lines, but BCPM does not.[106]

52. Both models use a closing factor, i.e., a ratio of line counts, as provided by the NECA and ARMIS databases, compared to the models' estimates, to adjust the estimates produced by their algorithms to reflect the actual ILEC line counts. Neither model, however, clearly discloses the closing factors for all lines that are used in their line count calculations.

(2) Issues for Comment

53. Platform Design. At this time it appears that neither the Hatfield nor BCPM algorithms accurately predict line count, and seek comment on what changes can be made to those algorithms to improve their accuracy. Because reliable line counts are necessary for determining accurate cost estimates, it appears that reasonable estimates of the number of lines in each CBG, CB, or grid cell are necessary to calculate universal service support, even if we decide to provide support on a wire center basis. Reasonable estimates of lines at the wire center and study area level will allow us to verify that the models' means of estimating line-count leads to accurate results. The models' algorithms should produce estimates that are accurate enough to avoid the need for a large closing factor to force the line-count estimate to match the wire center line count. We tentatively conclude that the sizes and uses of models' closing factors should be evident to the user so that they may be evaluated. We seek comment on whether the selected mechanism should adopt a maximum closing factor of 10 percent, as suggested by the state members of the Joint Board. We also seek comment on whether other data sources could be used to enhance the models' algorithms or be used to create an alternative method for determining line counts. We seek comment on whether, for example, we should assign business lines to geographic units by using commercially produced maps that give the coordinates of all businesses located in the U.S. along with their employment by standard industrial classification (SIC) code. We seek comment on whether such a method should use some multiple of the employment data to estimate the number of business lines in each grid block. Alternatively, we seek comment on whether there are any databases that use zip code information or geo-coding information that could be used to improve the line-count estimation process.

d. Dates for Comments on Customer Location

54. As discussed in section III.B.2, interested parties may file comments on all of the issues regarding customer location on or before September 2, 1997, and reply comments on or before September 10, 1997.[107]

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[106] Majority State Members' Second High Cost Report at 4.

[107] *See infra* app. A, Comment Submission Schedule.

2. Outside Plant Investment

55. Outside plant investment includes every part of an ILEC's network infrastructure connecting the wire center to customer locations.

a. Plant Mix

(1) Background

56. Platform Design. The 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. The plant mix is determined by the geographic distribution of population as well as terrain and weather conditions.[108] For example, terrain that includes hard rock, soft rock, near-surface groundwater, and steep slopes may increase the cost of underground plant placement substantially when compared with terrain that includes normal soil conditions. An efficient carrier will minimize forward-looking costs when selecting a mix of aerial, buried, and underground cable. For example, an efficient provider facing difficult terrain might determine that aerial plant has the lowest forward-looking costs, despite its higher maintenance costs, because aerial plant has substantially lower installation costs, or due to terrain or climatic conditions. Similarly, an efficient provider facing severe weather conditions, such as hurricanes, might determine that underground or buried cable has lower forward-looking costs than aerial cable, despite its higher installation costs. Although both Hatfield and BCPM include terrain factors and line density zones to estimate the cost of installing cable, neither model incorporates terrain factors to make decisions about outside structure plant mix. In addition, neither model seeks to minimize the total lifetime cost, including maintenance, of outside structure plant mix.

57. Input Values. Both BCPM and Hatfield use tables to assign the percentage share of feeder and distribution cable to aerial, buried, and underground installation. These percentages vary only by line density zone. The Hatfield model generally assigns more aerial cable, and BCPM assigns more buried cable. In very high-population density areas, both models assign most cable to underground installation. Both BCPM and Hatfield allow the user to alter plant mix assumptions for each population density zone, or to accept the default values supplied with the models.

(2) Issues for Comment

58. Platform Design. It appears that, while both models have made many

[108] In this regard, we note that GVNW has shown that actual plant mix varies with soil type. Letter from Bob Schoonmaker, GVNW, to William F. Caton, FCC, dated Feb. 20, 1997 (GVNW Feb. 20 *ex parte*).

improvements, the failure of both BCPM and Hatfield to incorporate terrain factors into their plant-mix tables seriously undermines the accuracy of the outside plant costs predicted by each model. For example, their assumptions that carriers will bury cable, regardless of terrain conditions, will lead to predictions of costs well above levels incurred by an efficient provider in very rocky areas or in areas with near-surface ground water. We thus find that an efficient carrier will vary its plant mix according to the population density of an area. We, therefore, tentatively conclude that the assignment of plant mix defined by the selected mechanism should reflect both terrain factors and line density zones. Specifically, we tentatively conclude that relatively more feeder and distribution cable should be assigned to aerial installation for all population density groups in wire centers characterized by "hard rock" conditions than those in wire centers with other terrain conditions. We seek comment on these tentative conclusions. We also seek comment on identifying the terrain that would lead an efficient firm to minimize forward-looking costs by using aerial plant and on whether climate conditions, such as the possibility that a hurricane will destroy aerial plant, will affect an efficient carrier's decision to deploy aerial plant.

59. Input Values. We direct the models' proponents to justify fully the default values they selected for their outside-structure plant mix. We note that recent installations of outside structure may more closely meet forward-looking design criteria than do historical installations. We seek comment on these issues and encourage parties to file documentation supporting suggestions to alter either Hatfield or BCPM's input values or default assumptions concerning plant mix. We also seek comment on the input values that will accurately reflect the level of impact that varying terrain conditions have on costs.

b. Installation and Cable Costs

(1) Background

60. The default values for installation costs included in the BCPM and Hatfield models represent their proponents' estimates of the total cost of installing wire and cable facilities. The forward-looking economic cost mechanism must estimate the cost of installing wire and cable facilities as part of the overall cost of building a network to provide supported services. These costs can be expected to vary by soil type and line density zone. In very rocky terrain or in densely populated areas, for example, the cost of digging through rock or pavement will increase installation costs.

61. Design Platform. Both BCPM and Hatfield make assumptions about soil conditions and population density to estimate the cost of installing buried and underground cable. Specifically, the models use different numbers of density zones. It appears that a greater number of density zones helps identify high and low cost areas more accurately; too many density zones, however, would make the data calculations too complex. BCPM makes different estimates for the cost of installing conduit and buried cable in each of seven line

density zones (categories based on the number of households per square mile). BCPM also distinguishes between the costs of installing feeder and distribution cable and includes detailed tables for installation costs in various soil conditions. Moreover, cost estimates used take into account the costs of different installation methods, and the relative frequency of each installation method for each soil type.

