EXHIBIT ___ (MAC-RT)

BEFORE THE WASHINGTON
UTILITIES AND TRANSPORTATION COMMISSION

IN THE MATTER OF THE PRICING PROCEEDING FOR INTERCONNECTION. UNBUNDLED ELEMENTS, TRANSPORT AND TERMINATION, AND RESALE [FOR U S WEST COMMUNICATIONS, INC.] [FOR GTE NORTHWEST INCORPORATED]	)))))))	**Docket Nos. UT-960369; UT-960370; UT-960371**

RESPONSIVE DIRECT TESTIMONY OF

Michael A. Carnall

ON BEHALF OF U S WEST COMMUNICATIONS INC.

January 18, 2000

I.QUALIFICATIONS AND PURPOSE OF TESTIMONY

Q. PLEASE STATE YOUR NAME AND POSITION.

A. My name is Michael A. Carnall. I am a Senior Managing Economist at LECG, Inc. My business address is 2000 Powell Street, Suite 600, Emeryville, CA 94608.

Q. PLEASE DESCRIBE YOUR PROFESSIONAL QUALIFICATIONS.

A. I earned my Doctor of Philosophy degree in Economics from the University of Illinois at Urbana-Champaign, in 1996. I also earned Bachelors and Masters degrees in Civil Engineering from Bradley University in 1977 and 1986. My professional experience prior to joining LECG in 1996 includes eight years of involvement in the measurement and analysis of product quality and reliability at Caterpillar Inc. in Peoria, Illinois. In connection with that position in 1982 I developed a system for tracking and evaluating the quality and reliability of prototype products. I later developed a method of directly applying field reliability analysis to the redesign of product components and coordinated the use of the method in the design of the powertrain of Caterpillar's largest track type tractor. As Senior Reliability Analyst, I conducted seminars on the theory, interpretation and use of field quality and reliability measurements throughout the U.S. and at subsidiary plants throughout the world. As part of my responsibility to train new reliability analysts, I taught short courses in reliability analysis as required. When I left Caterpillar in 1991 to enter the doctoral program at the University of Illinois, I was retained by the Company as a consultant to develop a system which gathers production quality data, matches that data with the subsequent field information and examines the correlation between the two experiences. As a teaching assistant at the University of Illinois, I taught undergraduate statistics in the College of Commerce. At LECG, my work in telecommunications has focused on the analysis of service quality, economic and cost issues. However, in the electric power industry, I have been involved in projects concerned with power quality and the optimization of transmission grid security in a deregulated industry. My vita is attached as MAC-1.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to provide an assessment of Staff's proposal for deaveraging the rates of U S WEST unbundled loops. Specifically I have been asked to examine and evaluate the conceptual bases and methods used by Mr. Spinks to determine his proposed prices.

DEAVERAGING UNBUNDLED LOOPS BY DENSITY ZONES

WHAT IS YOUR UNDERSTANDING OF THE OBJECTIVE OF MR. SPINKS

DEAVERAGING SCHEME.

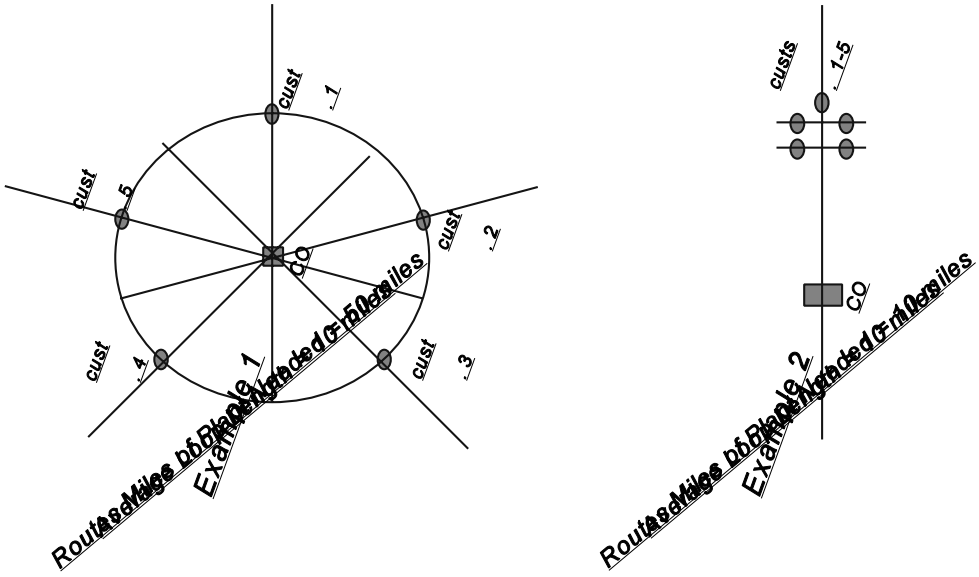
I believe that Mr. Spinks' objective was to create a deaveraging scheme based on the relationships between cost, density (in lines per square mile) and distance from the central office. He first attempted to group together exchanges having similar cost/density relationships. He then established and applied a relationship between cost and distance from central office to those costs in an attempt to determine a cost per line which would reflect the effects of both distance and density.

