The projected average service lives included in SNET's 1993 represcription was 14 years for the digital switching account;[98] however, this average life reflects the replacement of early vintage digital switches.[99] Longer lives should be assumed, as Hatfield/MCI have done, thereby producing a lower forward-looking cost factor than the embedded cost factor advocated by the LECs. For example, the depreciation expenses reported for all Tier I LECs for the year ending December 31, 1994 totalled approximately $18.7-billion.[100] Total reported expenses for this time period were approximately $70.3-billion,[101] and thus depreciation expenses accounted for more than one quarter of all operating costs. These depreciation expenses should be scaled down to reflect longer estimated lives.

Table 4.1 shows that depreciation expenses comprised 7.0% of total plant in service (TPIS) for all reporting LECs. As a rough rule of thumb, altering this percentage to 5.0% (i.e., approximately 20 years), would reduce *depreciation expenses to $13.4-billion.*

Return on investment

The cost factor of 31.6765% most likely reflects the LECs' authorized return of 11.25%. The return on investment should instead be computed using 10.3125% to reflect (1) a jurisdictional weighting of 25% of the FCC's authorized return of 11.25%[102] and a 75% jurisdictional weighting of recent state PUC decisions, which have resulting from comprehensive investigations of LEC capital structures, cost of debt, and cost of equity.[103]

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98. SNET Response to OCC-623, *op.cit.*, footnote 97.

99. For example, SNET planned to replace 12 early vintage digital switches in the years spanning 1993 through 1996. SNET 1993 Depreciation Rate Study, December 29, 1992, Account 2212, at 15-17.

100. SOCC, Table 2.9, line 250, column 3.

101. *Id.*

102. In the Matter of Represcribing the Authorized Rate of Return for Interstate Services of Local Exchange Carriers, CC Docket No. 89-624, *Order*, 5 FCC Rcd 7507 (1990).

103. The ETI figure relies on the 10% return authorized by the California Public Utilities Commission. California PUC, Consolidated A.92-05-002, A.92-05-004, I.87-11-033 and A.87-05-049, I.85-03-078 and A.85-01-034, *Applications of GTE California Incorporated (U 1002 C) and Pacific Bell (U 1001 C) for Review of the Operations of the Incentive-based Regulatory Framework Adopted in Decision 89-10-031, and Related Matters*, Decision 94-06-011, June 8, 1994, at 52. Also, the Vermont Public Service Board authorized an effective rate of return of 8.5%. Vermont PSB, Dockets No. 5700/5702, *Investigation of Proposed Vermont Price Regulation Plan and Proposed Interim Incentive Regulation Plan of New England Telephone and Telegraph Company and Petition of Department of Public Service for an Investigation of New England Telephone and Telegraph Company Rates*,

(continued...)

4.2 The price that policy makers choose to support will significantly influence the USF requirement

The model allows a user to compute the USF requirement for three different monthly price levels: $20, $30, and $40. The price being supported is one of the major factors influencing the size of a USF.[104] The establishment of a price threshold, i.e., a monthly rate above which USF support would be provided, is a key policy consideration. The national average rate for basic local exchange service should be viewed as setting a lower bound of affordability. The national average residential rate for unlimited local exchange service and the subscriber line charge is approximately $16.76.[105] However, the range of monthly local exchange service rates and the size of the local calling area are diverse, with some paying $23.56 for this same service.[106] It would thus be misleading to consider simply the average rate as the measure of affordability. Furthermore, subscribership rates are also critical sources of relevant information about affordability. When federal and state policy makers address the establishment of affordability levels, they should examine penetration rates as well as monthly local exchange prices and prices for other relevant services (e.g., touchtone). Finally, as is well recognized, household income is a major factor in subscribership,[107] and therefore universal service support should be targeted to those most in need.

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103. (...continued)
Order, October 5, 1994, at 82. The Massachusetts Department of Public Utilities authorized an effective rate of return of 9.63%. Massachusetts D.P.U. 94-50, *Petition of New England Telephone Company d/b/a NYNEX for an Alternative Regulatory Plan for the Company's Massachusetts Intrastate Telecommunications Services*, May 12, 1995, at 507.

104. Although the price thresholds are not user inputs, *per se*, one can effectively alter the price thresholds that are modelled simply by changing a single formula and copying that new formula to the other 5,000-plus rows in the model. It appears that it would be fairly straightforward for the Joint Sponsors to modify the BCM to allow this essential variable to be altered by changing a number in a single cell. Assuming that it is feasible, such a modification would be a useful improvement to the BCM.

105. FCC Monitoring Report, 1995, Table 5.7 (1993 Data).

106. New York Telephone Company, P.S.C. No. 901 Telephone Tariff, Section D., 33rd Revised Page 29; The NYNEX Telephone Companies, Tariff F.C.C. No. 1, Effective September 1, 1995, Section 31.4.3, 19th Revised Page 31-2.

107. Common Carrier Bureau, Federal Communications Commission, "Preparation for Addressing Universal Service Issues: A Review of Current Interstate Support Mechanisms", February 23, 1996, at 15-16.

Furthermore, the national average rate represents a composite of pre- and post-rate rebalancing of local and toll rates.[108] The scope of "local service" varies widely from state to state and, for that matter, as between urban and rural areas within the same state. For customers with small local calling areas, toll calls to nearby points are equivalent to extended area service and metropolitan exchange calling areas insofar as meeting the customer's local community of interest communications needs. Customers in nonmetropolitan areas generally spend far more on toll calls to nearby localities (intraLATA toll) than do customers in large cities. If some national average "affordability" level is to be developed, it must focus not on tariff definitions of "local" service as these may exists from place to place, but upon a defined basket of services that includes both access and usage within a defined region. A "national average" rate for local exchange access service necessarily understates the actual amounts being paid by customers to meet their basic telecommunications needs.

