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***Ex parte* Notice**

December 3, 1997

Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M Street, NW
Room 222
Washington, DC 20554

RE: CC Docket No. 96-45; Federal-State Joint Board on Universal Service and CC Docket No. 97-160/Forward-Looking Mechanism for High Cost Support for Non-Rural LECs

Dear Ms. Salas:

On December 2, 1997, Dr. Robert F. Austin, Mary McDermott, Whit Jordan, and Porter Childers representing the United States Telephone Association (USTA) met with Natalie Wales, Chuck Keller, Bob Loube, Emily Hoffnar, Bryan Clopton, William Sharkey, and Anthony Bush of the Federal Communications Commission's Common Carrier Bureau. In addition, staff members Charles Bolle of the South Dakota Commission, Rowland Curry of the Texas Public Utilities Commission, and Berry Payne of the Indiana Regulatory Commission participated by telephone. The purpose of this meeting was to provide USTA's comments on the initial two modules of the FCC's Hybrid Cost Proxy Model. The attached document was used during USTA's discussion.

USTA remains concerned regarding the use of a proxy model for purposes of calculating universal service support as discussed in its prior comments filed in this proceeding and consequently is not endorsing the FCC's model. However, USTA will continue to examine the proxy models under consideration and will provide the FCC the results of its analyses for inclusion in the public record.

An original and a copy of USTA's *ex parte* filing are being filed in the Secretary's office on December 3, 1997. Please include this filing in the public record of the above-mentioned proceedings.

Respectfully submitted,

Mary McDermott
Mary McDermott
Vice President,
Legal & Regulatory Affairs

Attachment

cc Natalie Wales
Bob Loube
Bryan Clopton
Anthony Bush
Chuck Keller
Emily Hoffnar
William Sharkey

Comment on the Hybrid Cost Proxy Model

for Determining Universal Service

Support for Non-Rural Carriers:

The CENBLOCK and FEEDDIST Software Modules

Principal Investigator:

Robert F. Austin, Ph.D.

Austin Communications Education Services, Inc.

December 2, 1997

Executive Summary

The United States Telephone Association retained Austin Communications Education Services, Inc. to provide an evaluation of the CENBLOCK and FEEDDIST software modules of Hybrid Cost Proxy Model for Determining Universal Service Support for Non-Rural Carriers (HCPM). The HCPM is being prepared by members of staff of the Federal Communication Commission in relation to CC Docket Nos. 96-45 and 97-160. This document reports our evaluation, comments and recommendations concerning the specified software modules.

We have identified two limitations associated with the modules. Recommended solutions for these shortcomings are provided.

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Introduction

In their Recommended Decision in the Federal Communication Commission's (FCC) Universal Service proceeding, CC Docket 96-45, the FCC Joint Board stated that a properly crafted forward-looking cost proxy model could be used to determine universal service support levels. However, they also observed that none of the models submitted were satisfactory as delivered, but that they could be modified and enhanced to satisfy all significant concerns. This position and the FCC's subsequent analysis of select enhancement methods were summarized in a Public Notice released on October 31, 1997:

> In the Universal Service Order released May 8, 1997, the Commission, acting on the recommendation of the Federal-State Joint Board, concluded that universal service support for non-rural carriers should be determined by subtracting a benchmark revenue amount from the forward-looking economic cost of providing the supported services. The Commission concluded that it should continue to review two cost models, the Hatfield Model and the Benchmark Cost Proxy Model (BCPM). The Commission further concluded that it would select the platform design features of a forward-looking economic cost mechanism by the end of 1997 and select a complete mechanism, including input values, by August 1998. In a *Further Notice of Proposed Rulemaking* (*FNPRM*) in this proceeding, the Commission stated that it would consider a hybrid mechanism, combining the best features of both models, and might also

"study alternative algorithms and approaches that could be submitted by parties other than model sponsors or that could be generated internally by Commission staff."[1]

