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

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

AFFIDAVIT OF JASON ZHANG
IN SUPPORT OF
GTE'S PETITION FOR RECONSIDERATION
OF THE TENTH REPORT AND ORDER

I, Jason Zhang, being duly sworn, say:

INTRODUCTION & SUMMARY

1. My name is Jason Zhang. I am employed by GTE as a Specialist -- Costing.

2. I received a Master's degree in 1994 and a Ph.D. in 1997 in Economics, both from Boston University. In addition, I have completed three years of graduate studies in Statistics. My areas of specialization are telecommunications economics, applied game theory, and industrial organization. My Ph.D. thesis focused on issues of costing, pricing, competition, and regulation in the cellular telephone industry.

3. Over the last six years, I have worked on the development, analysis, and application of telecommunications cost models. In particular, I have analyzed extensively various versions of the HAI Model (previously called

the Hatfield Model), the Benchmark Cost Proxy Model ("BCPM"), and the Hybrid Cost Proxy Model ("HCPM"). I have attempted to analyze the so-called "synthesis" model ("FCC Model" or "Model") platform adopted by the Federal Communications Commission (the "Commission" or "FCC") on October 28, 1998, in its Fifth Report & Order.[1] I previously filed an affidavit detailing the flaws associated with the FCC Model platform in support of GTE's Petition for Reconsideration of the Fifth Report & Order.

4. The objective of my present analysis was to determine whether the inputs adopted by the FCC in the Tenth Report and Order[2] are based on sound analysis, supported by the evidence in the record, and will produce reasonable, reliable and predictable estimates of the cost of universal service.

5. I have concluded that many of the adopted inputs are based on faulty and flawed methodologies and data, that many are not based on evidence in record, and many others are the result of inconsistent application of the FCC's own cost model criteria. I have also concluded that use of those inputs will lead to understated costs and distorted relative cost relationships between high and low cost areas. Adopting the recommendations contained in this affidavit will lead to a more reliable set of input values, as well as reasonable, reliable and predictable universal

[1] 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, 97-160, FCC 98-279, *Fifth Report & Order* (rel. Oct. 28, 1998). This docket -- CC Docket Nos. 96-45 and 97-160 -- is hereafter referred to and cited as the "Universal Service Cost Model Docket."

[2] Universal Service Cost Model Docket, FCC 99-304, *Tenth Report and Order* (rel. Nov. 2, 1999) ("Order").

service cost estimates, as required by the Telecommunications Act of 1996 (the "Act").

THE COMMISSION'S FLAWED USE OF THE NRRI STUDY LEADS TO UNDERSTATED COSTS AND DISTORTED RELATIVE COST RELATIONSHIPS

6. In the sections that follow, I explain that there are many problems associated with the FCC's use of the NRRI Study to extrapolate input values for non-rural LECs. In summary, the NRRI Study, as adopted by the Commission, is flawed. The NRRI Study's incomplete contract costs and arbitrary manipulation of the data causes overall costs to be understated. Inadequate data and flawed methodologies further lead to unreliable estimates for the coefficients in the cable and structure cost equations. Since those coefficients determine the relative costs (high cost areas vs. low cost areas), the unreliable estimates distort this relative cost relationship. This distorted relative cost relationship, in turn, distorts the characterization of high cost and low cost areas and thus leads to a distorted universal service fund. The flawed use of NRRI data affects structure cost inputs more than cable cost inputs because they depend more heavily upon the geological variables. Thus, my discussion relates mainly to structure costs.

Arbitrary Manipulation of Data Leads to Underestimated Costs

7. To begin with, the cost data collected by the NRRI Study are inadequate because the authors do not include all relevant costs. The data is biased downward by the NRRI Study's removal of high cost contracts from the data. The Commission used the Huber adjustments to arbitrarily reduce

further the weight of the high cost contracts that remain. These manipulations reduce the average cost of the sample data, and lead to understated cost estimates, using any econometric analysis. Some of the understated inputs are further reduced by the FCC's improper purchasing power adjustments.

8. The FCC did not dispute that the NRRI Study authors eliminated loading costs from some contracts (some of which were as high as 10.44% of the contract amount[3]) due to uncertainty about how to assign them. The FCC has provided no reason why it is appropriate to exclude those legitimate costs. The FCC also did not dispute that the NRRI Study removed only high cost contracts from its data, but claimed the removal was justified by *a priori* reasoning or record evidence.[4] For example, the FCC pointed out that certain excluded observations reflected higher costs in lower density areas, which, as the FCC noted, contradicted other evidence that structure costs generally increase as population density increases.[5] However, as the FCC acknowledged, the high cost contracts are unlikely to be errors.[6] The reasonable approach would have been to account for the high cost contracts, instead of eliminating them in a seeming effort to make the data

[3] Universal Service Cost Model Docket, *Comments of GTE Service Corporation and its Affiliated Domestic Telephone Operating Companies in Response to Further Notice of Proposed Rulemaking* (July 23, 1999), at p.18. ("GTE Comments").

