ORIGINAL FILE COPY

HOPPING GREEN SAMS & SMITH
PROFESSIONAL ASSOCIATION
ATTORNEYS AND COUNSELORS
123 SOUTH CALHOUN STREET
POST OFFICE BOX 6526
TALLAHASSEE, FLORIDA 32314
(904) 222-7500
FAX (904) 224-8551
FAX (904) 425-3415

JAMES S. ALVES
BRIAN H. BIBEAU
KATHLEEN BLIZZARD
ELIZABETH C. BOWMAN
RICHARD S. BRIGHTMAN
PETER C. CUNNINGHAM
RALPH A. DEMEO
THOMAS M. DEROSE
WILLIAM H. GREEN
WADE L. HOPPING
FRANK E. MATTHEWS
RICHARD D. MELSON
DAVID L. POWELL
WILLIAM D. PRESTON
CAROLYN S. RAEPPLE
DOUGLAS S. ROBERTS
GARY P. SAMS
ROBERT P. SMITH
CHERYL G. STUART

JAMES C. GOODLETT
GARY K. HUNTER, JR.
JONATHAN T. JOHNSON
ROBERT A. MANNING
ANGELA R. MORRISON
GARY V. PERKO
KAREN M. PETERSON
MICHAEL P. PETROVICH
LISA K. RUSHTON
R. SCOTT RUTH
JULIE R. STEINMEYER
T. KENT WETHERELL, II

OF COUNSEL
CARLOS ALVAREZ
W. ROBERT FOKES

Writer's Direct Dial No.
(904) 425-2313

November 7, 1996

Ms. Blanca S. Bayó
Director, Records and Reporting
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399-0850

Re: MCI/Sprint Arbitration
Docket No. 961230-TP

Dear Ms. Bayó:

Enclosed for filing on behalf of MCI are the original and fifteen copies of the following:

1. Revised page 21 to the prefiled direct testimony of Mr. Wood. This page has been revised to include some cost figures which were not available at the time the testimony was originally filed.

2. Exhibits DJW-2, DJW-3 and DJW-4. These exhibits are the Hatfield Model Inputs, Hatfield Model Outputs, and Hatfield Model Documentation.

If you have any questions regarding this filing, please call. By copy of this letter, these items have been furnished to the parties on the attached service list.

Very truly yours,

Richard D. Melson

RDM/mee
Enclosures
cc: Parties of Record

ACK ✓
AFA
APP
CAF
CMU
CTR
EAG
LEG 3
LIN 5+
OPC
RCH
SEC 1
WAS
OTH

RECEIVED & FILED
FPSC-BUREAU OF RECORDS

DOCUMENT NUMBER-DATE
11907 NOV-7 96
FPSC-RECORDS/REPORTING

CERTIFICATE OF SERVICE

I HEREBY CERTIFY that a copy of the foregoing was furnished to the following parties by hand delivery or by UPS Overnight Delivery (*) this 7th day of November, 1996.

Jerry M. Johns (*)
United Telephone Co. of Fla.
Central Telephone Co. of Fla.
555 Lake Border Drive
Apopka, FL 32703

John P. Fons
J. Jeffry Wahlen
Ausley & McMullen
227 S. Calhoun Street
Tallahassee, FL 32301

Martha Carter Brown
Division of Legal Services
Florida Public Service Commission
2540 Shumard Oak Boulevard
Tallahassee, FL 32399

Attorney

82020.1
COS/960980

DOCUMENT NUMBER-DATE
11907 NOV-7 96
FPSC-RECORDS/REPORTING

ORIGINAL FILE COPY

A. The inputs used to perform the run of the model used to develop costs for use in this proceeding are attached as Exhibit DJW-2. As with all data, MCI is continuing to evaluate the accuracy and validity of these inputs in order to ensure the reliability of the cost information produced by the model.

Q. WHAT ARE THE RESULTS OF THE MODEL?

A. In Exhibit DJW-3, I have included the results of running the Hatfield Model to develop costs for use in this proceeding. In summary, the results of MCI's analysis are as follows:

Hatfield Model Unbundled Network Element Summary

	Element	Unit Definition	Unit Cost
1.	Network Interface Device	per line-per month	$ 0.52
2.	Loop Distribution	per line-per month	$ 8.50
3.	Loop Concentrator	per line-per month	$ 2.49
4.	Loop Feeder	per line-per month	$ 2.34
5.	End Office Switching Port	per line-per month	$ 1.05
	Usage	per minute	$ .0023
6.	Signaling Links	per link-per month	$ 27.57
7.	Signal Transfer Point	per message	$ .00018
8.	Signal Control Point	per message	$ .00119
9.	Common Transport	per minute	$ .00063
10.	Dedicated Transport	per DSO - per month	$ 3.76
11.	Tandem Switching	per minute	$ .0025
12.	Operator Systems		$ 2,347,959

User Inputs

	B	C	D	E	G	H	I
1	Note: Anything in italics in the two columns containing values is a calculated value.					10/28/96 11:33	
2	***Don't change any of these manually.***					Complete	
3							
4	You may change any of the input values (highlighted in blue) directly in this sheet.						
5	However, if you subsequently use one of the dialogs to set values, any values entered						
6	there will override any changes you make manually here.						
7							
8	**State**		*Florida*		Workfile		
9	Company 1		*Sprint LTD (Centel/United)*		Workfile path		
10	Company 2				ID Code	HMG0819961400	
11	Company 3						
12				Variable			
13	Input Name	Default	Inputs	Name	Module	Sheet	Cell Ref
14							
15	**Cost of Capital Factors**						
16	***Depreciation Lives***						
17	Loop Distribution	20	20	DistLife	Expense	Inputs	H37
18	Loop Feeder	20	20	FeedLife	Expense	Inputs	H38
19	Loop Concentrator	10	10	ConcLife	Expense	Inputs	H39
20	Wire Center	37	37	WireLife	Expense	Inputs	H41
21	End Office Switching	14.3	14.3	EOLife	Expense	Inputs	H40
22	Tandem Switching	14.3	14.3	TandLife	Expense	Inputs	H42
23	Transport Facilities	19	19	TransLife	Expense	Inputs	H44
24	Operator Systems	8	8	OpLife	Expense	Inputs	H43
25	STP	14	14	STPLife	Expense	Inputs	H45
26	SCP	14	14	SCPLife	Expense	Inputs	H46
27	Links	19	19	LinkLife	Expense	Inputs	H47
28	Public Telephones	9	9	PubLife	Expense	Inputs	H48
29	General Support	7	7	GenLife	Expense	Inputs	H49
30							
31	***Cost of Capital***						
32	Debt Percent	45.00%	45.00%	DebtP	Expense	Inputs	C34
33	Cost of Debt	7.70%	7.70%	DebtCost	Expense	Inputs	C35
34	Cost of Equity	11.90%	11.90%	EquityCost	Expense	Inputs	C37
35	*Equity Percent*	*55.00%*	*55.00%*				
36	*Overall Cost of Capital*	*10.01%*	*10.01%*				
37							
38							
39	**Misc Expense Factors**						
40							
41	Variable Overhead Factor	10.00%	10.00%	VarOvhd	Expense	Inputs	C42
42	Federal Income Tax Rate	40.00%	40.00%	FITRate	Expense	Inputs	H35
43	Other Taxes Factor	5.00%	5.00%	OtherTax	Expense	Inputs	C43
44	Operating State and Local Income Tax F	1.00%	1.00%	StateIT	Expense	Inputs	C44
45	Billing/Bill Inquiry per line per month	$1.22	$1.22	Billing	Expense	Inputs	C45
46	Directory Listing per line per month	$0.15	$0.15	Directory	Expense	Inputs	C46
47	Forward-Looking Network Operations Fac	70.00%	70.00%	NetOps	Expense	Inputs	C48
48	Central Office Switching Expense Factor	2.69%	2.69%	COSwitch	Expense	Inputs	C47
49	End Office Traffic-Sensitive Fraction	70.00%	70.00%	EOTraffic	Expense	Inputs	C51
50	per-line Monthly LNP Cost	$0.25	$0.25	LNP	Expense	Inputs	C52
51	alternative CO switching factor	0.0269	0.0269	ACOSF	Expense	Inputs	C49
52	alternative circuit equipment factor	0.0153	0.0153	ACEF	Expense	Inputs	C50
53	Carrier-carrier customer service per line p	$1.56	$1.56	CarCar	Expense	Inputs	C58
54	NID expense per line per year	$3.00	$3.00	NIDExp	Expense	Inputs	C59
55	Swithc line circuit offset per DLC line	$35.00	$35.00	CircOffs	Expense	Inputs	C62
56							
57	**Fill Factors**						
58	Cable						
59	***Feeder***						
60	0-5	0.65	0.65	Feeder0	Loopmaster	Input	S18
61	5-200	0.75	0.75	Feeder5	Loopmaster	Input	S19
62	200-650	0.80	0.80	Feeder200	Loopmaster	Input	S20
63	650-850	0.80	0.80	Feeder650	Loopmaster	Input	S21
64	850-2550	0.80	0.80	Feeder850	Loopmaster	Input	S22
65	2550+	0.80	0.80	Feeder2550	Loopmaster	Input	S23
66							
67	*Distribution*						

User Inputs

	B	C	D	E	G	H	I
68	0-5	0.50	0.50	Dist0	Loopmaster	Input	T18
69	5-200	0.55	0.55	Dist5	Loopmaster	Input	T19
70	200-650	0.60	0.60	Dist200	Loopmaster	Input	T20
71	650-850	0.65	0.65	Dist650	Loopmaster	Input	T21
72	850-2550	0.70	0.70	Dist850	Loopmaster	Input	T22
73	2550+	0.75	0.75	Dist2550	Loopmaster	Input	T23
74							
75	**EO Switching Parameters**						
76							
77	Busy hour call attempts, residential	1.3	1.3	BHCAR	WireCenter	traffic and cost inputs	F28
78	Busy hour call attempts, business	3.5	3.5	BHCAB	WireCenter	traffic and cost inputs	F29
79	Switch Maximum Line Size	100,000	100,000	MaxLines	WireCenter	traffic and cost inputs	C27
80	Switch Maximum Line Fill	0.8	0.8	MaxLineFill	WireCenter	traffic and cost inputs	C29
81	Switch Maximum Processor Occupancy	0.9	0.9	MaxProc	WireCenter	traffic and cost inputs	C30
82	Processor Feature Loading Multiplier	1	1	FeatureMult	WireCenter	traffic and cost inputs	C31
83	Switch Installation Multiplier	1.1	1.1	InstallMult	WireCenter	traffic and cost inputs	C33
84							
85	*Switch Parameters*						
86	Switch real-time limit, BHCA						
87	1 - 1,000	10,000	10,000	BHCA1	WireCenter	traffic and cost inputs	C16
88	1,000 - 10,000	50,000	50,000	BHCA2	WireCenter	traffic and cost inputs	C17
89	10,000 - 40,000	200,000	200,000	BHCA3	WireCenter	traffic and cost inputs	C18
90	40,000+	600,000	600,000	BHCA4	WireCenter	traffic and cost inputs	C19
91							
92	Switch traffic limit, BHCCS						
93	1 - 1,000	10,000	10,000	BHCCS1	WireCenter	traffic and cost inputs	C23
94	1,000 - 10,000	50,000	50,000	BHCCS2	WireCenter	traffic and cost inputs	C24
95	10,000 - 40,000	500,000	500,000	BHCCS3	WireCenter	traffic and cost inputs	C25
96	40,000+	1,000,000	1,000,000	BHCCS4	WireCenter	traffic and cost inputs	C26
97							
98	*Switch cost points*	lines					
99	Low line size	2,782	2,782	LowSize	WireCenter	traffic and cost inputs	F6
100	Mid line size	11,200	11,200	MidSize	WireCenter	traffic and cost inputs	G6
101	High line size	80,000	80,000	HighSize	WireCenter	traffic and cost inputs	H6
102		cost/line					
103	Low line size	$220.00	$220.00	LowCost	WireCenter	traffic and cost inputs	F5
104	Mid line size	$86.00	$86.00	MidCost	WireCenter	traffic and cost inputs	G5
105	High line size	$59.00	$59.00	HighCost	WireCenter	traffic and cost inputs	H5
106							
107	Residential Holding Time Multiplier	1.00	1.00	resHT	WireCenter	traffic and cost inputs	F19
108	Business Holding Time Multiplier	1.00	1.00	busHT	WireCenter	traffic and cost inputs	F20
109	Busy Hour fraction of daily usage	0.10	0.10	BHF	WireCenter	traffic and cost inputs	F16
110	Annual to daily usage reduction factor	270.00	270.00	UsRed	WireCenter	traffic and cost inputs	F17
111							
112	**Interoffice and Tandem Parameters**						
113							
114	Operator Traffic Fraction	0.02	0.02	OpFrac	WireCenter	traffic and cost inputs	C39
115	Total Interoffice Traffic Fraction	0.65	0.65	InterFrac	WireCenter	traffic and cost inputs	C40
116	Direct-Routed Fraction of Local Interoffice	0.98	0.98	DirectFrac	WireCenter	traffic and cost inputs	C43
117	Maximum Trunk Occupancy, CCS	27.5	27.5	TrunkCCS	WireCenter	traffic and cost inputs	C46
118	Trunk Termination Investment, per end	$100	$100	TermInv	WireCenter	traffic and cost inputs	C47
119	Average Direct Route Distance, miles	10	10	Miles	WireCenter	traffic and cost inputs	C48
120	Average Trunk Usage Fraction	0.3	0.3	TrunkFrac	WireCenter	traffic and cost inputs	C50
121							
122	*Toll traffic inputs*						
123	Tandem-routed % of total intraLATA traffi	0.2	0.2	tandLATA	WireCenter	traffic and cost inputs	F82
124	Average direct intraLATA route distance,	25	25	LATAdist	WireCenter	traffic and cost inputs	F83
125	Tandem-routed % of total interLATA traffi	0.2	0.2	tandAccess	WireCenter	traffic and cost inputs	F85
126	Average direct access route distance, mi.	15	15	Accessdist	WireCenter	traffic and cost inputs	F86
127							
128							
129	*Tandem Switching parameters*						
130	real time limit, BHCA	1,500,000	1,500,000	tandBHCA	WireCenter	traffic and cost inputs	C53
131	port limit, trunks	120,000	120,000	portlimit	WireCenter	traffic and cost inputs	C54
132	common equipment investment	$1,000,000	$1,000,000	tandcominv	WireCenter	traffic and cost inputs	C55
133	maximum trunk fill	0.8	0.8	maxtrunkfill	WireCenter	traffic and cost inputs	C56
134	maximum real time occupancy	0.9	0.9	tandmaxocc	WireCenter	traffic and cost inputs	C57
135	common equipment intercept factor	0.25	0.25	tandintercept	WireCenter	traffic and cost inputs	C58
136							

	B	C	D	E	G	H	I
137	**Wire Center Parameters**						
138							
139	Lot size, multiplier of switch room size	2	2	LotSize	WireCenter	traffic and cost inputs	C71
140	Tandem/EO wire center common factor	0.4	0.4	WCcomm	WireCenter	traffic and cost inputs	C73
141							
142	*Power and frame investment*	sum of power & frame					
143	0	$10,000	$10,000	PF1	WireCenter	traffic and cost inputs	C83
144	1,000	$20,000	$20,000	PF2	WireCenter	traffic and cost inputs	C84
145	5,000	$40,000	$40,000	PF3	WireCenter	traffic and cost inputs	C85
146	25,000	$100,000	$100,000	PF4	WireCenter	traffic and cost inputs	C86
147	50,000	$500,000	$500,000	PF5	WireCenter	traffic and cost inputs	C87
148							
149	*Switch Room size table*	floor area required					
150	0	500	500	Room1	WireCenter	traffic and cost inputs	C92
151	1,000	1,000	1,000	Room2	WireCenter	traffic and cost inputs	C93
152	5,000	2,000	2,000	Room3	WireCenter	traffic and cost inputs	C94
153	25,000	5,000	5,000	Room4	WireCenter	traffic and cost inputs	C95
154	50,000	10,000	10,000	Room5	WireCenter	traffic and cost inputs	C96
155							
156	*Construction costs, per sq ft*	construction/$/sq ft					
157	0	$75	$75	Const1	WireCenter	traffic and cost inputs	C102
158	1,000	$85	$85	Const2	WireCenter	traffic and cost inputs	C103
159	5,000	$100	$100	Const3	WireCenter	traffic and cost inputs	C104
160	25,000	$125	$125	Const4	WireCenter	traffic and cost inputs	C105
161	50,000	$150	$150	Const5	WireCenter	traffic and cost inputs	C106
162							
163	*Land price, per sq ft* 0	price/sq ft					
164	0	$5.00	$5.00	Land1	WireCenter	traffic and cost inputs	C111
165	1,000	$7.50	$7.50	Land2	WireCenter	traffic and cost inputs	C112
166	5,000	$10.00	$10.00	Land3	WireCenter	traffic and cost inputs	C113
167	25,000	$15.00	$15.00	Land4	WireCenter	traffic and cost inputs	C114
168	50,000	$20.00	$20.00	Land5	WireCenter	traffic and cost inputs	C115
169							
170	**Distribution Structure Inputs**						
171							
172	*Aerial Fraction*						
173	0-5	0.5	0.5	distaerial1	Convergence	Inputs	C46
174	5-200	0.5	0.5	distaerial2	Convergence	Inputs	C47
175	200-650	0.5	0.5	distaerial3	Convergence	Inputs	C48
176	650-850	0.5	0.5	distaerial4	Convergence	Inputs	C49
177	850-2550	0.4	0.4	distaerial5	Convergence	Inputs	C50
178	2550+	0.65	0.65	distaerial6	Convergence	Inputs	C51
179							
180	*Buried Fraction*						
181	0-5	0.5	0.5	distbur1	Convergence	Inputs	D46
182	5-200	0.5	0.5	distbur2	Convergence	Inputs	D47
183	200-650	0.5	0.5	distbur3	Convergence	Inputs	D48
184	650-850	0.5	0.5	distbur4	Convergence	Inputs	D49
185	850-2550	0.5	0.5	distbur5	Convergence	Inputs	D50
186	2550+	0.05	0.05	distbur6	Convergence	Inputs	D51
187							
188	*Underground Fraction*						
189	*0-5*	*0*	*0*	*distug1*	Calculated	Inputs	E46
190	*5-200*	*0*	*0*	*distug2*	Calculated	Inputs	E47
191	*200-650*	*0*	*0*	*distug3*	Calculated	Inputs	E48
192	*650-850*	*0*	*0*	*distug4*	Calculated	Inputs	E49
193	*850-2550*	*0.1*	*0.1*	*distug5*	Calculated	Inputs	E50
194	*2550+*	*0.3*	*0.3*	*distug6*	Calculated	Inputs	E51
195							
196	*Buried Installation/foot*						
197	0-5	$2.00	$2.00	distburinv1	Convergence	Inputs	G46
198	5-200	$2.00	$2.00	distburinv2	Convergence	Inputs	G47
199	200-650	$2.00	$2.00	distburinv3	Convergence	Inputs	G48
200	650-850	$3.00	$3.00	distburinv4	Convergence	Inputs	G49
201	850-2550	$3.00	$3.00	distburinv5	Convergence	Inputs	G50
202	2550+	$20.00	$20.00	distburinv6	Convergence	Inputs	G51
203							
204	*Conduit Installation/foot*						
205	0-5	$25.00	$25.00	distcondinv1	Convergence	Inputs	H46

User Inputs

	B	C	D	E	G	H	I
206	5-200	$25.00	$25.00	distcondinv2	Convergence	Inputs	H47
207	200-650	$25.00	$25.00	distcondinv3	Convergence	Inputs	H48
208	650-850	$25.00	$25.00	distcondinv4	Convergence	Inputs	H49
209	850-2550	$45.00	$45.00	distcondinv5	Convergence	Inputs	H50
210	2550+	$70.00	$70.00	distcondinv6	Convergence	Inputs	H51
211							
212	Pole spacing, feet	150	150	distpolespace	Convergence	Inputs	C53
213	Pole investment	$450	$450	distpoleinv	Convergence	Inputs	C54
214	Conduit investment per foot	$1.00	$1.00	distcondinv	Convergence	Inputs	C55
215	Manhole investment, per manhole	$3,000	$3,000	distmanhinv	Convergence	Inputs	C56
216	Buried cable armoring multiplier	1.1	1.1	distarmormult	Convergence	Inputs	C57
217							
218	**Copper Feeder Structure Inputs**						
219							
220	*Aerial Fraction*						
221	0-5	0.5	0.5	cufeedaerial1	Convergence	Inputs	C64
222	5-200	0.5	0.5	cufeedaerial2	Convergence	Inputs	C65
223	200-650	0.5	0.5	cufeedaerial3	Convergence	Inputs	C66
224	650-850	0.4	0.4	cufeedaerial4	Convergence	Inputs	C67
225	850-2550	0.1	0.1	cufeedaerial5	Convergence	Inputs	C68
226	2550+	0.05	0.05	cufeedaerial6	Convergence	Inputs	C69
227							
228	*Buried Fraction*						
229	0-5	0.45	0.45	cufeedbur1	Convergence	Inputs	D64
230	5-200	0.45	0.45	cufeedbur2	Convergence	Inputs	D65
231	200-650	0.45	0.45	cufeedbur3	Convergence	Inputs	D66
232	650-850	0.4	0.4	cufeedbur4	Convergence	Inputs	D67
233	850-2550	0.1	0.1	cufeedbur5	Convergence	Inputs	D68
234	2550+	0.05	0.05	cufeedbur6	Convergence	Inputs	D69
235							
236	*Underground Fraction*						
237	*0-5*	*0.05*	*0.05*	*cufeedug1*	Calculated	Inputs	E64
238	*5-200*	*0.05*	*0.05*	*cufeedug2*	Calculated	Inputs	E65
239	*200-650*	*0.05*	*0.05*	*cufeedug3*	Calculated	Inputs	E66
240	*650-850*	*0.2*	*0.2*	*cufeedug4*	Calculated	Inputs	E67
241	*850-2550*	*0.8*	*0.8*	*cufeedug5*	Calculated	Inputs	E68
242	*2550+*	*0.9*	*0.9*	*cufeedug6*	Calculated	Inputs	E69
243							
244	*Buried Installation/foot*						
245	0-5	$2.00	$2.00	cufeedburinv1	Convergence	Inputs	G64
246	5-200	$2.00	$2.00	cufeedburinv2	Convergence	Inputs	G65
247	200-650	$2.00	$2.00	cufeedburinv3	Convergence	Inputs	G66
248	650-850	$3.00	$3.00	cufeedburinv4	Convergence	Inputs	G67
249	850-2550	$3.00	$3.00	cufeedburinv5	Convergence	Inputs	G68
250	2550+	$25.00	$25.00	cufeedburinv6	Convergence	Inputs	G69
251							
252	*Conduit Installation/foot*						
253	0-5	$25.00	$25.00	cufeedcondinv1	Convergence	Inputs	H64
254	5-200	$25.00	$25.00	cufeedcondinv2	Convergence	Inputs	H65
255	200-650	$25.00	$25.00	cufeedcondinv3	Convergence	Inputs	H66
256	650-850	$25.00	$25.00	cufeedcondinv4	Convergence	Inputs	H67
257	850-2550	$45.00	$45.00	cufeedcondinv5	Convergence	Inputs	H68
258	2550+	$75.00	$75.00	cufeedcondinv6	Convergence	Inputs	H69
259							
260	*Manhole Spacing, ft.*						
261	0-5	800	800	cufeedman1	Convergence	Inputs	F64
262	5-200	800	800	cufeedman2	Convergence	Inputs	F65
263	200-650	800	800	cufeedman3	Convergence	Inputs	F66
264	650-850	800	800	cufeedman4	Convergence	Inputs	F67
265	850-2550	600	600	cufeedman5	Convergence	Inputs	F68
266	2550+	400	400	cufeedman6	Convergence	Inputs	F69
267							
268	Pole spacing, feet	150	150	ufeedpolespac	Convergence	Inputs	C71
269	Pole investment	$450	$450	cufeedpoleinv	Convergence	Inputs	C72
270	Conduit investment per foot	$1.00	$1.00	cufeedcondinv	Convergence	Inputs	C73
271	Manhole investment, per manhole	$3,000	$3,000	cufeedmanhinv	Convergence	Inputs	C74
272	Buried cable armoring multiplier	1.1	1.1	ufeedarmormul	Convergence	Inputs	C75
273							
274	**Fiber Feeder Structure Inputs**						

