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BEFORE THE PUBLIC SERVICE COMMISSION
STATE OF MISSOURI

In the matter of Petition of Alma Telephone Company for Arbitration of Unresolved Issues Pertaining to a Section 251(b)(5) Agreement With T-Mobile USA, Inc.	))))	Case No. IO-2005-0468, et al Consolidated

DIRECT TESTIMONY
OF
W. CRAIG CONWELL
ON BEHALF OF T-MOBILE USA, INC.

JULY 21, 2005

Public Version

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ON BEHALF OF T-MOBILE USA

INTRODUCTION

Q1. PLEASE STATE YOUR NAME, BUSINESS ADDRESS AND EMPLOYER.

A1. My name is W. Craig Conwell. My business address is 405 Hammett Road, Greer, South Carolina. I am an independent consultant, specializing in telecommunications cost analysis.

Q2. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS CASE?

A2. I am testifying as the cost witness for T-Mobile USA ("T-Mobile").

Q3. PLEASE DESCRIBE YOUR EDUCATIONAL BACKGROUND.

A3. I have a Bachelors degree and Master of Science degree in Industrial Engineering from Auburn University in Auburn, Alabama.

Q4. PLEASE DESCRIBE YOUR WORK BACKGROUND.

A4. I have thirty years of experience in the telecommunications industry. From 1974 to 1979, I was with South Central Bell Telephone Company, now part of BellSouth. I also worked for AT&T from 1979 to 1987. During this period, I had a variety of assignments, ranging from performing service cost studies early in my career to serving as a division manager in planning, financial management and marketing assignments.

From 1988 to 1996, I was with Arthur Andersen & Co. in its telecommunications consulting practice in New York and Atlanta. I served as a firm-wide expert in telecommunications cost accounting and managed or provided advice on domestic and international consulting projects for telephone companies. These projects included:

- Performing cost studies for pricing telecommunications services.
- Designing cost accounting systems and databases for measuring service costs.
- Developing cost performance measures for cellular and wireline carriers.
- Performing reviews of cost models for regulators.
- Benchmarking service costs among telephone companies.

I managed two important cost reviews for regulators while with Arthur Andersen. One was a comparison of U.S. and Canadian toll costs for the Canadian Radio-television and Telecommunications Commission (CRTC), and the other was a review of Bellcore's Switching Cost Information System (SCIS) for the Federal Communication Commission.

While with Arthur Andersen, I developed and taught for several years a course in service costing for the United States Telephone Association (USTA) given to telephone company employees, regulatory staff and others.

Q5. PLEASE DESCRIBE YOUR WORK AS AN INDEPENDENT CONSULTANT.

A5. Beginning in 1997, much of my work as an independent consultant has been in assisting the SBC local exchange companies – Southwestern Bell, Pacific Bell, Nevada Bell and Ameritech – in developing and supporting cost studies for unbundled network elements, collocation and reciprocal compensation. My role was to analyze cost models produced by competitive local exchange carriers, to perform ad hoc analyses to address specific cost issues and to assist in cost model development. In recent years, I have developed cost models for new data services, including digital subscriber line (DSL) service, Voice over Internet Protocol (VoIP) and others. I also review for Commercial Mobile Radio Service (CMRS) Providers the cost studies of independent telephone companies underlying proposed rates for reciprocal compensation and assist them in negotiations or arbitrations of these rates. I have testified as a cost witness in California, Nevada, Texas, Arkansas, Kansas, Oklahoma, Missouri, Ohio, Wisconsin and Tennessee on UNE costing, collocation costs or costs for reciprocal compensation.

Q6. HAVE YOU PARTICIPATED IN OTHER ARBITRATIONS BETWEEN INCUMBENT LOCAL EXCHANGE CARRIERS (ILECS) AND CMRS PROVIDERS?

A6. Yes, I was the cost witness for the CMRS Providers in cases in Oklahoma and Tennessee. The Oklahoma cases were Cause Nos. PUD 200200150 and PUD 200300771, and in Tennessee, the case was Docket No. 03-00585.

Q7. WHAT IS YOUR CONSULTING ENGAGEMENT WITH T-MOBILE IN THIS CASE?

A7. I was engaged by T-Mobile to review the transport and termination cost studies produced by the four ILECs in this arbitration – Alma Telephone Co., Chariton Valley Telephone Co., Mid-Missouri Telephone Co. and Northeast Missouri Rural Tel. Co. The purpose of the review is to determine whether the studies meet the FCC requirements for establishing transport and termination rates. The review also is to determine whether the study results fairly represent the companies' *forward-looking economic costs* to transport and terminate telecommunications traffic originated by T-Mobile customers.

SUMMARY OF TESTIMONY

Q8. PLEASE SUMMARIZE THE MAIN POINTS OF YOUR TESTIMONY?

A8. My testimony addresses the following points:

- The FCC rules implementing the Telecommunications Act of 1996 require the ILECs to establish transport and termination rates *not to exceed* their forward-looking economic costs. The companies are required to produce cost studies consistent with the FCC definition of these costs and provide study documentation sufficient for a thorough review.

The four ILECs in this case have not met the FCC requirements. Issue 7 addresses the transport and termination rate to be incorporated in the Traffic Termination

Agreement. In their proposal for Appendix 1 of the Agreement, the ILECs have proposed a transport and termination rate of $0.035 per minute, which they contend does not exceed their forward-looking economic costs based on studies indicating costs of $0.**** to $0.**** per minute. However, the studies on which they rely do not comply with the FCC methodology for forward-looking economic costs. More importantly, the studies substantially overstate the costs of transporting and terminating telecommunications traffic originated by T-Mobile customers. This is clear based on the limited documentation provided by the ILECs and publicly available information.

- Given the studies fail to satisfy the FCC rules, I have corrected them for the major errors I have been able to identify, given the limited documentation. *The corrected average transport and termination cost is $0.0074 per minute.* A rate at this level meets the FCC requirements for transport and termination.

THE FCC REQUIREMENTS FOR TRANSPORT AND TERMINATION RATES

Q9. WHAT ARE THE REQUIREMENTS FOR TRANSPORT AND TERMINATION RATES?

A9. ILECs are permitted by the FCC to charge reciprocal compensation to recover costs for transporting and terminating traffic from other carriers. The rules for ILEC transport and termination rates are provided at 47 CFR § 51.705 (a).

