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

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

TENTH REPORT AND ORDER

Adopted: October 21, 1999 **Released: November 2, 1999**

By the Commission: Commissioner Tristani issuing a separate statement; Commissioner Furchtgott-Roth dissenting and issuing a statement.

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I. INTRODUCTION

1. In the Telecommunications Act of 1996 (1996 Act),[1] 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*, 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.[2] 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.[3]

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.[4] 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

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[1] Pub. L. No. 104-104, 110 Stat. 56. The 1996 Act amended the Communications Act of 1934, 47 U.S.C. §§ 151 *et. seq.* (Act). Hereinafter, all citations to the Act will be to the relevant section of the United States Code unless otherwise noted.

[2] *Federal-State Joint Board on Universal Service*, Report and Order, CC Docket No. 96-45, 12 FCC Rcd 8776 (1997) (*Universal Service Order*), as corrected by *Federal-State Joint Board on Universal Service*, Errata, CC Docket No. 96-45, FCC 97-157 (rel. June 4, 1997). *See also Texas Office of Public Utility Counsel v. FCC and USA*, 183 F.3d 393 (5th Cir. 1999) (affirming in relevant part the Commission's decisions regarding implementation of the high-cost support system).

[3] *Universal Service Order*, 12 FCC Rcd at 8888, para. 199. The Commission also determined that high-cost support for rural carriers should continue essentially unchanged and should not be based on forward-looking costs until 2001, at the earliest. *Universal Service Order*, 12 FCC Rcd at 8889, para. 203. The Commission adopted the Joint Board's recommendation to define "rural carriers" as those carriers that meet the statutory definition of a "rural telephone company." *Universal Service Order*, 12 FCC Rcd at 8943, para. 310 (*citing* 47 U.S.C. § 153(37)).

[4] *Federal-State Joint Board on Universal Service*, Fifth Report and Order, CC Docket Nos. 96-45, 97-160, 13 FCC Rcd 21323 (1998) (*Platform Order*).

companion order.[5]

II. PROCEDURAL HISTORY

A. *Universal Service Order*

3. Prior to the 1996 Act, three explicit interstate universal service programs provided assistance to small incumbent local exchange carriers (LECs) and LECs that served rural and high-cost areas: high-cost loop support;[6] dial equipment minutes (DEM) weighting; and the Long-Term Support (LTS) program.[7] Other mechanisms also have historically contributed to maintaining affordable rates in rural areas, including support implicit in geographic toll rate averaging, intrastate rates, and interstate access charges. Section 254 of the Communications Act of 1934, as amended, directed the Commission to reform universal service support mechanisms to ensure that they are compatible with the pro-competitive goals of the 1996 Act, and it required the Commission to institute a Joint Board on universal service and to implement the recommendations from the Joint Board by May 8, 1997.[8] After receiving the recommendations of the Joint Board on November 7, 1996,[9] the Commission adopted the *Universal Service Order* on May 7, 1997.

4. In the *Universal Service Order*, the Commission adopted a forward-looking economic cost methodology to calculate support for non-rural carriers. Under this methodology, a forward-looking economic cost mechanism selected by the Commission, in consultation with the Joint Board, would be used to estimate non-rural carriers' forward-looking economic cost of providing the supported services in high-cost areas.[10]

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[5] *Federal-State Joint Board on Universal Service*, Ninth Report and Order and Eighteenth Order on Reconsideration, CC Docket No. 96-45, FCC 99-306 (adopted Oct. 21, 1999) (*Methodology Order*).

[6] Although the existing high-cost loop fund has historically been known as the "Universal Service Fund," we will avoid this terminology because of the confusion it may create with the new universal service support mechanisms that the Commission has created pursuant to section 254 of the Communications Act.

[7] The Commission's rules governing these programs are set forth at 47 C.F.R. §§ 36.601 *et. seq.* (high-cost loop fund); 47 C.F.R. § 36.125(b) (DEM weighting); and 47 C.F.R. §§ 69.105, 69.502, 69.603(e), 69.612 (LTS).

[8] 47 U.S.C. § 254(a).

[9] *Federal-State Joint Board on Universal Service*, First Recommended Decision, CC Docket No. 96-45, 12 FCC Rcd 87 (1996) (*First Recommended Decision*).

[10] *Universal Service Order*, 12 FCC Rcd at 8890, para. 206. In the *Universal Service Order*, the Commission concluded that the federal universal service support mechanism would support 25 percent of the difference between the forward-looking economic cost of providing the supported service and a nationwide revenue benchmark. *See Universal Service Order*, 12 FCC Rcd at 8888, para. 201. In response to issues raised

B. *1997 Further Notice* and the Input Value Development Process

5. In a July 18, 1997 *Further Notice of Proposed Rulemaking*, the Commission established a multi-phase plan to develop a federal universal service support mechanism that would send the correct signals for entry, investment, and innovation.[11] The *1997 Further Notice* divided questions related to the cost models into "platform design" issues and "input value" issues.[12] The *1997 Further Notice* subdivided each of the platform and input issues into the following four topic groups: (1) customer location; (2) outside plant design; (3) switching and interoffice; and (4) general support facilities (GSF) and expense issues.[13]

6. After reviewing the comments received in response to the *1997 Further Notice*, the Common Carrier Bureau (Bureau) released two public notices to guide parties wishing to submit cost models for consideration as the high-cost federal mechanism.[14]

7. In addition to the *1997 Further Notice*, the Bureau has solicited comment and allowed interested parties the opportunity to participate in the development of the input values to be used in the forward-looking cost model. On May 4, 1998, the Bureau released a *Public*

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by commenters and state Joint Board members, the Commission referred back to the Joint Board questions related to how federal support should be determined. *See Federal-State Joint Board on Universal Service*, Order and Order on Reconsideration, CC Docket No. 96-45, 13 FCC Rcd 13749 (1998) (*Referral Order*). *See also Federal-State Joint Board on Universal Service*, Second Recommended Decision, CC Docket No. 96-45, 13 FCC Rcd 24744 (1998) (*Second Recommended Decision*).

[11] *Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs*, Further Notice of Proposed Rulemaking, CC Docket Nos. 96-45, 97-160, 12 FCC Rcd 18514 at 18519, para. 5 (1997) (*1997 Further Notice*).

[12] Generally, there is a platform component for each portion of the local exchange network being modeled. Examples of platform design issues are the establishment of switch capacity limitations and the routing of feeder and distribution cables. Examples of input values are the price of various network components, their associated installation and placement costs, and capital cost parameters such as debt-equity ratios. *See 1997 Further Notice*, 12 FCC Rcd at 18516-18, paras. 17-18.

