FEDERAL COMMUNICATIONS COMMISSION

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Federal-State Joint Board on Universal Service; Forward-Looking Mechanism for High Cost Support for Non-Rural LECs

AGENCY: Federal Communications Commission.

ACTION: Final rule.

SUMMARY: This document concerning the Federal-State Joint Boar on Universal Service and Forward-Looking Mechanism for High Cost Support for Non-Rural LECs completes the selection of a model to estimate forward-looking cost by selecting input values for the synthesis model the Commission previously adopted.

DATES: Effective December 1, 1999.

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SUPPLEMENTARY INFORMATION: This is a summary of the Commission's Tenth Report and Order in CC Docket Nos. 96–45 and 97–160 released on November 2, 1999. The full text of this document is available for public inspection during regular business hours in the FCC Reference Center, Room CY–A257, 445 Twelfth Street, S.W., Washington, D.C. 20554. The full text of this document is also available on the Internet: www.fcc.gov/ccb/universal service.

I. Introduction

1. In the Telecommunications Act of 1996 (1996 Act), Congress directed this Commission and the states to take the steps necessary to establish explicit support mechanisms to ensure the delivery of affordable telecommunications service to all Americans. In response to this directive, the Commission has taken action to put in place a universal service support system that will be sustainable in an increasingly competitive marketplace. In the *Universal Service Order,* 62 FR 32862 (June 17, 1997), the Commission adopted a plan for universal service support for rural, insular, and high-cost areas to replace longstanding federal support to incumbent local telephone companies with explicit, competitively neutral federal universal service support mechanisms. The Commission adopted the recommendation of the Federal-State Joint Board on Universal Service (Joint Board) that an eligible carrier's level of universal service support should be based upon the forward-looking economic cost of constructing and operating the network facilities and functions used to provide the services supported by the federal universal service support mechanisms.

2. In this Report and Order, we complete the selection of a model to estimate forward-looking cost by selecting input values for the synthesis model we previously adopted. These input values include such things as the cost of switches, cables, and other network components necessary to provide supported services, in addition to various capital cost parameters. The forward-looking cost of providing supported services estimated by the model will be used as part of the Commission's methodology to determine high-cost support for non-rural carriers beginning January 1, 2000. This methodology is established in a companion order in the final rule document published elsewhere in this issue of the **Federal Register.**

II. Determining Customer Locations

A. Customer Location Data

1. Geocode Data

3. While we affirm our conclusion in the *Platform Order,* 63 FR 63993 (November 18, 1998), that geocode data should be used to locate customers in the federal mechanism, we conclude that no source of actual geocode data has yet been made adequately accessible for public review. We conclude that we will use an algorithm based on the location of roads to create surrogate geocode data on customer locations for the federal mechanism until a source of actual geocode data is identified and selected by the Commission. We reiterate our expectation that a source of accurate and verifiable actual geocode data will be identified in the future for use in the federal mechanism.

4. In the *Platform Order,* we concluded that a model is most likely to select the least-cost, most-efficient outside plant design if it uses the most accurate data for locating customers within wire centers, and that the most accurate data for locating customers within wire centers are precise latitude and longitude coordinates for those customers' locations. We noted that commenters generally support the use of accurate geocode data in the federal mechanism where available. We further noted that the only actual geocode data in the record were those prepared for HAI by PNR, but also noted that "our conclusion that the model should use geocode data to the extent that they are available is not a determination of the accuracy or reliability of any particular source of the data." Although commenters supported the use of accurate geocode data, several commenters questioned whether the PNR geocode data were adequately available for review by interested parties.

5. In the *Universal Service Order,* 62 FR 32862 (June 17, 1997), the Commission required that the "model and all underlying data, formulae, computations, and software associated with the model must be available to all interested parties for review and comment." In an effort to comply with this requirement, the Commission has made significant efforts to encourage parties to submit geocode data on the record in this proceeding. PNR took initial steps to comply with this requirement in December 1998 by making available the "BIN" files derived from the geocoded points to interested parties pursuant to the *Protective Order,* 63 FR 42753 (August 11, 1998). PNR also has continued to provide access to the underlying geocode data at its facility in Pennsylvania. Several commenters argue, however, that the availability of the BIN data alone is not sufficient to comply with the requirements of criterion eight, particularly in light of the expense and conditions imposed by PNR in obtaining access to the geocode point data. In addition, PNR acknowledges that its geocode database relies on third-party data that PNR is not permitted to disclose.

6. Consistent with our tentative conclusion in the *Inputs Further Notice,* 64 FR 31780 (June 14, 1999), we conclude that interested parties have not had an adequate opportunity to review and comment on the accuracy of the PNR actual geocode data set. The majority of commenters addressing this issue support this conclusion. We note that a nationwide customer location database will, by necessity, be voluminous, relying on a variety of underlying data sources. In light of the concerns expressed by several commenters relating to the conditions and expense in obtaining geocode data from PNR, we find that no source of actual geocode data has been made sufficiently available for review. While PNR has made some effort to satisfy the requirements of criterion eight, we prefer to adopt a data set that is more readily available for meaningful review. In particular, we note that the geocode points are available only on-site at PNR's facilities, making it difficult for parties to verify the accuracy of those points. We recognize, however, that more comprehensive actual geocode

data are likely to be available in the future, and we encourage parties to continue development of an actual geocode data source that complies with the criteria outlined in the *Universal Service Order* for use in the federal mechanism.

2. Road Surrogate Customer Locations

7. We conclude that PNR's road surrogating algorithm should be used to develop geocode customer locations for use in the federal universal service mechanism to determine high-cost support for non-rural carriers beginning January 1, 2000. In the *Platform Order,* we concluded that, in the absence of actual geocode customer location data, associating road networks and customer locations provides the most reasonable approach for determining customer locations.

8. As we noted in the *Platform Order,* ''associating customers with the distribution of roads is more likely to correlate to actual customer locations than uniformly distributing customers throughout the Census Block, as HCPM proposes, or uniformly distributing customers along the Census Block boundary, as HAI proposes.'' We therefore concluded in the *Platform Order* that the selection of a precise algorithm for placing road surrogates should be conducted in the inputs stage of this proceeding. In the *Inputs Further Notice,* we tentatively adopted the PNR road surrogate algorithm to determine customer locations.

9. Currently, there are two road surrogating algorithms on the record in this proceeding—those proposed by PNR and Stopwatch Maps. On March 2, 1998, AT&T provided a description of the road surrogate methodology developed by PNR for locating customers. On January 27, 1999, PNR made available for review by the Commission and interested parties, pursuant to the terms of the *Protective Order,* the road surrogate point data for all states except Alaska, Iowa, Virginia, Puerto Rico and eighty-four wire centers in various other states. On February 22, 1999, PNR filed a more detailed description of its road surrogate algorithm. Consistent with the conditions set forth in the *Inputs Further Notice,* PNR has now made available road surrogate data for all fifty states and Puerto Rico.

10. In general, the PNR road surrogate algorithm utilizes the Census Bureau's Topologically Integrated Geographic Encoding and Referencing (TIGER) files, which contain all the road segments in the United States. For each Census Block, PNR determines how many customers and which roads are located within the Census Block. For each Census Block, PNR also develops a list of road segments. The total distance of the road segments within the Census Block is then computed. Roads that are located entirely within the interior of the Census Block are given twice the weight as roads on the boundary. This is because customers are assumed to live on both sides of a road within the interior of the Census Block. In addition, the PNR algorithm excludes certain road segments along which customers are not likely to reside. For example, PNR excludes highway access ramps, alleys, and ferry crossings. The total number of surrogate points is then divided by the computed road distance to determine the spacing between surrogate points. Based on that distance, the surrogate customer locations are uniformly distributed along the road segments. In order to ensure that its road surrogate data set includes all currently served customers, PNR has made minor adjustments to its methodology in some instances. For example, Census Blocks that are not assigned to any current wire center have been assigned to the nearest known wire center, based on the ''underpinned of the census block in relation to the wire center's central office location.''

11. Stopwatch Maps has compiled road surrogate customer location files for six states suitable for use in the federal mechanism. We conclude, however, that until a more comprehensive data set is made available, the Stopwatch data set will not comply with the *Universal Service Order's* criterion that the underlying data are available for review by the public. Only GTE endorses the use of the Stopwatch data set. In addition, we note that the availability of customer locations for only six states is of limited utility in a nationwide model designed to be implemented on January 1, 2000.

12. AT&T and MCI contend that the exclusive use of a road surrogate algorithm to locate customers produces a 2.7 percent upward bias in loop cost on average on a study area basis when compared to a data set consisting of PNR actual geocode data, where available, and surrogate locations where actual data are unavailable. AT&T and MCI argue that this occurs because the road surrogate methodology uniformly disperses customers along roads, failing to take into consideration actual, uneven customer distributions that tend to cluster customer locations more closely. AT&T and MCI therefore suggest a downward adjustment to produce more accurate outside plant cost estimates. GTE disagrees and contends that, because the PNR actual geocode data create serving areas that are too dense, it is not surprising that AT&T and MCI have found that the use of road surrogate data produces costs that are slightly higher. GTE argues that there is no evidence to conclude, therefore, that a uniform dispersion of customers is likely to overstate outside plant costs. Sprint contends that the decision to optimize distribution plant in the model mitigates any concern that the road surrogate algorithm overstates the amount of outside plant.

13. We agree with GTE and Sprint that there should be no downward adjustment in cost to reflect the exclusive use of a road surrogate algorithm. In doing so, we note that, although the Commission has gone to great lengths to identify a source of actual, nationwide customer locations, no satisfactory data source has been identified. In fact, only one source of such data, the PNR geocode data, has been placed on the record. As noted, however, we have rejected the PNR geocode data set at this time because it has not been made adequately available for review. In the absence of a reliable source of actual customer locations by which to compare the surrogate locations, it is impossible to substantiate AT&T and MCI's contention that the road surrogate algorithm overstates the dispersion of customer locations in comparison to actual locations. Although LECG has made comparisons between Ameritech geocode locations and the PNR road surrogate locations, the validity of that comparison is dependent on the accuracy of the geocode data used in that comparison. As Ameritech has not filed that data on the record, we have no way of verifying the accuracy of its geocoded locations. In addition, we note that Ameritech agrees that the PNR road surrogate ''is a reasonable method for locating customers in the absence of actual geocode data.'' Having no reliable evidence that the PNR road surrogate algorithm systematically overstates customer dispersion, we conclude that no downward adjustment to the outside plant cost estimate is required.

14. We also disagree with Bell Atlantic's contention that road surrogate data is inherently random and likely to misidentify high-cost areas. As noted in the *Platform Order*, we believe that it is reasonable to assume that customers generally reside along roads and, therefore, associating customers with the distribution of roadways is a reasonable method to estimate customer locations. We note that PNR's methodology of excluding certain road segments is consistent with the Commission's conclusion in the

Platform Order that certain types of roads and road segments should be excluded because they are unlikely to be associated with customer locations. In addition, we note that PNR's reliance on the Census Bureau's TIGER files ensures a degree of reliability and availability for review of much of the data underlying PNR's road surrogate algorithm, in compliance with criterion eight of the *Universal Service Order.* The PNR road surrogate algorithm is also generally supported by commenters addressing this issue. While AT&T and MCI advocate the use of actual geocode data points, AT&T and MCI endorse the PNR road surrogate algorithm to identify surrogate locations in the absence of actual geocode data. We therefore affirm our tentative conclusion in the *Inputs Further Notice* and adopt the PNR road surrogate algorithm and data set to determine customer locations for use in the model beginning on January 1, 2000.

3. Methodology for Estimating the Number of Customer Locations

15. In addition to selecting a source of customer data, we also must select a methodology for estimating the number of customer locations within the geographic region that will be used in developing the customer location data. In addition, we must determine how demand for service at each customer location should be estimated and how customer locations should be allocated to each wire center. In the *Inputs Further Notice,* we tentatively concluded that PNR's methodology for estimating the number of customer locations based on households should be used for developing the customer location data. In addition, we also tentatively concluded that we should use PNR's methodology for estimating the demand for service at each location, and for allocating customer locations to wire centers. We now affirm these tentative conclusions.

16. In the *Universal Service Order,* the Commission concluded that a ''model must estimate the cost of providing service for all businesses and households within a geographic region.'' The Commission has sought comment on the appropriate method for defining ''households,'' or residential locations, for the purpose of calculating the forward-looking cost of providing supported services. Interested parties have proposed alternative methods to comply with this requirement.

17. AT&T, MCI, and Ameritech support the methodology devised by PNR, which is based upon the number of households in each Census Block, while BellSouth, GTE, SBC, USTA, and US West propose that we use a methodology based upon the number of housing units in each Census Block. A household is an occupied residence, while housing units include all residences, whether occupied or not.

18. In the *Inputs Further Notice,* we tentatively adopted the use of the PNR National Access Line Model, as proposed by AT&T and MCI, to estimate the number of customer locations within Census Blocks and wire centers. The PNR National Access Line Model uses a variety of information sources, including: survey information; the LERG; Business Location Research (BLR) wire center boundaries; Dun & Bradstreet's business database; Metromail's residential database; Claritas's demographic database; and U.S. Census Bureau estimates. PNR's model uses these sources in a series of steps to estimate the number of residential and business locations, and the number of access lines demanded at each location. The model makes these estimates for each Census Block, and for each wire center in the United States. In addition, each customer location is associated with a particular wire center. We conclude that PNR's process for estimating the number of customer locations should be used for developing the customer location data. We also conclude that we should use PNR's methodology for estimating the demand for service at each location, and for allocating customer locations to wire centers. We believe that the PNR methodology is a reasonable method for determining the number of customer locations to be served in calculating the cost of providing supported services.

19. PNR's process for estimating the number of customer locations results in an estimate of residential locations that is greater than or equal to the Census Bureau's estimate of households, by Census Block Group, and its estimate is disaggregated to the Census Block level. PNR's estimate of demand for both residential and business lines in each study area will also be greater than or equal to the number of access lines in the Automated Reporting and Management Information System (ARMIS) for that study area.

20. The BCPM model relied on many of the same data sources as those used in PNR's National Access Line Model. For example, BCPM 3.1 used wire center data obtained from BLR and business line data obtained from PNR. In estimating the number of residential locations, however, the BCPM model used Census Bureau data that include household and housing unit counts from the 1990 Census, updated based upon 1995 Census Bureau statistics regarding household growth by county. In addition, rather than attempting to estimate demand by location at the Block level, the BCPM model builds two lines to every residential location and at least six lines to every business.

21. A number of commenters contend that the total cost estimated by the model should include the cost of providing service to all possible customer locations, even if some locations currently do not receive service. Some commenters further contend that, if total cost is based on a smaller number of locations, support will not be sufficient to enable carriers to meet their carrier-of-last-resort obligations. These commenters argue that basing the estimate of residential locations on households instead of housing units will underestimate the cost of building a network that can provide universal service. They therefore assert that residential locations should be based on the number of housing units—whether occupied or unoccupied. These commenters contend that only this approach reflects the obligation to provide service to any residence that may request it in the future.

22. Some commenters also contend that the PNR National Access Line Model has not been made adequately available for review. As noted, the National Access Line Model is a multi-step process used to develop customer location counts and demand and associate those customer locations with Census Blocks and wire centers. As a result, PNR contends that the National Access Line Model cannot be provided in a single, uniform format. The HAI sponsors have provided a description of the National Access Line Model process in the HAI model documentation. PNR has made the National Access Line Model process available for review through on-site examination and has provided more detailed explanation of the National Access Line Model upon request from interested parties. PNR notes that several parties have taken advantage of this opportunity. PNR also notes that the National Access Line Model computer code is available for review on-site. PNR also has filed with the Commission the complete output of the National Access Line Model process. In addition, Bell Atlantic and Sprint argue that the National Access Line Model produces line counts that vary significantly from actual line counts.

23. In adopting the PNR approach for developing customer location counts, we note that the synthesis model currently calculates the average cost per line by dividing the total cost of serving customer locations by the current number of lines. Because the current

number of lines is used in this average cost calculation, we agree with AT&T and MCI that the total cost should be determined by using the current number of customer locations. As AT&T and MCI note, ''the key issue is the consistency of the numerator and denominator'' in the average cost calculation. According to AT&T and MCI, other proposed approaches result in inconsistency because they use the highest possible cost in the numerator and divide by the lowest possible number of lines in the denominator, and therefore result in larger than necessary support levels. AT&T and MCI also assert that, in order to be consistent, housing units must be used in the determination of total lines if they are used in the determination of total costs. MCI points out that ''[i]f used consistently in this manner, building to housing units as GTE proposes is unlikely to make any difference in cost per line.'' Although SBC advocates the use of housing units, it agrees that the number of lines resulting from this approach should also be used in the denominator of any cost per line calculation to prevent the distortion noted by AT&T and MCI. We agree with AT&T and MCI that, as long as there is consistency in the development of total lines and total cost, it makes little difference whether households or housing units are used in determining cost per line. For the reasons discussed, we believe that PNR's methodology based on households is less complex and more consistent with a forward-looking methodology than housing units.

24. To the extent that the PNR methodology includes the cost of providing service to all currently served households, we conclude that this is consistent with a forward-looking cost model, which is designed to estimate the cost of serving current demand. As noted by AT&T and MCI, adopting housing units as the standard would inflate the cost per line by using the highest possible numerator (all occupied and unoccupied housing units) and dividing by the lowest possible denominator (the number of customers with telephones).

25. If we were to calculate the cost of a network that would serve all potential customers, it would not be consistent to calculate the cost per line by using current demand. In other words, it would not be consistent to estimate the cost per line by dividing the total cost of serving all potential customers by the number of lines currently served. The level and source of future demand, however, is uncertain. Future demand might include not only demand from currently unoccupied housing units, but also demand from new housing units, or potential increases in demand from currently subscribing households. We also recognize that population or demographic changes may cause future demand levels in some areas to decline. Given the uncertainty of future demand, we noted in the *Inputs Further Notice* that we are concerned that including such a highly speculative cost of future demand may not reflect forward-looking cost and may perpetuate a system of implicit support. Ameritech and AT&T and MCI also note that adopting the proposed conservative fill factors will ensure sufficient plant to deal with any customer churn created as a result of temporarily vacant households.

26. In addition, we do not believe that including the cost of providing service to all housing units would necessarily promote universal service to unserved customers. We note that there is no guarantee that carriers would use any support derived from the cost of serving all housing units to provide service to these customers. Many states permit carriers to charge substantial line extension or construction fees for connecting customers in remote areas to their network. If that fee is unaffordable to a particular customer, raising the carrier's support level by including the costs of serving that customer in the model's calculations would have no effect on whether the customer actually receives service. In fact, as long as the customer remains unserved, the carrier would receive a windfall. We recognize that providing service to currently unserved customers in such circumstances is an important universal service goal and the Commission is addressing this issue more directly in another proceeding.

27. We also find that interested parties have been given a reasonable opportunity to review and understand the National Access Line Model process for developing customer counts. The HAI sponsors have documented the process by which the National Access Line Model derives customer location counts and PNR has made itself available to respond to inquiries from interested parties. The National Access Line Model is a commercially licensed product developed by PNR, and we do not find it unreasonable for PNR to place some restriction on its distribution to the public. In addition, we agree that the National Access Line Model is more correctly characterized as a process consisting of several steps, and therefore we find no practical alternative to on-site review. Even if it were possible for PNR to turn the National Access Line Model over to the public in a single format, we believe that this would be of limited utility without a detailed explanation of the entire process. We therefore conclude that PNR has made reasonable efforts to ensure that interested parties understand the underlying process by which the National Access Line Model develops customer counts and has made that process reasonably available to interested parties. In addition, unlike the case with PNR's geocode data points, PNR's road surrogate customer location points are available for review and comparison by interested parties.

28. In response to Bell Atlantic and Sprint's concern regarding the line counts generated by the National Access Line Model, we note that the line count data proposed in the *Inputs Further Notice* had been trued up by PNR to 1996 ARMIS line counts. We subsequently have modified those data to reflect the most currently available ARMIS data. Accordingly, the input values that we adopt in this Order will true up the line counts generated by the National Access Line Model to 1998 ARMIS line counts. While the Commission has requested line count data from the non-rural LECs, no party has suggested, and we have not been able to discern, any feasible way of associating such data with wire centers used in the model. The Commission intends to continue to review this issue in addressing future refinements to the forward-looking cost model.

29. In the *Inputs Further Notice,* we also noted that the accuracy of wire center boundaries is important in estimating the number of customer locations. PNR currently uses BLR wire center information to estimate wire center boundaries. As noted, the BCPM model also uses BLR wire center boundaries, as does Stopwatch Maps in its road surrogate customer location files. A few commenters support the use of BLR wire center boundaries, noting widespread use by the model proponents. Others advocate the use of actual wire center boundaries. These commenters acknowledge, however, that this information is generally considered confidential and may not be released publicly by the incumbent LEC. We conclude that the BLR wire center boundaries are the best available data that are open to inspection and that they provide a reasonably reliable estimation of wire center boundaries. We note that both the BCPM and HAI proponents have utilized the BLR wire center data in their respective models. While use of actual wire center boundaries may be preferable, we agree that such information is currently unavailable or proprietary. We therefore approve the

use of the BLR wire center boundaries in the current customer location data set.

III. Outside Plant Input Values

A. Introduction

30. In this section, we consider inputs to the model related to outside plant. The *Universal Service Order's* first criterion specifies that ''[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.'' Thus, while the model uses existing incumbent LEC wire center locations in designing outside plant, it does not necessarily reflect existing incumbent LEC loop plant. Indeed, as the Commission stated in the *Platform Order,* ''[e]xisting incumbent LEC plant is not likely to reflect forward-looking technology or design choices.'' The *Universal Service Order's* third criterion specifies that ''[o]nly long-run forward-looking costs may be included.'' We select input values consistent with these criteria.

31. As the Commission noted in the *Platform Order,* outside plant, or loop plant, constitutes the largest portion of total network investment, particularly in rural areas. Outside plant investment includes the copper cables in the distribution plant and the copper and optical fiber cables in the feeder plant that connect the customers' premises to the central office. Cable costs include the material costs of the cable, as well as the costs of installing the cable.

32. Outside plant consists of a mix of aerial, underground, and buried cable. Aerial cable is strung between poles above ground. Underground cable is placed underground within conduits for added support and protection. Buried cable is placed underground but without any conduit. A significant portion of outside plant investment consists of the poles, trenches, conduits, and other structure that support or house the copper and fiber cables. In some cases, electric utilities, cable companies, and other telecommunications providers share structure with the LEC and, therefore, only a portion of the costs associated with that structure are borne by the LEC. Outside plant investment also includes the cost of the SAIs and DLCs that connect the feeder and distribution plant.

B. Engineering Assumptions and Optimizing Routines

33. As noted in the *Inputs Further Notice,* the model determines outside plant investment based on certain cost minimization and engineering considerations that have associated input values. In the *Inputs Further Notice,* we recognized that it was necessary to examine certain input values related to the engineering assumptions and optimization routines in the model that affect outside plant costs. Specifically, we tentatively concluded that: (1) The optimization routine in the model should be fully activated; (2) the model should not use T–1 feeder technology; and (3) the model should use rectilinear distances and a ''road factor'' of one.

1. Optimization

34. When running the model, the user has the option of optimizing distribution plant routing via a minimum spanning tree algorithm discussed in the model documentation. The algorithm functions by first calculating distribution routing using an engineering rule of thumb and then comparing the cost with the spanning tree result, choosing the routing that minimizes annualized cost. The user has the option of not using the distribution optimization feature, thereby saving a significant amount of computation time, but reporting network costs that may be significantly higher than with the optimization. The user also has the option of using the optimization feature only in the lowest density zones.

35. In reaching our tentative conclusion that the model should be run with the optimization routine fully activated in all density zones, we recognized that using full optimization can substantially increase the model's run time. We noted that a preliminary analysis of comparison runs with full optimization versus runs with no optimization indicated that, for clusters with line density greater than 500, the rule of thumb algorithm results in the same or lower cost for nearly all clusters. Accordingly, we sought comment on whether an acceptable compromise to full optimization would be to set the optimization factor at ''−p500,'' as described in the model documentation.

36. We adopt our tentative conclusion that the model should be run with the optimization routine fully activated in all density zones when the model is used to calculate the forward-looking cost of providing the services supported by the federal mechanism. The first of the ten criteria pronounced by the Commission to ensure consistency in calculations of federal universal support specifies that ''[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.'' As we explained in the *Inputs Further Notice,* running the model with the optimization routine fully activated complies with this requirement. In contrast, running the model with the optimization routine disabled may result in costs that are significantly higher than with full optimization. The majority of commenters that address the optimization issue support the use of full optimization. GTE opposes any implementation of optimization.

37. We agree with AT&T and MCI and GTE that it is inappropriate to deviate from full optimization merely to minimize computer run time. While the rule of thumb algorithm generally results in costs that are approximately the same as the spanning tree algorithm for dense clusters, for some dense clusters the spanning tree algorithm will result in lower costs. For this reason, we believe that any choice in maximum density clusters in which the minimum spanning tree algorithm is not applied may result in an arbitrary overestimate of costs for some clusters. Accordingly, running the model with full optimization is consistent with ensuring that the model uses the least-cost, most efficient, and reasonable distribution plant routings for providing the supported services.

38. As explained, the model seeks to minimize costs by selecting the lower of the cost estimates from the spanning tree algorithm and the rule of thumb algorithm. Both GTE and US West challenge the selection of the routing that minimizes annualized cost on the basis of a comparison between an engineering rule of thumb and the spanning tree result. US West claims that use of the rule of thumb approach is inappropriate because combining it with the spanning tree analytical approach to determine the amount of needed plant biases the results downward and will produce inappropriately low results.

39. We find that US West's concerns are misplaced. Contrary to US West's characterization, the rule of thumb used in the model is not an averaging methodology. Instead, it is a methodology that determines a sufficient amount of investment to serve each customer in every cluster using a standardized approach to network design. This approach connects every populated microgrid cell to the SAI using routes which are placed along the vertical and horizontal boundaries of the microgrid cells constructed in the distribution algorithm. The rule-of-thumb algorithm is somewhat similar in

its functioning to the so-called ''pinetree'' methodology proposed by both the early HAI and BCPM models for building feeder plant. Thus, the rule of thumb provides an independent calculation of sufficient outside plant for each cluster. The minimum spanning tree algorithm connects drop terminal points to the SAI using a more sophisticated algorithm in which routes are not restricted to following the vertical and horizontal boundaries of microgrid cells. The algorithm ''chooses'' a path independently of the set route structure defined by the rule-of-thumb, but still connects all drop terminals to the SAI. Since both the rule of thumb algorithm and the spanning tree algorithm use currently available technologies and generate investments that are sufficient to provide supported services, an approach which selects the minimum cost based on an evaluation of both of the algorithms is fully consistent with cost minimization principles.

40. We also disagree with GTE's assertion that the optimization routine should be disabled because it disproportionately affects lower density areas where universal service is needed most. The task of the model is to estimate the cost of the least-cost, most-efficient network that is sufficient to provide the supported services. Moreover, we note that the model does not determine the level of high-cost support amounts. We have taken steps in our companion order to ensure that sufficient support is provided for rural and high-cost areas.

41. We also reject GTE's claim that the optimization routine does not work as intended. GTE bases this contention on the observation that in some instances when the optimization factor is increased from −p100 to −p200 (*i.e.* going from density zones less than or equal to 100 lines per square mile to density zones less than or equal to 200 lines per square mile), both loop investment and universal service requirements increase. This, according to GTE, would not happen if the optimization worked properly.

42. We disagree. Optimizing the distribution plant is not synonymous with optimizing the entire network. Because the model's optimization routine optimizes distribution and feeder sequentially, and the starting point for the optimization of feeder plant is the distribution plant routing chosen, there are occasions when the optimal feeder plant will be more costly than it would be if distribution plant and feeder plant had been optimized simultaneously. In some cases, the lower distribution investment produced by the optimization routine may be offset by higher feeder investment, resulting in higher total outside plant costs than produced by the rule of thumb algorithm. Contrary to GTE's assertion, this phenomenon does not demonstrate that the optimization works improperly. To the contrary, it demonstrates that optimization occurs properly within the constraints of the model's design.

43. Moreover, we conclude that such rare occurrences do not outweigh the benefits of the optimization routine. The magnitude of the difference between the network cost produced by the optimization routine in these instances and the rule of thumb algorithm is *de minimis.* Furthermore, altering the model to optimize distribution investment and feeder investment simultaneously would greatly add to the complexity of the model.

2. T–1 Technology

44. A user of the model also has the option of using T–1 on copper technology as an alternative to analog copper feeder or fiber feeder in certain circumstances. T–1 is a technology that allows digital signals to be transmitted on two pairs of copper wires at 1.544 Megabits per second (Mbps). If the T–1 option is enabled, the optimizing routines in the model will choose the least cost feeder technology among three options: analog copper; T–1 on copper; and fiber. For serving clusters with loop distances below the maximum copper loop length, the model could choose among all three options; between 18,000 feet and the fiber crossover point, which earlier versions of the model set at 24,000 feet, the model could choose between fiber and T–1, and above the fiber crossover point, the model would always use fiber. In the HAI model, T–1 technology is used to serve very small outlier clusters in locations where the copper distribution cable would exceed 18,000 feet.

45. In the *Inputs Further Notice,* we tentatively concluded that the T–1 option in the model should not be used at this time. We noted that the only input values for T–1 costs on the record were the HAI default values and tentatively found that, because the model and HAI model use T–1 differently, it would be inappropriate to use the T–1 technology in the model based on these input values. We also noted that the BCPM sponsors and other LECs maintained that T–1 was not a forward-looking technology and therefore should not be used in the model. Other sources indicated that advanced technologies, such as HDSL, could be used to transmit information at T–1 or higher rates. We sought comment on this issue. We also sought comment on the extent to which HDSL technology presently is being used to provide T–1 service.

46. We conclude that the T–1 option should not be employed in the current version of the model. We agree with those commenters addressing this issue that traditional T–1 using repeaters at 6000 foot intervals is not a forward-looking technology. While HDSL and other DSL variants are forward-looking technologies, we do not at this time have sufficient information to determine appropriate input values for these technologies for use in the model. We conclude, therefore, that use of T–1 in the optimization routine as an alternative to analog copper or digital fiber feeder for certain loops under 24,000 feet is not appropriate at this time. Accordingly, the model will be run for universal service purposes with the T–1 option disabled.

3. Distance Calculations and Road Factor

47. In the distribution and feeder computations within the model, costs for cable and structure are computed by multiplying the route distances by the cost per foot of the cable or the structure facility, which depends on capacity and terrain factors. Distances between any two points in the network are computed using either of two distance functions. The model allows a separate road factor for each distance function, and every distance measurement made in the model is multiplied by the designated factor. Road factors could be computed by comparing average distances between geographic points along actual roads with distances computed using either of the two distance functions. Given sufficient data, these factors could be computed at highly disaggregated levels, such as the state, county, or individual wire center.

