: The investment in voice grade to DS-1 multiplexers in wire centers required for some special access circuits.

Default Value:

Channel Bank Investment, per 24 lines
$5,000

Support: Industry experience and expertise of Hatfield Associates, supplemented by consultations with telecommunications equipment suppliers.

4.4.10. Fraction of SA Lines Requiring Multiplexing

Definition: The percentage of special access circuits that require voice grade to DS-1 multiplexing in the wire center in order to be carried on the interoffice transmission system. This parameter is for use in conjunction with a study of the cost of special access circuits.

Default Value:

Fraction of SA Lines Requiring Multiplexing
0.0

[29] Futjitsu Network Communications, Inc. product sheet for Flash™-192 multiplexer, "Typical Optical Span Lengths SMF Fiber {Single Mode Fiber} 110 km (with post- and pre-amp).

Support: This value is based on Hatfield Associates engineering judgment. The default value of zero is appropriate for the existing set of UNEs, which do not include a special access UNE.

4.4.11. Digital Cross Connect System, Installed, per DS-3

Definition: The investment required for a digital cross connect system that interfaces DS-1 signals between switches and OC-3 multiplexers, expressed on a per DS-3 (672 DS-0) basis.

Default Value:

Digital Cross Connect System, Installed, per DS-3
$30,000

Support: Industry experience and expertise of Hatfield Associates, supplemented by consultations with telecommunications equipment suppliers.

4.4.12. Transmission Terminal Fill (DS-0 level)

Definition: The fraction of maximum DS-0 circuit capacity that can actually be utilized in ADMs, DS-1 to OC-3 multiplexers, and channel banks.

Default Value:

Transmission Terminal Fill (DS-0 level)
0.90

Support: Based on outside plant subject matter expert judgment.

4.4.13. Interoffice Fiber Cable Investment per Foot, Installed

Definition: The installed cost per foot of interoffice fiber cable, assuming a 24-fiber cable.

Default Value:

Interoffice Fiber Cable Investment, Installed, per foot
$3.50

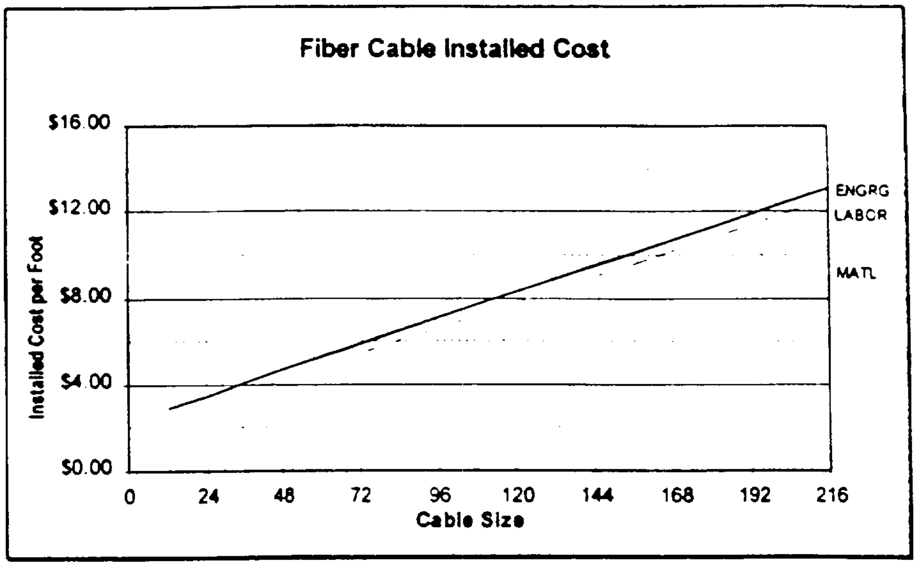
Support: *{NOTE: The discussion in Section 3.4.2. [Fiber Feeder] is reproduced here for ease of use.}*

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.



4.4.14. Number of Strands per ADM

Definition: The number of interoffice fiber strands connected to the ADM in each wire center. At least four per ADM are required around the ring.

Default Value:

Number of Strands per ADM
4

Support: This is the standard number of strands required by an ADM. It provides for redundant transmission in both directions around the interoffice fiber ring.

4.4.15. Interoffice Structure Percentages

Definition: The relative amounts of different structure types supporting interoffice transmission facilities. Aerial cable is attached to telephone poles or buildings, buried cable is laid directly in the earth, and underground cable runs through underground conduit. Aerial and buried percentages are entered by the user; the underground fraction is then computed.

Default Values:

Structure Percentages		
Aerial %	Buried %	Underground %
20%	60%	20%

Support: These are average figures that reflect the judgment of a team of outside plant experts regarding the appropriate mix of density zones applicable to interoffice transmission facilities.

4.4.16. Transport Placement

Definition: The cost of fiber cable structures used in the interoffice transmission system.

Default Values:

Transport Placement, per foot	
Buried	Conduit
$1.77	$16.40

Support: Structures closer to the central office are normally shared with feeder cable. Additional structures at the end of feeder routes may be required to complete an interoffice transport path. Since distances farther from the central office normally involve lower density zones, average structure costs appropriate for lower density zones are reflected in the default values. A default value for Buried representing the lower density zones is used, while a conservatively higher value is used for Conduit, representing the default value expected in a 850-2,550 line per square mile density zone.

4.4.17. Buried Sheath Addition

Definition: The cost of dual sheathing for additional mechanical protection of fiber interoffice transport cable.

Default Value:

Buried Sheath Addition
$0.20 per foot

Support: *{NOTE: The discussion in Section 3.2.3. [Fiber Feeder] is reproduced here for ease of use.}*

Incremental cost for mechanical sheath protection on fiber optic cable is a constant per foot, rather than the ratio factor used for copper cable, because fiber sheath is approximately ½ inch in diameter, regardless of the number of fiber strands contained in the sheath. The incremental per foot cost was estimated by a team of experienced outside plant experts who have purchased millions of feet of fiber optic cable.

4.4.18. Interoffice Conduit, Cost and Number of Tubes

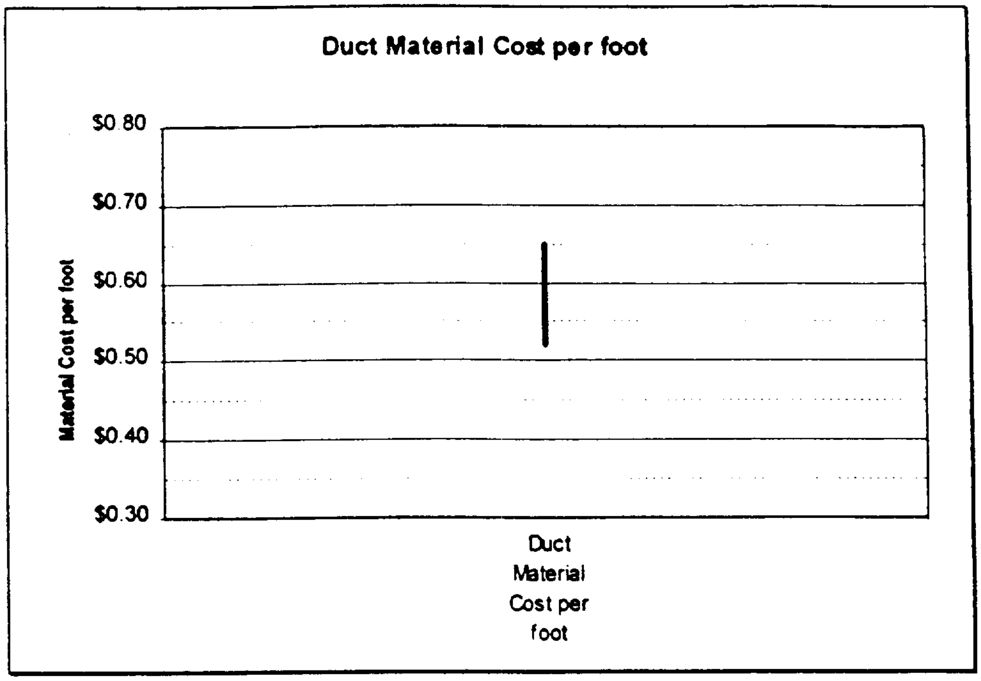
Definition: The cost per foot for interoffice fiber cable conduit, and the number of spare tubes (conduit) placed per route.

Default Values:

Interoffice Conduit, Cost and Number of Tubes	
Cost	Spare Tubes per Route
$0 60 per foot	1

Support: *{NOTE: The discussions in Sections 2.4.3. and 2.4.4. [Distribution] are reproduced here for ease of use.}*

Conduit Cost per foot:
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.

Spare Tubes per Route:
"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."[30] Version 4.0 of the Hatfield Model provides one spare maintenance duct (as a default) in each conduit run.

4.4.19. Pullbox Spacing

Definition: Spacing between pullboxes in the interoffice portion of the network.

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

Default Value:

Pullbox Spacing
2,000 feet

Support: *{NOTE: The discussion in Section 3.2.2. [Feeder] is reproduced here for ease of use.}*

Unlike copper manhole spacing, the spacing for fiber pullboxes is based on the practice of coiling spare fiber (slack) within pullboxes to facilitate repair in the event the cable is cut or otherwise impacted. Fiber feeder pullbox spacing is not a function of the cable reel lengths, but rather a function of length of cable placed. The standard practice during the cable placement process is to provide for 5 percent excess cable to facilitate subsurface relocation, lessen potential damage from impact on cable, or provide for ease of cable splicing when cable is cut or damaged.[31] It is common practice for outside plant engineers to require approximately 2 slack boxes per mile.

4.4.20. Pullbox Investment

Definition: Investment per fiber pullbox in the interoffice portion of the network.

Default Value:

Pullbox Investment
$500

Support: *{NOTE: The discussion in Section 3.7. [Fiber Feeder] is reproduced here for ease of use.}*

The information was received verbally from a Vice President of PenCell Corporation at their Supercom '96 booth. 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.

4.4.21. Pole Spacing, Interoffice

Definition: Spacing between poles supporting aerial interoffice fiber cable.

Default Value:

Pole Spacing, Interoffice
150 feet

Support: This is a representative figure accounting for the mix of density zones applicable to interoffice transmission facilities.

4.4.22. Interoffice Pole Material and Labor

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

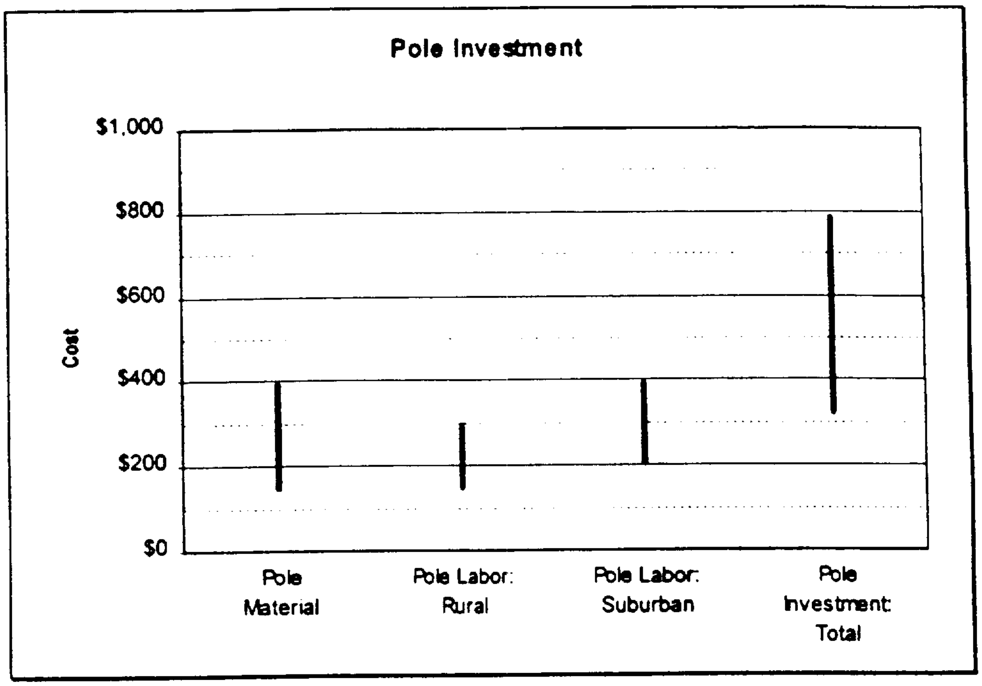
[31] *Cable Construction Manual, 4th Edition*, CommScope, p. 75.

Default Values:

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.

4.4.23. Fraction of Interoffice Structure Common with Feeder

Definition: The percentage of structure supporting interoffice transport facilities that is also shared by feeder facilities, expressed as a fraction of the smaller of the feeder and interoffice investment in each of the three types of facilities (i.e., aerial, buried and underground are treated separately).

Default Value:

Fraction of Interoffice Structure Common with Feeder
.75

Support: Interoffice transport facilities will almost always follow feeder routes which radiate from each central office. Typically only a small distance between adjacent wire centers is not traversed by a feeder route; for this distance, structure is appropriately assigned exclusively to interoffice transport. In the opinion of a team of outside plant engineers, the additional structure required exclusively for interoffice transport is no more than 25 percent of the distance. Therefore, 75 percent of the interoffice route is assumed by the HM 4.0 to be shared with feeder cables.

