ATTACHMENT C

BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

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

AFFIDAVIT OF
HAROLD WARE AND CHRISTIAN MICHAEL DIPPON

NATIONAL ECONOMIC RESEARCH ASSOCIATES, INC.

July 23, 1999

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Federal-State Joint Board on Universal Service	)	CC Docket No. 96-45
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Forward-Looking Mechanism For High Cost Support for Non-Rural LECs	)	CC Docket No. 97-160

AFFIDAVIT OF

HAROLD WARE AND CHRISTIAN MICHAEL DIPPON

Harold Ware and Christian Michael Dippon, being duly sworn, depose and say:

1. My name is Harold Ware. I am Vice President of National Economic Research Associates, Inc. ("NERA"). Since joining NERA, I have advised clients, directed studies, and prepared testimony for regulatory proceedings and antitrust cases in a variety of industries. My research has focused on telecommunications, including: studies of costs, pricing and entry policy, and universal service issues associated with the transition to competition; studies of competition in the local, interexchange, Centrex/PBX, and private line markets; analyses of regulatory policy on stranded plant; analyses of competitive effects of mergers in wireless telecommunications and between telephone and cable TV companies, and analyses of the planning and deployment of new technology in telecommunications networks. I have also studied competition and demand for postal services and the impact of postal rate changes. I have testified before state regulatory commissions and the U.S. Postal Rate Commission, and filed affidavit testimony before the FCC and the Department of Justice.

2. I received a B.A. *cum laude* in Economics from the State University of New York at Stony Brook, and M.A. and Ph.D. degrees in Economics from Cornell University. While pursuing my graduate studies at Cornell, I taught courses in economics and industrial organization and did research on cellular mobile communications in the Technology Assessment Project of the Program on Science, Technology, and Society. My articles have been published in *Public Utilities Fortnightly*, *The Journal of Regulatory Economics*, *IEEE Communications*, proceedings of the *Fifth* and *Seventeenth Annual Telecommunication Policy Research Conferences*, and in *Managing Change in the Postal and Delivery Industries*. I am also co-author of three chapters of *Communications for a Mobile Society: An Assessment of New Technology*. A copy of my resume is attached as Exhibit A.

3. My name is Christian Michael Dippon. I have a B.S. *cum laude* in Business Administration from California State University and an M.A. in Economics from the doctoral program of the University of California, Santa Barbara. After completing my undergraduate degree, I worked for BMW in the Bangkok office, where I performed economic and financial analysis, strategic planning, and forecasting for the Thailand operations. Since joining NERA in 1996 as an Economic Consultant, I have worked on regulatory, antitrust, and strategic management issues for the increasingly competitive telecommunications markets and other industries. I have analyzed cost studies for telecommunications services and elements and determined reasonable long-run incremental costs (TELRIC and TSLRIC) that meet competitive standards and are consistent with the Federal Communications Commission's ("FCC") guidelines. Specifically, I have analyzed and commented on more than ten versions of the HAI Model (previously called the Hatfield Model), several versions of the Benchmark Cost Proxy Model ("BCPM"), the Telecom

Economic Cost Model ("TECM"), the Hybrid Cost Proxy Model ("HCPM"), and other industry-sponsored cost models. On several of these models, I have prepared testimony and co-authored expert reports detailing the results of NERA's analysis. I also have appeared before several state public utilities commissions as a subject matter expert in telecommunications matters. A copy of my resume is attached as Exhibit B.

I. PURPOSE OF THIS AFFIDAVIT

4. In a Further Notice of Proposed Rulemaking ("*FNPRM*") released on May 28, 1999,[1] the Commission seeks comment on the inputs to the universal service cost proxy model platform adopted in the *Fifth Report & Order*, released October 28, 1998.[2] Bell Atlantic has asked us to review the Commission's proposed cable and switch cost inputs to the model. Therefore, the purpose of this affidavit is to present our findings regarding the validity of the basic economic concepts, data, and econometric methods underlying the Commission's proposed switch and cable cost inputs.

II. THE PROPOSED INPUTS ARE INCONSISTENT WITH FUNDAMENTAL ECONOMIC PRINCIPLES.

5. To produce a forward-looking economic cost study that accurately reflects attainable real-world costs, appropriate economic cost principles must be applied to real-world facts and reasonable business assumptions. As discussed below, we conclude that the recommended inputs

[1] Federal State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, *Further Notice of Proposed Rulemaking*, CC Docket Nos. 96-45, 97-160, FCC 99-120 (rel. May 28, 1999).

[2] Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs, *Fifth Report & Order*, CC Docket Nos. 96-45, 97-160, FCC 98-279 (released October 28, 1998) ("*Fifth Report & Order*").

rely upon unrealistic assumptions in violation of fundamental economic principles and of the FCC's own forward-looking cost standards.[3] In this section, we summarize the major conceptual problems—*e.g.*, the unrepresentative nature of the inputs, and flaws in the inputs stemming from the fundamental (structural) failing of the Model to account for the dynamic process by which efficient firms deploy networks in the real world—and we show that these failings are inconsistent with efficiency and with FCC and Joint Board findings that forward looking costs should be grounded in actual data. Failing to use representative data that reflect how networks are deployed will produce cost estimates that understate (or overstate) costs in various areas and will, therefore, lead to inefficient outcomes.

A. To reflect true forward-looking costs, the study must use representative data and realistic assumptions about network deployment.

6. A forward-looking economic cost study must assume that the network would be built (or rebuilt) in a way that reflects how actual networks evolve to serve changing demand. It is crucial that the study use forward-looking guidelines and projections, which take into account representative local exchange carriers' ("LECs"') (including non-rural LECs') experience in constructing and managing real networks. Thus, forward-looking cost models should be based on representative, realistic data.

7. LEC engineering guidelines are designed to cope with three undeniable facts: (1) demand grows over time; (2) demand growth is uncertain; and (3) technological change and changing

[3] As discussed later, the FCC established costing standards not only in the *Universal Service Order*, but also in the *Interconnection Order*. *See* Federal State Board on Universal Service, *Report and Order*, CC Docket No. 96-45, 12 FCC Rcd 8776 (1997) ("*Universal Service Order*"), *subsequent citations omitted*. *See also* Implementation of the Local Competition Provisions of the Telecommunications Act of 1996, *First Report and Order*, CC Docket No. 96-98, 11 FCC Rcd 15499 (1996) ("*Interconnection Order*") *subsequent citations omitted*.

market conditions require periodic upgrades to software and hardware. In this environment, it is not efficient for firms to install all the equipment they will ever need at a single point in time; it is efficient to install plant that includes enough capacity to meet some short-run demand growth (*e.g.*, two to three years for new switches), and subsequently to implement growth jobs and upgrades over the life of the plant. Therefore, to minimize costs, firms continually adjust their factors of production to augment and replace facilities. The long-run costs of all real networks reflect this fundamentally dynamic optimization process. While a properly conducted, long-run forward-looking analysis should assume that all costs vary, it: (1) should *not* assume that all costs vary simultaneously; and (2) must recognize that firms replace outdated and defective network equipment and accommodate growth by adding capacity to their networks throughout the life of the plant. The FCC's proposed "at once" method defies the concepts of both forward-looking and long run.

B. Realistically attainable input assumptions should be used.

8. Cost models (and their inputs) should not be based on a textbook case in which the long run is a period long enough to allow a firm to reach its optimum scale of operation, namely, one at the bottom of its average cost curve. Economists recognize that this is a hypothetical, limiting case, not the case in which firms generally operate. Even new entrants are constrained by current conditions such as the location of buildings, streets, and existing and forthcoming customers. No real world firm has enough knowledge about all current and future technologies so that it could determine, *in advance of making any investment decisions*, with perfect certainty what its global cost-minimizing scale of operations might be. Future technologies are *not* perfectly foreseeable. Therefore, a real world firm necessarily makes investment decisions without perfect knowledge

about the future of technology or demand, but with the expectation that demand will grow and shift and that facilities will be relieved and replaced.[4] The FCC Model's platform and inputs need to reflect such realities.