48. In the *Inputs Further Notice,* we tentatively concluded that the model should use rectilinear distance in calculating outside plant distances, rather than airline distance, because rectilinear distance more accurately reflects the routing of telephone plant along roads and other rights of way. We also tentatively concluded that the road factor in the model, which reflects the ratio between route distance and road distance, should be set equal to one. In addition, we asked whether we should use airline miles with wire center specific road factors as an alternative to rectilinear distance.

49. We reaffirm our tentative conclusion that the model should use rectilinear distance rather than airline distance in calculating outside plant

distances. As we noted in the *Inputs Further Notice,* research suggests that, on average, rectilinear distance closely approximates road distances. We agree with SBC that the calculation of outside plant distances should reflect the closest approximation to actual route conditions and road distance. We also conclude that it would be inappropriate to use airline distance in the model without simultaneously developing a process for determining accurate road factors (which would be uniformly greater than or equal to 1 in this case). While the use of geographically disaggregated road factors may merit further investigation, we note that the absence of such a data set on the record at this time precludes our ability to adopt that approach. We therefore conclude that the model should use a rectilinear distance metric with a road factor of one.

C. Cable and Structure Costs

1. Nationwide Values

50. As discussed in this section, we adopt nationwide average values for estimating cable and structure costs in the model rather than company-specific values. In reaching this conclusion, we reject the explicit or implicit assumption of most LEC commenters that company-specific values, which reflect the costs of their embedded plant, are the best predictor of the forward-looking cost of constructing the network investment predicted by the model. We find that, consistent with the *Universal Services Order's* third criterion, the forward-looking cost of constructing a plant should reflect costs that an efficient carrier would incur, not the embedded cost of the facilities, functions, or elements of a carrier. We recognize that variability in historic costs among companies is due to a variety of factors and does not simply reflect how efficient or inefficient a firm is in providing the supported services. We reject arguments of the LECs, however, that we should capture this variability by using company-specific data rather than nationwide average values in the model. We find that using company-specific data for federal universal service support purposes would be administratively unmanageable and inappropriate. Moreover, we find that averages, rather than company-specific data, are better predictors of the forward-looking costs that should be supported by the federal high-cost mechanism. Furthermore, we note that we are not attempting to identify any particular company's cost of providing the supported services. We are estimating the costs that an efficient provider would incur in providing the supported services.

51. AT&T and MCI agree that nationwide input values generally should be used for the input values in the model. AT&T and MCI concur with our tentative conclusion that the use of nationwide values is more consistent with the forward-looking nature of the high-cost model because it mitigates the rewards to less efficient companies. Additionally, AT&T and MCI maintain that developing separate inputs values on a state-specific, study-area specific, or holding company-specific basis is not practicable. As AT&T and MCI contend, doing so would be costly and administratively burdensome.

52. While reliance on company-specific data may be appropriate in other contexts, we find that for federal universal service support purposes it would be administratively unmanageable and inappropriate. The incumbent LECs argue that virtually all model inputs should be company-specific and reflect their individual costs, typically by state or by study area. For example, GTE claims that the costs that an efficient carrier incurs to provide basic service vary among states and even among geographic areas within a state. GTE asserts that the only way for the model to generate accurate estimates, *i.e.,* estimates that reflect these differences, is to use company-specific inputs rather than nationwide input values. As parties in this proceeding have noted, however, selecting inputs for use in the high-cost model is a complex process. Selecting different values for each input for each of the fifty states, the District of Columbia, and Puerto Rico, or for each of the 94 non-rural study areas, would increase the Commission's administrative burden significantly. Unless we simply accept the data the companies provide us at face value, we would have to engage in a lengthy process of verifying the reasonableness of each company's data. For example, in a typical tariff investigation or state rate case, regulators examine company data for one time high or low costs, pro forma adjustments, and other exceptions and direct carriers to adjust their rates accordingly. Scrutinizing company-specific data to identify such anomalies and to make the appropriate adjustments to the company-proposed input values to ensure that they are reasonable would be exceedingly time consuming and complicated given the number of inputs to the model.

53. Where possible, we have tried to account for variations in costs by objective means. As explained, the model reflects differences in structure costs by using different values for the type of plant, the density zone, and geological conditions. As discussed, we sought comment in the *Inputs Further Notice* on alternatives to nationwide plant mix values, but the algorithms on the record produce biased results. We continue to believe that varying plant mix by state, study area, or region of the country may more accurately reflect variations in forward-looking costs and intend to seek further comment on this issue in the future of the model proceeding.

2. Preliminary Cable Cost Issues

54. *Use of 24-gauge and 26-gauge Copper.* In the *Inputs Further Notice,* we tentatively concluded that the model should use both 24-gauge and 26-gauge copper in all available pair-sizes. We based our tentative conclusion on a preliminary analysis of the results of the structure and cable cost survey, in which it appeared that a significant amount of 24-gauge copper cable in larger pair sizes currently is being deployed. We also noted that, while HAI default values assume that all copper cable below 400 pairs in size is 24-gauge and all copper cable of 400 pairs and larger is 26-gauge, the BCPM default values include separate costs for 24-and 26-gauge copper of all sizes.

55. We conclude that the model should use both 24-gauge and 26-gauge copper in all available pair sizes. No commenter refuted our observation that a significant amount of 24-gauge copper cable in larger pair sizes currently is being deployed. Those commenters addressing this issue concur with our tentative conclusion. SBC confirms our analysis of the survey data and notes that it deploys 24-gauge cable in sizes from 25 to 2400 pairs. GTE explains, and we agree, that the model should use both 24-gauge and 26-gauge copper in all available pair sizes in order to stay within transmission guidelines when modeling 18 kilofoot loops.

56. *Distinguishing Feeder and Distribution Cable Costs.* In the *Inputs Further Notice,* we reaffirmed the Commission's tentative conclusion in the *1997 Further Notice* that the same input values should be used for copper cable whether it is used in feeder or in distribution plant. We adopt this tentative conclusion. Those commenters addressing this issue agree with our tentative conclusion. GTE contends that it is both unnecessary and inappropriate to have different costs for feeder and distribution cable material. GTE explains that, although quantities of material and labor related to cable size may differ between feeder and distribution, the unit costs for each

remain the same. Similarly, Sprint agrees that the material cost of cable is the same whether it is used for distribution or feeder. In sum, we find that the record demonstrates that it is appropriate to use the same input values for copper cable whether it is used in feeder or in distribution plant.

57. *Distinguishing Underground, Buried, and Aerial Installation Costs.* In the *Inputs Further Notice,* we also tentatively concluded that we should adopt separate input values for the cost of aerial, underground, and buried cable. We reached this tentative conclusion on the basis of our analysis of cable cost data supplied to us in response to data requests and through *ex parte* presentations. We found considerable differences in the per foot cost of cable, depending upon whether the cable was strung on poles, pulled through conduit, or buried.

58. We conclude that separate input values for the cost of aerial, underground, and buried cable should be adopted. Those commenters addressing this issue confirm our analysis of the data, *i.e.,* that there are differences, some significant, in placement costs for aerial, underground, and buried cable. GTE explains that, from a material perspective, the cable may have different protective sheathing, depending on construction applications. GTE adds that labor costs also differ depending on the type of placement. Both SBC and Sprint identify the cost of labor as varying significantly depending upon the type of placement. Based upon a review of the record in this proceeding, we conclude that separate input values for the cost of aerial, underground, and buried cable are, therefore, warranted.

59. *Deployment of Digital Lines.* We also conclude that two inputs, ''pct DS1'' and ''pct 1sa'', should be modified to provide more accurate deployment of digital lines in the distribution plant. The model can deploy a portion of distribution plant on digital DS1 circuits by specifying these two user adjustable inputs. The input ''pct DS1'' determines the percentage of switched business traffic carried on DS1 circuits, and the input ''pct 1sa'' determines the percentage of special access lines carried on DS1 circuits. Previously, we used default values for the inputs ''pct DS1'' and ''pct 1sa.'' We now adopt more accurate values for these inputs using 1998 line count data, following the methodology described.

60. Initially the model determines the number of special access lines from a ''LineCount'' table in the database ''hcpm.mdb,'' which provides for each wire center the number of residential lines, business lines, special access lines, public lines, and single business lines. The Commission required incumbent LECs to provide line counts for business switched and non-switched access lines on a voice equivalent basis and on a facilities basis. Upon receipt of those filings, we determined industry totals for each of the line count items requested. By applying the model's engineering conventions to the totals, the model determines the percentage of switched and non-switched lines provided as DS1-type service. Thus, using the channel and facility counts submitted in response to the *1999 Data Request,* it is possible to determine the ''pct DS1'' input value using the following formula: (1-pct DS1)*channels + pct DS1*channels/12 = facilities. A similar calculation is performed to solve for the ''pct 1sa'' input value. For both switched business and special access lines, the number of digital lines is then determined by multiplying the respective line count by the input value ''pct DS1'' or ''pct 1sa.'' Since 24 communications channels can be carried by two pairs of copper wires, the number of copper cables required to carry digital traffic is computed by dividing the number of digital channels by 12. These percentages are used to adjust the wire center cable requirements by reducing the facilities needed to serve multi-line business and special access customers.

3. Cost Per Foot of Cable

61. We affirm our tentative conclusion that we should use, with certain modifications, the estimates in the NRRI Study for the per-foot cost of aerial, underground, and buried 24-gauge copper cable and for the per-foot cost of aerial, underground, and buried fiber cable. We conclude that, on balance, these estimates, as modified in the *Inputs Further Notice,* and further adjusted herein, are the most reasonable estimates of the per-foot cost of aerial, underground, and buried 24-gauge copper cable and fiber cable on the record before us. In reaching this conclusion, we reject, for the reasons enumerated, the arguments of those commenters who contend that we should use company-specific data to develop the inputs for the per-foot cost of cable to be used in the model.

62. *Company-specific data.* As we discussed, we have determined to use nationwide average input values for estimating outside plant costs. In reaching this conclusion, we determined that the use of company-specific inputs was inappropriate because of the difficulty in verifying the reasonableness of each company's data, among other reasons. We have examined cable cost and structure cost data received from a number of non-rural LECs, as well as AT&T, in response to the structure and cable cost survey and through a series of *ex parte* filings. In addition, we have examined additional company-specific data submitted by certain parties with their comments. We conclude that these data are not sufficiently reliable to use to estimate the nationwide input values for cable costs or structure costs to be used in the model.

63. We conclude that the cable cost and structure cost data received in response to the structure and cable cost survey, in the *ex parte* filings, and in the comments are not verifiable. We find that with regard to the survey data, notwithstanding our request, most respondents did not trace the costs submitted in response to the survey from dollar amounts set forth in contracts by providing copies of these contracts and all of the interim calculations for a single project or a randomly selected central office. With regard to the *ex parte* data and data submitted with the comments, we find that, because most respondents did not document in sufficient detail the methodology, calculations, assumptions, and other data used to develop the costs they submitted, nor did they submit contracts or invoices setting forth in detail the cable and structure costs they incurred, these data cannot be substantiated. Moreover, we note that the structure and cable costs reported in the survey by some parties differ significantly from those reported by the same parties in the *ex parte* filings. These differences are not explained, and render those sets of data unreliable.

64. We find this lack of back-up information particularly unsettling given the magnitude of certain of the costs reported. We agree with AT&T and MCI that the cable installation costs submitted by the incumbent LECs appear to be high. We also agree with AT&T and MCI that this is because the loading factors employed in calculating these costs appear to be overstated. Because of the lack of back-up information to explain these loading costs, however, there is no evidence on the record to controvert our initial assessment. Accordingly, the level of these costs remains suspect.

65. Moreover, we find additional deficiencies beyond the critical lack of substantiating data, impugning the reliability of the LEC survey data and the *ex parte* data we have received. As discussed, the task of the model is to

calculate forward-looking costs of constructing a wireline local telephone network. To that end, the survey directed respondents to submit cable and structure costs for growth projects for which expenditures were at least $50,000. We believed that such projects would best reflect the costs that a LEC would incur today to install cable if it were to construct a local telephone network using current technology. In contrast, absent from the data would be costs associated with maintenance or projects of smaller scale which do not represent the costs of installing cable during such construction using current technology. Thus, the data would capture the economies of scale enjoyed on large projects which, should result in lower cable costs on a per-foot basis. Notwithstanding the survey directions, several of the respondents submitted data representing projects that were not growth projects or projects for which expenditures were less than the $50,000 minimum we established.

66. Conversely, some respondents included costs that should have been excluded under the definitions employed in the survey. For example, some respondents included costs for terminating structures, such as cross-connect boxes, in the cable costs they reported. Similarly, some respondents reported underground structure costs on a ''per duct foot'' basis contrary to the instructions set forth in the survey directing that such costs be reported on a ''per foot'' basis. We find that these inconsistencies render the use of the survey data inappropriate.

67. In sum, we find that certain of the concerns we identified with regard to using company-specific data, rather than nationwide average inputs for model inputs, have been borne out in our review of the cable cost and structure cost data we have reviewed. Specifically, we find that we are unable to verify the reasonableness of such data. Accordingly, we find that we are unable to use the company-specific data we have received for the estimation of cable cost and structure cost inputs for the model.

68. In reaching this conclusion, we reject the contention that the inability to link the costs submitted in response to the cable and structure cost survey to contracts is irrelevant because the survey request was not intended to create such a trail. This claim ignores the fact that the reasonableness of the survey data was placed into question by the presence of data received on the record that was inconsistent with the survey data. For this reason, as GTE attests, we attempted to create such a trail by requesting contracts and other supporting data in an effort to verify the reasonableness of the company-specific data received in response to the survey as well as in *ex parte* filings.

69. *Methodology.* As we explained in the *Inputs Further Notice,* our tentative decision to rely on the NRRI Study was predicated on our inability to substantiate the default input values for cable costs and structure costs provided by the HAI and BCPM sponsors. For that reason, we tentatively concluded, in the absence of more reliable evidence of cable and structure costs for non-rural LECs, to use estimates in Gabel and Kennedy's analysis of RUS data, subject to certain modifications, to estimate cable and structure costs for non-rural LECs. As we explained, Gabel and Kennedy first developed a data base of raw data from contracts for construction related to the extension of service into new areas, and reconstruction of existing exchanges, by rural-LECs financed by the RUS. Gabel and Kennedy then performed regression analyses, using data from the HAI model on line counts and rock, soil, and water conditions for the geographic region in which each company in the database operates to estimate cable and structure costs. Regression analysis is a standard method used to study the dependence of one variable, the dependent variable, on one or more other variables, the explanatory variables. It is used to predict or forecast the mean value of the dependent variable on the basis of known or expected values of the explanatory variables.

70. Those commenters advocating the use of company-specific data provide a litany of alleged weaknesses and flaws in the NRRI Study, and the modifications we proposed, to discredit its use to estimate the input values for cable costs and structure costs. In sum, they argue that the overall approach we proposed is unsuitable for estimating the cable and structure costs of non-rural LECs and generally leads to estimates which understate actual forward-looking costs. We find the contentions in support of this claim unpersuasive. Significantly, we note that these commenters provide no evidence that substantiates the reasonableness of the company-specific cable costs and structure costs submitted on the record to permit their use as an alternative in the estimation of cable and structure cost inputs to be used in the model.

71. For similar reasons, we reject AT&T and MCI's recommendation that we rely on the RUS data to develop cost estimates for the material cost of cable and then adopt ''reasonable'' values for the costs of cable placing, splicing, and engineering based on the expert opinions submitted by AT&T and MCI in this proceeding. We find that the expert opinions on which AT&T and MCI's proposed methodology relies lack additional support that would permit us to substantiate those opinions. Moreover, we reject AT&T and MCI's contentions, often analogous to those raised by the non-rural LECs, that the approach we proposed to estimate cable and structure costs is flawed in certain respects.

72. We reject the contentions of the commenters, either express or implied, that it is inappropriate to employ the NRRI Study because the RUS data set on which it relies is not a sufficiently reliable data source for structure and cable costs. We find that the RUS data set is a reasonably reliable source of absolute cable costs and structure costs, and more reliable and verifiable than the company-specific data we have reviewed. As explained in the NRRI Study, and noted, the RUS data reflect contract costs for construction related to the extension into new areas, and reconstruction of existing exchanges, by rural LECs financed by the RUS. Thus, the RUS data reflect actual costs derived from contracts between LECs and vendors. These costs are not estimates, but actual costs. Nor do they reflect only the opinions of outside plant engineers. In sum, we conclude that these are verifiable data.

73. We also note that the RUS data reflect the costs from 171 contracts covering 57 companies operating in 27 states adjusted to 1997 dollars. These companies operate in areas that have different terrain, weather, and density characteristics. This fact makes the RUS data sample suitable for econometric analysis. Moreover, we find that, because the costs are for construction that must abide by the engineering standards established by the RUS, these data are consistent. We note also that the imposition of consistent engineering requirements mitigate the impact of any inefficiencies or inferior technologies that may otherwise be reflected in the data.

74. Finally, as noted, the RUS data reflect costs for additions to existing plant or new construction. The use of such costs is consistent with the objective of the model to identify the cost today of building an entire network using current technology.

75. In reaching our conclusion to use the NRRI Study and thus the underlying RUS data, we have considered and rejected the contentions of the commenters that the RUS data set is flawed thereby rendering use of the NRRI Study inappropriate. GTE claims

that because certain high-cost observations were removed from the RUS data, the NRRI Study's results are unrepresentative of rural companies' costs, and are even less representative of non-rural companies' costs. We disagree. Gabel and Kennedy omitted data reflecting certain contracts from the RUS data they used to develop cost estimates because estimates produced using the data were inconsistent with the values of such estimates suggested by *a priori* reasoning or evidence. For example, they excluded certain observations from the buried copper and structure regression analysis because buried copper cable and structure estimates obtained from this analysis would otherwise be higher in low density areas than in higher density areas. Such a result is contrary to the information contained in the more than 1000 observations reflected in the data from which Gabel and Kennedy developed their buried copper cable and structure regression equation. Thus, removing the observations does not render the remaining data set less representative of rural companies' costs or, as adjusted, the estimates of the costs of non-rural companies. Moreover, we note that the evidence supplied on the record in this proceeding demonstrates that structure costs increase as population density increases. Thus, we find that the RUS data set is not flawed as GTE contends. We conclude that the removal of certain high cost observations was reasonable.

76. We also disagree with GTE's and Bell Atlantic's assertion that the NRRI Study is flawed because the RUS company contracts do not reflect actual unit costs for work performed, but rather the total cost for a project. Both commenters claim that this alleged failure results in unexplained variations in the RUS data which undermine the validity of the estimates produced. Contrary to GTE's and Bell Atlantic's contention, the contracts from which Gabel and Kennedy developed their data base for developing structure and cable costs do set forth per unit costs for materials and per unit costs for specific labor tasks.

77. We also disagree with AT&T and MCI's claim that the RUS data are defective because they consist of primarily small cables. AT&T and MCI claim that 74 percent of the RUS data are for cables of 50 pairs or less, and 95 percent are for cable sizes of 200 pairs or less. As a result, AT&T and MCI contend that the RUS data are inaccurate, especially for cable sizes above 200 pairs. We disagree with AT&T and MCI's analysis. We note that, for the buried copper cable and structure regression equations we proposed and adopt, approximately 39 percent of the observations are for cable sizes of 50 pairs or less, and approximately 76 percent are for 200 pairs or less. For the underground copper cable regression equation we proposed and adopt, approximately 10 percent of the observations are for cable sizes of 50 pairs or less, and approximately 33 percent are for 200 pairs or less. For the aerial copper cable regression equation we proposed and adopt, approximately 40 percent of the observations are for cable sizes of 50 pairs or less, and approximately 76 percent are for 200 pairs or less. Thus, the proportion of the observations reflected in the copper cable cost estimates we adopt are significantly greater for relatively large cables than what AT&T and MCI contend.

78. Finally, we reject the contention that it is inappropriate to use the NRRI Study because the RUS data base is not designed for the purpose of developing input values for the model. In the NRRI Study, Gabel and Kennedy explain that they began developing the data base as an outgrowth of the Commission's January 1997 workshop on cost proxy models when it became apparent that costs used as inputs in such models should be able to be validated by regulatory commissions. For this reason, they prepared data that is in the public domain to provide independent estimates of structure and cable costs.

79. We also find unpersuasive the contention that there are econometric flaws in the NRRI Study which render it unsuitable for developing input values. We disagree with the contentions of several commenters that the structure cost and cable cost regression equations that we develop from the RUS data are flawed because they are based on a relatively small number of observations. As a general rule of thumb, in order to obtain reliable estimates for the intercept and the slope coefficients in a regression equation, the number of observations on which the regression is based should be at least 10 times the number of independent variables in the regression equation. Ameritech claims that the sample size used to estimate the costs of buried placement is too small because it contains only 26 observations in density zone one. Ameritech's criticism ignores the fact that we use a single regression equation to estimate buried copper cable and structure costs for density zones one and two based on 1,131 observations (1,105 in zone two and 26 in zone one). There are four independent variables in the buried copper cable and structure regression equation, i.e., the variables that indicate the size of the cable, presence of a high water table, combined rock and soil type, and density zone. This suggests that approximately 40 observations are needed to obtain reliable estimates for the parameters in this regression equation. The total number of observations used to estimate this regression equation, 1,131, readily exceeds the number suggested for estimating reliably this regression equation. The number of observations for density zone one alone, 26, provides 65 percent of the suggested number of observations. Similarly, AT&T and MCI claim that the sample size for underground cable is too small because it contains only 80 observations. There is one independent variable in the adopted underground copper cable equation, i.e., the variable that indicates the size of the cable. Based on the rule of thumb noted, 10 observations are needed to reliably estimate this regression equation. The number of observations used to estimate the adopted underground copper cable regression equation, 81, is more than eight times this suggested number. Moreover, we note that Ameritech does not provide any evidence that suggest that a sample that has 26 observations in density zone 1 produces biased estimates of buried structure and cable costs for density zone one. Similarly AT&T and MCI do not provide any evidence to support their allegation that a sample size of 80 observations produces biased estimates of underground copper cable costs. Finally, we note that GTE contends that the regression results for aerial structure are undermined because the sample size for poles is based only on 19 observations. While a sample of this size fails to satisfy the general rule of thumb we noted, we find that the estimates produced are reasonable. As we pointed out in the *Inputs Further Notice,* the average material price reported in the NRRI Study for a 40-foot, class four pole is $213.94. This is close to our calculations of the unweighted average material cost for a 40-foot, class four pole, $213.97, and the weighted average material cost, by line count, $228.22, based on data submitted in response to the *1997 Data Request.* Moreover, we note that GTE does not provide any evidence that suggests that a sample size of 19 poles for developing aerial structure costs produces biased estimates as GTE seems to allege.

80. We also disagree with GTE's contention that the NRRI Study contains three methodological errors that make its results unreliable. First, GTE asserts

that the most serious of these flaws is that the NRRI Study improperly averages ordinal or categorical data, i.e., qualitative values, for the costs of placing structure in different types of soil. Contrary to GTE's claim, the independent variables that indicate soil type, rock hardness, and the presence of a high water table used in the regression equations for aerial and underground structure and buried structure and cable costs in the NRRI Study and proposed in the *Inputs Further Notice* do not reflect an incorrect averaging of ordinal data. The variables for soil, rock, and water indicate the average soil, rock, and water conditions in the service areas of RUS companies. They are based on averages of data obtained from the HAI database for the Census Block Groups in which the RUS companies operate. In general, the magnitude of the t-statistics for the coefficients of the independent variables for soil, rock, and water in the structure regression equations indicate that these variables have a statistically significant impact on structure costs. The magnitude of the F-statistic indicates that the independent variables in the structure regression equations, including those that indicate water, rock, and soil type, jointly provide a statistically significant explanation of the variation in structure costs. These statistical findings justify use of these variables in the structure regression equations. We also note that HAI uses as cardinal values, i.e., quantitative, not ordinal values, the soil and rock data from which the averages reflected in the rock and soil variables in the NRRI Study are calculated. For example, HAI uses a multiplier of between 1 and 4 to calculate the increase in placement cost attributable to the soil condition. Moreover, and more importantly, we note that no commenter has demonstrated the degree of, or even the direction of, any bias in the cost estimates derived in the NRRI Study or in the regression equations proposed in the *Inputs Further Notice* as a result of the use of soil, water, and rock variables based on averages of HAI data.

81. GTE also claims that the NRRI Study is flawed because it relies on the HAI model's values relating to soil type which GTE claims were ''made up.'' GTE contends that this renders the variable relating to soil type judgmental and biased. We find GTE's concern misplaced. As explained, the econometric analyses of the data demonstrate a statistically significant relationship between the geological variables developed from the HAI data and the structure costs. Finally, we disagree with GTE's claim that the NRRI Study is flawed because of a mismatch in the geographic coverage of the RUS data and the HAI model variables. GTE does not provide any evidence showing that the alleged mismatch introduces an upward or downward bias on the cost estimates obtained from the regression equations. Moreover, and more importantly, the t-statistics for the coefficients of the variables that measure rock and soil type generally indicate that these geological variables provide a statistically significant explanation of variations in RUS companies' structure costs.

82. We also reject the claims that the derivation of the equations for 24-gauge buried copper cable, buried structure, and buried fiber cable from the NRRI Study regression equations for 24-gauge buried copper cable and structure and buried fiber cable and structure, respectively, is inappropriate. As we explained in the *Inputs Further Notice,* we modified the regression equations in the NRRI Study for 24-gauge buried copper cable and structure and buried fiber cable and structure, as modified by the Huber methodology described, to estimate the cost of 24-gauge buried copper cable, buried structure and buried fiber cable because the regression equations for buried copper cable and structure and buried fiber cable and structure provide estimates for labor and material costs for both buried cable and structure combined. In layman's terms, we split the modified 24-gauge buried copper cable and structure regression equation into two separate equations, one for 24-gauge buried copper cable and one for buried structure costs. We also split the modified buried fiber cable and structure regression equation to obtain an equation for buried fiber cable. We did this because the model requires a separate input for labor and material costs for cable and a separate input for labor and material costs for structure. In contrast, the RUS data and buried cable and structure regression equations developed from these data, reflect labor and material costs for buried cable and structure combined.

83. Significantly, the criticisms of our development of the 24-gauge buried copper cable equation, buried structure equation and buried fiber cable equation in this manner ignore the fact that reliable, alternative data for buried cable costs and buried structure costs is not available on the record. Given that the model requires a separate input reflecting labor and material costs for both copper and fiber cable and a separate input reflecting labor and material costs for structure, and that the only reliable data on the record does not separate such costs between cable and structure, we find it necessary to split the regression equation.

84. Contrary to the assertions of the commenters, either express or implied, the steps we took to derive these equations were not arbitrary. We used a single buried structure equation to estimate the cost for buried structure without distinguishing between the equation for buried copper structure and the equation for buried fiber structure because the model does not distinguish between buried copper structure costs and buried fiber structure costs. We find that this is reasonable because the intercept and the coefficients for the variables that primarily explain the variation in structure costs, i.e., the variables that indicate density zone, the combined soil and rock type, and the presence of a high water table, in the combined regression equation for buried fiber cable and structure are not statistically different from the intercept and the coefficients for these variables in the combined regression equation for 24-gauge buried copper cable and structure. We also find that it is reasonable to develop a separate structure equation from the regression equation for the combined cost of 24-gauge buried copper cable and structure rather than from the regression equation for the combined cost of buried fiber cable and structure because the water and soil and rock type indicator variables in the regression equation for the combined cost of 24-gauge buried copper cable and structure are statistically significant. In contrast, these variables are not statistically significant in the buried fiber cable and structure regression equation. In addition, we note that the number of observations used to estimate the 24-gauge buried copper cable and structure regression equation, 1,131, exceeds the number of observations used to estimate the buried fiber cable and structure regression equation, 707 observations.

85. We note that we included in the separate buried cable equations the variable for cable size and its coefficient reflected in the combined cable and structure regression equations. We find that this is reasonable because the cable size variable and its coefficient explain the variation in cable costs. We also note that we excluded from the separate buried cable equations the independent variables in the combined cable and structure regression equations that indicate density zone, the presence of a high water table, and the soil and rock type. We find that this is reasonable because these variables and their coefficients explain primarily the variation in buried structure costs.

Conversely, we excluded from the separate buried structure equation the variable for cable size and its coefficient reflected in the combined 24-gauge buried copper cable and structure regression equation because this variable and its coefficient explain the variation in cable costs.

86. We also included in the separate structure equation the variables and the coefficients for the variables that indicate density zone, the combined soil and rock type, and the presence of a high water table in the combined regression equation for 24-gauge buried copper cable and structure. Again, we find this is reasonable because these independent variables and coefficients primarily explain the variation in structure costs.

87. Finally, because the estimated intercepts in the regression equations for the cost of buried cable and structure reflect the fixed cost for both buried cable and structure in density zone one, we included in the separate equations for buried cable an intercept reflecting the fixed cost of cable. Similarly, we included in the equation for buried structure an intercept reflecting the fixed cost of structure in density zone one. Specifically, we allocated an estimate of the portion of the combined fixed cable and structure costs that represents the fixed copper cable costs reflected in the intercept in the 24-gauge buried copper cable and structure cost regression equation to the intercept in the equation for 24-gauge buried copper cable. Correspondingly, we allocated an estimate of the portion of fixed cable and structure cost that represents the fixed costs of buried structure reflected in the intercept in the buried 24-gauge copper cable and structure cost regression equation to the intercept in the equation for structure costs. We also allocated to the intercept in the separate buried fiber cable equation the remaining portion of the fixed costs reflected in the intercept in the combined buried fiber cable and structure regression equation after subtracting from the value of this intercept the estimate for fixed structure costs in density zone 1 in the separate buried structure equation. The sum of the particular values that we adopt for the fixed cable cost in the separate 24-gauge copper cable equation, $.46, and the fixed structure cost in density zone 1 in the separate structure equation, $.70, equals the 24 gauge buried copper cable and structure fixed costs reflected in the intercept in the combined copper cable and structure regression equation of $1.16. The sum of the particular values that we adopt for the fixed cable cost in density zone 1 in the separate fiber cable equation, $.47, and the fixed structure cost in the separate structure equation of $.70 equals the buried fiber cable and structure fixed costs reflected in the intercept in the combined fiber cable and structure regression equation, $1.17. We find that these values are reasonable. We note that $.46 lies between AT&T and MCI's estimate of the fixed cost for a 24-gauge buried copper cable of $.12 and the HAI default value for the installed cost of a 6-pair 24-gauge buried copper cable of $.63. Moreover, we note that we could have used relatively higher or lower values for the fixed structure and cable costs in the separate structure and cable equations. However, we note that the sum of the fixed costs reflected in the buried structure cost estimates (excluding LEC engineering costs) developed from the separate buried structure equation and the fixed costs reflected in the buried cable cost estimates (excluding LEC engineering and splicing costs) developed from the separate buried copper or fiber cable equation is not affected by the relative values that we use for the fixed cost in these separate equations.

