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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W. Room 222
Washington, D.C. 20554

RE: CC Docket No. 96-45 - In the Matter of Federal-State Joint Board on Universal Service

Dear Mr. Caton,

The attached information is provided in response to the August 2, 1996, letter of Mr. John Morabito in the above referenced proceeding. The attached information is provided by Sprint Corporation and US West, Inc., as joint sponsors of the Benchmark Cost Model 2 (BCM2). The original version of the BCM was filed in September 1995 and the enhanced BCM2 was filed in the proceeding on July 3, 1996.

The fourteen questions in Mr. Morabito's August 2 letter are restated on the attached pages with the associated responses. Please be advised that the response to question 14 is still under development and will be provided as soon as possible.

The joint sponsors request that this information be made a part of the record in this matter. Two copies of this letter, in accordance with Section 1.1206(a)(1), is provided for this purpose. If you have any questions, please feel free to call.

Respectfully submitted,

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Attachments

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List ABCDE

CERTIFICATE OF SERVICE

I, Melinda L. Mills, hereby certify that I have on this 22nd day of August, 1996, sent via U.S. First Class Mail, postage prepaid, or Hand Delivery, a copy of the foregoing Ex Parte in the Matter of Federal-State Joint Board on Universal Service, CC Docket No. 96-45, filed this date with the Acting Secretary, Federal Communications Commission, to the persons on the attached service list.

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Melinda L. Mills

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BCM2 Specific Joint Board Data Request
August 2, 1996

1) Question:

How do the actual reported loop costs (as computed by NECA) of incumbent local exchange carriers compare with the calculated proxy loop costs of the BCM2 on a study area by study area basis and on a state by state basis? Show results both on a total study area loop cost basis; total state loop cost basis; study area cost per loop basis; and state cost per loop basis. Show the actual annual USF dollars currently received (as reported by NECA) and the amount of support that would be received under the BCM2 at the benchmark levels of $20, $30 and $40. Identify each study area by NECA study area code and identify the state of operation. Data provided should be submitted on computer diskettes in a Excel format (version 4 or less) as well as on paper.

Answer:

NECA has provided an analysis of study area by study area comparisons for the BCM2 data, CPM data, and USF. This data is displayed in Attachment 1.

2) Question:

What are the advantages and disadvantages of using a wire center instead of a Census Block Group (CBG) as the appropriate geographic area to project costs.

Answer:

Proponents of using the wire center as the appropriate geographic area to project costs have identified two main advantages for developing costs at this level: 1) It is easier to administer, from a regulatory stand point, and 2) the over-all size of a Universal Service Fund might be somewhat smaller than a fund developed using smaller areas like Census Block Groups.

The major disadvantages of using the wire center as the area to project costs are:

1) Costs are not directed to customers who live in high costs areas. Even in very small towns there are areas close to the central office where the costs to serve are comparable to costs in urban areas. Customers who live in these relatively low cost areas should not receive subsidies.

2) Wire centers cover large areas and the terrain can vary greatly. Census Block Groups cover relatively small geographic areas which allows for more accurate cost development based on terrain differences.

3) Projecting costs at the wire center level is at odds with the efficient evolution of bona fide competition. Carriers should receive high-cost funding when they serve customers who are high-cost to serve. They should not receive funding when they are, in fact, serving customers who are low-cost to serve.

4) Using wire centers level cost development continues the practice of implicit subsidies. Service providers are forced to charge higher than economic cost based prices for low-cost areas in order to offset the price charged for high-cost areas. This is the reason that a universal service fund developed using wire center level cost development may be less than one based on Census Block Groups.

Attached hereto as Attachment 2 are three wire center maps (Porterville, California; Brenham Texas; and Magnolia, Arkansas) that show BCM2 calculated monthly cost of basic residential service broken down for each CBG within the wire center. As can be seen from these maps, the cost in the Porterville, California wire center ranges from a low of $21.78 to a high of $148.52; in the Brenham, Texas wire center range from a low of $16.74 to a high of $72.41; and in Magnolia, Arkansas wire center range from a low of $21.42 to a high of $93.84. Such great variances demonstrate the disadvantages, including implicit subsidies that would be created, of using a wire center as opposed to the smaller CBG.

3) Question:

The Maine PUC and several other State commissions proposed inclusion in the BCM1 of the costs of connecting exchanges to the public switched network through the use of microwave, trunk, or satellite technologies. Those commenters also proposed the use an additional extra-high-cost variable for remote areas not accessible by road. What is the feasibility and the advisability of incorporating these changes into the BCM2?

Answer:

Connection of switches to the public switched network is an interoffice process and these costs are not included in BCM2. However, BCM2 does recognize certain interoffice costs associated with the provision of basic local service. The extraordinary interoffice costs described by the Maine Public Utilities Commission would not be captured in BCM2 because they are associated with toll service. Since interoffice facilities associated with toll service are not included in the definition of universal service, it is not appropriate to include those costs.

