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April 9, 1997

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

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

RE: CC Docket No. 96-45 - Universal Service

Dear Mr. Caton;

Attached are copies of two papers that the United States Telephone Association (USTA) would like to have placed on the record in the above referenced proceeding. They are;

(1) Engineering Evaluation of Cost Models for Determining Universal Service Support : Benchmark Cost Proxy Model by Dr. Robert F. Austin of Price Technical Services, Inc. and Austin Communications Education Services, Inc.; and,

(2) Engineering Evaluation of Cost Proxy Models for Determining Universal Service Support : Hatfield Model Version 3.0/3.1 by Dr. Robert F. Austin of Price Technical Services, Inc. and Austin Communications Education Services, Inc.

In accordance with Section 1.1206(a)(1) of the Commission's rules, two copies of this notice are being submitted to the Secretary of the FCC today. Please include it in the public record of the proceeding.

Respectfully submitted,

Porter E. Childers

Porter E. Childers
Executive Director
Legal and Regulatory Affairs

Attachments

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Engineering Evaluation of Cost Proxy Models

For Determining Universal Service Support:

Benchmark Cost Proxy Model

Price Technical Services, Inc. and

Austin Communications Education Services, Inc.

Principal Investigator:

Robert F. Austin, Ph.D.

February 23, 1997

Executive Summary

The United States Telephone Association retained Price Technical Services to provide an engineering evaluation of cost proxy models submitted in the Federal Communication Commission's Universal Service proceeding, CC Docket 96-45. This report contains our engineering evaluation of the Benchmark Cost Proxy Model ("BCPM"), sponsored by Sprint, US West and Pacific Bell.

This report is a companion to the report of our engineering evaluation of the Hatfield Model. To facilitate comparison, the current report retains the structure and outline of that earlier document.

We begin our critique with an evaluation of the concept of structure sharing. We then review three aspects of the model: model structure, engineering assumptions, and materials assumptions. In our discussion of the model structure, we consider the logic that underlies the model and defines its function. In the section on engineering, we consider the assumptions and methodologies of the engineering paradigm that supports the model. In the section on materials, we evaluate the materials recommended or specified in the model and consider possible conflicts between the materials specified and the model's assumptions.

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Engineering Evaluation of Cost Proxy Models For Determining Universal Service Support: Benchmark Cost Proxy Model

Price Technical Services, Inc. and
Austin Communications Education Services, Inc.

Principal Investigator:
Robert F. Austin, Ph.D.

February 23, 1997

Introduction

In their Recommended Decision in the FCC's Universal Service proceeding, CC Docket 96-45, the 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 thus far were satisfactory. Price Technical Services, in conjunction with Austin Communications Education Services, has been retained by the United States Telephone Association to provide an engineering evaluation and comparison of two cost proxy models submitted in CC Docket 96-45: the Benchmark Cost Proxy Model ("BCPM"), sponsored by Sprint, US West and Pacific Bell; and the Hatfield Model Version 2.2, Release 2 ("Hatfield Model"), sponsored by AT&T and MCI.

This report summarizes our engineering evaluation of the BCPM. In view of its importance to the BCPM, we begin our critique with an evaluation of the concept and assumptions of structure sharing. We then review three aspects of the BCPM: model, engineering and materials. In our critique of the model, we consider the logic that underlies the model and that defines its structure. In the section on engineering, we consider the assumptions and methodologies of the engineering paradigm that supports the model. In the section on materials, we evaluate the

materials recommended or specified in the model and consider possible conflicts between the materials specified and the model's assumptions.

Structure Sharing

Introduction

The Federal-State Joint Board on Universal Service, CC Docket 96-45 ("Joint Board") published its *Recommended Decision* on November 8, 1996. In that document, the Joint Board specified that the "technology assumed in the model should be the least-cost, most efficient and reasonable technology for providing the supported services that is currently available for purchase."[1] Furthermore, the Joint Board specified that: "All underlying data should be verifiable, engineering assumptions reasonable, and outputs plausible." [See Appendix A for the complete list of recommendations.]

