exchange service. These models include the Benchmark Cost Model ("BCM"), originally submitted in CC Docket 80-286 by its sponsors (MCI Communications Corporation, NYNEX Corporation, Sprint Corporation, and US West, Inc.), the Cost Proxy Model ("CPM") submitted by Pacific Bell, the Benchmark Cost Model 2 ("BCM2") submitted by Sprint Corporation and US West, Inc., and the Hatfield Model (Version 2.2, Release 1) submitted by MCI Communications Corporation and AT&T Corporation.

To understand how these models compare for the purpose of generating benchmark cost ranges for network functions and services, in general, and basic residential exchange service, in particular, the FCC, on July 10, 1996, issued a Public Notice in CC Docket 96-45, asking interested parties to comment on the models. At the request of BellSouth Telecommunications, Inc., we provide below our analysis of the Hatfield model (and of the BCM, to the extent necessary) and our conclusions regarding that model's usefulness.

III. GENERAL SUMMARY OF ISSUES

Our analysis of the Hatfield model begins with its set of underlying assumptions and postulates. Some of those assumptions are explicit. For example, the model assumes that existing networks respond to increases in demand in a "scorched node" fashion, i.e., their existing wire center locations remain fixed even as the networks are otherwise reconstructed to serve new demand.[2] The model also makes several assumptions about technical or engineering parameters that drive estimates of cost. These include, for example, "fill factors" (or, utilization rates), placement of feeder and distribution plant, density zones, and the distribution of businesses or households within the density zones.[3] The model also makes some important

[2] *Documentation of the Hatfield Model, Version 2.2, Release 1*, ("Hatfield Document"), Boulder, CO: Hatfield Associates, Inc., May 16, 1996, filed in CC Docket 96-45 on July 5, 1996, on behalf of MCI Communications Corporation and AT&T Corporation. See, especially, p. 3.

[3] In fact, some of these assumptions are borrowed by the Hatfield model from the BCM where they first appeared. This is because the Hatfield model relies substantially on the BCM for calculating the costs associated with loop investments.

— and, as we argue below, disputable — assumptions about financial parameters such as those involved in calculating the weighted cost of capital or for converting capital expenditures into annualized expenses.

The model's results also appears to make several implicit assumptions that are significant influences on the model's cost outcomes. Even if those assumptions were never intended to be made, it is safe to say that the cost outcomes only make sense if those assumptions are indeed made. A significant part of our critique of the Hatfield model focuses on these unstated assumptions and the extent to which they are responsible for cost estimates that we believe to be neither credible nor acceptable.

By construction, every model is an abstraction of reality, and assumptions about the model are frequently made to keep the necessary calculations tractable. The Hatfield model's assumptions or premises, however, often appear untenable for both engineering and economic reasons. Specifically, several of its technical assumptions (regarding engineering parameters) are flawed in light of current best engineering practices and have the effect of biasing cost estimates significantly downwards. The model's hidden economic assumptions — which also lead to understated costs — are particularly questionable. Some of these economic assumptions appear to be as follows:

1. Costs estimated for the so-called *average* or hypothetical network (that presently does not exist) are sufficient to inform public policy deliberations about the pricing of an *actual* network's unbundled services or the *actual* costs of the universal service program. Any departure of an incumbent LEC's costs from the "benchmark" costs of a hypothetical network must be regarded as *prima facie* evidence of inefficiencies in the LEC's operations.

2. Incumbent and entrant LECs alike will pursue identical strategies and technology choices despite their very different starting points under competition. For example, an incumbent and an entrant — both in pursuit of the most efficient, forward-looking network for serving future demand — will somehow opt for the same choice of technology and architecture. If those choices differ, then the *incumbent's* preferences regarding technology and network upgrades must be considered suspect and inefficient.

3. The local exchange market in which entrant firms will compete with incumbent local exchange carriers (LECs) will retain many vestiges of its monopoly past. For example, the low regulatorily-prescribed depreciation rates will continue to remain relevant under

competition, and so will cost-of-capital or hurdle rates that reflect the considerably lower risks associated with regulated monopoly markets. Also, the scale economies which accrue to regulated monopolies as single providers of service will continue to be available to multiple, competing LECs who (in the process of sharing the market) may only serve demand segments that are smaller than the entire market.

We explain below how these assumptions taint fundamentally the usefulness of the Hatfield model for the purposes of implementing universal service reform as contemplated in Section 254 of the Telecommunications Act of 1996 and the present docket.

IV. ANALYSIS OF SPECIFIC ISSUES/ASSUMPTIONS IN THE HATFIELD MODEL

A. The Hatfield Model's Approach to Cost Estimation

The Hatfield model is primarily an engineering model of cost. It is a "bottoms-up" model that builds to service- or function-level cost by making several assumptions and specifications about the elements and piece parts that make up the service or function. It contains cost modules that calculate the investment costs of loop plant and wire center operations (switching, signaling, operator, and inter-office facilities). To costs of total plant investments the model adds annual service expenses related to the provision of services and unbundled functions. It reports the compiled investment requirements and expenses at the summary level desired, e.g., for individual functions like loop distribution, end-office switching, or signaling links, or for services like basic residential exchange service.

