Converging Industries Research Foundation
Practical Solutions for Communications Policy

November 5, 2001

Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, SW
Room TW-B204
Washington, DC 20554

Dear Ms. Salas,

I am filing the attached research in my role as President of the Converging Industries Research Foundation (CIRF), formerly the Telecommunications Industries Analysis Project (TIAP). This is an information filing for the FCC's Federal-State Joint Board on Universal Service, Comments on Review of Lifeline and Link-Up Service for All Low-Income Consumers, CC Docket No. 96-45.

This filing consists of:

- ***Redefining Universal Service: The Cost of Mandating the Deployment of New Technology in Rural Areas:*** A research paper that provides a solution for when to revise the universal service definition in the context of new technology deployment.
- An executive summary.

This research was produced by a neutral forum to assist policy makers in their decision making. This paper is intended to provide general public information and does not constitute or foretell the official position of any of the parties (agencies, companies, or individuals) who contributed to this paper.

In accord with the FCC guidelines, this filing has been submitted electronically.

Sincerely,

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President

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Redefining Universal Service: The Cost of Mandating the Deployment of New Technology in Rural Areas

July 18, 1994
Presentation at the July 1994 NARUC Meeting, San Diego, CA

Telecommunications Industries Analysis Project

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Telecommunications Industries Analysis Project:
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Carol Weinhaus, Sandra Makeeff, Peter Copeland, et al.
July 18, 1994.

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The Telecommunications Industries Analysis Project is associated with the Public Utility Research Center at the University of Florida College of Business Administration.

Gordon Calaway, NECA, supplied data for some of the analysis.

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Project Background

List of Participants in the Telecommunications Industries Analysis Project, July 1994

State Regulators	NARUC representatives from: Iowa Utilities Board New York Public Service Commission Washington Utilities and Transportation Commission
Regional Holding Companies	Ameritech Bell Atlantic BellSouth NYNEX Pacific Telesis Southwestern Bell US WEST
Large Independents	GTE Sprint Local Telecom Division Anchorage Telephone Utility
Interexchange Carrier	AT&T Sprint
Foreign Domestic	NTT America InfoCom Research, Inc.
Local, National, and International Services	BT
Materials Manufacturers	Corning

Sponsors:

Corporation for Public Broadcasting

Assisting with *public* data:

Federal Communications Commission
National Exchange Carrier Association

Background on the Telecommunications Industries Analysis Project

The goal of the Telecommunications Industries Analysis Project is to provide information to support the development of alternative communications policies to meet the needs of stakeholders in an environment that includes competitive and non-competitive markets, federal and state regulatory jurisdictions, and a proliferation of new services made possible by technological advances. The purpose of the project is to produce research and analysis which will assist policy makers in making informed decisions.

The project is a neutral forum of communications industry stakeholders exploring multiple viewpoints of selected issues. This forum incorporates the following elements:

- **Broad representation:** The current forum includes foreign and domestic local exchange carriers (LECs), interexchange carriers (IXCs), materials and equipment manufacturers, and federal and state regulators. The project actively seeks expansion of this forum to include other communications industry representatives such as competitive access providers, cable television companies, computer companies, electric power utilities, or publishers.

- **Multiple viewpoints:** Participants are required to play an active role in the research and analysis, to represent their own interests, to understand and to assist in developing others' perspectives, and to work toward the common goal of representing multiple views.

- **Analysis and results of alternative policies:** Research tools, including a jointly produced data base and computer software models, and data analysis developed by this forum create a common language for examining issues. The common language allows the participants to focus on underlying issues. Appropriate computer software tools, including modifications to existing tools, are developed.

- **All data, analysis methods, and results are public:** Data used by this project must be publicly available on a nationwide basis. Research products become public domain information.

- **Neutral setting:** The project resides in a neutral setting, free of partiality, thereby ensuring objective and independent research.

Project Background, cont.

What the Project has Done

The project has conducted public workshops at the national meetings of the telecommunications industry regulators. The project's research papers have been the basis for meetings with the Federal Communications Commission (FCC), Congressional staffs, the Congressional Research Service, and the National Telecommunications Information Administration.

The project has also produced a number of papers plus software modeling tools for analysis of financial structures and new technology deployment.

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List of Acronyms

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ARMIS	Automated Reporting Management Information System
FCC	Federal Communications Commission
ISDN	Integrated Services Digital Network
IXC	Interexchange Carrier
LATA	Local Access and Transport Area
LEC	Local Exchange Carrier
Mbps	Megabits per Second
MSA	Metropolitan Statistical Area
NARUC	National Association of Regulatory Utility Commissioners
NECA	National Exchange Carrier Association
NII	National Information Infrastructure
ONU	Optical Network Unit
PSN	Public Switched Network
RBOC	Regional Bell Operating Company
REA	Rural Electrification Administration
SLC	Subscriber Line Charge
Tier 1	LECs with over $100 million annual regulated operating revenues.
U.S.	United States
V&H	Vertical and Horizontal Coordinates

I. Introduction

I. Introduction

The Universal Service Debate

> *"I want there to be no peasant in my realm so poor that he will not have a chicken in his pot every Sunday."*
>
> Attributed to Henri IV, Henry of Navarre [1]

In 1580, it was quite a revolutionary thought that every person should have at least one basic meal a week. Through the years, the concept of basic rights and privileges has developed in a number of societies. The guarantee or statement that no individual should be without basic rights and goods is part of creating a better society as a whole .

But you might ask, why didn't Henry say that every peasant should have venison? Surely, some nobility regularly supped upon venison. So why shouldn't everyone have it at least once a week? A good question.

In today's United States, it could be argued that society at large would be better off if everyone were guaranteed the use of an automobile. If so, would society be better off guaranteeing each household a Chrysler minivan or a Cadillac Seville? Surely, most would be more comfortable and arrive faster in the Seville. On the other hand, each Seville costs roughly twice that of a minivan. So, in which scenario, if either, is society better off?

This is the essence of the debate today concerning the definition of universal service. If universal service is an acceptable policy, then how is it defined? Some people are in the chicken camp (voice grade, 1-party service), while some people are in the venison camp (interactive broadband service). It all boils down to this: What level of service is a society willing to guarantee to all its members as a basic right and how is society better off as a whole through its provision? Further, how should that guarantee be funded?

[1] *Bartlett's Familiar Quotations,* Little, Brown and Company, Boston, 1980, page 174.

I. Introduction, cont.

Debates Over Mandating Technology for Universal Service

The objective of this paper is to examine the debates about universal service:

- ***Is it defined as dial-tone or as interactive video?***
  This paper examines why this question is being debated and provides background on the pressures and incentives leading to this controversy.

- ***What will universal service cost?***
  This paper provides numbers for the costs associated with these two definitions, thereby providing upper and lower bounds for the discussion.

- ***Should the level of universal service be mandated?***
  This paper examines the cost to mandate the ubiquitous deployment of specific technology and discusses the merits of an evolving definition of universal service.

Telephone, cable and broadcast television, electric power utilities, computer, and other communications companies are all affected by the answers to these questions. Similar analysis could be performed for other industries deploying fiber, satellite, and cellular networks. However, this paper focuses on the traditional telephone industry since public data and the related models used in this analysis are only available for this sector of the communications industry. Also, this paper focuses on analysis of rural numbers since current legislation (*The Rural Electrification Loan Restructuring Act of 1993*)[2] is accelerating the pressure to answer these questions.

