volume purchasers of switching equipment, such as the RBOCs and other large local exchange companies. Accordingly, the model uses two switching cost curves, one for large telephone companies and one for small independent telephone companies (ICOs). Both curves reflect the decreasing cost of switching per line as a function of switch size.

The switching cost curves 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."[34] In addition, public line and switch data from the ARMIS 43-07 and responses to the USF NOI data request from 1994 are employed as well.

The module uses a large telephone company switching investment curve that is based on the RBOC and GTE average switching costs per line reported in the NBI study. These two switching cost points were paired with the average sizes of current RBOC and GTE switches derived from 1995 ARMIS 43-07 line and switch data. A third cost point for large switches of 80,000 lines was developed from other industry sources. A logarithmic curve was then fit to these data using least-squares regression. As demonstrated in figure 9, this functional form fits the data very closely.

The 1993 USF NOI (Universal Service Fund Notice of Inquiry) data was used to estimate an average line size for small LEC switches. A 1995 average line size was estimated by assuming the ICOs have experienced growth in average lines per switch between 1993 and 1995 similar to that experienced by GTE. The value on the large LEC curve corresponding to this 1995 small LEC average line size was compared to the ICO per line value from the NBI report. This produced a 1.7 factor which was applied to the constant term in the logarithmic functional form to produce a curve of identical shape, but shifted upward by $173 per line compared to the large LEC curve.

The per-line investment figures from the NBI study are for the entire end office switch, including trunk ports. The investment figures are then reduced by $16 per line to remove trunk port investment based on a line to trunk ratio of 6:1. The actual number of trunks per wire center is calculated in the transport calculation, and the port investments for these trunks are then added back into the switching investments. Figure 9 shows the switching investment curves for large LECs resulting from this methodology.

[34] Northern Business Information study: U.S. Central Office Equipment Market -- 1995, McGraw-Hill, New York , 1996

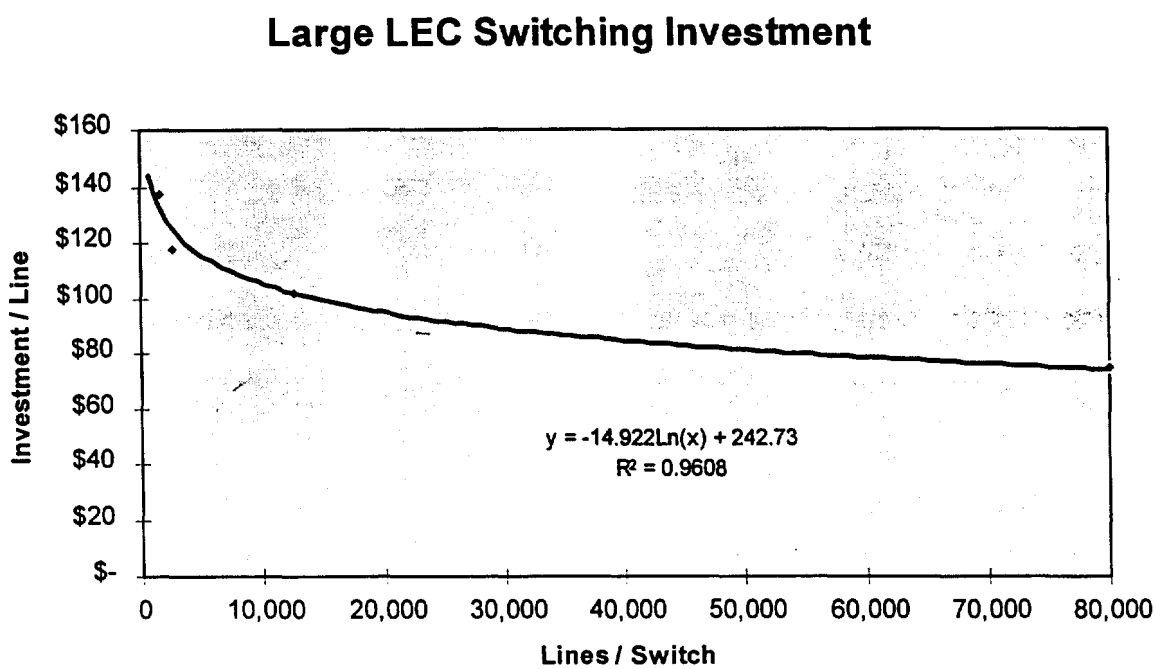


Figure 9 Switching investment Curve

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

The model computes required wire center investments separately for each switch. For wire centers housing multiple end office switches, the wire center investment calculation adds switch rooms to house each additional switch.

b) Transport calculations

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

user-adjustable maximum trunk utilization of 27.5 CCS in the busy hour.[35]

HM 4.0 uses a substantially different interoffice transport configuration, and correspondingly different transport distance calculations, than HM2.2.2. HM 4.0 assumes that, with some exceptions, all interoffice facilities take the form of a set of interconnected OC-48 Synchronous Optical Network (SONET) fiber rings. It provisions enough of these rings to support the total interoffice circuit requirement, taking fill into account. There are enough ring intersections to fully interconnect the number of rings the model calculates are necessary. There is a ring interconnection in at least each tandem switch location and in one wire center in every city that has two or more wire centers and no tandem switches. In offices where the SONET rings are assumed to interconnect, the model equips the offices with multiple add/drop multiplexers (ADMs). At each end office switch, the investment in transmission equipment includes sufficient ADMs, terminal multiplexers (to provide interfaces to end office and tandem switches at the DS-1 level), and digital cross-connect systems to support the number of trunks that terminate in that wire center's switch or switches. It also includes, as specified, channel banks for multiplexing voice-grade and unmultiplexed digital special access lines in cases where special access lines are not carried by DLC in the feeder portion of the network.

