COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF TELECOMMUNICATIONS AND ENERGY

Investigation by the Department of Telecommunications and Energy on its own Motion into the Appropriate Pricing, based upon Total Element Long-Run Incremental Costs, for Unbundled Network Elements and Combinations of Unbundled Network Elements, and the Appropriate Avoided Cost Discount for Verizon New England, Inc. d/b/a Verizon Massachusetts' Resale Services in the Commonwealth of Massachusetts	D.T.E. 01-20

SURREBUTTAL TESTIMONY OF ROBERT A. MERCER
ON BEHALF OF AT&T

December 17, 2001

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I. INTRODUCTION AND SUMMARY

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Robert A. Mercer. I am the Principal of BroadView Telecommunications, LLC ("BVT"), a consulting firm specializing in analyses of the telecommunications infrastructure. The address of the firm is 5201 Holmes Place, Boulder, Colorado, 80303.

Q. ARE YOU THE SAME DR. ROBERT A. MERCER THAT FILED DIRECT TESTIMONY ON BEHALF OF AT&T IN THIS PROCEEDING?

A. Yes, I am. My resume was included as Exhibit RAM-1 to that Direct Testimony.

Q. WHAT IS THE PURPOSE OF THIS SURREBUTTAL TESTIMONY?

A. First, I want to explain a very minor correction that we have made to one cell within the HAI 5.2a-MA model. This minor change makes only a small difference in the results, but I am providing the revised results for completeness. All of the results presented in this testimony are based on the corrected model.

Second, I will respond to assertions made in the Rebuttal Testimonies of Verizon witnesses Dr. Timothy Tardiff and Mr. Joseph Gansert. I will focus on their numerous mischaracterizations of the attributes and operation of the HAI Model, Release 5.2a for Massachusetts ("HM 5.2a-MA"). AT&T witness Mr. John C. Donovan will rebut the numerous specific statements made by Dr. Tardiff and Mr. Gansert about the model's outside plant calculations and inputs. AT&T witness Mr. Steven Turner will deal with Mr. Gansert's assertions about common industry practice concerning the use and deployment of interoffice SONET rings. Concerning the latter, I will show that HM 5.2a-MA develops SONET rings that are entirely consistent with the industry practice.

Q. ARE THERE EXHIBITS TO YOUR TESTIMONY?

A. Yes, my testimony includes the following exhibits (exhibits RAM-1 through RAM-10 are attached to my pre-filed direct testimony):

?? RAM-11: Figure “Customer Locations in a Census Block”

?? RAM-12: Worksheets for Terrain Study Runs

?? RAM-13: Figure, “MST Versus Right-Angle Strand Distance”

?? RAM-14: Figure, “Customer Concentration within a Cluster”

?? RAM-15: The Impact of Model Changes Between HM 2.2.2 and HM 5.2a-MA (with one attachment)

?? RAM-16: Abstract from article titled “Clustering for the Design of SONET Rings in Interoffice Telecommunications”

?? RAM-17: Figure: “Logical versus Physical Interoffice Rings”

?? RAM-18a: Figure: “Logical Rings overlaid on Physical Ring”

?? RAM-18b: Figure: “Ring Interconnection”

?? RAM-19: Figure: “Ring Interconnection within Wire Center”

?? RAM-20a: Figure: “Ring Interconnection in HM 5.2a-MA”

?? RAM-20b: Figure “Mapping HM 5.2a-MA Interconnection to Wire Center Interconnection

?? RAM-21: A CD containing the corrected version of the model in electronic form.

Q. WHAT IS THE NATURE OF THE MODEL CORRECTION YOU HAVE MADE?

A. In the previous version of the model, the Calculation worksheet of the Distribution Module contained a variable name “lot_front” that assigned the absolute cell reference calculations!K2. Instead, it should have been assigned the variable reference calculations!$K2. The error caused a fixed lot frontage distance to be used in every cluster. As corrected, the lot frontage that is applied is the actual lot frontage for each cluster. Nothing else in the model has changed. For the Department's convenience a substitute CD-ROM with an electronic copy of the HAI 5.2a-MA model including this one change from the prior version is being provided as Exhibit RAM-21.

Q. WHAT IMPACT DOES THIS CHANGE HAVE ON THE BOTTOM LINE RESULTS?

A. It has a very small impact on the loop costs, which I had summarized in Table 1 to my direct testimony. I have reproduced the original Table 1 below, and have then revised Table 1 showing the results after the model correction that I just described. The third column in each table shows results by *wire center* zone, in which the wire centers have been grouped into the three wire center zones defined by the Department.[1] As you can see, the result of the change I have described is that: (i) the monthly loop rate in the Urban Zone drops by five cents from $4.97 to $4.92; (ii) the rate in the Suburban Zone drops by one cent from $7.76 to $7.75, and (iii) the rate in the Rural Zone increases by ten cents from $16.81 to $16.91.

Original Table 1: Monthly Total Loop Cost

Density Zone	Wire Center	Wire Center Zone
Lowest $ 3.63	Maximum $ 44.67	Zone 1 (Urban) $ 4.97
Highest $ 41.63	Minimum $ 1.04	Zone 2 (Suburban) $ 7.76
State $ 7.11		Zone 3 (Rural) $ 16.81

[1] As explained in my Direct Testimony, Zone 1 combines the Metro and Urban zones as defined by the Department.

Revised Table 1: Monthly Total Loop Cost

Density Zone	Wire Center	Wire Center Zone
Lowest $ 3.56	Maximum $ 44.97	Zone 1 (Urban) $ 4.92
Highest $ 41.96	Minimum $ 1.04	Zone 2 (Suburban) $ 7.75
State $ 7.09		Zone 3 (Rural) $ 16.91

In addition, these minor changes in monthly loop costs result in slight changes in xDSL costs, which I had summarized in Table 5 in my Direct Testimony. I have reproduced the original Table 5 below, and have then revised Table 5 showing the results after the model correction that I just described. As you can see, this slight model change results in a few pennies per month change in some of the rates for copper-fed xDSL.

Original Table 5: Monthly XDSL Costs

xDSL Type	XDSL-Capable Loop		xDSL-Equipped Loop		Additional Voice UNEs	
Feeder?	Copper	DLC	Copper	DLC	Copper	DLC
G.Lite ADSL	$4.57	$11.28	N.A.	N.A.	$ 3.85	$ 3.85
HDSL (4-W)	$5.94	$12.65	$25.52	$32.23	N.A.	N.A.

Revised Table 5: Monthly XDSL Costs

xDSL Type	XDSL-Capable Loop		XDSL-Equipped Loop		Additional Voice UNEs	
Feeder?	Copper	DLC	Copper	DLC	Copper	DLC
G.Lite ADSL	$4.52	$11.28	N.A.	N.A.	$ 3.85	$ 3.85
HDSL (4-W)	$5.88	$12.65	$25.46	$32.23	N.A.	N.A.

Q. PLEASE SUMMARIZE YOUR RESPONSE TO DR. TARDIFF'S TESTIMONY ABOUT HM 5.2A-MA.

A. The overarching theme of Dr. Tardiff's testimony is his false assertion that the HAI Model developers are "results oriented" and "conveniently" change the model and its inputs to obtain results favorable to their clients. Corollaries to this theme are his beliefs that (1) every change that acts to decrease costs is inherently wrong, and (2) it is sufficient for him to identify cases where the results have changed, not to properly understand and identify any alleged failings in the model. Thus, for instance, even when inputs are state-specific or based on values adopted by the FCC for use in its Synthesis Model, Dr. Tardiff suggests that those inputs must be illegitimate if they cause costs to decrease compared to inputs used in earlier versions of the model. None of his contentions have merit.

Dr. Tardiff's testimony wraps a small amount of addressable content inside a large volume of inflammatory rhetoric. The latter is replete with misleading statements about the way the model operates and the results it produces, incorrect claims about supposed errors in the model that are in fact not errors at all, and attempted character assassination directed at the model's developers (Dr. Tardiff describes the developers as being "results-oriented," or having "conveniently" made some change to inputs to the model, no less than five times in his testimony). What is particularly disturbing is that Dr. Tardiff's testimony ignores the substantial and growing record of past proceedings that have dealt fully with many of its assertions. This is perhaps not surprising, since the testimony is substantively the same as, and in many instances identical to, Dr. Tardiff's testimonies filed in New York and New Jersey well over a year ago.

Once the empty rhetoric is eliminated from Dr. Tardiff's testimony, there remain a few substantive issues to address, and these issues will be the focus of this testimony, with further discussion by Mr. Donovan. In a nutshell, I will demonstrate that, contrary to Dr. Tardiff's assertions:

?? HM 5.2a-MA properly incorporates TELRIC principles, and in particular appropriately treats the only two specific issues Dr. Tardiff has raised in Section III of his testimony — fill factors and switch prices;

?? HM 5.2a-MA has been validated in the most appropriate fashion — against other forward-looking models, not against the totality of Verizon's embedded investments and costs (which under the TELRIC methodology are irrelevant and may not be taken into account);

?? Dr. Tardiff's interpretation of past regulatory decisions about the model are entirely one-sided, and largely quote regulators' views of defects in past versions of the model that have been corrected in the current version and thus are not at issue in this proceeding;

?? With one exception, none of the specific defects identified in Section V of Dr. Tardiff's testimony are in fact present, and the model operates as it should in all instances he has addressed. His one bona fide issue led to the discovery of the very minor glitch in the model that I have identified above. The corrected model resolves his one valid, albeit inconsequential, criticism.

Q. PLEASE SUMMARIZE YOUR RESPONSE TO MR. GANSERT'S CRITIQUE OF THE MODEL'S INTEROFFICE FACILITIES CALCULATIONS.

A. As discussed briefly in my testimony, and dealt with at length in Mr. Turner's testimony, Mr. Gansert's comments are premised on a wholly flawed understanding of industry practices for designing interoffice SONET rings.

Mr. Gansert's misunderstanding of common industry practice spills over into his analysis of HM 5.2a-MA, causing him to make incorrect claims about both what the model does do and what it should do. In actuality, the model operates as it should in a manner that is consistent with industry practice for SONET rings, and therefore produces estimates of the costs of Verizon's interoffice UNEs that if anything tend to be conservatively high because HM 5.2a-MA does not have all the detailed planning information available that Verizon's interoffice planners utilize.

Q. AFTER REVIEWING THE CRITICISMS OF HM 5.2A-MA CONTAINED IN THE REBUTTAL TESTIMONIES OF DR. TARDIFF AND MR. GANSERT, DO YOUR BELIEVE THERE ARE THERE ANY ASPECTS OF THE MODEL'S ASSUMPTIONS, ALGORITHMS, OR OPERATION THAT NEED TO BE CHANGED, OTHER THAN THE ONE MINOR CORRECTION YOU HAVE ALREADY DESCRIBED?

A. No, not one. The criticisms by Dr. Tardiff and Mr. Gansert are without substance, and neither demonstrate how a correctly-crafted model of local exchange costs should work nor that HM 5.2a-MA possesses any shortcomings compared to such a properly-crafted model.

Q. WHY SHOULD THE DEPARTMENT USE THE RESULTS OF HM 5.2A-MA TO DETERMINE THE COST OF UNBUNDLED NETWORK ELEMENTS OFFERED BY VERIZON IN MASSACHUSETTS?

A. HM 5.2a-MA possesses all of the following attributes that make it the Department's appropriate choice for determining Verizon's UNE costs:

- ?? It is a state-of-the-art cost model that is in the forefront of cost models applicable to the local exchange network;
- ?? It is fully consistent with the FCC's forward-looking costing principles.
- ?? It deals with the local exchange network as a whole, not one or a few components of the network, thereby ensuring a consistent and appropriate assignment of all of Verizon's recurring costs to individual UNEs;
- ?? It is publicly-available, straightforward to install and run, and flexible in its provision of a massive number of inputs that users can modify;

?? It has been under development for more than seven years, during which time it has been subject to exhaustive external and internal scrutiny, and to the extent that scrutiny has identified bona fide concerns with certain aspects of the model, including criticisms identified by this Department about an earlier version of the model during the 1996 Consolidated Arbitration proceeding, the model has been changed to resolve those concerns.

Nothing said about the model by Dr. Tardiff or Mr. Gansert in this proceeding should give the Department any pause in relying upon the HAI 5.2a-MA model.

II. RESPONSE TO REBUTTAL TESTIMONY OF DR. TARDIFF

(A) HM 5.2a-MA Complies with TELRIC Principles.

Q. ON PAGES 5-11 OF HIS REBUTTAL TESTIMONY, DR. TARDIFF CLAIMS THAT THE HM 5.2A-MA MODEL VIOLATES TELRIC PRINCIPLES. PLEASE RESPOND.

A. This section is replete with the rhetoric that appears throughout Dr. Tardiff's testimony. For example, it alleges that HM 5.2a-MA makes a "purely hypothetical assumption that a brand new, 'fully functioning' network is dropped into place at a single point in time – a network that will never experience any growth, customer churn, or fluctuations in demand," and therefore produces an "instant network in a box."[2] In fact, however, no such treatment is assumed by, or incorporated into, the model; this is entirely a pejorative characterization invented by Dr. Tardiff. Instead, the model appropriately accounts for

[2] Tardiff, at p. 6.

the FCC requirement that the "long run" part of TELRIC means "a period long enough that all costs are treated as variable and avoidable."[3]

As another example, Dr. Tardiff claims that "the Hatfield Model [sic] implicitly assumes that an ILEC would instantly size its plant to perfectly accommodate current demand."[4] The model's designers made no such assumptions, nor do the methodologies of the model support that characterization, since the model provides user-adjustable fill factors that affect the sizing of all relevant network components.

After such rhetoric is removed from Dr. Tardiff's rebuttal testimony, Dr. Tardiff really makes only two specific claims with respect to the theoretical aspects of the model. First, he claims that the fill factors assumed in the model are set too high (i.e., fail to include the cost of enough unused plant). Second, the model assumes it can obtain facilities from suppliers at maximum volume discounts. Neither of these claims is correct.

Q. HOW DO YOU RESPOND TO DR. TARDIFF'S CLAIM THAT THE FILL FACTORS ASSUMED IN THE MODEL ARE TOO HIGH?

A. While there are many fill factors in HM 5.2a-MA, distribution cable fill is the area where one would most expect the factors Dr. Tardiff identifies as impacting fill — growth and churn — to come into play. Dr. Tardiff criticizes the HAI 5.2a-MA model for having a "distribution cable 'default' utilization factor [of] 75%."[5] He fails to recognize the important distinction between a target fill factor (which is what this 75 percent figure represents) and the very different effective utilization rate or effective fill factor.

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[3] FCC's *First Report and Order,* CC Docket No. 96-325, Released August 8, 1996, ¶692.
[4] Tardiff Testimony at p. 8.
[5] Tardiff Testimony at p. 10, fn. 9.

The distribution fill factor issue has been dealt with extensively in the Rebuttal Testimony of Michael R. Baranowski, filed on behalf of AT&T and WorldCom on July 18, 2001. Table 1 of Mr. Baranowski's rebuttal testimony, at p. 27, shows that after making appropriate forward-looking adjustments to Verizon's fill factor calculations the effective fill factor taking "breakage" (that is, the modularity in available cable sizes) into account should be 64.1 percent. Even if one were to use Verizon's own treatment of fill without adjustments, one would still arrive at an effective fill factor of 51.3 percent, as shown in Table 9 below:

Table 9 [6]
Verizon's View of the Appropriate Distribution Fill Factor

Description	Source	Value
1. 2 Lines per Living Unit Design Criteria	Verizon	0.5 (1/2.0)
2. Current Lines Per Living Unit	Verizon	1.2
3. Starting Fill	Line 1 x Line 2	0.60
4. Churn (Vacancy) Adjustment	Verizon	0.95
5. Fill	Line 3 x Line 4	0.570
6. Breakage Adjustment	Verizon	0.90
7. Effective Fill	Line 5 x Line 6	51.3%

By contrast, while HM 5.2a-MA has a ***target*** fill of 75 percent, its ***effective*** fill after accounting for breakage is only 48.4 percent. In other words, in running the HAI 5.2a-MA model we have made a more conservative (i.e. favorable to Verizon) assumption regarding spare capacity than does the Verizon model, and a far more conservative assumption compared to the Verizon model with appropriate forward-looking adjustments. Indeed, as Mr. Baranowski has demonstrated, the HAI 5.2a-MA

[6] Tables 1-8 were included in my Direct Testimony.

model should actually be re-run using the much ***higher*** effective fill of 64.1 percent, rather than the 48.4 percent effective fill.

In any case, though, let me emphasize that distribution fill, and all other appropriate fill factors, can be adjusted by the user of the model, so at best, Dr. Tardiff's arguments really pertain to input values, not to the theoretical basis of the model.

Q. WHAT IS YOUR RESPONSE TO DR. TARDIFF'S CLAIM AT PAGE 8 OF HIS REBUTTAL THAT THE MODEL ASSUMES IT CAN OBTAIN FACILITIES FROM SUPPLIERS AT "MAXIMUM VOLUME DISCOUNTS."