While these specifications arguably may be in conflict in some instances, they certainly constitute an endorsement for sharing network construction costs among several companies where feasible. Both the BCPM and the Hatfield Model address the subject of structure sharing explicitly in several tables and implicitly in their structure. In brief, the concept assumes that several companies could use some or all support structures in a telephone network simultaneously. For example, in theory several companies could attach aerial cables to a given pole in a pole line.[2]

It seems reasonable to state that low relative rates of structure sharing would best serve the interests of the BCPM's sponsors. In support of this statement, we note first that a low assumed rate of structure sharing will result in a calculated increase of the average forward-looking costs of construction, hence a higher cost for unbundled network elements. This would result in higher network "assembly" or

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[1] Federal-State Joint Board on Universal Service, CC Docket 96-45, *Recommended Decision*, November 8, 1996, ("Joint Board Decision"), paragraph 277.

[2] For a detailed discussion of this topic, see: Robert F. Austin, Ph.D. *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.

"element leasing" costs (as opposed to construction costs) for the sponsors. In other words, the lower the rate of sharing that the model assumes, the higher the *pro rata* cost of new network construction that the model will calculate. However, we find no evidence of such bias in the construction of the model: the values used in the BCPM are reasonable and appropriate in most instances.

Incorporating Structure Sharing in a Model

The Hatfield Model sponsors have stated that: "It is more than reasonable to assume that, *on a forward-looking basis*, ... ILECs [Incumbent Local Exchange Carriers] will be able to recover an increasing portion of their structure costs through joint ownership or rental arrangements."[3] This is an unreasonable assumption, for many reasons.

The BCPM correctly identifies that few underground structures and no buried structures should be shared in the feeder network.[4] This is first a matter of public convenience given the amount of overbuilding one must expect in the feeder network. It takes longer to perform overbuild construction if this work must be coordinated with multiple conduit-manhole system occupants.

It also is a matter of common sense in the case of buried structures. It is hazardous to the integrity of the systems to dig up existing cables for maintenance. This is a particular problem if the cables belong to a power company. In the case of power companies, there is also a question of safety given the need for separation of communication cables from power cables and the sizing of the power systems in their equivalent feeder networks. This also affects the economic argument for

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[3] "AT&T and MCI Submission on the Hatfield Proxy Model," (*Ex Parte* Presentation - Proxy Cost Model Questions, CC Docket 96-45), January 7, 1997, page 20.

[4] Benchmark Cost Proxy Model, January 31, 1997, Attachment 9 - *Model Methodology*, pages 19 and

sharing because trenches must be dug substantially deeper (and somewhat wider) for larger power cables, obviating any benefit from sharing with power companies.

Finally, given that the electric companies and Community Access Television ("CATV") companies already have their feeder networks built, the case for sharing structures in the feeder network is moot. Consequently, we judge the BCPM provisions for sharing to be reasonable and proper.

The BCPM does make provisions for structure sharing in the distribution network. Here the case for sharing is compelling and the percentages of structure sharing defined by the sponsors of the BCPM appear to be reasonable. The model properly identifies the paradox of sizing versus sharing -- the smaller the structure, the less the capacity for sharing and *vice versa.* The default structure sizes in the BCPM support moderate amounts of sharing that appear to reflect the assumptions of the Joint Board well. If additional sharing capacity is required, the structures may be resized - at additional cost – to satisfy this demand.

We believe that one minor correction should be incorporated in future revisions. We recognize that power companies will not share guys and anchors with telephone companies for reasons of safety (bonding and grounding considerations). We also recognize that the height of attachment for power cables is such that the lead-over-height ratio would dictate guying to a separate anchor in any event. However, CATV cables can be attached to poles with just one foot of separation from telephone cables. Assuming the poles are tall enough to permit attachment and still ensure clearance over ground, CATV companies probably would be able and willing to share pole lines. Under these circumstances, it is feasible and likely that CATV companies would negotiate the right to attach a down guy to an existing anchor, if indeed the plant condition and circumstances required an additional down guy.

24.

The BCPM logic makes provisions for anchor sharing. However, the default value assigns 100% of the cost to the telephone company. Presumably, this is because the guy and anchor assumed in the default BCPM values is only adequate to support telephone company facilities.

