run for the State of New Hampshire, HM 5.0 produces an average drop length of only 83 feet, understating the New Hampshire drop investment by nearly $16 million.

HM 5.0 also significantly understates buried and aerial drop placement costs. The basic assumptions behind the time estimates that were arbitrarily assigned to drop placement activities are flawed. Except in new housing developments, drops are typically not placed to living units until a company (Telco or CATV) has received an order for service at that living unit. HM 5.0 claims economies of scale by unrealistically assuming that drops are placed by low cost, dedicated crews that invade entire neighborhoods, placing drops to every living unit. With the release of HM 4.0, the engineering team reduced these time estimates by nearly 75% for some density zones.

Finally, HM 5.0 makes an unreasonable assumption about buried drop sharing. The model assumes only 50% of the drop cost will be borne by the telephone company.[71] There is no basis or support for this assumption other than the rationale that "drop wires in new developments are most often placed in conjunction with other facilities."[72] In reality, only a very small percentage of total drop wire installations would occur in new developments if the ILEC networks were to be rebuilt today. Because every line has an associated drop wire, the consistent understatement of drop material, distance, and labor cost values in HM 5.0 has a significant negative impact on the model's estimate of the total cost of the loop.

[71] Hatfield Inputs Portfolio, Section 2.2.3.
[72] Hatfield Inputs Portfolio, Section 2.2.3.

B. The Model Fails to Estimate Accurate Switching Costs and Violates Accepted Engineering Practices.

In addition to designing faulty loops, the Hatfield Model underestimates switch sizes and corresponding costs.

1. The Switch Cost Curve

By selectively using heavily discounted prices for new switches and by assuming that a local service provider could instantly install all of the switching capacity it needs at once, the Hatfield Model produces costs that are substantially lower than the forward-looking local switching costs that real telephone providers actually incur.

To estimate switching costs, the Model creators developed a relationship between switching cost per line and the size of the switch. The relationship is based on four data points that were pieced together from various sources. For the three lower points, the average line size is taken from 1995 ARMIS data and the cost per line is from a Northern Business Information report. The information on the largest switch size is based on conversations with unidentified switch vendors.

The Model creators then fitted a logarithmic curve to these four data points using least-squares regression. The Model uses two different intercept terms, one at $242.73 for large ILECs, and one at $416.11 for small ILECs. HM 5.0 continues to use these cost curves despite the introduction of new algorithms for the Host/Remote option.

This approach suffers from the fundamental error that the two sets of data used in the regression curve pertain to different mixes and sets of switches and are therefore incompatible. The Model uses ARMIS average *existing* (in-use) switch size for the GTE and RBOC points, located on

the horizontal axis. These data are *not* compatible with the average switching costs of the same companies for switches *purchased in 1995*, which are formatted on the vertical axis.

The developers of the Hatfield Model appear to base their confidence in their numbers resulting from their curve fitting exercise on the R^2 figure of 0.96. The R^2 statistic is often misused and misrepresented as an always-appropriate measure of the quality of the estimation. As illustrated by the fact that a regression of any two pairs of data points always results in the maximum R^2 of 1.0, no meaningful conclusions can be drawn from this statistic in regard to extremely small data sets. In fact, if one were to substitute for the cost figures in the Hatfield Model the numbers 1, 800, 555, and 1212, the same regression would result in an R^2 figure of 0.95.

Comparison of the Model's switch cost assumptions to actual GTE switching cost data in California is instructive and further reveals the Model's systematic understatement of costs. GTE provided data on 53 competitive switch contracts during the period 1989 to 1996. Statistical analysis on the data gave a best-fit relationship of

$C_G = C/L = \$97.30 + \$781{,}599/L$,

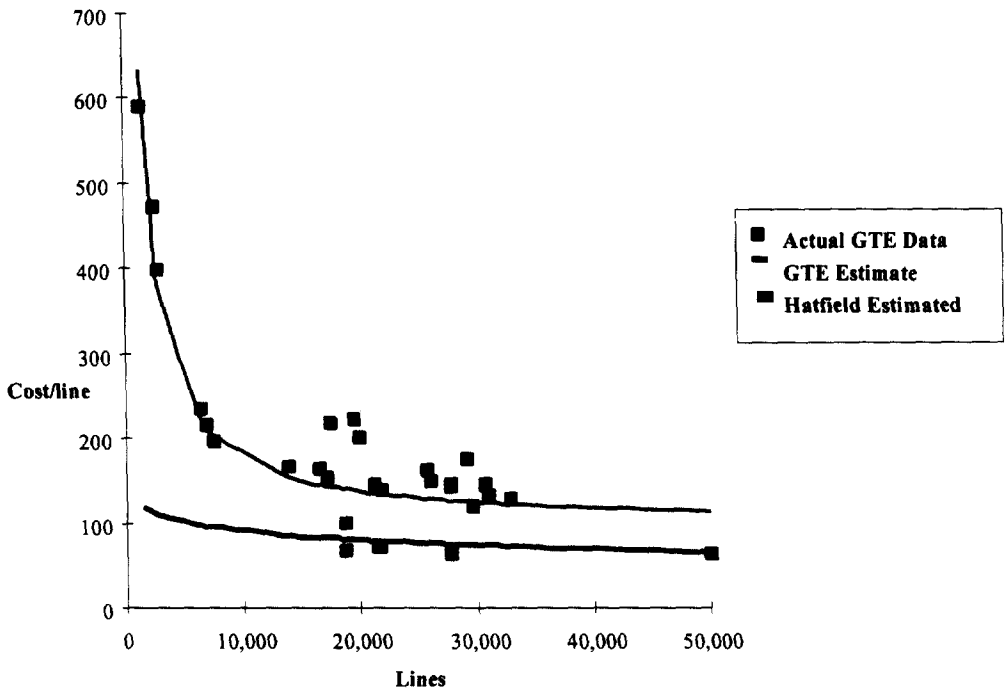
Where C = cost of switch and L = number of lines.