"Commission staff members William Sharkey and Mark Kennet of the Competitive Pricing Division, Common Carrier Bureau; C. Anthony Bush of the Competition Division, Office of the General Counsel; and Commission contractor Vaikunth Gupta of Panum Communications have developed an engineering process mechanism, known as the Hybrid Cost Proxy Model or HCPM."[2] The United States Telephone Association retained Austin Communications Education Services, Inc. to provide an engineering evaluation of the Hybrid Cost Proxy Model (HCPM) components prepared by these members of staff of the FCC in relation to CC Docket Nos. 96-45 and 97-160.[3] Given the author's previous experience with these models, this action permitted continuity in analysis.[4] This document reports our evaluation, comments and recommendations concerning two specific software modules: CENBLOCK and FEEDDIST.

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[1] *Common Carrier Bureau Makes Available Potential Modules For Determining Customer Location And Outside Plant Design In Forward-Looking Mechanism For Determining Universal Service Support For Non-Rural Carriers Comment Date: November 26, 1997*, CC Docket Nos. 96-45 and 97-160, DA 97-2311, Released October 31, 1997, page 1.

[2] FCC DA 97-2111, page 2.

[3] Bush, C.A., Kennet, D.M., Prisbrey, J., Sharkey, W.W. and Gupta, V., "The Hybrid Cost Proxy Model: Customer Location and Loop Design Modules," October 30, 1977, FCC document available at http://www.fcc.gov.

[4] Austin, Robert F., *Engineering Evaluation of Cost Proxy Models for Determining Universal Service Support: Hatfield Model 2.2, Release 2, Ex Parte* Filing, Federal Communications Commission Docket No. 96-45, February 5, 1997. Austin, Robert F., *Engineering Evaluation of Cost Proxy Models For Determining Universal Service Support: Benchmark Cost Proxy Model, Ex Parte* Filing, Federal Communications Commission Docket No. 96-45, February 23, 1997. Austin, Robert F., *Engineering Evaluation of Cost Proxy Models for Determining Universal Service Support: Hatfield Model 3.0/3.1, Ex Parte* Filing, Federal Communications Commission Docket No. 96-45, March 17, 1997.

CENBLOCK Software Module

Overview of the Module

"The HCPM differs from previous models that have been submitted to the Commission primarily in its usage of Census data to locate subscribers to the network and in its greater reliance on explicit optimization techniques in modeling loop plant."[5] The HCPM includes consideration of U.S. Census data through the use of a "customer location module" called CENBLOCK. The operation of this module is described by one of its authors:

> This software, CENBLOCK, represents an attempt to use the most highly disaggregated data available on the location and distribution of population in the U.S. in order to approximate stylized carrier serving areas for telephone company cost simulations.
>
> The software performs its task by "installing" a grid (set to the user's specifications) over the region of interest. Census blocks are accumulated in the grid blocks according to whether the Census block centroid falls within the grid block. After a first pass, each grid block is examined to determine if the total number of "customers" exceeds a user-determined maximum. If so, the affected grid blocks are "sliced" repeatedly until no grid block contains more than the target maximum.
>
> Within each grid block, a "microgrid" is defined. The size of the microgrid is based on the average area of all Census blocks included in the grid block, rounded to form an integer number of microgrids.[6]

The CENBLOCK software module uses two user-provided text files in its performance. The CENBLOCK.PRM parameter file contains user-defined parameters for subsequent analysis. The discussion provided with the module suggested these assumptions:

- square areas of analysis 11 kilofeet in length by 11 kilofeet width
- a maximum of 2,000 subscribers per carrier serving area

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[5] FCC DA 97-2111, page 2.

[6] Kennet, D. Mark, *CENBLOCK User's Manual*, 12 September 1997, prepared for the Federal Communications Commission, page 1. The manual is available at http://www.fcc.gov.

- 100% of households served

Users may change these values easily in an ASCII text file.