Practical Considerations

The BCPM recognizes and incorporates currently accepted, industry-wide engineering practices dictating minimal use of aerial facilities. This design principal recognizes 1) the higher whole-life costs (including maintenance) of the facilities, 2) the exposure of the aerial facilities to more and greater environmental hazard, and 3) the zoning requirements of many local governments regarding design aesthetics. The BCPM assumptions regarding the mix of aerial, buried and underground plant is reasonable. Moreover, the model permits adjustment of this mix.

Regarding manhole-conduit system use, there are no identifiable cable placement problems in the BCPM. The model specifies manholes compliant with the recommendations of the *AT&T Outside Plant Engineering Handbook*.[5]

The BCPM dedicates the fourth duct in a four-duct manhole conduit system for maintenance purposes.[6] This is appropriate engineering design. However, it does compromise to some extent implicit dictates concerning duct sharing.

The BCPM considers the additional cost associated with sharing underground, buried and aerial structures. There will be an increase in construction placement

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[5] *Outside Plant Engineering Handbook*, January 1990, AT&T Document Development Organization, Winston-Salem, North Carolina, Section 8. The sponsors of the model cite as support for this selection a publication called the National Construction Estimator, 44th edition, page 442.

costs in most cases if trenches or other structures are shared or jointly occupied.[7]

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[6] Benchmark Cost Proxy Model, January 31, 1997, Attachment 9 - *Model Methodology*, page 24.

[7] *Outside Plant Engineering Handbook*, January 1990, AT&T Document Development Organization, Winston-Salem, North Carolina, page 9-5. The *Handbook* specifies "**Joint trenching with power facilities should be employed only for distribution cables and service wires, not for feeder or trunk cables**" [emphasis in original].

Model

Introduction

It appears that the BCPM contains no individual hidden cells. In general, the logic of the model is readily apparent and the model is relatively simple to use.

Missing Inputs

There are no significant inputs missing from the model. The input values and multipliers appear to be reasonable. However, the method of presenting these inputs should be modified in the future. We recommend the following specific adjustments:

- Identify permit costs as a separate cost.
- Separate material and placement costs for cable and switch.
- Separate material and placement costs for switch investments.
- Provide greater detail concerning the land and building investments.
- Provide greater detail for support expenses (see Construction Equipment below).

Construction Equipment

The BCPM makes adequate provisions for vehicles, buildings, tools, equipment and similar network construction, operation and maintenance costs. This is of particular importance if structure sharing is intended to recover the costs of operation as well as construction.

The BCPM makes adequate provisions for the cost of Operational Support Systems ("OSS"). The true cost of a network must include the cost of numerous support systems, including switching software systems and their associated routing tables and databases. The inclusion of the cost of these systems, which we estimate to be approximately five to eight percent of the network construction costs, is a distinct

advantage of the BCPM.

Cost

The BCPM includes consideration of the costs and design of Digital Cross-Connects ("DSX"). We consider this to be a significant matter because it indicates forward looking thinking in design.

Logic

The BCPM incorporates reasonable assumptions concerning the relative mix of aerial, buried, and underground facilities.

Engineering

Cable

The BCPM uses currently available technology to generate the costs of operational, useable voice grade service networks. The loop lengths are reasonable and satisfy the requirements of a 1,500-ohm supervisory limit. Proper cable gauging ensures a power limit on line cards of 900 ohms and minimizes card costs. The system does not presuppose cable loading and makes no provision for the costs of loading.

Carrier

Users of the BCPM can design and size generic Next Generation Digital Loop Carrier ("NGDLC") based on the number of lines served by the Digital Loop Carrier ("DLC"). This distinguishes the BCPM from the Hatfield Model, which uses population density groups to design and size DLC, a methodology likely to yield inconsistencies in design. It also distinguishes the BCPM from the Hatfield Model in that it allows the user to deploy a variety of equipment types; the Hatfield Model currently is restricted to two specific brands/types of equipment.

The BCPM provides tables for various DLC cabinets and systems and by default uses the minimum size cabinet that is required to serve the actual demand shown for each terminal location within the Census Block Group ("CBG"). The BCPM recognizes that current technology allows the sharing of systems on fibers. The BCPM input and default value tables are user adjustable to satisfy changes in these technologies.

