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V.42*bis*

There are various implementations of V.42 *bis* data compression in existence, and it cannot be guaranteed that all implementations will yield the same theoretical compression ratios on the five data files specified for throughput testing. For information purposes only, the compressed file sizes have been provided as measured by a V.42 *bis* implementation when there are no processor run-time limitations. This technique was used to measure the file size after compression for each of the five data files using dictionary sizes of 512, 1024, 1536, 2048, 2560, 3072, 3584 and 4096 bytes and maximum string lengths of 6, 16, 32, 64, 128 and 250 bytes. The results provided in the tables below may be used as a baseline to determine the relationship between the actual and reference throughput results.

A diskette is provided with the TSB-38 document containing these standardized data files. These files were chosen to simulate different types of data which could be transferred between dial modems in actual user applications

The following tables show the compressibility of the test files for V.42 *bis*.

Compressed File Size for File 1 (Bytes)

	Dictionary Size							
String Length	**512**	**1024**	**1536**	**2048**	**2560**	**3072**	**3584**	**4096**
6	302368	252603	256748	245566	260517	255311	252566	250715
16	275588	205447	186131	165708	167283	157911	149073	141110
32	276398	195772	175579	156260	155653	145456	136528	128715
64	276398	193077	171011	150933	149494	139273	132208	124869
128	276398	192020	168022	148967	148221	138880	130383	122821
250	276398	192020	168022	148967	148221	138880	130383	122821

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Compressed File Size for File 2 (Bytes)

String Length	Dictionary Size 512	1024	1536	2048	2560	3072	3584	4096
6	146832	144262	152050	147944	156845	154037	151112	147145
16	141082	138835	143452	137085	144921	140244	136835	133358
32	140995	138101	142925	135954	142230	138346	134698	131167
64	140995	138148	142913	135904	142870	138204	134164	130668
128	140995	138148	142913	135904	142870	138204	134164	130668
250	140995	138148	142913	135904	142870	138204	134164	130668

Compressed File Size for File 3 (Bytes)

String Length	Dictionary Size 512	1024	1536	2048	2560	3072	3584	4096
6	128414	135102	145482	143213	154983	153706	152136	151273
16	127544	134313	144185	142421	153707	152398	150957	149997
32	127544	134313	144585	142421	153691	152456	151161	149976
64	127544	134313	144585	142421	153691	152456	151161	149976
128	127544	134313	144585	142421	153691	152456	151161	149976
250	127544	134313	144585	142421	153691	152456	151161	149976

Compressed File Size for File 4 (Bytes)

String Length	Dictionary Size 512	1024	1536	2048	2560	3072	3584	4096
6	131072	131072	131072	131072	131072	131072	131072	131072
16	131072	131072	131072	131072	131072	131072	131072	131072
32	131072	131072	131072	131072	131072	131072	131072	131072
64	131072	131072	131072	131072	131072	131072	131072	131072
128	131072	131072	131072	131072	131072	131072	131072	131072
250	131072	131072	131072	131072	131072	131072	131072	131072

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Compressed File Size for File 5 (Bytes)

String Length	Dictionary Size 512	1024	1536	2048	2560	3072	3584	4096
6	192435	189885	200729	192744	202513	197089	190030	186304
16	161244	154731	161368	151260	156741	150060	145621	138632
32	154008	145541	150258	140830	145075	137956	133091	126738
64	152992	141404	145665	136666	139470	132286	127579	121244
128	157755	140615	146451	135502	138731	131748	125322	118319
250	158525	142686	147018	135403	138013	131273	125024	117684

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File Transfer Protocols

This section briefly describes asynchronous-based file transfer protocols in common use today. More detailed information is contained in TIA TSB-38 or from the author/supplier of each.

XMODEM

Created by Ward Christensen (as MODEM7) this is a very simple ARQ protocol. The frame check consists of an 8-bit sum of the framed data, not a true CRC. Single control codes make up the control sequences.

XMODEM is incompatible with the XON/XOFF flow control protocol.

XMODEM was designed for use over local connections with insignificant end-to-end delays. XMODEM slows down considerably when used in large delay environments, such as long links, V.42/V.42 *bis*, and store-and-forward packet networks.

XMODEM-CRC

This XMODEM variations basically the same as XMODEM, except that it replaces the 8-bit checksum with a 16-bit CRC. The data can be 133 bytes per frame. XMODEM-CRC is incompatible with the XON/XOFF flow control protocol.