Hatfield's reported analog of this function is:

$C_H = C/L = 242.73 - 14.922 \ln (L)$

The following chart graphically illustrates the large difference between the cost function used by the Model and that of GTE's actual cost function.

Graph 1



HM Switch Cost Curve versus Actual Switch Cost Curve

More fundamentally, the Hatfield Model ignores the fact that ILECs buy additional lines for installed switches as well as new lines for new switches. The additional lines for installed switches actually cost more, as the McGraw-Hill Switch Cost Study used by the Hatfield Model describes:

> The add-on market provides significant revenue potential for switch suppliers, particularly as the margins on new switches remain below the margins for the add-on market. A digital line shipped and in place will generate hundreds of dollars in add-on

software and hardware revenue during the life of the switch. Suppliers can afford to lose a few dollars on the initial (new) line sale in exchange for the increased revenue in the after-market, where prices are less likely to be set by competitive bidding. [73]

By not including any provision for growth, the Hatfield Model, once more, completely ignores its own source documentation. When sizing its hypothetical network, HM 5.0 considers only those lines reported for 1996 in ARMIS. The implication of this is that HM designs a switch today that is only capable of serving line counts that are more than one year old. This methodology is contrary to customary engineering practices and simple logic and provides further evidence on why the switching costs in HM 5.0 are unreasonable.

2. The Hatfield Model Does Not Accurately Model Host/Remote Relationships

In HM 5.0, Model developers assert that the capability to model Host/Remote and Stand-Alone configurations is available. This is not true for the state of Alabama. The GTE network in Alabama contains central offices that were previously owned by Contel. The Hatfield Model does not allow the offices that were previously part of Contel to connect to GTE offices and vice-versa. Consequently, it is impossible for HM 5.0 to accurately model the host/remote architecture that is the basis of GTE's combined network in the state of Alabama. This inability of HM 5.0 to properly model switch types fails to meet the FCC criterion regarding cost proxy models that states that models should permit individual switches to be identified as host, remote or stand-alone.[74]

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[73] Northern Business Information, *US Central Office Equipment Market—1994*, McGraw-Hill, p. 71.

[74] "Guidance to Proponents of Cost Models in Universal Service Proceeding: Switching, Interoffice Trunking, Signaling, and Local Tandem Investment", FCC Public Notice, CC Docket Nos. 96-45 and 97-160, Released 9/3/97, Page 2.

HM 5.0 allows its user to select a host-remote option that applies different switching cost functions which correspond to host, remote, or standalone switches. These new switching cost functions are still based on the spurious cost curve developed using per-line switch costs reported in a NBI publication as discussed above. The methods for scaling of the default switching cost function is neither explained or documented.[75]

In addition to suffering the same problems of the default switching cost function described above, the three new switch cost functions imply the impossible: for switches in the 4,400 to 10,000 lines/switch size range, any combination of the three specific switch cost functions yields less cost than the default or blended switch cost function. No combination of the three specific switches can have cost equal to the default switch.

On a more theoretical level, the development of the three optional cost functions, each with 4 intercept coefficients and 4 slope coefficients is essentially solving for 24 parameters of 3 extra equations from one equation (default cost curve) with 2 known parameters.[76] It is quite a stretch to suggest that HM modelers' engineering expertise can validate such an undertaking of estimating 24 unknown parameters of three new equations based on two parameters in one equation.

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[75] It is unclear how the three different cost curves were generated for three types of switch. The HM 5.0 Model Description on page 52 does explain that "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."

[76] The standalone, host, and remote cost curves are partitioned into four size ranges—each of these ranges have its own intercept and slope coefficients.

Additionally, there is no separate database or software module in HM 5.0 that allows the end user to activate the host/remote component of the switching module as recommended by the FCC.[77] Rather, the end user must ascertain the relevant designations and input them manually. Needless to say, this is an extremely burdensome requirement for users of the Model and it ignores FCC directives about using a separate database or software module.

3. The Model Contains Unsubstantiated Reduction In Switching Investment

The Hatfield Model contains three reductions to the switching investment per line and, consequently, understates the switched investment per line. At the outset, the Model reduces the switched investment per line to remove the trunk port related costs from the value found in the NBI study. Model developers remove an investment of $16.00 per line (predicated upon a 6:1 trunk ratio)[78] prior to constructing the switch cost curve.[79] The rationale for this reduction in investment per line is that trunk port costs, which are included in the NBI study figures, are developed elsewhere in the Model, and therefore should be excluded from the values that make up the switching cost curve. The problem arises when Hatfield goes on to make an additional reduction in the switched investment per line within the Model's algorithms.