C. The Commission has recognized that unrealistic, hypothetical assumptions have no place in a properly designed forward-looking study.

9. This Commission has recognized that forward-looking costs should *not* be developed based on a purely hypothetical network. Instead, under the Commission's own standard, cost studies should be based upon the most efficient technology available using *existing* switching center locations *and* should be compatible with existing infrastructure. In the *Universal Service Order* the FCC clarifies that to model forward-looking costs:

> [t]he technology assumed in the cost study or model must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed. A model, however, must include the ILECs' wire centers as the center of the loop network and the outside plant should terminate at ILECs' current wire centers. ... Wire center line counts should equal actual ILEC wire center line counts, and the study's or model's average loop length should reflect the incumbent carrier's actual average loop length.[5]

10. Thus, the Commission's position on cost principles, as articulated in this statement, is inconsistent with the Commission's own proposed inputs and with the structure of the cost Model. If the Commission really believed that cost studies should be based on a static, hypothetical network instantaneously built from scratch without regard to real-world constraints, it is inconceivable that it would have found that the:

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[4] Even from a theoretical perspective, optimum operation may not occur; control theory suggests that when finite resource commitments do not expire simultaneously, the sequence of long run optimum adjustments to plant may not reach the "scorched earth" solutions ever.

[5] *Universal Service Order* at ¶ 250 (emphasis added).

- technology assumed must be technology *currently being deployed*;
- study must include the ILECs' wire centers as the center of the loop network;
- the outside plant should terminate at the ILEC's *current* wire centers;
- line counts should equal *actual* ILEC wire center line counts; and
- average loop length should reflect the ILEC's *actual* average.

11. These positions are not consistent with the hypothetical method embodied by the proposed inputs, where the entire network is replaced instantaneously from the ground up with no regard for how networks are deployed over time to accommodate demand growth and technological change. Rather, they are consistent with a forward-looking economic cost study approach that takes the most efficient technologies available and deploys them *over time* based on more realistic expected future capital investment programs and forward-looking engineering guidelines. This is reflected in the Commission's *Interconnection Order*, where the Commission adopted the concept of a "forward-looking economic cost methodology based on the most efficient technology deployed in the incumbent LEC's current wire center locations."[6]

D. Input estimates should be based on representative data.

12. Econometric estimates can be used to generate realistic forecasts of forward-looking costs. However, as discussed above the Commission has recognized that proper studies should use realistic, attainable assumptions. Furthermore, common sense and statistical principles imply that the data on which such estimates are based must be representative of the firms in question and that factors explaining inter-firm differences be accounted for in the econometric models. Our review of the data and statistical methods used to estimate two key cost drivers—switching costs

[6] *Interconnection Order* at ¶ 685.

and cable costs—shows that these principles have not been followed closely enough to rely on the proposed inputs. We address these problems in more detail in the sections that follow.

III. REVIEW OF SWITCH COST STUDY

13. The *FNPRM* (at 151) seeks comment on the derivation of the switching inputs to the Model. In this section, we assess the database and switch cost model developed by Gabel and Kennedy and modified by the FCC. Our review of the data and methods reveals a number of errors and concerns about the validity of these inputs. Our principal concern with the proposed switch cost investment inputs is that they do not explicitly allow for the mix of new and growth lines. That is, the proposed inputs reflect an unobtainable hypothetical approach that assumes switches are deployed instantaneously at a single point in time. This ignores the fact that demand changes and networks expand over time. The results of the proposed approach will not reflect the going forward costs of either incumbent local exchange carriers or of new entrants. They will also understate switch costs.

14. In addition to these basic flaws, the preliminary switch investment cost curves: (1) incorporate the implicit suggestion that the same switch inputs can be used for all states and all companies, which is inconsistent with the economic principle that rates should be based on incremental costs incurred to provide service; (2) are based on an unrepresentative database; and (3) contain a number of problems and shortcomings in the Model's econometric specifications. For these reasons, adopting the suggested inputs would be inconsistent with the Commission's goals of promoting competition and developing more efficient subsidy mechanisms.

A. The proposed inputs wrongly suggest that all switch capacity can be deployed instantaneously.

15. By looking only at switch costs for new switches, the inputs effectively are based on the assumption that networks are built *instantaneously* from scratch with no need to account for demand growth. The Commission's switch inputs assume that the network is destroyed, with the exception of current wire center locations, and rebuilt from scratch using the most efficient available technologies. This approach can be applied consistently with the following (correct) economic view: *we should assume that the new network is rebuilt to reflect the way real networks evolve and accommodate growth in a forward-looking manner; we should not assume it is instantaneously rebuilt in one day.* However, the proposed inputs do not allow for growth:

- They do not distinguish between the costs of initial capacity and of additional lines, which usually cost more because switch manufacturers generally give lower discounts for additional lines.
- They do not reflect the fact that initial switch purchases normally account for only a few years of anticipated growth.
- They do not account for the cost of switch software and hardware upgrades. (Indeed, the sample data on which the assumed investment costs were estimated were "[d]esigned to eliminate upgrades from the analysis.")[7]

16. Accounting for expected future growth patterns and differences in costs is necessary to capture how an efficient carrier operating in the real world attempts to minimize its costs by making reasonable and prudent decisions about serving growing, uncertain demand and meeting regulatory and market obligations. A proper forward-looking long-run cost study cannot ignore this fundamental fact. Thus, relying on the proposed inputs will understate the forward-looking

[7] Federal Communications Commission, Common Carrier Bureau Universal Service Support Preliminary Input Values Workshop, December 1, 1998, "Gabel and Kennedy (NRRI)," 2. Methodological Notes (b) 1993-1995 Sample Selection.

costs of a real network because they assume that the network is deployed to serve *instantaneously* only a snapshot level of existing demand.

17. A firm building a new network (or replacing an existing network) would not size and purchase new switches to serve all future anticipated customers, because demand growth is uncertain and switches are used for a number of years. Rather, entrants (the same as incumbents) would purchase switches sized to meet a few years of growth and then add capacity as needed to meet future demand growth. Therefore, pretending that a LEC simply replaces all of its switches in every time period would bias the estimated cost of switching downward.

18. The Commission's proposed switch investment inputs assume that a LEC can instantaneously build a purely hypothetical network to serve total present and future demand on day one. By assuming that LECs add capacity only by installing new switches, the inputs "build in" an artificial downward bias into the assumed switch costs and, thus, into the switching cost estimates. This approach effectively assumes that a LEC can continually re-optimize its network, and leads to the highly unrealistic premise that *all* switches can be instantly (and at no extra cost) resized and/or replaced to reflect current demand conditions. Real world LECs respond to increasing demand by either adding lines to an existing switch or by adding another switch because they recognize that demand grows—and has to be satisfied—over time. Further, as discussed above, Commission decisions on the implementation of forward-looking long-run principles do not require—indeed are not consistent with—the approach reflected in the proposed switching inputs.