XMODEM-1K

A variation of XMODEM, XMODEM-1K uses a 16-bit CRC for frame checking. Total frame size of the data is 1,029 bytes.

XMODEM-1K is incompatible with the XON/XOFF flow control protocol.

XMODEM-1K's advantage is improved file-transfer throughput when using data connections that have significant end-to-end delay. XMODEM-1K is a good protocol for use on V.42 error-controlled connections, makes use of V.42*bis* compression when sending files containing text or graphic data.

YMODEM

YMODEM builds on XMODEM-1K to transfer information about file name, size, creation date, and other "directory" information. Otherwise, YMODEM is identical to XMODEM-1K.

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YMODEM-G

YMODEM-G is used only on error-controlled circuits, the DTE must be fast and well controlled. Generally, end-to-end delay has little or no affect on data transmission.

ZMODEM

ZMODEM was developed by Chuck Forsberg for the TYMNET packet-switched network. ZMODEM transmits files in data frames containing 1024 bytes of data plus six framing characters. The data receiver only transmits during initial setup, transfer completion, and for error detection & re transmit requests. ZMODEM's frame check sequence is a 32-bit. Data frame sizes are dynamically reduced below the 1024 byte maximum, in response re transmission request rates.

ZMODEM works with file transfers that use XON/XOFF flow control.

KERMIT

Developed by Bill Catchings at CMU, this fairly complex protocol transmits only the 96 printable graphics plus a few control code characters. KERMIT has defined three frame check sequences, they are: 6-bit arithmetic sum, 12-bit CRC, and 16-bit CRC.

KERMIT accepts the use of XON/XOFF flow control

Southwestern Bell Evidence on Switch Costs

Import of Southwestern Bell Testimony on Switching Costs

In Interconnection Arbitration proceedings before the Texas PUC (Docket Nos. 16189, 16196, 16226, 16285 and 16290), Southwestern Bell Telephone Company (SWB) submitted the testimony of Hugh W. Raley to address the issue of Central Office plant inputs to the Hatfield Model. Mr. Raley's Direct Testimony was filed on September 6, 1996, and a deposition took place on September 19, 1996. The relevant portions of these testimonies are attached below.

In his testimony, Mr. Raley compares the $59 price per line for a large (80,000 line) switch in the Hatfield Model to his estimated average bid of $85 per line received by SWB. The first point to note is that this $85 figure for SWB switch costs appears to lie well below alternative figures proffered by many ILECs, including the sponsors of the BCPM. Second, although Mr. Raley concludes that his $85 estimate demonstrates that the switch costs assumed in Hatfield are low relative to SWB's recent bids, this conclusion is misplaced. There are two reasons. The first is that Mr. Raley's $85 figure for SWB includes the costs of the switch's trunk ports. Hatfield's $59 number excludes trunk port costs. When Hatfield trunk port costs of approximately $16 per line are added to its base switch investment of $59, the resulting Hatfield investment figure is $75 per line. However, a second adjustment closes the gap even further. In the SWB testimony, the switch investment of figure of $85 is based on an average switch size of 53,653 lines – while the Hatfield figure of $75 (with trunk port costs) is based on an 80,000 line switch. If a per line switch cost for a 53,653 line switch were derived from the HM3.1 switch curve for large LECs, the $75/line figure would become $80.23/line. This figure is exceedingly close to the $85 figure cited in Mr. Raley's SWB testimony in Texas.

In his deposition, Mr. Raley also indicates that the $85 includes "everything that is required to make the switch work," "the trunks, the fabric, the processors - the total price from a vendor standpoint divided by the number of lines on the switch." He goes on to say that this figure represents recent bids both from Lucent on 5ESS® switches and Nortel on DMS-100® switches.

While the sponsors of the Hatfield Model do not propose that these SWB figures for switching costs be adopted for use as default inputs into the HM, the values that SWB attests to for these inputs certainly reduces the range over which reasonable disagreement about switch prices may exist.

TX 09-09-0 COIN

DOCKET NOS. 16189, 16196, 16226, 16285, 16290

SOUTHWESTERN BELL TELEPHONE COMPANY

DIRECT TESTIMONY

OF

HUGH W. RALEY

PUC Issues

VII.(j)(2) Central Office Plant Inputs to the Hatfield Model

September 6, 1996

Q. **WHAT OTHER PROBLEMS HAVE YOU IDENTIFIED?**

A. The biggest problem with the Hatfield Model, in my opinion, is the basic assumption that the entire network would be put out for bid at one time. This is totally impractical and results in an unrealistically low price for major network elements such as switches. However, even if you accept that unrealistic premise, the model inputs for switching are perilously understated.

