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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

# The Louisiana Public Service Commission Submission of

## State Forward-Looking Cost Studies for Federal Universal Service Support CC Docket Nos. 96-45 and 97-160

May 19, 1998

## I. Overview

The Louisiana Public Service Commission (LPSC) hereby submits its recommended cost proxy model and input assumptions for use in determining the amount of universal service support that will be funded at the federal level. The LPSC recommends that the Hatfield model be used to calculate the amount of universal service support. The LPSC also recommends that the universal service support be calculated at the census block group level. This provides a better estimate of the amount of universal service support required to serve high cost customers. The LPSC also submits a cost study which calculates the amount of universal service support at the wire center level. It is our understanding that BellSouth is currently not equipped to administer universal service support at the census block group level, but that it will be able to do this in the future. Assuming the federal universal service support will be 25% of the total, the amount of federal support recommended by the LPSC at the census block group level is $41,414,158, the total support figure is $165,656,633. At the wire center level, the amount of federal support, assuming a 25% contribution, is $32,203,365, the total support amount is $128,813,458.

Because Exhibits 2 and 3 below contain the actual wire center line counts of BellSouth, the LPSC has locked and hidden the columns that contain the wire center line counts and columns that use these line counts to make calculations. The LPSC has been informed that any public version of the model placed on the web or otherwise made available to the public should contain the locked and hidden cells so as to not divulge this proprietary information. The FCC and its Staff can gain access to this information by contacting Ms. Vicki McHenry, General Counsel for BellSouth's Louisiana operations, at (504) 528-2948 to obtain the password to unlock the cells.

Attached with this submission are several documents. They are listed and described below.

Excel Files

- Exhibit 1 - file name Exh1 - contains the Commission's requested input file
- Exhibit 2 - file name Exh2 - contains the LPSC recommended run of Hatfield 5.0, at the census block group level
- Exhibit 3 - file name Exh3 - contains the LPSC's run of Hatfield 5.0, at the wire center level
- Exhibit 4 - file name Exh4 - contains the deaveraged revenue benchmarks
- Exhibit 5 - file name Exh5 - Hatfield UNE run
- Exhibit 6 - file name Exh6 - Buried Drop Costs
- Exhibit 7 - file name Exh7 - Installed Copper Cable Prices
- Exhibit 8 - file name Exh8 - Expenses per Line per Month

WordPerfect Files

- Exhibit 9 - file name Exh9 - Staff Final Recommendation in the Universal Service Docket No. U-20883 (Subdocket A)
- Exhibit 10 - file name Exh10 - Commission Order in the Universal Service

Docket No. U-20883 (Subdocket A), adopting the Staff's Final Recommendation.

## A. General and Supporting Information

**1. State:**

Response: Louisiana

**2. Date of Filing**

Response: May 19, 1998

**3. Contact Person & Telephone Number (also include electronic mail address if available)**

Response: Kim Dismukes (504) 768-4490 kdism@premier.net or Stephanie Folse (504) 342-9888 sfolse@lpsc.org

**4. Hardware Requirements (i.e., disk space, memory requirements, etc.)**

Response: 133 MHZ or faster Pentium processor, 64 megabytes of RAM, SVGA monitor set to 800 x 600 display resolution, 400 megabytes of available hard drive capacity.

**5. Software Requirements (i.e., operating system and version, spreadsheet software and version, etc.)**

Response: Windows 95 or Windows NT, Microsoft Professional 97, with Microsoft Service Release 1 installed.

**6. General Description of Study (identify whether study is based on the Benchmark Cost Proxy Model (BCPM)1 or HAI Model2 (identify version), a study or model prepared by a local exchange carrier (LEC), a state study or model for pricing unbundled network elements, or other source)**

Response: The cost study was prepared using Hatfield 5.0.

**7. Supporting Information**

(a) Please provide supporting information that includes a detailed description of the proposed cost study and all underlying data, formula, computations, and software associated with the study. The documentation should include a complete listing of algorithms and formulas used in the study and in any pre-processing modules. The supporting information should begin with an overview of the basic approach taken in the

cost study, including the study's general methodology and basic assumptions. (Note: If the state cost study is a version of a cost model that is already being considered by the Commission as the basis for determining federal high cost support,3 it is not necessary to provide all underlying documentation; if the proposal contains changes to the algorithms or inputs of a model under consideration by the Commission, however, such changes must be clearly documented.)

Response: The cost study being submitted is Hatfield 5.0 which is already under consideration by the Commission. A complete description of the process used by the Hatfield model, version 5.0, including calculations and algorithms, is provided as part of model and accompanying documentation which has already been provided to the Commission. The methodology used by Hatfield 5.0 is described in detail in Hatfield 5.0 Model Description. Appendices to the documentation describe the data tables present in the model and describe and explain the input fields. There were some changes make by the LPSC to the formulas used in the model and input values. These are as follows:

**Formula Changes**

1) Plant specific expense factors contained in the 95Actuals workbook were modified to use BellSouth-Louisiana specific expense factors consistent with the LPSC's UNE Docket U-22022 (UNE docket). In addition, the plant specific expense factors for cable were separated to account for the difference between the maintenance cost of fiber verus copper. To apply different factors to fiber versus copper cable a column was added in the 95Actuals workbook for fiber plant specific expense factors, column H, rows 44-46.