The remaining sections of this paper provide a context for debating whether universal service is dial-tone (current narrowband) or interactive video (broadband). **Section II** explores issues underlying current debates over the definition of universal service. Then, **Section III** presents pressures and incentives to deploy new technology. The next two sections **(Sections IV, and V)** compare the cost of providing rural service, assuming different definitions of universal service. At one end of the spectrum is the current dial-tone cost and at the other end is the cost for a selected broadband deployment scenario. **Section VI** discusses a mandated versus a market driven approach for deploying new technologies and the benefits of allowing the definition of universal service to evolve based upon customer demand. **Section VII** provides a summary of the analysis and conclusions. **Section VIII** discusses additional pressures and incentives to deploy broadband technology. All background data, sources, models, assumptions, and caveats are found in **Section IX**.

[2] *The Rural Electrification Loan Restructuring Act of 1993,* Public Law No. 103-129, 107 Stat. 1356-1367

II. Why Is There a Debate?

II. Why Is There a Debate?

Competition and New Technology

Two major structural shifts occurring simultaneously have accelerated the debate about mandating technology for universal service:

- The transition from a monopolistic to a competitive environment.

  This transition has sparked numerous debates on the effect of competition on universal service. Universal service has generally been defined as telephone service that is available and affordable. However, it should be noted that telephone handsets, toll calls, and other services and products that people expect are not included in basic telephone service prices. [3] Also, telephone monopolies used averaged rates to avoid major price differences between high-cost and low-cost areas. Competition will likely put pressure on rates, driving them closer to costs. In some high-cost areas, rates might become prohibitively expensive. These are legitimate concerns. [4]

  In the debate, most policy makers agree that telephone service is important to individuals and the country as a whole (since the network's value increases with the number of subscribers). [5] The concept of universal service is seen as a policy that must be maintained in a competitive environment. Accepting that universal service is a policy goal, the question arises, "Which services should be included in universal service?"

- ***Technology is moving the telecommunications industry from a single telephone service provider to many multi-service providers.***

[3] Universal Service definitions vary since what constitutes basic local service varies among companies and with geographic locations. In general, basic service consists of local calling, access to long distance networks, access to directory and operator services, some form of 911 emergency services, and installation. There are arguments that touch-tone should be part of this package.

[4] There are different reasons why an area might have high costs. Geography, population density, existing technology (outdated or inefficient), and company efficiency are all contributing factors. Different technologies or the entry of competitors might lower costs.

[5] The 1992 percent of households with telephone service is 93.8%. *FCC Statistics of Communications Common Carriers*, 1992/1993 Edition, U.S. Government Printing Office, Washington, DC, Table 8.1, page 301.

II. Why Is There a Debate?

Historically, voice, video, and computer services were distinct services provided by separate industries. While telephone companies have been

providers of many services, these services have all been dial-tone related. Similar shifts are occurring in the cable television industry. While there are various cable television services, these have been primarily one-way transmission of television programs.

New technology gives the traditional dial-tone provider the opportunity to become the multi-service provider of voice, video and computer/information services.

Conflict of Monopoly Policies and New Technologies

The transition to competition is compelling policy makers to look for methods to preserve universal service. The fact that the telephone companies have the potential to offer interactive broadband services gives policy makers the opportunity to include broadband services in the definition of universal service. If, as in the past, the telephone companies continued to provide only dial-tone related services, universal service would more than likely be defined as the provision of dial-tone service.

The Traditional Communications Provider

Many policy makers today advocate expanding the universal service definition to include information services, high-speed transmission and two-way interactive video. Because the traditional telephone industry is a regulated industry and is, or will be, providing these services (as will other non-traditional industry participants), policy makers feel justified in including these services in the definition of universal service. However, these policy makers assume that monopoly policies can be applied to new services made possible by new technologies. The emerging competitive market for broadband services makes such a mandate too risky for one company to undertake in a multi-provider environment.

The Traditional Government Role

Another way of examining this situation is to look at government's traditional role in the provision of information. Government currently fulfills two roles in the information market:

- **A source of original information** created in the public domain (e.g., census data, economic indicators data); and
- **A distribution channel** of information created in the private domain (e.g., libraries).

In both of the above cases, the public policy goals are well established and the funds for these activities are provided through some form of taxation. The provision of this information creates a public good, and in turn, the public provides funding.

If the definition of universal service were expanded to include information services, high-speed data transmission, or two-way interactive video, the government would be expanding and moving some of its public functions to the private sector without shifting any public funding support. Should the cost of these publicly mandated services be recovered from the telecommunications industry, or should the cost of public services continue to be recovered from the general public through taxes?

II. Pressures and Incentives to Deploy New Technologies

III. Pressures and Incentives to Deploy New Technology

Government Pressures

Today there is political, economic, social, and regulatory pressure to expand the definition of universal service to include interactive video and information services. In some cases, public policy makers want to mandate specific technologies in advance of clearly demonstrated consumer demand. Some of this pressure arises from vested interests, various industries, consumer groups, and the government itself. There is an underlying question as to the role of government. How much should it direct the development of the communications infrastructure? The government is already responsible for spectrum allocation, interconnection standards, and the like. How much should government stand clear and let the markets develop on their own? (See **Section VIII, Appendix A**, for a description of economic, social and regulatory pressures and incentives.)

Clinton Administration Initiatives

The Clinton administration has launched an initiative, The National Information Infrastructure (NII), to promote the physical deployment of an advanced communications network. The President has formed a Federal inter-agency "Information Infrastructure Task Force" that will work with Congress to propose policies that will accelerate the deployment of a National Information Infrastructure. [6]

The NII states that one of the administration's objectives is the expansion of the definition of universal service:

> Extend the universal service concept to ensure that information resources are available to all at affordable prices. Because information means empowerment, the government has a duty to ensure that all Americans have access to the resources of the Information Age. [7]

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[6] Information Infrastructure Task Force, *The National Information Infrastructure: Agenda For Action,* National Technical Information Service, U.S. Department of Commerce, Springfield, Va., September 15, 1993.

[7] *Ibid.*

Legislative Proposals

Recently passed and currently proposed legislation reflect the desire to expand the definition of universal service. [8]

Besides restructuring the loan program, the intent of the *Rural Electrification Loan Restructuring Act of 1993* is to modernize the telecommunications infrastructure in rural areas. Before borrowers are eligible for Rural Electrification Administration (REA) or Rural Telephone Bank loans a "State Telecommunications Modernization Plan" must be established and approved by the REA. REA's implementation rules set forth specific technology requirements that must be included in these modernization plans. Each plan must provide for uniform deployment of advanced services in rural and non-rural areas.

The REA plan does not take into consideration the demand for services. Time tables are set for specific deployment without consideration of the economic consequences. Normally a business, whether regulated or not, performs a cost-benefit analysis to determine where and when a new technology should be deployed. In some cases, the decision to deploy a particular technology would be made even if it were not immediately economically justifiable. However, it would be expected that a service would be deployed with an established demand and a plan for cost recovery.

Sections IV and **V** analyze the cost of the REA mandate if the new technology is defined as two-way interactive broadband services.

[8] Senate bill S.1822, *The Communications Act of 1994* and *The Telecommunications Equipment Research and Manufacturing Competition Act of 1994* (introduced on February 2, 1994), and House bill H.R.3636, *The National Communications Competition and Information Infrastructure Act of 1994* (introduced on November 22, 1993 and passed June 28, 1994), have a stated goal of expanding the nation's communications infrastructure.

IV. Universal Service: Rural Dialtone Costs

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Current Cost to Provide Service in Rural (High-Cost) Areas: Current Rates and Subsidy

On a national basis, rural customer (business and residential) payments are on average less than the cost of providing service. **Figure 1** uses REA rural cost characteristics in order to estimate the national rural costs and customer payments (revenues). [9]

The nationwide total data in **Figure 1** provides an overall picture of the larger local exchange carriers (known as Tier 1 LECs), [10]but does not include the smallest local exchange carriers that are not considered Tier 1. Additionally, this paper covers only the averaging effects within individual LECs and does not cover the complex interplay among large LECs, small LECs, and interexchange carriers (IXCs).