While such an engineering approach to estimating cost is necessary to account for the several hundreds, or even thousands, of components that make up a network, it often has to rely on facilitating assumptions (such as the use of multiplicative "factors" or ratios) to account for several *non*-network related and non-investment costs. Second, the engineering approach must make several assumptions about the prices at which network components would be purchased, or even the pricing structures (discounts, etc.) themselves. Third, that approach must postulate the utilization rate past which the network would consider expanding capacity despite having spare capacity on hand. Fourth, the engineering approach must make assumptions about the distribution of customers (by density zones, by proximity to the serving wire center, etc.) in

order to construct the most efficient network layout needed to serve those customers. In the process, assumptions must be made about the type and configuration of outside plant (copper or fiber cable, aerial or buried cable, feeder and distribution loops, loop concentrators, etc.) and end-office equipment (digital or analog switches, signaling systems, operator systems, transport, etc.). Finally, assumptions would be needed for the physical, topographical, and climatic features of the geographic areas that are served by the network. For example, the Hatfield model — as the BCM before it — contains assumptions about rock hardness, surface conditions, water table depth, etc., all of which have implications for the mix and type of structures (poles, trenches, conduit, etc.) used for housing outside plant.

A cost model that depends on assumptions about so many crucial parameters must be judged by two criteria: (i) how well can its assumptions and cost estimates represent or reproduce those of an *actual* network? and (ii) how easily can it be modified to accommodate a network's historical circumstances and future technology and operational choices, given the increasing uncertainty about demand engendered by greater market competition and reduced regulation?

The first criterion recognizes that engineering estimates of economic costs are, at best, hypothetical, namely, the costs that would be realized were the network, in reality, to conform exactly to the assumptions made for it. Differences between engineering costs and actual (or, *booked*) costs are natural and should be expected. Given that engineering costs are usually lower than booked costs, the model must be capable of being modified in order to reconcile or explain the discrepancy between hypothetical and actual costs. The second criterion tests the model's flexibility on its economic merits, i.e., primarily its ability to produce cost estimates that reflect the changing market and regulatory environment, rather than just the setting initially assumed for it.

B. The Hatfield Model Does Not Produce Costs for an Actual Network

1. Model Design Skewed Toward Hypothetical Network

Because of its numerous assumptions about technical parameters, the engineering approach has a built-in potential to mis-estimate a network's actual costs. This problem is likely to be aggravated when the technical parameters entered as model inputs represent *not* the specific network being modeled but rather an entirely hypothetical or "average" network. The sponsors of the model openly acknowledge its orientation toward a hypothetical network.

> The Hatfield Model develops estimates of the economic costs (TSLRIC) of providing local telephone services by determining the specifications of a local network, using most efficient practices and best forward-looking technologies, to meet the total demand for local narrowband telephone services. By doing this, *the model simulates the construction and operations decision-making of an efficient local service provider that must create and operate a new network to meet current and reasonably forecasted demand levels* for narrowband telephone services. In simulating the construction of these *hypothetical* networks, the model incorporates realistic assumptions concerning the LECs' ability to adopt and implement efficient, cost minimizing production techniques.[4]

The model sponsors add:

> The technologies considered in the Model are forward-looking. As such, they are those an efficient LEC *would* adopt if it were to *begin today to rebuild its telephone service network from the bottom up.*[5]

Despite its sponsors' claims that the Hatfield model incorporates "realistic assumptions" about (presumably, incumbent) LECs' networks and their abilities to implement new, more efficient production techniques, it is abundantly clear that the model is intended for no such purpose. First, the Hatfield model depends in substantial part on outputs of the BCM model for which *its* sponsors had the following goal:

---

[4] Hatfield Document, p. 2. Emphasis added.

[5] Hatfield Document, pp. 2-3. Emphasis added.

> The BCM does *not* define the *actual* cost of any telephone company, nor the embedded cost that a company might experience in providing telephone service today. Rather, the BCM provides a benchmark measurement of the relative costs of serving customers residing in given areas, i.e., the [Census Block Groups].[6]

Second, among other things, the Hatfield model's sponsors (i) freely admit to not using LECs' actual fill factors,[7] (ii) make arbitrary and uniform assumptions about "line multipliers" meant to account for business and other lines that the BCM leaves out,[8] (iii) input into the model not actual prices paid by LECs for local network components but those constructed by the model developers themselves,[9] and (iv) use an AT&T report on *inter*-exchange capacity expansion costs to calculate a *LEC's* tandem switching investments.[10]

---

[6] *Benchmark Cost Model.* A Joint Submission by MCI Telecommunications Corporation, NYNEX Corporation, Sprint Corporation, and US West, Inc., in CC Docket 80-286, September 12, 1995. See, especially, p. 3. Emphasis added.

[7] Hatfield Document, p. 3, wherein the now-familiar but unproven assertion is made that LECs' actual fill factors reflect built-in LEC inefficiencies.