[13] *See generally 1997 Further Notice.*

[14] *Guidance to Proponents of Cost Models in Universal Service Proceeding: Switching, Interoffice Trunking, Signaling, and Local Tandem Investment*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 97-1912 (rel. Sept. 3, 1997) (*Switching and Transport Public Notice*); *Guidance to Proponents of Cost Models in Universal Service Proceeding: Customer Location and Outside Plant*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 97-2372 (rel. Nov. 13, 1997) (*Customer Location & Outside Plant Public Notice*).

Notice to update the record on several input-related issues.[15] The Bureau also issued data requests designed to acquire information that could be useful in determining the final input values,[16] and conducted a series of public workshops designed to elicit further comment from interested parties in selecting final input values.[17] Finally, the Bureau conducted numerous *ex parte* meetings with interested parties throughout this proceeding.[18]

C. *Platform Order* and *Second Recommended Decision*

8. In the *Platform Order*, released on October 28, 1998, the Commission adopted the forward-looking cost model platform to be used in determining federal universal service high-cost support for non-rural carriers.[19] The model platform that the Commission adopted combined elements from each of the three models under consideration in this proceeding: (1) the BCPM, Version 3.0 (BCPM);[20] (2) the HAI Model, Version 5.0a (HAI);[21] and (3) the Hybrid Cost Proxy Model, Version 2.5 (HCPM).[22] In the *Platform Order*, the Commission also specified several issues that would be addressed in the inputs stage of this proceeding.

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[15] *Common Carrier Bureau Requests Further Comment On Selected Issues Regarding The Forward-Looking Economic Cost Mechanism For Universal Service*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 98-848 (rel. May 4, 1998) (*Inputs Public Notice*).

[16] *Federal-State Joint Board on Universal Service*, Order, CC Docket No. 96-45, 12 FCC Rcd 9803 (1997) (*1997 Data Request*).

[17] *Common Carrier To Hold Three Workshops On Input Values To Be Used To Estimate Forward-Looking Economic Costs For Purposes Of Universal Service Support*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 98-2406 (rel. Nov. 25, 1998) (*Workshop Public Notice*).

[18] *See, e.g.*, Letter from W. Scott Randolph, GTE, to Magalie Roman Salas, FCC, dated March 2, 1999; Letter from Pete Sywenki, Sprint, to Magalie Roman Salas, FCC, dated, February 26, 1999; Letter from Chris Frentrup, MCI, to Magalie Roman Salas, FCC, dated February 9, 1999.

[19] *See Platform Order.*

[20] Submission in CC Docket Nos. 96-45 and 97-160 by BellSouth Corporation, BellSouth Telecommunications, Inc., U S WEST, Inc., and Sprint Local Telephone Company (BCPM proponents), dated Dec. 11, 1997 (BCPM Dec. 11, 1997 submission).

[21] Letter from Richard N. Clarke, AT&T, to Magalie Roman Salas, FCC, dated Dec. 11, 1997 (HAI Dec. 11, 1997 submission). HAI was submitted by AT&T and MCI (HAI sponsors). *See also* Letter from Richard Clarke, AT&T, to Magalie Roman Salas, FCC, dated February 3, 1998 (HAI Feb. 3 submission).

[22] HCPM was developed by Commission staff members William Sharkey, Mark Kennet, C. Anthony Bush, Jeffrey Prisbrey, and Commission contractor Vaikunth Gupta of Panum Communications. *Common Carrier Bureau Announces Release of HCPM Version 2.0*, Public Notice, DA 97-2712 (rel. Dec. 29, 1997). *See also* United States Government Memo from W. Sharkey, FCC, to Magalie Roman Salas, FCC, dated Feb. 6, 1998.

These issues include: (1) the geocode data source to determine customer locations;[23] (2) the road surrogate method to determine the location of non-geocoded customer locations;[24] and (3) the use of the local exchange routing guide (LERG) to identify the existing host-remote switch relationships.[25]

9. On November 25, 1998, the Joint Board released the *Second Recommended Decision*, in which it recommended that the Commission compute federal high-cost support for non-rural carriers through a two-step process.[26] First, the Joint Board recommended that the Commission should estimate the total support amount necessary in those areas considered to have high costs relative to other areas. Second, the Joint Board recommended that the Commission should consider, in a consistent manner across all states, any particular state's ability to support high-cost areas within the state.[27] The Joint Board recommended that federal support should be provided to the extent that the state would be unable to support its high-cost areas through its own reasonable efforts.[28] In addition, the Joint Board recommended that the Commission continue to work with the Joint Board to select the input values to complete a forward-looking cost model and to finalize the methodology for distributing federal high-cost support.[29]

D. *Inputs Further Notice* and *Seventh Report and Order*

10. On May 28, 1999, the Commission released the *Inputs Further Notice* and the *Seventh Report and Order*.[30] In the *Inputs Further Notice*, we proposed and sought comment

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[23] *Platform Order*, 13 FCC Rcd at 21338, para. 34.

[24] *Platform Order*, 13 FCC Rcd at 21341, para. 41.

[25] *Platform Order*, 13 FCC Rcd at 21355, para. 76. The LERG is a database of switching information maintained by Telcordia Technologies (formerly Bellcore) that includes the existing host-remote relationships.

[26] *Second Recommended Decision*, 13 FCC Rcd at 24746, para. 5.

[27] *Second Recommended Decision*, 13 FCC Rcd at 24746, para. 5.

[28] *Second Recommended Decision*, 13 FCC Rcd at 24746-47, para. 5.

[29] *Second Recommended Decision*, 13 FCC Rcd at 24757, para. 28.

[30] *Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs*, Further Notice of Proposed Rulemaking, CC Docket Nos. 96-45, 97-160, FCC 99-120 (rel. May 28, 1999) (*Inputs Further Notice*); *Federal-State Joint Board on Universal Service, Access Charge Reform*, Seventh Report and Order and Thirteenth Order on Reconsideration in CC Docket No. 96-45; Fourth Report and Order in CC Docket No. 96-262; and Further Notice of Proposed Rulemaking, CC Docket Nos. 96-45, 96-262, 14 FCC Rcd 8078 (1999) (*Seventh Report and Order*). *See also Common Carrier Bureau Releases Preliminary*

on a complete set of input values for use in the model, such as the cost of switches, cables, and other network components.[31] For the most important inputs, we provided a detailed description of the methodology that was used to arrive at the proposed values.[32]

11. In the *Seventh Report and Order*, we adopted revisions to the federal support mechanisms, in light of the Joint Board's recommendations, to permit rates to remain affordable and reasonably comparable across the nation, consistent with the 1996 Act. To accomplish these goals, we established and sought comment on a methodology for determining non-rural carriers' support amounts, based on the forward-looking costs estimated using a national cost model, and a national cost benchmark, that will begin on January 1, 2000.[33]