19. If the Commission wants to assume that there are never any growth jobs, then it would need to allow for the following effects on other input assumptions, each of which would raise costs: First, if any company actually installed a replacement switch with no plans to ever add additional

lines, then the switch would need substantial excess capacity—much higher than assumed by the FCC—and/or the switch would have to be replaced ever few years to allow for growth. In the latter case, the depreciation on switches would have to be much higher because the life of the switch would be drastically shorter than currently assumed by the FCC. Alternatively, every time the firm experienced enough growth to exhaust existing capacity, it would have to install a new smaller switch to handle the expected growth lines. Thus, if a wire center currently had 70,000 lines in service and the inputs assume that the switch has 4,000 lines for administrative fill and about 6,000 lines for expected growth, then the assumed switch size would be about 80,000 lines. At a growth rate of about 3 percent per year, during the third year that switch would have to be replaced with a larger switch, augmented with a new smaller switch at the same location or would have to have growth lines added.[8]

20. The cost consequences of any of these scenarios are all quite different than assumed by the Commission's switch cost inputs. Putting in a switch with enough excess capacity to stay in place for the 16 year life now assumed by the FCC would imply a need for about 60 percent initial spare capacity to meet growth and handle administrative fill over that period. This would obviously increase the initial investment and the subsequent capital costs by substantial amounts. Replacing the switch every three, rather than every 16, years implies depreciation that is more than five times higher per year; this would also increase annual switch costs by substantial amounts. Adding new switches every three years to serve line growth and maintain an assumed administrative fill of 95

[8] Under these assumptions, the 6,000 lines would be used before the end of year three because $70,000 \times 1.03^3 =$ 76,490 which when added to the 4,000 lines for administrative fill comes to about 80,500.

percent would increase the cost per line substantially, even if we were to accept the low fixed costs for host switches assumed in the proposed inputs.[9]

21. In addition, if LECs only deployed replacement switches, and never added growth lines, then manufacturers' discounts would be much smaller for replacement lines. Because the switch manufacturers could not count on the higher margins they currently receive for growth lines to offset the very low margins on initial (replacement) installations, they would have to charge higher prices for new switches. Further, as Sprint pointed out, the basic premise (of the FCC Model and inputs) that all switches are to be replaced at a single point is not plausible because manufacturers do not have enough capacity to do so; and trying to meet so much demand in a short time would dramatically bid up prices for equipment.[10]

22. Thus, the use of only original equipment lines generates unreasonably low switch investment costs. If the FCC wants to use this approach—contrary to the way in which any real world telecommunications firm does or would deploy switches—then it should at least recognize that many other determinants of costs would also change. It is simply unreasonable to assume these complications away.

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[9] If we assume the FCC host switch equation holds (with fixed costs of $447,000 and per-line costs of $83 per line), a growth rate of 3 percent, enough spare capacity for three years of growth, 94 percent administrative fill, we would need about 4 growth jobs over the 16 year life assumed by the FCC. This would add about $820,000 in net present value terms (assuming a 12 percent cost of money) to the cost of the switch for fixed costs, alone. Of course, the need for floor space and various other added costs not covered by the FCC Model for interconnections between the additional switches and other costs of disrupting the central office should be accounted for also.

[10] *See* "Switch Investment Inputs for the HCPM/HAI Platform," Prepared by the BCPM Sponsors—BellSouth, INDETEC International, Sprint and U S WEST, *Ex Parte* filed by Pete Sywenki, Sprint, December 17, 1998 (cited below as the Sprint *Ex Parte* filing).

B. The switch cost estimates are based on a flawed database.

23. The switch cost study by Gabel and Kennedy (as well as the FCC's adaptation of it) relies on a database with serious limitations. As discussed above, the most severe limitation is the fact that it excludes information about add-on lines and upgrade costs for new software and hardware *after* initial placement. In addition, the data set is not representative and omits key explanatory variables.

1. The data set used is not representative.

24. The RUS data set does not seem to be randomly selected and is unlikely to be representative of non-rural ILECs such as a Bell Atlantic. Similarly, the depreciation data set, which comes from depreciation-related data filed by large LECs with the FCC, includes about 20 states and may not be very representative of some non-rural LEC operations. To the extent that these disparate data sources omit data from mid-sized companies. More generally, since the data exclude many states and companies, and since the sample was not randomly selected, we can not be comfortable that the sample is representative.

2. The data set omits key variables.

25. The database used to estimate the Model does not contain:

- Specific information on switch and wirecenter characteristics. For instance, there is no information on the engineered blocking probability of the switch, or on calling volumes (i.e., numbers of calls and minutes of use per line)—both of which can have significant impacts on the cost of the switch.
- Any information about the concentration ratio of the switch. Again, this piece of information is important, as switches with low concentration ratios—needed to handle more traffic per line—will be more expensive.

- Information on the lead-time of each switch. It is likely that switches with a short lead-time are more expensive that switches with a longer lead-time.

- Investment characteristics specific to wire centers. Investments differ considerably between wire centers—*e.g.*, between urban wire centers in which it is more costly to install a switch and in lower-cost rural areas.

- Data that could be associated with differences in volume and term discount structures contained in contracts. These discount structures, which may differ by vendor, affect the costs reported in the database and, hence, the estimates from the regressions, but are not captured in the data. Thus, not having information on the switch vendor or the contract specifications could lead to inaccurate estimates.

- Separate vertical services and features from the basic investment.

3. The data set apparently contains suspect data.

26. A review of the data set provided by the FCC raises concerns regarding the accuracy and completeness of the switch data set. The proposed method would eliminate the large majority of observations before even running the regressions. As noted above, this is particularly troubling because about ¾ of those omitted were to exclude the effects of growth and upgrades. More specifically:

- According to Appendix E of the FNPRM, the depreciation database (for large LECs that file investment data in connection with depreciation reports) starts off with almost 3,600 observations, from which the proposed method removes about 600 observations to delete "outliers," confine the sample to post-AT&T divestiture data, and eliminate switches that could not clearly be classified as hosts or remotes. For some reason, the FCC evidently did not make the same adjustments to the RUS data. (Instead, the FCC proposes to eliminate only 42 of the 181 RUS switches to "remove… observations [on] upgrades… and switches … having no attached lines.") As discussed below, this process contains some very arbitrary methods.

- Further, the FCC's proposed data set excludes almost two thirds (over 2,000) of the observations to "exclude costs associated with upgrading switches" and include only costs for new switches. [11] The final depreciation data set contains 921 observations.

27. The final data set contains only 1,060 of the approximately 3,780 observations in the initial data. This yields a data set that is likely to be even less representative of the true population than the original data set.

28. Furthermore, even after the adjustments described above, the data set contains large variations in the cost of switches per line. These variations are present even when we confine the comparisons to the same type of switch within the same year. The 1995 data show host switches ranging in cost from $155 to $14,472 per line. Remote switches show similarly large ranges. See Table 1 below. While we would expect substantial variations in the data, the degree to which the switch data fluctuate implies that there are many possible inconsistencies in the reporting methods. This makes it all the more important to use careful econometric analysis that accounts for as many explanatory variables as possible, rather than to simply use *ad hoc* processes to delete selected observations as seems to have been done.

[11] According to Appendix E, they propose to exclude 2,102 observations from the depreciation data set and fewer than 42 observations from the RUS data for this reason.

Table 1
Examples of Ranges Between Low and High Estimates for Host and Remote Switches

Switch Designation	Year	Minimum Cost per Line	Maximum Cost per Line
(1)	(2)	(3)	(4)
Host	1990	163.58	830.91
Host	1992	116.32	756.80
Host	1995	155.53	14,471.96
Host	1996	250.36	1,066.43
All Host Observations	1989 to 1996	31.68	14,471.96
Remote	1990	132.74	821.82
Remote	1991	98.53	850.38
Remote	1995	23.14	3,129.75
Remote	1996	559.98	1,867.14
All Remote Observations	1989 to 1996	23.11	3,129.75

4. The adjustment approach is arbitrary and inconsistent.

29. The authors of the NRRI Study and the FCC evidently recognized some of the apparent problems with the quality of this database. Unfortunately, they opted for various arbitrary tests to identify and eliminate potential outliers and "bad" data. For instance, under Test (A), to eliminate outliers from the depreciation data, if there is a price gap of 20 percent or more between the per-line cost of the switch and the next lower or higher switch, then it fails this test.[12] The FCC offers no justification for the 20 percent benchmark and does not explain how it was derived. Furthermore, they evidently do not make this same adjustment to the RUS data. In addition, while the FCC approach discards switches with fewer than 1,000 lines from the depreciation data, it leaves in such switches from the RUS data. This inconsistent approach is not explained in Appendix E. The inclusion of small line counts explains why some of their observations have

[12] These exclusion criteria are slightly more complex than described in the text above: "(B) a low-priced switch that failed test A nevertheless was retained in the data set if a switch with that per-line cost would have passed test A in a previous year; (C) a high-priced switch that failed test A was retained … if a switch with that per line-cost

such large costs per line. However, even if we were to eliminate switches from the RUS data with fewer than 1,000 lines, we would still observe an extremely wide range of variation in the data—from $23 to $850 per line for hosts and from $32 to $970 per line for remotes.