[8] Hatfield Document, p. 12. It is noteworthy that no attempt whatsoever is made to base the line multipliers on actual data for a LEC from a representative sample of its CBGs. Instead, the Hatfield model uses an iterative fitting technique that produces a uniform ratio of business-residence lines across all CBGs. This is justified by claiming that "... although specific CBGs may exhibit exceptions from ... trend, at higher levels of aggregation (e.g., the wire center or LATA level), the mix of services will progressively approach the total company mix reported in ARMIS data." Ironically, its sponsors have no intention of modifying the model to use *actual* data on business lines instead of the arbitrary multipliers (see pp. 132-133 of the Transcript of the Pre-Hearing Conference before Administrative Law Judge Kirk McKenzie, Case R. 93-04-003, P.U.C., California, July 12, 1996). This position is taken even though a public source for such data has been identified and employed by a new version of the BCM model called "BCM2" (see Executive Summary of a press release, *Sprint & US West Refine Previous Benchmark Cost Model and Deliver to FCC*, Washington D.C., July 11, 1996).

[9] Hatfield Document, p. 24. The sponsors state: "While actual prices paid for these components and their network characteristics may vary from carrier to carrier, [Hatfield Associates, Inc.] has developed a set of standard input values, based on public data sources and *the informed judgments of its engineers and other industry experts.*" Emphasis added.

[10] Hatfield Document, p. 38.

2. BCM's Deficiencies are Shared by the Hatfield Model

In adopting the BCM virtually in its totality for calculating loop investments, the Hatfield model also retains the BCM's infirmities. The BCM often assigns Census Block Groups (CBGs) to the wrong wire center, a clear demonstration that the hypothetical network constructed by the BCM does not correspond to the actual, physical network. This problem is, in principle, correctable if intervening topographical features such as rivers, lakes, and mountains are taken into account when mapping a CBG to a wire center. When such intervening features are present, sheer proximity alone of a CBG to a wire center may not be sufficient reason for assigning it to that wire center. Where geography requires that a CBG be assigned to a more distant wire center, the actual cost of loop plant will likely exceed that calculated for an assignment based purely on proximity. Neither the BCM nor the Hatfield model adjusts for these topographical features.

For calculating the placement of feeder and distribution plant, the BCM assumes that loop feeders and sub-feeders emanate from the wire center only up to the edge of a square-shaped CBG. Within the CBG, the BCM assumes a uniform distribution of households and the placement only of distribution plant. These assumptions may often be untenable and produce average loop lengths and investment costs that are quite different in reality. The Hatfield model's sponsors recognize this limitation but fail to explore its full ramifications. The model sponsors claim that "[b]ecause populations tend to cluster in towns and subdivisions, the BCM assumption of uniform population distribution tends to overstate distribution distance and thus the required loop investment." [11] This implies that the error in the estimated cost is only one way — toward *over*-estimation. In fact, under-estimation of cost could occur, in principle, for a large CBG in a low-density zone where the population clustering occurs not at the geometrical center of that CBG, but in several spots more widely dispersed from the center than would be assumed under a uniform distribution.

---

[11] Hatfield Document, p. 16.

In addition, the Hatfield model documentation reports that there are economies of scale (i.e., falling unit costs) in the deployment of copper or fiber cables. For example, the unit cost declines from 1.26¢ to 1.14¢ to 0.61¢ per foot of buried copper cable for cable sizes of 100, 400, and 4,200 (the presumed maximum deployment within a CBG), respectively.[12] Similarly, the unit cost declines from 6.58¢ to 4.13¢ to 3.86¢ per foot of buried fiber cable for cable sizes of 12, 48, and the maximum 144, respectively. Similar economies are observed for aerial copper or fiber cable. Since the BCM works with CBGs, rather than the actual distribution areas employed by LECs, it is quite possible for the BCM (and the Hatfield model) to assign larger cable sizes (and, therefore, to experience greater economies of scale) to a densely-populated CBG than the cable sizes actually deployed by LECs in their largest distribution areas. For example, while the BCM's maximum deployments are 4,200 feeder cable pairs and 3,600 distribution cable pairs, the largest actual deployments in California are 3,600 feeder and 1,800 distribution cable pairs by Pacific Bell and 3,000 feeder pairs by GTE.[13] Under these circumstances, the BCM assumptions would tend to overstate the economies of scale and, hence, to understate the true costs of LECs' actual loop plant.

Finally, the BCM assumes that each CBG is served by four equal distribution legs.[14] This can be problematic for calculating the cost of support structures used for housing the deployed cables. The BCM's (and the Hatfield model's) current practice is to calculate that cost by applying a multiplier or "factor" to the price of cable. As demonstrated by an example provided by Timothy Tardiff, if the actual number of distribution routes in fact exceeds four, the BCM will understate the component of the cost of structures that varies with route miles.[15]

---

[12] Hatfield Document, p. 28. All unit costs are computed from Tables 17 and 18.

[13] Tardiff, *op cit.*, pp. 8-9.

[14] *Benchmark Cost Model*, p. 11.