88. Finally, we note that GTE contends that the proposed equations for buried cable and buried structure are questionable because the buried structure costs would not vary with the presence of water. We have modified the regression equation for buried copper cable and structure by adding the variable that indicates the presence of a high water table. We obtain structure cost estimates used as input values by setting the coefficient for the water indicator variable equal to zero. These structure cost estimates, therefore, assume that a high water table is not present. The model adjusts these estimates to reflect the impact on these costs of a high water table. GTE also claims that the proposed equations are questionable because the costs for buried structure derived from the buried structure equation would not vary with cable size. We reject this contention. GTE has not provided any evidence that demonstrates that buried structure costs vary with cable size. To the contrary, GTE states that it cannot produce such evidence because it is not able to separate actual costs of buried structure from total costs of buried plant.

89. In sum, we find that the regression equations we proposed and tentatively adopted in the *Inputs Further Notice* are an appropriate starting point for estimating cable costs and structure costs for non-rural LECs for purposes of developing inputs for the model, particularly given the absence of more reliable cable and structure cost data from any other source. We find, however, that certain commenters' criticisms of the regression equations we proposed have merit. We make the following adjustments to improve the regression equations consistent with those criticisms.

90. First, we remove the independent variable that indicates whether two or more cables are placed at the same location from the regression equations for 24-gauge aerial copper cable, 24-gauge buried copper cable and structure, aerial fiber cable, and buried fiber cable and structure. As a result, the regression equations we adopt do not have this variable as an independent variable. We do not include this independent variable in any of the cable and structure equations because the model does not use a different cable cost if the outside plant portion of the network it builds requires more than one cable.

91. We also remove from the regression equation for 24-gauge underground copper cable the variable that is the mathematical square of the number of copper cable pairs. We remove this variable because its use results in negative values for the largest cable sizes, as some parties point out. We note that none of the other proposed cable and structure regression equations had this variable as an independent variable.

92. We add the variable that indicates the presence of a high water table to the regression equations for buried copper cable and structure and underground structure costs. With this change, all of the regression equations for structure costs adopted in this Order have this variable as an independent variable. We include this variable in the structure equations because the model applies a cost multiplier to all structure costs when the water table depth is less than the critical water depth. To develop structure cost inputs, we set the value of the water indicator variable equal to zero in the structure regression equations, thereby developing structure costs that assume that there is no water in the geographic area where the structure is installed. The multiplier in the model then adjusts these costs to reflect the impact on these costs of a high water table when it determines that the water table depth is less than the critical water depth.

93. We reduce the value of the intercept to $.46 from $.80 in the equation proposed in the *Inputs Further Notice* for calculating the labor and material costs for buried copper cable (excluding structure, LEC engineering, and splicing costs). We now estimate the buried 24-gauge copper cable and structure regression equation after

removing the multi-cable variable and adding the water indicator variable. The value of the intercept in this regression equation of $1.16 is less than the intercept in the proposed regression equation of $1.51. As we did in the *Inputs Further Notice,* we derive the buried copper cable equation from the regression equation for 24-gauge buried copper cable and structure costs. The value of the intercept in the buried copper cable and structure regression equation represents the fixed cost for both buried copper cable and buried copper cable structure in density zone 1. We assume, as we did in the *Inputs Further Notice,* that $.70 is the fixed cost for buried copper cable structure in density zone 1. Accordingly, the fixed labor and material cost for buried copper cable is $1.16 minus $.70, or $.46.

94. We also reduce the value of the intercept to $.47 from $.60 in the equation proposed in the *Inputs Further Notice* for calculating the labor and material costs for buried fiber cable (excluding structure, LEC engineering, and splicing costs). We now estimate the buried fiber cable and structure regression equation after removing the multi-cable variable. The value of the intercept in this regression equation, $1.17, is greater than the value of the intercept in the proposed regression equation, $1.14. As we did in the *Inputs Further Notice,* we derive the buried fiber cable equation from the regression equation for buried fiber cable and structure costs. The value of the intercept in the buried fiber cable and structure regression equation represents the fixed cost for both buried fiber cable and buried fiber cable structure in density zone 1. We assume that $.70 is the fixed cost for buried fiber cable structure in density zone 1. Accordingly, the fixed labor and material cost for buried fiber cable in density zone 1 is $1.17 minus $.70 or $.47

95. *Huber Adjustment.* In the *Inputs Further Notice,* we tentatively concluded that one substantive change should be made to Gabel and Kennedy's analysis. As we explained, we tentatively concluded that the regression equations in the NRRI Study should be modified using the Huber regression technique to mitigate the influence of outliers in the RUS data. Statistical outliers are values that are much higher or lower than other data in the data set. The Huber algorithm uses a standard statistical criterion to determine the most extreme outliers and exclude those outliers. Thereafter, the Huber algorithm iteratively performs a regression, then for each observation calculates an observation weight based on the absolute value of the observation residual. Finally, the algorithm performs a weighted least squares regression using the calculated weights. This process is repeated until the values of the weights effectively stop changing.

96. We affirm our tentative conclusion to modify the regression equations in the NRRI Study using the Huber methodology to develop input values for cable and structure costs. The cable and structure cost inputs used in the model should reflect values that are typical for cable and structure for a number of different density and terrain conditions. If they do not reflect values that are typical, the model may substantially overestimate or underestimate the cost of building a local telephone network. As discussed, application of the Huber methodology minimizes this risk, thereby producing estimates that are consistent with the goal of developing cable and structure cost inputs that reflect values that are typical for cable and structure for different density and terrain conditions.

97. The commenters attest to the fact that there are significant variances in the RUS structure and cable cost data. We find that the presence of these outliers warrants the use of the Huber methodology. By relying on the Huber methodology to identify and to exclude or give less than full weight to these data outliers in the regressions, we decrease the likelihood that the cost estimates produced reflect measurement error or data anomalies that may represent unusual circumstances that do not reflect the typical case. We note that we are not readily able to ascertain the specific circumstances that may explain why some data points are outliers relative to more clustered data points because of the multivariate nature of the database. Such occurrences are expected when dealing with such a database. Not only are there many observations, but these observations reflect the circumstances surrounding the construction work of many different contractors done for a large number of companies on different projects over a number of years. We also note that the task of identifying structure cost outliers without using a statistical approach such as Huber is especially difficult because these costs are a function of different geological conditions and population densities. Given that it is not feasible, as a practical matter, to determine why particular data points are outliers and our objective is to develop typical cable and structure costs, we conclude that use of the Huber methodology is appropriate.

98. We find the comments opposing application of the Huber methodology unpersuasive. In the first instance, we reject the assertions of the commenters, either express or implied, that the application of robust regression analysis is not the preferred method of dealing with outliers in a regression. There is no preferred method. The use of robust regression techniques is a matter of judgement for the estimator. As we explained, the goal of our analysis is to estimate values that are typical for cable and structure costs for different density and terrain conditions. We determined that we should mitigate the effects of outliers occurring in the data to ensure that the estimates we produce reflect typical costs. Noting that such outliers have an undue influence on ordinary least squares regression estimates because the residual associated with each outlier is squared in calculating the regression, we determined, in our expert opinion, to employ the Huber methodology to diminish the destabilizing effects of these outliers. Thus, while it can be argued that we could have produced a different estimate, the commenters have not established that application of the Huber methodology produces an unreasonable estimate.

99. Bell Atlantic and GTE assert that the probability distribution of the error term must be symmetric about its mean and have fatter tails than in the normal distribution in order to use the Huber methodology. We disagree. The Huber methodology in effect fits a line or a plane to a set of data. The algebraic expression of this line or plane explains or predicts the effects on a dependent variable, *e.g.,* 24-gauge aerial copper cable cost, of changes in independent variables, *e.g.,* aerial copper cable size. It does this by assigning zero or less than full weight to observations that have extremely high or extremely low values. The assignment of weights to observations depends on the values of the observations. It does not depend on the probability of observing these values. The error term to which Bell Atlantic and GTE refer is the difference between the predicted or estimated values of the dependent variable and the observed values of the dependent variable. Given that the error term is the difference between the predicted and observed values of the dependent variable, and that the assignment of weights by the Huber methodology does not depend on the probability of observing particular values of this variable, this assignment of weights does not depend on the probability of observing particular values of the error

term. It, therefore, does not depend on whether the probability distribution of the error term is symmetric about its mean and has fatter tails than in the normal distribution.

100. Bell Atlantic also argues that the Huber methodology should not be used unless there is evidence that outliers in the RUS data are erroneous. We disagree. We believe that use of the Huber methodology with RUS data ensures that cost estimates reflect typical costs regardless of whether there is evidence that outliers in the RUS data are erroneous. The RUS data, as Bell Atlantic and other parties point out, have a number of high values and low values. These outliers may reflect unusual circumstances that are unlikely to occur in the future. The Huber methodology dampens the effects of anomalistically high or low values that may reflect unusual circumstances. Notwithstanding the dispersion in the RUS data, we believe that there are relatively few errors in these data. As we explained, the RUS data are derived from contracts. Gabel and Kennedy determined that the values reflected in the RUS data are within one percent of the values set forth on the contracts. There are likely to be few errors in the contracts themselves because these are binding agreements that involve substantial sums of money between RUS companies and contractors. These parties have an obvious interest in ensuring that these values are correctly reflected in these contracts. While we believe that errors in these contracts are likely to be infrequent, outlier observations in the RUS data may reflect large errors. The Huber methodology dampens the effects of outlier observations that may reflect large errors.

101. We find that the estimates produced by applying the Huber methodology are reasonable. The estimates resulting from application of the Huber methodology reflect most of the information represented in nearly all of the cable and structure cost observations in the RUS data. Approximately 80 percent of the cable and structure observations are assigned a weight of at least 80 percent in each structure and regression equation that we adopt. This large majority comprises closely clustered observations that clearly represent typical costs. Conversely, approximately 20 percent of the cable and structure observations are assigned a weight of less than .8 in each of these regression equations. This small minority comprises observations that have extremely high and extremely low values that do not represent typical costs. We also note that because the Huber methodology treats symmetrically observations that have high or low values, it excludes or assigns less than full weight to data outliers without regard to whether these are high or low cost observations.

102. *Buying Power Adjustment.* In the *Inputs Further Notice*, we tentatively concluded that we should make three adjustments to the regression equations in the NRRI Study, as modified by the Huber methodology described, to estimate the cost of 24-gauge aerial copper cable, 24-gauge underground copper cable, and 24-gauge buried copper cable. We further tentatively concluded that these adjustments should be made in the estimation of the cost of aerial fiber cable, buried fiber cable, and underground fiber cable. The first of these adjustments was to adjust the equation to reflect the superior buying power that non-rural LECs may have in comparison to the LECs represented in the RUS data. We noted that Gabel and Kennedy determined that Bell Atlantic's material costs for aerial copper cable are approximately 15.2 percent less than these costs for the RUS companies based on data entered into the record in a proceeding before the Maine Public Utilities Commission (the ‘‘Maine Commission). Similarly, Gabel and Kennedy determined that Bell Atlantic's material costs for aerial fiber cable are approximately 33.8 percent less than these costs for the RUS companies. We also noted that Gabel and Kennedy determined that Bell Atlantic's material costs for underground copper cable are approximately 16.3 percent less than these costs for the RUS companies and 27.8 percent less for underground fiber cable. We tentatively concluded that these figures represent reasonable estimates of the difference in the material costs that non-rural LECs pay in comparison to those that the RUS companies pay for cable. Accordingly, to reflect this degree of buying power in the copper cable cost estimates that we derived for non-rural LECs, we proposed to reduce the regression coefficient for the number of copper pairs by 15.2 percent for aerial copper cable, and 16.3 percent for 24-gauge underground copper cable.

103. We also proposed to reduce the regression coefficient for the number of fiber strands by 33.8 percent for aerial fiber cable and 27.8 percent for underground fiber cable. As we explained, this coefficient measures the incremental or additional cost associated with one additional copper pair or fiber strand, as applicable, and therefore, largely reflects the material cost of the cable. Because the NRRI Study did not include a recommendation for such an adjustment for buried copper cable or buried fiber, we tentatively concluded we should reduce the coefficient by 15.2 percent for buried copper cable and 27.8 percent for buried fiber cable. We explained that the level of these adjustments reflect the lower of the reductions used for aerial and underground copper cable and aerial and underground fiber cable, respectively.

104. We adopt the tentative conclusion in the *Inputs Further Notice* and select buying power adjustments of 15.2 percent, 16.3 percent and 15.2 percent for 24-gauge aerial copper cable, 24-gauge underground copper cable, and 24-gauge buried copper cable, respectively. Correspondingly, we adopt buying power adjustments of 33.8 percent, 27.8 percent, and 27.8 percent for aerial fiber cable, underground fiber cable, and buried fiber cable, respectively. We find that, based on the record before us, the buying power adjustment is appropriate and the levels of the adjustments we proposed for the categories of copper and fiber cable we identified are reasonable.

105. As we explained in the *Inputs Further Notice*, the buying power adjustment is intended to reflect the difference in the materials prices that non-rural LECs pay in comparison to those that the RUS companies pay. Because non-rural LECs pay less for cable, a downward adjustment to the estimates developed from data reflecting the costs of rural-LECs is necessary to derive estimates representative of cable costs for non-rural LECs. The commenters generally concede that such differences exist. There is, however, disagreement among the commenters that an adjustment is necessary in this instance to reflect this difference.

106. Those commenters advocating the use of company-specific data oppose the buying power adjustment as unnecessary. GTE and Sprint contend that the use of a more representative data set, i.e., company-specific data, would account for any differences in buying power. As we explained, however, the RUS data are the most reliable data on the record before us for estimating cable and structure costs. Because there is a difference in the material costs that non-rural LECs pay in comparison to those that the RUS companies pay, a downward adjustment to the RUS cable estimates is necessary to obtain representative cable cost estimates for non-rural LECs.

107. We note that AT&T and MCI support the proposed adjustment for aerial and underground copper and fiber cable. AT&T and MCI oppose, however,

the use of the lower of the reductions adopted for aerial and underground cable categories, for the buried cable category. Although AT&T and MCI agree that an adjustment is appropriate for buried cable, they contend that the buying power adjustment should be set at the higher figures of 16.3 percent for buried copper cable and 33.8 percent for buried fiber cable, or at the very least, at the average of the higher and lower values for aerial and underground cable. We disagree. We find that AT&T and MCI offer no support to demonstrate why the higher values should be used. As explained, the levels of the adjustments we proposed and adopt are the most conservative based on the available record evidence.

108. Apart from opposing the buying power adjustment on the ground that as a general matter the adjustment is unnecessary, those opposing the adjustment take issue with the adjustment on methodological grounds. GTE contends that the adjustment cannot properly convert RUS data into costs for non-rural carriers because the RUS data do not reflect the cost structure of rural carriers. As we explained, the assertion that the RUS data does not reflect the cost structure of rural carriers is without merit. GTE also contends that the application of the adjustment factors to the coefficients in the regression equations is contrary to the fundamentals of sound economic analysis. The solution GTE recommends is that additional observations for non-rural companies be added to the data set. This solution echoes GTE's assertion that company-specific data should be used. Reliable observations for non-rural LECs are not available, however, as explained.

109. GTE also identifies what it considers flaws in the development of the buying power adjustment. GTE argues that because the adjustment to the RUS data was developed using only one larger company's data (Bell Atlantic's) reflecting costs for a single year, the adjustment is not proper. We disagree for several reasons. First, we note that although we specifically requested comment on this adjustment and its derivation in the *Inputs Further Notice,* GTE and other parties challenging the use of Bell Atlantic's data have not provided any alternative data for measuring the level of market power, despite their general agreement that such market power exists. These parties failed to submit comparable verifiable data to show that the buying power adjustment we proposed was inaccurate. Under these circumstances, we cannot give credence to the unsupported claims that the Bell Atlantic data is not representative.

110. Equally important, we have reason to conclude that the adjustment we adopt is a conservative one. The buying power adjustment we proposed and adopt is based upon a submission by Bell Atlantic to the Maine Commission in a proceeding to establish permanent unbundled network element (UNE) rates. In that context, it was in Bell Atlantic's interests to submit the highest possible cost data in order to ensure that the UNE rates would give it ample compensation. But in the context of the adjustment we consider here for buying power, a relatively higher cost translates into a *reduced* adjustment because the greater the LEC costs, the less the differential between LEC and rural carrier costs. Therefore, given the source of this data, we conclude that it is likely to produce a conservative buying power adjustment, not an excessive one. Nevertheless, in the proceeding on the future of the model, we intend to seek further comment on the development of an appropriate buying power adjustment to reflect the forward-looking costs of the competitive efficient firm. In sum, we find that GTE's criticisms are not persuasive, and that the adjustment is a reasonable one, supported by the record.

111. GTE also asserts a litany of other concerns that, according to GTE, render the buying power adjustment invalid. We find these concerns unpersuasive. GTE claims that the adjustment is suspect because some RUS observations used in the determination of material costs are not used in the regression. We disagree. As discussed, we apply the Huber methodology to RUS cable costs that reflect both labor and material costs. The observations in the RUS database to which the Huber methodology assigns zero or less than full weight are those with the highest and the lowest values. As described, a statistical analysis demonstrates that this assignment of weights to these observations has little impact on the level of material costs reflected in the cable cost estimates derived by using this methodology. Therefore, material cost averages based on all of the RUS data are not likely to vary significantly from material cost averages based on a subset of these data.

112. Specifically, with one exception, the value of the regression coefficient for the variable representing the size of the cable in the cable cost regression equations derived by using the Huber methodology lies inside the 95 percent confidence interval surrounding the value of this coefficient in these regression equations in the NRRI Study obtained by using ordinary least squares. The coefficient for the variable that represents cable size represents the additional cost for an additional pair of cable and therefore represents cable material costs. The values of the coefficient for the cable size variable obtained by using Huber and ordinary least squares are based on a sample of RUS companies' cable costs drawn from a larger population of such costs. The values of the coefficient obtained from this sample by using the Huber methodology and ordinary least squares are estimates of the true values of this coefficient theoretically obtained from the population of cable costs by using these techniques. Generally speaking, a 95 percent confidence interval associated with a coefficient estimate contains, with a probability of 95 percent, the true value of the coefficient. The fact that the value of the cable size coefficient obtained by using the Huber methodology lies within an interval that contains with 95 percent certainty the true value of the ordinary least squares cable size coefficient supports the conclusion that the Huber methodology does not by its weighting methodology have a statistically significant impact on the level of the material costs reflected in the cable cost estimates derived by using this methodology.

113. GTE also claims that some RUS observations appear to be from rescinded contracts or contracts excluded from the NRRI Study per-foot cable cost calculation. However, GTE offers no evidence that this is the case. Finally, GTE claims that some RUS observations are for technologies that may not be appropriate for a forward-looking cost model. On the contrary, loading coils were excluded from the RUS data base. Thus, we find that the RUS data do not reflect any non-forward-looking technologies.

114. GTE and Sprint each attempt to impugn the validity of the buying power adjustment, claiming that there may be an incongruity between the data submitted to the Maine Commission by Bell Atlantic and the RUS data. We find this claim unpersuasive. Both GTE and Sprint assert that it is unknown whether the underlying data include such items as sales tax or shipping costs and, if so, whether the level of these items is comparable between Maine and the states included in the RUS data. Significantly, neither claim that such an incongruity exists in fact, nor do they provide viable alternatives for the calculation of the adjustment. We note that the RUS data reflect the same categories of costs as those reflected in the Bell Atlantic data. More importantly, this data reflects the best

available evidence on the record on which to base the buying power adjustment.

115. BellSouth claims that the buying power adjustment is flawed because it does not take into account the exclusion of RUS data resulting from the Huber adjustment. Bell Atlantic makes a similar claim. Both parties argue that because the Huber methodology excludes high cost data from the regression analysis, it is inappropriate to apply a discount which essentially has the same effect. In sum, these commenters claim that we are adjusting for high material costs twice. We disagree. This contention ignores the fact that the application of the Huber methodology and the buying power adjustment are fundamentally different adjustments. The Huber adjustment gives reduced weight to observations that are out of line with other data provided by the RUS companies. The Huber adjustment provides coefficient estimates that can be used to estimate the cost incurred by a typical RUS company. The adjustment is designed to dampen the effect of outlying observations that otherwise would exhibit a strong influence on the analysis. The large buying power adjustment, on the other hand, adjusts for the greater buying power of the non-rural companies. None of the RUS companies have the buying power of, for example, Bell Atlantic or GTE, and therefore have to pay more for material. The buying power adjustment could only duplicate the Huber adjustment if some of the RUS companies have the buying power of a company as large as Bell Atlantic. Because none of the firms in the RUS data base are close to the size of Bell Atlantic, the commenters are incorrect when they assert that, since the Huber methodology excludes high cost data from the regression analysis, it is inappropriate to apply the buying power adjustment.

116. We also reject BellSouth's argument that, to determine the size of the buying power adjustment, we should use a weighted average of the cable price differentials between Bell Atlantic and the RUS companies that is based on the miles of cable installed, not the number of observations, for each cable size. In the NRRI Study, this weighted average price differential is determined by: (1) calculating the price differential between Bell Atlantic's average cable price and the RUS companies' average cable price for each cable size; (2) weighting the price differential for each cable size by the number of observations used to calculate the RUS companies' average cable price; and (3) summing these weighted price differentials. The average measures the central tendency of the data. In general, the average more reliably measures this central tendency the larger the number of observations from which this average is calculated. In the NRRI Study, the average cable prices calculated for the RUS companies that reflect a relatively large number of observations are more reliable than those that reflect relatively few observations. Accordingly, weighting the price differentials for each cable size by the number of observations reflected in the average cable price calculated for the RUS companies provides a weighted average that reliably measures the central tendency of the price. In contrast, use of the miles of cable installed as weights to determine the average cable price differentials could result in a less reliable measure of central tendency because price differentials based on a small number of observations but reflecting a high percentage of cable miles purchased would have a greater impact on the weighted average than price differentials based on a large number of observations of cable purchase prices. Moreover, use of the number of miles of cable installed as the weights would result in a weighted average price differential that reflects RUS companies' relative use of different size cables. The RUS companies' relative use of different size cables is irrelevant for use in a model used to calculate non-rural LECs' cost of constructing a network.

117. We also reject Bell Atlantic's contention that the buying power adjustment is flawed because it should have been applied to the material costs rather than the regression coefficient of copper cable pairs or the number of fiber strands. Bell Atlantic has provided no evidence that demonstrates that applying the discount to the coefficient is incorrect. It is an elementary proposition of statistics that the result of applying the discount to the regression coefficient is equal to applying the discount to the material costs. Significantly, Bell Atlantic has not demonstrated that applying the discount to the regression coefficient does not produce the same result as applying the discount to the material costs.

118. Finally, we disagree with Sprint that, because buying power equates to company size, it is inappropriate to apply this adjustment uniformly to all carriers. We are estimating the costs that an efficient provider would incur to provide the supported services. We are not attempting to identify any particular company's cost of providing the supported services. We find, therefore, that applying the buying power adjustment as we propose is appropriate for the purpose of calculating universal service support.

119. In sum, we find unpersuasive the criticisms of the buying power adjustment we proposed. We conclude that, based on the record before us, a downward adjustment to the estimates developed from data reflecting the cable costs of rural LECs is necessary to derive estimates representative of cable costs for non-rural LECs and that the levels we have proposed for this adjustment are reasonable.

120. *LEC Engineering.* The second adjustment we proposed to the regression equations used to estimate cable costs was to account for LEC engineering costs, which were not included in the RUS data. As we noted, the BCM2 default values include a loading of five percent for engineering. In contrast, the HAI sponsors claimed that engineering constitutes approximately 15 percent of the cost of installing outside plant cables. This percentage includes both contractor engineering and LEC engineering. The cost of contractor engineering already is reflected in the RUS cable cost data. In the *Inputs Further Notice,* we tentatively concluded that we should add a loading of 10 percent to the material and labor costs of cable (net of LEC engineering and splicing costs) to approximate the cost of LEC engineering.

121. We affirm our tentative conclusion to add a loading of 10 percent to the material and labor for the cost of cable (net of LEC engineering and splicing costs) to approximate the cost of LEC engineering. We find that, based on the record before us, the proposed LEC engineering adjustment, as modified, is appropriate. We also find that the level of the adjustment we proposed is reasonable. We note that there is a general consensus among the commenters that the proposed adjustment is necessary. We reject, however, the contentions of those commenters that advocate that the level of the LEC adjustment be based on company-specific data. As we explained, we find such data to be unreliable. For similar reasons, we reject the LEC engineering adjustment proposed by AT&T and MCI. As we explained, AT&T and MCI's proposal is based on expert opinions which we find to be unsupported and, therefore, unreliable. Accordingly, the level of the adjustment that we proposed, which, as we explained in the *Inputs Further Notice* represents the mid-point between the HAI default loading and the BCPM default loading, is the most reasonable value on the record before us.

122. Sprint contends that we should calculate the loadings for LEC engineering on a flat dollar basis rather than on a fixed percentage of the labor and material costs of cable. We find persuasive Sprint's contention that LEC engineering costs do not vary with the size of the cable and therefore do not vary with the cost of the cable. Accordingly, we find it reasonable to apply the loading for LEC engineering in the manner that Sprint recommends.

123. We also find that the commenters are correct that the loading for LEC engineering should not reflect any adjustment for buying power because the buying power differential between non-rural and rural LECs only relates to materials. We adjust our calculation accordingly. Similarly, we also find it appropriate to include in the loading for LEC engineering an allowance for LEC engineering associated with splicing. We find that this is appropriate because the loading for LEC engineering is based on BCPM and HAI default values for this loading that are expressed as a percentage of cable costs inclusive of engineering.

124. *Splicing Adjustment.* The third adjustment to the regression equations that we proposed in the *Inputs Further Notice* was to account for splicing costs, which also were not included in the RUS data. As we explained, Gabel and Kennedy determined that the ratio of splicing costs to copper cable costs (excluding splicing and LEC engineering costs) is 9.4 percent for RUS companies in the NRRI Study. Similarly, Gabel and Kennedy determined that the ratio of splicing costs to fiber cable costs (excluding splicing and LEC engineering costs) is 4.7 percent. Thus, we tentatively concluded that we should adopt a loading of 9.4 percent for splicing costs for 24-gauge aerial copper cable, 24-gauge underground copper cable, and 24-gauge buried copper cable. Correspondingly, we tentatively concluded that we should adopt a loading of 4.7 percent for splicing costs for aerial fiber cable, underground fiber cable, and buried fiber cable.

125. We affirm these tentative conclusions. We find that, based on the record before us, the splicing cost adjustment is appropriate and the levels of the adjustments proposed are reasonable. In reaching this conclusion, we reject the claims of those commenters that advocate the use of company-specific data to develop the splicing loadings. For the reasons enumerated, we find such data unreliable.

126. We disagree with GTE's claim that, because the splicing factor is based on the RUS data, it is flawed. This contention echoes GTE's assertion that we should use company-specific data. As we explained, however, we conclude that such data are not reliable. We also disagree with GTE's contention that an analysis of the source contract data shows that some splicing costs are invalid. GTE is mistaken. The RUS cost data from which the regression equations in the NRRI Study and in this Order are derived exclude splicing costs. Cable cost estimates obtained by using this methodology and these data are net of LEC engineering and splicing costs. We add to these cable cost estimates a loading factor for splicing that Gabel and Kennedy developed separately using the RUS data in the NRRI Study without using the regression analysis. In the NRRI Study, Gabel and Kennedy determined the ratio of splicing to cable costs by comparing the cost for splicing and the cost for cable (exclusive of splicing and LEC engineering costs) reflected in the contracts included in the RUS data base. Some of the splicing costs reflected in this database are relatively high and some are relatively low. None of these high or low values is likely to influence significantly this ratio because it reflects a large number of observations. Accordingly, we find it reasonable to apply the splicing ratios developed in the NRRI Study to the cable cost estimates developed separately in this Order by using the Huber methodology with the RUS data.

127. We also disagree with AT&T and MCI's contention that, rather than adopting the proposed splicing loadings or the incumbent LEC's loading factors, we should adopt ''reasonable values for the costs of cable placing, splicing, and engineering based on the expert opinions submitted in this proceeding.'' As discussed, we find that these expert opinions are unsupported, and therefore unreliable.

128. For the same reason, we also find unpersuasive AT&T and MCI's claim that the loading of 9.4 percent for splicing copper cable is excessive. AT&T and MCI estimates that splicing costs vary between 3.4 and 6.9 percent of cable investment in contrast to the proposed rate of 9.4 percent. We find that these estimates, which rely on assumptions concerning the per-hour cost of labor, the number of hours required to set up and close the splice, the number of splices per hour, and the distance between splices, are unreliable. AT&T and MCI have provided no evidence other than the unsupported opinions of their experts to substantiate these data. In contrast, Bell Atlantic supports the use of the 9.4 percent loading indicating, that this level is consistent with its own data.

129. While Sprint agrees that a splicing loading is required in the NRRI regression, Sprint recommends that a flat dollar ''per pair per foot'' cost additive should be employed rather than the adjustment we proposed. We disagree. We find that Sprint's flat dollar ''per pair per foot'' cost additive ignores the differences in set-up costs among different cable sizes. In contrast, the percent loading for splicing costs we adopt herein implicitly recognizes such differences because these loadings are applied to cable costs estimates (exclusive of splicing and LEC engineering costs) derived from regression equations that have an intercept term that provides a measure of the fixed cost of cable. Accordingly, we conclude that the percent loading approach is more reasonable.

130. Sprint also asserts that underground splicing costs are higher due to the need to work in manholes. We agree. The dollar amounts associated with the fixed percentage loadings adopted in this Order for underground copper and fiber cable are generally larger than for aerial and buried copper cable and fiber cable. The dollar amounts that we adopt for splicing are generally larger for underground cable because the costs that we develop from RUS data for underground cable net of splicing and engineering costs are generally larger than the costs that we develop for aerial and buried cable net of splicing and engineering costs. As a result, when the fixed percentage is applied to these cable costs, the dollar amount for splicing is generally larger for underground cable than for aerial and buried cable.

131. We disagree with those commenters who argue that the splicing costs do not vary with the cost of cable (net of splicing costs). We find that cable costs increase as the size of the cable increases. Splicing costs increase as the size of the cable increases because larger cables require more splicing than small cables. Therefore, splicing costs increase as the cost of the cable increases.

132. Finally, we disagree with SBC's claim that the 14 percent splicing factor for fiber cable is more appropriate than the 4.7 percent we proposed. We find that the 14 percent factor SBC proposes is unsupported. SBC asserts that this factor is based on an average cost ratio from an analysis using various lengths of underground fiber placement, including placing labor and comparing it to associated splicing costs from

current cost dockets. However, SBC has not provided this analysis on the record.