C. Omitted variables lead to biased estimators

30. As indicated in the section above, there seems to be a serious problem with omitted variables in this model. The only variables in the recommended FCC cost curves are lines, a host or remote classification, and time period. Omitted variables lead to biased estimators.[13] For example, the study does not include variables to capture differences from add-on costs, such as hardware improvements or software upgrades. (Indeed, as noted above, these crucial cost determinants were specifically excluded from the model.) The equations also omit explanatory variables to capture the effect of different vendors on switch costs. Different vendors may influence switch costs because the relative mixes of their getting-started and line-sensitive costs (that vary with the number of lines) may differ. Further, the cost curves do not capture the specific features of the switch or any company- or area-specific differences.

31. For example, by omitting the impacts of different traffic volumes per line and the need for different concentration ratios in the switch, the equations may bias the results. In particular, if as seems reasonable, there is a correlation between traffic per line and population density—e.g., if urban switches have greater traffic per line and, thus, lower concentration ratios, then omitting these variables from the regression could understate costs in urban areas and overstate them in rural areas. In addition, Bell Atlantic negotiated a multi-year contract that covered all switches

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would have passed test A in a subsequent year." *See* Appendix E of the *FNPRM*. These rules are also arbitrary and not explained in the *FNPRM*

installed from 1994 to 1998 at a fixed-price discount.[14] This had a one-time downward impact on its costs for new switches; when the contract was renegotiated in 1998, the discount for initial, new switches was not changed. If this pattern was similar for other firms, or even if enough Bell Atlantic data were in the data set, then using data from 1990 to 1995 to forecast a further decline in switch costs from 1996 through 1999 would generate misleading results.

32. Although information on the type of switch (*e.g.*, 5ESS, DMS100, etc.) and, hence, vendor name was available, the FCC Model does not capture a vendor's impact on switch costs. Different vendors may use different bidding strategies and these strategies could influence the time pattern of costs as well as the estimated cost structure, *e.g.*, the start up costs vs. the costs per line. These omitted variables are analogous to limitations of the cost model platform's intrinsic failure to account for the influence of many differences in wirecenter characteristics or switch characteristics on switch costs.

D. Available data show that the switch cost estimates understate true costs.

33. We have obtained two sources that reveal the impacts of the concerns mentioned above. In this section, we summarize the results of our comparisons of these sources with the FCC's proposed switch cost inputs. Our comparisons suggest that the FCC inputs understate switch costs by substantial amounts.

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[13] For a more detailed discussion of the omitted variables problem, *see* William H. Greene, *Econometric Analysis, Second Edition (*Macmillan Publishing Company: New York, 1993) Section 8.4.2.
[14] *See* Garzillo Affidavit, ¶ 5

1. Estimates from Sprint *Ex Parte* show that the FCC costs are too low.

34. In an *ex parte* filed December 1998, Sprint[15] presented illustrative switch cost curves that suggest that the FCC Model understates host switch costs by about 85 percent for switches with 50,000 lines. (We derived this result and others presented below by applying the FCC's proposed switch cost curves and the illustrative switch cost curves from page 14 of Sprint's *Ex Parte* to switches of various line sizes.) The Sprint *Ex Parte* estimates the forward-looking switching costs using current booked switched investments for a sample of switches by: (1) accounting for changes in costs using the C.A. Turner Telephone Plant Index ("TPI"); and (2) removing investments for equipment not needed for basic universal service.[16] According to the Sprint *Ex Parte*, the TPI is used to translate historical investment data into current "reproduction cost" values. In this way, data are generated that include costs incorrectly omitted by the FCC Model—*i.e.*, costs needed for growth and for new software and hardware to upgrade the switch after its initial placement. The results implied by Sprint's illustrative switch cost curves include the following:

- For host switches Sprint's estimates are about 100 percent higher than the FCC's investment estimate for a 40,000-line switch and about 60 percent higher than the FCC for an 80,000 line switch. The range reflects Sprint's estimate of $3.4 million for fixed costs and $100 for "per-line" costs compared to only $447,000 and $87 per line for the FCC model. (For stand-alone Sprint estimates that the fixed costs are about $2.5 million, while the FCC uses the same estimates for standalone and host switches. Thus, Sprint's estimates are about 75 to 50 percent higher than the FCC's for 40,000 and 80,000 line switches, respectively.

- For remote switches Sprint's estimates are higher for switches with more than about 5,000 lines—*e.g.*, the Sprint estimate is about 10 percent higher than the FCC's for a

[15] Sprint *Ex Parte* Filing, *Op. Cit.*
[16] *Id.*, Attachment 2.

10,000 line switch. More generally, the Sprint model produces lower estimates for remote switches with less than 5000 lines and higher estimates for larger remotes. The pattern reflects Sprint's lower estimate for remote fixed costs ($100,900 compared to about $186,400 for the FCC model) and its higher estimate for per line costs. (However, as noted below, the underlying data on remotes are quite limited.)

35. The Sprint switch cost curves are meant to be illustrative, as they are based on limited data from one state, Nevada.[17] However, when combined with the Bell Atlantic data discussed below they provide strong evidence that the FCC's cost curves understate the true costs by substantial amounts.

2. Bell Atlantic data show that the FCC costs are too low.

36. Bell Atlantic data from its 1998 New York depreciation filing show that the FCC Model is particularly inaccurate for predicting switch costs for at least this one large state. For comparison purposes, Bell Atlantic followed the FCC methodology and excluded the effects of growth jobs and equipment upgrades. The Bell Atlantic actual data for newly installed switches average over 40 percent higher than projections made using the FCC's cost curves.[18] We want to emphasize that these comparisons understate the true magnitude of the FCC's underestimates because they do not account for the higher costs of growth lines.

3. The time trend analysis could further exacerbate the underestimates.

37. As noted above, Bell Atlantic (at least) has a long-term, fixed-price contract under which costs will not decline. Further, under the most recent Bell Atlantic contract, the costs for new switches are the same as in the prior (1994) contract; thus, the trends implied by the FCC analysis

[17] Sprint's sample includes data for 17 switches.
[18] *See* Garzillo Affidavit, ¶¶ 4-6 and Chart 1

appear to be misleadingly optimistic about the prospects of lower forward-looking costs for switch replacements. Since Bell Atlantic and others with similar contracts will not see declining prices, extrapolations based on past reductions will be misleading.

IV. REVIEW OF CABLE COST STUDY

A. The proposed cable costs are not representative of actual costs.

38. In its desire to use independent, publicly available data whenever possible, the Commission has turned to an NRRI Study, which relies on public data, for its approach to cable cost estimation. However, the desire to use publicly available data should not overshadow other *at least* equally important issues, such as accuracy, reliability, and verifiability. The Commission's tentative decision to adapt the NRRI cable cost regression approach cannot be supported because of problems with: the data set, the NRRI Study itself (*i.e.*, the "Gabel-Kennedy" approach),[19] and the FCC's adaptation of that approach, which produces anomalous results—*i.e.*, negative values for larger cable sizes and/or cost estimates that depart substantially from the FCC's own suggested cable cost inputs.

39. As we discuss below, Rural Utilities Services' ("RUS") data are not the right data to estimate non-rural LECs' cable costs. Further, econometric misspecifications in the proposed approach and anomalies in the results generated by the FCC's modified regressions make the proposed method untenable. In addition, the Huber adjustment is inappropriate. Finally, evidence in Mr. Garzillo's affidavit shows that these failings lead to underestimates of fiber optic cable costs.[20]

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[19] *See FNPRM* at ¶ 72.
[20] *See* Garzillo Affidavit, Charts 2-12

B. The data set is not suitable for estimating non-rural LEC cable costs.

40. The database for the NRRI Study's cost model was compiled based on data from recent RUS company contracts for rearrangements or new additions.[21] We reviewed this database and uncovered a series of errors that demonstrate that the data set is unfit for estimating cable costs. In addition, the various modifications, adjustments, and allocations performed by Gabel and Kennedy seem arbitrary and yield inaccurate results. The most obvious problems with the database are:

- The data set was not designed for the proposed use. The data are based on RUS company contracts for work performed for these particular companies. These contracts usually do not list *actual unit costs*, but rather a total cost for the project, which may or may not include an itemized list of covered items. The NRRI Study attempts to allocate the covered items, which usually have no separately identifiable costs, in a totally arbitrary fashion to specific unit costs for each item.[22] Unless a contract lists each unit cost separately, any attempt at estimating separate unit costs based on total cost runs the risk of seriously distorting the accuracy of the data. The cost of individual contract items often is dependent on the particular makeup of the included items and the composite sum for all of these items. Thus, it is next to impossible to determine accurately the costs of piece parts based on the total cost.