Figure 1 displays a comparison of the national rural customer costs of $19.2 billion and nationwide customer payments of $14.2 billion. This translates into a difference of $5.0 billion.

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[9] Estimates use REA companies as a nationwide surrogate because there is no nationwide public data on large LEC rural areas. Cost characteristics include percentage of residential and business lines and annual rural cost per line.

[10] On July 25, 1993, the Telecommunications Industries Analysis Project released a report titled, *What is the Price of Universal Service? Impact of Deaveraging Nationwide Urban/Rural Rates*; Weinhaus, Carol; Makeeff, Sandra; *et al.,* Telecommunications Industries Analysis Project, Center for Telecommunications Management, University of Southern California. While the data presented in this section of the current paper appears on the surface to be an updated version of last year's analysis, there are three substantive differences between the data. See **Section IX, Appendix B, Figure 4**, for a definition of Tier 1 LECs.

The first and most important difference is that last year's paper focused on the total costs and revenues generated by rural customers, including payments to interexchange carriers (IXCs), as well as revenues generated by rural customers, including payments to interexchange carriers (IXCs), as well as payments to LECs and the costs to provide services by both. The focus of this paper is rural broadband deployment by LECs. Therefore, the analysis is based on rural customer payments to LECs and the LECs costs of providing service to rural customers.

The second difference is that last year's analysis developed a difference between costs and revenues for all rural customers. On the other hand, this paper looks only at the differences between the costs and revenues generated by the rural customers on Tier 1 LECs. The customers of the Tier 1 LECs are the focus because extensive data is available on these companies and their customers.

The final difference between the past year's and the current analysis is the source of state and interstate usage per rural line. Last year's data source was the REA data. This year the source is the "Total Industry Loops" data from the FCC, *Monitoring Report, Prepared by the Staff of the Federal-State Joint Board in CC Docket 80-286,* CC Docket No. 87-339, Table 4.19, June 1, 1993. Data filed in accordance with the FCC's *Establishment of a Program to Monitor the Impact of Joint Board Decisions,* DA 89-503, May 1994.

IV. Universal Service: Rural Dialtone Cost, cont.

Rural customer bills would have to increase by 35% to cover costs. Today, high-cost rural support is provided through support mechanisms embedded in the telecommunications local and toll pricing structure. [11]

Figure 2 shows the potential impacts of deaveraging urban and rural LEC customer (business and residential) payments on a monthly per line basis. The figure illustrates that urban customer bills on a nationwide basis would decrease monthly by $3.80 per line. In contrast, rural customer bills on a nationwide basis would increase monthly by approximately $19.00. [12]

[11] See Weinhaus, Carol; Makeeff, Sandra; *et al., Who Pays Whom? Cash Flow for some Support Mechanisms and Potential Modeling of Alternative Telecommunications Policies,* Alternative Costing Methods Project, Program on Information Resources Policy, Harvard University, November 15, 1992.

[12] It should be noted that the per-line decrease for urban customers is relatively small because there are far more urban customers than rural customers

IV. Universal Service: Rural Dialtone Cost, cont.

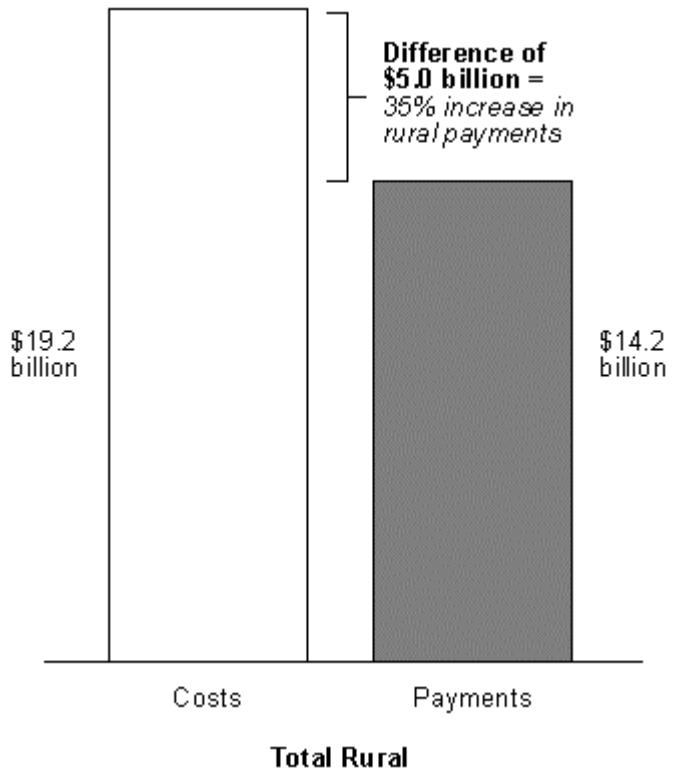

Figure 1:
1992 Rural Business and Residential Customers: Costs and Payments

Figure 2:
1992 Potential Impact of Deaveraging Urban and Rural Annual Customer Payments Per Line

V. Universal Service: Rural Broadband Costs

V. Universal Service: Rural Broadband Costs

The cost of universally deploying broadband facilities in rural areas varies by the length of time over which the deployment is made and the percent of customers who actually subscribe to broadband services. **Figure 3** shows how the monthly cost per rural line for broadband facilities changes as the length of the deployment changes. Additionally, **Figure 3** depicts the deployment costs of three levels of broadband service.

For a fully broadband capable rural network, on which only today's telephone services are carried, the total cost per line varies from a high of $105 per month for a 10-year deployment, to $92 per month for a 20-year deployment schedule. [13] The costs in **Figure 3** are only loop costs. Total costs would include non-loop costs as well. In addition, one method of estimating non-loop costs would bring the total rural deployment costs to $142 for a 10-year schedule and to $129 for a 20-year schedule.

The current average revenue per line for telephony services for these rural customers is approximately $54 per month. [14] Therefore, the costs of these broadband facilities exceeds the revenues generated by current services by at least $38 per month per line for the loop costs alone (and by $75 per line for total costs). This compares to the average $19 per month per line shortfall (**Figure 2**) of providing current telephone services over the current network. In this example, the network has been upgraded but additional costs would be incurred to provision the individual lines that subscribe to broadband services.

If the fully broadband capable rural network offers broadband services to 100% of the rural lines, then the cost per line varies from a high of $132 per month for a 10-year deployment to $117 per month for a 20-year deployment. [15] In this case, the total loop and non-loop rural cost per line would range from $168 for a 10-year deployment to $154 for a 20-year deployment.

While the difference between the loop cost per line and the current revenues is at minimum $63 per month per line (and $100 per month for total costs), there is a great potential for generating additional revenues from broadband services. However, projections of potential revenues are unreliable since broadband services, other than cable TV, are undeveloped with little market testing information available.

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[13] See **Section IX: Appendix B**, for the definitions of the various broadband deployment scenarios. Total costs are from **Figure 10, Lines 6, 7, and 8.**

[14] This includes basic exchange revenue, intra-LATA toll revenue, and access revenue from IXCs from those rural lines (see **Section IX, Appendix B, Figure 10, Line 4**).

[15] For total costs, see **Section IX, Appendix B, Figure 10, Line 8.**

V. Universal Service: Rural Broadband Costs, cont.

The costs for providing broadband services to 50% of the rural lines falls between the costs discussed above.

There is also the cost of the customer premises equipment to be considered. Two-way interactive video will require some type of combination TV/computer to interact with the network. If the provision of this customer equipment is included in the cost of universal service, the cost will be much greater. [16] Certainly the superhighway will have no value if the public does not have access to a vehicle to traverse it.