Design

All relevant state authorities dictate quality of service parameters. Among the most significant, relevant quality of service parameters is the requirement for the provision

of service within some specified time frame. System designs must comply and any reasonable engineering model must be adaptable to this requirement. The BCPM satisfies this demand for flexibility in scheduling service by providing reasonable, albeit minimal, capacity for growth.

The BCPM designs all the distribution cables within each CBG to the distance and size required to meet the specific demand of each individual CBG with plant placed to the rear lot line of all household locations. Moreover, the BCPM includes adjustments to the distribution area to prohibit the placement of cable in unoccupied areas that are based on individual CBG geographic data.

The BCPM uses the average lot size in each CBG, as well as the number of households, to allocate the distribution network sections. The BCPM then adjusts low density CBGs to assume that the local population resides within 500 feet of a roadway.

Drops

The costs of terminals and drops vary greatly between zones of different population density. Within more densely populated areas, where subscribers concentrate closer together, the design engineer can spread installation costs over a larger number of subscribers, particularly when pre-cabling subdivisions. The BCPM provides sufficient detail and flexibility for the design of drops.

Interoffice/Inter-Exchange

One minor, albeit puzzling, omission is the lack of discussion of interoffice trunking. The sponsors of the BCPM acknowledge this omission.

> "The current version of the BCPM does not have a separate module to develop the interoffice investment. Rather, a factor is applied to switch investment to estimate the interoffice. The BCPM sponsors do

> not feel that this materially impacts the results of the model ... because these costs only constitute approximately three present (3%) of the switching investment."[8]

Nevertheless, we believe that future iterations of the model should expand on this issue to clearly define common costs.

Loop

Presumably reflecting the experience of the sponsors in building and maintaining local loop, the BCPM provides plausible and reasonable designs. All user inputs are, in general, reasonable and in any event can be changed by users.[9]

In high capacity CBGs such as found in urban or suburban areas, the BCPM provides for a capacity driven, low cost fiber alternative to reinforcing the network with copper cables. It also recognizes that in these high-density areas, there is a high propensity for cable/conduit congestion, and recognizes the economies of fiber replacing copper in lieu of additional conduit relief.

Manholes

The BCPM specifies correctly the number of manholes necessary for a manhole-conduit system. The BCPM also makes appropriate provision for the use of manholes in the distribution network by providing flexibility in sizing and spacing.

Plausibility

The model apparently incorporates no provision for growth, presumably because of the "green field" approach dictated by the forward-looking cost assumption.

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[8] Benchmark Cost Proxy Model, January 31, 1997, Attachment 9 - *Model Methodology*, page 21.

[9] Benchmark Cost Proxy Model, January 31, 1997, Attachment 9 - *Model Methodology*, page 2 and following provides a detailed discussion of the nature and practice of loop design within the industry in

However, sound engineering principles and least total cost economic planning principles dictate the assumption of some growth and the design of a distribution system that will accommodate ultimate demand. This is particularly compelling in view of the expected growth in demand for services that the Joint Board currently defines as "unsupported".

The BCPM assumes that the Entrant Local Exchange Carrier ("ELEC") or the Incumbent Local Exchange Carrier ("ILEC") will build the local network to satisfy a perfectly known demand. Consequently, the model does not appear to include any breakdown of costs to reflect variable construction quantities. This makes any attempt to compare the specified unit prices with professional experience very difficult.

Poles

The BCPM specifies correctly the number of poles necessary for a pole line. The BCPM specified reasonable default sizes for poles and reasonable spacing of poles in a pole line.

Switch

The BCPM supports proper host/remote switching designs.

Terrain

The BCPM incorporates terrain in several ways. The first and most significant method of including terrain is accomplished by direct measurement. The BCPM uses a digital database of terrain information built by a third party. The BCPM incorporates a two-step modification of prices on each CBG based on this slope

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general and the model in particular.

data. Second, the model considers the local water table and the effects of water "near the surface" on construction.

Materials

Cables

The cable sizes appear to be reasonable. Moreover, the specification of fiber versus copper cable is reasonable and appropriate.