The addition of an extra-high-cost variable for remote areas where there is no road access is possible but, in our opinion, it is not advisable. BCM2 includes factors

for differences in terrain and density. Other factors can be added if required, but where variables are relative anomalies, the value achieved from such modifications are out weighed by the effort to identify and include all such variables.

4) Question:

The National Cable Television Association proposed a number of modifications to the BCM1 related to switching cost, fill factors, digital loop carrier subscriber equipment, penetration assumptions, deployment of fiber versus copper technology assumptions, and service area interface costs. Which, if any, of these changes would be feasible and advisable to incorporate into the BCM2?

Answer:

Several of the modifications suggested by NCTA have been included in BCM2. Most of the NCTA modifications have been incorporated as inputs to BCM2 to allow the user to set such things as fill factors and copper fiber break points to reflect economic engineering standards at a state or company level. In addition, the switching section of BCM2 now uses multiple switch sizes and a more accurate modeling of the structure and costs of the local telephone network.

5) Question:

The BCM2 appears to compare unseparated costs, calculated using a proxy methodology, with a nationwide benchmark. Does use of the BCM2 suggest that the costs calculated by the model would be recovered only from basic local service rates and universal service fund payments? Is the model designed to change as those rules are changed? Does the comparison of model costs with a local rate affordability benchmark create an opportunity for over-recovery from universal service support mechanisms?

Answer:

BCM2 does calculate unseparated costs and, as an aid in understanding how the costs developed by BCM2 could work in determining support, several benchmarks were supplied.

As a costing model, BCM2 does not provide any input to how fund support should be determined. However, the costs from the model can be supported through a surcharge on end user bills for all telecommunications services - interstate and intrastate - that an end user takes from any service provider.

BCM2, in and of itself, does not create an opportunity for over-recovery from support mechanisms. It is suggested that a way to guard against any over-

recovery is to make a reduction in existing support systems, both implicit and explicit, of an amount equal to the support provided through the use of BCM2.

6) Question:

Is it feasible and/or advisable to integrate the grid cell structure used in the Cost Proxy Model proposed by Pacific Telesis into the BCM2 for identifying terrain and population in areas where population density is low?

Answer:

The BCM2 has the capability to allow the use of any small geographic area as an input. A balance needs to be struck between the cost, complexity, and accuracy of small area data. In changing geographic data areas, it is also important to pay attention to the availability of census block data and CBG data, as well as grid data to determine which provides the greatest cost/benefit ratio and the appropriate level of granularity in identifying areas where basic local service costs exceed the affordability benchmark. The sponsors of both the CPM and BCM2 are, along with representatives from several other companies, looking into the possibility of merging the two models by using the strongest parts of each. It appears that a combination of CBG and grid cell structure will provide the most accurate method of geographic population identification.

7) Question:

Provide the BCM2 and BCM1 study area results for Pacific Bell (PTCA), GTE SW - Arkansas (GTAR) and Southwestern Bell - Texas (SWTX). For each study area please provide:

7) a. Summary statistics: total investment; investment per line; loop investment per line; end office switching investment per line; monthly cost per line; monthly transport cost per line; total households; total residential lines; total business lines; total switched lines; the number of residential lines per density zone, and monthly cost per line per density zone.

Answer:

Attachment 3 through Attachment 11 provide the study area comparison of BCM2 and BCM1 summary statistics. Additionally, comparable CBG by CBG data comparisons are provided for the GTAR study area. This supplemental information demonstrates the detail provided in the BCM2 model and provides the BCM2 and BCM1 sourcing for the summary statistics.

7)b. Question:

Model results reported on an ARMIS basis: all expenses and plant in service rows that are contained in ARMIS report 43-03. If any of these rows can not be shown separately, provide a list of rows that have been combined and the algorithm used to combine the rows.

Answer:

Neither BCM1 nor BCM2 were developed based upon detailed account data. BCM2 can be broken down into some major plant categories. However, comparable information is not available for BCM1. A mapping of BCM2 ARMIS 43-03 to ARMIS 43-01 Accounts is included in Attachment 12. Following are BCM2 account detail for PTCA, SWTX, and GTAR.