[16] A Forrester Research study indicates that the computer set-top box for fully interactive video will cost somewhere between $2,000 and $5,000 per TV receiver. Mary A. Modahl and William M. Bluestein, "ITV. Anybody Home? *The Computing Strategy Report*, Volume Eleven, Number Four, February 1994, page 9.

V. Universal Service: Rural Broadband Costs, cont.

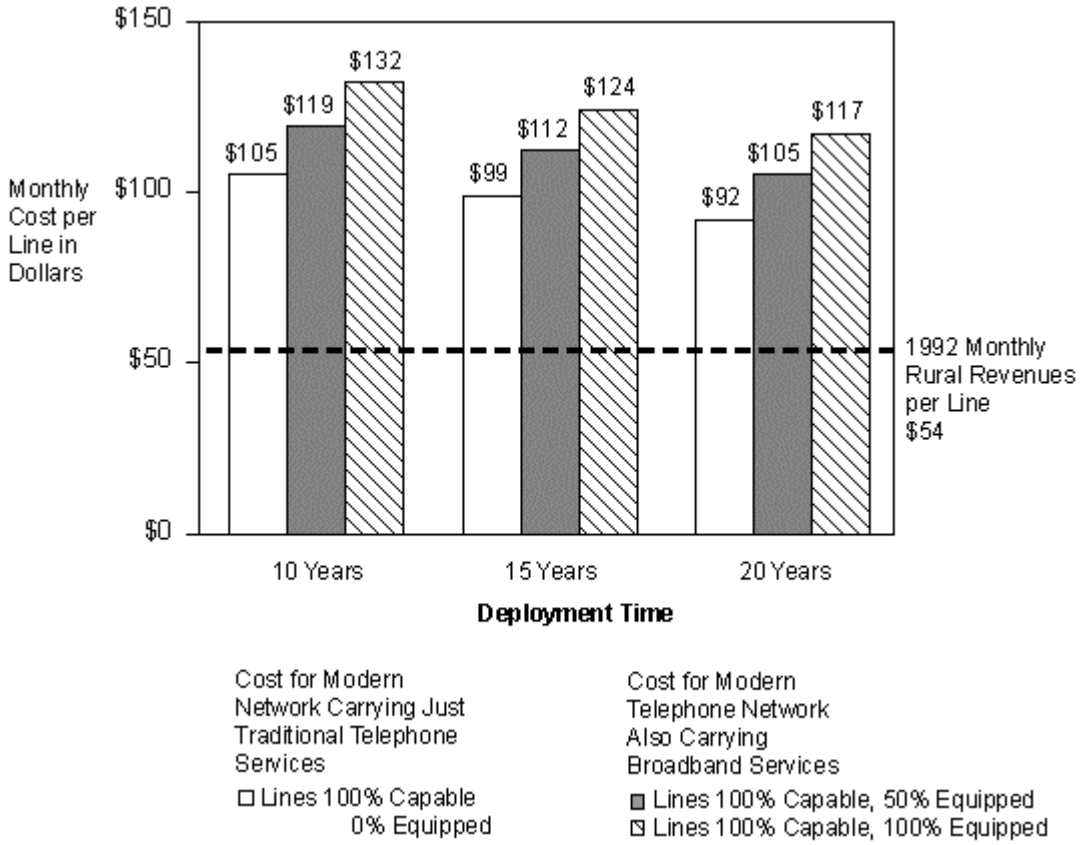

Figure 3:
Comparison of Three Levels of Rural Broadband Deployment

V. Universal Service: Rural Broadband Costs, cont.

VI. Analysis and Conclusions

Who will Pay for Expanded Universal Service?

Expanding the definition of universal service through governmental mandates will be expensive. If policy makers decide that the benefits exceed the cost and society as a whole is better off if every citizen has interactive broadband services, then some subsidy scheme must be developed.

Continue Rate Averaging

One means of recovering the cost of providing broadband services to rural areas would be to continue the system of averaging, in which the rural broadband costs are recovered from all customers. This type of averaging would increase both urban and rural customers' monthly payments between $16 per line and $19 per line, depending on the length of the deployment schedule. Urban customers would also pay an additional amount for the broadband services to which they subscribe.

While rate averaging may be a short-term solution, it is not viable for the long term. As competition increases, companies will not be able to maintain average rates. Competitors taking advantage of high profit margins in low-cost areas will force companies with average prices to price services based on cost.

Government Mandated or Market Driven?

Figure 3 shows that providing broadband services to 100% of rural lines will increase the cost by $100 per month per rural line, even if deployed over a 20-year period. The government could mandate deployment and subsidize the companies or individuals so that the services are affordable. However, mandating new technology deployment, while at the same time promoting competition, appears to be promoting contradictory policies. [17] If subsidies are provided to companies, as is done today, [18]so that over-all prices are kept low, competitors will be discouraged from entering the market. Allowing market demand to drive the deployment of new technology should reduce the cost of broadband services.

The REA's legislative mandate appears to be premised on the belief that competition (and new technologies) won't come to rural areas. Mandating new technology deployment could have the effect of forestalling the development of more cost-effective technology.

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[17] On June 18, 1994 the U.S. House of Representatives passed H.R.3636, the *National Communications Competition and Information Infrastructure Act of 1994.*

[18] See Weinhaus, Makeeff, *Who Pays Whom?*

The costs presented above are based on the telephone companies' cost of current landline technology. Maybe landline technology is inappropriate for bringing broadband services to rural areas at affordable prices. If the broadband market is allowed to develop, then technology changes that deliver these services will advance. The development of new compression techniques may allow service delivery over current narrowband facilities or new satellite services may be able to provide interactive broadband in a more cost effective manner.

Reasons to let the Market Determine the Definition of Universal Service

Forecasting new consumer markets is a very risky business. This is especially true when the new market is totally undeveloped and the technology for providing services to this fledgling market is undergoing tremendous change. Government intervention to define and mandate service to these emerging markets requires that policy-makers assign the risk to consumers and/or to taxpayers, instead of allowing industry and entrepreneurs the opportunity to assume the risk based on the evolutionary trends of those markets. Allowing the market to drive this process may take more time. However, a market approach places the burden of risk on the party that stands to receive the benefit, and provides the consumers with an opportunity to express their demands for feature and functionality.

When services are deployed based upon customer demand, each firm assesses its own risk and potential, thus the overall market is able to generally keep its costs for deploying the new broadband services in line with the revenues generated by the market.

New and undeveloped markets provide incentives for non-traditional industry participation. Innovative solutions not being pursued by main-stream market players may develop. Additionally, non-traditional industry members may be more interested in developing niche markets.

Demand-driven deployment may provide incentives for joint ventures, creating new synergies in the marketplace. Firms that have strengths in one area may seek to work with firms that have expertise in other areas.

What About the Information Have-Nots?

Generally, when new technology is introduced (e.g., home computers, compact disk players, VCRs), prices for products using that new technology are high. Thus, in the early years of the developing broadband market, there may be information have-nots based on the income and education characteristics of a household. This would be

analogous to the current home computer market, which has an approximately 15% penetration level after ten years of availability. [19]

When a service becomes part of what's required to conduct daily business or personal activities, this indicates that it's time to include this service in the universal service definition. Prior services have not been included in basic service until the technology or the services have been widely accepted. Touch-tone is an example of a service that in many areas has been included in the cost of basic service.

[19] U.S. Bureau of the Census, *Statistical Abstract of the United States: 1993,* 113th edition, Washington, DC, Table No. 1244, page 732.

VII. Summary.

VII. Summary

Before the definition of universal service is revised to include broadband services, there should be a demand for the services and a demonstrated benefit to society as a whole.