   To effectuate this change, it was necessary to alter the formulas in the workbook "investment input" for columns CY, DB, DE, DT, DU, DV, EB, EC, ED, EJ, EK, and EL. These columns calculate the direct expense associated with fiber cable used for feeder and transport. The Hatfield default formulas would have multiplied the direct investment associated with this fiber times an expense factor which contained both copper and fiber maintenance costs. By modifying the formulas contained in the Hatfield output spreadsheet to pull the expense factors from 95Actuals column H, rows 44-46, a more accurate calculation of the expense associated with maintaining copper and fiber cable is calculated.

2) The formula for calculating general support expenses was also changed to be consistent with the LPSC's UNE docket. The LPSC found that the amount of expenses per line per

month associated with general support expenses should be $1.29. To reflect this in the Hatfield model it was necessary to modify the formula in row 128, columns C, D, E, and H. To reflect the cost of $1.29 per line per month the formulas in these cells were changed by increasing the result by 2.15 times.

3) The LPSC also changed the revenue benchmark calculations. While the LPSC used the default values of $31 for primary residential lines and $51 for single-line business customers, the LPSC deaveraged these revenue benchmarks consistent with the deaveraging of costs at the wire center level or the CBG level. The revenue benchmarks were deaveraged by using rates charged by BellSouth-Louisiana at different exchanges. These rates were compared to the weighted average rate for all exchanges. A factor was then developed based upon the rates charged at each wire center or CBG to the weighted average rate for all exchanges. This factor was then applied to the $31 and $51 revenue benchmark to arrive at a deaveraged revenue benchmark by wire center or CBG. The development of the deaveraged factors and revenue benchmarks are contained in Exhibit 4, attached in electronic form. The results of the Hatfield model were altered to compute the amount of universal service support based upon the deaveraged revenue benchmarks as opposed to the average revenue benchmarks. The formulas in columns E and G of the workbook "USF" were modified to compute the universal service support using the deaveraged rates set forth in Exhibit 4.

4) The LPSC also scaled the results of the Hatfield model to take into consideration the price of the loop and port resulting from running the Hatfield model on a UNE basis to the price of the loop and port set by the Commission in its UNE docket. This analysis which is provided as Exhibit 5, indicated that the Hatfield model produced a combined loop and port price that was higher than what was set by the Commission in the UNE docket. Therefore, the LPSC has scaled the resulting universal service amounts (for only the loop and port) by 87%. This is the UNE scaling factor reflected in Exhibits 2 and 3. The calculations to effectuate these modifications are reflected in columns M through Q of the workbook USF in Exhibits 2 and 3.

5) Also, several of the LPSC's recommended input changes,

primarily expense factors and formula changes, could not be altered in the USF calculations at the CBG level. Therefore, the LPSC applied the percentage difference between a wire center run with all of its recommended changes and a wire center run that did not include changes that were made directly to the excel spreadsheets. At the wire center level, this difference was negative 7% for primary residential lines and negative 7% for single-line businesses. The LPSC applied this percentage to the results produced when calculated at the CBG level to arrive at the universal service funding amount.

## Input Changes

There were several input changes to the Hatfield model. These changes were made to be consistent with the LPSC's decision in the UNE docket, but where necessary were adjusted to reflect the differences between calculating UNE costs and universal service costs. The input changes were as follows:

1) A drop wire length of 177 feet.

   A drop wire length of 177 feet was used based upon the analysis conducted in the UNE docket. Because the parties did not submit additional information validating their proposed drop wire length, the LPSC adopted a length of 177 feet, adjusted by density zone.

2) Aerial and buried drop costs as reflected on Exhibit 6 in electronic form.

   The buried and aerial drop costs used by the LPSC are based upon BellSouth-Louisiana specific costs adjusted to reduce the labor rate and to reflect a more accurate representation of the differences in costs across density zones. These recommended inputs are the same as the ones used in the UNE docket, however, they are adjusted to reflect differing costs in different density zones.

3) NID investment of $7.43 for the case, $30.92 for labor, and $9.92 for the protection block.

   The LPSC used these costs for the NID investment because they are based upon BellSouth-Louisiana specific costs, after adjustments to reduce the labor rate used in BellSouth's calculations. These recommended inputs are the same as used by the LPSC in the UNE docket.

4) Pole costs of $228.68 for material and $224.06 for labor, which are BellSouth-Louisiana specific costs and include the cost of guys and anchors.

The values replaced the Hatfield default values because they are specific to BellSouth-Louisiana and are reasonable when compared to other data. These are the same values as recommended for use by BellSouth in the BCPM, with the exception that they have not been inflated.

5) The installed cost of copper cable as reflected on Exhibit 7, in electronic form.

6) Fiber cable material prices as developed by BellSouth.

Fiber cable prices as set forth below. These are BellSouth-Louisiana specific prices for the installed cost of fiber cable in Louisiana. They are not significantly different from the Hatfield default values. Therefore, the LPSC found them appropriate for use in calculating universal service funding.

| Size | Installed Price |
|---|---|
| 216 | $15.32 |
| 144 | $11.11 |
| 96 | $6.26 |
| 72 | $4.83 |
| 60 | $4.07 |
| 48 | $3.43 |
| 36 | $2.77 |
| 24 | $2.26 |
| 18 | $1.79 |
| 12 | $1.42 |

7) For the cost of SAIs, the LPSC used the Hatfield default prices increased by 25%.