When the switching algorithm is deciphered, it becomes evident that the Hatfield Model reduces switching investment for a second time by $16.00.[80] There is absolutely no justification for this reduction in any Model documentation. One must conclude then that this reduction is an attempt

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[77] *Id.*, at 3.

[78] Hatfield Model Description, Release 5.0, Page 53.

[79] AT&T's Responses to GTE's Seventh Set of Document Requests, Before the Washington Utilities and Transportation Commission, Docket Nos. UT-93-0369,-70,-71, Request No. 146, June 13, 1997.

[80] *See* HM 5.0 Switching IO.XLS Module, Wire Center Investment Spreadsheet, Cell BU2.

on the part of Model developers to artificially lower the switching related investment. When this double reduction is coupled with the DLC offset per line of $5.00 (discussed later in this paper), it is indisputable that the switching investment per line in Hatfield 5.0 is significantly understated.

4. Common Switching Engineering Practices Are Ignored

a. Centum Call Seconds Are Not Adjustable

To model a functional digital switching line network, correct engineering practices must be considered to ensure that all aspects of the network are adequately sized and properly accounted. Network engineers size their networks to carry the offered load measured in Centum Call Seconds ("CCS"). CCS is one of the most important measurements that local telephone companies utilize to size and monitor their networks. HM 5.0 does not provide a user adjustable input for CCS per line. The calculations HM 5.0 uses to arrive at a CCS/MS value include 1989 values for call attempts with no adjustments on a per office basis.

Every central office switch in the country has a declared CCS per line value, or per main station ("CCS/MS"), which represents the office's usage activity. CCS/MS for the office is determined during the busiest hour of the busiest 10 days of the year, so that the network is effectively designed to be virtually non-blocking for the average of the ten highest days. This CCS value indicates to engineers the level of switching activity for which capacity must be provided. Engineering tables provide the engineer with threshold value limits and service level parameters, and denote adequate switch capacity for certain CCS levels at both the subsystem (discussed in more detail below) and central processor level. HM 5.0 uses its own unique approach, completely ignoring traffic peaks, that is neither effective nor used in the engineering community.

b. Line Concentration Ratio Calculations Are Inaccurate

A network engineer must consider the composite usage of all lines and trunks in order to determine the overall line concentration ratio ("LCR") for a given switch. To properly design and engineer a switch, switching subsystems, such as line units, must be equipped with sufficient call capacity. Bellcore confirms this requirement by stating that "call capacity must be defined with respect to both a global view and a component view of the switch." HM 5.0 does not properly account for either view.

The most critical calculation in switch sizing is the determination of how many switch lines can be contained in a line subsystem. This calculation determines the LCR. The LCR determination has implications that affect not only the performance of the switch but also the total cost. The overall LCR determines how many lines can be contained in a peripheral unit. This peripheral unit (line unit, line concentrating module, etc.) is the basic foundation of the switch that limits the throughput capacity (CCS), provides the interface to customers, determines the number of bays and the overall office footprint, and has a major impact on costs. These peripherals must be properly engineered before any throughput calculations on central processors and common units can be performed, for it is these units that process calls both to and from subscribers. The Hatfield Model fails both to perform the critical LCR calculation, and to properly engineer the necessary peripherals, thereby making false assumptions about switching capacities and costs.

c. High Usage Lines Are Omitted.

HM 5.0 also fails to account for the increasing number of high usage lines on a forward-looking basis. High usage lines require much lower line concentration ratios (with their attendant

lower line fills and higher costs) to maintain acceptable service levels. High usage lines are typically centered around a geographical area, such as locations of Internet access providers. Engineers consider the effects of this high usage on the telecommunications network and adjust line fills and trunk groups accordingly. The costs of adjusting to these high usage factors take the form of either lower line concentrations or lower allowable administrative line fill levels. In order to load balance a switch, there must be some place in the switch that has spare capacity in which to place the overload. Absent spare equipment, there can be no load balancing and high usage lines will produce traffic congestion and overload conditions. While HM 5.0 proponents claim that these lines can be absorbed into spare capacity, no spare capacity exists within HM 5.0's network.

Most states have seen tremendous growth in traffic over the last twelve months, a large portion of which can be attributed to Internet usage. Internet calls produce a disproportionately large volume of usage due to their extremely long holding times. Internet traffic is circuit switched through ILEC networks; thus, the added costs of its capacity demands are forward-looking requirements. HM 5.0, however, disregards these costs.

d. Switch Line Modularity Is Ignored

HM 5.0's practice of averaging switch sizing omits the cost of modularity of the switching algorithm entirely. Hatfield wrongly assumes that one single line can be purchased at a time. In fact, HM 5.0 models switch sizes that are smaller than even the minimum size that one can purchase. For example, Lucent Technology's 5ESS switch is comprised of switch modules that house and interface analog lines and Digital Loop Carriers. The subsystem that contains analog lines is the line unit. This unit comes equipped with line grids that can provide multiples of 64 lines. The line unit is

required whether there are 64 lines or 640 lines terminated in the unit. This line unit, the frame, cabling, time slot inter-exchange unit, and the switch module processor unit all have a basic minimum cost regardless of the number of lines equipped in the unit.