III. ESTIMATING FORWARD-LOOKING ECONOMIC COST

A. Designing a Forward-Looking Wireline Local Telephone Network

12. To understand the assumptions made in the mechanism, it is necessary to understand the layout of the current wireline local telephone network.[34] In general, a telephone network must allow any customer to connect to any other customer. In order to accomplish this, a telephone network must connect customer premises to a switching facility, ensure that adequate capacity exists in that switching facility to process all customers' calls that are expected to be made at peak periods, and then interconnect that switching facility with other switching facilities to route calls to their destinations. A wire center is the location of a switching facility. The wire center boundaries define the area in which all customers are connected to a given wire center. The *Universal Service Order* required the models to use

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Results Using Proposed Input Values In The Forward-Looking Cost Model For Universal Service, Public Notice, CC Docket Nos. 96-45, 97-160, DA 99-1165 (rel. June 16, 1999) (*Preliminary Input Values Public Notice)*; *Common Carrier Bureau Releases Revised Spreadsheet For Estimating Universal Service Support Using Proposed Input Values In The Forward-Looking Cost Model*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 99-1322 (rel. July 2, 1999).

[31] *See Inputs Further Notice* at Appendix A.

[32] *See generally Inputs Further Notice.*

[33] *See generally Seventh Report and Order.*

[34] We also note that technologies such as wireless services are likely to become more important over time in providing universal service. We will continue to review suggestions for incorporating such technologies into the forward-looking mechanism for future years. *See, e.g.*, Letter from David L. Sieradzki, on behalf of Western Wireless, to Magalie Roman Salas, FCC, dated January 26, 1999 (submitting the "Wireless Cost Model"). In addition, we intend to initiate a proceeding in the near future to consider how changes in technologies and other related factors should be accounted for in the model.

existing incumbent LEC wire center locations in estimating forward-looking cost.[35]

13. Within the boundaries of each wire center, the wires and other equipment that connect the central office to the customers' premises are known as outside plant. Outside plant can consist of either copper cable or a combination of optical fiber and copper cable, as well as associated electronic equipment. Copper cable generally carries an analog signal that is compatible with most customers' telephone equipment. The range of an analog signal over copper is limited, however, so thicker, more expensive cables or loading coils must be used to carry signals over greater distances. Optical fiber cable carries a digital signal that is incompatible with most customers' telephone equipment, but the quality of a signal carried on optical fiber cable is superior at greater distances when compared to a signal carried on copper wire. Generally, when a neighborhood is located too far from the wire center to be served by copper cables alone, an optical fiber cable will be deployed to a point within the neighborhood, where a piece of electronic equipment will be placed that converts the digital light signal carried on optical fiber cable to an analog, electrical signal that is compatible with customers' telephones. This equipment is known as a digital loop carrier remote terminal, or DLC, which is connected to a serving area interface (SAI). From the SAI, copper cables of varying gauge extend to all of the customer premises in the neighborhood. Where the neighborhood is close enough to the wire center to be served entirely on copper cables, copper trunks connect the wire center to the SAI, and copper cables will then connect the SAI to the customers in the serving area. The portion of the loop plant that connects the central office with the SAI or DLC is known as the feeder plant, and the portion that runs from the DLC or SAI throughout the neighborhood is known as the distribution plant.

14. The model's estimate of the cost of serving the customers located within a given wire center's boundaries includes the calculation of switch size, the lengths, gauge, and number of copper and fiber cables, and the number of DLCs required. These factors depend, in turn, on how many customers the wire center serves, where the customers are located within the wire center boundaries, and how they are distributed within neighborhoods. Particularly in rural areas, some customers may not be located in neighborhoods at all but, instead, may be scattered throughout outlying areas. In general, the model divides the area served by the wire center into smaller areas known as serving areas. For serving areas sufficiently close to the wire center, copper feeder cable extends from the wire center to a SAI where it is cross-connected to copper distribution cables. If the feeder is fiber, it extends to a DLC terminal in the serving area, which converts optical digital signals to analog signals. Individual circuits from the DLC are cross-connected to copper distribution cables at the adjacent SAI.

[35] The *Universal Service Order* established ten criteria to ensure consistency in calculations of federal universal service support. *Universal Service Order*, 12 FCC Rcd at 8913, para. 250. Criterion one requires that a model must include incumbent LECs' wire centers as the center of the loop network and the outside plant should terminate at incumbent LECs' current wire centers.

15. The model assumes that wire centers are interconnected with one another using optical fiber networks known as Synchronous Optical Network (SONET) rings.[36] The infrastructure to interconnect the wire centers is known as the interoffice network, and the carriage of traffic among wire centers is known as transport. In cases where a number of wire centers with relatively few people within their boundaries are located in close proximity to one another, it may be more economical to use the processor capacity of a single switch to supervise the calls of the customers in the boundaries of all the wire centers. In that case, a full-capacity switch (known as a host) is placed in one of the wire centers and less expensive, more limited-capacity switches (known as remotes) are placed in the other wire centers. The remotes are then connected to the host with interoffice facilities. Switches that are located in wire centers with enough customers within their boundaries to merit their own full-capacity switches and that do not serve as hosts to any other wire centers are called stand-alone switches.

16. There are also a number of expenses and general support facilities (GSF) costs associated with the design of a forward-looking wireline telephone network.[37] GSF costs include the investment related to vehicles, land, buildings, and general purpose computers. Expenses include: plant-specific expenses, such as maintenance of facilities and equipment expenses; plant non-specific expenses, such as engineering, network operations, and power expenses; customer services expenses, such as marketing, billing, and directory listing expenses; and corporate operations expenses, such as administration, human resources, legal, and accounting expenses.[38]

B. Synthesis Model

1. Historical Background

17. The synthesis model adopted in the *Platform Order* allows the user to estimate the cost of building a telephone network to serve subscribers in their actual geographic locations, to the extent these locations are known.[39] To the extent that the actual geographic locations of customers are not available, the Commission determined that the synthesis model

[36] SONET is a set of standards for optical (fiber optic) transmission. It was developed to meet the need for transmission speeds above the T3 level (45 Mbps) and is generally considered the standard choice for transmission devices used with broadband networks. BCPM Dec. 11 submission, Model Methodology at 68.

[37] *See Platform Order*, 13 FCC Rcd at 21357-61, paras. 81-91.

[38] *Platform Order*, 13 FCC Rcd at 21357-58, para. 82.