The LPSC concluded that BellSouth's material as well as engineered, furnished, and installed cost for indoor and outdoor SAIs are incorrect and overstated. Accordingly, the LPSC used the Hatfield default prices increased by 25%. The prices were increased by 25% because when compared to the default BCPM prices, the Hatfield prices are considerably lower.

8) Large DLC Channel Unit Cards that are .31% higher than the

Hatfield default assumptions and the Hatfield default assumptions for small DLC Channel Unit Cards.

The LPSC found that it was appropriate to increase the cost of large DLC sites by .31% to account for the added costs associated with the additional electronics needed to support loops that severe beyond 13,200 feet of the DLC site. With respect to small DLC site, no increase was necessary to the prices for channel unit cards. (The rationale for this adjustment is explained in greater detail in the attached Exhibit 9.)

9) Fill factors that result in output fill factors of approximately 42.9% for copper distribution cable 75% for copper feeder cable.

To calculate universal service funding the LPSC used these fill factors, adjusted by density zone, as they are the same as adopted by the LPSC in the UNE docket.

10) Structure sharing percentages for poles of 65% and trenching of 25%. In other words, 65% and 25% of these costs would be borne by companies other than BellSouth.

The LPSC used these structure sharing percentages as they are effectively the same as those used by the LPSC in the UNE docket. The LPSC, however, has adjusted these percentages to reflect differences in density zones.

11) Cable and wire expense factors including nonrecurring costs are: poles .0078, aerial cable metallic .0420, aerial cable fiber .0025, underground cable metallic .0148, underground cable fiber .0014, buried cable metallic .0398, buried cable fiber .0037, conduit .0009, which are based upon BellSouth-Louisiana's specific cable and wire expenses.

The LPSC used these cable and wire expense factors as they are based on BellSouth-Louisiana's costs adjusted to be forward-looking and they are the same factors used by the LPSC in the UNE docket, but they include costs related to nonrecurring functions. The LPSC found BellSouth's recommended expense factors failed to reflect a forward-looking environment. Similarly, the LPSC found Hatfield's default cable and wire expense factors are based upon the relationship between 1996 ARMIS expenses and 1996 ARMIS investment for cable and wire facilities. The Hatfield default cable and wire expense factors are based on historical embedded costs and do not accurately depict the

differences between the maintenance cost of copper and fiber cable.

12) A circuit plant factor, including nonrecurring costs, of 1.97%.

The LPSC used this circuit expense factor as it is based on BellSouth-Louisiana's actual costs adjusted to be forward-looking and it is the same factor used by the LPSC in the UNE docket, except that it includes nonrecurring costs. BellSouth's recommended circuit expense factor is 2.24% which was not adjusted to reflect a forward-looking environment. For this reason, the LPSC rejected BellSouth's proposed circuit expense factor. The Hatfield default circuit factor of 1.53% is based upon a 1993 study conducted by New England Telephone Company. While the Hatfield documentation claims that the default circuit factor is forward-looking it is clearly not based upon BellSouth-Louisiana specific information. Therefore, the LPSC rejected the Hatfield default circuit factor.

13) A switching expense factor, including nonrecurring costs, of 4.4818%.

The LPSC used this switching expense factor as it is based on BellSouth-Louisiana's costs adjusted to be forward-looking and it is the same factor used in the UNE docket, but it includes nonrecurring costs. BellSouth's recommended switching factor of 4.62% was rejected because it did not include nonrecurring costs and it did not reflect a forward-looking environment. The Hatfield default of 2.69% and is based upon a 1993 study conducted by New England Telephone Company. The Hatfield default switching factor was rejected because it was not BellSouth-Louisiana specific and it did not include the cost of generic upgrades.

14) Other switching inputs as follows which are more specific to BellSouth-Louisiana than the default inputs used in the Hatfield model.

(a) Main Distribution Frame Cost of $20.29, which is based upon BellSouth-Louisiana specific costs divided by the feeder fill factor of 75%.
(b) Switch port administrative fill of 94%4.
(c) Constant end-office switching investment term of $280.435.
(d) Switching installation multiplier of 1.13876.

The LPSC found these inputs to be more specific to BellSouth's Louisiana operations than the default inputs used in the Hatfield model. The Hatfield default values were rejected in favor of inputs that were specific to BellSouth-Louisiana.

15) A forward-looking network operations cost per line per month of $2.86.

The calculation for this cost per month is depicted on Exhibit 8. The foundation for this cost is the same as was used by the LPSC in its UNE docket. The calculation is forward-looking in that it uses BellSouth's projected expenses for the years 1997 through 1999, however, it adjusts these expenses downward considerably over the amounts proposed by BellSouth.

16) Network support expenses of $.03 per month per access line, general support expenses of $1.29 per month per access line.

The calculation for this cost per month is depicted on Exhibit 8. The foundation for this cost is the same as was used in the UNE docket and adopted by the LPSC. The calculation is forward-looking in that it uses BellSouth's projected expenses for the years 1997 through 1999, however, it adjusts these expenses downward considerably over the amounts proposed by BellSouth. This recommendation produces a result that is identical for network support expenses, but higher for general support expenses relative to the Hatfield default calculations.

17) Marketing and billing and inquiry expenses that equate to $1.88 per line per month.