108. For example, as a result of a directive by the Massachusetts Department of Public Utilities in 1990, NYNEX gradually increased local exchange rates and decreased intraLATA toll charges in a series of revenue-neutral filings. Massachusetts D.P.U. 89-300, *NET*, June 29, 1990; Massachusetts D.P.U. 91-30, *NET*, September 9, 1991; Massachusetts D.P.U. 92-100, *NYNEX*, October 28, 1992; Massachusetts D.P.U. 93-125, *NYNEX*, January 13, 1994. In 1994, the DPU determined that: "There has been no statistically significant change in the Massachusetts telephone service penetration rates in the years 1989 to 1992. ... Thus we find that through 1992 the transition to cost-based rates has not negatively impacted universal service, and the current proposed increase is unlikely to have an adverse impact on universal service." Massachusetts D.P.U. 93-125, *NYNEX*, January 13, 1994, at 58 (footnote omitted). This rate rebalancing experience in Massachusetts as well as similar experiences in other state jurisdictions can be instructive as policy makers define "affordable."

Appendix 4A | PRELIMINARY ANALYSIS OF LEC EXPENSE ACCOUNTS

Preliminary Analysis of LEC Expense Accounts

Background

Among other reasons,[1] reliance upon reported historical costs for the purpose of developing a cost factor to be used in a forward-looking cost study for basic residence local exchange service is inapropriate because many of the expenses included in the reported costs either do not support the provision of basic residential local exchange service at all, or they disproportionately support other services and/or customer classes. The illustrative analysis in this appendix examines certain accounts in the cost of service study submitted by NYNEX to the Massachusetts Department of Public Utilities[2] in order to provide some specific examples of why the ARMIS costs should not form the basis of the determination of a cost factor used in a forward-looking cost study.

The account numbers identified below and in Table App-4A correspond with the account numbers that are included with the data in the FCC *Statistics of Common Carriers* (e.g., Table 2.9). ETI's analysis is not intended to provide a comprehensive examination of all LEC accounts, but rather to provide specific examples that, when considered with the discussion of the return on investment and depreciation expenses in Chapter 4, demonstrate why it would be erroneous to rely upon ARMIS data to derive a cost factor to be used in a benchmark cost proxy model for basic residential local exchange service. Table App-4A simply translates the results of ETI's state-specific analysis to the national figures reported by Tier 1 companies to the FCC. Meanwhile, the Joint Sponsors have provided minimal supporting documentation for the two cost factors that were used in the BCM and, therefore, should be encouraged to provide additional information.

Account 6611: Product Management

1. See Chapter 4 for further discussion.

2. Massachusetts Cost of Service Study (COSS), NYNEX, 12 Months Ended November 30, 1992.

- The Massachusetts COSS describes this account as including "costs incurred in performing administrative activities related to marketing products and services."[3] Of the approximately $46-million in expenses associated with this account in Massachusetts, a vastly disproportionate amount, i.e., 84% of the total costs, is related to market management and planning for *business* customers.[4] The remaining 16% is related to market forecasting and rates and tariffs for all customer classes and also to market management and planning for residential customers. It is unlikely that all of these efforts are required for universal service (e.g., it is not readily obvious that "costs incurred to identify, quantify and plan for customer requirements for new or changed communications services" supports universal service). Therefore, the upper bound that should be associated with this account is 16%.

Account 6612: Sales

- According to the Massachusetts COSS, "[t]his account contains the pay and other expenses primarily of personnel engaged in performing the functions of canvassing for new business or for changing or renewing existing service."[5] Of the five organizations associated with this account, only the Administration and System Group Sales organization performs functions potentially related to universal service (e.g., satisfying customer requests for service). This organization comprises approximately 37% of the expenses for Account 6612, so at least 63% of the expenses should be subtracted from this account. Furthermore, only 7.3% of the entire account is allocated to the residential class, which suggests that even the Administration and System Group Sales organization is primarily serving other customer classes (e.g., businesses, Centrex, etc.).[6] Therefore, this account should be reduced by at least 85%.[7]

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3. *Id.*, Book IV of VI, Tab H1, at 1.

4. *Id.*, at 3.

5. Tab H1, at 22.

6. By way of comparison, approximately 49% of the Building Plant Account (Account No. 2121 Tab L1, pp. 84-85 and 57% of one of the Digital Switch account (Account No. 2212.1000, at 262-263) is allocated to the residence class.

7. If the residence class were proportionately supported by this activity, one would expect that approximately 50% of the expenses would be assigned to the residence class. Instead, only 7.3% was assigned to the residence class, i.e., approximately 14.5% of what would be expected. Therefore, the remaining approximate 85% of this account should be eliminated for the purposes of determining expenses associated with the provision of basic service.

Account 6613: Advertising

- As described in the COSS, "[t]his account includes expenses incurred in commercial advertising activities in developing and implementing promotional strategies to stimulate the purchase of products and services."[8] There is nothing in the account description to suggest that any of the advertising is of an instructional nature. This amount should be removed entirely because advertising is not necessary for primary basic local exchange service. Therefore this account should be entirely eliminated in the calculation of a forward looking cost factor for primary residential basic local exchange service.

Account 6621: Call Completion Services

- This account covers expenses associated with helping customers place and complete calls, except for directory assistance (e.g., quoting rates, etc.).[9] These expenses are entirely associated with the provision of operator services and thus belong in the cost factor only if operator services are encompassed within the scope of the universal service being costed. Approximately two-thirds of these expenses are assigned to the coin class, however, so even if operator services are being encompassed in a cost model, the expenses should be scaled back significantly from the total shown. In the Massachusetts COSS, approximately 15% of the total account is assigned to the residential class.[10] We set this amount at zero because the inclusion of operator expenses should be made explicitly and should reflect the fact that the expenses are disproportionately associated with pay telephones.

Account 6622: Number Services

- Approximately half the expenses in this account are assigned to the residential directory assistance category in the Massachusetts COSS.[11] This account includes expenses incurred in preparing, compiling and disseminating listings through directory assistance or other means. **If a directory assistance calling allowance of some sort is included within the scope of basic residential service, it is appropriate that the portion of this account attributable to the DA calling allowance be captured as a cost of universal

8. Mass. COSS, Book IV of VI, Tab H-1, at 33.

9. COSS, Volume IV of VI, Tab H2, at 1.

10. Most likely few of these operator services are provided in connection with local calls so arguably the entire account should be eliminated from the cacluation of a revised cost factor for basic local exchange service.

11. *Id.*, at 14.

service. In states where all DA calls are separately charged, none of these costs should be attributed to the primary residential access line.

Account 6722: External Relations

The COSS indicates that the majority of this account relates to corporate advertising, public relations, investor relations and regulatory/government relations. NYNEX allocates approximately half of these expenses to the residential class.[12] For the purpose of a forward-looking cost study, however, none of these activities support primary residential basic local exchange service and therefore this entire account should be eliminated for the purpose of determining relevant expenses.

