premature plant retirements caused by LEC modernization programs intended to support provision of advanced services.

Fortunately, the structure of the CPM permits the use of alternative input assumptions, including revised depreciation lives. While other deficiencies of the CPM may be much harder to remedy (see other chapters of this report), model users should be able to input the longer depreciation lives that are more appropriate for universal service costing purposes.

The HM

In the HM, recurring annual expenses are developed from investments and non-plant related expense data in the Expense Module. The HM is similar to the BCM2 in that its expense analysis begins with LECs' ARMIS report data, but differs in that the HM develops detailed, state-specific expense factors in a relatively transparent and open fashion. The HM Expense Module calculates expense factors separately for each unbundled network element (UNE),[67] which are combined, together with allocated portions of joint network expenses and a 10% markup to reflect "variable overhead" expenses, to produce recurring expenses for local telephone service.[68] The current version of the HM Expense Module derives several different types of expenses, namely: plant-specific operating expenses ("network expenses"), calculated from ARMIS expense-to-investment ratios; plant non-specific operating expenses and network support expenses; customer service expenses, and miscellaneous expenses.

Rather than simply accepting all ARMIS-reported expenses as necessary for the provision of universal service, however, the HM developers have attempted to apply a forward-looking view of expenses for basic telephone service. For example, the HM's customer services expense calculations do not apply the total Customer Service expense category, but instead reflects Product Management, Sales, and Service Order Processing accounts, and excludes, among other things, Product Advertising, on the grounds that advertising is not required for primary line residential service. As discussed earlier, this type of analysis is distinctly lacking in the BCM2. The HM developers have stated that the next version of their model (release 2) will introduce further changes to the Expense Module, including a further disaggregation of expense factors.[69] Presumably, however, the same type of approach will be carried forward.

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67. The HM models the following UNEs: distribution, concentrator, feeder, end office switching, signaling, dedicated transport, common transport, tandem switching, plus operator systems and public telephone facilities.

68. HM, Expense Module, Sheet "Expenses by Service."

69. *Hatfield Model Version 2 2, Presentation to the New Jersey Board of Public Utilities Staff*, August 7, 1996.

Appendix 3A | ANALYSIS OF SELECTED LEC EXPENSE ACCOUNTS

Analysis of Selected LEC Expense Accounts

Background

In our April report, we demonstrated that 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 inappropriate 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. This appendix reiterates some of our previous analysis in order to provide an assessment of the reasonableness of the BCM2's assumptions regarding non-plant-related expenses associated with local exchange service. 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[1] in order to provide some specific examples of why ARMIS costs should not form the basis of the determination of a cost factor used in a forward-looking cost study, unless they are at a minimum, subject to rigorous evaluation by regulators.

The account numbers identified below and in Table App-3A 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 demonstrate why the BCM2's treatment of non-plant-related expenses is incorrect. Table App-3A simply translates the results of ETI's state-specific analysis to the national figures reported by Tier 1 companies to the FCC. The sponsors of any cost proxy models should be directed to provide comprehensive account-specific supporting documentation for the cost factors being proposed for use in order to compute the cost of *primary line* residential local exchange service.

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

Furthermore, where expenses in a given account are disproportionately incurred in order to serve business customers or for additional lines,[2] expenses should be adjusted accordingly.

Analysis of selected accounts illustrates that a disproportionate amount of the expenses are associated with services other than primary residential lines

Account 6611: Product Management

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 potentially performs functions that may possibly be related to universal service (because the description of the activity includes the activity of satisfying customer requests for service). However, an examination by customer class of this account indicates that only 7.3% of the entire account is assigned to the residence class and that the expenses assigned to the residence class do not concern the Administration and System Group Sales organization, but rather are related to activities in the Direct Marketing/Direct Response Center, which

2. For example, ILECs may have undertaken targeted marketing campaigns in order to encourage customers to subscribe to additional line service.

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

4. *Id.*, at 3.

5. Tab H1, at 22.

concern the sales and fulfillment of service orders for supplemental services.[6] Since the activities in this account do not support basic residential service, we have excluded the entire account. Although this analysis is based upon a Massachusetts COSS, it is nonetheless difficult to envision any sales activity by ILECs associated with *primary* line basic local exchange 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."[7] 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.).[8] 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.[9] 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.

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6. *Id.*, at 21. Furthermore, 42.3% of the expenses in this account are associated with the provision of Centrex, a competitive service. *Id.*, at 24

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

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

9. 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.

Account 6622: Number Services

Approximately half the expenses in this account are assigned in the Massachusetts COSS to the residential directory assistance category.[10] This account includes expenses incurred in preparing, compiling and disseminating listings through directory assistance or other means, and relates to handling calls for local and toll directory assistance and non-published number requests, among other things. The Massachusetts COSS does not distinguish requests for directory assistance relating to local calls from those relating to toll calls. Furthermore, in many states, ILECs receive revenues for those calls made in excess of a DA allowance, and also receive revenues for non-published listings.[11] Thus, it would be misleading to include the substantial expenses associated with directory assistance unless the revenues are also included. Therefore we have excluded this expense figure.