[15] Tardiff, *op cit.*, pp. 8-9. Tardiff also reports that GTE estimated that doubling the number of distribution routes raises installation and structure costs by 49 per cent, rather than the 17 per cent predicted by the BCM. This and other discrepancies between BCM-reported and actual costs loom even larger when it is realized that roughly half of a switched network's total cost arises from its distribution plant.

3. Other Problems With the Hatfield Model's Cost Estimates

There are several other problems with the Hatfield model that can cause an understatement of a LEC's actual costs.

First, the Hatfield model's calculation of switching costs contains several inaccuracies and anomalies. As pointed out by Tardiff, the model matches a 1994 forecasted switch price with a 1993 average embedded switch size. The model assumes three switch sizes: small, medium, and large, and assembles prices and average sizes for them from numerous sources. While independent LECs *excluding* GTE are used for the small switch price, the model nevertheless includes GTE in estimating the average small switch size. Also, the model equates the average size of an *installed* switch with the average size of a *new* switch, a dubious assumption at best.[16]

Second, the Hatfield model's relationship between the cost of switching per line and the size of the switch is developed from only three data points. It also produces switching cost estimates that are lower than, and inconsistent with, those produced by the BCM. For example, the Hatfield model takes as a data point that a medium size switch with an average of 11,200 lines would have a switching cost per line of $104. In contrast, the BCM estimates[17] that a switch of size 11,000 lines (closest to the Hatfield number) would have a per line cost of $298. Even though the BCM reports cost for a DMS-100 switch, and it is not immediately clear what switch type the Hatfield model has in mind, the discrepancy in the per line estimate of cost is significant enough to warrant a critical second look at Hatfield's claimed relationship between switch size and per line cost.

Third, the Hatfield model appears to assume that LECs serve new demand only by installing *new* switches. In fact, Tardiff cites a McGraw-Hill report[18] that LECs frequently buy

---

[16] Tardiff, *op cit.*, pp. 12-13.

[17] *Benchmark Cost Model*, Attachment 1.

[18] Tardiff, *op cit.*, p. 13.

additional lines for their already *installed* switches, and that those additional lines each cost more than lines on new switches. Switch suppliers frequently sell initial lines at deep discounts, but not so the lines added subsequently. By failing to account for the LECs' practice of adding lines to installed switches for serving new demand, the Hatfield model very likely understates actual switching costs. In effect, by assuming that LECs only add capacity by installing new switches, the Hatfield model "builds in" the lowest possible switch prices into its switching cost estimates.

Fourth, the Hatfield model makes no effort to capture the alternative ways that a LEC may choose to expand its switch capacity. Recall that the Hatfield model utilizes fill factors for loop plant and switching equipment that are considerably greater than those actually reported by LECs. In addition, when developing the costs of wire center investments, the model first fixes the maximum effective switch size — the "large" switch — at 80,000 lines (assuming a fill factor of 80% for a 100,000 line switch). Next, it equips a wire center with only one such switch as long as the line count served is between 0 and 80,000. However, if the served line count rises to 90,000, the model recomputes the investment as that required for *two* 45,000-line switches (expressed net of the assumed fill factor). That is, the demand for the last 10,000 lines over the first 80,000 is not assumed to be served by a new switch that is added to the 100,000-line switch already in use. The Hatfield model approach of resizing *all* switches imparts to the LEC the remarkable ability to reconfigure and optimize its network, both instantaneously and without any additional adjustment cost. In the real world, LECs do not add capacity in this manner. Instead of instantly resizing and replacing its existing switch(es), a LEC would more likely respond by either adding lines to the existing switch or adding another switch.

The LEC may decide to add a second 100,000-line switch because it expects significant demand growth. The Hatfield model's instant resizing algorithm does not recognize that, in the real world, investment decisions are often irreversible because of the substantial costs associated with (i) scrapping and disposing of older but functioning equipment and (ii) instantaneous and continual network reconfiguration. Nor, in the face of uncertain market demand, can that model foresee a LEC's reasons for wishing to add a 100,000-line switch

instead of a smaller switch. Often, the addition of larger equipment may entail higher *initial* costs (including the cost of spare capacity) as well as higher inventory carrying costs, but such equipment may also produce economies of scale and scope and the ability to respond to quickly surging demand. Every LEC has to confront these trade-offs and choices according to its best forecast of future demand. To be able to account for this, a cost model would need to be far more "intelligent" and adaptable than the Hatfield model currently is.

Finally, the Hatfield model resorts to multiplicative factors to account for the cost of structures used to house copper and fiber cable and for network and non-network operating expenses. In the absence of direct observations on these costs and expenses, the model can only apply these factors to observed entities like cable prices or historical revenues/line demand. The use of such factors can create some important measurement problems. For example, the cost of housing structure for cable is calculated by multiplying the cable price by the appropriate structure factor. The resulting "cost" can easily change as the price of cable changes, even though the real underlying cost of the structure may not. Also, the use of historical investment-expense ratios (developed from ARMIS reports) to calculate forward-looking operating costs is completely contrary to the Hatfield model's basic underpinning — that past costs, based on past technologies, cannot represent the costs of newer, more efficient technologies. It is inconceivable that as technologies change and become cheaper, operating expenses will not follow suit.