Illustrative Analysis of LEC Expenses (000s omitted)				
			All Reporting LECs	
Line No.	**Account No.**	**Item**	**As Filed**	**Partially Corrected (upper bound)**
255	6560	Total Depreciation and Amortization Expenses	18,994,418	13,400,000
257	6611	Product Management	958,201	153,312
258	6612	Sales	1,934,013	290,102
259	6613	Product Advertising	600,470	0
260	6610	Total Marketing Expenses	3,492,684	443,414
261	6621	Call Completion Services	734,690	0
262	6622	Number Services	2,201,208	**??
270	6722	External Relations	764,039	0
Sources: Statistics of Common Carriers, 1994/1995, Table 2.9; Massachusetts NYNEX Cost of Service Study, 12 Months Ended November 30, 1992.				

12. Tab I2, at 20, 22.

Appendix 4B

DISTRIBUTION OF SWITCHED ACCESS LINES BY LOCAL EXCHANGE CARRIER

Distribution of Switched Access Lines by Local Exchange Carrier
(1993)

Company	Total Lines Served*	Share Lines Served
Seven RBOCs	112,215,811	75.7%
Cincinnati Bell	838,006	.6%
SNET	1,937,185	1.3%
Citizen Communications	79,134	.1%
Commonwealth Telephone	207,995	.1%
GTE	15,289,500	10.3%
Lincoln Telephone	251,610	.2%
Puerto Rico Telephone	1,159,565	.8%
Rochester Telephone	492,512	.3%
Sprint Corporation	5,504,431	3.7%
Total for Non-RBOC Tier 1 LECs	25,759,938	17.4%
Tier II LECs**	10,214,671	6.9%
Total # of Local Loops* **	148,190,420	100%

*SOCC, 1993/1994 Edition, Table 2.10.
**Note: Share of loops served by Tier II LECs is equal to: Total # of Local Loops-# of Loops served RBOCs-# of Loops served by Tier I LECs
***FCC Monitoring Report, May 1995, Table 3.6

Notes: Lines as reported in the SOCC include residential, business, public and mobile access lines. Loops are approximately comparable to lines.
Numbers do not add to 100% due to rounding.

5 | DEVELOPMENT OF CORRECTED SWITCH COSTS

5.1 Outdated, unrealistically high switch costs overstate line costs

How the BCM reflects switch costs

The BCM "deploys" switches to serve all CBGs associated with a given wire center. The cost allocation of this theoretical deployment is accomplished by taking the common fixed cost of a digital switch (which, in the BCM, is $647,526) and allocating 79%[109] of these common fixed costs to all lines (the total of actual households grossed up for (1) business lines and (2) an 80% fill factor) served by the wire center. Common costs are the central processor frames, billing and data recording equipment, power equipment and backup power, main distribution frame, testing frames, and basic software.[110] In addition, a variable switch cost of $238.87 is also assigned to each line. Thus, the total switch-related costs assigned to a line consist of two parts, the line's share of the common cost (which varies among the wire centers depending upon the total number of lines served) and a per-line cost (which is identical for each line).

Because of the wide range of total numbers of lines served by a wire center, the final switch-related investment cost per line varies from a low of, for example, $4.88 per month[111] to a high of, for example, $254.82.[112] As Figure 5.1 indicates, on average,

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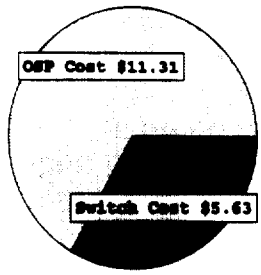
109. This figure is based upon the following calculation: 70% of the switch costs are assumed to be non-traffic-sensitive, and remaining 30% traffic-sensitive costs. Of those remaining traffic sensitive costs, 30% are assumed to be associated with *local* calling. Thus, the allocation consists of .7 + (.3 * .3), which equals .79. BCM, OTPT60~1.xls.

110. Mark Bryant, MCI, in California PUC Workshops on Universal Service, February 5, 1996, Tr. 374, lines 13-16.

111. This is for a line served by the RNTNWA01 wire center (Renton, a suburb of Seattle), which serves 42,935 households in 90 CBGs.

approximately one-third of the *monthly* line cost (according to the BCM) is associated with the switch.[113]

Figure 5.1
Outside Plant Costs Comprise the Majority of the Average BCM Line Cost
(Monthly)



Note: Assumes cost factor of 22.97%
Source: Washington State BCM Results

The major factors that affect the BCM's computations of the per-line switch-related costs are: (1) the common switch costs; (2) the per-line switch costs; (3) the fill factor; (4) the business gross-up factor; and (5) the percentage of switch costs allocated to lines.

The BCM relies upon a relatively old (1990) secondary source for its switching costs.[114] Switching costs have decreased significantly since 1990, in part to the rapid pace of technological advances in the computer and electronics field, and in part due to the intense competition that has emerged in the switch market.[115] These same factors will ensure that prices continue to decline; in fact, competition in the switch market is likely to intensify if the RBOCs reenter this market now that the MFJ manufacturing restriction has been lifted. Moreover, not only has there been a sharp drop in the *list* prices of digital switching equipment, manufacturers have been offering progressively larger discounts to LECs as part of volume purchase contract negotiations.[116]

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112. (...continued)

112. This is for a line served by the STPSWAXA wire center (Stevens Pass, a small area in Eastern Washington), which serves only 23 households in a single CBG.

113. This conclusion is based on an analysis of the approximate 5000 CBGs in Washington State.

114. See Joint Submission, at IV-4 which lists as the source for switching costs, *Telecommunications Policy for the 1990s and beyond*, Walter G. Bolter, James W. McConnaughey,and Fred J. Kelsey (M.E. Sharpe, Inc., Armonk, New York, 1990), at 167, Table V-2.

115. Brand, T.L. et al. "An Updated Study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," AT&T Bell Laboratories, April 19, 1995 submitted as Attachment C to Pacific Bell's Second Set of Data Request in R.95-01-020, February 28, 1996.

116. The presence of such discounting is not denied by LECs, and in fact they regularly decline to divulge any details of such terms and conditions, claiming that they are subject to confidentiality agreements with the switch manufacturers.

