April 9, 1996

Mr. William F. Caton
Secretary
Federal Communications Commission
Room 222
1919 M Street NW
Washington, D.C. 20554

Re: CC Docket 96-45: Joint Board

Dear Mr. Caton:

Today, Mark Bryant, Mike Pelcovits, Chris Frentrup, and I met with Pam Szymczak, John Morabito, Gary Seigel, Rafi Mohammed, Alex Belinfante, Whitey Thayer, and Tracy Walden of the Common Carrier Bureau and David Kresch of the Wireless Bureau. The purpose of the meeting was to review results of the Hatfield Associates study on the cost of unbundled network elements. MCI also recounted its positions on universal service. The attached information was used during the meeting and describes the topics covered.

Sincerely,

Leonard S. Sawicki

Attachments

cc: Mr. Belinfante
    Mr. Kresch
    Mr. Mohammed
    Mr. Morabito
    Mr. Seigel
    Ms. Szymczak
    Mr. Thayer
    Mr. Walden
The Cost of Basic Network Elements: Theory, Modeling, and Policy Implications
Methodology

- Model estimates TSLRIC of unbundled network functions
- Based on 1994 Hatfield approach to costing of basic universal service
  - extends analysis to all major unbundled network elements
  - "greenfield" approach
  - estimates costs separately for six population density zones
  - standard Bellcore engineering practices to construct forward-looking network
- Adjusted to incorporate some assumptions made in Benchmark Cost Model
Methodology - Assumptions

- **Loop**
  - Feeder is 75% analog copper, 25% digital loop carrier
  - Distribution 100% copper

- **End Office Switching**
  - 100% digital switching, switch size varies by density range

- **Transport**
  - 100% fiber
  - all traffic is tandem-routed
Plant sized for Full Range of LEC Services

- Bus & Res Local Exchange Service
- IntraLATA Toll & Private Line
- Switched & Special Access
- Operator Services
- Public Telephone Services
Methodology - Data Sources

- 1994 Statistics of Common Carriers
  - Switched Traffic for all services
  - Switched and Special Access Lines
- 1990 Census Data
  - Population Density by Census Tract
  - Census Tract Land Area
- Benchmark Cost Model
  - loop plant placement & materials costs
Methodology - Expenses

- Levelized Capital Costs
  - 10% overall return
  - 40% state + federal tax rate
  - FCC-approved depreciation lives by plant category

- Operating Expenses
  - plant-specific operating expense based on relationship between SOCC expenses and investment
  - network operations expense based on Ameritech SOCC per-line expense
  - 6% factor applied to represent variable corporate operations expense
Network Elements

- Loop
  - Distribution
  - Concentration
  - Feeder
- Switching
  - Port
  - Switch Usage
- Transport
  - Dedicated
  - Common
  - Tandem Switching
- Signaling
- Operator Systems
- Public Telephone Equipment
# Results - Unbundled Loops

<table>
<thead>
<tr>
<th>Loop Distribution</th>
<th>0-10 pop/km²</th>
<th>10-100 pop/km²</th>
<th>100-500 pop/km²</th>
<th>500-1,000 pop/km²</th>
<th>1,000-5,000 pop/km²</th>
<th>&gt;5,000 pop/km²</th>
<th>Totals pop/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$2,423,179,454</strong></td>
<td><strong>$6,150,810,401</strong></td>
<td><strong>$1,643,963,604</strong></td>
<td><strong>$1,275,061,157</strong></td>
<td><strong>$3,690,920,048</strong></td>
<td><strong>$770,922,988</strong></td>
<td><strong>$15,954,857,652</strong></td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>8,969,439</td>
<td>30,420,078</td>
<td>27,516,643</td>
<td>19,807,291</td>
<td>56,445,945</td>
<td>13,066,968</td>
<td>156,226,363</td>
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<tr>
<td><strong>Unit Cost</strong></td>
<td>$22.51</td>
<td>$16.85</td>
<td>$4.98</td>
<td>$5.36</td>
<td>$5.45</td>
<td>$4.92</td>
<td>$8.51</td>
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</table>