(a) An incumbent LEC's rates for transport and termination of local telecommunications traffic shall be established, at the election of the state commission, on the basis of:

(1) the forward-looking economic costs of such offerings, using a cost study pursuant to §§51.505 and 51.511;

(2) default proxies, as provided in §51.707; or

(3) a bill-and-keep arrangement, as provided in §51.713.

Transport and termination rates, if cost-based, are to be based on *forward-looking economic costs*, which the FCC defines in §51.505 as the sum of *total element long-run incremental cost* (TELRIC) and a reasonable allocation of *forward-looking common costs*. In §51.505 (e), the FCC states that rates shall not exceed the forward-looking economic costs.

(e) *Cost study requirements*. An incumbent LEC must prove to the state commission that the rates for each element it offers do not exceed the forward-looking economic cost per unit of providing the element, using a cost study that complies with the methodology set forth in this section and §51.511 of this part.

From the point of view of determining who must bear the burden of proving compliance with the cost study requirements, it is the incumbent LEC which must do so, not the party which will be charged the transport and termination rates imposed by the ILEC.

Q10. HOW ARE TRANSPORT AND TERMINATION DEFINED?

A10. The FCC in §51.701 (c) defines transport as "the transmission and any necessary tandem switching of local telecommunications traffic subject to section 251 (b)(5) of the Act from the interconnection point between the two carriers to the terminating carrier's end

office that directly serves the called party, or equivalent facility provided by a carrier other than an incumbent LEC."

Termination is defined in §51.701 (d) as "the switching of local telecommunications traffic at the terminating carrier's end office switch, or equivalent facility, and delivery of such traffic to the called party's premises." *Termination* is the usage sensitive portion of the end office switch, excluding the line ports and other non-usage sensitive portions of the switch. In addition, termination excludes the subscriber loop, which is non-usage sensitive.

Q11. WHAT ARE THE SPECIFIC REQUIREMENTS FOR DETERMINING THE TELRIC OF TRANSPORT AND TERMINATION AND A REASONABLE ALLOCATION OF FORWARD-LOOKING COMMON COSTS?

A11. Section §51.505 (b) and (c) define total element long-run incremental cost and forward-looking common costs. The FCC has described specific requirements related to calculating transport and termination costs. Among these are the following:

- *Plant is to reflect forward-looking technology and costs*. The costs of switching, transmission and cable plant are to reflect currently available equipment, at current vendor prices and company-specific discounts. The FCC rules specifically prohibit the use of embedded or historical costs.[1]

[1] For example, the cost study should reflect today's cost to construct a new end office switching system, representing the prices the ILEC would currently pay its switch vendor to engineer, furnish and install the new switch. The study should not reflect switch costs that are either outdated or based on the original cost of existing switches.

- *Plant capacity is to reflect an efficient network configuration.* The transport and termination technologies in the cost study should be the most efficient alternative available to the ILEC and its specific situation. In addition, the capacities of switching, transmission and cable plant in the study should be sized for efficient forward-looking utilization.[2]

- *Support asset costs and operating expenses are to be forward-looking, efficiently sized and directly attributable to transport and termination.* Support assets include land, buildings, power equipment and other plant used to house and operate switching systems and transport equipment. In a TELRIC study, these assets are to be sized to support today's technologies, rather than representing existing land, buildings and other assets acquired to support operations and plant in the past. At the same time, support asset costs are to reflect current, rather than embedded land, building and other costs. Similarly, operating expenses for repair and maintenance of switching and transport equipment, engineering, network administration, etc. are to reflect today's business processes, productivity and labor costs. To the extent support assets or various workgroups are employed in producing other products, their costs should be attributed to those products and not transport and termination.

- *Common costs allocated to transport and termination are to be forward-looking and costs that are efficiently incurred.* Common costs typically include executive, legal,

accounting and other general and administrative costs. These costs are shared among all products and services. The FCC rules call for a reasonable allocation of these costs to be added to the TELRIC of transport and termination in setting reciprocal compensation rates.

Q12. SHOULD TRANSPORT AND TERMINATION RATES REFLECT COMPANY-SPECIFIC COSTS?

A12. Yes, rates should be based on each ILEC's forward-looking economic costs, determined by a company-specific cost study. The study should reflect its unique serving area, forward-looking network architecture, business processes and current resource costs.

Q13. WHAT DOCUMENTATION IS REQUIRED TO SUPPORT THE COST STUDIES?

A13. 47 CFR 51.505 (e) (2) specifically requires "a written factual record that is sufficient for purposes of review". It requires a cost study be included in the record if the study is considered by the Commission in establishing transport and termination rates, and that all affected parties (here, T-Mobile) have the opportunity to review and comment on the study. The cost study and its documentation must be sufficient for T-Mobile to verify that the study results represent a company's forward-looking economic costs of transport and termination. Consequently, the documentation must show that the requirements I described earlier are met; i.e., costs are company-specific, forward-looking, reflective of

[2] Transmission equipment and cables used for interoffice transport, for example, should not be sized so large in the cost study as to produce excessive spare capacity and costs. This would cause transport costs to exceed forward-looking economic costs, which is prohibited by §51.505 (e).

current technology and efficient plant utilization, direct to transport and termination, and include a reasonable allocation of common costs.

THE ILEC COST STUDIES DO NOT MEET THE FCC'S REQUIREMENTS FOR ESTABLISHING TRANSPORT AND TERMINATION RATES

Q14. PLEASE DESCRIBE THE COST STUDY DOCUMENTATION YOU REVIEWED FOR THE FOUR ILECS?

A14. The ILECs have not filed a cost study in this proceeding to date. T-Mobile was provided with three items of cost support on July 1, 2005, pursuant to discovery requests sent to counsel for the ILECs: a letter transmitting cost support dated April 28, 2005 from Bob Schoonmaker, the ILEC's cost consultant, to Craig Johnson, counsel for the ILECs, an Excel file summarizing costs for the ILECs, and Excel files containing the input and output of the Hatfield model ("HAI model") used to compute each company's transport and termination costs.[3,4] The cost summary included costs for the four ILECs and two others not involved in this arbitration (Choctaw Telephone Company and MoKan Dial Inc. Missouri).