A. This claim, which is made by Dr. Tardiff without explanation and without citing any portion of the model or supporting documentation, presumably has reference to the position taken by Verizon, and adopted in Section V.B of Dr. Tardiff's testimony, that the forward-looking cost of investment in switches should be estimated by assuming that an efficient provider of unbundling switching would buy its entire inventory of switches at the relatively high prices charged for add-on capacity, not the more deeply discounted prices for new capacity that an efficient new entrant would pay (and that incumbent carriers like Verizon have actually paid). I understand that this position has been rejected by the FCC, by several state commissions in Verizon's service area that considered the issue, and by several federal district courts in the region. The FCC was very explicit on this issue in its order pertaining to the inputs values to be used in its Synthesis Model:

> In the Inputs Further Notice, we tentatively concluded that in order to capture the costs associated with the purchase and installation of new switches, and to exclude the costs associated with upgrading switches, we should exclude switch cost data that contained costs reported more than three years after installation. We tentatively concluded that this restriction eliminates switch cost data that contain a significant amount of upgrade costs and, therefore, do not solely represent the purchase and installation costs of new switches.
>
> We affirm our tentative conclusion that, in order to estimate the costs associated with the purchase and installation of new switches, and to

> exclude the costs associated with upgrading switches, we should remove from the data set those switches installed more than three years prior to the reporting of their associated book-value costs. We believe that this restriction will eliminate switches whose book values contain a significant amount of upgrade costs, and recognizes that, when ordering new switches, carriers typically order equipment designed to meet short-run demand.
>
> We reject the suggestions of Ameritech, Bell Atlantic, BellSouth, GTE, and Sprint that the costs associated with purchasing and installing switching equipment upgrades should be included in our cost estimates. The model platform we adopted is intended to use the most cost-effective, forward-looking technology available at a particular period in time. The installation costs of switches estimated above reflect the most cost-effective forward-looking technology for meeting industry performance requirements. Switches, augmented by upgrades, may provide carriers the ability to provide supported services, but do so at greater costs. Therefore, such augmented switches do not constitute cost-effective forward-looking technology.[7]

Q. BUT DR. TARDIFF SAYS AT PAGE 64 THAT "VERIZON MA HAS NO PLANS OF INSTALLING NEW LOCAL SWITCHES.

A. Whether true or not, that is irrelevant to a TELRIC cost study. The TELRIC cost study requires that forward-looking prices be set "based on the use of the most efficient telecommunications technology currently available and the lowest cost network configuration, given the existing location of the incumbent LEC's wire centers."[8] As the FCC made clear in the language that I quoted above, this means that UNE switch prices are to be based on the best prices available for new switches, not the allegedly higher cost of buying switches one piece at a time.

Q. ACCORDING TO DR. TARDIFF (AT P. 11), HM 5.2A-MA "EXCLUDES MANY COSTS FROM ITS ESTIMATING ALGORITHMS." IS THIS ASSERTION CORRECT?

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[7] *In the Matter of Federal-State Joint Board on Universal Service*, CC Docket No. 96-45, and Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket No. 97-160, Tenth Report and Order ("Inputs Order"), at ¶ 295, ¶315, ¶317, respectively, emphasis added.

[8] 47 C.F.R. § 51.505(b)(1).

A. No. While Dr. Tardiff claims the model excludes "many" costs, he has identified only the two I have discussed in my previous answer. Even if Dr. Tardiff were right about the proper treatment of those two inputs, which he is not, those examples would hardly be evidence that "There are many costs omitted from the Hatfield Model's [sic] approach,"[9] or that "The Hatfield Model [sic] specifically excludes, by design, many costs of an actual dynamic network."[10] He provides no support for these false and hyperbolic assertions.

(B) HM 5.2a-MA Uses Appropriate Methodologies, Procedures, and Inputs

(1) HM 5.2a-MA Includes Extensive and Detailed Documentation of Its Assumptions, Methodologies, and Inputs.

Q. DR. TARDIFF CLAIMS THAT THE DOCUMENTATION ACCOMPANYING THE HATFIELD MODEL IS NOT SUFFICIENT FOR EXPLAINING AND UNDERSTANDING THE INNER WORKINGS OF THE MODEL (TARDIFF REBUTTAL, P. 12). LATER, HE COMPLAINS THAT IT IS DIFFICULT TO "REVERSE ENGINEER" THE MODEL BECAUSE TO DO SO REQUIRES A LABORIOUS STUDY OF MANY INTERRLATED FORMULAS (TARDIFF AT PP. 13-14). HOW DO YOU RESPOND?

A. AT&T has produced nearly 250 pages of documentation of HM 5.2a-MA concerning the operations and inputs of the model. A great deal of information about the workings of the model is provided in this documentation. The inputs documentation provided with my direct testimony provides the source and rationale for each of the more than 1,400 input values used in the model. Moreover, with one exception, the model is formatted in Microsoft Excel, a standard spreadsheet program, and the derivation and disposition of every formula and cell in the model can be traced by examining the cells of the

[9] Tardiff, at p. 10, emphasis added.
[10] Tardiff, at p. 6, emphasis in original.

spreadsheet workbooks and using the trace functions of the program. Even the exception, the calculation of interoffice fiber rings, is coded in Visual Basic for Applications, another standard programming language that is straightforward. The ring calculating code is presented to the model user for review as well.

Any cost model of a local exchange network that adequately captures the way the local network is configured is inherently complex. The Verizon model is also complex, as are the Benchmark Cost Proxy Model and the FCC's Synthesis Model. Moreover, the notion that the HM 5.2a-MA and its predecessors are too complex to understand, test and manipulate is refuted by the actions of Verizon itself. Verizon, and Dr. Tardiff, have criticized various aspects of the model in numerous state proceedings since 1996, and in some instances have identified very detailed calculations that were in error, which have since been corrected.

Finally, I find it ironic that during the early history of the model, incumbent telephone companies specifically argued that the model was too simple to adequately capture the nature of the local exchange network it was modeling; now, Dr Tardiff's complaint is that it is too complex.

Q. AT PP. 14-16, DR. TARDIFF MAKES A NUMBER OF ASSERTIONS ABOUT THE ALLEGED LACK OF VALIDATION FOR THE INPUTS USED IN THE MODEL. WHAT IS YOUR RESPONSE TO THESE CRITICISMS?

A. I have documented the basis for each and every input value to the model in documentation called the HM 5.2a-MA Inputs Portfolio ("HIP") submitted as Exhibit RAM-3 with my Direct Testimony. The values specified therein are the result of more than seven years of work to determine the appropriate value for each input. They have been refined whenever meaningful, verifiable information has come to light. Where we still do not have quantitative documents, we have invoked our expert judgment or cited what we believe to be common industry knowledge, and we have made it clear when we have done so. In each state proceeding, the sponsors of the model have tendered appropriate expert witnesses for cross-examination on the reasonableness of the inputs.

If Verizon, one of the largest suppliers of local telephone service in the United States (and one of the largest purchasers of inputs for local telephone service) believes there are better values for some parameters, it has ample opportunity to put them on the record. Early on, the FCC recognized the greater burden of proof on the ILECs in this matter:

> We note that incumbent LECs have greater access to the cost information necessary to calculate the incremental cost of the unbundled elements of the network. Given this asymmetric access to cost data, we find that incumbent LECs must prove to the state commission the nature and magnitude of any forward-looking cost that it seeks to recover in the prices of interconnection and unbundled network elements.[11]

Nowhere in Dr. Tardiff's testimony does prove that better values for some input parameters exist. We therefore stand by our statement that the inputs, and the sources of those inputs, are publicly available through the HIP.

Q. ONE OF DR. TARDIFF'S ASSERTIONS IS THAT THE MODEL'S DEVELOPERS "MIX AND MATCH PARTS OF PRICE QUOTES IN AN ATTEMPT TO JUSTIFY THEIR INAPPROPRIATELY LOW 'DEFAULT' VALUES" (TARDIFF, P. 15). WHAT EXAMPLES DOES HE GIVE OF THIS, AND HOW DO YOU RESPOND TO THOSE EXAMPLES?

A. He gives two purported examples of what he apparently considers to be a self-serving process. The first has to do with telephone poles, in which he states the inputs rely on one quote for the material cost of a pole and on another quote for the labor involved in placing a pole (see Tardiff Rebuttal at page 15). Mr. Donovan addresses this issue, pointing out that this is both appropriate and necessary, because it mirrors the independent steps by which Verizon purchases poles and places them. Quite simply, it is common for an ILEC to purchase a pole from one vendor (the one with the lowest price), but have another vendor install the pole (again, the vendor with the lowest price for that service).

The second purported example has to do with the model's use of a Bell South ex parte letter to the FCC as a basis for the cost of various items of interoffice transmission equipment, while allegedly not using BellSouth's cost of cable or its cost of Serving Area Interfaces ("SAIs") (see Tardiff Rebuttal at page 16). Dr. Tardiff's statement is drawing a misleading contrast. Proponents of the HAI Model have continuously evaluated information on input values as additional information has become available. Some costs have increased as a result and others have decreased. In the case of interoffice terminal equipment, the information available before the BellSouth letter was sketchy and largely qualitative. Therefore, the letter contains the most definitive information on terminal equipment prices that has been put on the record, hence its adoption in the HAI Model. In the case of SAI and cable prices, the FCC undertook an exhaustive analysis of available data on both cable and SAI prices over the course of several months, choosing not to accept BellSouth's alleged costs. The outside plant team advising the HAI Model developers took full account of that work, and there have been substantial adjustments to those inputs in the model. But as Mr. Donovan discusses, the FCC analysis was not correct in all its particulars, therefore the model inputs are not identical to the inputs

(continued)

[11] *Local Competition Order*, ¶ 680.

adopted by the FCC. In both cases, then, input values used in the model appropriately reflect the inputs adopted by the FCC, but represent additional analysis done by the HAI Model developers.

The Bell South example Dr. Tardiff cites illustrates an obvious flaw in Dr. Tardiff's "mix and match" argument. The following table shows inputs to the HAI model before (second column) and after (third column) the Bell South *ex parte* values were applied to the model. For each category of equipment, the bold number indicates the higher value. When the bold figure appears in the "After" column, as it does in five of the seven entries, it means the HM 5.2a-MA developers have ***increased*** that cost input as a result of adopting the BellSouth values.

Table 10: Interoffice terminal equipment inputs to HAI Model Before and After the Incorporation of BellSouth's Propose Values

User Input	Value Before BellSouth	Value After BellSouth
OC-48 ADM, installed, 48 DS-3s	$50,000	**$130,372**
OC-48 ADM, installed, 12 DS-3s	$40,000	**$78,978**
OC-3/DS-1 Terminal Multiplexer, installed, 84 DS-1s	$26,000	**$33,764**
Investment per 7 DS-1s	$500	**$1,042**
Optical Distribution Panel	$1,000	**$4,021**
Channel Bank Investment, per 24 lines	**$5,000**	$3,415
DCS installed, per DS-3	**$30,000**	$8,742

The majority of the cost inputs for the various types of terminal equipment has significantly increased as the result of using the BellSouth values, which in turn leads to higher transport UNE costs than would be the case if those increases had been ignored.

What Dr. Tardiff is actually demonstrating here is his own evident bias: he believes the only legitimate changes to the model and its inputs are those that would increase the cost results the model produces. He therefore criticizes our reliance on the

BellSouth *ex parte* with respect to the last two entries in the above table, while saying nothing about the fact that the same reliance also resulted in the first five entries.

Q. AT P. 16-17, DR. TARDIFF CLAIMS THE MODEL ASSUMES THAT ALL LINE GROWTH FROM 1996 TO 1999 OCCURRED ON EXISTING FACILITIES (*I.E.*, THAT ALL LINE GROWTH HAS BEEN IN ADDITIONAL LINES), AND THAT THEREFORE THE MODEL "ASSUMES THAT MOST EXISTING SUPPORT STRUCTURE WILL BE USED — AN ASSUMPTION THAT DECREASES THE SUPPORT STRUCTURE COSTS." PLEASE COMMENT ON THESE ASSERTIONS.

A. Dr. Tardiff is apparently claiming that the model only adds more lines at the same number of premises as existed in 1996. That is simply wrong. The model's database assumes that part of the growth is caused by lines at new locations. This causes the model to produce additional terminals, splices, and drops to serve those new locations.

There is another possible interpretation of Dr. Tardiff's intent here. He may be claiming it is inappropriate to use the same strand distance for 1999 as was used in 1996, and that by doing so, the model is underestimating 1999 structure costs. If that is his intent, his conclusion is misleading. The effect of using the same strand distance is <u>not</u> to underestimate structure costs (and cable costs, for that matter), but to bring them more in line with the correct amount of costs. This is true because the model generally disperses, or scatters, customers more than they should be due to TNS' use of surrogate locations (for those customers whose locations are not precisely geocoded) that are distributed uniformly along the roads of a census block. As a result, the model's cost estimates are also overstated. As census blocks tend to be inhabited by additional customers as time passes, the model's conservative over-dispersion of customers gradually comes more in line with the actual customer dispersion.

This effect is illustrated in Exhibit RAM-11. Known customer locations are depicted by black dots. Possible locations of the remaining customers are shown by gray dots. Those locations are shown as concentrated in developments and settlements occupying only portions of the census block, consistent with population grouping that typically occurs. Finally, the open dots show TNS' assumed locations of the non-geocoded customers, which are distributed evenly along the roads that make up the census block. As is evident from the figure, this process of combining geocoded and surrogate locations leads to a conservative over-dispersion of customers throughout the census block.

Because the TNS process has conservatively over-dispersed customer locations, the model correspondingly assumes outside plant is distributed throughout the census block. Thus, to the extent the unknown customer locations are actually located in smaller portions of the census block and are not actually uniformly dispersed along roads throughout the entire census block, the model over-estimates the amount of outside plant required. Only in the rare case that the unknown customer locations truly are distributed throughout the census block would the model not be over-estimating the amount of cable required.

Some census blocks, particularly those located in urban areas, may have already had customer locations distributed throughout the census block by 1996, not concentrated in the fashion depicted in the figure. But in those cases, the model is also distributing cable throughout the census block sufficient to pass all customers, and therefore it is appropriate that the only kind of structure growth that has occurred is in the additional drops to new customer locations.

(2) HM 5.2a-MA's Calculations of Outside Plant Costs Work Exactly as Its Developers Intended.

Q. AT P. 45, DR. TARDIFF CLAIMS THAT RE-RUNNING THE MODEL BY SETTING STRUCTURE PLACEMENT COSTS TO THEIR LOWEST VALUES, CORRESPONDING TO THE MOST FAVORABLE TERRAIN CONDITIONS, HAS VERY LITTLE EFFECT ON COSTS. FROM THIS HE IMPLIES THE MODEL IS NOT WORKING PROPERLY, SINCE THE IMPACT SHOULD BE NOTICEABLE. IS HE CORRECT IN THIS ASSERTION?

A. His claim is literally correct – the monthly loop cost changes by $0.08 per month – but this is a very misleading way to present terrain impacts. The effect of terrain on monthly costs is diluted by the presence of many factors that have nothing to do with placement costs, such as investments in outside plant materials (poles, conduit, cable, NIDs, SAIs, etc.), investments in the cost of operating the network, non-plant costs such as those associated with general support and corporate overhead, and so on.

The right way to examine this issue is to see the effect of terrain on outside plant placement investment. I have done two runs of the corrected model, one with the Massachusetts terrain conditions and one with the bedrock placement multipliers and all surface texture effects set to unity to produce the "most favorable terrain" scenario to which Dr. Tardiff is referring. In both runs, I have set the "Buried Fraction Available for Shift" option to 0 for both distribution and feeder in order to avoid the complexity of the model optimizing the relative amounts of buried and aerial cable differently between the two runs. Exhibit RAM-12 provides the Scenario Inputs, Distribution, and Feeder worksheets from each of these runs. The particular cells used in Table 11 below are highlighted. The table compares all relevant outside plant placement investments for the default run of the model and for the run with easy terrain conditions.[12]

It is obvious from this table that terrain has a noticeable impact on placement costs, since the total investment under the terrain conditions supplied in the terrain database is more than $23 million, or 14.7 percent, higher than the most favorable terrain investment. If one considers only the rural areas by looking at, say, the lowest three zones, the difference is at even higher fraction of the most favorable terrain placement cost, 20.4 percent. These percentages refer to the study area or rural area, respectively, as a whole. In individual clusters, placement costs can as much as triple due to bedrock just below the surface or particularly difficult soil conditions. Dr. Tardiff's contrary assertion is based on a flawed analysis, and is simply wrong.

Table 11:
Impact of Terrain Conditions on Placement Costs

		Default Terrain	Most Favor-able Terrain	Difference
Distribution				
	buried trenching	$15,255,439	$13,069,257	$2,186,182
	underground trenching	$23,693,966	$20,733,476	$2,960,490
	poles	$42,346,180	$36,092,876	$6,253,304
Feeder				$0
	manholes	$18,340,955	$17,851,030	$489,925
	copper u/g placement	$29,709,089	$25,830,347	$3,878,742
	fiber u/g placement	$45,947,895	$39,360,754	$6,587,141
	copper buried placement	$185,386	$161,560	$23,826
	fiber buried placement	$61,905	$52,917	$8,988
	poles	$4,979,861	$4,176,222	$803,639
Total		$180,520,675	$157,328,439	$23,192,236
Difference in placement investment as a % of most favorable terrain investment				14.7%

Q. AT P. 46, DR. TARDIFF CLAIMS THE MODEL IS NOT OPERATING PROPERLY BECAUSE IT ONLY SHIFTS A SMALL FRACTION OF LINES FROM BURIED TO AERIAL PLANT. PLEASE COMMENT ON THIS CLAIM.

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[12] These runs also set the material parts of the pole cost, manholes, and pullboxes to zero in order to focus on the placement cost portions of those investments.

