Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Inquiry Concerning the Deployment of	)	
Advanced Telecommunications	)	CC Docket No. 98-146
Capability to All Americans in a Reasonable	)	
And Timely Fashion, and Possible Steps	)	
To Accelerate Such Deployment	)	
Pursuant to Section 706 of the	)	
Telecommunications Act of 1996	)	

SECOND REPORT

Adopted: August 3, 2000 **Released:** August 21, 2000

By the Commission: Commissioner Ness issuing a statement; Commissioners Furchtgott-Roth and Tristani concurring and issuing separate statements.

I. INTRODUCTION

1. In this Second Report, the Commission concludes its second inquiry into the availability of advanced telecommunications capability in the United States.[1] In general, we find that advanced telecommunications capability is being deployed in a reasonable and timely fashion, although we identify certain groups of consumers that may be particularly vulnerable to untimely access to this capability. We have seen significant investment in the facilities needed to provide advanced telecommunications capability, steadily rising subscription rates for advanced services, and a proliferation of providers in the marketplace. We are encouraged that these factors will lead to widespread deployment. As with any technology, particularly in its early stages, deployment of advanced telecommunications capability is not uniform across the nation. Some consumers will gain access to that capability before others. While we expect that economic forces will drive deployment as the market develops, it appears that consumers in certain areas of the country may be particularly vulnerable to not receiving timely access to advanced

[1] This inquiry is required by section 706 of the Telecommunications Act of 1996 (the 1996 Act). *See* §706, Pub.L. 104-104, Title VII, Feb. 8, 1996, 110 Stat. 153, reproduced in the notes under 47 U.S.C. §157; *see* Appendix A.

telecommunications capability. As discussed below, we have already taken -- and will continue to take -- steps to ensure that consumers in all regions of the nation have access to advanced telecommunications capability in a reasonable and timely fashion.

2. In its most basic form, advanced telecommunications capability allows users to send and receive large amounts of information. More specifically, advanced telecommunications capability is "high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology."[2] With advanced telecommunications capability consumers can take advantage of advanced services that allow residential and business customers to create and access content, sophisticated applications, and high-bandwidth services. For example, advanced services allow businesses and their customers quickly to exchange data over long distances, doctors to provide real-time diagnosis to patients in remote areas, people with hearing and speech disabilities to communicate through video links using sign language, teachers to create interactive multimedia learning environments for their students, and individuals to have faster, more robust access to the Internet.

3. The E-rate program, authorized by Congress in the 1996 Act and implemented by this Commission, is an example of our commitment to bring the benefits of the information age to all Americans. The E-rate provides support for telecommunications services, Internet access and internal connections, with the goal of allowing every school child and every community to take advantage of modern communications technology -- both to learn more about the world and to become proficient at the skills required in the modern workplace. Those people who benefit from the connections provided through the E-rate, having seen the power of the technology, likely will stimulate demand in their communities by asking for more and better advanced services. The facilities built to serve schools and libraries through the E-rate program can serve as the foundation for more broadly available networks.

4. Recognizing the importance of access to advanced telecommunications capability in modern society, Congress directed the Commission and the states, in section 706 of the Telecommunications Act of 1996, to encourage deployment on a reasonable and timely basis. Congress also instructed the Commission to conduct regular inquiries concerning the availability of advanced telecommunications capability and, based on our findings, to take action to accelerate deployment, if necessary. In our *First Report*, issued in February 1999, we found that the overall deployment of advanced telecommunications capability generally appeared reasonable and timely, given the early stage of deployment.[3] We lacked adequate data, however, to reach more definitive conclusions at that time.

5. In conducting our second inquiry and issuing this Second Report, we expanded our information collection efforts to gain a more comprehensive understanding of the availability of advanced telecommunications capability. First, we issued a Notice of Inquiry on the issue of

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[2] *Id.* §706(c)(1).

[3] *Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, CC Docket No. 98-146, Report, 14 FCC Rcd 2398 (1999) (*First Report*).

advanced telecommunications capability in February 2000.[4] In that Notice, we asked four basic questions: (1) What is advanced telecommunications capability? (2) Is advanced telecommunications capability being deployed to all Americans? (3) Is overall deployment reasonable and timely? and (4) What actions will accelerate deployment? Second, in addition to seeking comment and building a record on these four questions, we launched a formal data collection program to gather standardized information from providers of advanced telecommunications capability in the United States, including wireline telephone companies, cable providers, terrestrial wireless providers, satellite providers, and any other facilities-based providers of advanced telecommunications capability.[5] Third, we convened a Federal-State Joint Conference on Advanced Telecommunications Services (Joint Conference), consisting of federal and state regulators, for the purpose of providing a forum for an ongoing dialogue among the Commission, the states, and local and regional entities regarding the deployment of advanced telecommunications capability.[6] The Joint Conference conducted a series of field hearings across the country -- from Alaska to Miami -- to gather data on the deployment of advanced telecommunications capability. The Joint Conference has also begun to develop a publicly accessible database of "best practices" employed in various regions to spur rapid deployment. Finally, we undertook a series of in-depth case studies to gain a detailed understanding of how advanced telecommunications capability is being deployed and used in different communities. Specifically, we examined deployment in Los Angeles County, California; Waltham, Massachusetts; Muscatine, Iowa; Miller, South Dakota; and Wilsondale, West Virginia.

6. Based on all of the information gathered from our Notice of Inquiry, our data collection program, the Joint Conference field hearings, our case studies, and reports from industry, analysts, academics and other agencies, we now issue our Second Report. In the sections that follow, we address the four basic questions we asked in the Notice of Inquiry. We make our judgement as to whether deployment of advanced services to all Americans is reasonable and timely by looking at three major factors. First, we examine subscribership levels, and how they have changed since our *First Report*. Next, we look at levels of investment in infrastructure and projections of future growth with advanced telecommunications capability. Finally, we assess the choices available to consumers today and in the near future, looking at both choices among service providers and among technology options.

7. As Congress directed in section 706, we focus on the *availability* of advanced telecommunications capability. Accordingly, we concentrate our efforts largely on addressing the deployment of the infrastructure necessary to bring advanced telecommunications capability to consumers, as well as the level of subscribership to the services provided over that infrastructure. We recognize, however, that deployment of infrastructure alone does not guarantee that the

[4] *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996*, CC Docket No. 98-146, Notice of Inquiry, FCC 00-57 (rel. Feb. 18, 2000) (*Second NOI*).

[5] *Local Competition and Broadband Reporting*, CC Docket No. 99-301, Report and Order, 15 FCC Rcd 7717 (rel. Mar. 30, 2000) (*Data Gathering Order*).

[6] *Federal State Joint Conference on Advanced Telecommunications Services*, Order, 14 FCC Rcd 17622 (1999) (*Joint Conference Order*).

benefits of advanced telecommunications capability will flow to all consumers as Congress intended. Factors such as household income, computer ownership, education, and technical skill, to name a few, all affect whether consumers are able to access the advanced services available through advanced telecommunications capability. We also recognize that the speed and ubiquity of advanced telecommunications capability deployment will depend in large measure on consumers' demand for content and services that require this capability. However, many of these factors implicate a variety of economic, sociological, and demographic issues that are beyond the scope of this report. Nonetheless, as discussed below, the market for advanced telecommunications capability is in its early stages and this Commission has already taken important steps to accelerate and facilitate widespread deployment. We will continue and expand these efforts as we strive to ensure that all Americans have access to advanced telecommunications capability.

II. EXECUTIVE SUMMARY

8. This Report answers the four basic questions we set forth in the Notice of Inquiry.

(1) What is advanced telecommunications capability?

- We retain our current definition: infrastructure capable of delivering a speed in excess of 200 kbps in each direction. We denominate as "high-speed" those services capable of delivering transmission speeds in excess of 200 kbps in at least one direction. Advanced telecommunication capability and advanced services thus are a subset of the larger "high-speed" category.

- We reaffirm that a service may have asymmetrical upstream and downstream transmission paths and still be advanced telecommunications capability as long as both paths are capable of speeds in excess of 200 kbps to the network demarcation point at the subscriber's premises.

(2) Is advanced telecommunications capability being deployed to all Americans?

- In determining whether advanced telecommunications capability is being deployed to all Americans, we examine the networks used to provide those advanced services, including the backbone, the middle mile, the last mile, the last 100 feet, and connection points to those facilities.

- We conclude that, as of December 31, 1999, there were approximately 1.8 million residential subscribers of high-speed services. We further estimate that approximately 1.0 million of these users subscribed to services that meet our definition of advanced telecommunications services. This is a three-fold increase in residential advanced services (again, full two-way services) from the previous year.

- At the end of 1999, there were approximately 1.0 million high-speed lines providing service to large business and institutional customers. We estimate that almost all of these lines satisfy our definition of advanced telecommunications capability.

- Subscribers to high-speed services are spread throughout all fifty states, the District of Columbia, and Puerto Rico. In addition, there is at least one subscriber to high-speed services in 59 percent of the country's zip codes, and 91 percent of the country's population lives in

these zip codes. The data further indicates that population density is highly correlated with the availability of facilities necessary to support advanced services.

- In determining whether advanced telecommunications capability is being deployed to all Americans, we undertake an examination of deployment of advanced services in various locations throughout the United States: Los Angeles County, California; Waltham, Massachusetts; Muscatine, Iowa; Miller, South Dakota; and Wilsondale, West Virginia.

- We also review community-based deployment efforts in order to identify successful strategies that have led to increased access to advanced telecommunications capability; and we examine trends in investment and growth in various high-speed access technologies.

(3) Is overall deployment reasonable and timely?

- Recognizing that the development of advanced services infrastructure remains in its early stages, we conclude that, overall, deployment of advanced telecommunications capability is proceeding in a reasonable and timely fashion. Specifically, competition is emerging, rapid buildout of necessary infrastructure continues, and extensive investment is pouring into this segment of the economy.

- We conclude that there has been ample national deployment of backbone and other fiber facilities that provide backbone functionality. There is no indication that specific types of areas have inadequate access to backbone or functionally equivalent facilities.

- We find that extensive middle mile facilities exist; that innovative compression and modulation techniques continue to expand the capability of existing fiber links; and that the broad geographic distribution of subscribers to high-speed services demonstrates the wide availability of middle mile facilities. Nonetheless, there remains the potential that a bottleneck exists in certain areas and that a lack of competition in that market could lead to high prices.

- We find that, throughout the country, deployment of last-mile facilities to support advanced services is expanding rapidly.

- Despite our conclusion that deployment is reasonable and timely overall, the data support the troubling conclusion that market forces alone may not guarantee that some categories of Americans will receive timely access to advanced telecommunications capability. We identify certain categories of Americans who are particularly vulnerable to not having access to advanced services. These include low-income consumers, those living in sparsely populated areas, minority consumers, Indians, persons with disabilities and those living in the U.S. territories.

- We find that approximately 52 percent of schools have high-speed connections to the Internet, largely as a result of the use of the E-rate for high-speed services.

- Current regulatory requirements will help ensure that advanced services are accessible to persons with disabilities. However, it still appears likely that, in the near future, some networks and services will be developed that are not accessible to this population.

- There does not appear to be a lack of infrastructure with respect to the last 100 feet, and we

are currently considering questions regarding access to inside wires and other such facilities.

(4) What actions by the Commission will accelerate deployment?

- In accordance with our statutory mandate, we are committed to ensuring that advanced services become available to all Americans. We believe the recommendations outlined below, many of which are already are underway in separate dockets, will promote access to advanced services especially to consumers we have identified as being particularly vulnerable to not being served by the operation of market forces alone.

    - We are considering modifications to our collocation rules to provide for competitive access to incumbent LECs' remote terminals.

    - We are considering streamlining the equipment approval process for customer premises equipment with advanced telecommunications capability.

    - Upon completion of our current work on the high-cost support mechanism for rural carriers, and in collaboration with the states, we will consider the appropriate mechanisms to ensure broadband access for customers who do not have access as a result of market forces. In addition, we will further examine our rules for the E-rate program to determine if we can encourage broadband services and connections; and if sharing of school and library facilities can improve access or deployment in surrounding communities.

    - We will consider whether to allow access by multiple Internet service providers to cable companies' infrastructure for the delivery of advanced services.

    - We will examine ways to make more licensed and unlicensed spectrum available for broadband services, as well as ways to enable the increased use of spectrum.

    - We will increase data collection and dissemination practices in order to monitor more closely the deployment of advanced telecommunications capability.

9. We also encourage several additional entities to consider actions that will encourage investment in, and stimulate demand for, advanced services and reduce the cost of deployment. Additionally, we encourage the integration of telecommunications and economic development policies, as well as increased funding for technological research and development, particularly for the purpose of developing solutions to serving remote and low-demand areas.

III. WHAT IS ADVANCED TELECOMMUNICATIONS CAPABILITY?

10. In this section, we address the first question asked in our Second Notice of Inquiry: What is advanced telecommunications capability? Section 706 (b) of the 1996 Act defines advanced telecommunications capability as "high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology." In the *First Report*, we defined "broadband" -- and, in effect, advanced telecommunications capability and advanced services -- as "having the capability of supporting, in both the provider-to-customer (downstream) and the customer-to-provider (upstream) directions, a speed (in technical terms, 'bandwidth') in excess of

200 kilobits per second (kbps) in the last mile."[7] We stated several reasons for choosing 200 kbps. First, it appeared that Congress intended advanced telecommunications capability to be faster than ISDN service, which operates at a data rate of 128 kbps and was widely available at the time of the 1996 Act.[8] Also, 200 kbps is enough to provide the most popular applications -- to change web pages as fast as one can flip through the pages of a book.[9] Finally, we required that both upstream and downstream paths have this capability because Section 706 (b) uses the words "originate *and* receive."[10]

11. In this Report, we again examine the availability of 200 kbps, or faster, speeds in both the upstream and downstream paths of the last mile. However, we use the terms "advanced telecommunications capability" and "advanced services" to refer to this capability. Since the *First Report*, the terms "broadband" and "broadband services" have come to include a much broader range of services and facilities. In light of its now common and imprecise usage, we decline to use the term broadband to describe any of the categories of services on facilities that we discuss in this report. Rather, we denominate as "high-speed" those services with over 200 kbps capability in at least one direction. Thus, high-speed is the larger category, consisting of those services and facilities with a transmission speed of 200 kbps in at least one direction. Advanced telecommunications capability and advanced services form a subset of this larger category and denote that portion capable of 200 kbps or greater transmission in *both* directions.

12. In keeping our present definition, we follow the suggestion of several commenters who observe that it sets a standard above the bandwidth that most residential customers use today, but well below the fastest rates possible with today's technologies.[11] We view this definition as a benchmark. If it reflects merely what most residential customers want or are receiving today, then we risk setting our sights unduly low. We think Congress meant us to do more.[12] We are particularly reluctant to lower our standard for the upstream path below 200 kbps. To do so would omit transmissions of home and community events, frustrating important applications of advanced telecommunications capability. It would omit lip-reading and signing, denying a major potential benefit for persons with speech and hearing disabilities and those wanting to converse with them. Narrowband upstream paths would also render difficult, if not impossible, many advanced telecommunications capability applications for telecommuting,

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[7] *First Report*, 14 FCC Rcd at 2406.

[8] *Id*. n.13.

[9] *Id*. at 2406. 200 kbps is more than enough bandwidth to permit the video transmission of sign language. In comparison, typical business teleconferencing services are 120-250 kbps, conventional televisions are 750 kbps to 1 Mbps, videocassette tapes are 1.5 Mbps, and movie theatre images are several Mbps. As changes in technology, such as compression, advance we may need to revise our definition. *See infra* para. 14.

[10] Section 706(b) (emphasis added); *First Report*, 14 FCC Rcd at 2406-07 & n.17.

[11] Bell South comments at 8; MCI WorldCom comments at 4; OPASTCO comments at 2.

[12] AT&T comments at 2-9; Bell Atlantic comments at 2-5; Citizens Communications comments at 11; GTE comments at 8-9; Metricom, Inc. comments at 4-6; NCTA comments at 26-27; Northpoint Communications, Inc. comments at 6-7; SBC corrected comments at 5-6.

consumer-originated broadcasting, distance education, desktop publishing, and health care.[13] We believe that Congress intended advanced telecommunications capability to bring to all Americans a two-way, truly interactive medium, rather than one that is passive and entertainment-oriented.

13. We also re-affirm the other definitional findings of our *First Report*.[14] These findings include that a service may have asymmetrical upstream and downstream paths and still be advanced telecommunications capability as long as both paths provide speeds in excess of 200 kbps to the network demarcation point at the subscriber's premises.

14. We emphasize, as did our *First Report*, that our definition of advanced telecommunications capability will evolve over time.[15] Future reports will reconsider it in light of changing conditions in both supply and demand. We may change the definition, for example, if compression technologies make possible with 100 kbps what now requires more than 200 kbps. We may also increase the speed as higher bandwidths become more affordable,[16] or as demand among millions of residential customers takes firm shape.[17] Periodically reviewing these definitions will ensure flexibility that fits the dynamic, recurrent review process that section 706 contemplates.

IV. IS ADVANCED TELECOMMUNICATION CAPABILITY BEING DEPLOYED TO ALL AMERICANS?

15. In this section, we address the second question that we asked in our Second Notice of Inquiry: Is advanced telecommunications capability being deployed to all Americans? In order to answer this question, it is instructive to begin with a brief overview of the networks used to provide advanced services, followed by a description of the specific technologies employed in those networks. We then discuss the subscribership data reported by providers who completed our Broadband Survey. Next, we discuss our findings from the case studies we conducted in various communities across the nation. The case studies provided us insight into practices that communities have employed to encourage providers to offer services in their communities, which we detail in the "Best Practices" section of this report. Finally, we discuss industry and analyst assessments of investment and deployment.

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[13] See Public Utility Law Project comments at 5-6 (businesses, hospitals, schools, libraries and museums may choose to locate in low-income neighborhoods only if they can transmit as well as receive data at high-speeds).

[14] *First Report*, 14 FCC Rcd at 2406-2407 (advanced telecommunications capability must be two-way and switched, but upstream and downstream paths need not be in the same self-contained offering; advanced telecommunications capability includes facilities that have been upgraded or otherwise altered in ways that make them capable of high-speed bandwidth).

[15] *Id*. at 2407-2408.

[16] Commercial Internet Exchange comments at 4.

[17] We may also elaborate the definition of advanced telecommunications capability to include maximum allowable amounts of latency, delay and packet loss. Two-way video conferencing, for example, could be degraded to a significant degree if a certain technology or congestion in a network introduced a one-second delay in the exchange of video or audio signals.

A. Overview of the Networks Used to Provide Advanced Services

16. Advanced services are provided using a variety of public and private networks that rely on different network architectures and transmission paths. Some of these networks, like the Internet, are public in the sense that access to the network is open to all users. Other networks, like those built and maintained by corporations for their internal use, are private in the sense that access to the network may be restricted to a particular class of users, often the corporation's employees. Moreover, depending on the network, data may travel from the sender to the recipient over various architectures and transmission paths such as copper wire, cable, terrestrial wireless radio spectrum, satellite radio spectrum, or a combination of these and other media. In addition, data may be transmitted using different communications protocols that manage and direct traffic at different layers of a particular network.[18]

17. Although advanced services are provided over myriad combinations of public and private networks using a variety of transmission paths and protocols, for the purposes of this report we focus on the physical components of the network infrastructure. For simplicity, we have divided network infrastructure into four general categories: backbone, middle mile, last mile, and last 100 feet.[19] In addition, we refer to the points of connection between these components of the network as connection points.

18. In conceptualizing the categories of network infrastructure identified above, we find it helpful to analogize network infrastructure to a system of roads. In our simplified analogy, each of the categories corresponds to a different type of road:

> Backbone -- Multi-lane Interstate Highway: Backbone provides a long-distance, high-capacity, high-speed transmission path for transporting massive quantities of data, much like the way a large multi-lane interstate highway allows large amounts of traffic quickly to travel long distances. Most backbone consists of fiber optic lines, either buried in the ground or laid under the sea. In addition, backbone can be provided using satellite systems and radio spectrum.
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> Middle Mile -- Divided Highway: As its name suggests, middle mile facilities provide relatively fast, large-capacity connections between backbone and last mile, similar to the way a divided highway may connect local roads to multi-lane interstate highways. Middle mile facilities can range from a few miles to a few hundred miles. They are often constructed of fiber optic lines, but microwave and satellite links can be used as well.

[18] For instance, the Internet Protocol (Transmission Control Protocol/Internet Protocol suite) supports interconnections across any physical transport medium, including wireline, terrestrial wireless and satellite, at various rates, and can support various applications. Other transmission protocols such as asynchronous transfer mode (ATM) or frame relay exist within other networks capable of supporting advanced telecommunications capabilities.

[19] These four network components are useful for organizing our analysis; however we recognize that because of the wide variety of network architectures and transmission media that deliver advanced telecommunications capabilities, some of these categories may overlap or be absent in a specific situation. Additionally, we note that the pictures and maps in this report depict logical and symbolic simplifications of the extremely complex and dynamic interconnections that support advanced telecommunications capabilities and services.

Last Mile -- Local Road: The last mile is the link between the middle mile and the last 100 feet to the end-user's terminal. The last mile is analogous to the local road between a larger, divided highway and a traveler's driveway. A last mile with advanced telecommunications capability provides speeds in excess of 200 kbps in each direction. Last miles may consist of cable modem service, digital subscriber line (DSL) service, terrestrial wireless service, or satellite service. Some last-mile segments -- for example those on certain cable systems -- provide faster downstream speeds than upstream speeds either because their network configurations will not support the higher upstream speed or because they rely on a telephone return path.

Last 100 Feet -- Driveway: The last 100 feet is the link between the last mile and the end-user's terminal, which is similar to the way a driveway connects a traveler's home or office to a local road. The last 100 feet includes the in-house wiring found in a consumer's residence, the wiring in an apartment or office building, the more complex wiring in a wireline local area network, or the wireless links in a local wireless network.

Connection Points -- Intersections, On-Ramps, and Interchanges: Connection points are the places at which the various components of the network interconnect, often with the aid of an electronic or optical device (e.g., switches and routers between the middle mile and backbone), so that data can move across the network. Connection points are analogous to the intersections, on-ramps, and interchanges between local roads, divided highways, and multi-lane interstate highways.

B. Components of the Network

19. In this section we examine each of the components of the network described above, both in terms of the technology used and the types of entities providing these components. We focus particularly on the last mile because it is a critical link between existing backbone and middle mile infrastructure on the one hand and the last l00 feet to the end-user's terminal on the other hand. In examining each component of the network, we also attempt to identify any major technological barriers to deployment of advanced telecommunications capability.

1. Backbone Facilities

20. At the core of the physical infrastructure supporting advanced telecommunications capabilities are nationwide backbone transport facilities.[20] Much of the terrestrial fiber optic backbone in this country has been constructed along public rights of way created for railroad, telephone, and electric-utility owned companies. Providers have created additional backbone capacity in the form of undersea cables and satellite systems.

21. National backbone transport providers in the United States include large nationwide providers such as AT&T, WorldCom and Sprint and a number of smaller facilities-

[20] In this report we use the term backbone to refer to high-speed physical transport. Our use of the term is broader than, and distinguishable from, an Internet backbone that uses interstate transport networks to transport Internet traffic.

based transport providers, as depicted on the following map, Figure 1.[21] There are an additional 35 to 50 wireline, terrestrial wireless and satellite-based national Internet backbone providers, with varying amounts of physical facilities.[22] The major Internet backbone providers transport traffic with capacity ranging from approximately 155 Mbps to over 10 Gbps (OC-3 to OC-192 equivalent speeds).[23]

22. Although the cost of building and maintaining backbone facilities is high, there do not appear to be significant technological barriers to deployment of these facilities. To date, advances in fiber optic and microwave technologies have allowed backbone capacity to keep pace with demand for backbone facilities.[24] While backbone capacity does not appear to present a barrier to deployment of advanced telecommunications capability at this time, the ability to access that capacity presents other questions which are addressed later in this section.

2. Middle Mile Facilities

23. Middle mile facilities provide transport or routing from last mile aggregation points in order to interconnect and exchange traffic with national backbone providers or directly with other middle mile networks. It appears that most fiber optic, middle-mile facilities, like backbone, exist along public rights of way.[25] Other middle miles include fixed wireless and satellite links.[26]

[21] KMI Corp., *North American Fiberoptic Long-Haul Routes Planned and in Place*, May 2000. Copyrighted. Permission to reproduce paper copies obtained from KMI. No electronic reproduction permitted.

[22] Boardwatch Magazine's Directory of Internet Service Providers, Introduction to the Directory of Internet Service Providers (1999) (visited July 25, 2000) <http://boardwatch.Internet.com/isp/summer99/introduction.html> (listing 44 Internet backbone service providers); National Telecommunications and Information Administration & Rural Utilities Service, *Advanced Telecommunications in Rural America: The Challenge of Brining Broadband Service to All Americans* < http://www.ntia.doc.gov/reports/ruralbb42600.pdf> at 8 (Apr. 2000) (*NTIA/RUS Report*).