Not only does the BCM rely upon an outdated secondary source, but the cost data used in that publication is even older than the 1990 copyright date: The source is a New England Telephone Company submission in an investigation by the Massachusetts Department of Public Utilities begun in 1986, some four years before the cited text was published.[117] Therefore, the switch cost data employed in the BCM model is at least ten years old. Considering the fact that digital switching costs were steadily declining over the last decade, this category of costs is overstated. Indeed the Bolter book cites an industry observation that "the equipment local carriers buy is going to fall in price."

Examining these cost data and then applying BCM's assumptions about the distribution of traffic-sensitive and non-traffic-sensitive costs illustrates the implausibility of the switch cost data upon which the model relies. If the cost of a digital state-of-the-art switch with a capacity of 100,000 lines indeed included $647,000 in fixed costs and $238.87 in per-line costs, and one used the BCM's algorithms, the total non-traffic-sensitive switch costs that would be allocated to lines would approach $24-million,[118] and only approximately $200,000 would be allocated to traffic-sensitive use.

How the BCM should be corrected

ETI developed a corrected switch cost figure by analyzing additions to plant and to digital access line capacity in California. In 1994, Pacific Bell added approximately $541.4-million in digital switch gross plant (Account 2211) and retired approximately $104.8-million in the same account.[119] This account includes Class 5 and Class 4 switches, as well as current and older generation digital switches. Assuming that approximately 80% of the plant additions in this account were for end office digital switches (the balance being for tandems, SCPs and other network switching facilities), approximately $433.1-million is attributable to subscriber lines. The BCM assumes that 70% of digital switch costs are line-sensitive and that the remaining 30% are traffic-sensitive. Of the latter, 30% are assigned to residential access line service, representing the "base" level of local use included within the basic residential service package. This results in a total assignment of $342.1-million in switch-related costs to lines added in 1994. In 1994, the *net* gain in capacity for digital

117. Massachusetts D.P.U. 86-33, *Investigation by the Department into the propriety of the cost studies filed by New England Telephone and Telegraph Company on April 18, 1986, pursuant to the Department's Orders in D.P.U.*, March 21, 1989.

118. [(100,000 lines * $238.87/line) + ($647,000) * (70)%]. The non-traffic-sensitive costs would "approach" this number because. clearly, the switch would not be deployed to full capacity.

119. Pacific Bell, *Report on the Results of Operations of Pacific Bell*, Tracking Code PD-XX-14, 1994, at 13-9.

access lines was 02,344,303.[120] However, the actual gross additions were greater than the 2.34-million net line gain, because approximately $104.8-million of digital switch plant was retired during that same year. Assuming that the digital switches that were retired were likely of a mid-1980s vintage (generally fairly small machines used in rural exchanges to replace step-by-step equipment), the average original cost per line for that equipment was probably in the $500 range. Therefore, the $104.8-million in retirements represents a decrease of approximately 209,600 digital lines. On this basis, the gross additions (corresponding to the 80% of the $541.4-million) represented about 2,553,903. Dividing the gross plant additions for end-office switches (80% of $541.4-million, or $433.1-million) by the 2,553,903 digital lines added, we develop an estimate of the per-line incremental cost of $170. However, only 70% of this cost, or $119, is line-sensitive. Of the remaining $51 of traffic-sensitive cost, only 30%, or about $15, is assignable to a primary residential access line. Hence, based upon this analysis, the corrected incremental switch-related investment that should be assigned to the primary residential access line is approximately $134.[121]

However, erring on the side of overstating the switch costs, ETI ran the BCM assuming that, for the sake of exaggeration, 100% of the Pacific Bell plant additions were for end office switches (an implausible situation, conducted as a type of "upper bound" analysis), which meant that we ran the BCM using a per-line switch cost of $167. Implementing the ETI corrected switch cost produces a dramatic reduction in the amount of universal service support requirement. The effect of making this sole correction (i.e., to $167 per line) is to reduce the statewide average monthly cost to $14.64, i.e., by approximately 14%, and, to reduce the USF requirement that the BCM computes by between 19% and 21%, depending upon the price threshold.[122]

We also conducted a sensitivity analysis of this assumption by analyzing the impact of using the cost of $134 (which reflects the assumption that 80% of Pacific Bell's additions to

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120. This is the difference between actual 1994 digital access line capacity of 10,964,743 and actual 1993 digital access line capacity of 8,620,440. *Pacific Bell Central Office Equipment Annual View Deployment and Utilization Forecasts.*

121. Note that the costs basis here is for *1994*. Digital switch costs are continuing to fall, so in a *forward-looking* cost model a further downward adjustment could be made. According to Telephone Plant Index (TPI) data provided by the USTA in CC Docket 94-1, central office costs decreased by approximately 10% from 1984 to 1992, i.e., at about 1.3% per year over the eight-year period. Hence, extrapolating to 1997, the switch costs could be further reduced by approximately 4%.

122. Mechanically, we corrected the switch cost as follows: we changed the amount in cell H5 of the Tables and Inputs sheet of the OTPT60~1.XLS file from the default $238.87 to the corrected $167. Also, we changed the fixed cost per switch located in cell H7 of the same file, from the default of $647,526 to $0. The practical result of this latter adjustment is to change the fixed cost per line calculations in column C of the Tables and Inputs sheet to $0, which, in turn, nullifies the effect of the non-traffic sensitive, and traffic sensitive percentages located in cells H9 and H12 respectively. (The reason is that these BCM calculations only affect the allocation of the fixed cost per switch which we have assigned a zero factor.) The effect of the business gross-up factor in cell H14 is similarly nullified by assigning a zero value to the fixed cost per switch.

plant were for end office switches). The result of this sensitivity analysis — relative to the result of using a cost of $167 — was a reduction of sixty-six cents.[123]

Table 5.1

Implausibly High Switch Costs Exaggerate USF Requirements

	BCM	ETI Correction	Percent Difference
USF if $20	$77,846,835	$61,393,675	(21%)
USF if $30	$50,692,630	$41,171,091	(19%)
USF if $40	$37,662,589	$30,674,620	(19%)
Average monthly cost	$16.94[124]	$14.64	(14%)

Notes: Data reflect a cost factor of 22.97%; a corrected per-line switch cost of $167. The fixed cost per line of $647,526 was set to zero. The table reflects no other ETI corrections. Results are for Washington State.
Source: Washington BCM files.