The calculation of this expense factor is forward-looking in that it uses BellSouth's projected marketing expenses for the years 1997 through 1999. However, it adjusts these expenses downward considerably over the amounts proposed by BellSouth. In addition, the LPSC further adjusted the expense per line per month for marketing expenses by removing costs related to multiline business customers and secondary residential lines. For billing and inquiry expenses, Staff used the default assumption of $1.22 used in the Hatfield model.

18) A common cost factor that equates to cost per line per month of $2.86.

The calculation for this cost per month is depicted on Exhibit 8. The foundation for this cost is the same as was used in the UNE

docket and adopted by the LPSC. The calculation is forward-looking in that it uses BellSouth's projected expenses for the years 1997 through 1999. However, it adjusts these expenses downward considerably over the amounts proposed by BellSouth.

19) Use of BellSouth specific tax rates.

The LPSC used a combined state and federal tax rate of 38.48%, which is BellSouth's actual combined tax rate. This is the same as used by BellSouth in the BCPM. The Hatfield default assumption used by AT&T is 39.25%. The LPSC also used an effective other tax rate of 5.17%, which is based upon BellSouth's actual taxes. The Hatfield defaults were not BellSouth specific and therefore were rejected.

20) The prices for manholes, fiber pull boxes, and terminals were set at zero because these costs are included in the BellSouth-Louisiana in-plant factors. Because the LPSC used in-plant factors that were more comparable to the BellSouth-Louisiana proposed in-plant factors, it is appropriate to zero out the costs for these facilities.

(b) Please identify the sources of all underlying data used in the study and state whether these sources are included with this filing. If not, explain why not.

Response: The sources of the underlying data used in the study, include Hatfield default values that come with the Hatfield model and BellSouth-Louisiana specific data which were obtained during the LPSC's docket addressing the cost of unbundled network elements and in the docket addressing the cost model and input assumptions to use for developing the cost of universal service to be funded at the federal level. The sources have not been included with the filing because many are not in electronic format and the documents are voluminous. The LPSC can provide this information if it is deemed necessary.

## B. Demonstration That the Cost Study Fulfills the Order's Criteria for State Cost Studies

***Criterion 1: The technology assumed in the cost study must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed. A model, however, must include the incumbent LECs' wire centers as the center of the loop network and the outside plant should terminate at incumbent LECs' current wire centers. The loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services. For***

***example, load coils should not be used because they impede the provision of advanced services. Wire center line counts should equal actual incumbent LEC wire center line counts, and the study's or model's average loop length should reflect the incumbent carrier's actual average loop length.***

(a) Describe the network technology for which costs are computed, including switch types used, feeder and distribution technology, digital loop carrier devices, and other electronics, if any; type of interoffice technology; and any assumptions, such as maximum copper loop lengths or copper resistance constraints.

Response: The Hatfield model uses least-cost, most efficient technology that is currently being deployed by incumbent local exchange carriers (ILECs). Such technology includes next generation digital loop carrier systems, digital switching, fiber rings for interoffice transport, and signaling system 7 for the signaling network.

The maximum total copper cable length that is allowed to carry voiceband analog signals is 18,000 feet.. When the potential copper cable length exceeds the threshold, it triggers long loop treatment and/or the deeper penetration of fiber based Digital Loop Carrier (DLC). Loops are designed to guarantee that loop transmission loss is statistically distributed and that no single loop in the distribution network exceeds the signaling range of the central office. Based on the most common current design plans applied on a forward-looking basis it is recommended, using Revised Resistance Design guidelines, that loops 18,000 feet in length should be nonloaded and have loop resistance of 1300 Ohms or less. The default value of 18,000 feet was chosen to be consistent with the minimum distance at which long loop treatment is usually required. (See section 2.7.6, HM 5.0 HIP)

Hatfield treats subscribers served by cable lengths that exceed 18,000 ft (i.e., "long loops"), by locating small "subsidiary remote terminals" along the road cable to restrict the analog transmission distance over copper pairs to 18,000 ft. The road cables contain copper pairs and support T1 signals used to provide digital connections between the DLC remote terminals located in the centers of the subclusters and the subsidiary remote terminals. The model assumes conventional T1 transmission with 6,000 ft repeater spacing.

A road cable, depending on its length, may require several remote terminals. If, for example, the cable is 24,000 ft long, the model will serve the subscribers located along the first 18,000 ft of cable directly from the SAI and will place a small remote terminal at 18,000 ft to serve the remaining subscribers. If the cable length is,

say, 42,000 ft, the model will again serve those subscribers along the first 18,000 ft directly and locate a small remote terminal at 36,000 feet. This remote terminal then serves the subscribers lying between 18,000 ft and 42,000 feet over copper pairs in the road cable; the remote terminal serves those subscribers lying between 18,000 and 36,000 ft by "back-feeding" over pairs in the same cable containing the T1 pairs. In all cases, the model equips sufficient repeaters at 6,000 ft intervals beginning at a point 3,000 ft from the remote terminal located in the center of the subcluster from which the road cables emanate.