The *districtname*.IN file contains specific input information for a given district. The author of the model wrote:

> Note that this file requires substantial preprocessing by the user. First, the study area must be identified in terms of those Census blocks which are to be included. This can be accomplished with commercial GPS software, such as MapInfo.
>
> Second, the file requires that the user have a source for business line data as well as the geologic information at the Census block level. For the FCC internal runs, we have simply allocated data on the record from the BCPM model at the CBG level to the component Cbs. However, users may have more granular sources which they are encouraged to exploit.[7]

In passing, we note our inference that in the first paragraph of this quotation the author probably meant "GIS" (geographic information system) software rather than "GPS" (global positioning system) software. The Census Bureau has not, to our knowledge, integrated U.S. Navstar satellite or Russian GLONASS satellite cluster information in its published data sets nor would analysis of GPS data be feasible or useful in this context.[8] Nevertheless, the methodology suggested by Dr. Kennet remains sound.

The source code for the program, written in Turbo Pascal, was made available on the FCC's worldwide web page. According to the internal documentation, the module was written originally in September 1995 for a New Zealand study. The present version represents an adaptation prepared for the FCC during the summer of 1997. The model uses SI (ISO) metric measurements internally, which as the internal documentation

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[7] Kennet, CENBLOCK Manual, pages 5-6.

[8] We acknowledge that GPS systems might prove useful in geo-coding subscriber addresses, but that is a separate point of discussion.

notes, should be converted to English measurements for comparison with more traditional United States information sources.

Testing the Module

The CENBLOCK software model is used to define hypothetical serving areas and to calculate straight-line, air route distances between central offices and the population centroid of those hypothetical serving areas. A sample of 20 Common Language Location Identifier (CLLI) areas (Appendix A) was selected from the data set labeled CO.ZIP and used to test the module.[9] The module was tested using an IBM ThinkPad 765D computer equipped with a 166 MHz Pentium processor, 32 megabytes of memory and 3 gigabytes of hard drive storage. The operating systems was Windows 95 with SR-1 and SR-2 patches. Performance seemed satisfactory, although it appeared that additional memory would have speeded operation.

Attempts to use the CEN.BAT file were unsuccessful, as were attempts to run multiple sessions using the CENBLOCK.EXE. This experience confirms the observation in a release note that batch processing functions only under the Windows NT operating system. In both cases, the programs crashed during operation. In both cases, it was possible to terminate the program using the CTRL-ALT-DEL toggle facility without rebooting the system. The creation of a batch file that will operate under the Windows 95 operating systems would be useful, given the laborious nature of multiple submissions. However, we understand that the ultimate application of this program probably will be as a sub-routine within another program and such an interface may not be justifiable at the present time.

The system also locked if the name of a *district*.IN file name was mistyped in the CENBLOCK.EXE file or, not surprisingly, if the specified *district*.IN file was missing from

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[9] The file is available at http://www.fcc.gov

the CENBLOCK sub-directory. We encourage the developers to implement a more elegant recovery procedure or, more preferable, a look-up table of available *district*.IN files. Again, this may be a feature that is better placed within the ultimate interface program.

The CENBLOCK software module was tested for these areas using five sets of grid size values in the CENBLOCK.PRM parameter file: 6 kilofeet, 12 kilofeet, 18 kilofeet, 24 kilofeet and 30 kilofeet. In two instances (from different telephone operating companies), the module crashed (repeatedly) during attempts at calculation. In both cases -- CLSPCOMA and VERNTXLI -- the parameter file specified 30 kilofeet grids. We infer that this size, which is somewhat larger than might be expected in certain urban (although not necessarily suburban) areas, may be the source of the problem.[10] This result seems to reaffirm the author's comment, quoted earlier, regarding the substantial amount of pre-processing necessary for data use.

The authors of the model have identified additional problems related to the size of the census blocks.