The lack of publicly available switch cost data should not excuse an exaggerated calculation of the size of the USF. Given the sensitivity of per-line costs to the costs that are assumed for switches, it is critical that a concerted effort be made to acquire the relevant switch cost data from the best available *current* source.[125] Clearly, the key

123. See Appendix 8B. Indeed, even the $134 cost per line may well be too high. In 1993, Pacific Bell announced a $1-billion plan to deploy modern switching technology statewide, and indicated that the new switches would serve 9.1-million lines — thus its deployment plan would cost approximately $110 per line. Pacific Bell Press Release, January 25, 1993.

124. The figure of $16.94 is eight cents less than the BCM results for Washington State reflected in the December 1 Joint Submission due to minor differences between the model that was submitted on September 12, 1995 to the FCC and the model that was used by the Joint Sponsors for the December 1, 1995 submission. Conversation with James Dunbar (Sprint) on March 25, 1996. The September version of the model was the one that was widely circulated and that is the basis of our report, with the exception regarding modifications for Surface Types that we made (see footnote 72, above).

125. California PUC, Universal Service Proceeding, *A Discussion of Input Assumptions Used in the Hatfield Proxy Model*, op. cit., footnote 27, at 2 which states, "Even if they were readily available, the discounts large LEC purchasers obtain are necessary to determine the effective prices the LECs paid. Hatfield Associates Inc. ("HAI") understands that such discounts can be impressive: e.g., in the vicinity of 50% or more for switching equipment." See *id.*, at 7, citing *U.S. Central Office Equipment Market — 1994*, McGraw Hill in support of HAI's estimates per

(continued...)

reason that the switch cost data in the BCM are flawed is that LECs refuse to disclose this information, claiming that it is proprietary; until such time as LECs provide data that can substantiate a different result, the costs developed by ETI should be used. LECs do not have "clean hands" to challenge the accuracy of switch costs derived in this manner when they persistently decline to produce the allegedly "actual" costs on which they rely.

The model unrealistically deploys Nortel DMS 100 switches in small rural exchanges

In modelling switching, the BCM assumes that all switches are Nortel DMS 100s. The model appears to address those situations where remote serving units would typically be deployed[126] to minimize the costs of serving rural areas in one of the two following ways, either of which would cause the cost results to be exaggerated: Either the model deploys DMS 100 switches in these situations or it does not deploy any switch, but rather assumes distribution facilities all the way to the area served.[127]

For example, as Table 5.2 shows, the BCM "deploys" a switch costing a minimum of $647,526 in a wire center that serves only 23 households and 50 total lines.[128] As a result of deploying a DMS 100 to serve a relatively small number of lines, the total switch-related component of the per-line cost for the wire center in this example is $207.76 *per month*.[129] By comparison, the Washington state average switch-related cost component is $5.63. It would make no economic sense to deploy a large-scale switch in a small wire center, and numerous lower-cost alternatives are available. The BCM, however, does not consider such alternatives.

The inappropriate deployment of DMS 100 switches is a significant component of the overstated per-line cost for basic local exchange service that is yielded by the uncorrected

125. (...continued)
line for digital switching in 1995 of $105 for BOCs, $114 for GTE, and $241 for other independents. Appendix 4B shows that Tier I LECs serve approximately 93% of lines.

126. See, e.g., New England Telephone (Vermont) Depreciation Study, December 4, 1992, Account Narrative for Account 2212.

127. This problem has been recognized by the Joint Sponsors and they have indicated their intent to address this issue. *Ex parte* submission, February 21, 1996, *op. cit.*, footnote 75.

128. The STPSWAXA wire center. This number reflects a business gross-up factor of 1.75 and a fill factor of 80%. This results in 50.3 lines ((23*1.75)/0.8) which we rounded to 50 for this analysis.

129. This number is based upon a cost factor of 22.97%.

BCM.[130] ETI's analysis shows that of the households for which the BCM determines a universal service support requirement,[131] 44% are in CBGs where, according to the BCM, the total switch investment is over $500 per line.[132] Clearly, one must question whether the decision to deploy a stand-alone switch under such conditions is prudent or necessary to meet universal service objectives.

Table 5.2

Comparison of Switch Costs for the BCM Washington State Average and for an Illustrative Rural Wire Center[133]

	Washington State Average	**Wire Center STPSWAXA**
Outside plant cost per line	$11.31	$178.94
Switch cost per line	$5.63	$207.76
Total	$16.94	$386.70
Switch Cost as Percentage of Overall Cost Per Line	33%	54%

Note: STPSWAXA is Stevens Pass.

130. In their *Ex parte* submission of February 21, 1996, the Joint Sponsors indicate that they plan to develop a matrix that will allow for the design of host and remote switches, and that will identify fixed and per-line costs for various switch sizes. The Joint Sponsors indicate further that different fixed and per-line cost factors will be used depending upon the switch size to allow for optimal switch selection. These improvements are appropriate and worthy of development. See, Ex parte Submission, *op. cit.*, footnote 75.

131. This assumes Cost Factor 2 and a price threshold of $30.

132. Expressed in another way, according to the unrealistic results of the BCM, more than 60,000 households in Washington would require per-line switch costs of over $500 to serve. Results sheet, otpt60*1.xls.

133. As is the case with all numbers yielded by the BCM, the results of the uncorrected BCM are neither fish nor fowl because the per-line switch costs reflect the presence of business lines but the outside plant costs do not. This internal inconsistency is addressed in Chapter 6.

6 AN EXAMINATION OF OUTSIDE PLANT COSTS

6.1 The BCM should be corrected to more accurately reflect the economy of scale and scope inherent in incumbent LECs' networks

The BCM only partially recognizes the presence of business lines

All else being equal, the unit cost of providing basic local exchange service within a given area declines as the quantity of lines served increases. There are several reasons for this condition. Among other things, fixed common costs (e.g., the common switch costs) are allocated over a relatively greater number of lines, thus driving down the cost assigned to any individual line, and relatively higher numbers of lines means that larger cable sizes are deployed, which result in lower per-line costs (see Appendix 3D).