133. *26-Gauge Copper Cable.* In the *Inputs Further Notice*, we explained that, because the NRRI Study did not provide estimates for 26-gauge copper cable, we must either use another data source or find a method to derive these estimates from those for 24-gauge copper cable. To that end, we tentatively concluded that we should derive cost estimates for 26-gauge cable by adjusting our estimates for 24-gauge cable. We proposed to estimate these ratios using data on 26-gauge and 24-gauge cable costs submitted by Aliant and Sprint and the BCPM default values for these costs. We noted, that while we would prefer to develop these ratios based on data from more than these three sources, we tentatively concluded that these were the best data available on the record for this purpose.

134. We affirm our tentative conclusion to derive cost estimates for 26-gauge cable by adjusting our estimates for 24-gauge cable. As we explained in the *Inputs Further Notice*, we agree with the BCPM sponsors that the cost of copper cable should not be estimated based solely on the relative weight of the cable. Instead, we proposed to use the ordinary least squares regression technique to estimate the ratio of the cost of 26-gauge to 24-gauge cable for each plant type (*i.e.,* aerial, underground, buried). We conclude that, based on the record before us, this approach is reasonable.

135. Consistent with their position on estimating the costs of 24-gauge cable, many commenters advocate that we use company-specific data to estimate the costs of 26-gauge cable. As we explained, we have determined that such data are not sufficiently reliable to employ in the model. Accordingly, we reject the use of company-specific data to estimate the costs of 26-gauge cable. We note that AT&T and MCI endorse the derivation of cost estimates for 26-gauge cable from estimates for 24-gauge cable. Notwithstanding their support of the general approach we proposed, AT&T and MCI oppose estimating the ratio of costs of 26-gauge cable to 24-gauge cable using the cable costs submitted by Aliant and Sprint and the BCPM default values. Instead, AT&T and MCI advocate the use of the relative weight of copper to adjust the cost of the 24-gauge copper. AT&T and MCI claim that this approach is the most logical because 26-gauge copper costs are directly proportional to the weight of the metallic copper in the cable. We reject AT&T and MCI's recommended approach. We find that, because AT&T and MCI have provided no evidence that the weight differential is approximately equal to the price differential, there is insufficient evidence on the record demonstrating the reasonableness of this approach.

136. Many of those commenters advocating the use of company-specific data contend that there are flaws in the methodology adopted herein to derive cost estimates for 26-gauge cable by adjusting our estimates for 24-gauge cable. Bell Atlantic and GTE contend that our methodology results in biased estimates due to statistical error. We agree and modify our proposed methodology as explained.

137. As we explained in the *Inputs Further Notice*, in order to derive the 26-gauge copper cable costs, we first estimated the cost for 24-gauge copper cable for each cable size from the RUS data using the Huber methodology. More specifically, we obtained an estimate of the expected or mean value of the cost for 24-gauge copper cable (for given values of the independent variables in the regression equation). We then obtained values for the ratio of 24-gauge copper cable to 26-gauge copper cable for each cable size using *ex parte* data obtained from Aliant and Sprint and BCPM default values for the costs and employing ordinary least squares regression analysis. As a result, we obtained an estimate of the expected value of the ratio of 24-gauge copper cable to 26-gauge copper cable (for given values of the independent variables in the regression equation). Finally, we multiplied the reciprocal of this ratio by the cost of 24-gauge copper cable obtained by using the Huber methodology with RUS data to obtain the proposed 26-gauge copper cable cost for each copper cable size. Bell Atlantic and GTE contend, and we agree, that this is a biased estimate of the expected value of the cost for 26-gauge copper cable because the expected value of the ratio of two random variables, *e.g.,* 26-gauge copper cable cost and 24-gauge copper cable, does not equal the ratio of the expected value of the first random variable to the expected value of the second random variable. We note that the magnitude of the bias is larger as the difference grows between the expected value of the ratio of 26-gauge copper cable cost to 24-gauge copper cable cost and the ratio of the expected value of 26-gauge copper cable cost to the expected value of 24-gauge copper cable cost.

138. Accordingly, we modify the methodology tentatively adopted in the *Inputs Further Notice* to derive estimates of 26-gauge copper cable costs from 24-gauge copper cable costs that are not biased. In addition to estimating the expected value of the cost for 24-gauge copper cable for each cable size using the RUS data, we also estimate the expected value of the costs of 24-gauge and 26-gauge copper cable for each cable size using the data submitted by Aliant and Sprint and the BCPM default values, as well as data submitted by BellSouth, hereinafter identified in the aggregate as ''the non-rural LEC data.'' We divide the estimate of the expected value for 24-gauge copper cable cost derived from the non-rural LEC data into the estimate of the expected value for 26-gauge copper cable cost derived from these data for each cable size. The result is a ratio of an estimate of the expected value for 26-gauge copper cable cost to an estimate of the expected value for 24-gauge cable cost for each cable size. Finally, we multiply this ratio by the estimate of the expected value of the cost for 24-gauge copper cable derived from the RUS data to obtain an estimate of the expected value of the cost for 26-gauge copper cable for each cable size. We find that this adjustment eliminates the bias identified by the commenters. We conclude, therefore, that these estimates are reasonable and adopt them as inputs for 26-gauge copper cable costs.

139. We note that, in adopting these modifications, we find that it is reasonable to rely on the non-rural LEC data for calculating the ratio of the cost for 24-gauge copper cable to that for 26-gauge copper cable, but not for calculating the absolute cost for 24-gauge copper cable and 26-gauge copper cable. As discussed, we find that the non-rural LEC data are not a reliable measure of absolute costs. Notwithstanding this finding, we conclude that it is reasonable to use the non-rural LEC data to determine the relative value of the cost for 24-gauge copper cable to that for 26-gauge copper cable. We find that it is reasonable to conclude that each LEC used the same methodology to develop both 24-gauge and 26-gauge copper cable costs. Accordingly, any bias in the costs for 24-gauge and 26-gauge copper cable that results from using a given methodology is likely to be in the same direction and of a similar magnitude. As a consequence, the estimate of the expected value of the cost for 26-gauge copper cable for each cable size and the estimate of the expected value of the cost for 24-gauge copper cable obtained from non-rural LEC data are likely to be biased by approximately the same factor. The ratios of the estimates of these expected values are not likely to be affected significantly because the bias in one estimate approximately cancels

the bias in the other estimate when the ratio is calculated.

140. GTE also contends that the proposed methodology systematically reduces the amount of labor associated with placing cable. We conclude that the adjustments made in response to GTE and Bell Atlantic's criticisms discussed render this criticism irrelevant. We find that no systematic bias will result because the ratio of the 24-gauge cost of copper cable to the cost of 26-gauge copper cable represents the installed cost of 26-gauge copper cable including all labor and materials divided by the installed cost of 24-gauge copper cable including all labor and materials. Moreover, this ratio is applied to the installed cost of 24-gauge copper cable which includes all labor and material costs.

141. BellSouth claims that neither the data used to develop the ordinary least squares regression equation we employ in the *Inputs Further Notice* to estimate the cost of 26-gauge copper cable or the computations used to derive that equation have been provided. BellSouth contends that, as a result, it is not possible to confirm or contradict the discount value. We disagree. Contrary to BellSouth's assertion, the data are available. As we explained, the regression equation uses *ex parte* data submitted by Aliant and Sprint. These data are available subject to the Commission's rules regarding the treatment of confidential material. We also note that the BellSouth data we employ in the adjusted methodology we adopt herein are publicly available. Moreover, the BCPM data are publicly available.

4. Cable Fill Factors

142. We affirm our tentative conclusion that fill factors for copper cable should be lower in the lowest density zones. Significantly, those commenters addressing this issue agree that lower density zones should utilize lower copper cable fill factor inputs. We also reject, at the outset, certain assertions made by GTE and others, challenging the overall approach we proposed and adopt herein for determining the appropriate cable fill factors to use in the federal mechanism and reject GTE's assertions that the model is flawed.

143. We disagree with GTE's assertion that the use of generalized fill factors are not proper inputs for a cost model that seeks to estimate the forward-looking costs of building a network. GTE claims that the use of generalized fill factors disregards how actual distribution plant is designed and that different levels of utilization are observed in different parts of the local network. However, we find that GTE's concerns are misplaced. Contrary to GTE's implication, generalized fill factors are an administrative input and are not the sole determinate of the effective fill factor. As we explained in the *Inputs Further Notice*, the effective fill factor will vary with the number of customer locations and the available discrete size of cable. Thus, the effective fill factor will reflect how distribution plant is designed and different levels of utilization that are observed in different parts of the local network.

144. Similarly, we disagree with GTE's assertion that company-specific information should be used to determine appropriate fill factor inputs. We note that the final effective fill factors are the result of the input of the administrative fill factors and company-specific customer location data. We also disagree with the contention that administrative fill factors must be company-specific. The administrative fill factors are determined per engineering standards and density zone conditions. These factors are independent of an individual company's experience and measured effective fill factors. The administrative fill factors would be the same for every efficient competitive firm.

145. We reject GTE's contention that the model should be modified to accept the number of pairs per location to determine the required amount of distribution plant rather than using fill factors. GTE claims that this is necessary because using fill factor inputs produces anomalous results. GTE contends that the use of fill factors causes the number of implicit lines per location to decrease as density increases, in contrast to what occurs in reality. There are, according to GTE, always more business customers in higher density zones; therefore, the number of lines that must be provisioned per location should increase as density increases.

146. We find that there is no need to modify the model to accept pairs per location rather than fill factors, as GTE contends. The number of implicit lines per location does not decrease in the model as GTE claims. On the contrary, the number of implicit lines per location increases as a function of the number of business lines. The model will build to the level of business demand. With business demand increasing as a function of density, the model generates a higher number of lines per location as density increases. In sum, the anomaly that GTE identifies does not exist. GTE's claim reflects a misunderstanding of the model's operation.

147. Finally, we disagree with GTE's assertion that there is an error in the way the model calculates density zones that prevents correct application of zone-specific inputs. As GTE explains, after the model has assigned customer locations to clusters, it constructs a ''convex hull'' around all locations in the cluster. The model then calculates density as the lines in the cluster divided by the area within the convex hull. GTE claims that the calculated densities will be higher than those observed in the real world because the denominator excludes all land not contained in the convex hull. While we agree with GTE's description of how the model determines cluster density, we find GTE's claim that this methodology is erroneous to be misplaced. In sum, GTE argues that the model employs a restricted definition of area which causes the model to use excessively high utilization factors. In other words, the issue is whether the model should recognize all of the area around a cluster. We conclude that it should not. If the land outside the convex hull were included in the denominator, as GTE implies it should, the denominator would recognize unoccupied areas where no customers reside. As a result, the model would select density zone fill factors that are lower than needed to service the customers in that cluster. There would be a downward bias in the model fill factors. Thus, there is not an error in the way the model calculates density zones, as GTE contends. The model generates density values that correspond to the way the population is dispersed. To do otherwise would introduce a bias and distort the forward-looking cost estimates generated by the model.

148. *Distribution Fill Factors.* We also affirm our tentative conclusion that the fill factors selected for use in the federal mechanism generally should reflect current demand and not reflect the industry practice of building distribution plant to meet ultimate demand. As we explained in the *Inputs Further Notice*, the fact that industry may build distribution plant sufficient to meet demand for ten or twenty years does not necessarily suggest that these costs should be supported today by the federal universal service support mechanism.

149. We find unpersuasive GTE's assertion that the input values for distribution fill factors should reflect ultimate demand. In concluding that the fill factors should reflect current demand, we recognized that correctly forecasting ultimate demand is a speculative exercise, especially because of rapid technological advances in

telecommunications. For example, we note that ultimate demand decreases substantially when computer modem users switch from dedicated lines serving analog modems to digital subscriber lines where one pair of copper wire provides the same function as a voice line and a separate dedicated line. Given this uncertainty, we find that basing the fill factors on current demand rather than ultimate demand is more reasonable because it is less likely to result in excess capacity, which would increase the model's cost estimates to levels higher than an efficient firm's costs and could potentially result in excessive universal service support payments.

150. Significantly, we note that, contrary to GTE's inference, current demand as we define it includes an amount of excess capacity to accommodate short-term growth. We find that GTE has not provided any evidence that demonstrates that the level of excess capacity to accommodate short-term growth is unreasonable. Rather, GTE claims that, if distribution is not built to reflect ultimate demand there will be delays in service and increased placement costs due to the need to reinforce distribution plant in established neighborhoods on a regular basis. GTE also contends that telephone companies do not design distribution plant with the expectation that it will require reinforcement because that is rarely the least-cost method of placing plant. GTE also claims that, in a competitive environment, facilities-based competitors would build plant to serve ultimate demand. We find, however, that these unsupported claims do not demonstrate that reflecting ultimate demand in the fill factors more closely represents the behavior of an efficient firm and will not result in the modeling of excess capacity. Finally, we find that we did not misinterpret the meaning of building distribution plant to serve ''ultimate demand,'' as GTE asserts. Rather, we refused to engage in the highly speculative activity of defining ''ultimate demand.'' Moreover, we believe that universal service support will be determined more accurately considering current demand, and not ultimate demand. Although firms may have installed excess capacity, it does not follow that the cost of this choice should be supported by the universal service support mechanism. As growth occurs, however, we anticipate that the requirement for new capacity will be reflected in updates to the model.

151. Concomitantly, we adopt the proposed values for distribution fill factors. As we explained in the *Inputs Further Notice*, the model designs outside plant to meet current demand in the same manner as the HAI model. Accordingly, it is appropriate to choose fill factors that are set at less than 100 percent. We conclude that, based on the record before us, the proposed values reflect the appropriate fill factors needed to meet current demand.

152. There is divergence among the commenters with regard to the adoption of the proposed values for the distribution fill factors. Sprint does not object to the use of the proposed values, stating that ''they appear to reasonably represent realistic, forward-looking practices.'' As noted, Ameritech contends that the copper distribution and feeder fill factors are reasonable estimates to use if company-specific or state-specific fill factors are not used. In contrast, SBC disagrees with the HAI proponents' claim that the level of spare capacity provided in the proposed values is sufficient to meet current demand plus some amount of growth. SBC, however, offers no controverting evidence demonstrating that the proposed values are insufficient to meet current demand plus short-term growth. We find that the lone fact that SBC disagrees is insufficient to controvert our conclusion that the proposed values reflect the appropriate fill needed to meet current demand. BellSouth contends that the proposed values will significantly understate distribution cable requirements. BellSouth submits instead projected fill factors for its distribution copper, feeder copper, and fiber cables determined by BellSouth network engineers. We find these estimates unsupported. Similarly, Bell Atlantic contends that the proposed fill factors for feeder and distribution are too high and recommends we adopt its proposed fill factors. We find these recommended fill factors unsupported. We, therefore, select the proposed values for distribution fill factors.

153. We also disagree with AT&T and MCI's contention that the proposed values for the distribution fill factors are too low. AT&T and MCI claim that distribution fill factors of 1.2 lines per household are more than adequate in a forward-looking cost study. We disagree. We find that 1.2 lines per household are inadequate because they simply reflect the existing provision of telephone service and are less than current demand as we define it herein. Moreover, AT&T and MCI's claim is belied by their own assertions. AT&T and MCI contend that the ''proposed conservative fill factors will ensure sufficient plant capacity to accommodate potentially unaccounted service needs in the PNR data.'' AT&T and MCI also state that ''[t]he fill levels used in HAI provides more than enough spare capacity for service work, churn, and unforeseen spikes in demand. In sum, AT&T and MCI attest to the reasonableness of not only use of the HAI default values for distribution plant, but also the use of the average of the HAI and BCPM default values for copper feeder.

154. We also disagree with AT&T and MCI's claim that higher factors are appropriate because the model's sizing algorithm produces effective fill factors that are lower than optimal values. As we explained in the *Inputs Further Notice*, because cable and fiber are available only in certain sizes, the effective fill factor may be lower than the administrative fill factor adopted as an input. We find that AT&T and MCI's claim ignores this fact.

155. Finally, we note that AT&T and MCI also claim that the factor should be higher because universal service support does not include residential second lines or multiple business lines. The Commission has never acted on the recommendation in the *First Recommended Decision*, 61 FR 63778 (December 2, 1996, that only primary residential lines should be supported. Moreover, we also note that AT&T and MCI's claim ignores the sixth criterion, which requires that:

> The Cost Study or model must estimate the cost of providing service for all businesses and households * * * Such inclusion of multi-line business services and multiple residential lines will permit the cost study or model to reflect the economies of scale associated with the provision of these services.

In sum, we find AT&T and MCI's claim in this regard unpersuasive.

156. *Feeder Fill Factors.* We also affirm our tentative conclusion to adopt copper feeder fill factors that are the average of the HAI and BCPM default values. The divergence among the commenters noted with regard to the use of the average of the HAI and BCPM default values for the distribution fill factors is reflected in the comments regarding the proposed feeder fill factors. Sprint finds that use of the average of the HAI and BCPM default values for feeder fill factors is reasonable. Ameritech's conditional support was noted. In contrast, BellSouth contends that the average of the HAI and BCPM default values will significantly understate copper feeder cable requirements. As noted, BellSouth advocates the use of projected fill factors for copper feeder determined by BellSouth network engineers. Similarly, Bell Atlantic contends that the feeder fill factors are too high. We reject the

use of these fill projections for copper feeder for the reasons enumerated. We also reject, for the reasons enumerated, AT&T and MCI's contention that feeder fill factors based on the average of the HAI and BCPM default values are too low.

157. *Fiber Fill Factors.* Finally, we affirm our tentative conclusion that the input value for fiber fill in the federal mechanism should be 100 percent. The majority of commenters addressing this specific issue agree with our tentative conclusion. AT&T and MCI contend that fiber feeder fill factors of 100 percent are appropriate because the allocation of four fibers per integrated DLC site equates to an actual fill of 50 percent, since a redundant transmit and a redundant receive fiber are included in the four fibers per site. AT&T and MCI explain that, because fiber capacity can easily be upgraded, 100 percent fill factors applied to four fibers per site are sufficient to meet unexpected increases in demand, to accommodate customer churn, and, to handle maintenance issues. Similarly, SBC asserts that fiber fill factors of 100 percent can be obtained because they are not currently subject to daily service order volatility and are more easily administered. In contrast, BellSouth advocates that we employ projected fills estimated by BellSouth engineers. As noted, these estimates are unsupported and we reject them accordingly. In sum, we find that the record demonstrates that it is appropriate to use 100 percent as the input value for fiber fill in the federal mechanism.

5. Structure Costs

158. We affirm our tentative conclusions to use the regression equation for aerial structure in the NRRI Study as a starting point for the cost estimate for aerial structure; to use the regression equation for underground structure in the *Inputs Further Notice* as a starting point for the cost estimate for underground structure for density zones 1 and 2; and to use the regression equation for the cost of 24-gauge buried copper cable and structure, as modified, to estimate the cost of buried structure for density zones 1 and 2. Concomitantly, we affirm our tentative conclusion to add to the estimates for aerial structure the costs of anchors, guys, and other materials that support the poles. As we explained in the *Inputs Further Notice*, the RUS data from which this regression equation was derived do not include these costs. We also adopt the following values we proposed in the *Inputs Further Notice* for the distance between poles: 250 feet for density zones 1 and 2; 200 feet for zones 3 and 4; 175 feet for zones 5 and 6; and 150 feet for zones 7, 8, and 9.

159. As noted, several commenters advocate that the input values we adopt for structure costs reflect company-specific data. For the reasons enumerated, we reject the use of the company-specific data we have received to estimate the nationwide average input values for structure costs to be used in the model.

160. Notwithstanding this conclusion, we find that it is unnecessary to extrapolate cost estimates for underground and buried structure for density zones 3 through 9 as we proposed. At the time of the *Inputs Further Notice*, we believed the extrapolated data were the best data available to us at the time for density zones 3 through 9 although we noted our preference to use data specific to those density zones. Upon further examination, we find that cost data, which include values for density zones 3 through 9, submitted by various state commissions for use in this proceeding are more reliable than the extrapolated data. Specifically, we reviewed structure cost data from North Carolina, South Carolina, Indiana, Nebraska, New Mexico, Montana, Minnesota, and Kentucky. These data reflect structure costs designed for use in the HAI and BCPM models.

161. The structure costs submitted by the state commissions have values for normal rock, soft rock, and hard rock for density zones 3 through 9. We adopt as the buried and underground structure cost input values for these density zones weighted average structure costs developed from these data based on the number of access lines for the companies to which the state decisions regarding the submitted structure costs apply. We find that these weighted averages represent reasonable estimates for buried and underground structure costs in normal, soft, and hard rock conditions for density zones 3 through 9.

162. Apart from the criticism of the extrapolation of structure costs for density zones 3 through 9 from the estimates for density zone 2, the comments we have received regarding the values we proposed for structure costs vary as to the type of structure the commenters address and vary as to the position they take on the reasonableness of the estimates. BellSouth states that the values we adopt for aerial structures are ''fairly representative of BellSouth's values'' but claims that, based on a comparison to its actual data, the values for underground and buried structure are too low. Cincinnati Bell states that the values we adopt for underground structure never vary from Cincinnati Bell's actual costs by more than 15 percent. Sprint claims that our proposed cost of poles are understated but the costs of anchor and guys appear to be reasonable. SBC claims that its actual weighted cost of a 40 foot pole is inconsistent with the loaded cost from the NRRI Study. SBC asserts, however, that the NRRI-specified cost is more closely aligned with SBC's anchor and guy costs. We find that, given this divergence of positions, the support in the record for some of our proposed values, and lack of back-up data to support the arguments opposing our proposals, on balance, the structure cost estimates we adopt for aerial, underground, and buried structure for density zones 1 and 2 are reasonable. Moreover, we find it is reasonable to use the values we adopt for density zones 3 through 9. As we discussed, these values reflect cost data for density zones 3 through 9 and have been submitted to us by state commissions for use in this proceeding. These values are more reliable than those derived through the extrapolation of data reflecting density zones 1 and 2, and for the reasons discussed, the company-specific data submitted on the record.

163. In reaching these conclusions, we note that AT&T and MCI advocate that we adjust the regressions used to estimate structure costs to reflect the buying power of large non-rural LECs. We find that, because AT&T and MCI did not provide any data to support such a determination, the record is insufficient to determine that such an adjustment is necessary. We also reject AT&T and MCI's claim that the costs of underground structure are excessive because they fail to exclude manhole costs from the costs of underground distribution. Contrary to AT&T and MCI's assertion, we find that manhole costs are necessary to allow for splicing when the length of the distribution cable exceeds minimum distance criteria adopted by the model.

164. Finally, we note, as described, that we have made adjustments to certain of the regression equations in the *Inputs Further Notice* from which we estimate structure costs in order to address certain of the criticisms reflected in the comments and improve the regression equations accordingly.

165. *LEC Loading Adjustment.* In the *Inputs Further Notice*, we tentatively concluded that we should add a loading of ten percent to the material and labor cost (net of LEC engineering) for aerial, underground, and buried structure because the cost of LEC engineering was not reflected in the data from which Gabel and Kennedy derived their

estimates. We find that, based on the record before us, the LEC engineering adjustment is appropriate and the proposed level of the adjustment is reasonable. In reaching this conclusion, we reject at the outset the position of those commenters advocating that the adjustment be based on company-specific data. As we explained, we find such data are not the most reliable data on the record.

166. As with the LEC adjustment proposed for cable costs discussed, there is a general consensus on the record among the commenters that an adjustment is necessary. We find, therefore, that an adjustment to reflect the cost of LEC engineering is appropriate. Beyond the general claim that we should adopt company-specific data, there is divergence among the commenters regarding the appropriate level of this adjustment. GTE claims that the adjustment should be greater than 10 percent based on a comparison to its data for buried plant. SBC agrees that 10 percent is appropriate for aerial and buried structure but too low for underground structure. SBC proposes a loading factor of 20 percent instead for underground structure. Based on our review of the information, it is our judgement that the 10 percent adjustment is the most reasonable value on the record before us to reflect the cost of LEC engineering.

6. Plant Mix

167. As explained, although we tentatively chose to adopt nationwide plant mix values, we presented and sought comment on an alternative algorithm based on sheath miles reported in ARMIS to develop plant mix values. Consistent with that alternative, GTE asserts that company-specific plant mix should be used instead of nationwide input values. Similarly, Sprint contends that company-specific or state-specific plant mix values should be used. US West asserts that the model should utilize study-area specific plant mix values that are available in ARMIS as a starting point for plant mix inputs in the model.

168. We find, however, as discussed, because companies do not report aerial and buried route miles in ARMIS, that it is not possible to develop plant mix factors directly from these data at this time. Moreover, we note that the record does not reflect company-specific plant mix values for all companies, nor has any commenter presented a methodology that recognizes the fact that plant mix varies across density zones and allocates it accordingly. In sum, we conclude that neither company-specific nor ARMIS-derived data represent reasonable alternatives to the use of nationwide inputs. We find, therefore, that the use of nationwide inputs is the most reasonable approach in developing plant mix values on the record before us.

169. US West claims that the plant mix algorithm we proposed places too much plant in aerial. US West traces this flaw to several alleged errors in the plant mix algorithm. US West claims that the algorithm erroneously double weights the model plant mix. This is not an error as US West claims. Because the model results used in US West's analysis are based on the low aerial distribution input, we find that the double weight should result in low levels of aerial construction rather than high levels of aerial construction. US West also identifies several formulaic errors. We find these errors attributable, however, to US West's lack of understanding of how the proposed algorithm works. We agree, however, with US West that the high aerial results do appear to be a function of incorrectly weighting aerial plant. We find that this problem is a function of treating the aerial plant mix factor as a residual rather than directly estimating an aerial factor. Given this flaw, we conclude that we should not adopt the plant mix algorithm on which we sought comment.

170. As noted, we sought comment on alternatives to nationwide plant mix input values. US West has proposed two algorithms. As explained, we find that each of these has its own biases and, therefore, that neither is a reasonable alternative to what we have proposed. In brief, US West's first algorithm takes the geometric mean of the national default and a structure ratio to determine the plant mix factor. It defines the structure ratio for underground plant as the ratio of ARMIS trench miles to model route miles; for buried and aerial plant the structure ratio is defined as the relative sheath miles of the structure type multiplied by the model route miles less the ARMIS trench miles. We find that the final result of this algorithm places too much underground structure because, for all but the lowest density zone, the underground plant mix factor is significantly higher than the ARMIS ratio. The second algorithm US West proposes starts with the relative share of ARMIS sheath miles for all three structure types. It then establishes two series of fractions that sum to one. In the first series, the fractions increase as the density zone increases. This series is applied to underground structure and thus places more underground structure in the higher density zones. In the second series, the fractions decrease as the density zones increase. This series is applied to aerial structure, with the result that the percentage of aerial cable declines as density increases. For buried structure, the ARMIS ratio is used for all density zones. We find that this algorithm is flawed because it does not recognize the difference between sheath and route miles. As a consequence, the algorithm produces a biased result. Specifically, it constructs too much underground cable. We find that, until this problem is resolved, relying directly on ARMIS information leads to unreasonable results.

171. *Distribution Plant.* We adopt the proposed input values for distribution plant mix which. We conclude that these values for the lowest to the highest density zones, which range from zero percent to 90 percent for underground plant; 60 to zero percent for buried plant; and 40 to ten percent for aerial plant, are the most reasonable estimates of distribution plant mix on the record before us.

172. There is divergence among the commenters with regard to the appropriateness of the input values for the distribution plant mix proposed in the *Inputs Further Notice.* SBC supports the proposed distribution plant mix, noting that it ''closely aligns with the embedded plant and future outside plant design.'' AT&T and MCI advocate the use of the HAI default values for plant mix because, according to AT&T and MCI, they more properly reflect the use of aerial and underground cable than the proposed distribution plant mix inputs. AT&T and MCI claim that the proposed inputs reflect too much underground and too little aerial cable. As we explained in the *Inputs Further Notice,* the model does not design outside plant that contains either riser cable or block cable. Accordingly, use of the HAI default values, which assume a high percentage of aerial plant in densely populated areas, would be inconsistent with the model platform. AT&T and MCI ignore this fact.

173. In the *Inputs Further Notice,* we stated that we disagreed with HAI's assumption that there is very little underground distribution plant and none in the six lowest density zones. In support of the HAI values for underground distribution plant, AT&T and MCI proffer the distribution plant mix values for BellSouth, notably the only company to provide such data, showing that its underground distribution plant mix value is very low. We find that, because we are not adopting a company-specific algorithm, it is not necessary to address this issue. As noted, we will not adopt an

alternative algorithm until the issue of underground structure distances has been resolved. We adhere to employing a national value because we find that, though it may not be exact for every company, it will be reasonable for all companies.

174. *Feeder Plant.* We also adopt the proposed input values for feeder plant mix. We conclude that these values for the lowest to the highest density zones, which range from five percent to 95 percent for underground plant; 50 to zero percent for buried plant; and 45 to five percent for aerial plant, are the most reasonable estimates of distribution plant mix on the record before us. GTE's and Sprint's comments specifically address the specific issue of feeder plant mix inputs. As noted, both carriers advocate the use of company-specific data for plant mix. We reject the use of such data for feeder plant mix for the reasons we enumerated.

175. Finally, we affirm our tentative conclusion that the plant mix ratios should not vary between copper feeder and fiber feeder. In reaching our tentative conclusion, we noted that, although the HAI sponsors proposed plant mix values that vary between copper feeder and fiber feeder, they have offered no convincing rationale for doing so. We find such support still lacking. GTE claims that a distinction is necessary because the existing plant mix indicates that the trend for more out-of-sight construction has already resulted in differing copper and fiber feeder plant mixes. In contrast, SBC contends that plant mix ratios should not vary between copper feeder and fiber feeder because existing structure is used whenever available for fiber and copper placement so the mix ratio would not differ. We find neither of these claims to be persuasive. Accordingly, we conclude that, given the absence of controverting evidence, it is reasonable to assume that plant mix ratios should not vary between copper feeder and fiber feeder in the model.

D. Structure Sharing

176. We adopt the following structure sharing percentages that represent what we find is a reasonable share of structure costs to be incurred by the telephone company. For aerial structure, we assign 50 percent of structure cost in density zones 1–6 and 35 percent of the costs in density zones 7–9 to the telephone company. For underground and buried structure, we assign 100 percent of the cost in density zones 1–2, 85 percent of the cost in density zone 3, 65 percent of the cost in density zones 4–6, and 55 percent of the cost in density zones 7–9 to the telephone company. In doing so, we adopt the sharing percentages we proposed in the *Inputs Further Notice,* except for buried and underground structure sharing in density zones 1 and 2, as explained.