> Some modifications to the above algorithms are required for blocks with an area significantly greater than the area of a standard grid (which in the case of 18 kilofeet squares is approximately 12 square miles). For these large census blocks the CENBLOCK algorithm will assign only one microgrid cell in each grid. However, it might be inappropriate to assign the entire population of the block to the particular grid containing the interior point of the block.[11] Based on a working hypothesis that the population of a census block is uniformly distributed within the block, an

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[10] The error message was: CENBLOCK caused a general protection fault in module CENBLOCK.EXE at 0001:00000da5. Registers: EAX=81b20fa4 CS=488f EIP=00000da5 EFLGS=00000202 EBX=c10c0000 SS=48cf ESP=00004d6c EBP=00004d90 ECX=0043058f DS=48cf ESI=000003bf FS=0437 EDX=81b20000 ES=48f7 EDI=00000fa4 GS=0000 Bytes at CS:EIP: 26 89 5d fe a1 4e 07 8b 16 50 07 05 01 00 83 d2 Stack dump: 01200020 01200020 00000696 00000009 00000002 00000002 00000005 00000005 0000058f 42f04e94 736c630b 6d6f6370 4e492e61 00000000 00000000 00000000

[11] To the extent that an interior point of a block is correlated with population clustering, this assignment would in fact be the correct one. In the absence of further evidence on this issue, we believe that the more conservative "uniform distribution" assumption that we adopt is the correct one.

alternative approach would be to create new interior points and thereby subdivide the block into smaller units. The population of the block would then be assigned to the newly created "blocks" to maintain a uniform distribution. A second problem that may occur in both low and medium density areas is the issue of isolated cells within a grid. In some cases, such cells could be served from a neighboring grid at lower cost, and it would be appropriate to reassign the microgrid to the nearest neighbor. Neither of these extensions is incorporated into the initial October 1997 release of CENBLOCK. Both modifications, however, will be included in all future releases.[12]

We expect that the problem related to size that we identified in our analysis would be resolved when the author addresses these other issues related to grid size.

Analysis of Results

The results of our calculations are summarized by grid size in the tables in Appendix B. The maximum and minimum lengths calculated by the CENBLOCK software module are summarized in the following table.

Table 1. Maximum and Minimum Distances from CO to Hypothetical SAI

Grid Size	Maximum Lengths (feet)		Minimum Lengths (feet)	
(kilofeet)	Smallest	Largest	Smallest	Largest
6	16,688	184,139	230	7,691
12	17,955	181,374	366	7,557
18	15,793	188,635	333	7,627
24	16,483	193,733	366	6,961
30*	16,685	193,733	269	7,853

* Values for two exchanges could not be calculated for 30 kilofeet grids.

In aggregate, there does not appear to be consistency in the way in which changes in the length and width of the grid affect the lengths calculated by the module. This lack

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[12] Bush, Kennet, Prisbrey, Sharkey and Gupta, 1997, page 6.

of predictability may reflect some underlying structural characteristic of the model, but that is not clear from our review. Furthermore, it is not readily apparent how one might evaluate the impact of such inconsistencies on the overall efficacy of the module.

In addition to the inconsistencies noticed in the results, we observe a decided bias introduced through the selection of the distance mensuration system (distance metric). We will return to this major problem later in this report. However, we note here that the decided disparity in feeder versus distribution calculations will ripple through the remaining calculations in the HCPM to skew the estimated cost of network construction substantially. This is due to the minimization of the calculated distribution network necessary to provide service to subscribers.

FEEDDIST Software Module

Overview of the Module

The FEEDDIST software module is designed to estimate the investment necessary to provide narrowband telephone services within specified areas. This is done by processing the results of the CENBLOCK software module distance calculations using algorithms detailed by the authors in their definitive paper.[13]

> Within every microgrid with non-zero population, customers are assumed to be uniformly distributed. Each microgrid is divided into a number of equal sized lots, and distribution cable is placed to connect every lot. Non-empty microgrids are connected to the nearest concentration point, called a serving area interface (SAI), by further distribution plant. During this phase of the loop design algorithms, the heterogeneity of microgrid populations, and the locations of populated microgrids are explicitly accounted for. Finally, the SAIs are connected to the central office by feeder cable. On every link of the feeder and distribution network, the number of copper or fiber lines and the corresponding number of cables are explicitly computed. The total cost of the loop plant is the sum of the costs incurred on every link.[14]

Thus, the results produced by the FEEDDIST software module are constrained in large part by the results of the CENBLOCK software module. After the distances are calculated, and assuming that one accepts the simplifying assumption that population are uniformly distributed within the microgrid cells, the calculation of costs is indeed relatively straightforward. The only other input variables are user-supplied parameters described in the next section.