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.

Exclusion of unrelated non-plant-related costs brings the BCM2 results much closer to those previously presented in the original BCM and in other cost analyses

Table App-3A below shows that the total illustrative expenses for Tier 1 LECs is $7,192,621,000, or approximately $50 per line.[13] Furthermore, extrapolating from an examination of the Massachusetts Cost of Service Study suggests that at most 2.1% of these

10. *Id.*, at 14.

11. Even in Massachusetts, which is one of only a few states with a DA allowance as high as 10 calls, the estimated revenues from directory assistance is anticipated to exceed the costs associated with fulfilling certain legislated requirements (e.g., providing a relay service and E-9-1-1 service). Massachusetts D.P.U. 91-68, *Investigation by the Department on its own motion, released July 12, 1991.*

12. Tab I2, at 20, 22.

13. Tier 1 LECs serve 137,975,749 lines. *Statistics of Common Carriers*, 1993/1994 Edition, Table 2.10.

expenses might be considered relevant to the provision of basic local exchange service.[14] The table below does not purport to summarize all expense accounts that may be associated with the provision of basic local exchange service but is included in order to illustrate the type of supporting documentation that is conspicuously absent from the BCM2.

The Massachusetts Cost of Service Study was presented at a level of detail sufficient to permit the kind of account-specific analysis that is presented here. Unfortunately, however, the BCM and BCM2 cost support is too aggregated to permit a similar account-specific examination at the national level. But the absence of detail *that is within the control of the ILECs and that could have been provided* should not be permitted to foreclose appropriate and accurate regulatory review. The pervasive use of companywide averages or aggregates as being representative of the costs properly *caused* by basic primary residential exchange access lines (the current universal service baseline) produces a systematic bias in which the costs of this service are consistently overstated. It would be a monumental error to permit such consistently overstated costs to drive national or state telecommunications policy. Before federal or state regulators can make decisions as to the appropriate components of cost factors, it is critical that the ILECs be required to provide account-specific information with narratives and explanations of the purposes of the accounts, so as to permit service-level disaggregation. Furthermore, expense information needs to be provided separately for (a) primary residential basic local exchange service and (b) additional residential exchange service and business service.

14. For runs of the BCM2 that include business lines, the expense factors should clearly reflect some expenses associated with providing basic local exchange service. However, the expense factor should not reflect the disproportionate level of expenses caused by activities such as marketing, advertising, and sales. The legitimate expenses are those associated with providing basic local exchange service.

Table App-3A
Illustrative Analysis of Non-Plant-Related Expenses
(000s omitted)

			All Reporting LECs		
Line No.	**Account No.**	**Item**	**As Filed**	**Partially Corrected (upper bound)**	**Percent (upper bound)**
257	6611	Product Management	$958,201	$153,312	16.0%
258	6612	Sales	$1,934,013	0	0
259	6613	Product Advertising	$600,470	0	0
260	6610	Total Marketing Expenses	$3,492,684	$153,312	4.4%
261	6621	Call Completion Services	$734,690	0	0
262	6622	Number Services	$2,201,208	0	0
270	6722	External Relations	$764,039	0	0
		TOTAL	$7,192,621	$153,312	2.1%

Note: Selected accounts shown for Tier I LECs.
Sources: Statistics of Common Carriers, 1994/1995, Table 2.9; Massachusetts NYNEX Cost of Service Study, 12 Months Ended November 30, 1992.

Appendix 3B | RUNS RELATING TO NON-PLANT-RELATED EXPENSES

State: Washington

Date: 8/4/92
Time: 3:22:38 PM

Assumptions:
Other Allocation Ratio = 20%
(i.e. the non-plant-related expenses per line = 0.0015)

Aggregate Support		ARMIS
At $20 =	$	176,011,630
At $30 =	$	92,082,893
At $40 =	$	57,832,254
At $50 =	$	37,025,754
At $60 =	$	25,336,760
At $70 =	$	17,664,736
At $80 =	$	12,363,309
Annual Benchmark Cost =	$	920,638,181
State Average Monthly Cost=	$	23.29

Density	Households	Lines
Less 5	19,098	26,849
5 to 200	408,594	634,397
200 to 650	266,499	487,515
650 to 850	101,986	181,135
850 to 2550	681,340	1,181,569
Greater 2550	397,991	782,457
Total	1,875,508	3,293,923