62. Hatfield uses separate cost estimates for each of nine different line density zones, and defines these zones based on the number of lines per square mile, rather than households. Hatfield accounts for rocky conditions by multiplying the cost of cable by a factor that is adjusted depending on depth to bedrock, hardness of bedrock, and surface soil texture.[109] It also includes an additional distance multiplier to reflect the assumption that difficult soil conditions will increase the length of feeder and distribution cable by 20 percent. Hatfield also uses a slope factor to account for steep terrain for both conduit and buried installations. Hatfield does not separately identify installation costs for aerial cable, but includes installation costs in the cost of the cable itself.[110]

63. Input Values. BCPM's input values appear as table entries that can be adjusted by the user. The BCPM does not differentiate the cost of installing feeder from the cost of installing distribution by soil type, but it does differentiate the costs for feeder cable from distribution cable. Costs for installing feeder and distribution cable range from $1.14 to $13.82 per foot for installations in normal soil and up to $18.92 per foot for installation in hard rock. The BCPM adds 30 percent to installation costs if groundwater is within three feet of the surface. The BCPM also increases cable distance by 10 to 35 percent in the presence of steep grade for both buried cable and conduit. BCPM lists distribution cable costs ranging from $1.16 to $61.78 per foot, aerial cable being the most expensive cable type.

64. Hatfield's cost multipliers can be adjusted by the user. Hatfield's costs for conduit range from $10.29 to $75.00 per foot for normal soil. Hatfield assigns copper and fiber conduit equal installation costs. For fiber cable conduit, Hatfield adds $0.20 per foot for protective sheathing. For fiber feeder cable conduit, Hatfield assumes that pullboxes are installed every 2000 feet. For both conduit and buried cable, Hatfield includes several multipliers to increase costs to account for difficult soil conditions, hard rock placement, and soft rock placement.[111] Hatfield's costs for buried cable range from $1.77 to $45.00 per foot for normal soil, whether fiber or copper. Hatfield lists distribution cable sizes from 6 to 2400 pairs, with costs ranging from $0.63 to $42.75 per foot, including installation, delivery, and

[109] A multiplier of 1.2 extends cable in difficult soil conditions, hard rock placement multiplies costs by 3.5, soft rock placement multiplies costs by 2.0.

[110] Hatfield Feb. 28 submission, app. B at 9.

[111] *See supra* note 107.

the cable itself.

(2) Issues for Comment

65. Platform Design. We tentatively conclude that the selected mechanism should specify costs for installation of aerial cable, buried cable, and underground cable that incorporate terrain factors and line density zones. We seek comment on this tentative conclusion.

66. In the Majority State Members' Second Report, state members expressed preference for BCPM's approach because they found that Hatfield's approach did not adequately account for the effect of different types of installation activity on outside plant costs, and because using a multiplier will overestimate costs in some areas and underestimate costs in other areas.[112] Based on the majority state member's recommendations, we tentatively conclude that the selected mechanism should adopt BCPM's approach of prescribing additional costs to account for additional expenses caused by difficult terrain, rather than Hatfield's approach of using cost multipliers. We seek comment on this tentative conclusion, on how this tentative conclusion would affect cost estimates, and on the appropriate input values for such additional expenses. In addition, we seek comment on the majority state members' conclusion that it is not reasonable to assume, as Hatfield does, that an installer could simply increase its use of distribution cable by 20 percent to avoid burying cable in difficult soil conditions.[113] Commenters disagreeing with our tentative conclusion to adopt BCPM's approach should provide data about the costs of installing cable to support platform designs they favor.

67. We tentatively conclude that the selected mechanism should specify costs per foot for conduit installation that vary by line density zone, as proposed in both BCPM and Hatfield. Because it appears that each census-defined household does not necessarily have a single telephone line, we prefer Hatfield's assumption that the number of lines per square mile more accurately measures the line density of a local telephone system than the number of households per square mile, especially in urban areas where there may be few households but many business lines. We therefore tentatively conclude that the mechanism should define density zones based on lines per square mile, as in Hatfield 3.1. We seek comment on these tentative conclusions and on the number of density zones that should be included in the selected mechanism. Specifically, we seek comment on whether the nine density zones identified in Hatfield accurately estimate costs in an efficient network. We invite comment on how to calculate forward-looking economic costs of conduit installation and welcome data on any recent conduit installations, including conduit installed for purposes other than the

[112] Majority State Members' Second High Cost Report at 8-9.

[113] Majority State Members' Second High Cost Report at 9.

construction of telephone networks.

68. Input Values. We tentatively conclude that materials and installation costs should be separately identified by both density zone and terrain type. We seek comment on the default input values that the selected mechanism should use. Any party supporting specific input values should present cost data about materials and installation supporting its position. We seek comment on the accuracy of the values in BCPM's cost tables and of Hatfield's cost multipliers, and encourage parties to submit company records or other industrial data to support their position. We seek comment on the cost of installing aerial, buried, and underground cable, regardless of whether it is used to provide telephone service, and encourage parties to submit detailed cost data on any recent cable installations. In addition, we seek comment on whether it would be possible to use national statistical averages of contractor construction prices and independent verification of the cost of installation of distribution plant to verify these costs. We also seek comment on whether a labor cost variable should be incorporated into the selected mechanism.

69. Because we also have received no documentation confirming that feeder and distribution cable installation costs should differ, we tentatively conclude that the selected mechanism will adopt Hatfield's assumption that such costs are identical. We seek comment on this tentative conclusion and encourage parties to submit documentation in support of their positions.

c. Drops

(1) Background

70. A drop is the connection between a residence or business and the distribution cable. In BCPM and Hatfield 3.1, several cost elements are combined under the general heading of drops. These cost elements include the cost of the copper or fiber loop that extends from the distribution cable to the residence or business, the terminal and splice investment, and the pedestal costs.

71. Platform Design. BCPM estimates the drop length as the distance from the corner of the residential lot to the center of the residential lot. The lot size is a function of the number of customers per square mile in each CBG. Thus, low density CBGs will have larger lots, and hence, longer drops than high density CBGs. Hatfield 3.1 assigns pre-determined loop lengths for each of seven density zones. The lengths are longer in low density areas than elsewhere. In general, the drop lengths are longer in BCPM than in Hatfield 3.1.[114]

[114] Letter from Richard N. Clarke, AT&T, to William F. Caton, FCC, dated Apr. 21, 1997 (AT&T Apr. 21 *ex parte*).

72. Input Values. BCPM uses $0.77 per foot for drop costs, including materials and installation. Hatfield uses a cost of $0.095 per foot for aerial drop cable (two-pair) and $0.140 per foot for buried drop cable (three-pair). Hatfield uses installation costs that range from $0.23 to $0.47 per foot for aerial drops and from $0.75 to $5.00 per foot for buried drops.

73. BCPM estimates a cost of $95.98 for a six-pair aerial terminal, or about $32.00 per two-pair drop, and $157.05 for a six-pair buried terminal, or $52.35 per three-pair drop for terminal and splice investment. BCPM also estimates the cost of larger terminals, not specified in Hatfield. BCPM includes pedestal costs in drop terminal costs. Hatfield estimates the cost for terminal and splice investment at $32.00 per aerial drop and $42.50 for buried cable.