Q15. DID THE ILECS SUBSEQUENTLY REVISE THIS COST SUPPORT?

A15. Yes, on July 14, 2005, counsel for the ILECs produced revised Excel files containing the summary of costs and the input / output of the HAI model for each company. Costs for

[3] The three items of cost support were provided by the ILECs in response to T-Mobile's June 30, 2005 Discovery / Data Requests (requests 3, 4 and 5).

[4] The ILEC cost studies were produced using the Hatfield model – version 5.0a (HAI 5.0a) developed by HAI Consulting, Inc., Boulder, CO, 1998.

Choctaw Telephone Company and MoKan Dial Inc. Missouri were removed in the revised cost support.

Q16. WERE THE REVISED TRANSPORT AND TERMINATION COSTS SIGNIFICANTLY DIFFERENT FROM THE ORIGINAL COSTS PROVIDED TO T-MOBILE?

A16. Yes. Exhibit WCC-1 shows the transport and termination costs from the original and revised cost studies. The ILECs reduced their cost estimates by ** to ** percent. A brief explanation of the revisions was provided in an email from ILEC counsel:

> "Bob Schoonmaker advises he has reviewed the cost study HAI assumptions based upon updated data from 2003 for certain items. He will be modifying the cost studies with respect to rate of return, central office switching expense as a percentage of COE investment, and the percentage of intraLATA traffic going through access tandems."[5]

This was a substantial change in the cost information T-Mobile had been provided in support of the ILECs' proposed rate.

Q17. HAVE YOU BASED YOUR REVIEW ON THE REVISED TRANSPORT AND TERMINATION COSTS PROVIDED ON JULY 14TH?

A17. Yes. I reviewed the revised Excel files containing the cost summary and input / output of the HAI model. Copies of these files are included in Exhibit WCC-2.

[5] Email from Mr. Johnson to Mark P. Johnson, attorney for T-Mobile, dated July 12, 2005.

Q18. DID T-MOBILE REQUEST ADDITIONAL COST SUPPORT?

A18. T-Mobile's June 30, 2005 data requests asked for additional cost support, including the following:

- A description of the basis of the proposed transport and termination rate of $0.035 per minute.
- Citations to the FCC rules for which the proposed rate is in compliance.
- 2003 and 2004 financial statements.
- Operational data on switches, lines in service and, in particular, network diagrams showing interoffice transport mileages and transport systems, and points of interconnection with Southwestern Bell Telephone.
- Indication of switching, fiber cable and interoffice transport terminal equipment placements in the past three years and copies of related cost and capacity details.

Q19. DID THE ILECS DESCRIBE THE BASIS OF THE PROPOSED TRANSPORT AND TERMINATION RATE?

A19. No. In Mr. Schoonmaker's April 28th letter to Mr. Johnson transmitting the original cost support, he states the following:

> "In approaching negotiations (*with US Cellular*), we are aware that the FCC has required that in arbitration that costs be developed on a forward-looking cost basis rather than on the basis of access rates. As a consequence we have produced forward-looking costs for each of the companies using the HAI model (version 5.0a). For most of the companies, the forward-looking cost results produce cost levels that are higher (sometimes substantially higher) than rates that we have proposed based on our agreements with other wireless carriers. While under the FCC's cost requirements, we could have pursued

> these higher rates, we have chosen to request a more moderate rate level rather than the higher HAI cost based rates."[6]

This does not describe the basis of the $0.035 per minute rate proposed in this arbitration. Mr. Schoonmaker is referring to an unknown rate proposed to US Cellular and one based on "agreements with other wireless carriers." We do not know whether the rate is the same $0.035 per minute proposed to T-Mobile. More importantly, we do not know the basis of the agreements with other wireless carriers. Consequently, we are left to infer that because the $0.035 per minute is below the HAI model results from the *original* cost study, it is a reasonable rate.

Q20. SHOULD T-MOBILE AND THE MISSOURI COMMISSION BE SATISFIED THE PROPOSED RATE IS BELOW THE HAI MODEL RESULTS?

A20. Absolutely not. I will describe how the HAI model results substantially overstate forward-looking economic costs for transport and termination. The evidence available in this case and on the public record indicates the proposed rate exceeds the costs of the four ILECs, which is contrary to the FCC requirements for reciprocal compensation.

In addition, in a similar arbitration of transport and termination rates between rural ILECs and CMRS Providers in Oklahoma the arbitrator was most critical of the HAI model. He stated the following in his findings and conclusions for the case:

> "The Arbitrator further finds that the Hatfield Model, which was utilized by the RTCs herein, has already been found suspect by the Arbitrator in at least

[6] Mr. Schoonmaker's letter transmitted cost support for negotiations with US Cellular, rather than T-Mobile, and included costs for six ILECs, two of which are not involved in this arbitration.

> one previous hearing due to the ability of persons using it to be able to manipulate the inputs to reach about almost any imaginable result."[7]

The substantial change in HAI model results from the original studies to the revised studies – a reduction of ** to ** percent – shows how dramatically one can affect estimates of transport and termination costs using the model. Neither T-Mobile nor the Missouri Commission should be satisfied simply because the proposed rate is below the HAI model results.

Q21. ARE THERE OTHER ITEMS IN THE JUNE 30TH DATA REQUEST THAT HAVE NOT YET BEEN PROVIDED?

A21. Yes. T-Mobile has been provided only partial information describing the ILEC networks. The network information furnished for Chariton Valley Telephone specifies interoffice cable sizes, distances and embedded costs, but not transport systems. Information from Mid-Missouri describes interoffice transport systems and distances, but not cable sizes. And, the Northeast Missouri Rural information provided the day before the filing of direct testimony (July 20th) specifies transport systems, but the interoffice distances and cable sizes cannot be determined due to the poor quality of the .pdf image. This information is important in making a complete review of the ILEC cost studies.

Q22. DOES THE COST STUDY DOCUMENTATION PROVIDED BY THE ILECS MEET THE FCC REQUIREMENTS OF 47 CFR § 51.505 (e) (2)?

A22. No, it does not. The Excel files from the HAI model contain user-adjustable input data, ARMIS financial data *from 1996* and summary-level output worksheets. The full HAI

[7] "Arbitrator's Finding of Fact and Conclusion of Law #11", Oklahoma PUD 200200150.

model, which would show the underlying calculations for end office switching, signaling and common transport costs, was not provided. In addition, the ILECs modified key default input values in the HAI model, and little or no explanation for the new input values was provided.