<table>
<thead>
<tr>
<th>Loop Concentration</th>
<th>0-10 pop/km²</th>
<th>10-100 pop/km²</th>
<th>100-500 pop/km²</th>
<th>500-1,000 pop/km²</th>
<th>1,000-5,000 pop/km²</th>
<th>&gt;5,000 pop/km²</th>
<th>Totals pop/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$1,407,376,597</strong></td>
<td><strong>$4,356,341,762</strong></td>
<td><strong>$46,557,808</strong></td>
<td><strong>$34,169,753</strong></td>
<td><strong>$97,158,618</strong></td>
<td><strong>$24,034,105</strong></td>
<td><strong>$5,965,638,642</strong></td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>8,969,439</td>
<td>30,420,078</td>
<td>27,516,643</td>
<td>19,807,291</td>
<td>56,445,945</td>
<td>13,066,968</td>
<td>156,226,363</td>
</tr>
<tr>
<td><strong>Unit Cost</strong></td>
<td>$13.08</td>
<td>$11.93</td>
<td>$0.14</td>
<td>$0.14</td>
<td>$0.14</td>
<td>$0.15</td>
<td>$3.18</td>
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</table>

<table>
<thead>
<tr>
<th>Loop Feeder</th>
<th>0-10 pop/km²</th>
<th>10-100 pop/km²</th>
<th>100-500 pop/km²</th>
<th>500-1,000 pop/km²</th>
<th>1,000-5,000 pop/km²</th>
<th>&gt;5,000 pop/km²</th>
<th>Totals pop/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$570,854,034</strong></td>
<td><strong>$1,498,576,213</strong></td>
<td><strong>$1,245,621,890</strong></td>
<td><strong>$264,379,205</strong></td>
<td><strong>$414,853,516</strong></td>
<td><strong>$35,456,956</strong></td>
<td><strong>$4,029,741,714</strong></td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>8,969,439</td>
<td>30,420,078</td>
<td>27,516,643</td>
<td>19,807,291</td>
<td>56,445,945</td>
<td>13,066,968</td>
<td>156,226,363</td>
</tr>
<tr>
<td><strong>Unit Cost</strong></td>
<td>$5.30</td>
<td>$4.11</td>
<td>$3.77</td>
<td>$1.11</td>
<td>$0.61</td>
<td>$0.23</td>
<td>$2.15</td>
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</table>

<table>
<thead>
<tr>
<th>Total Loop</th>
<th>0-10 pop/km²</th>
<th>10-100 pop/km²</th>
<th>100-500 pop/km²</th>
<th>500-1,000 pop/km²</th>
<th>1,000-5,000 pop/km²</th>
<th>&gt;5,000 pop/km²</th>
<th>Totals pop/km²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Cost</strong></td>
<td><strong>$4,401,410,085</strong></td>
<td><strong>$12,005,728,376</strong></td>
<td><strong>$2,936,143,301</strong></td>
<td><strong>$1,573,610,115</strong></td>
<td><strong>$4,202,932,183</strong></td>
<td><strong>$830,413,948</strong></td>
<td><strong>$25,950,238,009</strong></td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>8,969,439</td>
<td>30,420,078</td>
<td>27,516,643</td>
<td>19,807,291</td>
<td>56,445,945</td>
<td>13,066,968</td>
<td>156,226,363</td>
</tr>
<tr>
<td><strong>Unit Cost</strong></td>
<td>$40.89</td>
<td>$32.89</td>
<td>$8.89</td>
<td>$5.62</td>
<td>$5.30</td>
<td>$13.84</td>
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</table>
# Results - Other Network Functions