The BCM relies upon household data that is available in the census, and because the model is census-based, it does not generally account for business lines that actually exist in each of the CBGs. Although the creators of the model have adjusted in some respects for the presence of business lines, the adjustments to reflect the cost impact of business lines have not been made on a sufficiently comprehensive basis to even remotely justify the low fill factors for outside plant that are assumed in the BCM.

One area where the BCM does, at least implicitly, recognize business lines is in the allocation of switch costs, by applying a gross-up factor of 1.75 to the quantity of residential lines before calculating the per-line share of common costs. Thus, for any given CBG, the model multiplies the number of households by 1.75 and then divides that result by the model's assumed switch fill factor of .8 to derive a total "Switched Lines" count for each CBG. A fixed cost per line is then calculated at the wire center level by multiplying the BCM's default switch cost of $647,526 by the percent of the switch cost that is

allocated to the line and then dividing that product by the total number of switched lines for the wire center.[136]

However, the BCM does not recognize the presence of business lines in sizing cable. It thus understates cable size and thereby overstates the associated per-line cost. In the Hatfield Cost Model (HCM) submitted in the California Universal Service proceeding,[137] the HCM multiplies the number of household lines by business line multipliers which range from a low of 1.20 in the lowest density to a high of 1.83 in the highest density.[138] The consequence of incorporating this multiplier is to more accurately reflect the presence of business lines.[139]

By way of background, we note that, unlike the BCM, an earlier cost proxy study appears to account for business lines:

> We obtained residential telephone penetration levels from the FCC's *Statistics of Communications Common Carriers* to estimate the total number of residential lines per density class, and we applied single- and multiple-line business access line percentages from the FCC document to the residential figures to obtain total business lines.[140]

Also, more recently, testimony submitted on behalf of MCI and AT&T in a state universal service proceeding states the following regarding the Hatfield Model's modification to the BCM:

> We have modified the input data to account for business lines and two-line residences by density range. We select numbers per range to make the final access line totals approximately equal to those shown in the Common Carrier Statistics.

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136. The total per-line switch costs are the sum of the assumed per-line switch cost of $238.87 (which does not vary) and the computed per-loop share of common switch costs (which varies).

137. California PUC, Consolidated R.95-01-020 and I.95-01-021, *Rulemaking and Investigation on the Commission's Own Motion into Universal Service and to Comply with the Mandates of Assembly Bill 3643.*

138. California Universal Service Proceeding, A Discussion of the Input Assumptions Used in the Hatfield Proxy Model, Appendix A, page entitled *Output Module, "inputs" worksheet.*

139. However, the Joint Sponsors have specifically rejected the use of a different business line multiplier for each density group, although they have not yet provided the rationale for this position. *Ex parte* submission, February 21, 1996, *op. cit.*, footnote 75.

140. *The Cost of Basic Universal Service*, Hatfield Associates, July, 1994, at 6.

This allows the Hatfield Model to size the line plant to accommodate these lines; basic BCM does not have this capacity built into the calculations.[141]

The low fill factors that are incorporated in the BCM likely reflect the volatility associated with providing telecommunications services other than first line, basic residence local exchange service, e.g., business lines and additional residence lines. However, although the BCM reflects the volatility of business lines, among other things, through the Joint Sponsors' assumption of low fill factors, the business lines themselves are not reflected in the BCM. Thus the BCM is internally inconsistent. We tested the implications of leaving the BCM's low fill factors intact, but increasing the lines served in the model by a gross-up factor of 1.44[142] in order to make the BCM more consistent internally. In this "high-volatile, including businesses" run, we multiplied the number of households in each CBG by 1.44; used the corrected switch cost of $134; used the BCM's default (i.e., low) fill factors; and made no other corrections. We compared the results of this run to a "non-volatile, single line residence only" run of the BCM assuming the default values for the quantity of households in each CBG, the corrected switch cost of $134, and the corrected fill factors of 95%.[143]

The low-fill factor run (with the business gross-up) yielded an average monthly cost of $13.20 (which is approximately $3.50 less than the BCM's uncorrected result) and the high-fill factor run (reflecting single-line residence) yielded an average cost of $11.88.[144] For the purpose of modelling universal service costs, the result yielded by the low-fill factor should be rejected because under no circumstances should universal service support requirements be *increased* as a result of the costs of serving business lines. On the other hand, the high-fill factor represents an upper bound cost because (1) it does not yet reflect

141. Pennsylvania PUC, Universal Service Proceeding, Direct Testimony of Dr. Robert Mercer, *op cit*, footnote 6, at 12.

142. This figure of 1.44 is the ratio of all lines in the state of Washington to the number of households in the state of Washington. The number of residential lines is 2,062,385. SOCC, 1994-1995, Table 2.5. The number of households that have telephone service and that also have second lines is 7.2% based on ETI's calculation of additional residential lines using FCC methodology. The subscribership rate in Washington State is 96.0%. Monitoring Report, May 1995, Table 1.2 (1994 Data). Therefore, using these same data yields a computed number of households of 2,004,028 (i.e., [2,062,385 divided by 1.072] divided by 0.96). The total number of lines (including second lines, business lines, and public access lines) is 2,881,344. Statistics of Common Carriers, 1994-1995, Table 2.5. Thus, the ratio of the total number of lines to the number of households is 1.44. (Because the BCM does not document the source of its business gross up factor of 1.75, we cannot explain the discrepancy between our figure and that of the Joint Sponsors.)

143. Because in this "baseline" run we use 95% fill factors, we adjusted the distribution cable multipliers as discussed in 6.3.

144. These data reflect Cost Factor No. 2. Appendix 8B.

other necessary corrections to the BCM, which are discussed in more detail below and in Chapter 7 and Chapter 8 and (2) some of the benefits of the economies of scale and scope associated with the fact that LECs serve residence and businesses should flow back to households.[145]

The use of CBGs as the relevant unit for high-cost analysis does not require that CBGs be used as the basis for determining support requirements

CBGs are relevant in the BCM for several reasons:

- CBGs define the area within which average per-line costs are computed and evaluated for the purpose of defining the need for and size of USF support.
- Each CBG is assigned to one of six density zones to determine certain cost characteristics (e.g., the mixture of underground and aerial plant).[146]
- CBGs define the boundaries of the areas that wire centers serve.