California- Pac Tel BCM2 Results		Total Reg Amount Basic Local Service	% of TPIS
1690 Total Plant		$12,202,665,276	100.00%
Acct 2410	Cable & Wire Facilities	$10,569,973,221	
Acct 2212	Digital Electronic Switching	$1,528,455,323	
Acct 2232	Circuit Equipment	$104,236,732	
1910 Average Net Investment		$5,419,184,092	44.41%
Return @ 11.25%	(1910*.1125)	$609,658,210	5.00%

FIT Base	(Return-1510+1520-1540)	$411,998,667	7.60%
FIT @ 35%		$209,675,730	1.72%

State & Lcl Tax	(1410/1590*FIT above)	$32,551,136	0.27%
1420 Other State & Local Taxes		$198,245,927	1.62%

1120 Plant Specific	$748,548,637	6.13%
1130 Plant Non-Specific	$291,816,683	2.39%
1140 Customer Op-Marketing	$155,657,728	1.28%
1150 Customer Op-Services	$393,004,473	3.22%
1160 Corporate Operations	$477,519,303	3.91%
1170 Access	$57,445,488	0.47%
1180 Depreciation/Amortization	$860,656,145	7.05%
1190 Total Expenses	$2,984,648,457	24.46%
1290 Other Operating Inc/Loss	($5,138,409)	-0.04%
1390 Non-Operating Inc/Loss	($127,345,918)	-1.04%

Revenue Requirement (Return+FIT+ST&Lcl Tax+Tot Exp+Oth Oper+NonOP)	$3,902,295,133	
Carrying Charges on TPIS (Rev Req/1690)		32.01%

Texas - Southwestern Bell BCM2 Results		Total Reg Amount Basic Local Service	% of TPIS
1690 Total Plant		$7,883,454,614	100.00%
Acct 2410	Cable & Wire Facilities	$6,984,998,803	
Acct 2212	Digital Electronic Switching	$862,819,927	
Acct 2232	Circuit Equipment	$35,635,884	
1910 Average Net Investment		$3,501,029,559	44.41%
Return @ 11.25%	(1910*.1125)	$393,865,825	5.00%
FIT Base	(Return-1510+1520-1540)	$266,169,130	7.60%
FIT @ 35%		$135,459,677	1.72%
State & Lcl Tax	(1410/1590*FIT above)	$21,029,455	0.27%
1420 Other State & Local Taxes		$128,075,525	1.62%
1120 Plant Specific		$483,595,106	6.13%
1130 Plant Non-Specific		$188,526,320	2.39%
1140 Customer Op-Marketing		$100,561,689	1.28%
1150 Customer Op-Services		$253,898,051	3.22%
1160 Corporate Operations		$308,498,321	3.91%
1170 Access		$37,112,293	0.47%
1180 Depreciation/Amortization		$556,021,451	7.05%
1190 Total Expenses		$1,928,213,232	24.46%
1290 Other Operating Inc/Loss		($3,319,637)	-0.04%
1390 Non-Operating Inc/Loss		($82,271,023)	-1.04%
Revenue Requirement		$2,521,053,055	
(Return+FIT+ST&Lcl Tax+Tot Exp+Oth Oper+NonOP)			32.01%

Carrying Charges on TPIS
(Rev Req/1690)

Arkansas - GTE BCM2 Results		Total Reg Amount Basic Local Service	% of TPIS
1690 Total Plant		$217,851,248	100.00%
Acct 2410	Cable & Wire Facilities	$198,873,672	
Acct 2212	Digital Electronic Switching	$18,658,657	
Acct 2232	Circuit Equipment	$318,919	
1910 Average Net Investment		$96,747,390	44.41%
Return @ 11.25%	(1910*.1125)	$10,884,081	5.00%
FIT Base	(Return-1510+1520-1540)	$7,355,313	7.60%
FIT @ 35%		$3,743,290	1.72%

State & Lcl Tax (1410/1590*FIT above)	$581,128	0.27%
1420 Other State & Local Taxes	$3,539,237	1.62%

1120 Plant Specific	$13,363,659	6.13%
1130 Plant Non-Specific	$5,209,733	2.39%
1140 Customer Op-Marketing	$2,778,920	1.28%
1150 Customer Op-Services	$7,016,214	3.22%
1160 Corporate Operations	$8,525,037	3.91%
1170 Access	$1,025,560	0.47%
1180 Depreciation/Amortization	$15,365,087	7.05%
1190 Total Expenses	$53,284,211	24.46%
1290 Other Operating Inc/Loss	($91,735)	-0.04%
1390 Non-Operating Inc/Loss	($2,273,476)	-1.04%

Revenue Requirement (Return+FIT+ST&Lcl Tax+Tot Exp+Oth Oper+NonOP)	$69,666,736	32.01%

Carrying Charges on TPIS
(Rev Req/1690)

7)c. Question:

Switching: The total number of switches; the number of host; remote and stand alone switches; and the lines per each switch. Please explain how the cost of the switches was determined, provide all cost input data, and explain how the model determines whether a switch will be a host, remote or stand alone switch.