[23] Boardwatch Magazine's Directory of Internet Service Providers, Introduction to the Directory of Internet Service Providers (1999) (visited July 25, 2000) <http://boardwatch.Internet.com.isp.html>; *Hubs and Spokes: A Telegeography Internet Reader*, TeleGeography, Inc., (2000)

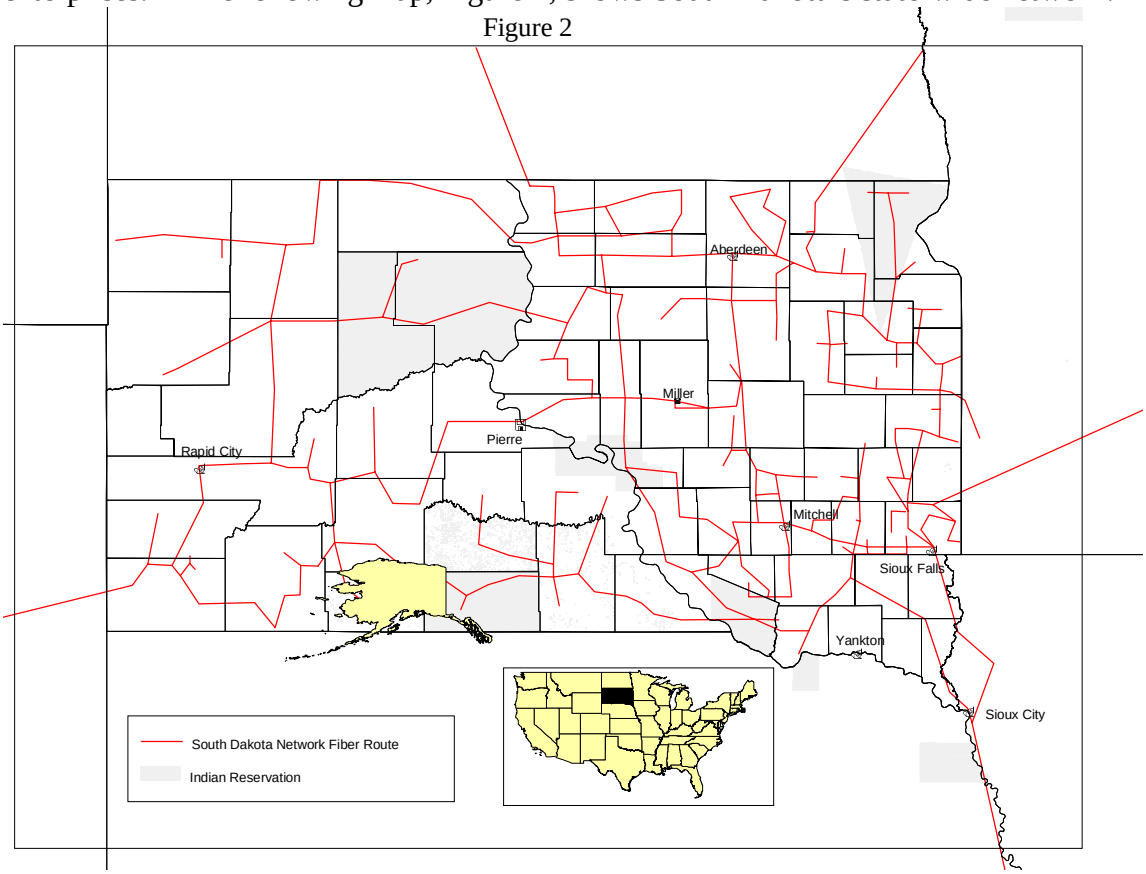
[24] *See, e.g.*, Price Waterhouse Coopers, *Technology Forecast: 2000, Carrier Backbone Transmission Networks* at 452-63 (2000).

[25] In a recent study, NECA suggests construction of additional transport facilities across private property, including farm land, significantly increases the cost of construction. NECA Rural Broadband Cost Study, 2000 (visited Aug. 1, 2000) <http://www.neca.org/broadban.asp>.

[26] *See* AT&T comments at 19-21; *NTIA/RUS Report* at 9.

24. Many middle mile facilities were originally built by telephone and cable companies for ordinary telecommunications or cable television services. For example, the fiber optic connections that transport telephone traffic between telephone company central offices can be considered middle mile facilities. Additional examples of middle mile networks include statewide networks such as the fiber optic network in South Dakota and numerous regional commercial enterprises.[27] The following map, Figure 2, shows South Dakota's state-wide network.

Figure 2

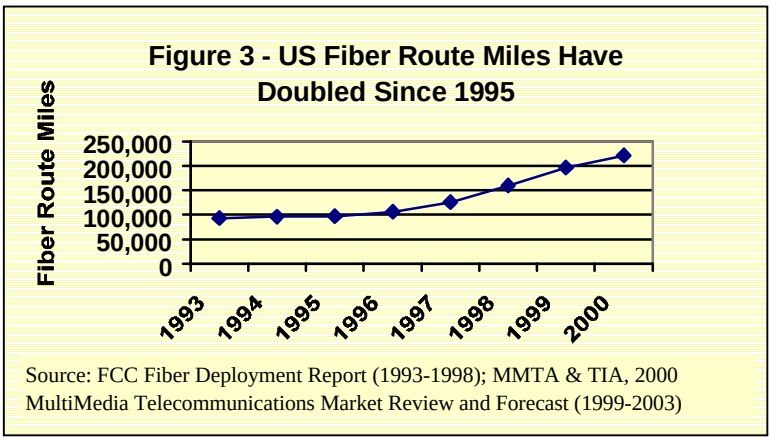


25. Many providers of middle mile transport lease capacity on their networks to non-facilities based Internet service providers (ISPs) and high-speed providers, who find the transport speeds adequate to meet their needs. For example many local exchange carriers (LECs) currently lease the fiber or high-speed lines connecting their central offices. Most cable systems also have fiber or satellite transport facilities to regional and national backbone, which they may lease to other providers. In addition, there are entities known as Global Service Providers providing interLATA transport service.[28]

[27] Examples of regional commercial networks include: Electric Lightwave, with an OC12 trunk in the Pacific Northwest; CapRock Communications, which connects second tier communities in Texas; and the recently formed America's Fiber Network, a consortium of energy and telecom companies that promises to provide transport facilities to the nations Tier 2 and Tier 3 cities. *See* Electric Lightwave (visited July 25, 2000) <http://www.eli.net>; America's Fiber Network *ex parte* (June 28,2000); America's Fiber Network, *Is the Digital Divide a Mirage?*, 5/1/2000 at 42, (2000).

[28] *See T-NETIX* (visited July 25, 2000) <http://www.uswest.com:80/ps/gsp.html> (for information about US West's Global Service Provider).

26. As demand for middle mile facilities has increased, existing providers and new providers have deployed additional facilities. As Figure 3 demonstrates, in the past five years, the amount of fiber miles deployed in the United States has doubled.[29] Interexchange carriers, incumbent and competitive local exchange carriers, cable television companies and others, including fixed wireless service providers, have invested enormous amounts of money into construction of fiber facilities.[30]



27. We noted in the *First Report* that high capacity fiber connects to almost every local exchange carrier central office.[31] Indeed, significant amounts of unused high capacity fiber, typically referred to as dark fiber, exist within the fiber conduit connecting local exchange carrier central offices.[32] In part because of the lack of ubiquitous alternative middle mile transport, we recently determined that interoffice dark fiber transport qualified as an unbundled network element.[33] This determination allows competitive carriers access to interoffice dark fiber.[34]

3. Last Mile Facilities

28. Last mile facilities provide the connection between middle mile facilities and the last 100 feet to an end-user's terminal. While all components of the network play important roles in the delivery of advanced services, we focus particular attention on the deployment of last mile

[29] Fiber miles are the sum of the number of miles of each cable multiplied by the number of fiber strands in each cable; this includes both lit and unlit strands. *Fiber Deployment Update, End of Year 1998*, FCC, Industry Analysis Division (visited July 25, 2000) <http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/Fiber/fiber98.pdf> (FCC Fiber Deployment Update, 1998).

[30] Multimedia Telecommunications Ass'n & Telecommunications Industry Ass'n, *2000 MultiMedia Telecommunications Market Review and Forecast*, *Fiber Optic Spending*, at 67 (2000).

[31] *First Report*, 14 FCC Rcd at 2417 ("High-capacity fiber goes into almost every telephone central office in this country, and new Dense Wave Division Multiplexing technology will increase its capacity hugely.")

[32] The local exchange carriers that serve about 90% of local customers had, at the end of 1999, a total of 10.2 million fiber miles of dark fiber. The vast majority of this was between central offices. *See ARMIS Report* (visited July 25, 2000) <http://gullfoss.fcc.gov:8080/cgi-bin/websql/prod/ccb/armis1/forms/43-08/frame1a.hts>.

[33] *Implementation of the Local Competition Provisions of the Telecommunications Act of 1996*, Third Report & Order & Fourth Further Notice of Proposed Rulemaking, 15 FCC Rcd 3696, 3853 (1999) (*Dark Fiber Order*) ("a competitive wholesale market for alternative network elements has not developed for dedicated transport, in part because of the lack of ubiquitous transport alternatives.") *petitions for reconsideration & appeal pending*.

[34] *Dark Fiber Order*, 15 FCC Rcd at 3772, 3376, 3785-86 ("interoffice transport"), 3843-45 ("we modify the definition of dedicated interoffice transport to include dark fiber"), 3852-55.

facilities because they are often the missing link in communities that do not have access to advanced telecommunications capability. The last mile connection to the end-user can take the form of cable modem service, digital subscriber line service (DSL) or some other LEC-provided service, terrestrial wireless service, or satellite service. Some operators of last mile facilities, like cable providers, transport data entirely over facilities that they own. Others, including many terrestrial wireless providers, lease transport to regional and/or national connection points from local exchange carriers. Last mile facilities called very small aperture terminals (VSATs) may also use satellite links to transport traffic to middle mile facilities or directly to the national backbone networks.[35] In the sections that follow, we examine each of the four major technologies used to provide last mile facilities: cable modem service, DSL and other LEC-provided services, terrestrial wireless, and satellite service. We discuss the types of entities that provide these last mile facilities, from the technology used to deliver advanced services and subscribership rates, to their investments in infrastructure and analysts' forecasts, as well as the significant technological barriers to deployment of each technology.

a. Overview of Cable Modem Service

29. Cable companies offer advanced services, most notably high-speed Internet access services, using cable modem technologies. Cable modem technologies rely on the same basic network architecture used for many years to provide multichannel video service, but with upgrades and enhancements to support advanced services.[36] The typical upgrade incorporates what is commonly known as a hybrid fiber-coaxial (HFC) distribution plant. HFC networks use a combination of high-capacity optical fiber and traditional coaxial cable.[37] Most HFC systems utilize fiber between the cable operators' offices (the "headend") and the neighborhood "nodes." Between the nodes and the individual end-user homes, signals travel over traditional coaxial cable infrastructure. These networks transport signals over infrastructure that serves numerous users simultaneously, i.e., a shared network, rather than providing a dedicated link between the provider and each home, as does DSL technology. As discussed below, the shared architecture of cable networks poses certain challenges for providers that seek to offer high-speed Internet access or other advanced services over cable infrastructure.

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[35] Very small aperture terminals or "VSATs" are small earth stations or antennas usually designed to operate in the Ku satellite band that are installed at a user location to allow two way communications via satellite. In addition to providing point to multipoint data network services to merchants to transmit credit card, inventory management and other business related data, VSATs are used for distance training and high speed intranet and Internet access.

[36] As noted in the *First Report*, our inclusion of cable modem technology in our assessment of advanced telecommunications capability does not implicate any determination by this Commission as to whether cable services constitute telecommunications services.

[37] HFC networks can be composed of any combination of fiber and coaxial cable. The most common architecture is fiber to the node (FTTN) which involves a fiber cable to each cluster of subscriber homes or neighborhood, where the optical signal is converted for coaxial cable for delivery to individual homes. Less common architectures include fiber to the curb (FTTC) where a single strand typically serves between 8 and 16 homes, and fiber to the home (FTTH) where each individual home has its own fiber termination point. *See* Texas A&M University, Department of Computer Science (visited July 25, 2000) <http://www.cs.tamu.edu/people/jhamann/hfc/node3.html>.

30. Before offering high-speed Internet and other two-way high-speed services, most cable providers upgrade their networks.[38] This process often includes extending optical fiber closer to the end-user and improving system quality to reduce signal leakage.[39] Through this upgrade process, cable operators typically increase the system's transmission capacity to 550 MHz or 750 MHz, which allows the operator greater flexibility in allocating bandwidth for two-way high-speed services without reducing the capacity available for existing video services.[40]

31. Upgrading a system for high-speed Internet service typically requires installation of equipment that enables the transmission of digital data packets: routers, switches, and a cable modem termination system. Further, to allow the high-speed transmission of data over the cable infrastructure in both the upstream and downstream directions, operators install amplifiers and optical lasers in both directions. Without such equipment, providers typically can provide high-speed service only in the downstream direction and must rely on a telephone line return path. Once an HFC network is upgraded, new services are available to all homes passed by the upgraded infrastructure. This contrasts with DSL technologies, where variations in legacy outside plant conditions can limit access to certain end-users even in upgraded areas, and with wireless technologies where line-of-sight requirements may be a factor.

32. Many cable systems providing high-speed data services offer asymmetric service, as the great majority of available bandwidth is allocated for downstream transmissions. The limited remaining bandwidth available for the return path results in lower upstream speeds. Most systems' upstream capacity appears to be sufficient to support current consumer demand for established services such as web surfing. In some instances, however, this asymmetric service may not offer sufficient upstream speed to qualify under our definition of advanced telecommunications capability. As consumers use applications with higher upstream requirements such as video conferencing, cable operators may need to allocate greater network capacity for upstream transmission.

33. Under optimal conditions, and using the best available technology, an upgraded cable system can provide maximum downstream speeds of 27 Mbps and maximum upstream speeds of 10 Mbps, more than sufficient to qualify as advanced telecommunications capability.[41] In practice, however, cable transmission speeds typically range from several hundred kilobits per

[38] Cable operators are struggling to meet consumer demand for high-speed residential Internet access. *See e.g.*, Richard Bilotti, Benjamin Swinburne, Morgan Stanley Dean Witter, *Broadband Industry Update – The Time to Buy Selectively* at 3 (2000). One analyst notes that sufficient labor appears to be in place to accommodate the upgrade schedules of the major cable operators. *See* Stanford C. Bernstein & Co. and McKinsey & Co., Inc., *Broadband!* at 71 (2000) (Bernstein/McKinsey, *Broadband!*).

[39] Signal leakage can result in either lost data or the transmission of unusable data. Digital signals are composed of discrete packets of information and carry error-correcting codes that can regenerate any lost data. If these error-correcting codes are lost due to system leaks, the packets may not be transmitted accurately or may be re-assembled incorrectly at the receiving end.

[40] Operators typically devote approximately 90% of their system capacity to traditional video services. Bernstein/McKinsey, *Broadband!* at 39.

[41] *See Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, CS Docket No. 99-230, Sixth Annual Report, 15 FCC Rcd 978, 1004, ¶ 56 (2000) (*1999 Video Competition Report*). In most cases, however, cable operators offer a maximum theoretical downstream capacity of 10 Mbps.

second to 1.5 Mbps. The lower speed is attributable to several factors. First, because of the shared architecture of cable networks, the bandwidth – and consequently the speed – available to any single user drops as the number of simultaneously active users increases.[42] Second, a system's transmission speed is affected by the proportion of capacity devoted to advanced services. Third, congestion on the Internet itself often limits the speed of access to well below 10 to 27 Mbps. Given these limitations on system throughput, cable operators typically offer a "maximum speed available" rather than a guaranteed stable speed of service.

34. High-speed Internet access over cable is available primarily to the residential market.[43] Several factors may explain this. First, cable operators historically have deployed facilities for video services to the residential market. This leaves them poorly situated to offer service to many business districts. Second, cable's shared network architecture makes it difficult for providers to guarantee the consistent high speeds and secure transmissions that some business customers require. Third, the relatively narrow bandwidth typically allocated to upstream transmission renders cable unable to provide upstream speeds and symmetric transmission capabilities sufficient to support the requirements of some business customers.[44]

b. Overview of Digital Subscriber Line Service

35. Since 1996, local telephone carriers have offered consumers high-speed data service through their digital subscriber line (DSL) service offerings. With the addition of certain electronics to the telephone line, carriers can transform the copper loop that already provides voice service into a conduit for high-speed data traffic. While there are multiple variations of DSL, some of which we discuss below, most DSL offerings share certain characteristics. With most DSL technologies today, a high-speed signal is sent from the end-user's terminal through the last 100 feet and the last mile (sometimes a few miles) consisting of the copper loop until it reaches a Digital Subscriber Line Access Multiplexer (DSLAM), usually located in the carrier's central office. At the DSLAM, the end-user's signal is combined with the signals of many other customers and forwarded though a switch to middle mile facilities.

36. The most common form of DSL used by residential customers is asymmetric DSL, or ADSL.[45] As its name suggests, ADSL provides speeds in one direction (usually downstream) that are greater than the speeds in the other direction.[46] Many, though not all, residential ADSL offerings provide speeds in excess of 200 kbps in only the downstream path with a slower

[42] *See 1999 Video Competition Report*, 15 FCC Rcd at 1004, ¶ 56.

[43] *See infra* para. 0; Jeff Camp, Richard Bilotti, Simon Flannery, and Mary Meeker, Morgan Stanley Dean Witter, *The Broadband Report - Reaping What You Sow: ROI in the Broadband Market* at 13 (2000) (Morgan Stanley Dean Witter, *Broadband Report*).

[44] Morgan Stanley Dean Witter, *The Broadband Report* at 12.

[45] In using the acronym "ADSL," we are referring generally to DSL service that is asymmetric, not the specific protocol ADSL.

[46] AT&T reply comments at 3; Bell Atlantic comments at 4; GTE comments at 9; NTCA comments at 3.

upstream path and thus do not meet the standard for advanced telecommunications capability.[47] However, ADSL permits the customer to have both conventional voice and high speed data carried on the same line simultaneously because it segregates the high frequency data traffic from the voice traffic. This segregation allows customers to have an "always on" connection for the data traffic and an open path for telephone calls over a single line. Thus a single line can be used for both a telephone conversation and for Internet access at the same time. A survey of various LEC web sites indicates that prices for low-end ADSL service typically range from $39.95 to $49.95 per month. Faster ADSL services ranged from $99.95 to $179.95 per month. Installation fees ranged from free, typically where customers are offered "DSL in a box,"[48] to $99.95, where a technician visit is necessary to install premises equipment.

37. In contrast to ADSL, symmetric DSL (SDSL) provides users with equal speeds in the downstream and upstream path, usually in excess of 200 kbps. Because of the symmetrical nature of SDSL, it is well-suited to applications that require high-speed capacity in the upstream path, such as videoconferencing. Because of its higher capacity needs, SDSL service typically requires a dedicated copper pair for its high-speed data transmissions. The price of SDSL service currently ranges from $150 to $450 per month, with installation costs ranging from free to $1550, and equipment costs from $225 to $360, depending on the transmission speed desired and the equipment purchased.[49]

38. DSL service is subject to certain limitations that currently prevent it from being deployed as a last mile facility to all potential end-users. First, it is distance sensitive. Currently, an ADSL customer must be within approximately 18,000 feet of the carrier's central office; SDSL customers must be between 10,000 and 12,000 feet of the central office depending on the speed of the service in question.[50] Eighty percent of the subscriber loop plant falls within these distance limitations,[51] and thus is capable of supporting DSL service, but this factor remains an impediment to DSL deployment in more sparsely populated and remote locations. New technologies may allow DSL deployment at substantially greater distances.[52]

39. The second factor limiting the deployment of DSL to some potential customers is the presence on their loops of load coils and bridged taps, devices that were used to enhance the quality of voice traffic over the copper. While they improve the quality of voice transmission,

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[47] Depending on the configuration of the ADSL technology deployed by the carrier, rates ranging from 1.544 Mbps to 6.1 Mbps can be achieved in the downstream path, and rates ranging from 90 kbps to 640 kbps may be achieved in the upstream path.

[48] "DSL in a box" is a form of ADSL in which the provider sends the customer filters and a modem that the customer installs. By having the customer install these filters, the provider avoids sending a technician to the customer's premises, thus reducing the time and cost associated with establishing ADSL service.

[49] Based on a survey by Commission staff of SDSL service offering posted on the Internet.

[50] As distance from the telephone company's central office decreases, the potential data rate increases.

[51] *General Introduction to Copper Access Technologies*, (visited Aug. 1, 2000) <http://www.adsl.com/general_tutorial.html>.

[52] AT&T comments at 11 ("Next generation Digital Loop Carrier deployed using fiber distribution facilities to the central office makes DSL throughput virtually independent of customer distance from the central office").

these devices prevent the deployment of DSL service over a line on which they are installed. Thus, in contrast to an upgraded cable network, which can offer upgraded service to all homes it passes, LECs must "condition" each end-user's line by removing the load coils and bridged taps while increasing the strength of the signal to maintain the quality of the line's voice traffic. Moreover, older loops or loops in need of maintenance, which may occur in poor or inner-city areas, pose additional problems for the deployment of DSL service. Frayed insulation or poorly spliced loops can cause signal leakage, which can result in poor quality transmission.

40. A third factor that impedes DSL deployment is the choice by some incumbent local exchange carriers to abandon copper wire and instead deploy Digital Loop Carrier (DLC) in their networks. DSL service is incompatible with most currently deployed DLC systems. However, it appears that new DLC products will allow DSL providers to circumvent this limitation.

c. Overview of Other LEC-Provided Wireline Services

41. In addition to DSL offerings, many local exchange carriers offer more traditional high-speed, circuit switched services like T1 lines, which have been available for some time. The monthly charge for T1 service can range from $450 to $2000, with installation cost ranging from $750 to $5500, depending on the transmission speed desired and equipment purchased.[53] Additionally, local exchange carriers have used fiber technology for many years for their interoffice plant. It is also used to deliver signals at speeds in excess of 45 Mbps directly to certain large business customers. Most residential and smaller business customers currently do not need the transmission speed of fiber, and the cost of fiber service generally makes it prohibitive for all but the largest users. Several fiber-based residential architectures have been devised[54]; however, the high cost associated with deploying this technology makes it economically viable, if at all, only in the most densely populated of residential settings.[55]

d. Overview of Fixed Wireless Service

42. Wireless services and technologies have the potential to deliver high-speed services to residential, rural, and otherwise underserved areas and to increase competition in the last mile in the near future. As discussed below, fixed wireless technologies may offer unique advantages and quick-to-market solutions for the delivery of high-speed services in a number of circumstances.[56] At present, however, technical limitations may constrain the breadth of their

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[53] Based on a survey by Commission staff of T1 service offerings posted on the Internet.

[54] SBC's "Project Pronto" is an architecture that is focusing on residential customers and pushes fiber closer to the end-user in an effort to offer high-speed access to a larger number of customers in its service areas. SBC comments at 3. *See also SBC's New Broadband Neighborhood Network* (visited August 1, 2000) <http://www.sbc.com/Technology/data_strategy/project_pronto/dsl.html>.

[55] For instance, SBC estimates it will take an investment of over $6 billion to achieve its planned network conversions. *See SBC Announces Supplier for Broadband Network Project* (visited Aug. 1, 2000) <http://www.sbc.com/News_Center/Article.html?query_type=article&query=19991103-04>.

[56] While the future of wireless high-speed services likely will include mobile service, it does not appear from our recent Broadband Survey that any providers currently are offering mobile data service at a speed that comports with the our definition of high-speed. No provider that met our 250 high-speed line (or wireless channel) (continued….)

overall deployment and their effectiveness in certain settings. At this point, many of these services are in an earlier stage of deployment than the traditional "wired" services, cable-modem and DSL technology, but significant growth is anticipated over the next three to five years, potentially leading to service to millions of households.

43. In a fixed wireless system that provides high-speed services to consumers, a provider generally attaches to a customer's premises a radio transmitter/receiver (transceiver) that communicates with the provider's central antenna site. The central antenna site then acts as the gateway into the public switched telephone network or the Internet for these transceivers. The radio signals that travel over this network architecture serve as a substitute for the copper wire or cable strand that connects customers to the network in traditional, wired technologies.

44. Providers of fixed wireless services typically can deploy their networks much more quickly and with substantially less expense than is required to build a network capable of supporting either cable-modem or DSL service. First, wireless networks are free of the substantial costs associated with installing and maintaining wires that run to a customer's premises.[57] These savings make wireless technology especially well suited to deployment in many rural areas, where substantial distances between customers may be cost-prohibitive for wireline technologies. Wireless technologies may also serve as an economic alternative in urban areas where consumers are not otherwise served by certain forms of wireline technologies. For example, only a small percentage of multi-tenant office buildings are currently served by fiber networks. Thus, fixed wireless services may make high-speed access more affordable for those small and medium-sized businesses for which direct fiber connections remain too expensive.

45. Second, the relative ease of installation of this technology allows wireless providers to deploy their networks much more quickly than is possible for providers that must actually install wires leading to each customer's premises. This permits wireless providers to respond rapidly and dynamically to developing demand for advanced telecommunications capability.

46. Third, the architecture of a wireless network allows providers to roll out their facilities in a manner more closely related to the product demand they encounter. A traditional wired provider often will install the network infrastructure in an entire area before it begins to market its service in that area. Thus, a cable provider will upgrade its cable plant throughout a neighborhood when it begins to offer advanced telecommunications service to the neighborhood's residents even if initial subscription rates are low. Similarly, a DSL provider likely will make certain network investments in an area where it intends to offer service before it signs up its first customer. By contrast, once a wireless provider has installed its antenna in an area, it completes the last-mile connection by installing an on-premises transceiver only for those customers who have actually subscribed to its service. This incremental build-out process allows wireless

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threshold reported delivering high-speed service over mobile wireless technology. Nor do industry analysts report that any provider is offering such service. Accordingly, we discuss only fixed wireless offerings in this report.