(2) Issues for Comment

74. Platform Design. We seek comment on whether the selected mechanism should estimate drop lengths or should incorporate predetermined drop length assumptions. Proponents of using the selected mechanism to generate drop-length estimates should identify the inputs and factors that the mechanism should use to estimate drop length. Parties that favor including fixed drop-length assumptions in the mechanism should identify and provide support for drop-length assumptions they advocate. We also seek comment on the accuracy of Hatfield's assumed drop lengths.

75. Input Values. Because an efficient carrier's network must include drops in order to provide the supported services, we tentatively conclude that the selected mechanism will determine the forward-looking economic cost of drops, including installation, terminal, splice, and pedestal costs. We invite comment on the accuracy of the estimated costs of these items under the proposed models.

d. Structure Sharing

(1) Background

76. Platform Design and Input Values. Structure sharing describes the practice of sharing facilities such as poles, trenches, and conduits with other utilities. BCPM assumes that an efficient telecommunications carrier will not benefit very much from sharing. BCPM's default input values assign between 50 and 100 percent of the costs of the poles and between 80 and 100 percent of the cost of trenches and conduits used by telephone companies to those companies. BCPM estimates the cost of different types of installation -- trenching, plowing, and cutting and restoring asphalt -- and the relative frequency of each type of installation. BCPM's estimate of the percentage of facilities that are shared does not vary much with respect to different installation activities or different types of terrain. The Hatfield

model assumes utilities will engage in substantial sharing; for the most part, Hatfield's default input values assign between 25 percent and 50 percent of the costs of shared facilities to telephone companies. Hatfield does not use different estimates for different installation activities or for different terrain. Both models alter the percentages of costs they assume will be shared depending on the type of structure (buried, conduit, or aerial) and on the line density zone.

77. Many commenters disagree with the structure sharing assumptions in the Hatfield model.[115] Aliant Communications Co. (Aliant) states that in remote areas there will be minimal sharing, because of the distinct design parameters and costs associated with facility placement for each type of utility.[116] RTC/GVNW contend that, in remote areas, carriers often cannot share structures because few cable companies are located in these areas and electric utilities often use construction methods different from those used by telephone companies.[117] GTE comments that sharing is limited in its territory.[118] Several commenters specifically criticize Hatfield's assumptions with respect to buried cable. They indicate that Hatfield should not assume buried cable is shared because, when cable is buried using cable plows, it cannot be shared.[119] Hatfield's proponents counter that, while under rate-of-return regulation monopoly ILECs had no incentive to engage in sharing, under competitive conditions LECs will have increased incentives to share in order to reduce costs.[120] They also indicate that municipalities are increasingly encouraging utilities to share trenching operations and pole usage in order to minimize disruption and congestion.[121] In addition, they note that the 1996 Act requires ILECs to provide nondiscriminatory access to poles, ducts, conduits,

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[115] *See, e.g.,* National Cable Television Association (NCTA) pre-workshop comments at 3; BellSouth model comments, att. 1 at 3; SBC Communications (SBC) model comments at 23.

[116] Aliant model comments at 6.

[117] RTC/GVNW post-workshop comments at 19.

[118] GTE model comments at 72 (stating that it pays 97.5 percent of the cost for buried plant its uses, 95 to 99 percent for underground plant, and 57-61 percent for aerial plant).

[119] Gabel model comments at 22 (suggesting that, for buried cable, close to 100 percent of costs should be assigned to telephone, rather than the 33 percent used in the Hatfield model); RUS model reply comments at 5. A cable plow is a piece of industrial equipment used to bury cable.

[120] Letter from Richard N. Clarke, AT&T to William F. Caton, FCC, dated Mar. 18, 1997 (AT&T Mar. 18 *ex parte*).

[121] Letter from Richard N. Clarke, AT&T to William F. Caton, FCC, dated Mar. 18, 1997 (AT&T Mar. 18 *ex parte*).

and rights-of-way.[122]

78. Sprint suggests an alternative to the values assumed by BCPM and Hatfield. Sprint suggests that, except for plowing, telephone companies should be assumed to bear 66 percent of the costs for all types of structures in all types of terrain.[123] The majority state Joint Board members make a similar proposal, suggesting that telephone companies should bear 66 percent of structure costs, with the following exceptions: telephone companies should bear 100 percent of the costs of plowing and rocky plowing, 50 percent of the costs of poles, and 100 percent of the costs of anchors and guys.[124]

(2) Issues for Comment

79. Platform Design. Because it appears that an efficient carrier would vary its sharing levels according to installation activity and terrain, as BCPM assumes, we tentatively conclude that the selected mechanism should adopt BCPM's categories for installation activities and terrain conditions. We seek comment on BCPM's estimates for the relative frequency for each type of installation activity. Because it appears that an efficient carrier would also vary its sharing levels according to line density zones, we tentatively conclude that the selected mechanism should also include line density zones in its estimates of sharing and we seek comment on whether, because we tentatively conclude above that Hatfield's line density zones are superior, the selected mechanism should use Hatfield's line density zones to estimate sharing. We seek comment on how BCPM's assumptions would need to be altered to accommodate Hatfield's line density zones. Commenters should provide cost data about sharing to substantiate their positions.

80. Input Values. Based on the record,[125] it appears that efficient carriers are likely to bury a significant portion of their cable using plows and that it appears that carriers cannot benefit from sharing when using cable plows. Therefore, we tentatively conclude that Hatfield incorrectly assumes that carriers benefit from sharing for such cable and that the selected mechanism will assign 100 percent of costs to the telephone company for cable that is buried using a cable plow.

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[122] Letter from Richard N. Clarke, AT&T to William F. Caton, dated Mar. 18, 1997 (AT&T Mar. 18 *ex parte*); *see* 47 U.S.C. § 224.

[123] Letter from Warren Hannah, Sprint, to William F. Caton, FCC, dated Mar. 24, 1997 (Sprint Mar. 24 *ex parte*).

[124] Majority State Members' Second Report, app. at 5. Guys are wires that hold up a telephone pole, and anchors attach guys to the ground.

[125] Gabel model comments at 22; RUS model reply comments at 5.

81. We also tentatively conclude that Sprint's suggested value of 66 percent is an acceptable aggregate default input value for the percent of costs assigned to the telephone company for all other shared facilities. It appears that this value is a reasonable compromise between the values included in BCPM and the values included in Hatfield. Nevertheless, because we also find that the percent of sharing will vary with installation activity, terrain, and line density zone, we seek comment on the correct input values for these disaggregated categories.