Due to its modular construction, it is simply not possible to purchase a single line at a time in the 5ESS switch, as assumed by HM 5.0. By overlooking this modularity, Hatfield ignores all costs beyond the currently demanded lines, and underestimates the costs associated with the lines it counts.

The same logic applies to Nortel switches. While it is possible to purchase a single line card for the Nortel switch, there must be a slot in the switch line drawer in which the single line can be placed. Hatfield does not consider the costs associated with pre-provisioning a line drawer, line concentration module, frame work, or other peripheral equipment required to accommodate single line growth.

As an example, when we performed a calculation to consider modularity for Hatfield's entire GTE network for Alabama, we computed a need to purchase 2,621 more lines than HM 5.0 allows. This computation was done by rounding up, to the nearest whole number, the number of line modules required. Multiplying this whole number by the minimum number of lines per unit produced the minimum quantity of lines that could be purchased in a line module/unit. These lines would have to be purchased in the modeled network at an approximate cost of $393,124. This cost is not captured anywhere in the Model.

5. Switching Investment is Understated

a. Software Investment

The per-line price used by HM 5.0 to calculate switch investment is understated because it is based on a Northern Business Information ("NBI") study that excludes certain software expenses. The Hatfield developers mistakenly use an RBOC figure of $102 and a GTE figure of $118 as the cost incurred for a bundled digital line in 1995. These numbers do not represent the entire investment required as part of the "negotiated purchases" discounting under which the ILECs purchase digital switching equipment. Rather, they project a trimmed down version of hardware and "some software." We estimate the costs that were not included in the study to be $40 per line,[81] which would account for the cost of Centrex, 3-way calling, and other features required with the switching UNE. Our conversations with an NBI analyst show these costs were removed from the data that HM 5.0 uses to derive its line prices.

b. Switch Investment Associated With Trunks is Understated

GTE South equips its switches with trunks determined by both the demand of switched network traffic and demand from the IXCs. HM 5.0 attempts to model the demand generated by switch usage and then attempts to calculate the required number of trunks to carry that load. There are discrepancies in the computation of this usage since the assumptions used to calculate demand are at least seven years old and HM 5.0 depends on assumptions that are inconsistent with sound

[81] The 1996 NBI Regional Holding Company installed cost per line is $109.00 ($99 x 1.10) (See Page 27). Bell Atlantic has disclosed its actual installed cost on a per line basis was approximately $150. See Rebuttal Testi mony of John C. Klick on Behalf of AT&T and MCI, Before the Washington Utilities and Transportation Commission, Docket Nos. UT-960369,-70,-71, April 25, 1997, Attachment JCK-3.

engineering principles and logical sizing techniques. These incorrect assumptions create the size and investments of trunks and help explain the differences between the HM 5.0 network and GTE's actual network.

To quantify this difference, we analyzed the Alabama trunk network and discovered that GTE has 75,618 installed trunk ports while HM 5.0 models only 25,627 trunk ports. This difference represents 49,991 missed trunk ports in the Hatfield modeled network. The corresponding shortfall in switching investment equates to over $20.5 million in missed switching investment.[82] Additional reasons for this difference in trunk ports and their corresponding trunk quantities are discussed in more detail below.

First, HM 5.0 ignores the fact that switch trunks are built in a modular fashion. Basic engineering principles dictate that switched trunks are built in groups of 24. The Hatfield Model in contrast calculates trunk requirements to the nearest whole number, thereby ignoring basic engineering principles. When the Hatfield Model is adjusted to account for trunk modularity principles, an additional 8,570 trunks are required in the Model.[83]

Second, HM traffic assumptions regarding trunks are unrealistic. HM assumes that all network traffic is levelized throughout each business day. It uses a simplistic approach for sizing

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[82] This number is computed by adding together:
(1) GTE missed trunk ports (49,991) x $305 per trunk port = $15,247,255
(2) Trunk ports modeled by Hatfield (25,627) x $205 per trunk port = $5,253,535
(3) Total Missed Trunk Port Investment = $15,247,255 +$5,253,535 = $20,500,790.
Note: $305 per trunk port is from the NBI "US Central Office Equipment Market Database," January 1996, Exhibit 3-37, row 211, Page 89, Column 1995.
$205 = $305 less $100 used in Hatfield Model for DSO port

[83] This value was calculated by adjusting the trunks found in HM 5.0 to the nearest multiple of 24 in order to reflect the fact there are 24 trunks in a trunk group.

trunk groups that would never be used by real-world engineers. Specifically, it assumes that annual traffic occurs evenly on each business day throughout the year, and that 10% of it will comprise the busy hour of any given day in any given office. This straight-line averaging approach does not reflect traffic dispersion across switches or hours of the day. The result is that HM fails to provide sufficient trunk capacity to handle peak traffic loads.