	ARMIS
Cost Category	Households
$0<=$ 5	-
$5<=$10	33,200
$10<=$15	254,952
$15<=$20	443,492
$20<=$25	489,059
$25<=$30	278,538
$30<=$35	94,907
$35<=$40	58,778
$40<=$45	47,953
$45<=$50	48,905
$50<=$55	28,872
$55<=$60	19,251
$60<=$65	15,157
$65<=$70	8,598
$70<=$75	10,405
$75<=$100	27,547
$100<=$150	11,741
$150<=$200	2,916
$200<=$250	1,214
$250<=$300	-
$300<=$500	23
$500<=$1000	-
$1000+	-
Total Households	1,875,508

Loop Category	Households
0 <= 5Kft	194,576
5Kft <= 10Kft	473,673
10Kft <= 15Kft	432,323
15Kft <= 20Kft	283,523
20Kft <= 25Kft	171,102
25Kft <= 30Kft	106,537
30Kft <= 40Kft	102,024
40Kft <= 50Kft	51,096
50Kft <= 60Kft	21,986
60Kft <=70Kft	14,541
70Kft <= 80Kft	10,481
80Kft <= 90Kft	7,398
90Kft <= 100Kft	3,685
100Kft <=150Kft	2,511
150Kft <= 200Kft	52
200Ktf+	-

Loop Information	Length
Minimum Loop Length	756
Maximum Loop Length	165,901
Average Loop Length	15,199

Maximum Monthly Cost	$	408.16
Average Monthly Cost	$	23.29
Lines Above $10K Loop Inv		1,307

State: Washington

Density	Summary Results		Weighted
Less 5	Sum of # Households		19,098
	Sum of # Lines		26,849
	Average of Loop Length		70,190
	Average of Loop $ per Line		$4,771
	Average of Total Invstmnt $/Ln		$5,196
	Average of Monthly Cost1		$ 104.68
5 to 200	Sum of # Households		408,594
	Sum of # Lines		634,397
	Average of Loop Length		29,933
	Average of Loop $ per Line		$1,815
	Average of Total Invstmnt $/Ln		$1,981
	Average of Monthly Cost1		$ 41.36
200 to 650	Sum of # Households		266,499
	Sum of # Lines		487,515
	Average of Loop Length		15,436
	Average of Loop $ per Line		$813
	Average of Total Invstmnt $/Ln		$931
	Average of Monthly Cost1		$ 20.75
650 to 850	Sum of # Households		101,986
	Sum of # Lines		181,135
	Average of Loop Length		13,082
	Average of Loop $ per Line		$814
	Average of Total Invstmnt $/Ln		$924
	Average of Monthly Cost1		$ 20.55
850 to 2550	Sum of # Households		681,340
	Sum of # Lines		1,181,569
	Average of Loop Length		11,279
	Average of Loop $ per Line		$702
	Average of Total Invstmnt $/Ln		$809
	Average of Monthly Cost1		$ 18.29
Greater 2550	Sum of # Households		397,991
	Sum of # Lines		782,457
	Average of Loop Length		7,629
	Average of Loop $ per Line		$574
	Average of Total Invstmnt $/Ln		$676
	Average of Monthly Cost1		$ 15.62

State: Washington

Date: 8/7/92
Time: 9:01:55 AM

Assumptions:
Other Allocation Ratio = 0%
(i.e. the non-plant-related expenses per line = 0)

Aggregate Support		ARMIS
At $20 =	$	148,125,581
At $30 =	$	82,805,441
At $40 =	$	52,204,653
At $50 =	$	33,959,651
At $60 =	$	23,361,352
At $70 =	$	16,270,164
At $80 =	$	11,435,944
Annual Benchmark Cost =	$	832,762,240
State Average Monthly Cost=	$	21.07

Density	Households	Lines
Less 5	19,098	26,849
5 to 200	408,594	634,397
200 to 650	266,499	487,515
650 to 850	101,986	181,135
850 to 2550	681,340	1,181,569
Greater 2550	397,991	782,457
Total	1,875,508	3,293,923

	ARMIS
Cost Category	Households
$0<=$ 5	2,451
$5<=$10	105,334
$10<=$15	389,735
$15<=$20	451,802
$20<=$25	431,136
$25<=$30	171,568
$30<=$35	70,643
$35<=$40	51,278
$40<=$45	48,863
$45<=$50	44,929
$50<=$55	19,924
$55<=$60	19,187
$60<=$65	10,148
$65<=$70	8,131
$70<=$75	10,734
$75<=$100	24,569
$100<=$150	11,024
$150<=$200	3,056
$200<=$250	973
$250<=$300	-
$300<=$500	23
$500<=$1000	-
$1000+	-
Total Households	1,875,508