[57] *Implementation of Section 6002(b)of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services*, Fourth Report, 14 FCC Rcd 10145, 10267 (1999) (*Fourth Report*).

providers to avoid much of the up-front investment that traditional wired advanced telecommunications capability providers must make.

47. Although wireless services can generally be deployed more rapidly and at lower cost than comparable wireline services, they remain subject to certain technical limitations that may reduce their effectiveness in certain areas and for certain purposes. For example, in addition to requiring access to telecommunications equipment closets and any necessary in-building wiring, wireless providers often must obtain access to rooftops for the placement of antennas. This can become particularly problematic in the case of multi-tenant buildings, in which a building owner may resist permitting access. Also, many, though not all, fixed wireless technologies are subject to line-of-sight restrictions. Thus, there must be an unobstructed path from a wireless provider's antenna to the customer's antenna on the rooftop of a building. While certain advances in wireless technology may help to overcome this limitation in the future, buildings, topographical features, certain adverse weather conditions, and even vegetation can interfere with the provision of service.

48. While physical infrastructure costs of wireless networks may be significantly less than wireline networks, wireless networks require access to spectrum. Some of the wireless systems providing high-speed services today obtained free spectrum licenses and other providers obtained spectrum through auctions.[58] The explosive growth in recent years of wireless networks has created substantial demand for spectrum. New wireless and satellite services are increasingly constrained by spectrum scarcity and encumbrances,[59] which may result in substantial additional acquisition costs in the future.

49. There are several different bands of spectrum over which wireless providers offer their services. The characteristics of the service, their means of deployment, and the service's potential technical limitations all vary somewhat over the different spectrum bands. Accordingly, we briefly discuss each separately below.

50. The Upperbands (above 24 GHz). The technologies deployed in the "upperband" spectrum generally provide data rates of up to 155 Mbps, a speed adequate to support a host of multimedia applications.[60] As a general matter, wireless services in the upperbands may suffer signal loss in adverse weather conditions. However, by adjusting factors such as cell size and transmission power, these systems can be engineered to the standard reliability level for telecommunications networks. Fixed wireless technologies operating in these bands have

[58] Spectrum licenses have garnered nearly $24 billion in winning bids since the Commission received authority to auction spectrum, with spectrum capable of providing high-speed terrestrial services receiving bids over $1.2 billion. *FCC Wireless Telecommunications Bureau AuctionTopics, General Auction Data, Summary Matrix* (visited July 28, 2000) <http://www.fcc.gov/wtb/auctions/Welcome.html>.

[59] *See Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium*, Policy Statement, 14 FCC Rcd 19,868 (1999) (*Spectrum Reallocation Policy Statement*).

[60] The upperbands of spectrum include those with frequencies of 24 GHz and above. The largest commercial deployment of wireless high-speed systems has occurred in the 24 GHz (formerly known as Digital Electronic Messaging Service or "DEMS"), 28 GHz (Local Multipoint Distribution Services or "LMDS"), and 39 GHz bands.

relatively small cell sizes, with an average cell radius of between three and five miles. Also, since upperband signals behave more like visible light than cellular or PCS signals, wireless networks deployed in these spectrum bands require a clear line of sight between transmitters and receivers. Terrain, buildings, and even vegetation may interfere with the provision of service.[61]

51. The Lowerbands (below 3 GHz). *MDS.* Fixed wireless high-speed is currently provided by multipoint distribution service (MDS) in the 2 GHz range.[62] MDS was originally a video programming service. More recently, MDS providers have been shifting their business focus to providing high-speed Internet access, including two-way service.[63] The downstream Internet speeds reported by MDS operators range from 750 kbps to 11 Mbps. Until recently, upstream transmission often relied on a telco-return and consequently was much slower.

52. MDS transmissions have a substantially greater radius than upperband fixed wireless services, generally 25 to 35 miles versus three to five miles for upperband services. This is partly because MDS signals do not degrade in adverse weather conditions. MDS's larger radius makes the service well suited for not only urban and suburban residential customers, but also customers in rural, underserved, and unserved areas, where the larger cell-size substantially reduces the cost of providing service.[64] MDS typically has functioned best with a direct line of

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[61] The most significant operators in the upperbands are Teligent, Inc. and WinStar Communications, Inc., both of which are currently targeting business customers. In 1999, WinStar's wireless network expanded to sixty domestic markets, up from thirty at the end of 1998. *WinStar Reports Fourth Quarter Results; Revenue, Gross Margin and EBITDA Continue Sharp Improvement*, Press Release, WinStar Communications, Inc. (Feb. 10, 2000). With this coverage, WinStar claims to be able to reach more than 292 million people. WinStar, *WinStar Communications Gets FCC OK for Added Spectrum*, Press Release WinStar Communications, Inc. (Mar. 22, 2000). By the end of 1999, it claimed 23,000 customers, 618,000 lines, and access rights to more than 8,000 buildings. *WinStar Reports Fourth Quarter Results; Revenue, Gross Margin and EBITDA Continue Sharp Improvement*, Press Release, WinStar Communications, Inc. (Feb. 10, 2000).

In 1999, Teligent completed its plan to roll out service in forty U.S. markets, covering more than 100 million people. *Teligent Reports $31 Million In 1999 Revenue; Expands Reach To Four Continents*, Press Release, Teligent (Mar. 6, 2000). At the end of 1999, Teligent claimed more than 15,000 customers, 166,000 lines and access rights to more than 7,500 buildings. *Id.*

In addition to these two providers, at least five other wireless carriers are in the process of testing or rolling out their service in more limited numbers of markets: NEXTLINK; Advanced Radio Telecom, Inc.; SPEEDUS.COM; Highspeed.com L.L.C.; and Touch America, a wholly owned subsidiary of the Montana Power Company. *Implementation of Section 6002(b)of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions with Respect to Commercial Mobile Services*, Fifth Report, FCC 00-289, at App. E (rel. Aug. 3, 2000) (*Fifth Competition Report*).

[62] The Multipoint Distribution Services (including multichannel multipoint distribution service and the instructional television fixed service) operate in the 2000-2700 MHz bands. 47 C.F.R. § 21.900 *et.seq.*; 47 C.F.R. § 74.901 et seq. As of the end of 1999, there were at least nine MDS companies offering high-speed Internet access. *See infra* note 142.

[63] *See Request for Declaratory Ruling on the Use of Digital Modulation by Multipoint Distribution Service and Instructional Television Fixed Service Stations*, 11 FCC Rcd 18839 (1996); *Amendment of Parts 21 and 74 to Enable Multipoint Distribution Service and Instructional Television Fixed Service Licensees to Engage in Fixed Two-Way Transmissions*, Report and Order, 13 FCC Rcd 19112 (1998), *Order on Reconsideration*, 14 FCC Rcd 12764 (1999).

[64] Sprint comments at 4, 7; Wireless Communications Ass'n Int'l comments at 3; WorldCom comments at 11-12. Homes and offices in Phoenix can subscribe to Sprint's high-speed MDS service for $39.95 per month. *See* (continued….)

sight between the transmitter and the receiver. However, recent technological developments may help to overcome this restriction.[65]

53. *Broadband PCS.* Although cellular and broadband Personal Communications Services (PCS) spectrum technically can support high-speed services, relatively few licensees are currently using their frequencies in this manner. The primary offering in that spectrum is AT&T's Project Angel system, which uses broadband PCS spectrum[66] to reach homes and small businesses outside of AT&T's cable television systems.[67] AT&T maintains that it plans to price its high-speed data offering at a substantial discount to the competing ADSL offering. In particular, AT&T announced at the end of 1999 that it plans to charge residential customers $29.95 per month for a high-speed (1 Mbps) fixed wireless access line in the Dallas/Ft. Worth area.[68] According to AT&T, this compares with a $39.00 monthly charge for an access line (256kbps) plus a $12.00 monthly charge for renting a modem in the case of ADSL.[69]

54. *Wireless Communications Service (2.3 GHz).* WorldCom is using Wireless Communications Service (WCS) spectrum[70] for the return path of certain high-speed Internet access service trials it is conducting.[71] AT&T also plans to use its WCS licenses for its fixed wireless service.[72] This year, BellSouth will begin testing one-way, high-speed Internet access

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Sprint Launches First Broadband Wireless Market in Phoenix, (visited May 16, 2000) <http://www3.sprint.com/Stemp/press/releases/200005/200005080990.html>.

[65] For example, in December 1999, Cisco released an MDS cellularization technology that captures signals as they bounce off buildings and other objects and redirects them to end-user transceivers. Cliff Edwards, *Cisco Hopes Advances New Wireless Technology Strategy for Internet*, AP NEWSWIRES, Dec. 2, 1999. At least two companies have announced plans to deploy this technology, known as Vector Orthogonal Frequency Division Multiplexing, this year. *Nucentrix Broadband Networks and Cisco to Deliver First VOFDM-Based Wireless Broadband Internet Services*, News Release, Nucentrix Broadband Networks, Feb. 4, 2000; *WorldCom Adds Dallas to 'Fixed Wireless' Service Trials*, News Release, WorldCom, Inc., Apr. 5, 2000. A start-up called NextNet, Inc. has also developed an end-to-end MDS system with a desktop customer-premises unit that requires no rooftop antenna and no inside wiring connections. NextNet, Inc., *Products* (visited Jan. 20, 2000) <http://www.nextnetworks.com/products_prod_bottom.html>.

[66] Broadband PCS services operate between 1850 and 2200 MHz.

[67] As initially deployed, the system permits two voice channels, data rates up to 512 kbps, and "always-on" Internet access. AT&T Corp., Form S-3, Feb. 2, 2000, at 60; *IPO Debut in 2000: AT&T to Launch Wireless Tracking Stock, Beef Up Fixed Wireless*, COMMUNICATIONS DAILY, Dec. 7, 1999. AT&T expected the service to be capable of four voice channels and speeds up to one Mbps by mid-year 2000, *id.* and anticipates a full-scale rollout in 2001. AT&T Comments at 17. Early this year, Project Angel was serving 200 customers in Dallas. AT&T Corp., Form S-3, Feb. 2, 2000, at 60.

[68] Lew Chakrin, AT&T Fixed Wireless, presented at 1999 Analysts' Meeting, December 6, 1999.

[69] Lew Chakrin, AT&T Fixed Wireless, presented at 1999 Analysts' Meeting, December 6, 1999.

[70] WCS service operates on the 2305-2320 MHz and 2345-2360 MHz bands.

[71] Wireless One, Form 10-K, Mar. 31, 1999. These trials are occurring in Baton Rouge, LA, Jackson, MS, and Memphis, TN.

[72] AT&T Corp., Form S-3, Feb. 2, 2000, at 53.

using WCS spectrum at a downstream speed of 1.5 Mbps.[73]

55. *Unlicensed spectrum*. A handful of companies across the U.S. use unlicensed spectrum in the 2 GHz and 5 GHz spread spectrum bands to offer short-distance high-speed Internet access and other high-speed services, such as wireless wide area network or local area network systems for businesses. As of April 2000, at least eleven companies were reportedly providing these services in twenty-three markets.[74] Unlicensed spectrum, which may be used without a license but is not protected from interference from other services, offers a low-cost means for smaller companies to enter the wireless high-speed market.[75]

e. Overview of Satellite Service

56. Satellite service provides another option for last mile facilities with its own set of unique characteristics. In most current residential satellite-based last mile facilities, only the downstream path is provided by satellite; the upstream path is often provided by a standard dial-up telephone connection. Thus, many current residential satellite offerings are capable of providing speeds in excess of 200 kbps only in the downstream path, and therefore do not meet the definition of advanced telecommunications capability.[76] Nonetheless, satellite-based last mile facilities may provide consumers and small businesses in geographically remote and sparsely populated areas with access to high-speed services that would not otherwise be available. Moreover, several satellite providers have announced plans to begin offering residential service with the downstream and upstream paths both provided by satellite.[77]

57. High-speed satellite service is currently provided to both residential and business customers. Much of the current business use is for bursty high-speed service and data communications such as credit card verification or inventory control. Most of this traffic apparently is handled under private contractual arrangements similar to private line service. A

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[73] *Mexico-U.S. Talks Heat Up on DARS Interference Concerns*, AUDIO WEEK, Apr. 24, 2000; *BellSouth Launching Trial to Cross Digital Divide*, WIRELESS TODAY, Dec. 10, 1999. BellSouth's trial will take place in Houma, LA. If trials are successful, BellSouth reports it will upgrade the system to two-way service. *Id.*

[74] *EMCEE Completes Equipment Installation for Sunbury Broadband's Wireless Internet System*, PR Newswire, Sept. 14, 1999; IJNT.net, Inc. Form 10KSB/A, Filed May 10, 2000; SkyLynx Communications, Inc., Form 10KSB, Filed Apr. 14, 2000; *United Online Web Page* (visited May 23, 2000) <http://www.uoli.com>.

[75] Many of the unlicensed operators are small start-ups, and some, such as SkyLynx, are local or regional ISPs that have added a fixed wireless offering for customers who demand high-speed access. Metricom is currently deploying its Ricochet2 service, which provides full Internet access, fixed or mobile, at an overall transmission rate of 128 kbps, in 21 markets. *See Watch 128 kbps Mobile Data Service Become a Reality* (visited May 23, 2000) <http://www.metricom.com/about/128kbps_progress.htm.>. Micro Design Systems provides high-speed wireless hand-held LAN computer system integration currently used by some brokerage firms. Micro Design Services, LLC (visited July 12, 2000) <http://www.microdesignservices.com>. Infrared Communications Systems, Inc. offers last mile facilities using unlicensed infrared spectrum and advertises speeds ranging from 1.544 Mbps to 622 Mbps over distances of a few hundred meters to more than 3.5 miles. *See* Infrared Communications Systems, Inc. (visited July 25, 2000) <http://www.infraredsystems.net>.

[76] In many large business satellite-based offerings, the end-user's terminal (i.e., satellite dish) is capable of both receiving and sending data. This allows for downstream and upstream speeds that exceed 200 kbps.

[77] *See infra* paras. 201 - 202.

growing number of business customers are also using satellite service for Internet connections.

58. Hughes' DirecPC provides high-speed service in the downstream direction at speeds ranging up to 400 kbps. Upstream transmissions use conventional telephone dial-up connection, typically at 28.8 kbps or 56 kbps. DirecPC charges between $19.99 and $49.99 per month depending upon the number of hours of service and whether an ISP is included in the package.[78] Necessary hardware, including installation materials start at $189.99.[79]

59. Satellite-based last mile facilities have some limitations. Consumers must have a clear line of sight to the south in order to access satellite-based services. Areas subject to extreme rain or snow may have difficulty receiving satellite signals in those conditions. Additionally, DirecPC does not provide service using its standard receiving antenna to Alaska and Hawaii, because the satellite currently used to carry DirecPC service does not provide a sufficiently robust signal to operate reliably with small antennas located there.[80] It may be technically feasible, using a larger dish, to receive DirecPC outside the continental United States, however, DirecPC does not support or guarantee its system when installed using a non-standard dish.[81] Furthermore, because DirecPC currently relies on a telephone return path, a subscriber may incur toll charges depending on the distance to the closest point of presence or may be required also to incur an additional expense to subscribe to a dial-up Internet service provided through a toll-free number.

f. Last 100 Feet Facilities

60. The last 100 feet typically refers to the final infrastructure segment from the end of the local access network to the end-user's terminal. This includes in-building wiring, local area networks and wireless local area networks. There do not appear to be technological barriers for last 100 feet facilities; indeed there are a variety of wireline and wireless options for constructing these facilities.[82] Nevertheless, the cost of some of these facilities may be a significant factor in the deployment of advanced telecommunication capability in the small business or school and library context. Additionally, certain last 100 feet segments may be in poor condition and consequently unable to support advanced services. Unlike a residential setting with a handful of users, small businesses or schools and libraries may have multiple users accessing advanced services simultaneously. This need for simultaneous access may require upgrades to the existing in-building wiring and other last 100 feet facilities, which may have been originally installed only with enough capacity for standard voice telephony services. In addition, access to last 100 feet

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[78] *See DirecPC – How Much Does It Cost?* (visited Aug. 15, 2000) <http://www.direcpc.com/consumer/cost/cost.html>.

[79] *See DirecPC – Where Can I Buy It?*, <http://www.direcpc.com/consumer/buy/usa.html#search> (visited July 6, 2000); *Satellite Internet Access Cable Modem Dish DirecPC* (visited July 6, 2000) <http://www.infodish.com/Products/products.html>.

[80] *DirecPC - Where Can I Buy It?* (visited August 1, 2000) <www.direcpc.com/consumer/buy/buy.html>.

[81] *DirecPC - Owner's Club-FAQ's* (visited August 1, 2000) <www.direcpc.com/consumer/owners/faqs/faqs.html>

[82] *See DirecPC Two-Way Service Also to be Offered as DirecTV Broadband Satellite Service* News Release (Apr. 27, 2000) (visited Aug. 4, 2000) <http://www.hns.com/news/pressrel/csp_pres/p042700.htm>; *Gilat-to-Home Frequently Asked Questions* (visited Aug. 2, 2000) <http://www.gilat2home.com/faq/index.html>.

facilities may be controlled by someone other than the end-user, such as the landlord of a multiple tenant dwelling. This also may create access barriers for these facilities, especially for competitors of the incumbent service provider.

g. Connection points

61. In the preceding discussion, we have examined the various components of the network. In order for advanced services to be delivered to end-users, however, these components must interconnect with each other at the places we loosely describe as connection points -- those places at which traffic passes between the various components of networks. High-speed networks exchange traffic at a variety of different places and in a variety of different mechanisms. For example, public telephone networks, including local, long distance and international networks, interconnect at Points of Presence (POPs) or through other interconnection arrangements. Satellite networks exchange traffic with terrestrial networks. Internet backbone service providers exchange traffic at network access points (NAPs), Metropolitan Area Exchanges (MAEs),[83] and through other public and private peering and transit arrangements. National Internet backbone providers report operating commercial exchange points in over 200 cities in the United States and having over 900 POPs where they interconnect with regional networks, private networks and other providers.[84] As usage and demand increase, network operators establish additional arrangements for the exchange of traffic.[85]

C. Overview of Deployment – Survey Data

1. Commission's Broadband Survey

62. In this section of the report, we discuss data obtained through the Commission's first systematic, nationwide survey of subscription to high-speed services, which began earlier this year.[86] The Commission's "Broadband Survey" required any facilities-based firm that provides 250 or more high-speed service lines (or wireless channels) in a given state to report basic

[83] *See, e.g., Exchange Point Information* (visited July 24, 2000) <www.ep.net> (listing 55 Internet exchange points in North America); Boardwatch Magazine's Directory of Internet Service Providers, *The Internet - What Is It?* (visited July 25, 2000) <http://www.boardwatch.com/isp/summer99/Internetarch.html>.

[84] Boardwatch Magazine's Directory of Internet Service Providers, *Introduction to the Directory of Internet Service Providers* at 4 (12th Edition, 2000); Tisha White, *Backbone Profiles* (visited July 18, 2000) <http://www.ispworld.com/isp/bb/Backbone_Profiles.htm> (listing 41 Internet backbone service providers); *NTIA/RUS Report* at 8.

[85] In response to Internet congestion and delay, content creators, service providers and users employ different strategies, including caching and web hosting server site selection. Caching is the practice of placing copies of the popular content nearer to the users on web servers off of the major Internet exchanges or in major cities. Web hosting site selection permits a content creator to locate its content off of a major access point in order to maximize accessibility to their content while minimizing latency and intermediary network routing. Both these strategies minimize the impact of the location of content creator on the accessibility of the content created.

[86] *See Data Gathering Order*, 15 FCC Rcd 7717 (adopting FCC Form 477 as a vehicle for collecting this information). In this report, we refer to the Local Competition and Broadband Reporting program as the "Broadband Survey."

information about its service offerings and customers.[87] We note again that in this report -- and in our Broadband Survey -- we use the term "high-speed services" to include not only those services that meet our definition of advanced services (*i.e.*, in excess of 200 kbps in both directions simultaneously) but also to include services that only support an information carrying capacity of greater than 200 kbps in one direction. As part of the Broadband Survey, providers reported the total number of high-speed lines (or wireless channels) -- broken down by type of technology -- for each state in which they exceeded the reporting threshold. For each of these "technology subtotals," providers reported additional detail concerning the percentage of lines that were connected to residential and small business users (as opposed to large business and institutional users) and the percentage of lines that met the Commission's definition of advanced services (as opposed to one-way high-speed lines).[88] Finally, these providers also reported a list of the zip codes where they had at least one customer of high-speed service.[89]

63. Using data from the Commission's Broadband Survey, in combination with publicly-available data from high-speed service providers themselves, financial analysts, and the U.S. Census Bureau, we are able to develop our understanding of the current deployment of high-speed services. The snapshots derived from our Broadband Survey shed light on the availability of high-speed services in different parts of the country and across different demographic variables, such as population density and income. Comparison with data on advanced services subscribership included in our *First Report* suggests that there has been appreciable growth in the deployment of high-speed services to residential consumers in the past year. Moreover, these figures reveal that advanced services are available in many parts of the country and suggest that certain factors -- such as population density and income -- appear to be highly correlated with the availability of high-speed services at this time. We detail these findings, below.

64. Some participants in the Commission's Broadband Survey requested non-disclosure of all or portions of their data, asserting that it contains competitively-sensitive information.[90] In the *Data Gathering Order*, the Commission agreed to publish in its regular reports high-speed data only once it has been aggregated in a manner that does not reveal individual company data.[91] Accordingly, the Broadband Survey data is presented here in a manner

[87] *See* Form 477, available at <http://www.fcc.gov/Forms/Form477/477.xls>.

[88] Providers also reported information about: the percentage of lines that were provided solely over their own facilities (as opposed to over leased facilities); the percentage of lines that they billed directly to the end-user (as opposed to billing to another provider or reseller); and the percentage of lines that had an information carrying capacity greater than 2Mbps in both directions.

[89] Reflecting concerns about regulatory burden on firms providing high-speed services, the Commission did not require providers to report the specific number of subscribers in a particular zip-code or detailed breakdowns by speed of service or type of customer. Nor did the Commission require firms to report data concerning states where they provided fewer than 250 high-speed lines. Accordingly, our data concerning areas where there are many small providers may understate deployment. For some indications of the important role small providers play in high-speed deployment, *see* Transcript of June 21, 2000, Montana Field Hearing (visited July 25, 2000) www.fcc.gov/jointconference.

[90] *Cf.* 47 C.F.R. § 0.459(d).

[91] *See Data Gathering Order*, 15 FCC Rcd at 7760.

that does not reveal individual company data.[92] We are optimistic that our approach in this report will encourage companies that fall below the threshold for mandatory reporting to participate on a voluntary basis in future rounds of the Broadband Survey.

2. National Data on High-Speed Lines in Service

a. Subscribership By Residential and Small Business Customers

65. Residential and Small Business Subscribership. One measure of deployment is the number of residential customers that subscribe to high-speed services. By measuring subscribership, we seek a verifiable count of exactly how much high-speed service is being delivered and purchased in the marketplace. Subscribership necessarily reflects a combination of factors including availability of infrastructure, service offerings tailored to customers' needs, and affordable pricing. We believe that this is a vital benchmark in assessing the state of high-speed deployment.

66. In the *First Report*, we combined small business and residential customers and referred to them collectively as "residential customers."[93] We do the same here.[94] In this report, we compare data concerning subscribership at the end of 1999, based on our Broadband Survey, with similar information gathered in our *First Report*, the data for which were from late 1998 and were based on a variety of public sources.[95]

67. Results of the Broadband Survey show that there were a total of approximately 1.8 million high-speed (again, including advanced services) residential subscribers, as of December 31, 1999. We estimate that approximately 1.0 million of these residential customers subscribed to services that meet the Commission's definition of advanced services. (See Figure 4.)

68. By comparison, we stated in the *First Report* that there were at least 375,000 residential subscribers to advanced services as of late 1998.[96] This total consisted of at least

[92] We note that Hughes Network Systems has filed a petition for declaratory ruling seeking to clarify how the Commission will ensure the non-disclosure of information submitted in the Broadband Survey that filers identify as competitively-sensitive and proprietary. *Local Competition and Broadband Reporting, Petition for Declaratory Ruling*, CC Docket 99-301 (filed May 15, 2000). We do not address Hughes' petition here. In this report, the Commission uses statistical methods, such as suppression and aggregation, to ensure that individual company-filed broadband data obtained in the Broadband Survey will not be revealed through the use of released information.

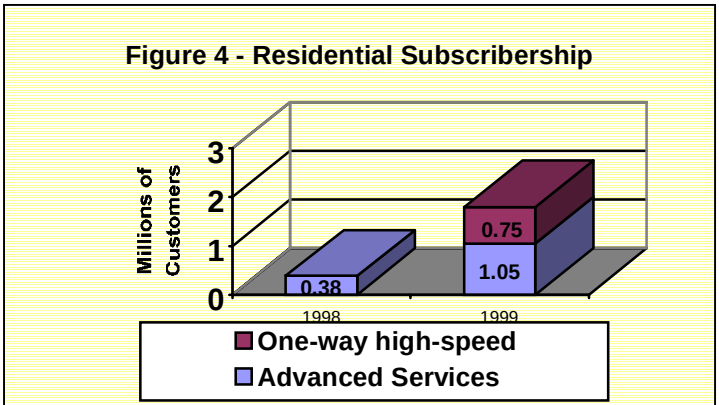
[93] *First Report*, 14 FCC Rcd at 2409.