4.4.24. Interoffice Structure Sharing Fraction

Definition: The fraction of investment in interoffice poles and trenching that is assigned to LECs. The remainder is attributed to other utilities/carriers

Default Values:

Fraction of Interoffice Structure Assigned to Telephone		
Aerial	Buried	Underground
33	.33	.33

Support: The structure sharing with other utilities covered by this parameter involves the portion of interoffice structure that is not shared with feeder cable. Sharing with other utilities is assumed to include at least two other occupants of the structure. Candidates for sharing include electrical power, CATV, competitive long distance carriers, competitive local access providers, municipal services and others. See also Appendix B.

4.5. TRANSMISSION PARAMETERS

4.5.1. Operator Traffic Fraction

Definition: Fraction of traffic that requires operator assistance. This assistance can be automated or manual (see Operator Intervention Fraction in the Operator Systems section below)

Default Value:

Operator Traffic Fraction
0.02

Support: Industry experience and expertise of Hatfield Associates.

4.5.2. Total Interoffice Traffic Fraction

Definition: The fraction of all calls that are completed on a switch other than the originating switch, as opposed to calls completed within a single switch.

Default Value:

Total Interoffice Traffic Fraction
0.65

Support: According to *Engineering and Operations in the Bell System*, Table 4-5, p. 125, the most recent information source found to date, the percentage of calls that are interoffice calls ranges from 34 percent for rural areas to 69 percent for urban areas. Assuming weightings according to the typical number of lines per wire center for each environment (urban, suburban, rural), these figures suggest an overall interoffice traffic fraction of approximately 65 percent.

4.5.3. Maximum Trunk Occupancy, CCS

Definition: The maximum utilization of a trunk during the busy hour.

Default Value:

Maximum Trunk Occupancy, CCS
27.5

Support: AT&T Capacity Cost Study.[32]

4.5.4. Trunk Port Investment, per End

Definition: Per trunk equivalent investment in switch trunk port at each end of a trunk.

[32] Blake, et al., "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p.4.

Default Value:

Trunk Investment, per end
$100

Support: AT&T Capacity Cost Study.[33] Hatfield Associates judgment is that $100 is for the switch port itself.

4.5.5. Direct-Routed Fraction of Local Interoffice Traffic

Definition: The amount of local interoffice traffic that is directly routed between originating and terminating end offices as opposed to being routed via a tandem switch.

Default Value:

Direct-Routed Fraction of Local Interoffice
0.98

Support: The direct routed fraction of local interoffice is based on data filed by the LECs in response to an FCC data request issued in Docket 80-286: *In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board*, Docket 80-286, Order, December 1, 1994, 9 FCC Rcd 7962 (1994). See Universal Service Fund Data Request, File 1 of 4, page 8 of 11, 9 FCC Rcd 7962, 7976.

4.5.6. Tandem-Routed Fraction of Total IntraLATA Toll Traffic

Definition: Fraction intraLATA toll calls that are routed through a tandem.

Default Value:

Tandem-Routed Fraction of Total IntraLATA Toll Traffic
0.2

Support: The tandem routed fraction of total intraLATA toll traffic is based on data filed by the LECs in response to an FCC data request issued in Docket 80-286: *In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board*, Docket 80-286, Order, December 1, 1994, 9 FCC Rcd 7962 (1994). See Universal Service Fund Data Request, File 1 of 4, page 8 of 11, 9 FCC Rcd 7962, 7976.

4.5.7. Tandem-Routed Fraction of Total InterLATA Traffic

Definition: Fraction of interLATA (IXC access) calls that are routed through a tandem instead of directly to the IXC.

[33] Blake, et al., "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 7.

Default Value:

Tandem-Routed Fraction of Total InterLATA Traffic
0.2

Support: The tandem routed fraction of total interLATA traffic is based on data filed by the LECs in response to an FCC data request issued in Docket 80-286: *In the Matter of Amendment of Part 36 of the Commission's Rules and Establishment of a Joint Board*, Docket 80-286, Order, December 1, 1994, 9 FCC Rcd 7962 (1994). See Universal Service Fund Data Request, File 1 of 4, page 8 of 11, 9 FCC Rcd 7962, 7976.

4.5.8. POPs per Tandem Location

Definition: The number of IXC points of presence requiring an entrance facility, per LEC tandem.

Default Value:

POPs per Tandem Location
5

Support: An assumption that envisions POPs for three principal IXCs plus two smaller carriers associated with each LEC tandem.

4.6. TANDEM SWITCHING

4.6.1. Real Time Limit, BHCA

Definition: The maximum number of BHCA a tandem switch can process.

Default Value:

Real Time Limit, BHCA
750,000

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. See 4.1.1.

4.6.2. Port Limit, Trunks

Definition: The maximum number of trunks that can be terminated on a tandem switch.

Default Value:

Port Limit, Trunks
100,000

Support: AT&T Updated Capacity Cost Study.[34]

4.6.3. Tandem Common Equipment Investment

Definition: The amount of investment in common equipment for a large tandem switch. Common Equipment is the hardware and software that is present in the tandem in addition to the trunk terminations themselves. The cost of a tandem is estimated by the HM as the cost of common equipment plus an investment per trunk terminated on the tandem.

Default Value:

Tandem Common Equipment Investment
$1,000,000

Support: AT&T Capacity Cost Study.[35]

4.6.4. Maximum Trunk Fill (Port Occupancy)

Definition: The fraction of the maximum number of trunk ports on a tandem switch that can be utilized.

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[34] Brand, T.L., Hallas, G.A., et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," April 19, 1995, p. 9.

[35] Blake, et. al., "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p.9.

Default Value:

Maximum Trunk Fill (port occupancy)
0.90

Support: This is a Hatfield Associates estimate, which is used in lieu of forward looking alternatives from public sources or ILECs. It is based on consultations with AT&T and MCI subject matter experts.

4.6.5. Maximum Tandem Real Time Occupancy

Definition: The fraction of the total capacity (expresses as the real time limit, BHCA) a tandem switch is allowed to carry before an additional switch is provided.

Default Value:

Maximum Tandem Real Time Occupancy
0.9

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.

4.6.6. Tandem Common Equipment Intercept Factor

Definition: The multiplier of the common equipment investment input that gives the common equipment cost for the smallest tandem switch, allowing scaling of tandem switching investment according to trunk requirements.

Default Value:

Tandem Common Equipment Intercept Factor
0.50

Support: Value selected to allow tandem common equipment investment to range from $500,000 to $1,000,000 which is the appropriate range based on expertise of Hatfield Associates.

4.6.7. Entrance Facility Distance from Serving Wire Center & IXC POP

Definition: Average length of trunks connecting an IXC POP with the wire center that serves it.

Default Value:

Entrance Facility Distance from Serving Wire Center & IXC POP
0.5 miles

Support: Value selected in recognition of the fact that IXCs typically locate POPs close to the serving wire center to avoid long cable runs.

4.7. SIGNALING

4.7.1. STP Link Capacity

Definition: The maximum number of signaling links that can be terminated on a given STP pair.

Default Value:

STP Link Capacity
720

Support: AT&T Updated Capacity Cost Study.[36]

4.7.2. STP Maximum Fill

Definition: The fraction of maximum links (as stated by the STP link capacity input) that the model assumes can be utilized before it adds another STP pair.

Default Value:

STP Maximum Fill
0.80

Support: The STP maximum fill factor is based on Hatfield Associates engineering judgment and is consistent with maximum link/port fill levels throughout HM 4.0.

4.7.3. STP Maximum Common Equipment Investment, per Pair

Definition: The cost to purchase and install a pair of maximum-sized STPs.

Default Value:

STP Maximum Common Equipment Investment, per pair
$5,000,000

Support: AT&T Updated Capacity Cost Study.[37]

4.7.4. STP Minimum Common Equipment Investment, per Pair

Definition: The minimum investment for a minimum-capacity STP, i.e.: the fixed investment for an STP pair that serves a minimum number of links.

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[36] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 26.

[37] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 26.

Default Value:

STP Minimum Common Equipment Investment, per pair
$1,000,000

Support: It is necessary to allow the scaling of STP common equipment for smaller STPs that in some configuration are sufficient for local exchange carriers. The minimum STP common equipment investment cost is Hatfield Associates' judgment of the lower end of the range of common equipment investment.

4.7.5. Link Termination, Both Ends

Definition: The investment required for the transmission equipment that terminates both ends of an SS7 signaling link.

Default Value:

Link Termination, Both Ends
$900

Support: AT&T Updated Capacity Cost Study.[38]

4.7.6. Signaling Link Bit Rate

Definition: The rate at which bits are transmitted over an SS7 signaling link.

Default Value:

Signaling Link Bit Rate
56,000 bits per second

Support: The AT&T Updated Capacity Cost Study, and an SS7 network industry standard.[39]

4.7.7. Link Occupancy

Definition: The fraction of the maximum bit rate that can be sustained on an SS7 signaling link.

Default Value:

Link Occupancy
0.40

Support: AT&T Updated Capacity Cost Study.[40]

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[38] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 26.

[39] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

[40] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 24.

4.7.8. C Link Cross-Section

Definition: The number of C-links in each segment connecting a mated STP pair.

Default Value:

C Link Cross-Section
24

Support: The input was derived assuming the 56 kbps signaling links between STPs are normally transported in a DS-1 signal, whose capacity is 24 DS-0s.

4.7.9. ISUP Messages per Interoffice BHCA

Definition: The number of Integrated Services Digital Network User Part (ISUP) messages associated with each interoffice telephone call attempt. Switches send to each other ISUP messages over the SS7 network to negotiate the establishment of a telephone connection.

Default Value:

ISUP messages per Interoffice BHCA
6

Support: AT&T Updated Capacity Cost Study.[41]

4.7.10. ISUP Message Length, Bytes

Definition: The average number of bytes in each ISUP (ISDN User Part) message.

Default Value:

ISUP Message Length
25 bytes

Support: Bellcore Technical Reference TR-NWT-000317, Appendix A, shows that 25 bytes per message is a conservatively high figure. Northern Telecom's DMS-STP product/service information booklet shows an average ISUP message length of 25 bytes.[42] Therefore a default value of 25 average bytes per message is appropriate for use in the Hatfield Model.

4.7.11. TCAP Messages per Transaction

Definition: The number of Transaction Capabilities Application Part (TCAP) messages required per Service Control Point (SCP) database query. A TCAP message is a message between a switch and a

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[41] Brand, at al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

[42] Northern Telecom, DMS-STP Planner 1995, Product/Service Information, 57005.16, Issue 1, April, 1995, p.13.

database that is necessary to provide the switch with additional information prior to setting up a call or completing a call.

Default Value:

TCAP Messages per Transaction
2

Support: AT&T Updated Capacity Cost Study.[43]

4.7.12. TCAP Message Length, Bytes

Definition: The average length of a TCAP message.

Default Value:

TCAP Message Length
100 bytes

Support: Bellcore Technical Reference TR-NWT-000317, Appendix A, shows that 100 bytes per message is a conservatively high figure. Northern Telecom's DMS-STP product/service information booklet shows an average TCAP message length of 85 bytes.[44]

4.7.13. Fraction of BHCA Requiring TCAP

Definition: The percentage of BHCAs that require a database query, and thus generate TCAP messages.

Default Value:

Fraction of BHCA Requiring TCAP
0.10

Support: The AT&T Updated Capacity Cost Study assumes that 50% of all calls require a database query, but that is not an appropriate number to use in the HM because a substantial fraction of IXC calls are toll-free (800) calls.[45] When reduced to reflect the fact that a large majority of calls handled by the LECs are local calls that do not require such a database query, the 50% would be less than 10%; Hatfield Associates has used the 10% default as a conservatively high estimate.

4.7.14. SCP Investment per Transaction per Second

Definition: The investment in the SCP associated with database queries, or transactions, stated as the investment required per transaction per second. For example, if the default of $20,000 is assumed, an SCP

[43] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

[44] <u>DMS-STP Planner 1995</u>, p.13.

[45] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 25.

required to handle 100 transactions per second would require a 2 million dollar ($20,000 times 100) investment.

Default Value:

SCP Investment per Transaction, per Second
$20,000

Support: AT&T Updated Capacity Cost Study uses a default value of $30,000 from the 1990 study, but notes that this is "conservatively high because of the industry's advances in this area and the resulting decrease in technology costs since the 1990 study."[46] The default value used in the HM represents the judgment of HAI as to the reduction of such processing costs since then.

[46] Brand, et al., "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p. 27.

4.8. OS AND PUBLIC TELEPHONE

4.8.1. Investment per Operator Position

Definition: The investment per computer required for each operator position.

Default Value:

Investment per Operator Position
$6.400

Support: Based on AT&T experience in the long distance business.

4.8.2. Maximum Utilization per Position, CCS

Definition: The estimated maximum number of CCS that one operator position can handle during the busy hour.

Default Value:

Maximum Utilization per Position
32 CCS

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

4.8.3. Operator Intervention Factor

Definition: The percentage of all operator-assisted calls that require operator intervention, expressed as 1 out of every N calls, where N is the value of the input. Given the default values for operator-assisted calls, this parameter means that 1/10, or 10%, of the assisted calls actually require manual intervention of an operator, as opposed to *automated* operator assistance for credit card verification, etc.

Default Value:

Operator Intervention Factor
10

Support: Industry experience and expertise of Hatfield Associates.

4.8.4. Public Telephone Equipment Investment per Station

Definition: The weighted average cost of a public telephone and pedestal (coin/non-coin and indoor/outdoor).