Answer:

Attachment 13 through Attachment 15 display the number of switches and the lines per switch for both BCM1 and BCM2. It also displays the host, stand alone and remote data for BCM2. This data is not available for BCM1. The BCM2 uses the Local Exchange Routing Guide (LERG) to identify switch locations and whether the switch is a host, remote, or stand alone.

Switching investment is calculated using generic digital switch investments for five sizes of switch. Due to the proprietary nature of manufacture switching prices, it was not possible to obtain or use a great amount of detail regarding switching prices. However, by averaging some of the prices used for estimating costs, we were able to develop investment numbers for five sizes of switch. Each size of switch represents multiple manufacturers and sizes within that range. Stand alone switches are split by line size grouping: up to 10,000 lines, 10,000 lines to 60,000 lines, 60,000 lines to 100,000 lines, and over 100,000 lines. The fifth size is a remote switch with umbilical costs added. The over 100,000 line category includes two switches, each with a startup cost, and the trunking and

switch investment necessary for the two switches to pass traffic between each other. Each size switch has a unique fixed or start up cost and a unique per line cost. The start up cost includes central processor frames, billing and data recording equipment and frames, miscellaneous power equipment and back-up power, the main distribution frame, frames for testing, and basic software. Per line costs consist of primarily line equipment card costs. The host, stand-alone, or remote designator as well as the switch locations are taken directly from the LERG database and are inputs to BCM2. The switch input costs for BCM1 and BCM2 are displayed below.

BCM2 Switch Cost Table		
CO Switch Cost	Fixed/Startup $	Per Line $
Remote	250,000	100
10,000	400,000	100
60,000	600,000	100
100,000	900,000	100
500,000	1,500,000	100

BCM1 Switch Cost Table		
CO Switch Cost	Fixed/Startup $	Per Line $
Remote	647,526	239

7) d. Cable and wire statistics: percent underground, buried and aerial; the length, gauge and size of copper cable used; length and size of fiber cable used; fill factors used as inputs; percent distribution fill determined by the number of lines served divided by the total number of distribution lines installed; percent of feeder fill determined by the number of lines served divided by the total number of feeder lines installed (when the feeder is fiber, explain what assumptions were used to determine the capacity and use of the fiber); the distribution of households by loop length; and any factors that alter the cost of cable or the installation of cable such as additional costs associated with placing cable in dense urban areas.

Answer:

Attachment 16 includes two examples of the calculation of specific cable and wire statistics for BCM2 and BCM. Examples are provided instead of study area summaries because of the complexity of calculating study area level statistics. BCM2 and BCM have multiple feeder and distribution segments by Census Block Group. The BCM2 designs a network based on the unique combination of CBGs for each wire center. Thus, each plant segment will have its own actual fill based on the particular segment's demand for voice circuits and the available cable or

fiber size. The attached examples use the CBGs associated with the JCVLARXA wire center. The example displays feeder segment lengths, actual fill factors, lines served, the input fill factors, the input of below ground/aerial mix, as well as any terrain factor which may impact structure cost. These data are displayed for each feeder segment (copper and fiber) and for all distribution segments serving each CBG. The BCM2 spreadsheet example is displayed in Attachment 16 on pages 1 through 5, while the equivalent BCM spreadsheet example is in the same Attachment on pages 6 though 10. The equivalent feeder and distribution segments for BCM2 and BCM appear under the same column letters so that the data can be readily compared.

The copper cable is 24 and 26 gauge. The distribution of households by loop length for each study area is included in the response to question 7) a in Attachments 4, 5, 7, 8, 10, 11. The response to question 10 addresses the factors which alter the cost of installing cable, such as additional costs associated with placing cable in urban areas.

Feeder cable (cable placed so that it can be supplemented at a later date) is deployed as analog copper plant where the total loop distance is less than the user-specified maximum copper cable length.[1] If the loop distance exceeds the maximum loop distance value, fiber feeder plant is deployed. Fiber feeder may extend into the CBG to maintain the maximum copper cable distance.

Distribution plant may contain analog copper technology when terminating signals at a voice grade level or may utilize fiber loop technology or digital carrier on copper, when terminations are made at the DS1 signal level for a percentage of business lines.

BCM2 uses two types of DLC equipment depending on the number of lines needed at each remote terminal location. For remote terminal requiring line capacities greater than 240 lines, Lucent Technologies SLC Series 2000 equipment is used. For remote terminals requiring 240 lines or less capacity, American Fiber Communications equipment is used. Both products are deployed in drop/add configurations, with SLC having a total capacity of 2,016 voice grade channels per four fibers and AFC having a total capacity of 672 voice grade channels per four fibers.

7)e. Question:

Digital Carrier: the number of lines served by carrier, the investment in carrier and investment in carrier as a percent of circuit investment.

[1] The user may specify maximum copper distances of 9,000 feet, 12,000 feet, 15,000 feet, or 18,000 feet. The default value is 12,000 feet.