	B	C	D	E	G	H	I
275							
276	*Aerial Fraction*						
277	0-5	0.35	0.35	fibfeedaerial1	Convergence	Inputs	C81
278	5-200	0.35	0.35	fibfeedaerial2	Convergence	Inputs	C82
279	200-650	0.35	0.35	fibfeedaerial3	Convergence	Inputs	C83
280	650-850	0.2	0.2	fibfeedaerial4	Convergence	Inputs	C84
281	850-2550	0.1	0.1	fibfeedaerial5	Convergence	Inputs	C85
282	2550+	0.05	0.05	fibfeedaerial6	Convergence	Inputs	C86
283							
284	*Buried Fraction*						
285	0-5	0.6	0.6	fibfeedbur1	Convergence	Inputs	D81
286	5-200	0.6	0.6	fibfeedbur2	Convergence	Inputs	D82
287	200-650	0.6	0.6	fibfeedbur3	Convergence	Inputs	D83
288	650-850	0.6	0.6	fibfeedbur4	Convergence	Inputs	D84
289	850-2550	0.1	0.1	fibfeedbur5	Convergence	Inputs	D85
290	2550+	0.05	0.05	fibfeedbur6	Convergence	Inputs	D86
291							
292	*Underground Fraction*						
293	*0-5*	*0.05*	*0.05*	*fibfeedug1*	Calculated	Inputs	E81
294	*5-200*	*0.05*	*0.05*	*fibfeedug2*	Calculated	Inputs	E82
295	*200-650*	*0.05*	*0.05*	*fibfeedug3*	Calculated	Inputs	E83
296	*650-850*	*0.2*	*0.2*	*fibfeedug4*	Calculated	Inputs	E84
297	*850-2550*	*0.8*	*0.8*	*fibfeedug5*	Calculated	Inputs	E85
298	*2550+*	*0.9*	*0.9*	*fibfeedug6*	Calculated	Inputs	E86
299							
300	*Buried Installation/foot*						
301	0-5	$2.00	$2.00	fibfeedburinv1	Convergence	Inputs	G81
302	5-200	$2.00	$2.00	fibfeedburinv2	Convergence	Inputs	G82
303	200-650	$2.00	$2.00	fibfeedburinv3	Convergence	Inputs	G83
304	650-850	$3.00	$3.00	fibfeedburinv4	Convergence	Inputs	G84
305	850-2550	$3.00	$3.00	fibfeedburinv5	Convergence	Inputs	G85
306	2550+	$20.00	$20.00	fibfeedburinv6	Convergence	Inputs	G86
307							
308	*Conduit Installation/foot*						
309	0-5	$25.00	$25.00	fibfeedcondinv1	Convergence	Inputs	H81
310	5-200	$25.00	$25.00	fibfeedcondinv2	Convergence	Inputs	H82
311	200-650	$25.00	$25.00	fibfeedcondinv3	Convergence	Inputs	H83
312	650-850	$25.00	$25.00	fibfeedcondinv4	Convergence	Inputs	H84
313	850-2550	$45.00	$45.00	fibfeedcondinv5	Convergence	Inputs	H85
314	2550+	$70.00	$70.00	fibfeedcondinv6	Convergence	Inputs	H86
315							
316	*Manhole Spacing, ft.*						
317	0-5	2,000	2,000	fibfeedman1	Convergence	Inputs	F81
318	5-200	2,000	2,000	fibfeedman2	Convergence	Inputs	F82
319	200-650	2,000	2,000	fibfeedman3	Convergence	Inputs	F83
320	650-850	2,000	2,000	fibfeedman4	Convergence	Inputs	F84
321	850-2550	2,000	2,000	fibfeedman5	Convergence	Inputs	F85
322	2550+	2,000	2,000	fibfeedman6	Convergence	Inputs	F86
323							
324	Buried cable armoring per foot, fiber	$0.20	$0.20	ibfeedarmormul	Convergence	Inputs	C88
325							
326	**Misc Loop Investment Inputs**						
327							
328	Drop investment per line	$40.00	$40.00	dropinv	Convergence	Inputs	J3
329	NID investment per line	$30.00	$30.00	NIDInv	Convergence	Inputs	J4
330	Terminal and splice per line	$35.00	$35.00	SpliceInv	Convergence	Inputs	J5
331	Average lines per business location	4	4	BusLinesLoc	Convergence	Inputs	J6
332	Feeder structure fraction shared w/ intero	0.25	0.25	FeedShare			
333							
334	*Distribution structure % assigned to telephone*						
335	aerial	0.33	0.33	AirDistTel	Expense	Inputs	F59
336	buried	0.33	0.33	BurDistTel	Expense	Inputs	H59
337	underground	0.33	0.33	UgDistTel	Expense	Inputs	G59
338							
339	*Feeder structure % assigned to telephone*						
340	aerial	0.33	0.33	AirFeedTel	Expense	Inputs	F60
341	buried	0.33	0.33	BurFeedTel	Expense	Inputs	H60
342	underground	0.33	0.33	UgFeedTel	Expense	Inputs	G60
343							

User Inputs

	B		C	D	E	G	H	I
344	*SAI investment, installed*							
345	*Distribution cable size*		copper feeder					
346		0	$500.00	$500.00	cuSAI1	Convergence	Inputs	I16
347		100	$700.00	$700.00	cuSAI2	Convergence	Inputs	I17
348		200	$900.00	$900.00	cuSAI3	Convergence	Inputs	I18
349		400	$1,100.00	$1,100.00	cuSAI4	Convergence	Inputs	I19
350		600	$1,300.00	$1,300.00	cuSAI5	Convergence	Inputs	I20
351		900	$1,500.00	$1,500.00	cuSAI6	Convergence	Inputs	I21
352		1200	$1,700.00	$1,700.00	cuSAI7	Convergence	Inputs	I22
353		1800	$1,900.00	$1,900.00	cuSAI8	Convergence	Inputs	I23
354		2400	$2,100.00	$2,100.00	cuSAI9	Convergence	Inputs	I24
355		3000	$2,300.00	$2,300.00	cuSAI10	Convergence	Inputs	I25
356		3600	$2,500.00	$2,500.00	cuSAI11	Convergence	Inputs	I26
357								
358	*Distribution cable size*		fiber feeder					
359		0	$2,500.00	$2,500.00	fibSAI1	Convergence	Inputs	J16
360		100	$2,700.00	$2,700.00	fibSAI2	Convergence	Inputs	J17
361		200	$2,900.00	$2,900.00	fibSAI3	Convergence	Inputs	J18
362		400	$3,100.00	$3,100.00	fibSAI4	Convergence	Inputs	J19
363		600	$3,300.00	$3,300.00	fibSAI5	Convergence	Inputs	J20
364		900	$3,500.00	$3,500.00	fibSAI6	Convergence	Inputs	J21
365		1200	$3,700.00	$3,700.00	fibSAI7	Convergence	Inputs	J22
366		1800	$3,900.00	$3,900.00	fibSAI8	Convergence	Inputs	J23
367		2400	$4,100.00	$4,100.00	fibSAI9	Convergence	Inputs	J24
368		3000	$4,300.00	$4,300.00	fibSAI10	Convergence	Inputs	J25
369		3600	$4,500.00	$4,500.00	fibSAI11	Convergence	Inputs	J26
370								
371	**Digital Loop Carrier Inputs**							
372								
373	*SLC (TR-303)*							
374	site, housing, and power per remote term		$3,000.00	$3,000.00	SLChouse	Convergence	Inputs	D26
375	maximum lines		672	672	SLCmaxlines	Convergence	Inputs	D27
376	remote terminal fill factor		0.9	0.9	SLCfill	Convergence	Inputs	D28
377	common equipment investment		$42,000.00	$42,000.00	SLCcomm	Convergence	Inputs	D29
378	channel unit investment per line		$75.00	$75.00	SLCchan	Convergence	Inputs	D30
379	DS-0s per fiber		$2,016.00	$2,016.00		Loopmaster	Input	X19
380	Fibers per remote terminal		4	4		Loopmaster	Input	Y19
381								
382	AFC							
383	site, housing, and power per remote term		$2,500.00	$2,500.00	AFChouse	Convergence	Inputs	D34
384	maximum lines		100	100	AFCmaxlines	Convergence	Inputs	D35
385	remote terminal fill factor		0.9	0.9	AFCfill	Convergence	Inputs	D36
386	common equipment investment		$10,000.00	$10,000.00	AFCcomm	Convergence	Inputs	D37
387	channel unit investment per line		$150.00	$150.00	AFCchan	Convergence	Inputs	D38
388	DS-0s per fiber		2,016	2,016		Loopmaster	Input	X20
389	Fibers per remote terminal		4	4		Loopmaster	Input	Y20
390								
391	Fiber feeder distance threshold, ft. (feeder		9,000	9,000		Loopmaster	Input	W23
392								
393	**Signaling Parameters**							
394								
395	STP Link Capacity		720	720	STPcap	WireCenter	traffic and cost inputs	F39
396	STP Maximum Fill		0.8	0.8	STPfill	WireCenter	traffic and cost inputs	F40
397	STP Investment, per pair, fully equipped		$5,000,000.00	$5,000,000.00	STPInv	WireCenter	traffic and cost inputs	F41
398	STP common equipment investment, per		$1,000,000.00	$1,000,000.00	STPcomm	WireCenter	traffic and cost inputs	F42
399	Link Termination, both ends		$900.00	$900.00	LinkTerm	WireCenter	traffic and cost inputs	F43
400	Signaling Link Bit Rate		56000	56000	LinkRate	WireCenter	traffic and cost inputs	F45
401	Link Occupancy		0.4	0.4	LinkOcc	WireCenter	traffic and cost inputs	F46
402	C Link Cross-Section		24	24	LinkCross	WireCenter	traffic and cost inputs	F47
403	ISUP messages per interoffice BHCA		6	6	ISUPmsgs	WireCenter	traffic and cost inputs	F48
404	ISUP message length, bytes		25	25	ISUPlen	WireCenter	traffic and cost inputs	F49
405	TCAP messages per transaction		2	2	TCAPmsgs	WireCenter	traffic and cost inputs	F51
406	TCAP message length, bytes		100	100	TCAPlen	WireCenter	traffic and cost inputs	F52
407	Fraction of BHCA requiring TCAP		0.1	0.1	TCAPFrac	WireCenter	traffic and cost inputs	F53
408	SCP investment per transaction per seco		$20,000.00	$20,000.00	SCPInv	WireCenter	traffic and cost inputs	F54
409								
410								
411	**Misc Inputs**							
412								

User Inputs

	B	C	D	E	G	H	I
413	*Operator position parameters*						
414	Investment per position	$3,500.00	$3,500.00	opinv	WireCenter	traffic and cost inputs	C62
415	Maximum utilization per position, CCS	27	27	opccs	WireCenter	traffic and cost inputs	C63
416	Operator intervention factor	10	10	opint	WireCenter	traffic and cost inputs	C64
417	Operator position remote distance, mi.	0	0	opdist	WireCenter	traffic and cost inputs	C65
418							
419	*Other*						
420	DS0/DS1 crossover	24	24	DS0cross	Expense	Inputs	C60
421	DS1/DS3 crossover	28	28	DS1cross	Expense	Inputs	C61
422							
423	Public Telephone investment per station	$1,200.00	$1,200.00	PubInv	WireCenter	traffic and cost inputs	F130
424							
425	**Transport Investment**						
426							
427	*Terminal Investment*						
428	Number of Fibers	24	24	termfib	WireCenter	traffic and cost inputs	C142
429	FOT capacity, DS-3s	12	12	FOTcap	WireCenter	traffic and cost inputs	C143
430	FOT fill	0.8	0.8	FOTfill	WireCenter	traffic and cost inputs	C144
431	FOT, installed	$43,000.00	$43,000.00	FOTinst	WireCenter	traffic and cost inputs	C145
432	Pigtails	$60.00	$60.00	pigs	WireCenter	traffic and cost inputs	C146
433	Panel	$1,000.00	$1,000.00	panel	WireCenter	traffic and cost inputs	C147
434	EF&I, per hour	$55.00	$55.00	efi	WireCenter	traffic and cost inputs	C148
435	EF&I units	32	32	EFIU	WireCenter	traffic and cost inputs	D148
436							
437	*Medium Investment*						
438	Fraction of structure assigned to telephon	0.33	0.33	telfrac	WireCenter	traffic and cost inputs	C152
439	Fraction of structure shared with feeder	0.25	0.25	feedfrac	WireCenter	traffic and cost inputs	C153
440	Distance, mi.	41	41	dist	WireCenter	traffic and cost inputs	C154
441	Regenerator spacing, mi.	40	40	regensp	WireCenter	traffic and cost inputs	C155
442	Regenerator investment, installed	$15,000.00	$15,000.00	regeninv	WireCenter	traffic and cost inputs	C157
443	Fiber Cable investment per foot	$2.00	$2.00	fibinv	WireCenter	traffic and cost inputs	C159
444	Placement	$2.00	$2.00	fibplace	WireCenter	traffic and cost inputs	C160
445	Splice Spacing, ft.	20000	20000	splicesp	WireCenter	traffic and cost inputs	C161
446	Splice Cost	$15.00	$15.00	splice	WireCenter	traffic and cost inputs	C162
447	Trenching per foot	$45.00	$45.00	trench	WireCenter	traffic and cost inputs	C163
448	Resurfacing per foot	$10.00	$10.00	resurf	WireCenter	traffic and cost inputs	C164
449	Conduit per foot	$4.00	$4.00	condft	WireCenter	traffic and cost inputs	C165
450	Number of tubes	2	2	tubes	WireCenter	traffic and cost inputs	C166
451	Manhole investment	$5,000.00	$5,000.00	manhinv	WireCenter	traffic and cost inputs	C170
452	Manhole spacing	1000	1000	manhsp	WireCenter	traffic and cost inputs	C169
453	Buried installation per foot	$5.00	$5.00	burinst	WireCenter	traffic and cost inputs	C173
454	Pole investment	450	450	poleinv	WireCenter	traffic and cost inputs	C175
455	Pole spacing	150	150	polesp	WireCenter	traffic and cost inputs	C176
456	Underground percent	35.00%	35.00%	ugfrac	WireCenter	traffic and cost inputs	C179
457	Buried percent	50.00%	50.00%	burfrac	WireCenter	traffic and cost inputs	C180
458	Aerial percent	0.15	0.15	airfrac	WireCenter	traffic and cost inputs	C181
459							
460	**Call Attempts & DEMs**						
461							
462	*Call Attempts*						
463	Local	3,759,659,000	3,759,659,000	CALocal	WireCenter	traffic and cost inputs	F66
464	IntraLata Intrastate	209,658,571	209,658,571	CARaRa	WireCenter	traffic and cost inputs	F68
465	InterLata Intrastate	517,640,000	517,640,000	CAErRa	WireCenter	traffic and cost inputs	F69
466	InterLata Interstate	684,810,000	684,810,000	CaErEr	WireCenter	traffic and cost inputs	F70
467	Call Completion Fraction	0.70	0.70	CallComp	WireCenter	traffic and cost inputs	F67
468							
469	*DEMs*						
470	Local	18,545,325	18,545,325	DEMsLocal	WireCenter	traffic and cost inputs	F71
471	Intrastate	3,075,939	3,075,939	DEMsIntra	WireCenter	traffic and cost inputs	F72
472	Interstate	5,204,808	5,204,808	DEMsInter	WireCenter	traffic and cost inputs	F73
473	Local bus/res DEMs	1.1	1.1	LocalDF	WireCenter	traffic and cost inputs	K78
474	Intrastate bus/res DEMs	2	2	IntraDF	WireCenter	traffic and cost inputs	K79
475	Interstate bus/res DEMs	3	3	InterDF	WireCenter	traffic and cost inputs	K80
476							
477	**Line Counts**						
478							
479	Residential	1,227,659	1,227,659	LCRes	LineConv	Output	V3
480	Business	472,479	472,479	LCBus	LineConv	Output	W3
481	Special Access	93,847	93,847	LCSA	LineConv	Output	X3

User Inputs

	B	C	D	E	G	H	I
482	Public	11,269	11,269	LCPub	LineConv	Output	Y3
483							
484	**Cable Costs**						
485	***Feeder***						
486	***Underground***						
487	Cable Size	Cost UG					
488	4200	74.25	74.25	FeedUG42	Loopmaster	Input	T64
489	3600	63.75	63.75	FeedUG36	Loopmaster	Input	T65
490	3000	53.25	53.25	FeedUG30	Loopmaster	Input	T66
491	2400	42.75	42.75	FeedUG24	Loopmaster	Input	T67
492	1800	32.25	32.25	FeedUG18	Loopmaster	Input	T68
493	1200	21.75	21.75	FeedUG12	Loopmaster	Input	T69
494	900	16.5	16.5	FeedUG9	Loopmaster	Input	T70
495	600	11.25	11.25	FeedUG6	Loopmaster	Input	T71
496	400	7.75	7.75	FeedUG4	Loopmaster	Input	T72
497	200	4.25	4.25	FeedUG2	Loopmaster	Input	T73
498	100	2.5	2.5	FeedUG1	Loopmaster	Input	T74
499	***Aerial***						
500	Cable Size	Cost Aerial					
501	4200	74.25	74.25	FeedA42	Loopmaster	Input	U64
502	3600	63.75	63.75	FeedA36	Loopmaster	Input	U65
503	3000	53.25	53.25	FeedA30	Loopmaster	Input	U66
504	2400	42.75	42.75	FeedA24	Loopmaster	Input	U67
505	1800	32.25	32.25	FeedA18	Loopmaster	Input	U68
506	1200	21.75	21.75	FeedA12	Loopmaster	Input	U69
507	900	16.5	16.5	FeedA9	Loopmaster	Input	U70
508	600	11.25	11.25	FeedA6	Loopmaster	Input	U71
509	400	7.75	7.75	FeedA4	Loopmaster	Input	U72
510	200	4.25	4.25	FeedA2	Loopmaster	Input	U73
511	100	2.5	2.5	FeedA1	Loopmaster	Input	U74
512							
513	***Distribution***						
514	***Underground***						
515	Cable Size	Cost UG					
516	3600	63.75	63.75	DistUG36	Loopmaster	Input	X64
517	3000	53.25	53.25	DistUG30	Loopmaster	Input	X65
518	2400	42.75	42.75	DistUG24	Loopmaster	Input	X66
519	1800	32.25	32.25	DistUG18	Loopmaster	Input	X67
520	1200	21.75	21.75	DistUG12	Loopmaster	Input	X68
521	900	16.5	16.5	DistUG9	Loopmaster	Input	X69
522	600	11.25	11.25	DistUG6	Loopmaster	Input	X70
523	400	7.75	7.75	DistUG4	Loopmaster	Input	X71
524	200	4.25	4.25	DistUG2	Loopmaster	Input	X72
525	100	2.5	2.5	DistUG1	Loopmaster	Input	X73
526	50	1.625	1.625	DistUG5	Loopmaster	Input	X74
527	25	1.19	1.19	DistUG25	Loopmaster	Input	X75
528	***Aerial***						
529	Cable Size	Cost Aerial					
530	3600	63.75	63.75	DistA36	Loopmaster	Input	Y64
531	3000	53.25	53.25	DistA30	Loopmaster	Input	Y65
532	2400	42.75	42.75	DistA24	Loopmaster	Input	Y66
533	1800	32.25	32.25	DistA18	Loopmaster	Input	Y67
534	1200	21.75	21.75	DistA12	Loopmaster	Input	Y68
535	900	16.5	16.5	DistA9	Loopmaster	Input	Y69
536	600	11.25	11.25	DistA6	Loopmaster	Input	Y70
537	400	7.75	7.75	DistA4	Loopmaster	Input	Y71
538	200	4.25	4.25	DistA2	Loopmaster	Input	Y72
539	100	2.5	2.5	DistA1	Loopmaster	Input	Y73
540	50	1.625	1.625	DistA5	Loopmaster	Input	Y74
541	25	1.19	1.19	DistA25	Loopmaster	Input	Y75
542							
543	***Fiber***						
544	***Underground***						
545	Cable Size	Cost UG					
546	216	13.1	13.1	FiberUG216	Loopmaster	Input	W47
547	144	9.5	9.5	FiberUG144	Loopmaster	Input	W48
548	96	7.1	7.1	FiberUG96	Loopmaster	Input	W49
549	72	5.9	5.9	FiberUG72	Loopmaster	Input	W50
550	60	5.3	5.3	FiberUG60	Loopmaster	Input	W51