It is not necessary to specify which offices are connected to a given ring in the model. However, on the basis that each office is on a ring, the model calculates an effective distance the ring must traverse to link each wire center. It does this by 1) adding the areas of all the CBGs served by a wire center to arrive at an estimate of the total area served by the wire center; 2) calculating the square root of the area to arrive at the length of a side of the serving area, considering the area to be a square; and 3) calculating the ring route across the serving area as 1.5 times the length of the side. The extra 50% accounts for the fact that the route is unlikely to be a straight line across the wire center area. The model also checks to determine whether twice the distance from the wire center to its assigned tandem is less than the distance calculated above; if so, it assumes that routing is physically via the tandem as an alternative to being across the serving area, and thus estimates the route miles as twice the tandem distance.

Because the SONET ring architecture is most efficient when serving high traffic wire centers, the model tests for very small wire centers that would be better served by lower-capacity, less expensive technology. The threshold is set at 5,000 lines. For such offices, it assigns an OC-3 terminal multiplexer of sufficient capacity for that office's traffic, assuming the office will simply terminate all

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

circuits on this transmission facility, rather than dropping/adding circuits to a fiber ring via ADMs. It then assumes a point-to-point trunk to the tandem switch along a right angle route, similar to the scenario for routing feeder cable between the wire center and SAI for each CBG. The route distance is determined from a data step, relying on licensed LERG data, that produces end office to tandem, end office to STP and tandem to STP distances.

Once the model determines the requisite amount of fiber optic cable, it calculates the costs of installed cable and structure based on user-definable inputs for cable costs, structure costs and configurations (e.g., pullbox spacing), the mix of different structure types, and the amount of structure sharing between interoffice and feeder plant. To account for this structure sharing, the model determines the smaller of the investment in feeder and the investment in interoffice facilities, and applies the user-specified sharing percentage to the smaller value to calculate the amount of shared structure investment. The model then subtracts this amount of investment from both the interoffice and feeder investment, and reassigns it back to feeder and interoffice according to the proportional remaining investment in feeder versus interoffice. It does this separately for underground, buried, and aerial structure.

Interexchange access facilities require additional treatment because interexchange carrier POPs are typically not located on LEC fiber rings, so dedicated entrance facilities must be engineered. It is not possible to compute the route miles between wire centers (or tandems) and IXC POPs to size the lengths of these entrance facilities, because in general the locations of IXC POPs are not publicly available. Therefore, the number of POPs per tandem, and the average entrance facility distance, are user-adjustable, with default values of 5 and 0.5 miles, respectively.

c) Tandem switch calculations

Tandem and operator tandem switching investments are computed according to assumptions contained in an AT&T Capacity Cost Study.[36] The investment calculation assigns a price for switch "common equipment," switching matrix and control structure, and adds to these amounts the investment in trunk interfaces. The numbers of trunks and their related investments, are derived from the transport calculations described above.

The module scales the investment in tandem switch common equipment

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

according to the total number of tandem trunks computed for the study area. By doing so, it avoids equipping maximum-capacity tandems whenever a LATA is served by multiple tandems. The calculations also recognize that a significant fraction of tandems are "Class 4/5" offices that serve both tandem and end office functions. The amount of sharing assumed is user-adjustable, with a default value of 40%. Tandem wire center calculations assume the maximum switch room size, and further assume the tandem will reside in a wire center that contains at least one end office switch.

d) Signaling network calculations

The Module computes signaling link investment for STP to end office to or tandem "A links," "C links" between the STPs in a mated pair, and "D link" segments connecting the STPs of different carrier's networks. All links are assumed to be carried on the interoffice rings.

The model always equips at least two signaling links per switch. It also computes required SS7 message traffic according to the call type and traffic assumptions described earlier. User inputs define the number and length of ISDN User Part (ISUP) messages required to set up interoffice calls. Default values are six messages per interoffice call attempt to set up, with twenty-five octets per message.

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

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

SCP investment is expressed in terms of dollars of investment per transaction per second. The transaction calculation is based on the fraction of calls requiring TCAP message generation. The total TCAP message rate in each

LATA is then used to determine the total SCP investment. The default SCP investment is $20,000 per transaction per second, based on a number reported in the AT&T Capacity Cost Study.

e) Operator systems calculations

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

Operator positions are assumed to be based on current workstation technology. The default operator position investment is $6,400. The Model includes assumptions for maximum operator "occupancy" expressed in CCS. The default assumption is that each position supports 32 CCS of traffic in the busy hour. Also, because many operator services traditionally handled by human operators may now be served by announcement sets and voice response systems, the model includes a "human intervention" factor that reflects the fraction of calls that require human operator assistance. The default factor is 10, which is believed to be a conservative estimate. (A factor of 10 implies that one out of ten calls will require human intervention).