ARE THERE CONCEPTUAL PROBLEMS WITH THIS SCHEME?

A. Yes there are. The primary problem is that density and distance, especially average distance, are not the only determinants of loop cost. For purposes of estimating universal service funding, average loop length comparisons can provide very misleading information about the reasonableness of a model's distribution distances. This is because the average loop length does not account for customer dispersion and, therefore, does not provide an appropriate indicator of the route miles of distribution plant necessary to reach all customers. In a cost proceeding in Minnesota, AT&T witness Mr. John Klick quotes an FCC filing by the Rural Utilities Service (RUS) that explains the weakness of average loop length as a benchmark for distribution distances and costs:

> "The average loop length in an exchange has little value as an indicator of the average cost of serving customers in that exchange…Average loop length does not take clustering into consideration. Five customers evenly distributed on a circle with a wire center at its center, where each is at a distance of 10 miles from the central office (thus with an average loop length of 10 miles), would cost about five times as much to service with outside plant as the same five customers if they were all clustered at a point 10 miles north of the wire center (again with an average loop length of 10 miles)."[1]

[1] Rebuttal Testimony of John C. Klick on behalf of AT&T Communications of the Midwest, Inc. and MCIMetro Access Transmission Services, Inc. before the Office of Administrative Hearings for the Minnesota Public Utilities Commission, MPUC Docket Nos. P-42, 5321, 3167, 446,421/CI-96-1540; OAH Docket No. 12-2500-10956-2, March 2, 1998, p. 39 citing Comments of the Rural Utilities Service On Outside Plant Structure Before The FCC, CC Docket No. 97-160, September 24, 1997. Note that the drawings are included in the RUS filing.



It is clear from the above diagram that the use of average loop length cannot accurately explain the variation in loop cost.

IS IT YOUR BELIEF THAT WHOLESALE LOOP PRICES SHOULD NOT BE RELATED TO DISTANCE FROM THE CENTRAL OFFICE?

Not at all. Loop cost is certainly related to distance from the central office. However, average loop cost and average loop length do not contain the information required to accurately establish the relationship between loop cost and loop length. In addition, as shown above, average loop length does not explain all of the variation in cost. For those reasons, the accuracy of the relationship between loop length and cost should not be overstated by using an inappropriately small length increments. There is also a cost benefit relationship between level of deaveraging and the cost of implementation which must be evaluated in determining the most appropriate level of deaveraging.

ARE THERE METHODOLOGICAL PROBLEMS RELATED TO MR. SPINKS OBJECTIVE?

A. Yes. Mr. Spinks apparently would like to set prices based on the length of each loop, that is the distance from the CO to the particular customer premises. However, he does not have data at the level required to determine that relationship. He has only average cost and average loop length. Aside from the problem of dispersion noted above, the use of average loop length data to determine the relationship between length and cost is inappropriate for other reasons. A central office having an average loop length of 1kilofoot could be serving all of its customers within a band between 0 and 2 kilofeet or it could be serving a large number of customers very close to the CO and another smaller group at 10 kilofeet. Each would have an average loop length of 1 kilofoot, but only if loop cost were a perfectly linear function of length

would these two offices yield the same average loop cost. As will be discussed later, Mr. Spinks recognizes that the relationship between loop cost and loop length is not linear and uses a model of constant elasticity to quantify that relationship.

Q. PLEASE SUMMARIZE THE METHOD USED BY MR. SPINKS TO CALCULATE HIS PROPOSED DEAVERAGED UNE RATES BY LOOP LENGTH WITHIN DENSITY ZONES.

A. Mr. Spinks begins his analysis with the result of a wire center run of the HAI model. That is, his basic data are estimates of UNE loop costs for each wire center, along with the number of lines, area, density, and average loop length for each. Wire centers are then aggregated to the exchange level, and exchanges are grouped into the density ranges used by the HAI model.[2] Mr. Spinks then combines density zones based on the results of a series two-sample t-tests which he uses to determine whether or not the arithmetic means of the exchange UNE loop costs in adjacent density zones are statistically significantly different. Next, Mr. Spinks weights the exchange UNE loop costs by number of lines to compute the weighted average UNE loop costs for each of his density zones. The relationship between length of loop and cost is then applied to each density zone and finally the UNE loop costs of density zones are trued up to so that the weighted average loop cost using his scheme matches the statewide, commission mandated average.