The ILECs have not completely described their networks. They have not provided the costs of switching, transport and other plant they would expect to incur today based on current material prices and other costs of construction. It is important to note that the HAI 5.0a model was produced in 1998 and contains plant construction costs dating from the mid- to early-1990s. It is unlikely the HAI 5.0a model results are representative of the ILECs' forward-looking economic costs in 2005.

Q23. ARE THE RESULTS OF THE ILEC COST STUDIES REASONABLE; *i.e.*, DO THEY ACCURATELY REFLECT THE COMPANIES' FORWARD-LOOKING ECONOMIC COSTS OF TRANSPORT AND TERMINATION?

A23. No, the studies overstate the ILECs' forward-looking economic costs of each component of transport and termination – end office switching, ISUP signaling and common transport. I will describe the major errors for each component.

Q24. PLEASE EXPLAIN HOW THE ILECS COMPUTED END OFFICE SWITCHING COSTS.

A24. I have replicated the calculations for each company in Exhibit WCC-3. The calculations begin with investments per line for the end office switch, wirecenter and land (rows 8 –

10). Wirecenter includes the investment in building space and power equipment supporting the switch. These figures are intended to represent the current cost to construct digital switches, as well as the current cost of land, buildings and power equipment.

Annual direct expense factors are shown for each type of plant on rows 14 – 16. These are the capital costs (depreciation, cost of money and income taxes) and operating expenses for plant expressed as a percentage of investment. The factors are multiplied times the investments per line and the results summed to compute the direct expenses per line on row 18. Note that the expense factors are the same for all four ILECs, rather than being company-specific.

In rows 20 – 23, additional factors are added for support expenses, variable overheads and other items. Variable overheads in the HAI model represent the common costs added to TELRIC to determine forward-looking economic costs. Again, the same expense factors are assumed for each company, with the exception of support expenses. These are applied to the direct expenses per line to compute total end office switching costs per line (row 24).

The next calculation is very important. Termination costs should only include the costs of switch equipment components that are usage-sensitive. A factor is multiplied times the total costs per line to compute the usage-sensitive portion of costs. This factor is referred to as the *EO non-port fraction*, and the value assumed in each study is 70%.

Seventy percent of the total cost per line on row 24 is attributed to usage. The remaining cost is assigned to equipment providing line terminations on the switch. The capacity of line port equipment is determined by the number of lines, rather than the amount of calling or minutes of use handled by the switch.[8]

After the non-line port or usage-sensitive cost per line is computed, the amount is multiplied times the total switched lines (row 31) to calculate total usage-sensitive costs (row 29). Usage-sensitive costs are then divided by total annual minutes of use to calculate the end office switching cost per minute (row 37).

Q25. WHAT ARE THE MAIN ERRORS IN THE END OFFICE SWITCHING COST CALCULATIONS?

A25. There are two predominant errors in the calculations.

- *First, the usage-sensitive portion of total switching costs is substantially overstated.* The ILECs assume 70% of the end office switching costs are usage-sensitive. In recent years, switch vendors have changed their pricing of digital switches so that most switch costs now are driven by line capacity rather than usage. This shifts end office switching costs to subscriber lines and reduces termination costs. The *EO non-port fraction* in row 26 of WCC-3 should be less than ten percent.

[8] Usage includes setting up calls and providing call connections or paths for the duration of calls.

- *Secondly, end office switching investments per line are high.* Row 8 of WCC-3 shows current digital switch investments for the ILECs of $*** to $*** per line. This is unrealistic.

The HAI model computes the switching investment per line for *small* telcos using the following equation:

Investment / line = -14.922 X Ln (number of lines) + $416.11 / line

The investment per line begins at $416.11 and decreases as switch size increases in terms of lines.[9] The parameters in the HAI equation are based on a study by Northern Business Information *in 1996*. In each study, the ILECs substituted $**** for the $416.11 per line. This is an increase of **%, with no explanation. The change is counterintuitive. It is generally understood that digital switch prices have declined over time.[10] I expected the ILECs to have reduced the switching constant from its value a decade ago, rather than increase it by **%.

[9] The *constant EO switching term* of $416.11 is for small telcos. The HAI model has a lower switching constant for large telcos of $242.73.

[10] For example, the Public Service Commission of Utah in a May, 2003 case regarding Qwest unbundled loop costs stated the following:

> "All parties agree that digital switching costs have dropped and continue to drop significantly over time. The issue then is to set a price that reflects current realities. We adopt AT&T's default inputs for the basic switch investment. We clarify that switching will be billed on a flat-rate basis, with no usage charges. We direct the Division to adjust its version of the HAI model to the AT&T default switching investment input of $89.00, and to use the flat rate monthly price for switching developed by the HAI model as adjusted in this order."

"In the Matter of the Determination of the Cost of the Unbundled Loop of QWEST Corporation," Docket No. 01-049-85, Report and Order, pp. 16-18.

I also compared the ILECs' embedded switching investments per line with investments per line from the HAI model. This comparison is shown in Exhibit WCC-4. The investments per line from the HAI model are greater than the embedded investments in switching systems made by the ILECs at least ten years ago.[11] Again, this is contrary to the downward trend in digital switching costs.

Finally, the ILEC switching investments per line are high compared to those I calculated based on actual switch cost data from a 1997 study by the Rural Utility Service (RUS).[12] The RUS cost data are shown in Exhibit WCC-5, and my calculations of switching investments per line for the four ILECs are in Exhibit WCC-6. The switching investments I calculated range from $236 to $364 per line, compared to the ILEC study values of $*** to $*** per line.

There are other questionable elements in the ILEC studies of end office switching costs, such as the debt ratio, cost of debt, cost of equity and investments in wirecenter and land. However, the end office switching investment per line and 70% usage-sensitive assumption are the dominant errors. These cause the switching costs to more closely approximate embedded costs than forward-looking economic costs, which is not permitted by the FCC rules.

[11] Note that the embedded investment per line is computed by dividing the actual book investment in accounts 2211 and 2212 (analog and digital electronic switching) by lines in service. If there is excess capacity in the existing switching plant, the embedded investment per line will be higher than it would be when the plant is efficiently sized. If this is the case, removing the investment in excess capacity would lower the embedded investment per line and make the ILEC estimates of current investments per line appear even higher.