	B	C	D	E	G	H	I
551	48	4.7	4.7	FiberUG48	Loopmaster	Input	W52
552	36	4.1	4.1	FiberUG36	Loopmaster	Input	W53
553	24	3.5	3.5	FiberUG24	Loopmaster	Input	W54
554	18	3.2	3.2	FiberUG18	Loopmaster	Input	W55
555	12	2.9	2.9	FiberUG12	Loopmaster	Input	W56
556	*Aerial*						
557	Cable Size	Cost Aerial					
558	216	13.1	13.1	FiberA216	Loopmaster	Input	X47
559	144	9.5	9.5	FiberA144	Loopmaster	Input	X48
560	96	7.1	7.1	FiberA96	Loopmaster	Input	X49
561	72	5.9	5.9	FiberA72	Loopmaster	Input	X50
562	60	5.3	5.3	FiberA60	Loopmaster	Input	X51
563	48	4.7	4.7	FiberA48	Loopmaster	Input	X52
564	36	4.1	4.1	FiberA36	Loopmaster	Input	X53
565	24	3.5	3.5	FiberA24	Loopmaster	Input	X54
566	18	3.2	3.2	FiberA18	Loopmaster	Input	X55
567	12	2.9	2.9	FiberA12	Loopmaster	Input	X56
568							
569	Duplicates--these inputs are set equal to the corresponding inputs listed above						
570							
571	**Fill Factors**						
572	Cable						
573	*Distribution*						
574	0-5	*0.50*	*0.50*		Convergence	inputs	N5
575	5-200	*0.55*	*0.55*		Convergence	inputs	N6
576	200-650	*0.60*	*0.60*		Convergence	inputs	N7
577	650-850	*0.65*	*0.65*		Convergence	inputs	N8
578	850-2550	*0.70*	*0.70*		Convergence	inputs	N9
579	2550+	*0.75*	*0.75*		Convergence	inputs	N10
580							
581	**Transport Investment**						
582	Local Direct Routes						
583	*Terminal Investment*						
584	Number of Fibers	*24*	*24*		WireCenter	traffic and cost inputs	C200
585	FOT capacity, DS-3s	*12*	*12*		WireCenter	traffic and cost inputs	C201
586	FOT fill	*0.8*	*0.8*		WireCenter	traffic and cost inputs	C202
587	FOT, installed	*$43,000.00*	*$43,000.00*		WireCenter	traffic and cost inputs	C203
588	Pigtails	*$60.00*	*$60.00*		WireCenter	traffic and cost inputs	C204
589	Panel	*$1,000.00*	*$1,000.00*		WireCenter	traffic and cost inputs	C205
590	EF&I, per hour	*$55.00*	*$55.00*		WireCenter	traffic and cost inputs	C206
591	EF&I units	*32*	*32*		WireCenter	traffic and cost inputs	D206
592							
593	*Medium Investment*						
594	Fraction of structure assigned to telephon	*0.33*	*0.33*		WireCenter	traffic and cost inputs	C210
595		*0.25*	*0.25*				
596		*41*	*41*				
597	Regenerator spacing, mi.	*40*	*40*		WireCenter	traffic and cost inputs	C213
598	Regenerator investment, installed	*$15,000.00*	*$15,000.00*		WireCenter	traffic and cost inputs	C215
599	Fiber Cable investment per foot	*$2.00*	*$2.00*		WireCenter	traffic and cost inputs	C217
600	Placement	*$2.00*	*$2.00*		WireCenter	traffic and cost inputs	C218
601	Splice Spacing, ft.	*20000*	*20000*		WireCenter	traffic and cost inputs	C219
602	Splice Cost	*$15.00*	*$15.00*		WireCenter	traffic and cost inputs	C220
603	Trenching per foot	*$45.00*	*$45.00*		WireCenter	traffic and cost inputs	C221
604	Resurfacing per foot	*$10.00*	*$10.00*		WireCenter	traffic and cost inputs	C222
605	Conduit per foot	*$4.00*	*$4.00*		WireCenter	traffic and cost inputs	C223
606	Number of tubes	*2*	*2*		WireCenter	traffic and cost inputs	C224
607	Manhole investment	*$5,000.00*	*$5,000.00*		WireCenter	traffic and cost inputs	C228
608	Manhole spacing	*1000*	*1000*		WireCenter	traffic and cost inputs	C227
609	Buried installation per foot	*$5.00*	*$5.00*		WireCenter	traffic and cost inputs	C231
610	Pole investment	*450*	*450*		WireCenter	traffic and cost inputs	C233
611	Pole spacing	*150*	*150*		WireCenter	traffic and cost inputs	C234
612	Underground percent	*35.00%*	*35.00%*				
613	Buried percent	*50.00%*	*50.00%*				
614	Aerial percent	*0.15*	*0.15*				
615							
616							
617	**Transport Investment**						
618	intraLATA direct routes						
619	*Terminal Investment*						

User Inputs

	B	C	D	E	G	H	I
620	Number of Fibers	24	24		WireCenter	traffic and cost inputs	C259
621	FOT capacity, DS-3s	12	12		WireCenter	traffic and cost inputs	C260
622	FOT fill	0.8	0.8		WireCenter	traffic and cost inputs	C261
623	FOT, installed	$43,000.00	$43,000.00		WireCenter	traffic and cost inputs	C262
624	Pigtails	$60.00	$60.00		WireCenter	traffic and cost inputs	C263
625	Panel	$1,000.00	$1,000.00		WireCenter	traffic and cost inputs	C264
626	EF&I, per hour	$55.00	$55.00		WireCenter	traffic and cost inputs	C265
627	EF&I units	32	32		WireCenter	traffic and cost inputs	D265
628							
629	*Medium Investment*						
630	Fraction of structure assigned to telephon	0.33	0.33		WireCenter	traffic and cost inputs	C269
631	Fraction of structure shared with feeder	0.25	0.25				
632							
633	Regenerator spacing, mi.	40	40		WireCenter	traffic and cost inputs	C272
634	Regenerator investment, installed	$15,000.00	$15,000.00		WireCenter	traffic and cost inputs	C274
635	Fiber Cable investment per foot	$2.00	$2.00		WireCenter	traffic and cost inputs	C276
636	Placement	$2.00	$2.00		WireCenter	traffic and cost inputs	C277
637	Splice Spacing, ft.	20000	20000		WireCenter	traffic and cost inputs	C278
638	Splice Cost	$15.00	$15.00		WireCenter	traffic and cost inputs	C279
639	Trenching per foot	$45.00	$45.00		WireCenter	traffic and cost inputs	C280
640	Resurfacing per foot	$10.00	$10.00		WireCenter	traffic and cost inputs	C281
641	Conduit per foot	$4.00	$4.00		WireCenter	traffic and cost inputs	C282
642	Number of tubes	2	2		WireCenter	traffic and cost inputs	C283
643	Manhole investment	$5,000.00	$5,000.00		WireCenter	traffic and cost inputs	C287
644	Manhole spacing	1000	1000		WireCenter	traffic and cost inputs	C286
645	Buried installation per foot	$5.00	$5.00		WireCenter	traffic and cost inputs	C290
646	Pole investment	450	450		WireCenter	traffic and cost inputs	C292
647	Pole spacing	150	150		WireCenter	traffic and cost inputs	C293
648	Underground percent	35.00%	35.00%				
649	Buried percent	50.00%	50.00%				
650	Aerial percent	0.15	0.15				
651							
652							
653	**Transport Investment**						
654	Access Direct Routes						
655	*Terminal Investment*						
656	Number of Fibers	24	24		WireCenter	traffic and cost inputs	C318
657	FOT capacity, DS-3s	12	12		WireCenter	traffic and cost inputs	C319
658	FOT fill	0.8	0.8		WireCenter	traffic and cost inputs	C320
659	FOT, installed	$43,000.00	$43,000.00		WireCenter	traffic and cost inputs	C321
660	Pigtails	$60.00	$60.00		WireCenter	traffic and cost inputs	C322
661	Panel	$1,000.00	$1,000.00		WireCenter	traffic and cost inputs	C323
662	EF&I, per hour	$55.00	$55.00		WireCenter	traffic and cost inputs	C324
663	EF&I units	32	32		WireCenter	traffic and cost inputs	D324
664							
665	*Medium Investment*						
666	Fraction of structure assigned to telephon	0.33	0.33		WireCenter	traffic and cost inputs	C328
667							
668							
669	Regenerator spacing, mi.	40	40		WireCenter	traffic and cost inputs	C331
670	Regenerator investment, installed	15000	15000		WireCenter	traffic and cost inputs	C333
671	Fiber Cable investment per foot	2	2		WireCenter	traffic and cost inputs	C335
672	Placement	2	2		WireCenter	traffic and cost inputs	C336
673	Splice Spacing, ft.	$20,000.00	$20,000.00		WireCenter	traffic and cost inputs	C337
674	Splice Cost	$15.00	$15.00		WireCenter	traffic and cost inputs	C338
675	Trenching per foot	$45.00	$45.00		WireCenter	traffic and cost inputs	C339
676	Resurfacing per foot	10	10		WireCenter	traffic and cost inputs	C340
677	Conduit per foot	$4.00	$4.00		WireCenter	traffic and cost inputs	C341
678	Number of tubes	$2.00	$2.00		WireCenter	traffic and cost inputs	C342
679	Manhole investment	$5,000.00	$5,000.00		WireCenter	traffic and cost inputs	C346
680	Manhole spacing	$1,000.00	$1,000.00		WireCenter	traffic and cost inputs	C345
681	Buried installation per foot	5	5		WireCenter	traffic and cost inputs	C349
682	Pole investment	$450.00	$450.00		WireCenter	traffic and cost inputs	C351
683	Pole spacing	150	150		WireCenter	traffic and cost inputs	C352
684	Underground percent	$0.35	$0.35				
685	Buried percent	0.5	0.5				
686	Aerial percent	0.15	0.15				

COST OF NETWORK ELEMENTS Florida Sprint LTD (Centel/United)

Exhibit ____ (DJW-3)
Docket No. 961230

A. Loop elements

	0 - 5 lines/sq mi	5 - 200 lines/sq mi	200 - 650 lines/sq mi	650 - 850 lines/sq mi	850 - 2550 lines/sq mi	> 2550 lines/sq mi	Totals
Loop Distribution (including NID)							
Annual Cost	$ 12,454,139	$ 83,006,147	$ 28,177,190	$ 7,612,151	$ 39,443,196	$ 24,715,470	$ 195,408,293
Unit Cost/month	$ 57.14	$ 18.99	$ 8.04	$ 6.59	$ 5.38	$ 4.87	$ 9.02
Loop Concentration							
Annual Cost	$ 1,437,445	$ 16,996,020	$ 10,387,050	$ 2,748,077	$ 15,291,183	$ 7,042,829	$ 53,902,604
Unit Cost/month	$ 6.60	$ 3.89	$ 2.96	$ 2.38	$ 2.08	$ 1.39	$ 2.49
Loop Feeder							
Annual Cost	$ 1,666,708	$ 10,788,896	$ 6,512,128	$ 2,012,450	$ 16,923,815	$ 12,867,334	$ 50,771,332
Unit Cost/month	$ 7.65	$ 2.47	$ 1.86	$ 1.74	$ 2.31	$ 2.53	$ 2.34
Total Loop							
Annual Cost	$ 15,558,292	$ 110,791,063	$ 45,076,368	$ 12,372,679	$ 71,658,195	$ 44,625,633	$ 300,082,229
Unit Cost/month	$ 71.38	$ 25.35	$ 12.86	$ 10.72	$ 9.77	$ 8.79	$ 13.85
Total lines	18,163	364,204	292,186	96,225	611,193	423,283	1,805,254
Total lines served by DLC	18,163	335,047	211,723	57,286	316,035	140,936	1,079,190

	Annual Cost	Units		Unit Cost	
End office switching	$ 71,559,427				
1. Port	$ 21,467,828	1,711,407	switched lines	$ 1.05	per line/month
2. Usage	$ 50,091,599	21,991,648,017	minutes	$ 0.0023	per minute
Signaling network elements	$ 3,840,144				
1. Links	$ 100,561	304	links	$ 27.57	per link per month
2. STP	$ 2,607,576	14,128,741,847	TCAP+ISUP messages	$ 0.00018	per signaling message
3. SCP	$ 1,132,008	949,627,000	TCAP messages	$ 0.00119	per signaling message
Transport network elements					
1. Dedicated	$ 10,502,056	232,896	trunks	$ 3.76	per DS-0 equivalent/month
Switched	$ 6,270,177	139,049		$ 0.00037	per minute
Special	$ 4,231,879	93,847			
2. Common	$ 1,145,557	1,828,542,909	*minutes*	$ 0.00063	per minute per leg (orig or term)
3. Tandem switch	$ 4,062,400	1,653,675,936	minutes	$ 0.0025	per minute
Operator systems	$ 2,347,959				
Total	$ 393,539,772				
Total cost of switched network elements	$ 18.20	per line/month			

Intrastate Toll DEMs	3,075,939,138
Interstate Toll DEMs	5,204,807,550

10,044 trk-min/mo

				interLATA ded. trunks		62,816
Common Transport MOU				end office trk port inv	$	21,528,123
Local	172,393,571	w/o OS usage				
Intrastate Toll	615,187,828					
Interstate Toll	1,040,961,510					
	1,828,542,909					
Intrastate IntraLATA Calls	146,761,000	28.83%	SOCCC message counts			
Intrastate InterLATA Calls	362,348,000	71.17%				
	509,109,000					
		trunk port usage	30,914,120,606			
Calculation of EO Usage						
Local DEMs, incl OS	18,545,325,128	69.1%	of total DEMs			
Intraoffice Local DEMs	9,668,847,597					
Intraoffice Local Actual Min	4,834,423,799		Dedicated Transport MOU			
Interoffice Local Actual Min	8,876,477,531	per end	Local, w/o OS	4,223,642,493		
Intrastate Toll Actual Min	3,075,939,138		IntraLATA Toll	354,680,749		
Interstate Toll Actual Min	5,204,807,550		InterLATA Toll	7,571,385,190		
	21,991,648,017			12,149,708,431		
Tandem Switch MOU			Dedicated Trunk-SW	100,800		
Local	86,196,786					
IntraLATA Toll	88,670,187					
InterLATA Toll	1,478,808,963					
	1,653,675,936					

Cost Detail

Loops percent	1.01%	20.22%	16.19%	5.34%	33.87%	23.37%	100.00%
Loops	18,099	362,672	290,504	95,814	607,629	419,267	1,793,985

	interconnected at end office	tandem	wtd average
Local interconnection	$ 0.0025	$ 0.0056	n/a
IXC switched access	$ 0.0028	$ 0.0059	$ 0.0035

per 800 attempt (TCAP)	$ 0.0028
	$ 0.0011
ISUP cost/transaction	$ 0.0012
ISUP cost/completion	$ 0.0016
IXC switched access MOU/comp	8.78
ISUP cost/min	$ 0.0002
D link per month	$ 20.68
DS-1 per month	$ 90
DS-3 per month	$ 2,525

	0 - 5 lines/sq mi	5 - 200 lines/sq mi	200 - 650 lines/sq mi	650 - 850 lines/sq mi	850 - 2550 lines/sq mi	> 2550 lines/sq mi	wtd average
NID cost per month	$ 0.56	$ 0.56	$ 0.53	$ 0.58	$ 0.54	$ 0.44	$ 0.52

trunk port costs	
per trunk port (DS-0)	$ 3.31
per trunk port minute	$ 0.00050
total EO usage per minute	$ 0.00228
trk port/min	$ 0.00050
other	$ 0.00178

Exhibit ____ (DJW-4)
Docket No. 961230

Model Description

Hatfield Model

Version 2.2, Release 2

Hatfield Associates, Inc.
International Telecommunications Consultants
737 29th Street, Suite 200
Boulder, Colorado 80303

September 4, 1996

TABLE OF CONTENTS

I. INTRODUCTION

A. OVERVIEW{PRIVATE }

The Hatfield Model has been developed by Hatfield Associates, Inc. (HAI), of Boulder, Colorado, at the request of AT&T and MCI. Its purposes are: 1) to estimate the forward-looking economic cost of unbundled network elements referenced in § 252(d)(1)(A) and (B) of the Telecommunications Act of 1996 based on Total Element Long Run Incremental Cost (TELRIC) principles;[1] and 2) in a separate calculation using consistent procedures and input data, to estimate the forward-looking economic cost of the basic local telephone service that is the target of universal service funding mechanisms.[2]

B. EVOLUTION OF THE HATFIELD MODEL

The original version of the Hatfield Model was developed to produce estimates of the TSLRIC of basic local telephone service as part of an examination of the cost of universal service. This original model was a "greenfield" model in that it assumed all network facilities would be built without consideration given to the location of existing wire centers or transmission routes. When the original Benchmark Cost Model (BCM1)[3] became available, HAI revised the original Hatfield Model to incorporate certain loop investment data

---

1 TELRIC is the term used by the Federal Communications Commission to refer to the total service long run incremental cost (TSLRIC) of unbundled network elements.

2 The definition of basic universal service used in the model includes the following functional components:

single-line, single-party access to the first point of switching in a local exchange network;

usage within a local exchange area;

touch tone capability;

a white pages directory listing; and

access to 911 services, operator services, directory assistance, and telecommunications relay service for the hearing-impaired.

Excluded from this definition are many other local telephone company services, such as toll calling, interexchange carrier access, custom calling and CLASS[SM] features, and private line services, although the existence of such services is taken into account in developing the cost estimates for unbundled elements.

3 The Benchmark Cost Model is a model of basic local telephone service developed by MCI, NYNEX, Sprint, and U S WEST.

produced by BCM1. As a result, the Hatfield Model became a "scorched node" model that developed efficient, forward-looking network investments and costs for basic universal service based on existing wire center locations. Thus, this new version of the Hatfield Model combined results from BCM1's loop modeling (based on actual population distributions) with the extensive wire center and interoffice calculations from the earlier Hatfield Model.

Early in 1996, an expanded version of earlier Hatfield Models, referred to as the Hatfield Model, Version 2.2, Release 1, was developed to estimate the costs for unbundled network elements. It was submitted to the Federal Communications Commission (FCC) in CC Docket No. 96-98 on May 16 and 30, 1996, accompanied by descriptive documentation.[4] On July 3, 1996, this model was placed into the record of CC Docket No. 96-45 to assist the Commission in determining the economic costs of universal service.[5]

The Hatfield Model, Version 2.2, Release 2 (hereafter HM2.2.2), described in this document, estimates the efficient, forward-looking economic cost of both unbundled network elements and basic local telephone service. This release incorporates a number of enhancements over earlier versions.[6] HM2.2.2 derives certain of its inputs and methods from the BCM-PLUS model. The BCM-PLUS model is a derivative of BCM1 that has been developed for and is copyrighted by MCI Telecommunications Corporation.[7] Furthermore, because populated data workfiles now accompany HM2.2.2, Release 2 executes more quickly than Release 1, and without required user intervention.

The Hatfield Model comprises several workbook files in Microsoft Excel 7.0 for Windows 95 or Windows NT. An automated front end interface permits the user to select the study area to be modeled and to enter any desired user-adjustable input assumptions. The entire model will then execute without any

---

4 See, Appendix E of the *Comments* of AT&T in CC Docket No. 96-98, In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, and Appendix D of AT&T's *Reply Comments*. In the same proceeding, MCI submitted results based on an earlier "greenfield" version of the Model as Attachment 1 to its *Comments*.

5 Ex parte submission of L. Sawicki, MCI.

6 Appendix A to this documentation contains a summary of the differences between Release 1 and Release 2 of Version 2.2 of the Hatfield Model.

7 On July 3, 1996, Sprint Corporation and U S WEST presented version 2 of the BCM (BCM2) to the FCC. NYNEX and MCI are not sponsors of BCM2. A careful review by HAI indicates that all of BCM2's relevant enhancements over BCM1 are already present in the Hatfield Model. Furthermore, the Hatfield Model has important attributes and capabilities that are not available in the BCM2.

required user intervention.[8] Although AT&T and MCI typically have run HM2.2.2 for 49 continental U.S. study areas (Bell Operating Companies "BOCs" plus Southern New England Telephone Company), it may be run for any Tier 1 study area.[9]

C. PURPOSE OF THIS DOCUMENT

This document describes: 1) the structure and operation of HM2.2.2, and 2) inputs to the model, emphasizing those that can be changed by the user and their default values. It should be emphasized that the model provides a large number of inputs that can be altered by the user. However, the default values for these inputs are believed to be appropriate based on the experience and engineering judgment of HAI personnel and other subject matter experts.