A. Dr. Tardiff is quite confused on this point. For starters, the statement, "The buried share of investment produced by the Model is almost double the actual buried share," is unintelligible. I assume he means that the buried plant investment as a percentage of total outside plant investment is twice the fraction of buried route miles. If that is the case, then he is not looking at the whole story, because the model's analysis of whether or not to shift cable is a life cycle cost analysis, not an investment comparison. Buried cable has a lower maintenance cost per investment dollar than does aerial cable. (For example, falling trees can knock down aerial cable, but ice storms tend not to harm buried cable.) In addition, there is a maintenance cost associated with poles and none with a trench. (For example, car accidents and termites both sometimes knock down telephone poles. They rarely harm buried cable.) Considering cable and pole maintenance together, the maintenance cost per dollar of aerial plant investment is more than twice that of buried plant for copper cable; for fiber cable, there is a more than a factor of four difference between the two.

Furthermore, the cost per foot of buried cable placement is more than six times the cost per foot of aerial cable in the second highest density zone, and it is more than 45 times higher than the cost of aerial cable in the highest zone. Yet in those two zones, the model does not allow any shift of buried distribution cable to aerial distribution cable because the fraction available for shift is set to 0% in those zones. This much higher per-foot cost of buried cable that cannot shift to aerial cable will alone cause the buried investment percentage to be considerably higher than the buried route mile percentage. Beyond these specific factors, many other factors come into play in selecting between aerial and buried cable, such as the relative amounts of structure sharing, the effect of difficult terrain, and the like.

Because of these complexities, there is no way Dr. Tardiff could have reached the conclusion there is an error in the first place, unless he manually performed the tremendous number of operations the model performs. His simplistic assertion regarding buried versus aerial cable has no basis.

(3) The Customer Location Geocoding and Clustering Processes Work Properly and are an Appropriate Basis for Estimating Forward-Looking Costs.

(a) HM 5.2a Uses a Cluster Database Derived From State-Of-The-Art Demographics Modeling, Based on Credible Data Regarding the Geographic Location of Customers.

Q. DR. TARDIFF SAYS THAT THE MODEL IS BASED ON "A COMPLEX AND CLOSED PROCESS TO PRODUCE THE MODEL'S SO-CALLED DISTRIBUTION "CLUSTERS" (TARDIFF, P. 13). LATER, AT PP. 17-19, HE MAKES A NUMBER OF ADDITIONAL ASSERTIONS ABOUT THE PROPRIETARY NATURE OF THE DATABASES, AND AT&T'S ALLEGED "REFUSAL" TO PROVIDE ACCESS TO THE DATABASES AND THE PROCESS THAT PRODUCED THEM. PLEASE RESPOND TO THESE CRITICISMS.

A. There are a number of points that can be made as a summary response to this entire section of Dr. Tardiff's testimony.

First, the customer location database Dr. Tardiff refers to is not part of the HM 5.2a-MA model per se. Just as HM 5.2a-MA relies on databases and information produced by other entities — the Verizon ARMIS report from the FCC that is based on data produced by Verizon itself, the Special LERG[13] Extract Data database developed by Telcordia Technologies, Inc. for use in the HAI Model, and various input values reported to or developed by the FCC for use in its Synthesis Model — it relies in this case on a third-party database produced by Taylor Nelson Sofres Telecoms ("TNS"). TNS' business is to produce databases such as this for commercial purposes; for instance, the FCC also relies on TNS to produce the customer location database used in its Synthesis Model.

TNS in turn relies on databases provided to it by Metromail to locate residential customers and by Dun & Bradstreet to locate business customers. Both of those firms' reputations depend on the quality of the databases they produce, as they are used in critically important functions such as credit verification and consumer lists for mass mailings. It is no more inappropriate or questionable for the HM 5.2a-MA developers to rely on credible third parties to produce the customer location databases and the derivative cluster database than it is for the developers to rely on Telcordia, the FCC, or, for that matter, Verizon's ARMIS data.

Second, Verizon's model is also based on important data that resides in proprietary databases, which Verizon has not produced in this proceeding. However, Verizon's refusal to produce such data is far more problematic than is the HM 5.2a-MA customer location database because unlike the latter, which was produced by a disinterested third party whose business is the creation of demographic databases such as the one use in HM 5.2a-MA, the Verizon data were prepared by its own personnel specifically to support its advocacy position in cost proceedings. These data include: (1) data from a feeder route survey that form the basis for its Loop Cost Analysis Model

(continued)

[13] Local Exchange Routing Guide, a Telcordia document widely accepted by the U.S. telecommunications industry that identifies and provides data on virtually every switching entity in the United States.

("LCAM"); (2) data from its Detailed Continuing Property Record ('DCPR') database that are used by Verizon in calculating the Engineer, Furnish & Install ("EF&I") and power factors used within its digital switching and digital circuit cost models; and (3) data on past and projected future Right to Use ("RTU") fees that form the basis for Verizon's proposed RTU fees for digital switching. None of those have been submitted by Verizon in their complete form notwithstanding AT&T's long-standing data request for this information.

Third, Dr. Tardiff claims that the FCC "explicitly rejected the customer location database and algorithms used by the Hatfield Model in its universal service proceeding, because of the closed nature of the geocoding process."[14] This claim is taken completely out of context to arrive at a misleading conclusion. Prior to the Inputs Order Dr. Tardiff cites, the FCC had concluded in its Platform Order that a combination of geocoded information, where available, and road surrogate information for non-geocoded locations, was appropriate:

> HAI's proposal to use actual geocode data, to the extent that they are available, is the preferred approach, and BCPM's proposal that we use road network information to determine customer location where actual data are not available, provides the most reasonable method for determining customer locations."[15]

It had also accepted the appropriateness of clustering customers in order to form reasonable serving areas, although it concluded that the specific clustering mechanism proposed by the FCC staff was preferable to the HAI approach:

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[14] Tardiff, at p. 18.

[15] In the Matter of Federal-State Joint Board on Universal Service; In the Matter of Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket Nos. 96-45 and 97-160, Fifth Report and Order, FCC 98-279 (released October 28,1998) ("Platform Order"), at ¶31.

> As discussed below, we conclude that a clustering approach, as first proposed by HAI in this proceeding, is superior to a grid-based methodology in modeling customer serving areas accurately and efficiently. In addition, we conclude that the federal high cost mechanism should use the HCPM clustering module.[16]

In neither of these findings had the FCC said anything about the closed nature of the processes involved. However, in adopting inputs to be used in the Synthesis Model, the FCC was facing a problem of a very different scope than the parties face in this proceeding: it needed to ensure that all parties involved in a nationwide process had the opportunity to review the geocode database for the entire nation. It found that this review had not been successfully completed. Its finding to this effect is not relevant to this proceeding, in light of the fact that parties have had access to the TNS database and the process that created it.

My final comment is that it is highly misleading for Dr. Tardiff to characterize AT&T's position as "expect[ing] Verizon and TNS to work out some form of limited review of the data and software" (Tardiff page 15). AT&T has taken a proactive stance on this matter, offering to arrange from the access that Verizon requires in order to understand and review the TNS process in detail. Such access has taken place.

Q. HOW SHOULD THE DEPARTMENT PROCEED ON THIS MATTER?

A. It seems to me that the choice available to the Department on this issue is straightforward. Detailed and accurate demographics databases, and the processing required to convert those databases into a form suitable for a cost methodology like HM 5.2a-MA, have a high degree of commercial value, and are not publicly available without payment of the licensing fees demanded by the developers of the databases. Thus it seems to me there is

[16] Platform Order, at ¶42.

a tradeoff between the sophistication and accuracy of the customer location database used in the cost model and the commercially proprietary nature of the database. A finding that only non-proprietary databases could be used in a cost model would significantly set back the progress that has been made in the accuracy of the customer location process. This is obvious when one compares the sophistication of the current customer location process in HM 5.2a-MA to the mathematical approximations used to locate customers at a CBG level of granularity in Version 2.2.2 of the HAI Model. Absent the ability to use the TNS data, HM 5.2a-MA would have to rely on less sophisticated mechanisms such as those available at the time HM 2.2.2 was developed. Or, equally unfortunately, it might be forced to rely on broad average loop length data prepared by Verizon for use specifically to support its advocacy position, and not for commercial purposes.

(b) The Clustering Process Accurately Represents Customer Locations and Estimates Distribution Route Miles for Purposes of Estimating Outside Plant Costs.

Q. AT P. 49, DR. TARDIFF STATES "AS IN PREVIOUS MODEL RELEASES, CUSTOMER LOCATIONS IN THE HATFIELD MODEL ARE SIMPLY ASSUMED TO BE UNIFORMLY SPREAD ACROSS THE RECTANGULAR SERVING AREAS." IS THIS A CORRECT STATEMENT?

A. No, it is not, and Dr. Tardiff's mistake on this point propagates through his subsequent discussion of supposed model errors. The model now includes an optional mechanism – which has been invoked in the Massachusetts runs of the model – to normalize the total route distance calculated by the model in a given cluster to an independent measure of the route distance required to connect all the customer locations in that cluster to each other. This process is described in detail in Section 6.3.4 of the HM 5.2a-MA Model Description, appearing in Exhibit RAM-2 of my Direct Testimony.

This process is specifically intended to capture the effect of customers being concentrated in only a portion of a cluster. Thus, for instance, if customers are concentrated in an area that is one-half the total area of the cluster, the strand distance will be approximately 50% of the distance that would be necessary to connect the customers if they were distributed uniformly throughout the cluster. When the total distribution distance calculated by the model is then normalized to the strand distance, it will then appropriately reflect the amount of cable required to reach the concentrated customer locations. Incidentally, this normalization cuts both ways – if the strand distance exceeds the total distribution route distance calculated by the model, which sometimes happens, the calculated distribution distance will be normalized upward to the strand distance.

Q. STARTING AT P. 49, DR. TARDIFF GIVES TWO EXAMPLES OF CLUSTERS IN EACH OF WHICH THE MODEL'S DISTRIBUTION CABLE IS SUPPOSEDLY "PACKED" INTO AN AREA THAT IS LESS THAN 10% OF THE ACTUAL AREA OF THE CLUSTER. DOES THIS STATEMENT ACCURATELY REFLECT WHAT IS GOING ON IN THESE CLUSTERS?

A. No, it does not. Dr. Tardiff actually misses <u>two</u> aspects of the model's calculations for these clusters.

First, in both cases, the strand distance I have just described indicates that the customer locations in each cluster are concentrated in about 36% of the total cluster area. Therefore, the distribution distances calculated by the model appropriately reflect the need to serve an area smaller than the entire cluster.

Second, as described in Section 6.3.1 of the HM 5.2a-MA Model Description, the model ensures that the copper portion of the loop serving the customer furthest from the SAI in a given cluster does not exceed a maximum distance parameter. This user-adjustable parameter, called the Maximum Analog Copper Total Distance, is set to

18,000 feet. If this maximum distance would otherwise be exceeded, the model splits the cluster along either or both of its dimensions to form sub-clusters, and extends the feeder cable from its original terminus at the center of the cluster to remote terminals located at the center of each of the sub-clusters. This reduces the remaining distance that must be traversed by analog signals over copper distribution cable,[17] at the expense of additional DLC remote terminals and fiber optics cable.

It turns out that each of the clusters identified by Dr. Tardiff is split in both dimensions, creating four sub-clusters. This can be seen by the presence of a non-zero amount of both vertical connecting cable and horizontal connecting cable in columns AM and AN, respectively, of the Distribution Output By Cluster worksheet in the workfile that is produced by the model. The backbone and branch lengths Dr. Tardiff observed pertain to <u>each</u> of the four clusters. Therefore, to calculate the effective area served by the distribution cable, one must quadruple the area calculated by multiplying the backbone and branch lengths together. As opposed to the area of about 1.4 square miles Dr. Tardiff claims the model serves in each cluster, it actually serves four times that much, or about 5.5 square miles. This is roughly 36% of the original area in each cluster, since, as I have already noted, the strand distance normalization is roughly 0.6 in each (strand normalization reduces cable lengths in both dimensions, and 0.6 squared is 0.36).

These examples also demonstrate a great deal about Dr. Tardiff's selective use of data to make a biased point. In both of the wire centers in question, there are clusters with strand normalization factors substantially greater than unity. In the case of STBR,

[17] This is done to ensure the modeled network provides high-quality transmission, the ability to signal customer telephone sets, and the ability to support high-speed data services with the addition of appropriate terminal equipment, as required by the FCC.

a cluster immediately adjacent to the one Dr. Tardiff singled out has a normalization factor of 2.24. Thus, for that cluster, the distances calculated by the model are all increased by a factor of 2.24, substantially increasing the investment the model would otherwise calculate.

Q. AT P. 50, DR TARDIFF GIVES TWO OTHER EXAMPLES OF CLUSTERS WHICH HE CLAIMS DEMONSTRATE A "SEVERE PROBLEM" THAT THE MODEL PRODUCES ONLY BACKBONE CABLE. IS HE CORRECT?

A. Exploring this problem led to discovery of the model glitch I have previously identified, and that we have corrected with negligible impact on the model results. Its symptom was that in some cases the model failed to produce branch cables when it should have, and in other cases, it produced too much branch cable distance. The corrected model produces 20 branch cables, each of unadjusted length 854.6 feet, in Cluster 3, and 10 branch cables, each of length 1102.6 feet, in cluster 6. Thus, this issue disappears with change to the one cell for the "lot_front" variable.

Q. IN ANY CASE, COULD THERE EVER BE CASES IN WHICH A CLUSTER SHOULD NOT REQUIRE BRANCH CABLES?

A. Yes. Imagine customers located along a single road, such as might occur in a settlement along a road in a rural area. Those customers would be served by a single cable running down the road, with drops to the individual premises. If the rectangle representing that cluster of customers were thin enough, the model would not produce branch cables, and this would be the appropriate treatment. Notice, though, that if there were any kind of curvature in the road, the rectangle representing the cluster might have both dimensions significantly different than zero, and cause the model to produce branch cables. This would be an example of a case where the model overestimated the amount of cable required. The key point, however, is that the absence of branch cables in some clusters is not *a priori* evidence that the model has made a mistake.

Q. DR. TARDIFF ALSO CLAIMS AT PAGE 50 THAT IN THESE TWO CLUSTERS THE MODEL PRODUCES BACKBONE CABLES "THE LENGTH OF WHICH FAR SURPASSES THE CONFINES OF THE DISTRIBUTION AREA." IS HE CORRECT IN THIS ASSERTION?

A. No. Columns EH and EI in the Distribution Module's 'calculations' worksheet do not allow the unadjusted branch and backbone lengths to exceed the cluster boundary. The areas of the clusters are 0.172 and 0.106 square miles with aspect ratios of 1.42 and 0.54, respectively. The resulting "vertical" dimensions of the clusters (the dimension along which the backbone cables run) are 2,608 ft and 1,270 ft. The unadjusted backbone lengths are 2,344 ft and 1006 ft, which are manifestly less than the corresponding cluster dimension along which they run. The strand adjustment factors for the two clusters are 0.972 and 1.44. These are applied to the unadjusted backbone (and branch) lengths in the two clusters to produce adjusted backbone distances of 2,279 ft and 1,453 ft.

So Dr. Tardiff is wrong when he says the length of both backbones far surpass the confines of the distribution area exceed – only one backbone exceeds its dimensions at all. As far as that case is concerned, Dr. Tardiff is right to the extent that the 1,453 ft backbone distance obviously exceeds the vertical dimension of cluster 6 – by approximately 15%. However, this happens only during the strand normalization process, and it will only happen when the strand normalization is greater than unity. It is part of the process of ensuring there is sufficient cable to reach all customers, and the model is working exactly as it is advertised to work, and exactly as it should work in order accurately to model the outside plant in a forward-looking network.

Q. AS PART OF HIS DISCUSSION OF THESE TWO CLUSTERS, DR. TARDIFF STATES AT PAGE 50 THAT THE STRAND NORMALIZATION SHOULD

HAVE MERELY "MINIATURIZED (OR EXPANDED) THE PLANT THE MODEL OTHERWISE WOULD HAVE REPRESENTED (E.G., IF AN UNCONSTRAINED MODEL RUN WOULD HAVE BUILT 1,000 FEET OF BACKBONE CABLE AND BRANCH CABLE SPANNING 800 FEET ACROSS THE HORIZONTAL DIMENSION OF A CLUSTER, THE ADJUSTED OUTPUT WOULD REPRESENT 800 FEET OF BACKBONE AND BRANCHES 640 FEET LONG)" HE CONCLUDES "CLEARLY, THIS IS NOT HAPPENING IN THE MODEL." PLEASE COMMENT.

A. Dr. Tardiff is wrong. The strand normalization process does exactly what Dr. Tardiff says should happen – it scales all components of distribution cable, including backbone, branch, connecting cable, and the cable to remote clusters, by a fixed amount. I have no idea why he thinks anything else is happening.

Q. PLEASE SUMMARIZE YOUR REVIEW OF DR. TARDIFF'S ALLEGATIONS THAT THE MODEL IS NOT WORKING CORRECTLY.

A. With the one exception I have discussed, none of the purported flaws in HM 5.2a-MA that Dr. Tardiff has allegedly uncovered turns out to be a flaw at all. And the one item that we have corrected is minor, with essentially no impact on the bottom line. The model works as it is intended to work. In fact, if anything, Dr. Tardiff's examples have served to bring out positive aspects of the model, such as reflecting concentrations of customers within a cluster and the ability to ensure the copper distance in the longest loop in a cluster does note exceed a user-adjustable maximum.