Default Value:

Public Telephone Equipment Investment, per Station
$760

Support: New England Incremental Cost Study.[47]

[47] New England Telephone Company, "1993 New Hampshire Incremental Cost Study," p. 90.

4.9. ICO PARAMETERS

4.9.1. ICO STP Investment, per Line

Definition: The surrogate value for equivalent per line investment in STPs by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

ICO STP Investment per Line
$5 50

Support: The average STP investment per line estimated by the Hatfield Model for all states, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.2. ICO Local Tandem Investment, per Line

Definition: The surrogate value for the per line investment in a local tandem switch by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO Local Tandem Investment
$1 90

Support: The average local tandem investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.3. ICO OS Tandem Investment, per Line

Definition: The surrogate value for the per line investment in an Operator Services tandem switch by a small independent telephone company (ICO),that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO OS Tandem Investment
$0.80

Support: The average OS tandem investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.4. ICO SCP Investment, per Line

Definition: The surrogate value for the per line investment in a SCP by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO SCP Investment
$2.50

Support: The average SCP investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.5. ICO Local Tandem Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in a local tandem wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO Local Tandem Wire Center Investment
$2.50

Support: The average local tandem wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.6. ICO OS Tandem Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in a operator services tandem wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO OS Tandem Wire Center Investment
$1.00

Support: The average OS tandem wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.7. ICO STP/SCP Wire Center Investment, per Line

Definition: The surrogate value for the per line investment in an STP/SCP wire center by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line STP / SCP Wire Center Investment
$0.40

Support: The average STP/SCP wire center investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

4.9.8. ICO C-Link / Tandem A-Link Investment, per Line

Definition: The surrogate value for the per line investment in a C-link / tandem A-link by a small independent telephone company (ICO), that is used in lieu of calculating it directly in the model.

Default Value:

Per Line ICO C-Link / Tandem A-Link Investment
$0.30

Support: The average C-Link / tandem A-link investment per line from the Hatfield Model, with 20 percent added to reflect the higher cost a small ICO is likely to encounter, due to its character of use.

5. EXPENSE

5.1. COST OF CAPITAL AND CAPITAL STRUCTURE

Definition: The capital cost structure, including the debt/equity ratio, cost of debt, and return on equity, that make up the overall cost of capital.

Default Values:

Cost of Capital	
Debt percent	0.450
Cost of debt	0.077
Cost of equity	0.119
Weighted average cost of capital	0.1001

Support: Based on FCC-approved cost of capital methodology using 1996 financial data and AT&T and MCI-sponsored DCF and CAPM analyses calculating the RBOCs' cost of capital. See, for example, "Statement of Matthew I. Kahal Concerning Cost of Capital," In the Matter of Rate of Return Prescription for Local Exchange Carriers," File No. AAD95-172, March 11, 1996. See also 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.

5.2. DEPRECIATION AND NET SALVAGE

Definition: The economic life of various network plant categories.

Default Values:

Plant Type	Economic Life	Net Salvage %
motor vehicles	8.24	11.21
garage work equipment	12.22	-10.71
other work equipment	13.04	3.21
buildings	46.93	1.87
furniture	15.92	6.88
office support equipment	10.78	6.91
company comm. Equipment	7.40	3.76
general purpose computers	6.12	3.73
digital electronic switching	16.17	2.97
operator systems	9.41	-0.82
digital circuit equipment	10.24	-1.69
public telephone term. Equipment	7.60	7.97
poles	30.25	-89.98
aerial cable, metallic	20.61	-23.03
aerial cable, non metallic	26.14	-17.53
underground cable, metallic	25.00	-18.26
underground cable. non metallic	26.45	-14.58
buried cable, metallic	21.57	-8.39
buried cable, non metallic	25.91	-8.58
intrabuilding cable, metallic	18.18	-15.74
intrabuilding cable. non metallic	26.11	-10.52
conduit systems	56.19	-10.34

Support: The default values are the weighted average set of projected depreciation lives, and net salvage percentages, coming from 76 LEC study areas including all the BOCs, SNET, Cincinnati Bell, and numerous GTE and United companies. Weighting is based on total lines per operating company. The projected lives and salvage values are determined in a triennial review process involving each state PUC, the FCC, and the LEC to establish unique state-and-operating-company-specific depreciation schedules. See, FCC Public Notice D.A. #'s 95-1635, 93-970, 96-1175, 94-856, 95-1712. NID and SAI lives are calculated as the average life of metallic cable, since lives are not separately specified for those plant categories and they are classified as outside plant.

5.3. STRUCTURE SHARING FRACTION

Definition: The fraction of investment in distribution and feeder poles and trenching that is assigned to LECs. The remainder is attributed to other utilities/carriers.

Default Values:

Structure Percent Assigned to Telephone Company						
	Distribution			Feeder		
Density Zone	Aerial	Buried	Underground	Aerial	Buried	Underground
0-5	50	.33	1 00	.50	.40	50
5-100	33	.33	.50	33	.40	50
100-200	.25	.33	50	25	.40	.40
200-650	.25	.33	.50	25	.40	.33
650-850	25	.33	40	.25	.40	.33
850-2,550	.25	.33	33	.25	40	.33
2,550-5,000	25	.33	.33	25	.40	.33
5,000-10,000	.25	.33	.33	.25	.40	.33
10,000+	.25	.33	.33	.25	.40	.33

Support: Industry experience and expertise of Hatfield Associates and outside plant engineers; Montgomery County, MD Subdivision Regulations Policy Relating to Grants of Location for New Conduit Network for the Provision of Commercial Telecommunications Services; Monthly Financial Statements of the Southern California Joint Pole Committee; Conversations with representatives of local utility companies. See the structure sharing discussion in Appendix B.

5.4. OTHER EXPENSE INPUTS

5.4.1. Income Tax Rate

Definition: The composite federal and state income tax rate on earnings paid by a telephone company.

Default Value:

Income Tax Rate
39.25%

Support: Based on a nationwide average of composite federal and state tax rates.

5.4.2. Corporate Overhead Factor

Definition: Forward-looking corporate overhead costs, expressed as a fraction of the sum of all capital costs and operations expenses calculated by the model.

Default Value:

Overhead Factor
10.4%

Support: Based on data from AT&T's Form M. See, also earlier ex parte submission by AT&T dated March 18, 1997 and Appendix C.

5.4.3. Other Taxes Factor

Definition: Operating taxes (primarily gross receipts and property taxes) paid by a telephone company in addition to federal and state income taxes.

Default Value:

Other Taxes Factor
5%

Support: This is the average for all Tier I LECs, expressed as a percentage of total revenue. Revenue and tax data are taken from ARMIS report 43-03. See, also Appendix B.

5.4.4. Billing/Bill Inquiry per Line per Month

Definition:

The cost of bill generation and billing inquiries for end users, expressed as an amount per line per month.

Default Value:

Billing / Bill Inquiry per line per month
$1.22

Support: Based on data found in the New England Incremental Cost Study, section for billing and bill inquiry where unit costs are developed. This study uses marginal costing techniques, rather than TSLRIC. Therefore, billing/bill inquiry-specific fixed costs were added to conform with TSLRIC principles.[48]

To compute this value from the NET study, the base monthly cost for residential access lines is divided by the base demand (lines) for both bill inquiry (p. 122) and bill production (p. 126). The resulting per-line values are added together to arrive at the total billing/bill inquiry cost per line per month.

5.4.5. Directory Listing per Line per Month

Definition: The monthly cost of creating and maintaining white pages listings on a per line, per month basis.

Default Value:

Directory Listing per line per month
$0.15

Support: This is a Hatfield Associates estimate.

5.4.6. Forward-Looking Network Operations Factor

Definition: The forward-looking factor applied to a specific category of expenses reported in ARMIS called Network Operations. The factor is expressed as the percentage of current ARMIS-reported Network Operations costs per line.

Default Value:

Forward Looking Network Operations Factor
50%

Support: ARMIS-based network operations expenses are -- by definition -- a function of telephone company embedded costs. As reported, these costs are artificially high because they reflect antiquated systems and practices that are more costly than the modern equipment and practices that the Hatfield Model assumes will be installed on a forward-looking basis. Furthermore, today's costs do not reflect much of the substantial savings opportunities posed by new technologies, such as new management network standards, intranets, and the like. See Appendix D for a more detailed discussion of the savings opportunities associated with network operations.

5.4.7. Alternative Central Office Switching Expense Factor

Definition: The expense to investment ratio for digital switching equipment, used as an alternative to the ARMIS expense ratio, reflecting forward looking rather than embedded costs. Thus, this factor multiplies the calculated investment in digital switching in order to determine the monthly expense associated with digital switching. This factor is not intended to capture the cost of software upgrades to the switch, as all switching software is part of the capital value inputs to HM 4.0.

[48] Ibid., p. 122, 126.

Default Value:

Alternative Central Office Switching Expense Factor
2.69%

Support: New England Incremental Cost Study.[49]

5.4.8. Alternative Circuit Equipment Factor

Definition: The expense to investment ratio for all circuit equipment (as categorized by LECs in their ARMIS reports), used as an alternative to the ARMIS expense ratio to reflect forward looking rather than embedded costs.

Default Value:

Alternative Circuit Equipment Factor
0.0153

Support: New England Incremental Cost Study.[50]

5.4.9. End Office Non Line-Port Cost Fraction

Definition: The fraction of the cost of switching that is associated with switch usage, as opposed to the port (non-traffic sensitive) costs.

Default Value:

End Office Non Line-Port Cost Fraction
70%

Support: This factor is a Hatfield Associates estimate of the average over several different switching technologies.

5.4.10. Monthly LNP Cost, per Line

Definition: The estimated cost of permanent Local Number Portability (LNP), expressed on a per-line, per-month basis, including the costs of implementing and maintaining the service. This is included in the USF calculations only, not the UNE rates, because it will be included in the definition of universal service once the service is implemented.

Default Value:

Per Line Monthly LNP Cost
$0.25

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[49] Ibid., p. 394

[50] Ibid., p. 394

Support: This estimate is based on an ex parte submission by AT&T to the FCC in CC Docket No. 95-116.

5.4.11. Carrier-Carrier Customer Service, per Line, per Year

Definition: The yearly amount of customer operations expense associated with the provision of unbundled network elements by the LECs to carriers who purchase those elements.

Default Value:

Carrier-Carrier Customer Service per line
$1.69

Support: This calculation is based on data drawn from LEC ARMIS accounts 7150, 7170, 7190 and 7270 reported by all Tier I LECs in 1995. To calculate this charge, the amounts shown for each Tier 1 LEC in the referenced accounts are summed across the accounts and across all LECs, divided by the number of access lines reported by those LECs in order to express the result on a per-line basis, and multiplied by 70% to reflect forward-looking efficiencies in the provision of network elements. See, also Appendix C.

5.4.12. NID Expense, per Line, per Year

Definition: The estimated annual NID expense on a per line basis, based on an analysis of ARMIS data modified to reflect forward looking costs. This is for the NID only, not the drop wire, which is included in the ARMIS cable and wire account.

Default Value:

NID Expense per line per year
$1.00

Support: The opinion of outside plant experts indicate a failure rate of less than 0.25 per 100 lines per month, or 3 percent per year. At a replacement cost of $29, this would yield an annual cost of $0.87. Therefore, the current default value is conservatively high.

5.4.13. DS-0/DS-1 Terminal Factor

Definition: The relative terminal investment per DS-0, between the DS-1 and DS-0 levels.

Default Value:

DS-0 / DS-1 Terminal Factor
12.4

Support: The computed ratio for investment per DS-0 when provided in a DS-0 level signal, to per DS-0 investment when provided in a DS-1 level signal, based on transmission terminal investments (see 4.4.1 for terminal investments).

5.4.14. DS-1/DS-3 Terminal Factor

Definition: The relative investment per DS-0, between the DS-3 and DS-1 levels.

Default Value:

DS-1 / DS-3 Terminal Factor
9.9

Support: The computed ratio for investment per DS-0 when provided in a DS-1 level signal, to per DS-0 investment when provided in a DS-3 level signal, based on transmission terminal investments (i.e., 4.4.1).

5.4.15. Average Lines per Business Location

Definition: The average number of business lines per business location, used to calculate NID and drop cost. This parameter should be set the same as 2.2.5.

Default Value:

Average Business Lines per Location
4

Support: *{NOTE: The discussion in Section 2.2.5. [Distribution] is reproduced here for ease of use.}*

The number of lines per business location estimated by Hatfield Associates is based on data in the *1995 Common Carrier Statistics* and the *1995 Statistical Abstract of the United States*.

5.4.16. Average Trunk Utilization

Definition: The 24 hour average utilization of an interoffice trunk.

Default Value:

Average Trunk Utilization
0.30

Support: AT&T Capacity Cost Study.[51]

[51] Blake, et al., "A Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," p.4.

6. EXCAVATION AND RESTORATION

6.1. UNDERGROUND EXCAVATION

Definition: The cost per foot to dig a trench in connection with building an underground conduit system to facilitate the placement of underground cables. Cutting the surface, placing the 4" PVC conduit pipes, backfilling the trench with appropriately screened fill, and restoring surface conditions is covered in the following section titled, "Underground Restoration Cost per Foot". These two sections do not include the material cost of the PVC conduit pipe, which is covered under "Conduit Material Investment per foot", and is affected by the number of cables placed in a conduit run, and the number of "Spare tubes per Route."