Although each CBG is assigned to one of six density zones for the purpose of determining certain cost characteristics, the presence of other factors (such as the total number of lines, rock hardness, etc.) means that the calculated cost per line is unique for each CBG.[147]

Because certain topographic and demographic information that would help to ensure an objective basis for specifying certain cost inputs to the model is available by CBG, the BCM uses that geographic unit for purposes of modelling costs. Although there are criticisms that can fairly be leveled at the choice of costing unit, the advantages of having these objective inputs is considerable. However, this decision to use CBGs to identify

145. Throughout this report, ETI's corrections are intended to modify the BCM so that it reflects the appropriate scope of service, i.e., the deployment of a single line to each and every household, so that the BCM quantifies the stand-alone costs of that basic residence local exchange service. However, conceptually, a separate BCM should be run to quantify the stand-alone costs of meeting all other local exchange service. Because the combined cost of serving both "universes" (i.e., single-line residence *and* all other local service) should be *less* than the sum of the two parts (contrary to the aphorism, "the whole is greater than the sum of the parts"), the results of the stand-alone analysis of residence costs should then be scaled back appropriately.

146. See Appendix 3C.

147. For example, CBG 80379534002 and CBG 80379534006 of wire center AVONCOMA, Colorado are both assigned to the second Density Zone (5 to 200 per square mile), but the monthly cost per loop in the former CBG is $50.15 and the monthly cost per loop in the latter CBG is $34.94. See output derived from CODTIN1.XLS, Rows 225 and 229.

discrete areas that have a higher cost to serve can and should be de-linked from the decision as to the most appropriate unit of aggregation for purposes of determining support requirements.

Very small geographic areas, such as CBGs, are not economic service areas for the provision of telephone service. Standing alone, they would not be served by a switching entity and distribution architecture confined to that particular geographic unit. Individual wire centers and central office switch entities can most efficiently serve thousands, or even tens of thousands, of households and businesses, whereas CBGs embrace at most several hundred households (and no nonresidential customers), and would never be adopted as the foundation of an efficient network architecture.

In fact, in rural areas, the economic choice may well be to deploy wireless technology rather than to construct long runs of copper or fiber cables with extremely low utilization. Therefore, the BCM should incorporate a cost threshold above which wireless service is deployed rather than wireline. Wireless technologies, by their very nature, are not constrained to CBG boundaries.

By determining the need for USF support on a CBG basis rather than a wire center basis, the BCM significantly exaggerates USF requirements

The BCM overstates the USF requirement because it determines USF need based upon an examination of the cost per line separately for each of the approximate 220,000 CBGs. Instead, the determination of the need for universal service funding should be made over a geographic area at least the size of the wire center, to recognize that a LEC enjoys considerable economies of scale and scope that are only partially operative at the unduly granular CBG level.[148] Moreover, by its adoption of a "scorched node" model design in which all existing wire center locations are held constant, even the CBG-specific costs are misstated to the extent that a more efficient overall network architecture would have been indicated had the number and locations of wire centers been allowed to change. Accordingly, while the average costs of serving households may be calculated separately for each of the 220,000 CBGs (as the BCM does), the results of those individual calculations

148. The Joint Sponsors have indicated that they will *not* make a modification to the model that would allow a user to calculate the average cost at the wire center level. *Ex parte* submission, January 26, 1996, *op. cit.*, footnote 75. The Joint Sponsors indicate that an "interested user of the BCM could perform an aggregation of all CBGs in a wire center to obtain an approximation of cost at the wire center level." *Ex parte* submission, February 21, 1996, *op. cit.*, footnote 75.

should then be aggregated at least to the level of the wire center before they are compared with the desired price to be supported.[149]

A clear demonstration of the need for wire center aggregation can be seen in the BCM's treatment of feeder costs. In general, there are typically a number of individual CBGs within the geographic area served by a LEC wire center; hence, under this construct, costs of serving individual customers within a given wire center serving area could vary based, among other things, upon distance from the CO, type of feeder/distribution plant construction, density, and terrain.

Because the BCM develops costs on a CBG by CBG basis, where certain costs are shared by two or more CBGs, the BCM must necessarily allocate these shared costs among the several CBGs in some manner. Where the use of plant by several CBGs within a wire center serving area is less costly, overall, than if each CBG were configured on a stand-alone basis, the savings is the result of some economy of scale. The particular means by which the shared costs and the scale economies are allocated among the several CBGs will materially affect the overall conclusions of the BCM or of any other modelling process that is based upon smaller-than-wire-center serving areas. There are, in fact, several alternative methods by which such costs and scale economies can be apportioned among a group of individual CBGs. To see why, consider the following example:

Suppose that a particular feeder cable consisting of 24 strands of fiber optic cable leaves the CO building heading due north. The cable connects to four Service Area Interfaces (SAIs), each one of which serves a CBG.[150] The four SAIs (A, B, C and D) are located at distances of 10,000, 15,000, 20,000 and 25,000 feet, respectively, from the CO, and each requires four (4) strands (one working pair and one "hot" spare pair). Assume further that 24 strands is the smallest practical size for feeder cable.[151]

The installed cost of this cable is $200,000, which works out to $8 per sheath-foot. How is this $200,000 to be apportioned among the four CBGs?

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149. Certain RBOCs have raised this problem. See, e.g., Comments of Bell Atlantic, Docket 80-286, at 8: "[a]s the Commission acknowledges, use of such a small measurement area [CBGs] could substantially increase the total subsidy requirement and with it the size of the USF."

150. Under the architecture assumed in the BCM, each individual CBG is served by one SAI. In fact, of course, the actual design of the feeder and distribution networks bear no relationship whatsoever to CBGs and CBG boundaries.

151. To be precise, the BCM would not assume the use of fiber to serve CBG A, because it is less than 12,000 feet from the CO. Thus, the model would engineer *copper* feeder cable as far as CBG "A" along the very same route as the fiber, with the fiber bypassing "A" and serving only B, C and D. Such a configuration would, of course, make no real sense; hence, if anything, the arbitrary use of the 12,000 copper/fiber crossover point will almost invariably lead to an overstatement of optimally engineered feeder costs.