82. We also seek comment on AT&T's contention that changes to the regulatory climate will increase the extent to which carriers are required or are willing to share structures. In particular, we seek comment on whether these changes will affect carriers' decisions in the near term, or whether regulatory changes will not have a significant impact on carriers' willingness to share structures for a significant time into the future. Commenters contending that such changes will increase sharing should provide support for their positions. For example, we encourage commenters to submit data detailing the extent to which federal, state and local regulation is forcing carriers to share structures.

e. Loop Design

83. The loop plant constitutes a significant part of the network cost that the models calculate. The two models, however, differ greatly in their assumptions regarding loop design and standards. For example, Hatfield calculates costs based on very long copper loops using loading coils, while BCPM includes more optical fiber in its loop design. In selecting the loop design components for the selected mechanism, we seek to implement our conclusion that the mechanism employ the least-cost, most-efficient and reasonable technology for providing the supported services[126] and the Act's provision that universal service support be sufficient.[127]

(1) Fiber-Copper Cross-over Point

(a) Background

84. Platform Design. The fiber-copper cross-over point determines when carriers will use fiber cable instead of copper cable in their feeder plant. In addition, a carrier's decision regarding the fiber-copper cross-over point will affect whether that carrier uses loading coils, because loading coils are used to extend the viable length of copper cable.

85. The Joint Board recommended that the choice between fiber and copper should

[126] Order at para. 250, criterion 1.

[127] 47 U.S.C. § 254(b)(5), (d).

reflect the least-cost method of placing loop facilities,[128] and we agreed in the Order that "the technology assumed must be the least-cost, most-efficient, and reasonable technology"[129] and that the "model must include the capability to examine and modify the critical assumptions and engineering principles . . . includ[ing] . . . fiber-copper cross-over points . . ."[130] BCPM uses a fiber-copper cross-over of 12,000 feet, i.e., it assumes that feeders of more than 12,000 feet will be fiber cables. Hatfield uses a cross-over point of 9,000 feet, i.e., feeders of more than 9,000 feet will be fiber cables. As discussed below, Hatfield assumes that copper cable may exceed 18,000 feet, while BCPM limits the copper loop to 12,000 feet. Nevertheless, neither the BCPM nor Hatfield proponents have submitted studies showing whether their cross-over points are designed to reflect the Commission's least-cost criterion. NCTA/ETI evaluated the fiber-copper cross-over algorithms used in BCPM and Hatfield 3.1.[131] Based on the other default values in BCPM (e.g., the costs of copper, fiber, and electronics), NCTA/ETI indicates that the most efficient value in the BCPM model is 18,000 feet,[132] and for Hatfield, the most efficient value is 6,000 feet. NCTA/ETI further reports that, in the Hatfield model, differences in cost between the most efficient cross-over point and the default cross-over point are negligible.[133] The state Joint Board members support an 18,000 foot maximum copper distribution for the BCPM, and a 12,000 foot breakpoint for Hatfield.[134] The majority state Joint Board members assert that the BCPM loop design is superior to Hatfield's.[135]

86. In the Order we also addressed the inclusion of loading coils in the models, concluding that "the loop design incorporated into a forward-looking economic cost study or model should not impede the provision of advanced services."[136] Thus, we concluded that

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[128] Recommended Decision, 12 FCC Rcd at 531.

[129] Order at para. 250, criterion 1.

[130] Order at para. 250, criterion 9.

[131] Letter from Teresa Pitts, NCTA, to William F. Caton, FCC, dated Mar. 27, 1997 (NCTA Mar. 27 *ex parte*), att. Susan M. Baldwin, Lee L. Selwyn, Economics and Technology, Inc. (ETI), "The Use of Cost Proxy Models to Make Implicit Support Explicit," (NCTA Mar. 27 *ex parte*, att. ETI) at 33-35. The attachment is a report prepared by ETI on behalf of NCTA assessing the BCPM and the Hatfield Model 3.1.

[132] NCTA Mar. 27 *ex parte*, att. ETI at 33-35.

[133] NCTA Mar. 27 *ex parte*, att. ETI at 33-35.

[134] State Members' High Cost Report at 17.

[135] Majority State Members' Second Report at 7-8.

[136] Order at para. 250, criterion 1.

loading coils should not be used because they impede the provision of advanced services.[137] BCPM extends fiber cable further into the distribution network instead of using loading coils, while Hatfield adds loading coils to cables and would install coarser gauge copper cables for copper cable lengths over 18,000 feet.[138] NCTA asserts that BCPM could change its copper loop length from 12,000 to 18,000 feet and still model a network offering "quality" service.[139] The Hatfield proponents indicate that the Hatfield model could be modified to eliminate loading coils.[140] Hatfield indicates that its proposed modifications would not presume the installation of unnecessarily expensive fiber optic cable and terminals in sparsely-populated areas, as it contends BCPM does.[141]

(b) Issues for Comment

87. Platform Design. We tentatively conclude, based on the comments of NCTA/ETI and the recommendation of the majority state members of the Joint Board, that the BCPM maximum cross-over default value should be set at 18,000 feet rather than 12,000 feet, and seek comment on this tentative conclusion. We seek comment on whether the BCPM fiber/copper cross-over point can also be set at 18,000 feet when the copper loop length is extended to 18,000 feet. Parties disputing NCTA/ETI's analysis should submit detailed data to support their positions. Consistent with our conclusion in the Order that the selected mechanism cannot include loading coils, as Hatfield does, we tentatively conclude that we should adopt BCPM's approach of installing optical fiber in the network to avoid loading coils.[142] We seek comment on this tentative conclusion. In the alternative, we seek

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[137] Order at para. 250, criterion 1. *See also* RUS model reply comments at 4 (stating that ILECs are phasing out such loops and that no new entrant would build outside plant based on that antiquated technology and that loaded loops cannot support the bandwidth for voice grade service recommended by the Joint Board).

[138] Hatfield Feb. 28 submission at 9; BCPM Jan. 31 submission, att. 9 at 116.

[139] NCTA model reply comments at 30.

[140] Letter from Richard N. Clarke, AT&T, to William F. Caton, FCC, received Apr. 29, 1997 (AT&T Apr. 29 *ex parte*). The Hatfield proponents indicated that the model would limit road cable lengths to 18,000 feet, and would serve subscriber locations beyond the 18,000-foot threshold with low-capacity remote terminals connected to "host" terminals in town clusters using T1 connections on HDSL equipment. AT&T Apr. 29 *ex parte* at 4.

[141] AT&T Apr. 29 *ex parte* at 4.

[142] We note that commenters have raised issues regarding whether it is appropriate to use loading coils in extremely remote areas. *See* AT&T Apr. 29 *ex parte*, att. at 2; letter from Warren Hannah, Sprint to William F. Caton, FCC (dated Mar. 24, 1997) att. C (letter from P. Michael Henderson, Rockwell Semiconductor Systems to Rod Thompson, Sprint (dated Feb. 13, 1997)). We will address this issue when we address the development of a cost methodology for rural carriers.

comment on whether another approach, such as the one suggested by Hatfield, would be a better approach to avoid the use of loading coils in sparsely-populated areas. As discussed in more detail below, we also seek comment on the impact on the costs for digital loop carriers of our decision regarding the appropriate fiber-copper cross-over point.