- Further, the data used in the Gabel-Kennedy approach simply do not represent the majority of firms for which the FCC Model will be used to estimate costs. The RUS companies are notably different from non-rural carriers, especially large regional carriers serving mostly metropolitan, urban, and suburban areas. Using data from rural carriers to estimate the costs of non-rural carriers can lead to a serious estimation bias. As discussed below, the FCC seems to recognize (at ¶ 78) this potential problem by way of its various suggested adjustments, such as the "superior bargaining power" adjustment. As noted by the Commission (at ¶ 79), Gabel and Kennedy determined that, in the State of Maine alone, Bell Atlantic's "material costs for aerial copper cable are approximately 15.2 percent less than these costs for the RUS companies." We agree with the FCC that the nature of rural and non-rural companies is dramatically different, but we do not support the FCC's "quick fix" to accommodate these differences. First, this type of tinkering with the regression coefficient is inappropriate from an economic perspective. Second, the use of one company's costs in one state is

[21] David Gabel and Scott Kennedy, "Estimating the Cost of Switching and Cables Based on Publicly Available Data," The National Regulatory Research Institute, April 1998, page 3.

[22] An example of this arbitrary allocation is illustrated in the allocation of loading costs to material costs, discussed on page 26 of the Gabel-Kennedy paper.

not sufficient data on which to base an adjustment factor. Moreover, there is nothing on the record to indicate that Bell Atlantic's costs in Maine represent the costs of other non-rural carriers or even Bell Atlantic's costs in other states. The sample size on which the adjustment factor is based is too small and the nature of the sample is too limited—a single state with unique properties—to justify its use.

- Gabel and Kennedy have applied a series of rather arbitrary allocations in developing the data for their model. In particular, the distribution of "cable loading" to cable costs does not seem to be statistically or economically justified. Further, with this approach, the sum of all the contracts *prior* to allocating loading is not equal to the sum of all the contracts *after* loading.

- The data do not contain sufficient information to distinguish between the costs for underground and the costs for buried cable. This is a serious weakness of the data since the FCC Model specifically has separate costs for these two structure types.

- The data vary tremendously; *e.g.*, the material unit cost for a six-pair cable ranges between $0.01 and $1.74 per foot. Similarly, the labor cost for the same kind of cable ranges between $0.1 and $6.50 per foot. (*See* Table 2 below.) While we expect some variation in the data, these variations imply that the data are reported in an inconsistent fashion.

Table 2
Variances Between Low and High Estimates for Labor and Materials

Gauge	Number of Pairs or Fibers	Minimum Unit Cost of Labor	Maximum Unit Cost of Labor	Minimum Unit Cost of Materials	Maximum Unit Cost of Materials
(1)	(2)	(3)	(4)	(5)	(6)
24	6	0.10	6.50	0.10	1.74
24	25	0.07	6.50	0.08	8.28
24	50	0.07	6.50	0.31	8.54
24	100	0.10	9.80	0.17	24.55
24	200	0.10	9.80	1.07	4.22
24	600	0.10	6.00	0.54	12.22
24	900	0.10	8.00	0.54	17.73
24	1200	0.10	12.80	7.25	23.53
24	1500	0.50	6.00	9.29	30.00
24	1800	0.80	6.00	11.25	23.80

41. Finally, the NRRI Study simply does not account for many costs incurred by ILECs. For example, the data set does not include the costs for acquiring rights-of-way, supervision, and

safety precautions. This omission will bias the estimates downward. It also may distort the relationship of costs of more urbanized areas compared to those in more rural areas. Bell Atlantic's actual data, which include rights-of-way costs, are significantly higher than the results of the NRRI Study.[23]

C. The Model specifications contain econometric errors and inconsistencies.

42. In our review of the proposed cable cost estimation approach, we identified at least four econometric errors and inconsistencies. First, as shown in Appendix D of the *FNPRM*, some of the regressions for cable costs include a dummy variable when more than one cable is placed at the same location—*i.e.*, the regressions for 24-gauge aerial copper and aerial fiber cable, respectively.[24] The FCC proposes to set the variable to a value of zero for this when estimating cable costs because:

1. the estimated coefficient of the variable is not significantly different from zero; and
2. the FCC Model does not differentiate costs based on whether there are two or more cables placed in the same location.[25]

43. Setting the dummy variable to zero after fitting the Model is inaccurate and provides a downward bias in the estimated costs. To remedy this downward bias, the regression equations should be estimated without this dummy. Omitting the variable in estimation is consistent with the finding that the coefficient of the dummy is not significantly different from zero. Doing so allows the regression to more accurately reflect the relationship between the other variables and

[23] *See* Garzillo Affidavit, ¶ 10 and Charts 4, 6-9
[24] S*ee* D-1 and D-9.
[25] *See* D-2.

the cable costs. In contrast, omitting the dummy only in forecasting may obscure these relationships.

44. Second, in some instances, the FCC specifies its regression variables the same as Gabel and Kennedy. However, in other instances, the FCC uses different variables or different forms of the variables than those used by Gabel and Kennedy. For example, the FCC's regression for 24-gauge underground copper cable includes a squared term for the number of copper cable pairs, not in the original regression Gabel and Kennedy specification. An important issue is to determine the reason for these changes in specification and the effect of the changes on the accuracy of the FCC Model.[26]

45. Third, the FCC proposes to estimate the costs for 26-gauge cable in a two-step process. In step 1, the ratio of 24-gauge cable costs to 26-gauge cable costs is predicted from a regression equation that has this ratio as its dependent variable. In step 2, the inverse of this ratio is multiplied by 24-gauge cable costs to produce an estimate of 26-gauge cable costs. This raises several problems and questions.

- Why use different procedures for 26- and 24-gauge cable? The FCC Model can estimate the costs of 26-gauge cable with regressions for these costs directly, rather than applying ratios to the costs of 24-gauge cable.
- Why not reverse the procedure? That is, why not regress the costs of 26-gauge cables directly and then calculate the cost of 24-gauge cables as an estimated ratio. The results will be different for the two approaches.

46. It is unclear why the FCC selected one procedure over the other. In any case, the procedure is biased due to a statistical error. As stated above, the FCC estimated regressions where the

dependent variable was the ratio of the cost of 24-gauge cable to the cost of 26-gauge cable. In estimating cable costs, the FCC took the inverse of the estimated ratio. The inverse then was multiplied by the cost of 24-gauge cable to obtain the forecast for 26-gauge cable. The problem in this procedure arises in taking the inverse of the estimated ratio. In a regression with Y as the dependent variable, the inverse of the forecasted Y is not an unbiased estimate of the inverse of Y. That is, E (1/Y) does not equal 1/E (Y), where E is the expectation. For instance, consider a variable Y that can take on either of two values, 1 or 3. The expected value of 1/Y is 2/3.[27] However, the expected value of 1/E (Y) = 1/2.[28] Clearly, the two results are quite different.

47. The correct procedure is to re-estimate the regressions using the ratio of the cost of 26-gauge cable to the cost of 24-gauge cable (i.e., the inverse of the dependent variable that the FCC used) as the dependent variable. Then this regression equation can be used to estimate the ratio directly, as opposed to taking the inverse of the forecasted ratio. This difference in approach is important and can give different results, especially since the distribution of a ratio and its inverse are quite different.