For example, the Hatfield Model shows a price of $59 per line for a large switch. In several recent bids for switches in this size range, the "Engineered, Furnished and Installed" (EF&I) price was $85/line. In addition, if you add telephone company cost plus tax, you arrive at a total of $109/line. If you then add frame, power and test sets, you have a total cost of $183/line. This is using the Hatfield Model assumption of simultaneous replacement. SWBT's average growth cost per line on a digital switch is $248/line. It appears that the Hatfield Model may be only considering bid prices (and even then the costs shown are unrealistically low), ignoring the associated costs for the installation and testing of the switch.

I have attached an exhibit which shows recent actual bid prices versus recent actual growth prices for common units of central office equipment. Even just looking at the bid price scenario, the Hatfield Model is very unrealistic for most types of equipment. Below I give a comparison of some of these differences:

NETWORK DEPLOYMENT COST ANALYSIS
SOUTHWESTERN BELL TELEPHONE COMPANY

- Average New Digital Switch Cost Per Line

	Digital Lines					
Cost Per Line	0 - 15,000		15 - 40,000		40 - 80,000	
Digital Switch	Capital	Expense	Capital	Expense	Capital	Expense
EF&I	140	14	115	11	85	8
Telco & Tax	39	1	32	1	24	1
TOTAL	179	15	147	12	109	9
New COSMIC Frame	58	0	58	0	58	0
Power & Emgy Engine	26	0	24	0	15	0
Test Sets	5	0	2	0	1	0
TOTAL	268	15	231	12	183	9

Per line cost based on the following switch sizes:

0 - 15,000 ~ 7,703 lines
15 - 40,000 ~ 21,062 lines
40 - 80,000 ~ 53,653 lines

Note: Switch cost exclude transmission equipment (umbilical), Network Operations conversion, OSP Cost splicing and equipment side half tap

- Average Digital Switch Growth Cost (Including EF&I, Telco and Tax)
  - ⇒ $ 248 / Line ($ 225 Capital, $ 23 Expense)
  - ⇒ $ 517 / Trunk ($ 470 Capital, $ 47 Expense)

- Average New Tandem Total (Typical Size ~ 55,000 Trunks)

Description	Capital	Expense
Digital Switch	4.3	0.9
End Office Trunking	4.7	0.8
Power	1.0	0.0
Transmission Eqpt	1.0	0.0
Ntwk Operations	0.0	0.6
TOTAL	11.0	2.3
Cost/trunk	$200	$42

Note: Operations expense includes cost of conversion, translations and training

- Average Tandem Growth Cost
  - ⇒ $ 517 / Trunk (Assume same as trunk growth cost for End Office switch)

- Average STP Pair Total Cost

Extracts from the Deposition of

Hugh W. Raley

Southwestern Bell Telephone Company

Texas PUC Docket 16226, etc.

9/13/96

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1 network, you've got - a certain percentage
2 of your switches at any given time are
3 relatively new switches. There's no
economic incentive to replace them. So if
5 you assume that the total demand that
6 you're trying to satisfy is going to be
7 handled by bid switches, dial-to-dial
8 replacements on everything that's out
9 there, no one would even remotely consider
10 doing that.
11 Q Okay, anything else?
12 A That's the primary point there.
13 Q Okay, beginning on Line 8, you
14 say that the Hatfield model shows a price
15 of $59 per line for a large switch. Do you
16 see that?
17 A Yes.
18 Q Did you get that out of the
19 Hatfield model itself?
20 A Out of the input, yes.
21 Q Okay, do you know what that
22 59-dollar charge refers to? In other
23 words, let me put it this way: Do you know
24 whether that includes or does not include
25 the switch port?

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A I did not know with any degree of
2 certainty. When I read it, I assumed that
3 it handled the line termination itself and
4 the basic switching function of the switch
5 involved, but it doesn't explain it one way
6 or the other.
7 Q Okay, now, you then say in
8 several bids EF&I price for switches at
9 Southwestern Bell was $85 a line. Do you
10 see that?
11 A Yes, I do.
12 Q Okay, first of all, what
13 particular bids are you referring to?
14 A Basically it was bids on switches
15 that we were replacing in Texas over the
16 past year and a half, I believe it was, in
17 that size range. We took a specific
18 example there, and the Hatfield model had
19 several sizes, and these were switches in
20 the forty to eighty thousand line size, and
21 this was the average bid in Texas over the
22 last 18 months.
Q What switches were you receiving
bids on?
25 A The name of the specific switch?