Q. AT PAGE 50, DR. TARDIFF CLAIMS THAT FOR VERIZON MA, THERE ARE MORE CBGS THAN CLUSTERS, "DIRECTLY CONTRADICTING DR. MERCER'S CLAIM ABOUT THE VASTLY SUPERIOR PRECISION OF THE CLUSTERS." PLEASE COMMENT ON THIS INTERPRETATION.

A. Dr. Tardiff's implication here is misleading. In dense metropolitan areas, clusters can be bigger than CBGs, because CBG boundaries do not define meaningful telephone company serving area, as critics of past versions of the model that equated CBGs with serving areas have often emphasized. Since a large majority of either CBGs or clusters fall in metropolitan areas, the count of CBGs may well exceed the cluster count for the state as a whole. By contrast, clusters are defined by the known location of customers to the maximum extent possible, the extent of clusters is never more than a few miles on a side and usually much smaller, the number and lengths of cables in a cluster are based on the size and shape of the cluster rather than a fixed formula that is not based on the characteristics of each cluster, clusters are constrained to fall within wire center boundaries and to otherwise meet meaningful serving area criteria, and the model uses the strand distance calculation to further check for concentrations of customers within clusters. If Dr. Tardiff cannot see the difference in accuracy that results from these changes, he is simply ignorant of the arguments made against the use of CBGs in past proceedings, including, if my memory serves correctly, some that have been advanced by his own firm, and he is ignoring the adoption by the FCC of the principle of identifying clusters, rather than CBGs, with telephone company serving areas.

Q. AT BOTH P. 50 AND P. 56 OF HIS REBUTTAL TESTIMONY, DR. TARDIFF SUGGESTS THAT THE PROCESS OF CREATING CUSTOMER CLUSTERS AND TREATING THEM AS SERVING AREAS ELIMINATES THE PRECISION THAT GEOCODING MIGHT HAVE PROVIDED IN THE FIRST PLACE, WHICH, ACCORDING TO DR. TARDIFF, MEANS THE GEOCODING INFORMATION IS IGNORED. FURTHERMORE, HE CLAIMS, THE PROCESS IGNORES THE FACT THAT CUSTOMER LOCATIONS TEND TO BE ALONG ROADS AND GENERALLY ARE NOT EVENLY DISTRIBUTED WITHIN CLUSTERS, PARTICULARLY IN LOW DENSITY AREAS. ARE THESE VALID COMMENTS?

A. Not at all. Concerning the first point, the cluster data used by the model makes thorough use of the geocoding information. Geocoded data allows the size, shape, and orientation of a serving area to be identified, as well as the number of lines of each type that belong to each cluster. Geocoding also allows a calculation of the so-called strand distance, which represents the amount of cable needed to connect the customer locations in a cluster to each other and to the serving area interface. This leads to the second point. I agree with Dr. Tardiff that customers often tend to be concentrated within clusters, just as they are concentrated within CBGs. That is why HAI uses clusters instead of CBGs as the serving areas, and further introduces the strand distance normalization process. The strand distance is a measure of the actual total amount of cable required to connect the customer locations to each other, and therefore informs the model as to the degree of concentration that exists.

Q. DID THE FCC REJECT THE CLUSTERING PROCESS USED IN THE HAI MODEL BECAUSE THE CLUSTERS PROVIDE INADEQUATE FACILITIES IN LOW DENSITY AREAS, AS DR. TARDIFF CLAIMS AT P. 57?

A. No, in fact quite the opposite. In adopting the clustering algorithm developed by the FCC staff in its HCPM model rather than the HAI clustering algorithm, the FCC specifically noted it was doing so because

> "We find that the HCPM clustering algorithm provides the least-cost, most-efficient method of grouping customers into serving areas. The HCPM clustering algorithm tends to create the smallest number of clusters . . . The divisive algorithm has greater ability to minimize costs while conforming to technological constraints and network quality standards. By considering at all times the most efficient assignment of a customer to a particular cluster, HCPM's divisive clustering algorithm ensures that customers will be served at the least cost possible. . . a clustering algorithm such as HCPM's that generates the smallest number of clusters should provide the least-cost, most-efficient method of determining customer serving areas in rural areas.[18]

Obviously, the FCC believed the alternative mechanism it adopted would produce lower, not higher, costs than the HAI algorithm it was also considering.

[18] FCC Fifth Report and Order, CC Docket No. 96-45, *In the Matter of Federal-State Joint Board on Universal Service* and CC Docket No. 97-160, *In the Matter of Forward-Looking Mechanism for High Cost Support for Non-Rural LECs*, Released October 28, 1998, ¶ 53, emphasis added.

Q. STARTING AT P. 57, DR. TARDIFF MAKES A NUMBER OF CRITICISMS ABOUT THE PROCESS BYWHICH THE MODEL IDENTFIES AND SERVES HIGH-RISE BUILDINGS. PLEASE RESPOND TO THESE ASSERTIONS.

A. First, the maps shown in Exhibits D and E to Dr. Tardiff's rebuttal testimony are erroneous, because Dr. Tardiff mistakenly mapped these clusters in an improper orientation. It became clear during a recent New Jersey proceeding that Dr. Tardiff was not using the correct coordinate system in plotting clusters in the fashion he has in these exhibits. Cluster locations are specified with respect to a so-called V-H coordinate system well known in the telephone industry, not in terms of latitude and longitude. In this coordinate system, the "H" axis is tipped some 30 degrees with respect to the east-west line. If this difference is not recognized in plotting cluster locations on a map, then all locations will be rotated around the location of the wire center. In addition, the exhibits show all clusters with their axes running in a north-south and east-west direction. But clusters generally are not oriented in that fashion; rather, their axes run at a variety of angles. When one looks at Exhibit D, for instance, it is obvious that the clusters are plotted in a nonsensical orientation compared to the streets on which they are overlaid. This happens for either or both reasons that the clusters are not shown in the right place and that the rectangles are not shown with the right orientation of their axes. The problem is in Dr. Tardiff's mapping, not in the clustering process.

Second, Dr. Tardiff's exhibits appear to show a considerable amount of both overlapping clusters and gaps in coverage. Since the clusters are not mapped with their proper orientation, this alone can cause the appearance of significant overlaps and gaps. Furthermore, even in downtown areas, there are areas of open space, such as parking garages, plazas, small parks, and unoccupied buildings, that cause real physical gaps in the area for which Verizon must provide coverage.

Third, to the extent they still appear after clusters are properly oriented, gaps and overlaps may be caused by the presence of high-rise buildings. In urban areas, many customers, both residential and business, may be located in high-rise buildings. In the databases available to TNS, the customers residing in a given building will appear to be at the same location (and in fact, they are at the same street address, since they are stacked on top of one another). There is no available database of actual building "footprints" (horizontal dimensions), so such clusters are assigned a null area. The Point Code process will assign a small area to such clusters as placeholders to ensure the model recognizes them as high rise buildings and treats them accordingly. Since this is a placeholder only, and not treated by the model as an accurate determination of the area, when mapped the resulting clusters may appear to overlap if two building are very close together, or leave a gap if two adjacent buildings are large (or have open space between them). This mapping oddity has no impact on the model's proper calculation of outside plant requirements.

Fourth, the model has a mechanism for determining if a cluster is a high-rise building, and according special treatment to it if it does. This process is described in Section 6.3.1 of the HM 5.2a-MA Model Description. It assigns a certain amount of floor space to each residence and to each business employee. The model then divides by the area of the cluster to arrive at an estimate of the number of floors. Since clusters corresponding to true high-rise buildings are assigned a very small area, the result is often a very large number. Recognizing that buildings seldom exceed 50 floors, the model limits the number of floors to 50. The model then assumes the cluster is served by an

SAI located in the basement of the building, and extends vertical riser cables to reach as high as the number of floors that the model has estimated.

Knowing this process full well, Dr. Tardiff is being disingenuous when he suggests the model has identified buildings that are hundreds of stories high. He is being even more so when he suggests that since the approximation yields floor counts that exceed the typical maximum number of floors in high-rise buildings, the model should nevertheless serve that number of floors, and is understating costs by not doing so.[19]

But there is a serious point underlying his sarcasm, albeit a point that undermines his critique: the process tends to overestimate the actual number of floors in a high rise. As a result, the model ***overestimates*** the amount of distribution cable required, and thereby overestimates the cost of serving these customers. This is particularly true inasmuch as the model includes the riser cable in its calculation of distribution investment, even though in many cases the wiring is not owned by Verizon or is provided by them under a separate tariff. Therefore, I strongly disagree with Dr. Tardiff that the model ***underestimates*** the amount of distribution cable required. There is no basis for Dr. Tardiff to state categorically that the model's high rise methodology understates costs, as he does at page 57.

Q. AT P. 60, DR. TARDIFF CLAIMS THERE IS "SUBSTANTIAL EVIDENCE" HM 5.2a-MA UNDERSTATES DISTRIBUTION COSTS, AND CITES THE FCC AND FLORIDA COMMISSION TO THAT EFFECT. HAS DR. TARDIFF PRESENTED ANY SUCH EVIDENCE IN HIS TESTIMONY?

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[19] For instance, at p. 59, Dr. Tardiff finds it "absurd" that the model has identified a building with 801 floors, then turns right around and finds it "ridiculous" that the model only deploys enough cable to serve the first 50 floors.

A. None. In the first place, both citations are speculative – the FCC says the model "could" result in an underestimation of outside plant costs. The Florida Commission says the use of rectangular areas "appears" to have introduced a downward bias into the model.

More importantly, The FCC citation referred to HM 5.0a, which had neither the strand normalization capability nor the mechanism that HM 5.2a-MA has to ensure there is enough cable to reach the corners of each cluster. The Florida citation from 1996 obviously referred to an even earlier version of the model – and of course is belied by the fact that the HAI Model produces substantially more route distance than Bell South's own loop model, the BSTLM.

Q. STARTING AT P. 62, DR. TARDIFF LEVELS SEVERAL CRITICISMS AGAINST THE STRAND DISTANCE NORMALIZATION PROCESS IN HM 5.2A-MA. HOW DO YOU RESPOND TO THOSE CRITICISMS?

A. Dr. Tardiff makes several wrong, misleading, or baseless statements about the strand distance normalization.

First, he describes the adjustment as "completely arbitrary." He is wrong. There is nothing arbitrary about ensuring the amount of distribution route distance calculated by the model is equal to the amount needed to connect all the locations in the cluster to each other.

Second, Dr. Tardiff claims "the MST distance is the <u>minimum</u> distance; however, actual distribution distance can be considerably larger than a mathematical minimum (e.g., natural obstacles, the layout of streets, etc.)" (the emphasis is Dr. Tardiff's). His characterization of the strand distance used by the model is wrong. The strand distance utilized is <u>not</u> the straight-line MST defined in graph theory, but recognizes "right angle routing" between different locations, thus providing for routing along streets and around obstacles. This is made clear in Footnote 50 of the HM 5.2a-MA Model Description.

The difference between the minimum spanning tree distance and the strand distance is shown in Exhibit RAM-13.

Third, Dr. Tardiff errs in saying the normalization replaces the model's grid routing based on engineering principles by a "connect the dots" MST distance. Since both the original model's algorithms <u>and</u> the strand distance assume right angle routing between points, the routing principle is the same in both cases. The difference is that inasmuch as customer locations are concentrated in areas smaller than the entire cluster, the process will recognize such concentration. On the other hand, if the customer dispersion is greater than the model assumes based on its layout of regular-shaped lots in a cluster, the process will create an upward adjustment of the distance calculated by the model. Not surprisingly, Dr. Tardiff chooses to ignore the upward adjustments that take place, which significantly increases distribution route distance and therefore cost in some clusters.

Fourth, Dr. Tardiff characterizes the process as one that "distorts" clusters because the clusters are compressed along both dimensions," so that "customers are in effect packed into smaller, higher density lots." Let alone the fact this statement ignores situations where the strand distance normalization <u>increases</u> the amount of cable, it is both backward and wrong. It is backward because the process does not pack customers into a smaller area. Rather, the customers are <u>actually</u> concentrated into an area smaller than the entire cluster, as evidenced by the strand distance, and the model recognizes this by adjusting the distribution route distance to serve the smaller area. This is depicted in Exhibit RAM-14. Dr. Tardiff is in the illogical position of having earlier criticized the model (wrongly) because it "locates distribution plant under the assumption that customers are evenly distributed within the clusters defined by the Model," which he concludes is "imprecise, especially in low-density areas, where customer locations tend to be along roads and generally are not evenly distributed,"[20] and now criticizing the model because it recognizes customers are not uniformly distributed throughout the cluster! His criticism is wrong because the model does not shrink the boundaries of the cluster.

(4) HM 5.2a-MA Uses the Appropriate Mechanism for Pricing Switches

Q. AT P. 66, DR. TARDIFF CLAIMS THAT HM 5.2A-MA DOES NOT INCORPORATE THE FCC SWITCH COST COMPUTATION BECAUSE IT REDUCES SWITCHING COSTS WHEN DLC LINES ARE DEPLOYED. PLEASE COMMENT ON THIS ISSUE.

A. First, it is quite a stretch to claim we do not use the FCC switch costs because we disagree with the FCC on this one minor aspect of switch pricing. We have utilized the fixed and per-line cost of host and remote switches adopted by the FCC in establishing the switch price inputs to the model. However, we do disagree with the FCC on the issue of digital versus analog port costs, because data previously provided by Verizon itself in a UNE proceeding in New York shows digital ports are 34% to 51% less expensive than analog line ports.[21] .

The HAI adjustment reflects the fact that the FCC's switch prices were based on switches purchased in the mid-1990's when very few, if any, GR303 digital line ports were installed. Consistent with the forward-looking orientation of the model, a considerably higher number of lines are provided over DLC, and thus use GR303 ports

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[20] Tardiff, p. 52.

[21] State of New York Public Service Commission, Case 98-C-1357, *Proceeding on Motion of the Commission to Examine New York Telephone Company's Rates for Unbundled Network Elements*, Panel Testimony Of Bell

(continued)

on the switch. A credit is necessary to adjust the FCC switch prices to reflect the amount of GR303 digital line ports being assumed in Massachusetts. If the Department rejects this position, then the adjustment can be eliminated by reducing the analog line offset to $0 in the user adjustable inputs (Local Switching – End Office Switching screen, "Analog Line Circuit Offset of DLC Per Line" parameter).

(5) HM 5.2a-MA Uses Appropriate Prices for Add-Drop Multiplexers and Other Interoffice Terminal Equipment

Q. WHAT DOES DR. TARDIFF HAVE TO SAY ABOUT HM 5.2A-MA'S INTEROFFICE RING CALCULATIONS?

A. His comments, at page 67 of his rebuttal testimony, are limited to two points.

First, he states that the Model is inconsistent in determining the quantities of various electronic components because while the add-drop multiplexers ("ADMs") located in each wire center and those that are used to connect rings that do not overlap at a tandem are equipped with OC3 multiplexers, ADMs used to join the so-called "logical rings" are not so equipped. I will deal with this comment in my discussion of Mr. Gansert's comments on interoffice rings, below.

Second, he claims that the model has changed "without explanation" the prices for ADM electronic components from earlier versions of the Model.

Q. HOW DO YOU RESPOND TO HIS CLAIM THAT THE TERMINAL EQUIPMENT COSTS HAVE CHANGED "WITHOUT EXPLANATION?"

A. It is unfathomable to me how Dr. Tardiff can make the assertion that these inputs were changed "without explanation." Section 4.4.1 of the HM 5.2a-MA Inputs Portfolio,

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Atlantic - New York On Revised Costs And Rates For Unbundled Network Elements And Related Wholesale
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which appears as Exhibit RAM-3 in my direct Testimony, states that the values are based on an *ex parte* submission by BellSouth to the FCC on the appropriate inputs to use in the HAI Model. Prior to that time, the prices were based on the judgment of the HAI Model developers, who did not have specific data available to them. Furthermore, Dr. Tardiff himself has taken note of the BellSouth *ex parte* letter, and the Inputs Portfolio citation to the letter.[22]

(6) The Expense Factors Utilized in HM 5.2a-MA Are Fully Supported in the Documentation Accompanying the Model

Q. STARTING AT P. 68, DR. TARDIFF CRITIQUES SEVERAL EXPENSE INPUTS IN HM 5.2A-MA. HOW DO YOU RESPOND TO HIS CRITIQUE OF PLANT-SPECIFIC EXPENSES – THAT IS, EXPENSES DIRECTLY RELATED TO THE OPERATION OF SPECIFIC PLANT ITEMS, SUCH AS CABLE OR SWITCH MAINTENANCE?

A. First, Dr. Tardiff criticizes the use of national average, rather than Massachusetts-specific, expense to investment (E/I) ratios. The problem with using Massachusetts-specific ratios is that it potentially rewards Verizon for operational inefficiencies that appear as high historic E/I ratios compared to other more efficient companies. The FCC expressed the same concern, stating that:

> We tentatively concluded that averages are more consistent with the forward-looking nature of the high-cost model <u>because less efficient firms are not rewarded if they have higher than average costs</u>.[23]

Using nationwide average E/I ratio at least recognizes that Verizon should be as efficient as other incumbents of comparable size, although a downward adjustment of even the

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Services, Exhibit, Part J, 5/19/00 Revision, Lines 98-103.

[22] Tardiff, at p. 16.