177. Commenters continue to diverge sharply in their assessment of structure sharing. As noted by US West, ''[s]ince forward-looking sharing percentages for replacement of an entire network are not readily observable, there is room for reasonable analysts to differ on the precise values for those inputs.'' While commenters engage in lengthy discourse on topics such as whether the model should assume a ''scorched node'' approach in developing structure sharing values, little substantive evidence that can be verified has been added to the debate. AT&T and MCI contend that the structure sharing percentages proposed in the *Inputs Further Notice* assign too much of the cost to the incumbent LEC and fail to reflect the greater potential for sharing in a forward-looking cost model. In contrast, several commenters contend that the proposed values assign too little cost to the incumbent LEC and reflect unrealistic opportunities for sharing. In support of this contention, some LEC commenters propose alternative values that purport to reflect their existing structure sharing percentages, but fail to substantiate those values. SBC, however, claims that the structure sharing percentages we propose reflect its current practice and concurs with the structure sharing values that we adopt in this Order.

178. More than with other input values, our determination of structure sharing percentages requires a degree of predictive judgement. Even if we had accurate and verifiable data with respect to the incumbent LECs' existing structure sharing percentages, we would still need to decide whether or not those existing percentages were appropriate starting points for determining the input values for the forward-looking cost model. AT&T and MCI argue that past structure sharing percentages should be disregarded in predicting future structure sharing opportunities. Incumbent LEC commenters argue that sharing in the future will be no more, and may be less, than current practice.

179. In the *Inputs Further Notice,* we relied in part on the deliberations of a state commission faced with making similar predictive judgment relating to structure sharing. The Washington Utilities and Transportation Commission, conducted an examination of these issues and adopted sharing percentages similar to those we proposed.

180. In developing the structure sharing percentages adopted in this Order, we find the sharing percentages proposed by the incumbent LECs to be, in some instances, overly conservative. While we do not necessarily agree with AT&T and MCI as to the extent of available structure sharing, we do agree that a forward-looking mechanism must estimate the structure sharing opportunities available to a carrier operating in the most-efficient manner. As discussed in more detail in this Order, the forward-looking practice of a carrier does not necessarily equate to the historical practice of the carrier. Given the divergence of opinion on this issue, and of AT&T and MCI's contention that further sharing opportunities will exist in the future, we have made a reasonable predictive judgment, and also anticipate that this issue will be revisited as part of the Commission's process to update the model in a future proceeding.

181. In the *1997 Further Notice,* 62 FR 42457 (August 7, 1997), the Commission tentatively concluded that 100 percent of the cost of cable buried with a plow should be assigned to the telephone company. In the *Inputs Further Notice,* we sought comment on the possibility that some opportunities for sharing existed for buried and underground structure in the least dense areas and proposed assignment of 90 percent of the cost in density zones 1–2 to the telephone company. Several commenters contend that there are minimal opportunities for sharing of buried and underground structure, particularly in lower density areas. In addition, several commenters contend that, to the extent sharing is included in the RUS data, it is inappropriate to count that sharing again in the calculation of structure cost. While we agree that structure sharing should not be double counted, we note that the RUS data includes little or no sharing of underground or buried structure in density zones 1–2. This does, however, support the contention of commenters that there is, at most, minimal sharing of buried and underground structure in these density zones. We therefore modify our proposed input value in this instance and assign 100 percent of the cost of buried and underground structure to the telephone company in density zones 1–2.

182. We believe that the structure sharing percentages that we adopt reflect a reasonable percentage of the structure costs that should be assigned to the LEC. We note that our conclusion reflects the general consensus among commenters that structure sharing varies by structure type and density.

While disagreeing on the extent of sharing, the majority of commenters agree that sharing occurs most frequently with aerial structure and in higher density zones. The sharing values that we adopt reflect these assumptions. SBC also concurs with our proposed structure sharing values. In addition, as noted, the Washington Utilities and Transportation Commission has adopted structure sharing values that are similar to those that we adopt. We also note that the sharing values that we adopt fall within the range of default values originally proposed by the HAI and BCPM sponsors.

E. Serving Area Interfaces

183. We affirm our approach to derive the cost of an SAI on the basis of the cost of its components and adopt a total cost of $21,708 for the 7200 pair indoor SAI. We find that there remains an absence of contract data between the LECs and suppliers with regard to SAIs on the record before us. Accordingly, we affirm, as discussed in more detail, our tentative conclusions with respect to the following issues: (1) the cost per pair for protector material; (2) the appropriate splicing rate and corresponding labor rate; (3) the methodology employed in cross-connecting in a SAI; and (4) the appropriate feederblock and distribution installation rate.

184. Based on the record before us, we conclude that $4 per pair is a reasonable estimate of the cost for protected material. As we explained in the *Inputs Further Notice,* this estimate is based on an analysis of *ex parte* submissions, which is the only evidence we have available to evaluate the cost of SAI components. We also noted that Sprint has agreed that $4 is a reasonable estimate of the cost. SBC and AT&T and MCI concur with our tentative conclusion to adopt the $4 per pair cost. In sum, the record fully supports our conclusion that $4 per pair is a reasonable estimate of the cost for protector material.

185. We also conclude that the record demonstrates that a splicing rate of 250 pairs is reasonable, and adopt it accordingly. As we explained in the *Inputs Further Notice,* the HAI sponsors proposed a splicing rate of 300 pairs per hour, while Sprint argued for a splicing rate of 100 pairs per hour. We believed that HAI's proposed rate was a reasonable splicing rate under optimal conditions, and therefore, we tentatively concluded that Sprint's proposed rate was too low. We noted that the HAI sponsors submitted a letter from AMP Corporation, a leading manufacturer of wire connectors, in support of the HAI rate. We recognized, however, that splicing under average conditions does not always offer the same achievable level of productivity as suggested by the HAI sponsors. For example, splicing is not typically accomplished under controlled lighting or on a worktable. Having accounted for such variables, we proposed a splicing rate of 250 pairs per hour.

186. AT&T and MCI, the proponents of the 300 pairs per hour rate, support our tentative conclusion. Sprint takes issue with the splicing rate we proposed. Sprint impugns the evidence, appearing in the form of a letter from AMP Corporation on which we relied in part, to determine a reasonable splicing rate. In sum, Sprint contends the letter represents an ''unsupported claim of someone trying to sell equipment.'' While Sprint is correct that the proponent is an equipment manufacturer, neither Sprint nor any other commenter provided evidence from any other equipment manufacturer to refute AMP.

187. Sprint also questions the fact that we did not utilize the data available from the NRRI Study to determine the splicing rate. Sprint maintains that an analysis of that data results in a splicing rate of 58.8 pairs per hour, substantially less than the 300 pairs per hour we recognized as a ceiling in our analysis. We based our proposed splicing rate on an analysis of such rates as they relate specifically to the installation of a complete and functional SAI. In contrast, although the data to which Sprint refers is for modular splicing, it is not clear, nor does Sprint claim, that such data specifically relates to the installation of SAIs. In sum, the validity of this data as a measure in the derivation of splicing rates for SAI installation is not established on the record. Sprint's critique ignores this fact. Accordingly, we reject the use of the data available from the NRRI Study to determine the splicing rate.

188. We also conclude that the $60 per hour labor rate we proposed for splicing is reasonable and adopt it accordingly. Those commenters addressing this specific issue agree. As we explained in the *Inputs Further Notice,* this rate, which equates with the prevalent labor rate for mechanical apprentices, is well within the range of filings on the record.

189. We also conclude that the model should assume that a ''jumper'' method will be used half the time and a ''punch down'' method will be used the remainder of the time to cross-connect an SAI. A cross-connect is the physical wire in the SAI that connects the feeder and distribution cable.

190. In the *Inputs Further Notice,* we tentatively concluded that neither the jumper method nor the punch down method is used exclusively in SAIs. We reached this tentative conclusion based on the conflicting assertions of Sprint and the HAI sponsors. We noted that, Sprint asserted that the ''jumper'' method generally will be employed to cross-connect in a SAI. In contrast, the HAI sponsors claimed that the ''punch down'' method is generally used to cross-connect. We also noted that, in buildings with high churn rates, such as commercial buildings, carriers may be more likely to use the jumper method. On the other hand, in residential buildings, where changes in service are less likely, carriers may be more likely to use the less expensive punch down method. Thus, we tentatively concluded that it appeared that both methods are commonly used, and that neither is used substantially more than the other.

191. Based on the record before us, we affirm our tentative conclusion to assume that the ''jumper'' method and the ''punch down'' method will be used an equal portion of the time. SBC challenges this conclusion, pointing out that it uses the ''jumper'' method in applications involving hard lug or insulation displacement contact and that it is currently replacing existing ''punch down'' interfaces. We conclude that SBC's sole claim is not sufficient to demonstrate that the ''jumper'' method is used substantially more than the ''punch down'' method. We note also that Sprint contends that the cross-connect proposed by AT&T and MCI is not an SAI, but a building entrance terminal. We disagree. The design meets the SAI definition of providing an interface between distribution and feeder facilities. In sum, we find that the record demonstrates that it is reasonable for the model to assume that a ''jumper'' method will be used half the time and a ''punch down'' method will be used the remainder of the time to cross-connect an SAI.

192. We also adopt a feeder block and distribution installation rate of 200 pairs per hour. As we explained in the *Inputs Further Notice,* we derived this installation factor based on a comparison of Sprint's proposed installation rate of 60 pairs per hour with HAI's proposed 400 pair per hour rate. We concluded that, because neither feeder block installation nor distribution block installation is a complicated procedure, Sprint's rate of 60 pairs per hour is too low. We also recognized that installation conditions are not always ideal. As we explained, feeder block and distribution block installations are not typically accomplished under

controlled lighting or on a worktable. We proposed a rate of 200 pairs per hour to recognize these variables.

193. We note that our proposed feeder block and distribution block rates are unchallenged. Significantly, SBC attests that this installation rate aligns with time-in-motion studies performed in cross-connect building applications. We conclude, therefore, that our proposed rate is reasonable, and adopt input values based upon it accordingly.

194. We also adopt the cost estimates for other size indoor and outdoor SAIs tentatively adopted in the *Inputs Further Notice.* We conclude that, based on the record before us, the derivation of the costs of the other SAI sizes from the cost of the 7200 pair indoor SAI is reasonable.

195. GTE takes issue with the derivation of the costs of the other SAIs from the cost of the 7200 pair indoor SAI. First, GTE contends that there is no need to extrapolate the costs of other SAIs because the costs of individual SAI sizes and associated labor are readily available. We disagree. We concluded that it was necessary to extrapolate the costs of other SAI sizes from the cost of a 7200 pair SAI because of the lack of component-by-component data for other SAI sizes on the record. As noted, we find the record still lacks such data. We also disagree with GTE's contention that SAI costs are not subject to a linear relationship across all sizes as we determined. We find GTE's contention, which relies on GTE's SAI estimates, unpersuasive given the lack of substantiating data supporting these estimates. In sum, the record demonstrates that the derivation of the costs of the other SAIs from the cost of the 7200 pair indoor SAI is reasonable.

196. US West contends that the costs of a SAI should be determined by the actual cable sizes for the cables entering and leaving the SAI rather than the number of cable pairs entering and leaving the interface. We agree. The model has been revised to calculate the costs of an SAI on the basis of actual cable sizes for the cables entering and leaving the SAI.

197. US West raises an additional issue concerning the sizing of SAIs. US West notes that some clusters created by the clustering module exceed the default line limit of 1800 lines and gives as an example a specific cluster containing 7,900 lines. The largest SAI can accommodate only 7200 lines, counting both feeder side and distribution side lines. Therefore, US West contends that, in situations such as this, insufficient SAI plant is deployed by the model. We agree with this analysis. There is no way to guarantee that the line limit of 1800 lines will not be exceeded for some clusters, even though modifications have been made to the cluster algorithm to mitigate this possibility to the greatest possible extent. Therefore, in the current version of the model, we modify the input table for SAI costs so as to allow for serving areas (clusters) in which the capacity of feeder cable plus distribution cable meeting at the interface may exceed 7200. We do this by allowing for line increments of 1800 up to a total line capacity of 28,800. The values in the input table assume that, whenever more than 7200 lines are required in an SAI, two or more standard SAIs are built, one with full capacity of 7200 and the others with capacities equal to 1800, 3600, 5400 or 7200. The input values for each of the multiply-placed SAIs are then summed.

198. A related issue is raised by US West with respect to drop terminal capacity in the model. In previous versions of the model, drop terminals were sized for residential housing units and small business locations, with a maximum line capacity per drop location equal to 25 lines. For medium size and larger business locations with line demand greater than 25 lines, no specific provision for additional drop terminal capacity was provided, except in situations in which a single business accounted for all of the lines in a single cluster. Again, we agree with the US West analysis of this issue. Accordingly, we have modified the input table for drop terminal costs by adding additional line sizes equal to 50, 100, 200, 400, 600, 900, 1200, 1800, 2400, 3600, 5400, and 7200. At any location requiring a drop terminal with capacity exceeding 25 lines, the model will assume that the location will be served by an indoor SAI, and the cost of the corresponding interface is equal to the corresponding value from the table for SAI costs.

F. Digital Loop Carriers

199. We adopt an average of the contract data submitted on the record, adjusted for cost changes over time, as the cost estimates for DLCs. This decision is predicated on two conclusions. The first is our determination that the contract data submitted to the Commission in response to the *1997 Data Request,* and in *ex parte* submissions following the December 11, 1998, workshop, remains the most reliable data on the record. Significantly, no additional information has been proffered nor has any alternative method been proposed, on which to base our estimate of DLC costs. The second is that we conclude that it is reasonable to reduce both the fixed DLC cost and per-line DLC cost reflected in this data by a factor of 2.6 percent per year in order to capture changes in the cost of purchasing and installing DLCs over time.

200. As we explained in the *Inputs Further Notice,* the contract data submitted to the Commission in response to the *1997 Data Request,* and in *ex parte* submissions following the December 11, 1998, workshop, is the most reliable data because, not only is it the only data on the record, but it reflects the actual costs incurred in purchasing DLCs. Moreover, although we would have preferred a larger sample, the contract data is sufficiently representative of non-rural carriers because it reflects the costs incurred by several of the largest non-rural carriers, as well as two of the smallest non-rural carriers.

201. GTE, Bell Atlantic and Sprint support the use of the contract data in estimating the cost of DLCs. Only AT&T and MCI and SBC challenge the use of these data. SBC contends that the contract data is not the most reliable data on DLC costs because labor costs associated with testing, turn-up, and delivery of derived facilities are not factored into the input values. We disagree. The data we identify as ''contract data'' include these costs. As we explained in the *Inputs Further Notice* and noted, we sponsored a workshop on December 11, 1998, to further develop the record on DLC costs in this proceeding. During the workshop, we presented a template of the components of a typical DLC to the attendees. The template provided the respondents the opportunity to identify their contract costs with regard to each of the components. In addition, we requested that the respondents identify, and thereby include, other costs associated with DLC acquisition, including labor costs associated with testing, turn-up, and delivery of the DLC. Using this opportunity to submit DLC cost data, GTE and Aliant included such costs in their submissions. Sprint submitted similar data in a September 9, 1998 *ex parte* filing. These costs were identified and added to the analysis of US West's and BellSouth's contract data. We derived these costs from *ex parte* filings made by these carriers in this proceeding.

202. AT&T and MCI allege that the contract data overstates the actual costs of DLC equipment and therefore, should not be adopted. AT&T and MCI instead advocate use of the HAI default values. AT&T and MCI argue that the contract costs are not only unsupported by any verifiable evidence but, more

importantly, are refuted by the contract information from which they were derived. In support, AT&T and MCI submit an analysis of the DLC cost submissions of Bell Atlantic, BellSouth, and Sprint. In each instance, AT&T and MCI assert that these data demonstrate DLC costs that are far below those proposed by the incumbent LECs and the Commission and that are fully consistent with the HAI default values.

203. We disagree with AT&T and MCI's analysis. For example, AT&T and MCI claim that information provided by Bell Atlantic shows that total DLC common equipment costs for DLC systems capable of serving 672, 1344, and 2016 lines are similar to, and uniformly less than, the corresponding HAI values. In reaching this conclusion, however, AT&T and MCI omit the costs for line equipment. As Bell Atlantic points out, the cost of digital line carrier equipment should include these costs, and we agree.

204. Similarly, AT&T and MCI assert that certain of Sprint's costs are significantly inflated and, once adjusted, are similar to and uniformly less than the corresponding HAI values. We find, however, these adjustments to be unsupported. AT&T and MCI reduce the supply expenses associated with Sprint's DLC costs, more than 66 percent, based on the experience of AT&T and MCI's engineering team members. AT&T and MCI offer no evidence, however, other than the opinions of their experts to substantiate this proposed adjustment.

205. AT&T and MCI also contend that Sprint applies excessive mark-ups for sales tax. AT&T and MCI argue that, because Sprint operates its own logistics company, there is no reason to apply sales tax to both supply expense and materials. We find that AT&T and MCI offer no support to demonstrate that this results in an excessive mark-up for sales tax. We reach the same conclusion with regard to AT&T and MCI's proposed reduction to Sprint's labor costs. AT&T and MCI contend that Sprint's labor costs are inflated and propose reductions in such costs through a reduction in the number of labor hours associated with DLC installation. AT&T and MCI provide no support for such a reduction and, therefore, we decline to reduce Sprint's labor costs.

206. Significantly, AT&T and MCI offer no evidence to controvert our tentative conclusion that the HAI values they employ as a comparative benchmark, and advocate that we adopt, are not more reliable than the contract data. We rejected the use of the HAI and the BCPM default values because they are based on the opinions of experts without substantiating data. Similarly, we rejected data submitted by the HAI sponsors following the December 11, 1998, workshop. We found that data to be significantly lower than the contract data on the record, and concluded that it would be inappropriate to use because it also lacked support. AT&T and MCI have not provided any additional evidence to substantiate the HAI data.

207. We also affirm our tentative conclusion that it is reasonable to reduce both the fixed DLC costs and per-line DLC costs reflected in the contract data in order to capture changes in the cost of purchasing and installing DLCs. As we explained in the *Inputs Further Notice,* this reduction recognizes the fact that the cost of purchasing and installing a DLC diminishes over time because of improvements in the methods and components used to produce DLCs, changes in both capital and labor costs, and changes in the functionality requirements of DLCs. The premise that overall DLC costs move downward over time is not disputed on the record.

208. We also conclude that the 2.6 percent reduction we proposed in both the fixed DLC costs and per-line DLC costs is appropriate. As we explained in the *Inputs Further Notice,* this is a conservative estimate, based on the change in cost of remote switches, which is a reasonable proxy for changes in DLC cost. More importantly, a comparison of data submitted on the record by Sprint for the years 1997, 1998, and 1999 demonstrates that an overall reduction of 2.6 percent is considerably less than Sprint's actual experience. An analysis undertaken by staff produces an average reduction in DLC costs for Sprint of 9.2 percent per year. We note that this estimate reflects both material and labor costs.

209. Only SBC and GTE specifically address the 2.6 percent reduction. SBC supports the 2.6 percent reduction in fixed and per-line DLC costs as it applies to material costs only. In contrast, GTE opposes the adjustment. GTE suggests that, as the inputs are adjusted over time, the cost of current technology will be reflected in the revised data. GTE is correct that the current cost of technology would be reflected in revised data. The adjustment we proposed and adopt updates cost to current cost. Implicit in SBC's comment is the premise that labor costs will not decrease over time. Although this may be a reasonable assumption, the 2.6 percent reduction we adopt is applied to the overall cost of a DLC. As we explained, the 2.6 percent reduction is a conservative estimate compared to the actual reductions we have observed in the Sprint data. As a result, we conclude that increases in labor will be offset by reductions in other factors in the cost of DLCs.

210. Finally, as noted, we sought comment on the extent, if any, to which we should increase our proposed estimates for DLCs to reflect material handling and shipping costs because it was unclear whether the DLC data submitted by other parties include these costs. On further analysis, we note that material handling and shipping costs are reflected in the proposed DLC estimates we adopt herein. Moreover, we conclude that it is appropriate to include these costs in the cost estimates for DLCs. We note that no comments were filed opposing the inclusion of such costs.

IV. Switching and Interoffice Facilities

A. Switch Costs

211. *Switch Cost Estimates.* We adopt the fixed cost (in 1999 dollars) of a remote switch as $161,800 and the fixed cost (in 1999 dollars) of both host and stand-alone switches as $486,700. We adopt the additional cost per line (in 1999 dollars) for remote, host, and stand-alone switches as $87.

212. For the reasons set forth, we affirm our tentative conclusion to use the publicly available data from LEC depreciation filings, and to supplement the depreciation data with data from LEC reports to the RUS. We also affirm our tentative conclusion that we should not rely on the BCPM and HAI default values, because these values are largely based on non-public information or opinions of their experts, without data that enable us adequately to substantiate those opinions.

213. *Switch Cost Data.* The depreciation data contains for each switch reported: The model designation of the switch; the year the switch was first installed; and the lines of capacity and book-value cost of purchasing and installing each switch at the time the depreciation report was filed with the Commission. The RUS data contains, for each switch reported: The switch type (*i.e.,* host or remote); the number of equipped lines; cost at installation; and year of installation.

214. The sample that we use to estimate switch costs includes 1,085 observations. The sample contains 946 observations selected from the depreciation data, which provide information on the costs of purchasing and installing switches gathered from 20 states. All observations in the depreciation data set are for switches with 1,000 lines or more. In order to

better estimate the cost of small switches, we augmented the depreciation data set by adding data from RUS. The RUS sample contains 139 observations which provide information from across the nation on the costs of small switches purchased and installed by rural carriers. Over 80 percent of the observations of switch costs in the RUS data set measure the costs for switches with 1,000 lines of capacity or less. The combined sample represents purchases of both host and remote switches, with information on 490 host switches and 595 remote switches, and covers switches installed between 1989 and 1996. This set of data represents the most complete public information available to the Commission on the costs of purchasing and installing new switches.

215. The depreciation data set proposed in the *Inputs Further Notice* excluded 26 observations that had been deemed to be outliers by the Bureau of Economic Analysis. Bell Atlantic criticizes the Commission for excluding these outliers. The excluded observations were not available in electronic form prior to the release of the *Inputs Further Notice.* Subsequently, the Bureau obtained these outlying observations from the Bureau of Economic Analysis and reinserted them into the data set used to derive the input values we adopt herein. In addition, several commenters recommend that the depreciation data set also should include switches with fewer than 1,000 lines of capacity. This information, however, is not available in electronic format and, therefore, would be unduly burdensome to include.

216. In response to the *1997 Data Request,* the Commission received a second set of information pertaining to 1,486 switches. Upon analysis, however, we have identified one or more problems with most of the data submitted: missing switch costs; zero or negative installation costs; zero or blank line counts; unidentifiable switches; or missing or inconsistent Common Language Local Identification (CLLI) codes. After excluding these corrupted observations, 302 observations remained. The remaining observations represented switches purchased by only four companies. We affirm our tentative conclusion that the data set we use is superior to the data set obtained from the data request, both in terms of the number of usable observations and the number of companies represented in the data set.

217. Following the December 1, 1998, workshop, three companies voluntarily submitted further data regarding the cost of purchasing and installing switches: BellSouth provided data on switch investments for its entire operating region; Sprint provided similar data for its operations in Nevada, Missouri, and Kansas; and GTE provided switch investment information for California. When consolidated, this information forms a data set of approximately 300 observations representing the costs of new switches. As AT&T has noted, however, the information submitted contains some inconsistencies. Considering these inconsistencies, the limited number of companies represented, and the size of this voluntarily submitted data set, we conclude that the data set we use is preferable.

218. BellSouth suggests that we merge either the information received in response to the *1997 Data Request,* the information from the voluntary submissions, or both, with the data set we use. We reject this suggestion because there are significant inconsistencies between the different data sets. For example, in its voluntary submission, GTE provides the amount of total investment for each of its California switches at the time these switches were installed, but reports associated line counts only for October 1998. This information is not consistent with the data set used by the Commission, which contains aggregate investment and line counts measured at the same point in time. Second, our analysis of the information provided in both the voluntary submissions and the data request reveals, based on simple linear regression, inconsistencies between these two data sets and the data set employed by the Commission. Our analysis reveals that both alternative data sets contain information that is inconsistent with the comments in this proceeding.

219. *Adjustments to the Data.* As discussed, in the *Inputs Further* Notice, we proposed certain adjustments to the RUS data to account for the cost of MDF and power equipment, which were omitted from the RUS information. Specifically, we proposed increasing the cost of purchasing and installing switches by $12 per line for MDF and $12,000, $40,000, or $74,500, depending upon switch size, for power costs. Commenters who address this issue agree that the RUS data must be modified to account for the costs of MDF and power to make the RUS data consistent with the depreciation data, which include these costs. Some commenters who address these adjustments claim that we should use different values for MDF and power costs, but provide little or no information we can use to verify their suggested values. Sprint, for example, claims our power costs are too low and provides a breakdown of power costs, but does not supply any data to support their higher proposed values for power costs. AT&T and MCI claim our proposed power costs should be reduced because they are substantially higher than those proposed by their experts.

220. We find that we need not attempt to resolve disagreement over the reasonableness of our proposed values, in the absence of any additional information, because we adopt an alternative methodology for estimating MDF and power costs. We find that we should adjust the RUS data for MDF and power equipment costs in a way that is more consistent with the way in which these costs are estimated in the depreciation data set. In the depreciation data, MDF and power equipment costs are estimated as a percentage of the total cost of the switch, as are all other components of the switch. Based on the estimates of Technology Futures, Inc., we find that these costs were eight percent of total cost. Because we are adjusting the RUS data so that they are comparable with the depreciation data, we find it is appropriate to use a comparable method to estimate the portion of total costs attributable to MDF and power equipment. Accordingly, in order to account for the cost of MDF and power equipment omitted from the RUS information, we conclude that the cost of switches reported in the RUS data should be increased by eight percent.

221. In the *Inputs Further Notice,* we tentatively concluded, based on an estimate provided by Gabel and Kennedy, that $27,598 should be added to the cost of each remote switch reported in the RUS data. SBC recommends that remote termination costs should be added to remote switch costs on a per-line basis, but provides no estimates of the per-line cost of remote termination. Sprint provides remote termination estimates of $22,636 for termination of remote switches with less than 641 lines and $46,332 for termination of remote switches with between 641 and 6,391 lines. Using Sprint's methodology, the average cost of terminating a RUS remote switch on a RUS host switch is $29,840. Sprint's estimate is consistent in magnitude with Gabel and Kennedy's estimate. Therefore, because Sprint's tiered estimates captures differences between remote termination costs associated with remote switch size, we adopt Sprint's estimates.

222. Based upon Gabel and Kennedy recommendations, derived from data

analysis undertaken by RUS, we conclude that the cost of switches reported in the RUS data should be increased by eight percent in order to account for the cost of LEC engineering. We conclude, however, that this adjustment should not be added to the cost of power and MDF, because these estimates already include the costs of LEC engineering.

223. *Methodology.* Consistent with our tentative conclusions in the *Inputs Further Notice,* we employ regression analysis. In this Order, we also adopt our tentative conclusion to use a linear function based on examination of the data and statistical evidence.

224. Sprint recommends using a non-linear function, such as the log-log function, to take into account the declining marginal cost of a switch as the number of lines connected to it increases. We affirm our tentative conclusion that the linear function we adopt provides a better fit with the data than the log-log function. A discussion of the effect of time and type of switch on switch cost is presented.

225. Based upon an analysis of the data and the record, we conclude that the fixed cost (i.e., the base getting started cost of a switch, excluding costs associated with connecting lines to the switch) of host switches and remote switches differ, but that the per-line variable cost (i.e., the costs associated with connecting additional lines to the switch) of host and remote switches are approximately the same. This is consistent with statistical evidence and the comments of Sprint, BellSouth, and the HAI sponsors.

226. *Accounting for Changes in Cost Over Time.* We recognize that the cost of purchasing and installing switching equipment changes over time. Such changes result, for example, from improvements in the methods used to produce switching equipment, changes in both capital and labor costs, and changes in the functional requirements that switches must meet for basic dial tone service. In order to capture changes in the cost of purchasing and installing switching equipment over time, we affirm our tentative conclusion in the *Inputs Further Notice* to modify the data to adjust for the effects of inflation, and explicitly incorporate variables in the regression analysis that capture cost changes unique to the purchase and installation of digital switches.

227. To the extent that the general level of prices in the economy changes over time, the purchasing power of a dollar, in terms of the volume of goods and services it can purchase, will change. In order to account for such economy-wide inflationary effects, we multiply the cost of purchasing and installing each switch in the data set by the gross-domestic-product chain-type price index for 1997 and then divide by the gross-domestic-product chain-type price index for the year in which the switch was installed, thereby converting all costs to 1997 values.

228. In order to account for cost changes unique to switching equipment, we enter time terms directly into the regression equation. US West agrees that the costs of the equipment, such as switches and multiplexers, used to provide telecommunications services are declining, and that the per-unit cost of providing more services on average is declining. Bell Atlantic and GTE, however, contend that the cost of switches is not currently declining and therefore pricing declines should not be expected to continue into the future. As evidence, they cite their own fixed-cost contracts. As AT&T notes, however, ''[i]f Bell Atlantic in fact agreed to switching contracts that 'effectively froze prices on switching equipment,' those prices would reflect its idiosyncratic business judgement * * *'' GTE expresses concern that, under certain specifications of time, the regression equation produces investments for remote switch ''getting started'' costs that are negative and that such specifications overstate the decline in switch costs. As noted in the *Inputs Further Notice,* the HAI sponsors also caution that the large percentage price declines in switch prices seen in recent years may not continue. We affirm our tentative conclusion that the reciprocal form of time in the regression equation satisfies these concerns by yielding projections of switch purchase and installation costs that are positive yet declining over time.

229. Ameritech and GTE advocate the use of the Turner Price Index to convert the embedded cost information contained in the depreciation data to costs measured in current dollars. We note, however, that this index and the data underlying it are not on the public record. We prefer to rely on public data when available. Moreover, we affirm our tentative conclusion that it is not necessary to rely on this index to convert switch costs to current dollars. Rather, as described in the preceding paragraph, we will account for cost changes over time explicitly in the estimation process, rather than adopting a surrogate such as the Turner Price Index.

230. *Treatment of Switch Upgrades.* The book-value costs recorded in the depreciation data include both the cost of purchasing and installing new equipment and the cost associated with installing and purchasing subsequent upgrades to the equipment over time. Upgrades costs will be a larger fraction of reported book-value costs in instances where the book-value costs of purchasing and installing switching equipment are reported well after the initial installation date of the switch. We affirm our tentative conclusion that, in order to estimate the costs associated with the purchase and installation of new switches, and to exclude the costs associated with upgrading switches, we should remove from the data set those switches installed more than three years prior to the reporting of their associated book-value costs. We believe that this restriction will eliminate switches whose book values contain a significant amount of upgrade costs, and recognizes that, when ordering new switches, carriers typically order equipment designed to meet short-run demand.