[4] Order at ¶ 119.

[5] *Id.*

[6] Order at ¶ 144.

fit the desired results. The removal of high cost contracts seems to serve only the purpose of lowering the cost estimates.

9. The FCC defended the Huber adjustments by claiming they helped attain the goal of "estimat[ing] values that are typical for cable and structure costs for different density and terrain conditions."[7] The FCC further stated that the Huber adjustments treated "symmetrically" observations that have high or low values. Neither defense has merit.

10. First, the FCC's own cost model criteria state that "the cost study or model must estimate the cost of providing service for all businesses and households within a geographic region."[8] The only way to meet this standard is to include the costs of all areas, regardless if they are "typical" or not. Given the nature of the RUS data, the use of the Huber adjustments will bias the "typical" costs to the low side, making the FCC Model incapable of estimating the cost of providing services for all businesses and households within a geographic region.

11. Second, the Huber adjustments could not have treated the high and low cost contracts "symmetrically" because extremely high and low cost contracts could not have presented themselves in the RUS data symmetrically. Most observations in the RUS data are in the lowest density areas, which, with initial removal of high cost contracts, reflect mainly contracts with easy placement conditions. As a result, the average

[7] Order at ¶ 142 (emphasis added).

[8] In the Matter of Federal-State Joint Board on Universal Service, CC Docket No. 96-45, *Report and Order,* FCC 97-157 (rel. May 8, 1997) at ¶ 250 ("Universal Service Order") (criterion 6).

cost of those contracts is very low. Since contract costs can never be negative, the contracts that reflect extreme values, or "outliers," are more likely to be high cost contracts.[9] Those high cost contracts are unlikely to be errors, and must have reflected more difficult placement conditions, such as the need for traffic control and cutting through roads, and should not be discounted. Although such conditions are not typical in rural areas, they are frequently encountered in a non-rural setting. Again, the only apparent purpose of the Huber adjustments is to produce lower cost estimates.[10]

Inadequate Data and Flawed Methodology Distort the Relative Costs

12. In addition to manipulating the RUS raw data to reduce the overall level of cable and structure costs, the FCC approach ignores the fundamental weakness of the data and uses flawed methodology to estimate cable and structure cost equations. The FCC ignores the fact that RUS data do not describe a cost causative relationship between the modeled cost and the explanatory variables. The FCC inappropriately applies to ordinal (ranked) variables statistical techniques that are appropriate only for cardinal (quantitative and continuous) variables. The FCC also uses an unrepresentative data set for its pole cost estimation. Finally, the FCC arbitrarily separates the buried cable and structure cost equation into two.

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[9] Imagine that the cost of contracts follows a normal distribution with contracts with extreme values showing up at the tails of the distribution. The constraint that contract costs have to be positive simply makes the tail of distribution corresponding to lower cost contracts truncated at zero.

As a result of these errors, the estimates for the coefficients in the cost equations are unreliable. Since these coefficients determine the relative costs, the unreliable estimates will lead to distorted relative costs, which will further lead to a distorted universal service fund.

13. GTE previously expressed its concern that a mismatch between dependent and independent variables makes the NRRI Study flawed.[11] The FCC did not dispute this or that it caused a bias. That is, the Commission did not dispute that there may not be a cost causative relationship between the modeled costs and the explanatory variables. This failure to describe a cost causative relationship would lead to unreliable cost estimates. The FCC argued that since GTE had not identified the direction of the bias, and since the coefficients of the variables for geological variables were generally significant, the mismatch was not a problem.[12] This is not true.

14. The results of an econometric analysis are useful only if the econometrics equation is correctly specified and the data reflect the underlying causal relationship in the specification. A mis-specified equation, such as one with omitted variables, will generally lead to biased estimates.[13] The structure cost equations adopted by the FCC are mis-specified because

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[10] Universal Service Cost Model Docket, *Comments of Bell South Incorporated* (July 23, 1999), at Table 1, ("Bell South Comments"). *See also* GTE Comments at Attachment 3.

[11] GTE Comments at p. 22.

[12] Order at ¶ 125.