[23] Inputs Order, ¶ 341, emphasis added. See also ¶ 347.

national averages would be warranted to recognize the growing productivity in plant operations. But if the Department should decide that the use of Verizon-specific factors is appropriate, then it should at least utilize the four-step process the FCC went through to adjust booked investments to current investments in each plant category before calculating the ratios.[24]

Second, Dr. Tardiff raises a number of entirely speculative issues as to possible distortions in the use of E/I ratios, such as "an expense whose costs are unrelated to the underlying technology." Such speculative issues were considered by the FCC, which rejected them and found the use of E/I ratios based on current expenses and investments to be appropriate.[25] In fact, the FCC noted that a number of incumbent telephone companies agreed that the best way to calculate plant-specific expenses.[26]

Q. HOW DO YOU RESPOND TO DR. TARDIFF'S CRITICISM OF THE CORPORATE OVERHEAD FACTOR ASSUMED BY THE MODEL?

A. The HM 5.2a-MA Inputs Portfolio shows the derivation of the 4.35% factor used in the model. The derivation combines a regression analysis of the corporate overhead of local exchange companies that report ARMIS data to the FCC with Verizon's own representation that it would save $2 billion, or 3.57% of its current total costs, due to its merger with GTE. Dr. Tardiff argues that the $2 billion in savings includes reductions in various plant-specific and network operations expenses, and that therefore the 4.35% factor is double-counting those expense reductions. But the justifications for the reductions in plant- specific and network operations expenses do not depend in any way

[24] Further Notice of Proposed Rulemaking, CC Docket Nos. 96-45 and 97-160, Released May 28, 1999, ¶205.
[25] See, e.g., Inputs Order, para. 346-375
[26] Inputs Order, ¶365.

on these anticipated merger savings – they result from regression analyses and consideration of potential network operations cost savings. Therefore, it truly should be the case that even if the merger savings include plant-specific and network operations expenses, those should be additive to the savings that have already been accounted for.

(7) Differences between the HM 5.2a-MA Results and Those of Earlier Versions of the HAI Model Are Not Evidence that Costs Are Understated; Rather, They Appropriately Reflect the Vastly Improved Modeling Methodologies of HM 5.2a-MA, Different Demand Levels, Use of Massachusetts-Specific Inputs, and Other Legitimate Input Changes.

Q. AT P. 20, DR. TARDIFF CLAIMS THAT "CONVENIENT" CHANGES TO INPUT COSTS CAUSED A DECREASE IN AVERAGE UNIT STRUCTURE COSTS IN HM 5.2A COMPARED TO HM 2.2.2 THAT OFFSET A SUBSTANTIAL INCREASE IN DISTRIBUTION ROUTE MILES BETWEEN THE TWO VERSIONS OF THE MODEL. AT P. 24, DR. TARDIFF PRESENTS A COMPARISON OF THE PER-FOOT DISTRIBUTION STRUCTURE COSTS BETWEEN VERSIONS 2.2.2, 4.0, AND 5.2A-MA OF THE MODEL, ATTRIBUTING THE DIFFERENCES TO THE "RESULTS-ORIENTED" APPROACH OF THE MODEL DEVELOPERS. PLEASE EXPLAIN WHY THE PER-FOOT DISTRIBUTION STRUCTURE COSTS HAVE CHANGED SIGNIFICANTLY BETWEEN EARLIER AND LATER VERSIONS OF THE MODEL.

A. I will do so by focusing on the changes between HM 2.2.2 and HM 5.2a-MA, then building on that discussion to deal with the differences between HM 4.0 and HM 5.2a-MA. There are three primary reasons for the change in structure cost between HM 2.2.2 and HM 5.2a-MA. They are:

?? HM 5.2a-MA uses later ARMIS data that shows a greater number of loops (and also usage, although usage does not affect the outside plant investment) than does HM 2.2.2, which tends to cause HM 5.2a-MA to produce lower costs due to economies of scale present in the loop portion of the local exchange network;

?? The loops are distributed across density zones differently in HM 5.2a-MA due to the more precise mechanisms for locating customers utilized in HM 5.2a-MA compared to HM 2.2.2;

?? Whereas HM 2.2.2 used nationwide values for the mix of outside plant structure types – aerial, buried, and underground—HM 5.2a-MA reflects the mix that is appropriate for Verizon, as reported by Verizon in its Massachusetts ARMIS data; and

?? HM 5.2a-MA has appropriately divided what was a single "urban" density zone in HM 2.2.2 into three density zones, corresponding to suburban, dense suburban, and downtown urban zones, and assigned structure costs to each area that are based on the characteristics of those areas. In making this last point, I should emphasize I am talking about the *line* density zones as I defined them at the beginning of the surrebuttal testimony, not the categorization of wire centers into different *wire center* density zones or bands for the purpose of setting final rates.

These differences, and their effect on the comparison of the average per-foot structure costs, are discussed in detail in Exhibit RAM-15. Table 12 summarizes the findings presented in the exhibit. Line A of the table repeats the per-foot distribution structure cost that Dr. Tardiff has reported for HM 2.2.2 and HM 5.2a in Table 1 of his testimony.[27] The large difference in results shown in that line is the basis for Dr. Tardiff's claim that we have used a "convenient" or "results oriented" approach to setting input values to the model. Line B shows what happens when HM 2.2.2 inputs are substituted into HM 5.2a-MA in the fashion described in Exhibit RAM-15 in order to create an "HM 2.2.2" run of the model that eliminates differences caused by different demand levels and a different distribution of customer lines across density zones between HM 2.2.2 and HM 5.2a-MA. Line C demonstrates the effect of substituting the Massachusetts-specific outside plant structure type mix for the nationwide mix used in the HM 2.2.2 run. Finally, Line D shows what happens when HM 5.2a-MA simulates the collapse of the top three density zones into the single urban density zone to be consistent with the definition of density zones in HM 2.2.2.[28]

Table 12: Comparison of Average Per-Foot Structure Costs Between HM 2.2.2 and HM 5.2a-MA for Various Scenarios

Line	Scenario	HM 2.2.2	HM 5.2a-MA
A	Tardiff, Table 1, p. 24	$3.31	$0.82
B	HM 2.2.2 input values in HM 5.2a-MA (revised HM 2.2.2 baseline)	**$2.36**	$0.82
C	HM 2.2.2 baseline except MA-specific outside plant structure mix	**$1.35**	$0.82
D	HM 5.2a-MA inputs with top three density zones collapsed into one	$1.35	**$1.06**

Note: the bold entry on each line shows the result that has changed since the previous line

As can be seen in Line D, what started off as a large difference between the average per-foot structure cost of HM 2.2.2 versus HM 5.2a-MA has been reduced by these changes to a difference of about 20%.

Q. WHAT FACTORS EXPLAIN THE REMAINING 20% DIFFERENCE BETWEEN THE RUNS WITH HM 2.2.2 AND HM 5.2A-MA INPUTS?

I have considered only three changes that impact the comparison of the HM 2.2.2 and HM 5.2a-MA results. There are many other inputs that impact the average structure cost

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[27] Tardiff Testimony, at p. 24.

that have not been varied in these runs. In some cases, use of the HM 5a-MA inputs act to produce higher costs than would the corresponding inputs in HM 2.2.2; in other cases, lower. In all cases, however, I must emphasize that the input differences between the two versions of the model resulted from the advice of the outside plant engineering team that came into existence after the completion of HM 2.2.2.

Q. WHICH, IF ANY, OF THESE FACTORS EXPLAINS THE MUCH MORE MODEST DIFFERENCE BETWEEN HM 4.0 AND HM 5.2A-MA?

A. To answer this question, I have followed the same process I describe in Exhibit RAM-15 in order to provide a meaningful comparison of the average structure costs in HM 4.0 and HM 5.2a-MA. Table 13 shows the results, starting in Row A with Tardiff's reported average per-foot structure cost for HM 4.0 and HM 5.2a-MA.

Table 13: Comparison of Average Per-Foot Structure Costs Between HM 4.0 and HM 5.2a-MA for Various Scenarios

Line	Scenario	HM 4.0	HM 5.2a-MA
A	Tardiff, Table 1, p. 24	$1.08	$0.82
B	HM 4.0 input values in HM 5.2a-MA (revised HM 4.0 baseline)	**$1.06**	$0.82
C	HM 4.0 baseline except MA-specific outside plant structure mix	**$0.79**	$0.82

Note: the bold entry on each line shows the result that has changed since the previous line

First, I did an "HM 4.0" run of HM 5.2a-MA by substituting all HM 4.0 inputs into HM 5.2a-MA. As shown in Row B, this produced an average structure cost of $1.06, versus the $1.08 reported by Dr. Tardiff.

Second, I substituted the Massachusetts-specific structure percentages into the HM 4.0 run in place of the HM 4.0 nationwide default values. This lowered the average

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28 The "HM 2.2.2" baseline also assumes the collapse of these upper three density zones, so the results on line

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structure cost to $0.79 per foot as shown in Row C. This is less than the HM 5.2a-MA value of $0.82. Thus the difference between the HM 4.0 and HM 5.2a-MA results can be fully explained by the difference in Massachusetts-specific versus nationwide structure mix percentages.[29]

Q. PLEASE SUMMARIZE YOUR DISCUSSION OF DR. TARDIFF'S CLAIMS ABOUT THE DIFFERENCE IN THE AVERAGE STRUCTURE COST FROM HM 2.2.2 TO HM 4.0 TO HM 5.2A-MA.

A. In summary, I have identified four primary reasons for the difference in average structure cost that explain the vast majority of the difference between the three versions of the model. These reasons are based on differences in the vintage of demand data utilized, differences in Massachusetts-specific versus nationwide inputs, and differences in the demographic context of the model. None of these reasons reflects a "convenient" change of inputs or a "result-oriented" attitude on the part of the HAI developers. Nor are they caused by the HAI developers assuming that "the costs of support structure materials and their installation are less than half as expensive as AT&T and MCI OSP 'experts' asserted in this proceeding just three years ago," as Dr. Tardiff asserts.[30]

Q. AT P. 20, DR. TARDIFF CLAIMS THAT "THE HATFIELD MODEL ARBITRARILY REDUCES CURRENT NETWORK OPERATIONS EXPENSE (ACCOUNT 6530) IMMEDIATELY BY ONE HALF." ACCORDING TO DR. TARDIFF, "THERE IS SIMPLY NO BASIS TO CONCLUDE THAT THE COST OF AN ILEC'S FORWARD-LOOKING NETWORK OPERATIONS EXPENSE WILL BE INSTANTLY REDUCED BY ONE HALF, AND WILL CONTINUE TO DECREASE BY 50% EACH YEAR." HE THEN GOES ON TO CITE HIS VERSION OF THE HISTORY OF THE NETWORK OPERATIONS FACTOR IN THE HAI MODEL. HOW DO YOU RESPOND TO THESE ASSERTIONS?

(continued)
D are based on a consistent definition of the zones.

[29] As in the case of the HM 2.2.2 versus HM 5.2a-MA comparison, there are other factors that affect this comparison as well, some of which tend to increase the cost of HM 4.0 relative to HM 5.2a-MA, and others of which tend to decrease the relative costs.

[30] Tardiff, at p. 24.

A. Dr. Tardiff's discussion of this topic is partly nonsensical, partly continues to demonstrate his misunderstanding of TELRIC principles, and partly reflects his preference to provide a misleading interpretation of ancient history than to deal with the quantitative and qualitative evidence that supports at least a 50% reduction in the network operations expense.

The nonsensical part of his statement is the claim that we believe the network operations expenses "will continue to decrease by 50% each year" after being "instantly reduced by one-half." Verizon's current annual per-line network operations expense is $41.51. With the network operations factor input to the model set at 50%, the model assumes the annual per-line expense is reduced to one-half of 50%, or roughly $20.75 per line. Nothing in the model assumes the expense continues to decrease by 50% each year thereafter; this is entirely a fiction created by Dr. Tardiff.

The non-TELRIC part of his statement comes when he claims the model envisions an "immediate" reduction of current network operations expense by one half. As I have stated before, citing Paragraph 692 of the FCC's First Report and Order on Local Competition, the model appropriately accounts for the requirement that the "long run" part of TELRIC means "a period long enough that all costs are treated as variable and avoidable." If 50% of the current network operations expense are uneconomic costs, then the proper application of TELRIC principles should eliminate them.

As for the history of the network operations factor, Dr. Tardiff's interpretation is flawed in a number of respects, including an inadvertent, and erroneous, reference to a New Hampshire study on our part at an early stage of the history and the role (or non-role) of the cited memorandum by AT&T employee Paul Hansen in the development of the factor. I have presented the actual basis for the factor based on current findings. This support appears in Section 5.5.6 of the HM 5.2a-MA Inputs Portfolio included as Exhibit RAM-3 to my Direct Testimony. The section presents a clear, quantitative rationale for at least a 36% reduction in network operations expense just to bring Verizon's expenses into line with the current best practices of large local exchange companies. Appendix D of that exhibit identifies numerous technologies and practices that can lead to additional reductions in the network operations expense for all local exchange companies. I have conservatively assumed that these technologies and practices have the potential for an additional 10-15% reduction in current network operations expenses, bringing the total reduction to at least 50%.

Q. TABLE 2 ON P. 25 OF DR. TARDIFF'S TESTIMONY SHOWS HOW THE MONTHLY COST OF VARIOUS NETWORK ELEMENTS HAVE CHANGED BETWEEN HM 2.2.2, HM 4.0, AND HM 5.2A-MA, WHICH HE CLAIMS ARE LARGELY CAUSED BY "BASELESS" REDUCTIONS IN EXPENSES (TARDIFF AT P. 25). PLEASE EXPLAIN THE REASONS FOR THE REDUCTION IN UNE COSTS BETWEEN THE VARIOUS VERSIONS OF THE MODEL.

A. For starters, I want to emphasize that telecommunications is a declining cost industry. It should not be surprising that over time more up-to-date information shows that the forward-looking cost of providing UNEs today is less than it used to be, although this is certainly not the primary cause of the differences Dr. Tardiff has noted. The differences in UNE costs between different versions of the model can be attributed to one or more of the following: 1) changes in the algorithms and operation of the model; 2) changes in the relative percentages of customer locations in different density zones, since that mix affects the average structure cost, which is a major factor in the overall monthly cost; 3) changes in demand levels, including both the number of lines served and the amount of usage supported by the network; and 4) changes in input values to the model, some of which are due to the availability of new information, some to a closer scrutiny of the existing data, and some because costs are declining. I will show the effect of such changes using much the same process I used earlier in discussing changes in the average per foot cost of structure between various versions of the model. Again, I will start by comparing the HM 2.2.2 and HM 5.2a-MA results, then compare versions HM 4.0 and HM 5.2a-MA.

Row A of Table 14 shows the monthly loop cost for HM 2.2.2 and HM 5.2a-MA, as identified by Dr. Tardiff. I have updated the HM 5.2a-MA number from $7.11 to $7.09 to reflect the results of the corrected model.

Table 14: Comparison of Monthly Loop Cost between HM 2.2.2 and HM 5.2a-MA for Various Scenarios

Line	Scenario	HM 2.2.2	HM 5.2a-MA
A	Tardiff, Table 2, p. 25	$11.55	7.09
B	HM 2.2.2 input values in HM 5.2a-MA (revised HM 2.2.2 baseline)	**$12.05**	7.09
C	HM 2.2.2 baseline except MA-specific outside plant structure mix and expense factors	**$10.91**	7.09
D	HM 2.2.2 with selected additional input changes	**$7.54**	7.09
E	HM 5.2a-MA inputs with top three density zones collapsed into one zone	$7.54	**$7.32**

Note: the bold entry on each line shows what has changed since previous line

Row B shows the monthly cost that results from substituting HM 2.2.2 input values in HM 5.2a-MA in order to create a new "HM 2.2.2" baseline run that takes into account the more sophisticated calculations of HM 5.2a-MA, the different distribution of customer locations by density zone, and the different level of demand for loops. This is the same run I referenced previously in my discussion of the average per-foot outside plant structure costs; its inputs are shown in Attachment 1 of Exhibit RAM-15. Note that the monthly loop cost for the new baseline run actually increases, from $11.55 to $12.05.

Second, I substitute several Massachusetts-specific inputs in place of the nationwide average values utilized in HM 2.2.2 inputs; these include[31]

- the mix of outside plant structure types, as I discussed previously in connection with the analysis of average structure cost;
- Verizon's combined federal-state income tax rate of 39.23%; and
- Verizon's depreciation lives and net salvage values.

I have singled out this particular set of changes on the basis that they are presumably not controversial since they are derived, respectively, from 1) Verizon's ARMIS data; 2) the tax rates reported by Verizon; and 3) the three-way depreciation agreement between Verizon, the DTE and the FCC. The HM 2.2.2 result with this set of input changes is shown in Row C of Table 14; it is $10.91.

Third, I make an additional set of input changes to the values used in the HM 5.2a-MA run of the model. I realize these inputs are likely to be the subject of more contention by Verizon, but each of these input values has been presented on its merits in either Mr. Donovan's Direct Testimony or mine. The inputs include:

- The cost per foot for various copper and fiber cable sizes;
- The HM 5.2a-MA cable utilization factors for distribution and copper feeder cable, as discussed by Mr. Donovan;
- Strand adjustment option turned on;
- The network operations reduction factor of 50%, as I have discussed at some length earlier in this surrebuttal testimony; and
- The corporate overhead factor of 4.35%, based on an analysis of the overhead costs of other large incumbent exchange carriers combined with Verizon's own statement of anticipate savings due to its merger with GTE.[32]

[31] The rationale for the Massachusetts-specific value of these inputs is discussed in Section V of my Direct Testimony and the HM 5.2a-MA Inputs Portfolio that appears as Exhibit RAM-3 of that testimony.