231. Bell Atlantic criticizes the Commission for excluding a large percentage of the observations from the initial depreciation data set. As noted in the preceding paragraph, however, the observations that have been excluded do not accurately represent the price of a new switch.

232. We reject the suggestions of Ameritech, Bell Atlantic, BellSouth, GTE, and Sprint that the costs associated with purchasing and installing switching equipment upgrades should be included in our cost estimates. The model platform we adopted is intended to use the most cost-effective, forward-looking technology available at a particular period in time. The installation costs of switches estimated reflect the most cost-effective forward-looking technology for meeting industry performance requirements. Switches, augmented by upgrades, may provide carriers the ability to provide supported services, but do so at greater costs. Therefore, such augmented switches do not constitute cost-effective forward-looking technology. In addition, as industry performance requirements change over time, so will the costs of purchasing and installing new switches. The historical cost data employed in this analysis reflect such changes over time, as do the time-trended cost estimates.

233. *Additional Variables.* Several parties contend that additional independent variables should be included in our regression equation. Some of the recommended variables include minutes of use, calls, digital line connections, vertical features, and regional, state, and vendor-specific identifiers. For the purposes of this analysis, our model specification is limited to include information that is in

both the RUS and depreciation data sets. Neither data set includes information on minutes of use, calls, digital line connections, vertical features, or differences between host and stand-alone switches. State and regional identifiers are not included in the regression because we only have depreciation data on switches from 20 states. Thus, we could not accurately estimate region-wide or state-wide differences in the cost of switching. Our model specification also does not include vendor-specific variables, because the model platform does not distinguish between different vendors' switches.

234. *Switch Cost Estimates.* A number of commenters criticize the switch cost estimates contained in the *Inputs Further Notice* and suggest that they should be dismissed or substantially revised. For example, Sprint suggests that we dismiss the results because the data are collinear and the model is mis-specified. Bell Atlantic and BellSouth suggest that the Commission underestimates the cost of switches, while AT&T and MCI suggest that the Commission overestimates the cost of switches. The Commission's estimates, however, are based upon the most complete, publicly-available information on the costs of purchasing and installing new switches and therefore represent the Commission's best estimates of the cost of host and remote switches. We have addressed the specific objections that have been raised by parties with regard to the methodology, data set, or other aspects of the approach we adopt to derive switch cost estimates, and for the reasons given there, we reject those objections. We conclude that the remaining evidence provided as grounds for dismissing or substantially revising these estimates is largely anecdotal or unconfirmed and undocumented and does not lead us to believe that our estimates should be altered. We conclude, therefore, that the switch cost estimates we adopt are the best estimates of forward-looking cost.

B. Use of the Local Exchange Routing Guide (LERG)

235. In the *Inputs Further Notice,* we tentatively concluded that the Local Exchange Routing Guide (LERG) database should be used to determine host-remote switch relationships in the federal high-cost universal service support mechanism. We now affirm that conclusion. In the *1997 Further Notice,* the Commission requested ''engineering and cost data to demonstrate the most cost-effective deployment of switches in general and host-remote switching arrangements in particular.'' In the *Switching and Transport Public Notice,* the Bureau concluded that the model should permit individual switches to be identified as host, remote, or stand-alone switches. The Bureau noted that, although stand-alone switches are a standard component of networks in many areas, current deployment patterns suggest that host-remote arrangements are more cost-effective than stand-alone switches in certain cases. No party has placed on the record in this proceeding an algorithm that will determine whether a wire center should house a stand-alone, host, or remote switch. We therefore affirm our conclusion to use the LERG to determine host-remote switch relationships.

236. In the *Platform Order,* we concluded that the federal mechanism should incorporate, with certain modifications, the HAI 5.0a switching and interoffice facilities module. In its default mode, HAI assumes a blended configuration of switch technologies, incorporating both hosts and remotes, to develop switching cost curves. HAI also allows the user the option of designating, in an input table, specific wire center locations that house host, remote, and stand-alone switches. When the host-remote option is selected, switching curves that correspond to host, remote, and stand-alone switches are used to determine the appropriate switching investment. The LERG database could be used as a source to identify the host-remote switch relationships. In the *Platform Order,* we stated that ''[i]n the inputs stage of this proceeding we will weigh the benefits and costs of using the LERG database to determine switch type and will consider alternative approaches by which the selected model can incorporate the efficiencies gained through the deployment of host-remote configurations.''

237. The majority of commenters throughout this proceeding have supported the use of the LERG database as a means of determining the deployment of host and remote switches. These commenters contend that the use of the LERG to determine host-remote relationships will incorporate the accumulated knowledge and efficiencies of many LECs and engineering experts in deploying the existing switch configurations. Sprint contends that there are many intangible variables that can not be easily replicated in determining host-remote relationships. Commenters also contend that an algorithm that realistically predicts this deployment pattern is not feasible using publicly available data and would be unnecessarily ''massive and complex.'' AT&T and MCI argue, however, that use of the LERG to identify host-remote relationships may reflect the use of embedded technology, pricing, and engineering practices.

238. We conclude that the LERG database is the best source set forth in this proceeding to determine host-remote switch relationships in the federal high-cost universal service support mechanism. As noted, no algorithm has been placed on the record to determine whether a wire center should house a stand-alone, host, or remote switch. In addition, many commenters contend that development of such an algorithm independently would be difficult using publicly available data. While GTE suggests that the best source of host-remote relationships would be a file generated by each company, we note that no such information has been submitted in this proceeding. In addition, GTE's proposal would impose administrative burdens on carriers. We conclude that the use of the LERG to identify the host-remote switch relationships is superior to HAI's averaging methodology which may not, for example, accurately reflect the fact that remote switches are more likely to be located in rural rather than urban areas. We therefore conclude that use of the LERG is the most feasible alternative currently available to incorporate the efficiencies of host-remote relationships in the federal high-cost universal service support mechanism.

C. Other Switching and Interoffice Transport Inputs

239. *General.* In the *Inputs Further Notice,* we proposed several minor modifications to the switching inputs to reflect the fact that the studies on which the Commission relied to develop switch costs include all investments necessary to make a switch operational. These investments include telephone company engineering and installation, the main distribution frame (MDF), the protector frame (often included in the MDF), and power costs. To avoid double counting these investments, both as part of the switch and as separate input values, the commenters agree that the MDF/Protector investment per line and power input values should be set at zero. In addition, commenters agree that the Switch Installation Multiplier should be set at 1.0. We agree that including these investments both as part of the switch cost and as separate investments would lead to double counting of these costs. We therefore adopt these values.

240. *Analog Line Offset.* In the *Inputs Further Notice,* we tentatively

concluded that the ''Analog Line Circuit Offset for Digital Lines'' input should be set at zero. We now affirm that conclusion. AT&T and MCI contend that the switch investment in the model should be adjusted downward to reflect the cost savings associated with terminating digital, rather than analog, lines. AT&T and MCI assert that this cost savings is due primarily to the elimination of a MDF and protector frame termination. AT&T and MCI further contend that the model produces, on average, 40 percent digital lines, while the data used to determine switch costs reflect the use of only approximately 18 percent digital lines. In contrast, GTE contends that the model may calculate more analog lines than carriers have historically placed due to the use of an 18,000 feet maximum copper loop length.

241. AT&T and MCI suggest that the analog line offset input should reflect a $12 MDF and $18 switch port termination savings per line in switch investment for terminating digital lines in the model. Several commenters disagree and recommend setting the analog line offset to zero. Sprint contends that the analog line offset is inherent in the switching curve in the model, thus making this input unnecessary and, therefore, justified only if the switch cost curve is based on 100 percent of analog line cost. Sprint argues that an unknown mixture of analog and digital lines are taken into consideration in developing the switch curve.

242. The record contains no basis on which to quantify savings beyond those taken into consideration in developing the switch cost. We also note that the depreciation data used to determine the switch costs reflect the use of digital lines. The switch investment value will therefore reflect savings associated with digital lines. AT&T and MCI's proposed analog line offset per line is based on assumptions that are neither supported by the record nor easily verified. For example, it is not possible to determine from the depreciation data the percentage of lines that are served by digital connections. It is therefore not possible to verify AT&T and MCI's estimate of the digital line usage in the ''historical'' data. In the absence of more explicit support of AT&T and MCI's position, we conclude that the Analog Line Circuit Offset for Digital Lines should be set at zero.

243. *Switch Capacity Constraints.* In the *Inputs Further Notice,* we proposed to adopt the HAI default switch capacity constraint inputs as proposed in the HAI 5.0a model documentation. We now adopt that proposal. The forward-looking cost mechanism contains switch capacity constraints based on the maximum line and traffic capabilities of the switch. In their most recent filings on this issue, AT&T and MCI recommend increasing the switch line and traffic capacity constraints above the HAI input default values for those inputs. AT&T and MCI contend that the default input values no longer reflect the use of the most current technology. For example, AT&T and MCI recommend that the maximum equipped line size per switch should be increased from 80,000 to 100,000 lines.

244. We conclude that the original HAI switch capacity constraint default values are reasonable for use in the federal mechanism. We note that Sprint, the only commenter to respond to this issue, supports this conclusion. We also note that the HAI model documentation indicates that the 80,000 line assumption was based on a conservative estimate ''recognizing that planners will not typically assume the full capacity of the switch can be used.'' AT&T and MCI therefore originally supported the 80,000 line limitation as the maximum equipped line size value with the knowledge that the full capacity of the switch may be higher.

245. *Switch Port Administrative Fill.* In the *Inputs Further Notice,* we proposed a switch port administrative fill factor of 94 percent. We now adopt that proposed value. The HAI model documentation defines the switch port administrative fill as ''the percent of lines in a switch that are assigned to subscribers compared to the total equipped lines in a switch.'' HAI assigns a switch port administrative fill factor of 98 percent in its default input values. The BCPM default value for the switch percent line fill is 88 percent.

246. Bell Atlantic contends that switches have significant unassigned capacity due to the fact that equipment is installed at intervals to handle growth. Sprint recommends an average fill factor of 80 percent. US West contends that its actual average fill factor is 78 percent. AT&T and MCI contend that the switching module currently applies the fill factor input against the entire switch when it should be applied only to the line port portion of the switch. AT&T and MCI therefore contend that, either the formula should be modified, or the input needs to be adjusted upward so that the overall switching investment increase attributable to line fill will be the same as if the formula were corrected.

247. We note that the switch port administrative fill factor of 94 percent has been adopted in several state universal service proceedings and is supported by the Georgetown Consulting Group, a consultant of BellSouth. We also note that this value falls within the range established by the HAI and BCPM default input values. The BCPM model documentation established a switch line fill default value of 88 percent that included ''allowances for growth over an engineering time horizon of several years.'' Sprint has provided no substantiated evidence to support its revised value of 80 percent. US West's average fill factor of 78 percent is based on data that include switches with unreasonably low fill factors. Regarding AT&T and MCI's contention that the switching module currently applies the fill factor input against the entire switch rather than the line port portion of the switch, we note that this occurs only when the host-remote option is not utilized in the switch module. As noted, we are using the host-remote option and therefore no adjustment to the switch fill factor is required. We therefore adopt a switch port administrative fill factor of 94 percent.

248. *Trunking.* In the *Inputs Further Notice,* we tentatively concluded that the switch module should be modified to disable the computation that reduces the end office investment by the difference in the interoffice trunks and the 6:1 line to trunk ratio. In addition, we tentatively adopted the proposed input value of $100.00 for the trunk port investment. We now affirm these tentative conclusions and adopt this approach.

249. The HAI switching and interoffice module developed switching cost curves using the Northern Business Information (NBI) publication, ''U.S. Central Office Equipment Market: 1995 Database.'' These investment figures were then reduced per line to remove trunk port investment based on NBI's implicit line to trunk ratio of 6:1. The actual number of trunks per wire center is calculated in the transport calculation, and port investment for these trunks is then added back into the switching investments.

250. Sprint notes that, under the HAI trunk investment approach, raising the per-trunk investment leads to a decrease in the switch investment per line, ''despite a reasonable and expected increase'' in the investment per line. GTE also notes that the selection of the trunk port input value creates a dilemma in that it is used to reduce the end office investment, as noted, and to develop a tandem switch investment. GTE and Sprint recommend that the switch module be modified by disabling the computation that reduces the end office investment by the difference in

the computed interoffice trunks and the 6:1 line to trunk ratio. MCI agrees that the trunk port calculation should be deactivated in the switching module.

251. In the *Inputs Further Notice,* we agreed with commenters that the trunk port input creates inconsistencies in reducing the end office investment. Consistent with the suggestions made by GTE and MCI, we conclude that the switch module should be modified to disable the computation that reduces the end office investment by the difference in the computed interoffice trunks and the 6:1 line to trunk ratio. Sprint, the only commenter to address this issue in response to the *Inputs Further Notice,* agrees with our conclusion.

252. Because the trunk port input value is also used to determine the tandem switch investment, we must determine the trunk port investment. In the *Inputs Further Notice,* we proposed an input value for trunk port investment per end of $100.00. SBC and Sprint contend that this value should be higher—ranging from $150.00 to $200.00. BellSouth has filed information on the record that supports our proposed trunk port investment value. BellSouth notes that the four states that have issued orders addressing the cost of the trunk port for universal service have chosen estimates of the cost of the trunk port that range from $62.73 to $110.77. We conclude that the record supports the adoption of a trunk port investment per end of $100.00, as supported by the HAI default values. As noted, this value is consistent with the findings of several states and BellSouth. In addition, we note that SBC and Sprint provide no data to support their higher proposed trunk port investment value. We therefore adopt the HAI suggested input value of $100.00 for the trunk port investment, per end.

V. Expenses

A. Plant-Specific Operations Expenses

253. Consistent with our tentative conclusions, we adopt input values that reflect the average expenses that will be incurred by non-rural carriers, rather than a set of company-specific maintenance expense estimates. We adopt our proposed four-step methodology for estimating expense-to-investment ratios using revised current-to-book ratios and 1997 and 1998 ARMIS data. We clarify that the ARMIS investment and expense balances used to calculate the expense-to-investment ratios in steps three and four should be based on the accounts for all *non-rural* ARMIS-filing companies. Although some rural companies file ARMIS reports, the mechanism we adopt today will be used, beginning January 1, 2000, to determine high-cost support only for non-rural carriers. We find, therefore, that it is appropriate to include only data from the non-rural ARMIS-filing companies in calculating these expense-to-investment ratios.

254. *Current Data.* Parties commenting on whether we should update our methodology using more current ARMIS data agree that we should use the most currently available data. We obtained account-specific current-to-book ratios for the related plant investment accounts, for the years ending 1997 and 1998, from Ameritech, Bell Atlantic, BellSouth, GTE, and SBC. Accordingly, we adopt input values using these updated current-to-book ratios and 1997 and 1998 ARMIS data to calculate the expense-to-investment ratios that we use to obtain plant-specific operations expense estimates for use in the federal mechanism.

255. *Nationwide Estimates.* As discussed in this section, we adopt nationwide average values for estimating plant-specific operations expenses rather than company-specific values for several reasons. We reject the explicit or implicit assumption of most LEC commenters that the cost of maintaining incumbent LEC embedded plant is the best predictor of the forward-looking cost of maintaining the network investment predicted by the model. We find that, consistent with the *Universal Service Order's* criteria, forward-looking expenses should reflect the cost of maintaining the least-cost, most-efficient, and reasonable technology being deployed today, not the cost of maintaining the LECs' historic, embedded plant. We recognize that variability in historic expenses among companies is due to a variety of factors and does not simply reflect how efficient or inefficient a firm is in providing the supported services. We reject arguments of the LECs, however, that we should capture this variability by using company-specific data in the model. We find that using company-specific data for federal universal service support purposes would be administratively unmanageable and inappropriate. Moreover, we find that averages, rather than company-specific data, are better predictors of the forward-looking costs that should be supported by the federal high-cost mechanism. In addition, we find that using nationwide averages will reward efficient companies and provide the proper incentives to inefficient companies to become more efficient over time, and that this reward system will drive the national average toward the cost that the competitive firm could achieve. Accordingly, we affirm our tentative conclusion that we should adopt nationwide average input values for plant-specific operations expenses.

256. AT&T and MCI agree with our tentative conclusion that we should adopt input values that reflect the average expenses incurred by non-rural carriers, rather than company-specific expenses. They argue that the universal service support mechanism should be based on the costs that an efficient carrier *could* achieve, not on what any individual carriers *has* achieved. In contrast, incumbent LEC commenters argue that we should use company-specific values.

257. BellSouth, for example, contends that the approach suggested by AT&T and MCI conflicts with the third criterion for a cost proxy model, which states that ''[t]he study or model, however, must be based upon an examination of the current cost of purchasing facilities and equipment * * *.'' BellSouth argues that the ''only logical starting point for estimating forward-looking expenses is the current actual expenses of the ILECs.'' We agree that we should start with current actual expenses, as we do, in estimating forward-looking maintenance expenses. We do not agree with the inferences made by the incumbent LEC commenters, however, that our input values should more closely match their current maintenance expenses.

258. BellSouth's reliance on criterion three fails to quote the first part of that criterion, which states:

> Only long-run forward-looking economic cost may be included. The long-run period must be a period long enough that all costs may be treated as variable and avoidable. The costs must not be the embedded cost of facilities, functions, or elements.

Thus, the model's forward-looking expense estimates should not reflect the cost of maintaining the incumbent LEC's embedded plant. The *Universal Service Order's* first criterion specifies that ''[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.'' As we explained in the *Inputs Further Notice,* while the synthesis model uses existing incumbent LEC wire center locations in designing outside plant, it does not necessarily reflect existing incumbent LEC loop plant. Indeed, as the Commission stated in the *Platform Order,* ''[e]xisting incumbent LEC plant is not likely to reflect forward-looking technology or design choices.'' Thus, for example, the model may design outside plant with more fiber and DLCs and less copper cable than has been deployed historically in an incumbent LEC's network. We find that the forward-looking maintenance expenses also should reflect changes in technology.

259. GTE argues that expense-to-investment ratios should not be developed as national averages, because no national average can reflect the composition of each company's market demographics and plant. GTE argues further that costs vary by geographic area and that this variability reflects operating difficulties due to terrain, remoteness, cost of labor, and other relevant factors. GTE contends that ''[u]sing national average operating expenses will either understate or overstate the forward-looking costs of providing universal service for each carrier, depending on the variability of each company to the average.'' GTE claims that the use of the national average penalizes efficient companies that operate in high-cost areas.

260. Similarly, Sprint contends that the use of nationwide estimated data does not accurately depict the realities of operating in Sprint's service territories. Sprint claims that the national averages are far below Sprint's actual costs, because the Commission's methodology for estimating plant-specific expense inputs is heavily weighted toward the Bell companies' urban operating territories. According to Sprint, the Bell companies have a much higher access line density than Sprint, and the expense data from such companies with a higher density of customers will result in expense levels that are much lower than the expense levels experienced by smaller carriers. AT&T and MCI respond by showing that a particular small carrier, serving a lower density area than Sprint, has plant-specific expenses that, on a per-line basis, are less than half of Sprint's expenses. AT&T and MCI claim that ''the most significant driver of cost differences between carriers in the ARMIS study area data is *efficiency*.'' Like other LECs, SBC argues that the costs for LECs vary dramatically, based on various factors including size, operating territories, vendor contracts, relationships with other utility providers and the willingness to accept risk. SBC asserts that ''[t]hese differences are not in all instances attributable to inefficient operations.''

261. We agree with SBC that not all variations in costs among carriers are due to inefficiency. Although we believe that some cost differences are attributable to efficiency, we are not convinced by AT&T and MCI's example that Sprint is less efficient than the small carrier they identify. Sprint could have higher maintenance costs because it provides higher quality service. But we also are not convinced by Sprint's argument that maintenance expenses necessarily are inversely proportional to density. Sprint provides no evidence linking higher maintenance costs with lower density zones, and we can imagine situations where there are maintenance costs in densely populated urban areas that are not faced by carriers in low density areas. For example, busy streets may need to be closed and traffic re-routed, or work may need to be performed at night and workers compensated with overtime pay.

262. We cannot determine from the ARMIS data how much of the differences among companies are attributable to inefficiency and how much can be explained by regional differences or other factors. BellSouth's consultant concedes that there is nothing in the ARMIS expense account data that would enable the Commission to identify significant regional differences. GTE concedes that it may be difficult to analyze some data because companies have not been required to maintain a sufficient level of detail in their publicly available financial records. GTE's proposed solution for reflecting variations among states is simply to use company-specific data. Indeed, none of the LECs propose a specific alternative to using self-reported information from companies. For example, SBC argues we should use company-specific expenses provided pursuant to the *Protective Order* to develop company-specific costs, because these are the costs that will be incurred by the providers of universal service.

263. While reliance on company-specific data may be appropriate in other contexts, we find that, for federal universal service support purposes, it would be administratively unmanageable and inappropriate. The incumbent LECs argue that virtually all model inputs should be company-specific and reflect their individual costs, typically by state or by study area. As parties in this proceeding have noted, selecting inputs for use in the high-cost model is a complex process. Selecting different values for each input for each of the fifty states, the District of Columbia, and Puerto Rico, or for each of the 94 non-rural study areas, would increase the Commission's administrative burden significantly. Unless we simply accept the data the companies provide us at face value, we would have to engage in a lengthy process of verifying the reasonableness of each company's data. For example, in a typical tariff investigation or state rate case, regulators examine company data for one-time high or low costs, pro forma adjustments, and other exceptions and direct carriers to adjust their rates accordingly. Scrutinizing company-specific data to identify such anomalies and to make the appropriate adjustments to the company-proposed input values would be exceedingly time consuming and complicated given the number of inputs to the model. We recognize that such anomalies invariably exist in the ARMIS data, but we find that, by using averages, high and low values will cancel each other out.

264. Where possible, we have tried to account for variations in cost by objective means. As we stated in the *Inputs Further Notice*, we believe that expenses vary by the type of plant installed. The model takes this variance into account because, as investment in a particular type of plant varies, the associated expense cost also varies. The model reflects differences in structure costs by using different values for the type of plant, the density zone, and soil conditions.

265. As discussed, we cannot determine from the ARMIS data how much of the differences among companies are attributable to inefficiency and how much can be explained by regional differences or other factors. To the extent that some cost differences are attributable to inefficiency, using nationwide averages will reward efficient companies and provide the proper incentives to inefficient companies to become more efficient over time. We find that it is reasonable to use nationwide input values for maintenance expenses because they provide an objective measure of forward-looking expenses. In addition, we find that using nationwide averages in consistent with our forward-looking economic cost methodology, which is designed to send the correct signals for entry, investment, and innovation.

266. Bell Atlantic contends that using nationwide averages for plant specific expenses, rather than ARMIS data disaggregated to the study area level, defeats the purpose of a proxy model because it averages high-cost states with low-cost states. Bell Atlantic argues that we should use the most specific data inputs that are available, whether region-wide, company specific, or study-area specific. Conceding that data are not always available at fine levels of disaggregation, Bell Atlantic contends there is no reason to throw out data that more accurately identify the costs in

each area. Bell Atlantic argues that, even if the Commission does not have current-to-book ratios for all of the ARMIS study areas, it could use average current-to-book ratios and apply them to company-specific ARMIS data.

267. Contrary to Bell Atlantic's contention, we do not find that using nationwide average input values in the federal high-cost mechanism is inconsistent with the purpose of using a cost model. In addition to the administrative difficulties outlined, we find that nationwide values are generally more appropriate than company-specific input values for use in the federal high-cost model. In using the high-cost model to estimate costs, we are trying to establish a national benchmark for purposes of determining support amounts. The model assumes, for example, that all customers will receive a certain quality of service whether or not carriers actually are providing that quality of service. Because differences in service quality can cause different maintenance expense levels, by assuming a consistent nationwide quality of service, we control for variations in company-specific maintenance expenses due to variations in quality of service. Clearly, we are not attempting to identify any particular company's cost of providing the supported services. We are, as AT&T and MCI suggest, estimating the costs an efficient provider would incur in providing the supported services. We are not attempting to replicate past expenses, but to predict what support amounts will be sufficient in the future. Because high-cost support is portable, a competitive eligible telecommunications carrier, rather than the incumbent LEC, may be the recipient of the support. We find that using nationwide averages is a better predictor of the forward-looking costs that should be supported by the federal high-cost mechanism than any particular company's costs.

268. *Estimating regional wage differences.* We do not adjust our nationwide input values for plant-specific operations expenses to reflect regional wage differences. Most LEC commenters advocate the use of company-specific data to reflect variations in wage rates. GTE, for example, claims that regional wage rate differentials are reflected in the company-specific data available from ARMIS. GTE complains that our proposed input values suggest there is no difference in labor and benefits costs between a company operating in Los Angeles and one operating in Iowa. As discussed, the publicly available ARMIS expense account data for plant-specific maintenance expenses do not provide enough detail to permit us to verify significant regional differences among study areas or companies based solely on labor rate variations. For the reasons discussed, we find that we should not use company-specific ARMIS data to estimate these expenses, but instead use input values that reflect nationwide averages.

269. Although they would prefer that we use company-specific data, some LEC commenters suggest that the wage differential indexes used by the President's Pay Agent, on which we sought comment, would be an appropriate method of disaggregating wage-related ARMIS expense data. GTE, on the other hand, contends that these indexes are not relevant to the telecommunications industry, because they are designed for a specific labor sector, that is, federal employees. GTE claims that there are numerous publicly available sources of labor statistics and that, if we adopt an index factor, it should be specific to the telecommunications industry.

270. We agree with GTE that, if we were to use an index to adjust our input values for regional wage differences, it would be preferable to use an index specific to the telecommunications industry. We looked at other publicly available sources of labor statistics, however, and were unable to find a data source that could be adapted easily for making meaningful adjustments to the model input values for regional wage differences. Specifically, we looked at U.S. Department of Labor, Bureau of Labor Statistics (BLS) information on wage rate differentials for communications workers comparing different regions of the country. The Employment Cost Indexes calculated by BLS identify changes in compensation costs for communications workers as compared to other industry and occupational groups. In a number of the indexes, communications is not broken out separately, but is included with other service-producing industries: transportation, communication, and public utilities; wholesale and retail trade; insurance, and real estate; and service industries. In making regional comparisons, the Employment Cost Indexes divide the nation into four regions: northeast, south, midwest, and west. There also are separate indexes comparing metropolitan areas to other areas.

271. We find that the regions used in the BLS data are too large to make any significant improvement over our use of nationwide average numbers. For example, Wyoming is in the same region as California, but we have no reason to believe that wages in those two states are more comparable than wages rates in California and Iowa. That is, there is no simple way to use the BLS data to make the type of regional wage adjustments suggested by GTE. We note that no party has suggested a specific data source or methodology that would be useful in making such adjustments. Accordingly, we decline to adopt a method for adjusting our nationwide input values for plant-specific operations expenses to reflect regional wage differences.

272. *Methodology.* As discussed in this section, we adopt our proposed methodology for calculating expense-to-investment ratios to estimate plant-specific operations expenses. We reject arguments of some LEC commenters that this methodology inappropriately reduces these expense estimates.

273. Several LEC commenters generally support our methodology for calculating expense-to-investment ratios to estimate plant-specific operations expenses, although, as discussed, only if we use company-specific input values. For example, GTE agrees with our tentative conclusion that input values for each plant-specific operations expense account can be calculated as the ratio of booked expense to current investment, but only if this calculation is performed on a company-specific basis. BellSouth states that ''[t]he methodology proposed by the Commission for plant-specific expenses is very similar to the methodology employed by BellSouth.''

274. Other LEC commenters object to our use of current-to-book ratios to convert historic account values to current cost. Although their arguments differ somewhat, they essentially claim that the effect of our methodology is to reduce forward-looking maintenance expenses and that this is inappropriate because the input values are lower than their current maintenance expenses. AT&T and MCI counter that, if there is any problem with our maintenance expense ratios, it is that they reflect the servicing of too much embedded plant, which has higher maintenance costs, and too little forward-looking plant, which has lower maintenance costs.

275. US West asserts that, while in theory it is correct to adjust expense-to-investment ratios using current-to-book ratios, in practice there is a problem because the current-to-book ratio is based on reproduction costs and the model estimates replacement costs. US West defines reproduction cost as the cost of reproducing the existing plant using today's prices and replacement cost as the cost of replacing the existing plant with equipment that harnesses new technologies and is priced at

today's prices. US West claims that our methodology actually increases the mismatch between historic and forward-looking investment levels because the reproduction costs are not the same as the replacement costs. We agree that reproduction costs are not the same as replacement costs because the mix of equipment and technology will differ, but we disagree with US West's characterization of this as a mismatch.

276. US West estimates that applying current-to-to book ratios to existing investment would generate reproduction costs that are 141 percent higher than historic costs. US West claims that, in contrast, forward-looking models generally show that the cost of replacing those facilities would be slightly less than historic costs, if new technologies were deployed. US West's claim that our methodology results in a mismatch because of these cost differences, however, is wrong. Rather, the differences between reproduction costs and replacement costs merely show that the mix of technologies has changed. The hypothetical example US West uses to illustrate its argument fails to account for changes in technology. The following hypothetical example illustrates how changes in the mix of technology will change maintenance expenses. If historic investment on a company's books consists of 100 miles of copper plant, at a cost of $10 per mile, and 10 miles of fiber plant, at a cost of $1 per mile, then the historic cost is $1010. If current maintenance costs are $10 for the copper plant and $0.10 for the fiber plant, the total maintenance expense is $10.10. If the price of copper increases to $15 per mile and the price of fiber decreases to 80 cents per mile, then the reproduction costs would increase to $1508. If the forward-looking model designs a network with 60 miles of copper and 50 miles of fiber, the resulting replacement cost is $940. Using our methodology, we use the current-to-book ratios of 1.5 ($15/$10) and .8 (80 cents divided by $1) to revalue the copper and fiber investment, respectively, at current prices, and the resulting maintenance expense for the forward-looking plant would be $6.58 rather than $10.10. This does not result in a mismatch. In our hypothetical example, the maintenance costs for fiber were substantially less on a per-mile basis than they were for copper. Thus, we would expect the forward-looking plant with considerably more fiber and less copper to have lower maintenance costs than the current plant, which has more copper. Because the mix of plant changes, the Commission should not, as US West suggests, simply adjust book investment to current dollars to derive maintenance expenses for the forward-looking plant estimated by the model.

277. Sprint argues that we should simply divide the current year's actual expense for each account by the average plant balance associated with that expense. Sprint claims that, when this ratio is applied to the investment calculated by the model, forward-looking expense reductions occur in two ways: (1) the investment base is lower due to the assumed economies of scale in reconstructing the forward-looking network all at one time; and (2) greater use of fiber in the forward-looking network reduces maintenance costs because less maintenance is required of fiber than of the copper in embedded networks. Sprint claims that reducing maintenance for a current-to-book ratio as well as for technological factors constitutes a ''double-dip'' in maintenance expense reduction.