F. EXPENSE MODULE

1. Overview

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

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

The expense module requires a number of user inputs. These inputs, and their corresponding default values, appear as inputs B161-B179 in Appendix B.

Appendix A

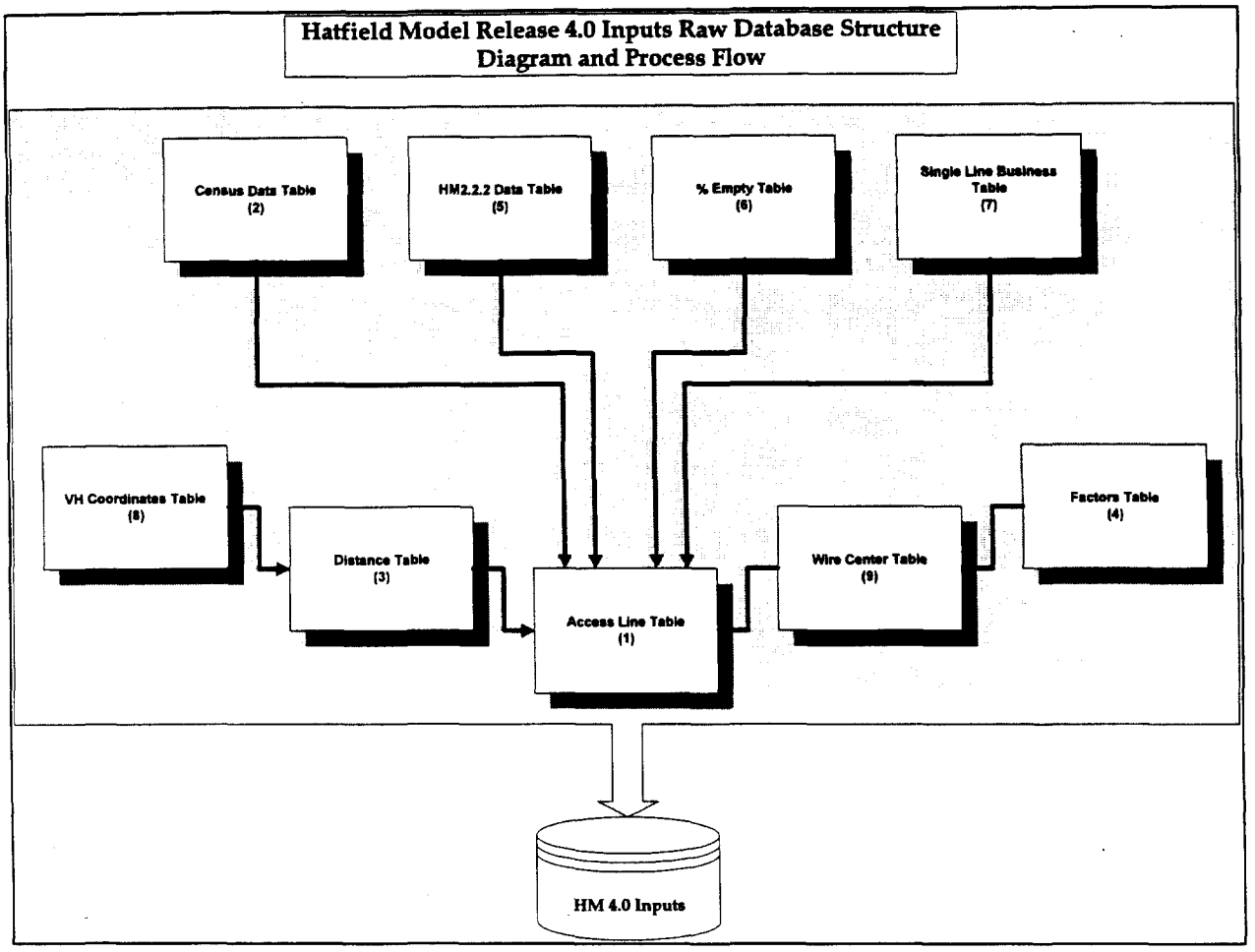
Hatfield Model

Release 4.0

Data Inputs Development Description

I. Raw Database Structure Description

Raw Database Structure Diagram



1. Access Line Table

The Access Line Table is based upon the Wire Center Access Line Model which is a methodology developed by PNR and Associates to allocate access lines to wire centers. This methodology uses PNR survey information, Claritas estimates of current-year residential demographics, Dun & Bradstreet business establishment information, and First Data InfoSource/Donnelley Marketing's household database to estimate the number of residential and business access lines by geography. The methodology applies these estimates against each Census Block Group (CBG) in the United States, and maps these CBGs to the telephone company wire center that serves them

Residential Access Lines

Using survey results, residential lines are estimated as function of age and income demographic information, by local telephone company and state. The models are projected to the CBG level using U.S. Census Bureau age and income distributions, and to each Census Block (CB) within a CBG using Census household data at the CB level. The number of households for each CB was obtained using 1990 CB household percent composition distributions from the U.S. Census, and proportionally inflating these values until they match the Claritas 1995 CBG subtotals. CBG and CB geography showing "no households" were compared to actual, deliverable households subtotal counts for the same area derived from the Donnelley household data, and this data is used where these counts are greater than zero. PNR considers these 1995 household data to be superior to the estimates of CACI Marketing Systems that were employed in HM2.2.2. The percentage of households without telephones was obtained from the 1990 Census for every CBG. The number of residential access lines within a CB was estimated using household count information, second line penetration and telephone penetration.