II. STRUCTURE OF THE MODEL

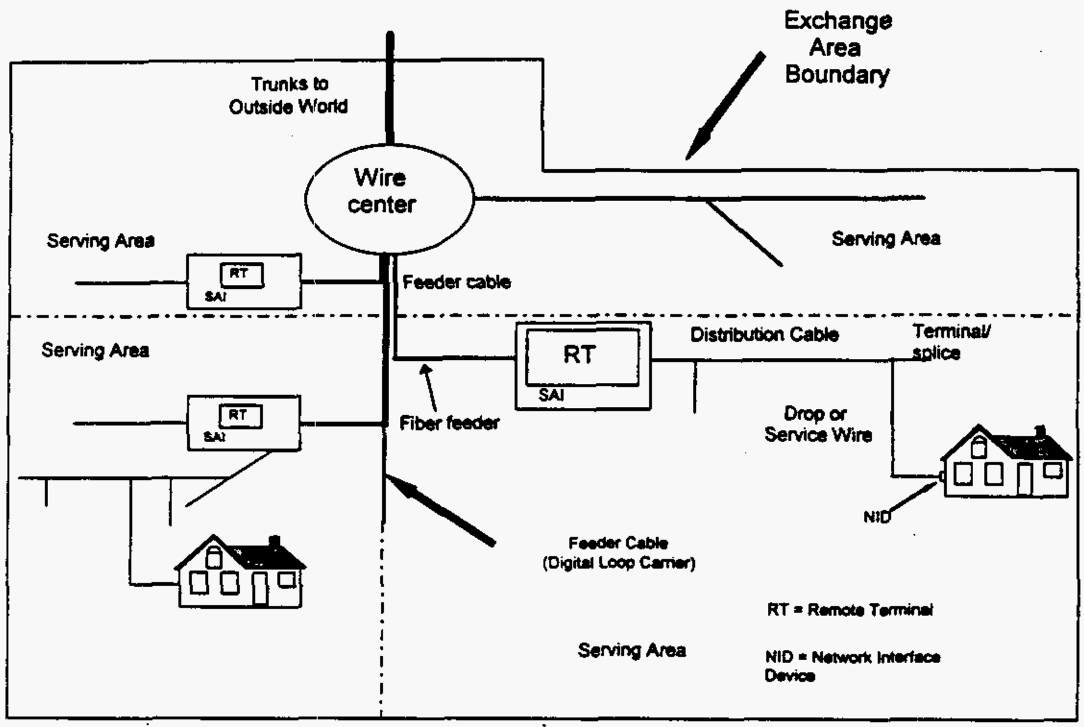
A. GENERAL NETWORK COMPONENTS DESCRIPTION

This section describes generally the network components modeled in HM2.2.2. Figures 1, 2 and 3 depict the relationships among the network components discussed in the following sections.

8 Documentation of this automated user interface is provided in Appendix B.

9 AT&T has retained telecommunications consultants from the Deloitte & Touche Consulting Group (and not Deloitte & Touche, LLP as might have been inferred from the prior reference to "Deloitte & Touche" in footnote 7 of AT&T's August 9, 1996 *Further Comments* in CC Docket No. 96-45), to provide additional Hatfield support. Deloitte & Touche Consulting Group personnel have: (1) provided analytical support to Hatfield and AT&T personnel; (2) assisted with data entry, results interpretation, and version and release testing; and (3) worked to improve the Hatfield Model's user interfaces, as well as to identify other areas for improvement with regard to the operation of the model.

1. Loop description



dlcsys2b

Adopted from Engineering and Operations in the Bell System Edition, 1983

Figure 1 Loop components

a) General loop description

The local loop begins at a physical demarcation frame within the central office building (wire center). Copper cable feeder facilities terminate on the vertical side of the main distributing frame (MDF) in the wire center. Fiber optic feeder cable serving integrated digital loop carrier terminates on a fiber distribution frame in the wire center. At its distant end, the local loop terminates at the Network Interface Device (NID) at the customer's premises.

Loop cables are supported by "structures." These "structures" may be underground conduit, poles, or trenches for buried cable. Underground cable is distinguished from buried cable in that underground cable is placed in conduit, while buried cable comes into direct contact with soil.[10]

---

10 While the conduit supporting underground cable is placed in a trench, buried cable may either be placed in a trench or be directly plowed into the earth.

b) Local Loop Components

(1) NID

The demarcation point between the local carrier's network and the customer's inside wiring is known as the Network Interface Device (NID). This device terminates the drop wire and is an access point that may be used to isolate trouble between the carrier's network and the customer's premises wiring.

(2) Drop

A drop wire extends from the NID at the customer's premises to the block terminal at the distribution cable that runs along the street or the lot line.

(3) Block Terminal

The block terminal is the interface between the drop and the distribution cable. With aerial distribution cable, the block terminal is attached to a pole in the subscriber's backyard or at the edge of a road. If the distribution cable is buried, then the block terminal is contained within a pedestal.

(4) Distribution Cable

Distribution cable runs from each of the block terminals to the Serving Area Interface (SAI), also called a "cross box" or Serving Area Concept (SAC) box or connection. Distribution cable connects the feeder cable with all customer premises within a Census Block Group (CBG). The model assumes that each CBG contains one SAI, and that the SAI is placed one quarter of the way into the CBG. Distribution structure components may consist of poles, trenches and conduit. Manholes normally are not used in distribution facilities.

(5) Feeder facilities

Feeder cable may be copper wires or optical fibers. Feeder cables extend from the wire center to the SAIs. The Hatfield Model assumes that there is a standard feeder distance beyond which optical feeder cable will be installed and Digital Loop Carrier (DLC) equipment will be used to serve subscribers.

Feeder structure components also include poles, trenches and conduit. Manholes are also normally installed in conjunction with underground feeder cable. Manhole spacing is a function of population density and the type of feeder cable used. Manholes installed for underground fiber cable are normally farther apart than are manholes used with copper cables because the lightness and flexibility of fiber cable permits it to be pulled over longer lengths than copper cable. The costs of structure components are normally shared among at least three utilities, e.g., electric utilities, local exchange companies (LECs) and cable television (CATV) operators.

2. Interoffice network description

This section describes generally network components at the wire center and interoffice level. Figures 2 and 3 illustrate the relationships among the components described below.

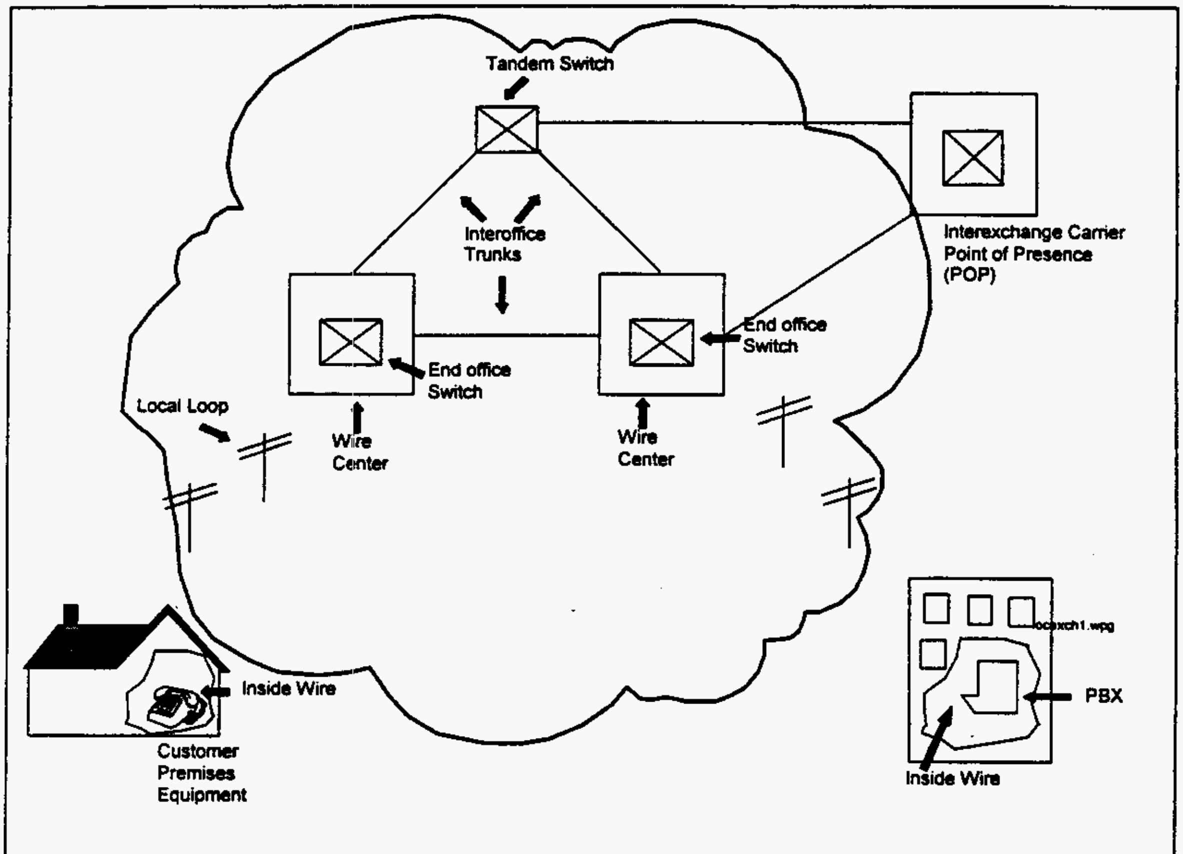


Figure 2 Interoffice network

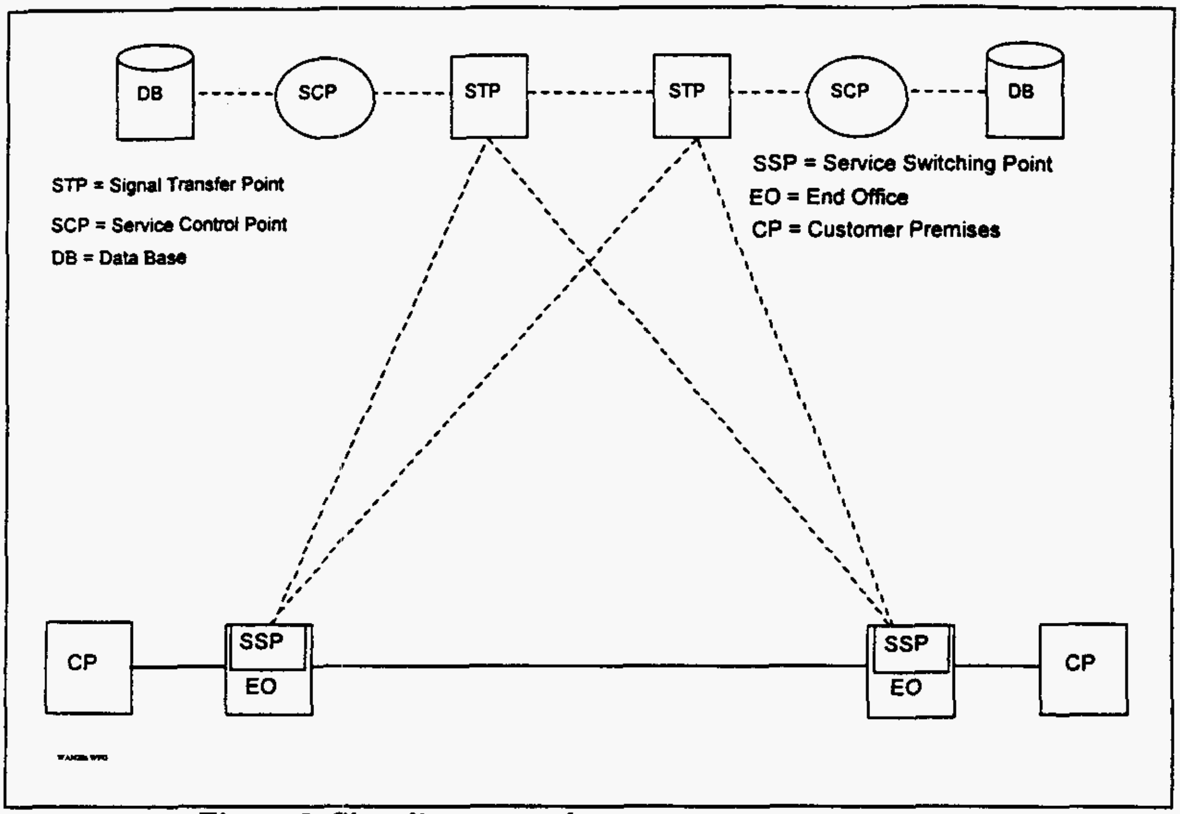


Figure 3 Signaling network components

a) Wire center

The wire center is a location from which local feeder routes emanate. A wire center normally contains at least one End Office (EO) switch and also may contain a tandem office, a Signal Transfer Point (STP), an operator tandem, or any combination of these facilities. Wire center physical facilities include a building, power and air conditioning systems, separate rooms housing switches, transmission equipment, distributing frames and entrance facilities for interoffice and loop cables.

b) End office switch

The end office switch provides dial tone to the switched access lines it serves. It also provides connections to other end offices via direct trunks, to tandem switches via tandem trunks, and to operator tandems via operator trunks. The model computes the numbers of trunks for each route according to input traffic assumptions and the breakdown of business, residential, and public access lines served by each end office switch.

c) Tandem switch

Tandem switches interconnect end office switches via tandem trunks. These trunks provide an alternate route for traffic between end offices when direct routes are unavailable. The tandem also may route access traffic between end offices and interexchange carriers' (IXC's) points of presence (POPs). Tandem switching functions often are performed by switches that also perform end office functions.

d) Signal transfer point

STPs route signaling messages between switching and control entities in a Signaling System 7 (SS7) network via signaling links between STPs and SS7-compatible end offices and tandems (called Service Switching Points "SSPs") as well as Service Control Points (SCPs). STPs are equipped in mated pairs, with at least one pair in each LATA.

e) Service switching points

SSPs are SS7-compatible end office or tandem switches. They communicate with each other and with SCPs through signaling links, which are 56 kbps dedicated circuits connecting SSPs with the mated STP pair serving the LATA.

f) Service control points

SCPs are databases residing in an SS7 network that contain various types of information such as IXC identification or routing instructions for 800 numbers in regional 800 databases and customer line information in Line Information Databases (LIDB).

B. OVERVIEW OF MODEL ORGANIZATION

Figure 4 shows the relationships among the various modules contained within HM2.2.2. An overview of each component module follows.

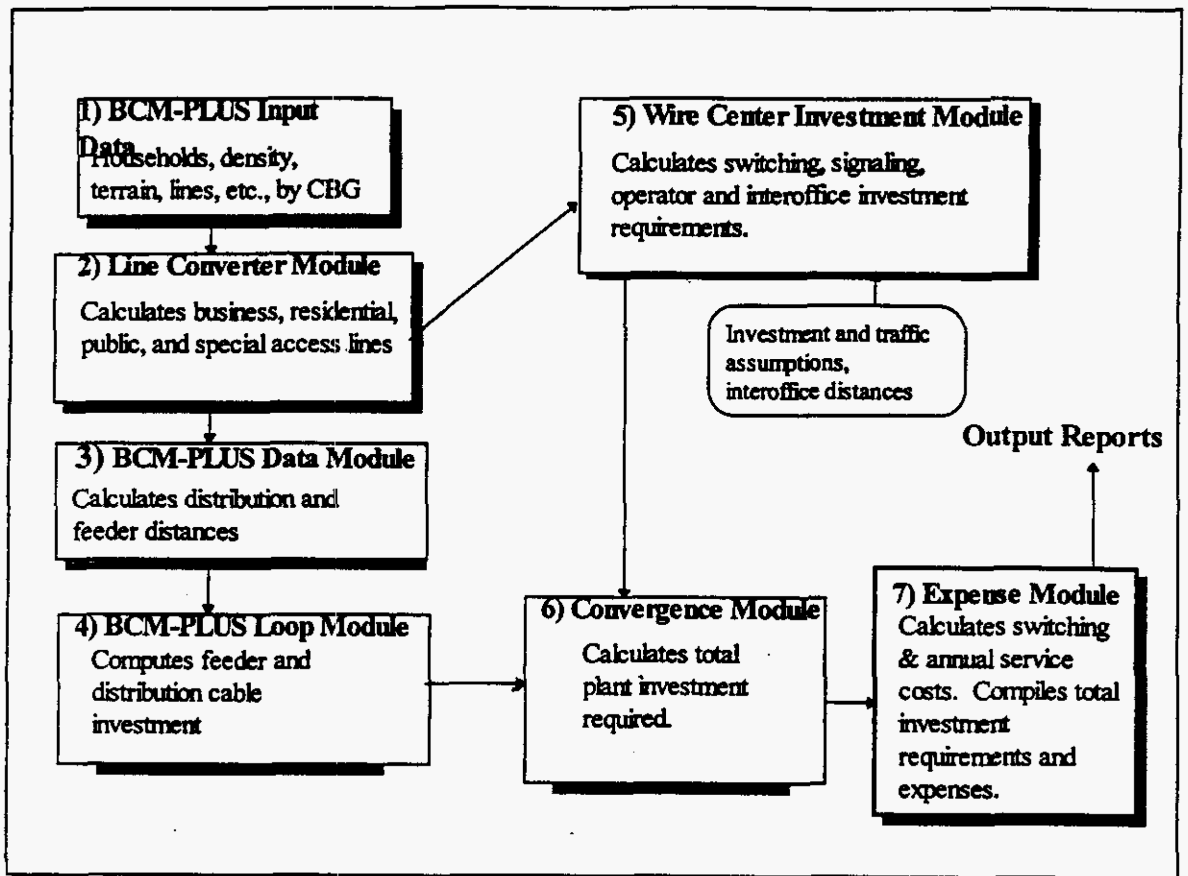


Figure 4 Hatfield Model Organization Flow Chart

1. BCM-PLUS loop input data file

The BCM-PLUS input data for the model generally consist of the original BCM state-by-state worksheets filed with the FCC.[11] The input household counts in each CBG (which in BCM1 were derived from 1990 Census Bureau data) have been replaced with 1995 household counts estimated from more recent Census Bureau data. As the following section discusses, HM2.2.2 modifies these BCM-PLUS data in several significant ways.

2. Line Converter Module

The model calculates all network costs on a per line basis, thus it must first determine the total access lines of all types within each CBG. The Line Converter Module transforms the Census data included in the BCM-PLUS input data files (which contain only household counts for each CBG) into total line counts by

11 These data are for all states except Alaska. While the pertinent data for Alaska are included with BCM2, the BCM2 sponsors have placed more restrictive terms in the BCM2 license agreement that prohibit the use of these data for modeling use here.

customer type. The Line Converter Module performs this function while recognizing that residential subscriber penetration is less than 100%, that some residences contain second lines, and that business, public, and special access lines need also to be added. The module adds these latter line types based on other of its input data that indicate the number of business employees in each CBG. These line number calculations, which are performed on a CBG by CBG basis, are also required to accord with the number of lines that the incumbent LEC (ILEC) reports for the study area in ARMIS.

3. BCM-PLUS Data Module

The Data Module computes the distribution and feeder cable lengths necessary to serve each CBG and determines facilities placement difficulty according to geological parameters included in the BCM-PLUS input data.

4. BCM-PLUS Loop Module

The Loop Module estimates cable investments in each CBG according to the distribution and feeder lengths calculated in the Data Module. The module selects either fiber or copper feeder cable according to a user-adjustable parameter that specifies the feeder distance beyond which fiber is to be installed. The module then determines the size of copper or fiber cable required to serve each CBG according to user-adjustable maximum engineered fill levels for each population density range. Once the module has determined the required types and sizes of cable, it computes the total investment in feeder and distribution cables.[12]

5. Wire Center Module

The Wire Center Module computes investment in wire centers, switching (including end offices, tandems, and operator tandems), signaling, and interoffice transmission facilities. It uses line totals by type across all CBGs served by the wire center, along with user-adjustable traffic inputs, to estimate required switching capacities.

The model determines switching and interoffice capacity sufficient to serve all demand in the service area studied. HM2.2.2 derives its switch investment estimates by using data on typical per-line prices paid by BOCs, GTE and other independents,[13] and data from Table 2.10 of the FCC's *Statistics of Communications Common Carriers*, which provides the average number of access lines served by existing LEC switches.

---

12 A later module, the Convergence Module, adds investment for placement and "structure" (conduit, poles, trenching, and manholes), as well as other components, including SAIs, terminals, splices, subscriber drops and NIDs.

13 See *U.S. Central Office Equipment Market – 1994*, McGraw-Hill.

6. Convergence Module

The Convergence Module combines output of the Loop Module (loop cable investments) with that of the Wire Center Module (per-line wire center and interoffice investments). The Convergence Module also adds investment in SAIs, buried, underground and aerial cable placement, terminals and splices, drop wires, NIDs, and structure components including poles, conduit, and manholes. Output from this module contains total investment for all plant categories by density range.

7. Expense Module

The Expense Module uses output from the Convergence Module to produce monthly costs of Unbundled Network Elements (UNEs) and basic local service. These costs include the annual user cost of capital for network investment (e.g., depreciation, return, and tax on return), network operating and maintenance expenses, and other per-line expenses incurred by ILECs in the provision of local service and UNEs. This module uses investment, revenue and expense data relationships that are available from ILEC ARMIS reports and allows the user to set different economic lives for various plant categories as well as adjust capital structure parameters.

C. MODULE DESCRIPTIONS

1. BCM-PLUS Input Data File

BCM-PLUS includes input data files organized by state. Each state file contains a list of that state's CBGs. CBGs are assumed to be served from the nearest existing wire center.[14] Each CBG appears as a separate record in a Microsoft Excel 7.0 spreadsheet, and each record includes a set of geometric parameters describing the physical relationship (distance and direction) between the center of the CBG and the wire center serving it. The data also contain certain geological parameters associated with the CBG that indicate bedrock depth, bedrock hardness, and soil type.[15] The input data file also contains the estimated number of households in each CBG as of 1995.

---

14 Because wire centers are associated with specific telephone companies, the model may be run on a company-specific basis.

15 Studies of the effects of these parameters on the estimate of placement difficulty show that the parameters affect overall results only slightly. The HM2.2.2 Convergence Module produces much more accurate estimates of placement investment with user-adjustable inputs than did the original BCM with its undocumented input assumptions. As noted in the text, however, HM2.2.2 (continued)

2. Line converter module

a) Overview

HM2.2.2 engineers loop facilities for residence, business, public and special access lines. As shown in Figure 5, the Line Converter Module calculates total access line counts for each CBG, as well as overall line totals for use in the BCM-PLUS Data Module and the Wire Center Investment Module. The Line Converter Module replaces the household count in each CBG with estimated total access lines, including business, public, special access, and first and second residential lines. This allows the BCM-PLUS Loop Module to calculate the sizes of feeder and distribution cables required to serve the existing demand.

b) Description of inputs and assumptions

The Line Converter module uses access line demand data from the Operating Data Reports, ARMIS 43-08, submitted to the FCC annually by all Tier 1 LECs.[16] HM2.2.2 thus incorporates the following data.