278. Sprint's claim that our methodology constitutes a ''double dip'' in reducing maintenance expenses is misleading because the effect of using current-to-book ratios depends upon whether current costs have risen or fallen relative to historic costs. Current-to-book ratios are used to restate a company's historic investment account balances, which reflect investment decisions made over many years, in present day replacement costs. Thus, if current costs are higher than historic costs for a particular investment account, the current-to-book ratio will be greater than one, and the expense-to-investment ratio for that account will decrease when the investment (the denominator in the ratio) is adjusted to current replacement costs. Sprint calls this double dipping because copper costs have risen and the model uses less copper plant than that which is reflected on Sprint's books. If current costs are lower than historic cost, however, the current-to-book ratio will be less than one and the adjusted expense-to-investment ratio for that account will increase when the investment (the denominator in the ratio) is adjusted to current replacement costs. Fiber cable and digital switching costs, for example, have fallen relative to historic costs. Sprint essentially is arguing that our methodology is wrong because it understates Sprint's historical costs. The input values we select are not intended to replicate a particular company's historic costs, for the reasons discussed.

279. SBC disputes our assumption that the model takes into account variations in the type of plant installed because, as investment in a particular type of plant varies, so do the associated expense costs. SBC argues that expenses do not vary simply because investment varies. Nonetheless, SBC believes that developing a ratio of expense to investment and applying it to forward-looking investments is a reasonable basis for identifying forward-looking plant specific expenses. SBC complains that our methodology is inconsistent, however, because it has defined two completely different sets of forward-looking investments: one based on historical ARMIS investments adjusted to current amounts; and another derived on a bottom-up basis employing the cost model. Until we reconcile these ''inconsistencies,'' SBC recommends that we use unadjusted historical investment amounts in developing plant specific expense factors, because they are closer to SBC's historical plant specific expenses.

280. Although they characterize the issue somewhat differently, US West, Sprint, and SBC essentially argue that our methodology is wrong because it understates their historical costs. AT&T and MCI counter that a forward-looking network often will result in lower costs than an embedded network and that the trend in the industry has been to develop equipment and practices to minimize maintenance expense. AT&T and MCI claim that, if there is any problem with our maintenance expense ratios, it is that they reflect the servicing of too much embedded plant, which has higher maintenance costs, and too little forward-looking plant, which has lower maintenance costs. AT&T and MCI further claim that, if our analysis had been based exclusively on financial information that reflected equipment consistent with the most-efficient forward-looking practices, the maintenance expenses would have been lower.

281. None of the commenters provide a compelling reason why we should not use current-to-book ratios to adjust historic investment to current costs. SBC in fact suggests that the Commission consider using the Telephone Plant Index (TPI) in future years to convert expense estimates to current values. SBC appears to be confusing the effect of measuring inputs in current dollars, which it recognizes is reasonable, and the end result of the calculation, which includes the impact of measuring all inputs in current dollars, changes in the mix of inputs, the impact of least-cost optimal design used by the model, and the model's engineering criteria. The relationship between maintenance costs and investment in the Commission's

methodology is related to all of these factors.

282. Sprint also claims that our methodology understates maintenance costs, because it assumes new plant and the average maintenance rate will be higher than the rate in an asset's first year. AT&T and MCI dispute Sprint's claim that maintenance costs per unit of plant increase over time. Sprint provides an example which purports to show that an asset with a ten year life, a ten percent maintenance fee in the first year, and annual costs increasing annually at three percent, would result in an average maintenance rate of 11.55 percent. Sprint's example, however, does not consistently apply our methodology. Sprint's example fails to apply the current-to-book ratio to the total and average plant in service estimates used in the example. When the current-to-book ratio is applied to the total and average plant in service estimates, the resulting maintenance rate is ten percent for all years.

283. BellSouth argues that the investment calculated by the model is unrealistically low because sharing assigned to the telephone company is unrealistically low and fill factors are unrealistically high. BellSouth argues that, because it has shared in cost of trenching, this does not mean the maintenance cost for buried cable would be less, and in fact, the costs may be higher. BellSouth apparently is confused about the Commission's methodology, because the sharing percentages apply only to the costs of structure, not the costs of the cable.

B. Common Support Services Expenses

284. Consistent with our tentative conclusions, we adopt input values that estimate the average common support services expenses that will be incurred by non-rural carriers on a per-line basis, rather than a set of company-specific common support services expenses. We affirm our tentative conclusion that input values for corporate operations, customer service, and plant non-specific expenses should be estimated on a nationwide basis, rather than a more disaggregated basis. As noted, we find that for universal service purposes nationwide averages are more appropriate than company-specific values. We conclude that we should use Specification 1 of our proposed regression methodology to estimate expenses for ARMIS accounts 6510 (Other Property, Plant, and Equipment); 6530 (Network Operations); 6620 (Service Expense/Customer Operations); and 6700 (Executive, Planning, General, and Administrative). As discussed, we use an alternative methodology to estimate expenses for ARMIS account 6610 (Marketing). We conclude that we should use 1998 ARMIS data in both methodologies, and an estimate of 1998 Dial Equipment Minutes of Use (DEMs) in the regression equation, to calculate these input values. We clarify that the ARMIS data we use to calculate these estimates are based on ARMIS accounts for all *non-rural* ARMIS-filing companies. We find that it is appropriate to include only data from the non-rural ARMIS-filing companies in calculating the expense per line for common support services expenses.

285. *Current Data and Use of Productivity Factor.* The input values we adopt in this Order contains a summary of the per-line, per-month input values for plant non-specific expenses, corporate operations expenses, and customer services expenses, including regression results, calculations, and certain adjustments made to the data based on the methodologies described. Because we used 1996 ARMIS data in our regression methodology to estimate our proposed input values for common support services expenses, we proposed a method of converting those estimates to 1999 values. Specifically, we proposed using a productivity factor of 6.0 percent for the years 1997 and 1998 to reduce the estimated input values. We further proposed adjusting the expense data for those years with an inflation factor based on the Gross Domestic Product Price Index (GDP–PI) in order to bring the input values up to current expenditure levels.

286. AT&T and MCI claim that the 6.0 productivity factor is too low, while most LEC commenters contend that it is too high. Sprint argues that expenses should not be adjusted for a productivity or an inflation factor and that we should use 1998 data. GTE argues that no productivity adjustments are necessary, if we use current, company-specific ARMIS data to develop input values. Although we generally decline to adopt company-specific input values for common support services expenses, we agree that using the most currently available ARMIS data (1998) obviates the need to adjust our estimates for either productivity gains or an inflation factor at this time. We believe, however, that there should be an incentive for increased productive efficiency among carriers receiving high-cost universal service support. Accordingly, we believe that a reasonable productivity measure or some other type of efficiency incentive to decrease costs associated with common support services expenses should be incorporated into the universal service high-cost support mechanism in the future. We intend to address this issue in the proceeding on the future of the model.

287. The input values we adopt in this Order are estimates of the portion of company-wide expenses that should be supported by the federal high-cost mechanism. We derive the estimates using standard economic analysis and forecasting methods. The analysis relies on publicly available 1998 ARMIS expense data and the most current minutes of use information from NECA. This data is organized by study area. The estimate of 1998 DEMs is based on a calculated growth rate of 1997 to 1996 DEMs reported by NECA. As a result of deleting rural ARMIS-filing companies and including company study area changes since 1996, pooling of the 1998 data sets provides expense, minutes of use, and line count data for 80 study areas. This is in comparison to the 91 study areas resulting from pooling the 1996 data described in the *Inputs Further Notice.*

288. Some parties object to our using data at the study area level, because they claim that ARMIS-filing companies report data in two distinct ways. Ameritech and US West argue that parent companies generally assign a significant portion of plant non-specific and customer operations expenses across their operating companies on the basis of an allocation mechanism. As a result, they claim that a simple regression on the study area observations will produce coefficients that reflect a blend of two relationships: the cost-based relationship and the allocation-based relationship, of which only the former is appropriate to measure. They argue further that it is necessary to model the allocation method explicitly, to net out the latter data, or to aggregate the data to the parent company level. Although we acknowledge that our accounting rules provide carriers with some flexibility, we expect that the allocation mechanism used by the parent company represents underlying cost differences among its study areas. We find that it is reasonable to assume that the companies use allocation mechanisms that are based on cost relationships to allocate costs among their study areas. Accordingly, we find that it is reasonable to use ARMIS data at the study area level in the regression methodology.

289. *Regression Methodology.* As described in the *Inputs Further Notice,* we adopt standard multi-variate regression analysis to determine the portion of corporate operations expenses, customer services expenses,

and plant non-specific expenses attributable to the services that should be supported by the federal high-cost mechanism. We adopt an equation (Specification 1) which estimates total expenses per line as a function of the percentage of switched lines, the percentage of special lines, and toll minutes per line. We use this regression methodology to estimate the expenses attributable to universal service for the following accounts:

Other Property, Plant, and Equipment (6510); Network Operations (6530); Service Expense/Customer Operations (6620); and Executive, Planning, General and Administrative (6700).

We adopt this specification, rather than an average of the two specification estimates suggested in the *Inputs Further Notice,* to separate the portion of expenses that could be estimated as attributable to special access lines and toll usage, which are not supported by the federal high-cost mechanism, from switched lines and local usage. As explained, we use an adjusted weighted average of study areas to estimate the support expense attributable to Account 6610, Marketing.

290. Several parties contend that our regression analysis is flawed. Sprint, for example, claims that we have exaggerated the significance of our statistical findings beyond a level justified by the regression result; and have made the often-committed error of interpreting our regression results in a way that implies causality. US West argues that, although there is a causal relationship between the level of expenses and the variables we use in the regression, the coefficient of determination or R^2 is fairly low, which implies that the causal relationship only explains a small portion of the total costs. GTE claims that our regression is mis-specified because it utilizes only the mix of output as explanatory variables, and excludes important variables related to differences in input prices and production functions. Because of this mis-specification and the omitted variables, GTE also claims that our equations have a low predictive ability, as measured by the R^2s.

291. We disagree with commenters who claim that there is little explanatory value in our regression analysis. In accounts 6620, 6700, 6530 the regressions explain a high degree of the variability in the expense variables. Only account 6510 (Other Property, Plant, and Equipment) has a low R^2, which is not surprising given the reported data in this account. Based on the 1998 ARMIS data, the resulting regression coefficient for this expense category is negative due to the numerous negative expenses reported by carriers in 1998. Because the ARMIS reports represent actual 1998 expenses incurred by the non-rural telecommunications companies within their various study areas, we find that it is appropriate to include this negative expense in our calculations. We note, however, that inclusion of this account in our calculations represents less than one percent of the total expense input for common support services expenses.

292. We believe that our regressions represent a cost-causative relationship, and that common support services expenses are a function of the number of total lines served, plus the volume of minutes. Because in the long run, all costs are variable, we disagree with commenters who suggest that our methodology is flawed because we do not include an intercept term in our regression equation to represent fixed or start-up costs. As discussed, the model is intended to estimate long-run forward-looking cost over a time period long enough so that all costs may be treated as variable and avoidable. Moreover, the federal high-cost mechanism calculates support on a per-line basis, which is distributed to eligible carriers based upon the number of lines they serve. We would not provide support to carriers with no lines. Nor would we vary support, which is portable, between an incumbent and a competitive eligible telecommunications carrier, based on differences in their fixed or start-up costs. We explicitly assume, therefore, that if a company has zero lines and zero minutes, it should have zero expenses. Thus, we have no constant or fixed cost in our regressions. We also believe that these expenses are driven by the number of channels, not the number of physical lines.

293. That is, our assumptions imply that expenses are a linear function of lines and minutes. We next need to separate out the common support services expenses related to special access lines and toll minutes, because these services are not supported by the federal high-cost mechanism. Therefore, we split the lines variable into switched and special access lines, and we split the minutes variable into local and toll minutes. In this modified equation, expenses are a function of switched lines, plus special access lines, plus local minutes, plus toll minutes. We believe that changes in local minutes, however, should not cause changes in common support services expenses that are not already reflected in the expenses associated with switched lines. We find that it is reasonable to assume that local calls do not increase these overheard costs in the same way that toll minutes do. For example, in most jurisdictions local calls are a flat-rated service and additional local calling requires no additional information on the customer's bill. With toll calling, however, even subscribers that have some kind of a calling plan receive detailed information about those calls. It is reasonable to assume that adding an additional line on a subscriber's bill for a toll call causes overhead costs that are not caused by local calls. Moreover, toll calling outside a carrier's serving area involves the costs associated with completing that call on another carrier's network. As discussed, we tested our assumption that local calls do not affect costs in the same way that toll calls do by running the regressions to include local minutes. Based on theory and our analysis, we decided to drop the local minutes variable, so that expenses are a function of switched lines, plus special access lines, plus toll minutes. Because we are calculating a per-line expense estimate, we divide all the variables by the total number of lines to derive our final equation: expenses divided by total lines equals the percentage of switched lines, plus the percentage of special lines, plus toll minutes divided by total lines.

294. US West claims that our regressions may not be based on appropriate cost-causative relationships, because we count special access lines by channels and not by physical pairs. The ARMIS data used in the regressions count special lines as channels. That is, special access lines are counted as DS0 equivalents: a DS1 has 24 channels, and a DS3 has 672 channels. US West contends that it is far from clear how this method of counting special access lines reflects how these services cause expenses, because it is clear that DS1s and DS3s are not priced as if they cause 24 and 672 times the amount of expenses as a narrowband line.

295. The fact that DS1s and DS3s are priced differently in the current marketplace does not imply that it is improper to count lines as channels. US West's suggested alternative, counting special lines as physical pairs, would assume that a residential customer with two lines causes the same amount of overhead expenses as a special access customer with one DS1 line. To the contrary, we find that it is reasonable to assume that more overhead expenses are devoted to winning and keeping the DS1 customer than the residential customer. Further, we expect that more overhead expenses are related to customers using higher capacity services than those using lower capacity

services. Accordingly, we find that it is reasonable to use channel counts in our regression equations.

296. Some commenters also criticized our regression analysis on the grounds that variables are highly correlated and that the predicted coefficients are not stable. In particular, US West claims that the confidence intervals and standard errors are large and that a dividing-the-sample experiment leads to drastically different results. While these commenters are correct that the correlation values are high for the raw variables, the values are not high once the variables under consideration are adjusted by dividing by total lines. We find that the correlation values are all very reasonable. We note, in particular, the −1 correlation between switched lines and special lines. The fact that switched lines plus special lines equals one is the reason the regression cannot be run with a separate constant. We note that our parameterization has switched lines, special lines, and toll minutes as explanatory variables. We have chosen not to include local minutes in our regressions for theoretical reasons. So, the key correlation values are the correlations of toll minutes with special lines and with switched lines. We find that those values are reasonable.

297. Several commenters suggested that we use local minutes as an explanatory variable. Despite our tentative conclusion that our regressions should not include local minutes as a variable, in response to these comments, we re-ran each of the regressions with local minutes per line as an additional variable. In three of the four regressions, the coefficient for local minutes was not significant at the five percent level, and for account 6700, its sign was the opposite of what was expected. The resulting difference in the estimated expenses attributable to supported services was very small in magnitude as well. If we used the local minutes variable in our parameterization, after summing across all expense accounts, our per-line, per-month estimate for a switched line would be approximately $0.01 more. Given our belief that local minutes should not influence these expenses, the lack of significance in the coefficients, and the overall lack of impact when the variable was consistently included in the regressions, we conclude that we should not include local DEMs per line in our specifications.

298. Except for the inclusion of local minutes as a variable, no commenters have suggested a better parameterization or methodology for using the ARMIS data to estimate expense inputs for these accounts. Further, no commenters have suggested an alternative publicly available data set to use for our estimation of expense input values. We acknowledge that there is substantial variation in the underlying expense data taken from the ARMIS reports. Common support services expenses often contain charges unrelated to the specified relationships in the regression equation. For example, there are many one-time expenses and non-recurring charges associated with these accounts. We have tried to limit the effect of this problem by making adjustments to the expense data, as discussed. Given the data limitations and the parameterization we have chosen, we find that the estimated coefficients are the best estimate of the applicable expenses, regardless of the resulting standard errors.

299. *Removal of One-Time Expenses.* In the *Inputs Further Notice,* we discussed our efforts to adjust estimates of common support services expenses to account for one-time and non-recurring expenses. We sought comment on the need for information about and estimates of various types of exogenous costs and common support service expenses that are recovered through non-recurring charges and tariffs. These expenses include specific one-time charges for the cost of mergers or acquisitions and process re-engineering, and network and interexchange carrier connection, disconnection, and re-connection (*i.e.,* churn) costs.

300. In the *Inputs Further Notice,* we tentatively concluded that we should not use an analysis submitted by AT&T and MCI to estimate one-time and non-recurring expenses for corporate and network operations expenses. This analysis averaged five years (1993–1997) of data from Security and Exchange Commission (SEC) 10–K and 10–Q filings for all tier one companies to identify and calculate a percentage estimate of corporate and network operations expenses classified as one-time and non-recurring charges associated with these types of activities. Our tentative conclusion not to rely on the AT&T and MCI analysis to make these adjustments was based on the fact that we were using 1996 ARMIS data to estimate the expense inputs. Because the SEC reports do not indicate whether the one-time expenses were actually made solely during a specific year indicated, we tentatively concluded that we could not use the analysis' five year average or the actual 1996 SEC figures to make adjustments to the 1996 ARMIS data. In the *Inputs Further Notice,* we noted however that the AT&T and MCI analysis indicates that one-time expenses for corporate and network operations can be significant. We sought comment on how to identify and estimate one-time and non-recurring expenses associated with these common support services.

301. AT&T and MCI disagree with our tentative decision to reject their one-time cost estimates and argue that it is better to estimate one-time costs through use of the SEC reports, although these reports may imperfectly establish the precise date of the occurrence, than to fail to exclude these costs at all. Although some LEC commenters may agree that we should adjust our estimates to exclude one-time and non-recurring expenses, they provide no data or methodology to accomplish this, other than suggesting that we should get this information from the companies. GTE claims that unless companies implement specific tracking mechanisms, these data are not generally or easily identified after the fact.

302. We now reconsider our tentative conclusion not to use the analysis submitted by AT&T and MCI to adjust our network and corporate operations expense estimates to account for one-time and non-recurring expenses. We do so for a number of reasons. First, we received no additional information on publicly available data sources or other reasonable methods to estimate these one-time and non-recurring costs at this time. Second, the problems associated with determining the actual costs of 1996 one-time expenses based on the SEC reports are obviated because we are using 1998 expense data to estimate the forward-looking input values. We find that using the estimated average of one-time costs over the five preceding years (1993–1997) to adjust 1998 data is a reasonable method to determine the impact of costs related to mergers and acquisitions and work force restructuring. Further, we believe any adjustments for one-time costs based on the AT&T and MCI analysis may be biased downward after comparing the number of companies involved in these types of activities in 1998 and 1999 to those in 1993–1997. Accordingly, we adjust downward estimated expenses in account 6530 (Network Operations) by 2.6 percent and in account 6700 (Executive, Planning, General, and Administrative) by 20 percent.

303. *Removal of Non-Supported Expenses.* In the *Inputs Further Notice,* we also discussed our efforts to adjust marketing and other customer service expenses to account for recurring expenses that are not related to services supported by the federal high-cost mechanism. The non-supported expenses we attempted to identify include vertical features expenses,

billing and collection expenses not related to supported services, operational support systems and other expenses associated with providing unbundled network elements and wholesale services to competitive local exchange carriers. We proposed adjustments to extract non-supported service costs related to marketing, coin operations, published directory, access billing, interexchange carrier office operation, and service order processing. Specifically, we made percentage reductions to the regression coefficient results for specific expense accounts based on a time trend analysis of average ARMIS 43–04 expense data for five years (1993–1997).

304. Some commenters argue that our proposed methodology removes non-supported services twice because these expenses were already taken out by the regression when expenses are subdivided among switched lines, special lines, and toll minutes. Although we agree, as discussed, that our methodology double counted the marketing expenses associated with special access lines, we do not agree with the theory that combining a percentage reduction with the regression methodology invariably removes expenses twice. For example, vertical features associated with switched lines such as call waiting are not supported, but the expenses associated with call waiting are not removed using the regression analysis. If we had the data to separately identify and remove vertical features expenses from switched lines, we believe that it would be appropriate to do so and to continue using the regression analysis to separate the remaining expenses. Nonetheless, upon further analysis, we find that we should not adopt our proposed method of removing these non-supported recurring expenses. We find that this method is not sufficient to adequately identify non-supported common support service expenses due to differences in account classifications from the ARMIS 43–03 and ARMIS 43–04 reports. Therefore, we do not utilize the time trend analysis or take reductions for these non-supported expenses in the input values at this time. We recognize that this causes an overstatement of in our estimate of the expenses attributable to supported services in account 6620 (Service Expense and Customer Operations). Unlike the case with marketing, however, we do not have an alternative source of information on which to base a methodology for removing the non-supported expenses in this account. We plan to seek comment on a verifiable and systematic method to identify and remove these costs in the proceeding on the future of the model.

305. *Marketing.* As explained in the *Inputs Further Notice,* we made an adjustment to the Account 6610 (Marketing) regression coefficient based on an analysis made by Economics and Technology, Inc. (ETI). The ETI analysis offered a method for disaggregating product management, sales, and advertising expenses for basic (residential) telephone service from total marketing costs. Based on information from the New England Telephone Cost Study, ETI attributed an average of 95.6 percent of company marketing costs to non-supported customers or activities, such as vertical and new services. Relying on this analysis, we reduced the input estimate to reflect 4.4 percent of marketing expenses determined by the regression. In the *Inputs Further Notice,* we tentatively concluded that this was the most accurate method on the record for apportioning marketing expenses between supported and non-supported services.

306. We agree with commenters that, in making this adjustment to the post-regression analysis input estimate, we incorrectly estimated marketing expenses because reductions were taken twice for special access lines. We agree with the commenters that any adjustments to exclude expenses based on the type of service should be made from total relevant marketing expenses rather than the regression results. Therefore, we do not use the regression methodology to estimate marketing expenses. Instead, using the 1998 ARMIS data, we adjust the total weighted average of relevant expenses for all study areas.

307. Commenters also point out that the adjustment figure of 4.4 percent based on the ETI Study as initially reported was determined under the assumption that only expenses attributable to residential local service would be supported. Further, the ETI estimate of costs associated with the marketing of supported services was calculated by taking a percentage of expenses only from Account 6611, Product Management. Specifically, the ETI estimate did not include any relevant expenses from Account 6613, Product Advertising. As noted in the *Inputs Further Notice,* funding support for marketing is to be based on those expenses associated with advertising. Section 214 of the Communications Act requires eligible telecommunications carriers to advertise the availability of residential local exchange and universal service supported services. Moreover, we note that under the current high cost loop support mechanism, carriers receive no support for marketing.

308. We received further documentation and an alternative analysis from ETI which included an estimate for advertising expenditures. The revised analysis included proportional allocations of advertising costs based on the percentage of lines estimated for primary line residential service and single-line business service. ETI also used line count source material from the Preliminary Statistics of Common Carriers 1998 rather than relying on 1996 data used in its original analysis.

309. Based on the new information provided and the lack of any reasonable alternative presented by the commenters, we calculate an input estimate of supported advertising expenses using the ETI study and 1998 ARMIS expenses. By adding a proportional allocation for multi-line business advertising expenses to the ETI alternative analysis (which only included an estimate representing primary line and single line business advertising costs), we conclude that 34.4 percent of Account 6613, Product Advertising, would be the most appropriate expense amount for the advertising of universal service. Because the additional data provided by ETI allowed for the calculation and estimate of supported and non-supported advertising expenditures, we did not allocate costs associated with product management or sales. As previously mentioned, these marketing activities are not specifically required for support under section 214 of the Communications Act and currently receive no high cost loop support. Taking 34.84 percent of total 1998 advertising expenses for the 80 non-rural high cost study areas and dividing by total lines per month, the average per line per month input value for advertising support is $0.09. This level of advertising expenses represents 5.82 percent of total 1998 marketing costs for non-rural carriers.

310. *Local Number Portability.* There is an additional input value that we estimate separately from our consideration of other expense input values. Specifically, the synthesis model has a user-adjustable input for the per-line costs associated with local number portability (LNP). In the *Inputs Further Notice,* we proposed a per-line monthly LNP cost of $0.39, based on a weighted average of the LNP rates filed by the LECs available at that time. AT&T and MCI point out that the Commission suspended and investigated some of those rates, and that the rates we approved are generally lower than the

rates we used to estimate our LNP input value. They argue that we should use the line-weighted nationwide average of approved LNP rates, which they estimate currently is $.032. GTE claims that there is no justification for using the nationwide average LNP rate, as suggested by AT&T and MCI, because the approved LNP rates provide the best representation of each company's LNP costs. We agree with GTE and in this instance depart from our general practice of using nationwide input values in the federal universal service support mechanism. Because the Commission has investigated and approved LNP rates for most LECs, we find that it is appropriate to use the company-specific input values listed. For those carriers that have not yet filed an LNP tariff, we will use the line-weighted nationwide average of approved LNP rates.

C. GSF Investment

311. We conclude that the model's preliminary estimates of GSF investment should be reduced in the third step of the algorithm, because we find that only a portion of GSF investment is related to the cost of providing the services supported by the federal mechanism. In response to certain comments, however, we modify our proposed allocation factor, as discussed. Although we reject commenters' arguments that the preliminary GSF investment should not be reduced at all, we agree that we should not exclude facility-related maintenance expenses in our proposed allocation factor. In addition, we modify our method of calculating the denominator of our allocation factor so that both the numerator and denominator are simple averages. Finally, we clarify that the ARMIS TPIS used in the first step of the algorithm excludes ARMIS GSF investment.

312. *Reduction of Preliminary GSF Estimate.* Several LEC commenters argue that the preliminary GSF investment should not be reduced by an allocator in the third step of the algorithm. SBC contends that the factor we use to reduce our preliminary GSF investment estimates substantially underestimates the GSF amounts related to the supported services. SBC claims that the ratios used to estimate the preliminary GSF investment already provides a reasonable basis for allocating GSF to supported services, because the GSF ratio (derived from the ARMIS accounts) is only applied to investment identified by the model as associated with supported services. BellSouth also claims that the TPIS calculated by the model is the investment necessary to provide the supported services and that no further reductions in the preliminary GSF investment estimate are appropriate. Sprint similarly claims that by applying a book GSF ratio to the forward-looking plant necessary to provide supported services, the modeled GSF plant also has been converted to a forward-looking level necessary to provide the supported services. Sprint contends that applying an additional allocator is not necessary and has the effect of reducing GSF plant twice.

313. We disagree with SBC's contention that only a portion of GSF is assigned to supported services in deriving our preliminary estimates of GSF investment. To the contrary, the GSF ratio is applied to all model investment, which includes the investment required to provide both supported and non-supported services. As discussed, the model estimates the cost of providing services for all businesses and households within a geographic region, including the provision of special access, private lines, and toll services. Because these services are not supported by the federal high-cost mechanism, the preliminary GSF investment estimate must be adjusted to reflect the portion of GSF investment attributable to the supported services. Thus, BellSouth's assertion that the TPIS calculated by the model is the investment necessary to provide the supported services is wrong. For the same reasons, we reject Sprint's argument that, by applying the book GSF ratio, the modeled GSF plant has somehow been converted to a forward-looking level necessary to provide the supported services. On the contrary, the conversion estimates the amount of GSF investment attributable to all services, supported and non-supported. The second reduction is required to estimate the amount of GSF investment that should be supported by the federal universal service support mechanism.

314. *Allocation Factor.* Assuming that we use an allocator to reduce preliminary GSF investment, several commenters criticize the particular allocator that we proposed in the *Inputs Further Notice.* For example, GTE questions why we used only expenses for customer operations, network operations, and corporate operations in the allocation calculation and excluded plant-specific expenses. GTE argues that plant-specific operations also use GSF investments and should be counted in the calculation. SBC also argues that GSF investment supports all aspects of a LEC's operations, and contends that it makes no sense to exclude facility-related maintenance expenses in our proposed allocation factor. We agree that expenses for plant-specific operations expenses should be included in our calculation of the nationwide allocation factor derived from the regression methodology. Accordingly, the allocation factor we adopt to estimate GSF investment includes plant-specific operations expenses.

315. GTE also contends that the forward-looking way to calculate a GSF investment ratio is to convert all ARMIS investments to current values using current-to-book ratios, before calculating an adjusted ARMIS GSF to TPIS investment ratio. Although we concede there is some logic to GTE's argument that we should convert ARMIS GSF investments to current values by using current-to-book ratios, we note that this would require a change in the model platform. As we explain, the model platform uses a three-step algorithm to estimate GSF investment. Although we can easily change the input value for the factor used in step three, we could not adjust the ARMIS data by applying a current-to-book factor without modifying the model platform. Proposals to change the model platform are properly addressed in response to pending petitions for reconsideration of the *Platform Order* or the proceeding on the future of the model.

316. Finally, GTE claims that our estimation of the universal service portion of the GSF investment is flawed because our regression methodology uses a wrong specification and incorrectly excludes expenses. GTE also claims that the calculation allocator itself is flawed because the numerator is a simple average of expenses derived from the regression results, but the denominator is a weighted average of the total expenses developed from ARMIS data. GTE argues that the type of average in the numerator and denominator should match. While we do not agree that our regression methodology is flawed, we find that GTE has pointed out an inconsistency in our GSF methodology. Specifically, we agree that we should use the same type of average in both the numerator and denominator of our allocation factor. As a result, we use the simple average of total expenses in the denominator of the allocation factor we adopt for estimating the portion of GSF attributable to supported services.

317. *Clarification.* BellSouth claims that the algorithm used to estimate GSF investment contains an error in consistency. BellSouth suggests that in step one we should determine the ratio of ARMIS-based GSF investment to the ARMIS-based TPIS less GSF investment. In step two, this ratio is multiplied by

the TPIS investment determined by the model, which excludes GSF. We clarify that the model calculates GSF investment as BellSouth suggests it should. That is, the model uses ARMIS-based TPIS less GSF investment. US West claims that in the second step of the algorithm the synthesis model includes only fifty percent of the building investment and no land investment. The synthesis model incorporates the HAI switching and expense modules and calculates the investment related to wire center buildings and land in the switching module. So, US West is mistaken that fifty percent of the building and land investment is eliminated, because this investment is added back in calculating switching costs.

318. For the reasons stated, we adopt input values for GSF investment that reflect the portion of GSF investment attributable to the cost of providing the services supported by the federal mechanism. Specifically, we calculate preliminary GSF investment on a study area specific basis, using 1998 ARMIS data, and then multiply these estimates by a nationwide allocation factor derived from the regression methodology that we used to estimate the portion of common support services expenses attributable to switched lines and local usage and the portion of plant-specific operations expenses attributable to the supported services. The allocation factor is the sum of plant specific operations expenses, customer operations expenses, network operations expenses, and corporate operations expenses attributable to the supported services, divided by the sum of those expenses calculated on a total regulated basis.