In other words, Mr. Spinks first aggregate exchanges into an arbitrary set of "density zones," then tests each adjacent pair to determine whether their average loop costs are different and combines the zones if they are not. The average loop cost of each group is then normalized so that when reaggregated, they produce the statewide average. He then establishes a relationship between average loop length and cost and applies that relationship to each of these zones, normalizing the resulting rates to the average cost for each range.

Q. WHAT IS YOUR ASSESSMENT OF STAFF'S CALCULATION OF THE UNBUNDLED LOOP RATE FOR EACH EXCHANGE?

A. It appears that Mr. Spinks estimates the average UNE loop cost for each exchange as the weighted average UNE loop cost of the wire centers in the exchange. However, it is unclear how he assigned the weights to each wire center. The natural approach is to weight cost by number of lines, but Mr. Spinks' results are only close, not exactly equal, to the line weighted UNE loop cost.[3]

Q. WHAT IS YOUR ASSESSMENT OF MR. SPINKS' METHODOLOGY FOR GROUPING EXCHANGES INTO DENSITY ZONES?

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[2] The HAI model uses these density "zones" to categorize CBG density. Mr. Spinks' application of these ranges for average density of an exchange, a much larger area, is a substantial deviation from the original use.

[3] The poor organization of Mr. Spinks workpapers makes it very difficult to track the calculations.

A. There are several problems with Mr. Spinks' method of grouping exchanges by density. First, the statistical tests he used to determine whether there is a significant cost difference between exchanges are not appropriate for that purpose. Second, when comparing costs between density zones, Mr. Spinks seriously understates the variation in cost by ignoring the cost variation within exchanges. And finally, he erroneously includes the cost variation due to loop length when assessing the cost variation due to density.

Q. WHY ARE MR. SPINKS' STATISTICAL TESTS INAPPROPRIATE?

A. Mr. Spinks statistical tests are formulated using inappropriate null and alternate hypotheses. The null being the proposition he assumes to be true unless the data show it to be very unlikely, and the alternate hypothesis he assumes to be true if the null is rejected. Mr. Spinks assumes that, if it is unlikely that the two groups have the same loop cost, they must have different loop costs. The problem with that formulation is that it does not specify a magnitude of difference. That is, a statistically significant difference could be materially very small or very large.

Mr. Spinks combines density zones based on the results of a series of two-sample t-tests that show whether the simple arithmetic means of exchanges' UNE loop costs in adjacent density zones are statistically different. However, statistical difference is positively related to the size of the difference of the means and is inversely related to the variance of the costs in the density zones and the number of exchanges within each density zone. Therefore, even a sizable difference can be determined to be insignificant if the UNE loop costs within density zones have a large variance or the number of exchanges is small. Conversely, a very small difference in cost could be found to be significant if the variance in cost is small and/or the number of exchanges in the density range is large.

Using Mr. Spinks method, the magnitude of a significant difference is not quantified, it could be very small or very large. A more appropriate statistical test would determine whether the difference in cost between the two density ranges was different by at least an economically meaningful amount.

Q. WHY SHOULD STAFF CONSIDER COST VARIATION WITHIN EXCHANGES AND WITHIN CENTRAL OFFICES?

A. Mr. Spinks' density zones are groups of exchanges, and exchanges are groups of central offices. By using only the variation of exchange average cost in his statistical tests Mr. Spinks seriously understates the variation in cost within an exchange. To see why, consider the effect of combining ten families, 5 consisting of 10 people varying in age from 1 to 50 and five consisting of 10 people all exactly 25 years old. The average age of each family is 25. The average age of the combined group of 10 families will also be 25. The first 5 families will each have a significant variance, reflecting the variation in age of its members. The second set of 5 will each have a variance of zero, reflecting the fact that they consist of people of only one age. The

variance of the combined group, ignoring the variation within families, would be zero because each constituent family has the same average age.

A zero variance indicates that all members of the combined group are of exactly the same age. Clearly that is wrong since we know that there are members of the group who are 1 year old and others who are 50 years old. Proper calculation of the variance of the combined group of families accounts for the variation within each of the constituent families as well as the variation of the average age of each.