Finally, HM 5.0 excludes capitalized labor costs associated with trunk installation. The installation of switched DS-0 level trunks requires circuit design, central office translations and initial testing prior to turn up of the trunks. The labor associated with these activities is capitalized labor that is included with trunk investment. AT&T's own study provides details of capitalized labor required to install trunks. The value identified in this study is $45 per trunk.[84] When this value is multiplied by number of trunks necessary for Alabama, an additional shortfall of $3.4 million in trunk-related investment is realized.

c. Switch Software Expenses Have Been Omitted Entirely.

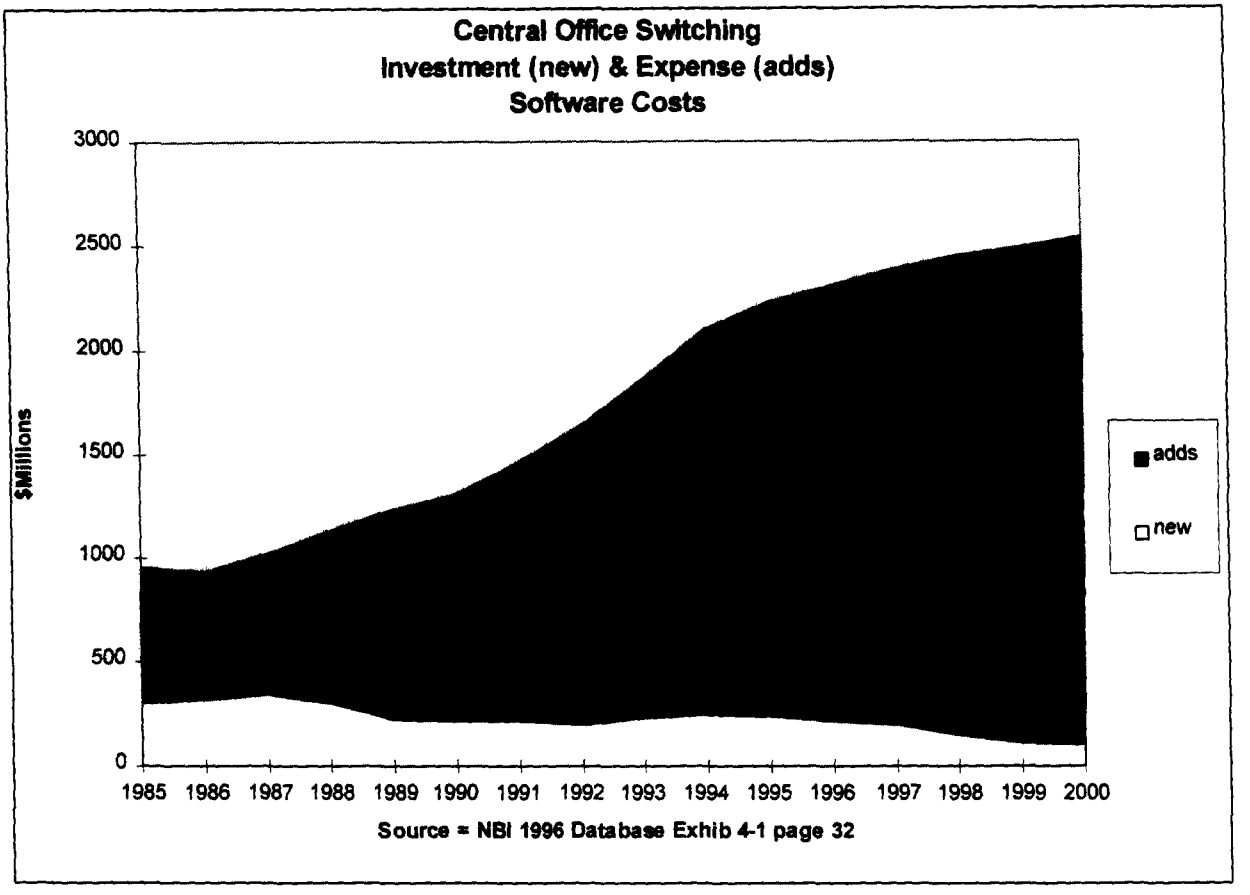
Switch software investments and expenses are significant costs incurred by switch consumers such as GTE. Software costs are an integral cost of the switch investment, and are appropriately capitalized by telephone companies when the software is purchased in conjunction with the initial purchase of a switch. Switch software that is purchased and installed after the initial purchase and deployment of a switch, for purposes of upgrading to the latest software, is appropriately expensed. Software upgrade purchases are made to allow switches to function more effectively, more efficiently, and more economically than earlier versions might have allowed. ILECs purchase switching

[84] A Study of AT&T's Competitor's Capacity to Absorb Rapid Demand Growth, June 20, 1990, Page 7.

equipment from predominant switch vendors. Switches require software upgrades on a scheduled basis to keep current with the latest software release (referred to as "generic programs"). Failing to keep current with the latest generic program can cause the ILEC to lose support from the switch vendor. Also, failing to keep current, or skipping new software releases, can cause ILECs to incur greater expenses, at a later date, due to higher costs of upgrading a switch that has not been previously upgraded. Moreover, switches need to keep current with the latest software generics to be able to satisfy mandated services, such as number portability. Additionally, they provide vertical features that ILEC customers demand, and allow ILECs to make available features that the ILECs will be obligated to provide either as UNEs or in conjunction with UNEs.