48. A fourth problem with the specifications is that the FCC adjusts part of the cable costs for the "supposed" bargaining power of non-rural LECs. The size of the adjustment varies from 15.2 percent for 24-gauge aerial copper cable to 33.8 percent for aerial fiber cable. The FCC does not explain why the discount is applied only to the coefficient of copper cable pairs or number of strands, rather than to all the costs. If a difference in bargaining power were truly present, then

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[26] As discussed *infra*, these specifications have a tremendous impact on the estimated cable costs. For instance, the adding of the square term in the 24-gauge underground copper cable equation leads to negative estimated cable costs.

[27] Y = [1, 3], thus E(1/Y) = E (1/1 + 1/3) = 2/3

[28] Y = [1, 3], thus E (Y) = E (1 + 3) = 2. It follows that 1/E(Y) = 1/2

cable prices would need to be adjusted for that, not regression coefficients. In other words, the analyst would adjust the raw data accordingly and re-run the regression, rather than tinker with regression coefficients.

49. A fifth problem appears in the way in which the bedrock, soil, and water indicator variables are used in the regression model. The bedrock, soil, and water variables are called ordinal variables in statistics. Ordinal variables generally take on a small number of values, like zero for normal soil, one for soft soil, and three for hard soil. However, these values only indicate the ranking of soil types in terms of hardness. They do not indicate that hard soil is three times "harder" than soft soil or that it is three times costlier to place cable in hard soil. Any other coding scheme that preserves the ranking, such as minus five for normal, two for soft, and seven for hard soil conveys the same information.

50. The FCC uses the bedrock, soil, and water variables in the regressions as if they were genuine quantitative variables rather than ordinal variables. The result is that the regressions impose invalid restrictions on the relationship between costs and bedrock, soil, and water types. For example, the FCC's regression for estimating the cost of 40-foot, class four poles restricts the impact of hard rock on costs to be double that of soft rock.

51. The correct approach to using ordinal variables as explanatory factors in a regression equation is the "dummy variable" approach.[29] In this approach, a set of "indicator" variables in the regression represents each ordinal variable. These indicator variables allow the data to determine the impacts of bedrock, soil, and water types on costs, rather than restricting these impacts to

[29] *See* Peter Kennedy, *A Guide to Econometrics*, Third Edition (MIT Press: Cambridge, MA, 1993) Chapter 14 ("*A Guide to Econometrics*").

those implicit in the arbitrary coding scheme used by Gabel and Kennedy in the NRRI Study. For example, in the regression equation for the cost of installing 40-foot, class four poles, the dummy variable approach allows the impact of hard rock to be other than double that of soft rock—depending on the relationship actually embedded in the data.

D. The application of the robust regression technique is questionable.

52. We disagree with the application of the Huber adjustment method recommended in the *FNPRM* (at ¶ 76). According to the FCC, this approach uses an algorithm that determines and excludes "extreme outliers." (*Id.*) First, we note that the verbal characterization of the Huber methodology is wrong. The Huber *method* does not determine or exclude "outliers." Instead, by minimizing a more general distance function, it diminishes the destabilizing effects of outliers. Second, the goal of this exercise is to estimate switch prices that would be paid by non-rural LECs. As we have pointed out above, the problem with the proposed Model is not the existence of outliers, but instead the lack of comparability to non-rural LEC costs and prices. The proposed changes to the NRRI Study, through the use of the Huber adjustment, have not alleviated any of these problems and have the potential to make the analysis even less relevant for non-rural LECs. Third, the FCC states that "the ordinary least squares technique is efficacious, however, only for a data set lacking statistical outliers."[30] We disagree with this statement. As discussed in *A Guide to Econometrics* by Peter Kennedy, true outliers are valuable and, in the presence of such, the ordinary least squares methodology can well be the most appropriate estimator. In particular, Kennedy states:

[30] *FNPRM* at ¶ 75.

> Once influential observations have been identified, it is tempting just to throw them away. This would be a major mistake. Often influential observations are the most valuable observations in a data set; if for years interest rates or relative energy prices do not change much, when they do change the new observation are exactly what is needed to produce good estimates. Furthermore, outliers may be reflecting some unusual fact that could lead to an improvement in the model's specifications.
>
> The first thing that should be done after influential observations have been identified is to examine these observations very carefully to see if there is some obvious reason why they are outliers. There may have been an error in measuring or classifying the data, or the data may have been entered into the computer erroneously, for example, in which case remedying these mistakes is the best solution; if a mistake cannot be remedied, then throwing an observation away is justified. There may be an unusual circumstance associated with an observation, such as an earthquake or an accountant's "extraordinary item," in which case some thought should be given to modifying the model to allow incorporation of this observation.
>
> If influential observations remain after this examination, it is not obvious what should be done. If as a result of this examination the researcher is convinced that these observations are bona fide and therefore valuable, OLS should not necessarily be abandoned….[31]

53. It is unclear to what extent the FCC has inspected the database for possible errors. However, what is evident is that even if they did, a robust regression will not necessarily be the most preferred estimator simply because outliers are present. Further, as discussed in another prominent econometric textbook:

> These [robust] estimators have found little use in econometrics, primarily because of the difficulty in implementing them and their largely ad hoc nature. Tinkering with the outlying observations amounts to letting the computer be the ultimate judge of the estimated relationship and diminishes the role of the underlying theory. Least squares remains by far the estimator of choice for the linear regression model.[32]

54. Finally, robust estimators, such as the Huber adjustment, should be considered only if there is evidence that the distribution of the error term is symmetric about its mean and has fatter tails

[31] *A Guide to Econometrics*, page 280.
[32] William H. Greene, *Econometric Analysis*, Second Edition (MacMillan: New York, 1993) page 309.

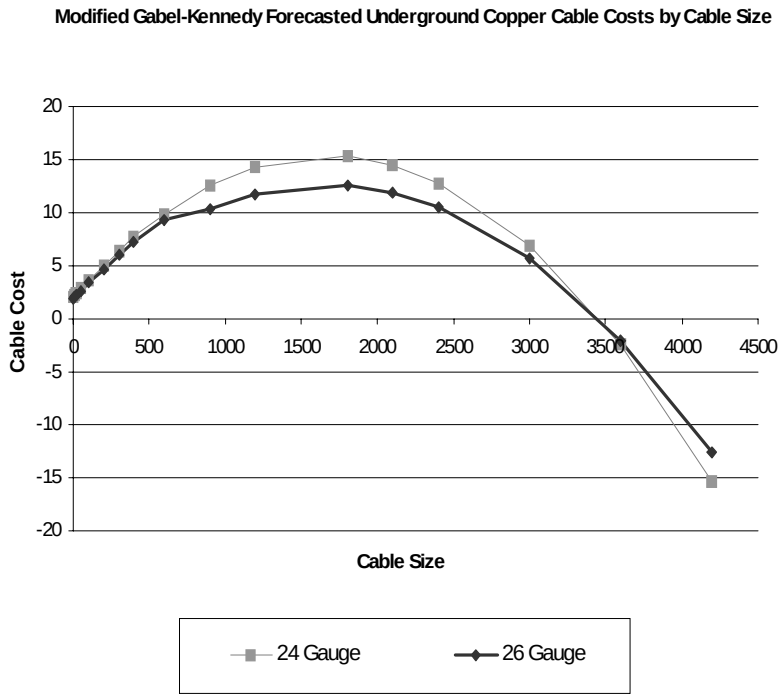
than the normal distribution.[33] Only when this is the case can a robust estimator yield the most preferred estimates. When examining the cable cost data, however, it should be clear that these two conditions are not met. First, since cable costs cannot be negative, their distribution is truncated at zero and most likely is not symmetrical.[34] Thus, it follows that the distribution of the disturbance term also is truncated and most likely is asymmetrical.[35] Second, the FCC has not presented any evidence that the tails of the distribution are any fatter than the normal distribution. The presence of fatter tails can only be determined by analyzing the nature of the underlying true population—all non-rural ILECs. Since the NRRI Study relies on RUS data only, it is not a representative sample of the real population. Further, even if there were evidence (which there is not) that the distribution of the error term for RUS companies has fatter tails than normal distribution, nothing can be said about the true population. Thus, there is no information on whether the tails are fatter than normal. Moreover, the lack of a normal distribution will not ensure that the robust regression is any superior than the ordinary least squares technique. Even if the use of a robust regressor were warranted, the appropriate application of the robust regression is to *first* apply it to all the data and *then* check for outliers and discuss whether to reject them or model them. Often it can be found that the problem, which seems be one of lack of robustness, is caused by other problems such as heteroskedasticity.