[39] *Platform Order*, 13 FCC Rcd at 21337, para. 33. *See also* discussion of customer location data, *infra* section IV.

should assume that customers are located along roads.[40]

18. Once the customer locations have been determined, the model employs a clustering algorithm to group customers into serving areas in an efficient manner that takes into consideration relevant engineering constraints.[41] After identifying efficient serving areas, the model designs outside plant to the customer locations.[42] In doing so, the model employs a number of cost minimization principles designed to determine the most cost-effective technology to be used under a variety of circumstances, such as varying terrain and density.[43]

19. The Commission concluded that the federal universal service mechanism should incorporate, with certain modifications, the HAI 5.0a switching and interoffice facilities module to estimate the cost of switching and interoffice transport.[44] The Commission noted that it would consider adopting the LERG at the inputs stage of this proceeding to determine the deployment of host and remote switches.[45] In addition, the Commission adopted the HAI platform module for calculating expenses and capital costs, such as depreciation.[46]

20. The Commission noted that technical improvements to the cost model will continue, both before implementation of the model for non-rural carriers and on an ongoing basis, as necessary.[47] The Commission therefore delegated to the Bureau the authority to make changes or direct that changes be made to the model platform as necessary and appropriate to ensure that the platform of the federal mechanism operates as described in the *Platform Order*.[48] As contemplated in the *Platform Order*, Commission staff and interested parties have continued to review the model platform to ensure that it operates as intended. As a result, some refinements have been made to the model platform adopted in the *Platform*

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[40] *Platform Order*, 13 FCC Rcd at 21340-41, para. 40. *See also* discussion of road surrogating method, *infra*.

[41] *Platform Order*, 13 FCC Rcd at 21342, para. 44.

[42] *Platform Order*, 13 FCC Rcd at 21346, para. 55.

[43] *Platform Order*, 13 FCC Rcd at 21348, para. 61.

[44] *Platform Order*, 13 FCC Rcd at 21354-55, para. 75.

[45] *Platform Order*, 13 FCC Rcd at 21355, para. 76.

[46] *Platform Order*, 13 FCC Rcd at 21357, para. 81.

[47] *Platform Order*, 13 FCC Rcd at 21329, para. 13.

[48] *Platform Order*, 13 FCC Rcd at 21329, para. 13.

Order.[49] All changes to the model platform are posted on the Commission's Web site.[50]

2. Validation

21. In the *Universal Service Order*, the Commission concluded that high-cost support should be based on forward-looking costs.[51] Since that time, the Commission has continued to work to adopt a cost model that is reasonably accurate and verifiable.[52] Although we have remained confident in our ability to adopt a model, in the *Inputs Further Notice*, we sought comment on how the Commission might determine support levels without using a model, "[i]n the unlikely event that the model is not ready for timely implementation."[53] A few commenters offered concrete suggestions in response to this request, virtually all of which involved the use of carriers' book costs in lieu of the model.[54]

22. As an initial matter, we affirm the Commission's decision to base support calculations on forward-looking costs. We have repeatedly articulated our reasons for believing that forward-looking costs represent a superior method for determining support amounts. The most significant of these is that forward-looking costs are the basis of economic decisions in a competitive market, and therefore send the correct signals for entry and investment.

23. Moreover, the Commission and its staff have undertaken a thorough review of the model and its input values over the past six months. In so doing, the staff has coordinated extensively with and received substantial input from the Joint Board staff and interested outside parties. As a result of this examination of the model, we are convinced that it

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[49] *Common Carrier Bureau To Post On The Internet Modifications To The Forward-Looking Economic Cost Model For Universal Service Support*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 98-2533 (rel. Dec. 15, 1998).

[50] Model platform changes can be found at http://www.fcc.gov/ccb/apd/hcpm. Changes to the model are detailed in the "History.doc" file. The model platform was not modified after June 2, 1999, in order to allow parties an opportunity to evaluate the model platform, the proposed inputs to the model, and issues related to the methodology for determining high-cost support. After release of this Order, we will post a revised model platform on the Commission's Web site, including the input values adopted herein.

[51] *Universal Service Order*, 12 FCC Rcd at 8899-8900, paras. 224-226.

[52] *See, e.g.*, *1997 Further Notice*; *Inputs Public Notice*; *Workshop Public Notice*; *Inputs Further Notice*.

[53] *Inputs Further Notice* at para. 243.

[54] *See, e.g.*, Bell Atlantic *Inputs Further Notice* comments at 5-6, GTE *Inputs Further Notice* comments at 89-91, USTA *Inputs Further Notice* comments at 4-5. *But see* US West *Inputs Further Notice* comments at 70-71.

generates reasonably accurate estimates of forward-looking costs and that the model is the best basis for determining non-rural carriers' high-cost support in a competitive environment.

24. After this review of the model, we find that none of the criticisms of the model undermine our decision to use it for calculating non-rural carriers' high-cost support. For example, some parties have observed that the model seems to generate unexpectedly high cost estimates for certain states, such as Mississippi and Alabama.[55] Because of the high levels of cost estimated in these states, they receive larger shares of forward-looking support than they receive under the current mechanism, and also receive higher levels of support than some other states (such as the sparsely populated Western and Midwestern states) that many parties expected to lead the list of high-cost states. After further review, however, we have found several factors that explain the model's results.

25. We first sought to verify the model's results by determining whether the model generated higher costs in areas where customers are more dispersed. Although there are other relevant factors, most people agree that telephone plant costs tend to be highest when customers are spread thinly over a large area. We used a "minimum spanning tree" measurement to determine relative dispersion of customers.[56] We found that the model's cost estimates were highly correlated with dispersion of customers. This provides a preliminary, objective check on the model's accuracy.

26. This analysis does not, however, explain why the model estimates higher costs in some states relative to others in a distribution that differs from carriers' book costs and from some observers' expectations. In researching this issue, we discovered that significant differences exist among the states in the territory served by larger carriers, which are typically considered non-rural carriers under the Act.[57] It is important to remember that the present model runs only cover the territory served by non-rural carriers. The costs estimated by the model will be significantly affected by the type of territory served by those carriers in the state whose costs are being calculated, and to the extent that a rural territory is being served by a rural carrier that is not receiving high-cost support under this mechanism, the cost of serving that territory will not be reflected in the level of support for that state determined in this phase of the proceeding. In general, we found that the states where the model estimated the highest costs were those states in which the territory served by the non-rural carriers, which are typically larger carriers, included more rural areas than in other states. We also found that some states that are generally perceived as rural are served primarily by small

[55] Bell Atlantic *Inputs Further Notice* comments at 4.