The cost to mandate the ubiquitous deployment of the technologies for universal broadband services will greatly increase the over-all cost of telephone service for rural customers. [20] The cost of the broadband technology will decrease over time and substantial savings will result if deployment is on a market-demand basis and the definition of universal service is allowed to evolve.

If it is determined that the definition of universal service should include two-way broadband services, then the provision of universal service should not be limited to the telephone industry (or the cable TV industry). The old automatic assumption that the telephone company will be the provider of last resort for telephone services may no longer hold true. New procedures are needed to ensure universal service: how is it defined, who will pay, who will be subsidized, who is obligated to serve, and how will this be done?

The telephone industry has in place a network for the provision of universal dial-tone. However, no one industry has in place a network for the provision of universal two-way broadband services. The most economical provider will vary according to geographic area and the infrastructure of any one of a number of industries--the telephone company, the cable company or even the electric company. The mechanism that is developed to determine the payment into universal service should also establish a procedure that is industry neutral for determining the carrier of last resort. Any carrier of last resort, regardless of its current industry classification, should also have the common carrier obligations of open network architecture so that new carriers and/or technologies may be given the opportunity to interconnect on equal terms.

[20] The cost increase is lower for other market segments

VIII. Appendix A: Other Pressures and Incentives

VIII. Appendix A: Other Pressures and Incentives

Economic Incentives

The information age is in its early stages of development. However, there are forecasts of potentially large revenues from information-age services. [21] These forecasts provide tremendous incentives for research and product development for broadband services by virtually every segment of the computer, telecommunications, broadcast and cable television, information services, and entertainment industries. Potential technical solutions for providing these information-age services are too numerous to mention and it is not clear whether any one solution or standard can dominate this new industry. However, one point is clear: competing technical solutions and products will help develop and shape the consumer market for broadband services.

Regulatory Pressure: Federal Communications Commission

One of the major goals of the Federal Communications Commission (FCC) is the development of the national communications infrastructure. However, Congressional law requires the FCC to insure that the rates charged for telecommunications and cable services are reasonable and non-discriminatory. Therefore, the FCC must balance cable TV and telephone industry concerns over regulations with consumer interest group concerns. On the industry side there is concern that *Cable Rate Regulation* [22] and *Video Dial-tone Regulation* [23] hamper the development of NII-type services. On the consumer interest group side, there is a desire to keep prices for basic telephone and cable services low and not increase prices as a result of the introduction of NII-type services.

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[21] See Weinhaus, Carol; Pitts, Teresa; *et al., Beyond Future Shock: Need for a New Response to Technological Change,* Telecommunications Industries Analysis Project, Center for Telecommunications Management, University of Southern California, November 13, 1993, Figure 10, pages 33 and 79. Also, see Weinhaus, Carol; Pitts, Teresa; *et al., Abort, Retry, Fail? The Need for New Communications Policies,* Telecommunications Industries Analysis Project, Public Utility Research Center, University of Florida, July 11, 1994, Figure 9, page 12.

[22] *In the Matter of Section 623 of the Cable Television Consumer Protection and Competition Act of 1992/Rate Regulation*, MM Docket No. 92-266, *Report and Order and Further Notice of Rulemaking*, FCC Order No. 93-177, May 3, 1993.

[23] *In the Matter of Telephone Company Cable Television Cross-Ownership Rules*, Sections 63.54-63.58, CC Docket No. 87-266, *Second Report and Order, Recommendation to Congress, and Second Further Notice of Proposed Rulemaking,* FCC Order No. 92-327, of FCC Rcd 5781, August 14, 1992.

VIII. Appendix A: Other Pressures and Incentives, cont.

Regulatory Pressure: State Commissions

Strong competition exists among states to attract new businesses. One way states seek to distinguish themselves from other states is through the development of an advanced communications network. Regulatory agencies in many states have set into place regulatory schemes that allow companies to earn a higher rate of return if the company will invest additional dollars into the infrastructure. [24] Some states have mandated that companies deploy certain technologies. [25]

Social Pressures: New technologies

Many policy makers and consumer groups have expressed concerns that the nation will be divided into information "haves" and "have-nots." Recently a coalition of consumer and civil rights groups accused telecommunication companies deploying video dial-tone of "electronic redlining." [26] The groups claim that the companies are designing their advanced communications systems to bypass low income and minority communities. In two petitions filed with the FCC, the groups ask that the FCC prevent discriminatory practices in the deployment of video dialtone and reaffirm its commitment to universal service. [27]

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[24] *State Telephone Regulation Report,* "Infrastructure and Technology Deployment," Telecom Publishing Group, March 25, 1993, pages 9 and 10.

[25] *Ibid.*

[26] *Petition for Relief from Unjust and Unreasonable Discriminating in the Deployment of Video Dialtone Facilities,* filed with the FCC on May 23, 1994 by the Center for Media Education, the Consumer Federation of America, the Office of Communications of the United Church of Christ, the National Association for the Advancement of Colored People, and the National Council of La Raza. *Order Inviting Comment,* FCC Press Release No. DA 94-621.

[27] *Advanced Intelligence Network News*, "RBOCs Respond to Electronic Redlining Claims by Coalition of Advocacy Groups," Section 12, Vol. IV, June 15, 1994.

Broadband Deployment Model: Facilities Statistics

The data set for the *New Technology Deployment Model* is 1992 nationwide for all LECs. The regulatory reporting requirements group the LECs into three categories (**Figure 4**). The data is as filed in the public records. Errors may lie in the original public sources.

Figure 5 gives the number of vertical and horizontal (V&H) coordinates, or wire centers. In common terms, these perform switching functions. In addition, **Figure 5** provides the number of access lines by type of service and by area. "Urban" is represented by Metropolitan Statistical Areas (MSAs) and "rural" is represented by Non-MSAs.

Sources: *V&H Coordinates:*
NECA data filed in Tariff Federal Communications Commission No. 4, 63rd Revised Section 3, April 1, 1992.

Access Lines:
Calculated from FCC, *Monitoring Report, Prepared by the Staff of the Federal-State Joint Board in CC Docket 80-286*, CC Docket No. 87-339, Table 4.19, June 1, 1993.

LEC Category	Definition:
Tier 1	Over $100 million annual regulated operating revenues.
Tier 2A	Over $40 million annual regulated operating revenues, but under $100 million.
Tier 2B	Under $40 million annual regulated operating revenues. These are primarily National Exchange Carrier Association (NECA) Companies.

Figure 4:
Definitions of Tier 1 Local Exchange Carrier Categories

IX. Appendix B: Data Sources and Calculations, cont.

Line:	1992 LEC Facilities:	Total LEC:	Tier 1:	Tier 2A and 2B	NECA:
1	V&H Coordinates	20,636	13,233	1,453	5,950
	Access Lines:				
2	Total by Market Size:	143,478	132,353	3,126	7,999
3	Total MSA:	115,857	110,308	1,559	3,990
4	Residential:	81,284	76,615	1,083	3,586
5	Residential	77,567	73,023	1,032	3,512
6	Lifeline	3,717	3,592	51	74
7	Business:	34,573	33,692	476	405
8	Single-Line	2,554	2,327	33	195
9	Multi-Line	32,019	31,365	443	210
10	Total Non-MSA:	27,622	22,045	1,567	4,009
11	Residential:	22,318	17,813	1,266	3,239
12	Residential	22,318	17,813	1,266	3,239
13	Lifeline	0	0	0	0
14	Business:	5,303	4,233	301	770
15	Single-Line	2,552	2,037	145	370
16	Multi-Line	2,751	2,196	156	399
	Access Lines:				
17	Total by Type Service:	143,478	132,353	3,126	7,999
18	Total Residential:	103,602	94,428	2,349	6,825
19	Residential	99,885	90,836	2,298	6,751
20	Lifeline	3,717	3,592	51	74
21	Total Business:	39,876	37,925	777	1,174
22	Single-Line	5,107	4,364	178	565
23	Multi-Line	34,770	33,561	599	609

Figure 5:

IX. Appendix B: Data Sources and Calculations, cont.

Vertical and Horizontal (V&H Coordinates) and Number of Access Lines (in thousands)

IX. Appendix B: Data Sources and Calculations, cont.

Broadband Deployment Model: Definitions and Modeling Assumptions

Data for **Figure 3** from revised version of *New Technology Deployment Model*, Weinhaus, Carol; Garbanati, Linda; *et al*., Telecommunications Industries Analysis Project, Public Utility Research Center, University of Florida, June 7, 1994.