[33] The term fatter tails refers to a distribution in which it is more probable for an error observation to fall in the tail region of the distribution than in the normal distribution.
[34] Moreover, to the extent firms try to obtain lowest prices possible, one expects a price distribution that is skewed to the left.
[35] If $P = E(P) + e$ and $E(p) > 0$ and $P > 0$, then $e > -E(P)$. It follows that e is truncated at $-E(P)$.

E. Efforts at external validation of the cable cost regressions reveal serious flaws.

55. The Commission proposes to use modified versions of the NRRI regressions, as reported in Appendix D of the *FNPRM*. The FCC regressions apparently yield highly unrealistic results. For example, as illustrated in Figure 1, underground 24-gauge copper cable costs are negative for cables larger than approximately 3,400 pairs.

Figure1



56. The FCC apparently did ***not*** use the estimates from these regressions for its proposed inputs, as the proposed inputs (in Appendix A) are all positive numbers. Thus, as illustrated in Table 3, there are significant differences between the forecasted costs from the FCC modified NRRI Study and the FCC's proposed cable costs.

Table 3
Costs from Modified Gabel-Kennedy Model and FCC Proposed Values Underground Copper Distribution Cable

Cable Size	26-Gauge Modified Gabel-Kennedy App. D	26-Gauge FCC Proposed Inputs App. A1	24-Gauge Modified Gabel-Kennedy App.D	24-Gauge FCC Proposed Inputs App. A1	26-Gauge Percentage Difference between Gabel-Kennedy and FCC	24-Gauge Percentage Difference between Gabel-Kennedy and FCC
(1)	(2)	(3)	(4)	(5)	(6)	(7)
					((3)-(2))/(3)	((5)-(4))/(5)
4200	$ (12.57)	$ 29.35	$ (15.28)	$ 39.32	143%	139%
3600	$ (2.05)	$ 25.49	$ (2.49)	$ 33.70	108%	107%
3000	$ 5.65	$ 21.54	$ 6.87	$ 28.09	74%	76%
2400	$ 10.52	$ 17.47	$ 12.79	$ 22.47	40%	43%
2100	$ 11.89	$ 15.39	$ 14.46	$ 19.66	23%	26%
1800	$ 12.56	$ 15.05	$ 15.26	$ 19.10	17%	20%
1200	$ 11.77	$ 12.80	$ 14.30	$ 16.02	8%	11%
900	$ 10.31	$ 10.88	$ 12.54	$ 13.51	5%	7%
600	$ 9.28	$ 9.53	$ 9.91	$ 10.35	3%	4%
400	$ 7.19	$ 7.30	$ 7.68	$ 7.88	2%	3%
300	$ 6.01	$ 6.06	$ 6.42	$ 6.53	1%	2%
200	$ 4.74	$ 4.76	$ 5.06	$ 5.11	0%	1%
100	$ 3.38	$ 3.39	$ 3.61	$ 3.63	0%	0%
50	$ 2.67	$ 2.67	$ 2.85	$ 2.86	0%	0%
25	$ 2.31	$ 2.30	$ 2.46	$ 2.46	0%	0%
18	$ 2.20	$ 2.20	$ 2.35	$ 2.35	0%	0%
12	$ 2.12	$ 2.12	$ 2.26	$ 2.26	0%	0%
6	$ 2.03	$ 2.02	$ 2.16	$ 2.16	0%	0%
1	$ 1.95	$ 1.93	$ 2.08	$ 2.06	-1%	-1%

Costs from Modified Gabel-Kennedy Model and FCC Proposed Values Underground Fiber Cable

Cable Size	Fiber Modified Gabel-Kennedy App. D	Fiber FCC Proposed Inputs App. A1	Fiber Percentage Difference between Gabel-Kennedy and FCC
(1)	(2)	(3)	(4)
			((3)-(2))/(3)
288	$ 9.61	$ 8.23	-17%
144	$ 6.01	$ 6.01	0%
96	$ 4.81	$ 4.91	2%
72	$ 4.21	$ 4.29	2%
60	$ 3.91	$ 3.96	1%
48	$ 3.61	$ 3.62	0%
36	$ 3.31	$ 3.27	-1%
24	$ 3.01	$ 2.91	-3%
18	$ 2.86	$ 2.72	-5%
12	$ 2.71	$ 2.53	-7%
1	$ 2.43	$ 2.18	-11%

57. These results, especially the copper wire results for larger cable sizes, reveal fundamental problems with the FCC's reported cable cost regression results. In addition, as shown in Mr. Garzillo's affidavit, the FCC cable cost results from Appendix A also are understated for all fiber cable sizes.[36]

F. The Commission should not use cable estimates based on the NRRI Study approach.

58. Based on the evidence available, the only conclusion one can draw is that the NRRI Study data sample and Model specifications are flawed, and should definitely not be used to estimate non-rural LEC cable costs. Compounding the inherent problems in the NRRI Study, the Commission has proposed modifications and adjustments, which make it even more suspect. We

[36] *See* Garzillo Affidavit, Chart 2

urge the Commission to obtain more accurate cost inputs directly from the non-rural LECs and to build a more econometrically sound model.

V. UNDERSTATING INVESTMENT COSTS HAS A DOMINO EFFECT ON EXPENSES.

59. In some categories, the FCC Model estimates annual expenses by multiplying investment amounts by an aggregate expense-to-current investment ratio. To the extent that the proposed inputs understate the investment amounts, this method will lead to an underestimate of expenses as well. This is the case because maintenance and repair expenses depend on the network's physical capacity and characteristics and will not change simply because we now assume that the dollar investment amounts are different. This problem is particularly pronounced for switch costs because the proposed switch investment inputs are based solely on the lower-cost (more steeply discounted) replacement-line investments, while the denominator of the expense-to-investment ratio presumably is based on a higher-cost mix of replacement and growth lines obtained from historical actual data. If the historical data had included only replacement lines, the ratio would be higher than the actual ratio; however this is not the case. In addition, to the extent that the switch investment cost curve trends the investment costs downward, the negative bias would be increased. Even if investment costs were declining over time, we can not infer that labor costs and other expenses will decline proportionately. For example, a vendor may give an ILEC a discount on a particular investment, but the associated maintenance contract would not be discounted. Further, as labor costs rise, the cost for the maintenance contract likely will escalate over time.

VI. STATE COMMISSIONS HAVE REJECTED THE USE OF UNREALISTIC DATA.

60. Regulatory commissions in several states have agreed that forward-looking costs should be based on realistic data and assumptions. For example several have found that: (1) the precursor to the FCC switch cost approach (the HAI Model) improperly ignored the differences in switch discounts between replacement switches and growth jobs; and (2) the HAI Model inputs were flawed because they did not account for state-specific conditions. Although some of the HAI input deficiencies might have been corrected in the FCC Model, the Commission's proposed inputs for switch-related costs and cable costs are still subject to the same criticisms.