[94] Our Broadband Survey also reflected this grouping. Thus, data from the Broadband Survey concerning deployment of high-speed lines to residential customers includes not only residential users, but also home office and small business users.

[95] The Broadband Survey generally collected data on high-speed lines or wireless channels, rather than customers, per se. Our estimates of the number of residential customers, therefore, rely on the assumption that most residential high-speed subscribers tend to purchase only one high-speed line, in contrast to many business customers that may purchase multiple high-speed lines.

[96] *First Report*, 14 FCC Rcd at 2446.

350,000 subscribers to cable modem service and at least 25,000 subscribers to DSL.[97] Because we had no data about subscribers to utility-based, CLEC-provided, or wireless advanced services, we did not include estimates for these services in the *First Report*.[98]

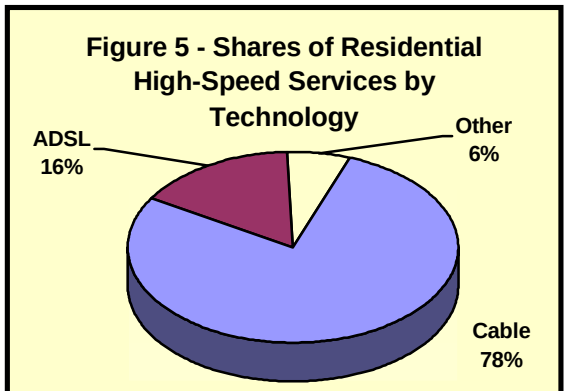


Source: First 706 Report (1998); Broadband Survey (1999) (Note: The First 706 Report did not estimate for one-way, high-speed services).

69. The data reported in our Broadband Survey show a substantial increase in residential customers of advanced services. Using the 375,000 figure from our *First Report* as a baseline, the new data show a three-fold increase in "full two-way" advanced services. (See Figure 4.) Indeed, the increase may be even somewhat greater than that because providers were not required to report data for states where they provide fewer that 250 lines.

70. Residential and Small Business Penetration. Though relatively few residences and small businesses have high-speed services at this time, our data suggest an appreciable increase in the penetration rate during the past year. Measuring only advanced services subscribers, penetration more than tripled from 0.3% of households at the end of 1998 to 1.0% at the end of 1999.[99] Looking more broadly at all high-speed services (*i.e.*, not only advanced services), the residential penetration rate was 1.6% at the end of 1999.

71. Multiple Technologies Delivering Service to Residential and Small Business Subscribers. Our data show not only appreciable growth in residential advanced services subscribership overall, but also growth among each of the individual technologies that is being used to deliver these services to residential and small business consumers. At year-end 1999, of the 1.8 million residential customers who subscribed to high-speed services, approximately 1.4 million subscribed to services using cable coaxial technology approximately 0.3 million subscribed to asymmetric DSL services, while the balance



Source: Broadband Survey (1999). "Other" includes: fixed wireless, satellite, and optical fiber.

[97] *Id.*

[98] *Id.*

[99] There are about 105 million households and about 4 million small businesses (establishments with 1-4 employees) in the U.S. FCC Industry Analysis Division, *Trends in Telephone Service*, Tbl. 17.1 <http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/Intl/itltrd99.pdf> (Sept. 1999); U.S. Census Bureau, Statistical Abstract of the United States 559, No. 881 (1999).

subscribed to other media, including satellite and fixed wireless services. Figure 5 shows the relative subscribership for various high-speed service technologies.

72. Considering only the 1.0 million residential and small business subscribers to advanced services, there were approximately 875,000 residential customers subscribed to cable-based services and approximately 115,000 residential customers subscribed to asymmetric DSL, with the balance subscribing to other media. Comparing these figures to the totals reported in our *First Report*, we see significant growth in advanced services provided by both cable companies and local exchange carriers between 1998 and 1999. More precisely, these figures show cable companies multiplying their residential advanced services subscribership approximately three-fold in the past year and local exchange carriers multiplying their residential DSL subscription to advanced services far faster.[100]

b. Subscribership For Large Business and Institutional Customers

73. Business Subscribership. In the Broadband Survey, providers reported there were approximately 1.0 million high-speed lines in service to large business and institutional customers at the end of 1999.[101] Almost all of these lines satisfy our definition of advanced services[102]; and, we conclude that there were approximately 0.9 million advanced service lines in service to business customers at the end of 1999. We did not make an estimate of the number of business high-speed lines in service to business customers in our *First Report*, so we are unable, at this time, to draw inferences about the rate of growth in the market for business customers.

74. We note that data from our Broadband Survey allow only a partial view into deployment of high-speed services to large business and institutional customers. For methodological reasons, the Broadband Survey did not collect data about all of the high-speed service offerings that are targeted at large business and institutional users. The Broadband Survey collected data solely concerning high-speed services that connect end-users to the Internet or other public data networks. This focus excludes high-speed services that are used as part of private networks -- so-called "private line" high-speed services. Many businesses and educational and healthcare institutions have for some time used such private lines as part of their internal networks and realized significant benefits from the high-speed services which their high-speed

[100] We note that our estimate of residential asymmetric DSL subscribers for year-end 1999 does not include any symmetric forms of DSL, which are typically purchased by business customers, whereas our estimate for 1998 DSL service may have included some symmetric DSL services. Thus, this estimate may understate overall DSL growth for residential users.

[101] For simplicity, we refer to these customers as "business customers" in this report.

[102] Filers of Form 477 did not directly report the number of advanced services lines provided to residential and small business users, as opposed to large business users. In estimating these advanced service counts, staff assumed that reported advanced service lines were more likely to be delivered to large business users first and residential and small business users second. This methodology provides the most conservative estimate of the number of residential advanced service lines reported. To achieve the highest level of precision, estimates were conducted at the individual Form 477 level. Staff conducted a sensitivity analysis against an alternative methodology, which would allocate lines to residential users first. This sensitivity analysis shows that the two methodologies vary by less than 1% of total advanced service lines reported.

services deliver. Evidence also suggests that some larger institutions, including universities and governments, are building their own high-speed networks for their own internal needs. Though we did not require high-speed service providers to report these services in our Broadband Survey, they play a significant role in the overall high-speed services industry, if not the market for residential users.

75. Large Business Penetration. We do not have sufficient data to enable us to calculate penetration rates for large business and institutional customers. However, we remain convinced that a wide variety of broadband services are generally available to business customers.

76. Multiple Technologies Delivering Services to Large Business Users. Of the estimated 950 thousand advanced service lines in service to larger business customers as of late 1999, approximately 70,000 subscribed to asymmetric DSL, 560,000 to other wireline services, and slightly over 300,000 to other media, including optical carrier services.

3. Geographic Distribution of High-Speed Deployment

77. Overview and methodology. The results of our Broadband Survey give two perspectives into the geographic distribution of high-speed services.[103] First, we are able to calculate the number of high-speed and advanced service lines in each state, the District of Columbia and Puerto Rico – all of which report at least some level of high-speed service. No high speed services were reported for the U.S. Virgin Islands.[104] Second, the zip code data present an elementary view of where high-speed service subscribers are located on a more granular basis. The providers reported a list of each zip code in which they had at least one high-speed service subscriber. These data give insight into whether there are high-speed service subscribers in any given zip code.

78. In order to minimize the burden associated with the Broadband Survey, the Commission did not require providers to report the *number* of high-speed service subscribers in each zip code, but only to identify the zip codes in which they had at least one high-speed service subscriber. Therefore, we cannot determine from our data the extent to which the presence of high-speed service in a given zip code indicates that high-speed services are widely available, or whether they are restricted to a few customers. Similarly, providers did not distinguish whether

[103] Again, we note that we use the term "high-speed services" broadly to include those services that meet the Commission's definition of advanced services and also to include those services that provide an information carrying capacity of over-200 kbps in one direction only.

[104] The Commission's *Data Gathering Order* requires any provider of high-speed services to report data for each state in which it meets the specified reporting thresholds. Under section 3(40) of the Act, the term "state" "includes the District of Columbia and the Territories and possessions." 47 U.S.C. § 153(40). Accordingly, the *Data Gathering Order* applies to data on broadband services or local telephone services that are provided in the District of Columbia and the territories and possessions as well as the fifty states. We will conduct additional outreach efforts to providers in the territories to ensure that they are aware of their reporting obligations under the *Data Gathering Order* and to improve our understanding of broadband deployment in these areas.

We note that, except for Puerto Rico, no broadband data was filed for any of the U.S. territories. It is unclear whether this absence signifies that there are no broadband providers that exceed our reporting thresholds in these areas or whether any such providers were uncertain about their obligation to file data under the *Data Gathering Order*. In comments filed in this proceeding, the Northern Mariana Islands report that there are no high-speed services available in that territory.

the high-speed subscribers in a given zip code are residential or business users. Thus, in some zip codes, high-speed services may be available to some large, primarily business users, but not be available, affordable or marketed to residential users. In addition, service could be marketed to limited neighborhoods, or very localized infrastructure barriers such as inside wiring issues could prevent some customers in a zip code from accessing services available to other customers in the same zip code.

79. The scope of the Broadband Survey reflects the Commission's understanding that a data collection that required detailed reporting at finer geographic levels would have created an appreciable regulatory burden for the firms providing high-speed service. Of course, we may determine in the future that it is necessary to incorporate some of this additional granularity into our Broadband Survey. Also, to supplement the data obtained in our Broadband Survey, we have undertaken several case studies, set forth below, that look more comprehensively at the deployment, availability, and affordability of high-speed services in discrete geographic areas.[105]

80. By analyzing the zip codes where there are actual high-speed subscribers, we can gain useful insight into the deployment and location of high-speed-capable infrastructure.[106] The zip code data depict where actual high-speed subscribers are located as of year-end 1999 and, more precisely, show areas where at least one customer receives high-speed *in the last mile* to the customer premises. We believe this data can help us identify issues for further exploration. For instance, consumers in zip codes with no reported subscribers may be differently situated, and therefore may require different solutions to bring them access to services, than consumers in zip codes where last mile infrastructure exists but other barriers prevent them from accessing it.

81. A substantial majority of the zip codes reporting high speed subscribership contained services that rely on infrastructure that is generally available to more than a single customer at a time. For instance, as discussed above, cable operators generally do not upgrade their networks on a piecemeal basis; an upgraded cable network can provide high-speed service to all of the homes that it passes.[107] Accordingly, the presence of a few – or even one – cable modem subscribers on a particular system likely indicates that other subscribers to the same system could obtain similar service. Similarly, much of the infrastructure work necessary to provide DSL service occurs in the carrier's central office. Once that work has taken place, most customers served by that central office typically can obtain DSL service without great additional difficulty.[108] The presence of terrestrial wireless or satellite service also indicates the likely availability of the signal to nearby customers.

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[105] *See infra* section IV.D.

[106] This focus on actual subscribership to high-speed service offerings, as opposed to future or present high-speed capability, reflects a combination of factors that result in any given customer being able to subscribe to high-speed services. These factors include: availability of infrastructure, service offerings that are tailored to that consumer's needs, and affordable pricing.

[107] We note that the boundaries of zip codes and cable service areas and wire center boundaries are not coextensive. Accordingly, the presence in one zip code of a high-speed subscriber does not conclusively indicate the availability of similar service to a substantial number of other residents of that zip code.

[108] In this regard, DSL service contrasts with T1 service, subscription to which does not necessarily indicate the availability of supporting infrastructure within the area surrounding a single subscriber.

82. Zip code data from the Broadband Survey show the presence of high-speed subscribership and, to some extent, the presence of high-speed-capable last miles. These data do not purport to show all of the infrastructure which is capable of supporting high-speed service. By collecting data on actual subscribers, we only capture part of the overall infrastructure (namely, the last mile) that is currently used to provide high-speed services.[109] We also know that many providers are deploying or upgrading last mile facilities that will soon be capable of providing high-speed services. We attempt, in other areas of this report, to describe the capital investment in high-speed infrastructure, plans for growth announced by particular firms, and analyst projections for the deployment of high-speed infrastructure. In future years, this investment will be reflected in increased subscribership, which will be captured in future Broadband Surveys and in our zip code data.[110]

83. High-Speed Subscribers Across the Country. Results of the first Broadband Survey indicate that there is at least one customer for high-speed service in each of the fifty states, the District of Columbia, and Puerto Rico and in 59% of all the zip codes in the United States. No provider reported subscribers in the U.S. Virgin Islands or other territories. The number of high-speed lines reported in each state varies significantly with reported high-speed subscribership ranging from a high of 547,000 lines in California to a low of less than 1,000 lines in four states. Figure C in Appendix B shows reportable line counts on a state-by-state basis.[111] Similarly, in some states there are many providers reporting -- with 20 reporting in California and Pennsylvania -- and in other states there are only one or two providers reporting. Figure B in Appendix B shows the number of providers reporting in each state.[112]

84. Again, looking broadly for the presence of high-speed services, data reported in the Broadband Survey show that 59% of the zip codes in this country have at least one subscriber to high-speed services. Those zip codes and the number of providers in them are shown below in the High-Speed Subscribership Map, Figure 6, and High-Speed Providers Map, Figure 7. The High-Speed Subscribership Map shows that high-speed service is deployed in many areas in the United States. Our analysis further shows that much of the population of the United States tends to be concentrated in those 59% of zip codes where high-speed subscribers are located. More precisely, 91% of the country's population lives in those zip codes where high-speed subscribership was reported.

[109] For example, the Broadband Subscribership Map below illustrates the location of high-speed subscribers. It does not attempt to illustrate the presence of backbone and middle mile facilities used to transport high-speed services or the last mile facilities that may be high-speed capable at some point in the future.

[110] We note that high-speed providers will complete and file the Broadband Survey, again, on September 1, 2000 and semi-annually thereafter for five years. *See Data Gathering Order*, 15 FCC Rcd at 7746..

[111] Again, we note that some charts and tables contain data that has been aggregated or suppressed to prevent the release of information that may be deemed competitively-sensitive. In other cases, data may be presented as a range (*e.g.* "there are between 150,000 to 250,000 high-speed lines in a state") rather than as an exact number.

[112] As noted above, we expect that there may be many other providers that did not meet the reporting threshold for given states and that did not choose to file on a voluntary basis.

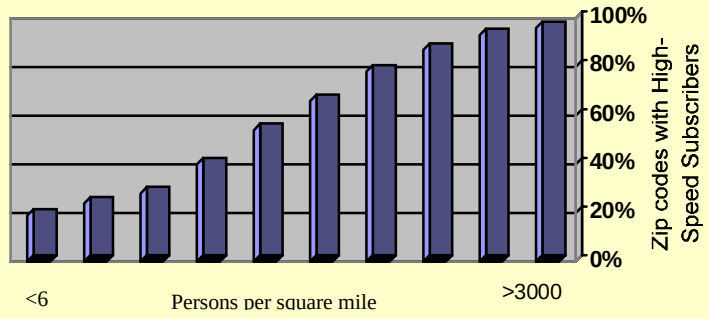
85. To better gauge where competition for high-speed services may be developing, we include the High-Speed Providers Map, which reflects the number of high-speed providers reporting data for given zip codes. As indicated by the red- and brown-shaded areas of the map, there are competing suppliers -- sometimes as many as ten -- in the major population centers of the country.[113]

4. Demographic Variables

86. In this section, we use zip code data from the Broadband Survey in conjunction with demographic data to try to discern relationships between the presence of high-speed service and the demographic characteristics of areas that have some level of high-speed subscribership.[114] As discussed above, the zip code data do not allow us to determine how many customers are subscribing to high-speed service or have access to it in a given zip code.[115] Despite these limitations, the zip code data provide a simple, and to our knowledge, unique indicator about where high-speed services are being delivered and where high-speed-capable last miles are deployed.

87. We emphasize that the demographic data in this section is presented in a preliminary and descriptive fashion. Many of the statistics discussed here indicate how, or to what extent certain variables are associated with each other. We caution readers that such associations do not establish cause-and-effect relationships between variables and we decline to draw conclusions about the statistical significance of these demographic variables until we have had the opportunity to conduct a more sophisticated statistical analysis of these data.

Figure 8 - High Speed Service Availability Rises with Population Density



Source: Broadband Survey (1999)

88. Population Density. The Broadband Survey data suggest that there is a great disparity between population densities with high-speed services reported more often in high density areas than in less dense areas. Figure 8 shows the percentage of zip codes with high-speed subscribers by deciles based on population density.[116] As it indicates, high population density has a strong positive correlation with the presence

[113] *See also* Figure A in Appendix B, which shows -- on a state-by-state basis -- the percentage of zip codes with -- number of providers.

[114] Demographic data was obtained from "Demographic Power Pack, Current Year Survey," MapInfo Corporation (2000 issue).

[115] Nor do the zip code data allow us to determine whether high-speed subscribers in a given zip code are residential or business customers.

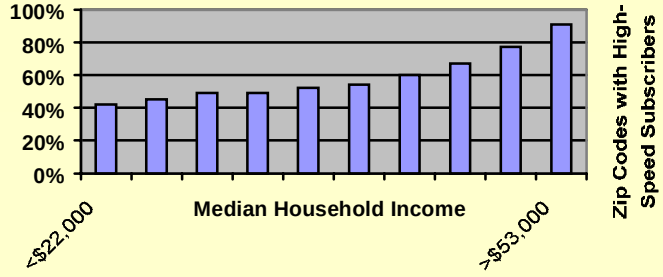
[116] Deciles are created by sorting the zip codes into ascending order based on population density. The zip codes are then placed into ten groups (*i.e.*, deciles) containing equal numbers of zip codes.

of high-speed subscribership and low population density has a strong negative correlation. Nearly all the most densely populated zip codes (over 90%) have one or more high-speed subscribers, but less than 20% of the sparsely populated zip codes have high-speed subscribers.[117] We note that this correlation may be accentuated by the fact that high-speed service providers only report when they have 250 or more subscribers in a given state. Thus, many smaller providers that serve discrete communities in sparsely-populated areas may not have reported, thereby creating the impression that there is less high-speed service in rural areas than there may actually be.

89. From the Broadband Survey data we can also see that the largest number of high-speed providers reported in any single zip code was ten.[118] Though these large concentrations of high-speed providers tend to be located in high-density areas, several of the most sparsely populated zip codes have almost as many high-speed providers. Indeed, some of these zip codes may have few people living in them, but are highly industrialized sections of major metropolitan areas.[119] For example, several of these low density zip codes with many providers are located in the business districts of large cities, where business demand exists, but there are few, if any, residents. These areas apparently exhibit high demand for high-speed services -- which may or may not be consistent with the demand exhibited by the residents of these areas – and are able to attract competition for high-speed services. At the same time, the availability of high-speed services to business users in these areas does not necessarily indicate their availability to any residents of these areas.

90. Household Income. Figure 9 shows the percentage of zip codes with high-speed subscribers by deciles based on median household income. As the chart indicates, high median family income, too, has a marked positive correlation with the presence of high-speed subscribership.[120] Of the highest income zip codes, 91% have high-speed subscribers, while of the lowest income zip codes, just over 40% have high-speed

Figure 9 - High-Speed Service Availability Rises with Income



Source: Broadband Survey (1999)

[117] Figure D in Appendix B illustrates the relationship between population density and the presence of high-speed service in more detail. As that table shows, even within the most sparsely-populated zip codes, density appears to be a major positive factor, with high-speed service deployed in those areas where the bulk of the population is concentrated.

[118] *See* Figure D in Appendix B.

[119] These primarily business districts demonstrate that "sparsely populated" areas are not necessarily rural or under-developed.

[120] *See also* Figure E in Appendix B. This table illustrates the relationship between household income and the presence of high-speed service in more detail.

subscribers.[121] Again, as we observed with the population density data, some of the low-income zip codes that have high-speed subscribers include business or industrial areas of major cities that have large demand for high-speed services. Thus, high-speed availability for residential low-income residents in these zip codes actually may be less prevalent than that suggested here.

91. Small Towns. Based on data from the Broadband Survey, we estimate that 57% of zip codes in small towns have at least one high-speed services subscriber.[122] Consistent with the observations about population density above, we find that 72% of the small town population across the country live in zip codes with a high-speed subscriber.

92. Indian - Tribal Areas. Our data also show that there is at least one subscriber to high-speed services in 44% of the zip codes that contain tribal territories. This is below the national average of 59%, described above.

93. Minority Populations. Data obtained in the Broadband Survey do not allow us at this time, to draw significant conclusions about the availability of high-speed services to discrete minority groups at this time. We note that other studies have indicated that minority consumers are less likely to own computers and to have Internet access than other segments of the population.[123] Thus, we are committed to working to gain a better understanding of the availability of high-speed services to minority populations in the future.

5. Survey Data By Last Mile Technologies

94. We report below data on high-speed subscribership by last mile technology based on our Broadband Survey and, where indicated, based on publicly-available sources. These data show that there are multiple paths for high-speed service in the last mile. Some are clearly still in the early stages of deployment but others -- such as cable and certain wireline technologies -- are more firmly established. In addition to data on subscribership, we report data that sheds light on strategies for deployment and the strengths and weakness of these last mile technologies. These data may be predictive of which technologies will serve particular types of customers and which technologies will have such significant capacity that lend themselves to particular applications. For example, the Broadband Survey data show that cable high-speed services are delivered primarily to residential and small business customers, while high-speed services over fiber and other traditional wireline technologies tend to be delivered to large business and institutional customers.

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[121] We treat as the highest income zip codes those that fall into the top decile when zip codes are ranked by median household income. Similarly, the lowest income zip codes are those that fall into the bottom decile when zip codes are ranked by median household income.

[122] We consider a "small town" to be a locale with a zip code that meets the following criteria: 1) between 1,000 and 15,000 in population; 2) between the 25th percentile and 75th percentile in population density; 3) no adjacent zip codes have more than 10,000 population; and 3) adjacent zip codes have no more than 80% of the population density of the small town's zip code. Our zip code data do not distinguish among communities within a zip code.

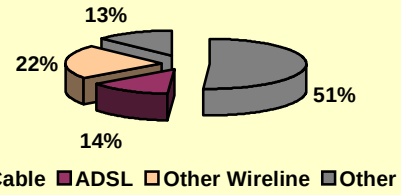
[123] *See* U.S. Government Working Group on Electronic Commerce, *Towards Digital eQuality*, Second Annual Report, at vi (1999) (visited July 25, 2000) < http://www.ecommerce.gov/annrpt.htm>; U.S. Department of Commerce, *Falling Through the Net: Defining the Digital Divide* (July 1999) (visited July 25, 2000) <http://www.ntia.doc.gov/ntiahome/net2/falling.html >.

95. We expect that, over time, the Broadband Survey will continue to provide valuable information about the state of high-speed deployment. For example, we report below data on the percentage of lines billed directly to end-user customers, as opposed to another provider or retailer, and we report data on the percentage of high-speed lines that providers deliver over their own facilities, as opposed to facilities that they lease from another provider. These data reveal that most reporting firms are selling directly to end-user customers and that most firms provide high-speed services over their own facilities. It is possible that, over time, a more robust market for resale of high-speed services may develop and that access policies may lead competitors to lease facilities from incumbent providers. We expect that the Broadband Survey will allow us to track differences across the last mile technologies and that these differences may assist us in our periodic reviews of different regulatory regimes.

a. Cable Coaxial Systems

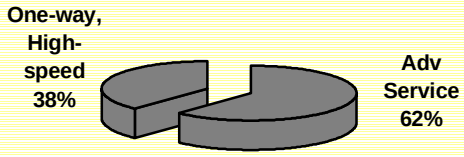
96. According to our Broadband Survey, high-speed lines delivered over coaxial carrier systems in the last mile account for 51% of the total high-speed lines as of year-end 1999.[124] (See Figure 10.) More specifically, cable companies report over 1.4 million high-speed lines in service using cable modem technology at the end of 1999. Of these, 62% meet the Commission's definition of advanced telecommunications capability. (See Figure 11.) As noted above, our data show a three-fold increase in the number of advanced service lines provided over

Figure 10 - Cable Modems Serve 51% of High-Speed Subscribers



Source: Broadband Survey (1999). "Other" includes: fixed wireless, satellite, and optical fiber.

Figure 11 - 62% of Cable Subscribership is Advanced Services



Source: Broadband Survey (1999)

cable modem technology to residential customers, alone, between 1998 and 1999. Combining our Broadband Survey data with publicly-available sources about the availability of cable modem-ready plant, the 1.4 million cable high-speed lines reported represents a penetration rate of approximately 3% of cable modem capable homes subscribing to cable modem service at the beginning of the year 2000.[125] Residential and small business subscribers, not surprisingly,

[124] The Broadband Survey collected information on high-speed lines delivered over "coaxial carrier systems including hybrid fiber-coaxial systems. In this report, we refer to these lines as being delivered over "cable modem technology."