Second line penetration rates for use in the Access Line Model were developed from PNR's ReQuest III consumer survey. ReQuest III, which has been purchased by several local and long distance companies, was sent to 45,000 households and had a response rate of over 65 percent. Responses were weighted to reflect national demographic distributions. In ReQuest III, respondents were asked if they had additional lines (separate numbers). For each respondent PNR was able to append household income, age of the head of household and other demographic measures. In addition, PNR was able to identify the respondent's current local exchange carrier by matching the respondent's NPA NXX with local exchange information contained in Bellcore's LERG database.

PNR proceeded to model second line penetration rates using a non parametric regression procedure. The output from this procedure was a multidimensional matrix of second line penetration rates by age, by income and by Tier 1 local exchange company by state. Age and income were represented by categories (i.e. income less than $15,000, income between $15,000 and $25,000 and so forth).

This multidimensional matrix of second line penetration rates was projected onto each Census Block Group using information obtained from Claritas and from the 1990 Census. The projections first required estimates of the number of households with telephones. This number was computed by taking the percent of households with telephones times the number of households. The percent of households with telephones was derived from the 1990 Census for each block group (1 - percent of households without telephones). The number of households were obtained using Claritas' 1995 household projections. Where there were no households reported in the 1990 Census, and where the Claritas estimates were also zero, current household counts were obtained for those block groups from the Donnelley DQI[2] file.

Claritas supplied 1995 projections of households and age and income distributions. Default age and income distributions were obtained from the 1990 Census. Projections of access lines were computed by applying the second line multidimensional penetration matrix against the age and

income distribution for each block group, by state and Tier 1 local exchange company. For non Tier 1 companies, the state average was used.

Summarizing, estimates of the number of residential access lines used current estimates of households, the percent of households with telephones and the penetration rate of second lines. The CBG estimates were then distributed to each Census Block using the share of households in each block.

The entire Donnelley DQI[2] database of approximately 95 million households was geo-coded by PNR with latitude and longitude values and with CB codes. For each CB a correspondence table was created linking CBs to wire centers based on the NPA-NXXs of the telephone numbers in the CB and Bellcore's LERG data that link NPA-NXXs to wire centers. Where there are multiple wire centers associated with a CB, the mode wire center was chosen. The total number of residential access lines at the state level is then constrained to be consistent with the number of residential access lines reported to the FCC in ARMIS.

Business Access Lines

Using proprietary PNR and Dun and Bradstreet information, two business access line models were developed for use in the Access Line Model. The two models are differentiated by the presence of Centrex or PBX systems. This delineation takes into account trunking efficiencies associated with PBX installations.

Generally, the number of business access lines was estimated as a function of the number of employees at the business location, the SIC code of the company (at that location), the legal status of the company (corporation, partnership, proprietorship), location type (headquarters, branch, single location) and region. The probability of a Centrex installation was also estimated. The estimated number of lines was then appended to each firm in the Dun & Bradstreet database.

Using business survey results, models of business line penetration were developed including the probability of use of Centrex. The models were based on SIC code, employment size, region of country and legal status. Model results are appended to each firm in the Dun & Bradstreet database.

Firms in the Dun & Bradstreet database are geo-coded and assigned CB codes and latitude and longitude values. Using the CB to wire center correspondence table, the number of access lines within a CB or CBG were aggregated to obtain an estimate of the total number of business access lines within each wire center. The total number of business access lines at the state level, including Centrex, are constrained to be consistent with the number of business access lines reported to the FCC in ARMIS.

Special lines are developed by applying the ratio of Special lines to Business lines in the ARMIS 4308 report to each CBG for a specific company within the data set. Public lines are developed in the same fashion.

Fields in Access Line Table

- *State*
- *CBG*
- *WIRE CENTER*
- *COMPANY*
- *EMPLOYEES*
- *FIRMS*
- *BUSINESS LINES*
- *CENTREX PENETRATION*
- *HOUSEHOLDS WITH TELEPHONES*
- *RESIDENCE LINES*

2. Census Data Table

This table contains housing unit types for each group in each CBG. The values for each field are developed by using 1990 Census Bureau data which is then normalized (inflated proportionally) according to the Claritas 1995 household counts. These housing unit types are used for development of lot sizes within a CBG.