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1 Q Yes, sir.
2 A I do not recall.
3 Q You don't know if they were
4 DMS-10s?
5 A Oh, you're talking about vendor?
6 I thought maybe you were talking about
7 location.
8 Q No, I didn't mean location. I
9 meant the type of switch. There's like a
10 DMS-10 and DMS-100 and 5E.
11 MS. HUNT: I'm going to
12 caution here. Again, if we're getting into
13 vendor-specific prices where you can really
14 tell what their individual price is, we
15 need to advise the court reporter and make
16 arrangements.
17 Q (By Mr. Dawson) At this point,
18 I'm not trying to get into prices. I just
19 want to know which particular switches were
20 you receiving bids on.
21 A Okay, I might have to rephrase it
22 just a little bit.
23 Q Well, I don't —
24 A I think what you want to know is
25 which vendors were we —

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1 Q What types of switches?
2 A — were we inviting to bid on
3 these particular projects. Right?
4 Q And the types of switches you
5 were asking them to bid on.
6 A Okay, well, they're not
7 bidding on a type of switch. They are
8 bidding a type of switch. You know, as an
9 example, Lucent bids a 5ESS. Nortel bids a
10 DMS-100 typically on — well, they really
11 have virtually no choice in this size
12 switch. That's the only one they could
13 bid, and those are the two vendors that we
14 have in this model.
15 Q Okay, so when you say - when
16 you're referring to recent bids, are you
17 referring to bids from Lucent and Nortel?
18 A That's correct.
19 Q And no others?
20 A That is correct. Let me clarify
21 that. For the 59-dollar line - not the 59,
22 but the 85-dollar line, that portion of it
23 was just those. Some of the other stuff
24 down here had other bidders involved in it.
25 Q And what was the - what did the

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1 bid comprise? What were they bidding on?
2 A It was an EF&I – engineering,
3 furnish and install – price for a switch
4 of - in the size range between forty and
5 eithty thousand lines. It was for the
6 switch itself. It did include, you know,
7 the processor and line termination and the
8 trunk terminations. It was the entire
9 switch.
10 Q Okay, did the bid contemplate
11 doing anything with the existing switch?
12 A No.
13 Q Did the bid include the switch
14 port?
15 A The switch port? I'm sorry. I
16 don't know what a switch port is.
17 Q Okay, so you don't know whether
18 it included it or didn't include it
19 presumably?
20 A Well, were you asking on the
21 85-dollar line bid?
22 Q Yes, sir.
23 A That bid included everything that
24 is required to make the switch work. So
25 when you say "switch port," that's a little

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1 generic for me. There are lines, and there
2 are trunks, and they could either one be
3 considered ports. So I didn't know which
4 one you were talking about.
5 Q Did it include a trunk port —
6 A Yes.
7 Q — at $85 a line?
8 A Yes.
9 Q Is there such a thing as a line
10 port?
11 A Well, that's not a
12 nomenclature that I'm used to dealing with,
13 but you could look at it that way, yes.
14 Q Do you-all have a fancy name for
15 what I would call a line port?
16 A Well, actually I would just call
17 it a line.
18 Q A line? Okay.
19 A I call it line and trunk and
20 port. Some people, I guess, use that, but
21 that's not the common nomenclature for us.
22 Q Okay, now, the $85 a line that
23 you reference in your testimony - was that
24 the low bid price?
25 A No, that was the average.

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1 Q What was the low bid price? I'm
2 going to ask you the question without
3 identifying the particular vendor.
4 A I would be very uncomfortable
5 answering that because of confidentiality.
6 Q Well, then let's —
7 MS. HUNT: Let's go off the
8 record a second. I think we have a
9 misunderstanding as to what is being asked.
10 Can we go off for one minute?
11 MR. DAWSON: Let's go off
12 the record. That's fine.
13 (Discussion off the record.
14 Q (By Mr. Dawson) Tell me
15 - explain to me what the $85 a line
16 represents.
17 A The $85 a line – I thought I had
18 done that, but it's the EF&I costs -
19 engineering, furnish and install costs for
20 the switch that includes the lines, the
21 trunks, the fabrics, the processors - the
22 total price from a vendor standpoint
23 divided by the number of lines on the
24 switch.
25 Q And with respect to the bids,