[13] *See Econometric Models & Economic Forecasts*, Robert S. Pindyck & Daniel L. Rubinfelf. McGraw-Hill, Inc., at pp. 163-164, Section 7.3.1.

they contain only a limited number of variables. They do not include variables such as the need for traffic control, the need to cut through roads, etc., that increase costs. This mis-specification compounds the problems with the NRRI data, making the cost results even more unreliable. While the structure cost data used in the NRRI Study typically come from small contracts that cover small geographical areas (e.g., the specific area needed to place a pole), the explanatory variables (e.g., the geological variables) come from rural companies' entire serving areas, some of which are as large as 9,500 square miles.[14] Granted, the cost of placing structure depends on the geological conditions where placing occurs. But, the cost of placing structure in a particular location is unlikely to have much to do with the general geological conditions of an entire serving area. Therefore, there is unlikely to be a causal relationship between the modeled cost and the explanatory variables used in the NRRI Study. Without a causal relationship, the analysis of the data is meaningless and the cost estimates based on that analysis will be unreliable for any purpose. Since the relative costs depend on the correct estimates of the coefficients of the cost equations, unreliable estimates will lead to distorted relative costs. The direction of bias, even if it is possible to estimate, is irrelevant. What matters is that the relative costs and the universal service fund will be distorted.

[14] NRRI data indicate that Western New Mexico Telephone Co., Inc., has a serving area of about 9,510 square miles.

15. The FCC's argument that some of the geological variables in part of its analysis are significant does not solve the problem caused by the mismatch. First of all, reliable estimates of the coefficients depend on both the significance and the correct magnitude of the estimates. To see why the significance of an estimate alone does not validate an analysis, one need only look at the FCC's underground structure cost equation. The coefficient for the "Water Indicator" variable is significant, which, using the FCC's flawed logic, would validate its analysis.[15] But, a more careful look proves that the Commission is wrong: the negative sign in the coefficient indicates that encountering water during placement reduces structure costs. That is an absurd result. Additionally, the same FCC study indicates that underground structure costs are not impacted by density, contrary to common experience.[16] Finally, only one-half of the geological variables used in its structure cost equations are significant.

16. GTE also previously expressed the concern that the NRRI Study uses improperly averaged ordinal variables that indicate soil type, rock hardness, and the presence of high water table, again leading to unreliable estimates.[17] The FCC did not seem to dispute that those variables are, in fact, ordinal. But, the FCC argued that the NRRI Study's methods "do not reflect an incorrect averaging of ordinal data" because "they are based on averages of data obtained from the HAI database for

[15] Order at Attachment B-12.

[16] Order at ¶ 119.

the Census Block Groups in which the RUS companies operate," and that "HAI uses as cardinal values, i.e., quantitative values, the soil and rock data from which the averages reflected in the rock and soil variables in the NRRI Study are calculated."[18] As with the use of mismatched data, the FCC supported its approach by citing the statistical significance of those variables, and the lack of the evidence showing the direction and magnitude of the bias.[19] Neither argument has merit.

17. Its first argument, the FCC seems to indicate that if there were improper averaging of ordinal variables, the HAI Model, not the FCC, was to blame. The fact that the selected values come from the HAI Model proves, if anything, their unreliability, since even the developers of that model concede that they fabricated its soil texture data.[20] The use of improperly averaged ordinal variables will lead to unreliable estimates for the coefficients in the cost equations. Regardless of the direction of the bias, the use of these ordinal variables will lead to distorted relative costs.

18. The FCC also mistakenly relied on the statistical significance of the soil type variable to validate the use of observations that were fabricated by HAI Model.[21] As stated previously, the significance of the variables does

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[17] GTE Comments at pp. 19-21

[18] Order at ¶ 124.

[19] *Id.*

[20] GTE Comments at Attachment 2.

[21] GTE Comments at p. 21 and Attachment 2; Order at ¶ 125.

not validate an analysis and certainly does not validate the use of those fabricated observations.

19. In response to evidence that the separation of buried cable and structure cost equation into two are without basis and could lead to questionable results,[22] the FCC first contended that the value of its separated structure cost intercept was within the range of the costs provided by the HAI Model and by AT&T/MCI. But, as the FCC has pointed out on many occasions, the HAI Model inputs tend to be unsubstantiated expert opinions and on the low side.[23] Having found that its structure cost intercept fell within the range of low numbers from AT&T/MCI and the HAI Model, the FCC should have concluded that its structure cost intercept was too low.