[125] Richard Bilotti, Benjamin Swinburne, Gary Leiberman, and Marc Nabi, *1Q00 Review/2Q00 Preview: Party On at the Oligopoly Lounge*, Morgan Stanley Dean Witter, Apr. 4, 2000 at 15 (Morgan Stanley Dean Witter, *Oligopoly Lounge*) (almost one-third of all homes in the U.S. households were passed by cable modem infrastructure as of year-end 1999). This penetration rate is similar to that predicted by some analysts. *See id.* (end of 1999, high-speed penetration (the percent of data-ready homes subscribing to data service) was about 3.6%.)

(continued….)

account for 99% of the reported high-speed lines delivered over cable systems. This is consistent with our understanding that most cable systems are currently deployed in primarily residential areas.

97. In addition, high-speed services using cable technology (such as cable modems) are reported in 45 states and the District of Columbia.[126] As depicted in Figure 12, publicly available information indicates that cable systems capable of providing cable modem service tend to be located in more densely populated areas, especially in the East, the Midwest, and the West Coast.[127]

98. Data from the Broadband Survey also show that 96% of high-speed lines over cable modem technology are sold and billed directly to end-user customers, as opposed to another provider or retailer, and that 100% of these lines are delivered solely over facilities owned by the reporting provider. In addition, 7% of these lines provide an information carrying capacity in excess of 2 Mbps in both directions (though not necessarily symmetric).

(Continued from previous page)

[125] Jessica Reif Cohen and Nathalie Brochu, *Q4: Cable Modems, Christmas 1999's Hot Toy! Expect High-Speed Data to Drive Results in 2000*, Merrill Lynch, Feb. 16, 2000 at 34 (Merrill Lynch*: Q4 High-Speed Data Drives Results*). Penetration is the number of subscribers divided by homes passed by cable modem-ready plant.

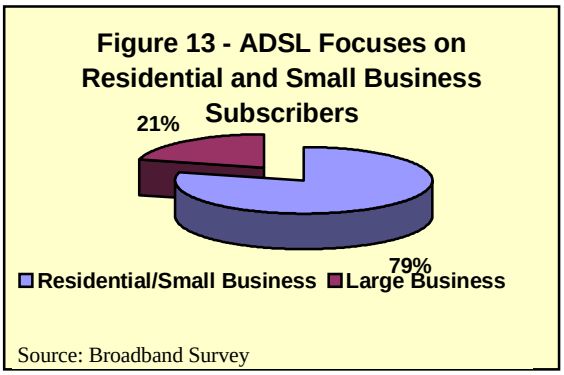
[126] Between 1995 and 1997, when system upgrades to provide increased channel capacity and new services were beginning, the Commission entered into "social contracts" with several large cable operators, which, established specific system upgrade requirements. Generally, these social contracts required operators to upgrade the majority of their systems to at least 550 MHz and to ensure that at least 50% of their subscribers were served by systems having a capacity of at least 750 MHz. *See Social Contract for Comcast Cable Communications, Inc.*, Order, 13 FCC Rcd 3612, 3646-47 (1997); *Social Contract for Continental Cablevision*, Memorandum Opinion and Order, 11 FCC Rcd 299, 361-62 (1995); *Continental Cablevision, Inc., Amended Social Contract,* Order, 11 FCC Rcd 11118, 11156-57 (1996); *Social Contract for Time Warner*, Memorandum Opinion and Order, 11 FCC Rcd 2788, 2862-63 (1995), *appeal dismissed per stipulation sub nom. Intercommunity Cable Regulatory Comm'n v. FCC*, No. 96-1027 (D.C. Cir., March 25, 1999). Pursuant to these social contracts, operators further agreed to provide free cable modems and high-speed Internet service to public and private schools, and to public libraries passed by their systems.[126] *Comcast Social Contract*, 13 FCC Rcd at 3650-51, 3652-53; *Continental Amended Social Contract*, 11 FCC Rcd at 11159; *Time Warner Social Contract*, 11 FCC Rcd at 2868-69.

[127] Confidentiality concerns prevent us from producing a map based on the Broadband Survey data that shows the zip codes containing subscribers to cable modem service.

b. Wireline Technologies

99. In this section we have divided wireline technologies into three categories. First, we look at asymmetrical DSL (ADSL)[128] service, the most popular residential offering. Second, we examine other traditional wireline services, including both T1 and symmetrical DSL (SDSL)[129] services. This category is primarily used by business customers. Third, we review optical fiber services, which, because of their very high speed and substantial expense, are of interest mostly to large business users. Together these LEC-delivered services represent a significant share of high-speed subscribers nationwide, with asymmetric DSL accounting for 14% of all high-speed lines and traditional wireline accounting for 22% of all high-speed lines, and optical fiber accounting for between 9-13% of all high-speed lines.[130]

100. Asymmetric DSL. Data from our Broadband Survey show that there were just under 0.4 million asymmetric DSL lines in service in the United States at the end of 1999, representing 13% of all high-speed lines.[131] This is consistent with other publicly available analyst estimates, which show incumbent and competitive LECs serving approximately 20% of all high-speed customers.[132] Of these approximately 0.4 million asymmetric DSL lines, 50% of them meet the Commission's definition of advanced services. These services were reported in 44 states and the District of Columbia, with 28 LECs reporting.



101. Of the approximately 0.4 million asymmetric DSL lines reported, an estimated 79% serve residential or small business customers.[133] (See Figure 13.) The vast majority of these

[128] We use the term "ADSL" in this report to refer simply to *asymmetric* DSL services, not to any particular protocol or standard for DSL technology.

[129] We use the term "SDSL" in this report to refer simply to *symmetric* DSL services, not to any particular protocol or standard for DSL technology.

[130] In this report, we aggregate high-speed subscribership data for the optical carrier (fiber), fixed wireless, and satellite technologies to address certain confidentiality issues. *See supra* note 111. Thus, the percentage of high-speed lines over optical fiber technology reflects percentages based on the range of 250,000-350,000 such lines nationwide.

[131] This includes all lines capable of supporting speeds of 200 kbps in at least one direction.

[132] *Cable Modem Market Stats & Projections*, CABLE DATACOM NEWS (March 3, 2000) (visited July 25, 2000) <http://www.cabledatacomnews.com/cmic/cmic16.html> (U.S. cable modem subscribers were estimated at 1.5 million). *Cf., Deployment - Updated 02/15/00*, TELECHOICE, INC. (visited July 25, 2000) <http://www.xdsl.com/content/resources/deployment_info.asp> (DSL lines in service at end of year 1999 were 504,110).

[133] This total number is close to estimates made by the research and consulting firm TeleChoice for the same point in time. *See supra* note 132. Note, however, that our count is lower because it only includes ADSL lines while the TeleChoice count includes all forms of DSL deployment. As noted earlier, we included SDSL services (continued….)

lines are sold directly to end-user customers (90%) and delivered solely over facilities owned by the reporting provider (93%). Almost none (0.1%) of the asymmetric DSL lines were reported to provide an information carrying capacity in excess of 2 Mbps in both directions.

102. According to public estimates, incumbent LECs served approximately 93% of ADSL subscribers, while the competitive LECs serve just under 7%. However, competitive LECs reportedly have DSL capable equipment in one-third more central offices than do incumbents.[134] Additionally, over the last year, competitive LECs appear to be adding customers at a faster rate (64% increase in subscribership) than are incumbent LECs (46% increase in subscribership).[135] (See Figure 14.)

103. Other Wireline. Carriers reported over 0.6 million high-speed lines in this category, which includes T1 and SDSL services. All of these lines meet the Commission's definition of advanced services. These services were reported in every state plus the District of Columbia and Puerto Rico, with approximately 48 holding companies reporting, representing both incumbent LECs and competitive LECs.

104. In this category of other traditional wireline technologies, 92% were delivered to large business and institutional users. Reporting providers indicate that 65% of their lines are billed directly to end-users, with the balance billed to other providers or retailers. Most of these lines, 93%, are provided over the reporting companies own facilities, though we note that only facilities-based providers are required to complete the Broadband Survey. Finally, our data show that 14% of these non-ADSL lines deliver an information carrying capacity in excess of 2 Mbps in both directions.

(Continued from previous page)
in "other traditional wireline services" because they are products that the providers market to larger businesses as an alternative to T1 service.

[134] *Deployment - Updated 02/15/00*, TELECHOICE, INC. (visited April 20, 2000) <http://www.xdsl.com/content/resources/deployment_info.asp> (U.S. CLECs have 5,619 DSL-equipped central offices compared to 3,843 DSL-equipped central offices in service by ILECs as of first quarter 2000). Note that this represents a narrowing of the gap between competitive LECs and incumbent LECs. At year-end 1999, CLECs (4,475) had more than double the number of DSL-equipped central offices of ILECs (2,042).

[135] *See* TeleChoice Deployment Statistics, *supra* note 132.

105. Optical Carrier (*i.e.*, Fiber). In our Broadband Survey, both LECs and cable providers reported having deployed this technology. We do not release, at this time, specific line counts for high-speed services delivered over fiber in the last mile. These numbers are aggregated with totals for high-speed lines delivered over fixed wireless and satellite technology to address confidentiality concerns. In lieu of a precise subscribership total, we report that high-speed lines over optical fiber systems account for between 250,000 and 350,000 lines.[136]

106. We can, however, report information about how these services are provided. Ninety-eight percent of the reported optical fiber lines meet the Commission's definition of advanced telecommunications capability, and 21% were reported as offering service in excess of 2 Mbps in both directions. None of these lines were reported in service to residential customers. Most of these lines (79%) are billed directly to end-users and virtually all (99%) are delivered over facilities owned solely by the reporting company.

c. Terrestrial Wireless Technologies

107. The results of our Broadband Survey confirm that wireless high-speed is still in the early stages of deployment, with wireless service representing fewer than 50,000 subscribers to high-speed lines.[137] Of these reported lines, 77% meet the Commission's definition of advanced services. Almost all of the reported wireless high-speed lines (99%) serve residential or small business customers. According to the data from the Broadband Survey, none deliver information carrying capacity in excess of 2 Mbps in both directions.

108. Confidentiality concerns preclude us from providing more detailed analyses from the collected wireless data and from producing a map based on zip codes where wireless subscribers exist. However, publicly available information indicates that, as indicated in Figure 15, fixed wireless high-speed systems are scattered throughout the country.

109. Public estimates of the extent of wireless high-speed deployment differ markedly and some industry analysts estimates substantially exceed our reported figures.[138] For instance, Morgan Stanley Dean Witter estimates that in 1999 there were roughly 70,000 fixed wireless subscribers, accounting for 0.2 percent of the total Internet access market.[139] Bernstein & McKinsey also predict fixed wireless will capture 70,000 high-speed subscribers, but in 2000.[140] On the other hand, Strategis Group reports substantially higher penetration rates for wireless high-speed, estimating that 5 percent of businesses and between 3 and 4 percent of residences

[136] *See supra* note 130.

[137] *See supra* note 130.

[138] Several factors may explain these differences. Not all wireless providers met the reporting threshold, either in terms of the number of high-speed subscribers in a state, or the transmission speed of their service. Business customers utilizing wireless under private contractual arrangements similar to private line services are generally not captured in our data. Wireless services with transmission speeds of 128 kbps may be included in some analysts' estimates.

[139] Morgan Stanley Dean Witter, *The Broadband Report* at 13.

[140] Bernstein/McKinsey, *Broadband!* at 33-34.

subscribe to such services.[141]

110. Two-way MDS fixed wireless technology is in its early stage of development. Based on various public information sources, it appears that at least nine companies were offering high-speed Internet access via MDS in a total of ten markets as of the end of 1999.[142] One analyst estimates there were 12,000 MDS Internet subscribers at that time.[143] According to another analyst, two thirds of the roughly 4,000 MDS Internet subscribers estimated to exist at the end of 1998 were residential.[144] The largest MDS operators, WorldCom and Sprint, have been targeting their high-speed Internet access and other high-speed services to residential and small office/home office customers, particularly customers that are beyond the reach of wireline DSL.[145]

[141] Strategis Group, *U.S. Wireless Broadband, LMDS, MMDS, and Unlicensed Spectrum*, Feb. 2000, at 243, 252, 262; Strategis Group, *High Speed Internet, Cable Modems, DSL and Wireless Broadband*, Dec. 1999, at 131.

[142] These companies include Alaska Wireless Cable in Fairbanks, AK; IJNT.net, Inc. in Salt Lake City, UT and Beaumont, TX; AIRNET in Cache Valley, UT; Nucentrix Broadband Networks, Inc. in Sherman and Austin, TX; Sioux Valley Wireless in Sioux Valley, SD; SkyLynx Communications in Fresno, CA and Sarasota, FL; U.S. Interactive d.b.a. AccelerNet in Houston, TX; Wireless First in Traverse City, MI; and Sunbury Broadband Services in Sunbury, PA. *Regional Wireless Operators Select Hybrid Networks' 2-Way Today Solution To Launch Multiple Markets*, PR Newswire, Jan. 10, 2000; IJNT.net, Inc. Form 10KSB/A, Filed May 10, 2000; Cache Valley AIRNET, *Area* (visited May 23, 2000) <http://www.cvairnet.com/body.html>; Nucentrix Broadband Networks Reports Financial Results, News Release, Nucentrix Broadband Networks, Inc. May 9, 2000; Sioux Valley Wireless, *Service Area Map* (visited May 23, 2000) <http://svswe.com/html/SV_Wireless/about_us.htm>; SkyLynx Communications, Inc., Form 10KSB, Filed Apr. 14, 2000; AccelerNet, *Coverage Area* (visited May 23, 2000) <http://www.accelernet.net/services/index.html>. Some of these companies, including AIRNET and IJNT.net, lease spectrum from MDS and ITFS licensees.

[143] Andrew Backover, *Cable, DSL and Wireless Vie for Market Leadership*, DENVER POST, Jan. 24, 2000 (citing the Strategis Group).

[144] Paul Kagan Associates, Inc., *MMDS: Analog Continues to Decline*, WIRELESS/PRIVATE CABLE INVESTOR, Jul. 13, 1999, at 2.

[145] Bernie Ebbers, *Merger Speech, National Press Club, Jan. 12, 2000* (visited Jan. 21, 2000) <http://www.worldcom-merger.com/press_room/ebbers_npc_speech.htm>.

d. Satellite Technologies

111. Data from the Broadband Survey confirm that provision of high-speed services over satellite technology is still in the early stages of deployment with fewer than four providers reporting. Based on our standardized ranges, high-speed service over satellite technology account for less than 50,000 high-speed lines.[146] We note that most of these lines are provided to residential and small business users, most are billed directly to end-user customers, and most are delivered solely over the reporting companies' own facilities. We also note that none of these lines satisfy the Commission's definition of advanced services. Again, confidentiality concerns prevent us from providing information on the geographic distribution of satellite service.

D. Integrated View of Deployment – Case Studies

1. Introduction

112. In this section, we present five case studies detailing advanced services deployment in various locations across the United States. The case studies complement the report's aggregate data on advanced services by providing an integrated view of actual deployment in particular communities. Our case studies focus on: Los Angeles County, California, which contains the second largest city in the United States; Waltham, Massachusetts, a suburb of 58,000 outside of Boston; Muscatine, Iowa, a town of 23,000; Miller, South Dakota, a small town of 1,600; and Wilsondale, West Virginia, a rural, residential town of 571. We chose these locations to provide an illustrative, rather than a representative, view of advanced services deployment. Some of these locations are ones in which certain factors, such as local efforts or competitive pressures, have resulted in a greater level of deployment than that enjoyed by other communities of similar size and composition. We chose these areas to demonstrate some of the factors that appear to stimulate deployment. We recognize, however, that other locations with similar demographics may have more or less advanced services deployment than these five locations. The case studies provide several important insights about the possibilities for advanced services deployment in a variety of communities.

113. While recognizing that some states and localities are successfully bringing high-speed services to rural areas, to some degree, the level of deployment in the case study areas depended on population density. At the extremes, the findings are perhaps not surprising: Consumers in Los Angeles County have a rich variety of choices of advanced services, while there are no providers of advanced services for residents of rural Wilsondale. On the other hand, as the result of a cable overbuild, both Waltham and Muscatine have three facilities-based providers of advanced services, facts that evince an encouraging degree of competition outside dense urban areas. Finally, we found that advanced services deployment extends, at least to some extent, to all ethnic and economic groups in Los Angeles County, and likewise to the rural town of Miller, South Dakota. We take these facts as indicating the potential for meaningful deployment of advanced services to all Americans.

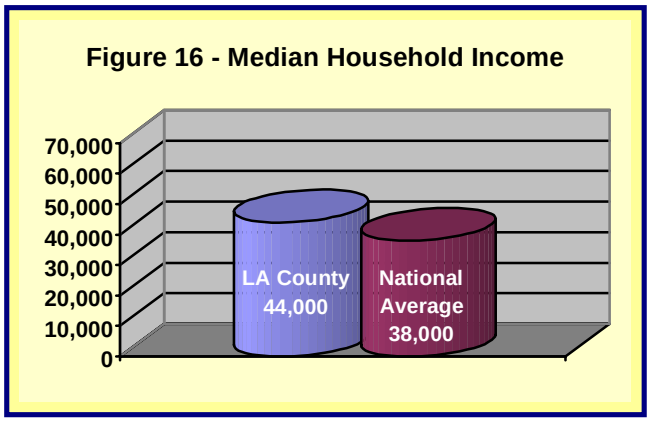
114. The case studies show that several factors can help stimulate the provision of advanced services. Local businesses and governments can have a great impact on both the introduction of advanced services and the degree of ensuing competition. We found that small

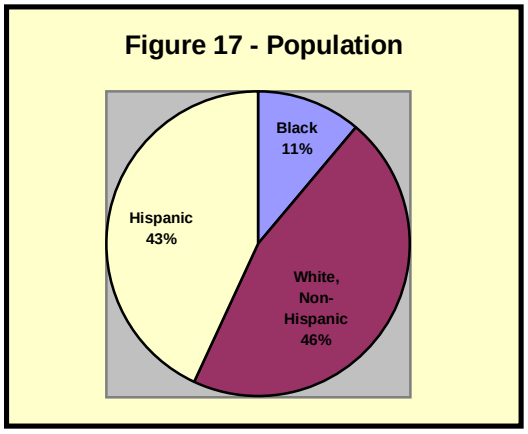
[146] *See supra* note 130.

towns such as Muscatine and Miller are likely to benefit greatly from a local firm with the resources and interest to introduce advanced services into their communities. In both rural Muscatine and suburban Waltham, progressive state laws and local officials had a positive impact on advanced services deployment. Finally, it appears that, after the initial introduction of advanced services, incumbents and new competitors often respond with competitive offerings of their own, even in towns the size of Waltham and Muscatine. Los Angeles County

a. Introduction

115. Los Angeles County, California (the County), is one of the nation's largest





counties with more than four thousand square miles of land area.[147] It has the largest population of any county in the nation and contains the second most populous city in the nation, the City of Los Angeles.[148] In 1999, the County had an estimated population of 9.7 million people, of which approximately 3.8 million reside in the City of Los Angeles.[149] In Los Angeles County, the median household income is estimated to be $44,058.[150] (See Figure 16.) Additionally, the population is estimated to be 75 percent white, 11 percent African American, and 43 percent Hispanic.[151] (See Figure 17.) As detailed below, high-speed Internet services are largely available to residents throughout Los Angeles County and are not limited to consumers in particular areas of the County or to those of particular economic status.

116. Los Angeles is the top ranked county in the United States in manufacturing, producing more than 10 percent of the nation's aircraft and aircraft equipment, aluminum, dental

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[147] *LA County Online: About Los Angeles County* (visited July 12, 2000) <http://www.co.la.ca.us/overview/htm> (*About Los Angeles County*).

[148] *City of Los Angeles 2000 Economic & Demographic Information* at 2 (visited July 26, 2000) <http://www.ci.la.ca.us/oars/econdemo.htm> (*Economic and Demographic Information*).

[149] *Id.* Located in southern California, the County includes the islands of San Clemente and Santa Catalina and has a Pacific Ocean coastline measuring 76 miles long. *See About Los Angeles County*. In addition to the City of Los Angeles, eighty-seven other cities comprise the County. *Id.*

[150] *USA Counties 1998, Los Angeles County* (visited August 1, 2000) <http://www.census.gov/statab/USA98/06/037.txt>.

[151] *Id.* Note that persons of any race can be Hispanic. *Id.*

equipment, games and toys, gas transmissions and distribution equipment, and women's apparel. The County is home to the film, television, and recording industries and therefore serves as one of the nation's cultural centers. In addition, Los Angeles County is one of the most ethnically diverse areas in the United States.

117. Because of its large and concentrated population, the presence of the second largest city in the nation, a vibrant and growing local economy, and its competitive communications markets, Los Angeles County is a particularly successful case of high-speed deployment. Residents throughout the county have access to several high-speed alternatives, and the multitude of offerings has resulted in competitive choices for both residential and business consumers. Additionally, it appears that high-speed deployment has penetrated the entire County and residents from the full range of ethnic and economic backgrounds have access to competitively provided high-speed services.

118. The incumbent local exchange carriers serving the County are Pacific Bell, a subsidiary of SBC Communications, and Verizon, formerly GTE. Wireless telephony providers in the County include Pacific Bell, Verizon, formerly GTE, Sprint PCS, and AT&T, and satellite television services are provided by DirecTV and EchoStar/the Dish Network. The County has a fragmented cable franchise system and is divided into several franchise areas operated by Time Warner, MediaOne/AT&T, Charter Communications, Adelphia, Buenavision, Comcast/Jones Intercable, and Cox.

b. Current Deployment

119. **DSL Services**: Both business and residential customers in Los Angeles County may obtain high speed Internet access over copper telephone lines from a number of providers of DSL services. Several DSL providers began offering County residents and businesses high-speed access to the Internet in 1998. In addition to the two incumbent local exchange carriers, several competitive local exchange carriers -- including Covad Communications, Rhythms Netconnections, Inc. and NorthPoint Communications -- offer wholesale DSL services. Furthermore, many Internet service providers resell various carriers' DSL services branded under their own name.[152] In Appendix B, we present a summary of the variety of DSL services offered to residential and business users in Los Angeles County.

120. **Cable Modem Services:** Charter Communications began rolling out high-speed Internet access in Los Angeles County through cable modem service in 1997. Currently, twenty-five communities in Charter's service area have access to cable modem service through Charter's affiliated Internet service providers. Through the end of 2000, Charter anticipates that network upgrades will be complete in six additional communities, which will amount to a total of 690,000 households throughout its service area.[153] MediaOne/AT&T began offering high-speed cable services in early 1998. By year-end 2000, MediaOne expects to have completed deployment of

[152] Consequently, many of the DSL service offerings in Los Angeles County are not provided by facilities-based carriers.

[153] *See ex parte* letter from Natalie Wales, Director, Law and Public Policy, California Cable Television Association, to Julie Patterson, Common Carrier Bureau, Policy Division, CC Docket No. 98-146 (dated July 26, 2000).

cable modem service throughout its entire Los Angeles County service area, which would comprise more than 783,000 homes.[154] Time Warner launched cable modem services in the County in 1999 and provides service to customers throughout seven cities within its service area, with five additional areas being added by the end of 2000.[155] Additionally, Buenavision offers cable modem service throughout its entire Los Angeles service area, and 99 percent of Cox's Los Angeles residential cable customer can obtain high-speed cable modem service.[156] Adelphia's cable modem service is available to 386,000 homes in seven markets within the County, and the company expects availability to increase to 750,000 homes by year-end 2000.[157] We discuss details of the cable-modem service offerings in Appendix B.

121. **Wireless:** In addition to DSL and cable modem services, Los Angeles business consumers may access the Internet through high-speed connections provided by fixed wireless providers. Teligent, for instance, offers high-speed Internet service to business customers in Los Angeles through digital microwave technology.[158] Similarly, Nextlink recently launched commercial fixed-wireless high-speed service in Los Angeles.[159] It also appears that this technology will be marketed to residential consumers in the near future. Fixed wireless providers boast high-speed Internet connections at a fraction of the cost offered by local telephone companies.[160] In addition, fixed wireless service offers dedicated Internet bandwidth of up to 45 Mbps.[161]

122. **Satellite:** Also available in Los Angeles County is Hughes Network Systems' DirecPC product, which offers high-speed Internet access via satellite transmission. DirecPC offers downstream speeds of up to 400 kbps, while upstream transmission is offered through the conventional telephone network. DirecPC offers satellite Internet access through several dealers in Los Angeles County and either with or without Internet service.[162] DirecPC offers unlimited Internet access as a package, as well as packages that include bundles of hours of access.[163]

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[154] *Id.*

[155] *Id.*

[156] *Id.*

[157] *Id.*

[158] Patricia Horn, *Vienna VA Based Firm Seeks Inroads Against Bell Atlantic*, THE PHILADELPHIA INQUIRER, 1999 WL 5573613 (Jan. 20, 1999).

[159] Marcia Martinek, *The Next Best Thing*, WIRELESS REVIEW, 2000 WL 7119147 (Mar. 31, 2000).

[160] Sarah L. Roberts-Witt, *A Network's Anatomy*, INTERNET WORLD, Dec. 15, 1999, at 56 ("[Teligent] can provide . . . Internet needs for a business—usually at roughly 30 percent off the phone company's bill").

[161] *Id.*

[162] Prices for DirecPC range from $19.99 to $49.99 per month for residential service depending on the number of hours of service and whether an ISP is included in the package. *DirecPC.com: How Much Does It Cost* (visited Aug 15, 2000) <http://www.direcpc.com/consumer/cost/cost.html>.