While the NBI study relied upon by the Hatfield modelers to estimate future switch investment predicts that switch prices will decline in future years, the study also predicts that demand for software additions increase at the same time. This increase in software sales and corresponding increased expense is a function of the bargaining for switch line prices between switch purchasers and switch producers. While the discounts for switch line prices may seem steep currently, there is a future increased cash outflow for switch software associated with the initial switch purchase. HM 5.0 considers only a portion of the initial capital outflow requirement, entirely disregarding future software expense increases. The graph below illustrates the fact that the dollars spent by the telecommunications industry for software expense are expected to increase significantly in the upcoming years.

Graph 2



HM 5.0 completely ignores this data (which is contained in one of its own sources -the NBI Study) and consequently understates switch software related expense. This is a grave oversight in light of the fact that model supporters, such as AT&T, have made changes to their switch software in the past. In fact, the chief modeler of AT&T's NRCM Model has stated unequivocally that ILECs failing to update switch software, "risk the chance of interruption of customer service and long delays

in turning up and provisioning customer services."[85] ILECs spend over $1 billion annually for such software--costs that are not included in the Hatfield Model.

Using the NBI study as the source for software addition expenditures, we computed the software expense for GTE/Contel Alabama, for example, to be approximately $11.00 per line/per year. This $11.00 per line/per year cost is not accounted for in HM 5.0.[86]

d. Switch Line Circuit Offset Per DLC is Incorrect

GTE, RBOCs, and other telephone companies buy switching equipment capable of providing service to subscribers served either by analog signals from analog lines (copper cable), or digital signals over a Digital Loop Carrier ("DLC"). The fact that both types of signals require different switch equipment is irrelevant when the weighted average price for such equipment is computed in the NBI study the Hatfield modelers rely upon. Because the study includes both types of switching equipment, there would be no need to offset one against the other. The Hatfield Model does, however, inappropriately offset one against the other. The fact that the Hatfield developers have altered the amount of the offset by a factor of six since the introduction of HM Release 2 confirms the suspicion that there is no foundation for this reduction. The Hatfield developers claim they went to great lengths to find what they term "publicly available information" to support the model's assumptions (i.e., the NBI study), yet the modelers continue to second guess their data source. The offset HM 5.0 applies *reduces* LEC switch costs to allegedly account for the fact that DS-0 level line

[85] Deposition of John Lynott, In the State of California Before the Public Utilities Commission, Docket Nos. R.93-04-003 and I.93-04-02, November 19, 1997, at 426.

[86] This expense amount is derived from the NBI study by dividing Total Digital Line Software for growth additions by the number of embedded lines served by digital switches.

cards are not required in digital switches when integrated DLCs, which work over fiber feeder, are used in the loop, because the switch can handle traffic at the DS-1 level. HM 5.0 sets this reduction at $5 per line for GTE. This offset should be eliminated and replaced with a *cost-increase* to account for the additional switch investment required to implement the hairpinning arrangement that can be used to hand off unbundled IDLC loops to CLECs. When we calculate the total number of modeled DLC lines, multiplied by the $5 offset, we compute $1.1 Million worth of artificial-switch investment reductions that should be added back into GTE/Contel's investment in Alabama.

HM 5.0 is not modeling any known and identified switch that is available and in use today. It is questionable whether the unidentified switches actually contain switch line circuit cards that can be physically separated from the switch in the event they are not required. Nortel switches have separable line cards, but frames, cables, shelves, line drawers, and other common equipment must be installed initially, and at a cost not captured in Hatfield, before single line augmentation can be accomplished. Lucent switches do not have separable line cards. In fact, Lucent switches require a minimum line purchase also not reflected anywhere in the Hatfield Model. We find these assumptions to be indicative of the unreliability of the many other assumptions contained in HM 5.0.

6. Power Investment is Insufficient

The Hatfield Model grossly underestimates the power investment for local switches and does not include any power investment for tandem switches. The Model assigns a power investment value ranging from $5,000 to $250,00 depending on the number of lines in the wire center.[87] This power

[87] Hatfield Inputs Portfolio Summary, Section 4.2.3.

investment is intended to cover the cost of power attributable to powering the switch itself.[88] The Model erroneously ignores all the additional power requirements necessary to ensure the switch and the network do not cease to function. There is no power investment included in the Model for the building in which the switch resides. No provisions have been made for the HVAC systems that are critical in maintaining the proper temperature range in which switches must operate. There is no investment for the circuit and transmission equipment found in the wire center. The Model also neglects to include any investment for back-up generators that are critical to ensuring uninterrupted telephone service. In short, the local switches modeled by Hatfield cannot function because insufficient power investment has been allocated. This shortcoming becomes even more evident when one compares the power investment values incorporated in the Hatfield Model with those used in the AT&T/MCI Collocation Cost Model Release 1.2.