Q26. PLEASE EXPLAIN FURTHER WHY THE SEVENTY PERCENT USAGE-SENSITIVE FACTOR IS TOO HIGH.

A26. Until the late 1990's, ILECs purchased switches based on *component pricing*, in which they specified the quantities of line and trunk equipment, switch processors, memory and other switch components. The cost of the line equipment or ports was driven by equipped lines; the cost of trunk equipment was driven by interoffice usage; and, the cost of processors, memory, etc. was driven by calling, call duration, feature processing and other measures of usage. Each component was priced separately. The quantity of line ports on the switch that terminate end-user access lines were not usage sensitive, because their quantity was independent of the amount of calling over them. Trunk equipment, processors, memory and other components were categorized as usage-sensitive. HAI 5.0a assumes 70% of the total switch cost to be "non-line port" or usage-sensitive based on the model developers' experience in the *mid-1990's*.

In recent years, switch vendors and telephone companies have moved to *per-line pricing*, in which the predominant factor determining the total switch cost is the quantity of equipped lines. Vendors charge a fixed "getting started cost" and a per-line price for the number of equipped lines. Charges do not vary by usage, unless a high threshold of usage per line is exceeded. The switch is provisioned with ample call and feature processing capacity, such that usage does not trigger capacity additions or cause costs. Trunk equipment, which depends on the amount of interoffice traffic, is priced separately, and its costs are usage sensitive. Trunk equipment costs, though, are a

[12] The RUS produced a study of actual rural ILEC switch costs that it filed in "Comments of the Rural Utilities Service," In the Matter of Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, CC Docket

relatively small portion of the total switch cost. As a result, the usage-sensitive portion of switch costs has become small, much less than the traditional 70% assumed in the HAI model.

Using the 70% usage-sensitive cost factor in the ILEC studies overstates end office switching costs, assuming they purchase switches on a per-line basis rather than component pricing.

Q27. HAS THIS ISSUE BEEN ADDRESSED BY THE FCC?

A27. Yes, the FCC addressed the question of whether end office switching costs are usage-sensitive in a recent arbitration in Virginia. The FCC concluded that most, if not all, switching costs should be recovered on a per-line port basis, rather than based on usage. I have included excerpts of the FCC Order in Exhibit WCC-7.

Q28. HAS THE HAI MODEL BEEN MODIFIED TO ASSIGN END OFFICE SWITCHING COSTS TO LINES RATHER THAN USAGE?

A28. A staff witness for the Washington Utilities and Transportation Commission in June, 2003 testimony indicated that a more recent version of the HAI model (HAI 5.3) assigns to line-ports costs previously treated as usage-sensitive.[13] Based on the testimony of this

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No. 97-160, August 7, 1997.

[13] The witness testified the follows in recommending switch port rates for Qwest and Verizon:

"Q. What rates do you propose for ports with local switching?

A. The proposed rates for ports including flat-rate local switching are as follows:

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Qwest	$2.70	$2.41	$2.65	$2.70	$5.03

member of the Commission staff, the HAI model developers appear to have changed the default value from 70% to 0% usage-sensitive costs for end office switching.

Q29. HAVE YOU CORRECTED THE ILEC END OFFICE SWITCHING COSTS?

A29. Yes, in Exhibit WCC-8, I show corrected costs for each ILEC. These corrections reduce the average end office switching cost per minute from $0.**** to $0.****.

Q30. PLEASE DESCRIBE THE CORRECTIONS YOU MADE?

A30. First, I corrected the end office switching investments per line. As I described earlier, the corrected values are based on the August, 1997 RUS actual switch cost data shown in WCC-5, adjusted to reflect current switch costs. The calculations are shown in WCC-6.

I began with the average switch cost per line for host and remote switches (rows 6 and 7) and developed a weighted average of the two, recognizing each ILEC's proportion of lines served by remote switches. I added costs for engineering fees, the additional, higher cost of growth lines and the cost of software upgrades based on data in the RUS study. I adjusted the embedded switch cost on row 22 to a current cost assuming a 90% current-to-embedded cost ratio. This is a conservative estimate of the decline in switch costs

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Verizon $2.65 $2.84 $2.84 $3.54 $7.83

The tariffed port rate is currently $1.34 for both Qwest and Verizon. The reason for the increase in the port rate between this study and prior studies is that flat-rated usage is now included in the port rate in the HAI 5.3 model."

"Direct Testimony of Thomas L. Spinks," Staff of Washington UTC, Docket No. UT-023003, p. 8.

over the past decade.[14] The results on row 25 show current end office switching investments of $236 to $364 per line.

Q31. DID YOU CORRECT THE PERCENTAGE OF END OFFICE SWITCHING COSTS THAT ARE USAGE-SENSITIVE?

A31. Yes. I assumed that if an ILEC places a new end office switch and the switch is priced on a per-line basis, the cost of the switch includes (1) the getting started cost, (2) charges based on the quantity of equipped lines multiplied times the per-line price, and (3) charges for interoffice trunk equipment.[15] The per-line price would be for a normal level of busy hour usage per line, and the price would not vary with usage unless ILEC subscribers have extremely high use.

The four ILECs do not appear to have extremely high usage per line. Their average annual minutes per line are **** minutes (WCC-8, cell F33). I used common assumptions regarding the peakedness of traffic and determined that busy hour usage for a typical line would be about *** BH CCS per line.[16] This is not an unusual or

[14] In the July, 2004 arbitration of reciprocal compensation rates between rural ILECs and CMRS Providers in Tennessee, the cost witness for Sprint PCS gave the following testimony:

> "Q. Are the TPI (Turner Price Index) index values for digital switching declining?
>
> A. Yes. The index factors for digital switching for the past five years have declined by 12%. Over the past ten years they have declined 31%. This confirms that the forward-looking economic cost of switching would be less than embedded cost of switching."

"Supplemental Consolidated Direct and Rebuttal Testimony," Talmage O. Cox, III, Sprint PCS, Tennessee Regulatory Authority, Docket 03-00585, 07/27/04.