4. Conclusion

The Hatfield model is replete with assumptions about technical parameters that do not necessarily resemble a LEC's actual situation. Its sponsors claim that the model is flexible enough to accept non-proprietary LEC-specific inputs. That would suggest that the model itself should remain a valid instrument for calculating a LEC's actual costs, even if the costs it currently reports using hypothetical inputs are disregarded. Our objection to the Hatfield model is at a more fundamental level. While LEC-specific inputs could conceivably bring the model's cost outcomes closer to reality, we believe that a purely engineering model like the Hatfield can

never expect to fully reproduce or explain all the actual booked costs reported by a LEC. We discuss the reasons for these below. For now, we conclude that the Hatfield model, powered in large part by the BCM and hypothetical technical parameters that disregard the choices a LEC actually faces cannot possibly expect to produce the actual costs of that LEC.

C. The Hatfield Model Cannot Produce Costs That Reflect Changing Market or Regulatory Environments

1. Hypothetical Efficiency *v.* Reasonably Achievable Efficiency

As we stated earlier, the Hatfield model appears to rely on a set of unstated economic assumptions. If those assumptions were true, not just fictitious networks but actual LECs would experience costs lower than those they actually report. The first problem with those assumptions is that they invoke a perfect and friction-less world where the ideal of perfectly optimized networks is achieved at all times, even in times of sweeping market and regulatory change. While the costs yielded under such assumptions may be closer to those produced by purely engineering models that have embedded in them best engineering and cost-minimizing practices, the real world often produces sources of cost that engineering models cannot predict in advance. Therefore, what is "efficient" from a hypothetical *engineering* and friction-less standpoint may be quite different from the efficiency that can reasonably be achieved by actually operating networks. Unit costs yielded by models such as the BCM or the Hatfield can, at best, provide lower bounds for unit costs of efficient networks in practice.[19] That is why booked costs (that include the consequences of network actions actually undertaken) usually exceed costs derived from a hypothetical bottoms-up approach. Only real costs have real consequences; therefore, public policy deliberations need to be informed by costs as they actually are, not as they could be in a perfect friction-less world.

[19] Actually, the BCM or Hatfield model provides a lower bound for forward-looking costs which, *in turn*, provide lower bounds for actual or booked costs.

The primary economic issues at stake here concern the manner in which the Hatfield model deals with a changing market and regulatory environment. A dynamic environment tests the stability and flexibility of a cost model, and the following discussion examines that issue in depth.

2. Hypothetical Costs in a Dynamic Environment

Local exchange competition and more relaxed regulation of incumbent LECs are expected to alter fundamental and long-standing public policy arrangements regarding universal service, the pricing of regulated services, and access to the networks of incumbent carriers. Given the Telecommunications Act's prescription that the cost of any universal service program should be shared in a competitively neutral way by *all* providers of service, the priority is now to determine the cost of that program as a prelude to determining the burden share of each service provider.

The Hatfield model and its predecessor, the BCM, have been offered as instruments for determining what basic residential exchange service *should* cost in a world of perfectly optimized networks. The implication is that any excess of an incumbent LEC's actual cost over the benchmark or threshold cost established by the Hatfield model should be attributed strictly to the incumbent's inherent inefficiencies and, therefore, be declared ineligible for recovery through the rates for the incumbent's regulated services. Put another way, the incumbent LEC's actual cost should be compared to a hypothetical optimized network's cost, and any excess actual cost should be disallowed for recovery through the universal service funding system.

There are two fundamental problems with this message. First, if the hypothetical optimized network can never be reasonably achieved by the incumbent LEC, then of what value can the comparison be? Even though the present Hatfield model describes itself as a "scorched

node" model, its earlier version[20] had been of a "scorched earth" or "greenfield" variety, namely, one that compared the incumbent LEC to a start-up network that had the complete freedom to implement the most efficient forward-looking technologies without any regard for the past. While a new entrant LEC could aspire to being that start-up network, it is ludicrous to believe that that could be true of incumbent LECs with long histories in the business.

Second, in view of the fact that unexpected costs do arise under actual operation, even the most "efficient" LEC can expect its actual costs to exceed the costs produced by the engineering bottoms-up approach. This is the real world with friction, one in which not every aspect of a LEC's operations can be predicted, and its consequences evaluated, in advance. Even LECs that adopt cost-minimizing production techniques based on forward-looking technologies must contend with the vagaries of uncertain demand in a changing and competitive marketplace or unexpected developments like political or policy change and catastrophic weather events. Therefore, the Hatfield model's implicit message that any cost in excess of that calculated by the model should be attributed to unproven inefficiencies is overly simplistic and utterly misleading. There is no simple or expedient way to distinguish a LEC's excess actual costs under efficient operation from costs due to inefficiency.