- Residential access lines, both analog and digital. These totals measure all residential switched access lines, including flat rate (1FR) and measured rate (1MR) service.[17]
- Business access lines, including analog single line, analog multiline and digital. These totals include flat rate business (1FB) and measured rate business (1MB) single lines, PBX trunks, Centrex lines, hotel/motel long distance trunks and multi-line semi-public lines.[18]
- Special access lines, including analog and digital. These totals include dedicated lines connecting end users' premises to an IXC POP, but do not include intraLATA private lines.[19]

---

increases feeder and distribution cable lengths in the presence of shallow bedrock or rocky soil types for routing of facilities around areas with difficult placement conditions.

16 See, Reporting Requirements for Certain Class A and Tier 1 Telephone Companies (Parts 31, 43, 67 and 69 of the FCC's Rules), CC Docket No. 86-182, 2 FCC Rcd 5770 (1987) (ARMIS Order), modified on recon., 3 FCC Rcd, 6375 (1988). Tier 1 LECs are those with more than $100 million in annual revenues from regulated services. This includes over 50 carriers.

17 Revision of ARMIS USOA Report (FCC Report 43-02) for Tier 1 Telephone Companies and Annual Report Form M, AAD 92-46, DA 92-1405, released October 16, 1992, Appendix C, at FCC Report 43-08 - Report Definition for Table S-3, page 2.

18 *Id.* at 1-2.

19 *Id.* at 2-3.

- Public access lines, which include lines associated with coin (public and semi-public) phones, but exclude customer owned pay telephone lines.[20]

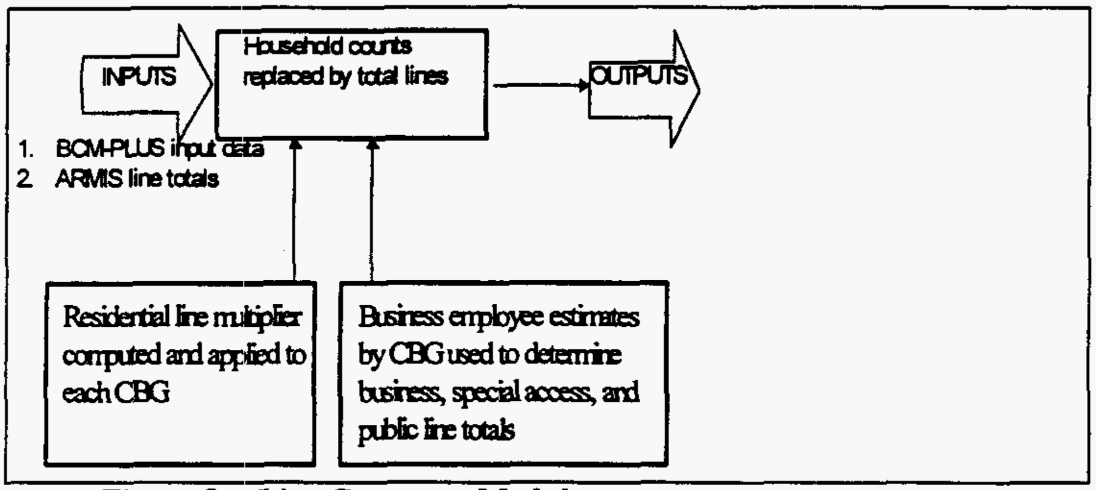


Figure 5 Line Converter Module

c) Explanation of calculations

In order to estimate loop plant investment properly, the model must consider the demand for all services, *e.g.*, business, first and second residential, special access and public access lines, within each CBG. Presumably, these service-specific demand data are known to the ILECs at a wire center or finer level. But because the ILECs have declared these data to be proprietary, absent Commission directive they are not available for incorporation into HM2.2.2.[21]

The Line Converter Module uses ARMIS access line data to assist in estimating total line counts per CBG. To compute residential lines in each CBG, the module multiplies the household count by the ratio of total reported residential access lines to total households. This accounts for total household penetration and multiple residential lines via a single average factor. The module similarly computes business lines in each CBG by multiplying the number of business employees in each CBG by the ratio of total reported business lines to total employees in the study area. Special access and public line calculations also are

20 *Id.* at 2.

21 Some BOCs, notably the Southwestern Bell companies, formerly published this information for use by their interexchange carrier customers, but the practice apparently has been discontinued. See, Southwestern Bell, *Interexchange Customer Information Handbook*, Volume IV (End Office Profile), 1987.

based on business employee counts because both services are closely associated with businesses.

d) Description of module outputs and connection to next module

The primary output from the Line Converter Module is the Input Data File -- with household counts in each CBG replaced by total residential, business, special access and public lines. The other data in the Input Data File pass through the module unchanged for eventual use by both the BCM-PLUS Data Module and the Wire Center Module.

3. BCM-PLUS Data module

a) Overview

The BCM-PLUS Data Module uses Line Converter Module output to calculate feeder, subfeeder, and distribution cable lengths. The BCM-PLUS Data Module uses the distance between each CBG and its serving wire center, and the area of each CBG, to estimate feeder and distribution cable lengths. In areas of increased placement difficulty, generally those CBGs with shallow bedrock (within one foot of the surface) or having rocky (*e.g.*, "bouldery") soil types, the Data Module increases the calculated feeder and distribution distances to allow for routing of facilities around these rocky conditions.

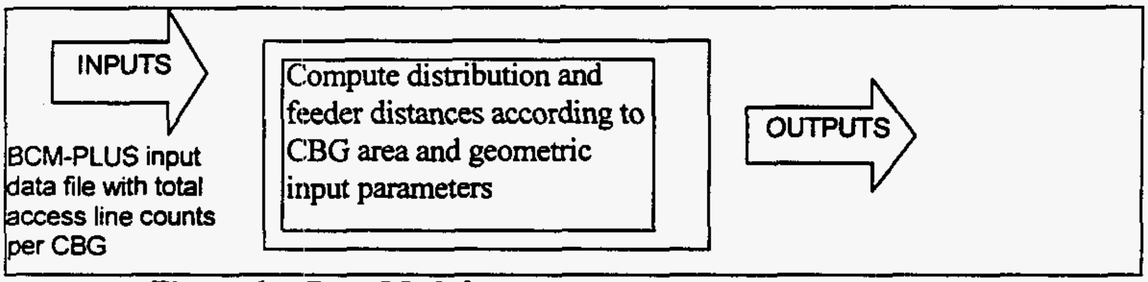


Figure 6 Data Module

b) Description of inputs and assumptions

The Data Module bases its loop length calculations on the following assumptions.

- Feeder cable extends from the wire center to an SAI located midway between the edge and the center of the CBG.
- There are four main feeder routes that leave each wire center, with sub-feeder routes placed at 90 degree angles from the main feeder routes.
- Customer premises are spaced uniformly across a CBG.

- Distribution cables extend from the SAI within the CBG to terminals serving several customers' premises.
- A variable number of equal-length distribution cables serve each CBG. The area of the CBG determines the length of each cable, and the CBG line density determines the number of cables.

A more detailed description of the model's feeder route design is contained in the documentation to Release 1.[22]

c) Explanation of calculations

Distribution Distance -- BCM-PLUS uses geometric relationships to calculate distribution distances. The distribution distance is the average distance between a customer premises and the SAI. The module calculates the average distribution distance within a CBG to equal 0.625 times the length of one side of the CBG.

SAI placement -- The Data Module adds sufficient feeder cable to place the SAI at a point midway between the CBG boundary and its center. This approach comports with telephone company outside plant engineering practices.

d) Outputs

The output of the BCM-PLUS Data Module includes total line counts per CBG, along with feeder and distribution cable lengths. Other parameters include "cable multipliers" used in a previous version to estimate combined placement investment. Because HM2.2.2 calculates separately cable placement and structure investments, these values are not used by BCM-PLUS.

4. BCM-PLUS Loop Module

This section discusses inputs and calculations in the BCM-PLUS Loop Module.

a) Module overview

The BCM-PLUS Loop Module estimates loop cable facilities investment for HM2.2.2. The Loop Module employs a "bottoms-up" network design process that uses forward-looking loop plant engineering and planning practices, publicly-available information on component prices, and least-cost cable sizing algorithms to estimate the outside plant investment appropriate to a TELRIC-based analysis.

---

22 See, note 4, *infra*.

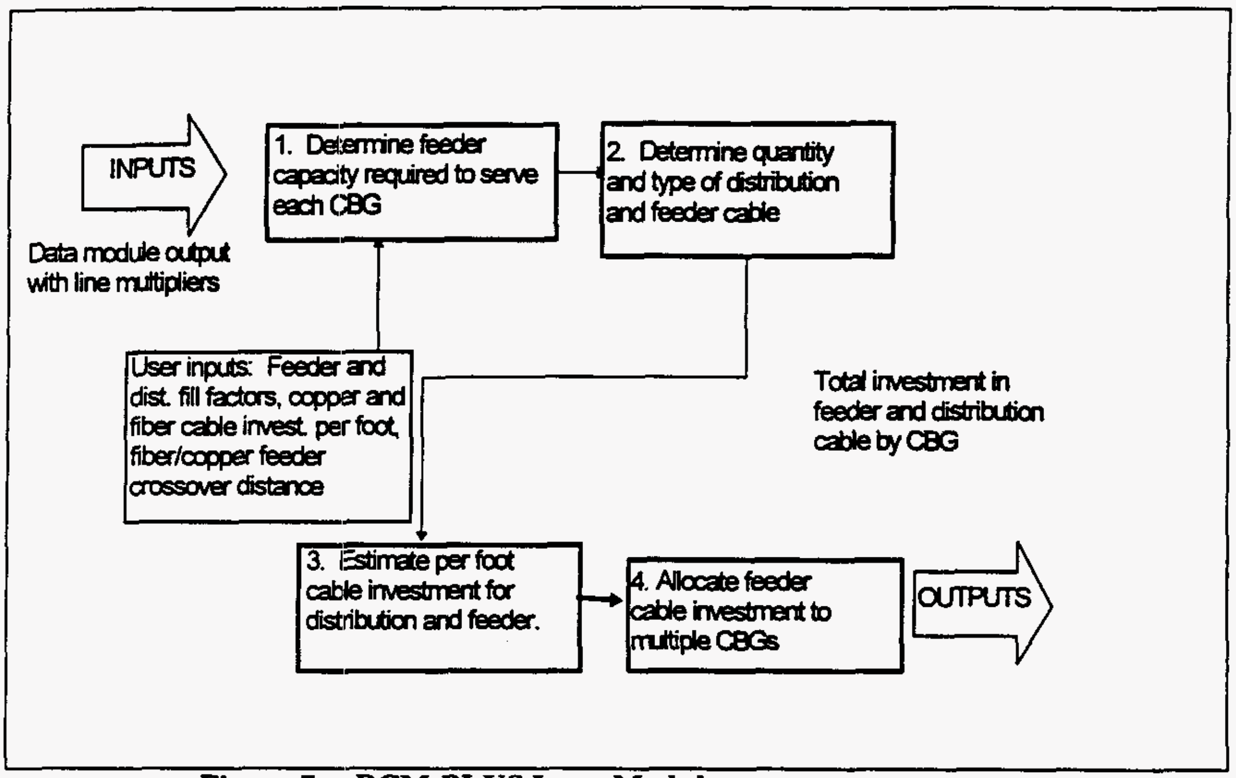


Figure 7 BCM-PLUS Loop Module

b) Description of inputs and assumptions

Inputs to the Loop Module include the per-foot investment cost for copper and fiber cable, the distance at which fiber feeder cable is installed, the number of DS-0s that can be carried on a single fiber, and the number of fibers required to feed a DLC remote terminal. There are separate per-unit investment tables for distribution, copper feeder, and fiber feeder cables. These tables show the assumed per-foot investment for cables having different cross sections. The default numbers in these tables assume discounted cable materials prices, along with per-unit costs for installation, engineering, and delivery.

c) Inputs derived from the Data Module

The following outputs from the Data Module are used as inputs by the Loop Module.

Feeder and Distribution Distances -- These are the feeder, sub-feeder and distribution lengths calculated for each CBG. The main feeder distance (called the "B" distance in the model) for each CBG is expressed as the incremental distance from the CBG to the CBG served by that feeder that is the next closest to the wire center (the "B segment" length). The formula used to develop B segment length is to first match the CBG with all others served by the same wire center and within the same quadrant (*i.e.*, on the same main feeder route). The module then calculates the B segment length for each CBG by subtracting from its total B length the total B length associated with the next CBG closer to the wire center. Segmentation of the main feeder in this way allows the Loop Module to simulate the tapering of cable facilities along the feeder route.

The model also computes a "subfeeder" distance (called the "A" distance within the model) which is the distance from the main feeder route to the SAI in CBGs that are not astride the main feeder route.

d) User Specified Inputs

Because the Loop Module simulates the "bottoms up" development of a network, it requires several inputs specifying the type and purchase price for copper distribution cable and copper and fiber feeder cable, as well as maximum engineered cable fill factors that vary by density range. Because the actual prices paid for these components may vary from carrier to carrier, these values may be adjusted, if appropriate, by the user. The model, however, contains HAI's best estimates as default values for cable investment per foot and cable fill factors. These default values for fill factors and cable investment per foot are as follows:

Density (lines/sq. mi.)	Feeder fill	Distribution fill
0 - 5	0.65	0.50
25 - 200	0.75	0.55
200 - 650	0.80	0.60
650 - 850	0.80	0.65
850 - 2550	0.80	0.70
> 2550	0.80	0.75

Fiber feeder cable investment per foot (including engineering, delivery and installation)	
Fiber cable size(strands)	Investment per foot
12	$2.90
18	$3.20
24	$3.50
36	$4.10
48	$4.70
60	$5.30
72	$5.90
96	$7.10
144	$9.50
216	$13.10

Copper feeder cable investment per foot (including engineering, delivery and installation)	
Pairs in sheath	Investment per foot
100	$2.50
200	$4.25
400	$7.75
600	$11.25
900	$16.50
1200	$21.75
1800	$32.25
2400	$42.75
3000	$53.25
3600	$63.75
4200	$74.25

Distribution cable investment per foot (including engineering, delivery and installation)	
Copper cable sizes	Investment per foot
25	$1.19
50	$1.63
100	$2.50
200	$4.25
400	$7.75
600	$11.25
900	$16.50
1200	$21.75
1800	$32.25
2400	$42.75
3600	$63.75

Other user inputs are discussed in the feeder plant section below.

e) Distribution plant

This section examines components of the distribution facilities. The model assumes that all distribution cables serving a CBG are of equal length. The number of distribution cables per CBG varies by density range as shown below.

Density (lines/sq. mi.)	Number of cables
0 - 5	2
5 - 200	4
200 - 650	4
650 - 850	4
850 - 2,550	6
> 2550	8

The larger number of cables serving higher density CBGs reflects the fact that households will tend to be distributed more uniformly across densely populated CBGs than across less dense CBGs. In addition, customer premises plot sizes will be smaller. Lower numbers of cables serving lower density CBGs reflect the fact that customer premises will either be concentrated along a few roads, or clustered in towns rather than being distributed uniformly.

Mix of aerial and underground plant for distribution -- Distribution cables typically connect with the feeder network at one or more SAIs and run along streets within a defined area. Distribution plant may be aerial (carried on poles), underground (placed in conduit), or buried (plowed directly in the ground or placed in a trench without conduit). The proportions of aerial, underground and buried cable are user-adjustable variables set in the Convergence Module.

Unit Costs for Distribution Cable -- The default cable investment figures shown in the preceding table include discounted materials prices, engineering, delivery to the site, and placement or installation.[23] These costs are added to other loop investments in the Convergence Module, described later.)

Fill Factors for Distribution Cable -- The Loop Module permits users to input values specifying the maximum engineered level of plant utilization or "fill" for distribution and feeder cable.[24] Engineered cable fills are always less than 100% in practice, with some spare pairs necessary to accommodate unforeseen growth, breakage and line administration.

The effective fill factors achieved by the Hatfield Model are even lower than the engineered fill factors because the model requires that the next larger available cable size be installed to accommodate the engineered fill.

f) Feeder plant

Feeder cables extend along any of four routes from the wire center to one or more points where they are cross-connected to the distribution network. Depending on required feeder capacity, distance or economics may dictate that feeder be provisioned using various sizes of copper cabling, or fiber cables in conjunction with DLC systems. The Loop Module assumes that a CBG will be served with fiber-fed DLC equipment whenever the feeder length exceeds a user-adjustable threshold value (the default is 9,000 feet); otherwise it assumes copper feeder cable.

The user may specify the number of fibers assigned per DLC remote terminal. The default value is four. Similarly, the number of equivalent voice

23 Placement investment consists of pulling underground cable through conduit and mounting aerial cable on poles. It should not be confused with the actual "structure" investment in poles, conduit and manholes, or in the installation of structure components.

24 A cable fill factor represents the ratio of working lines (measured in terms of voice grade equivalent channels or copper wire pairs) to minimum installed line capacity.

circuits (DS-0s) that may be carried on this fiber may be set by the user. The default value is 2016, or 3 DS-3s.

Mix of aerial and underground plant for feeder -- These values are set in the Convergence Module, as they are for distribution cable.

g) Explanation of calculations

The Loop Module's calculations include the following:

- Selection of copper or fiber feeder cable to serve each CBG according to the user-adjustable threshold feeder distance (default is 9,000 ft).
- Sizing of main feeder segments to accommodate the cumulative capacity requirements along the route.
- Determination of the type and quantity of feeder facilities and distribution cables to meet each CBG's capacity requirements.

Applying unit investment costs to estimate total investment in loop cables -- The fundamental feeder length calculations, including the sharing of feeder sheath by multiple CBGs lying on a common route, are essentially unchanged from those described in the Release 1 documentation. The BCM-PLUS Data Module does, however, extend the SAI location into each CBG halfway to its center.

The BCM-PLUS Loop Module computes distribution cable lengths as 0.625 times the length of a side of the CBG. The number of cables serving a CBG varies according to the CBG's density range, as described in the Data Module discussion above. The Loop Module sizes the distribution cables according to the specified fill factor and number of cables in each CBG.

h) Description of model outputs

The Loop Module produces total investment by CBG for distribution and feeder cable. The Loop Module's "costing" worksheet contains these investments and is sent to the Convergence Module to determine overall network investment.

5. Wire Center Investment Module

a) Overview

This Module produces network investment estimates in the following categories:

Switching and wire center investment -- This category includes investment in local and tandem switches, along with associated investments in wire center facilities, including buildings, land, power systems and distributing frames.

Signaling network investment -- This includes investment in STPs, SCPs and signaling links.

Transport investment -- This category consists of investment in transmission systems supporting local interoffice (tandem and direct) trunks, intraLATA toll trunks (tandem and direct) and access trunks (tandem and direct). The model also separately calculates investment in operator trunks.

Operator Systems investment -- This includes investments in operator systems positions and operator tandems. The module allows the operator positions to be located at a distance from the operator tandem.

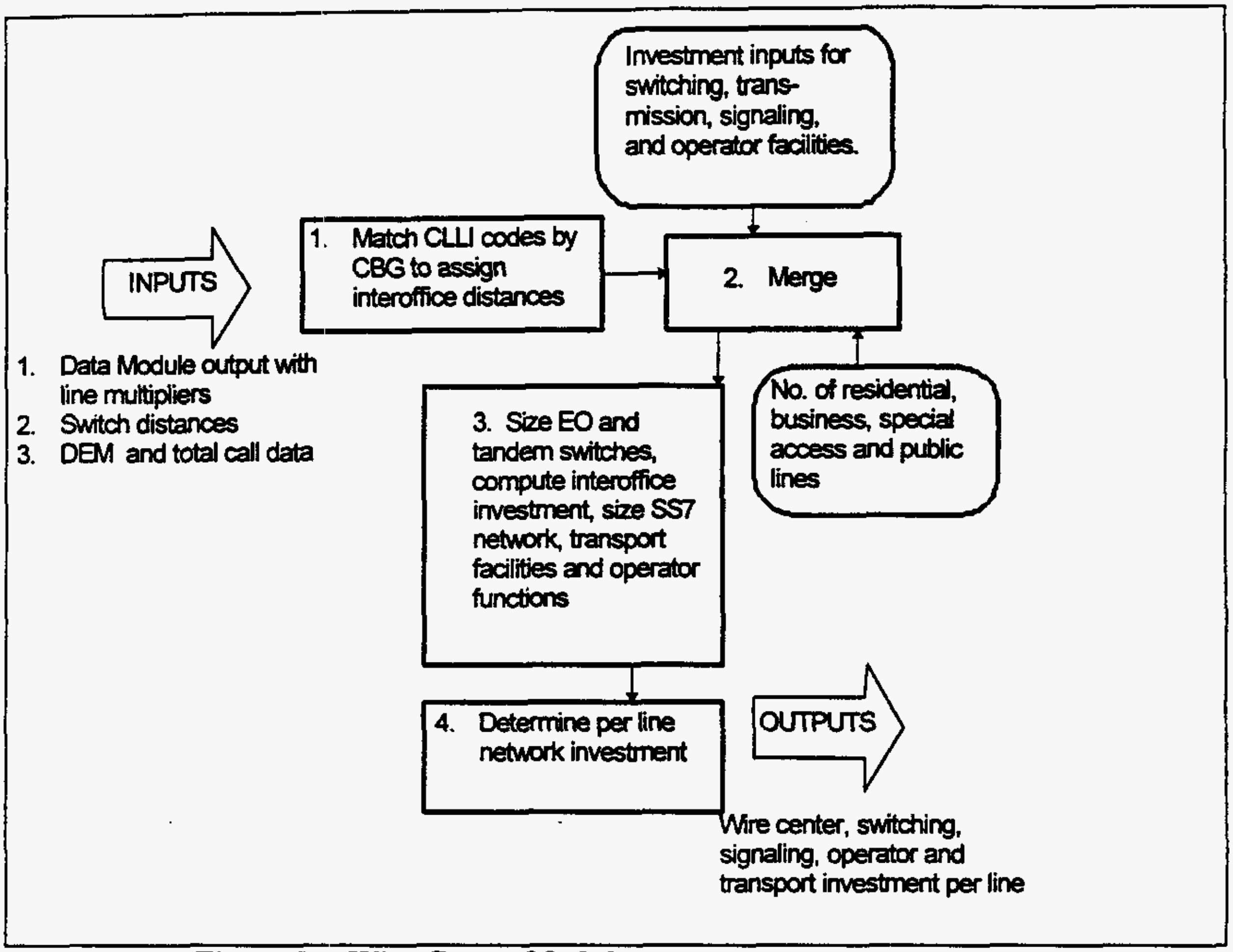


Figure 8 Wire Center Module

b) Description of inputs and assumptions

For the wire center module to compute required switching and transmission investments, it must have as inputs total line counts for each wire center, interoffice distances, traffic peakedness assumptions, as well as inputs describing the distribution of total traffic among local intraoffice, local interoffice, intraLATA toll, interexchange access and operator services. This module takes as data inputs overall line counts obtained from the Line Converter Module and interoffice distances for the calculation of transmission facilities investment.[25]

[25] The HM2.2.2 includes a set of interoffice distance calculations produced from wire center location information from Bellcore's Local Exchange Routing Guide (LERG). Because AT&T has now gained a site license for use of these data, users of the Hatfield Model no longer need to obtain their own copies of the LERG.