[15] The cost of the switch may also include charges for software, ISDN lines, TR303 interfaces (for digital loop carrier systems), etc. These charges, though, are not usage-sensitive.

[16] Dividing **** minutes by 250 business days and assuming 10% of daily traffic is in the busy hour yields busy hour usage of *** MOU or *** busy hour centi-call seconds (CCS).

extraordinary level of usage, so I would not expect the ILECs to have to pay per-line prices for high use lines. Consequently, the cost of the new switch largely consists of the getting started cost and charges based on equipped lines. The amount of calling, and in particular the amount of traffic terminated from CMRS Providers, does not drive these costs.

The charges for interoffice trunk equipment would be driven by interoffice usage. Telecommunications traffic originated by CMRS Providers and terminated by the ILECs would cause incremental trunk port requirements. So, it is appropriate to include costs for trunk ports. To do this, I calculated the *EO non-port fraction* to reflect the amount of the end office switching investment attributable to just interoffice trunk ports. These calculations are shown in rows 41 through 68 of WCC-8.

I used the default value for trunk port investments from the HAI model (rows 42 – 44). I also computed the number of lines that can be handled by a trunk port, based on the interoffice usage per line for each ILEC and assumptions regarding interoffice traffic. I assumed maximum usage of a trunk port of 27.5 BH CCS as in the HAI model and a forward-looking average utilization level of 70%. The resulting lines per trunk port range from ** to *** lines (row 62). I completed the calculations by dividing the investment for two trunk ports (one per end) by the lines per port and computing a corrected *EO non-port fraction* of ** to **% (row 68). These values are substituted on row 26 of the spreadsheet, and the calculations are completed resulting in corrected end office

switching costs of $0.**** to $0.**** per minute, with an average of $0.**** per minute.

Q32. WHAT WERE YOU FINDINGS FROM REVIEWING ISUP SIGNALING COSTS?

A32. ISDN User Part (ISUP) signaling costs include the costs of 56 Kbps data links from ILEC switches to Signal Transfer Points (STP) and ports on the STPs. These facilities are used for interoffice call setup and other signaling functions. ISUP signaling costs normally are minor portions of transport and termination costs. The ILEC cost studies estimated costs of $0.*** to $0.**** per minute.

Exhibit WCC-14 shows the development of the costs. The key cost driver is the monthly cost per 56 Kbps signaling link (row 7). This cost drives over ninety percent of the total ISUP signaling cost. The cost of the STP port (row 14) is fairly minor.

Monthly costs for basically a voice grade channel in the range of $*** to $*** seem quite high. The HAI model assumes the signaling links are carried on the ILEC's interoffice rings. It appeared to me that one of the factors driving these high monthly costs is the high interoffice cable costs per voice grade channel, which I describe shortly. Without the details of the development of the signaling link investments and costs, I chose to benchmark the costs against the Southwestern Bell unbundled signaling rates in Missouri, as an efficient alternative.

Exhibit WCC-15 computes ISUP signaling costs using signaling rates from the Missouri M2A (Schedule of Prices, 06-27-03). I included cross-connect charges (rows 29 and 30) and the fixed and per-mile charges for a 56 Kbps signaling link. Since I did not know the average distance from an ILEC switch to the STP, I assumed 200 miles. The resulting calculations indicate that a CLEC purchasing a 56 Kbps signaling link at this distance would pay approximately $88.59 per month, rather than the $*** to $*** costs shown in the ILEC studies.

I substituted the revised monthly cost in row 7 of WCC-15 and solved for the ISUP signaling cost per minute. The result is an average cost of $0.0012 per minute. I recommend this value be used as a reasonable cost benchmark.

Q33. HAVE YOU ALSO ANALYZED THE COMMON TRANSPORT COSTS IN THE ILEC STUDIES?

A33. I indicated earlier that the ILECs provided summary-level output from the HAI model. In the case of end office switching, it is possible to readily identify the primary cost drivers affecting switching costs – the end office investment per line, expense factors, the EO non-line port fraction, etc. The summary-level output for common transport is insufficient for a complete analysis of the underlying drivers of these costs. Common transport costs are determined by interoffice route mileages among switches, the bandwidth of the interoffice transport systems, forward-looking utilization levels, and current cable and transmission equipment costs. Some values for these drivers can be

determined from the recent network diagrams provided by the ILECs, but as I mentioned earlier, the information is incomplete.

I was able, though, to analyze common transport costs in enough detail to conclude that the ILEC studies overstate these costs. Exhibit WCC-9 shows the makeup of common transport costs based on the HAI model output.

Q34. HAVE YOU COMPARED THE ILEC COMMON TRANSPORT COSTS WITH UNE RATES OF OTHER TELCOS TO TEST THEIR REASONABLENESS?

A34. Yes, Exhibit WCC-10 shows common transport rates for the Regional Bell Operating Companies and large independent telephone companies across the U.S based on a January, 2004 survey of unbundled network element rates by the West Virginia Public Service Commission. It plots common transport costs for the four ILECs relative to these rates and the rate of Southwestern Bell in Missouri.

I would expect a small rural ILEC to have higher common transport costs due to longer distances among switches and transmission systems with less trunk capacity, but the ILEC common transport costs are ** to ** times the highest common transport rate (excluding Nevada), and their costs are *** to *** times the Southwestern Bell rate in Missouri. This is an extraordinary difference.

Q35. WHAT DRIVERS CAUSE ILEC COMMON TRANSPORT COSTS TO BE SO HIGH?

A35. Referring to WCC-9, you see that common transport costs consist of two elements - the cost of fiber cables connecting switching systems and the cost of transmission equipment for cross-connecting circuits, multiplexing the circuits and converting electrical signals to optical signals for transmission across cable plant. The fiber cable cost per minute, shown on row 39, ranges from $0.*** to $0.**** per minute. The transmission equipment cost is shown on row 57 and ranges from $0.**** to $0.**** per minute. Cable costs makeup **** to **** percent of the total common transport cost.

With regard to cable costs, the two key cost drivers are the cable investment / trunk (DS0) on row 8 of WCC-9 and the actual annual minutes of common transport on row 38.[17] The cable investments per trunk, which range from $***** to $***** are quite high. This can be seen from Exhibit WCC-11, which develops buried fiber cable investments per DS0 at varying interoffice mileages.