Mr. Spinks has made exactly this mistake in performing his statistical tests. He has calculated the variance of each density group using only the average costs of each exchange within the range, as if there were no variation in cost within each of its constituent exchanges and central offices. He has thus seriously understated the variation in cost within density range.

Q. WHY SHOULD MR. SPINKS HAVE CONSIDERED COST VARIATION DUE TO LOOP LENGTH?

A. Mr. Spinks attempts to form groups with similar cost and density without accounting for the effect of loop length on cost. His method would therefore group together density ranges which have high costs even though one range's high cost was due only to the fact that it consisted of very long loops. In order to accomplish his goal of grouping similar density and cost exchanges, Mr. Spinks should first have established the relationship between cost and loop length, and used it to correct the average cost of each density range to a common loop length.

To see the error in Mr. Spinks method, consider an attempt to determine whether genetically "tall" people are more inclined to take up basketball rather than soccer. This could be accomplished by comparing the heights of basketball and soccer teams at a high school for example. In comparing the average height of the freshman basketball team to the senior soccer team I would very likely find that the soccer team is, on average, the taller of the two.

Is that an indication that "tall" people are more inclined to play soccer than basketball? Certainly not. This test is obviously inappropriate because it ignores the fact that the height of high school students is related to age as well as genetic proclivity to being tall. In order to perform the test properly, the relationship between age and height must first be established, and the height of each player adjusted to a common age based on that relationship. Only then can a proper comparison of genetic height and choice of sports activity be made.

DEAVERAGING UNBUNDLED LOOP RATES BY DISTANCE

Q. PLEASE SUMMARIZE STAFF'S METHOD USED IN CALCULATING UNE LOOP COSTS BY DISTANCE.

A. Mr. Spinks first developed a linear regression model for the loop cost of each wire center. A regression analysis estimates, from observed data, the unknown coefficients of an equation (model) relating a single variable, such as cost, to other variables such as density and average length. Mr. Spinks chose a model using the corresponding natural logs of average loop length and density as explanatory variables for the log of cost. This is a model of constant elasticity, that is, it assumes that an increase in length of X percent will result in a change in cost of C*X percent, where C is estimated from the data. After the equation for the model is established, the coefficients of the model are estimated using cost data from all central offices. Mr. Spinks then derives the UNE loop cost for each of his proposed distance bands in each density zone by setting the density variable at the average density for the zone and then evaluating the model at each of his proposed loop lengths. These length specific costs are then trued up to match the density zone costs derived in the previous analyses.

WHAT IS YOUR ASSESSMENT OF STAFF'S STATISTICAL METHOD FOR DEAVERAGING UNE LOOP RATES BY DISTANCE?

For all the reasons stated above, average loop length is a bad choice as an explanatory variable. It does not account for customer dispersion, and therefore, does not provide an appropriate indicator of the route miles of distribution plant necessary to reach all customers. The use of an average loop length to cost relationship is not appropriate because it will only provide accurate information about the loop length to cost relationship if that relationship is linear. That is, if the cost increases with length at a constant rate. Mr. Spinks' model assumes, properly, that the relationship is not linear and therefore his analysis is not compatible with the use of average loop length data. In addition, Mr. Spinks' regression analysis did not account for the fact that central offices serve very different numbers of customers. That is, each central office represents a very different number of cost/length observations and should be weighted accordingly. Mr. Spinks' regression analysis gave each central office exactly the same weight, so offices serving 1,000 customers received the same weight as offices serving 100,000 customers.

HAVE YOU RECALCULATE MR. SPINKS' NUMBERS USING THE MORE APPROPRIATE METHODS YOU DESCRIBE?

A. No I have not. Because the data with which he begins is fundamentally inappropriate for the task he sets out to accomplish, recalculation would provide no useful information about the pricing of loops.

CONCLUSION

PLEASE BRIEFLY SUMMARIZE YOUR TESTIMONY.

Mr. Spinks has attempted to establish loop prices on the basis of average density of the area covered by an exchange and the distance of the customer from the serving central office. Unfortunately, the data used in his analyses, average cost, area served, number of access lines, and average loop length, for central offices, does not contain the information required to accurately accomplish this task. Also, throughout his analyses, Mr. Spinks uses inappropriate statistical tests and analytic procedures. Although many of these errors are very subtle, and obvious only to those very familiar with statistical methods, they render his final results meaningless. The result is a set of numbers which may appear to be reasonable length and density related prices, but which have no basis in the true cost of providing loops. For example, these numbers do not include the effects of customer dispersion or local density, factors which have been found to profoundly affect loop cost.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes it does.