There are many user-adjustable input assumptions in the Wire Center module. The following sections discuss these assumptions, and Appendix C includes additional tables showing all of the default values for the module's input parameters.

c) Traffic assumptions

Many of the calculations in the Wire Center module rely on traffic assumptions suggested in Bellcore documents.[26] These inputs, which the user may alter, assume 1.3 busy hour call attempts (BHCA) per residential line and 3.5 BHCA per business line. Total busy hour usage is then determined based on published Dial Equipment Minutes (DEM) information. Other inputs, which may be changed by the user, specify the fraction of traffic that is interoffice, the fraction of traffic that flows to operator services, the local fraction of overall traffic, as well as breakdowns between direct-routed and tandem-routed local, intraLATA toll, and access traffic. Appendix C contains tables showing the default settings for these parameters.

d) Explanation of calculations

The following sections describe the calculations used to generate investments associated with switching, wire centers, interoffice transport, signaling and operator systems functions.

(1) Switching investment calculations

The Module places at least one end office switch in each wire center. It sizes the switches placed in the wire center by adding up all the switched lines in the CBGs served by the wire center, then compares this line total to the maximum allowable switch line size. This parameter is user-adjustable, but its default setting is at 100,000 lines with a fill factor of 0.80, yielding a maximum effective switch line size of 80,000. By default, the model will equip the wire center with a single switch if the number of switched access lines served by the wire center is no greater than 80,000. If a wire center serves 90,000 lines, the model will compute the investment required for two 45,000 line switches.[27] The wire center module also compares the BHCA produced by the mix of lines served by each switch with a user-adjustable processor capacity (default set at a maximum of 600,000 BHCA) to determine whether the switch is line-limited or processor real-time-limited.

---

26 Bell Communications Research, *LATA Switching Systems Generic Requirements, Section 17: Traffic Capacity and Environment*, TR-TSY-000517, Issue 3, March 1989.

27 If multiple switches are required in the wire center, they are sized equally to allow for maximum growth on both switches.

Once the model determines the end office switch line size, it calculates the required investment per line from an investment function that relates per-line switching investment to switch line size. The data defining this function were obtained from a publicly-available study of the central office equipment market published annually by McGraw-Hill.[28] This study shows the average investment per new line of digital switching paid by BOCs to be $102, and by independents to be $235, in 1995.[29] The model combined these figures with average BOC (11,200) and independent (2,761) switch line sizes derived from data published in the FCC's *Statistics of Communications Common Carriers*, along with information on much larger switches obtained from switch manufacturers to develop the complete investment function.[30] The above per-line investment figures are for the entire end office switch, including trunk ports. These investment figures are then reduced by $16 per line to remove trunk port investment that will be accounted for in the module's trunk calculations. Figure 9 shows the resulting investment curve.

28 Northern Business Information study: *U.S. Central Office Equipment Market – 1995*, McGraw-Hill.

29 These per-line average prices represent investments over all types of switching, including remote switching systems, hosts, and stand-alone end office switches. Through this scaling, the switching investment curve thus represents automatically the cost of the average profile of remote, host, and stand-alone applications of end office switches.

30 Federal Communications Commission, *Statistics of Communications Common Carriers*, Tables 2.3 and 2.4, 1994 edition.

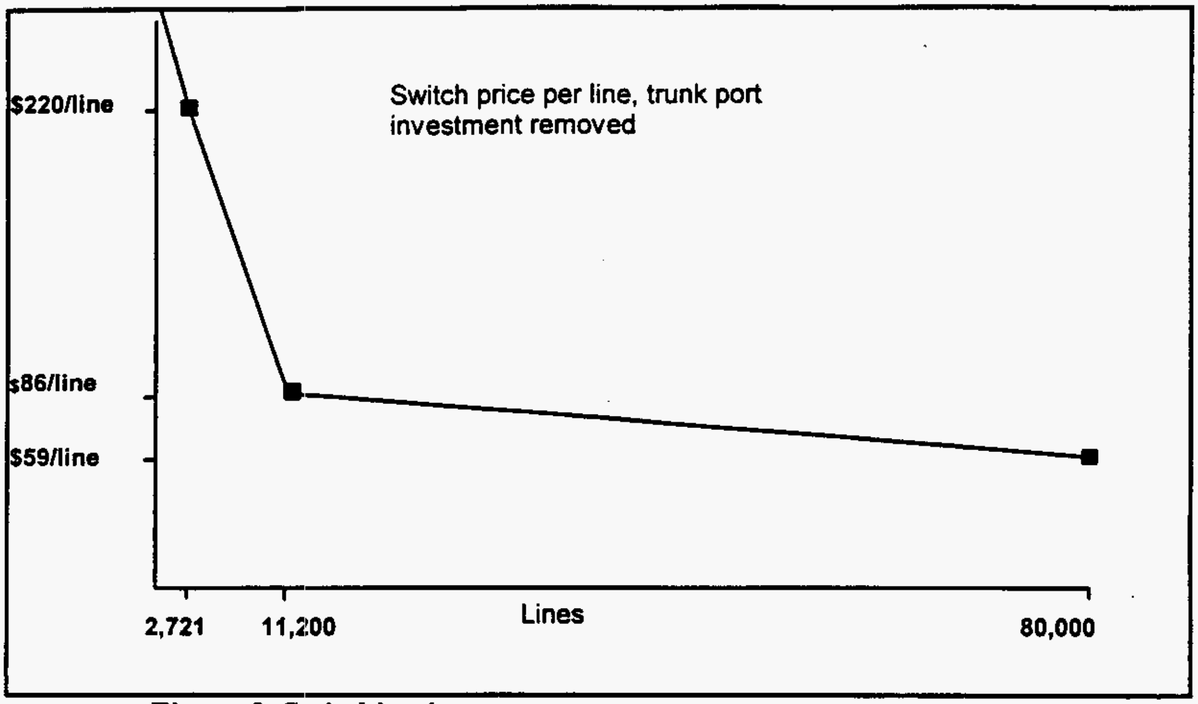


Figure 9 Switching investment curve

The wire center module uses existing tandem and end office wire center locations for computing interoffice transmission investments. A preprocessing step, relying on licensed LERG data, produces end office-to-tandem, end office-to-STP, tandem-to-STP, and STP-to-STP distances in a table that then is used by the module to estimate interoffice transmission facility investments. The module computes investments for end office and tandem "A" signaling links, "C" signaling links between the STPs in a mated pair, and it estimates investments in "D" signaling link segments that an interconnecting carrier such as an IXC may lease from the ILEC.

Tandem and operator tandem switching investments are computed according to assumptions contained in an AT&T report on interexchange capacity expansion costs filed with the FCC.[31] The investment calculation assigns a price to switch "common equipment," switching matrix and control structure, and adds to these amounts the investment in trunk interfaces. The numbers of trunks and their related investments, are derived from the transport calculations described below. The module recognizes that a significant fraction of local tandems also perform end office switching functions, and the inputs allow the user to vary the

31 AT&T, "An Updated study of AT&T's Competitors' Capacity to Absorb Rapid Demand Growth," filed with the FCC in CC Docket No. 79-252, April 24, 1995 ("AT&T Capacity Cost Study").

sharing of tandem common equipment with end office use. The default sharing value is 40%.

Wire center investments required to support end office and tandem switches are based on assumptions regarding the size of room required to house a switch (for end offices, this size varies according to the line sizes of the switch), construction costs, lot sizes, land acquisition costs and investment in power systems and distributing frames. The default values are shown in Appendix C.

The model computes required wire center investments separately for each switch. For wire centers housing multiple end office switches, the wire center investment calculation adds switch rooms to house each additional switch. Tandem wire center calculations assume the maximum switch room size, and further assume the tandem will reside in a wire center that contains at least one end office switch.

(2) Transport calculations

The traffic and routing assumptions listed above, along with the total mix of access lines served by each switch, form the basis for the model's transport calculations. The model determines the overall breakdown of traffic per subscriber according to the traffic assumptions and computes the numbers of trunks required to carry this traffic. These calculations are based on the fractions of total traffic assumed for interoffice, local direct routing, local tandem routing, intraLATA direct and tandem routing and access direct and tandem routing. These traffic fractions are applied to the total traffic generated in each wire center according to the mix of business and residential lines and appropriate per-line offered load assumptions. These trunk loading assumptions include a user-adjustable maximum trunk utilization of 27.5 CCS in the busy hour.[32]

The distance preprocessing calculations estimate interoffice distances using existing wire center and tandem locations. The calculation assumes rectilinear routing between end offices and tandems, and between switches and STPs. The resulting distances are greater than if they were calculated as airline mileage.

Average direct-route distances for local, intraLATA and access traffic are set as user-definable inputs. It is not possible to compute these values from wire center locations because existing exchange area definitions determine whether routes will carry local, intraLATA toll, or access traffic. In addition, the locations

32 The 27.5 CCS value is based on an AT&T estimate of maximum per trunk utilization. See, AT&T Capacity Cost Study.

of IXC POPs may not be publicly available. Because of these factors, the default distances for direct transport are 10 miles for local routes, 25 miles for intraLATA routes, and 15 miles for access routes. The user may alter these values.

The model contains explicit transport facilities investment calculations to produce both termination and per-mile investments, each expressed per DS-0 (a 64 kbps voice-equivalent circuit). The assumptions underlying these calculations include the facilities capacity expressed at a default SONET transmission rate of OC-12, multiplexer installed price per end, regenerator spacing and investment, buried/underground/aerial composition, manhole spacing and investment, pole spacing and investment, along with ancillary investments such as splicing, optical patch panels, and "pigtail" (short connectorized fibers between strands in the cable and the optical patch panel) investment. Interoffice investment calculations also include a "sharing" factor that accounts for the sharing of structure used by feeder and interoffice facilities. This eliminates double-counting of structure between feeder and interoffice routes. The amount of sharing, expressed as a percentage of interoffice route miles, is a user-adjustable input. The default value is 25%.

(3) Tandem switch calculations

The module scales the investment in tandem switch common equipment according to the total number of tandem trunks computed for the study area. By doing so, it thus avoids equipping maximum-capacity tandems whenever a LATA is served by multiple tandems. The calculations also recognize that a significant fraction of tandems in practice are "Class 4/5" offices that serve both tandem and end office functions. A sharing fraction may be set by the user to reflect the incidence of such dual-purpose switches.

(4) Signaling network calculations

The Wire Center Module uses the preprocessed interoffice distances to compute signaling link investment for end office and tandem A links, C links between the STPs in a mated pair, and D link segments. The investment per link-mile is the same as the computed per-DS-0 investment described above.

The model always equips at least two signaling links per switch. It also computes required SS7 message traffic according to the call type and traffic assumptions described earlier. User inputs define the number and length of ISDN User Part (ISUP) messages required for interoffice call control. Default values are six messages per interoffice call attempt with twenty-five octets per message. These values are those assumed in the AT&T Capacity Cost Study.

Other inputs define the number and length of Transaction Capabilities Application Part (TCAP) messages required for database lookups, along with the percentage of calls requiring TCAP message generation. Default values, also obtained from the AT&T Capacity Cost Study, are two messages per transaction, at 100 octets per message, and 10% of all calls requiring TCAP generation. If the message traffic from a given switch exceeds the link capacity (also user-adjustable and set at 56 kbps and 40% occupancy as default values), the model will add links to carry the computed message load. The total link distance calculation includes all the links required by a given switch.

STP capacity is expressed as the total number of signaling links each STP in a mated pair can terminate (default value is 720 with an 80% fill factor). The maximum investment per STP pair is set at $5 million, and may be changed by the user. These default values derive from the AT&T Capacity Cost Study. The STP calculation scales this investment based on the number of links the model requires to be engineered for the study area.

SCP investment is expressed in terms of dollars of investment per transaction per second. The transaction calculation is based on the fraction of calls requiring TCAP message generation, The total TCAP message rate in each LATA is then used to determine the total SCP investment. The default SCP investment is $20,000 per transaction per second and is based on a number reported in the AT&T Capacity Cost Study.

(5) Operator systems calculations

Operator tandem and trunk requirements are based on the operator traffic fraction inserted by the user into the model and on the overall maximum trunk occupancy value of 27.5 CCS discussed above. Operator tandem investment assumptions are the same as for local tandems.

Operator positions are assumed to be based on current personal computer terminal technology. The default operator position investment is $3500. The Model includes assumptions for maximum operator "occupancy" expressed in CCS. The default assumption is that each position can be in service 27.5/36 of the busy hour. This value is related to the maximum trunk occupancy assumption described above. Also, because many operator services traditionally handled by human operators may now be served by announcement sets and voice response systems, the model includes a "human intervention" factor that reflects the fraction of calls that require human operator assistance. The default factor is 10, which is believed to be a conservative estimate. (A factor of ten implies that one out of ten calls will require human intervention).

6. Convergence module

The Convergence Module combines the loop cable investments produced by BCM-PLUS with the wire center, switching, transport, signaling and operator systems investments calculated by the Wire Center Investment Module. The output of the Convergence Module is the complete collection of network investments stated by density range for use by the Expense module.

The module adds structure investment to the loop cable investments produced by the Loop Module based directly on the number of sheath miles of cable to be installed. The previous version of the Hatfield Model relied on BCM estimates of loop structure components which were calculated by applying "cable multipliers" to loop cable investment. The cable multipliers produced estimates of structure that varied directly with cable investment. In some cases, the structure estimates per unit length were unacceptably low. The multiplier approach also improperly made structure investment a function of cable materials price discounts.

In Release 2, the Convergence Module includes user-defined inputs for conduit investment, pole investment and spacing, manhole investment and spacing, trenching and direct burial investment, and breakdowns of aerial, buried, and underground cable. Although the Loop Module cable investment inputs include values for aerial and underground cable, where buried cable is required the Convergence Module adds an incremental amount per foot to represent the increased investment in armoring that is characteristic of cable intended to be directly buried. The default assumptions, which vary by density range, appear in Appendix C. There are separate sets of default inputs for distribution, copper feeder and fiber feeder facilities.[33]

The following tables display the default values for structure type:

Distribution Structure			
Density Range	Aerial Fraction	Buried Fraction	Underground Fraction
0 - 5	0.50	0.50	-
5 - 200	0.50	0.50	-
200 - 650	0.50	0.50	-
650 - 850	0.50	0.50	-
850 - 2550	0.40	0.50	0.10
> 2550	0.65	0.05	0.30

33 The HM2.2.2 Convergence Module still performs certain loop-related calculations. These were originally included in this module to correct deficiencies in the initial BCM loop calculations. HAI has chosen to keep these additional calculations in the Convergence Module even after the incorporation of BCM-PLUS into HM2.2.2.

Copper Feeder Structure			
Density	Aerial Fraction	Buried Fraction	Underground Fraction
0 - 5	0.50	0.45	0.05
5 - 200	0.50	0.45	0.05
200 - 650	0.50	0.45	0.05
650 - 850	0.40	0.40	0.20
850 - 2550	0.10	0.10	0.80
> 2550	0.05	0.05	0.90

Fiber Feeder Structure			
Density Range	Aerial Fraction	Buried Fraction	Underground Fraction
0 - 5	0.35	0.60	0.05
5 - 200	0.35	0.60	0.05
200 - 650	0.35	0.60	0.05
650 - 850	0.20	0.60	0.20
850 - 2550	0.10	0.10	0.80
> 2550	0.05	0.05	0.90

The Convergence Module adds several components to the loop cable investments produced by the Loop Module: NIDs, SAIs, terminals and subscriber drops. The drop and terminal/splice values are added for each line directly. The model computes one NID per household and one NID for every four (a user-adjustable value) business lines. The default per-unit investments are $30 for the NID (obtained from discussions with subject matter experts); $40 for the drop (taken from the New England Telephone Incremental Cost Study[34]), and $35 for the terminal and splice.

The SAI investments depend on whether copper or fiber feeder cable feeds a particular CBG. If the feeder cable is copper, the SAI is a simple cross-connect arrangement. This arrangement's investment is obtained from a table listing SAI installed prices by total lines served. For optical feeder cable, the SAI consists of an optical patch panel for connecting the cable to the remote terminal, along with an associated cross-connect for connecting the subscriber loops to the analog side of the remote terminal. Investment assumptions for both types of SAIs include engineering, a housing, and site preparation, along with common equipment and

34 NYNEX, 1993 New Hampshire Incremental Cost Study

per-line investments in channel units. A separate fill factor applies to the number of lines served by each set of common equipment.

Structure investment (*i.e.*, poles, conduit, trenches, and manholes) generally are shared among utilities, typically LECs, CATV operators, electric utilities, and others, including competitive access providers (CAPs) and IXCs. To the extent that several utilities may place cables in common trenches, conduits or on common poles, it is appropriate to share the costs of these structure items among them. Because the Convergence Module reports investments in different structure separately to the Expense Module, the user may select the fraction of each type of distribution and feeder structure investment that should be assigned to local telephone service.

The Convergence Module also adds investment for integrated DLC equipment. Inputs include site and power, common equipment, and per-line investment in channel units. The module allows two types of DLC equipment as described in the Release 1 documentation: TR-303-compatible SLC®-2000 equipment, used in all but the lowest density zone, and proprietary equipment manufactured by Advanced Fibre Communications, a California company, in the 0-5 lines per square mile range.

The Convergence Module produces investments in the following categories for each of the six density ranges:

- Distribution (aerial, buried, and underground copper cable and associated structure)
- Concentration (DLC remote terminal and associated investment in power, site preparation, and housing)
- Feeder (aerial, buried and underground fiber and copper feeder cable and associated structure)
- Switching (end office and tandem switching investment)
- Wire center (end office and tandem wire center investment)
- Operator services (operator tandem switching, tandem wire center, trunks and operator positions)
- Transport (common and dedicated)
- STPs
- SCPs
- Signaling links
- NID, drop, terminal and splice, and SAI

In addition, the Convergence Module output sheet summarizes line and trunk counts, and passes other parameters, such as tandem routing fractions and DEMs, to the Expense Module. Line counts include residential, business, special access and public access lines, and the module also reports households in each density range.

7. Expense Module

a) Overview

The Expense Module provides per-line and per-month cost summaries for each unbundled network element defined by the model, and for basic universal service. It does so by calculating capital carrying cost, operating expenses, network operation expenses, and attributable support expenses for each of eleven UNEs plus public telephone terminal equipment.

The Expense Module uses the output of the Convergence Module to capitalize the investments needed for each UNE and the per-line investments for basic universal service. The module requires investment, revenue and expense data reported by individual LECs in their annual ARMIS reports. The Module's other required inputs are capital structure parameters (e.g., debt/equity ratio, costs of debt and equity) as well as the total network investment produced by the Convergence Module.

The Expense Module uses ARMIS data to calculate several expense-to-investment ratios to be applied to the investments in different plant categories as computed by the model. It also uses estimates of LEC revenues, tax rates, costs of debt and equity and economic service lives for various types of network equipment

This section describes the inputs and assumptions of the Expense Module, including ARMIS data, capital structure parameters and expense factors built into the module. It also explains the calculations used to determine capital costs and operating expenses.