Method 1: Under this method, each CBG is charged a proportionate share of the segment(s) of the cable that it uses. Segment (1), which connects the CO with CBG (A), costs $80,000 (10,000 feet x $8/foot) and is shared by all four CBGs. Therefore, each CBG is assigned $20,000 for its share of this segment. Segment (2) costs $40,000 (5,000 feet x $8) and is shared by three CBGs (B, C and D), so each of these three CBGs is assigned $13,333. Segment (3) is shared by two CBGs, (C and D), so its $40,000 cost is split $20,000 to each. Finally, Segment (4) serves only CBG (D), so the entire $40,000 cost for this segment is charged to D. The result of these segment-by-segment allocations produces the following costs for each of the four CBGs:

A	$ 20,000
B	33,333
C	53,333
D	93,333

Method 2: Each CBG bears the cost of the immediately preceding segment. Under this approach, each CBG bears the cost of getting to it from the previous CBG (or CO, in the case of A) in the string. The result is the following set of allocations:

A	$ 80,000
B	40,000
C	40,000
D	40,000

Both of these approaches have certain validity, but neither is entirely satisfactory nor economically correct. Method 1, which is essentially the approach adopted in the BCM, imposes on the most distant CBGs costs that are not avoided if that CBG is not served at all. In other words, if (in our example) CBG D were simply not served, the LEC would avoid the last $40,000 of construction cost for the segment of feeder cable from C to D, *but would not avoid any of the costs of providing cable to A, B or C. Indeed, if D were not served, Method 1 would assign most costs to each of A, B and C:*

A	$ 26,667
B	46,667
C	86,667

In deciding whether to serve D, a new entrant would thus not consider Method 1 costs at all, but would instead look to Method 2. That is, the firm would consider the *incremental* costs of serving each CBG given that it had already decided to serve other CBGs. If the new entrant had decided to serve CBGs A, B and C, then the incremental cost of serving D is $40,000, the cost of the one additional segment.

Although Method 2 more accurately captures the economic decision process by which a new local exchange service competitor would consider serving a given market area, to be useful the analysis must closely track the decision process itself. For example, it might not be appropriate to utilize Method 2 to determine separately the costs of A, B and C if the CLEC had determined that serving all three of these CBGs was the minimum market size that was economically efficient to serve. In other words, the correct application of Method 2 requires that a "baseline" be established and that increments be examined relative to that baseline. There is, however, no clear algorithm for establishing the baseline except, perhaps, for a rule that would require, as a threshold matter, that the baseline be no lower than the minimum market size that the CLEC can efficiently serve.

Method 2 is far closer to a "competitive outcome" than Method 1, because it reflects the true cost increment required to serve the highest-cost, most distant subscribers *with all of the joint gains from scale and scope economies being assigned to the rural increment.* Such an assignment of the economies of scale resulting from serving D in addition to A, B and C is appropriate and economically valid *because those economies of scale would not be available at all, unless D were in fact being served.* To see why, let us posit one additional Method (call it Method 3) for assigning joint costs among these four CBGs. Under Method 3, each CBG is assigned the entire stand-alone cost of serving it and it alone, which costs are then reduced by an allocation of the economies of scale. The stand-alone and joint costs, and the resulting economies of scale, associated with serving each of the four CBGs, are as follows:

	Stand-alone	Total	Joint	Savings
A	$ 80,000	80,000	80,000	0
B	120,000	200,000	120,000	80,000
C	160,000	360,000	160,000	200,000
D	200,000	560,000	200,000	360,000

There are, of course, a number of means by which the savings could be allocated. In our present example, however, if A, B and C are the "baseline," then the only way in which the additional $160,000 of savings would become available to the carrier would be for that carrier to offer service to area D. Hence, strictly from the standpoint of the decision to serve, as long as area D generates sufficient revenue to offset the $40,000 of net additional construction cost, the carrier should choose to serve D.[152]

152. This is not to say that the *price* the carrier charges for serving D should be set to recover only the $40,000 incremental cost. For pricing purposes, it may be appropriate to spread the $160,000 in total efficiency gains among those other customers whose existence made those gains available to the carrier when serving D. However, for purposes of determining the effect of a requirement that the *incumbent* serve an entire wire center area, only the $40,000 cost incremental is relevant.

Costs should clearly be examined on a wire center, rather than on a CBG, basis in assessing whether a particular area exhibits "high cost" and is deserving of "high cost support." We have noted that there are substantial economies of scale and scope in jointly serving all of the individual CBGs within the wire center's serving area, and that the incremental cost of serving the ostensibly "high-cost" regions within the wire center service area must be determined in light of such economies of scale. In the examples provided here, it is apparent that the costs of serving the most outlying portions of a wire center district are also the ones that may benefit most heavily from the existence of the balance of the feeder and distribution infrastructure within that district, and it is economically wrong to assign to the most outlying area any costs that are not specifically avoided if the subject outlying area is not served at all. In the above example, the BCM would attribute to D a capital investment cost of $ 93,333. While still far below the $200,000 stand-alone cost of serving D, this method of assigning shared costs substantially overstates the actual incremental cost of extending service into the outlying area.

Method 2 best reflects competitive entry decisionmaking. When improving land for a new subdivision, a real estate developer, for example, is required only to construct the roads, water mains, and other infrastructure elements to the nearest point of connection to the existing infrastructure; he is not required to build a new road all the way to the center of town. The process for assigning shared costs to individual CBGs must similarly consider only those additional costs that would not be required but for the incremental addition of the new, outlying area. This is the approach that should be used if costs are to be determined at a CBG level. However, it is precisely because of the impact of scale economies on the shared costs of serving multiple CBGs that costs should not be determined at such a granular level, but should instead be determined and aggregated at a level no smaller than an entire wire center serving area.

Current high-cost support works off an average cost basis: LECs receive support when their costs in a given study area are more than 115% of the national average. Using this approach, the LEC only receives support if, on average, across its entire study area, its costs to serve are higher than the norm. Thus, a LEC with a combination of high-cost, low-cost, and average-cost exchanges might get little or no support, if the higher cost exchanges are cancelled out by lower cost ones. The design of the BCM prevents this sort of levelling effect from occurring. Under the BCM, any CBG that is modelled as having high-cost characteristics automatically generates an entitlement to support, regardless of the larger cost profile at the wire center (or some larger economic serving unit). The following example illustrates this point.

Consider the Colorado wire center AVONCOMA, which consists of 5 CBGs with per-line monthly costs ranging between $15.52 and $50.15. For sake of this example, assume Cost Factor #2 and a price of $30 per month being supported. In Table 6.1, the third column displays the BCM's calculations, given these assumptions. The fourth column is