The AT&T/MCI Collocation Model contains power investment far in excess of what is found in the Hatfield Model. This Model estimates the cost of a stand-by generator and AC entrance facilities alone to be $280,000 for a 400KW engine.[89] This $280,000 includes only the costs for the stand-by engine, fuel tanks and AC switch board.[90] (It should be noted that the corresponding investment for a larger office such as the 4ESS would be significantly higher where a 2500KW engine is required.) To compute the total power-related investment, the additional costs associated with the DC power plant (e.g., rectifiers, batteries) must be added to the stand-by generator costs.

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[88] Supplemental Reply Testimony of John C. Klick, Before the Washington Public Utilities Commission, Docket Nos. UT-960369, 960370, 960371, Pages 7&8, June 20, 1997.

[89] AT&T/MCI Collocation Model, Version 1.2, Before the Public Utilities Commission of the State of California, Docket Nos. R.93-04-003, I.93-04-002, September 15, 1997, Worksheet BU #11.

[90] *Id.*

The AT&T/MCI Collocation Model reflects costs as great as $471,000 for these DC power plant components alone.[91]

The Collocation Model also contains investment for Battery Distribution Fuse Boards (BDFBs), a common component in the powering of terminal equipment.[92] On a per unit basis, these boards represent a considerable investment. The AT&T/MCI Collocation Model reflects a $30,362 cost per BDFB.[93] In a large central office, multiple BDFBs would be required to provide sufficient power capacity. This investment is not accounted for in the Hatfield Model. Needless to say, when the power investment figures in both AT&T models are compared to the power investment in the Hatfield Model ($5,000 to $250,000), it is evident that the Model is producing much lower power costs than would possibly experienced by ILECs. This gross understatement of the power investment is yet another example of the results-oriented nature of the Hatfield Model. This attempt on the part of Hatfield developers to produce low power related costs is even more pronounced in their outright failure to include any power investment for tandem switches.

The Hatfield Model documentation for tandem power investment is incomplete and nonsensical. It states that power is allocated based on the number of lines in a switch, yet the tandem does not have lines. It assumes that tandems and local switches share the same buildings and, therefore, the same building power supply. Since there is no investment associated with building power for local switches in the Model, it logically follows that there is no power investment for

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[91] *Id.*, 48V DC Power Consumption Costs Worksheet.

[92] AT&T/MCI Collocation Model, Version 1.2, Before the Public Utilities Commission of the State of California, Docket Nos. R.93-04-003, I.93-04-002, September 15, 1997, Section 5.1.

[93] *Id.*, 48V DC Power Consumption Costs Worksheet.

tandems that are collocated with these switches. The Model assumes that there are no stand-alone tandems, and consequently does not develop any tandem related power investment for them.[94] One can conclude then that there is absolutely no power investment in the Model for GTE tandems. Consequently, like the power investment for local switches, power investment in the Hatfield Model is significantly understated for tandem offices.

C. Operation Support Systems Are Not Accurately Modeled

An important aspect of providing telecommunications services is the ability to build, test, and maintain all types of network elements. Presently, the two most common vehicles for performing these functions are the Switched Access Remote Test System ("SARTS") and the Mechanized Line Test ("MLT") system. SARTS allows for the centralized capability to test the various segments of special service type circuits. MLT provides extensive loop testing functions used for customer contact, screening, dispatch, and the closeout phases of trouble report handling. Both of these testing capabilities, and the centers in which they reside, are necessary in order to efficiently provide high quality telecommunications services. AT&T agrees that "testing is a network operations function that all loops must, or at least should undergo, whether provisioned for the LEC's own use or for CLECs."[95] AT&T also acknowledges that technicians are equipped to get remote access to test systems such as SARTS and MLT in order to complete their work in a mechanized fashion from the field.[96] In today's environment, testing capabilities are critical to providing telecommunications

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[94] AT&T's Response No. 73 to GTEC's 1st Set (Hatfield), OSS/NRC Phase, Before the California Public Utilities Commission, Docket Nos. R.9.-04-003/I.93-04-002, November 25, 1997.

[95] AT&T's Response to GTE's Data Request No. 115 in the Washington Generic Cost Proceeding. Docket Nos. UT-960369, -70, -71.

[96] Testimony of Bonnie R. Petti on Behalf of AT&T Communications, Washington Gener ic Cost Proceeding, Docket Nos. UT-960369, -70, -71.

services. The Hatfield Model, however, ignores both of the investments associated with testing functions and significantly understates an ILEC's associated testing expenses.

HM 5.0 maintains that the costs associated with testing network functionality are captured in the Model's Network Operations Factor. This factor, which is expense related only, reduces an ILEC's reported ARMIS expenses, some of which relate to testing, by 50%. This reduction is allegedly performed in order to reflect that network surveillance, provisioning, and software upgrades can be executed from a central facility.[97] This factor, however, ignores the investment associated with testing. For instance, the Model does not include the costs associated with Special Service Centers ("SSCs") and the SARTS vehicle used by the employees in the SSCs because "both are embedded methodologies that may reflect incumbent LEC inefficiencies and thus would not represent forward-looking technology."[98] The Hatfield Model supporters have offered no evidence that ILECs in general, and GTE in particular, are or have been inefficient, nor have the Model supporters modeled any forward-looking technology to replace the "embedded methodologies that may reflect incumbent LEC inefficiencies." Indeed, the NRCM Model sponsored by AT&T is predicated upon both MLT and SARTs testing capabilities.[99] Furthermore, the primary developers of the NRCM have stated that MLT and SARTs testing are in fact forward-looking technologies.[100]

HM 5.0 excludes the costs associated with an ILEC's present testing locations and methods of testing because they are not "forward-looking." If one accepts this precept, then one would expect

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[97] Hatfield Model Inputs Portfolio, Section 5.4.6.