Copper cable costs are not easily interpreted in the BCPM. We recommend disaggregation of material and placement costs to facilitate analysis in future iterations.

Poles

The pole sizes and materials specified in the model are reasonable and appropriate.

Conclusion

The BCPM shares one significant weakness with the Hatfield Model: a failure to incorporate contemporary thinking about feeder design in a "green fields" situation. The model does not recognize that the known wire center locations could be the basis of a SONET system. Although the BCPM permits inclusion of DLC that could support SONET, it does not assume dual-redundancy (or dual-resiliency) ring topology and at present does not incorporate Add-Drop Multiplexer ("ADM") technology.

In Russia, Kuwait, Malaysia, and numerous other countries in which deregulation has occurred, the ELECs are building their competitive networks using Synchronous Digital Hierarchy ("SDH") technology that is essentially identical (for the purposes of this discussion) to SONET. We believe this feature should be an integral part of design for any forward looking network because of its low cost, resiliency, and provision of quality-supported services. However, we recognize the intrinsic difficulty of incorporating proprietary elements in the United States network. Until there is international agreement on SONET protocols, therefore, we judge this shortcoming to be a minor issue.

The BCPM as presented satisfies substantially all the requirements of the Joint Board. One key characteristic of the BCPM is its flexibility. Virtually all input values are adjustable, allowing the user to identify and incorporate local variation, regulation and requirement. This flexibility gives significance to the fact that the sponsors of the model have granted the FCC and the Joint Board "the right to make any changes in the model that they believe are in the public interest and are necessary to carry out their responsibilities under the Telecommunications Act of 1996."[10]

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[10] Letter to William Caton, "Re: *Federal-State Joint Board on Universal Service – Proxy Model*

Workshops on January 14-15, 1997, CC Docket No. 96-45, *Response to Public Notice of December 12, 1996* (DA 96-2091), January 30, 1997, page 2.

Appendix A. Excerpt from the Joint Board Recommendations to the FCC (Paragraph 277)[11]

"The Joint Board recommends that the Commission use the following criteria to evaluate the reasonableness of any proxy model.

(1) Technology assumed in the model should be the least-cost, most efficient and reasonable technology for providing the supported services that is currently available for purchase, with the understanding that the models will use the incumbent LEC's wire centers of the loop network for the reasonably foreseeable future.

(2) Any network function or element, such as loop, switching, transport, or signaling, necessary to produce the supported services must have an associated cost.

(3) Only forward-looking costs should be included.

(4) A forward-looking cost of capital and the recovery of capital through economic depreciation expenses must be included.

(5) The model should estimate the cost of providing services for all businesses and households within a geographic region. This includes the provision of multi-line business services to allow the models to reflect the economies of scale associated with the provision of these services.

(6) A reasonable allocation of joint and common costs should be assigned to the costs of supported services. This allocation will ensure the forward-looking costs of providing the supported services do not include an unreasonable share of the joint and common costs incurred in the provision of both supported and unsupported services, e.g., multi-line business and toll services.

(7) The models and all underlying data should be available to all interested parties for review and comment. The data should be verifiable, engineering assumptions reasonable, and outputs plausible.

(8) The model should be able to examine and modify the critical assumptions and engineering principles. It should also allow for different costs of capital, depreciation and expenses for different facilities, functions, of elements."

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[11] Federal-State Joint Board on Universal Service, CC Docket 96-45, *Recommended Decision*, November 8, 1996, ("Joint Board Decision"), page 9, paragraph 277.

Engineering Evaluation of Cost Proxy Models

for Determining Universal Service Support:

Hatfield Model Version 3.0/3.1

Price Technical Services, Inc. and

Austin Communications Education Services, Inc.

Principal Investigator:

Robert F. Austin, Ph.D.

March 17, 1997

Executive Summary

The United States Telephone Association retained Price Technical Services to provide an engineering evaluation of cost proxy models submitted in the Federal Communication Commission's Universal Service proceeding, CC Docket 96-45. This report contains our engineering evaluation of the Hatfield Model Version 3.0/3.1, sponsored by AT&T and MCI.

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