Testing the Module

The FEEDDIST software module uses as input the three output files generated by the CENBLOCK procedure. For our analysis of the FEEDDIST software module, we used

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[13] Bush, Kennet, Prisbrey, Sharkey and Gupta, 1997, especially section 4, pages 6-13.

the output files from the twenty exchanges sampled in our analysis of the CENBLOCK software module. Our sample was structured as was the CENBLOCK sample: for 6 kilofeet, 12 kilofeet, 18 kilofeet, 24 kilofeet and 30 kilofeet grids. Because two exchanges crashed during the CENBLOCK processing, the total sample size available for FEEDDIST analysis was 98, rather than the originally anticipated 100 cases.

The FEEDDIST software module also uses a parameter file, named FEEDDIST.PRM, in processing. The following table displays the values (and variable names) that were used in our examination. We note that these were the values contained in the parameter file when it was downloaded from the FCC's Worldwide Web site.

Table 2. FEEDDIST Software Module Parameters

0.50	max_drop_length
0.5	user_lambda
0.96	takerate
1.242	lines_per_house
12	copper_gauge_xover
1.1736	multiplier_24
18	max_copper_distance
18	copper_t1_xover
24	t1_fiber_xover
2400	copper_line_max
2400	t1_line_max
1.25	t1_redundancy_factor
4200	feed_copper_cable_capacity
3600	dist_copper_cable_capacity
288	fiber_cable_capacity
24	copper_placement_depth
36	fiber_placement_depth
3	CriticalWaterDepth
1.3	WaterFactor
12	MinSlopeTrigger
1.1	MinSlopeFactor
30	MaxSlopeTrigger
1.05	MaxSlopeFactor
1.2	CombSlopeFactor
1.2	SoilTexFactor
1345	th2016

[14] Bush, Kennet, Prisbrey, Sharkey and Gupta, 1997, page 1.

193	th672
25	th96
0.35	pct_ds1
0.50	pct_lsa
0.13	SpclAccessRatio
10	lines_per_bus
10	SpclAccessLines_per_bus
1.0	RoadFactor
1.0	FiberFillFactor

Testing was performed using the same computer hardware configuration as that used to test the CENBLOCK software module. To facilitate processing, we created a simple batch file to run the files sequentially (Appendix C.) In one instance, the module crashed (repeatedly) during attempts at calculation. In this one case -- YUMACOXC -- the grid size was 6 kilofeet. We do not offer an attempt at explanation for this software failure. As a result of this failure, and due to the missing input files from the previous procedure, the total sample size available for analysis after FEEDDIST processing was 97. The detailed results of the FEEDDIST software module calculations are presented, by grid size, in the five tables in Appendix D.

Analysis of Results

As was the case with the CENBLOCK software module, the FEDDIST software module produces results that are internally inconsistent. That is, the results of the calculations vary significantly with the microgrid size, but not in any easily discerned linear manner. This inconsistency is a cause of some concern because, virtually by definition, it does not lend itself to consistent correction.

When we extracted the raw data presented in Appendix D and calculated total costs per line, feeder costs per line and distribution costs per line, we confirmed that the model did indeed introduce a decided skew in the estimated costs for network construction. In several instances, the calculated cost per line for the distribution network was virtually zero, while in all cases the cost per distribution line was substantially and suspiciously below the true costs experienced by any communications company. The results of these calculations are presented by CLLI code area in Appendix E.