(2) Loop Standards

(a) Background

88. WorldCom contends that the Commission should specify one or more loop design standards in order to create greater certainty in loop modeling process.[143] WorldCom states that the two loop standards that the Commission should consider are the Revised Resistance Design (RRD) and the Carrier Serving Area (CSA) standards.[144] The RRD permits copper loops up to 18,000 feet and will support data transmission speeds up to 1.544 mbps using xDSL technology. CSA permits copper loops up to 12,000 feet and will support data transmission speeds up to 6 mbps. Neither standard incorporates loading coils. Under either standard, using only 26 gauge copper decreases the maximum copper design lengths to only 15,000 feet and 9,000 feet respectively. WorldCom further contends that the RRD standard is consistent with the Rural Electrification Loan Restructuring Act (RELRA)'s[145] mandate that rural carriers design new loops to support 1 mbps transmission and will permit the extension of new high-speed services to all parts of the country.[146] Among the services that the RRD standard would support are Internet access, video-teleconferencing, tele-medicine, and distance learning. WorldCom contends that because the CSA standard will also enable LECs to offer video dialtone services, which would have significant commercial value, the universal service fund should not pay for LEC entry into this new market against competitors that would not receive universal service funding.[147]

(b) Issues for Comment

89. Platform design. We seek comment on whether we should adopt any loop design standards in the forward-looking economic cost mechanism. If a loop design standard

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[143] Letter from David N. Porter, WorldCom, to William F. Caton, FCC, dated June 6, 1997 (WorldCom June. 6 *ex parte*).

[144] WorldCom Jun. 6 *ex parte* at 2. Both standards are more fully described in the BellCore publication "BOC Notes on the LEC Networks - 1990."

[145] 107 Stat. 1356, codified in 7 U.S.C. § 935 (1994).

[146] WorldCom Jun. 6 *ex parte* at 2.

[147] WorldCom Jun. 6 *ex parte* at 2.

is to be included, which standard - the RRD, CSA, or any another alternative - should be adopted? Because these engineering standards essentially assure the provision of a particular level of network performance, should we instead adopt a performance standard? We also seek comment on what impact the incorporation of particular design or performance standards would have on the size of the fund.

(3) Digital Loop Carriers

(a) Background

90. Digital loop carriers (DLCs) connect fiber feeder cables and copper loops. DLCs transform electric signals carried on the copper loops into optical signals carried on fiber lines and vice versa. Most large DLCs can assign multiple subscriber lines to a single electronic channel rather than assigning one channel per subscriber line.

91. Platform Design. Both Hatfield and the BCPM assume that, when they are to be used, DLCs would be one of two sizes, depending upon the number of subscriber lines connected to them. BCPM assumes the larger DLC will be used for more than 672 subscriber lines. Hatfield, by contrast, switches to the larger DLC at 384 subscriber lines, but allows adjustment of this level as a variable.

92. Input Values. Although both Hatfield and BCPM assume extensive deployment of DLCs, their cost estimates differ significantly. BCPM estimates the common cost of a large DLC at $125,121.00, plus $92.81 per line.[148] Sprint, one of BCPM's proponents, suggests changes to BCPM, including lower DLC costs "consistent with Sprint's internal costs."[149] Hatfield calculates investment associated with site and power for the remote terminal of a DLC system. For a large DLC, Hatfield uses an estimate of $66,000.00 for initial common investment, including fiber optics multiplexer; $3,000.00 for site and power; $310.00 for channel unit investment; $1,000.00 for optical patch panel; and $18,500.00 for common equipment investment per additional line investment. For all line sizes, BCPM estimates higher costs than Hatfield, with the largest differential associated with the smaller DLCs.[150] State Joint Board members assert that DLC data are inadequately documented.[151]

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[148] BCPM Feb. 28 submission, att. 9 at 145.

[149] Letter from Warren D. Hannah, Sprint, to William F. Caton, FCC, dated March 24, 1997, att. at 4.

[150] *See* Letter from Mary J. Sisak, MCI, to William F. Caton, FCC, dated Apr. 3, 1997 (MCI Apr. 3 *ex parte)*.

[151] State Members' High Cost Report at 8.

(b) Issues for Comment

93. Platform Design. We seek comment on the models' assumptions regarding the number of subscriber lines that should trigger the use of a large DLC. Parties should include a discussion of the differences between the two models and the reasonableness of their underlying assumptions. We also request comment on whether the models should consider use of DLCs of more than two sizes; we particularly seek comment on whether DLCs smaller than those used in the model are available and under what circumstances such smaller DLCs might be used. We also request comment on the impact of the fiber-copper cross-over on the number and size of DLCs needed in the network. For example, in some CBGs, BCPM would place multiple DLCs to serve a population spread across a large geographic area. We seek comment on whether the models should also compare the cost of extending fiber to fewer points in the CBG, placing larger DLCs at those points, and running copper to customers including the possible additional cost of repeater electronics on the longer copper loops.

94. Input Values. We seek discussion of how to calculate the forward-looking economic cost of DLCs. Parties should discuss whether the models' current inputs for these costs are reasonable, as well as Sprint's proposed BCPM modification.

f. Wireless Threshold

(1) Background

95. In the Order, we concluded that universal service support should be portable to any eligible carrier, including a wireless carrier, that provides the supported services in high cost areas.[152] Once the level of support a carrier will receive is determined, the carrier may use whatever technology it prefers to provide the supported services; the level of support it receives is not dependent upon the technology it uses. Both BCPM and Hatfield, however, estimate the costs of providing the supported services using engineering assumptions based on wireline technology.

96. Platform Design. In calculating the cost of providing service, BCPM attempts to account for the possibility that wireless technology may be less expensive than wireline technology, while Hatfield does not. To calculate the cost of providing service, BCPM

[152] Order at paras. 286-88. By "eligible" carrier we refer to any carrier that satisfies the requirement of section 214(e) of the Act. Section 214(e) requires that any carrier designated as an eligible carrier must, throughout its service area: (1) offer the services which are supported by federal universal service support mechanisms under section 2549c); (2) offer such services using its own facilities or a combination of its own facilities and resale of another carrier's services, including the services offered by another eligible telecommunications carrier; and (3) advertise the availability of and charges for such services using media of general distribution. 47 U.S.C. § 214(e).

assumes that if the loop investment for serving a single customer exceeds $10,000.00, an efficient carrier would not use wireline service, but would substitute wireless service instead. Thus, BCPM places a $10,000.00 cap on its estimate of loop investment per customer. RUS asserts that BCPM's $10,000.00 cap is unrealistic.[153] RUS claims that the most expensive wireline loops are usually far enough apart that multiple wireless systems are required to serve these customers. RUS indicates that, if each wireless system serves only a few subscribers, they are economically impractical.[154] AT&T/MCI assert that the cost of wireless loops may be greater than the $10,000.00 cap used by BCPM.[155]