Answer:

Digital carrier data can be found in Attachments 3, 6, and 9 on lines 16 and 17. Digital carrier represents 100 percent of the circuit equipment investment in the model.

7)f. Question:

Depreciation: the model depreciation rate and expected life by type of plant.

Answer:

BCM2 does not use a specific depreciation rate or expected life in the computation of costs. Instead, 1995 ARMIS data is used to derive a historical ratio of depreciation expense to the gross investment for the plant categories of: cable and wire facilities, circuit equipment, and switching equipment. These factors are then multiplied by the relative plant investments to derive depreciation costs. (See Attachment 17).

In an effort to provide some information on what the depreciation rates and expected lives would be for GSF, Operator Systems, Switching, Circuit, IOT, and C&WF, we have prepared Attachments 18 and 19. These calculations are based on data summarized from the 1995 ARMIS 43-04 filings by all study areas subject to ARMIS reporting. This data was used to desegregate the total regulated amounts from the ARMIS 43-01 report summary.

For the six telephone plant accounts listed, this data reflects the annual average gross investment, the annual average accumulated depreciation (reserve) and the annual depreciation expense adjusted for any out-of-period entries. Factors are shown for illustrative purposes only relating the depreciation reserve and expense to the gross plant.

7) g. Question:

Expenses: direct network expenses; indirect expenses; and common and overhead expenses. Please explain how the model allocates expenses among these various expense categories.

Answer:

In the allocation of expenses, the BCM2 uses both investment related expense factors and line related expense factors.

Investment related factors are developed separately for three plant categories: cable and wire facilities, switching equipment, and circuit equipment. For each of these three investment categories, 1995 ARMIS data are used to derive the historical ratio of certain investment related expenses to the gross investment for each plant category. Expense categories include:

Return on Investment at 11.25%
FIT, State, and Local Taxes
Plant Specific Expenses
Plant Non-Specific Expenses
Depreciation/Amortization

Historical booked expenses were developed using national 1995 ARMIS data. Thus, the factors reflect the historical maintenance expense to investment relationship as well as regulatory-approved lives. These factors are user adjustable. The BCM2 default values for the three plant category factors are:

Cable and Wire	.23276
Circuit Equipment	.24241
Switching Equipment	.25703

The expenses that vary based on the number of lines includes customer operations - marketing, customer operations - services, corporate operations, and other depreciation/amortization. This cost per line is also developed from 1995 ARMIS. This annual cost per line is $133.39. The BCM2 uses an allocation factor to associate non-plant related expenses to local service. Both the annual cost per line and the allocation factor are user adjustable. The BCM2 default value for the allocation factor is .75.(See Attachment 17 for expense factor calculations).

7)h. Question:

Capital Costs: return on capital; and taxes. Please explain how the percentage return on capital was calculated; and how tax gross-ups were determined.

Answer:

As explained in 7) g., above, 1995 ARMIS data is used to derive the historical ratio of investment related expenses to the gross investment for the plant categories. Return on capital and taxes are included in the derivation of these factors. (See Attachment 17)

8) Question:

Explain why there is a difference in loop length between the statistics provided in support of BCM1 and BCM2. For example, in the BCM1 filing of December 1,

1995, the results show 213,176 households for the 0 to 5Kft category in Arkansas, while the BCM2 filing of July 3, 1996 shows 45,644 households for the 0 to 5Kft category in Arkansas.

Answer:

During the calculation process for BCM1, several computers were being used to calculate results for the states that were filed on December 1, 1995. This process required the transfer of several files. During the transfer of the files for Arkansas and a few other states, several formulas were lost. When the error was discovered, the affected states were rerun but the corrected results were not refiled due to the impending filing of BCM2 results. Attachment 20 reflects the results from the original BCM1 and Attachment 21 reflects the results of the corrected BCM1, for Arkansas.

9) Question:

For the GTAR, PTCA and SWTX study areas, state the impact of changing from the BCM1 uniform population distribution to the BCM2 mapping algorithm for CBGs of less than 20 households in terms of the change in the total and average loop length and loop investment.

Answer:

There has been insufficient time to complete this analysis for August 16. This analysis will be filed at a later date.

10) For the GTAR, PTCA and SWTX study areas, provide a comparison of BCM1 and BCM2 cost of placing outside plant.

Answer:

Structure and the cost of placing plant include the costs of poles, conduit, innerduct, etc., and the capitalized costs of installing cable and wire facilities plant. The study area structure costs for GTAR, PTCA, SWTX are displayed on line 18 of Attachments 3, 6 and 9. The BCM2 uses a cost per foot for structure that varies by plant type, terrain, and density group. It represents the cost of structure and placing the smallest size cables. Each density group and terrain difficulty reflects a different mix of placing activities and structures.