(b) Explain how this technology is the least-cost, most-efficient, and reasonable technology currently being deployed for providing the supported services that are reflected in your study. Are technology determinations based on engineering practice rules of thumb or explicit optimization processes? If relying on engineering practices, provide any studies that show that these practices result in a least-cost network. Describe any optimization routines or engineering rules of thumb that are used in the study to achieve a least-cost, most-efficient, and reasonable network design. In your response, please answer the following questions:

Response: In addition to the response provided in part (a) above, the model developers state that they have considered all technologies that are known to be deployable and for which costs can be established, and have selected what the industry considers to be the appropriate forward-looking technology. Where forward-looking practices embrace more than one technology, the selection of which depends on the particular demographics and/or topography of a particular area, the model includes an optimization routine to select between them. This includes, for instance, the selection of copper or fiber feeder (Section 6.3.5 of HM5.0 Model Description and Section 3.5.10 of HM5.0 HIP), wireline or wireless distribution (Section 6.3.4 of the HM5.0 Model Description and Section 2.11 of the HM5.0 HIP), type of structure -- aerial, buried, or underground (Section 6.2.5 of the HM5.0 Model Description and Sections 2.5, 3.1 and 3.2 of the HM5.0 HIP), and choice of interoffice rings versus redundant point-point links Section 6.5.3.2 of the HM5.0 Model Description).

(1) Describe how the study determines whether feeder, sub-feeder, and distribution plant should consist of fiber or copper, and whether electronics, such a T-1 carrier system, are used in the feeder and sub-feeder plant. Also, please describe the gauge(s) of copper considered in the study.

Response: Copper/Fiber Crossover (Section 6.3.5 of the HM5.0 Model Description)

The decision whether to use fiber feeder is based on whether any of the following conditions are met:

a. The total feeder and subfeeder distance from the wire center to the main cluster centroid is greater than the user-adjustable Copper Feeder Max Distance value.

b. A life-cycle cost analysis of fiber versus copper feeder on the route shows that fiber is more economical.

c. The longest distribution cable run from the wire center to the farthest corner of a main cluster is greater than a user-input maximum analog copper distance, whose default value is 18,000 ft.

d. There is at least one outlier cluster subtending the main cluster.

e. The wireless investment cap is invoked and leads to the conclusion that one of the two wireless systems is the least-cost solution for the serving area.

Use of T-1 Carrier (See sections 6.3.1. and 6.3.2 of HM5.0 Model Description, see also Section 2.8.8 of the HM5.0 HIP for discussion of T-1 repeater spacing parameters)

The basic distribution configuration employed by HM 5.0 for main clusters of customer locations is a "grid" topology, in which tapering backbone cables run north and south from the SAI(s), while branch cables extend east and west from the backbone cables past the individual subscriber locations. Outlier clusters, each consisting of one or more customer locations, are served by the nearest main cluster. A main cluster and its subtending outlier clusters together constitute a serving area.

Outliers are connected to the main cluster by copper road cables extending from the centroid of the main cluster to the centroid of the outlier. A given outlier may be directly connected to the main cluster, in which case it is labeled a "first order" outlier, or it may be connected to another outlier which in turn is connected directly to the main cluster or another outlier. Outliers that are not directly connected to the main cluster are considered to be "higher order" outliers.

If the right-angle route distance from the main cluster to the farthest customer location in a first order outlier is less than the user-adjustable distance parameter whose default value is 18,000 feet, the road cable carries an ordinary analog voice signal, and is called "subscriber road cable." If the farthest customer in an outlier is more than the default distance from the main cluster, or the outlier is a higher order outlier, the cable carries a digital T1 format signal to a remote T1 terminal at the centroid of the outlier, and is served by "T1 road cable." From the T1 RT, copper cables carrying analog signals extend the remainder of the way to the customer locations within the outlier.

A T1 road cable contains copper pairs, and supports T1 signals used to provide digital connections between the fiber DLC remote terminals located at the centroid of the main cluster and subsidiary remote T1 terminals located at the centroid of each outlier cluster. HM5.0 assumes conventional T1 transmission with a user-adjustable 32 dB repeater spacing. The cables serving subscribers from the remote terminals are assumed to be different than those that carry the T1 signals to the remote terminals. The total investment calculated for the T1 system includes the cost of the T1 interfaces in the main cluster's DLC remote terminal.

Cable Gauges (See sections 3.3.2 and 3.4.1 of HM5.0 HIP)

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, 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 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.

(2) Describe how the model determines the feeder and subfeeder paths that connect distribution areas to the wire center. Does the model rely on current feeder paths or does the model choose a different path? If the study or model determines feeder paths, describe the algorithm that determines the feeder path. Similarly, a model will connect customer locations within a distribution area to the serving area interface. Does the

model employ an optimization routine or employ a rule of thumb for determining distribution routes?

**Response:** (See Section 6.4.2.1 and Figures 7 and 8 in Section 6.4.2.1, of the HM5.0 Model Description).

The feeder plant layout is modeled independently of the existing feeder routes employed by the ILEC in question, according to the following algorithm. Main feeder routes extend from the wire center in as many as four directions.7

Subfeeder cables branch from the main feeder at right angles, giving rise to the familiar tree topology of feeder routes. The points at which subfeeders branch off the main feeder delineate main feeder segments, which are the portions of main feeder cable between two branch points.8

The centers (centroids) of the main clusters may fall in any of the four feeder route quadrants. A set of parameters, including the quadrant, airline (radial) distance and angles (omega and alpha), locate the main cluster with respect to the serving wire center. With this information, HM 5.0 applies straightforward trigonometric calculations to compute main feeder and subfeeder distances.9 The model computes sufficient subfeeder cable to connect the main feeder route to the centroid of each main cluster. Copper feeder cable always terminates at an SAI at the centroid of the main cluster. If the model calls for fiber feeder, the subfeeder terminates at an RT at the centroid, adjacent to an SAI.