Loop Category	Households
0 <= 5Kft	194,576
5Kft <= 10Kft	473,673
10Kft <= 15Kft	432,323
15Kft <= 20Kft	283,523
20Kft <= 25Kft	171,102
25Kft <= 30Kft	106,537
30Kft <= 40Kft	102,024
40Kft <= 50Kft	51,096
50Kft <= 60Kft	21,986
60Kft <=70Kft	14,541
70Kft <= 80Kft	10,481
80Kft <= 90Kft	7,398
90Kft <= 100Kft	3,685
100Kft <=150Kft	2,511
150Kft <= 200Kft	52
200Ktf+	-

Loop Information	Length
Minimum Loop Length	756
Maximum Loop Length	165,901
Average Loop Length	15,199

Maximum Monthly Cost	$	405.94
Average Monthly Cost	$	21.07
Lines Above $10K Loop Inv		1,307

State: Washington

Density	Summary Results		Weighted
Less 5	Sum of # Households		19,098
	Sum of # Lines		26,849
	Average of Loop Length		70,190
	Average of Loop $ per Line		$4,771
	Average of Total Invstmnt $/Ln		$5,196
	Average of Monthly Cost1		$ 102.46
5 to 200	Sum of # Households		408,594
	Sum of # Lines		634,397
	Average of Loop Length		29,933
	Average of Loop $ per Line		$1,815
	Average of Total Invstmnt $/Ln		$1,981
	Average of Monthly Cost1		$ 39.14
200 to 650	Sum of # Households		266,499
	Sum of # Lines		487,515
	Average of Loop Length		15,436
	Average of Loop $ per Line		$813
	Average of Total Invstmnt $/Ln		$931
	Average of Monthly Cost1		$ 18.53
650 to 850	Sum of # Households		101,986
	Sum of # Lines		181,135
	Average of Loop Length		13,082
	Average of Loop $ per Line		$814
	Average of Total Invstmnt $/Ln		$924
	Average of Monthly Cost1		$ 18.33
850 to 2550	Sum of # Households		681,340
	Sum of # Lines		1,181,569
	Average of Loop Length		11,279
	Average of Loop $ per Line		$702
	Average of Total Invstmnt $/Ln		$809
	Average of Monthly Cost1		$ 16.07
Greater 2550	Sum of # Households		397,991
	Sum of # Lines		782,457
	Average of Loop Length		7,629
	Average of Loop $ per Line		$574
	Average of Total Invstmnt $/Ln		$676
	Average of Monthly Cost1		$ 13.39

4 | ASSESSMENT OF THE BCM2's REVISED SWITCHING COST MODULE

4.1 What the Original BCM did

Our earlier review of the original BCM demonstrated that the model's developers had overestimated switching-related costs for universal service in at least several important respects. First, the BCM used outdated, unrealistically high switching cost estimates, which (among other things) did not reflect the significant discounts off list price that LECs routinely negotiate with switch vendors;[70] second, the BCM assumed deployment of Nortel DMS100 switches in all circumstances, including small rural exchanges where it would be far more economic to deploy remote serving units (RSUs);[71] third, the BCM applied an over-simplified and inflated annual expense factor to develop recurring costs for switching.[72] In order to correct these deficiencies, we recommended that the following changes be made to the BCM:

- Use of a lower, more realistic estimate for switch-related investment. We developed an alternative estimate of $134 for the incremental switch-related investment assignable to the residential access line, and reran the BCM using this assumption and a conservative (i.e., erring on the side of overstating costs) assumption of $167 for per-line switching investment.[73] Making this correction alone reduced the average monthly costs for universal service for Washington state (our benchmark) by $2.30.[74]

70. ETI April Report at 81-86.

71. *Id.* at 86-87.

72. *Id.* at 66.

73. *Id.* at 84-85.

74. *Id.* at 85, Table 5.1.

- Modelling of RSUs where they would be appropriate, i.e., technically feasible and economically least-cost to deploy.[75]

- Application of a more reasonable, forward-looking annual expense factor for switching.

4.2 What the BCM2 does

The BCM developers appear to have responded to these concerns to some degree.[76] As explained below, the BCM2 incorporates a number of changes in how switching costs are calculated, including use of substantially lower cost switching investment values, plus the recognition of RSU deployment. As observed in Chapter 3 of this report, BCM2 still does not apply an appropriate forward-looking annual expense factor, and instead applies a switching-specific factor that is actually larger than the optional "forward-looking factor" available in the original BCM. The specific changes that have been made are detailed below, roughly in descending order of importance:

- The estimate of variable per-line switching investment was reduced from $239 to $100. The BCM2 documentation gives no explanation for this reduction. This is a major change in the model, with the most significant impact of all the changes that were made on overall switching investment costs.