[98] AT&T's Response No. 115 to GTE's Fifth Set of Data Requests to AT&T in Washington.

[99] AT&T's Response No. 3 to GTE Northwest Inc.'s First Set of Data Requests to AT&T/MCI in Oregon, Docket No. UT-138,139, November 26, 1997.

[100] Deposition of John Lynott, In the State of California Before the Public Utilities Commission, Docket Nos. R.93-04-003 and I.93-04-002, November 21, 1997, Pages 743 and 729 respectively.

the Model to include the costs associated with "forward-looking" testing technology. Yet, HM 5.0 fails to do so. HM 5.0's failure to account for testing investment means that the Model must assume that testing will be done manually by technicians with portable test equipment (which is also capital investment and excluded from the model). If this is the case, then using a 50% network operations factor is clearly inappropriate because testing will be manual and will require more expenses to be allocated to the labor portion of this testing procedure. If the Model is to exclude the required investment, then the labor-related expense should be increased markedly. Conversely, if HM 5.0 reduces the expense associated with testing, then it must increase the investment that will account for the decrease in manual labor. The Model, however, effectively "double counts" any potential savings by both decreasing costs associated with manual labor, and simultaneously ignoring labor-saving investment costs. There is no replacement testing technology modeled in HM 5.0. Thus, the existing technologies and investments should be modeled, and the level of network operations expenses should at least remain at current levels, if not increased, to reflect the increased complexity associated with the testing of unbundled loops and rising labor costs.

HM 5.0 also ignores the fact that when loops are unbundled they cannot be tested by ILECs via MLT, which works through the switch. In order to test unbundled loops, manual wiring of Switched Maintenance Access System ("SMAS") points used in conjunction with SARTS will be required for currently existing loops. Similarly, if new loops are being installed, a choice will have to be made at the time the cable is placed whether to wire the entire cable with SMAS points (which will increase up-front investment), or wire it as requests are made for unbundled loops (which will

increase costs later). Either way, Hatfield has neglected to include any of these costs associated with the testing of unbundled loops.

By excluding present technologies (for which there are no substitutions available at the present time), and simultaneously decreasing labor-related expenses, HM 5.0 significantly understates the costs associated with testing of the local loop. We estimate this understatement of costs on a per test center basis to be between $9 million and $11 million.

D. The Model's Average Holding Time Fails To Project Internet Usage And Growth Rate

The model's average holding time fails to project for any growth -- ignoring even Internet growth. The average holding time on a call is the actual duration that the call is in progress (i.e., from the time the handset is taken off hook until the time it is placed back on hook). This duration is normally measured in minutes or seconds. Busy hour call attempts, call completion ratios, and holding times are components of the offered load (usage) on the network. Usage is both a function of frequency (attempts) and duration (hold time).

As an example, assume one customer makes three calls between 10:00 AM and 11:00 AM. Each call is completed and the average length of each call is three minutes. The usage, which is measured as Centum Call Seconds (hundred call seconds), is thus (3*3*60/100) or 5.4 CCS for that customer. If the duration of each call changes by one minute, the usage changes to (3*4*60/100) = 7.2 CCS. This is a similar effect to that which telephone companies are experiencing as a result of increased Internet traffic. The effect of this traffic on cost becomes complicated because each switch

component is affected. Switch components (lines, trunks, processors, etc.) have limited capacity. Therefore, additional capacity must be added to accommodate any increase in usage.

HM 5.0 does not consider any change to usage. In fact, the Model uses a Bellcore study as the default input for busy hour call attempts for residence and business lines. While this may be an adequate source for "determining switch capacity objectives and traffic demand information," HM 5.0 extracts certain values while ignoring others, which, according to Bellcore, are "major traffic variables, and key traffic variables needed in the planning and engineering processes."[101]

For example, the Model assumes switches exhaust only on busy hour call attempts. As Bellcore documents in the LSSGR, however, traffic demand is more variable than that, for "each subsystem of a local switching system has its own capacity limits. These limits may appear either as terminal capacity, traffic usage capacity, or call handling capacity."

Furthermore, a study issued in 1989, which is what Hatfield relies upon, could not have foreseen the expansion of Internet and data communications that is prevalent in the network today. The document prepared by Bellcore in 1989 does not correspond with present calling patterns, and does not provide a clear, forward-looking view of the traffic requirements.

Note also that even though there exist means by which users can adjust the residential and business holding times, the model developers have been unable to identify what value a model user would have to enter in order to do so in one-minute increments.[102]

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[101] *Id.*

[102] Deposition of Dr. Mercer, et al., California OANAD Proceeding, March 8, 1997, Tr. at 482-83.