[32] See Section 5.5.2 of Exhibit RAM-3 to the Direct Testimony of Dr. Robert A. Mercer.

The result of this set of changes is shown in Row D of Table 14.

Finally, just as I did in the analysis of the average per-foot structure costs, I collapse the top three density zones of the HM 5.2a input values in order to replicate the less-precise density zone definitions utilized in HM 2.2.2. This increases the HM 5.2a-MA monthly loop cost to $7.32, as shown in Row E of Table 14.

As shown in Row E of the table, the net effect of all these changes is to bring the HM 2.2.2 and HM 5.2a-MA monthly loop costs within three percent of each other. . The changes required to do this are clearly identified above; they are finite, defensible, and certainly not "baseless" changes to expenses, as Dr. Tardiff contends. There are many other differences still remaining in the respective sets of input values. Some of these changes act to increase the cost of HM 2.2.2 relative to HM 5.2a-MA; some to lower the relative cost. The merits of all of them have been presented in the Direct Testimony of Mr. Donovan, my own Direct Testimony, and/or Exhibit RAM-3 of my Direct Testimony.

Q. SO FAR, YOU HAVE DEALT WITH ONLY THE DIFFERENCE IN MONTHLY LOOP COSTS BETWEEN HM2.2.2 AND HM 5.2A-MA. WHAT ABOUT THE DIFFERENCES IN OTHER ELEMENTS IDENTIFIED IN TABLE 2 OF DR. TARDIFF'S TESTIMONY?

A. The causes of those differences are similar. First, there are different demand levels between HM 2.2.2 and HM 5.2a-MA, not only with respect to the number of lines served but the amount of usage of local switching, tandem switching, interoffice transport, and the signaling network. Given the economies of scale that exist in the Verizon network, increased usage translates into lower unit costs for those elements. Second, HM 5.2a-MA is more sophisticated in its calculation of investments and costs in all these areas. For instance, HM 5.2a-MA includes a detailed process for identifying and sizing interoffice fiber optics transport rings that was not included in HM 2.2.2. Thus, just as in the case of the loop, it is meaningless to directly compare HM 2.2.2 and HM 5.2a-MA results in these portions of the network. Third, there are well-defined and justified changes in the inputs related to switching, transport, and signaling. For instance, HM 5.2a-MA utilizes the switching investment inputs adopted by the FCC in its Synthesis Model, whereas HM 2.2.2's switching cost calculation was based on a different algorithm and different input values.

Q. TABLE 2 OF DR TARDIFF'S TESTIMONY ALSO COMPARES THE MONTHLY LOOP COST FROM HM 4.0 AND HM 5.2A-MA, SHOWING THE FORMER TO BE $11.84 VERSUS THE LATTER'S $7.34. CAN YOU EXPLAIN THIS DIFFERNCE?

A. Yes. I will do so in steps similar to those I used in comparing HM 2.2.2 and HM 5.2a-MA. Row A of Table 15 shows the monthly loop cost for HM 4.0 and HM 5.2a-MA, as identified by Dr. Tardiff, except I have updated the HM 5.2a-MA number from $7.11 to $7.09 to reflect the results of the corrected model.

Table 15: Comparison of Monthly Loop Cost Between HM 4.0 and HM 5.2a-MA for Various Scenarios

Line	**Scenario**	**HM 4.0**	**HM 5.2a-MA**
A	Tardiff, Table 2, p. 25	$11.84	$7.09
B	HM 4.0 input values in HM 5.2a-MA (revised HM 4.0 baseline)	**$8.12**	$7.09
C	HM 4.0 baseline except MA-specific outside plant structure mix	**$7.66**	$7.09
D	HM 4.0 with selected additional input changes	**$6.21**	$7.09

Note: the bold entry on each line shows what has changed since previous line

First, I substitute the full set of HM 4.0 inputs into HM 5.2a-MA to produce the "HM 4.0 baseline" run of the model. This results in a monthly loop cost of $8.12. Second, I substitute the same Massachusetts-specific inputs for the structure mix and expenses in the HM 4.0baseline run that I previously identified in connection with the HM 2.2.2 versus HM 5.2a-MA comparison. This results in a monthly loop cost of $7.66. Finally, I have made the other input changes I identified previously in the HM 2.2.2 comparison, noting, however, that the 50% network operations factor is already assumed in HM 4.0, so there is no change to make in that case. These changes result in a loop cost of $6.21. This amount is significantly less than the HM 5.2a-MA result of $7.09.[33] In other words, these few changes to the HM 4.0 inputs are more than enough to account for the difference in the HM 4.0 and HM 5.2a-MA results reported by Dr. Tardiff.

(C) HM 5.2a-MA Has Been Validated in Direct Comparisons with Verizon's and other Incumbents' Cost Models, and Produces Reliable Results

(1) HM 5.2a-MA's Results Are Completely Reasonable When Appropriately Compared with Other Cost Results, and Should Not Be Compared to Historic, Embedded ARMIS Data

Q. IN TABLE 3 AT P. 26 OF HIS TESTIMONY, AND IN SUBSEQUENT DISCUSSION, DR. TARDIFF COMPARES THE HM 5.2A-MA RESULTS WITH VERIZON'S ARMIS RESULTS, CONCLUDING THAT THE MODEL IS DEFECTIVE BECAUSE IT PRODUCES LESS INVESTMENT AND LESS EXPENSES THAN VERIZON REPORTS IN ARMIS DATA. ARE SUCH COMPARISONS VALID?

A. No, they are not. HM 5.2a-MA generates estimates for forward-looking costs, not embedded costs. As such, it is inappropriate to validate its results by comparison with Verizon's embedded cost data, which are *not* based on forward-looking cost principles.

[33] It is not appropriate to collapse the upper three density zones of HM 5.2a-MA into one zone as I did in making the comparison with HM 2.2.2, since HM 4.0 uses the same density zone definitions as HM 5.2a-MA.

The FCC has specifically warned against the assumption that it was valid to compare the results of a forward-looking cost model to the current costs of an incumbent:

> We do not agree, as some parties have argued, that the models' outside plant design parameters should be verified by comparing the design of the model networks in specific locations to the design of incumbent LECs' existing plant in those locations in all cases. While we recognize that certain factors such as terrain, road networks, and customer locations are fixed, the design of the existing networks under these conditions may not represent the least-cost, most-efficient design in some cases. The Commission, in the *Universal Service Order*, adopted the Joint Board's recommendation that universal service support should be based on forward-looking economic costs. Existing incumbent LEC plant is not likely to reflect forward-looking technology or design choices. Instead, incumbent LECs' existing plant will tend to reflect choices made at a time when different technology options existed or when the relative cost of equipment to labor may have been different than it is today. Incumbent LECs' existing plant also was designed and built in a monopoly environment, and therefore may not reflect the economic choices faced by an efficient provider in a competitive market. Although we do not believe that a forward-looking platform can meaningfully be verified by comparing its network to an embedded network, we note that the platform is only one of many considerations used to set actual levels of support.[34]

Q. PLEASE EXPLAIN WHY COMPARISONS WITH ARMIS DATA CANNOT VALIDATE OR DISPROVE THE REASONABLENESS OF FORWARD-LOOKING UNE COST ESTIMATES.

A. First, ARMIS data are embedded cost data. For the reasons stated above, they cannot properly be used as a test of the reasonableness of forward-looking cost estimates. Second, ARMIS data reflect all of Verizon's regulated operations in a state. The investments and expenses calculated by the model pertain only to the set of UNEs at issue in the proceeding. They do not, for instance, cover the investment in facilities used to provide DS-3 and other broadband services to customer premises. Nor do they even necessarily cover all the narrowband services, since, for instance, the model does not have information on alarm circuits and other intraLATA dedicated circuits the companies may be offering. Third, ARMIS data contain a number of investments and costs associated with activities that should not be included in UNE rates. These include, for instance, marketing and most product management expenses. The HAI 5.2 model appropriately assigns significant fractions of many categories of general support and overhead investment and expenses, such as those associated with buildings, land, furniture, and general purpose computers to such activities, and excludes them from the model's calculations.

Q. ARE THERE MEANINGFUL COMPARISONS ONE CAN DRAW TO ASSESS THE VALIDITY OF A COST MODEL?

A. When all is said and done, given these drawbacks inherent in making comparisons with ARMIS data, I believe that appropriate comparisons can only be drawn between the results of correctly-formulated cost models. In this vein, it is instructive that, as shown in the Rebuttal Testimony of AT&T witness Michael Baranowski filed on July 18, 2001, when Verizon's own loop study is restated with an appropriate set of modifications, the statewide average loop cost it produces is $7.76 per month. This differs by less than 10% from the HM 5.2a-MA estimate of $7.09 per month.

Q. CAN YOU GIVE SOME SPECIFIC EXAMPLES OF THE FALLACY OF COMPARING HM 5.2A-MA INVESTMENTS WITH THE INVESTMENTS SHOWN IN ARMIS DATA?

(continued)
[34] *Federal-State Joint Board on Universal Service Forward-Looking Mechanism for High Cost Support for Non-Rural LECs*, CC Docket Nos. 96-4 and 97-160, Fifth Report & Order (released October 28, 1998) ("Model Platform Order"), ¶ 66 (footnotes omitted).

A. I will give three such examples: investment in cable, investment in digital switching, and investment in circuit equipment.

Table 3 of Dr. Tardiff's testimony purportedly shows that the cable investment produced by the model is only a fraction of the cable investment reported in ARMIS.[35] Since the total investment in cable is the product of the number of route feet of cable and the investment per foot of cable, the model could be producing too little investment in cable for two reasons: 1) it does not correctly capture the number of route miles of cable required, or 2) it is using the wrong per-foot investment. Concerning the number of route feet of cable produced by the model, a recent study has compared the amount of route miles produced in Florida by a Bell South loop model called the BSTLM, by an older-vintage ILEC cost model called the Benchmark Cost Proxy Model, and by version 5.0a of the HAI Model. The results are shown in Table 16. Note that in the BSTLM column under "Quantity of Material," the route mile total is 45,081. However, the column also shows that BSTLM has assumed 5,835 miles are shared between distribution and feeder structure. HM 5.2a-MA does not assume any sharing of feeder and distribution plant, so it would count those shared miles twice. If such sharing were not assumed in BSTLM, so the miles were also double-counted, the BSTLM total route miles would be 50,916. HM 5.0a produces 15% more route miles than does the Bell South model, and approximately 5% less than the now-obsolete BCPM model. Therefore, HM 5.2a-MA is not producing too few route miles.

[35] The comparison is misleading in the first place, since for each type of support structure – aerial, buried, and underground, the table compares the HM 5.2a -MA investment in metallic cable with the total metallic and non-metallic investment in ARMIS.

Table 16: Comparison of HAI Model Route Miles with Incumbent LEC Models

Equipment Type	Quantity of Material			Percent of BCPM	
	BCPM	BSTLM	HAI	BSTLM	HAI
Distribution Route Miles	44,504	37,228	47,751	83.65%	107.30%
Shared Route Miles (Distribution and Feeder)	-	5,835	-	N/A	N/A
Feeder Route Miles	17,466	2,018	10,819	11.55%	61.94%
Total Route Miles	**61,970**	**45,081**	**58,570**	**72.75%**	**94.51%**
Number of DLCs	**9,554**	**4,531**	**5,475**	**47.43%**	**57.31%**

Concerning the per-foot investment in cable, HM 5.2a-MA utilizes values consistent with the recommendations of the outside plant team that advised the models' developers. Those values are higher for some sizes of cable, and for other sizes lower, than the values adopted by the FCC in its Synthesis Model. Taken together, they certainly would not per se lead to a large difference in results compared to the FCC values. Therefore, HM 5.2a-MA is not assuming an unreasonably low per-foot cable investment. The problem is that Dr. Tardiff is comparing the HM 5.2a-MA results with Verizon's embedded loop cost data which apparently does not accurately reflect the amount of cable actually required to serve customers, or current prices for that cable.

The same discussion could apply to outside plant support structures – poles, conduit, and the trenching associated with buried and underground plant. However, another factor comes into play for such structures that illustrates a different frailty of ARMIS data: whether or not the data reflect an appropriate sharing of such structures with other utilities. To the extent Verizon is not fully taking advantage of such sharing opportunities, a proportion of its embedded structure costs are avoidable, and should not be included in a properly-crafted TELRIC model.

Turning now to the digital switching investment, Tardiff shows that the model produces only 25% of the ARMIS investment in digital switching. What could cause the model to produce too little digital switching investment? Either the number of switches could be wrong, the switches could be sized to serve the wrong number of lines, or the investment per line could be too low. HM 5.2a-MA places a switch in each wire center in which Verizon currently has a local switch operating, so the number of switches is correct on a forward-looking basis.[36] The number of switched lines in each of these wire centers has been normalized to the number of lines reported by Verizon, so each switch is serving the right number of lines. Finally, HM 5.2a-MA is using an investment formula and its parameters that are consistent with those adopted by the FCC for its Synthesis Model after an exhaustive analysis of available switching cost data, so its per-line and total-switch investments in each switch are correct. Therefore, HM 5.2a-MA's switching costs are consistent with the appropriate TELRIC treatment of switch investment and with the investment levels found to be appropriate by the FCC. The problem is that Dr. Tardiff is comparing the HM 5.2a-MA switching results with Verizon's embedded switching cost data that apparently do not accurately represent what Verizon would pay on a forward-looking basis for local digital switching.

Finally, Tardiff shows that the investment in circuit equipment produces only 30% of the ARMIS investment in circuit equipment. The model calculates investments

[36] In some cases, Verizon may have more than one switch operating in a wire center where the number of lines and amount of usage can be met by a single switch.

in circuit equipment associated with digital loop carrier systems (DLCs) and interoffice terminal equipment. DLC investments are based on the cost of DLC equipment adopted by the FCC in its Synthesis Model, properly adjusted as described in the Direct Testimony of Mr. John Donovan. Interoffice terminal equipment costs are based on a Bell South ex parte presentation to the FCC on the cost of such equipment.[37] Again, the likely primary reason for the discrepancy is that Verizon's embedded cost data does not reflect its current experience in purchasing such equipment. But this example is also illustrative of another issue I have identified with using ARMIS data: the model omits certain categories of services, such as broadband circuits and intraLATA private lines. Those services often utilize electronics, and to the extent they do, the model will miss the corresponding investments because it does not deal with such services.

Q. WHY WOULD YOU EXPECT THE EXPENSES ESTIMATE BY HM 5.2A-MA TO BE LESS THAN THE EXPENSES VERIZON REPORTS TO ARMIS?

A. Generally, of course, the key point is that ARMIS expense data, like investment data, represents the historical, not forward-looking, operation of the network. But beyond this general point, there are a number of specific aspects of the way in which the model treats expenses that will cause certain expenses reported in ARMIS to be omitted from the model's calculation of expenses associated with UNEs. These include the application of expense to investment (E/I) ratios to the investment levels estimated by the model in order to calculate plant specific expenses, the appropriate omission of certain specific expenses identified in the model, and the assignment of a portion of general support expenses to Verizon activities that are not associated with unbundled elements.

[37] *Ex parte* letter from W. W. Jordan, Vice President, Federal Regulatory, BellSouth, to Magalie Roman Salas, Secretary, FCC, re CC Docket No. 96-45 and 97-160, August 7, 1998.

Q. HAS THE FCC ENDORSED THE USE OF E/I RATIOS AS A LEGITIMATE MEANS OF ESTIMATING PLANT-SPECIFIC EXPENSES?

A. Yes. Just as HM 5.2a-MA does, the FCC Synthesis Model estimates the expenses associated with a particular category of plant by estimating the investment in that plant category and then multiplying the investment by the E/I ratio for that plant category.

> We tentatively concluded that these expense-to-investment ratios should be applied to the model-derived investment balances to obtain forward-looking plant-specific operations expense estimates. . . . As discussed in this section, we adopt our proposed methodology for calculating expense-to-investment ratios to estimate plant-specific operations expenses. <u>We reject arguments of some LEC commenters that this methodology inappropriately reduces these expense estimates</u>.[38]

In fact, the FCC spent a considerable amount of effort in determining the appropriate E/I ratio for each plant category based in order to increase the accuracy of the direct expenses estimated in this fashion. HM 5.2a-MA uses the FCC-adopted values for the E/I ratios, as I discuss in my Direct Testimony. Note that the FCC specifically rejected the argument advanced by several ILECs that this process inappropriately reduces the expense estimates. The upshot of this treatment is that, if an investment in some plant category is a fraction, F, of the embedded investment, then the plant-specific expense for that category of investment will <u>also</u> be reduced by F. Dr. Tardiff is trying to "double count" what he considers to be faults in the model when he cites <u>both</u> a portion of the investment to be missing and a portion of the related expenses to be missing.

Q. TO WHAT ARE YOU REFERRING WHEN YOU SAY THE MODEL OMITS CERTAIN SPECIFIC EXPENSES?

[38] Inputs Order, para. 340, 364, emphasis added.

A. The model omits a portion of network operations expenses, based on the experience of companies comparable to Verizon. It does the same for corporate operations. These reductions are consistent with the TELRIC orientation of the model.