- The BCM had assumed the same level of fixed costs ($647,000) for all switch sizes. The BCM2 separates switches into four size classes, with breakpoints at 10,000 lines, 60,000 lines, and 100,000 lines (see Table 4.1).[77] Increasing fixed costs are assumed for each size class, ranging from $400,000 to $1.5-million for switches over 100,000 lines.[78] While this additional refinement produces a somewhat smoother switching investment curve, the reduction in the initial fixed cost estimate (i.e., from $647,000 to $400,000) has the greatest impact, since it reduces the per-line costs attributed to the many smaller switches found in rural areas.

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75. *Id.* at 86-87.

76. Some of the changes detailed below were initiated by the BCM developers before issuance of ETI's April Report. *Ex parte* submission in CC Docket No. 80-286 by Glenn Brown, Executive Director—Public Policy, US West ("*Ex parte* submission"), January 26, 1996. *Ex parte* submission, February 21, 1996.

77. BCM2 Methodology at 23 (CO Switch Size table).

78. BCM2 Methodology at 23 (CO Switch Cost table).

Table 4.1

Comparison of Switching Cost Assumptions

Original BCM		**BCM2**		
Switching Costs		Switching Costs by Size/Type		
Fixed	Per Line	Switch	Fixed	Per Line
$647,526	$238.87	Remote	$250,000	$100
		<10,000 Lines	400,000	100
		<60,000 Lines	600,000	100
		<100,000 Lines	900,000	100
		<500,000 Lines	1,500,000	100

Source: BCM2 Methodology at 23 (CO Switch Cost table).

- The BCM2 includes a factor to reflect vendor discounts on switching equipment. This factor (with a default value of 20%) is applied to the total switching investment developed on a per-line basis. Obviously, using a higher discount factor (Hatfield Associates reports that discounts can approach 50%[79]) would further reduce the level of estimated switching investments. Appendix 4A provides results of a sensitivity run of the BCM2 on the Washington state dataset with the switching discount factor increased to 50%. The resulting Washington average monthly per-line cost of $28.43 is nearly $1.00 less than the default level of $29.41.

- The BCM did not explicitly recognize the possibility of host/remote switching architectures. BCM2 does this to a limited extent, applying a switch type parameter (H,S,R for host, stand-alone, vs. RSUs), and costing RSUs with a (lower) fixed cost of $250,000. BCM2 does not appear to attempt any forward-looking analysis to classify offices as remotes, instead using classifications based upon existing switch types. The BCM2's recognition of the option of RSU

79. AT&T Communications of California, Inc., MCI Telecommunications Corporation, and Hatfield Associates, Inc., *A Discussion of Input Assumptions Used in the Hatfield Proxy Model*, Response to Pacific Bell's Second Set of Data Request in California PUC Universal Service Fund Proceeding, March 11, 1996 ("California PUC, Universal Service Proceeding, *A Discussion of Input Assumptions Used in the Hatfield Proxy Model*"), at 2.

deployment is a significant improvement, but still falls short of the type of forward-looking analysis of switching investment that should be undertaken in a cost proxy model. The deployment of RSUs on a routine basis is a relatively recent phenomenon, and there is a fairly large installed base of standalone switches in the U.S. for which replacement by an RSU would be technically feasible and economically justified from a "scorched node," forward-looking perspective. Consequently, the accuracy of the BCM2's switching investments could be further improved by applying an appropriate RSU placement rule, e.g. identifying as RSUs for modeling purposes all end offices under a threshold switch size that are within a reasonable distance from a suitable host office. In the absence of such a modification, the BCM2's switching investment estimates should be considered to overstate those costs for universal service purposes.

- The BCM applied a single, average annual expense factor to all categories of investments, including switching. This factor (approximately 31.7%) was based upon Tier 1 LEC embedded expense levels as reported in 1994 ARMIS Form 43-01 reports, without any adjustments. BCM2 applies expense factors that are disaggregated into three basic categories of facilities (cable and wire, circuit equipment, and switching equipment). Consequently, in BCM2, the switching expense factor has declined from 31.7% (the embedded factor formerly applied) to 25.7%.[80] However, the new value continues to be based upon *embedded* data (national 1995 ARMIS data), without any forward-looking adjustments. We continue to recommend the use of forward-looking expense factors, which was an option under the BCM that has not been carried into BCM2.

- The BCM assigned 30% of the end office switch's traffic sensitive (TS) investments to local, apparently assuming that 30% of traffic is local. The BCM2 assumes that some 74% of traffic is local, and therefore significantly increases the TS investments assigned to local. This correction is warranted, since the 74% value is more consistent with local/non-local ratios reported for other companies.[81]

- The BCM did not explicitly recognize the additional costs to engineer, furnish, and install (EFI) end office switches. BCM2 includes a Switch Engineering factor (1.07) to reflect EFI costs. While the level of this EFI factor is reasonable, it is not clear whether an explicit factor is actually required, since switching equipment

80. Although the cost factor has seemingly declined, indeed, as is discussed in more detail in Chapter 3, above, the original BCM did not include a disaggregated component for non-plant-related expenses. When the non-plant-related expenses are taken into account, the overall cost factor is 33.1966%.