Multiple serving areas share capacity on certain segments of the main feeder route. Segments located closer to the wire center require more capacity than segments near the periphery. HM 5.0 addresses this need by tapering the main feeder facilities as the distance from the wire center increases. Thus, it must determine the various "segment distances" so it can size the cable in each segment. The segment distances along a main route are calculated in two steps. First, the main clusters are sorted so they appear in the order of increasing distance along the main route. Segment distances are then calculated as the difference between the main feeder distances of adjacent main clusters.

The Distribution Module models distribution plant using a rule-of-thumb approach that is, however, consistent with the way ILECs would deploy distribution plant for the areas in question. The Model developers believe this to be a reasonably optimum

way to lay out distribution plant.

(3) Describe how the study determines whether cable should be placed as either aerial, underground (conduit), or buried. Please identify whether the study assumes that plant mix decisions will be affected by zoning restrictions and, if so, how.

Response: Distribution and Feeder Structure Fractions (See sections 2.5.1 and 3.2.1 for HM5.0 structure fraction assumed default)

Definition:
The relative amounts of different structure types supporting distribution and feeder cable in each density zone. For distribution cable, in the highest two density zones, aerial structure includes riser and block cable.

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, it is assumed in HM5.0 that density, measured in Access Lines per Square Mile, is a good determinant of structure type.

Aerial/Block Cable:
The most common cable structure is still the pole line. 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.

HM 5.0 accounts for drop wire separately; drop wire is not considered part of aerial cable in HM 5.0. However, cable attached to the outsides of buildings, normally found in higher density areas, and referred to as "block cable," is appropriately classified to the aerial cable account. To facilitate modeling, HM 5.0 also reasonably includes Intrabuilding Network Cable under its treatment of aerial cable. Thus the default percentages (section 2.5.1, HM5.0 HIP) above 2,550 lines per square mile indicate a growing amount of block and intrabuilding cable, rather than cable placed on pole lines.

Buried Cable:
HM 5.0 assumes 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, as reflected by zoning ordinances and subdivision covenants, the public now clearly desires more out-of-sight plant for both aesthetic and safety-related reasons.

Underground Cable:
Underground cable, conduit, and manholes are primarily used for feeder and interoffice transport cables, not for distribution cable. 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 higher density residential areas, 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.

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.

Buried Fraction Available for Shift (See Section 6.2.5 of the HM5.0 Model Description and Section 2.5.2 of HM5.0 HIP)

HM5.0 also permits a user-specified percentage of plant structure to be optimized between aerial and buried, while still permitting zoning requirements to be taken into account by limiting the amount of plant that will be subject to the optimization procedure. The Model does that by shifting a greater percentage of structure to aerial from buried if the model finds abnormal local terrain conditions that make such a shift advantageous (a check in the model prevents percent aerial from going below zero). For example, if the user has entered an initial value of 0.40 for the buried cable fraction in a given density zone and then enters 0.75 as the buried fraction available for shift, the model can allow the computed buried fraction (according to changes in the relative costs of buried versus aerial structure occasioned by local surface and bedrock conditions) to vary between 0.10 (= 0.40 - 75% of 0.40) and 0.70 (= 0.40 + 75% of 0.40) – subject to the implied aerial fraction remaining non-negative. This feature was not invoked by the LPSC.

(4) Does the study incorporate wireless technology? If so, please describe how.

Response: (See Section 6.3.4 of the HM5.0 Model Description and Section and Section 2.11 of the HM5.0 HIP.)

As requested in the FCC's FNPRM, HM 5.0 permits the specification of a user-adjustable cap on the model's relevant wireline investments to reflect potentially more economical wireless distribution technologies. In HM 5.0 this cap, if invoked by the user, is implemented by placing a ceiling on the per-line investments computed in the Distribution module (i.e., NID, drop, terminal and splice, distribution cable and structure, SAI, and DLC RT) that would be replaced by the wireless system.

The optional cap calculation considers the cost of two different wireless systems: a "point-point" system serving customers on a one-one basis, and a "broadcast" system serving a number of customers from a shared base station. The point-point cost is assumed to be a fixed amount per line served; the broadcast system cost is structured as a fixed base station cost serving up to a given maximum number of customers, with the cost of the base station distributed among the number of customers that use it, plus a per-line cost of the radio terminal equipment at each customers' premises. The Model compares the cost of the two wireless systems to each other for a given serving area, then compares the cost of the lower-cost system to the wireline cost. If the most economical wireless system's cost is lower, the Model zeroes out the cost of the wireline distribution components for that serving area, and substitutes the cost of the wireless distribution system, while retaining the feeder portion of the wireline network. The LPSC did not use this feature of the Hatfield model.

(5) Does the study incorporate host-remote switching configurations? If so, how? In your explanation, please discuss how host locations are identified and how costs are allocated among customers in wire centers that are part of host-remote relationships.