In addition, the model assumes an amount of $1.22 per month per line for billing and related services, and a number portability cost of $0.23 per month per line. But these are appropriately applied to the cost of universal service, not to the cost of unbundled elements, since the TELRIC principles developed by the FCC that I cited before require that retail expenses be eliminated. In other words, the model recognizes certain costs, but by placing them in appropriate "buckets," they are taken out of the UNE calculations. It is inappropriate for Dr. Tardiff to then turn around and count these costs as missing.

Q. WHY DOES THE MODEL NOT ASSIGN ALL THE ARMIS INVESTMENTS AND ACTIVITIES ASSOCIATED WITH GENERAL SUPPORT FUNCTIONS—FURNITURE, OFFICE EQUIPMENT, GENERAL PURPOSE COMPUTERS, BUILDINGS, MOTOR VEHICLES, GARAGE WORK EQUIPMENT, AND OTHER WORK EQUIPMENT—TO UNBUNDLED ELEMENTS?

A. First, the level of general support activities are appropriately subject to a forward-looking adjustment consistent with the TELRIC orientation of the model. Second, many general support expenses are associated with retail customer operations, marketing, and product support. Since such activities are appropriately excluded from UNE costs, the model requires a mechanism for eliminating them.

Q. HOW ARE GENERAL SUPPORT COSTS TREATED BY THE MODEL?

A. As described in Section 6.6.3.2, the model determines the ratio of investments in the above categories to total network investment from ARMIS data. The ratio is then multiplied by the network investment estimated by the Model to produce the investment in general support equipment. The recurring costs—capital carrying costs and operating expenses—of these items are then calculated from the investments in the same fashion as the recurring costs for other network components. A portion of general support costs is assigned to customer operations and corporate operations according to the proportion of operating expense in these categories to total operating expense reported in the ARMIS data. The remainder of costs is then assigned directly to UNEs. The net effect of this process is that only the forward-looking UNE-related portion of the general support expenses reported in the ARMIS data is assigned to UNEs.

Q. IN SUMMARY, WHY ARE THE INVESTMENTS AND EXPENSES ESTIMATED BY HM 5.2A-MA LESS THAN THE CORRESPONDING AMOUNTS REPORTED BY VERIZON IN ITS ARMIS DATA?

A. Because the general support investments and expenses estimated by the model are 1) consistent with the TELRIC orientation of the model, in that they are forward-looking in the sense that all costs are treated as avoidable in the long term; and 2) they have been properly placed in "buckets," some of which are not properly attributable to UNEs.

Q. AT P. 30, DR. TARDIFF COMPARES THE INVESTMENT PER LINE ESTIMATED BY THE HAI MODEL WITH THE INVESTMENT PER LINE OF NATIONWIDE CLECS. IS THIS A MEANINGFUL COMPARISON?

A. No. Unlike Verizon, the CLECs serve a very small fraction of the customers located within an area. They therefore don't experience the tremendous economies of scale Verizon experiences. Furthermore, during the period in question, many CLECs were struggling to attain a national or regional presence by attempting to initiate service in a large number of areas simultaneously. Inevitably, this required a great deal of initially-idle capacity to be deployed, increasing the cost per subscriber. No serious observer of the local exchange industry believes a participant with a market share anywhere near that experienced by Verizon would incur Tardiff's claimed $3,000 per subscriber.

Q. AT P. 33, DR. TARDIFF PRESENTS A SUPPOSED COMPARISON OF THE HM 5.2A-MA INVESTMENT FOR VARIOUS CATEGORIES OF PLANT VERSUS

THE SUPPOSED CURRENT VERIZON REPLACEMENT COST OF THE SAME PLANT CATEGORIES. PLEASE COMMENT ON THIS COMPARISON.

A. It is nothing more than a rehashing of the same argument based on embedded costs that appear in Table 3. I agree with one point Dr. Tardiff makes: one can estimate the total investment in a given plant category by multiplying the unit cost of the plant item times the number of units. For instance, the total investment in aerial cable is the cost per foot of aerial cable times the number of feet of aerial cable. As I have shown earlier, HM 5.2a-MA produces more route feet of cable than does an incumbent's forward-looking model, the BSTLM, and the inputs for the per-foot cost of various cable sizes are in the aggregate consistent with the values adopted by the FCC for use in the Synthesis Model. Therefore, contrary to Tardiff's assertion that "the Hatfield Model [sic] believes that you need to install a lot less wire and/or much cheaper wire than reality would indicate,"[39] it is clear that HM 5.2a-MA must have the investment in cable about right, and that what Tardiff has <u>actually</u> demonstrated is the hazard of using embedded cost data.

(2) Although Verizon Has Been Unable to Supply Some Key Data that AT&T Requested to Validate the HM 5.2a-MA Results, The Results are Validated by Comparisons with Verizon's and Other ILECs' Cost Study Results

Q. AT PAGE 35, DR. TARDIFF CLAIMS THAT THE ONLY ATTEMPT THE HAI MODEL DEVELOPERS HAVE MADE TO VALIDATE THE MODEL'S OUTPUTS ARE IN CONNECTION WITH A GEORGIA PROCEEDING. WHAT EFFORTS HAVE HAI DEVELOPERS MADE TO VALIDATE THE MODEL'S OUTPUTS, AND WHAT ARE THE RESULTS OF THAT EFFORT?

A. In this proceeding, AT&T requested that Verizon-MA provide the average loop length, feeder route miles, and distribution route miles by wire center.[40] In its response, Verizon

[39] Tardiff, p. 34.
[40] AT&T Data Request 2-5 to Verizon dated May 8, 2001.

provided no information on route distances, and could only provide average loop lengths by wire center density zone and for the state as a whole:

> Verizon MA does not maintain a database of average loop lengths by wire center. The loop lengths used in determining the TELRIC costs are based on a sample of wire centers. The attached worksheet summarizes the length data on a density zone basis.[41]

Therefore, it is impossible to compare the HM 5.2a-MA route miles with Verizon's non-existent route miles.

However, the worksheet referenced in the attachment to Verizon's response to ATT-VZ 2-5 shows Verizon's statewide average loop length is 10,857 feet. (Verizon reports a statewide average feeder length of 8,968.15 feet and a statewide average distribution length of 1,889.03 feet, which produce a statewide average total loop length of 10,857.18 feet.) The statewide average loop length produced by HM 5.2a-MA is 12,015 feet, which is roughly 10% ***higher*** than the Verizon average.

Lacking route length data from Verizon that would enable a Massachusetts-specific comparison to be drawn, I will fall back on the comparison I presented in Table 16, above, between the HAI Model and the BSTLM loop model developed by BellSouth. I showed that HM 5.2a-MA produces about 15% more total route distance than does the BSTLM,[42] and just over 5% less than the BCPM.

Dr. Tardiff presents an interpretation of the results of a route distance comparison in the state of Georgia. This criticism, even if it were originally well-founded, is completely beside the point. HAI 5.2 has different cable algorithms than HAI 4.0, which

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[41] Verizon Response to AT&T 2-5.

[42] A raw comparison of the total route miles suggests HM 5.2a-MA produces 30% more route miles, but it is necessary to account for shared distribution and feeder route miles, as I did in presenting the results in Table 16, which leads to a 15% real difference.

is the model that was at issue in Georgia. The outside plant algorithms in the current model ensure that the model produces enough cable within each cluster to connect each customer premises to the Serving Area Interface. This is described in detail in Section 6.3.4 of the HAI 5.2 Model Description that appears in Exhibit RAM-2 of my Direct Testimony.

(3) There Has Not Been A Widespread Rejection of HM 5.2a, and in Fact, Administrative Law Judges in Arizona Recently Recommended Adoption of HM 5.2a.

Q. STARTING AT P. 37, DR. TARDIFF CLAIMS THAT THERE HAS BEEN A WIDESPREAD REJECTION OF THE HAI MODEL BY FEDERAL AND STATE REGULATORY BODIES. PLEASE RESPOND TO THIS ASSERTION.

A. I will leave a detailed recital of precedent to the lawyers, and limit myself to four points. First, all of the decisions cited by Dr. Tardiff predate HAI Model 5.2a, which was first introduced in UNE proceedings here, in New York, and in New Jersey.[43] The regulatory history of earlier Hatfield or other HAI cost models is irrelevant to the merits of the AT&T UNE cost study, because the earlier models are not on the table in this case. HM 5.2a-MA has benefited greatly from constructive comments by regulators and others on the methodology and inputs of the model, and as I have described in detail in my Direct Testimony, has substantially changed to address those comments. As I have demonstrated herein, HM 5.2a-MA is validated by comparison with Verizon's own cost model: when run with consistent assumptions, the Verizon model produces loop costs that are similar to those produced by HM 5.2a-MA.

[43] The differences in HM 5.2a-MA and the generic version of HM 5.2a submitted in New Jersey are described in detail in my Direct Testimony. The differences involve minor coding changes and the use of Massachusetts-specific input values.

Second, *none* of the FCC decisions cited by Verizon involve a comparison of any version of the HAI model or its predecessors with the cost models offered by Verizon here. There is a simple reason for this: Bell Atlantic and Verizon have never submitted their models for scrutiny by the FCC. The relative merits of the HAI or Hatfield models vs. the BCPM and other ILEC models are beside the point, because Verizon has not relied on those models in this case. In any event, Dr. Tardiff's discussion of the FCC's treatment of the HAI Model is at best incomplete. The FCC adopted substantial parts of the HAI Model, and even where it developed its own modules, it built upon concepts such as the use of geocoded customer locations and clustering in its own approach.

Finally, the timing of Dr. Tardiff's testimony of course precludes him from reflecting this, but on November 8th of this year in Arizona, two Administrative Law Judges recommended adoption of the HM 5.2a model for use in setting Qwest's rates for unbundled network elements:

> After considering the evidence submitted in this proceeding, we find that the HAI 5.2a Model relied upon by the CLECs and Staff provides the most appropriate measure of determining TELRIC-compliant, forward-looking costs and prices for UNEs when used as a starting point and subject to the determination of specific inputs as discussed below.[44]
>
> Reliance on an incumbent LEC's embedded costs clearly does not recognize the efficiencies that would likely be experienced in a truly competitive environment. . . . Although each of the issues discussed below is evaluated independently, we believe that, subject to the adjustments described herein, the HAI Model properly recognizes the TELRIC methodology that is required for assessing Qwest's costs and UNE prices.[45]

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[44] Arizona Corporation Commission, Recommended Phase II Opinion and Order, Docket No. T-00000A-00-0194, Released November 8, 2001, p. 10.

[45] Ibid., pp. 10-11.

The recommended decision specifically references and accepts several of the Model's principles and algorithms, including its outside plant placement assumptions,[46] fill factors based on current demand rather than relying on investments required to "serve some unidentified 'ultimate demand' and [spreading] the cost of serving that ultimate future demand over only current demand;"[47] the Model's Minimum Spanning Tree function because it "properly reflects legitimate network design inputs for modeling distribution plant," and because the process for determining surrogate customer locations "is likely to overstate distribution requirement because the model assumes a uniform spacing of customer locations along roads and does not recognize clusters of customers that often exist in small towns;"[48] and the Model's allocation of general support costs between wholesale and retail functions because "the inclusion of [Qwest's] clearly retail expenses in its [model] is inconsistent with TELRIC principles."[49]

III. RESPONSE TO REBUTTAL TESTIMONY OF JOSEPH GANSERT

(A) Mr. Gansert's Critique of the HM 5.2a-MA Interoffice Ring Structure Is Based on a Flawed Understanding of the Ring Design Practices Implemented by the Model.

Q. WHAT PORTION OF MR. GANSERT'S TESTIMONY ARE YOU ADDRESSING?

A. I will specifically address Section III.G of Mr. Gansert's Rebuttal Testimony. My primary purpose is to show that HM 5.2a-MA designs interoffice rings consistent with

[46] Ibid., p. 16.
[47] Ibid., p. 21.
[48] Ibid.; p. 22.
[49] Ibid., p. 25

industry practice and in accordance with the data available to the model, and produces a conservatively high amount of investment in interoffice terminal equipment.

(1) As Discussed in More Detail by AT&T Witness Steven Turner, There Is a Well-Understood Distinction Between Physical and Logical Networks as the HAI Model Uses the Terms.

Q. WHAT IS THE FUNDAMENTAL PREMISE UNDERLYING MR. GANSERT'S CRITICISMS OF THE INTEROFFICE FACILITIES METHODOLOGY OF HM 5.2A-MA?

A. His fundamental premise is that "there is nothing in an actual telephone network that is equivalent to the 'logical rings' assumed by the Model -- all SONET rings are quite physical."[50] From that flawed premise, he proceeds to make a number of mistakes in analyzing the interoffice ring calculations in HM 5.2a-MA. The reality is that there most definitely is a distinction between physical and logical rings as the model defines them. Mr. Turner describes the distinction as being between fiber rings and SONET rings, and equates the SONET rings to the logical rings defined by the model. The distinction is key to understanding the HM 5.2a-MA calculation of interoffice rings and why Mr. Gansert's critique is wholly without merit.

Q. ON WHAT BASIS DO YOU SAY THERE IS A WELL-UNDERSTOOD DISTINCTION BETWEEN PHYSICAL AND LOGICAL SONET RINGS?

A. I will primarily defer this question to Mr. Turner, who will describe in detail standard industry practices for deploying SONET rings. However, to set the stage for my explanation of the way in which HM 5.2a-MA calculates such rings, I will briefly provide evidence of this distinction, and how it is applied in HM 5.2a-MA.

[50] Gansert, p. 29.

When local exchange companies deploy fiber routes, they commonly deploy fiber optics cable containing a large number of fiber strands, normally between 24 and 144 fiber strands. Since add-drop multiplexers (ADMs) only use either two or four fiber strands,[51] depending on the particular ring technology utilized, the question naturally arises why there are so many strands in the physical fiber. The answer is that subset of wire centers (henceforth, "nodes") on the physical route are connected to each other using a particular set of 2-4 strands, and on the physical route connecting a large number of nodes, there may be many such subsets utilizing different sets of two or four strands. Having referred to the underlying fiber route as the "physical network," the HAI documentation uses the term "logical" or "coincident" ring, or what Mr. Turner refers to as SONET rings, to describe the connectivity between the subset of nodes connected to a given set of fiber strands. This terminology is not unique or new to the HAI Model – Exhibit RAM-16 is a journal reference from several years ago that uses the same distinction between logical networks and physical fiber paths.

Increasingly, the role previously played by multiple fiber strands is being assumed by different optical wavelengths (colors) on a given fiber strand utilizing wave division multiplexing (WDM).[52] In this case, one subset of nodes may use one wavelength to communicate, while another subset utilizes another wavelength. Wavelengths that are not utilized in a given node are simply passed through that node from the input fibers to the output fibers, much as strands that are not part of a logical network involving a given

[51] To avoid a non-productive argument I inadvertently touched off in one of my responses to a data request, let me state up front that when I say an ADM uses two strands, I mean there are two strands into and two strands out of the ADM, or four fiber terminations on the ADM. Likewise, the use of four strands implies four strands into and four strands out of the ADM, or eight terminations altogether.

node simply pass through that node without involving an ADM. Exhibit RAM-17 is a figure taken from an announcement of a commercial WDM system called MultiWave Metro™.[53] It shows different node connectivity on different wavelengths. The text accompanying the figure reads as follows (emphasis added):

> The multi-colored columns in the figure represent MultiWave Metro nodes, which are interconnected by a two-fiber ring. The different colors represent the different wavelengths available at each node. <u>The colored lines interconnecting the nodes represent logical connections between nodes. (Note that all wavelengths pass through all nodes; they are only dropped/added at nodes that need access to that wavelength.)</u>
>
> The connection formed by dropping wavelength 1 (red) at all nodes shows a typical SONET ring application where traffic is added and dropped at each node. The connection formed by dropping wavelength 2 (pink) at nodes 2, 3, 4, and 5 shows how a private SONET ring might be implemented.
>
> A "star" or hub-type application is shown by interconnecting node 1 with nodes 3, 4, 5, 7, and 8 using wavelengths 3 (blue), 4 (cyan), 5 (yellow), 6 (orange), and 7 (green). An arbitrary point-to-point connection is shown by interconnecting nodes 6 and 7 with wavelength 9 violet.)

From this example, it is obvious that not only are logical rings connecting subsets of nodes overlaid on physical paths, but in fact the overlaid logical network may not even be a ring in all cases!

(2) HM 5.2a-MA Assumes the Deployment of Interoffice Rings in a Manner that is Consistent with These Standard Industry Practices, Resulting in an Appropriate Estimate of the Amount of ADM and DCS Circuit Capacity Required

(continued)

52 Commonly, <u>both</u> multiple fibers and multiple wavelengths on a given fiber are utilized to increase the total amount of available capacity on a fiber route.

Q. PLEASE EXPLAIN HOW HM 5.2A-MA IMPLEMENTS THE CONCEPTS OF PHYSICAL AND LOGICAL RINGS YOU HAVE PRESENTED ABOVE.

A. The process of forming rings is described in considerable detail in Section 6.5.3.2 of the HM 5.2a-MA Model Description. Exhibit RAM-18, which I will describe later, depicts the resulting configuration. Basically, the model lays out cost-optimized physical transport rings involving up to 16 nodes,[54] with 24 fibers per ring. Rings are developed separately for the set of wire centers homing on each tandem switch. For a given tandem switch, the process results in a set of physical rings, one or more of which, but not necessarily all of which, include the tandem itself. Knowing the number of interoffice circuits the switch in each wire center must support, based on the traffic calculations it has done, the model then determines the amount of multiplexing equipment and ADMs required to connect that wire center to one or more OC-48 four-fiber Bi-directional Line Switched Rings.