81. HM Documentation, Version 2.2, Release 1 (May 16, 1996) at 36, footnote 28.

quotations from vendors customarily include EFI costs. Before accepting this adjustment, regulators should verify that inclusion of this factor does not amount to a double-counting of EFI costs.

- The BCM did not explicitly recognize the costs of interoffice facilities used for local switching, including interoffice trunks and tandem switch facilities. BCM2 includes an Interoffice Switching ratio (1.03) for this purpose.

The impact of these changes to the switching module are illustrated in Figure 4.1. Figure 4.1 compares the per-line switching investment curves generated using the algorithms of the BCM, BCM2, and the HM (Version 2.2, Release 1).[82] In addition, BCM2's per-line investment for RSUs is presented separately.

As shown in the Figure 4.1 graphs, the revised BCM2 switching algorithms produce per-line switching investment levels that decline from $431 for a 1,000 line switch, to $105 for a 40,000 line switch, and remain in the same range thereafter.[83] These values are approximately *one-half* those claimed in the original BCM. The BCM2 values for Remote Switching Unit (RSU) investment are lower still, particularly for smaller switch sizes (which occur most frequently for RSUs), declining from $304 for a 1,000 line unit, to $97 for a 40,000 line unit. The BCM2's per-line investments for stand-alone switches are much closer to our prior estimate of an average switching investment cost of $134 per line[84] than they are to the BCM's earlier estimates. In fact, they also appear in line with the estimate of $110 per line that we had derived from Pacific Bell's description of its 1993 digital switch deployment program.[85]

While LECs have criticized the HM for ostensibly underestimating network investments, the HM's estimates of per-line switching investments are in the same general range as those now estimated by BCM2. Figure 4.1 shows the basic switching investment curve utilized in the HM, version 2.2, release 1.[86] The per-line values indicated therein for the HM are slightly lower than, but generally consistent with, the BCM2 estimates, which are clearly more in line with the HM values than those formerly assumed by the BCM.

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82. Appendix 4B provides the underlying data for the graphs shown in Figure 4.1.

83. These values are for stand-alone switches only, excluding RSUs.

84. *The Cost of Universal Service* at 84.

85. *Id.* at 85, footnote 123.

86. The HM values shown are for the basic investment curve only, and do not include additional costs associated with EFI loadings and interoffice investments, which would move the curve slightly upward.

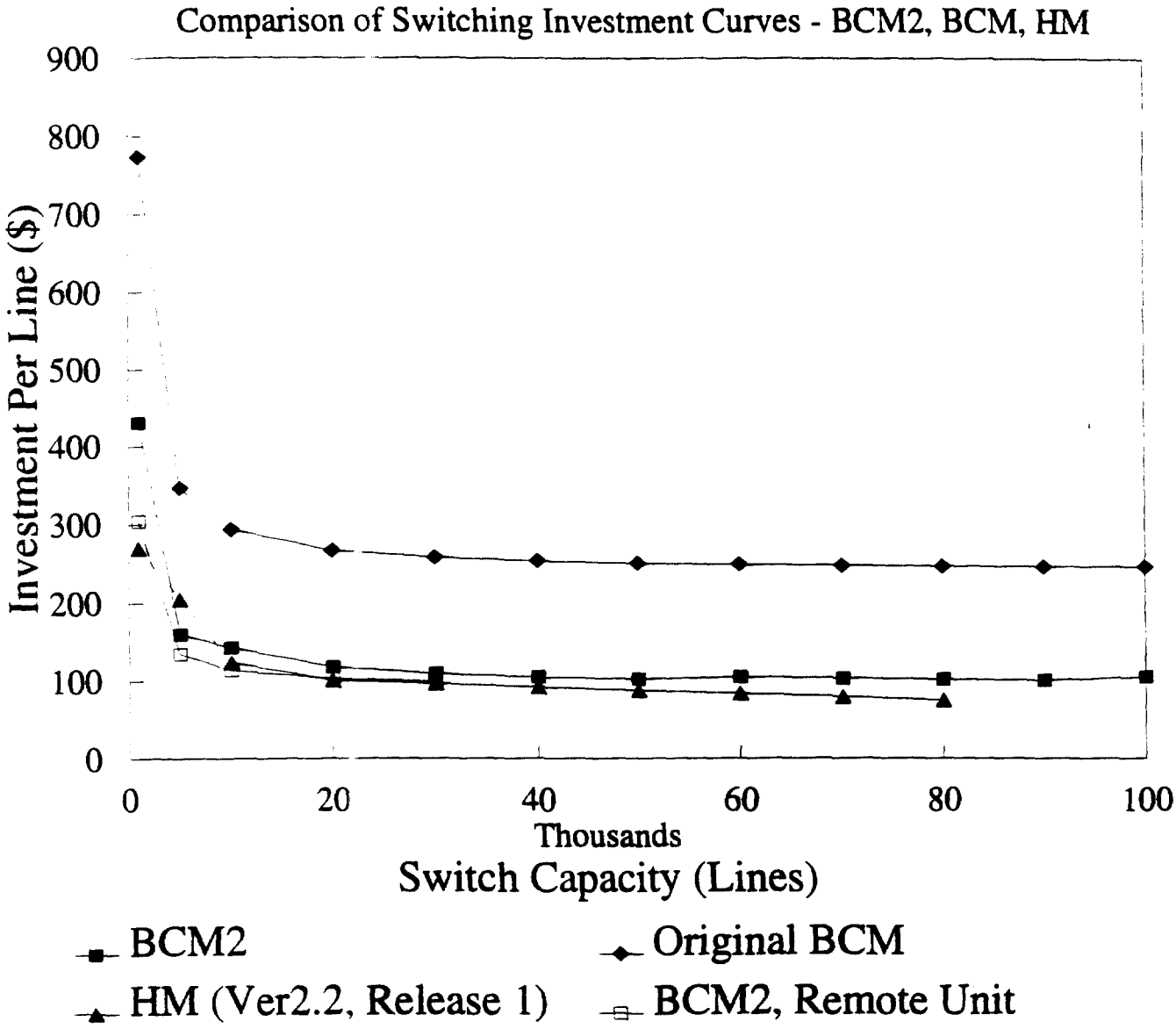
These values also appear much more realistic than those used in Pacific's CPM. We did not find publicly-available CPM data that would permit development of a comparable per-line switching investment curve.[87] However, Pacific has filed nonproprietary estimates of switching investment costs on a statewide basis for California that it calculated using the CPM. According to this submission, total switching costs are $239 per access line.[88] When compared to the curves shown in Figure 4.1, this estimate appears to have been grossly inflated. Pacific's strategy of modelling the characteristics of its existing network may have produced overstated investment estimates for switching, in the same way that it did for loop plant.[89]