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1 that is the average price over the various
2 bids that Southwestern Bell accepted during
3 the time period that you referenced
4 earlier?
5 A That's correct.
6 Q Do you know whether there were
7 any instances where Southwestern Bell chose
8 not to accept the lowest bid offered to it
9 for any reason?
10 A I do not know. I would be
11 surprised.
12 Q And do you know whether those bid
13 prices included the vendor discount?
14 A Yes, they did.
15 Q You then talk about telephone
16 company cost plus tax?
17 A Yes.
18 Q Where did you get that
19 information?
20 A The information on switch cost,
21 I'd say just in general, came from Gary
22 Shaw, an employee of Southwestern Bell in
23 Dallas, in the network planning
24 organization.
25 Q Back to the bid information,

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1 where did you get that? Is that from Mr.
2 Shaw also?
A That's correct.
Q And Mr. Shaw - you're relying on
5 him for the numbers that were used for the
6 telephone company cost?
7 A That's correct.
8 Q Would that also be true for the
9 frame, power and test sets?
10 A That's correct.
11 Q Do you know, sir, whether there
12 were any documents that would substantiate
13 the numbers that are contained on Page 7 of
14 your testimony?
15 A Yes, I believe so. At the time I
16 did the testimony, I was in telephone
17 contact with Mr. Shaw and actually some
18 others, although Mr. Shaw was the one that
19 put it together for me. After the
20 testimony had been filed, he has sent me
21 some confirming correspondence of where he
22 got some of these numbers from and their
23 basis and all. So I believe that that
24 probably satisfies what you're asking for
25 there.

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1 Q Well, what I'm trying to
2 understand, sir, is you've got a bunch of
3 numbers in here, and I'm not being
4 critical, but where did they come from?
5 All you've told me so far is Mr. Shaw. Do
6 you happen to know where he got them from?
7 A Oh, yes.
8 Q Where did he get them from?
9 A Mr. Shaw - his job
10 responsibilities include doing fundamental
11 switch planning for the state of Texas.
12 He's the individual that does - he and his
13 people do analysis that justify replacing
14 the switch. They are the ones that arrange
15 to bid it with the vendors. They're the
16 ones that track it on what it actually
17 costs. So he has a - he is a rich source
18 of factual information on the cost of
19 switching.
20 Q And do you expect that Mr. Shaw
21 has available to him documents that would
22 support the $85 a line bid cost that you
reference in your testimony?
24 A I would assume so.
25 Q Would you expect that Mr. Shaw

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1 has available to him documents which would
2 support or substantiate the total company
3 cost that's referenced in your testimony?
4 A Yes, I do.
5 Q And the same for the frame, power
6 and test sets?
7 A Yes.
8 Q And to your knowledge, sir, have
9 any of those documents been either produced
10 in this proceeding or made available to any
11 of the parties?
12 A They have not.
13 Q Then you say later in the
14 paragraph beginning on Line 13 - you say,
15 "Southwestern Bell's average growth cost
16 per line on a digital switch is $248." Do
17 you see that, sir?
18 A Yes, I do.
19 Q First of all, what is an average
20 growth of the cost per line on a digital
21 switch? What are you referring to there?
22 A The reference is basically the
23 same as the $59 or $85 a line cost. If you
24 took the - on a normal growth job on a
25 digital switch -- and we use that to be

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1 forward looking -- this is what the average
2 cost per line is for a total job.
3 Q Let me back up. The bids that
4 you received - were they for analog or
5 digital switches?
6 A Digital.
7 Q Okay, and that gives you a total
8 cost of $183 a line?
9 A For a new switch.
10 Q For a new switch? All right, and
11 is this what you're saying for an existing
12 digital —
13 A Growing an existing digital
14 switch costs 248, and that's - again, that
15 is illustrating what I was discussing
16 earlier of the cheapest you ever get the
17 switch is at the initial point. Growth
18 jobs cost you a bit more.
19 MS. HUNT: And I would
20 caution here to be real careful not to talk
21 over and let him finish the question
22 because the court reporter has a hard time
23 getting both down if you talk over each
24 other.
25 Q (By Mr. Dawson) Okay, what's the

Hatfield Model, Release 3.1 Edits

Hatfield Model, Release 3.1 Edits

This paper describes edits that may be made to the HM3.1 distribution and expense modules.