20. The FCC further stated that the separation did not really affect any costs except engineering loading. That is wrong. Even without the differences in the engineering costs for cable and structure as recognized by the FCC, the total costs of buried cable and structure costs would still be affected by how the intercept is split. The FCC Model populates the structure costs by density and terrain, while it populates the cable costs by size and placement. As a result, there is no way to ensure that the total cost for given quantity of buried cable and structure from the combined equation is recovered by the separate costs from the structure and cable. For example, suppose the FCC's combined equation says that it costs $15 to

[22] GTE Comments at p. 52.

[23] Order at ¶ 165.

place one foot of buried, 24-gauge, 400-pair cable and structure in normal terrain in a density zone of 100 lines per square mile. In this case, the FCC Model determines the cable costs by using the size and type of placement (buried). If the cable cost is $7 per foot, that would leave $8 per foot ($15-$7) for the structure cost for the buried cable. But, the Model does not use only the particular type of placement for the cable (buried) to figure out the structure cost of the cable. Instead, it also uses the density of the area (100 lines per square mile) to determine the percentages of aerial, buried and underground placements for the density, and then calculates the structure cost as the weighted average of the structure costs from the three placement methods. There is no way to be sure that the weighted average will equal the necessary $8. Therefore, how the intercept term in the combined buried cable and structure cost equation is split can affect the total costs of buried cable and structure produced by the Model. This is another reason why the FCC's adopted buried cable and structure costs for density zones 1 and 2 are unreliable.

21. GTE expressed concern that the FCC's regression for pole costs was unreliable because the pole cost equation was estimated using only 19 observations covering only 6 states, and differences in freight costs and terrain conditions in different areas, which the Commission ignored, could cause significant structures cost differences.[24] Additionally, GTE expressed concern that the rural, suburban and urban probabilities the

[24] GTE Comments at p. 15.

NRRI Study used to calculated pole accessory costs were unsupported and appeared to be solely a construct of the NRRI Study authors.[25]

22. The FCC conceded that the number of observations used in the estimate was far less than the minimum of 10 times the number of parameters that the FCC previously stated was necessary to arrive at reliable estimates.[26] The FCC abandoned this requirement for two reasons, neither of which withstands scrutiny from an econometric perspective. First, the FCC noted that the pole material cost it estimated from the sparse data was close to the average from the data and to the average of some incumbent local exchange carrier ("ILEC") responses to a FCC data request.[27] The FCC does not seem to understand that a linear regression will always produce a predicted mean value that is identical to the mean of the data sample on which the regression is based. The FCC's result is doubtful because the explanatory variables in the Commission's equation accounted for less than 30% of the variation in the cost of poles for the rural companies in the sample. In addition, since freight and terrain conditions can significantly affect a pole's cost, the similarity in material costs for poles alone does not establish that the FCC estimates are sufficient for total pole costs. Second, the FCC claimed that "GTE does not provide any evidence that suggests that a sample size of 19 poles for developing structure costs produces biased estimates…." Again, the

[25] GTE Comments at p. 52, fn. 81.

[26] Order at ¶ 123.

FCC forgets that in order for the cost estimates to provide valid relative costs, the estimates for the coefficients must be reliable. As I have explained above, unreliable estimates lead to distorted relative costs, regardless the direction of the bias.

23. Finally, GTE was concerned that the rural, suburban, and urban probabilities used by the NRRI Study to calculate the costs of pole accessories were unsupported and appeared to be solely a construct of the NRRI Study authors.[28] The FCC did not address this issue. As a result, the total pole cost estimated from the NRRI Study is not reliable and should not be used as basis to estimate the aerial structure costs for non-rural LECs.

NRRI Study-Based Inputs Lead To Understated Costs And Distorted Relative Costs, And Therefore Should Be Discarded

24. Faced with the numerous concerns expressed by the industry on the use of the NRRI Study, the FCC recognized that the cost data from state studies in North Carolina, South Carolina, Indiana, Nebraska, New Mexico, Montana, Minnesota, and Kentucky filings "are more reliable than the extrapolated data" from the NRRI Study, and accordingly adopted the state data as the inputs for the structure costs for underground and buried for density zones 3-9.[29] GTE has long maintained that only the use of the company-specific inputs can estimate the cost that a company in the

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[27] *Id.*

[28] GTE Comments at p. 52, fn. 81.

[29] Order at ¶¶ 220 - 222.

real world can be expected to incur on the forward-looking basis. In absence of that, GTE welcomes the FCC's efforts to make cost estimates more reliable by basing the inputs on actual state data from non-rural company serving areas instead of extrapolating them from NRRI data that contain no such information. The FCC's adopted structure costs based on the state data are more reasonable and logical than those based on the flawed use of the NRRI Study.