97. Other commenters debate whether engineering assumptions about wireless technology should be used in the selected forward-looking economic cost mechanism. Sprint indicates that cost data for wireless telecommunications are too limited to include in the selected mechanism.[156] The Majority State Members Second Report asserts that a wireless cap should not be used at this time.[157] In contrast, American Personal Communications (APC) and Cellular Telecommunications Industry Association (CTIA) claim that wireless technology may have lower per-subscriber costs in some areas than the costs determined by forward-looking economic cost model calculations.[158] They argue that failure to incorporate wireless technology into the models artificially inflates cost estimates, thus leading to unnecessarily high assessments for contributing carriers.[159] Nortel claims that recent deployments of fixed wireless access systems show declining costs for wireless loops.[160]

(2) Issues for Comment

98. Platform Design. In light of RUS's contention that wireless service does not necessarily cost less than $10,000.00 per loop, we seek comment on whether the cost of a

[153] RUS model reply comments at 3 (stating that most of the carriers that borrow from RUS have some loops that require investment over $10,000.00 and that it has found only a few instances where wireless loop plant is cheaper than wireline).

[154] RUS model comments at 4.

[155] AT&T/MCI model comments at 13.

[156] Sprint model comments at 12.

[157] Majority State Members' Second High Cost Report at 8.

[158] CTIA comments at 7; APC reply comments at 3.

[159] CTIA comments at 7; APC reply comments at 3. *See also* Northern Telecommunications (Nortel) comments at 5.

[160] Nortel comments at 5.

loop should be capped at $10,000.00 in all cases. We seek comment, however, subject to the discussion below, on whether the selected mechanism should include a cap, and on the level of such a cap, if a cap is necessary to reflect the lower costs of wireless technology.

99. We agree with the wireless commenters that, to the extent practical, the selected mechanism should estimate the cost of providing the supported services using wireless technology in areas where wireless technology is likely to be the least-cost, most efficient technology. We note, however, that we have received almost no information regarding how to estimate such costs, or the criteria that the selected mechanism should use to determine whether wireline or wireless service is more economical. Thus, we seek comment on the feasibility of including an additional component in the mechanism that would compare the cost of providing service via a wireless network with the cost of providing service via a wireline network and would choose the lowest-cost technology to calculate the costs of providing the supported services. We seek comment on whether, because wireless companies must currently determine whether it is economical for them to enter a particular market, wireless companies have already developed such models.[161] We strongly encourage commenters supporting the inclusion of engineering assumptions regarding wireless technology in the mechanism to submit models or other assumptions that they believe should be included. We further encourage commenters to submit data about the cost and types of wireless networks and their components in support of their suggestions, and remind commenters that any wireless component that might be added to the selected mechanism must also meet the Commission's criteria.[162]

100. We note that BCM was first filed with the Commission in December 1995. We seek comment on the length of time necessary to develop a mechanism that compares the cost of wireless engineering with the cost or wireline engineering. Specifically, we seek comment on whether modeling wireless technology would be less complex than modeling wireline technology, and therefore whether a wireless platform could be developed by December 1997, and a complete mechanism, including inputs, by August 1998, in accordance with the Commission's schedule. In the alternative, we seek comment on whether the development of a competitive bidding mechanism would be a better way to capture the differing costs between wireline and wireless technology.[163]

101. Because we are uncertain that we can develop a mechanism that includes the

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[161] *See also, e.g.,* David Gabel & D. Mark Kennet, "The Effect of Cellular Service on the Cost Structure of a Land-Based Telephone Network," 14 NRRI QUARTERLY BULLETIN 17 (Winter 1997). A more recent version of this paper can be found at: http://www.ctr.columbia.edu/citi/wireless/gabelpap.html.

[162] Order at paras. 249-50.

[163] We will consider competitive bidding in detail in a later proceeding.

cost of wireless technology within the Commission's schedule, we seek comment on whether basing support amounts on the cost of wireline technology will be consistent with section 254 and with the Commission's universal service goals. Because parties contend that wireless technology may be cheaper than wireline technology, we tentatively conclude that providing support based on the cost of a wireless network to provide the supported services would meet the statutory directive that support be "sufficient."[164] We seek comment on this tentative conclusion. We also seek comment on whether basing support solely on wireline costs, when wireless technology may offer a less expensive option, would be consistent with the Commission's conclusion that the mechanism should use the least-cost, most-efficient, and technology available.

102. As a separate but related issue, we seek comment on whether the models should include assumptions that would consider microwave, satellite, or other non-wireline technologies in situations where such technologies could allow the provision of universal service more cost-effectively than wireline technology.

g. Miscellaneous Outside Plant Input Value Issues

103. The following components of outside plant do not affect the structure of the models; for them the only issue is what input values we should use.

(1) Manholes

104. Background. Underground installations require manholes. BCPM and Hatfield calculate similar manhole costs. BCPM's cost estimates range from $4,583.00 to $6,440.00 for materials and labor, with no separate enumeration of costs for delivery, excavation, and backfill. Hatfield's costs -- including materials, delivery, excavation, and backfill -- range from $5,140.00 to $7,340.00 per manhole (depending on the population density zone).

105. Issues for Comment. We seek data demonstrating the forward-looking economic cost of manholes for inclusion in the selected mechanism. In light of the similarities in the two models' input values, we seek comment on whether these data are accurate and how the differences between the input values may be reconciled. Parties should submit documentation in support of their suggested input values.

(2) Poles, Anchors, Guys, Aerial Cable, and Building Attachments

106. Background. The BCPM estimates significantly higher costs for pole materials

[164] 47 U.S.C. § 254(e).

and installation than Hatfield 3.1. For example, BCPM uses an input value for pole costs of $368.17, but Hatfield uses an input value for a 40 foot Class 4 southern pine pole of $201.00. BCPM's installation costs range from $358.58 to $558.58, depending upon terrain. In contrast, Hatfield assigns a constant labor cost of $216.00, regardless of terrain, and it is not clear whether other installation costs, besides labor costs, are included in that figure.

107. BCPM states that guys[165] and anchors[166] together cost $68.00 for materials, and assigns $255.00 to $310.00 for installation. Hatfield does not include separately identified user input values for anchors and guys. BCPM does not include riser cable (cable attached to high-rise buildings), but Hatfield establishes a per-foot cost for riser cable, which includes installation costs.

108. Both models use similar pole spacing assumptions that are based on density zones. Both models place poles 250 feet apart in less dense areas, and 150 feet apart in the densest areas, though the two models' density zone assumptions are different.[167]

109. Cable costs vary widely between the BCPM and Hatfield models. BCPM uses cost tables for aerial, underground, and buried cable that estimate cable costs at $1.00 to $61.78 per foot. Hatfield's cable costs range from $1.19 to $74.25 per foot, with no distinction between costs for aerial, buried, and underground cable. BCPM's aerial cable costs are similar to Hatfield's cable costs.