87. In fact, the Executive Overview and the Detailed Description of Proxy Cost Modeling that Pacific submitted to the FCC on May 22, 1996 contain no details concerning how the CPM models switching costs. See attachments to the May 22, 1996 *Ex parte* letters from Gina Harrison, Pacific Telesis, to William Caton, Acting Secretary, FCC.

88. Pacific's statewide estimate includes $113 of line termination costs, $118 of usage costs, and $8 of shared costs. CPM: California Universal Service Subsidy, Preliminary Output-Statewide Average Results, contained in May 21, 1996 *Ex parte* filing, letters of Gina Harrison of Pacific Telesis to William F. Canton, Acting Secretary, FCC.

89. The ALJ in the California PUC's USF proceeding has concluded that the CPM overstates loop costs by, among other things, assuming a 9,000 foot crossover point for fiber vs. copper feeder plant. CPUC R.95-01-020/I.95-01-021, *Proposed Decision of ALJ Wong*, August 5, 1996, at 122.

Figure 4.1


Comparison of Switching Investment Curves - BCM2, BCM, HM
Investment Per Line ($)
900
800
700
600
500
400
300
200
100
0
0
20
40
60
80
100
Thousands
Switch Capacity (Lines)
BCM2
Original BCM
HM (Ver2.2, Release 1)
BCM2, Remote Unit

Appendix 4A

RUN OF ADJUSTED DIGITAL SWITCHING DISCOUNTS

State: Washington

Date: 8/7/92
Time: 4:01:35 PM

Assumptions:
Digital Switching Discount = 50%

Aggregate Support		ARMIS
At $20 =	$	259,094,065
At $30 =	$	120,362,695
At $40 =	$	70,880,222
At $50 =	$	44,258,634
At $60 =	$	29,113,761
At $70 =	$	20,069,454
At $80 =	$	13,870,598
Annual Benchmark Cost =	$	1,123,788,879
State Average Monthly Cost=	$	28.43

Density	Households	Lines
Less 5	19,098	26,849
5 to 200	408,594	634,397
200 to 650	266,499	487,515
650 to 850	101,986	181,135
850 to 2550	681,340	1,181,569
Greater 2550	397,991	782,457
Total	1,875,508	3,293,923

	ARMIS
Cost Category	Households
$0<=$ 5	-
$5<=$10	-
$10<=$15	28,239
$15<=$20	232,075
$20<=$25	452,138
$25<=$30	486,523
$30<=$35	299,361
$35<=$40	96,657
$40<=$45	59,060
$45<=$50	48,669
$50<=$55	51,176
$55<=$60	29,259
$60<=$65	16,191
$65<=$70	15,299
$70<=$75	8,459
$75<=$100	34,608
$100<=$150	13,116
$150<=$200	3,434
$200<=$250	1,221
$250<=$300	-
$300<=$500	23
$500<=$1000	-
$1000+	-
Total Households	1,875,508