25. However, aerial structure and the underground and buried structure costs for density zones 1 and 2 are still based on the flawed use of the NRRI Study. In fact, since the inputs based on NRRI Study are so understated, they cause an illogical disconnect between density zones 2 and 3. For example, the underground normal structure costs for an area with a density of 100 lines per square mile is more than four times that of an area with a density of 99 lines per square mile.[30] Even worse, the FCC's underground structure equation shows counterintuitive results -- the underground structure costs have nothing to do with an area's density, and even <u>decline</u> when water is encountered in the placement,[31] leading to a distortion of relative costs.

26. In absence of company-specific inputs, the FCC should use the same state data for the aerial structure costs for all density zones and the underground and buried structure costs for density zones 1 and 2. This

[30] Per hcpm_inputs_October1999.xls, the Normal underground structure for an area with density of 99 lines per square mile is only $1.68 per foot, but the same structure cost for an area with a density of 100 lines per square mile is $7.63 per foot.

will make the cost inputs more reliable and will resolve the apparent disconnect in the current input values between density zones 2 and 3.

THE FCC SHOULD ADJUST ITS POLE COST INPUTS

27. Although the FCC has continuously made platform-related changes in the input phase of this proceeding, e.g., changing switching formulae to correct the trunk investment calculation,[32] it refused to make a necessary correction to its per foot pole investment calculation,[33] arguing that it would represent a platform change.[34] The FCC's refusal to make the correction is without basis because the errors can be corrected through simple changes in the input values in the aerial structure cost tables.

28. Here is an example of how to make the correction: (1) select the state for which the cost study is needed. Run the clustering algorithm and use the resulted clusters to figure out the average size of clusters.[35] For example, if GTE-Oregon is chosen and 18 kft. is chosen as maximum size of cluster, the average cluster size is about 3.76 square miles. (2) Use the FCC default value of two SAIs per cluster and assume each SAI serving area is square and identical with the SAI located in the center. Use the average cluster size to calculate the typical distribution length for the SAI

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[31] Order at Attachment B-12.

[32] *See* RFCC_switching_io_October1999.xls, wire center investment!BU2 for an example.

[33] GTE Comments at p. 51.

[34] Order at fn. 465.

[35] If national average inputs are desired, then a sample of states can be run and resulted clusters pooled to generate the average cluster size.

serving areas for the clusters. For the example, it is about 3,620 feet.[36] (3) Based on the typical distribution length, calculate the adjustment factors for density zones 1-2, density zones 3-4, density zones 5-6 and density zones 7-9, respectively as follows. For each group of zones, the adjustment factor is equal to ratio of number of poles required based on GTE's correct formula and based on the FCC's current calculation (which is 1 less than output from GTE's correct formula) and the pole spacing for the group of density zones. For the example, the adjustment factors are 1.07, 1.06, 1.05 and 1.04 for the four zones used in the FCC pole calculation.[37] (4) apply those adjustment factors, by density and terrain, to the current FCC pole cost per foot inputs or the inputs based on state data that the FCC should adopt in absence of company-specific inputs. The adjustment factors described above are conservative because they are based upon an 18 kft. maximum cluster size. Use of a 12 kft. maximum cluster size should produce substantially higher factors.

29. GTE also pointed out that telephone companies used a variety of pole sizes, and that the taller the poles, the more likely they are to be shared. Since the FCC Model uses only the 40-foot poles and assumes all poles are shared, the amount of investments assigned to the ILEC will always be underestimated.[38] The FCC did not refute GTE's contention, but

[36] Sqrt[3.76/2]*5280/2=3620.

[37] For the example, the number of poles required for each SAI area per GTE (FCC) based on FCC pole spacing for the group zones are as follows: Zones 1-2: 15 (14), Zones 3-4: 19 (18), Zones 5-6: 22 (21) and Zones 7-9: 25 (24).

[38] GTE Comments at p. 50.

refused to make changes, citing insufficient evidence about the various pole sizes in a particular density zone.[39] The FCC decision is perplexing. The RUS data clearly indicated that the RUS companies used various pole sizes. Common sense proves that not all poles are shared. The FCC cited no evidence to contradict these facts, but adhered to its flawed approach, unsupported by any evidence in the record, that allows the use of only one pole size and assumes that all poles are shared. The FCC should increase the share of the aerial structure costs borne by the ILECs to account for the undisputed fact that not all poles are the same size and not all are shared.