Chart adapted from methods developed in Weinhaus, Carol; Pitts, Teresa; *et al*., *Beyond Future Shock*, **Figures 4** and **5**, pages 21 and 25; cumulative investment based on pages 29 and 30. The cost per line is based on a specific architecture and deployment schedule. Other technologies, policy changes, and deployment schedules would result in a higher or lower cost per line.

Figure 6 looks at broadband deployment on a monthly per line basis nationwide, for both urban and rural areas.

Definitions for Figures 3 and 6

The following broadband and revenue definitions are from *Beyond Future Shock*, page 22:

- **Cost for Telephone Network Carrying Broadband Services □**
  Figure 6, Line A:
  100% broadband capable and 100% broadband equipped lines.
  For a customer to receive broadband services (beyond the ONU, or optical network unit), additional costs over those associated with converting an access line to being broadband capable are required. Since a line must be broadband capable in order to be equipped, equipped lines are a percent of only those lines that are already broadband capable. Each year the total number of lines equipped to provide broadband services increases by 5% of the total lines.

- **Cost for Modern Telephone Network Carrying Just Traditional Telephone Services -**
  Figure 6, Line C:
  100% broadband capable and 0% broadband equipped lines.
  Broadband capable means that a wire center and its associated copper lines are converted to a broadband switching capability out to the optical network unit (ONU). All customers subscribing to narrow-band services will continue receiving these services.

- **1992 Rural Telephone Revenues per Telephone Line - Figure 6, Line B, Nationwide:**
  Derived from total Tier 1 local exchange carrier operating revenues (including basic service, state toll, and access). See pages 75 and 76 for development of $54.72 for the 1992 cost per line per month.
  Figure 3, Rural:
  See the development of $53.56 for the 1992 rural revenue per line in **Figure 10, Line 4.**

Cumulative Investments:

This cost per line includes overheads and other costs. Another way to look at the cost of broadband deployment is to examine different scenarios for the investment output. The investment for providing the fiber optic infrastructure, **Figure 7** (100% capable and 0% equipped), produces a cumulative nationwide investment of $233 billion over 20 years. This $233 billion is the estimated cost for the entire network - including loop, switching, and interoffice transport for both business and residential customers. For the components of the $233 billion for urban and rural deployments, see **Figure 7**.

The investment for providing broadband services, **Figure 7** (100% capable and 100% equipped), produces a nationwide investment of $424 billion dollars. This $424 billion is a conservative estimate that overstates the costs due to the selected technology platforms and the deployment schedules used in the model. For the components of the $424 billion for urban and rural deployments, see **Figure 7**.

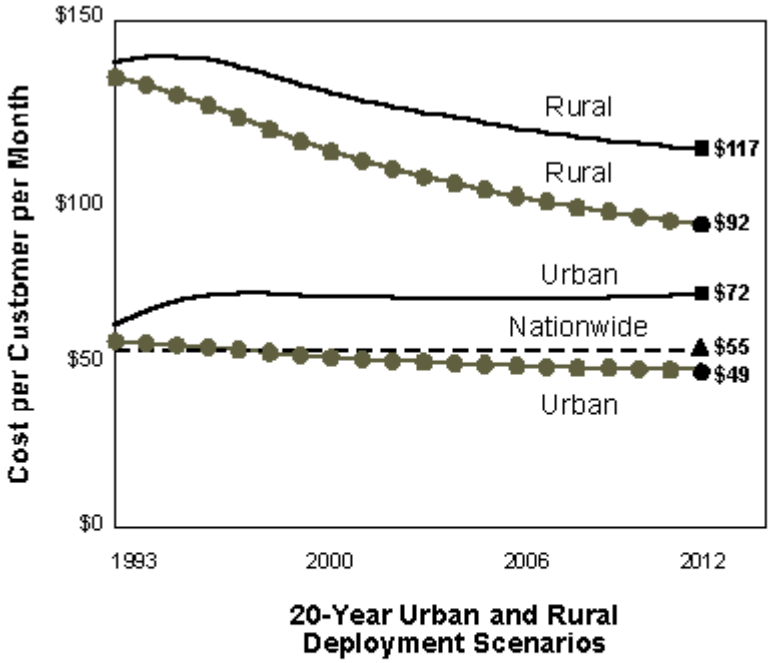
A 1992 benchmark of $21 billion per year in additional investment for local exchange carrier facilities over 20 years results in a cumulative investment of $440 billion if current spending levels continue (see *Beyond Future Shock*, pages 29 and 30). There is a $207 billion difference between current spending levels and providing the fiber optic infrastructure. There is a $16 billion difference between current spending levels and equipping everyone for broadband services.

Other Modeling Assumptions:

The default assumption for access line growth was revised from 3% in *Beyond Future Shock* to 2.35% in this paper. In the model, the point at which the capable curves cross the 1992 revenue line is sensitive to the percent of access line growth.

It should also be noted that both rural and urban scenarios represent averages. In reality, the decision to deploy broadband is determined by a number of individual market characteristics such as access line growth, length of lines (affects cost of technology), company costs, and demographics. Normally a local exchange carrier performs a cost-benefit analysis to determine where and when the new technology should be deployed. In some cases, the decision to deploy a particular technology would be made even if it

IX. Appendix B: Data Sources and Calculations, cont.



20-Year Urban and Rural Deployment Scenarios

Line A: ■
Cost for Modern Telephone Network Also Carrying Broadband Services

Line B: ▲
1992 Telephone Revenues per Telephone Line

Line C: ●
Cost for Modern Telephone Network Carrying Just Traditional Telephone Services

Figure 5:

IX. Appendix B: Data Sources and Calculations, cont.

Vertical and Horizontal (V&H Coordinates) and Number of Access Lines (in thousands)

IX. Appendix B: Data Sources and Calculations, cont.

		Cumulative Investment, 20-Year Deployment 100% Capable, 0% Equipped			
		Urban		Rural	
Line:	Investment Categories:	Dollars in Billions:	Percent of Total:	Dollars in Billions:	Percent of Total:
1	Loop Electronics	62.0	51.4%	18.7	16.6%
2	Cable and Wire	34.0	28.2%	86.1	76.6%
3	Circuit Equipment	24.3	20.1%	6.2	5.5%
4	Digital Switching	0.4	0.3%	1.4	1.2%
5	Total	120.7	100.0%	112.4	100.0%

		Cumulative Investment, 20-Year Deployment 100% Capable, 100% Equipped			
		Urban		Rural	
Line:	Investment Categories:	Dollars in Billions:	Percent of Total:	Dollars in Billions:	Percent of Total:
1	Loop Electronics	121.7	43.5%	29.6	20.6%
2	Cable and Wire	34.0	12.2%	86.1	59.8%
3	Circuit Equipment	25.6	9.2%	6.4	4.4%
4	Digital Switching	98.3	35.2%	21.9	15.2%
5	Total	279.6	100.0%	144.0	100.0%

IX. Appendix B: Data Sources and Calculations, cont.

Figure 7:
Cumulative Investments for 20-Year Deployment Scenarios

were not immediately economically justifiable. However, it would be expected that a service would be deployed with an established demand and a plan for cost recovery.