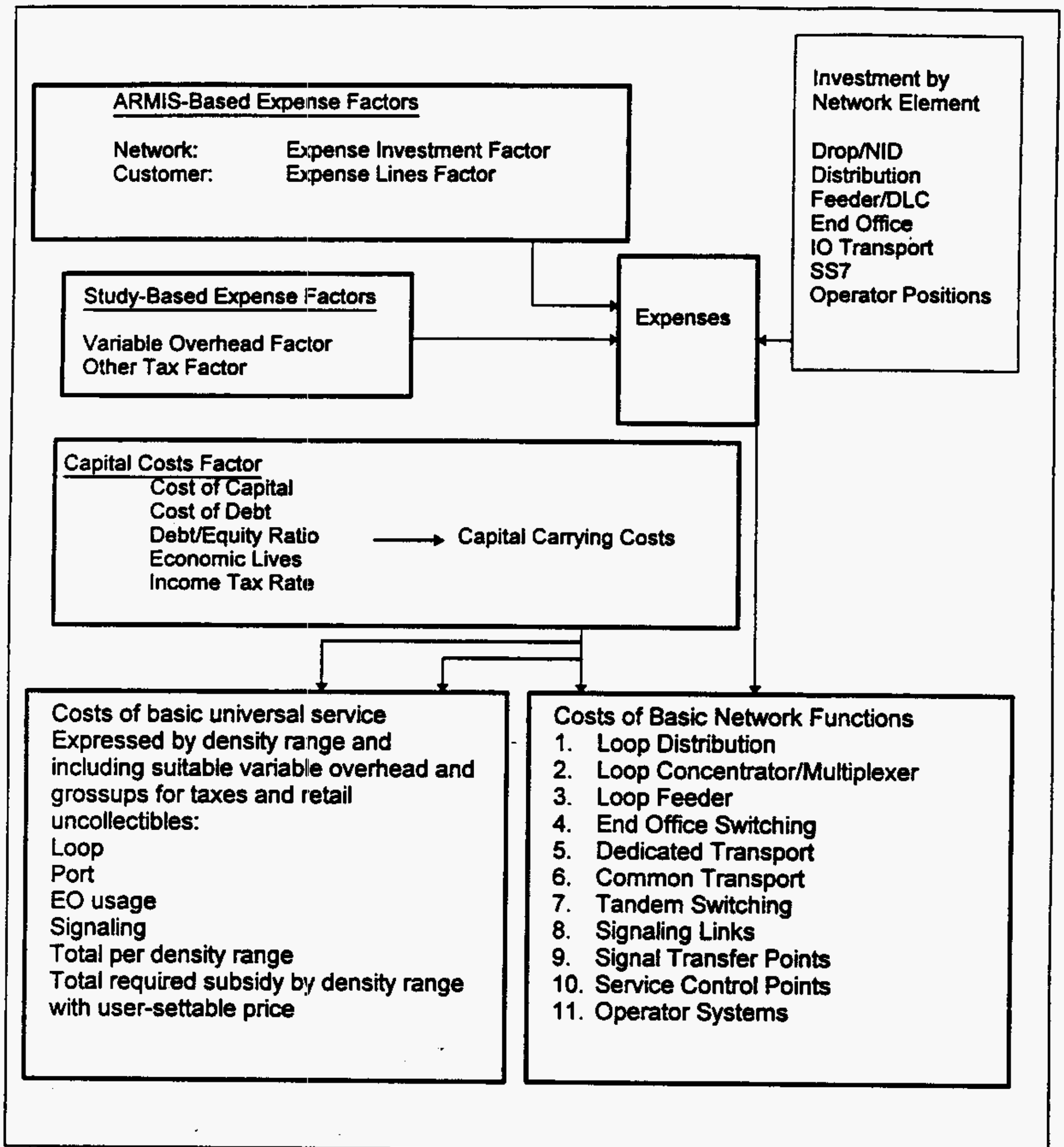


Figure 10 Expense Module

b) Description of inputs and assumptions

(1) ARMIS data

The ARMIS data used in the Expense Module include investment and operating expenses and revenues for a given local carrier and state. These data are used to derive the total investments, expenses and revenues for each UNE. The investment, expense and revenue categories are listed below, and described in detail in the Calculations section.

(a) plant specific operations

- end office and tandem switching -- digital switching, operator systems
- transmission -- circuit equipment, transmission
- information origination and termination -- public telephone, terminal equipment
- cable and wire facilities -- poles, cable, conduit

(b) plant non-specific operations

- provisioning
- power
- plant operations
- network administration
- testing
- general support equipment -- land, buildings, vehicles, furniture, office and other equipment

In addition, ARMIS data include local network service revenues by the following categories:

- access revenue -- end user, switched and special access revenue
- basic service revenue
- long distance network revenue

(c) Capital structure parameters

The Expense Module requires capital structure parameters to calculate the carrier's Weighted Average Cost of Capital (WACC), which is a discount factor used to calculate capitalized costs of UNEs and basic local service. Parameters required are for the carrier's debt/equity ratio, cost of debt, and cost of equity.

(d) Factors built into the expense module

The module uses a number of ratios and factors to calculate monthly per-line loop and annual switching costs. These factors are explained in detail in the Calculations section.

(e) Other user inputs

There are several explicit user inputs to the Expense Module, including economic lives by plant category, variable overhead factor, forward-looking Network Operations expense reduction factor, similar forward-looking expense factors for switching and circuit equipment, other taxes (principally franchise fees), and structure assignment factors. The model uses the latter to assign structure investment to telephone subscribers. Generally, plant structure (conduit, poles, and trenches) will be shared by several service providers. The structure assignment parameters in the Expense Module allow the user to vary the amount of structure investment for aerial, underground, and buried feeder and distribution facilities assigned to telephone users. The default value is 0.33 for all categories.

Other user inputs include an explicit value for the monthly cost per line for local number portability (set at a default of $0.25/line/month), a quantity used in estimating basic local service monthly costs. There is also a monthly factor of $1.22 per line that accounts for bill generation and bill inquiries relating to basic local service. The model includes a value for the NID's annual maintenance expense, the default is $3.00 per NID. There is an input for carrier-to-carrier customer expense, set at $1.56 per line per year, which is used in the determination of UNE costs. This default value derives from Tier 1 LEC expenses for servicing the access accounts of their IXC customers reported in ARMIS 43-04 for 1995.

Appendix C shows all user inputs to the Expense Module.

c) Explanation of calculations

The Expense Module is driven primarily by the calculated annual capital cost and operating expenses of the carrier(s) under study. All costs are summarized for each of the eleven UNEs. The algorithms used to determine these amounts are described below.

(1) Capital costs

The model calculates annual capital cost for each UNE based on the net plant investment, the expected service life (depreciation), the return on the net asset and the grossed-up income tax on the return of the net asset. The model assumes straight-line depreciation and assumes that cash flows are in arrears (*i.e.*, return from assets, tax gross-ups and depreciation are applied at the end of each year).

The WACC, the capital structure, and the cost of debt and equity must be provided for the modeled entity. Based on these data, the model calculates the investments required for each UNE. The model then determines the appropriate levelized monthly cost of these investments based on the economic lives for each of the UNEs.

(2) Operating Expenses - General

Operating expenses are derived from historic expense factors which are calculated from balance sheet and expense account information reported in carriers' ARMIS reports. These expense factors are applied to the investments developed by the Hatfield Model to determine associated operating expense amounts.

Certain expenses, particularly those for network maintenance, are strongly related to their associated capital investments. The Expense Module estimates these expenses using factors computed from the carrier's ARMIS reports. Other expenses, such as network operations, vary directly with the number of lines provisioned rather than with capital investment. Expenses for these elements are scaled by the number of access lines supported. Uncollectibles expense is calculated as a percentage of revenues.

(3) Network-Related Expenses and Expense Factors

The Expense Module assigns network-related expenses to each of eleven UNEs, plus public telephone terminal equipment. The module also assigns the cost of capital, expenses, total investment and attributable support expense to each UNE.

These network and non-network operating expenses are added to annual capital costs to determine the total economic cost of each UNE. Each network-related expense is described below:

Network Support -- This category includes the expenses associated with motor vehicles, aircraft, special purpose vehicles, garage and other work equipment.

Central Office Switching -- This includes end office and tandem switching, as well as equipment expenses.

Central Office Transmission -- This includes circuit equipment expenses associated with transport investment.

Cable and Wire -- This category includes expenses associated with poles, aerial cable, underground/buried cable and conduit systems. This expense varies directly with capital investment.

Network Operations -- The Network Operations category includes power, provisioning, engineering and network administration expenses.

The Expense Module uses specific forward-looking expense factors for digital switching and for central office transmission. These values derive from the New England Telephone Incremental Cost Study. The module similarly computes forward-looking Network Operations expenses based on corresponding ARMIS-reported expenses. Because total Network Operations expense is strongly line-dependent, the model computes this expense as a per-line additive value based on ARMIS-reported total Network Operations expense divided by the number of access lines, then deducting 30% of this quotient to produce a forward-looking estimate.[35]

(4) Non-network-related operating expenses and expense factors

The Expense Module assigns non-network related expenses to each density range based on its proportion to total expenses in each category. Each of these expenses is described below.

Variable support -- Historical variable support expenses for LECs are substantially higher than those of similar service industries operating in more competitive environments. Based on studies of these variable support expenses in competitive industries, such as the interexchange industry, the model applies a conservative 10% variable support factor to the total costs estimated for UNEs as well as basic local service.

General Support Equipment -- The module calculates investments for furniture, office equipment and general purpose computers. The Model uses actual 1995 company investments to determine the ratio of investments in the above categories to total investment. The ratio is then multiplied by the network investment estimated by the Model to produce the investment in general support equipment. The recurring costs of these items are then calculated in the same way as recurring costs for network investment.

(5) Revenues

Revenues are used to calculate the uncollectibles factor. This factor is a ratio of uncollectibles expense to adjusted net revenue. The module computes both retail and wholesale uncollectibles factors. The retail factor is applied to basic local telephone service monthly costs and the wholesale factor used in the calculation of UNE costs.

d) Outputs of the Expense Module

The Expense Module displays results in a series of reports which depict detailed investments and expenses for each UNE for each density range, summarized investments and expenses for all UNEs, unit costs by UNE and total

---

35 Although forecasting forward-looking expenses is difficult, there is evidence that the 30% reduction from currently reported per-line Network Operations expense is conservative. Testimony before the California Public Utilities Commission (Testimony of R. L. Scholl, Universal Service Proxy Cost Models, April 17, 1996, p. 11) states that Pacific Bell's forward-looking Network Operations expenses are 55% less than current per-line values computed from Pacific Bell's 1994 ARMIS data.

annual and monthly network costs, as well as basic local service costs per household.

(1) Unbundled Network Elements outputs

The Hatfield Model produces cost estimates for eleven UNEs, plus public telephone terminal equipment. These UNEs represent an unbundling of the local exchange network into discrete functions, which can be used singly or in any combination to furnish services. The UNEs are described below and their inter-relationships are illustrated in Figure 11.

Loop Distribution -- The individual communications channel originating from the DLC remote terminal or SAI and terminating at the customer's premises. In the Hatfield Model, this UNE also includes the investments in NID, drop and terminal/splice.

Loop Concentrator/Multiplexer -- The DLC remote terminal at which individual subscriber traffic is multiplexed and connected to loop distribution for termination at the customer's premises. The Hatfield Model includes DLC equipment and SAI investment in this UNE.

Loop Feeder -- The facilities on which subscriber traffic is carried from the line side of the end office switch to the DLC remote terminal or SAI. The UNE includes copper feeder and fiber feeder cable, plus associated structure investments (poles, conduit, etc.)

End Office Switching -- The facility connecting lines to lines, or lines to trunks. The end office represents the first point of switching. As modeled in the Hatfield Model, this UNE includes the end office switching machine investments and associated wire center costs, including distributing frames, power, land and building investments.

Operator Systems -- The systems that process and record special toll calls, public telephone toll calls, and other types of calls requiring operator assistance, as well as Directory Assistance. The investments identified in the Hatfield Model for the Operator Systems UNE include the operator position equipment, operator tandem (including required subscriber databases), wire center and operator trunks.

Dedicated Transport -- The full-period, bandwidth-specific interoffice transmission path between LEC wire centers or between LEC wire centers and an IXC POP. It provides the ability to offer individual and/or multiplexed switched and special services circuits between switches. Interoffice transport investments that provide dedicated transport are assigned to this UNE.

Common Transport -- A trunk between two switching systems on which traffic is commingled to include LEC traffic as well as traffic to and from other local or interexchange carriers. These trunks may originate at an end office and terminate at a tandem switch or at another end office. Interoffice transport investments that provide common transport are assigned to this UNE.

Tandem Switching -- The facility that provides the function of connecting trunks to trunks for the purpose of completing interoffice calls. Similar types of investments as are included in the End Office Switching UNE are also reflected in the Tandem Switching UNE.

Signaling Links -- Transmission facilities in a signaling network that carry all out-of-band signaling traffic between end office and tandem switches and STPs, between STPs, and between STPs and SCPs. Signaling link investment developed by the Hatfield Model and assigned to this UNE.

Signal Transfer Point -- This facility provides the function of routing TCAP and ISUP messages between network nodes (end offices, tandems and SCPs). The model estimates STP investment and assigns it to this UNE.

Service Control Point -- The node in the signaling network to which requests for call handling information (*e.g.*, translations for local number portability) are directed and processed. The SCP contains service logic and customer specific information required to process individual requests. The model estimates SCP investment and assigns it to this UNE.

(2) Universal Service Fund Outputs

The calculation of costs for basic local service is based on the costs of the UNEs constituting this service. These are the loop, local portions of end office and tandem switching, transport facilities for local traffic, and the local portions of signaling investment. No operator services or SCP investments are included. In addition, these UNE cost elements are adjusted to accommodate other items such as retail uncollectibles rather than wholesale uncollectibles. Finally, certain retail expenses required by basic local service, sucn as billing and bill inquiry, directory listings, number portability costs, etc. are added.

For illustrative purposes, the USF sheet in the expense module compares the monthly cost per line in each density range to a user-adjustable "affordable" monthly price for local service (which include the End User Common Line charge). If the cost exceeds the "affordable" price, the model accumulates the total required annual subsidy at the stated price level according to the number of households in each density range.

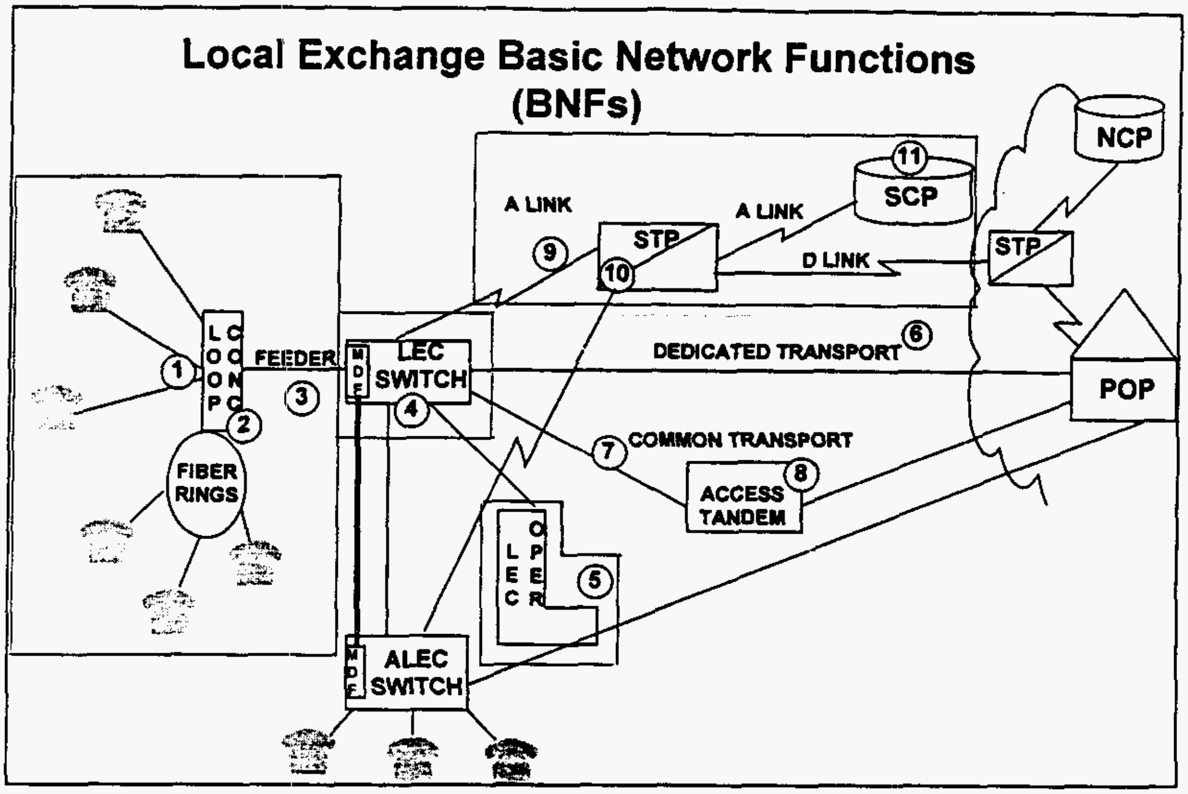


Figure 11 Local Exchange Network Elements

III. SUMMARY

In its Version 2.2, Release 2 formulation, the Hatfield Model estimates reliably and consistently both the forward-looking economic cost of unbundled local exchange network elements and the forward-looking economic cost of basic local telephone service. Because both of these calculations are performed in adherence to TELRIC/TSLRIC principles, Hatfield Model cost estimates provide an accurate basis for the efficient pricing of unbundled network elements and the calculation of efficient universal service funding requirements.

HM2.2.2's methodology is transparent, and it uses public source data for its inputs. These default input values represent the developers' best judgments of efficient, forward-looking engineering and economic practices. But, because many of these inputs are adjustable, users of HM2.2.2 can use the model's automated interface to model directly and simply any desired alternative scenario.

Appendix A

Summary of Changes Between Releases 1 and 2 of the Hatfield Model, Version 2.2

This document describes changes made to the Hatfield Model Version 2.2 between Release 1 and Release 2. The discussions refer specifically to changes incorporated in Release 2 that modify the updated Release 1 version as filed publicly with the FCC on May 30, 1996.

A Benchmark Cost Model (BCM) derivative work called BCM-PLUS has been developed for and copyrighted by MCI Telecommunications Corporation and incorporated into the Release 2 version of the Hatfield Model (which, in this description, is known as HM2.2.2, for Hatfield Model Version 2.2 Release 2). HM2.2.2 also includes an automated user interface with dialog boxes that allow the user to change options and adjust inputs. The interface automates the running of the model as well.

BCM-PLUS Modules

Data module

1. Input and output sheets include an additional column containing business line counts per census block group (CBG).

2. Feeder and distribution distances are increased by 20% in the presence of rocky terrain to accommodate routing of facilities around difficult placement conditions.

3. Feeder length calculation modified to place SAI inside CBG by one-fourth the length of a CBG side.

Loop module

1. The distance at which fiber feeder is assumed is now user-adjustable. In the original BCM, the model assumed fiber feeder cables for total loop lengths of 12,000 ft or greater. In the new version, the calculation is based on total feeder length, and the threshold distance may be adjusted by the user to any value. The default setting is 9,000 ft.

2. The DS-0 capacity per fiber is now adjustable with a default value of 2016 (equivalent to 3 DS-3s). In the original version, the model included a fixed capacity of 672 DS-0s (1 DS-3) per fiber.

3. The number of fibers required per digital loop carrier remote terminal is now adjustable. The default setting is four fibers, which is the same as the value fixed in the original BCM.

4. Lookup tables for optical feeder cable investment now allow user adjustment of cable sizes. The default maximum cable size is now 216 fibers. In the first BCM version, the maximum cross sections for optical and copper fiber and distribution cables were fixed. Also, fiber and copper cable investments per unit length have been adjusted to include engineering, delivery, and installation in addition to material investment. The original BCM did not include installation, engineering, and delivery in this table. The default distribution cable investment table now includes 25-pair cable.

5. The module now computes varying numbers of distribution cables according to density range to accommodate different population distributions in high and low density ranges.

6. Density ranges are now expressed in terms of lines per square mile instead of households per square mile.

Hatfield Model modules

Line Multiplier (now Line Converter) Module:

1. The original Line Multiplier Module used user-specified line multipliers that varied by density range to estimate total residential, business, special access, and public lines. The new Line Converter module applies uniform multipliers to all CBGs to compute residential access lines in each density zone. The business, special access, and public line calculations are based on data that estimate the number of business employees in each CBG. All line totals are computed to match those shown in the ILEC's most recent ARMIS 43-08 reports.

2. The input data contains estimated 1995 household counts per CBG in place of the 1990 counts in the original BCM data.

3. The module computes CBG density in terms of lines, instead of households, per square mile.

Wire Center Investment Module

1. The module removes previous double-counting of trunk ports by reducing the input per-line switching investment by $16 per line, because the model separately calculates the investment in trunk ports for the switches in each wire center and adds the total trunk port investment to the total switching investment in each wire center.

2. STP size is now scaled by the number of A links in the study area; the model previously equipped maximum-capacity STPs in all cases.

3. The module now computes Signaling System 7 C and D link investments, where it previously calculated only A link investments.

4. The transmission facilities investment, expressed as investment per DS-0-mile, is now calculated explicitly for each of the following routes:

common (tandem)
local direct
intra LATA direct
IXC switched access direct
special access

The calculations allow separate user assumptions for optical patch panels, optical multiplexers, regenerator investment and spacing, installation costs, mix of buried/underground/aerial plant, and manhole and pole spacing and installation.

5. The module eliminates double counting of structure costs typically shared between interoffice and feeder facilities.

6. The model now contains reconciled usage calculations between the Expense Module and Wire Center Investment Module.

7. Operator services positions may now be remote from the operator tandem. The user may select the distance; the default value is zero.

8. The module now includes tandem-to-POP switched access direct transport facilities.

9. The end office capacity limits now include entries for switch traffic; they previously included line and processor real-time limits. There are also separate holding time multipliers for business and residence lines to allow users to compute the effects of increased holding time on costs.

10. The module now uses pre-processed interoffice distance data derived from end office, tandem, and STP locations listed in the Local Exchange Routing Guide. This facilitates the running of the model.

Convergence Module

1. The module now separately computes structure costs for aerial, buried, and underground facilities, including poles, conduit, trenching, and manholes. The model independently treats underground and buried cable. The new version eliminates previous double counting of terminals and splices. All structure factors, including the mix of aerial, buried, and underground distribution and feeder facilities are user definable.

2. Digital loop carrier investment is now computed from "ground up." The calculation includes site, housing, power, engineering, common equipment (including multiplexing at the wire center), and line cards.

3. The new version corrects a previous calculation error in local direct and local tandem trunk investment.

4. Default settings eliminate optical multiplexers from the Serving Area Interface. Sufficient fiber capacity exists to allow dedicated fibers to serve each remote terminal, as is consistent with current practices.

Expense Module

1. The module allows economic lives of up to 50 years to be input, (previous maximum permitted life was 32 years).

2. Consistent with the new structure calculations and incorporation of separate underground and buried facilities inputs, the model now calculates separate expense factors for the following network components:

Aerial cable
Underground cable
Buried cable
Poles
Manholes
Conduit

Previously, only aerial and underground factors were calculated.