<table>
<thead>
<tr>
<th></th>
<th>Annual Cost</th>
<th>Units</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>End office switching</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Port</td>
<td>$5,751,872,548</td>
<td>141,126,511 switched lines</td>
<td>$1.02 per line/month</td>
</tr>
<tr>
<td>2. Usage</td>
<td>$1,725,561,764</td>
<td>2,264,200,000,000 minutes</td>
<td>$0.0018 per minute</td>
</tr>
<tr>
<td><strong>Signaling network elements</strong></td>
<td>$253,657,788</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Transport network elements</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Dedicated</td>
<td>$1,150,882,311</td>
<td>18,227,755 trunks</td>
<td>$5.26 per DS-0 equivalent/month</td>
</tr>
<tr>
<td>2. Common</td>
<td>$664,454,045</td>
<td>1,464,070,959,357 minutes</td>
<td>$126.28 per DS-1 equivalent/month</td>
</tr>
<tr>
<td>3. Tandem switch</td>
<td>$1,112,005,760</td>
<td>1,464,070,959,357 minutes</td>
<td>$3.535.78 per DS-3 equivalent/month</td>
</tr>
<tr>
<td><strong>Operator systems</strong></td>
<td>$116,117,445</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Public Telephones</strong></td>
<td>$1,098,242,547</td>
<td>n/a</td>
<td></td>
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</table>
Components of the Revenue Requirement

- Operating Inefficiencies
- Corporate Operations less variable overhead assigned to TSLRIC, Cust Ops
- Customer Operations + 6% variable overhead
- Amortization of Reserve Deficiency
- Return & Taxes on Reserve Deficiency
- Capital Carrying Cost of Overbuilt Plant
- TSLRIC Costs + 6% variable overhead

- $3,803,111,909
- $8,324,999,410
- $15,262,422,241
- $17,655,667,327
- $38,097,470,452
### Components of the Revenue Requirement

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>Total Revenues - Tier One Companies '93</td>
<td>$81,997,412,000</td>
</tr>
<tr>
<td>Total TSLRIC Wholesale Cost</td>
<td>$36,097,470,452</td>
</tr>
<tr>
<td>The &quot;Gap&quot;</td>
<td>$45,899,941,548</td>
</tr>
<tr>
<td>Model Investment</td>
<td>$131,320,817,108</td>
</tr>
<tr>
<td>Actual Investment</td>
<td>$256,803,243,000</td>
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<tr>
<td>Overbuilt Plant</td>
<td>$125,482,425,992</td>
</tr>
<tr>
<td>Capital Carrying Cost of Overbuilt Plant</td>
<td>$17,655,667,327</td>
</tr>
<tr>
<td>Depreciation Reserve Deficiency</td>
<td>$3,314,926,000</td>
</tr>
<tr>
<td>Return &amp; Taxes on Reserve Deficiency</td>
<td>$438,306,882</td>
</tr>
<tr>
<td>Amortization of Reserve Deficiency</td>
<td>$414,365,750</td>
</tr>
<tr>
<td>Customer Ops ('93 Actual)</td>
<td>$13,184,107,220</td>
</tr>
<tr>
<td>Plus CapCost of GSF</td>
<td>$2,078,315,021</td>
</tr>
<tr>
<td>Total Customer Ops</td>
<td>$15,262,422,241</td>
</tr>
<tr>
<td>Corporate Ops ('93 Actual)</td>
<td>$10,148,262,000</td>
</tr>
<tr>
<td>Less: overhead assigned to TSLRIC</td>
<td>$2,165,848,227</td>
</tr>
<tr>
<td>Less: overhead assigned to Customer Ops</td>
<td>$791,046,433</td>
</tr>
<tr>
<td>Net Corporate Ops</td>
<td>$7,191,367,540</td>
</tr>
<tr>
<td>Plus CapCost of GSF</td>
<td>$1,133,632,071</td>
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<tr>
<td>Total Corporate Ops</td>
<td>$8,324,999,410</td>
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<tr>
<td>Uncollectibles</td>
<td>$1,068,028</td>
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<tr>
<td>Operational Inefficiencies</td>
<td>$3,803,111,909</td>
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</table>
Network Element Cost Modeling Process