Response: HM 5.0 is capable of engineering and costing end office switching systems comprised of explicit combinations of host, remote and standalone switches. But, because accurate data on the purchase prices of a portfolio of host, remote and standalone switches of varying capacities may not be available to the user, the HM 5.0 Switching and

Interoffice Module defaults to computing end office switching investments using input values that average per-line investments over a portfolio of BellSouth's host, remote, and standalone end office switches.

If the user selects the host, remote, standalone option, the user must specify for each wire center whether the housed switches are hosts or remotes, as well as assign correspondences between hosts and remotes. The model will designate all remaining wire centers as housing standalone switches. The model then places the hosts and their subtending remotes on host/remote SONET rings.

The model sizes the host-remote rings to accommodate host-remote umbilical trunk and control link requirements. It then computes investment in SONET add/drop multiplexers ("ADMs") and digital cross connects ("DCSs") for the host/remote ring and calculates the average ADM and DCS investment per line for all lines in the system. The host interoffice calculations also are adjusted to account for the increased trunk and signaling capacity requirements imposed by the remotes served by the host.

When the host-remote option is selected, switching curves that correspond to host, remote and standalone switches are used to determine the appropriate switching investment. These switching curves incorporate a fixed plus variable investment per line for each switch type. It is recognized that there are large and small host and standalone switch technologies, and that remotes are available in multiple line sizes. Remote switches cause incremental variable investments primarily associated with the umbilical trunk ports necessary to carry traffic originating and terminating on the remote lines to the host switch. The user adjustable fixed and variable investments for host, standalone and remote switches have been scaled accordingly. In accordance with the FCC's Public Notice guidelines, the cost of an entire switching system consisting of a host and its associated remotes, is allocated evenly over all lines served by the host-remote configuration.

(c) Describe how the study incorporates assumptions that the incumbent LECs' wire centers are the center of the loop network and that the outside plant terminates at the incumbent LECs' current wire centers.

Response: See Section 5.2 of the HM5.0 Model Description

The source of the information used to locate wire centers in HM5.0

is Bellcore's LERG database, dated August 1, 1997.10 The portions of these LERG data that are used in the Hatfield model are an extract of key data from the LERG called the Special LERG Extract Data ("SLED") - which has been licensed from Bellcore by the Hatfield model developers. The SLED specifies the precise location of each ILEC wire center. The demographic data prepared by PNR for input to the model identifies, for each cluster identified by the customer location and clustering process, the wire center that serves that cluster, the precise location of the cluster relative to the wire center, and all other relevant information pertaining to the cluster, such as the terrain characteristics, number of households, and number of lines. The model then determines feeder cable types, capacities, and routes that emanate from the wire center and terminate in the clusters served by the wire center. In this fashion, the wire center appropriately becomes the center of the loop network, and forms one termination of all feeder cables serving clusters belonging to that wire center.

(d) Describe how the loop design incorporated into the study does not impede the provision of advanced services while still meeting the criterion in (b), above.

Response: As described in response to Criterion 1 (a) above, if the farthest customer in an outlier cluster is more than the default distance of 18,000 feet from the main cluster, the cable serving that customer, or customers carries a digital T1 format signal to a remote T1 terminal at the centroid of the outlier cluster, and is served by "T1 road cable." From the T1 RT, copper cables carrying analog signals extend the remainder of the way to the customer locations within the outlier.

The T1 road cable contains copper pairs, and supports T1 signals used to provide digital connections between the fiber DLC remote terminals located at the centroid of the main cluster and subsidiary remote T1 terminals located at the centroid of each outlier cluster. HM5.0 assumes conventional T1 transmission with a user-adjustable 32 dB repeater spacing. This ensures that all customers can receive digital services at an ISDN Basic Rate Interface or faster digital data rate

(e) Describe how distances are measured in the model (e.g., does the model use airline distances, adjusted airline distances, rectilinear distances, or road distances)? Please identify in each portion of the model in which a particular distance metric is used and why that metric was selected.

Response: (See Section 6.2 of the HM5.0 Model Description,

In most instances, the model uses "rectilinear" distances for routing

between any two points, meaning that cables follow a right-angle route between their endpoints. In this way, the calculated distances take into account the deviation from straight lines that are caused by various natural and man-made obstacles. An exception to this general practice is that when the user invokes the "feeder steering" option (See Section 6.3.6 of the HM5.0 Model Description), in which the main feeder routes are directed optimally towards the clusters they serve, a user-specifiable route/air ratio additionally multiplies the calculated rectilinear route distance, in order to ensure that the steered feeder has not followed an unrealistically efficient route to its destination. The LPSC did not invoke the feeder steering option.

(f) Do wire center line counts equal actual incumbent LEC wire center line counts? If so, and if a closing factor is used to achieve this equality, describe the size of the closing factor and how it is used in the study. If the study's wire center line counts do not equal actual incumbent LEC wire center line counts, explain why not.

Response: The wire center line counts equal BellSouth's actual wire center line counts for the year ending 1996.

(g) Does the study's average loop length reflect the incumbent LEC's actual average loop length? If not, explain why not.

Response: It is not known if the study's average loop length reflects BellSouth actual average loop length. To the best of the LPSC's knowledge, the Hatfield model does not readily calculate the average loop length resulting from running the model. While Hatfield does produce an average loop length by wire center, BellSouth does not have data analogous to that to make an appropriate comparison.