Figure 8 shows the schedule for deployment of capable and equipped lines assumed when generating data.

Fiber Platforms

A "platform," in very general terms, gives a generic capability. The specific services that a customer receives on this platform can be varied. Whatever the client wants - this is both the information service provider and what the market chooses □ is carried on the business and residential platforms. The following list covers some services that can be provided on this generic platform:

- **Entertainment:** Broadcast TV, basic cable TV, pay-per-view, narrow-casting, and video-on-demand.
- **Interactive Video:** Games, multi-media libraries, video-conferencing, formal education, and how-to-videos (start and stop and learn from).
- **Transactional Services:** Yellow pages directory, catalog shopping, grocery shopping, banking.
- **Publishing:** Telecommuting, digital radio, and real-time polling.

In more technical terms, a "platform" is the basic underlying capability upon which the service can be configured by adding hardware/software. In this model, fiber is the platform and there is flexibility to allow services to be personalized to the individual subscriber.

		Deployment Schedule for Access Lines			
		Capable		Equipped	
Line:	Year:	Annual Incremental:	Cumulative:	Percent of Capable:	Cumulative
1	1993	0.42%	0.42%	5%	0.02%
2	1994	0.85%	1.27%	10%	0.13%
3	1995	1.55%	2.82%	15%	0.42%
4	1996	2.64%	5.46%	20%	1.09%
5	1997	4.12%	9.58%	25%	2.40%
6	1998	5.94%	15.52%	30%	4.66%
7	1999	8.04%	23.56%	35%	8.25%
8	2000	8.04%	31.60%	40%	12.64%
9	2001	8.04%	39.64%	45%	17.84%
10	2002	8.04%	47.68%	50%	23.84%
11	2003	8.04%	55.72%	55%	30.65%
12	2004	8.04%	63.76%	60%	38.26%
13	2005	8.04%	71.80%	65%	46.67%
14	2006	8.04%	79.84%	70%	55.89%
15	2007	6.70%	86.54%	75%	64.91%
16	2008	5.36%	91.90%	80%	73.52%
17	2009	4.02%	95.92%	85%	81.53%
18	2010	2.68%	98.60%	90%	88.74%
19	2011	1.34%	99.94%	95%	94.94%
20	2012	0.06%	100.00%	100%	100.00%

Figure 8:
New Technology Deployment Model Input: Schedule for Deployment of Capable and Equipped Lines

IX. Appendix B: Data Sources and Calculations, cont.

For example, if this concept were applied to the computer, the platform would be the microprocessor itself (e.g., 486) and the associated wiring, cabinet, and power unit. Adjuncts added to provide specific services would be the monitor, keyboard, mouse, and software. In the case of local access, "platform" refers to cable facilities, passive devices, powering equipment and cabling, initial switching and interoffice transport capability, enhancements to operation support systems for normal operations, administration and maintenance, and personnel training. [28]

In general, patterns of acceptance of new technology by customers create network planning problems. Unlike consumer product manufacturers, who can adjust to the changes in demand by altering manufacturing schedules, telecommunications companies must install networks initially with sufficient capacity to handle current as well as future demand. Failure to install sufficient initial capacity causes expensive re-engineering.

Recognizing these issues, the participants "sized" the fiber-optic platforms for business and residential customers for the following average service deliveries:

- **Residential platform:** Provides work at home (data transfer, video conferencing,
  faxing, etc. all simultaneously) in addition to traditional voice. It also provides entertainment and other one-way video services.

  Should support an average of one switched wideband signal (up to 1.544 Mbps) per current residential access line (making work at home applications possible) and one broadcast video signal (providing video on demand) per person per household. In addition, this platform also provides current residential narrowband service.

- **Business platform:** Provides enough to support a burgeoning of a need for higher than 64 kilobit business services (quality video-conferencing, two-way interactive data services, primary and basic rate ISDN). It also has a dynamic

[28] Current limitations on transmission capacity for a single-mode fiber system are not found in the cable itself but in the associated optoelectronic equipment. Therefore, it makes sense to consider point-to-multipoint fiber-optic architectural platforms which reduce the amount of fiber deployed while still providing interconnection. Each network end point derives only that portion of the total information payload desired at that end point. The platform is "sized" to account for an average service delivery. Ideally, flexibility in service offering would only be limited by the maximum platform capacity.

allocation of bandwidth that lets the customer reconfigure the network in real-time to meet tailored business needs.

Should support two switched wideband signals per current business access line, as well as all current business services. Additionally, a business with a mix of wideband and broadband services should be able to reconfigure its own access to the PSN up to the information capacity of services purchased.

A single "broadband" service is defined as one offered at data rates of 45 Mbps or greater. It is worthy of note that the majority of broadband services derived off these platforms arise from residential broadcast video or from multiplexed narrowband and wideband signals to business buildings.

Additional network features include electronic interfaces at customer and network interconnection points; network power sources and power back-up customized to customer density; and integration of narrowband, wideband, and broadband services on the same fiber. The subscriber is met electrically, not optically in this model.

Development of Rural Costs and Revenues per Line

Figure 9 provides the background data and calculations for the costs and revenues for **Figures 1 and 2** and the output of the *New Technology Deployment Model* for the 10-year, 15-year, and 20-year broadband deployment scenarios. See also *What is the Price of Universal Service?,* Appendix B, for the methodology and sources used to develop rural costs and revenues.

Sources: Data filed in accordance with the FCC, *Commission Requirements for Cost Support Material to be Filed with 1989 Annual Access Tariffs*, 4 FCC Rcd 1662, Order (Tariff Review Plan), December 30, 1988. Used for the Tier 2A and Tier 2B company data.

Data Specifications and reporting requirements for the *ARMIS Access Report (FCC Report 43-04)* are described in the *Automated Reporting Requirements for Certain Class A and Tier 1 Telephone Companies (Part 31, 43, 67, and 69 of the FCC's Rules), Errata*, CC Docket 86-182, DA 90-30, Released January 16, 1990. Cited as *ARMIS* Report 43-04.

U.S. Department of Agriculture (USDA), Rural Electrification Administration (REA), *Telephone Operations Manual [REA Supertape],* Section 1800, Washington, DC, November 29, September 1992. Cited as REA Data.

FCC, *Monitoring Report, Prepared by the Staff of the Federal-State Joint Board in CC Docket 80-286*, CC Docket No. 87-339, Table 4.19, June 1, 1993. Data filed in accordance with the FCC's *Establishment of a Program to Monitor the Impact of Joint Board Decisions,* DA 89-503, Released May 12, 1989.

NECA rural company data.

Figure 10 provides further calculations for the development of **Figure 1, 2, and 3.**

IX. Appendix B: Data Sources and Calculations

Figure 9:
1992 Rural Calculations for Costs, Revenues, and Access Lines

Line:	Description:	Data:	Source:
1	Year	1992	
	Access Lines:		
2	# of Non-MSA	22,045,000	Estimated Non-MSA Lines, Tier 1 LECs, **Figure 5, Line 10.**
3	Total # of Study Area	132,353,000	Total Lines, Tier 1 LECs
	Revenues:		
	SLC Rates:		1993 FCC, *Tariff Review Plan*, Form RTE-1 for Price Cap Carriers, 1992 Rate
4	Residence (Single Line Rate)	$3.49	Weighted Average of Current Rates in Effect at Time of Filing.
5	Business (Multi-Line Rate)	$4.71	Weighted Average of Current Rates in Effect at Time of Filing.
6	State Toll and Access Revenues	$18,661,000,000	FCC, *ARMIS Report 43-04*, 1992, Lines 4013 and 4023, Tier 1 LECs
7	Interstate Carrier Access Revenues	$11,128,000,000	FCC, *ARMIS Report 43-04*, Line 4011, 1992, Tier 1 LECs.
8	% of Rural that are Residential	80.80%	See **Figure 5, Lines 10 and 11.**
9	% of Rural that are Single Line Business	9.24%	See **Figure 5, Lines 15 and 10.**
10	% of Rural that are Multi-Line Business	9.96%	See **Figure 5, Lines 16 and 10.**
11	Annual Rural Cost per Line	$871.08	REA Data, 1992, see Appendix B, Figure 11.