110. Issues for Comment. We seek comment on what the accurate input values should be for the forward-looking economic cost of materials and installation for poles. We seek comment on the reasonableness of the type of materials chosen by each model. We also seek comment on whether installation costs for poles should vary with terrain. Commenters should submit cost documentation in support of their suggested input values.

111. We also seek comment on whether BCPM's materials and installation cost estimates for anchors and guys are accurate, and whether Hatfield's pole materials and installation costs are sufficient to cover the cost of anchors and guys. We also seek comment on whether the selected mechanism should identify separately costs for poles, guys, and anchors. Parties should submit cost data in support of their suggested input values.

112. Because both models include them, we tentatively conclude that the selected mechanism should include pole spacing input values. We seek comment on this tentative

[165] Guys are wires that hold up a telephone pole.

[166] Anchors are wires that attach the guys to the ground.

[167] *See supra* section III.C.2.b. for a discussion of the two models' density zones.

conclusion and on the pole spacing input values that we should use. In light of the models' similar input values, we seek comment on whether the models' input values for these costs are accurate or on whether averaging the two sets of input values would provide an accurate calculation of these costs. Commenters should submit cost documentation in support of their suggested input values.

113. We tentatively conclude that the selected mechanism should include feeder and distribution cable costs for both copper and fiber. We seek comment on the forward-looking costs of copper and fiber cable. We specifically seek comment on whether, as the BCPM proponents contend, buried cable and underground cable[168] are less expensive than aerial cable. Commenters should submit cost documentation in support of their suggested input values.

(3) Network Interface Devices

114. Background. A network interface device (NID) is a device that connects the wiring that belongs to a customer, and is located inside a customer's premises, to the loop facilities outside a customer's premises. A protection block is installed with the NID to protect customers' wiring from electrical surges caused by lightning or other electrical disturbances that affect loop facilities belonging to the telephone company. BCPM assigns a cost of $30.73 per NID, and does not distinguish between residential and business connections. Hatfield assigns $25.00 per residential NID, which, it assumes, can handle up to six lines, plus $4.00 per line for each protection block. For business NIDs, Hatfield assigns $40.00, plus $4.00 per line for each protection block. Therefore, in Hatfield, a single line residence NID costs $29.00 and a single-line business NID costs $44.00.

115. Issues for Comment. We tentatively conclude that we should prescribe NID costs in the selected mechanism. We tentatively conclude that Hatfield correctly separates the cost of protection blocks from the cost of the NID, and correctly distinguishes between the cost of a residential NID and a business NID, and that the selected mechanism should incorporate these distinctions. We seek comment on our tentative conclusions, and on the correct input values that should be used for NID and related costs. Such comments should be supported with cost data wherever possible.

(4) Service Area Interfaces

116. Background. The Service Area Interface (SAI) is the physical interface between distribution and feeder cable. The SAI is usually located outside buildings, but is located inside buildings when the feeder plant terminates in the basement of a high-rise

[168] On the distinction between buried and underground cable, *see supra* section III.C.2.a.(1).

building. Hatfield estimates the cost of investment and installation for SAI for cable sizes ranging from six to 2400 lines. For example, Hatfield estimates the cost of investment and installation of SAI for size 2400 cable inside buildings at $1,052.00, and outdoor SAI investment at $4,469.00. The BCPM assigns much higher costs and makes no indoor/outdoor distinction. For example, the estimated cost for SAI with size 2401 cable is $20,430.00.

117. Issues for Comment. We tentatively conclude that the selected mechanism should include the cost of SAI for various cable sizes, and should assume different costs for indoor and outdoor cable as Hatfield does. We seek comment on our tentative conclusion. In light of the wide disparities in SAI costs assigned by the mechanisms, we seek comment on the forward-looking economic costs of SAIs, and encourage parties to submit additional data on these costs.

(5) Fill Factors and Utilization

118. Background. A cable fill factor is the percentage of the total usable capacity of cable that is expected to be used rather than the amount available in reserve. If cable fill factors are set too high, the cable will have insufficient capacity to accommodate small increases in demand or service outages. In contrast, if fill factors are set too low, the resulting excess capacity increases the models' cost estimates to levels higher than an efficient firm's costs, resulting in excessive universal service support payments and encouraging entry by inefficient firms. The current models differ in their default fill factors. BCPM distribution cable fill factors range from 40 to 75 percent, but Hatfield ranges from 50 to 75 percent. For copper feeder cable, BCPM's fill factors range from 75 to 85 percent; Hatfield's range from 65 to 80 percent. In both models, default fill factors differ by density zone.

119. Issues for Comment. We note that, over time, the models' estimates for fill factors have converged. We seek comment on the fill factor that should be used for the selected mechanism. In light of the similarities between the models, we seek comment on whether their input values are accurate and how the differences between the values may be reconciled. We encourage parties to submit engineering data or other relevant documentation in support of the fill factor that they favor.

h. Dates for Comments on Outside Plant Investment

120. As discussed in section III.B.2, interested parties may file comments regarding the design of the outside plant investment components, including the algorithms determining plant mix, installation and cable costs, drop lengths, structure sharing, the fiber-copper cross-over point, digital loop carriers, and the wireless threshold (sections III.C.2.a - g), on or

before September 24, 1997, and reply comments on or before October 3, 1997.[169] Interested parties may file comments regarding all input values regarding outside plant input investment on or before October 17, 1997, and reply comments on or before October 27, 1997.[170]

3. Switching

a. Mix of Host, Stand-Alone, and Remote Switches

(1) Background

121. Platform Design. Switches can be designated as either host switches, stand-alone switches, or remote switches. Both a host switch and a stand-alone switch can provide a full complement of switching services without relying on another switch. A remote switch relies on a host switch to supply a complete array of switching functions and for interconnection with other switches. Proponents of both models claim that they detect no difference in switching costs based on the type of switch used, and therefore their models do not distinguish among the different switch types.[171] A review of 1996 depreciation filings, however, shows that large ILECs are purchasing fewer host switches and more remote switches.[172] Suggesting that choices about switch type could affect the total cost computed more than the models currently suggest, the Joint Board expressed concern that the models did not distinguish among types of switches.[173]

(2) Issues for Comment

122. Platform Design. Based on the Joint Board's concern, we tentatively conclude that the selected mechanism should include an algorithm that will place host switches in certain wire centers and remote switches in other wire centers. Based on ILECs' decisions, as revealed in the depreciation filings, to deploy more remote switches, we tentatively conclude that the host-remote arrangement is more cost-effective in many cases than employing stand-

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[169] *See infra* app. A, Comment Submission Schedule.

[170] *Id.*

[171] BCPM Jan. 31 submission; Hatfield Jan. 7 submission.