Loop Category	Households
0 <= 5Kft	194,576
5Kft <= 10Kft	473,673
10Kft <= 15Kft	432,323
15Kft <= 20Kft	283,523
20Kft <= 25Kft	171,102
25Kft <= 30Kft	106,537
30Kft <= 40Kft	102,024
40Kft <= 50Kft	51,096
50Kft <= 60Kft	21,986
60Kft <=70Kft	14,541
70Kft <= 80Kft	10,481
80Kft <= 90Kft	7,398
90Kft <= 100Kft	3,685
100Kft <=150Kft	2,511
150Kft <= 200Kft	52
200Ktf+	-

Loop Information	Length
Minimum Loop Length	756
Maximum Loop Length	165,901
Average Loop Length	15,199

Maximum Monthly Cost	$	335.06
Average Monthly Cost	$	28.43
Lines Above $10K Loop Inv		1,307

State: Washington

Density	Summary Results		Weighted
Less 5	Sum of # Households		19,098
	Sum of # Lines		26,849
	Average of Loop Length		70,190
	Average of Loop $ per Line		$4,771
	Average of Total Invstmnt $/Ln		$5,037
	Average of Monthly Cost1		$ 107.38
5 to 200	Sum of # Households		408,594
	Sum of # Lines		634,397
	Average of Loop Length		29,933
	Average of Loop $ per Line		$1,815
	Average of Total Invstmnt $/Ln		$1,919
	Average of Monthly Cost1		$ 46.14
200 to 650	Sum of # Households		266,499
	Sum of # Lines		487,515
	Average of Loop Length		15,436
	Average of Loop $ per Line		$813
	Average of Total Invstmnt $/Ln		$886
	Average of Monthly Cost1		$ 25.92
650 to 850	Sum of # Households		101,986
	Sum of # Lines		181,135
	Average of Loop Length		13,082
	Average of Loop $ per Line		$814
	Average of Total Invstmnt $/Ln		$882
	Average of Monthly Cost1		$ 25.79
850 to 2550	Sum of # Households		681,340
	Sum of # Lines		1,181,569
	Average of Loop Length		11,279
	Average of Loop $ per Line		$702
	Average of Total Invstmnt $/Ln		$769
	Average of Monthly Cost1		$ 23.55
Greater 2550	Sum of # Households		397,991
	Sum of # Lines		782,457
	Average of Loop Length		7,629
	Average of Loop $ per Line		$574
	Average of Total Invstmnt $/Ln		$638
	Average of Monthly Cost1		$ 20.91

Appendix 4B | SWITCHING INVESTMENT PER LINE

Appendix 4B

Switching Investment Per Line

Switch Capacity (Lines)	BCM2, Stand-alone Switches [1]	BCM2, Remote Switches [1]	Original BCM[2]	HM[3]
1,000	$431	$304	$774	$270
5,000	$160	$134	$347	$205
10,000	$143	$113	$294	$124
20,000	$117	$103	$267	$100
30,000	$109	$99	$258	$96
40,000	$105		$254	$92
50,000	$102		$251	$88
60,000	$105		$249	$83
70,000	$103		$248	$79
80,000	$101		$247	$75
90,000	$100		$246	
100,000	$105		$246	

[1] Values were derived using BCM2 Main Logic sheet switching algorithms. Remote Switching Units are typically used for smaller exchanges, so no values are shown for switches exceeding 30,000 lines.

[2] Values were derived using BCM Main Logic sheet switching algorithms.

[3] Values based on Hatfield Model, Version 2.2, Release 1 switching curve. They do not include EFI costs or interoffice investments. Hatfield did not provide estimates for switches exceeding 80,000 line capacity.

5 THE BCM2 TREATMENT OF OUTSIDE PLANT DEPLOYMENT

5.1 The BCM2 still does not deploy outside plant in an economic manner

What the BCM did

In our April report, we identified several flaws regarding the BCM's treatment of outside plant deployment.[90] Among the major flaws we addressed were these:

- The unreasonably low fill factors that were used in configuring outside plant
- The use of the excessively granular CBGs as a basis for assessing the need for USF support.
- The failure to reflect the economies of scale and scope associated with serving other than primary residential lines.
- The hardwired, uneconomic choice between deploying copper and fiber in the outside plant.
- The undocumented assumptions as to the cost of digital loop carrier equipment.
- The assumption of uniform household density, particularly in areas with large amounts of uninhabited land.
- The absence of the service area interface (SAI).

90. See Chapters 6 and 10 of the April report.