Default Values:

Underground Excavation Costs per Foot					
Density Range	Trenching Per Foot	Backhoe		Hand Trench	
		Fraction	Per Foot	Fraction	Per Foot
0-5	$1.90	45.00%	$3.00	1.00%	$5.00
5-100	$1.90	45.00%	$3.00	1.00%	$5.00
100-200	$1.90	45.00%	$3.00	1.00%	$5.00
200-650	$1.90	45.00%	$3.00	3.00%	$5.00
650-850	$1.95	45.00%	$3.00	3.00%	$5.00
850-2,550	$2.15	45.00%	$3.00	5.00%	$5.00
2,550-5,000	$2.15	55.00%	$3.00	10.00%	$5.00
5,000-10,000	$6.00	67.00%	$20.00	10.00%	$10.00
10,000+	$6.00	72.00%	$30.00	12.00%	$18.00

Note: Fraction % for Trenching is the fraction remaining after subtracting Backhoe % & Trench %.

Support: See discussion in Section 6.2.

6.2. UNDERGROUND RESTORATION

Definition: The cost per foot to cut the surface, place the 4" PVC conduit pipes, backfill the trench with appropriately screened fill, and restore surface conditions. Digging a trench in connection with building an underground conduit system to facilitate the placement of underground cables is covered in the preceding section titled, "Underground Excavation Cost per Foot". These two sections do not include the material cost of the PVC conduit pipe, which is covered under "Conduit Material Investment per foot", and is affected by the number of cables placed in a conduit run, and the number of "Spare tubes per Route."

Default Values:

Underground Restoration Costs per Foot									
	Cut/Restore Asphalt		Cut/Restore Concrete		Cut/Restore Sod		Simple Backfill	Conduit Placement & Stabilization	
Density Range	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Per Foot	Pavement Per Foot	Dirt Per Foot
0-5	55.00%	$6.00	10.00%	$9.00	1.00%	$1.00	$0.15	$5.00	$1.00
5-100	55.00%	$6.00	10.00%	$9.00	1.00%	$1.00	$0.15	$5.00	$1.00
100-200	55.00%	$6.00	10.00%	$9.00	1.00%	$1.00	$0.15	$5.00	$1.00
200-650	65.00%	$6.00	10.00%	$9.00	3.00%	$1.00	$0.15	$5.00	$1.00
650-850	70.00%	$6.00	10.00%	$9.00	4.00%	$1.00	$0.15	$5.00	$1.00
850-2,550	75.00%	$6.00	10.00%	$9.00	6.00%	$1.00	$0.15	$9.00	$4.00
2,550-5,000	75.00%	$6.00	15.00%	$9.00	4.00%	$1.00	$0.15	$13.00	$11.00
5,000-10,000	80.00%	$18.00	15.00%	$21.00	2.00%	$1.00	$0.15	$17.00	$12.00
10,000+	82.00%	$30.00	16.00%	$36.00	0.00%	$1.00	$0.15	$20.00	$16.00

Note: Fraction % for Simple Backfill is the fraction remaining after subtracting Asphalt % & Concrete % & Sod %.

Support: The costs reflect a mixture of different types of placement activities.

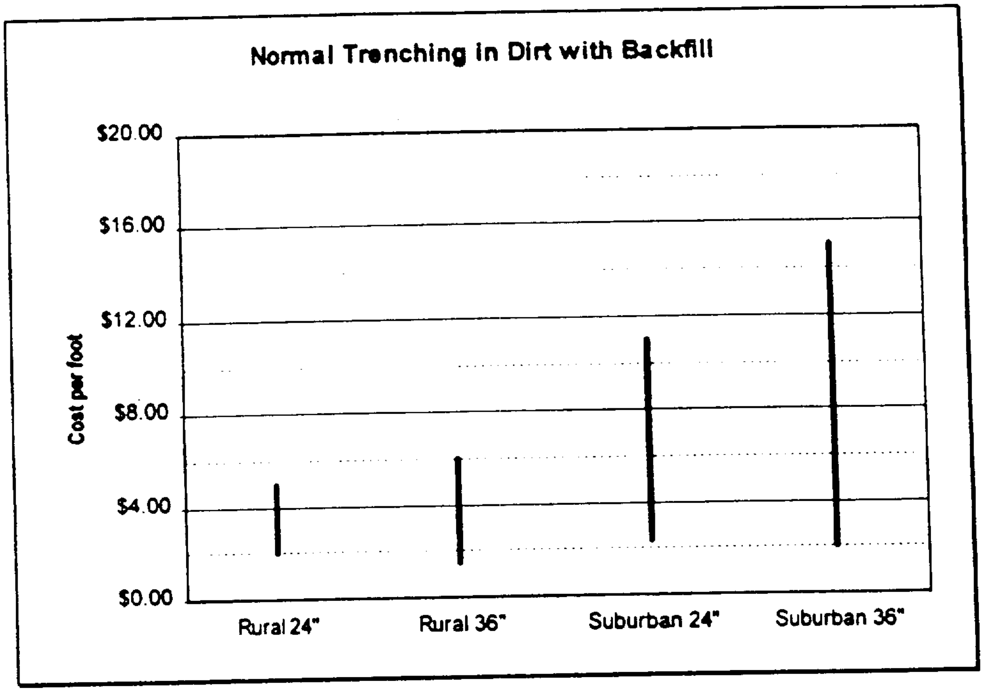
Note: Use of underground conduit structure for distribution should be infrequent, especially in the lower density zones. Although use of conduit for distribution cable in lower density zones is not expected, default prices are shown, should a user elect to change parameters for percent underground, aerial, and buried structure allowed by the HM 4.0 model structure.

A compound weighted cost for conduit excavation, placement and restoral can be calculated by multiplying the individual columns shown above and in the immediately preceding section, "Underground Excavation Costs per Foot". Performing such calculations using the default values shown would provide the following composite costs by density zone.

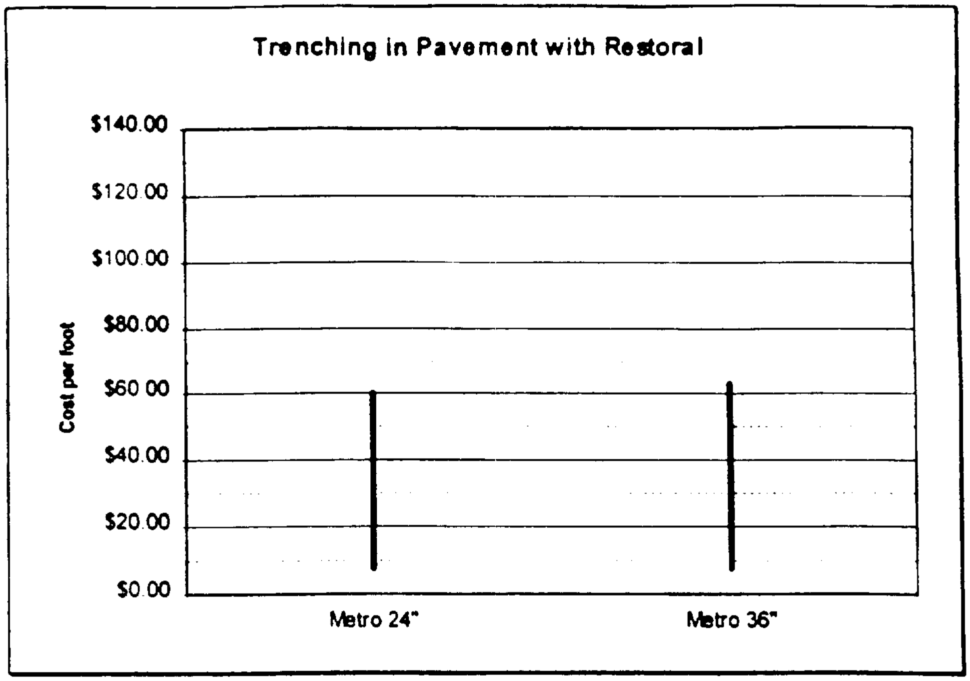
Underground Excavation, Restoration, and Conduit Placement Cost per Foot	
Density Zone	Cost Per Foot
0-5	$10.29
5-100	$10.29
100-200	$10.29
200-650	$11.35
650-850	$11.88
850-2,550	$16.40
2,550-5,000	$21.60
5,000-10,000	$50.10
10,000+	$75.00

Costs for various trenching methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources[52]. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries are revealed in the following charts. Note that this survey demonstrates that costs do not vary significantly between buried placements at 24" underground versus 36" underground. Therefore the Hatfield Model assumes an average placement depth ranging from 24" to 36", averaging 30".

Conduit placement cost is essentially the same, whether the conduit is used to house distribution cable, feeder cable, interoffice cable, or other telecommunication carrier cable, including CATV.



[52] Martin D. Kiley and Marques Allyn, eds., *1997 National Construction Estimator 45th Edition*, pp. 12-15.


Trenching in Pavement with Restoral
$140.00
$120.00
$100.00
$80.00
$60.00
$40.00
$20.00
$0.00
Cost per foot
Metro 24"
Metro 36"

6.3. BURIED EXCAVATION

Definition: The cost per foot to dig a trench to allow buried placement of cables, or the plowing of one or more cables into the earth using a single or multiple sheath plow.

Default Values:

Buried Excavation Costs per Foot									
	Plow		Trench	Backhoe		Hand Trench		Bore Cable	
Density Range	Fraction	Per Foot	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot
0-5	60.00%	$0.80	$1.90	10.00%	$3.00	0.00%	$5.00	0.00%	$11.00
5-100	60.00%	$0.80	$1.90	10.00%	$3.00	0.00%	$5.00	0.00%	$11.00
100-200	60.00%	$0.80	$1.90	10.00%	$3.00	0.00%	$5.00	0.00%	$11.00
200-650	50.00%	$0.80	$1.90	10.00%	$3.00	1.00%	$5.00	0.00%	$11.00
650-850	35.00%	$0.80	$1.95	10.00%	$3.00	2.00%	$5.00	0.00%	$11.00
850-2,550	20.00%	$1.20	$2.15	10.00%	$3.00	4.00%	$5.00	3.00%	$11.00
2,550-5,000	0.00%	$1.20	$2.15	10.00%	$3.00	5.00%	$5.00	4.00%	$11.00
5,000-10,000	0.00%	$1.20	$6.00	10.00%	$20.00	6.00%	$10.00	5.00%	$11.00
10,000+	0.00%	$1.20	$15.00	25.00%	$30.00	10.00%	$18.00	5.00%	$18.00

Note: Fraction % for Regular Trenching is the fraction remaining after subtracting Plow %, Backhoe %, Hand Trench %, and Bore Cable %.

Support: See discussion in Section 6.4.

6.4. BURIED INSTALLATION AND RESTORATION

Definition: The cost per foot to push pipe under pavement , or the costs per foot to cut the surface, place cable in a trench, backfill the trench with appropriately screened fill, and restore surface conditions. Digging a trench in connection with placing buried cable is covered in the preceding section titled, "Buried Excavation Cost per Foot".

Default Values:

Buried Installation and Restoration Costs per Foot											
	Push Pipe/Pull Cable		Cut/Restore Asphalt		Cut/Restore Concrete		Cut/Restore Sod		Restoral Not Req'd		Simple Backfill
Density Ranges	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Fraction	Per Foot	Fraction		Per Foot
0-5	2.00%	$6.00	3.00%	$6.00	1.00%	$9.00	2.00%	$1.00	62.00%		$0.15
5-100	2.00%	$6.00	3.00%	$6.00	1.00%	$9.00	2.00%	$1.00	62.00%		$0.15
100-200	2.00%	$6.00	3.00%	$6.00	1.00%	$9.00	2.00%	$1.00	62.00%		$0.15
200-650	2.00%	$6.00	3.00%	$6.00	1.00%	$9.00	2.00%	$1.00	52.00%		$0.15
650-850	2.00%	$6.00	3.00%	$6.00	1.00%	$9.00	2.00%	$1.00	37.00%		$0.15
850-2,550	4.00%	$6.00	5.00%	$6.00	3.00%	$9.00	35.00%	$1.00	27.00%		$0.15
2,550-5,000	5.00%	$6.00	8.00%	$6.00	5.00%	$9.00	35.00%	$1.00	9.00%		$0.15
5,000-10,000	6.00%	$6.00	18.00%	$18.00	8.00%	$21.00	11.00%	$1.00	11.00%		$0.15
10,000+	6.00%	$24.00	60.00%	$30.00	20.00%	$36.00	5.00%	$1.00	11.00%		$0.15

Note: Restoral is not required for plowing nor for pushing pipe & pulling cable. Fraction % for Simple Backfill is the fraction remaining after subtracting Restoral Not Required %.

Support: The costs reflect a mixture of different types of placement activities.