Fields in Census Data Table

- *CBG*
- *1-HOUSING UNIT DETACH*
- *1-HOUSING UNIT ATTACH*
- *HOUSING UNIT -2*
- *HOUSING UNIT -4*
- *HOUSING UNIT -5-9*
- *HOUSING UNIT -10-19*
- *HOUSING UNIT -20-49*
- *HOUSING UNIT 50+*
- *MOBILE*
- *OTHER*

3. Distance Table

Based on rectilinear routing, through a series of trigonometric calculations, the database produces a table with the radial distance from the wire center location to the centroid of a CBG, with its quadrant, alpha and omega. The angles determine the direction of the feeder. This information is used to determine the length of feeder facilities necessary to link wire centers to CBGs.

Fields in Distance Table

- *CBG*
- *CBG CENTROID VERTICLE COORDINATE*
- *CBG CENTROID HORIZONTIL COORDINATE*
- *WIRE CENTER VERTICLE COORDINATE*
- *WIRE CENTER HORIZONTIL COORDINATE*
- *RADIAL DISTANCE*
- *ALPHA*
- *OMEGA*
- *QUADRANT*

4. Factors Table

The table contains business and residential lines adjustment factors for each company in each state. These values are applied to the access lines in the access line table to ensure all line estimates equal 1995 ARMIS-reported lines, as discussed above in the documentation of the Access Line Table.

If a telephone company does not report ARMIS, its business and residential lines targets (which the factors are built from) were developed from three other sources, NECA-Tariff 4, U.S.T.A, and R.U.S..

Fields in Factor Table

- *STATE*
- *OCN (Modified OCN includes a 2 digit state specific code)*
- *COMPANY NAME*
- *BUSINESS FACTOR (adjustment for business lines)*
- *RESIDENTIAL FACTOR (adjustment for residential lines)*
- *PUBLIC FACTOR (multiplier of business lines to determine public line counts)*
- *SPECIAL FACTOR (multiplier of business lines to determine special line counts)*
- *SINGLE LINE BUSINESS FACTOR (adjustment for single line business)*

5. HM2.2.2 Data Table

This table contains Hatfield Model v.2.2.2 geological information (data which in HM2.2.2 were collected from the BCM-PLUS Model). Each CBG is assigned a value for the four fields listed below. This geological information is then used in the model to modify placement costs by degree of difficulty.

Fields in HM2.2.2 Data table

- *CBG*
- *ROCK DEPTH*
- *ROCK HARD*
- *SURFACE TEXTURE*
- *WATER DEPTH*

6. Percent Empty Table

The percentage of land empty is calculated by identifying census blocks which have no business or residential lines using the Donnelly and Dun and Bradstreet databases. The land area of these "empty" Census blocks are added to the water (rivers and lakes) within a CBG. This amount is divided by the total land area to determine total uninhabited percentage of the CBG.

Fields in Percentage Empty Table

- *CBG*
- *AREA LAND (SQ MILES)*
- *WATER*
- *TOTAL AREA*
- *LAND EMPTY*
- *LAND EMPTY plus WATER*
- *% EMPTY*

7. Single Line Business Table

To determine the number of single-line businesses in each CBG, company size data from Dun & Bradstreet were applied to an employees per phone line distribution. Data were derived from a sample of 3,414 small and medium sized firms (from 26 states) with sales under $10 million.

Fields in Single Line Business

- *CBG*
- *SINGLE LINE BUSINESS*

8. V&H Coordinates Table

PNR and Associates provides the latitude and longitude of the centroid of each CBG. These data were used to determine the Vertical and Horizontal (V&H) coordinates of the CBG's centroid. The database uses the V&H coordinates of the CBG and of the wire center to calculate the distances and angles listed above in the distance table.

Fields in V&H Table

- *CBG*
- *VERTICAL COORDINATE*
- *HORIZONTAL COORDINATE*

9. Wire Center Table

This table associates each wire center with its V & H, operating company number (OCN), company name and group. The OCN value has a two digit state code appended to the original four digit OCN code, making the six digit state code unique across states. The group categories are listed below. The purpose of this table is to assign Wire Centers to companies and companies to groups.

Group No.	Description
1	Non-RBOC Large Tier 1 (GTE/CONTEL and SPRINT/CENTEL)
2	All other independent telephone companies that file ARMIS
3	Greater than 50,000 lines nationwide, but that do not file ARMIS
4	Less than 50,000 lines nationwide (do not file ARMIS)
8	RBOC and SNET

The table contains the following fields:

Fields in Wire Center Table

- *STATE*
- *WIRE CENTER*
- *WC - VERTICAL COORDINATE*
- *WC- HORIZONTAL COORDINATE*
- *OCN*
- *COMPANY NAME*
- *GROUP*

II. HM 4.0 Input Issues

1. CBGs moving to other states

Issue

Occasionally, a CBG is assigned to a wire center that is in a state that neighbors the CBG's state.

Action

These CBG's are moved into the state in which the wire center is located and becomes part of the geography for that state.

2. CBG with Zero Area

Issue

Occasionally, CBGs are reported with zero area, but the CBG contains households or businesses.

Action

Calculate a new area for the CBG, then adjust the density (lines/sq. mile) using the following equation:

1. New area = 0.000386 x (No. of households + No. of firms)
2. New density = No. of total lines / new area.

Note: 0.000386 is the square mile equivalent of a 10,000 square foot lot.