Demographics
Network Structure
Equipment Capacities

Local Network Module

Required Network Equipment

Investment Module

Investment by Network Element

Expense Module

Expense Factors

Equipment Unit Costs

Capital Cost Module

Cost Capital
Cost Debt
D/E Ratio
Economic Life
Income Tax Rate

Capital Carrying Costs

Expenses

Network Element Costs
Local Exchange Network Structure

tandem switch

interoffice (tandem) trunk routes

end office switches

distribution facilities

subscribers

distribution facilities

subscribers

distribution facilities

subscribers
Distribution Network Structure

- Interoffice connections (to tandem office)
- End office switch housed in wire center
- Feeder cable
- Remote terminals
- Distribution cables
- Pedestals
- Drops (connections to customers' premises)
Details of Distribution Network Structure

- wire center
- optical feeder cable
- optical multiplexer
- remote terminals
- analog loops

Hatfield Associates, Inc
The Cost of Basic Network Elements:

Theory, Modeling, and Policy

Implications
THE COST OF BASIC NETWORK ELEMENTS: THEORY, MODELING AND POLICY IMPLICATIONS

HATFIELD ASSOCIATES, INC.

MARCH, 1996
THE COST OF BASIC NETWORK ELEMENTS:
THEORY, MODELING AND POLICY IMPLICATIONS

PREPARED FOR

MCI TELECOMMUNICATIONS CORPORATION

BY

HATFIELD ASSOCIATES, INC.

March 29, 1996
EXECUTIVE SUMMARY

The Telecommunications Act of 1996 requires unbundling of monopoly local exchange networks into functional elements that can be used by local and long distance competitors. Cost-based pricing is necessary to promote local competition and to reduce the possibility of competitive harm in the long distance business when the Regional Bell Operating Companies (RBOCs) are allowed to enter. This paper presents a new model that is used to estimate the economic cost of these network elements.

The New Hatfield Model estimates the Total Service Long Run Incremental Cost ("TS-LRIC") of unbundled network elements such as switching, loops and interoffice transport. It is well understood that existing Federal Communications Commission ("FCC") access charges are priced substantially above cost. The costs analysis produced here shows that access charges must fall from the current level of approximately seven cents per minute to less than a penny.

The Local Exchange Carriers ("LECs") will criticize the model on various grounds. However, the FCC will likely discover that to the extent these criticisms have any validity, they can only be addressed by the application of data that are currently in the exclusive possession of the LECs themselves. As the recently produced Benchmark Cost Model ("BCM") shows, when the LECs have incentives to cooperate, they are able to produce useful data and information to the FCC. The FCC should accept the estimates developed here unless and until the LECs provide additional data that can be used in the Hatfield Model.

The model can also be used to quantify the gap between the bottoms up economic cost of providing unbundled network elements and the tops down revenue requirement on which existing access charges are based. This gap is large – approximately 46 billion dollars. Some portion of this gap represents the economic costs of supporting the service that are purchased by
end-users as opposed to the carrier services included in this model. Some portion of the gap is due to underdepreciation and inefficiencies in LEC networks. However, the largest portion of the gap is due to excess investment by the LECs.

Reducing current interconnection rates to cost will not necessarily harm the LECs. The 1996 Act provides these carriers with new opportunities. More significantly, a significant portion of the existing gap may be explained by investments designed to allow local telephone companies to enter new markets, such as long distance and video. These investments are not necessary for the provision of existing monopoly services.

The model presented here is based on an earlier Hatfield Associates, Inc. study. The original study, titled The Cost of Basic Universal Service, was released in July, 1994. This study incorporates many additions and refinements to the original. The current model retains the "green field" approach in which the network is assumed to be constructed with new facilities, including loop and interoffice plant, along with wire centers.