THE TFI STUDY SUPPORTS
THE USE OF AT LEAST
<u>$45 PER LINE FOR MDF AND POWER</u>

30. I requested that Technology Futures, Inc. ("TFI") review the FCC's use of the TFI Study that was cited in the Order.[40] TFI has concluded, as have I, that the FCC misused the TFI Study in many significant ways.[41] As a result, its estimate for MDF and power investment is implausibly low. The FCC should correct its errors and adopt a conservative estimate of at least $45 per line to account for MDF and power investment for the RUS data.

31. The FCC mistakenly assumes that the "shell" percentage in the TFI study includes all MDF and power investment. According to TFI, the "shell" in

[39] Order at ¶ 222, fn 465.

[40] Order at ¶ 305, fn 638.

[41] Letter from Roy L. Hodges, Technology Futures, Inc., to Dr. Jason Zhang, GTE (dated December 22, 1999), attached as Attachment B to GTE's Petition for Reconsideration of the 10th Report and Order.

the TFI Study contained only part of MDF and power investments. It does not include "the protectors and the outside plant (OSP) cable terminated on the MDF," nor does it include "significant investments in power cables, fuse panels, filters, and low voltage electronic power equipment" that "was assigned directly to modules other than the shell."[42]

32. Second, the FCC misapplied the "shell" percentage that was derived from 1996 data to 1999 partial switching investment to estimate the amount of the MDF and power investment. In addition to its erroneous assumption that the "shell" included all MDF and power investment, the FCC's application of the ratio to 1999 partial switching investment suffered two more errors. The first is that the "shell" ratio in 1999 is expected to be substantially higher than the 8% for 1996. This is due to fact that while the total switching investment per line declined between 1996 and 1999, the costs of the "shell" components likely increased in the same period. As a result, the 1999 "shell" percentage would be substantially higher than 8%. The use of the 1996 "shell" percentage to 1999 switching investment will lead to substantially underestimated "shell" investment. The second error is that the FCC applied the "shell" percentage only to partial switching investments, rather than total switching investments.[43] This error compounded the extent of the underestimation for MDF and power investment. Based on 1996 FCC data, the TFI estimated "shell"

[42] *Id.* at p. 2.

[43] *Id.* at p. 1.

investment alone was about $33 per line in 1996, and is expected to be even higher for 1999.[44]

33. Third, the FCC's errors have led to ridiculously low estimates for the investments in MDF and power. To see how implausible the estimates are, one only needs to compare them to the estimates based on the HAI Model default values, estimates that have been shown by many to be unreasonably low.[45] Based on a FCC Model default run for GTE-Oregon, the FCC's proposed methodology would produce only about $10 per line for MDF and power investment.[46] In contrast, even the HAI Model default values would produce about $18 per line.[47] That is, the MDF and power investment estimated by the FCC is about one-half the unrealistically low HAI Model estimate.

34. Fourth, a reasonable estimate for MDF and power investment is much higher than the FCC estimate. According to TFI, the amount of "shell" investment for 1996 was about $33 per line, and is expected to be higher for 1999.[48] TFI's value of $33 per line is a conservative estimate for "shell" for 1999. To arrive at the amount of investment for MDF and power

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[44] *Id.* at pp. 2-3.

[45] For example, SBC indicated the reasonable MDF per line is $30. Universal Service Cost Model Docket, *Comments of SBC Communications Inc.,* (July 23, 1999) at p. 13 ("SBC Comments"). Sprint and GTE also commented that the HAI power investments were unreasonably low. Universal Service Cost Model Docket, *Comments of Sprint Corporation,* (July 23, 1999) at p. 44, Attachment 7 ("Sprint Comments"). *See also* GTE Comments at p. 66.

[46] The FCC Model default runs produces about $129 per line switching investment for GTE-Oregon. Applying 8% to that yields $10.32.

[47] The $18 HAI value includes $12 for MDF and $6 for power.

[48] Attachment B at pp. 2-3.

required in the FCC Model, the parts of MDF and power that are not included in "shell" must be added. These include "the protectors and the outside plant (OSP) cable terminated on the MDF," and "significant investments in power cables, fuse panels, filters, and low voltage electronic power equipment" that "was assigned directly to modules other than the shell."[49] Due to time constraints, I have not been able to estimate precisely the amount of those excluded investments except for the protectors, which is about $12 per line. Ignoring at this time other excluded investments, the "shell" and the protectors investments combined is already $45 per line, obviously, a conservative estimate for 1999. GTE encourages the FCC to adopt this estimate.