3. Percent Empty Calculation

Issue

Occasionally, a CBG is reported to be 100% empty, but the CBG contains households or businesses.

Action

Substitute a new percent empty for each CBG, according to the following rules.

1. If the total area of CBG is less than 0.5 square miles, adjust the percent empty to zero.
2. If the total area of the CBG is greater than 0.5 square miles, the new percent empty was calculated by the following equation:

$$1 - \frac{(0.000386 \times (\text{No. of households} + \text{No. of firms}))}{\text{Area of CBG}}$$

Note: 0.000386 is the square mile equivalent of a 10,000 square foot lot.

III. HM 4.0 Inputs Field Descriptions (per CBG)

Field	*Description*
STATE:	State Code
CLLI:	8 Digit CLLI of the wire center to which the CBG belongs
COMPANY:	Company Name
OCN:	6 digit OCN for each company - first two digits represent census state code and the next four is the LERG OCN code
GROUP:	1=NonRBOC Large Tier 1 (GTE/CONTEL and SPRINT/CENTEL) 2=All other independent telephone companies which file ARMIS 3=Greater than 50,000 lines nationwide and do not file ARMIS 4=Less than 50,000 lines nationwide and do not file ARMIS 8=RBOC and SNET
CBG:	Total geo-code
QUAD:	Quadrant where the centroid of the CBG falls CLLI
ALPHA:	Angle from main feeder route to CBG centroid
OMEGA:	Angle from horizontal to CBG centroid
DISTANCE:	Distance between centroid of the Wire Center and the centroid of the CBG
AREA:	CBG area including land and water
% EMPTY:	% of area of the CBG with no lines (% of empty land + water)
DENSITY:	Total Lines per square mile
ROCK DEPTH:	Geological data from HM2.2.2
SURF TEXT:	Geological data from HM2.2.2
ROCK HARD:	Geological data from HM2.2.2
WATER TABLE:	Geological data from HM2.2.2
TOTAL LINES:	Sum of Bus., Res., Special, and Public lines
BUS LINES:	Total Business lines
RES LINES:	Total Residential lines
SPECIAL LINES:	Total Special lines (Adjusted to 4308 1995 ARMIS)
PUBLIC LINES:	Total Public lines
SINGLE LB:	Number of SLB
HOUSEHOLDS:	Households with telephone per CBG
HU-1 DETACH:	1 unit structure detached from any other (all housing types include occupied and vacant)
HU-1 ATTACH:	1 unit structure attached to other structures

Field	*Description*
HU-2:	Structure containing 2 units
HU-4:	Structure containing 4 units
HU 5-9:	Structure containing 5-9 units
HU 10-19:	Structure containing 10-19 units
HU 20-49:	Structure containing 20-49 units
HU 50+:	Structure containing more than 50 units
MOBILE:	Mobile home or trailer
OTHER:	Any other
FIRMS:	Firms in a CBG (does not represent locations)
EMPLOYEES:	Employees in CBG

Appendix B – Hatfield Model Release 4.0 Inputs, Assumptions and Default Values

This appendix provides a list of the Hatfield Model Release 4.0 user inputs, as well as their definition and the default values set in the model. It is organized based on the series of user input dialogue boxes that are used to set parameters in the Hatfield Model interface. This yields the following hierarchy:

Input Parameter Category (distribution, feeder, wire center, expense, and excavation)
Category dialogue box (NID, drop, switching parameters, etc.)
User Input field (fiber strands per remote terminal, etc.)

The appendix is organized into two sections. The first contains the index of dialogue boxes and specific user input fields. The second lists the inputs with their definitions and default values. These are numbered sequentially from B1 through B178. To facilitate cross-referencing between the two sections, each user input field in the first section contains a numbered entry from the second section. Thus, for instance, the "B1" next to the Residential NID Materials, No Protector entry refers to the first item in the second section of the appendix.

With this organization, the appendix allows a user who is examining a given user input dialogue box and specific user input field to locate that box/field in the index in the first section, read the number of the corresponding input definition, and use that number to locate the input definition and default value in the second section.

Note that a few parameters are set in one module but used by several modules. In such cases, the parameter appears only once, but its use in other modules is noted at the end of each input parameter category in this index.

Part 1: Index of Dialogue Boxes and User Input Fields

Distribution

NID

B1	Residential NID materials, no protector
B1	Residential NID Basis Labor
B1	Residential Max Lines per NID
B1	Residential Protection Block, per pair
B1	Business NID case, no protector
B1	Business NID Basis Labor
B1	Business Protection Block, per pair

Drop

B2	Drop Distance

B3	Aerial Drop Installation, total
B3	Buried Drop Installation/foot
B4	Buried Drop Sharing Fraction
B5	Buried Drop Fraction
B6	Average Lines Per Business Locations
B7	Buried Terminal and Splice per Line
B7	Aerial Terminal and Splice per Line
B8	Buried Drop Investment per Foot
B8	Aerial Drop Investment per Foot
B8	Buried Pairs
B8	Aerial Pairs

Cable and Riser Investment

B9	Distribution Cable Size
B10	Distribution Cable, $/foot
B11	Riser Cable Size
B11	Riser Cable, $/foot