VI. Capital Costs

A. Depreciation

a. Method of Depreciation

319. For the reasons explained, we adopt a straight-line equal-life-group method of depreciation. Further, we select curve shapes to be used to distribute equal-life groups in each plant account.

320. Most commenters support our tentative conclusion to use the straight-line equal-life-group method of depreciation. Ameritech argues, however, that the Commission's adoption of a straight-line depreciation method in other contexts need not limit us to that method for use in this model, and that "the method of depreciation for a specific study area needs to be consistent with any study that underlie [sic] the development of economic lives or net salvage." Although Ameritech may correctly assert that there is no requirement that we adopt a method of depreciation simply because it is the method previously adopted by the Commission in another context, we believe that the Commission's adoption, in other proceedings, of the straight-line equal-life-group method reflects the well-considered conclusion that this method of depreciation is best-suited to determining the economic costs of providing local service. The straight-line equal-life-group depreciation method is also consistent with our method of developing economic lives and net salvage for the same plant accounts. Because the Commission consistently uses a straight-line equal-life-group depreciation method in all other Commission-proposed depreciation, and in light of the general support received in favor of straight-line equal-life-group depreciation, we conclude that straight-line equal-life-group depreciation is appropriate for use in the high-cost support mechanism.

321. In using the straight-line equal-life-group method of depreciation in other contexts, the Commission has acknowledged that the method necessarily requires the selection of a curve shape for the distribution of the equal-life groups. The HAI model assumed a single curve shape for all plant accounts. Because the curve shapes are not easily averaged across all categories, however, we believe that use of the single HAI curve shape will unduly distort the model input values. We, therefore, determine that separate curve shapes should be adopted for each plant account category. Actuaries have developed generic, standardized curve shapes, called Gompertz-Makeham (GM) standard curves, that describe generalized mortality patterns. GM standard curve shapes are recognizable to many knowledgeable parties concerned with depreciation methods and are normally more immediately meaningful to them than nonstandard curve shapes, which are identified by the values for three variables. For convenience purposes, GM standard curves are often substituted for nonstandard curves. USTA has developed nonstandard curve shapes for most plant accounts based on mortality data provided by its members, using the same methodology approved in other Commission proceedings. For the remaining plant accounts, the Commission has developed composite curves, also nonstandard, utilizing data from available depreciation studies. Because the GM standard curves are recognizable and convenient to parties interpreting the data inputs in the high-cost model, and because the standardized curves will not vary significantly from the nonstandardized curves, we conclude that GM standard curves will be more useful in the high-cost inputs model than nonstandard curves. For each plant category, therefore, we adopt the GM standard curve shape nearest that developed by USTA or the Commission.

b. Depreciation Lives and Future Net Salvage Percentages

322. We adopt the tentative conclusion of the *Inputs Further Notice* that we should use HAI's input values with respect to depreciation lives and future net salvage percentages. As explained, we reject the objections by some commenters that the HAI input values are not appropriate for determining depreciation rates in a competitive environment.

323. In estimating depreciation expenses, the model uses the projected lives and future net salvage percentages for the asset accounts in part 32 of the Commission's rules. Traditionally, the projected lives and future net salvage values used in setting a carrier's rates have been determined in a triennial review process involving the state commission, the Commission, and the carrier. In order to simplify this process, the Commission has prescribed ranges of acceptable values for projected lives and future net salvage percentages. The Commission's prescribed ranges reflect the weighted average asset life for regulated telecommunications providers. These ranges are treated as safe harbors, such that carriers that incorporate values within the ranges into their depreciation filings will not be challenged by the Commission. Carriers that submit life and salvage values outside of the prescribed range must justify their submissions with additional documentation and support. Commission-authorized depreciation lives are not only estimates of the physical lives of assets, but also reflect the impact of technological obsolescence and forecasts of equipment replacement. We believe that this process of combining statistical analysis of historical information with forecasts of equipment replacement generates forward-looking projected lives that are reasonable estimates of economic lives and, therefore, are appropriate measures of depreciation.

324. We disagree with comments by incumbent LECs that the Commission's prescribed ranges are not appropriate for determining depreciation rates in a competitive environment. These parties argue that rapid changes in technology and competition in local

telecommunications markets will diminish asset lives significantly below the Commission's prescribed range by causing existing equipment to become obsolete more quickly. We agree with GSA, AT&T and MCI that there is no evidence to support the claim that increased competition or advances in technology require the use of shorter depreciation lives in the model than are currently prescribed by the Commission. The Commission's prescribed lives are not based solely on the engineered life of an asset, but also consider the impacts of technological change and obsolescence. We note that the depreciation values we adopt are generally at the lower end of the prescribed range. We also find compelling the data presented in GSA's comments showing that, although the average depreciation rate for an incumbent LEC's Total Plant in Service is approximately seven percent, incumbent LECs are retiring plant at a four percent rate. This difference has allowed depreciation reserves to increase so that the depreciation reserve-ratio is currently greater than 50 percent. We conclude that the existence of this difference implies that the prescribed lives are shorter than the engineered lives of these assets. In addition, this difference provides a buffer against technological change and competitive risk for the immediate future. We, therefore, conclude that the Commission's prescribed ranges are appropriate to determine depreciation rates for use in the federal high-cost mechanism.

325. We also decline to adopt the values for projected lives and net salvage percentages submitted by several incumbent LEC commenters. These commenters propose adoption of default values for projected lives and salvage based LEC industry date surveys or on similar values currently used by LECs for financial reporting purposes. The LEC industry data survey's projected lives generally fall outside of the Commission's prescribed ranges. This is significant because the values that fall outside of the prescribed ranges represent accounts that reflect the overwhelming majority of plant investment, thus potentially triggering a dramatic distortion of the estimated cost of providing the supported services. Moreover, these commenters assert that technological advances and competition will have the effect of displacing current technologies, but offer no specific evidence that this displacement will occur at greater rates than the forward-looking Commission-authorized depreciation lives take into account. The record is particularly silent regarding the displacement of technologies associated with the provision of services supported by the federal high-cost mechanism. We do not believe that the LEC industry data survey's projected lives have been adequately supported by the record in this proceeding to justify their adoption.

326. We also agree with GSA's comments that the projected-life values currently used by LECs for financial reporting purposes are inappropriate for use in the model. In addition, the commenters proposing these values have not explained why the values used for financial reporting purposes would also reflect economic depreciation. The depreciation values used in the LECs' financial reporting are intended to protect investors by preferring a conservative understatement of net assets, partially achieving this goal by erring on the side of over-depreciation. These preferences are not compatible with the accurate estimation of the cost of providing services that are supported by the federal high-cost mechanism. We, therefore, decline to adopt the projected life values used by LECs for financial reporting purposes.

327. In the *1997 Further Notice,* the Commission tentatively concluded that it should adopt depreciation expenses that reflect a weighted average of the rates authorized for carriers that are required to submit their rates to us. The values submitted by the HAI sponsors essentially reflect such a weighted average. The HAI values represent the weighted average depreciation lives and net salvage percentages from 76 study areas. According to the HAI sponsors, these depreciation lives and salvage values reflect the experience of the incumbent LEC in each of these study areas in retiring plant and its projected plans for future retirements.

328. In the *Inputs Further Notice,* we tentatively concluded that HAI's values represent the best forward-looking estimates of depreciation lives and net salvage percentages. Generally, these values fall within the ranges prescribed by the Commission for projected lives and net salvage percentages. Although the HAI values for four account categories fall outside of the Commission's prescribed ranges, these values still reflect the weighted average of projected lives and net salvage percentages that were approved by the Commission and, therefore, are consistent with the approach proposed in the *1997 Further Notice.* As noted, the fact that an approved value falls outside of the prescribed range simply means that the carrier proposing the value was required to provide additional justification to the Commission for this value. We are satisfied that HAI calculated its proposed rates using the proper underlying depreciation factors and that HAI's documentation supports the selection of these values. We, therefore, adopt HAI's values for estimating the depreciation lives and net salvage percentages.

B. Cost of Capital

329. We now adopt the conclusions that we tentatively reached in the *Inputs Further Notice* regarding the cost of capital. For the reasons discussed, we do not find that any commenter has provided a compelling argument for altering the current federal rate of return of 11.25 percent, absent the adoption of a different rate of return by the Commission in a rate prescription order.

330. The cost of capital represents the annual percentage rate of return that a company's debt-holders and equity holders require as compensation for providing the debt and equity capital that a company uses to finance its assets. In the *Universal Service Order,* the Commission concluded that the current federal rate of return of 11.25 percent is a reasonable rate of return by which to determine forward-looking costs.

331. GSA, AT&T and MCI comment that the cost of capital for incumbent LECs is well below 11.25 percent. Bell Atlantic advocates a cost of capital rate in the range of 12.75 to 13.15 percent. GTE and USTA dispute the lower cost of capital asserted by AT&T and MCI and GSA. All commenters addressing this issue agreed that, if a different rate of return is adopted in a rate prescription order, that value should be adopted in the model.

332. We find that the commenters proposing an adjustment to the cost of capital have failed to make an adequate showing to justify rates that differ from the current 11.25 percent federal rate of return. We conclude, therefore, that the current rate is reasonable for determining the cost of providing services supported by the federal high-cost mechanism. If the Commission, in a rate prescription order, adopts a different rate of return, we conclude the federal mechanism should use the more recently determined rate of return.

C. Annual Charge Factors

333. We also now adopt our tentative conclusion in the *Inputs Further Notice* to use HAI's annual charge factor methodology. As explained, we find this appropriate because the synthesis model uses a modified version of HAI's expense module.

334. Incumbent LECs develop cost factors, called ''annual charge factors,'' to determine the dollar amount of recurring costs associated with acquiring and using particular pieces of investment for a period of one year. Incumbent LECs develop these annual charge factors for each category of investment required. The annual charge factor is the sum of depreciation, cost of capital, adjustments to include taxes on equity, and maintenance costs.

335. To develop annual charge factors, the BCPM proponents proposed a model with user-adjustable inputs to calculate the depreciation and cost of capital rates for each account. The BCPM proponents stated that this account-by-account process was designed to recognize that all of the major accounts have, among other things, differing economic lives and salvage values that lead to distinct capital costs. HAI's model is also user adjustable and reflects the sum for the three inputs: depreciation, cost of capital, and maintenance costs. In the *Inputs Further Notice,* the Commission tentatively adopted HAI's annual charge factor methodology, and invited comment on this tentative decision. GTE argues that the annual charge factors should be company specific, in order to make the cost calculations in the optimization phase and the expense module comparable. We do not believe it would be appropriate to adopt GTE's proposal of using company-specific annual charges, because we are adopting nationwide averages for all other inputs, including those that make up the annual charge. Adopting company-specific annual charges would therefore result in likely inconsistencies between various related inputs and in the model as a whole. AT&T and MCI support the use of the HAI annual charge factor methodology.

336. Because the synthesis model uses HAI's expense module, with modifications, we adopt HAI's annual charge factor methodology, utilizing the capital cost and expense inputs adopted. We believe that HAI's annual charge factor methodology is consistent with other inputs used in the model adopted by the Commission, and is, therefore, easier to implement and yields more reasonable results.

VII. Proposed Modification to Procedures for Distinguishing Rural and Non-Rural Companies

337. Consistent with our tentative conclusion in the *Inputs Further Notice,* we eliminate the annual filing requirements for carriers serving fewer than 100,000 access lines that have self-certified as rural, unless changes occur in their status as rural carriers. In addition, we will require carriers serving study areas with more than 100,000 access lines to file rural self-certifications that are consistent with the statutory interpretation discussed. Thereafter, such carriers also will be required to file only in the event of a change in their status.

338. As discussed, we interpret ''local exchange operating company'' in section 153(37) of the Act to refer to the legal entity that provides local exchange service. In addition, we interpret ''communities of more than 50,000'' in that section to refer to legally incorporated localities, consolidated cities, and census-designated places with populations of more than 50,000 according to Census Bureau statistics.

339. With respect to our request for comment on whether we should reconsider our use of section 153(37) to distinguish rural telephone companies from non-rural companies, we conclude that we should not use an alternative definition of rural telephone company to determine which companies are subject to the rural or non-rural high-cost support mechanisms.

340. Because of settled expectations in this ongoing proceeding, the Commission will accept a carrier's current rural self-certification for purposes of calculating support based on that status for calendar year 2000. We will require carriers serving study areas with more than 100,000 access lines to certify their rural status by July 1, 2000, for purposes of receiving support beginning January 1, 2001.

1. Annual Filing Requirement

341. *Carriers serving study areas with fewer than 100,000 access lines.* We adopt the proposed change in the annual self-certification requirement for rural carriers and will require that carriers serving fewer than 100,000 access lines file a rural self-certification letter only if their status has changed since their last filing. All commenters addressing this issue urge the Commission to eliminate annual filing requirements. We believe that this is a better approach because the overwhelming majority of the companies that filed rural certification letters qualified as rural telephone companies under the 50,000- or 100,000-line thresholds identified in the statute. Access line counts can be verified easily with publicly available data. Further, this relaxation in filing requirements will lessen the burden on rural carriers. We estimate that this change will eliminate the filing requirement for approximately 1,380 of the carriers that filed in 1998, many of which are small businesses on which even limited regulatory requirements may be unduly burdensome. We, therefore, conclude that carriers serving study areas with fewer than 100,000 access lines that already have certified their rural status need not re-certify for purposes of receiving support beginning January 1, 2000, and need only file thereafter if their status changes. As explained, we must determine the status for carriers serving study areas with more than 100,000 access lines.

342. We believe, as GTE suggests, that carriers generally (although not uniformly) have filed for rural status in this proceeding on a study area basis. Indeed, the synthesis model that has been posted on the Commission's Web site—allowing carriers to determine how the Commission has been treating them throughout this proceeding—estimates cost on a study area basis. Not all carriers, however, have uniformly filed for rural status on a study area basis, as we noted in the *Inputs Further Notice,* resulting in inconsistencies that must be resolved in order to assure equitable treatment of all carriers. These inconsistencies will be addressed.

343. *Carriers serving study areas with more than 100,000 access lines.* For purposes of calculating high cost support using the model for the year 2000, we will continue to treat carriers as rural if they have previously self-certified as rural carriers. We will then require rural carriers serving study areas with more than 100,000 access lines to file certification letters by July 1, 2000, for their year 2001 status. Commenters that address the issue broadly support re-certification requirements that require these carriers to re-certify only if their status has changed, rather than require them to re-certify each year. Finding that the relaxed re-certification requirements will reduce administrative burdens for carriers subject to rural certification and for the Commission, we conclude that certified rural carriers with more than 100,000 access lines need only re-certify their status if it changes. Therefore, in 2001 and subsequent years, a carrier serving study areas with more than 100,000 access lines and claiming rural status will be required to file only if its status changes.

2. Statutory Terms

344. As noted in the *Inputs Further Notice*, carriers' line counts are readily available to the Commission, but information about service territories and communities served are not. As a result, the Commission can easily determine whether a carrier satisfies criteria (B) or (C) of the rural telephone company definition, because these criteria are

based on information that can be verified easily with publicly available data—the number of access lines served by a carrier. In contrast, criteria (A) and (D) require additional information and analysis to verify a carrier's self-certification as a rural company. Specifically, under criterion (A), a carrier is rural if its study area does not include ''any incorporated place of 10,000 inhabitants or more'' or ''any territory * * * in an urbanized area,'' based upon Census Bureau statistics and definitions. Under criterion (D), a carrier is rural if it had ''less than 15 percent of its access lines in communities of more than 50,000 on the date of enactment of the [1996 Act].''

345. We conclude that criterion (A), by referencing Census Bureau sources, can be applied consistently without further interpretation by the Commission. We will require, however, that carriers self-certifying as rural telephone companies pursuant to criterion (A) include with their self-certification letter a description of the study areas in which they provide service and the basis for their assertion that they meet the requirements of criterion (A).

346. In the *Inputs Further Notice*, we sought comment on the meaning of the term ''local exchange operating entity.'' Commenters have offered three different interpretations of this term. Many commenters suggest that we should interpret the term as applying at the study area level. Although in most cases an operating entity will provide service to only one study area within a state, that is not always the case. As a result, the study area approach could mean classifying a carrier at an organizational level smaller than the actual legal entity responsible for the provision of the local exchange services (*e.g.,* a ''division'' of a company). In contrast, AT&T and MCI argue that the term should mean the holding company within a state whose affiliates provide the local exchange services. The third interpretation has been proposed by RTC and Citizens Utilities, who argue that the most natural understanding of ''local exchange operating entity'' is the legal entity responsible for the provision of local exchange services, regardless of whether that entity serves a single or multiple study areas. We conclude that this interpretation is the most reasonable one.

347. We believe that it is most logical to classify the carrier at the actual corporate level through which it offers its local exchange services. As RTC and Citizens Utilities point out, it is that entity that has legal responsibility for the provision of the local exchange services. The holding company interpretation proposed by MCI and AT&T seems to rest upon the concern that study area designations will be manipulated and, as a result, carriers will inappropriately be eligible for support as rural carriers, when they should not be. We do not believe that the potential for manipulation of the federal universal service support mechanism by rural carriers poses the threat that AT&T and MCI suggest; to the contrary, the study area waiver process provides the Commission with oversight over the creation, division, and combination of study areas.

348. On the other hand, if a carrier should be operating within multiple study areas, we see no basis for interpreting the term ''local exchange operating entity'' in a manner that would ignore the legal entity responsible for the provision of services by designating a subunit of the legal entity as the local exchange operating entity for a particular study area. Rather, it is more reasonable to have the term local exchange operating entity be synonymous with the corporate entity bearing legal responsibility for the services provided.

349. Although we adopt Citizen Utilities' interpretation of ''local exchange operating entity,'' we reject its proposed interpretation of criterion (C). Citizens Utilities proposes that a local exchange carrier operating entity be considered a rural carrier for each of its study areas, regardless of whether those study areas have fewer than 100,000 access lines, if any *single* study area in which it operates contains fewer than 100,000 access lines. Under this interpretation, which only Citizens Utilities supports, an incumbent LEC offering service to a significant portion of a state, including major urban areas, could be certified as a rural carrier for all study areas that it serves within the state if it merely has one outlying study area with less than 100,000 access lines. We find this interpretation to be inconsistent with the statutory language that an entity is an rural telephone company only ''to the extent'' that it serves a study area with fewer than 100,000 lines. Essentially, Citizens Utilities' interpretation would read that limiting language out of section 153(37). The effect of such a reading would be to permit some of the largest LECs in the nation to claim rural status for all of their study areas if they happen to serve a rural study area within in the state. Such an interpretation would undermine not only the Commission's universal service support mechanisms, but also the fundamental procompetitive policies underlying the 1996 Act. We do not believe that this could be what Congress intended when it specified that carriers would be deemed rural telephone companies ''to the extent'' that they satisfied the various criteria, including criterion (C) pertaining to serving study areas with less than 100,000 access lines. Accordingly, consistent with the language of the statutory provision, its purpose, and its context in the Act, we adopt the interpretation that a LEC may be properly considered a rural carrier with respect to those study areas to which its operating company provides service to fewer than 100,000 access lines. In contrast, a LEC will be deemed a non-rural carrier for study areas serving more than 100,000 access lines unless it satisfies one of the other criteria under section 153(37).

350. We also sought comment in the *Inputs Further Notice* regarding the proper interpretation of ''communities of more than 50,000.'' GTE offers an interpretation of this phrase based on the definition of ''rural area'' in § 54.5 of the Commission's rules. GTE calculates its percentages of rural and non-rural lines by determining whether each of its wire centers is associated with a metropolitan statistical area (MSA). The lines in each wire center associated with an MSA are considered to be urban, unless the wire center has rural pockets, as defined by the most recent Goldsmith Modification. The approach suggested by GTE in its comments has merit because it prevents rural treatment of a suburban area adjacent to a census-designated place. At this time, however, there is no information on the record to indicate that this circumstance presents a serious problem in our determination of a carrier's status as a rural or non-rural company. Other commenters addressing the issue support the definition of ''communities of more than 50,000'' by using Census Bureau statistics for legally incorporated localities, consolidated cities, and census-designated places, and some specifically reject the use of the Commission's definition in § 54.5 because of the added complication of its use.

351. Because GTE's approach is more complicated and difficult to administer and because the consequences of the approach would reach only a few, if any, rural carriers' study areas, we decline to adopt GTE's interpretation of ''communities of more than 50,000.'' Instead, we now adopt the use of Census Bureau statistics for legally incorporated localities, consolidated, cities, and census-designated places for identifying communities of more than 50,000, as Census Bureau statistics are widely

available and may be consistently applied by the Commission. We further require that, when a carrier files for rural certification under criterion (D), it must include in its certifying letter a list of all communities of more than 50,000 to which it provides service, the population of those communities, the number of access lines serving those communities, and the total number of access lines the carrier serves.

3. Identification of Rural Telephone Companies

352. States apply the definition of rural telephone company in determining whether a rural telephone company is entitled to an exemption under section 251(f)(1) of the Act and in determining, under section 214(e)(2) of the Act, whether to designate more than one carrier as an eligible telecommunications carrier in an area served by a rural telephone company. Although the Commission used the rural telephone company definition to distinguish between rural and non-rural carriers for purposes of calculating universal service support, there is no statutory requirement that it do so. The Commission adopted the Joint Board's recommendation to allow rural carriers to receive support based on embedded costs for at least three years, because, as compared to large LECs, rural carriers generally serve fewer subscribers, serve more sparsely populated areas, and do not generally benefit as much from economies of scale and scope. The Commission also noted that, for many rural carriers, universal service support provides a large share of the carriers' revenues, and thus, any sudden change in the support mechanisms may disproportionately affect rural carriers' operations.

353. In the *Inputs Further Notice,* we sought comment on whether to reconsider the means of distinguishing rural and non-rural carriers. Commenters generally oppose any reconsideration of our decision to use the definition of rural telephone company to distinguish between rural and non-rural carriers for the purpose of evaluating universal service support on the grounds that changing the definition at this time could disrupt the settled expectations that they have developed. We agree that we should not change our reliance on the statutory definition of rural telephone company to distinguish between rural and non-rural carriers for universal service purposes. Accordingly, we will leave in place the Commission's decision to use the definition of rural telephone company in section 153(37) of the Communications Act to distinguish rural telephone companies from non-rural ones.

VIII. Appendices

354. Appendix A contains the input values adopted in this Order for use in the synthesis model. Appendix B explains the methodology used for estimating the input values for outside plant structure and cable costs. Appendix C describes the methodology used for estimating the input values for switching costs. Appendix D describes the methodology used for estimating the input values for expenses, including: the development of expense to investment ratios; the regression equations used to estimate common support services expenses; the analysis used to estimate marketing expenses; local number portability rates for particular companies; and the formula used to calculate the general support facilities allocation factor.

IX. Procedural Matters and Ordering Clause

A. Final Regulatory Flexibility Analysis

355. As required by the Regulatory Flexibility Act (RFA), an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the *Inputs Further Notice.* The Commission sought written public comment on the proposals in the *Inputs Further Notice,* including comments on the IRFA. The Final Regulatory Flexibility Analysis (FRFA) in this Order conforms to the RFA, as amended.

356. *Need for and Objectives of This Order.* In the *Universal Service Order*, the Commission adopted a plan for universal service support for rural, insular, and high-cost areas to replace longstanding federal subsidies to incumbent local telephone companies with explicit, competitively neutral federal universal service mechanisms. In doing so, the Commission adopted the recommendation of the Joint Board that an eligible carrier's support should be based upon the forward-looking economic cost of constructing and operating the networks facilities and functions used to provide the services supported by the federal universal service mechanism.

357. In the *Universal Service Order,* the Commission also determined that rural and non-rural carriers will receive federal universal service support determined by separate mechanisms until at least January 1, 2001. The Commission stated that it would define rural carriers as those carriers that meet the statutory definition of a rural telephone company in section 153(37) of the Communications Act. We have found that carriers self-certifying as rural have not always applied section 153(37) uniformly. We clarify our interpretation of section 153(37). We also address the possibility that our annual self-certification requirements may be modified or eliminated in order to reduce the reporting burden on filing entities.

358. Our plan to adopt a mechanism to estimate forward-looking costs for larger, non-rural carriers has proceeded in two stages. On October 28, 1998, the Commission completed the first stage of this proceeding: the selection of the model platform. The platform encompasses the aspects of the model that are essentially fixed, primarily assumptions about the design of the network and network engineering. In this Order, we complete the second stage of this proceeding, by selecting input values for the cost model, such as the cost of cables, switches and other network components, in addition to various capital cost parameters.

359. *Summary and Analysis of the Significant Issues Raised by Public Comments in Response to the IRFA.* No comments were received specifically in response to the IRFA. We received several comments, however, addressing concerns that may affect small entities. These comments universally supported our proposal, adopted in this Order, to reduce the burden of carriers self-certifying as rural by eliminating the annual filing requirement.

360. *Description and Estimate of the Number of Small Entities to which the Order will Apply.* The RFA generally defines "small entity" as having the same meaning as the term "small business," "small organization," and "small government jurisdiction." In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act, unless the Commission has developed one or more definitions that are appropriate to its activities. Under the Small Business Act, a "small business concern" is one that: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) meets any additional criteria established by the SBA. The SBA has defined a small business for Standard Industrial Classification (SIC) category 4813 (Telephone Communications, Except Radiotelephone) to be small entities when they have no more than 1,500 employees.

361. We have included small incumbent LECs in this present RFA analysis. As noted, a "small business" under the RFA is one that, *inter alia*, meets the pertinent small business size standard (*e.g.*, a telephone

communications business having 1,500 or fewer employees), and ''is not dominant in its field of operation.'' The SBA's Office of Advocacy contends that, for RFA purposes, small incumbent LECs are not dominant in their field of operation because any such dominance is not ''national'' in scope. We have therefore included small incumbent LECs in this RFA analysis, although we emphasize that this RFA action has no effect on Commission analyses and determinations in other, non-RFA contexts.

362. *Local Exchange Carriers.* Neither the Commission nor SBA has developed a definition of small providers specifically directed toward LECs. The closest applicable definition under SBA rules is for telephone communications companies other than radiotelephone (wireless) companies. The most reliable source of information regarding the number of LECs nationwide of which we are aware appears to be the data that we collect annually in connection with the Telecommunications Relay Service (TRS). According to our most recent data, 1,410 companies reported that they were engaged in the provision of local exchange service as incumbents. Although it seems certain that some of these carriers are not independently owned and operated, or have more than 1,500 employees, we are unable at this time to estimate with greater precision the number of LECs that would qualify as small business concerns under SBA's definition. Consequently, we estimate that there are fewer than 1,410 small entity LECs that may be affected by this Order. We also note that, with the exception of our clarification of the definition of rural carrier under section 153(37) and the modification of reporting requirements, the rules adopted by this Order apply only to larger, non-rural LECs.

363. *Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements.* This Order imposes no new reporting, recordkeeping, or other compliance requirements. As discussed, this Order immediately eliminates the requirement that carriers serving study areas with fewer than 100,000 access lines must annually file letters certifying themselves as rural carriers in order to remain in the rural carrier universal service support mechanism. Further, this Order eliminates, after the July 1, 2000, filing deadline, the requirement that rural carriers serving study areas with more than 100,000 access lines must file annual self-certification letters. All rural carriers must, however, notify the Commission in the event of a change in rural status.

364. The overall effect of this Order will be to reduce reporting, recordkeeping, and other compliance requirements for small entities. This benefit will apply to all carriers deemed rural under section 153(37), regardless of whether they are a small or large entity. Carriers serving study areas with fewer than 100,000 access lines—which are more likely to be small entities than those serving study areas with more than 100,000 access lines—will be most immediately benefited, as no further filings will be required of them unless and until their rural status changes. The largest carriers will generally be non-rural and not affected by this change in reporting. To the extent that large and small entities are treated differently, therefore, small entities will not carry a disproportionately high cost of compliance.

365. *Steps Taken to Minimize Significant Economic Impact on Small Entities and Significant Alternatives Considered.* As noted, with respect to reporting requirements affecting small entities, we eliminate the burden of an annual filing requirement for rural carriers. For carriers serving study areas with fewer than 100,000 access lines, this change is effective immediately. Rural carriers serving study areas with more than 100,000 access lines will be required to file a self-certification letter by July 1, 2000, but will not be required to refile additional annual certifications unless their status changes. These changes have at their heart consideration of the resources of small entities, and will reduce, if not eliminate, the costs of compliance for small entities. The alternative to this approach would have been to require additional unnecessary self-certification letters from the vast majority of filing carriers, even though the data supporting those self-certifications are easily verified by publicly available documentation. The other changes to Commission rules that we adopt in this Order affect only larger, non-rural LECs, and should have no direct affect on small entities.

366. *Report to Congress.* The Commission will send a copy of this Order, including this FRFA, in a report to be sent to Congress pursuant to the Small Business Regulatory Enforcement Fairness Act of 1996. In addition, the Commission will send a copy of this Order, including FRFA, to the Chief Counsel for Advocacy of the Small Business Administration. A copy of this Order and FRFA (or summaries thereof) will also be published in the **Federal Register**.

B. Paperwork Reduction Act Analysis

367. The decision herein has been analyzed with respect to the Paperwork Reduction Act of 1995, Pub. L. 104–13, and has been approved in accordance with the provisions of that Act. On August 4, 1999, the Office of Management and Budget approved the proposed requirements contained in the *Inputs Further Notice* under OMB control number 3060–0793.

C. Ordering Clauses

368. It is ordered, pursuant to sections 1, 4(i) and (j), 201–209, 218–222, 254, and 403 of the Communications Act, as amended, 47 U.S.C. 151, 154(i), 154(j), 201–209, 218–222, 254, and 403 that this Report and Order is hereby adopted.

369. It is further ordered that the Commission's Office of Public Affairs, Reference Operations Division, shall send a copy of this Report and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

List of Subjects

47 CFR Part 36

Reporting and recordkeeping requirements, Telephone.

47 CFR Part 54

Universal service.

47 CFR Part 69

Communications common carrier.

Federal Communications Commission.

Magalie Roman Salas,

Secretary.

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FEDERAL COMMUNICATIONS COMMISSION

47 CFR Parts 36 and 54

[CC Docket No. 96–45; FCC 99–306]

Federal-State Joint Board on Universal Service

AGENCY: Federal Communications Commission.

ACTION: Final rule.

SUMMARY: This document concerning the Federal-State Joint Board on Universal Service adopts a new specific and predictable forward-looking mechanism that will provide sufficient support to enable affordable, reasonably comparable intrastate rates for customers served by non-rural carriers. This document also addresses specific