Editing the HM3.1 distribution module

Open the distribution module using Microsoft Excel The module may be found in the "Modules" subdirectory of the HM3.1 directory that typically is loaded under the "Program Files" directory. The module name is "r31_distribution.xls." Once it is open, resave it in the same directory using the "save as ..." command in the "files" menu; rename the file "r31_distribution_415.xls"

Two sets of operations are needed. The first is to add columns to the worksheets as described below. The second set of procedures involves changing formulas. These steps are described later.

Adding columns

1. Select the "calculations" worksheet

2. Select column AD (click the left mouse button on the AD column header)

   With the entire column selected, depress the right mouse button and select "insert." Excel will insert a blank column with heading AD. The column to the right (now AE) should be entitled "road frontage, ft"

3. Select columns AF, AG, and AH by locating the cursor on the AF column heading, depressing the left mouse button, and dragging the cursor from the column AF header to the column AH header

   With the three columns selected, depress the right mouse button and select "insert"

   Excel will insert three blank columns with headings AF, AG, and AH. The column to the right of the selection, now AI, should be entitled "road cable distance, per cable"

Changing formulas

Modify the formulas in the "calculations" worksheet so they read as following:

cell F2: IF(OR(D2>fiber_dist,BA2=1),1,0)

cell L2: IF(K2=1,inputs!$F$29,1)

cell M2: MAX(66,IF(R2=0,SQRT(0.5*P2),SQRT(0.5*inputs!$F$41)))

cell AB2: INDEX(cable_range,MATCH((W2*Z2+W2*AA2*max_cable)/ IF(BA2=1,2,1)-AC2*max_cable,cable_range,-1),1)

cell AD1: enter heading "backbone cable taper factor"

cell AD2: IF(W2<=2,1,0.5)

cell AF1: enter heading "road cable max. length, ft"

cell AF2: 0.707*5280*SQRT('CBG input data'!I2/T2)

cell AG1: enter heading "no. road cables per quadrant"

cell AG2: IF(AF2=0,0,CEILING(AH2/AF2,1))

cell AH1: enter heading "basic 'road' cable distance"

cell AH2: IF(R2=1,0.5*AE2*(1-inputs!$F$36)*(calculations!N2+O2)+M2+X2,0)

cell AI1: enter heading "effective per-cable distance"

cell AI2: IF(AG2=0,0,AH2/AG2)

cell AJ2: IF(AG2=0,0,IF(R2=1,INDEX(cable_range,MATCH((1-inputs!$F$36)* U2/VLOOKUP('CBG input data'!K2,density_inputs,2)/AG2-AK2* max_cable, cable_range,-1),1),0))

cell AK2: IF(AG2=0,0,TRUNC((1-inputs!$F$36)*U2/VLOOKUP('CBG input data'!K2,density_inputs,2)/AG2/max_cable))

cell AL2: IF(BI2=1,0,IF(R2=1,AG2*AK2*AI2*max_cable_inv+ AG2*AI2*VLOOKUP(AJ2,cable_inv,2,FALSE),0))

cell AM2: IF(BI2=1,0,((VLOOKUP(Z2,cable_inv,2,FALSE)*X2*W2+ AD2*VLOOKUP(calculations!AB2,cable_inv,2,FALSE)*calculations!V2 +AL2+(AD2*calculations!V2*calculations!AC2+AA2*X2*W2)* max_cable_inv)*T2+ T2*AY2)*(0.6+0.4*BH2)+BG2)

cell AN2: ($AM2)*VLOOKUP('CBG input data'!$K2,density_inputs,3)

cell AO2: ($AM2)*VLOOKUP('CBG input data'!$K2,density_inputs,5)* inputs!$C$19

cell AP2: ($AM2)*VLOOKUP('CBG input data'!$K2,density_inputs,4)+BN2

cell AQ2: IF(OR(BI2=1,'CBG input data'!K2>=inputs!$B$12),0, (1+CEILING((X2*W2+V2+AG2*AI2+ IF(BA2=1,0,AX2-IF(T2=2,0, 0.5*SQRT('CBG input data'!I2))))* T2/VLOOKUP('CBG input data'!K2, density_inputs,8)* (inputs!$C$16+inputs!$C$17*J2*L2)* VLOOKUP('CBG input data'!K2,density_inputs,4),1)))

cell AR2: IF($BI2=1,0,($V2+$W2*$X2+AG2*AI2+IF($BA2=1,0,AX2-IF(T2=2,0, 0.5*SQRT('CBG input data'!I2))))*$T2*VLOOKUP('CBG input data'!$K2,density_inputs,5)*VLOOKUP('CBG input data'!$K2, density_inputs,7)*$J2*$L2*(0.875+0.125*labor_adj))