A. State commissions have rejected unrealistic switch discounts.

61. Below, we list some examples of state commissions that have explicitly rejected unrealistic switch discounts such as those contained in the FCC's proposed cost proxy model. For instance, the California Public Utilities Commission found that:

> Based on our own review of Pacific's switching contracts, the LEC witnesses are correct that the deepest discount applies only to switches that are considered "new," and does not apply to "growth" lines for existing switches.
>
> Based upon the realities of the switch market, we see no reason to depart from the conclusion … [that] Pacific's life-cycle approach to switching costs, observing that "the prices for new switches are not discounted significantly until the new technology becomes standard, and a large number of older technology switches are replaced." (**Mimeo.** at 146-47.) Accordingly, we agree with Pacific that the Hatfield inputs must be modified to reflect a proper life cycle approach.[37]
>
> The assumption that AT&T and MCI made in specifying inputs for Version 2.2.2, that the hypothetical carrier modeled therein would be able to purchase all of its

[37] Before the Public Utilities Commission of the State of California, Decision 98-02-106 February 19, 1998, R. 93-04-003, I. 93-04-002 p. 40

> digital switches at the deepest discount available from switch manufacturers during the life-cycle for such switches, is unrealistic.[38]
>
> The AT&T-MCI assumption that Pacific should be able to purchase 90% of its digital lines at the new or replacement price is predicated upon an unrealistic assumption that digital switches are mere hardware that is fully depreciated with 10 years; in fact, for investment purposes, digital switches are combinations of hardware and software that demand continued investment over a period of at least 15 years.[39]
>
> The effect of adopting the AT&T-MCI assumption that Pacific should be able to purchase 90% of its digital lines at the new or replacement price would be to require Pacific to bear nearly the entire expense of line capacity added to serve customer growth, including growth attributable to UNE purchases by CLCs.[40]

62. Similarly, the Maryland Public Service Commission also rejected the HAI approach to switch discounts:

> The record indicates that the most significant dispute with regard to switching costs concerns the switch discounts that should be applied. We direct the parties to utilize the Staff approach to calculate such discounts based on the actual growth and replacement ratio for 1995, since 1995 was used as the baseline for developing certain forward-looking data.[41]

63. The Minnesota Public Service Commission also found that: "With respect to switch mix, we will accept the Bell Atlantic current switch mix as being efficient and reasonable."[42]

B. State commissions have rejected nation-wide "default" input values.

64. As noted above, the FCC has recognized that it is appropriate to account for company-specific conditions. Several state commissions have rejected cost inputs that are based on nationwide "default" values that do not reflect regional or state-by-state cost differences For

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[38] *Id.*, page 104, ¶ 22
[39] *Id.*, page 105, ¶ 28.
[40] *Id.*, page 105, ¶ 29.
[41] Before the Public Service Commission of Maryland, In the Matter of the Petitions for Approval of Agreements and Arbitration of Unresolved Issues Arising Under [Sec]252 of the Telecommunications Act of 1996, Case No. 8731 Phase II, Order No 73707, page 48.

instance, the South Carolina Public Service Commission recognized the need for more specific input values:

> HM 5.0a's default values are generic in nature, national in scope and largely form the basis for AT&T and MCI model filings in numerous states across the nation. Therefore, the HM 5.0a default inputs, unless changed, are the same for South Carolina as they would be for every other state. (Tr. Vol. X at 92). With respect to the default user adjustable inputs in this proceeding, AT&T and MCI changed only three—cost of capital, depreciation, and regional labor adjustment. (Id.) This approach to input development ignores South Carolina-specific operating conditions experienced by BellSouth and cannot reasonably reflect the universal costs in this State.[43]

65. The California Public Utilities Commission rejected cost inputs that the HAI sponsor's use of a lower maintenance factor picked from another state's study.

> We agree with Pacific that the use of New Hampshire data to estimate switch maintenance expense for California is unreasonable. Whether or not New Hampshire's use of smaller switches would tend to increase switch maintenance expense (an issue on which Mr. Scholl probably has the better of the argument), we think that a maintenance factor derived from investment - which is almost certain to be less precise than a maintenance estimate based on actual experience - should be based upon data for a state with demographic and topographic characteristics reasonably comparable to California's. New Hampshire's clearly are not. (Before the Public Utilities Commission of the State of California, Decision 98-02-106 February 19, 1998, R. 93-04-003, I. 93-04-002 p. 33)

66. The North Carolina Utilities Commission found that company-specific inputs were the correct starting point for a forward-looking analysis and rejected AT&T's and MCI's arguments to the contrary. The North Carolina Commission found that although arguments about future cost reducing innovations were plausible, their impacts were "speculative" and the IXCs had not provided a secure foundation on which to base them. Thus, the North Carolina Commission

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[42] *Id.* pages 48-49.

[43] Order No. 98-322 Issued by the Public Service Commission of South Carolina, Docket No. 97-239-C, May 6, 1998, page 60.

concluded "that company-specific inputs, where they are forward looking and reasonable, should be used in lieu of default values."[44]

67. Although, it may not be feasible to gather detailed input data on every state or area, the FCC Model should use cost inputs that are as specific to each area as possible to better identify high-cost areas. Where the local exchange companies have provided appropriate data specific to each region, company, or study area, those data should be used in lieu of nationwide inputs. Thus, the FCC inputs should be based on econometric cost curves and data sufficiently detailed to capture area characteristics such as traffic volumes per line, density, vendor, company, etc.

VII. CONCLUSION: ADOPTING THE PRELIMINARY INPUTS WOULD REDUCE EFFICIENCY.

68. Neither the switch cost regressions nor the cable cost regressions are derived from sufficiently representative data to estimate costs for public policy purposes. Furthermore, the equation specifications omit important explanatory variables that should be included to produce more accurate, area-specific estimates. As a result of these flaws, using the proposed inputs and cost model as presently structured would likely generate incorrect cost estimates and, thus, lead to inefficient policy outcomes.

69. Neither firms nor regulators are writing on a blank slate. There already exists a significant level of demand for network services and that demand is growing. A forward-looking economic study must recognize that carriers are serving customers today and must accommodate future (on-going) demand growth. Basing universal service support on a study that measures the costs

[44] North Carolina Utilities Commission, *In the Matter of Establishment of Universal Support Mechanisms Pursuant to Section 254 of the Telecommunications Act of 1996*, Docket No. P-100, Sub 133b, Order Adopting

of a hypothetical network that is sized instantly to serve a static level of demand understates the forward-looking costs that ILECs need to recover to provide universal service.

70. The Model assumption that 100 percent of the ILEC's switches are replaced instantly, at the very low prices for replacement switches, does not reflect the way that real-world companies operate. In a world of continuous technological progress, it would be irrational for firms constantly to update their facilities in order to incorporate completely today's lowest-cost technology, as though starting from scratch. As recently stated by Professor Alfred Kahn and Dr. Timothy Tardiff:

> As Professor William J. Fellner pointed out many years ago, firms even in competitive industries would systematically practice what he calls "anticipatory retardation," adopting the most modern technology only when the progressively declining real costs had fallen sufficiently below currently prevailing prices as to offer them a reasonable expectation of earning a return on those investments over their entire economic life. In consequence, even perfectly competitive prices would not be set at the level of these (totally) current costs—unless, to put it another way, the calculated costs of the new plan included an extremely high rate of return and of depreciation, in reflection of the exposure of any such investments to costs and prices progressively declining in real terms over their life.[45]

71. Thus, a firm that replaces its technology constantly, so that at every instant it uses the network that it would build if it were building from scratch, must have much shorter asset lives and a much higher cost of capital than suggested by the proposed inputs.

72. For these reasons, it would discourage economic efficiency to base universal service support on a cost proxy model that assumes 100 percent replacement switches. A forward looking cost

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Forward-Looking Economic Cost Model and Inputs, April 20, 1998, pages 13-14.

[45] Declaration of Alfred E. Kahn and Timothy Tardiff, *In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996*, CC Docket No. 96-98, May 30, 1996, citing William J. Fellner, "The Influence of Market Structure on Technological Progress," in Amer. Econ. Ass'n. *Readings in Industrial Organization and Public Policy* (Homewood: Richard D. Irwin, 1958), as described also in Kahn, *The Economics of Regulation*, Vol. 1, pp. 199-20, note 91.

approach demands that switch investment reflect the current value of the life-cycle mix of replacement switches and growth lines.

I hereby swear, under penalty of perjury, that the foregoing is true and correct to the best of my knowledge and belief.

_____
Harold Ware

Subscribed and sworn before me this ___ day of July 1999.

My Commission expires _____.

_____
Notary Public

I hereby swear, under penalty of perjury, that the foregoing is true and correct to the best of my knowledge and belief.

_____
Christian Michael Dippon

Subscribed and sworn before me this ___ day of July 1999.

My Commission expires _____.

_____
Notary Public