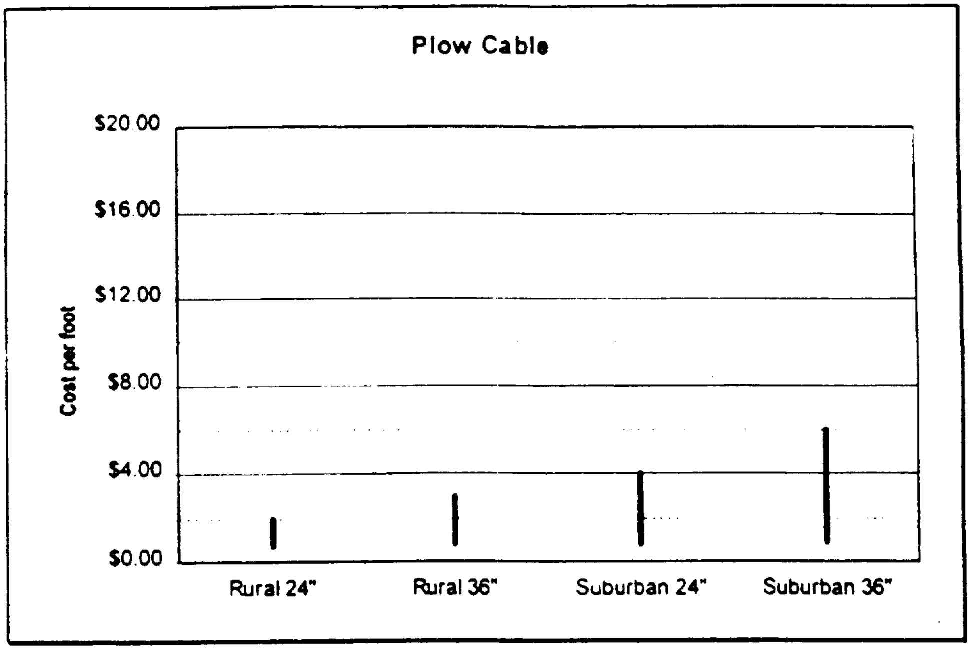
A compound weighted cost for conduit excavation, placement and restoral can be calculated by multiplying the individual columns shown above and in the immediately preceding section, "Buried Excavation Costs per Foot". Performing such calculations using the default values shown would provide the following composite costs by density zone.

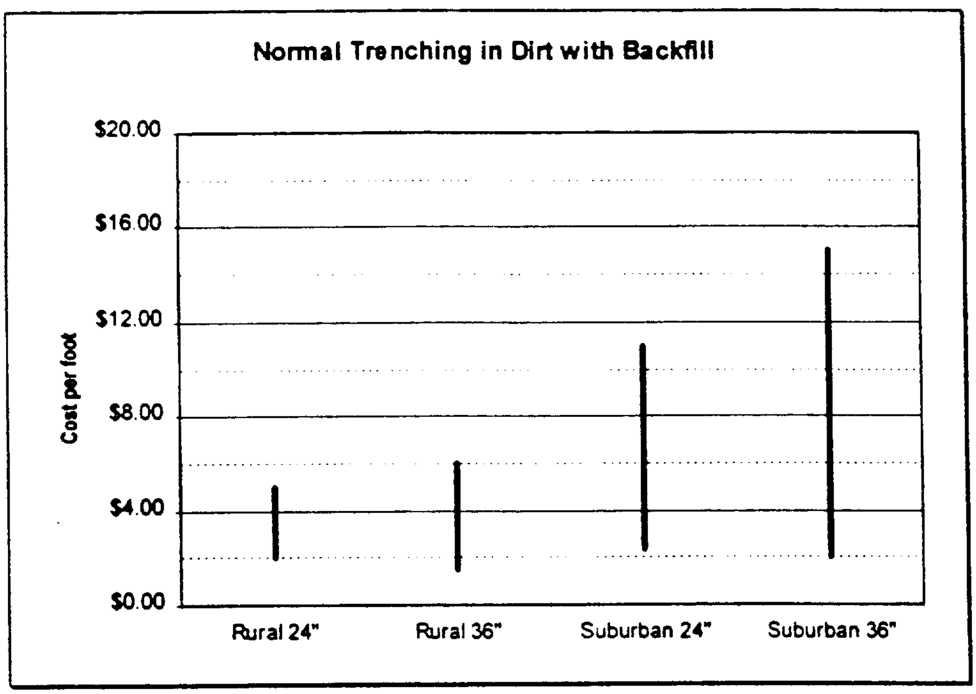
Buried Excavation, Installation, and Restoration Cost per Foot	
Density Zone	Cost Per Foot
0-5	$1.77
5-100	$1.77
100-200	$1.77
200-650	$1.93
650-850	$2.17
850-2,550	$3.54
2,550-5,000	$4.27
5,000-10,000	$13.00
10,000+	$45.00

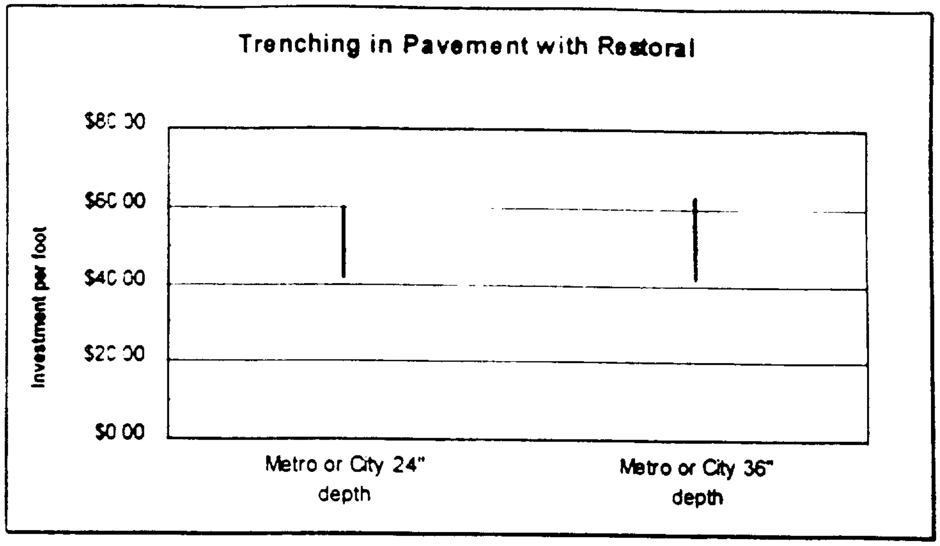
Costs for various excavation methods were estimated by a team of experienced outside plant experts. Additional information was obtained from printed resources[53]. Still other information was provided by several contractors who routinely perform excavation, conduit, and manhole placement work for telephone companies. Results of those inquiries are revealed in the following charts. Note that this survey demonstrates that costs do not vary significantly between buried placements at 24" underground versus 36"

[53] Martin D. Kiley and Marques Allyn, eds., *1997 National Construction Estimator 45th Edition*, pp. 12-15.

underground. Therefore the Hatfield Model assumes an average placement depth ranging from 24" to 36", averaging 30".






Trenching in Pavement with Restoral
$80.00
$60.00
$40.00
$20.00
$0.00
Investment per foot
Metro or City 24" depth
Metro or City 36" depth

6.5. SURFACE TEXTURE MULTIPLIER

Definition: The increase in placement cost attributable to the soil condition in a CBG, expressed as a multiplier that applies to any buried or underground structure excavation component in the CBG. The table lists effects in alphabetical order by Texture Code.

Default Values:

Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.00		Blank
1.00	1.00	BY	Bouldery
1.00	1.00	BY-COS	Bouldery Coarse Sand
1.00	1.00	BY-FSL	Bouldery & Fine Sandy Loam
1.00	1.00	BY-L	Bouldery & Loam
1.00	1.00	BY-LS	Bouldery & Sandy Loam
1.00	1.00	BY-SICL	Bouldery & Silty Clay Loam
1.00	1.00	BY-SL	Bouldery & Sandy Loam
1.00	1.10	BYV	Very Bouldery
1.00	1.10	BYV-FSL	Very Bouldery & Fine Sandy Loam
1.00	1.10	BYV-L	Very Bouldery & Loamy
1.00	1.10	BYV-LS	Very Bouldery & Loamy Sand
1.00	1.10	BYV-SIL	Very Bouldery & Silt
1.00	1.10	BYV-SL	Very Bouldery & Sandy Loam
1.00	1.30	BYX	Extremely Bouldery
1.00	1.30	BYX-FSL	Extremely Bouldery & Fine Sandy Loam
1.00	1.30	BYX-L	Extremely Bouldery & Loamy
1.00	1.30	BYX-SIL	Extremely Bouldery & Silt Loam
1.00	1.30	BYX-SL	Extremely Bouldery & Sandy Loam
1.00	1.00	C	Clay
1.00	1.00	CB	Cobbly
1.00	1.00	CB-C	Cobbly & Clay
1.00	1.00	CB-CL	Cobbly & Clay Loam
1.00	1.00	CB-COSL	Cobbly & Coarse Sandy Loam
1.00	1.10	CB-FS	Cobbly & Fine Sand
1.00	1.10	CB-FSL	Cobbly & Fine Sandy Loam
1.00	1.00	CB-L	Cobbly & Loamy
1.00	1.00	CB-LCOS	Cobbly & Loamy Coarse Sand
1.00	1.00	CB-LS	Cobbly & Loamy Sand
1.00	1.10	CB-S	Cobbly & Sand
1.00	1.00	CB-SCL	Cobbly & Sandy Clay Loam
1.00	1.00	CB-SICL	Cobbly & Silty Clay Loam
1.00	1.00	CB-SIL	Cobbly & Silt Loam
1.00	1.10	CB-SL	Cobbly & Sandy Loam
1.00	1.00	CBA	Angular Cobbly
1.00	1.10	CBA-FSL	Angular Cobbly & Fine Sandy Loam
1.00	1.20	CBV	Very Cobbly
1.00	1.20	CBV-C	Very Cobbly & Clay

Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.20	CBV-CL	Very Cobbly & Clay Loam
1.00	1.20	CBV-FSL	Very Cobbly & Fine Sandy Loam
1.00	1.20	CBV-L	Very Cobbly & Loamy
1.00	1.20	CBV-LFS	Very Cobbly & Fine Loamy Sand
1.00	1.20	CBV-LS	Very Cobbly & Loamy Sand
1.00	1.20	CBV-MUCK	Very Cobbly & Muck
1.00	1.20	CBV-SCL	Very Cobbly & Sandy Clay Loam
1.00	1.20	CBV-SIL	Very Cobbly & Silt
1.00	1.20	CBV-SL	Very Cobbly & Sandy Loam
1.00	1.20	CBV-VFS	Very Cobbly & Very Fine Sand
1.00	1.20	CBX	Extremely Cobbly
1.00	1.20	CBX-CL	Extremely Cobbly & Clay
1.00	1.20	CBX-L	Extremely Cobbly Loam
1.00	1.20	CBX-SIL	Extremely Cobbly & Silt
1.00	1.20	CBX-SL	Extremely Cobbly &Sandy Loam
1.00	1.30	CBX-VFSL	Extremely Cobbly Very Fine Sandy Loam
1.00	1.00	CE	Coprogenous Earth
1.00	1.00	CIND	Cinders
1.00	1.00	CL	Clay Loam
1.00	1.30	CM	Cemented
1.00	1.00	CN	Channery
1.00	1.00	CN-CL	Channery & Clay Loam
1.00	1.10	CN-FSL	Channery & Fine Sandy Loam
1.00	1.00	CN-L	Channery & Loam
1.00	1.00	CN-SICL	Channery & Silty Clay Loam
1.00	1.00	CN-SIL	Channery & Silty Loam
1.00	1.00	CN-SL	Channery & Sandy Loam
1.00	1.00	CNV	Very Channery
1.00	1.00	CNV-CL	Very Channery & Clay
1.00	1.00	CNV-L	Very Channery & Loam
1.00	1.00	CNV-SCL	Channery & Sandy Clay Loam
1.00	1.00	CNV-SIL	Very Channery & Silty Loam
1.00	1.00	CNV-SL	Very Channery & Sandy Loam
1.00	1.00	CNX	Extremely Channery
1.00	1.00	CNX-SL	Extremely Channery & Sandy Loam
1.00	1.00	COS	Coarse Sand
1.00	1.00	COSL	Coarse Sandy Loam
1.00	1.20	CR	Cherty
1.00	1.20	CR-L	Cherty & Loam
1.00	1.20	CR-SICL	Cherty & Silty Clay Loam
1.00	1.20	CR-SIL	Cherty & Silty Loam
1.00	1.20	CR-SL	Cherty & Sandy Loam
1.00	1.20	CRC	Coarse Cherty
1.00	1.20	CRV	Very Cherty
1.00	1.20	CRV-L	Very Cherty & Loam
1.00	1.20	CRV-SIL	Very Cherty & Silty Loam

Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.30	CRX	Extremely Cherty
1.00	1.30	CRX-SIL	Extremely Cherty & Silty Loam
1.00	1.00	DE	Diatomaceous Earth
1.00	1.00	FB	Fibric Material
1.00	1.00	FINE	Fine
1.00	1.00	FL	Flaggy
1.00	1.10	FL-FSL	Flaggy & Fine Sandy Loam
1.00	1.00	FL-L	Flaggy & Loam
1.00	1.00	FL-SIC	Flaggy & Silty Clay
1.00	1.00	FL-SICL	Flaggy & Silty Clay Loam
1.00	1.00	FL-SIL	Flaggy & Silty Loam
1.00	1.00	FL-SL	Flaggy & Sandy Loam
1.00	1.10	FLV	Very Flaggy
1.00	1.10	FLV-COSL	Very Flaggy & Coarse Sandy Loam
1.00	1.10	FLV-L	Very Flaggy & Loam
1.00	1.10	FLV-SICL	Very Flaggy & Silty Clay Loam
1.00	1.10	FLV-SL	Very Flaggy & Sandy Loam
1.00	1.10	FLX	Extremely Flaggy
1.00	1.10	FLX-L	Extremely Flaggy & Loamy
1.00	1.00	FRAG	Fragmental Material
1.00	1.10	FS	Fine Sand
1.00	1.10	FSL	Fine Sandy Loam
1.00	1.00	G	Gravel
1.00	1.00	GR	Gravelly
1.00	1.00	GR-C	Gravel & Clay
1.00	1.00	GR-CL	Gravel & Clay Loam
1.00	1.00	GR-COS	Gravel & Coarse Sand
1.00	1.00	GR-COSL	Gravel & Coarse Sandy Loam
1.00	1.00	GR-FS	Gravel & Fine Sand
1.00	1.00	GR-FSL	Gravel & Fine Sandy Loam
1.00	1.00	GR-L	Gravel & Loam
1.00	1.00	GR-LCOS	Gravel & Loamy Coarse Sand
1.00	1.10	GR-LFS	Gravel & Loamy Fine Sand
1.00	1.00	GR-LS	Gravel & Loamy Sand
1.00	1.00	GR-MUCK	Gravel & Muck
1.00	1.00	GR-S	Gravel & Sand
1.00	1.00	GR-SCL	Gravel & Sandy Clay Loam
1.00	1.00	GR-SIC	Gravel & Silty Clay
1.00	1.00	GR-SICL	Gravel & Silty Clay Loam
1.00	1.00	GR-SIL	Gravel & Silty Loam
1.00	1.00	GR-SL	Gravel & Sandy Loam
1.00	1.10	GR-VFSL	Gravel & Very Fine Sandy Loam
1.00	1.00	GRC	Coarse Gravelly
1.00	1.00	GRF	Fine Gravel
1.00	1.00	GRF-SIL	Fine Gravel Silty Loam
1.00	1.00	GRV	Very Gravelly

Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.00	GRV-CL	Very gravelly & Clay Loam
1.00	1.00	GRV-COS	Very Gravelly & coarse Sand
1.00	1.00	GRV-COSL	Very Gravelly & coarse Sandy Loam
1.00	1.00	GRV-FSL	Very Gravelly & Fine Sandy Loam
1.00	1.00	GRV-L	Very Gravelly & Loam
1.00	1.00	GRV-LCOS	Very Gravelly & Loamy Coarse Sand
1.00	1.00	GRV-LS	Very Gravelly & Loamy Sand
1.00	1.00	GRV-S	Very Gravelly & Sand
1.00	1.00	GRV-SCL	Very Gravelly & Sandy Clay Loam
1.00	1.00	GRV-SICL	Very Gravelly & Silty Clay Loam
1.00	1.00	GRV-SIL	Very Gravelly & Silt
1.00	1.00	GRV-SL	Very Gravelly & Sandy Loam
1.00	1.00	GRV-VFS	Very Gravelly & Very Fine Sand
1.00	1.00	GRV-VFSL	Very Gravelly & Very Fine Sandy Loam
1.00	1.10	GRX	Extremely Gravelly
1.00	1.10	GRX-CL	Extremely Gravelly & Coarse Loam
1.00	1.10	GRX-COS	Extremely Gravelly & Coarse Sand
1.00	1.10	GRX-COSL	Extremely Gravelly & Coarse Sandy Loam
1.00	1.10	GRX-FSL	Extremely Gravelly & Fine Sand Loam
1.00	1.10	GRX-L	Extremely Gravelly & Loam
1.00	1.10	GRX-LCOS	Extremely Gravelly & Loamy Coarse
1.00	1.10	GRX-LS	Extremely Gravelly & Loamy Sand
1.00	1.10	GRX-S	Extremely Gravelly & Sand
1.00	1.10	GRX-SIL	Extremely Gravelly & Silty Loam
1.00	1.10	GRX-SL	Extremely Gravelly & Sandy Loam
1.00	1.20	GYP	Gypsiferous Material
1.00	1.00	HM	Hemic Material
1.00	1.50	ICE	Ice or Frozen Soil
1.00	1.20	IND	Indurated
1.00	1.00	L	Loam
1.00	1.00	LCOS	Loamy Coarse Sand
1.00	1.10	LFS	Loamy Fine Sand
1.00	1.00	LS	Loamy Sand
1.00	1.00	LVFS	Loamy Very Fine Sand
1.00	1.00	MARL	Marl
1.00	1.00	MEDIUM coarse	Medium Coarse
1.00	1.00	MK	Mucky
1.00	1.00	MK-C	Mucky Clay
1.00	1.00	MK-CL	Mucky Clay Loam
1.00	1.00	MK-FS	Muck & Fine Sand
1.00	1.00	MK-FSL	Muck & Fine Sandy Loam
1.00	1.00	MK-L	Mucky Loam
1.00	1.00	MK-LFS	Mucky Loamy Fine Sand
1.00	1.00	MK-LS	Mucky Loamy Sand
1.00	1.00	MK-S	Muck & Sand
1.00	1.00	MK-SI	Mucky & Silty

Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.00	MK-SICL	Mucky & Silty Clay Loam
1.00	1.00	MK-SIL	Mucky Silt
1.00	1.00	MK-SL	Mucky & Sandy Loam
1.00	1.00	MK-VFSL	Mucky & Very Fine Sandy Loam
1.00	1.00	MPT	Mucky Peat
1.00	1.00	MUCK	Muck
1.00	1.00	PEAT	Peat
1.00	1.00	PT	Peaty
1.00	1.50	RB	Rubbly
1.00	1.50	RB-FSL	Rubbly Fine Sandy Loam
1.00	1.00	S	Sand
1.00	1.00	SC	Sandy Clay
1.00	1.00	SCL	Sandy Clay Loam
1.00	1.00	SG	Sand & Gravel
1.00	1.00	SH	Shaly
1.00	1.00	SH-CL	Shaly & Clay
1.00	1.00	SH-L	Shale & Loam
1.00	1.00	SH-SICL	Shaly & Silty Clay Loam
1.00	1.00	SH-SIL	Shaly & Silt Loam
1.00	1.50	SHV	Very Shaly
1.00	1.50	SHV-CL	Very Shaly & Clay Loam
1.00	2.00	SHX	Extremely Shaly
1.00	1.00	SI	Silt
1.00	1.00	SIC	Silty Clay
1.00	1.00	SICL	Silty Clay Loam
1.00	1.00	SIL	Silt Loam
1.00	1.00	SL	Sandy Loam
1.00	1.00	SP	Sapric Material
1.00	1.00	SR	Stratified
1.00	1.00	ST	Stony
1.00	1.00	ST-C	Stony & Clay
1.00	1.00	ST-CL	Stony & Clay Loam
1.00	1.00	ST-COSL	Stony & Coarse Sandy Loam
1.00	1.10	ST-FSL	Stony & Fine Sandy Loam
1.00	1.00	ST-L	Stony & Loamy
1.00	1.00	ST-LCOS	Stony & Loamy Coarse Sand
1.00	1.10	ST-LFS	Stony & Loamy Fine Sand
1.00	1.00	ST-LS	Stony & Loamy Sand
1.00	1.00	ST-SIC	Stony & Silty Clay
1.00	1.00	ST-SICL	Stony & Silty Clay Loam
1.00	1.00	ST-SIL	Stony & Silt Loam
1.00	1.00	ST-SL	Stony & Sandy Loam
1.00	1.10	ST-VFSL	Stony & Sandy Very Fine Silty Loam
1.00	1.20	STV	Very Stony
1.00	1.20	STV-C	Very Stony & Clay
1.00	1.20	STV-CL	Very Stony & Clay Loam

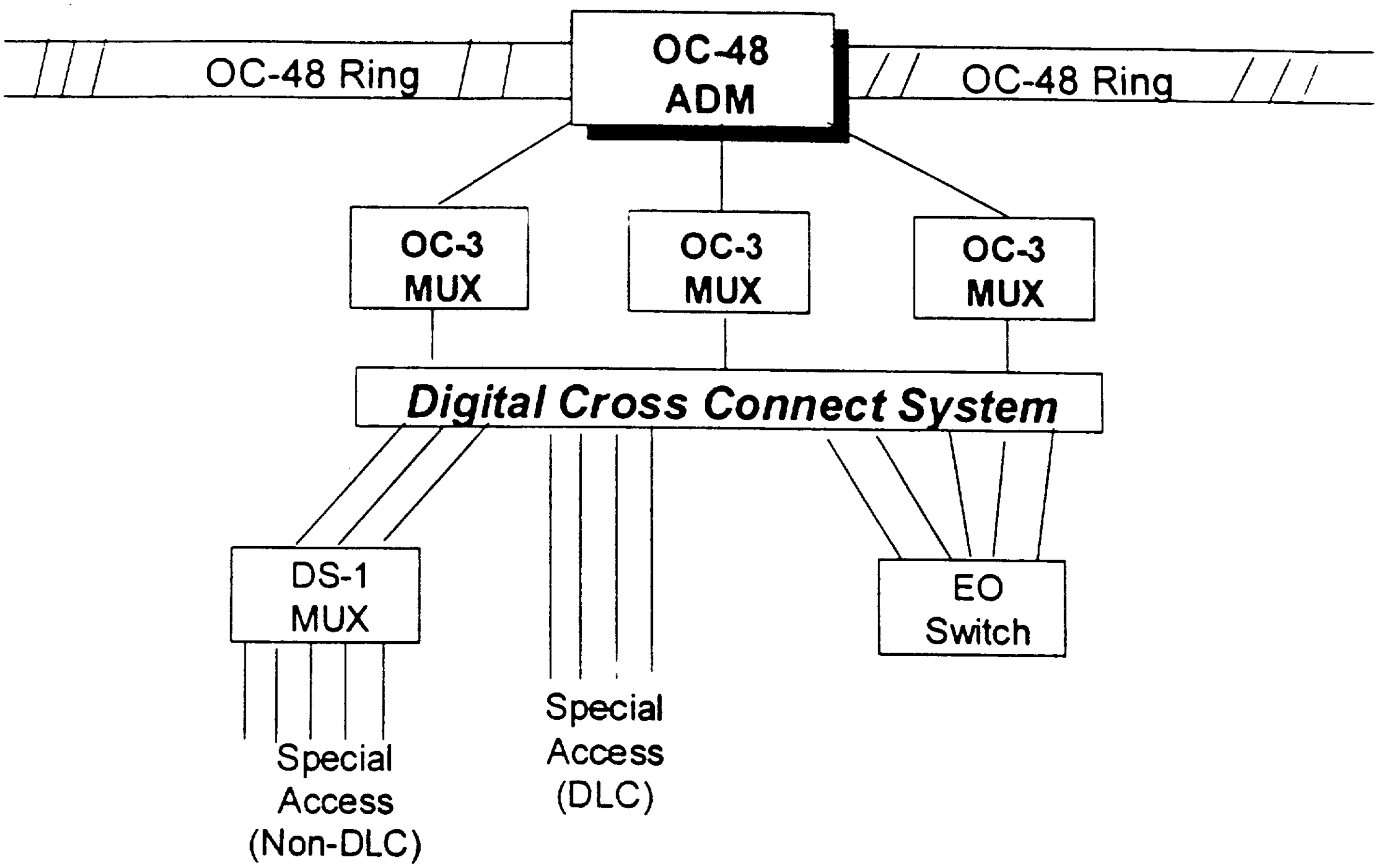
Fraction CBG Affected	Effect	Texture	Description of Texture
1.00	1.20	STV-FSL	Very Stony & Fine Sandy Loam
1.00	1.20	STV-L	Very Stony & Loamy
1.00	1.20	STV-LFS	Very Stony & Loamy Fine Sand
1.00	1.20	STV-LS	Very Stony & Loamy Sand
1.00	1.20	STV-MPT	Very Stony & Mucky Peat
1.00	1.20	STV-MUCK	Very Stony & Muck
1.00	1.20	STV-SICL	Very Stony & Silty Clay Loam
1.00	1.20	STV-SIL	Very Stony & Silty Loam
1.00	1.20	STV-SL	Very Stony & Sandy Loam
1.00	1.20	STV-VFSL	Very Stony & Very Fine Sandy Loam
1.00	1.30	STX	Extremely Stony
1.00	1.30	STX-C	Extremely Stony & Clay
1.00	1.30	STX-CL	Extremely Stony & Clay Loam
1.00	1.30	STX-COS	Extremely Stony & Coarse Sand
1.00	1.30	STX-COSL	Extremely Stony & Coarse Sand Loam
1.00	1.30	STX-FSL	Extremely Stony & Fine Sandy Loam
1.00	1.30	STX-L	Extremely Stony & Loamy
1.00	1.30	STX-LCOS	Extremely Stony & Loamy Coarse Sand
1.00	1.30	STX-LS	Extremely Stony & Loamy Sand
1.00	1.30	STX-MUCK	Extremely Stony & Muck
1.00	1.30	STX-SIC	Extremely Stony & Silty Clay
1.00	1.30	STX-SICL	Extremely Stony & Silty Clay Loam
1.00	1.30	STX-SIL	Extremely Stony & Silty Loam
1.00	1.30	STX-SL	Extremely Stony & Sandy Loam
1.00	1.30	STX-VFSL	Extremely Stony & Very Fine Sandy Loam
1.00	3.00	SY	Slaty
1.00	3.00	SY-L	Slaty & Loam
1.00	3.00	SY-SIL	Slaty & Silty Loam
1.00	3.50	SYV	Very Slaty
1.00	4.00	SYX	Extremely Slaty
1.00	1.00	UNK	Unknown
1.00	2.00	UWB	Unweathered Bedrock
1.00	1.00	VAR	Variable
1.00	1.00	VFS	Very Fine Sand
1.00	1.00	VFSL	Very Fine Sandy loam
1.00	3.00	WB	Weathered Bedrock

Support: Discussions with excavation contractors who routinely perform work in a variety of soil conditions are reflected in the default difficulty factors listed above. Difficulty factors range from 1.00, or no additional effect, to as high as 4.0, or 400% as much as normal.