THE FCC DID NOT SEEK COMMENT ON CERTAIN INPUT VALUES

The HAI Default Inputs

35. As many parties to this proceeding have concluded, including the FCC, the HAI Model default inputs are mostly based on the unsubstantiated opinions of its developers, and are mostly on the low side.[50] GTE expressed concerns about those inputs, with no response from the FCC.[51] Even worse, the FCC has apparently adopted some of those HAI Model default values without reasonable justification.

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[49] *Id.* at p. 2.

[50] *See* GTE Comments at p. 66; SBC Comment at p. 13; Sprint Comment at p. 44, Attachment 7; Order at ¶ 165.

[51] GTE Comments at Attachment 1.

36. Most of the now adopted HAI Model default inputs are located in the Model's end office and tandem switching, SS7 network and interoffice network components. For example, the HAI Model used two factors to reduce the tandem common equipment investments.[52] First, the calculated common equipment is arbitrarily reduced by 40% to account for the sharing with EO wire center. After the 40% reduction, the investment that is attributable to the excess capacities in tandem office,[53] is further reduced by 50%. There is no evidence that an investment reduction to this extent is possible, and such arbitrary sharing would lead to seriously underestimated costs for tandem investments. The FCC never put those inputs out for comments and, worse, adopted them without reasonable justification.

The PNR Data

37. In response to Bell Atlantic and Sprint's concern that the line counts generated by the National Access Line Model do not match their actual line counts, the FCC indicated in its Order that the Model will true up the line counts to reflect the 1998 ARMIS line counts.[54] However, the FCC did not indicate how the 1995/6 PNR surrogate data would be adjusted to reflect the 1998 location counts to be consistent with the FCC-adopted

[52] *See* RFCC_switching_io_October1999.xls, 'tandem and STP investment'! D12: total common equipment investment. The two reduction factors are inputs!C130 (40%--- tandem/EO wire center common factor) and inputs!C89 (50%---- common equipment intercept factor).

[53] The investment is calculated as the difference between maximum design capacities and the capacities that would be needed for all the switched lines in the entire study area based on study area averages.

[54] Order at ¶ 61.

1998 line count.[55] Since there is a large increase in the line counts between 1996 and 1998, corresponding increases are expected in the number of new residential and business locations. Adjusting line counts to 1998 without a corresponding adjustment to location counts will lead to substantially underestimated costs, and a substantially smaller universal service fund, because it will lead to economies of scale that do not exist. For example, switched lines increased about 10% between 1996 and 1998 in GTE South-Kentucky. Without making the location counts consistent with the 1998 line count, the FCC Model would underestimate the universal service costs by more than $2 per line.[56] Updating the line counts from 1996 to 1998 without also updating the location counts is like using a network built based on 1996 demand to serve 1998 demand. To arrive at correct cost estimates, the location counts must be updated to be consistent with the line counts, as AT&T and MCI noted, "the key issue is the consistency of the numerator and denominator."[57]

38. There are a number of ways to make the location counts consistent with line counts. As shown here, the most straightforward way is to use the ratios of 1998 switched lines to 1996 switched lines for each wire center to determine the number of residential and business locations for 1998. For

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[55] According to the FCC and HAI documentation, the PNR road surrogate data reflect the numbers of lines and locations for 1995/6. Order at p. 41; HAI Model Release 5.1 Model Description at pp. 24-26.

[56] The example is based on the default runs using the most recent FCC Model and PNR data that are available to GTE. The FCC default run produces $31.86 using 1998 line counts. The use of 1996 line counts produces $33.94 per line.

[57] Order at ¶ 56.

each wire center: (1) Calculate the ratio of switched lines between 1998 and 1996 for residential and business lines respectively; (2) Use the 1996 PNR location data to find out (a) the total number of residential and business locations, and (b) the average lines per location for residential and business, respectively; (3) Multiply the ratios arrived at in (1) to the total location counts in (2) for residential and business respectively to arrive at the total number of residential and business locations for 1998; (4) For the locations that are contained in 1996 PNR location data, their location line counts would remain the same as in 1996 PNR location data. For the locations that are new in 1998, their location would be calculated by dividing the total number of 1998 new lines by the total number of 1998 new locations, for residential and business respectively. The number of 1998 new lines and 1998 new locations are derived by subtracting the 1996 lines and locations from 1998 lines and locations. And finally, (5) the locations and line counts arrived at in (4) are geocoded using the FCC adopted road surrogate method to create the PNR location data for 1998.

39. GTE is not able to ascertain if the final PNR data selected by the FCC contains consistent line and location counts. The FCC should make available the new PNR data to allow interested parties to analyze and comment on them, before they are adopted.