U.S.G.S. data for four terrain characteristics that impact the structure and placing cost of telephone plant are included as inputs to BCM2 by CBG. These terrain variables include depth to water table, depth to bedrock, hardness of bedrock, and the surface soil texture. Combinations of these characteristics determine one of four placement cost levels. The normal placement cost for a density group occurs when neither the water table depth nor the depth to bedrock is within the placement

depth for the cable and the surface soil texture does not interfere with plowing activities. The next higher level of placing cost occurs when either the surface soil texture does interfere with normal plowing activities or soft bedrock is within the cable placement depth. The third level of placing difficulty occurs when hard bedrock is within the placement depth of copper cable or fiber cable. The last level of placement cost difficulty occurs when the water table is present within the placing depth of copper or fiber cable.

BCM and BCM2 calculations of structure cost both consider terrain variables to determine the difficulty of placing telephone infrastructure. However, the similarity ends there. BCM2 more accurately reflects the structure costs because it utilizes a matrix of the cost-per-foot to place minimum size cables that accounts for density and terrain situations. On the other hand, BCM calculated structure cost using a matrix of ratios that were multiplied by the cable investment. This methodology caused an overstatement of structure costs for cables above the average size and an understatement of cost for cables below the average size.

The basic structure calculations are done outside the BCM2. Following are four examples of the calculations for the installation and structure cost of below ground plant. First, the three different levels of structure and installation cost based on terrain difficulty for the 650 to 850 Households per square mile density group are displayed. Second, the calculations for the structure and installation costs for normal terrain conditions in an area with household density greater than 2550 households a square mile is displayed.

650-850 Normal			
Activity	$/Foot	% of Activity	Composite Cost
Plow	0.7		$ -
Rocky Plow	1.15		$ -
Trench & Backfill	1.95	25.00%	$ 0.49
Rocky Trench	2.23		$ -
Backhoe Trench	2.04	5.00%	$ 0.10
Hand Dig Trench	2.23	5.00%	$ 0.11
Bore Cable	12.12	20.00%	$ 2.42
Push Pipe & Pull Cable	9.8	5.00%	$ 0.49
Cut & Restore Asphalt	8.23	10.00%	$ .82
Cut & Restore Concrete	10.84	10.00%	$ 1.08
Cut & Restore Sod	2.06	20.00%	$ 0.41
		100.00%	$ 5.93
Conduit	40	0.50%	$ 0.20
Total Cost/Ft			$ 6.13

650-850 Rock Soft			
Activity	$/Foot	% of Activity	Composite Cost
Plow	0.7		$ -
Rocky Plow	1.15		$ -
Trench & Backfill	1.95		$ -
Rocky Trench	2.23	25.00%	$ 0.56
Backhoe Trench	2.04	5.00%	$ 0.10
Hand Dig Trench	2.23	5.00%	$ 0.11
Bore Cable	12.12	20.00%	$ 2.42
Push Pipe & Pull Cable	9.8	5.00%	$ 0.49
Cut & Restore Asphalt	14.23	10.00%	$ 1.42
Cut & Restore Concrete	16.84	10.00%	$ 1.68
Cut & Restore Sod	4.1	20.00%	$ 0.82
		100.00%	$ 7.61
Conduit	40	0.50%	$ 0.20
Total Cost/Ft			$ 7.81

650-850 Rock Hard			
Activity	$/Foot	% of Activity	Composite Cost
Plow	0.7		$ -
Rocky Plow	1.15		$ -
Trench & Backfill	1.95	5.00%	$ 0.10
Rocky Trench	10.23		$ -
Backhoe Trench	2.04		$ -
Hand Dig Trench	10.23	25.00%	$ 2.56
Bore Cable	12.12	10.00%	$ 1.21
Push Pipe & Pull Cable	14.8	10.00%	$ 1.48
Cut & Restore Asphalt	16.5	25.00%	$ 4.13
Cut & Restore Concrete	19.2	25.00%	$ 4.80
Cut & Restore Sod	11.15		$ -
		100.00%	$ 14.27
Conduit	40	0.60%	$ 0.24
Total Cost/Ft			$ 14.51

>2550 Normal				
Activity	$/Foot	% of Activity	Composite Cost	
Plow	1.12		$	-
Rocky Plow	1.95		$	-
Trench & Backfill	1.95	10.00%	$	0.20
Rocky Trench	2.23		$	-
Backhoe Trench	2.04	5.00%	$	0.10
Hand Dig Trench	2.23	5.00%	$	0.11
Bore Cable	12.12	25.00%	$	3.03
Push Pipe & Pull Cable	9.8	5.00%	$	0.49
Cut & Restore Asphalt	8.23	20.00%	$	1.65
Cut & Restore Concrete	10.84	20.00%	$	2.17
Cut & Restore Sod	2.06	10.00%	$	0.21
		100.00%	$	7.95
Conduit	40	15.00%	$	6.00
Total Cost/Ft			$	13.95

The tables above display the development of a weighted cost per foot for below ground structure. The first column shows the activity. The second column displays the cost per foot of the activity in that row. The cost per foot data used as the default values in the BCM2 are based on a national average of available contractor prices for that activity. The third column displays the percent of the activity in the specific density group and terrain difficulty. The final column represents the multiplication of the cost per foot and the percent occurrence of the activity. The final weighted average above is the sum of specific activity prices times the percent occurrence.