cell AT2: change terms reading as follows --

VLOOKUP('CBG input data'!$K2,density_inputs,3)*VLOOKUP('CBG input data'!$K2,density_inputs,7)

to read --

VLOOKUP('CBG input data'!$K2,density_inputs,3)*VLOOKUP('CBG input data'!$K2,density_inputs,6)

cell AU2: set equal to AB2

cell AV2: set equal to AC2

cell BD2: change first part of formula reading as follows --

IF($BB2<>0,$T2*($BC2*(inputs!$D$98+inputs!$D$95)

to read --

IF($BB2<>0,$T2*($BB2*(inputs!$D$98+inputs!$D$95)

cell BG2: IF(BA2=1,T2*(Z2+AA2*max_cable)*W2*VLOOKUP(BF2, longloop_adj,2),T2*(Z2+AA2*max_cable)*W2*VLOOKUP(IF(F2=1, AZ2,AZ2+output!F2+ output!G2),longloop_adj,2))+(IF(R2=1,T2*AG2* (AJ2+AK2*max_cable)* VLOOKUP(AI2,longloop_adj,2)+ T2*AG2*AI2*(VLOOKUP(AI2, longloop_adj,3)-1)* (0.6+0.4*VLOOKUP(AJ2-AK2*max_cable, cable_inv,2,FALSE)),0))* IF(AI2>18000, 1-18000/AI2,0)

Make the following edits on the "output" worksheet:

Alter the listed cells to read as shown

cell G2: IF(calculations!G2=0,0,(calculations!G2+0.5*calculations!I2))* IF(calculations!E2=1,inputs!$F$25,1)+IF(calculations!BA2=1, calculations!AW2*calculations!T2,0)

cell H2: calculations!T2*(calculations!V2*(1+calculations!AC2)+ calculations!W2*calculations!X2*(1+calculations!AA2)+ IF(calculations!BA2=0,calculations!AX2*(1+calculations!AV2),0)+ calculations!AH2*(1+ calculations!AK2))

Editing the HM3.1 Expense Modules

Open the density zone version of expense module found in the "modules" subdirectory under HM3.1; it will be named "r31_expense_density.xls". Once it is open, save it in the same directory as "r31_expense_density_415.xls" using the "save as ..." command under the "file" menu. Close the file. It will be reopened as necessary to make the edits listed below.

Open the wire center version of expense module found in the "modules" subdirectory under HM3.1; it will be named "r31_expense_wirecenter.xls". Once it is open, save it in the same directory as "r31_expense_wirecenter_415.xls" using the "save as ..." command under the "file" menu. Close the file. It will be reopened as necessary to make the edits listed below.

Some of the changes described below apply to the density zone version of the expense module, some apply to the wire center version of the expense module, and some apply to both.

1) The density zone and wire center versions of the expense module calculate the weighted average depreciation life for non-metallic cable. This value is used in calculating depreciation expense and cost of capital for drop wire. In version 3.1 as released, one category of cable investment is omitted ("Inputs" worksheet, cell J29, should add "Investment Input" worksheet, cell V21 to the existing term in the formula). The impact on costs of correcting this error should be minimal, as the effect of the error is to under-weight underground cable, which typically has a depreciation life between aerial and buried cable.

For the density zone version of the expense module:

Cell J29 currently is:

```
=Investment Input'!I21
```

It should be:

```
='Investment Input'!I21+'Investment Input'!V21
```

2) In calculating the weighted average depreciation life for non-metallic cable, the wire center version of the expense module incorrectly refers to row 21 of the "Investment Input" worksheet ("Inputs" worksheet, cells J27, J29, and J31). These formulae instead should sum the columns referred to rather than refer to the value in row 21 of each column. The impact on costs of correcting this error will vary by study area, depending on the relative mix of aerial, buried, and underground cable in the wire center appearing in row 21 and the mix of plant types contained in the study area as a whole.

For the wire center version of the expense module:

Cell J27 currently is:

```
='Investment Input'!K21+'Investment Input'!X21
```

It should be:

```
=SUM('Investment Input'!K:K)+SUM('Investment Input'!X:X)
```

Cell J29 currently is:

```
='Investment Input'!I21
```

It should be (also incorporating the change above):

```
=SUM('Investment Input'!I:I)+SUM('Investment Input'!V:V)
```

Cell J31 currently is:

```
='Investment Input'!J21+'Investment Input'!W21
```

It should be:

```
=SUM('Investment Input'!J:J)+SUM('Investment Input'!W:W)
```

3) All versions of the expense module assign a portion of investments and expenses for general support accounts to customer operations and corporate operations based on the proportion of expenses in these categories to total operating expense. The factor used is at the "95 Actuals" worksheet, cell H115. The assignment of investment is calculated correctly ("General Support" worksheet, columns B-J, rows 6-12). The assignment of expenses is calculated incorrectly at the "95 Actuals" worksheet, cell C129 (C130 in the wire center version). The impact on costs of correcting this error will be to increase costs slightly.