3. Double counting of DLC terminations and end office line circuits is eliminated.

4. Trunk port costs can now be estimated per DS-0 or per minute.

5. Default user inputs for cost of debt, equity, and debt/equity ratio have been changed.

6. Separate uncollectibles rates for retail and carrier-to-carrier are specified.

7. The module eliminates a previous triple counting of NID (other terminal equipment) investment.

8. Drops are now computed per household rather than per line basis.

9. Dedicated trunking calculations have been reconciled between the Expense Module and the Wire Center Investment Module.

10. IXC switched access and local interconnection unit costs have been added to a new "Cost Detail" worksheet in the Expense Module.

11. NID expenses are now based on ARMIS-reported regulated expense per line (other terminal account); they previously included all "other terminal" expenses and, as a result, overstated NID maintenance expenses.

12. A user-definable carrier-to-carrier customer service expense has been added. Its default value is set at $1.56/line/year -- based on ARMIS 43-04 data on current ILEC expense in serving IXC's access accounts.

13. The new version includes a NID monthly cost calculation in the "Cost Detail" worksheet.

14. Structure sharing fractions have been expanded to allow the user to set independent parameters for aerial, buried, and underground distribution and feeder structure. Default values are 0.33 for all categories.

15. The module now contains a Universal Service Module with the following features:

Network cost built up from UNEs

Network Operations factored to reflect local service only

Local number portability costs have been added as a user input; with a default setting of $0.25 per line per month.

Instruction Manual

Hatfield Model Version 2.2, Release 2

Automated Interface

I. GETTING STARTED

A. SYSTEM REQUIREMENTS

The Hatfield Model (HM) Automated Interface requires the following minimum PC system components to run properly:

- Pentium 133 MHz processor or higher
- 128 MB RAM or more
- CD-ROM drive
- Microsoft Windows 95 or Windows NT operating system
- Microsoft Excel version 7.0

B. TERMINOLOGY

The following terminology is used in this documentation when referring to the Hatfield Model and its components:

HM Modules: The HM Modules are the six functional Excel files which comprise the HM. They are Line Converter, Data Master, Loop Master, Wire Center, Convergence, and Expense.

HM Interface: The user interface to the Hatfield model, which is contained in the Excel file HM_Interface.xls. (Figure 1 shows what the HM Interface looks like.)

Workfile: A workfile is an Excel file created by the HM which contains state-specific HM data and outputs, and can reflect user-specified input parameters. Although the workfile is created by the HM, the user must provide a filename.

Data Template: The data template is a special workfile which contains the default inputs for each state. Data templates use a filename convention which looks like: AZ_rboc__tmplt.xls. Data templates should not be modified by HM users.

C. DIRECTORY STRUCTURE

The HM Interface assumes a basic directory structure as follows:

- HM modules should be stored in C:\hatfield modules
- HM data templates should be stored in C:\hatfield templates

The HM Interface allows users to specify which directories the HM components reside in by selecting 'HM Tools/Set Up Paths and Directories', but it is recommended that the default settings be used.

CD-ROM users should ensure that the paths and filenames point to the appropriate CD-ROM drive (e.g., D:\).

D. CREATING A NEW WORKFILE

- Select 'HM Tools/New HM Workfile...'
- Select the appropriate state from the dialog box.
- Select 'HM Tools/Save HM Workfile...' to give the workfile a unique name.
- Press 'GO!'
- Save Expense Module when HM is done calculating
- Select 'HM Tools/Close HM Workfile...' when finished

E. MODIFYING AN EXISTING WORKFILE

Once a workfile has been created, it can be modified to reflect different input parameters. To modify an existing workfile:

- Select 'HM Tools/Open HM Workfile...'
- Modify inputs as necessary, using process described below
- Press 'GO!'
- Save Expense Module when HM is done calculating
- Select 'HM Tools/Close HM Workfile...' when finished

F. CHANGING USER INPUTS

The HM contains several hundred user-adjustable parameters, each of which can be easily modified using the HM Interface. To change a user input, open the appropriate workfile, and select the desired category of inputs from the 'HM Inputs' menu. A dialog box will appear, in which alternative inputs may be specified. (See Figure 2.) If the workfile is saved, the alternative inputs will be saved with it. However, default inputs can always be restored by clicking the 'Reset Defaults' button on the input dialog box.

G. TROUBLESHOOTING

- If the HM Interface displays 'Cannot find file...' errors, ensure that the paths and filenames are correctly specified in the 'HM Tools/Set Paths and Filenames...' menu.
- In the unlikely event that the HM crashes, it is always best to restart.

Figure 1: HM Interface

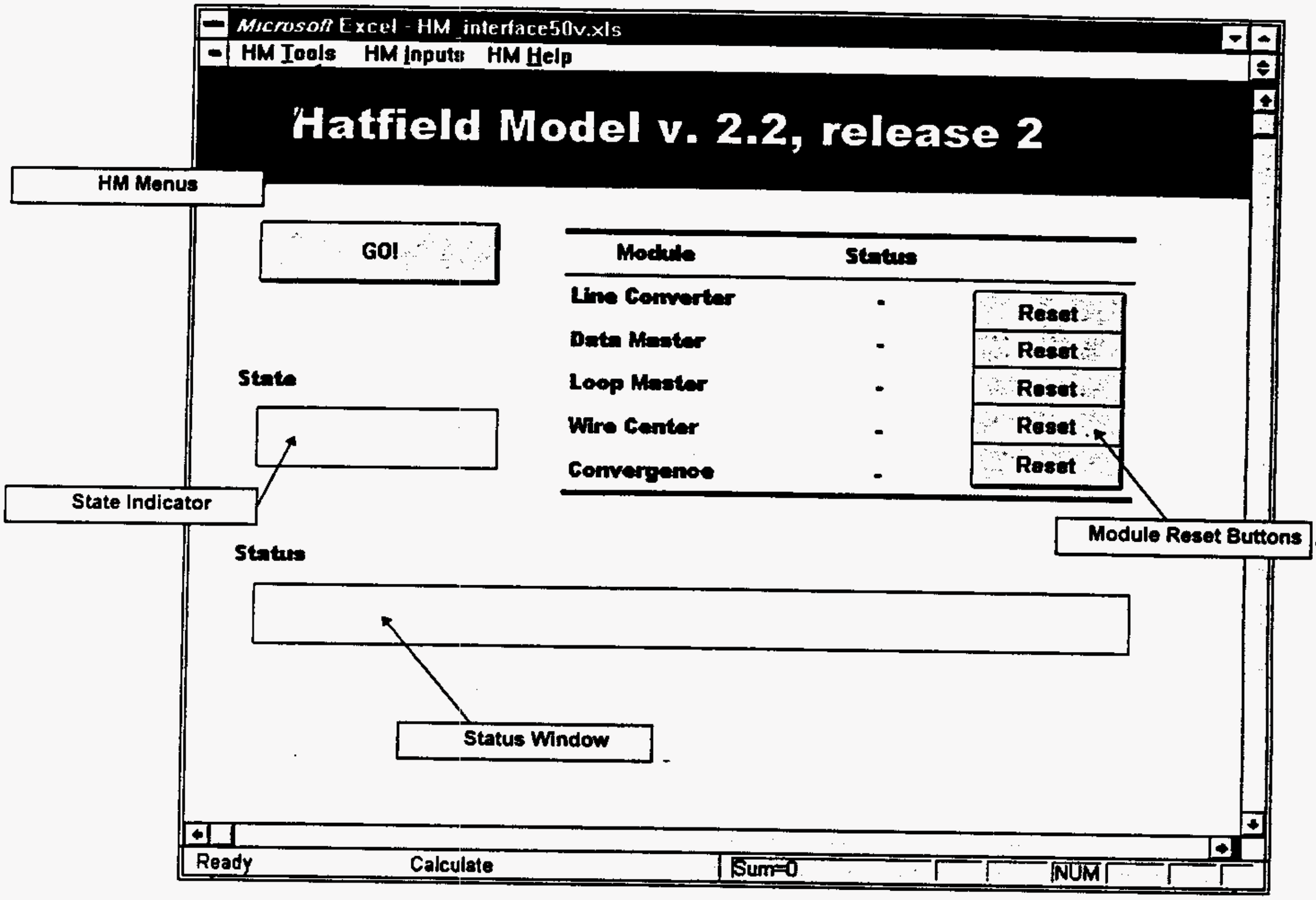
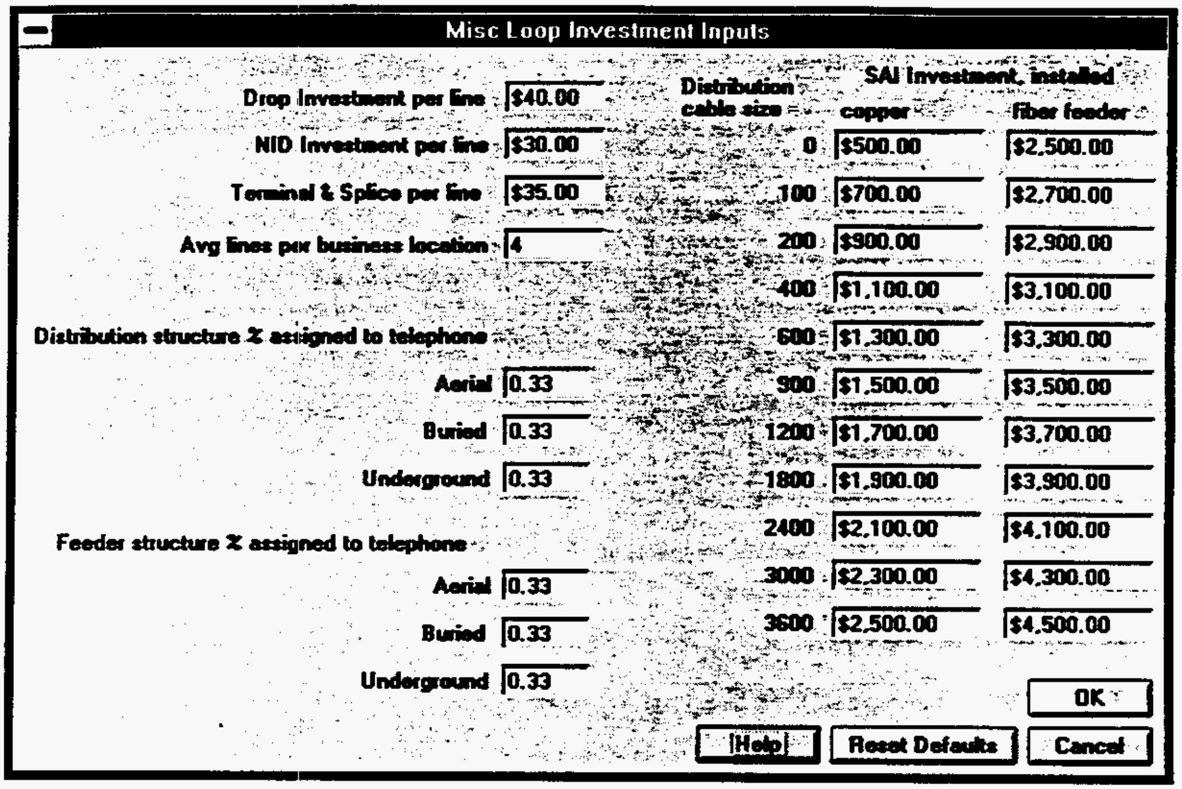


Figure 2: Sample User Input Dialog Box



BCM-PLUS Loop Module Inputs

Cable fill factors

density	Feeder	Distribution
0	0.65	0.5
5	0.75	0.55
200	0.8	0.6
650	0.8	0.65
850	0.8	0.7
2550	0.8	0.75

DS-0s per fiber		Fibers per RT
DLC case	2016	4
AFC case	2016	4

Fiber feeder distance threshold, ft
9,000

Fiber feeder cable inv per foot

Cable Size	u/g	aerial
216	$ 13.10	$ 13.10
144	$ 9.50	$ 9.50
96	$ 7.10	$ 7.10
72	$ 5.90	$ 5.90
60	$ 5.30	$ 5.30
48	$ 4.70	$ 4.70
36	$ 4.10	$ 4.10
24	$ 3.50	$ 3.50
18	$ 3.20	$ 3.20
12	$ 2.90	$ 2.90

Distribution cable inv per ft

Cable Size	u/g	aerial
3600	$ 63.75	$ 63.75
3000	$ 53.25	$ 53.25
2400	$ 42.75	$ 42.75
1800	$ 32.25	$ 32.25
1200	$ 21.75	$ 21.75
900	$ 16.50	$ 16.50
600	$ 11.25	$ 11.25
400	$ 7.75	$ 7.75
200	$ 4.25	$ 4.25
100	$ 2.50	$ 2.50
50	$ 1.63	$ 1.63
25	$ 1.19	$ 1.19

Copper feeder cable inv per ft

Cable Size	u/g	aerial
4200	$ 74.25	$ 74.25
3600	$ 63.75	$ 63.75
3000	$ 53.25	$ 53.25
2400	$ 42.75	$ 42.75
1800	$ 32.25	$ 32.25
1200	$ 21.75	$ 21.75
900	$ 16.50	$ 16.50
600	$ 11.25	$ 11.25
400	$ 7.75	$ 7.75
200	$ 4.25	$ 4.25
100	$ 2.50	$ 2.50

Wire Center Investment Module Inputs

EO switching and traffic parameters

switch real-time limit, BHCA

lines	limit
1	10,000
1,000	50,000
10,000	200,000
40,000	600,000

switch traffic limit, BHCCS

lines	limit
1	10,000
1,000	50,000
10,000	500,000
40,000	1,000,000

switch maximum line size		100,000
switch max line fill		0.80
switch max processor occupancy		0.90
processor feature loading multiplier		1.00
switch installation multiplier		1.1

switch price/line size references

switch price per line, less trunk circuits @	$	220.00	$	86.00	$	59.00
switch line size		2,782		11,200		80,000

BH fraction of daily usage	0.10
Annual to daily usage reduction factor	270
residential holding time multiplier	1.0
business holding time multiplier	1.0

(offered load assumed for afternoon busy hour)

call attempts/BH

residential	1.3
business	3.5

Interoffice parameters

operator traffic fraction		0.02
total interoffice traffic fraction		0.65
direct-routed fraction of local interoffice		0.98

Transmission parameters

maximum trunk occupancy, CCS		27.5
trunk port, per end	$	100.00
average direct route distance, miles		10
average trunk usage fraction		0.3

Tandem switching parameters

real time limit, BHCA		1,500,000
port limit, trunks		120,000
common equipment investment	$	1,000,000
maximum trunk fill		0.8
maximum real time occupancy		0.9
common equipment intercept factor		0.25

Signaling parameters

STP link capacity		720
STP maximum fill		0.8
STP investment, per pair, fully equipped	$	5,000,000
STP common equipment investment, per pair	$	1,000,000
link termination, both ends	$	900
signaling link bit rate		56,000
link occupancy		0.4
C link cross section		24
ISUP messages per interoffice BHCA		6
ISUP message length, bytes		25
TCAP messages per transaction		2
TCAP message length, bytes		100
fraction of BHCA requiring TCAP		0.10
SCP investment/transaction/second	$	20,000

Wire Center Investment Module Inputs

Operator position parameters

investment per position	$	3,500
maximum utilization per position, CCS		27
operator intervention factor		10
operator position remote distance, mi		0

Wire center parameters

lot size, multiplier of switch room size	2
tandem/EO wire center common factor	0.40

Power and frame investment

served lines in wire center		sum of power and frame
0	$	10,000
1,000	$	20,000
5,000	$	40,000
25,000	$	100,000
50,000	$	500,000

Switch room size table

switch size, lines	floor area required
0	500
1,000	1,000
5,000	2,000
25,000	5,000
50,000	10,000

Construction costs, per sq ft

switch size, lines		construction, $/sq ft
0	$	75
1,000	$	85
5,000	$	100
25,000	$	125
50,000	$	150

Land price, per sq ft

lines in wire center		price/sq ft
0	$	5.00
1,000	$	7.50
5,000	$	10.00
25,000	$	15.00
50,000	$	20.00

Toll traffic inputs

local call attempts	
call completion factor	0.70
intraLATA calls completed	
interLATA intrastate calls completed	
interLATA interstate calls completed	
local DEMs, thousands	
intrastate DEMs, thousands	
interstate DEMs, thousands	
tandem-routed fraction of total intraLATA traffic	0.2
average direct intraLATA route distance, mi	25
tandem-routed fraction of total interLATA traffic	0.2
average direct access route distance, mi	15

Interoffice transport investment		Unit Cost
Terminal investment		
Number of fibers		24
FOT capacity, DS-3s		12
FOT fill		0.80
FOT, installed	$	43,000
Pigtails	$	60
Panel	$	1,000
EF&I, per hour	$	55
Medium investment		
Fraction of structure assigned to telephone		0.33
Fraction of structure shared with feeder		0.25
Distance, mi		41
Regenerator spacing, mi		40
Regenerator investment, installed	$	15,000
Fiber cable inv/ft	$	2.00
Placement	$	2.00
Splice spacing,ft		20,000
Splice cost	$	15.00
Trenching/ft	$	45.00
Resurfacing/ft	$	10.00
Conduit/ft	$	4.00
Number of tubes		2
Manhole spacing		1,000
Manhole inv per manhole	$	5,000
Total Conduit		
Buried installation/ft	$	5.00
Pole inv.	$	450
Pole spacing		150
Weighting		

Wire Center Investment Module Inputs

Public telephone, per station	$	1,200

underground	0.3500
buried	0.5000
aerial	0.1500

Convergence Module Inputs

drop investment per line	$	40
NID investment per line	$	30
terminal and splice per line	$	35
average lines per business location		4

Distribution cable size	SAI investment (installed) copper feeder		fiber feeder	
0	$	500.00	$	2,500.00
100	$	700.00	$	2,700.00
200	$	900.00	$	2,900.00
400	$	1,100.00	$	3,100.00
600	$	1,300.00	$	3,300.00
900	$	1,500.00	$	3,500.00
1200	$	1,700.00	$	3,700.00
1800	$	1,900.00	$	3,900.00
2400	$	2,100.00	$	4,100.00
3000	$	2,300.00	$	4,300.00
3600	$	2,500.00	$	4,500.00

Digital loop carrier inputs

BCM "SLC" (TR-303)

site, housing, and power per RT	$	3,000
maximum lines		672
RT fill factor		0.90
common equipment investment	$	42,000
channel unit investment per line	$	75

BCM "AFC"

site, housing, and power per RT	$	2,500
maximum lines		100
RT fill factor		0.90
common equipment investment	$	10,000
channel unit investment per line	$	150

Convergence Module Inputs

Distribution structure Inputs

density range limit	aerial fraction	buried fraction	underground fraction	buried installation/foot	conduit installation/foot
0	0.50	0.50	-	$ 2.00	$ 25.00
5	0.50	0.50	-	$ 2.00	$ 25.00
200	0.50	0.50	-	$ 2.00	$ 25.00
650	0.50	0.50	-	$ 3.00	$ 25.00
850	0.40	0.50	0.10	$ 3.00	$ 45.00
2550	0.65	0.05	0.30	$ 20.00	$ 70.00

pole spacing, feet	150	
pole investment	$ 450	
conduit investment per foot	$ 1.00	w/o trenching
manhole investment, per manhole	$ 3,000	
buried cable armoring multiplier	1.10	

Feeder structure Inputs

Copper

density range limit	aerial fraction	buried fraction	underground fraction	manhole spacing, f	buried installation/foot	conduit installation/foot
0	0.50	0.45	0.05	800	$ 2.00	$ 25.00
5	0.50	0.45	0.05	800	$ 2.00	$ 25.00
200	0.50	0.45	0.05	800	$ 2.00	$ 25.00
650	0.40	0.40	0.20	800	$ 3.00	$ 25.00
850	0.10	0.10	0.80	600	$ 3.00	$ 45.00
2550	0.05	0.05	0.90	400	$ 25.00	$ 75.00

pole spacing, feet	150	
pole investment	$ 450	
conduit investment per foot	$ 1.00	w/o trenching
manhole investment, per manhole	$ 3,000	
buried cable armoring multiplier, Cu	1.10	

Fiber

density range limit	aerial fraction	buried fraction	underground fraction	manhole spacing, f	buried installation/foot	conduit installation/foot
0	0.35	0.60	0.05	2000	$ 2.00	$ 25.00
5	0.35	0.60	0.05	2000	$ 2.00	$ 25.00
200	0.35	0.60	0.05	2000	$ 2.00	$ 25.00
650	0.20	0.60	0.20	2000	$ 3.00	$ 25.00
850	0.10	0.10	0.80	2000	$ 3.00	$ 45.00
2550	0.05	0.05	0.90	2000	$ 20.00	$ 70.00

Buried cable armoring per foot, fiber $ 0.20

Expense Module Inputs

Debt fraction		0.45
Cost of Debt		0.077
Cost of Equity		0.119
corporate overhead factor		0.100
other taxes factor		0.050
operating state and local income tax factor		0.010
billing/bill inquiry per line per month	$	1.22
directory listing per line per month	$	0.15
– service order processing fraction of 6623		0.346
forward-looking network operations factor		0.700
– alternative CO switching factor		0.0269
– alternative circuit equipment factor		0.0153
EO traffic-sensitive fraction		0.70
per-line monthly LNP cost	$	0.25
Carrier-carrier customer service, per line per year	$	1.56
NID expense per line per year	$	3.00
DS-0/DS-1 crossover		24
DS-1/DS-3 crossover		28
– Switch line circuit offset per DLC line	$	35.00

economic life and tax inputs

tax rate	0.40
economic life -- 50 years maximum	
loop distribution	20
loop feeder	20
loop concentrator	10
end office switching	14.3
wire center	37
tandem switching	14.3
OS investment	8
transport facilities	19
STP	14
SCP	14
links	19
public telephones	9
general support	7

Structure fraction assigned to telephone

distribution	
aerial	0.33
underground	0.33
buried	0.33
feeder	
aerial	0.33
underground	0.33
buried	0.33