The Cost Factor Table in the BCM2 includes a weighted average structure cost per foot for below ground plant and aerial plant. This table includes separate entries for distribution plant, copper feeder plant, and fiber feeder plant by density group by terrain difficulty. Structure costs are adjusted for cable size in the structure cost calculations. As copper cable sizes increase, there are additional handling costs because each cable reel holds less cable. The BCM2 structure costs recognizes these additional handling costs separately for three copper cable size groupings: 600 - 900 pair, 1200 pair, and 1800 pair and above. Additional handling costs for fiber cables are less pronounced and only occur with fiber cables of 72 fiber strands or more. The final element of the structure and placement cost is the cost to pull the largest size cables through conduit. The structure cost calculation follows:

Structure Cost = Density Group Terrain Specific Cost Per Foot * Cable Length * Cable Size Factor + Number of Maximum Size Cables * Cost Per Foot to Pull Underground Cable Through Conduit

11) For the GRAR, PTCA an SWTX study areas, provide the cost of the pedestal, drop wire and network interface device by density zone and housing type.

The cost of the pedestal and network interface device are user adjustable input variables in BCM2. The default input prices are $48.22 for the pedestal and $30 for the network interface device. Each pedestal can serve up to four houses, while a network interface device is required for each house. The drop wire material price per foot is a user adjustable input. The default input is $0.10 per foot. The drop wire cost per foot is multiplied by the distance to the center of the lot (lot width *.5* sq. root (2)) and multiplied by the number of drops in the CBG. Drop wire lengths are capped at 500 feet. The calculation of drop wire cost also recognizes that multi-family housing units do not utilize an individual drop per household. In order to compensate for this phenomenon, the drop wire cost per foot is reduced by a factor of 10 when the distance to the center of the lot falls below 25 feet.

12) Question:

Describe the BCM2 enhanced switching module. What are the inputs and inputs sources used by the module. Provide a complete table of switch prices generated by the module.

Answer:

Please refer to the response to question 7) c. for this information.

13) Explain the primary reasons for the significant increase in costs from BCM1 results to BCM2 results. Provide mathematical examples to illustrate these increases.

Answer:

BCM2 includes many significant enhancements from BCM1. Some of these changes increased the cost calculated by the model, while other changes reduced the costs calculated by the model. These enhancements are designed to more accurately reflect actual engineering practices in the development of a local exchange network. First and foremost, BCM2 includes all costs of basic local telephone service, whereas the BCM only included the major cost drivers that differentiated high cost and low cost areas. The costs now include drop wire, pedestals, network interface devices, engineering, in-line terminals, and splicing, where BCM1 did not. The other major changes from BCM1 to BCM2 follow:

Population Distribution

The BCM2 rural CBG input data are modified by a Geographic Information System module to reduce the square mile area of the CBG to an area that reflects the clustering of households. This is done utilizing a third party road network database to identify the areas within the CBGs which have the highest probability of containing households. A 500 foot buffer is created on each side of roads in CBGs with 20 households a square mile or less. A new area is calculated by the buffer area. If road buffers overlap, the area is not double-counted. This change reduces costs.

Business Line Information

The BCM2 includes business lines, private line loops, as well as residential lines by CBG. State specific counts for reported business lines and private line loops are allocated to CBGs based on a third party data base of employees by CBG. Additional residential demand beyond a single line per household is included based on the national ratio of all residential lines reported in the end of year 1994 as a ratio of 1990 households.[2] The inclusion of these lines allows the realization of all economies of scale associated with loop plant. The inclusion of all types of loops reduces the per unit costs.

Engineering Assumptions

Additionally, there are four major areas where the engineering assumptions changed from BCM to BCM2: switching plant, distribution plant, feeder plant, the placing of a cap on wireline loop investment.

The BCM2 switching module changes includes five switch sizes to more closely reflect the switch application. The new switch module uses the Local Exchange Routing Guide information for remote switch locations to place remote switches in the locations where they are currently installed. Additionally, stand alone switch sizes of up to 10,000 lines, 10,000 to 60,000 lines, 60,000 to 100,000 lines and over 100,000 lines are used. The new switch module significantly lowers the cost of switching from BCM1 to BCM2.