The calculations begin with the current cost per foot for buried fiber cable.[18] I obtained construction cost data for Missouri from a public website.[19] The material cost for direct burial of 50 micron, eight fiber cable is $1.82 / foot. I selected eight fiber cable, because this provides four fibers for a working transport system (two working and two backup), with four additional fibers, if needed. The installation labor cost is $1.50 / foot and equipment costs are $0.32 / foot assuming a line truck and small tools are required to place the cable. This resulted in a buried cable cost per foot of $3.64.

[17] A DS0 is an interoffice channel with bandwidth of 64 kilobits / second; it represents one voice grade interoffice circuit.
[18] Buried fiber cable is assumed to be the forward-looking cable type placed by the ILECs for interoffice transport.

Cost data from Chariton Valley's network diagram confirmed the reasonableness of the $3.64 cost per foot. Exhibit WCC-16 shows network information for Chariton Valley and Mid-Missouri. The Chariton Valley data indicate it has an average embedded investment per foot of $*** for 28 and 32 fiber cable. My estimate of the current cost of smaller, eight fiber cable is actually higher.

On WCC-11, I computed buried cable investments in fifty mile increments, beginning with 50 miles and ending with 300 miles. I assumed the ILEC forward-looking interoffice transport system would be an OC-3 system. Some of the ILECs may use higher bandwidth systems, such as OC-12 or OC-48.[20] If so, this *reduces* the cable investment per DS0. The system has a nominal capacity of 2,016 DS0s, and I assumed a forward-looking average utilization of 70%, which allows for 30% spare capacity over a future planning period. Dividing the total buried cable investments by *** DS0s yields an average investment of $*** per DS0 at 50 miles of interoffice transport and $**** per DS0 at 300 miles. These unit investments are well below the HAI model estimates shown on row 8 of WCC-9. Unless the interoffice transport distances are much greater than 300 miles or the transport utilization level is much lower than 70%, the cable investments per DS0 from the HAI model are unrealistic.

Besides the high cable investments, the ILECs have used *actual* annual minutes of common transport on row 38 of WCC-9 to compute cable costs per minute, rather than

[19] The website address is www.get-a-quote.net. It provides construction cost data by state and for numerous types of construction, including telecommunications plant.

the estimate of minutes determined by the HAI model. The HAI model calculates the number of common transport trunks required by the ILEC (rows 10 – 13), and then computes the amount of traffic or minutes the trunks should handle. It bases this on an assumption of 30% utilization of the maximum trunk usage. The ILEC actual utilization is well below **%, ranging from ** – **%. Using the actual minutes further inflates the common transport cable costs. Furthermore, this method is contrary to the FCC rules in 47 CFR §51.511, which require that unit costs be based on forward-looking average utilization.

Q36. HAVE YOU CORRECTED THE CABLE PORTION OF COMMON TRANSPORT COSTS?

A36. Yes, Exhibit WCC-12 shows the common transport cost calculations with corrections. I was able to determine the interoffice cable mileages for Chariton Valley and Mid-Missouri based on the network diagrams for these companies. Chariton Valley apparently has a single fiber ring with a total length of *** miles (WCC-16, cell D32). Mid-Missouri has two rings, and I computed the average length, including the link to the Southwestern Bell point of interconnection, to be ** miles (WCC-16, cell D64). Usable information has not been provided on the Alma and Northeast Missouri cable distances, so I assumed distances of 75 and 100 miles, respectively.[21] These interoffice distances were used to compute cable investments per DS0 for each company in WCC-11. I substituted these values in row 8 of WCC-12. I divided the total cable costs on row 24 by the HAI model estimate of traffic carried by the trunks. I did this in order to base the

[20] The Northeast Missouri Rural network diagram shows it having OC-192 transport systems.

costs on forward-looking average utilization for efficiently sized trunks, rather than using actual, current utilization. The change is consistent with the FCC rules at 47 CFR §51.511. I have not modified the expense factors. The corrections lower the common transport cable cost per minute to $0.****.

Q37. HAVE YOU ALSO CORRECTED THE TRANSMISSION EQUIPMENT PORTION OF COMMON TRANSPORT COSTS?

A37. Yes, the transmission equipment investments and costs per DS0 also appear to be quite high. I believe this is due to the HAI model reflecting transport systems sized for large telco networks. Initially, I attempted to develop a transmission equipment investment per DS0 using the HAI model data for OC3 add / drop multiplexers, digital cross-connect systems, etc.; however, these network elements, particularly the digital cross-connect system, were too large to use in these circumstances. So, I developed an alternative transmission equipment investment using the *equivalent terminal investment per DS0* value in the HAI model, which is a surrogate for transmission equipment investment for a small telco.[22] These calculations are shown in Exhibit WCC-13.

This produced a transmission equipment investment per DS0 of $***, which I substituted in row 44 of WCC-12. After computing the annual costs associated with this plant, I again divided by the HAI model value for common transport minutes. The corrected

[21] Alma has a single switch, so its interoffice cable should only be to the Southwestern Bell point of interconnection.

[22] The HAI 5.0a documentation describes this variable as, "The per-DS0 surrogate investment by a small ICO for terminal equipment used on dedicated circuits between an end office and tandem switch belonging to the BOC (or other large LEC) on which the ICO relies for interoffice connectivity."

transmission equipment costs are shown on row 57. The total common transport costs per minute, including cable and transmission equipment, equal $0.**** to $0.**** per minute, after the corrections. The average cost is $0.**** per minute.

Q38. HOW DOES THIS COST COMPARE WITH THE RANGE OF UNBUNDLED COMMON TRANSPORT RATES IN WCC-10?

A38. It is four times higher than the highest common transport rate across the U.S., and 28 times higher than Southwestern Bell's common transport rate in Missouri. So, while the corrected common transport costs are significantly lower, they are still well above those of the RBOCs and major independent telcos.

Q39. WOULD YOU SUMMARIZE THE CORRECTIONS TO THE ILEC COST STUDIES AND THE RESULTING TRANSPORT AND TERMINATION COST?

A39. The following table summarizes the ILEC transport and termination costs, before and after corrections.