[56] *See* C.A. Bush et al., *The Hybrid Cost Proxy Model Customer Location and Loop Design Modules*, Dec. 15, 1998 at 13-14 (*HCPM Dec. 15, 1998 documentation*).

[57] *See* 47 U.S.C. § 153(37).

carriers, so that the remaining territory in the state, which would be served by the non-rural carrier, is less rural than the state as a whole. For example, in Mississippi, the large incumbent LEC serves the vast majority of the state's territory, including many very rural areas. By contrast, in Montana for example, the large incumbent LEC serves less than a third of the state's territory, and its serving area includes all but one of the largest cities in the state. Small rural carriers serve the most sparsely populated rural areas in Montana. As a result, considering only the non-rural carriers' territory, Mississippi appears to be a considerably more rural state than Montana. As discussed above, our analysis showed that the model's cost estimates were highly correlated with dispersion -- that is, the areas with the most dispersed customers were estimated by the model to have the highest costs. Although this results in relative cost estimates among states that differ from some people's expectations, we believe that this may primarily reveal that those expectations were based on a lack of information or incorrect premises about non-rural carriers' service territories.

27. Moreover, our investigation revealed that most of the variations between carriers' book cost levels and the model's estimated forward-looking costs can be explained by three factors. The first is the percentage of business lines in the study area. Study areas with a lower percentage of business lines tend to have lower book costs relative to forward-looking costs. The second factor is the percentage of customers in rural areas. Study areas with a higher percentage of rural customers also tend to have lower relative book costs. These two factors, taken together, suggest that the book cost of the existing network is more likely to be below the model's estimate of the cost of a forward-looking network in rural areas with fewer business customers. This may suggest that these areas are served by networks of a different quality standard than that assumed in the model, or that the networks in these areas have not been upgraded or experienced much growth in some time and therefore are substantially depreciated on carriers' books. The third factor is discrepancies in line counts between the data used in the model and the most current carrier-reported data. We have taken steps to correct these discrepancies in the line count data that we adopt in this Order.[58]

28. We believe that the model, as used in the methodology we set out in the companion *Methodology Order*, is the best way to generate non-rural carriers' support amounts for the funding year beginning January 1, 2000. We also recognize, however, that the model must evolve as technology and other conditions change. We therefore have committed to initiating a proceeding to study how the model should be used in the future (e.g., how often inputs data should be updated) and how the model itself should change to reflect changing circumstances. We anticipate releasing a further notice of proposed rulemaking on these issues in early 2000, and hope to reach significant decisions on these issues during the course of that year.

[58] *See infra* para. 61.

C. Selecting Forward-Looking Input Values

29. In the *Universal Service Order*, the Commission adopted ten criteria to be used in determining the forward-looking economic cost of providing universal service in high-cost areas.[59] These criteria provide specific guidance for our selection of input values for use in the synthesis model. Rather than reflecting existing incumbent LEC facilities, the technology assumed in the model "must be the least-cost, most-efficient, and reasonable technology for providing the supported services that is currently being deployed."[60] As noted below, existing LEC plant in a particular area may not reflect forward-looking technology or design choices.[61] Similarly, the input values we adopt in this Order are not intended to replicate any particular company's embedded or book costs. Criterion three directs that "costs must not be the embedded cost of the facilities, functions, or elements."[62] Rather, the model "must be based upon an examination of the current cost of purchasing facilities and equipment."[63]

30. As discussed below, we generally adopt nationwide, rather than company-specific, input values in the federal mechanism. In many cases, the only data for various inputs on the record in this proceeding are embedded cost, company-specific data. We have used various techniques to convert these data to forward-looking values. For example, we modify the switching data to adjust for the effects of inflation and the cost changes unique to the purchase and installation of digital switches.[64] Where possible, we have tried to account for variations in costs by objective means. For example, the model reflects differences in structure costs by using different values for the type of plant, the density zone, and geological conditions. There may be additional modifications we can make in the future to more accurately reflect variations in forward-looking costs based on objective criteria. For example, we do not adjust our maintenance expense estimates to reflect regional wage differences, as discussed below, because we have not found and no party has suggested a specific data source or methodology that would be useful in making such adjustments.[65] We certainly remain open to considering data sources in the future of the model proceeding that would permit us to vary these or other input values to reflect differences in forward-looking

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[59] *Universal Service Order*, 12 FCC Rcd at 8913-16, para. 250.

[60] *Universal Service Order*, 12 FCC Rcd at 8913, para. 250 (criterion one).

[61] *See infra* paras. 63, 351.

[62] *Universal Service Order*, 12 FCC Rcd at 8913, para. 250 (criterion three).

[63] *Universal Service Order*, 12 FCC Rcd at 8913, para. 250 (criterion three).

[64] *See infra* para. 311.

[65] *See infra* paras. 361-64.

cost that can be measured objectively.

31. Although the BCPM sponsors have provided nationwide default values, they and other LECs generally advocate company-specific input values. For purposes of determining federal universal service support amounts, however, we believe that nationwide default values generally are more appropriate than company-specific values. Under the new federal universal service support mechanism, support is based on the estimated costs that an efficient carrier would incur to provide the supported services, rather than on the specific carrier's book costs. We also believe that it would be administratively unworkable to use company-specific values in the federal nationwide model. Finally, we note that, for most inputs, we have no means of adopting company-specific input values, except possibly by relying on embedded data for each company. We make no finding as to whether nationwide values would be appropriate for purposes other than determining federal universal service support.[66]

32. For universal service purposes, we find that using nationwide averages is appropriate. The Commission has not considered what type of input values, company-specific or nationwide, nor what specific input values, would be appropriate for any other purposes. The federal cost model was developed for the purpose of determining federal universal service support, and it may not be appropriate to use nationwide values for other purposes, such as determining prices for unbundled network elements. We caution parties from making any claims in other proceedings based upon the input values we adopt in this Order.

IV. DETERMINING CUSTOMER LOCATIONS

A. Background

33. The determination of customer locations relative to the wire center heavily influences a forward-looking cost model's design of outside plant facilities. This is because assumptions about the locations of customers will determine the predicted loop length, which in turn will have a large impact on the cost of service and the technologies employed by the model.[67] Each of the models under consideration in the *Platform Order* provided a methodology for determining customer locations.[68] The Bureau sought comment on these

[66] State commissions, for example, may find that it is not appropriate to use nationwide values in determining state universal service support or prices for unbundled network elements and may choose instead to use statewide or company-specific values.

[67] *See 1997 Further Notice*, 12 FCC Rcd at 18535, para. 44.