The BCM2 distribution plant engineering has been altered to reflect the distribution demands of each CBG. Varying the distribution plant engineering assumptions in urban areas aligns the BCM2 engineering designs more closely with actual engineering practices in these areas. This is done by basing the

[2] BCM2 has a user variable input for the number of lines per household. The default value is 1.2.

number of distribution plant cable legs on the number of housing lots in each CBG. The original BCM utilized a simplifying assumption of a constant four distribution cables per CBG. This change significantly increases the cost from BCM1 to BCM2. Another aspect of this change is that BCM2 calculates the cost of structure on a per foot basis. Therefore, since more feet of distribution cable are placed by BCM2 than BCM1, there is also a significant increase in the cost of placing plant.

Another distribution plant enhancement is that no copper loop distances exceed those specified by the user. The user may choose between 9,000 feet, 12,000 feet (the default), 15,000 feet, or 18,000 feet for the maximum length for the copper portion of the loop. The limitation of copper technology serving distance has the effect of producing multiple distribution areas within rural CBGs, which in effect extends the feeder plant facilities into the CBG. This change also aligns the BCM2 more closely with actual engineering practices. The original BCM assumed all plant within the CBG was copper distribution plant and that there would always be four distribution cables. This change increases the cost from BCM1 to BCM2.

Two other areas of distribution plant engineering changes are driven by high concentrations of business lines in a CBG. The first change is that if a CBG line count exceeds 2,016, a variable percentage of lines will be terminated at the DS1 level to reflect costs of providing service to digital PBXs. This is a user variable input. This change reduces costs from BCM1 to BCM2. Additionally, if line demand for a single CBG exceeds the capacity of a maximum size copper cable, fiber will be deployed to the CBG regardless of the distance.

The third major area of engineering assumption change is that the costs for feeder plant digital loop carrier (DLC) systems reflect the fixed and variable nature of the costs. The last change ensures that the cost for DLC equipment properly reflects the effects of the equipment loading in each CBG. This is an important change since there can now be multiple remote terminals within a CBG for two reasons. First, the inclusion of business lines can cause the line demand to exceed that which can be provided by a single remote terminal. Second, the maximum copper distance can cause the deployment of multiple remote terminals. This change can either lower the cost per line or increase it. If the remote terminals have high utilization rates the BCM2 cost per line is significantly below BCM1. However, if the remote terminal has low utilization, the BCM2 cost per line is higher than BCM1.

The final major area of change is the assumption that an alternative wireless loop technology is utilized for loops requiring investment levels of over $10,000. This change reduces cost.

Other Enhancements

Another area of change provides separate annual cost factors that are plant related and an annual cost factor for line-related expenses. Three separate plant related factors are utilized for cable and wire facility investment, circuit equipment investment, and switch equipment investment. While this change does not in and of itself increase or decrease cost, it changes the distribution of expenses, so that CBGs that require relatively high amounts of investment for loop plant and switching plant have the same line-related expense as CBGs requiring small investment amounts. In BCM1 all expenses were allocated based upon investment.

Example

It is useful to explore the effects of some of these changes on a small rural CBG that has few engineering design changes from BCM1 to BCM2. For this example, Arkansas CBG number 050690001021 is used. This CBG is closest to GTE's COY ARXA wire center. This CBG is the only CBG on its feeder route. This CBG has 63 households in an area of 3.2 miles for a household density of 19.75 households a square mile. These quantities were basic inputs to BCM1. BCM2 used road network data to reduce the square miles of the area to 1.4 square miles, which increased the density to 45 households per square mile. The effect of the area reduction is a decrease in the average loop length in the CBG from 41,600 feet in BCM1 to 40,000 feet in BCM2.

In BCM1, the feeder technology was SLC using fiber cable, while in BCM2 the technology is AFC using fiber cable. The feeder plant distances are very similar. The distribution plant in both BCM1 and BCM2 use 4 distribution plant legs. However, BCM2 also uses a 3,100 foot fiber extension into the CBG and an additional copper leg to connect the four distribution legs to the feeder cable. Following is a comparison table of some key BCM1 and BCM2 calculations for this CBG.

AR CBG 050690001021				
	BCM1		BCM2	
Lines		63		76
Total Feeder Distance		34,494		36,084
Total Distribution Cable Length		28,292		26,559
Fiber Feeder Invest. with Structure	$	59,751	$	139,383
Electronics Investment	$	25,200	$	37,665
Distribution Cable Invst. with Structure	$	19,740	$	94,666
Switch Investment/Line	$	1,159	$	562
Monthly Cost/Line	$	74.47	$	94.23
Distribution Cable Multiplier	$0.3328 per $Material		$3.1976 per ft.	