Because HM 5.2a-MA is a cost model, not a detailed network planning model, it does not need to know which node is connected to which specific logical ring. What it <u>does</u> need to know is how many logical rings there are on a given physical ring. It requires this information since generally there will be circuits between nodes on different logical rings, so the logical rings must be connected to each other. HM 5.2a-MA assumes the different logical rings are connected at a hub on the physical ring. Again, in a cost model, the exact location of the hub is irrelevant, but it must be provisioned with

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[53] The figure and text are taken from the document appearing at URL http://www.hansolel.co.kr/english/network/dwdml090101.htm

[54] A sixteen-node limit was formerly imposed by signal synchronization considerations. Today, rings may contain a greater number of nodes. But generally the HAI developers have found that the cost optimization process

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sufficient capacity to support the interconnection of all the logical rings. The model sums up the circuit capacity of the nodes on the physical ring, multiplies by the quantity (1 + transit factor), where the transit factor is set to .4. to conservatively accounts for rings needing to carry "transit circuits" between two other rings, divides by the circuit capacity of an OC-48 ring, and assumes the answer to be the number of logical rings on the physical ring. It then provides sufficient ADMs and digital cross connects (DCS) at the hub point to allow for full interconnection of the logical rings.

There are circuits between nodes on different physical rings as well. Thus, the model also makes provision for linking rings to each other. Each ring-ring link is assumed to be deployed as a pair to provide redundancy; this is done by doubling the structure, cable, and ADM/DCS investment associated with the link. Enough such ring-ring links are provided to ensure that every physical ring serving nodes belonging to a given tandem is connected back to a ring on which the tandem resides. The connections may be direct or through another ring that is connected back to the tandem.

Finally, using the terminology that a ring "system" is the set of all interconnected physical rings serving nodes that home on a given tandem, the model provides for a mesh interconnection of all the ring systems belonging to tandems in a given LATA. Thus, for instance, if there are N tandems in a LATA, the model provides for N * (N-1) system-to-system links in that LATA.

The resulting ring and link configuration produced by the model is depicted in Exhibit RAM-18. Part a of the figure shows one physical ring, three logical rings

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seldom produces rings of greater than 16 nodes even if the limit is relaxed. The sixteen-node limit has therefore been retained in the model.

overlaid on that physical ring, each of which connects a subset of the nodes to each other, and a hub that provides connectivity between the logical rings. Part b of the figure is a broader view that shows the links between different physical rings to form a fully interconnected ring system associated with one tandem, and links between the ring systems belonging to different tandems.

Q. DOES HM 5.2A-MA PRODUCE A REASONABLE ESTIMATE OF THE AMOUNT OF TERMINAL EQUIPMENT (ADM'S AND DCS) REQUIRED TO INTERCONNECT LOGICAL RINGS?

A. While the calculation is not as sophisticated as it could be if the model were in possession of, and able to use, data on all of Verizon's point-to-point circuit requirements, I believe it nevertheless produces a reasonable, if not conservatively high, estimate of the number of logical rings, and thus the amount of ring interconnection equipment required. First, in determining the amount of interconnection capacity required, the model increases the circuit requirements by 40% above the circuit requirement estimated by adding up the circuit capacities of each node. This is done to account for transit circuits that may be passing through the node in question. Transit circuits are circuits between nodes on two different physical rings that pass through one or more intermediate physical rings.

Second, the model assumes every circuit on each logical ring must be fully interconnected at the hub. In reality, many circuits would start and end on the same logical ring, and not need to be cross-connected to another logical ring at the hub.

Finally, the model cannot reuse circuit capacity around a ring as an engineer configuring a ring would be able to do. I am referring to the practice in which the capacity committed to a circuit between, say, nodes A and B on a ring, can be reused for circuits between other nodes elsewhere on the ring. Lacking the point-point capacity requirement data, the model assumes each circuit goes all the way around the ring in each direction.

(3) Mr. Gansert's Fundamental Misunderstanding of the Distinction Between Logical and Physical Rings Causes Him to Overstate the Terminal Equipment Capacity Requirements that HM 5.2a-MA should meet.

Q. BUT MR. GANSERT CLAIMS HM 5.2A-MA SIGNIFICANTLY UNDERESTIMATES THE AMOUNT OF TERMINAL EQUIPMENT REQUIRED TO CONNECT NODES TO EACH OTHER. WHAT IS THE SOURCE OF THE DISCREPANCY BETWEEN HIS OPINION AND YOURS?

A. It stems from Mr. Gansert's failing to recognize the distinction between physical and logical rings, or what Mr. Turner refers to as fiber rings and SONET rings, respectively. In Mr. Gansert's opinion, there must be sufficient capacity at every node on a physical ring to terminate each and every circuit that any node on the ring originates or terminates. For instance, if the nodes on a physical ring had a total circuit capacity of, say, 300 DS-3s, then every node would have to have enough capacity to terminate that many circuits. This would create the need for an overwhelming number of circuits, particularly since the physical rings produced by the model generally have a number of nodes in the vicinity of the maximum number allowed, 16. His entire thesis is predicated on this idea, which, as Mr. Turner demonstrates, is fallacious. If there were 15 nodes on a physical ring whose circuit capacity totaled 300 DS-3s, there would need to be enough ADM capacity altogether to terminate 15 * 300, or 4,500, DS-3s. Of course, Mr. Gansert admits there could be some reduction due to circuit reuse, but that reduction is entirely dependent on knowing the circuit capacity between every pair of nodes to realize these reuse opportunities.

By contrast, if the physical rings are divided into, say, five logical rings, each supporting nodes with roughly the same amount of aggregate capacity, the nodes on each logical ring would only need to terminate 20% of 300, or 60, DS-3s each. This is what Exhibit RAM-17 is portraying, although HM 5.2a-MA creates logical rings based on the use of multiple sets of strands rather than on using multiple wavelengths in a WDM system.[55] Therefore, there would need to be only enough ADM capacity in the 15 nodes to terminate 15 * 60, or 900, DS-3s, plus enough ADMs at the hub to terminate all 300 ADMs, for a total of 1,200 ADMs, or only 27% of what Mr. Gansert claims. Of course, hubs must include another piece of equipment – the DCS required to fully interconnect the DS-3s – but this still leaves a considerable savings. HM 5.2a-MA takes advantage of the logical ring construct to realize those savings.

Q. DO YOU HAVE ANY COMMENTS TO MAKE ON MR. GANSERT'S SPECIFIC ASSERTIONS?

A. By and large, Mr. Gansert's specific statements are predicated on his fundamental misunderstanding that all DS-3s on a given physical ring must be terminated in each node on the ring, and could be rejected in their entirety on that basis. However, a few specific comments are worth addressing, particularly inasmuch as they cast light on the difference of his approach and the approach employed in the model.

At p. 29, Mr. Gansert says HM 5.2a-MA puts "an ad hoc amount of additional equipment investment in these so called 'hub' offices. In reality, the amount of equipment is not "ad hoc" at all, but provide enough capacity to fully interconnect all the DS-3s on any logical ring belonging to the physical ring.

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[55] The model checks to be sure that the 24-strand fiber optic cable assumed by the model has sufficient strands on a given physical ring to support all the logical rings on that ring, assuming four strands per logical ring (since we

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At p. 30, Mr. Gansert refers to the "impossibly large ring configurations constructed by the Model." This is a manifestation of his confusion between physical transport rings and the logical rings that interconnect specific, much smaller, numbers of nodes.

At p. 31, Mr. Gansert states that "all the 'through' DS-3s on a ring segment must pass through the ADM at each end of the segment, not just those DS-3s terminating at the node. The more nodes on a ring, the more 'through' traffic handled by each ADM on the ring. Later, at p. 33, he says that "every node on a SONET ring must have the same number of ADMs. Stand-alone ADMs provide no functional capability; they must be married to the fiber and an ADM at every other location on a ring." He is right, but only with respect to the logical, or SONET, rings constructed by the model. Each node has enough ADM capacity to terminate all the circuits on the logical ring that serves that node. Furthermore, every logical ring also terminates on an ADM in the hub, where the circuits belonging to different rings are cross-connected through a DCS. So Mr. Gansert's characterization that the model assumes "a small 'pool' of additional ADMs can magically create 'logical' rings"[56] is simply a pejorative statement borne of his lack of understanding of industry practices and the way the model operates.

At p. 31, Mr. Gansert states that the model "cannot determine the actual through [circuit] requirements; it cannot even crudely estimate them. The entire IOF calculation in the Model is based solely on the estimated total IOF traffic from each wire center." At p. 32, he goes on to describe the Verizon planning process as an "extraordinarily

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are assuming four-fiber BSLR rings), and provides additional fiber cables if necessary.

complex, iterative process in which demand already loaded on the ring may have to be moved or reconfigured to get the most efficient design" (emphasis added). In a sense, Mr. Gansert is right when he says the model fails to recognize this complexity, because it lacks the point-point circuit information needed to do this "extraordinarily complex" optimization. What the model does instead is proceed in a more "brute force" fashion by assuming that each node's traffic must travel all the way around the SONET ring it belongs to in each direction. This leads to a less efficient ring configuration than what otherwise might be possible, and thus a conservatively high estimate of interoffice investment. Incidentally, given the iterative, extremely complex nature of the Verizon planning process, I find it that much more curious that Verizon has represented to AT&T that it has no interoffice planning documents, so this extreme complexity is apparently left up to ad hoc decisions by each individual planner.

At p. 31, Mr. Gansert says that "[the estimated total IOF traffic from each wire center] in turn is derived from ARMIS access line data and some old Bellcore factors for busy-hour centum call seconds per-line." The "old Bellcore data" Mr. Gansert is referring to appears in the December, 1998, issue of the Telcordia LSSGR, the latest issue available at the time of my direct testimony. This hardly constitutes "old data." Mr. Gansert continues this point to say that using this "old" data is the cause of his earlier claim (p. 28) that HM 5.2a-MA understates tandem trunk requirements in Massachusetts by a factor of 20. However, that is not the source of the discrepancy he alleges. Instead, the key factor in the calculation of tandem traffic is the fraction of local, toll, and

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56 Gansert, at p. 33.

interLATA access traffic that is routed via the tandem. Those fractions are input parameters to the model, and can be adjusted if necessary. But when we asked Verizon for information on the fraction of traffic that is routed via a tandem, we were told that information is not available.[57] Since that is the case, it is meaningless for Verizon to claim that the model is wrong in this regard, since neither Mr. Gansert nor anyone else has produced evidence on the amount of tandem routing in Verizon's network.

At p. 34, Mr. Gansert presents his rationale as to why the model would require many more ADMs than it provides. In his explanation, a large number of ADMs would be added at each node. As near as I can tell, they would have no function whatsoever, since those nodes do not require the excess capacity. Instead, the model provides them once, at the hub, in associated with a DCS that can cross-connect the circuits from different rings. Transport hubs where transmission facilities come together so the circuits they carry can be cross-connected between route are a common architecture in both local exchange and interLATA networks. Mr. Gansert apparently agrees there are wire centers where rings are cross-connected (see p. 36). Such a wire center is depicted in Exhibit RAM-19. I have labeled the two rings as Ring A and Ring B, with ADMs at the cross connect point having circuit capacity C_A and C_B, respectively. The total capacity of the ADMs in the wire center is $C_A + C_B$. Mr. Gansert's characterization of what the model should do is tantamount to saying that extra ADMs with capacity C_B would have to be deployed at each node on ring A in addition to the ADM capacity C_A that is already

[57] AT&T Request 2-7(b), dated May 8, 2001, to which Verizon responded "The data requested is not available and would require a burdensome time-consuming special study to produce. Verizon does not keep such therefore cannot provide actual data or an estimate."

deployed there. This is obviously nonsensical, and the model rightly does not do this -- each node on Ring A has only the Capacity C_A.

Finally, at p. 36, Mr. Gansert says that rings are interconnected within wire centers, not through links between wire centers on the respective rings. Exhibit RAM-20a shows the interconnection assumed by HM 5.2a-MA. This configuration is assumed to avoid an additional complexity in the calculation of rings that would result if one ring were forced to run through a wire center on another ring. But a point Mr. Gansert apparently misses is that the model doubles the transport facilities and the ADMs at each end of the link as shown by the redundant connection, thereby providing two links between the rings.[58] There are thus four ADMs, two DCS, and two transport links between the wire centers assumed, as shown. This obviates Mr. Gansert's claim that the single link is a "bottleneck" that is "incredibly vulnerable to failure." Interconnection within a wire center has already been shown in Exhibit RAM-19. Exhibit RAM-20b shows that the HM 5.2a-MA interconnection configuration can be readily mapped into interconnection within a wire center. When this is done, the interconnection may actually require less transport route distance,[59] and it requires three fewer ADMs and one fewer DCS[60] than does the arrangement assumed by HM 5.2a-MA. Thus, HM 5.2a-MA conservatively overestimates the investment required to interconnect two physical rings.

[58] To facilitate the calculation of the ring interconnection costs, the transport investments are doubled as if the links were between the same pair of wire centers. We have recently studied a modification of the model that finds the next closest wire center pairs on the two rings and provides enough facilities to connect them. The difference in investment is small, and the difference in monthly cost for transport UNEs is almost insignificant.

[59] Because the route from the adjacent wire center on ring A directly to the wire center on ring B can be more direct than first routing to the wire center on A and then to the wire center on B.

Q. AS A BOTTOM LINE STATEMENT, MR GANSERT CLAIMS (P. 33) THAT "THE HATFIELD MODEL [SIC] GREATLY UNDERSTATES IOF COSTS BECAUSE IT OMITS MUCH OF THE COST OF THE MODEL'S INEFFICIENT IOF ARCHITECTURE." ON WHAT BASIS DOES HE CLAIM THE MODEL UNDERSTATES IOF COSTS?

A. He presents no basis whatsoever for this claim. In fact, when AT&T asked Verizon to supply its total investment in interoffice facilities, Verizon responded that it did not have such information.[61] So I cannot figure out how Mr. Gansert can possibly know that we understate IOF investments or costs.

Q. AT P. 67, DR. TARDIFF CLAIMS THAT "WHILE THE ADD-DROP MULTIPLEXERS ("ADMS") LOCATED IN EACH WIRE CENTER AND THOSE THAT ARE USED TO CONNECT RINGS THAT DO NOT OVERLAP AT A TANDEM ARE EQUIPPED WITH OC3 MULTIPLEXERS, ADMs USED TO JOIN THE SO-CALLED 'LOGICAL RINGS' DO NOT." CAN YOU COMMENT ON THIS CLAIM?

A. He is correct, but the model operates properly in this regard. My direct testimony explained why this difference in treatment is appropriate:

> Second, the same worksheet in the SIO module has been modified to remove the OC-3 multiplexers that were previously associated with the ADMs configured by the model in the interoffice network to cross-connect the logical rings on a given physical ring. The presence of OC-3 multiplexers allowed the cross-connection of individual DS-1 (1.544 megabits per second, consisting of 24 individual digitized voice circuits). However, this is an unnecessary level of "granularity" in the cross-connect capability on a given ring. Instead, HM 5.2a-MA assumes the cross-connects are made at the DS-3 level (28 DS-1s). There are, however, still OC-3 multiplexers associated with the ADMs at either end of the links between the different physical rings associated with a given tandem switch, and between the ring "systems" associated with different tandem switches.[62]

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[60] Even if one were to assume there were two points of interconnection between the two rings, two fewer ADMs would still be required, although it might involve somewhat more transport route distance.

[61] AT&T Request 2-46 dated May 8, 2001, asked Verizon to provide the total investment in the interoffice network estimated by the Verizon cost study, to which Verizon replied, "The cost study does not estimate total investments in the interoffice network."

[62] R. Mercer Direct Testimony, p. 48.

Amplifying on the point about granularity, since there are only a small number of logical rings on a given physical ring, it does not consume much capacity to commit circuit capacity on a given logical ring to each of the other logical rings on the same physical network in units of DS-3s, obviating the need for demultiplexing the cross-connected signals to the DS-1 level. However, to do the same to every other logical network on every physical ring would consume a great deal of capacity, so for the interconnection between physical rings, the model assumes demultiplexing to the DS-1 level via OC-3 multiplexers.

(B) In Summary, Dismissing Mr. Gansert's, As Well As Mr. Tardiff's, Incorrect Statements about HM 5.2a-MA's interoffice ring calculations, the Model Produces a Reasonable Estimate of Interoffice Ring Investment Consistent with the Limited Engineering Data Available to the Model.

Q. PLEASE SUMMARIZE YOUR COMMENTS ABOUT MR. GANSERT'S DISCUSSION OF THE INTEROFFICE RING CALCULATIONS OF HM 5.2A-MA, AND MR. TARDIFF'S ASSERTION ABOUT A SPECIFIC ERROR IN THE CALCULATION.

A. Mr. Gansert's comments are meaningless because they are based on an incorrect understanding about how interoffice fiber rings are constructed. I have addressed and resolved what few specific claims he makes that survive this fundamental error. As for Dr. Tardiff's claim about the signal level required to interconnect logical and physical rings, the model uses an appropriate level for each type of interconnection.

Q. DOES THIS CONCLUDE YOUR SURREBUTTAL TESTIMONY?

A. Yes, it does.