This skew would tend to understate the estimated costs of maintaining the distribution network and consequently the cost of unbundled network elements. We do not believe this was the intention of the designer, but rather that this is an artifact of the selection of the distance mensuration system (distance metric), which is discussed in detail in the next section of this report.

Model

User Inputs

We adopt the fundamental position that compliance with the recommendations, restrictions and guidelines presented in the *AT&T Outside Plant Engineering Handbook* serves as the fundamental test of the operation of any network design model.[15] To the extent that incorporation of the CENBLOCK and FEEDDIST software modules comply with those established standards for network design, we encourage their inclusion within the HCPM. To the extent that individual users can deviate from accepted practice, the modules should be modified in future revisions to preclude manipulation of inputs.

The *Outside Plant Engineering Handbook* specifies several categories of costs that must be considered in the design of the exchange network.[16] These include:

- Initial first cost considerations
- Future reinforcement requirements
- Maintenance considerations
- Potential service disruptions
- Government or company policy

In many cases, the most significant costs are initial first costs. However, despite philosophical posturing to the contrary, the other costs listed here may match or exceed the initial first costs. Sound engineering practice dictates that reasonable decisions must be made when selecting inputs for engineering calculations. Therefore, although the process of input definition may be painful, the process must be completed and agreed-upon inputs inserted in this or any model to ensure uniformity and model comparability.

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[15] *Outside Plant Engineering Handbook*, August 1994, AT&T Network Systems Document Number 900-200-318, Winston-Salem, North Carolina (Republished October, 1996 by Lucent Technologies).

Model Format

We are concerned that the introduction of compiled language programs in the Cost Proxy Model review process represents a departure from the FCC's previous position that all cost proxy models must be presented for public evaluation in as open a manner as possible. Although we acknowledge the provision of source code in the present instance, we encourage the FCC to specify that all future use of compiled language procedures also should be accompanied by the source code. Moreover, we note that even the availability of source code is not a guarantee that the model is readily open to review.

This issue is of particular concern given the inconsistency of the output of both modules. If the previously adopted methodology, which combined Microsoft Excel spreadsheets with Microsoft Access databases, had been used, we could quickly identify and correct many classes of errors (e.g., divide by zero errors). The iterative analysis cited by the sponsors as justification for using a compiled program could have been accommodated within that established methodology.

Distance Metrics

Air route distance, or "distance as the crow flies," is a construct associated with Euclidean geometric analysis.[17] The fundamental assumption underlying such analysis in this context is that the shortest distance between two points on a planar surface is a straight line. While this may be possible for certain functions, it is definitely not the case for most human activities, including several of particular significance for the

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[16] *Outside Plant Engineering Handbook,* 1996 reprint, pages 3-1 – 3-6.

[17] For overviews of the material discussed in this section, we refer to Greenberg, M.J., *Euclidean and Non-Euclidean Geometries*, 2nd edition, San Francisco, W.H. Freeman and Company, 1980 and Coxeter, H.S.M., *Projective Geometry*, 2nd edition, Toronto, University of Toronto press, 1974.

present discussion.[18] Rather, the appropriate distance mensuration system (distance metric) generally is a non-Euclidean geometry of the class of Riemannian geometries that sometimes is termed a "Manhattan metric" or "distance as the buffalo wanders."

Ignoring the fundamental mathematical distinctions, for the purposes of this discussion the key difference between these geometries is the way they treat the human-built environment. In the present case, Euclidean distance calculations underestimate the distances (lengths) that the HCPM model (through the CENBLOCK software module) will calculate for the construction of feeder and distribution networks. It does so by determining the shortest distance on a planar surface between the central office and an interface point (regardless of device type).

However, for almost all areas in the United States surveyed using the Public Land Survey System (PLSS), rights-of-way are defined in terms of a generally orthogonal network of streets. Despite such prominent exceptions as the District of Columbia, most street networks are predominantly rectilinear. The correct metric for such calculations is a Manhattan metric, which takes into account the ninety-degree angles that dominate the transportation systems. The predominance of rectilinear street grids and rights-of-way dictates that public utility easements, and consequently telephone company networks, are primarily rectilinear. The HCPM's use of Euclidean distance dramatically understates the true lengths of cables to be placed and the costs of placing those cables.