[163] *Id.*

c. Schools, Libraries, and other Programs

123. The Los Angeles County school system is comprised of 94 school districts, nearly 1,700 schools, and more than 30,000 classrooms.[164] Schools in Los Angeles County have received approximately $278 million in E-rate funding since the program's inception. With respect to high-speed services, 641 Los Angeles Unified School District[165] schools will have been upgraded from dial-up modems to T-1 lines by the end of Year 3 of the E-rate program.[166] In addition, in Years 1 and 2, Los Angeles Unified used $3.5 million of its e-rate funding for high-speed Internet access.[167] Los Angeles Unified reports that the new technology has resulted in students "taking virtual tours of educational sites and investigating new ways to apply their technical knowledge."[168]

124. Each of the cable operators serving Los Angeles County has made substantial commitments to providing free high-speed services to the County's schools and libraries. Adelphia, MediaOne/AT&T, Charter Communications, and Cox Cable each provides free cable modem service, including installation and equipment, to each of the schools and libraries in the markets in which they offer high-speed services. Similarly, although it does not yet provide residential cable modem service, Comcast/Jones Intercable provides free high-speed service, as well as unlimited Internet access through an affiliated ISP, to several schools and one library in Los Angeles County. Finally, Time Warner and Buenavision intend to begin providing high-speed cable service at no cost to the schools and libraries in the areas in which they offer residential and business services.[169] The cable operators indicate that high-speed Internet access provided to schools and libraries includes one "drop" from the cable headend to a single access point in the school or library, one cable modem, installation, and unlimited Internet access all at no cost to the school or library.[170]

d. Discussion

125. As detailed above and in Appendix B, there is much evidence that Los Angeles County, in addition to having a multitude of high-speed service providers, has an extremely competitive market for high-speed services. Extensive advertising campaigns and vigorous

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[164] *Los Angeles County Office of Education: County School Facts* (visited July 12, 2000) <http://www.lacoe.edu/schools/facts3.html>.

[165] Los Angeles Unified School District is the largest school district in Los Angeles County.

[166] *See ex parte* letter from James Konantz, Los Angeles Unified School District, to Julie Patterson, Federal Communications Commission, CC Docket No. 98-146 (filed by Common Carrier Bureau Staff on August 15, 2000).

[167] *Id.*

[168] *Id.*

[169] *See ex parte* letter from Natalie Wales, Director, Law and Public Policy, California Cable Television Association, to Julie Patterson, Common Carrier Bureau, Policy Division, CC Docket No. 98-146 (dated July 26, 2000).

[170] *Id.*

promotional deals offer consumers a wide variety of competitively priced high-speed services, with each provider touting what it considers to be important in differentiating its service from the many others available.

126. Competition in Los Angeles County appears to be most robust in the provision of DSL services, with incumbent LECs, competitive LECs, and wholesalers providing residential services. With increased competition for DSL services, partnerships among ISPs, carriers, and wholesalers have become more prevalent. Although partnerships between ISPs and DSL local exchange carriers have been common for some time, Los Angeles County's competitive market has begun to spring what until recently would have been thought unlikely partnerships. NorthPoint, for instance, is the first competitive DSL provider to form a wholesale agreement with an incumbent LEC, signing an agreement with Pacific Bell Internet Services to provide DSL service throughout its California territory, including Los Angeles County.[171]

127. Covad attributes the level of current competition for DSL services in Los Angeles to the high population density of the area, which permits companies to build facilities more rapidly and offers favorable economics because of the number of homes and businesses.[172] In addition, Covad cites a high rate of Internet usage throughout California for the relatively high level of high-speed penetration in the area to date[173]

128. Additionally, competition among the varying high-speed Internet service offerings in Los Angeles appears to be prevalent. Covad, for instance, differentiates its DSL products by stressing the dedicated connection, which, unlike cable-modem service, will not slow with the addition of other users to the system and which, again in contrast to cable, offers users greater security.[174] Deployment of cable modems, however, appears to be higher than that for DSL services.[175]

129. An additional observation regarding the availability of high-speed services in Los Angeles County is the broad geographic scope of deployment. Both cable modem and DSL service are largely available to residents throughout the County rather than being limited to consumers in particular areas of the County or of particular economic status. Indeed, as discussed above, several Los Angeles cable providers either currently offer, or soon will offer, cable modem service throughout their service areas. Furthermore, as demonstrated in Appendix C, figures J and K (maps of DSL deployment in the County overlaid with median household income and concentration of minority population) it appears that DSL service is more thoroughly deployed in

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[171] *NorthPoint Reports Fourth-Quarter and Year-End 1999 Results* (visited Apr. 27, 2000) <http://www.northpointcom.com/about_press_000209.asp>.

[172] Telephone Interview with Chuck Haas, Senior Vice President, Sales Development and Co-Founder, Covad (June 2, 2000).

[173] *Id.*

[174] *Id.*; *Covad: DSL Fast Facts* (visited July 12, 2000) <http://www.covad.com/dsl_facts.cfm>.

[175] *See e.g., Cable Modems Lead DSL in Broadband Consumer Race, Says Insight Research*, CAMBRIDGE TELECOM. REP., 2000 WL 7984718 (Apr. 24, 2000); Rebecca Cantwell, *Let it Ride*, INTERACTIVE WEEK, 2000 WL 4065171 (Mar. 3, 2000).

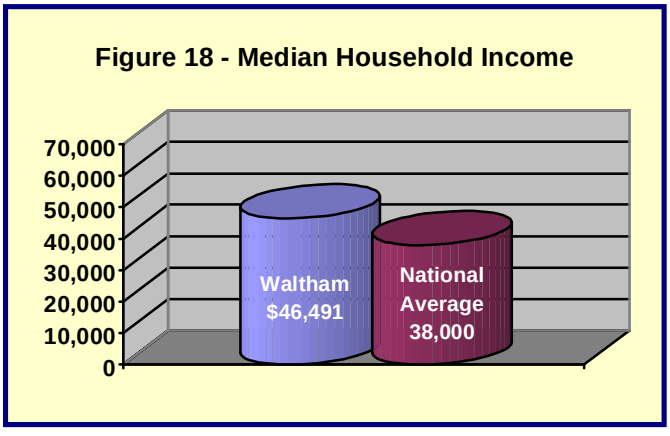
residential areas with lower median incomes and higher proportions of minority populations than it is in more affluent areas or in areas with a greater percentage of white residents. This appears to be attributable to the fact that these low-income and high minority areas are adjacent to the County's major business district, where, demand for, and consequently deployment of, advanced telecommunications capability is at its highest. We note that, as further discussed below, the availability of DSL and cable modem service in these areas does not indicate high subscription rates among either poor or minority residents of the County.

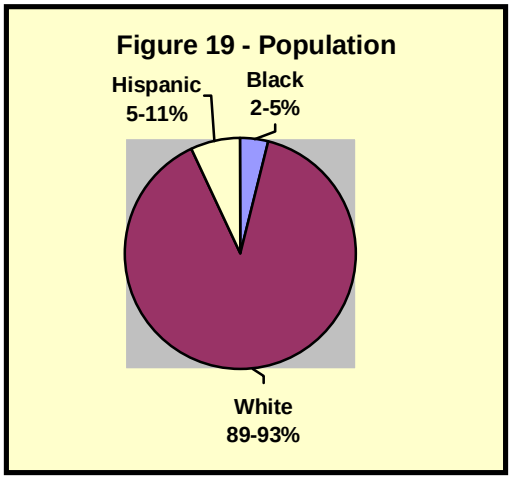
130. Overall, the high rate of deployment in Los Angeles County represents one of the more successful high-speed case studies in the nation. Incumbents as well as competitors are deploying high-speed services on a large scale, and cable modems, DSL services, and satellite access to the Internet are available to residential consumers throughout the County. Additionally, fixed wireless services, now available only to business customers, appear to be on their way to customers' homes. As a result, residents of Los Angeles County have many options when choosing among high-speed services as well as high-speed service providers.

2. Waltham, Massachusetts

a. Introduction

131. Waltham, Massachusetts (the City), our choice for the suburban case study, is a town on the Charles River nine miles west of Boston, that has a population of about 58,000. It is located on Route 128, which is the Boston tech corridor.[176] Employers in Waltham are primarily technology and computer companies, with some manufacturing. In addition, several universities have campuses in Waltham. In the three zip codes that encompass Waltham,[177] the median income ranges from $39,270 to $52,562. (See Figure 18.) In those zip codes, the population is 89% to 93% white, 2% to 5% African American, and 5% to 11% Hispanic. (See Figure 19.)





[176] *Waltham* (visited July 25, 2000) <http://www.magnet.state.ma.us/dhcd/iprofile/315.htm>.

[177] The three zip codes in Waltham are 02451, 02452, and 02453. MapInfo, Corp., *Demographic Power Pack, Current Year Update* (2000).

b. Current Deployment

132. High-speed services are available in Waltham using cable plant, telephone plant, a public network and satellite. Bell Atlantic is the incumbent local exchange carrier and MediaOne is the incumbent cable provider. Eleven CLECs collocate in Bell Atlantic's Waltham central office. Several offer DSL services.

133. RCN's entry as a competitive provider of cable and high-speed Internet access service, which it has accomplished by building its own network, has given consumers an additional option for high-speed Internet access. DirecPC also offers high-speed Internet access via satellite.[178] The presence of additional CLECs that offer services, both facilities-based and non facilities-based, has accelerated deployment and lowered prices. Full descriptions of the services offered in Waltham and the business strategies of the various service providers can be found in Appendix C.

c. Schools, Libraries, and Other Programs

134. The public schools in Waltham also have the option of cable Internet access as a result of the FCC's social contract policy and the City's franchise agreements. Waltham public schools have long benefited from a social contract, in which the provider undertakes to provide free video service to all schools.[179] RCN, as is typical in its franchise agreements, also provides facilities for cable modem service to all public buildings in Waltham, including schools.[180] However, Waltham's schools do not currently use either RCN's facilities or those of the incumbent cable provider because of the availability of the City's infrastructure.[181] In Waltham, RCN also provides cable modem service and hardware for a community center, the Charles River Public Internet Center, which is designed to allow citizens of the community to use this center to access the Internet at high speeds.

d. Discussion

135. Waltham's high-speed service market has benefited from the City's location on the Boston high tech corridor and its proximity to Boston. In addition, there appears to be a clear pattern of competitive response among providers that has spurred deployment of facilities in Waltham. In a series of consecutive actions, beginning with MediaOne's launch of cable modem service in the Boston area in September 1996, RCN, MediaOne, and Bell Atlantic introduced high-speed services, decreased prices and expanded service offerings. As a result, today residential consumers have the choice of multiple different high-speed Internet options for less than $100 a month.

136. City officials also believe that a critical factor in their success was the City's

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[178] *See supra* paras. 58, 122.

[179] *See supra* note 126.

[180] Telephone interview with Scott Burnside, RCN Corp., Apr. 19, 2000.

[181] Telephone interview with Paul Trane of Telecommunications Insights Group, telecommunications consultant to the City of Waltham (*Trane Interview*).

decision to hire a telecommunications consultant to seek out cable television and data access competitors for the city. The consultant, Paul Trane of Telecommunications Insight Group, developed a telecommunications plan for the city, handled all licensing and franchise negotiations, managed city rights of way, and invited RCN to become a competitive video and high-speed access provider. Thus, the city was welcoming to telecommunications competitors, and was proactive in its use of various means, such as short-term open video system agreements, to speed the deployment of advanced services while it negotiated longer-term telecommunications franchises.[182] Such openness to new entrants most likely helped speed the entry of competitors to the area.

137. Public investment in facilities has also played an important role in the deployment of high-speed infrastructure in Waltham. The City built its own public institutional fiber network in 1997 and 1998 because the existing networks were not meeting its needs, and analysts believed that construction of a municipal network was cost effective. The network currently provides data access services to all public buildings, including schools, and soon will provide telephone services as well. The city recently spent $1 million on a switch to support telephone service on the network. The City is also considering the provision of video services to public buildings over the network. Local telecommunications providers offer redundant support to this network rather than supplying the institutional network itself.[183]

138. The Commonwealth of Massachusetts will soon create another option for public entities in Waltham. The Massachusetts Community Network initiative has contracted with a provider to allow public entities across the state to purchase high-speed Internet access (at T1 rates, 1.54 Mbps) off a single contract.[184] While Waltham has the option of using this network once it is operational, it will not need to do so because of its own facilities.[185]

[182] An open video system (OVS) is an alternative regulatory treatment of multichannel video program distributor service established by the 1996 Act. 47 U.S.C. §571 (a)(3) - (4). An OVS agreement is analogous to a cable franchise agreement: it is an agreement with the local regulatory authority for permission to serve the local community, and usually involves some concessions on the part of the OVS provider, such as high-speed service to public buildings. Above, the agreements are described as "short term" because they were negotiated in order to allow RCN to begin providing service, but were later replaced with long term traditional cable agreements.

[183] *Trane Interview.*

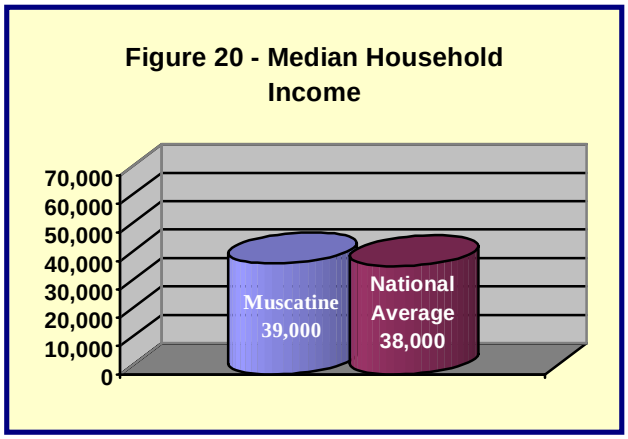
[184] Digital Broadband Communications, *Broadband Network to Serve All of Massachusetts,* News Release, Jan. 24 2000.

[185] *Trane Interview.*

3. Muscatine, Iowa

a. Introduction

139. Muscatine is a mid-sized town with a population of approximately 23,000 (county population of 40,000), located along the Mississippi River in southeastern Iowa.[186] The 1995 estimate of the median household income for Muscatine county is $38,840, while the median household income estimate for the state of Iowa is $33,436. (See Figure 20.) As of 1996, the county population had a racial composition of 98.0 percent white, 0.8 percent black, 0.3 percent Indian and 0.9 percent Asian or Pacific Islander. Based on the U.S. Census Bureau's *1997 County Business Patterns*, approximately 41 percent of the county's labor force is employed in manufacturing, with 17 percent employed in retail trade and 28 percent employed in services.[187] The town of Muscatine is the facility site of several Fortune 1000 companies, including Monsanto, Hon Industries, Inc. and Bandag, Inc.



140. It is notable in a town the size of Muscatine that there are three terrestrial, facilities-based, high-speed service providers for residential customers: (1) Muscatine Power and Water (MP&W), the town's incumbent utility; (2) US West, the incumbent phone company, in partnership with a local ISP; and (3) AT&T Cable Services. One factor contributing to this degree of advanced deployment is Iowa's legal environment, which has encouraged municipal involvement in the deployment of advanced telecommunications services. The state of Iowa actively has supported legislation and legal interpretations to overcome barriers that have restricted municipal entry into high-speed provision in some other states.[188] As a result, there are now some thirty Iowa communities that provide facilities-based telecommunication services.[189]

141. MP&W, Muscatine's municipally-owned public utility, which consists of separate electric, water and communications utilities, was the first to deploy high-speed facilities in

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[186] *Muscatine Development Corporation: Introduction* (visited Apr. 26, 2000) <http://www.muscatine.com/-mdc/mdc.html>.

[187] *U.S. Census Bureau: 1997 Business Patterns for Muscatine County, Iowa* (visited June 12, 2000) <http://www.census.gov/epcd/cbp/map/97data/19/139.txt>.

[188] *See* James Baller and Sean Stokes, *Sector's Authority to Engage in Telecommunications Activities* (visited July 12, 2000) <http://munitelecom.org/v1i1/Baller.html> (providing background on state barriers to municipal entry into telecommunications services); *Communications Update: Score Tied at 1-1 for Municipal Telecommunications* (visited July 12, 2000) <http://www.fredlaw.com/newsletters/cable/-cable9908122331.html> (same).

[189] Bob Haug, *Telecom: To Support and Strengthen Iowa's Municipal Utilities* (visited May 9, 2000) <http://www.iamu.org/main/telecom.htm>.

Muscatine.[190] It conducted a marketing study in 1996 that showed resident interest in municipally-provided telecommunications. A detailed feasibility study and business plan then followed. Finally, in a public referendum on July 22, 1997, 94% of the voters approved the communications utility. The communications utility received $18 million in initial funding from the municipal electric utility, and completed construction of its fiber network in the spring of 1999.

142. On the heels of the completion of MP&W's telecommunication network, Muscatine Information Services (MIS), a local ISP, announced, on June 7, 1999, that it was launching a DSL-based Internet service in Muscatine, called MuscaNet.[191] This service developed out of a partnership between US West and the Stanley Group, one of Muscatine's oldest businesses with eighty-five years of experience in environmental and telecommunication matters. Also in the summer of 1999, AT&T began to offer its AT&T@Home cable modem service to its cable customers in Muscatine.

b. Current Deployment

143. MP&W provides high-speed cable-modem Internet access to residential customers and a Municipal Area Network for business customers. MP&W's telecommunication network consists of a hybrid fiber coax (HFC) system with 125 homes per node. It can deliver a maximum of 4 Mbps downstream and 1 Mbps upstream for connected customers. MP&W obtains its connection to the Internet backbone through NetIns, a division of Iowa Network Services, Inc. (INS), a telecommunications firm formed in 1986 by a consortium of 128 independent telephone companies. INS has a point of presence in Muscatine, from which it carries traffic to Des Moines, where NetIns connects with the Internet backbone provider.

144. The telecommunications service area covered by MP&W includes the municipal boundaries of Muscatine, plus MP&W's authorized electric-service territory. The company is further authorized to extend these boundaries to neighboring service areas, wherever it is economically viable to provide telecommunication services. Within the Muscatine municipality, MP&W service passes 100 percent of approximately 9,400 city homes. Of these homes, some 3,500 homes subscribe to MP&W's cable video service and some 1,400 homes subscribe to its high-speed Internet service, as of April 2000. Thus MP&W's high-speed service has achieved a market penetration of nearly 15 percent, since the service began some 15 months ago.

145. Muscatine Information Services (MIS) offers high-speed service in conjunction with US West Interprise Megabit Services.[192] MIS acts as the hub, collecting and routing data traffic over the US West asynchronous transfer mode Cell Relay Network to its ISP service, MuscaNet. High-speed service is available at speeds ranging from 256 kbps to 7 Mbps.

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[190] *Muscatine Power and Water: Communications* (visited Apr. 25, 2000) <http://www.mpw.org/-communications.htm>.

[191] *Muscatine Information Service* (visited Apr. 25, 2000) <http://www.muscanet.com/html/-dsl_new_release.html>.

[192] U.S. West's MegaBit Services provides high-speed service to the Internet or to a corporate LAN, using Rate Adaptive DSL (RADSL) technology. *US West Megabit Services: Fast Facts* (visited Apr. 27, 2000) <http://www.uswest.com:80/products/data/dsl/fast_facts.html>.

Currently, DSL service is available in areas that meet line quality criteria and lie within 15,000 feet of US West's main office, which is located in downtown Muscatine. Some 75 percent of the city of Muscatine lies within 15,000 feet of the DSL-capable central office, and therefore customers living within this area should be able to qualify for DSL service.

146. The AT&T@Home service delivers high-speed cable modem access directly to the personal computer. This service has a downstream speed of up to 3 Mbps.[193] Upstream data transfer is limited to 128 kbps. The @Home service is operated by TCI of Eastern Iowa and is available everywhere within the Muscatine city limits. In addition, DirecPC's service is also available in Muscatine.[194]

c. Schools, Libraries and Other Programs.

147. Muscatine's high school offers its students Internet access through connections in every classroom, with a student-to-computer ratio of 4 for 1. These services are a part of the Iowa Communications Network (ICN). The Muscatine community school district has received approximately $75,000 in E-rate funding.

148. The Iowa Communications Network is a state-owned and administered fiber optics network created to make educational, medical, and governmental services more easily accessible to Iowans in each of the state's counties.[195] Completed in 1995, the ICN reaches all 99 Iowa counties with some 3,000 miles of DS3 fiber optic cable backbone, and some 705 full-motion video sites at public libraries, hospitals, physician clinics, and accredited schools and colleges.[196] Fiber optic endpoints are located in each county, at each of the three state universities, at the studios of Iowa Public Television, and at the Capitol Complex, giving a total of 104 such sites. Every school district which chooses to participate can obtain a video connection. In total, the state's network links hospitals, state and federal government, public defense armories, libraries, schools, and higher education through both high quality, full-motion video and high-speed Internet connections

149. Additional Internet-connection to area students is offered by Muscatine Community College through its degree programs.

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[193] The actual speed of transfer is dependent upon several variables, such as the customer's computer performance and configuration, performance characteristics of each component of the data network, the number of users and overall network traffic. *AT&T @Home Cable Internet Service: Frequently Asked Questions* (visited Apr. 27, 2000) <http://www.athome.att.com/pages/faq.html#HowfastisTCIHome>.

[194] *DirecPC.com: How Much Does It Cost?* (visited Apr. 27, 2000) <http://www.direcpc.com/-consumer/cost/cost.html>. The nearest point of presence for service in Muscatine is 26 miles away.

[195] The Iowa Communications Network supports full-motion, two-way video conferencing across the entire network. Its backbone network consists of very high-speed DS3 (T3) circuits. *Intergovernmental Information Technology Environmental Assessment* (visited May 9, 2000) <http://www.state.ia.us/government/iitt/assess.htm>.

[196] *State of Iowa: Iowa Access Network* (visited June 13, 2000) <http://www.icn.state.ia.us/text/txtindex.html>.

d. Discussion

150. One unique factor in the development of high-speed services in Muscatine is the strong role of public investment, both through the Iowa Communications Network and through both the state and municipal governments.[197] Like several other states, Iowa has been proactive in overcoming legal barriers that limit municipal provision of high-speed services. In 1997, the Iowa legislature voted unanimously to allow the provision of telecommunications services through municipal utilities.[198] Dissatisfied with the legislature's action, the Iowa Telephone Association challenged an Iowa town's plans to provide competitive telephone service; the lower court rejected the challenge, and the Iowa Supreme Court affirmed the judgment.[199]

151. For smaller Iowa communities attempting to attract new businesses and retain their current economic base, municipal provision of advanced services, combined with the Internet's ability to overcome distance barriers, can be an enticing factor. If municipal provision of high-speed infrastructure encourages growth and establishes the demand for high-speed service, other providers such as cable and telephone may then find a sufficient client base to begin to offer their own services. In Muscatine, the telephone and cable companies responded quickly to the deployment by the local utility. Municipal utilities-based deployment may also allow private providers to realize time and cost savings, for example, by sharing unused dark fiber capacity and with using public right-of-ways.

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[197] *See, e.g., Communications Update* (visited July 13, 2000) <http://www.fredlaw.com/newsletters/cable/-cable9908122331.html> (discussing the Iowa State Supreme Court ruling that Iowa towns may offer telecommunications services to the public).

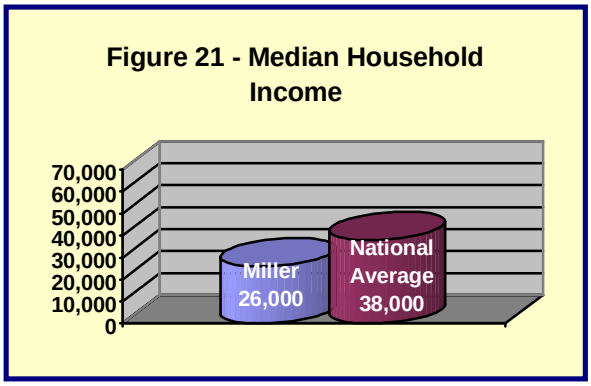
[198] *See* 1997 Iowa Acts, ch. 81 (codified at Iowa Code §§ 476.1B(1), .1B(3), .29(16), .96(3) (Supp. 1997)).

[199] *See Iowa Tel. Ass'n v. City of Hawarden*, 589 N.W.2d 245 (Iowa 1999). The Iowa telephone Association had argued that an Iowa law prohibited the public sector from providing services in competition with the private sector. The Iowa Supreme Court held that the State of Iowa is a "franchising authority" under 47 U.S.C. § 510(22), and that a franchising authority may not impose requirements that prohibit the provision of telecommunications service by a "cable operator" (pursuant to 47 U.S.C. § 541(b)(3)(B)). Because the City of Hawarden is a cable operator, the Court said, the State cannot prohibit the city from providing telephone service over its cable system. Further background on the *Hawarden* case is available from the *Federal-State Joint Conference on Advanced Services: Midwestern Regional Field Hearing* (visited July 13, 2000) <http://www.fcc.gov/jointconference>.

4. Miller, South Dakota

a. Introduction

152. Miller, South Dakota is a town of 1,655 and is the county seat of Hand County (population of 4,144).[200] Miller is located in central South Dakota to the east of the Missouri River. The great majority of Miller's population is employed in government, service and trade industries, and agricultural activities. In 1989, 728 out of 4,133 residents of Hand County were designated as living at or below the poverty level.[201] In 1993, the median yearly household income for Hand County was $26,454.[202] (See Figure 21.) Although high-speed service has recently been deployed in Miller, it has not been deployed to the extent described in the other case studies.