All of these reasons make us skeptical of the benchmark costs produced by models of hypothetical networks. Networks that do not recover their actual costs will, over time, go out of business. With the introduction of competition, LECs — incumbent and entrants alike — will have every incentive to lower their *actual* costs. Those that succeed will survive and qualify for support from the revamped universal service funding system. Such a market solution would be infinitely better than one based on the comparison of a LEC's actual costs to the benchmark costs of a hypothetical network.

---

[20] Hatfield Associates, Inc., *The Cost of Basic Universal Service*, prepared for MCI Communications Corporation, July 1994.

3. The Hatfield Model Pretends that Incumbent and Entrant LECs Should be Alike

Even with the less extreme scorched node orientation, the Hatfield model ascribes to its cost model the property of producing the least-cost network that "... an efficient LEC would adopt if it were to begin today to rebuild its telephone service network from the bottom up."[21] We interpret this to mean that an efficient LEC, at any given time, would have in place the same network that an entrant might choose to build. However, the direction in which an efficient incumbent LEC may take its existing network need not be the same as that taken by an "equally efficient" entrant LEC. The incumbent is constrained by its past choices that resulted in its present network. Because of this, it is quite probable that the incumbent LEC would make different technology choices than the entrant. Therefore, costs calculated for an efficient start-up LEC may well differ from those of an efficient incumbent LEC that is necessarily constrained by its past. Again, what matters for determining the cost of the universal service program is not the idealized cost of a start-up LEC, but rather the actual costs of LECs participating in that program.

4. The Hatfield Model Takes an Unrealistic View of the Market Environment

The Hatfield model's greatest drawback is that it creates a world in which the best features of both competition and monopoly are magically present. This allows the model to create the illusion that competitive LECs that perforce share the existing market demand can somehow still enjoy the benefits of economies of scale and scope that only monopoly supply can bring. For example, the model uses access line demand data from carriers' 1994 ARMIS 43-08 reports and usage data from other FCC sources as inputs into its investment cost modules. Such an exercise for calculating a LEC's investment costs might be legitimate if it were safe to assume that the level of demand experienced by the LEC under monopoly conditions would remain intact even under competition. If, as we expect, that assumption is not

[21] Hatfield Document, pp. 2-3.

tenable, the cost estimates produced by the Hatfield model for the major LEC in each of 48 states and the District of Columbia[22] also cannot be credible. Furthermore, since the Hatfield model builds in the economies of scale arising from being able to serve the higher levels of demand available under monopoly conditions, it also produces unit cost estimates that understate the true costs of competing LECs (incumbent and entrant alike) that serve smaller demand segments and, hence, do not enjoy the same scale economies.

The Hatfield model's implicit belief that certain regulated monopoly features would persist under competition is apparent in the manner in which it incorporates depreciation rates and the weighted cost of capital into its expense module. First, the Hatfield model appears to choose depreciation rates that are even below the BCM's unrealistically low rate of depreciation (an annual rate of 5.7 per cent) for outside loop plant. In addition, it assigns equally low depreciation rates to end-office switching (an annual rate of 5 per cent). The long depreciation lives implied by these rates were actually prescribed by regulators in the past when incumbent LECs operated as regulated monopolies. Under conditions of market competition, however, such slow depreciation rates are simply unrealistic. By failing to assume depreciation rates more likely to prevail under competition, the Hatfield model produces downward-biased annual costs of plant and wire center investments.[23] The model's failure to use higher depreciation rates that would be true under competition simply does not square with the model's implicit expectation that LECs will move seamlessly to the latest, most cost-reducing technologies as and when they become available. Faced with long depreciation lives on existing plant and equipment, no firm in the real world can be expected to act as envisioned by the model.

---

[22] Update of the Hatfield Model, Version 2.2, Release 1, prepared for AT&T Corporation and MCI Telecommunications Corporation by Hatfield Associates, Inc., May 30, 1996.

[23] Tardiff reports that moving from the BCM's assumed 5.7 per cent depreciation rate (corresponding to an 18-year economic life) to the book depreciation rates currently used by Regional Bell Operating Companies (RBOCs) will adjust costs upward by 12.6 per cent. See Tardiff, *op cit.*, p. 16. In addition, if AT&T's own 1994 book depreciation rate of about 11 per cent were used, costs would be adjusted upward by nearly 42 per cent.

Second, the Hatfield model calculates a weighted average cost of capital of 8.91 per cent under the assumption that the cost of debt is 7.46 per cent, the cost of equity is 11.25 per cent, the debt percentage is 61.82, and the equity percentage is 38.18. These assumptions are a marked departure from Hatfield Associates' own 1996 greenfield version of the model[24] in which it assumed the equity percentage to be a more realistic 60, and came up with a cost of capital of 10 per cent. Again, the consequence of the lower cost of capital is a lower annual cost of plant and wire center investments.[25] Professor Jerry Hausman has recently demonstrated that the increased risk and uncertainty associated with competition tends to raise annual costs by a factor of 3 to 7.[26] If the annual costs rise by a factor of 3, then the effective cost of capital or hurdle rate should be over 40%,[27] between four and five times that used by the Hatfield model.[28] Recently, the FCC itself recognized the need for states to establish "... appropriate *risk-adjusted* cost of capital and depreciation rates" for pricing purposes.[29]

V. CONCLUSION

The Hatfield model is an engineering model for estimating economic costs. It is premised on assumptions about technical parameter inputs and the belief that competing

---

[24] Hatfield Associates, Inc., *The Cost of Basic Network Elements: Theory, Modeling and Policy Implications*, prepared for MCI Telecommunications Corporation, March 29, 1996.