Although an engineer would normally modify plans to avoid difficult soil textures where possible, and although it is likely that population is located in portions of a CBG where conditions are less severe than is the average throughout the CBG, HM 4.0 has taken the conservative approach of assuming that the difficult terrain factors would affect 100% of the CBG.

APPENDIX A

Interoffice Transmission Terminal Configuration (Fiber Ring)



APPENDIX B

Structure Shares Assigned to Incumbent Local Telephone Companies

Overview

Due to their legacy as rate-of-return regulated monopolies, LECs and other utilities have heretofore had little incentive to share their outside plant structure with other users. To share would have simply reduced the "ratebase" upon which their regulated returns were computed. But today and going forward, LECs and other utilities face far stronger economic and institutional incentives to share outside plant structure whenever it is technically feasible. There are two main reasons. First, because utilities are now more likely to either face competition or to be regulated on the basis of their prices (e.g., price caps) rather than their costs (e.g., ratebase), a LEC's own economic incentive is to share use of its investment in outside plant structure. Such arrangements permit the LEC to save substantially on its outside plant costs by spreading these costs across other utilities or users. Second, many localities now strongly encourage joint pole usage or trenching operations for conduit and buried facilities as a means of minimizing the unsightliness and or right-of-way congestion occasioned by multiple poles, or disruptions associated with multiple trenching activities.

Because of these economic and legal incentives, not only has structure sharing recently become more common, but its incidence is likely to accelerate in the future – especially given the Federal Telecommunications Act's requirements for nondiscriminatory access to structure at economic prices.

The degree to which a LEC can benefit from structure sharing arrangements varies with the type of facility under consideration. Sharing opportunities are most limited for multiple use of the actual conduits (e.g., PVC pipe) through which cables are pulled that comprise a portion of underground structure. Because of safety concerns, excess ILEC capacity within a conduit that carries telephone cables can generally be shared only with other low-voltage users, such as cable companies, other telecommunications companies, or with municipalities or private network operators. Although the introduction of fiber optic technology has resulted in slimmer cables that have freed up extra space within existing conduits, and thus enlarged actual sharing opportunities, the Hatfield Model does not assume that conduit is shared because as a forward-looking model of efficient supply, it assumes that a LEC will not overbuild its conduit so as to carry excess capacity available for sharing.

Trenching costs of conduit, however, account for most of the costs associated with underground facilities – and LECs can readily share these costs with other telecommunications companies, cable companies, electric, gas or water utilities, particularly when new construction is involved. Increased CATV penetration rates and accelerated facilities based entry by CLECs into local telecommunications markets will expand further future opportunities for underground structure sharing. In addition, in high density urban areas, use of existing underground conduit is a much more economic alternative than excavating established streets and other paved areas.

Sharing of trenches used for buried cable is already the norm, especially in new housing subdivisions. In the typical case, power companies, cable companies and LECs simply place their facilities in a common trench, and share equally in the costs of trenching, backfilling and surface repair. Gas, water and sewer companies may also occupy the trench in some localities. Economic and regulatory factors are likely to increase further incentives for LECs to schedule and perform joint trenching operations in an efficient manner.

Aerial facilities offer the most extensive opportunities for sharing. The practice of sharing poles through joint ownership or monthly lease arrangements is already widespread. Indeed, the typical pole carries the facilities of at least three potential users – power companies, telephone companies and cable companies. Power companies and LECs typically share the ownership of poles through either cross-lease or condominium arrangements, or through other arrangements such as one where the telephone company and power company each own every other pole. Cable companies have commonly leased a portion of the pole space available for low voltage applications from either the telephone company or the power company. Methods of setting purchase prices and of calculating pole attachment rates generally are prescribed by federal and state regulatory authorities.

The number of parties wishing to participate in pole sharing arrangements should only increase with the advent of competition in local telecommunications markets. Economic and institutional factors strongly support reliance on pole sharing arrangements. It makes economic sense for power companies, cable companies and telephone companies to share pole space because they are all serving the same customer. Moreover, most local authorities restrict sharply the number of poles that can be placed on any particular right-of-way, thus rendering pole space a scarce resource. The Federal Telecommunications Act reinforces and regulates the market for pole space by prescribing nondiscriminatory access to poles (as well as to conduit and other rights-of-way) for any service provider that seeks access. The aerial distribution share factors displayed below capture a forward-looking view of the importance of these arrangements in an increasingly competitive local market.

Structure Sharing Parameters

The Hatfield Model captures the effects of structure sharing arrangements through the use of user-adjustable structure sharing parameters. These define the fraction of total required investment that will be borne by the LEC for distribution and feeder poles, and for trenching used as structure to support buried and underground telephone cables. Since best forward looking practice indicates that structure will be shared among LECs, IXCs, CAPs, cable companies, and other utilities, default structure sharing parameters are assumed to be less than one. Incumbent telephone companies, then, should be expected to bear only a portion of the forward-looking costs of placing structure, with the remainder to be assumed by other users of this structure.

The default LEC structure share percentages displayed below reflect most likely, technically feasible structure sharing arrangements. For both distribution and feeder facilities, structure share percentages vary by facility type to reflect differences in the degree to which structure associated with aerial, buried or underground facilities can reasonably be shared. Structure share parameters for aerial and underground facilities also vary by density zone to reflect the presence of more extensive sharing opportunities in urban and suburban areas. In addition, LEC shares of buried feeder structure are larger than buried distribution structure shares because a LEC's ability to share buried feeder structure with power companies is less over the relatively longer routes that differentiate feeder runs from distribution runs. This is because power companies generally do not share trenches with telephone facilities over distances exceeding 2500 ft.[54]

[54] A LEC's sharing of trenches with power companies, using random separation between cables for distances greater than 2,500 feet requires that either the telecommunications cable have no metallic components (i.e., fiber cable), or that both companies follow "Multi-Grounded Neutral" practices (use the same connection to earth ground at least every 2,500 feet).

Default Values in HM 4.0

Structure Percent Assigned to Telephone Company						
	Distribution			Feeder		
Density Zone	Aerial	Buried	Under-ground	Aerial	Buried	Under-ground
0-5	50	33	1.00	50	40	.50
5-100	33	33	50	33	40	.50
100-200	.25	33	.50	25	.40	.40
200-650	.25	33	50	25	40	.33
650-850	25	.33	.40	25	.40	33
850-2,550	.25	.33	33	25	.40	.33
2,550-5,000	.25	33	33	.25	.40	33
5,000-10,000	.25	.33	33	.25	.40	.33
10,000+	25	.33	.33	25	.40	.33

Support

Actual values for the default structure sharing parameters were determined through forward-looking analysis as well as assessment of the existing evidence of structure sharing arrangements. Information concerning present structure sharing practices is available through a variety of sources, as indicated in the references to this section. The HM 4.0 estimates of best forward-looking structure shares have been developed by combining this information with expert judgments regarding the technical feasibility of various sharing arrangements, and the relative strength of economic incentives to share facilities in an increasingly competitive local market. The reasoning behind the Hatfield Model's default structure sharing parameters is described below.

Aerial Facilities:

As noted in the overview to this section, aerial facilities (poles) are already a frequently shared form of structure, a fact that can readily be established through direct observation. For all but the two lowest density zones, the Hatfield Model uses default aerial structure sharing percentages that assign 25 percent of aerial structure costs to the incumbent telephone company. This assignment reflects a conservative assessment of current pole ownership patterns, the actual division of structure responsibility between high voltage (electric utility) applications and low voltage applications, and the likelihood that incumbent telephone companies will share the available low voltage space on their poles with additional attachers.[55]

ILECs and Power Companies generally have preferred to operate under "joint use," "shared use," or "joint ownership" agreements whereby responsibility for poles is divided between the ILEC and the power company, both of whom may benefit from the presence of third party attachers. New York Telephone reports, for example, that almost 63 percent of its pole inventory is jointly owned,[56] while, in the same

[55] This sharing may be either of unused direct attachment space on the pole, or via co-lashing of other users' low voltage cables to the LEC's aerial cables. See, Direct Panel Testimony of Richard Wolf, Clay T. Whitehead, Donald Fiscella, David Peacock and Dr. Miles Bidwell on Behalf of the Electric Utilities, Case 95-C-0341: Pole Attachments, State of New York Public Service Commission, January 27, 1997.

[56] New York Telephone's Response to Interrogatory of January 22, 1997, Case 95-C-0341: Pole Attachments, State of New York Public Service Commission, January 27, 1997.

proceeding, Niagara Mohawk Power Company reported that 58 percent of its pole inventory was jointly owned[57]. Financial statements of the Southern California Joint Pole Committee indicate that telephone companies hold approximately 50 percent of pole units[58]. Although proportions may vary by region or state, informed opinion of industry experts generally assign about 45 percent of poles to telephone companies. Note that both telephone companies and power companies may lease space on poles solely owned by the other.

While the responsibility for a pole may be joint, it is typically not equal. Because a power company commonly needs to use a larger amount of the space on the pole to ensure safe separation between its conductors that carry currents of different voltages (e.g., 440 volt conductors versus 220 volt conductors) and between its wires and the wires of low voltage users, the power company is typically responsible for a larger portion of pole cost than a telephone company.

Because of the prevalence of joint ownership, sharing, and leasing arrangements, it is unusual for a telephone company to use poles that are not also used by a power company. ILEC structure costs are further reduced by the presence of other attachers in the low voltage space. Perhaps the best example is cable TV. Rather than install their own facilities, CATV companies generally have leased low voltage space on poles owned by the utilities. Thus, the ILECs have been able to recover a portion of the costs of their own aerial facilities through pole attachment rental fees paid by the CATV companies. The proportion of ILEC aerial structure costs recoverable through pole attachment fees is now likely to increase still further as new service providers enter the telecommunications market.

As noted above, the other, most obvious reason for assigning a share of aerial structure costs as low as 25 percent to the ILEC is the way that the space is used on a pole. HM 4.0 assumes that ILECs install the most commonly placed pole used for joint use, a 40 foot, Class 4 pole.[59] Of the usable space on such a pole, roughly half is used by the power company which has greater needs for intercable separation. That leaves the remaining half to be shared by low voltage users, including CATV companies and competing telecommunications providers. The diagram below depicts the situation.

Thus, a) because ILECs generally already bear well less than half of aerial structure costs; b) because ILECs now face increased opportunities and incentives to recover aerial facilities costs from competing local service providers; c) because new facilities-based entrants will be obliged to use ILEC-owned structure to install their own networks; and, d) because the Telecommunications Act requires ILECs to provide nondiscriminatory access to structure as a means of promoting local competition, on a forward-looking basis, it is extremely reasonable to expect that ILECs will need, on average, bear as little as 25 percent of the total cost of aerial structure.

Buried Facilities:

Buried structure sharing practices are more difficult to observe directly than pole sharing practices. Some insight into the degree to which buried structure is, and will be shared can be gained from prevailing

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[57] Direct Panel Testimony of Richard Wolf, Clay T. Whitehead, Donald Fiscella, David Peacock and Dr. Miles Bidwell on Behalf of the Electric Utilities, Case 95-C-0341: Pole Attachments, State of New York Public Service Commission, January 27, 1997. These experts also predicted that sharing of poles among six attachers would not be uncommon.

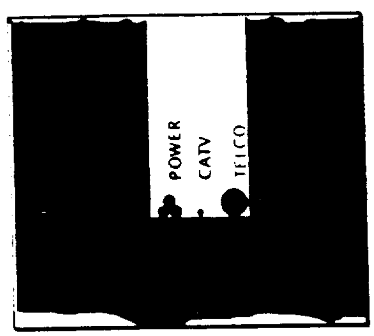
[58] " Statement of Joint Pole Units and Annual Pole Unit Changes by Regular Members", Monthly Financial Statements of the Southern California Joint Pole Committee, October, 1996.

[59] Opinion of engineering team. Also, "The Commission {FCC} found that 'the most commonly used poles are 35 and 40 feet high, ...'" {FCC CS Docket No. 97-98 NPRM dtd 3/14/97 pg. 6, and 47 C.F.R. § 1.1402(c). A pole's "class" refers to the diameter of the pole, with lower numbers representing larger diameter poles.

municipal rules and architectural conventions governing placement of buried facilities. As mentioned in the overview, municipalities generally regulate subsurface construction. Their objectives are clear: less damage to other subsurface utilities, less cost to ratepayers, less disruption of traffic and property owners, and fewer instances of deteriorated roadways from frequent excavation and potholes.

Furthermore, since 1980, new subdivisions have usually been served with buried cable for several reasons. First, prior to 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 esthetic and safety related reasons. Contacts with telephone outside plant engineers, architects and property developers in several states confirm that in new subdivisions, builders typically not only prefer buried plant that is capable of accommodating multiple uses, but they usually dig the trenches at their own expense, and place power, telephone, and CATV cables in the trenches, if the utilities are willing to supply the materials. Thus, many buried structures are available to the LEC at no charge. The effect of such "no charge" use of developer-dug trenches reduces greatly the effective portion of total buried structure cost borne by the LEC. Note, too, that because power companies do not need to use a disproportionately large fraction of a trench – in contrast to their disproportionate use of pole space, and because certain buried telephone cables are plowed into the soil rather than placed in trenches, the HM 4.0 assumed LEC share of buried structure generally is greater than of aerial structure.