(h) Please describe how the study determines customer location. Specify the data that were used to determine the number and location of customers. In addition, please describe in detail if the study locates customers in grids, clusters, census blocks, census block groups, or other areas smaller than a wire center. How does the study identify serving areas?

Response: (See Sections 5.4, 5.5 and 5.6 of the HM5.0 Model Description)

Residence Locations

The customer location approach used in HM 5.0 begins by first developing a database of about 109 million customer address records. These addresses are then geocoded (assigned latitude and

longitude coordinates). These locations are then divided among wire center serving areas based on geocoded customer location and the Business Location Research (BLR) wire center boundaries.

Data for residence locations are provided by Metromail, Inc. The Metromail National Consumer Database© ("NCDB") is a large, nationally compiled file of U.S. household-level consumer information that includes both deliverable postal addresses (and telephone numbers, when available). The file consists of close to 100 million records - which constitute over 90% of all residential housing locations that the U.S. Bureau of the Census reported for 1995.11

The file is compiled primarily from telephone white pages directory data, but also utilizes many other primary sources of information, such as household mover records, voter registration data, motor vehicle registration information, mail-order respondent records, realty data, and home sales and mortgage transaction information, to build a large repository of verified household-level data.

Business Locations:
Dun & Bradstreet (D&B) collects information on more than 11 million business establishments nationwide. Information is gathered from numerous sources such as business principals, public records, industry trade tapes, associations, directories, government records, news sources, trade organizations, and financial institutions. This information is validated each night. Additionally, D&B conducts millions of annual management interviews to help improve the timeliness and accuracy of its information.

This information is organized by D-U-N-S number, a nine digit identification sequence which allows for the placement of companies within larger business entities according to corporate structures and financial relationships. D&B also provides "demographic" information on each of the firms in its database. Such information includes counts of employees and the SIC code of the establishment.

Geocoding
Geocoding is used in order to most accurately assign known customer locations to actual, physical locations. Geocoding is also known as location coding. It involves the assignment of latitude and longitude coordinates to actual street addresses. Geocoding

software is sophisticated enough to provide information regarding the source and precision of the lat/long coordinates selected. This precision indicator allows PNR and Associates of Jenkintown, PA (PNR), to select only those addresses that have been geocoded to a highly precise point location. Almost uniformly, geographical address locations are derived from enhanced versions of the USGS' TIGER database.

To perform its geocoding, PNR uses a program by Qualitative Marketing Software called Centrus™ Desktop. The enhanced data behind Centrus is provided by GDT. Premium GDT data are updated bi-monthly to ensure accuracy. These data integrate new information from US Postal Service ("USPS") databases and private sources so that new streets and additions and changes to ZIP codes, street names, and address ranges are included as soon as possible.

Centrus™ Desktop allows geocoding on two levels. The first is a match to the actual address -- which is the only type of geocoding used in HM 5.0 customer location. The second is a match to a ZIP code (ZIP, ZIP+4, ZIP+2) level. Because of the lesser accuracy in the second method, these geocodes are not used in PNR's process of assigning customer locations.

Data hierarchy in address geocoding starts with the State. The hierarchy continues with City, Street Name, Street Block, and finally, House Range. Typically, a Street Block is the same as an actual physical block but it can also represent a partial block as well. The House Range displays address information from the USPS. Additionally, where there are gaps in the actual address range, the House range will account for these gaps.

Initially, the address coding module in Centrus™ Desktop compares the street addresses from the input file to the records contained in the USPS ZIP+4 directory and the enhanced street network files. If the address is located in the USPS files, the address is standardized and a ZIP+4 is also returned. If this address is also found in the street network files, Centrus™ Desktop determines a latitude and longitude for the location. Optionally, if the address is not found in the street network files, location information may be applied from the ZIP level.12

Location codes generated by Centrus™ Desktop indicate the accuracy of the geocode. For purposes of customer location clustering in the HM 5.0 only those geocodes assigned at the

6-decimal place point location made directly to the street segment are used.13

While the software and data used allow for a much more comprehensive output of data elements, for use in HM 5.0 customer location, the following addressing elements are extracted:

Address
City
State
ZIP
ZIP+4
Latitude
Longitude
Census Block
Match Code
Location Code

Gross-up

The above-derived geocoded locations are then counted by CB. These geocoded location counts by CB are then compared to target total line counts for that CB derived by the PNR NALM (described in section 2.3 of the HM5.0 Model Description). If the geocoded location counts are less than the target count, the residual number of customer location points is then computed, and geographical locations for these points are generated. This process is performed by PNR using TIGER file CB boundaries. Each of the additional number of customer location points that a CB requires to total to its target count is generated and assigned a geocode so as to place these "surrogate" points uniformly along the CB's boundary.

(i) How does the cost study determine the cost of the outside plant from the wire center to the customer locations identified in (g)? Does the cost study estimate the costs of a forward-looking network, or does the cost study rely on a loop length study? If the cost study relies on a loop length study, please describe how the cost study relies on the loop length study and provide the loop length study as part of the documentation provided in response to II.(7)(a), above, including a discussion of the sampling methods used in the loop length study. Also, if a loop length study is used to estimate forward-looking costs, please compare the mix of loop technologies in the loop length study sample to the mix of technologies in the loops assumed by the cost study. If the mix of loop technologies assumed in the cost study is based on the mix of technologies in the sample, please justify the use of this assumption.

Response: The cost study determines the cost of the outside plant from the wire