IX. Appendix B: Data Sources and Calculations

Figure 9:
1992 Rural Calculations for Costs, Revenues, and Access Lines, cont.

Line:	Description:	Data:	Source:
	Minutes of Use per Rural Line		
12	State Toll and Access	4,170	FCC, *Monitoring Report,* Table 4.16, May 1994.
13	Interstate Access	4,018	FCC, *Monitoring Report*,, Table 4.17, May 1994.
	Rural Local Rates ($/Line/Month)::		
14	Residence Rate	$12.88	Composite Local Rates for Non-Urban Areas in Ameritech, Bell Atlantic,
15	Business Rate	$31.26	Bell South, NYNEX, Pacific Telesis, Southwestern Bell, and U S West Operating Territories, see REA Data, Appendix B, Figure 12.
	Dial Equipment Minutes (DEM):		
16	State Toll and Access	281,318,896,000	FCC, *Monitoring Report,* Table 4.16 (Total Tier 1 Cost Companies for 1992), May 1994.
17	Interstate Access	355,313,253,000	FCC, *Monitoring Report,* Table 4.16 (Total Tier 1 Cost Companies for 1992), May 1994.
	Calculations:		
18	Local Rural Residential Revenues	$2,753,078,362	12 x (Line 2 x Line 8 x Line 14)
19	Local Rural Single Line Business Revenues	$764,103,685	12 x (Line 2 x Line 9 x Line 15)
20	Local Rural Multi-Line Business Revenues	$823,644,232	12 x (Line 2 x Line 10 x Line 15)
21	State Toll and Access Rate ($/Minute)	$0.0663	Line 6 / Line 16

Figure 9:
1992 Rural Calculations for Costs, Revenues, and Access Lines, cont.

Line:	Description:	Data:	Source:
22	Interstate Toll and Access Rate ($/Minute)	$0.0313	Line 7 / Line 17
23	Rural State Toll and Access Revenue	$6.097,926,236	Line 2 x Line 12 x Line 21
24	Rural Interstate Access Revenue	$2,774,123,209	Line 2 x Line 13 x Line 22
25	Rural SLC Revenue	$955,389,384	12 x (Line 4 x Line 2 x (Line 8 + Line 9) + Line 2 x Line 5 x Line 10)
26	Total Rural Revenue	$14,168,265,108	Line 18 + Line 19 + Line 20 + Line 23 + Line 24 + Line 25
27	Total Rural Cost	$19,202,958,600	Line 11 x Line 2
28	Difference	($5,034,693,492)	Line 25 - Line 27
29	Difference Per Non-MSA Line Per Month	$19.03	Line 28 / Line 2/ 12
30	Difference Per MSA Line Per Month	($3.80)	Line 28 / (Line 3 - Line 2) / 12
	Rural Broadband Cost Per Line Per Month		
31	10-Year Deployment; 100% Equipped	$131.52	Revised version of the *New Technology Deployment Model.*
32	15-Year Deployment; 100% Equipped	$124.49	Revised version of the *New Technology Deployment Model.*
33	20-Year Deployment; 100% Equipped	$117.72	Revised version of the *New Technology Deployment Model.*
34	10-Year Deployment; 0% Equipped	$105.42	Revised version of the *New Technology Deployment Model.*
35	15-Year Deployment; 0% Equipped	$98.50	Revised version of the *New Technology Deployment Model.*
36	20-Year Deployment; 0% Equipped	$92.11	Revised version of the *New Technology Deployment Model.*
37	10-Year Deployment; 50% Equipped	$118.57	Revised version of the *New Technology Deployment Model.*
38	15-Year Deployment; 50% Equipped	$111.61	Revised version of the *New Technology Deployment Model.*

Figure 9:
1992 Rural Calculations for Costs, Revenues, and Access Lines, cont.

Line:	Description:	Data:	Source:
39	20-Year Deployment; 50% Equipped	$105.17	Revised version of the *New Technology Deployment Model.*
40	Percent of Embedded Rural Cost Per Line Per Month Related to Non-Loop Cost	50.23%	NECA Rural Company Data
41	Rural Embedded Non-Loop Cost	$9,645,646,105	Line 27 x Line 40
	Total Rural Cost with Broadband Deployment		
42	10-Year Deployment; 100% Equipped	$44,437,946,905	(Line 31 x 12 x Line 2) + Line 41
43	20-Year Deployment; 100% Equipped	$40,787,294,905	(Line 32 x 12 x Line 2) + Line 41
	Difference between Total Rural Broadband Cost and Rural Revenues Per Month Per Non-MSA Line:		
44	10-Year Deployment; 100% Equipped	$114.42	(Line 42 - Line 26) / Line 2 / 12
45	20-Year Deployment; 100% Equipped	$100.62	(Line 43 - Line 26) / Line 2 / 12
	Difference between Total Rural Broadband Cost and Rural Revenues Per Month Per Line:		
46	10-Year Deployment; 100% Equipped	$19.06	(Line 42 - Line 26) / Line 3 / 12
47	20-Year Deployment; 100% Equipped	$16.76	(Line 43 - Line 26) / Line 2 / 12

IX. Appendix B: Data Sources and Calculations

Figure 10:
Calculations for Monthly Rural Broadband Costs per Line

		Broadband Deployment Scenarios			
Line:	1992 Costs and Revenues	10-Year	15-Year	20-Year	Sources
	Deployment Scenarios:				
1	100% Capable, 0% Equipped	$105.42	$98.50	$92.11	From **Figure 9, Lines 31** through **39.**
2	100% Capable, 50% Equipped	$118.57	$111.61	$105.17	From **Figure 9, Lines 31** through **39.**
3	100% Capable, 100% Equipped	$131.52	$124.49	$117.72	From **Figure 9, Lines 31** through **39.**
	Current Rural Monthly Dollars:				
4	Rural Revenue per Line	$53.56	$53.56	$53.56	**Figure 9: (Line 26 / Line 2)** / 12
5	Rural Non-Loop Cost per Line	$36.46	$124.49	$117.72	**Figure 9: (Line 41 / Line 2)** / 12.
	Total Costs:				
6	100% Capable, 0% Equipped	$141.88	$134.96	$128.57	Line 1 + Line 5
7	100% Capable, 50% Equipped	$155.03	$148.07	$141.63	Line 2 + Line 5
8	100% Capable, 100% Equipped	$167.98	$160.95	$154.18	Line 3 + Line 5
	Potential Impact of Deaveraging Payments:				
9	Urban	($3.80)			From **Figure 9, Line 30.**
10	Rural	$19.03			From **Figure 9, Line 29.**

Broadband Deployment Scenarios

Line:	1992 Costs and Revenues	10-Year	15-Year	20-Year	Sources
	Total Rural:				
11	Total Rural Revenue	$14,168,265,108			From **Figure 9, Lines 26.**
12	Total Rural Cost	$19,202,958,600			From **Figure 9, Lines 27.**