Facilities are easily placed next to each other in a trench as shown below:



Underground Facilities:

Underground plant is generally used in more dense areas, where the high cost of pavement restoration makes it attractive to place conduit in the ground to permit subsequent cable reinforcement or replacement, without the need for further excavation. Underground conduit usually is the most expensive investment per foot of structure -- with most of these costs attributable to trenching. For this reason alone, it is the most attractive for sharing.

In recent years, major cities such as New York, Boston, and Chicago have seen a large influx of conduit occupants other than the local telco. Indeed most of the new installations being performed today are cable placement for new telecommunications providers. As an example, well over 30 telecommunications providers now occupy ducts owned by Empire City Subway in New York City.[60] This trend is likely to continue as new competitors enter the local market.

References

[60] Empire City Subway is the subsidiary of NYNEX that operates its underground conduits in New York City.

Industry experience and expertise of Hatfield Associates

AT&T and MCI outside plant engineers.

Outside Plant Consultants

Montgomery County, MD Subdivision Regulations

Policy Relating to Grants of Location for New Conduit Network for the Provision of Commercial Telecommunications Services

Monthly Financial Statements of the Southern California Joint Pole Committee.

Conversations with representatives of local utility companies.

New York Telephone's Response to Interrogatory of January 22, 1997, Case 95-C-0341: Pole Attachments , State of New York Public Service Commission, January 27, 1997.

Direct Panel Testimony of Richard Wolf, Clay T. Whitehead, Donald Fiscella, David Peacock and Dr. Miles Bidwell on Behalf of the Electric Utilities, Case 95-C-0341: Pole Attachments, State of New York Public Service Commission, January 27, 1997.

"Statement of Joint Pole Units and Annual Pole Unit Changes by Regular Members", Monthly Financial Statements of the Southern California Joint Pole Committee, October, 1996.

APPENDIX C

Expenses in Hatfield 4.0 Model

Expense Group. Network Expenses
Explanation: Maintenance and repair of various categories of investment - outside plant (e.g., NID, drop, distribution, Service Area Interface, Circuit equipment, Feeder plant) and Central office equipment (e.g., switch)
Data Origin: New England Telephone Company Incremental Cost Study (switching and circuit operating expenses), Hatfield Consultant (NID), FCC ARMIS 43-03 (everything else).

6212 Digital Electronic Expense
6230 Operator Systems Expense
6232 Circuit Equipment Expense
6351 Public
6362 Other Terminal Equipment
6411 Poles
6421 Aerial Cable
6422 Underground Cable
6423 Buried Cable
6426 Intrabuilding Cable
6431 Aerial Wire
6441 Conduit Systems

Amount Determination: Expense-to-Investment ratio (NET Study, ARMIS); Dollar per Line for NID.
Application: Determine cost by multiplying Expense-to-Investment ratio times modeled investments; Determine NID cost by multiplying Dollar-per-Line times number of lines

Expense Group: Network Operations
Explanation: Network related expenses needed to manage the network but not accounted for on a plant type specific basis
Data Origin: ARMIS 43-03

6512 Provisioning Expenses
6531 Power Expenses
6532 Network Administration
6533 Testing
6534 Plant Operations Administration
6535 Engineering

Amount Determination: Hatfield default Network Operations Factor 50% times the embedded amount in ARMIS.
Application: Determine cost by allocating to unbundled network elements (UNEs) equiproportionally relative to UNE direct costs. Cost of "Network Administration" is allocated to traffic sensitive (i.e., switching, signaling and interoffice) UNEs only.

Expense Group: Network Support and Miscellaneous
Explanation: Miscellaneous expenses needed to support day to day operations
Data Origin: ARMIS 43-03

6112 Motor Vehicles	Hatfield: Network Support
6113 Aircraft	Hatfield: Network Support
6114 Special Purpose Vehicles	Hatfield: Miscellaneous
6116 Other Work Equipment	Hatfield: Miscellaneous

Amount Determination: In essence, embedded ARMIS levels are scaled to reflect the relative change in either cable and wire (C&W) investment for Network Support Expenses or total investment for Miscellaneous Expenses in the modeled results versus ARMIS. For example:
Hatfield Cost
= Embedded ARMIS Expense x (Hatfield C&W Inv./ARMIS C&W Inv.)
The rationale is that these costs will be lower in a forward-looking cost study.
Application: Determine cost by allocating to unbundled network elements (UNEs) equiproportionally relative to direct costs

Expense Group: Other Taxes
Explanation: Taxes paid on gross receipts and property (i.e., 7240 Other Operating Taxes)
Data Origin: Hatfield expert estimate of 5% is based on overall Tier 1 Company ratio of ARMIS 7240 Expenses to ARMIS Revenues.
Amount Determination: Modeled costs are grossed up by 5%.
Application: Determine cost by allocating to unbundled network elements (UNEs) equiproportionally relative to direct costs.

Expense Group: Miscellaneous
Explanation: Miscellaneous expenses needed to support day to day operations
Data Origin: ARMIS 43-03
- 6122 Furniture
- 6123 Office Equipment
- 6124 General Purpose Computer
- 6121 Buildings

Amount Determination: In essence, embedded ARMIS levels are scaled to reflect the relative change in total investment in the Hatfield model versus ARMIS. For example:
Hatfield Cost
= Embedded ARMIS Expense x (Hatfield Tot. Inv./ARMIS Tot. Inv.)
The rationale is that these costs will be lower in a forward-looking cost study.
Application: Determine cost by allocating to unbundled network elements (UNEs) equiproportionally relative to direct costs.

Expense Group: Carrier-to-carrier customer service
Explanation: This category includes all carrier customer-related expenses such as billing, billing inquiry, service order processing, payment and collections. End-user retail services are not included in UNE cost development.
Data Origin: ARMIS 4304 (carrier-to-carrier cost to serve IXC access service)
- 7150 Service Order Processing
- 7170 Payment and Collections
- 7190 Billing Inquiry
- 7270 Carrier Access Billing System

Amount Determination: Hatfield multiplies embedded amount (across Tier 1 LECs) times 70% to get $1.69 per line per year. The cost is determined by multiplying the cost per line times the number of lines. This figure includes the above business office activities, hence there is no need for a separate non-recurring charge to account for this activities. The underlying data that the UNE costs were developed from include other types of non-recurring costs outside the business office. Most of the non-recurring costs are captured in the Hatfield UNE estimate.
Application: Determine cost by allocating to unbundled network elements (UNEs) equiproportionally relative to direct costs.

Expense Group: Variable Overhead
Explanation: Executive, Planning and General and Administrative costs
Data Origin: ARMIS 43-03

6711 Executive
6712 Planning
6721 Accounting & Finance
6722 External Relations
6723 Human Resources
6724 Information Management
6725 Legal
6726 Procurement
6727 Research & Development
6728 Other General & Administrative

Amount Determination: Hatfield estimates 10.4% multiplier based on AT&T public data.

		$Mill	Source
A	Rev. Net of Settlements	36,877	Form M 1994
B	Settlement Payout	4,238	Intl Traffic Data 1/19/96
C	Gross Revenues	41,115	A + B
D	Corporate Operations	3,879	Form M 1994
E	Revenue less Corp. Op.	37,236	C - D
F	Ratio	10.4%	D/E

Application: Cost is determined by multiplying the sum of all costs by 1.104.

Expense Group: Carrier-to-carrier Uncollectibles
Explanation: Revenues not realized associated with services provided (i.e., delinquency, fraud)
Data Origin: Company-specific ratio calculated from ARMIS 4304 Uncollectibles to ARMIS Access Revenues.
Amount Determination: Modeled costs are grossed up by the uncollectible rate.
Application: Determine cost by allocating to unbundled network elements (UNEs) equiproportionally relative to direct costs.

APPENDIX D

Network Operations Reduction

No matter what area of network operations one looks at, one observes a rich set of target opportunities for cost savings. In Account 6512, Network Provisioning, new technologies such as the Telecommunications Management Network (TMN) standards, procedures, and systems, and Digital Cross-Connect Systems (DCS) provide for much more centralized access and control, and self-provisioning by customers (including, and especially, knowledgeable CLECs). Given the tiered nature of TMN, where there are element, network, service, and business layers of management, some of the advantages of TMN will redound to the benefit of plant-specific expenses, while others, associated with the network, service and business management layers, will benefit the more-general activities included in network operations. DCS, with its higher investment cost but favorable impact on expenses, is assumed in HM 3, whereas it was not assumed in HM 2.2.2.

The use of Electronic Data Interchange, intranet technology, and technologies such as bar coding provide substantial opportunities to reduce the costs of the inventory component of this category of accounts. On the human resources side, there is a greater emphasis on quality control in provisioning activities, reducing incipient failures in the services and elements provided.

As far as power expenses, Account 6531, digital components typically consume less power than their analog counterparts. Furthermore, centralization in other expense categories also spills over into this category, since centralization implies fewer buildings to power less of the time. Finally, due to the onset of competition in the electric power industry and the greater regulatory scrutiny of new generation resources, the industry is increasingly willing to provide price reductions to large business (and, increasingly, even residential and small business) customers. It is now quite common for firms to participate in energy programs in which, in exchange for reducing consumption during peak hours, they receive substantial discounts in the cost of power.

Network Administration, Account 6532, benefits from the deployment of SONET-based transport, because many administration activities are oriented to reacting to outages, which are lessened with the deployment of newer technologies. Testing, Account 6533, also benefits from the better monitoring and reporting capabilities provided by TMN and SONET. This can lead to more proactive, better-scheduled preventative maintenance. On the human resources side, there is a growing tendency for testing activities to be taken over by contractors, leading to lower labor costs for the ILECs. To the extent the activities are still performed by telephone company personnel, they can be performed by personnel with lower job classifications. Finally, the use of "hot spares" can reduce the need for out-of-hours dispatch and emergency restoral activities. Overall, fiber and SONET projects are often "proven in" partly on the assumption that they will produce significant operational savings.

Plant Operations and Administration, Account 6534, is likely to require fewer supervisory personnel, and more involvement by the vendors of equipment to the ILECs. For instance, as vendors take over many of the installation and ongoing maintenance activities associated with their equipment, there will be fewer ILEC engineers requiring management. The use of multi-skilled craft people will allow for fewer specialists to be sent out to address particular problems, and less supervision to manage the people that are sent out. It will, for instance, allow for greater span of control in supervisory and management ranks.

Finally, Engineering, Account 6535, will be more focused on activities associated with positioning the ILECs in a multi-entrant marketplace, less on the engineering of specific elements and services, as those activities become more automated and more in the hands of the purchasers of unbundled elements. To the extent that engineering addresses particular projects, or categories of projects, the use of better planning tools, such as the ability to geocode customer locations and sizes, will act to reduce the amount of such activities.

Additional specific reasons for adjusting the embedded level of these expenses include the following:

Recognize industry trends and the opportunities for further reductions. Network operations expenses, expressed on a per line basis, have already declined over the past several years. For the reasons described in the previous section, this trend is expected to continue as modern systems and technologies are deployed.

Eliminate incumbent LEC retail costs from the network operations expense included in the cost for unbundled network elements. A number of the sub-accounts (6533 Testing and 6534 Plant Operations Administration) include costs that are specific to retail operations that are not appropriately included in the cost calculated for unbundled network elements. A portion of the expenses booked to these sub-accounts represent activities that new entrants, rather than the incumbent LEC, will be performing. Analysis indicates that, as a conservative measure, 20% of the expenses in these two sub-accounts represent such retail activities and should be excluded. Since these two sub-accounts represent 56% of the total booked network operations expense, it is reasonable to conclude that, at a minimum, an additional 11% reduction should be applied to the historic booked levels of network operations expense.

Incorporate incumbent LEC expectations of forward-looking network operations expense levels. The Benchmark Cost Proxy Model ("BCPM"), sponsored by PacTel, Sprint, and US West, consistently calculates a level network operations expense per line that is well below historic levels and below the level calculated by the Hatfield Model. This projection of forward-looking network operations expenses, prepared for and advocated by three incumbent LECs, indicates that the Hatfield Model adjustment to the embedded levels of these expenses are appropriate and necessary (and may yield cost estimates that are conservatively high).

Minimize double counting of network operations expenses. A careful review of the way ARMIS account 6530 and the related sub-accounts (6531 Power, 6532 Network Administration, 6533 Testing, 6534 Plant Operations Administration, and 6535 Engineering) are constructed makes it clear that further adjustment is necessary to accurately produce forward-looking costs. Many of the engineering and administrative functions that are included in these accounts are recovered by the incumbent LECs through non-recurring charges. Without such an adjustment, these costs may be double-recovered through existing non-recurring charges and simultaneously through the recurring rates based on the Hatfield Model results. Similarly, double recovery is possible because these accounts are constructed as so-called "clearance accounts" where expenses are booked before they are assigned to a specific project. Without an adjustment, these expenses could be recovered as service or element-specific costs and as the shared costs represented by network operations expense.

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CERTIFICATE OF SERVICE

I, Scott M. Bohannon, do hereby certify that on this 17th day of October, 1997, I caused a copy of the foregoing Comments of AT&T Corp. and MCI Telecommunications Corporation on Customer Location Issues to be served upon each of the parties listed on the attached Service List by U.S. First Class mail, postage prepaid.

/s/ Scott M. Bohannon

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