[25] Using the relationship in the 1994 Hatfield report that a 175 basis point difference increases the cost per line by 11 per cent, Tardiff reports that increasing the cost of capital from 8.91 to 10 per cent (as in the 1996 Hatfield greenfield model report) would increase costs by about 7 per cent. And, moving to the 11.25 per cent rate of return currently allowed by the FCC for RBOCs would increase costs by 14.7 per cent over the Hatfield model estimates.

[26] Reply Affidavit of Jerry A. Hausman, CC Docket 96-45, May 30, 1996.

[27] This projection is based on the Hatfield relationship between the cost per line and the cost of capital in note 24, *supra*.

[28] This accords with the finding by Lawrence Summers that for competitive firms the mean and median hurdle rates tend to exceed the cost of capital by a factor of between 2 and 10. See L. Summers, "Investment Incentives and the Discounting of Depreciation Allowances," in M. Feldstein (ed.), *The Effects of Taxation on Capital Accumulation*, Chicago: University of Chicago Press, 1987.

[29] "Commission Adopts Rules to Implement Local Competition Provisions of Telecommunications Act of 1996 (CC Docket No. 96-98)," NEWSReport No. DC 96-75, August 1, 1996.

carriers continually optimize their networks. In the process, it only succeeds at producing the costs of a hypothetical carrier that (i) may never resemble the actual costs of real-world carriers and (ii) seriously underestimate those true costs.

Even the assertion that the model can be populated with LEC-specific data is misleading. First, simply replacing the model sponsors' own parameter inputs by LEC-specific inputs will not release the model from the confining assumption about continual optimization in a scorched node world. As long as real-world carriers behave differently than assumed, even LEC-specific inputs will not produce real costs. Second, no significance whatsoever can or should be attached to the cost outcomes reported in the Hatfield Document and its subsequent update on May 30, 1996. The cost estimates reported in those documents lack even indicative value because the circumstances under which they were calculated are far removed from reality.

While a model that estimates a carrier's cost of providing basic residential exchange and related services is crucial for estimating the size of and implementing a reformed universal service funding system, the Hatfield model cannot and should not be the vehicle for that purpose. Only real costs have consequences: a firm's ability to survive and function in a dynamic, competitive environment depends on its real costs — governed by real-world market and regulatory circumstances — not on hypothetical costs ascribed to it. Because the Hatfield model's basic premises about firm behavior are so far removed from reality, it cannot possibly expect to represent real costs for policy-making purposes.

Public policy on universal service reform has an understandable interest in minimizing the cost of implementing a program in which carriers need to be supported in order that they offer basic services at prices that are below their costs. The proper way to minimize the cost of such a program, however, is to set an initial level of support per line, make the support portable among competing service providers, and then to let competitive forces determine which carriers get to provide service and which do not. For example, if the *initial* level of support is based on the difference between the incumbent LEC's *actual* embedded cost per line and the basic residential service rate, competitive market forces will, over time, ensure that only the carrier with the lowest incremental cost of providing service will be the most successful at finding

customers.[30] More importantly, for present purposes, the use of hypothetical and misleading costs generated by the Hatfield model (and others of that ilk) is decidedly *not* the economically correct way for sizing and minimizing the universal service support fund.

[30] The mechanism underlying this is fully described on pp. 9-14 of Kenneth Gordon and William Taylor, *Comments on Universal Service*, in this Docket, filed April 12, 1996. That mechanism eventually ensures competition based on carriers' *actual* incremental costs, and requires minimal intervention by regulators.

DIRECT TESTIMONY OF DR. RICHARD D. EMMERSON

ON BEHALF OF BELLSOUTH TELECOMMUNICATIONS, INC.

BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

DOCKET NO. P-141, SUB 29

SEPTEMBER 17, 1996

INTRODUCTION

Q. PLEASE STATE YOUR NAME AND GIVE YOUR BUSINESS ADDRESS.

A. My name is Richard D. Emmerson. I am the President and CEO of INDETEC International, Inc. I am testifying on behalf of BellSouth Telecommunications ("BellSouth" or the "Company"). My business address is 341 La Amatista, Del Mar, CA 92014.