153. The cable television service provider in Miller is Midcontinent Communications, a company that has been providing cable television service in South Dakota since 1968.[203] US West is the incumbent local exchange carrier in Miller. It provides frame relay, ISDN, and ATM services to customers in Miller. US West provides these services using leased DS3 capacity from Sully Buttes Telephone Cooperative, Inc. Sully Buttes Telephone Cooperative is a member of the South Dakota Network, a consortium of 40 South Dakota independent telephone companies with over 4,000 miles of buried fiber optics in South Dakota. The South Dakota Network provides data, video and voice inter-city transport to South Dakota's commercial and medical sectors, the State of South Dakota, educational institutions, and national interexchange carriers.[204]

b. Current Deployment

154. On September 29, 1998, the @Home network announced an affiliate relationship with Midcontinent Cable Company and its TCI partnership systems, to deliver high-speed cable

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[200] *South Dakota: Miller-Hand County* (visited May 1, 2000) <http://www.state.sd.us/oed/profiles/miller.htm>.

[201] *U.S. Census Bureau: USA Counties 1998* (visited June 14, 2000) <http://tier2.census.gov/cgi-win/usac/table.exe>.

[202] *Id.*

[203] Midcontinent Cable Company is a wholly owned subsidiary of Midcontinent Communications. The vast majority of the Midcontinent systems now are interconnected by a newly-constructed fiber network extending from southeastern South Dakota into central North Dakota. *See Excite@Home: 2Home Network and Midcontinent Cable Co. Announce Affiliate Relationship* (visited Mar. 7, 2000) <http:corp.excite.com/News/pr_980929_01.html>.

[204] *See South Dakota Network LLC: State's Largest Fiber Network Adds 25 New Owner Companies* (visited June 12, 2000) <http://www.sdnet.net/article070699.html>.

Internet services to its cable communities in North and South Dakota, beginning early 1999.[205] Since February 1, 2000, Midcontinent Communications has provided Miller with high-speed cable service, offering its 1.5 Mbps @Home service to residential customers in Miller. This service is deployed on an HFC 750 MHz interactive cable system. Midcontinent Communications uses UUNet as its backbone provider; AT&T@Home transports traffic from Miller to UUNet's POP in Sioux Falls, South Dakota. Since the introduction of @Home service in February, 14 households out of the 1072 homes passed are subscribing to the @Home service -- a penetration rate of slightly over 1% in seven months.[206] Midcontinent @Home costs $29.95 per month for Midcontinent cable subscribers or $39.95 for non-subscribers. Customers have the option of leasing a cable modem for $10 per month or purchasing one for $225. There is a one-time set up fee of $99, which covers installation of an additional dataport, an Ethernet card, and Midcontinent@Home software.

155. US West has not found that there is a market or customer base to justify the expense of deploying DSL services. As described above, DirecPC is available to residents of Miller.[207]

c. Schools and Libraries

156. In addition, Miller schools have received approximately $42,000 in E-rate support. The E-rate allowed Miller to greatly increase the speed of its previously slow classroom connections. E-rate funds have also been used to purchase necessary internal connections. As part of the cable industry's and Midcontinent's commitment to the National Cable Television Association's High Speed Education Connection[208] and the Cable in the Classroom programs,[209] all state-certified K-12 schools in communities served by Midcontinent are eligible to receive free cable television service and, where available, high-speed Internet access. Midcontinent is currently providing these services to the three public schools in Miller.

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[205] *See @Home Network and Midcontinent Cable Co. Announce Affiliate Relationship* (visited mar. 7, 2000) <http://www.corp.excite.com/News/pr_980929_01.html>.

[206] These data reflect sales activity as of May 16, 2000.

[207] *See DirecPC.com: How Much Does It Cost?* (visited Apr. 27, 2000) <http://www.direcpc.com/consumer/cost/cost.html >. According to the DirecPC website, the closest retail outlet for DirecPC equipment is located in Sioux Falls, South Dakota, 131 miles from Miller. The nearest Internet point of presence is also in Sioux Falls. *Cf. supra* para. 59.

[208] The High-Speed Education Connection is a program begun in 1996 in which the cable television industry pledged to equip at least one site in every consenting elementary and secondary school passed by cable's high-speed services with a cable modem providing basic high-speed access to the Internet, free of charge. *National Cable Television Association: Cable Operators Expand Education Commitment* (visited June 12, 2000) <http://www.ncta.com/home.html>.

[209] Cable in the Classroom is a $2 million per week public service effort supported by 41 national cable networks and over 8,500 local cable companies. These networks and local cable companies act as a partner in learning with teachers and parents by providing a free cable connection and over 540 hours per month of commercial-free educational programming to schools across the country. *See Cable in the Classroom Home: What Is Cable in the Classroom?* (visited June 12, 2000) <http://www.ciconline.com/abthom.htm>.

157. Schools in Miller also have been wired under South Dakota's "Wiring the Schools" and "Connecting the Schools" (CTS) programs.[210] Wiring the Schools established a solid LAN and electrical infrastructure in the K-12 school buildings across South Dakota. CTS is a follow-up endeavor, building on that foundation for the creation of a statewide video and data intranet to improve the educational opportunities for K-12 students in South Dakota.[211] CTS ultimately will connect all K-12 schools into a single, statewide data and video intranet—referred to as the Digital Dakota Network—to enhance education opportunities for every student in South Dakota.[212] The State Bureau of Information and Telecommunications and Department of Education and Cultural Affairs coordinated the effort to set up the educational intranet. US West is partnering with the state and other telecommunications vendors to provide the high-speed infrastructure and services that connect the schools to the state-administered intranet and the World Wide Web.[213]

d. Discussion

158. Miller, South Dakota is an example of a small town in which high-speed service has been fully deployed by one provider. Unlike the other case studies, there is no competition in the provision of wireline high-speed services. That high-speed facilities are being deployed in so many of the smaller towns in South Dakota served by Midcontinent, including Miller, may owe to Midcontinent's longstanding relationships with the many small rural communities it serves, and a commitment on its part to provide its service area with high quality telecommunications.[214]

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[210] *Connecting the Schools Project Installation Progress of the Digital Dakota Network* (visited May 12, 2000) <http://cts.state.sd.us/status.htm >.

[211] The network infrastructure named Digital Dakota Network (DDN) provides a frame relay or a minimum of an asynchronous transfer mode (ATM) T1 to approximately 400 public school buildings in the state. The general rule is that elementary schools (K-6) receive frame relay and that grades 7-12 receive ATM. The frame relay circuits deliver data communications (World Wide Web, e-mail, *etc.*) and the ATM circuits deliver data and video (H.320 based). South Dakota Network (http://www.sdnet.net) and US WEST (www.uswest.com) are the telecommunication companies providing frame relay and ATM services. Vtel (http://www.vtel.com) LC5000 video room systems are being installed in the eligible distance learning classrooms.

[212] The Digital Dakota Network uses asynchronous transfer mode switching centers in telecommunications central offices throughout the state. This leading edge, cell-switched technology transports voice, video and data at speeds of up to 155 Mbps. ATM augments the existing statewide US West frame relay data network.

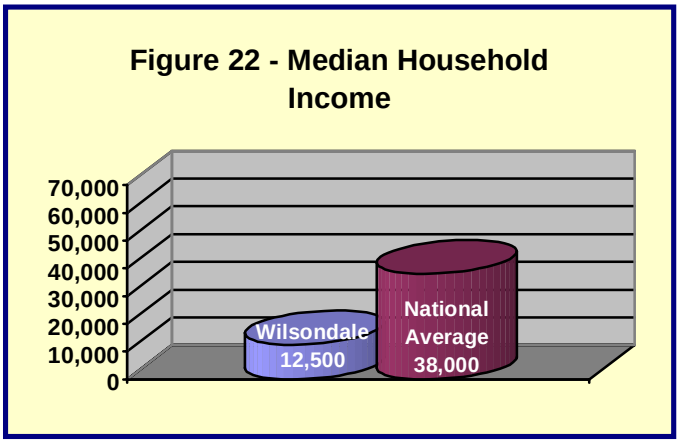
[213] US West will give schools participating in the Connecting the Schools project—including schools outside its service area—free access to more than $17 million worth of company data networking and interactive video equipment. VTEL, Cisco and 3Com are providing the equipment to US West at discounted prices. *See South Dakota: Janklow and U S West Make Giant Leap Forward in Providing Technology for State's School Children* (visited May 10, 2000) <http://www.state.sd.us/governor/Press/Releases/1999/december/USWestCTS.htm>.

[214] "Midcontinent is continuing to deploy high-speed service areas in rural America, even though the upgrades are very expensive and capital intensive. We are willing to undertake the substantial risk of deploying in low-density, high-cost areas because of the stable regulatory environment in which we have been operating, and because we believe that the service we are offering appeals to our customers." Statement of Joe H. Floyd, President and Chief Operating Officer of Midcontinent Media, Inc. at the *CEO Summit on Rural Telecommunications*, Washington, D.C. (Sept. 9, 1999). *The United States Senate: CEO Summit on Rural Telecommunications – Closing the Digital Divide* (visited July 3, 2000). <http://www.senate.gov/~dpc/events/990909>.

5. Wilsondale, West Virginia

a. Introduction

159. Wilsondale is a small, unincorporated town in Wayne County in southwestern West Virginia, on the edge of Cabwaylingo state forest. It is located on rural route 41, near highway 52. With a population of 571, Wilsondale is a residential town where about 80% of the 199 households are single family homes.[215] The population density is low, at about 17 persons per square mile. The median household income is $12,500, below the 2nd percentile in the nation. (See Figure 22.) Wilsondale was formerly a coal-mining town with a school, but there are no longer businesses or schools in Wilsondale. School-aged children attend schools in the neighboring towns of Dunlow, Crum or Wayne.



160. Verizon (formerly Bell Atlantic) is the incumbent carrier for Wilsondale itself, providing service from a switch in the nearby town of Kermit. Also, three of the schools that Wilsondale children attend, Crum Elementary, Crum Middle School and Tolsia High School lie in Verizon territory. Verizon currently has no plans to deploy high-speed services to Wilsondale.

161. Citizens Telecommunications Company of West Virginia (CTC-WV) is the principal incumbent local exchange carrier for much of Wayne County, and serves two schools that Wilsondale children attend, Dunlow Elementary and Wayne High School. CTC-WV does not receive Rural Utilities Service funds.

162. There is no cable operator serving Wilsondale. Charter Systems is the cable operator for the nearby towns of Dunlow and Crum, where Wilsondale children attend school. Charter Systems is in the process of updating its cable plant throughout Wayne County to two-way, but does not plan to extend any service to Wilsondale at this time.

b. Current Deployment

163. As noted, high-speed wireline service is not available in Wilsondale. No cable operator has found that there is even enough of a market to provide cable programming services to Wilsondale.

164. DirecPC offers high-speed Internet access across most of the U.S. and Wilsondale residents may obtain high-speed Internet access via satellite through this service. According to the DirecPC web site, the nearest brick and mortar retail outlet for DirecPC equipment is 165

[215] *See* Wayne County Homepage (visited July 7, 2000) <http://www.elocal.com/start.asp?cc=4&zipcode=&countyid=3036&portalid=0&stateid=48&cityid=30079&cs=5&parentid=197>.

miles away.[216]

c. Schools and Libraries

165. There are no schools in Wilsondale. The children attend elementary schools in the nearby towns of Dunlow and Crum. The middle school is located in Crum, and high school students attend one of two schools, Tolsia High School or Wayne High School, both north of town.

166. The Wayne County school system Technology Coordinator reported that none of the five schools have a high-speed Internet connection. The schools access the Internet over shared 56 kbps lines using Cisco 2500 routers. Tolsia H.S. has approximately 100 computers for 445 students on one 56 kbps line. The 594 students of Wayne H.S. share one 56 kbps line with 482 Wayne Middle School students. Thus, approximately 200 computers share the Wayne H.S. 56 kbps line. Crum Middle School's 45 computers and Crum Elementary School's 77 computers share a 56 kbps line using a frame relay circuit that is typically used for data traffic. Dunlow Elementary has approximately 35 computers for 103 students on a 56 kbps line. Thus, the computer density per student is high, but the number of computers sharing a 56 kbps line causes slow connections. Tolsia H.S. has received nearly $5000 in E-rate discounts. The Wayne County school system has received $210,000 in E-rate funds to support these services.

167. CTC-WV, the incumbent carrier for most of Wayne County, donated the routers and equipment for schools in its service area, Dunlow Elementary and Wayne High School. CTC-WV also installed and maintained the systems for one year. CTC-WV does not currently have plans to provide high-speed Internet connections to these schools, but could provide T1 lines to the schools at a discounted rate. Verizon, the incumbent carrier for Crum, assisted Crum schools with Internet connection through its World School program. Verizon donated a Cisco router to Crum Elementary and Crum Middle Schools for connection over their 56 kbps frame relay circuit. Verizon also donated free installation, browser software, training, two years of router maintenance and 2 years of Internet access. The schools also use the frame relay circuit for a state-wide administrative data network. Verizon provided the same equipment and services to Tolsia H.S., which is also a part of a Verizon-sponsored video distance learning pilot program. For the distance learning program, Verizon provided $50,000 in video equipment and an 80% discount on an upgraded router. This will enable Tolsia to disconnect its 56 kbps frame relay circuit and use a T1 line and ATM for both video and high-speed Internet access.

168. The area cable operator, Charter Systems, provides free cable to the area schools. Charter Systems is in the process of upgrading its system in Wayne County to two-way traffic and may be able to provide high-speed service to the schools when finished, but does not currently have plans to do so.

169. The school system receives annual state money for technology that is shared among the 21 schools in the county. West Virginia SUCCESS[217] funding provides about

[216] *See also supra* paras. 58, 122.

[217] SUCCESS, Student Utilization of Computers in Curriculum for the Enhancement of Scholastic Skills is an eight million dollar per year state funding program to provide technology tools to prepare students in grades 7-12 for college and employment. *See WV SUCCESS* (visited July 25, 2000) <http://access.k12.wv.us/success/>.

$200,000 per year for computer and network improvements and West Virginia Basic Skills funding provides about $180,000 per year to support a Compass Learning system.[218] According to the Wayne County School System Technology Coordinator, the funds were not distributed evenly among all the schools, because the impact would be minimal. Instead, funds were used first to create half-computer labs in the largest schools, then to upgrade the labs to full labs, then to bring computers to the smaller schools, and finally to bring computers into the classrooms. In addition, the school system has a Cisco Academy[219] lab in each high school. The school system also uses various grants and gets some funds from the governor when money from the state budget remains at the end of the fiscal year.

d. Discussion

170. Wilsondale, West Virginia is an example of a residential rural town with a small population, low population density and no broadband service. There are no plans to deploy broadband service to Wilsondale. For a small, rural town such as Wilsondale, adequate school and library Internet access is critical. Such towns could benefit from broadband connections to the area schools. Programs such as E-rate, in connection with assistance from local carriers or cable providers and state funding can make a great difference in bringing broadband service to these areas.

6. Best Practices

171. In addition to the geographic area case studies, we have also conducted, in conjunction with the Federal-State Joint Conference on Advanced Services, a review of community-based deployment efforts to identify best practices which have led to increased access to advanced telecommunications capability. This information has been developed through the series of hearings and site visits sponsored by the Joint Conference, the development of the database on project characteristics and literature review. The field hearings, site visits, and the Joint Conference's growing database of community deployment efforts,[220] have provided important insights into the kinds of efforts that can successfully bring advanced services to a diverse range of communities. This section outlines some of these successful strategies.

a. The E-rate and Rural Health Care Programs

172. The E-rate and the Rural Health Care Program, both elements of our universal service program, have been successful in bringing advanced services to many communities. The E-rate provides discounts on telecommunications and Internet services as well as on some of the

[218] Compass Learning, formerly Jostens Learning System, is a provider of instructional software to schools to help teachers manage student performance personalize learning, and connect communities of users. *See Compass Learning – About Us* (visited July 25, 2000) <http://www.compasslearning.com/about/about01.html>.

[219] The Cisco Networking Academy is a self-paced web program that teaches students to design, build, and maintain computer networks. It uses web-based delivery of educational content, coupled with online tools and network-based applications that provide a hands-on approach *See*, *Cisco Networking Academy Program – Program Overview*, (visited July 25, 2000) <http://www.cisco.com/warp/public/779/edu/academy/overview.html>.

[220] *See* <http://www.fcc.gov/jointconference>.

inside wiring and equipment necessary to bring modern communications technology to K-12 schools and public libraries. The program gives priority to applications from poor and rural schools. It funds eligible requests for telecommunications and Internet services before requests for internal connections. It funds eligible services regardless of the speed at which they provide transmissions.

173. The Rural Health Care Program provides discounts on telecommunication services for not-for-profit rural health care facilities to bring their rates for telecommunications services down to that of similar services in urban areas. The program provides discounts for telecommunication services related to telemedicine regardless of the speed of the transmission.

174. Both of these programs are designed to provide direct benefits to the recipients. At the same time, they can increase local demand for advanced services, improving the economics of building out necessary infrastructure. They can also provide exposure and training to the potential of advanced services, which may further stimulate demand.

175. The E-rate allows schools and libraries to obtain high-speed services where they had not been previously able to do so. In some instances the E-rate has made possible an advanced service connection to the Internet where even dial-up access was not available before. In the Alaska Field Hearing, we heard testimony from a remote school district that the E-rate is the single largest factor responsible for connecting virtually all rural Alaska schools to the Internet, most at least at speeds that at least meet our definition of high-speed service.[221] The Rural Health Care Program, too, has brought advanced services to many rural communities, and will provide over $9 million dollars in funding to support to applicants around the country by the end of its second year.[222] In the Aleutian Islands in Alaska, the rural health care corporation and the school district have been able to work together to build a shared network and leverage the discounts each receives from these universal service programs to obtain more bandwidth than either could do on its own.[223]

176. In Florida we heard testimony on how the E-rate enables libraries to provide consumers with both improved access to advanced services, and with the training necessary to take full advantage of the opportunities that these services present.[224]

b. Demand aggregation

177. One successful deployment technique is the practice of aggregating customer demand for advanced services when seeking a provider. Through this method, groups of customers can substantially reduce providers' customer acquisition costs, demonstrate demand sufficient to warrant infrastructure investment and use facilities efficiently.

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[221] Transcript of April 17, 2000, Alaska Field Hearing, <http://www.fcc.gov/jointconference/jc-transc-ak3.htm#beckley> (Alaska Field Hearing).

[222] *Universal Service Administrative Company 1999 Annual Report to Congress and the FCC: Reaching and Connecting Americans*, March 31, 2000.

[223] Alaska Field Hearing, <http://www.fcc.gov/jointconference/jc-transc-ak3.htm#beckley>.

[224] Transcript of June 9, 2000, Florida Field Hearing at 51, 137 (Florida Field Hearing).

178. Berkshire Connect[225] is an example of a successful demand aggregation effort. In rural Berkshire County, Massachusetts a consortium of business, cultural, academic and local economic development leaders formed Berkshire Connect and created an attractive market by aggregating demand from all sectors and all levels of users. The consortium was able to attract several million dollars for the construction of new facilities. As a result, they are now able to purchase advanced services at rates comparable to those paid in Boston. The Commonwealth of Massachusetts, through its Massachusetts Community Network, has taken a similar approach using the combined demand of local government traffic. The state requested bids for T1 services to all of its municipal governments and schools. To win the contract, the bidder was required to offer the same price for T1 service to any customer, regardless of location. According to the Project's management the winning contract cut T1 costs in Massachusetts nearly in half, and guaranteed access to T1 services for all towns, villages and schools in the state.[226]

c. Anchor Tenants

179. Anchor tenancy has also proved successful. In this strategy a public entity, or other large customer, uses its demand to attract investment in infrastructure with advanced telecommunications capability. The infrastructure which is used to provide service to this anchor tenant can then be used by other business and residential consumers, or it can be the springboard for deployment of additional facilities. In some instances, public entities acting as the anchor tenant have put conditions on their purchase agreements, such as requiring providers to serve rural areas in a certain time frame.

180. In Colorado, the state has acted as an anchor tenant. Colorado requested bids for high-speed service at each of its 64 county seats to carry the State's data traffic, such as data related to driver's license and registration and that related to public assistance benefits. The state intended to offer a multi-year contract to the winning bidder. Bids were evaluated based on price, and how quickly remote counties would be served. The state chose a winning bidder in April 2000, and by 2003 the successful bidder will be serving all counties with advanced telecommunications capability.[227] The State of Montana has undertaken similar initiatives, the most recent is called SUMMITNET II. This project connects 9 Montana communities and carries the traffic of public and educational entities. In addition to providing direct benefits to the public customers involved, the project sponsors believe it will to bring investment in advanced services capability to these communities.[228]

d. Public Investment

181. Direct public investment in desired infrastructure has also been used. There are many instances where a municipality, usually one that already provides another utility service like

[225] Transcript of May 22, 2000, Massachusetts Field Hearing at 96-104 (Massachusetts Field Hearing). *See also Berkshire Connect* (visited July 25, 2000) <http://www.bconnect.org>.

[226] Massachusetts Field Hearing at 114-115.

[227] *Owens Announces $37 Million State Contract for US West to Build High Speed Computer Network Linking all of Colorado* (visited Aug. 2, 2000) <http://www.state.co.us/gov_dir/o4-17-00a.htm>.

[228] Transcript of June 21, 2000, Montana Field Hearing at 24 (Montana Field Hearing).

cable or electricity, builds its own high-speed telecommunications facilities and directly serves customers. In other instances, states have invested in substantial fiber networks to schools or other customers.

182. Hawarden, Iowa took this approach. The City of Hawarden operated a successful electric and cable utility. Unhappy with the telecommunications service options available to them, the City decided to build its own advanced telecommunications facilities. They have now built a hybrid fiber coaxial cable network throughout the town. Businesses in the community that previously feared being left behind in a digital age, no longer fear being forced to relocate to have access to the modern communications they need. [229] In Orange City, Iowa the town government formed a partnership with its local telephone companies and is building a wireless system that is bringing high-speed Internet to its citizens. The case studies of both Waltham, Massachusetts and the Muscatine, Iowa illustrate the strong role public investment has played in those communities.[230]

e. Use of Unlicensed Spectrum

183. Several entries in our database are from small local Internet Service Providers who have used unlicensed spectrum in the 2 GHz band. This unlicensed spectrum can be used with little capital outlay to provide high-speed Internet access. Use of the spectrum does not require a license. Providers in rural counties in Utah, Wisconsin and Indiana all point to this unlicensed spectrum as the only realistic high-speed option for their communities.[231]

f. Strategic Planning

184. Several communities also point to the importance of incorporating telecommunications needs into other planning efforts in the community such as economic development, education and healthcare. Through these efforts community leaders can understand the potential uses and demand for high-speed services. Then, by combining this knowledge with an understanding of the existing infrastructure and the service options available, community leaders can strategize on how to obtain the advanced services they need. Several communities have cited knowledgeable staff or consultants as being crucial to developing and implementing a strategic telecommunications plan. The city of Waltham, Massachusetts, points to its hiring of a consultant as crucial to its success in providing so many options to its citizens. Colonel Michael McCabe of the Montana Army National Guard views his organization's use of an independent consultant as critical to understanding their needs and how to meet them.[232] The state of Colorado has made grants available to local governments to address this issue in a companion effort to its demand aggregation initiative. Local governments use these grants to develop

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[229] Transcript of April 19, 2000, Nebraska Field Hearing at 37 (Nebraska Field Hearing). Remarks of Jerry Klemme, Loll Craft Industries, Hawarden, Iowa site visit (Apr. 20, 2000).

[230] *See supra* sections IV.D.2, IV.D.3.

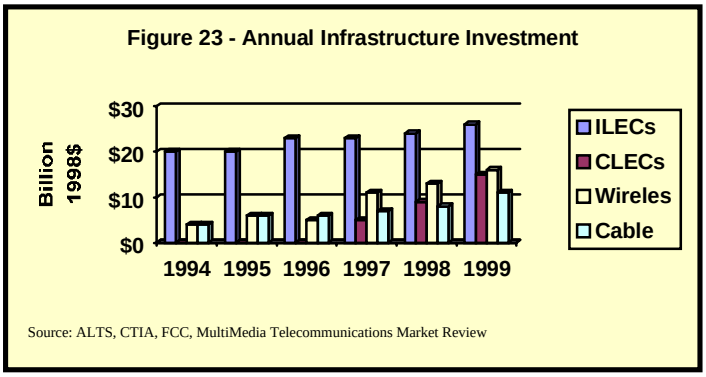
[231] See database entries from Walworth County, Wisconsin by Bella Mia, Inc.; Knox, Indiana by Wabash Valley Computing of Indiana, Inc.; Sevier, Utah by AirZip Internet, all available at <http://www.fcc.gov/jointconference>.

[232] Montana Filed Hearing at 33.