The metric defined and used in this model tends to understate the actual length of network facilities that must be constructed to serve the customers regardless of the size of the microgrid. The greatest understatement occurs in the case of a square with uniform distribution of population, resulting in the location of the population centroid in

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[18] Haggett, P., *Locational Analysis in Human Geography*, London, Edward Arnold, 1965. See also Gaile, G.L. and Willmott, C.J., eds., *Spatial Statistics and Models*, Dordrecht, D. Reidel Publishing Company, 1984.

the physical center. In this case, the understatement would be 29.29%. The understatement will diminish as one side of the "triangle is lengthened while the other is held constant.

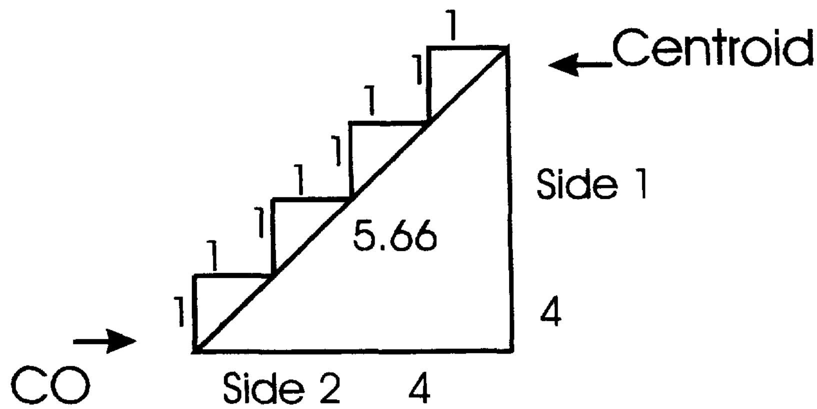

Figure 1.

Figure 1 displays the simple case of a central office that is located 5.66 distance units from the centroid, if the distance is measured using the "air route" metric. Because construction would almost invariably take place on public rights-of-way and easements and along transportation routes laid out in a rectilinear manner, the actual distance between these two points – for the purposes of exchange network cable construction – would be 8 distances units.[19] The understatement of the true length of the network in this case would 2.44 units (8 units minus 5.66 units), or 29.29%. The understatement of the length of distribution cable will be a function of this percentage and the medium selected for the feeder portion of the network.

[19] The assumption of construction along public-rights-of-way is a contingent assumption based on the prior assumption of cost minimization. Right-of-way acquisition costs are minimized by the use of public right-of-way. Furthermore, building along public transportation systems minimizes construction costs.

Table 3. Calculation Examples of Distance Understatement

"Length" (Side 1)	"Width" (Side 2"	Sum of the Sides	Hypotenuse of Triangle	Difference	% Under Actual
1	1	2	1.4142	0.5858	29.29%
1	2	3	2.2361	0.7639	25.46%
1	3	4	3.1623	0.8377	20.94%
1	4	5	4.1231	0.8769	17.54%
1	5	6	5.0990	0.9010	15.02%
1	6	7	6.0828	0.9172	13.10%
1	7	8	7.0711	0.9289	11.61%
1	8	9	8.0623	0.9377	10.42%
1	9	10	9.0554	0.9446	9.45%
1	10	11	10.0499	0.9501	8.64%
1	11	12	11.0454	0.9546	7.96%
1	12	13	12.0416	0.9584	7.37%
1	13	14	13.0384	0.9616	6.87%
1	14	15	14.0357	0.9643	6.43%
1	15	16	15.0333	0.9667	6.04%
1	16	17	16.0312	0.9688	5.70%
1	17	18	17.0294	0.9706	5.39%
1	18	19	18.0278	0.9722	5.12%

Table 3 shows sample calculations of the magnitude of the impact of this metric on the understatement of distribution cable lengths. Given the intention of the model to locate the centroid near the physical center to minimize the distance from the Central Office, the actual shortfall in every set of calculations will tend toward the maximum understatement values.