As before, the model follows TS-LRIC principles in employing "forward looking" network technology, including digital switching and use of digital loop carrier equipment along with optical fiber feeder cables. It also assumes full deployment of Signaling System 7 (SS7) among end-office and tandem switches and includes facilities – operator tandems and trunks – required to provide operator services. The network is sized to provide existing local service, including public telephones, as well as intraLATA toll, exchange access, and CLASS features.

The recurring costs of providing the unbundled network elements are estimated based on the investment figures generated by the network model. The recurring cost component of the model has three components. First, the model determines the capital carrying cost for each
component of investment associated with the network function. Second, it determines the
network-related expenses associated with each component of investment. Finally, it determines
non-network-related expenses, and assigns the expenses to the specific network functions.
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THE COST OF BASIC NETWORK ELEMENTS:
THEORY, MODELING AND POLICY IMPLICATIONS

Successful implementation of the Telecommunications Act of 1996 ("1996 Act") requires the unbundling and cost-based pricing of local monopoly network functions such as the local switching and transport components of exchange access. Prices for essential monopoly inputs must be set at cost, both to maximize the potential for local competition, and to minimize the potential for competitive problems in the long distance business. The Federal Communications Commission ("FCC") does not have a mechanism for evaluating the economic cost of these network functions. Therefore, an economic costing procedure must be established.

This paper presents the results of a new model that estimates the Total Service Long Run Incremental ("TS-LRIC") costs of the basic Local Exchange Carrier ("LEC") network functions. This analysis builds on The Cost of Basic Universal Service, a July, 1994 Hatfield Associates, Inc. ("HAI") study. The 1994 study estimated network costs for a subset of the services provided by the LECs. This estimate was used to put a $4 billion price tag on the subsidy now flowing to Universal Service. The expanded model, presented in this paper, allows two additional critical questions to be addressed. First, what are the costs of unbundled network functions? Second, to the extent existing LEC revenues exceed the TS-LRIC costs of the unbundled network elements, what explains this gap?

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1 A description of Hatfield Associates, Inc. ("HAI") is attached.

2 Existing access charges are based on the FCC's Price Cap Plan. Historical investment and expenses, together with the Jurisdictional Separations Process, provide the foundation for the capped rates. Consequently, access charges are significantly higher than economic cost, which continues to decline in this industry.
This paper begins in Section I by describing the relationship between local and long
distance competition and unbundling, costing, and pricing issues. Section II surveys the current
evidence regarding the cost of network elements for which costs must be developed. Further
identification of the unbundled network elements, or "building blocks," is in Section III. The
economics of network element costing is discussed in Section IV. Section V describes the HAI
costing model. Section VI provides the cost modeling results. Differences between the
economic cost of access measured by HAI and the existing embedded costs of the local exchange
carriers ("LECs") are explained in Section VII. Section VIII discusses ways to deal with the
difference between economic cost and existing inflated revenue requirements. The relationship
between Universal Service and the issues discussed in this paper is briefly described in Section
IX. The paper concludes in Section X with recommendations for next steps.

I. PREREQUISITES FOR RBOC INTERLATA ENTRY

The 1996 Act paves the way for Regional Bell Operating Company ("RBOC") entry into
the $70 billion long distance market, the largest portion of which is regulated by the FCC. When
this occurs, the RBOCs will again be in the position of providing essential monopoly inputs to
their competitors. The premise of the Modification of Final Judgment in U.S. v. AT&T ("MFJ"),
which the 1996 Act replaces, was that an input monopolist could leverage its market power in the
supply of access to reduce competition in the downstream long distance market.3

Monopoly leverage can be accomplished in many ways. Access to essential facilities can
be denied, the price of essential inputs can be set artificially high, or the prices of competitive

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