Final Model and Inputs

40. As of today, GTE still has not received the final FCC Model and inputs, as adopted in the FCC Order, and cannot duplicate the FCC's published

results. For example, GTE is still unable to duplicate either the published FCC results as contained in its Order or available via USTA for GTE South-Kentucky. The FCC results contained in the Order[58] indicate a switched line weighted cost of $34.24 per line, while the FCC results via USTA[59] indicate a different line weighted cost per line of $33.88. But, the use of the most recent available FCC Model and inputs on the FCC website (dated November 5, 1999) and the most recent PNR surrogate data available to GTE (dated July 17, 1999) produced only $31.86 per line, which is substantially different from either of the FCC's results.

41. Without the final Model platform and inputs, the FCC Model cannot be meaningfully evaluated. The FCC should make its proposed inputs and a finalized Model platform available to interested parties so that they may comment on them before they are adopted.

THE FCC SHOULD APPLY ITS CRITERIA CONSISTENTLY IN INPUT SELECTIONS

42. The FCC used inconsistent criteria and reasoning to select input values.

Inconsistent Use Of Company-Specific Inputs

43. The FCC rejected the use of company-specific inputs, but then used company-specific data from Bell Atlantic Maine to set purchasing power adjustments to reduce the cable costs from the NRRI Study.

[58] From the FCC results contained in support_october_1999.xls.

[59] USTA CD labeled "HCPM/HAI Synthesis Cost Proxy Model, Model Results Wire center Basis, November 2, 1999", KY_GTE South Inc - Kent_Default Scenario_WC.xls.

Inconsistent Data Adjustments

44. The FCC adjusted switching costs to 1999 to take full advantage of declining switch costs, but failed to adjust many other inputs, such as copper cable and labor intensive structure costs, some of which are based on 1992 data,[60] for which costs have been increasing over time. It appears that these adjustments were not made because they would produce higher costs.

Inconsistent Selection Criteria and Reasoning

45. The FCC rejected the use of its own requested industry data on cables and structures, claiming that (1) the data were "not verifiable" because most respondents did not trace the costs by "providing copies of these contracts and all of the interim calculations for a single project or a randomly selected central office,"[61] (2) in certain cable installation cost calculation, "loading factors appear to be overstated,"[62] and (3) certain data provided by the respondents did not confirm to FCC requests.[63] On the other hand, despite containing similar or even worse infirmities, the FCC found the NRRI Study data and even the PNR's National Access Line Model acceptable. The NRRI data did not have contracts attached to

[60] For example, the FCC uses 1992 Massachusetts advertising expense in its marketing expense calculation.

[61] Order at ¶ 107.

[62] Order at ¶ 108.

[63] Order at ¶¶ 109-110.

enable third parties to duplicate the contract prices used by the NRRI Study. As documented extensively by GTE and others, the costs as constructed by the NRRI Study's authors, using many unjustified assumptions and allocations, do not even correspond to the geological data that they use to explain the variations in the contract costs. Some of the geological variables are based on the data fabricated by developers of the HAI Model. The NRRI data also contain many observations with zero values for material or labor costs.[64] Even worse, the NRRI Study's authors arbitrarily eliminated loading costs, some as high as 10.44% of the contract amount, from some contracts due to uncertainty on how to assign them.[65] The only reason that the FCC continues to rely on the NRRI data seems to be that the FCC's flawed analysis based on the data yields low costs and a small universal service fund. The PNR's National Access Line Model (NALM) is even more problematic in that it is a commercial proprietary product that seems to produce incorrect line distributions. While the FCC acknowledged that the NALM contained proprietary information and a very complicated process consisting of several steps, it believed interested parties have been given the opportunity to review and understand it because the HAI Model sponsors have some explanatory documents and PNR has made itself available for inquires.[66] Previously, however, when numerous ILECs responded to a FCC data request on

[64] *See Sprint Ex Parte* (dated January 29, 1999) at Attachment 5.

[65] GTE Comments at p. 18.

cable and structure costs, provided ample related documentation, and (I believe) made themselves available for inquiries, the FCC did not think that was good enough. As pointed out by Bell Atlantic and Sprint and acknowledged by the FCC, the NALM has produced significantly different line counts in their study areas. The incorrect results should have added to the importance of verifying NALM. Instead, the FCC simply proposed to true up the line counts to the ARMIS data without looking into whether NALM produced correct line distribution across and within wire centers.

[66] Order at ¶ 55.

I hereby swear, under penalty of perjury, that the foregoing is true and correct.

_____/s/_____

Jason Zhang

Subscribed and sworn to before me this _____ day of December 1999.

Notary Public

My Commission Expires: _____