[172] Staff analysis of the depreciation rate studies submitted in 1996 to the Competitive Safeguards Branch, Accounting and Audits Division, Common Carrier Bureau, Federal Communications Commission, 2000 L Street, NW, Rm. 257, Washington, DC, 20554. Before an ILEC changes the depreciation rates applicable to its operated plant, it must file a report with the Commission pursuant to 47 C.F.R. § 43.43. ILECs generally submit depreciation rate studies to the Commission prior to filing such reports.

[173] Recommended Decision, 12 FCC Rcd at 532-533.

alone switches. We seek comment on this tentative conclusion, and urge parties to provide engineering and cost data to demonstrate the most cost-effective deployment of switches in general and host-remote switching arrangements in particular. We also seek detailed comment describing how to design an algorithm to predict this deployment pattern. We seek comment on how to obtain information that would verify or refute the assertion of the models' proponents that there is no cost difference between host switches and remote switches.

b. Capacity Constraints

(1) Background

123. Platform Design and Input Values. BCPM does not include any switch capacity limitations. The BCPM cost estimate for Texas, for example, included 22 switches that served more than 80,000 lines.[174] In contrast, Hatfield 3.1 includes a number of switch-capacity constraints. It limits the number of lines one switch can serve to 80,000. It limits the processing capacity of a switch to 600,000 busy-hour call attempts (BHCA) and traffic capacity to 1,800,000 busy-hour hundred call seconds (BHCCS). If any of these limits are reached in a wire center, the model will place another switch in that wire center.[175]

(2) Issues for Comment

124. Platform Design and Input Values. We tentatively conclude that the selected mechanism should assign more than one switch to a wire center whenever the mechanism predicts that any one of a set of capacity constraints would be exceeded. We seek comment on this tentative conclusion and on what capacity constraints the selected mechanism should adopt. Parties are encouraged to provide technical data to support any proposed capacity constraints.

c. Switch Costs

(1) Background

125. In the Order, we agreed with the state members of the Joint Board that estimating the switching investment cost is a significant unresolved problem of the cost models.[176] Proponents of the models are apparently having difficulty acquiring accurate

[174] BCPM Jan. 7 submission att. 3 at 1-11.

[175] Hatfield Feb. 28 submission at 43.

[176] Order at para. 244.

estimates of switch costs because of the lack of public information on those costs.[177] The Joint Board concluded that the convergence of the models' switch cost estimates should alleviate this lack of information[178] The state members of the Joint Board also noted that a small number of unusually high cost switches raised the BCPM switch input values.[179] They urged the Commission and its staff to perform additional analysis and to obtain more reliable switch cost information.[180]

126. Input Values. BCPM switching cost estimates are based on the results of a survey of large ILECs that asked ILECs to report the switching costs they use as inputs for ILEC Switching Cost Information System (SCIS)[181] model runs. BCPM model proponents estimated a switching curve based on the answers to the survey. The estimated per-line cost of a switch approaches $228.00 per line as the switch size reaches 80,000 lines.[182] This estimate is significantly higher than the $100.00 per-line cost used in the predecessor to the BCPM.[183]

127. The Hatfield 3.1 model combines public information and information from other unnamed industry sources to develop switching cost estimates. The model proponents fit a logarithmic curve to three data points to determine the relationship between switch-cost per line and switch-line size. This curve predicts a $74.00 per line cost for very large switches that approach 80,000 lines.[184] This result is approximately equal to the $75.00 per-line estimate used in the Hatfield 2.2.2 model.[185] Hatfield 3.1 reduces the per-line cost of the

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[177] *See, e.g.*, AT&T/MCI model comments at 19; NCTA reply comments at 41.

[178] Recommended Decision, 12 FCC Rcd at 532-533.

[179] State Proxy Model Report, app. B at 23.

[180] State Proxy Model Report, app. B at 23.

[181] SCIS is a computerized switching cost model owned by Bellcore that ILECs have used to establish the costs and prices of certain switch-related services in state proceedings and before the Commission. *See, e.g.*, 800 Database Access Tariffs and the 800 Service Management System Tariff; Provision of 800 Services, *Report and Order*, CC Docket Nos. 93-128 and 86-10, FCC 96-392 (rel. Oct. 28, 1996); Open Network Architecture Tariffs of US West Communications, Inc., *Memorandum Opinion & Order*, 11 FCC Rcd 5125 (1996).

[182] BCPM Jan. 31 submission, att. 4 at 34-40.

[183] Letter from Glenn Brown, U S West, to William Caton, FCC, dated Sep. 4, 1996 (U S West Sep. 4 *ex parte*).

[184] Hatfield Feb. 28 submission at 46.

[185] Letter from Richard N. Clarke, AT&T, to William Caton, FCC, dated Sep. 10, 1996 (AT&T Sep. 10 *ex parte*).

switch below the logarithmic curve by assuming more efficient use of trunk and line cards.[186] Hatfield 2.2.2 made a similar adjustment for trunk costs, but did not include an adjustment for the placement of line cards in DLC equipment.[187]

128. The majority of the state members of the Joint Board recommended that switch investment cost should include a fixed-cost input value of $150,000 and a per-line cost value of $110.00.[188] Aliant and Sprint suggested that the Commission should send a data request to ILECs and switch vendors to obtain accurate switch costs information.[189] BellSouth and GTE recommended using the Bellcore Switch Cost Information System (SCIS) to obtain switch cost information for use in the models.[190] Sprint also suggested that the Commission use the default input values for switch costs included in the BCPM predecessor, BCM2, until the Commission has completed an analysis of switching costs.

129. Pursuant to the Joint Board's recommendation, Commission staff examined information regarding switching costs from several sources. First, the staff obtained information from the RUS on switch purchases by RUS borrowers in 1995. The staff's statistical analysis of this information shows that the per-line cost for a 4,000 line switch is $157.75. Extrapolating the regression results to larger switches generates an estimate of $139.00 per line for an 80,000-line switch.[191] Second, the staff reviewed data filed by NECA regarding the investment in account 2210, switching investment.[192] While this investment is an accounting value recorded on the books and records of the carriers and therefore should not be used as an input of the models, the summary table can be used to evaluate the reasonableness of the models' assumption that switching costs per line decline as the size of a telephone company's study area increases.[193] These data support the models' assumptions, and imply that the current switching costs of small companies should be higher than the current switching costs of large companies.

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[186] Hatfield Feb. 28 submission at 42-46.

[187] Hatfield Sep. 10 submission at 25.

[188] Second State Members' Proxy Model Report, Majority, app. A at 3.

[189] Aliant model comments at 6; Sprint model comments at 9.

[190] BellSouth model comments, att. 1 at 3; GTE model comments at 84.

[191] *See* Public Notice, Commission Staff Analysis of Forward-looking Economic Cost Proxy Models, DA 97-56 (rel. Jan. 9, 1997) (Staff Analysis of Cost Models).

[192] 47 C.F.R. § 32.2210.

[193] Letter from Kathryn Falk, NECA, to William F. Caton, FCC, dated March 13, 1997 (NECA March 13 *ex parte*) at 2; *see* app. A.