Q. WHAT EXPERIENCE AND QUALIFICATIONS DO YOU HAVE PERTAINING TO YOUR TESTIMONY?

A. My academic qualifications include a Ph.D. in economics from the University of California, Santa Barbara in 1971. From 1971 through 1979, I was a full-time member of the Economics Department at the University of California, San Diego (UCSD). Since 1979, I have taught continuously (part time) at UCSD; I was the Director of the Executive Program for Scientists and Engineers (EPSE) at UCSD during 1990-1991, and I continue to teach courses on costing and pricing for EPSE at the present time. I have written articles in professional economic

1 journals, and I have performed research projects for government agencies and
2 private industry. I have also served as an expert witness in antitrust and business
3 litigation cases. I have testified before many Public Service Commissions on
4 various economic and policy subjects such as access charges, bypass, rate
5 structure, competition, terminal equipment pricing, network services pricing, and
6 cost analyses in the jurisdictions of California, Colorado, Connecticut, Delaware,
7 Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Maine, Michigan, Minnesota,
8 Montana, Nevada, Oklahoma, Pennsylvania, Virginia, Washington, Washington
9 D.C., and Wisconsin, as well as in Canada. Over the course of the past 12 years,
10 my provision of expert witness testimony in over 40 telecommunications
11 regulatory hearings has aided in establishing appropriate cost standards in several
12 jurisdictions within the industry. I have also worked for regulators and telephone
13 companies in nearly a dozen foreign countries during the past three years.
14
15 My work experience includes past positions as Senior Vice President of Criterion
16 Incorporated, President of the Institute for Policy Analysis, and President of
17 Economic Research Associates. These companies performed economic analysis
18 for competitive firms, regulated firms, government agencies, regulatory
19 commissions, and trade associations. INDETEC International, Inc. provides
20 consulting and training services to international telephone companies, Lucent
21 Technologies, the United States Telephone Association (USTA), Bellcore,
22 Commission staff members, partners and managers of large accounting and
23 consulting firms, and interexchange companies (these services were formerly
24 offered through INDETEC Corporation and Emmerson Enterprises, Inc.).
25 During the past 20 years, I have taught a wide variety of courses ranging from

basic economics for telecommunications to highly specialized courses in incremental cost study methodology. State regulatory commission staff members from numerous states periodically attend my classes in order to improve their understanding of current economics for telecommunications.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS PROCEEDING?

A. MCI Telecommunications Corporation ("MCI") has petitioned the North Carolina Utilities Commission ("NCUC" or "Commission") to arbitrate certain terms and conditions in its negotiation with BellSouth regarding interconnection, unbundled network elements ("UNEs"), and resale of existing services. My testimony has two purposes. First, I discuss the basic economic principles which should underlie the Commission's consideration of these issues. Second, I respond to certain positions taken by MCI in its petition and by Dr. Sarah Goodfriend and Mr. Don Wood who are appearing as witnesses for MCI.

A LOCAL EXCHANGE COMPANY (LEC) SHOULD NOT BE PROHIBITED FROM PRICING ITS SERVICES TO OBTAIN CONTRIBUTION TO RECOVER ITS SHARED AND COMMON COSTS

LEC Shared Costs are Significant

Q. MCI PROPOSES THAT BELLSOUTH PRICE ITS UNBUNDLED NETWORK ELEMENTS (UNES) AND INTERCONNECTION SERVICES

EQUAL TO INCREMENTAL COST.[1] DO YOU AGREE WITH THIS PROPOSAL?

A. No, I do not. A multiservice network-based Local Exchange Company (LEC) has shared costs which must be recovered by pricing services above incremental cost.

Q. ARE THE SHARED COSTS OF A MULTISERVICE NETWORK-BASED LEC LIKE BELLSOUTH SIGNIFICANT?

A. Yes, they are. Shared costs include some of the costs of general engineering of the network, right-to-use fees that apply to multiple functionalities, portions of many physical facilities, the cost of capital and depreciation expenses on facilities which are not directly attributable to individual services, operating expenses and even taxes. For example, Mr. Frank Kolb of BellSouth, in Georgia Public Service Commission Docket 5755-U (page 3) testified:

> "Q. COULD SOUTHERN BELL PRICE ALL OF ITS SERVICES AT INCREMENTAL COST? A. Not if Southern Bell wants to stay in business. The incremental cost of all services provided by Southern Bell represents approximately 50% of the total cost of doing business."

---

[1] MCI's Petition for Arbitration at page 25.

Similarly, Barb Smith of Southwestern Bell Telephone, in Kansas Docket No. 190,492-U (page 7) testified:

> "SWBT has conducted a preliminary analysis in Texas that shows that the difference between the sum of the LRIC studies for all services and the total costs of the company in Texas will be at a minimum in the range of 40% to 50%."

I would expect Kansas to have shared and common costs in the same range. Pricing services equal to the LRIC or TSLRIC will not allow SWBT to recover significant portions of its costs.

I have no reason to believe that the situation in North Carolina is any different.

Q. PLEASE EXPLAIN WHY SOME COSTS DO NOT APPEAR TO BE INCREMENTAL TO SERVICES.

A. First, many activities performed by LECs cannot be found to vary with the LECs' scope of services. Examples are activities such as: creating, updating and maintaining large computer systems for customer and network administration; executive function, legal and administrative work pertaining to the corporate entity as a whole. Indeed, extended unresolved disputes about how to fully distribute costs can be explained by a lack of a clear cost causative relationship. Thus, engineering and activity based studies do not assign all costs to services.