[68] *Platform Order*, 13 FCC Rcd at 21337, para. 31.

proposals and solicited alternative proposals from interested parties for locating customers.[69]

34. In the *Platform Order*, the Commission concluded that HAI's proposal to use actual geocode data, to the extent that they are available, and BCPM's proposal to use road network information to create "surrogate" customer locations where actual data are not available, provided the most reasonable method for determining customer locations.[70] The Commission concluded that "the source or sources of geocode data to use in determining customer location will be decided at the inputs phase of this proceeding."[71] The Commission also concluded that "the selection of a precise algorithm for placing road surrogates pursuant to these conclusions should be conducted in the inputs stage of this proceeding as part of the process of selecting a geocode data set for the federal mechanism."[72]

35. In the *Inputs Further Notice,* we tentatively concluded that no source of actual geocode data had been made sufficiently available for review to be used in the model at that time.[73] Therefore, we tentatively concluded that a road surrogate algorithm would be used to locate customers in the federal mechanism until a source of actual geocode data is selected by the Commission. In doing so, we tentatively adopted the road surrogate algorithm proposed by PNR Associates (PNR) to develop road surrogate customer locations.[74]

B. Customer Location Data

1. Geocode Data

36. While we affirm our conclusion in the *Platform Order* 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 below

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[69] *See, e.g., 1997 Further Notice*, 12 FCC Rcd at 18535, para. 44; *Inputs Public Notice* at 3-4; *Common Carrier Bureau Seeks Comment On Model Platform Development*, Public Notice, CC Docket Nos. 96-45, 97-160, DA 98-1587 (rel. Aug. 7, 1998) (*Platform Public Notice*) at 2-4.

[70] *Platform Order*, 13 FCC Rcd at 21337, para. 31. The term "geocode data" refers to the identification of each customer location by precise latitude and longitude coordinates. Surrogating methods, and customer location data provided by the Census Bureau, constitute geocode data. For purposes of clarity, however, we will use the term "geocode" data to refer only to actual precise latitude and longitude data, unless we specifically refer to the data as "surrogate geocode" data.

[71] *Platform Order*, 13 FCC Rcd at 21337-38, para. 34.

[72] *Platform Order*, 13 FCC Rcd at 21340-41, para. 40.

[73] *Inputs Further Notice* at paras. 25-28.

[74] *Inputs Further Notice* at para. 29.

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.[75]

37. 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.[76] We noted that commenters generally support the use of accurate geocode data in the federal mechanism where available.[77] 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."[78] 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.[79]

38. In the *Universal Service Order*, 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."[80] 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.[81] PNR took initial steps to comply with this requirement in December 1998 by making available the "BIN" files[82] derived from the

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[75] In the upcoming proceeding on future changes to the model, *see supra* note 34, we intend to consider alternatives for obtaining customer location data.

[76] *Platform Order*, 13 FCC Rcd at 21337, para. 33.

[77] *Platform Order*, 13 FCC Rcd at 21337-38, para. 34.

[78] *Platform Order*, 13 FCC Rcd at 21338, para. 34.

[79] *Platform Order*, 13 FCC Rcd at 21338, para. 34.

[80] *Universal Service Order*, 12 FCC Rcd at 8915, para. 250 (criterion eight).

[81] *See Federal-State Joint Board on Universal Service*, Protective Order, CC Docket Nos. 96-45, 97-160, 13 FCC Rcd 13910 (1998) (*Protective Order*). *See also Inputs Public Notice* at 3-4.

[82] BIN files are the output of the clustering routine in the synthesis model platform derived from the actual geocode customer locations and, as such, do not reveal the actual geocoded customer locations. The BIN files allow users to run all aspects of the model except for the clustering. PNR has made the BIN files available to

geocoded points to interested parties pursuant to the *Protective Order*.[83] 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.[84] In addition, PNR acknowledges that its geocode database relies on third-party data that PNR is not permitted to disclose.[85]

39. Consistent with our tentative conclusion in the *Inputs Further Notice*, 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.[86] 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.[87]

2. Road Surrogate Customer Locations

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interested parties for a fee of $25.00, pursuant to the terms of the *Protective Order*. *See* Letter from William M. Newman, PNR, to Magalie Roman Salas, FCC, dated December 17, 1998 (PNR Dec. 17 *ex parte*).

[83] *See* PNR Dec. 17 *ex parte*.

[84] *See, e.g.*, Bell Atlantic Petition for Reconsideration at 5-6; BellSouth Petition for Reconsideration at 3-4; GTE Petition for Reconsideration at 21; Sprint *Inputs Further Notice* comments at 11.

[85] Letter to Thomas W. Mitchell, on behalf of GTE, from Charles A. White, PNR, dated April 29, 1999 (PNR April 29 *ex parte*) at 1.

[86] *See, e.g.*, Ameritech *Inputs Further Notice* comments at 2; GTE *Inputs Further Notice* comments at 36-37; SBC *Inputs Further Notice* comments at 4; Sprint *Inputs Further Notice* comments at 11.

[87] We note that AT&T and MCI have suggested that the Commission condition receipt of universal service funding on the provision of customer location data by the carrier. *See* AT&T/MCI *Inputs Further Notice* comments at 5. We decline to adopt this suggestion at this time, but will consider this and other alternatives to obtaining customer location data in the upcoming proceeding on future changes to the model.

40. 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.[88]

41. 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."[89] 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.[90] In the *Inputs Further Notice*, we tentatively adopted the PNR road surrogate algorithm to determine customer locations.[91]

42. 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.[92] 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.[93] On February 22, 1999, PNR filed a more detailed description of its road surrogate algorithm.[94] Consistent with the conditions set forth in the *Inputs Further*

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[88] *Platform Order*, 13 FCC Rcd at 21340-41, para. 40.

[89] *Platform Order*, 13 FCC Rcd at 21340-41, para. 40.

[90] *Platform Order*, 13 FCC Rcd at 21341, para. 41.

[91] *Inputs Further Notice* at para. 34.

[92] Letter from Michael Liebermann, AT&T, to Magalie Roman Salas, FCC, dated March 2, 1998 (AT&T March 2 *ex parte*).

[93] Letter from William M. Newman, PNR, to Magalie Roman Salas, FCC, dated January 27, 1999 (PNR Jan. 27 *ex parte*). PNR has made available by mail to interested parties the road surrogate point data for a fee of $25.00, pursuant to the terms of the *Protective Order.*

[94] Letter from Charles A. White, PNR, to Magalie Roman Salas, FCC, dated February 22, 1999 (PNR Feb. 22 *ex parte*).