Poles and Conduit

B12	Pole Investment
B12	Pole Labor
B13	Buried Cable Sheath Multiplier
B14	Conduit Investment per Foot
B15	Spare Tubes per Route
B16	Regional Labor Adjustment Factor

Placement Fraction

B17	Aerial Fraction
B17	Underground Fraction

Cable Fill and Pole Spacing

B18	Cable Fill
B19	Pole Spacing

Geology and Clusters

B20	Difficult Terrain Distance Multiplier
B21	Rock Depth Threshold, inches
B22	Hard Rock Placement Multiplier
B23	Soft Rock Placement Multiplier
B24	Sidewalk / Street Fraction
B25	Local RT (per cluster) thresholds – Maximum Total Distance
B26	Town Factor
B27	Max lot size, acres
B28	Town lot size, acres

Long Loop Investments

B29	Repeater Investments, Installed
B30	Integrated COT, Installed
B31	Remote Multiplexer Common Equipment Investment, Installed
B31	Channel Unit Investment per Subscriber
B33	COT Investment per RT, Installed

SAI Investment

B34	Cable Size
B34	Indoor SAI
B34	Outdoor SAI

Dedicated Circuit Inputs

B35	Percentage of Dedicated Circuits
B36	Pairs per Dedicated Circuit

Feeder

Copper Placement

B37	Aerial Fraction
B37	Buried Fraction
B37	Underground Fraction
B38	Manhole Spacing/ft.
B39	Pole Spacing, ft.
B40	Pole Materials
B40	Pole Labor
B41	Inner Duct Investment per Foot

Fiber Placement

B42	Aerial Fraction
B42	Buried Fraction
B42	Underground Fraction
B43	Pullbox Spacing, ft.
B44	Buried Fiber Sheath Addition per Foot

Fill Factors

B45	Copper Feeder Fill
B46	Fiber Feeder Fill

Cable Costs

B47	Copper Investment per foot
B48	Fiber Investment per foot

DLC Equipment

B49	TR – 303 DLC Remote Terminal – Site and Power
B49	Low Density DLC Remote Terminal – Site and Power
B50	TR – 303 DLC Remote Terminal – Maximum Lines
B50	Low Density DLC Remote Terminal – Maximum Lines
B51	TR – 303 DLC Remote Terminal – RT Fill Factor
B51	Low Density DLC Remote Terminal – RT Fill Factor
B52	TR – 303 DLC Remote Terminal – Common Equipment Investment
B52	Low Density DLC Remote Terminal – Common Equipment Investment
B53	TR – 303 DLC Remote Terminal – POTS Channel Unit Investment
B53	Low Density DLC Remote Terminal – POTS Channel Unit Investment
B54	TR – 303 DLC Remote Terminal – POTS Lines per CU
B54	Low Density DLC Remote Terminal – POTS Lines per CU
B53	TR – 303 DLC Remote Terminal – Coin Channel Unit Investment

B53	Low Density DLC Remote Terminal – Coin Channel Unit Investment
B54	TR – 303 DLC Remote Terminal – Coin Lines per CU
B54	Low Density DLC Remote Terminal – Coin Lines per CU
B55	LD Crossover Lines
B56	TR – 303 DLC Remote Terminal – Fibers per RT
B56	Low Density DLC Remote Terminal – Fibers per RT
B57	TR – 303 DLC Remote Terminal – Optical Patch Panel
B57	Low Density DLC Remote Terminal – Optical Patch Panel
B58	Copper Feeder Max Distance, ft
B59	TR – 303 DLC Remote Terminal – Common Equipment Investment per 672 Lines
B59	Low Density DLC Remote Terminal – Common Equipment Investment per 96 Lines
B60	TR – 303 DLC Remote Terminal – Number of Max Line Modules / RT
B60	Low Density DLC Remote Terminal – Number of Max Line Modules / RT

Copper Manhole Investment

B61	Materials
B61	Frame and Cover
B61	Site Delivery
B61	Excavate and Backfill

Fiber Pullbox Investment

B62	Materials
B62	Installation

Note: The Feeder Module also uses inputs B13-B15.

Switching and Interoffice Transmission

End Office Switching

B63	Real time (BHCA)
B64	Traffic (BHCCS)
B65	Switch maximum line size
B66	Switch port administrative fill
B67	Switch maximum processor occupancy
B68	MDF/protector investment per line
B69	Analog line circuit offset of DLC per line
B70	Switch installation multiplier
B71	End Office Switching Investment Constant – BOC and Large ICO
B71	End Office Switching Investment Constant – Small ICO
B72	End Office Switching Investment Slope Term
B73	Processor Feature Loading Multiplier - Normal
B73	Processor Feature Loading Multiplier - Heavy business
B74	Processor Feature Loading Multiplier - Business penetration threshold

Wire Center

B75	Lot size, multiplier of switch room size
B76	Tandem/EO common factor
B77	Power

B78	Switch Room Size, square ft.
B79	Construction, square ft.
B80	Land, square ft.