This understatement of the network's actual length is, we believe, the primary source of the understatement of the length of the distribution network and consequently the cost of distribution network construction costs. Because the first *N* kilofeet of network construction is allocated to feeder cables, where *N* is a function of medium (copper, fiber, copper carrier), the reduction in total length must reduce the length of distribution predicted by the model.

These comments should not be interpreted to mean that we do not endorse the use of geo-coding in the determination of network construction costs. Rather, we encourage the use of geographic coordinates, albeit with a modified methodology. Specifically, we encourage use of the model using the more appropriate Manhattan metric. First, the presence of the *omega* and *alpha* "angle from feeder" variables within the model might be taken as evidence of the intention of the module's author to incorporate such a revision at a future date. However, it does not appear that proper provision is made in the model for the incorporation of a correction for this problem. Second, we observe that geo-coding the actual subscriber locations would eliminate the need for several assumptions in the definition of the centroid for each service area.

Conclusion

We have evaluated the CENBLOCK and FEEDDIST software modules proposed by members of staff of the FCC. In principle, the methodology implicit in these modules in unobjectionable. However, the implementation is flawed by two factors described in this report. The first shortcoming is the susceptibility of the model to manipulation by users. User inputs must be agreed upon as a critical next, first step in model development.

The second shortcoming is the selection of an inappropriate distance mensuration system (distance metric). The distance metric used in the module biases the calculation of distances that are used, in turn, to calculate fundamental costs. This bias can be corrected by incorporating an appropriate distance metric, perhaps through use of the *omega* and *alpha* angle variables defined in the module.

Appendix A. Sample Set for Analysis

Table A-1: Sample Set CLLI Codes and Operating Companies

albytxpo	Southwestern
alsncoxc	Universal
aurrcoma	US West
bldrcoma	US West
brfdcoma	US West
clspcoea	US West
clspcoma	US West
dllncoma	US West
dlthgahs	BellSouth
enwdcoma	US West
flglcoxc	Eastern Slope
flngcoxc	Haxtun Telephone
grelcoma	US West
gnsncoma	US West
hydncoma	US West
lnmtcoma	US West
publcoma	US West
verntxli	Southwestern
wybogaes	BellSouth
yumacoxc	Eagle Telecommunications

Appendix B. CENBLOCK Software Module Calculation Results

Table B-1: Air Route Distances from CO to Centroid – 6 Kilofeet Grids

Exchange	Mean	Maximum	Minimum	Standard Deviation	CLLIs
albytxpo	64,230	123,248	2,362	41,024	64
alsncoxc	15,977	36,259	2,993	10,697	19
aurrcoma	24,118	65,316	7,691	11,484	73
bldrcoma	27,541	113,651	1,060	27,765	136
brfdcoma	17,077	35,260	1,469	8,052	54
clspcoea	13,718	35,182	2,061	6,369	75
clspcoma	12,686	50,783	1,214	8,062	107
dllncoma	81,805	184,139	3,627	58,620	81
dlthgahs	13,580	23,511	1,437	5,323	42
enwdcoma	7,665	16,688	1,004	4,610	41
flglcoxc	59,642	123,111	3,068	32,115	47
flngcoxc	32,071	82,629	1,524	17,264	68
gnsncoma	67,278	178,880	2,686	45,693	126
grelcoma	31,226	79,268	1,609	18,366	173
hayden	43,554	86,529	1,576	25,779	38
lnmtcoma	21,855	53,713	1,706	13,025	114
publcoma	23,879	96,629	366	23,456	82
verntxli	31,187	88,910	1,408	22,995	81
wybogaes	38,569	73,262	230	16,970	190
yumacoxc	72,150	143,310	2,161	35,605	344

All calculated values rounded to whole numbers.