Notice, PNR has now made available road surrogate data for all fifty states and Puerto Rico.[95]

43. 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.[96] For each Census Block, PNR determines how many customers and which roads are located within the Census Block.[97] 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.[98] For example, PNR excludes highway access ramps, alleys, and ferry crossings.[99] 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.[100] 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."[101]

44. Stopwatch Maps has compiled road surrogate customer location files for six

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[95] Letter from Charles A. White, PNR, to Magalie Roman Salas, FCC, dated July 29, 1999 (PNR July 29 *ex parte*).

[96] PNR Feb. 22 *ex parte* at 1. A road segment is a length of road between two intersections. The Census Bureau classifies and numbers each of these road segments. PNR uses a slightly modified version of the Census Bureau road classifications. *Id.* at 2

[97] The PNR National Access Line Model is used to determine the number of residential and business customer locations in a given wire center. *See* PNR Feb. 22 *ex parte* at 1.

[98] PNR Feb. 22 *ex parte* at 2.

[99] PNR Feb. 22 *ex parte* at 2.

[100] PNR Feb. 22 *ex parte* at 2.

[101] *See* PNR July 29 *ex parte*. PNR has also filled in the states and wire centers that were missing from earlier versions of its road surrogate customer location data set.

states suitable for use in the federal mechanism.[102] 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.[103] 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.

45. 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.[104] 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.[105] AT&T and MCI therefore suggest a downward adjustment to produce more accurate outside plant cost estimates.[106] 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.[107] GTE argues that there is no evidence to conclude, therefore, that a uniform dispersion of customers is likely to overstate outside plant costs.[108] 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.[109]

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[102] *See* Letter from Pete Sywenki, Sprint, to Magalie Roman Salas, FCC, dated December 11, 1998 (Sprint Dec. 11 *ex parte*).

[103] GTE *Inputs Further Notice* comments at 38.

[104] AT&T/MCI *Inputs Further Notice* comments at 3. Because the PNR actual geocode data set does not provide a complete data set of customer locations, AT&T and MCI compare a combination of actual and surrogate data with the use of all surrogate data. The percentage of actual geocoded customer data varies in different areas.

[105] AT&T/MCI *Inputs Further Notice* comments at 3 (contending that customers tend to cluster unevenly along roads and even leave stretches unpopulated). *See also* Ameritech *Inputs Further Notice* comments at 5 (contending that PNR surrogate locations tend to spread customers more evenly than when compared to Ameritech's geocoded customer data).

[106] AT&T/MCI *Inputs Further Notice* reply comments at 10.

[107] GTE *Inputs Further Notice* reply comments at 4-5.

[108] GTE *Inputs Further Notice* reply comments at 5.

[109] Sprint *Inputs Further Notice* comments at 13.

46. 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 above, 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.[110] 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.[111] 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."[112] 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.

47. We also disagree with Bell Atlantic's contention that road surrogate data is inherently random and likely to misidentify high-cost areas.[113] 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.[114] In addition, we note that PNR's reliance on the Census

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[110] As noted above, AT&T and MCI rely on the PNR actual geocode data that we have rejected for lack of a meaningful verification process. In the absence of a verifiable, actual geocode data source, it is impossible to make the type of comparison suggested by AT&T and MCI to determine the accuracy of the road surrogate algorithm.

[111] Letter from Celia Nogales, Ameritech, to Magalie Roman Salas, FCC, dated July 14, 1999 (Ameritech July 14 *ex parte*). LECG is an economic consulting firm.

[112] Ameritech *Inputs Further Notice* comments at 3.

[113] Bell Atlantic *Inputs Further Notice* comments at 8. As noted, the decision to use a surrogating algorithm based on roads was made by the Commission in the *Platform Order*. Our purpose in this Order is not to revisit that decision but to select the road surrogate algorithm that will be used in the federal mechanism.

[114] *Platform Order*, 13 FCC Rcd at 21341, para. 41.

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*.[115] The PNR road surrogate algorithm is also generally supported by commenters addressing this issue.[116] 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.[117] 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

48. 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.[118] 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.[119] We now affirm these tentative conclusions.

49. 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."[120] 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.[121] Interested parties have proposed alternative methods to

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[115] We also note that PNR has made the road surrogate data points available to interested parties pursuant to the provisions of the *Protective Order* in this proceeding. *See* PNR Jan. 27 *ex parte*; PNR Feb. 9 *ex parte*; PNR Feb. 22 *ex parte*.

[116] *See, e.g.*, Ameritech *Inputs Further Notice* at 3; AT&T/MCI *Inputs Further Notice* comments at 6-7; Sprint *Inputs Further Notice* at 12.

[117] AT&T/MCI *Inputs Further Notice* comments at 6-7.

[118] *Inputs Further Notice* at para. 43.

[119] *Inputs Further Notice* at para. 43.

[120] *Universal Service Order*, 12 FCC Rcd at 8915, para. 250 (criterion 6).

[121] *Inputs Public Notice* at 4-6. *See also Inputs Further Notice* at para. 46.

comply with this requirement.[122]

50. 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.[123] A household is an occupied residence, while housing units include all residences, whether occupied or not.[124]

51. 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.[125] 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.[126] The model makes these estimates for each Census Block, and for each wire center in the United States.[127] In addition, each customer location is associated with a particular wire center.[128] 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

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[122] We note that the question of which residential and business locations should be included for purposes of estimating the forward-looking cost of providing the supported services is distinct from the question of which lines should be supported. *See Universal Service Order*, 12 FCC Rcd at 8829, paras. 95-96 (declining to adopt the Joint Board's recommendation to restrict universal service high-cost support to primary residential lines and single-line businesses).

[123] Ameritech *Inputs Further Notice* comments at 6; AT&T/MCI *Inputs Further Notice* comments at 7-8; BellSouth *Inputs Further Notice* comments at B-2; GTE *Inputs Further Notice* comments at 40; SBC *Inputs Further Notice* comments at 6; USTA *Inputs Further Notice* comments at 2-3; US West *Inputs Further Notice* comments at 45-46.

[124] These definitions reflect the Census Bureau's methodology for housing unit and household estimates. *See* http://www.census.gov/population/methods/sthhmet.txt.

[125] HAI Dec. 11, 1997 submission, Model Description at 21.

[126] *See Inputs Further Notice* at Appendix B.

[127] HAI Dec. 11, 1997 submission, Model Description at 21.

[128] Customer locations in unserved areas, as reflected by BLR wire center boundaries, are not associated with particular wire centers. *See* Letter from Charles A. White, PNR, to Magalie Roman Salas, FCC, dated April 12, 1999. PNR has, however, taken steps to assign such customer locations to the nearest wire center. PNR July 29 *ex parte*.

use PNR's methodology for estimating the demand for service at each location, and for allocating customer locations to wire centers.[129] 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.

52. 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.

53. 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.[130] 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.