Average ILEC Transport and Termination Costs Per Minute

	Before Corrections	After Corrections
End office switching	******	$ 0.0007
ISUP signaling	******	$ 0.0012
Common transport	******	$ 0.0055
Total	******	$ 0.0074

The corrected costs more accurately represent forward-looking economic costs of transport and termination as required by the FCC rules. *The ILEC rate charged to T-*

Mobile for terminating telecommunications traffic should be no greater than $0.0074 per minute.

Q40. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A40. Yes.

STATE OF SOUTH CAROLINA)
) ss.
COUNTY OF GREENVILLE)

VERIFICATION

EXECUTED VERIFICATION PAGE
IS BEING SENT AS A SEPARATE ATTACHMENT

Exhibit WCC-1 – Comparison of Original and Revised Transport and Termination Costs Provided by the ILECs to T-Mobile

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Exhibit WCC-2 – Revised Cost Support

Cost Summary – Transport and Termination Costs - Four ILECs.

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HAI Model – Input / Output

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Exhibit WCC-3 – ILEC End Office Switching Costs

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Exhibit WCC-4 – Comparison of ILEC Embedded Investments Per Line with HAI Model Results

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Rural Telephone Company Actual Switch Costs

Comments of the Rural Utilities Service
CC Docket No. 97-160
August 7, 1997

	Host Switches				Remote Switches		
	Number of Lines	Actual Cost	Cost / Line	Note	Number of Lines	Actual Cost	Cost / Line
	75	$ 81,000	$ 1,080		75	$ 80,762	$ 1,077
	120	$ 115,589	$ 963		120	$ 46,328	$ 386
	150	$ 121,319	$ 809		151	$ 72,413	$ 480
	253	$ 1,540,904	$ 6,091	*	250	$ 109,381	$ 438
	443	$ 164,290	$ 371		440	$ 60,559	$ 138
	460	$ 354,675	$ 771		460	$ 98,249	$ 214
	560	$ 467,603	$ 835		578	$ 88,733	$ 154
	598	$ 329,951	$ 552		600	$ 104,276	$ 174
	674	$ 163,218	$ 242		680	$ 181,249	$ 267
	684	$ 315,709	$ 462		688	$ 256,750	$ 373
	820	$ 977,080	$ 1,192	*	810	$ 296,970	$ 367
	850	$ 620,200	$ 730	*	865	$ 117,218	$ 136
	960	$ 451,225	$ 470		960	$ 176,249	$ 184
	1,412	$ 526,088	$ 373		1864	$ 117,218	$ 63
	1,779	$ 429,417	$ 241		1880	$ 229,663	$ 122
	2,100	$ 766,053	$ 365		2510	$ 273,000	$ 109
	2,615	$ 490,666	$ 188		2740	$ 281,600	$ 103
	2,714	$ 526,839	$ 194				
	2,830	$ 596,830	$ 211				
	3,810	$ 1,243,673	$ 326	*			
	4,760	$ 663,650	$ 139				
Total	28,667	$ 10,945,979	$ 382		15671	$ 2,590,618	$ 165
Total excluding four switches (*) constructed to serve large number of remotes.	22,934	$ 6,564,122	$ 286				

Exhibit WCC-6 – Corrected ILEC End Office Switching Investment Per Line

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Exhibit WCC-7 – FCC Position on Switch Costs – Virginia Arbitration, "Memorandum Opinion and Order," CC Docket Nos. 00-218 & 00-251, 8/28/2003.

Arbitration Order ¶ 458 – 459.

> The Commission's general rate structure rules specify that UNE rates be structured consistently with the manner in which the costs of providing them are incurred. In other words, the basis on which the element is sold to the competitive LEC should reflect the basis on which the cost is incurred by the incumbent LEC. If, for example, the incumbent LEC were to pay the switch manufacturer a per line fee for some of the switch hardware or software, then the incumbent LEC should recover these switch costs from the competitive LEC on the same basis. If the incumbent LEC were to recover these costs on a per MOU basis, then this would provide the competitive LEC's subscribers with an uneconomic incentive to reduce usage of this switch hardware or software.
>
> The Commission's general rate structure rules also specify that the costs of shared facilities should be recovered in a manner that efficiently apportions them among users, either through usage-sensitive charges or capacity-based flat-rated charges. That is, these costs should be allocated among subscribers on the basis of their causal responsibilities. The Commission's specific rate structure rule for local switching specifies that costs for this element be recovered through a combination of a flat-rated charge for line ports and one or more flat-rated or per MOU charges for the switching matrix and trunk ports, but it does not specify a particular combination or means for determining the appropriate combination. (*footnotes omitted*)

Arbitration Order ¶ 463 – 465.

> We find here that the "getting started" costs of the switch should be recovered on a per line port basis. "Getting started" costs are incurred for capacity that is shared among subscribers. Verizon incurs these costs to be ready to provide service upon demand. Given the record evidence that modern switches typically have large amounts of excess central processor and memory capacity, the usage by any one subscriber or group of subscribers is not expected to press so hard on processor or memory capacity at any one time as to cause call blockage, or a need for additional capacity to avoid such blockage … Principles of cost causation, therefore, support a per line port cost recovery approach because, more than any other approach, it spreads getting started costs to carriers in a manner that treats equally all subscribers served by a switch.
>
> ***
>
> The incumbent LEC's central processor and memory costs do not vary with respect to whether a subscriber connected to its switch is a high or low volume user, a residential or business user, or a peak-period or off-peak-period user.
>
> ***

A per MOU price for the central processor and memory, in contrast to a per line port price, would not recover these costs on a competitively neutral basis … Principles of cost causation do not, therefore, support a per MOU price. (*footnotes omitted*)

Exhibit WCC-8 – Corrected ILEC End Office Switching Costs

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Exhibit WCC-9 – ILEC Common Transport Costs

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Exhibit WCC-10 – Unbundled Common Transport Rates

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"A Survey of Unbundled Network Element Prices in the United States," updated January, 2004, Consumer Advocate Division, Public Service Commission of West Virginia.

Exhibit WCC-11 – Fiber Cable Investment Per DS0

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Exhibit WCC-12 – Corrected ILEC Common Transport Costs

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Exhibit WCC-13 – Transmission Equipment Investment Per DS0

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Exhibit WCC-14 – ILEC ISUP Signaling Costs

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Exhibit WCC-15 – Corrected ILEC ISUP Signaling Costs

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Exhibit WCC-16 – ILEC Interoffice Network Data

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