Traffic Parameters

B81	Local Call Attempts
B82	Call Completion Factor
B83	IntraLATA Calls Completed
B84	InterLATA Intrastate Calls Completed
B85	InterLATA Interstate Calls Completed
B86	Local DEMs, thousands
B87	Intrastate DEMs, thousands
B88	Interstate DEMs, thousands
B89	Local Business/Residential DEMs
B90	Intrastate Business/Residential DEMs
B91	Interstate Business/Residential DEMs
B92	BH Fraction of Daily Usage
B93	Annual to Daily Usage Reduction Factor
B94	Residential Holding Time Multiplier
B94	Business Holding Time Multiplier
B95	Residential Call Attempts/BH
B95	Business Call Attempts/BH

Interoffice Investment

B96	OC-48 ADM, installed, 48 DS-3s
B96	OC-48 ADM, installed, 12 DS-3s
B96	OC-3/DS-1 Terminal Multiplexer, installed, 04 DS-1s
B96	Investment per 7 DS-1s
B97	Number of Fibers
B98	Pigtails, per strand
B99	Optical Distribution Panel
B100	EF&I, per hour
B101	EF&I, hours
B102	Regenerator, installed
B103	Regenerator Spacing, miles
B104	Channel Bank Investment/24 lines
B105	Fraction of SA lines required multiplex
B106	Digital Cross Connect System, installed per STS3
B107	Transmission Terminal Fill (DS-0 level)
B108	Fiber Cable
B109	Number of Strands per ADM
B110	Buried Fraction
B111	Buried Placement
B112	Buried Sheath Addition
B110	Aerial Fraction
B113	Conduit
B113	Spare Tubes per route
B111	Conduit Placement
B114	Pullbox Spacing
B115	Pullbox Investment
B116	Pole Spacing, ft.
B117	Pole Material
B117	Labor (basic)

B118	Fraction of poles and buried/underground placement common with feeder
B119	Fraction of aerial structure assigned to telephone
B119	Fraction of buried structure assigned to telephone
B119	Fraction of underground structure assigned to telephone

Transmission Parameters

B120	Operator Traffic Fraction
B121	Total Interoffice Traffic Fraction
B122	Maximum Trunk Occupancy, CCS
B123	Trunk Port, per end
B124	Direct Routed fraction of local interoffice
B125	Tandem Routed fraction of intraLATA traffic
B126	Tandem Routed fraction of interLATA traffic
B127	POPs per Tandem Location

Tandem Switching

B128	Real Time Limit, BHCA
B129	Port Limit, trunks
B130	Common Equipment Investment
B131	Maximum Trunk Fill
B132	Maximum Real Time Occupancy
B133	Common Equipment Intercept Factor
B134	Entrance Facility Distance from Serving Wire Center & IXC POP

Signaling

B135	STP Link Capacity
B136	STP Maximum Fill
B137	STP investment, per pair, maximum
B138	STP investment, per pair, minimum
B139	Link Termination, both ends
B140	Signaling Bit Rate
B141	Link Occupancy
B142	C Link Cross Section
B143	ISUP Messages per interoffice BHCA
B144	ISUP Messages length, bytes
B145	TCAP Messages per transaction
B146	TCAP Message Length, bytes
B147	Fraction of BHCA requiring TCAP
B148	SCP investment/transaction/second

OS and Public Telephone

B149	Investment per position
B150	Maximum Utilization per position, CCS
B151	Operator Intervention Factor
B152	Public Telephone Equipment Investment, per station

ICO Parameters

B153	ICO STP Investment per line, Equipment
B154	ICO Local Tandem Investment per line, Equipment
B155	ICO OS Tandem Investment per line, Equipment
B156	ICO SCP Investment per line, Equipment

B157	ICO Local Tandem Wire Center Investment per line
B158	ICO OS Tandem Wire Center Investment per line
B159	ICO STP/SCP Wire Center Investment per line
B160	ICO C-Link / Tandem A-Link Investment per line

Note: The Switching and Interoffice Transmission Module also uses input B16.

Expense

Cost of Capital

B161	Cost of Debt
B161	Debt Fraction
B161	Cost of Equity

Depreciation and Net Salvage

B162	Motor Vehicles
B162	Garage Work Equipment
B162	Other Work Equipment
B162	Buildings
B162	Furniture
B162	Office Support Equipment
B162	Company Comm. Equipment
B162	General Purpose Computer
B162	Digital Electronic Switching
B162	Operator Systems
B162	Digital Circuit Equipment
B162	Public Telephone Terminal Equipment
B162	Poles
B162	Aerial Cable – metallic
B162	Aerial Cable – non metallic
B162	Underground Cable – metallic
B162	Underground Cable – non metallic
B162	Buried Cable – metallic
B162	Buried Cable – non metallic
B162	Intrabuilding Cable – metallic
B162	Intrabuilding Cable – non metallic
B162	Conduit Systems

Structure Fraction Assigned to Telephone

B163	Distribution Aerial
B163	Distribution Buried
B163	Distribution Underground
B163	Feeder Aerial
B163	Feeder Buried
B163	Feeder Underground

Other

B164	Income Tax Rate
B165	Corporate Overhead Factor
B166	Other Taxes Factor
B167	Billing/Bill Inquiry per line per month