54. 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.[131] 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.[132] They therefore assert that residential locations should be based on the number of housing units -- whether occupied or

[129] *See Inputs Further Notice* at Appendix B for a complete description of the PNR methodology for estimating the number of customer locations.

[130] BCPM April 30, 1998 documentation, Model Methodology at 26-27.

[131] BellSouth *Inputs Further Notice* at B-2; GTE *Inputs Further Notice* at 40; SBC *Inputs Further Notice* comments at 6; USTA *Inputs Further Notice* comments at 2-3; US West *Inputs Further Notice* comments at 45-46.

[132] BellSouth *Inputs Further Notice* comments at B-2; GTE *Inputs Further Notice* comments at 40; PRTC *Inputs Further Notice* comments at 5.

unoccupied.[133] These commenters contend that only this approach reflects the obligation to provide service to any residence that may request it in the future.[134]

55. Some commenters also contend that the PNR National Access Line Model has not been made adequately available for review.[135] As noted above, 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.[136] As a result, PNR contends that the National Access Line Model cannot be provided in a single, uniform format.[137] The HAI sponsors have provided a description of the National Access Line Model process in the HAI model documentation.[138] 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.[139] PNR also notes that the National Access Line Model computer code is available for review on-site.[140] PNR also has filed with the Commission the complete output of the National Access Line Model process.[141] In addition, Bell Atlantic and Sprint argue that the National Access Line Model produces line counts that vary significantly from actual line counts.[142]

56. 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

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[133] *See, e.g.*, BellSouth *Inputs Further Notice* at B-2; GTE *Inputs Further Notice* at 40; SBC *Inputs Further Notice* comments at 6; USTA *Inputs Further Notice* comments at 2-3; US West *Inputs Further Notice* comments at 45-46.

[134] *See, e.g.*, BellSouth *Inputs Further Notice* comments at B-2; GTE *Inputs Further Notice* comments at 40; US West *Inputs Further Notice* comments at 45-46.

[135] Bell Atlantic *Inputs Further Notice* comments at 14-15; GTE *Inputs Further Notice* comments at 37-38; Sprint *Inputs Further Notice* comments at 13-14; US West *Inputs Further Notice* reply comments at 12.

[136] HAI has provided a complete description of the process by which PNR's National Access Line Model develops customer counts. *See* HAI Dec. 11, 1997, Model Description at 21.

[137] PNR *Inputs Further Notice* reply comments at 2.

[138] *See* HAI Dec. 11, 1997, Model Description at 21.

[139] PNR *Inputs Further Notice* reply comments at 2.

[140] PNR *Inputs Further Notice* reply comments at 2-3.

[141] Letter from Charles White, PNR, to Magalie Roman Salas, FCC, dated October 6, 1999.

[142] Bell Atlantic *Inputs Further Notice* comments at 14-15; Sprint *Inputs Further Notice* comments at 13-14.

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.[143] 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.[144] 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."[145] 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.[146] 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 below, we believe that PNR's methodology based on households is less complex and more consistent with a forward-looking methodology than housing units.

57. 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).[147]

58. 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

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[143] AT&T and MCI *ex parte*, Dec. 23, 1997.

[144] Letter from Chris Frentrup, MCI, to Magalie Roman Salas, FCC, dated March 5, 1999 (MCI March 5 *ex parte*).

[145] MCI March 5 *ex parte* (Issues 1 and 2).

[146] SBC *Inputs Further Notice* comments at 6.

[147] AT&T and MCI *ex parte*, Dec. 23, 1997.

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.[148]

59. 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.[149]

60. 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

[148] Ameritech *Inputs Further Notice* comments at 7; AT&T/MCI *Inputs Further Notice* comments at 8. *See infra* section V for discussion of fill factors.

[149] *See Federal-State Joint Board on Universal Service: Promoting Deployment and Subscribership in Unserved and Underserved Areas, Including Tribal and Insular Areas*, Further Notice of Proposed Rulemaking, CC Docket No. 96-45, FCC 99-204 (rel. Sept. 3, 1999) at paras. 120-121.

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.

61. 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,[150] 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.

62. In the *Inputs Further Notice*, we also noted that the accuracy of wire center boundaries is important in estimating the number of customer locations.[151] PNR currently uses BLR wire center information to estimate wire center boundaries.[152] As noted above, the BCPM model also uses BLR wire center boundaries, as does Stopwatch Maps in its road surrogate customer location files.[153] A few commenters support the use of BLR wire center boundaries, noting widespread use by the model proponents.[154] Others advocate the use of actual wire center boundaries.[155] These commenters acknowledge, however, that this information is generally considered confidential and may not be released publicly by the incumbent LEC.[156] 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

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[150] *See Federal-State Joint Board on Universal Service, Forward-Looking Mechanism for High Cost Support for Non-Rural LECs*, Order, CC Docket Nos. 96-45, 97-160, DA 99-1406 (rel. July 19, 1999).

[151] *Inputs Further Notice* at para. 47.

[152] HAI Dec. 11, 1997 submission, Model Description at 21.

[153] *See* Sprint Dec. 11, 1998 *ex parte*, attachment at 1.

[154] AT&T/MCI *Inputs Further Notice* comments at 8; PNR *Inputs Further Notice* reply comments at 3.

[155] PRTC *Inputs Further Notice* comments at 6; SBC *Inputs Further Notice* comments at 6.

[156] SBC *Inputs Further Notice* comments at 6; PNR *Inputs Further Notice* reply comments at 3.

data set.

V. OUTSIDE PLANT INPUT VALUES

A. Introduction

63. 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."[157] 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.[158] 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."[159] The *Universal Service Order's* third criterion specifies that "[o]nly long-run forward-looking costs may be included."[160] . We select input values consistent with these criteria.

64. 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.[161] 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.[162]

65. Outside plant consists of a mix of aerial, underground, and buried cable.[163] 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

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[157] *Universal Service Order*, 12 FCC Rcd at 8913, para. 250.

[158] *Inputs Further Notice* at para. 11; *Universal Service Order*, 12 FCC Rcd at 8913, para. 250.

[159] *Platform Order*, 12 FCC Rcd at 21350, para. 66. "Instead, incumbent LECs' existing plant will tend to reflect choices made at a time when different technology options existed or when the relative cost of equipment to labor may have been different than it is today." *Id.*

[160] *Universal Service Order*, 12 FCC Rcd at 8913, para. 250.

[161] *Platform Order*, 13 FCC Rcd at 21335, para. 27.

[162] As discussed below, cable installation costs for buried cable often are included with the structure costs.

[163] The phrase "plant mix" refers to the ratio of outside plant that is aerial, underground, or buried in a network or particular area.