For the density zone version of the expense module:

Cell C129 currently is:

```
=((C127+D127+E127+F127+H127+G127+I127+J127)*1000)*H115
```

It should be (see change described below):

```
=((C127+D127+E127+H127+G127)*1000)*(1-$H$115)
```

For the wire center version of the expense module:
Cell C130 currently is:

```
=((C128+D128+E128+F128+H128+G128+I128+J128)*1000)*H116
```

It should be (see change described below):

```
=((C128+D128+E128+H128+G128)*1000)*(1-H116)
```

4) All versions of the expense module currently mistakenly assign expenses in Accounts 6112, 6115, and 6116 to miscellaneous expenses instead of to network support expenses. This can be corrected by removing these cells from the calculation of total miscellaneous expense in the "95 Actuals" worksheet at cell C129 (C130 in the wire center version), and adding these categories to the factor for network support expenses in the "95 Actuals" worksheet at cell C77. The correction below also will remove expenses associated with aircraft from network support expenses. The impact of these adjustments will be to increase costs slightly.

For both the density zone and wire center versions of the expense module:
Cell C77 currently is:

```
=C73+C74
```

It should be:

```
=C72+C74+C75+C76
```

5) All versions of the expense module currently overestimate buildings expenses (expenses associated with wire centers are double-counted). The calculation that needs to be adjusted is in the "95 Actuals" worksheet, at cell H122 (H123 in the wire center version). Correction of this error will results in a modest reduction in costs.

For the density zone version of the expense module:
Cell H122 currently is:

```
=E11
```

It should be:

```
=E11*0.5
```

For the wire center version of the expense module:
Cell H123 currently is:

```
=E11
```

It should be:

```
=E11*0.5
```

Modify headers in output sheets to indicate that modified versions of the HM3.1 expense modules have produced the results.

The following legend must be added to existing headers in expense module output sheets:

"amended version 4/11/97"

This must be applied to headers in these output sheets:

density zone version

A header must be added in each sheet. To add a header, select the sheet, then, under the "file" menu, select the "page setup..." option. Then choose the "header/footer" tab. Once this tab is selected, push the "custom header" button and delete the characters in the center section. Now enter the legend "amended version 4/11/97" in the center section, press the "OK" button in the "header" dialog box, then press the "OK" button in the "page setup" dialog box and save the file. This procedure must be applied to each of the five sheets in the density zone expense module listed below:

network diagram
summary
unit cost
usf
cost detail

CBG version

This workbook contains only one worksheet, "USF by CBG." Following the same procedure described for the density zone version, replace the existing header with one reading "USF by CBG -- amended version 4/11/97." Resave the file.

wire center version

This workbook contains two worksheets requiring header changes:

investment input
summary

Select the "investment input" sheet and add the following header, again using the procedure detailed above: "Investment input -- amended version 4/11/97"

Select the "summary" sheet and enter the following header using the same procedure: "Summary -- amended version 4/11/97"

Resave the file.

Add the edited modules to the model.

Start the model. When the "Hatfield Model 3.1" dialog box appears, pull down the "HM tools" menu and select "options." Next, highlight the edited distribution module in the right-hand window and press the button next to the "distribution module name" window. The edited module will now appear as the default distribution module to be used by the model. Follow the same procedure for each of the three expense modules. Then press the "OK" button. The model will now reply with a notification stating "updated successfully." Press the "OK" button, and the model may now be run with the edits.

Check the results

With all edits included, the model produces the following results for U S West in Colorado with default inputs and using the filed HM3.1 CBG database:

Density range results	Total weighted average loop cost	$15.22
	End office switching	
	port $1.13	
	usage $0.00188	
	Platform cost total $20.34	
	Total USF support @ $30	$59,905,799
	Total local service (USF sheet)	$21.54

Wire center results ("investment input" sheet)

Total distribution cost (sum of column GD)	$255,125,193
Total annual support (sum of column HX)	$40,392,959