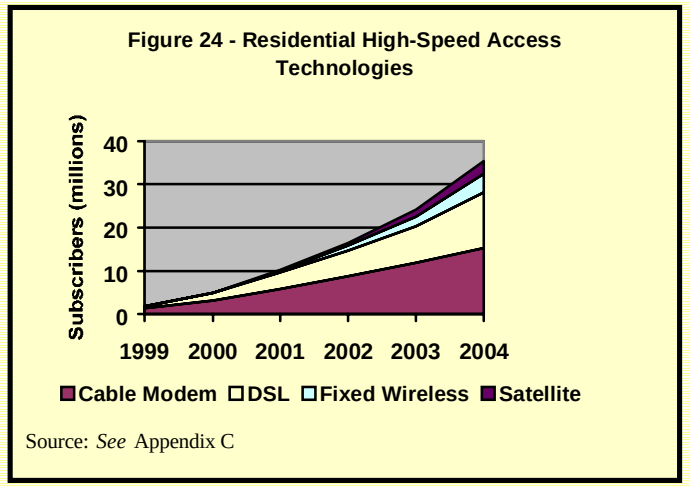
strategic plans for connecting their communities to the statewide network.[233]

E. Investment and Growth in High-Speed Access Technologies

185. Overview. Since 1996, industry investment in infrastructure to support high-speed services has increased dramatically, and analysts forecast that this upward trend will continue. One factor spurring this rise in investment appears to be the introduction of competition into the telecommunications market. Since the passage of the 1996 Act, infrastructure investments by incumbent LECs, competitive LECs and wireless carriers have risen substantially. Cable companies also began investing in facilities upgrades at about the same time. (See Figure 23.)

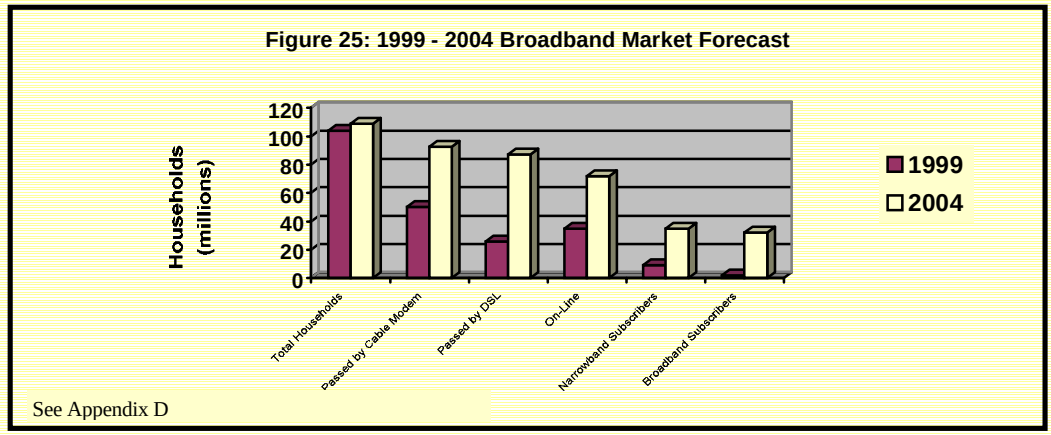


186. An equally significant factor driving infrastructure investment is the rapidly rising demand for high-speed services. Only a few years after the wide availability of Internet service, approximately 33% of US households are on-line, with the vast majority (92%) of these relying on narrowband connections. Within the next five years, analysts predict that the number of on-line households will more than double, to 67%, and between a third and a half of those access connections will be high-speed. (See Figure 24.) Thus, analysts call for residential high-speed subscribership to increase from 1.9 million at the beginning of 2000 to 35 million at the end of 2004.[234] With narrowband subscribership staying relatively constant during this time, high-speed will represent a major growth opportunity for the industry, rather than merely a new offering for former narrowband subscribers. (See Figure 25.)

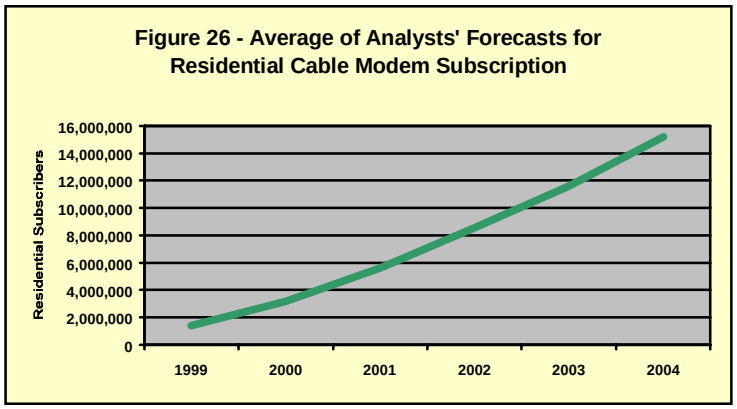


[233] *Bean Pole Project - Community Based Access grants* (visited Aug. 4, 2000) <http://www.state.co.us/mnt>.

[234] *See* Appendix D. *See also*, Morgan Stanley Dean Witter, *Broadband Report* at 13; Berstein/McKinsey, *Broadband!* at 33; Blake Bath, Lehman Brothers, *Broadband Report Card-Conference Call Notes* at 2 (Apr. 2000) (Lehman Brothers, *Broadband Report Card*); Telechoice, *DSL Deployment Summary, Projections, Updated Nov. 5, 1999* (visited July 25, 2000) <http://www.xdsl.com/content/resources/deployment_info.asp>; Strategis Group, *High-Speed Internet Report* at 129; Pioneer, *CLEC Report* at 6-13; Jonathan Atkin and David Coleman, Dain Rauscher Wessels, *Bullish on Broadband* at 77 (2000) (Dain Rauscher Wessels, *Bullish on Broadband*); Richard Klugman, *Telecommunications Services, First Quarter 2000 Preview* at 8 (Apr. 17, 2000).



187. Cable: The cable television industry currently provides video programming service to over 67.3 million subscribers, and has facilities that pass approximately 94% of U.S. households.[235] Industry studies report that by year-end 1999, upgraded cable plant, capable of providing service to cable modems, was available to 52% (50.3 million) of the country's 96.6 million homes passed by cable.[236] Analysts expect the percentage of two-way enabled cable plant to continue to grow at an average of 7.5% each year through 2003.[237] Within five years, analysts project that 84% of all US households will be passed by infrastructure capable of providing cable modem service.[238] (See Figure 26.)



188. Over the past five years, cable operators have increased their aggregate

[235] Paul Kagan Assocs., Inc., *10-Year Cable TV Industry Projections*, Cable TV Investor, Jun. 19, 2000 at 6.

[236] *See* Paul Kagan Assocs., Inc., *Media Index DataBase*, *The Kagan Media Index* at 8 (Jan. 31, 2000); Bernstein/McKinsey, *Broadband!* at 30. According to Morgan Stanley Dean Witter, almost one-third of all U.S. households were passed by cable modem infrastructure as of year-end 1999. *See* Morgan Stanley Dean Witter, *Oligopoly Lounge* at 15. Among the seven largest cable operators the percentage of upgraded facilities ranged from 32% to 85%. *See* Appendix D (Cable Company Specific Statistics on Upgrades, Investments).

[237] Bernstein/McKinsey, *Broadband!* at 30. *See also* Raymond Lee Katz and Adria B. Markus, Bear Stearns, *Cable Advanced Telecommunications Capabilities and Broadband, Byte Fight! Competition and Response in Residential Video and Broadband* at (2000) (Bear Stearns, *Byte Fight!*) ("Upgrades should be completed by year-end 2003, although we believe most of the operators we follow will be largely completed with their upgrades by the middle of 2002."); Merrill Lynch, *Cable Television* at 23 (Apr. 26, 2000) ("Merrill Lynch, *Cable Television*") ("By the end of this year, cable plants should be 60% to 85% upgraded to 750 MHz with two-way capability. By YE00, we anticipate that over 80% of cable plants will be upgraded and by YE01 we project that most of the plant upgrades will be complete."); Morgan Stanley Dean Witter, *Oligopoly Lounge* at 15.

[238] Morgan Stanley Dean Witter, *Broadband Report* at 10, 13 (cable modem pass 31% of households in 1999 and will increase to 84% of households in 2004).

infrastructure investment expenditures by between 10 and 25% annually.[239] Cable operators report aggregate expenditures of as much as $3.4 billion in 1999 for system upgrades – $2.3 billion for general system upgrades necessary to deploy high-speed data and $1.1 billion specifically for data access system modifications.[240] One analyst projects an 11% increase this year in capital expenditures by cable operators over 1999, with total capital expenditures of $3.8 billion, including $1.2 million for data-specific modifications.[241] However, this analyst also predicts a slight reduction and leveling of capital expenditures between 2001 and 2005 at approximately $2.5 billion annually.[242]

189. Industry analysts estimated an average of 1.42 million cable modem subscribers in the U.S. at the end of 1999[243]; this represents a penetration rate of 3%. Our Broadband Survey Data reported 1.41 million cable modem lines in service. Industry analysts estimate that**,** as of June 2000, the number of cable Internet subscribers in the United States has increased to 2.3 million, with reports of 7,500 new installations per day.[244] By year-end 2000, industry analysts estimate cable modem subscriptions will more than double, to 3.2 million subscribers.[245] Many analysts expect that over the next five years, cable modem subscriptions will continue to increase dramatically, reaching an average estimate of 15.2 million subscribers by year-end 2004[246];

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[239] *1999 Video Competition Report*, Report, 15 FCC Rcd 978, 997 at para. 39 (2000); Paul Kagan Assoc., Inc., *Estimated Capital Flows in Cable TV*, CABLE TV FINANCE at 2 (May 1999); Paul Kagan Assoc., Inc., *Estimated Capital Flows in Cable TV*, CABLE TV FINANCIAL DATABOOK at 149(Aug. 1999); Jessica Reif Cohen and Nathalie Brochu, Merrill Lynch, *Cable Television, Q1E: Digital and Data Rollouts Accelerating Significantly* at 25 (Apr. 2000); Multimedia Telecommunications Association and Telecommunications Industry Association, *2000 MultiMedia Telecommunications Market Review and Forecast* at 65 (2000) (MultiMedia, *2000 Market Review and Forecast*).

[240] Morgan Stanley Dean Witter, *Oligopoly Lounge* at 33.

[241] *Id.*

[242] *Id*.

[243] Dain Rauscher Wessels, *Bullish on Broadband* at 77. *Cf*. Strategis Group, *US Wireless Broadband* at 208.

[244] *Cable-Modem Count Rises* (June 8, 2000) (visited July 25, 2000) <http://www.multichannel.com/daily/26.shtml>.

[245] Morgan Stanley Dean Witter, *Oligopoly Lounge* at 15; Bernstein/McKinsey, *Broadband!* at 33; Lehman Brothers, *Broadband Report Card* at 2; Richard Klugman, *Telecommunications Services: First Quarter 2000 Preview*, at 8 (Apr. 17, 2000) (DLJ, *1Q Preview*); The Strategis Group, *High-Speed Internet: Cable Modems, DSL and Wireless Broadband* at 129 (Dec. 1999) (Strategis Group, *High-Speed Internet Report*); Pioneer Consulting, *Data CLEC's: xDSL Markets and Opportunities for Small and Medium-sized Businesses* at 6-13 (1999) (Pioneer, *CLEC Report*); Raymond Lee Katz, Adria B. Markus, Bear Stearns, *Cable TV & Broadband* at 45 (Apr. 2000) (Bear Stearns, *Cable TV & Broadband*).

[246] Morgan Stanley Dean Witter, *Oligopoly Lounge* at 15; Bernstein/McKinsey: *Broadband!* at 33; Lehman Brothers, *Broadband Report Card* at 2; DLJ, *1Q Preview* at 8; Strategis Group, *High-Speed Internet Report* at 129; Pioneer, *CLEC Report* at 6-13; Bear Stearns, *Cable TV & Broadband* at 45.

forecast penetration rates for cable by 2004 range from 17% to 30%.[247]

190. Cable operators invested earlier than other service providers in upgrades of their systems to provide residential customers with high-speed access to the Internet and other public data networks, in part in response to potential competition from other service providers such as telephone companies and DBS.[248] As a result, cable operators had captured over 70% of residential high-speed data subscribers nationwide by the end of 1999,[249] and they are likely to remain a strong presence among residential subscribers in the future. Cable's share of subscribers to advanced services will likely decline over time, however, as competitors to cable complete their facilities deployment to offer high-speed services on a widespread basis.[250]

[247] Jessica Reif Cohen and Nathalie Brochu, *Q4: Cable Modems, Christmas 1999's Hot Toy! Expect High-Speed Data to Drive Results in 2000*, Merrill Lynch, Feb. 16, 2000 at 34 (Merrill Lynch, *Q4 High-Speed Data Drives Results*); *see also* authorities cited *supra* note 234. *See also*, Appendix D.

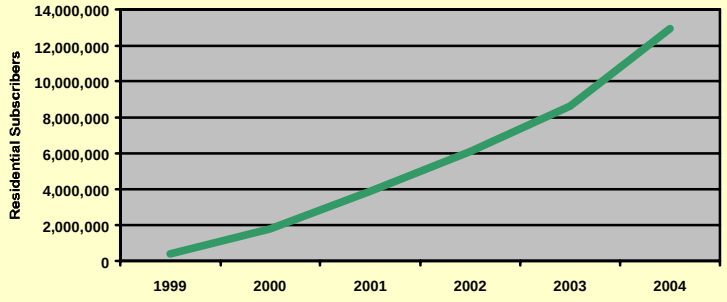
[248] *See e.g.*, Dain Rausher Wessel, *Bullish on Broadband* at 96.

[249] *Supra* para. 70.

[250] Morgan Stanley Dean Witter, *Broadband Report* at 10; Stephen Flynn, Jeffrey Camp, and Sean Grogan, Morgan Stanley Dean Witter, *Specialty Broadband* at 85 (2000) (Morgan Stanley Dean Witter, *Specialty Broadband*); Dean Rausher Wessels, *Bullish on Broadband* at 8; Bernstein/McKinsey, *Broadband!* at 30.

191. Wireline: At the beginning of 2000, analysts estimate there were approximately 500,000 DSL subscribers.[251] This represents about 11% of the total high-speed access subscribers and about 1.3% of the total on-line market.[252] Alone, the first quarter of 2000 saw more than 250,000 new DSL subscribers.[253] Incumbent LECs reported increases of between 25 and 50%, and competitive LECs reported subscriber increases of between 50 and 80%.[254] Analysts project 2 million DSL subscribers by the end of 2000.[255] Many analysts predict that, over the next five years, residential DSL subscription will grow to 13 million[256] Others suggest that the data market is growing at 30% per year.[257] (See Figure 27.)

Figure 27 - Analysts' Forecasts for DSL Subscription



Source: See Appendix D

192. In 1999, incumbent LECs invested almost $25 billion in infrastructure.[258] Competitive LECs' capital expenditures have also grown dramatically, rising from $5 billion in 1997, to $9.2 billion in 1998, and to $15.1 billion in 1999.[259] One analyst predicts that incumbent LECs will spend more than $8 billion dollars over the next four years just to provision DSL

[251] DSL Prime News, *US DSL Deployment and Subscribers*, Updated Feb. 4, 2000 (visited May 10, 2000) <http://www.dslprime.com/News_articles/availability.availability.html>; TeleChoice DSL Deployment Summary – Updated 5/5/00 (visited May 10, 2000) <http://www.xdsl.com/content/resources/deployment_info.asp>. Incumbent LECs were providing service to over 75% of those subscribers; competitive LECs were providing service to approximately 24%; and IXCs were serving the remaining 1%.

[252] Bernstein/McKinsey *Broadband!* at 33; Bear Stearns, *Cable TV and Broadband* at 72; Morgan Stanley Dean Witter, *Broadband Report* at 16.

[253] TeleChoice DSL Deployment Summary – Updated 5/5/00 (visited May 10, 2000) <http://www.xdsl.com/content/resources/deployment_info.asp>.

[254] Dave Burnstein, DSL Prime News, *The Numbers – First Quarter US Subscribers* at 1 (May 4, 2000).

[255] *See* authorities cited *supra* note 234.

[256] *See* authorities cited *supra* note 234.

[257] Dain Rauscher Wessels, *Bullish on Broadband* at 6.

[258] ALTS Annual Report *State of Competition in the US Local Telecommunications Marketplace* at 4 (Feb. 2000); Multimedia Telecommunications Association 2000, *Multimedia Telecommunications Market Review* at 55 (this is total capital investment, only portions of which are allocable to the provision of DSL).

[259] ATLS Annual Report, Graphic F, referencing PaineWebber and New Paradigm Resources Group. These investment figures represent capital expenditures by competitive LECs of over 56% of their revenues and expenditure by incumbent LECs of 23% of their revenues. ALTS Annual Report, Graphic G (citing company reports and New Paradigm Resources Group).

service.[260]

193. Investments in fiber and fiber optic equipment also illustrate the increasing trend in high-speed investment. Incumbent LEC fiber deployment has increased annually each of the past 10 years, including a 14.7% increase in 1998.[261] Competitive LECs increased deployment of fiber 66% in 1998 alone.[262] At least one analyst predicts a compound annual growth rate of 61% in fiber deployment for residential access in the next 5 years.[263] Similarly, annual spending on fiber optic equipment has tripled in the past ten years: in 1999 it was $14.6 billion. At least one analyst predicts that spending on fiber optics will continue at close to current levels for the next several years as new network deployments are completed.[264] Indeed, this analyst foresees a jump in spending on fiber optic equipment to $28 billion in 2003, a compound annual growth rate in excess of 23%.[265]

194. More broadly, the industry landscape also indicates a significant increase in investment. In 1996 there were nine public competitive LECs with a total market capitalization of $3.1 billion. In 1999, there were 35 competitive LECs with a market capitalization of $86.4 billion.[266] Eleven competitive LECs held initial public offerings in 1999, raising over $1.5 billion, and strategic investments within the competitive LEC sector raised an additional $7.4 billion in equity for these carriers.[267]

195. Currently, analysts estimate 25% of US households fall within the distance limits of a central office from which DSL is now being offered.[268] At least one analyst projects DSL penetration to increase from 2% in 1999 to 27% in 2004 and projects the number of households to which DSL is available to increase from 25% in 1999 to 80% in 2004.[269] Some analysts predict that DSL subscription will outpace new cable modem subscription in part because of the ease of DSL modem "plug and play" installation which reduces the need for technician visits.[270] Additionally, growth in the small to medium-sized business market is expected to be strong and may cause DSL to capture a larger share of high-speed access than cable.

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[260] Bernstein/McKinsey, *Broadband!* at 72.

[261] FCC Fiber Deployment Report at 2, Tbl. 6; MultiMedia, *2000 Market Review and Forecast* at 64.

[262] MultiMedia, *2000 Market Review and Forecast* at 65.

[263] *Id*. at 67.

[264] *Id*. at 68.

[265] *Id*.

[266] ALTS Annual Report at Graphic O.

[267] ALTS Annual Report, Graphics D and E; Dain Rausher Wessels, *Bullish on Broadband* at 15-17.

[268] Morgan Stanley Dean Witter, *Broadband Report* at 16; Bernstein/McKinsey, *Broadband!* at 30.

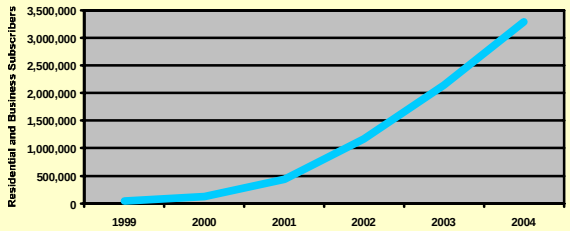
[269] Morgan Stanley Dean Witter, *Broadband Report* at 16; Bernstein/McKinsey, *Broadband!* at 30.

[270] Bernstein/McKinsey, *Broadband!* at 31. Standardized modems are not yet available and many consumers complain that DSL installation currently is fraught with difficulty.

196. DSL deployment started later than cable upgrades and began in response to the 1996 Act and the presence of competitive access providers. The availability of unbundled network elements and line sharing has spurred tremendous investment in DSL deployment. DSL equipment is currently installed in approximately 27% of the nation's central offices, as contrasted with cable having 52% of its plant currently upgraded. However, analysts project continued increases in annual capital expenditures by both incumbent and competitive LECs. This suggests continued growth for several years before infrastructure investment will level off. Analysts project that in the next five years DSL will have 13 million household subscribers which is 36 % of the residential high-speed market and 18% of the on-line market.[271] Analysts also predict DSL has the potential to reach 80 % of households.[272]

197. Wireless: Analysts expect the market for fixed wireless high-speed services to grow significantly over the next 3 to 5 years. Analyst projections for fixed wireless growth in the residential market range from 2 to 2.6 million subscribers in 2003 and from 3 to 4.4 million subscribers in 2004.[273] These estimates suggest penetration levels of between 12 and 15% of the projected residential high-speed market.[274] Projections for business use of fixed wireless high-speed range from 364,000 to 450,000 subscribers in 2003, with at least one analyst projecting an additional 100,000 unlicensed wireless business users in 2003.[275] Business use projections for wireless high-speed service beyond 2003 vary widely, from 14% to 50% penetration of the high-speed business market.[276] (See Figure 28.) One analyst predicts that by 2003, lowerband wireless providers will reach 34% of US households and upperband providers will reach 13% of US households.[277]

Figure 28 - Average of Analysts' Forecasts for Residential and Business High-Speed Terrestrial Wireless Subscription



Source: See Appendix D

198. Capital expenditures by MDS providers for two-way high-speed services began recently, in part because two-way service was authorized just two years ago, in September of

[271] See authorities cited *supra* note 234.

[272] Bernstein/McKinsey, *Broadband!* at 30; Morgan Stanley Dean Witter, *Specialty Broadband* at 16.

[273] Peter Jarich and James Mendelson, Strategis Group, *U.S. Wireless Broadband* at 243, 252, 262; Strategis Group, *High-Speed Internet Report* at 131; Bernstein/McKinsey, *Broadband!* at 33.

[274] Bernstein/McKinsey, *Broadband!* at 33.

[275] Strategis Group, *U.S. Wireless Broadband* at 243, 252, 262; Strategis Group, *High-Speed Internet Report* at 131; Bernstein/McKinsey, *Broadband!* at 33.

[276] Strategis Group, *U.S. Wireless Broadband* at 243, 252, 262; Strategis Group, *High-Speed Internet Report* at 131; Bernstein/McKinsey, *Broadband!* at 33; Wireless Week, *The Year of the Launch* at 1A (June 5, 2000).

[277] Strategis Group, *US Wireless Broadband* at 241, 251, 260.

1998.[278] Capital expenditures by MDS providers are expected to increase significantly in the next few years, as two-way fixed wireless services are currently in the early stages of deployment.[279] Even within the past year, acquisitions and consolidations within the MDS industry have accounted for more than $2 billion in transactions.[280] Although much of the spectrum used to provide MDS service was originally licensed, rather than being auctioned, auctions of some remaining MDS spectrum aroused substantial interest in the industry, bringing bids in excess of $216 million.[281]

199. Capital expenditures by upperband wireless providers have increased significantly in the past few years. Teligent reports capital expenditures of $262 million in 1999, up from $183 million in 1998.[282] Capital expenditures by upperband wireless services are expected to increase further over the next few years.[283] One analyst predicts cyclical LMDS capital expenditures over the next four years, reflecting market by market buildout schedules, with an initial 8-fold increase in hub expenditures this year.[284] The 28 GHz LMDS spectrum auctions have garnered $623.8 million in winning bids and the 39 GHz spectrum auctions garnered $410.6 million in winning bids.[285] Acquisitions in the upper bands in 1999 totaled another $1 billion in investment.[286] Over $36 million in public and private equity investments have been made in the past 18 months in

[278] Strategis Group, *US Wireless Broadband* at 152.

[279] Analysts estimate WorldCom will have to spend approximately $100 - $200 million in capital expenditures in 2000 and even more in 2001 to meet its plans to deploy high-speed services to 100 cities by 2001; Sprint is expected to spend $200 million on fixed wireless capital expenditures in 2000. Morgan Stanley Dean Witter, *Broadband Report* at 88, 105. *See also*, Strategis Group, *US Wireless Broadband* at 256.

[280] Sprint acquired six MDS operators for approximately $1.2 billion in 1999; WorldCom acquired four MDS operators for approximately $1 billion also in 1999. Dain Rauscher Wessels, *Bullish on Broadband* at 19.

[281] FCC Wireless Bureau, *Auction Topics, Original Auction Data, Summary Matrix* (visited Aug. 2, 2000) <http://www.fcc.gov/wtb/auctions>.

[282] *Teligent Reports $31 Million in 1999 Revenue: Expands Teach to Four Continents*, Press Release, Teligent (Mar. 6, 2000).

[283] Winstar estimates capital expenditures of approximately $1 billion in 2000. WinStar, Form 10-K at 40 (Mar. 10, 2000). Touch America anticipates spending $15 million to build it's initial LMDS footprint. *Touch America Launches Wireless, High-Speed Broadband LMDS Service in* Butte, Press Release, Touch America (Nov. 5, 1999). AT&T may spend up to $350 million on capital expenditures on fixed wireless services in 2000 in preparation for deployment of its 39 GHz licenses in 2001. AT&T Corp., Form S-3 at 60 (Feb. 2, 2000).

[284] Strategis Group, *US Wireless Broadband* at 246. (LMDS hub expenditures predicted to increase from $17.6 million in 1999 to over $133 million in 2000. LMDS hub expenditures over the next four years is expected to total nearly $700 million with almost another $700 million spent on CPE)

[285] FCC Wireless Bureau, *Auction Topics, Original Auction Data, Summary Matrix* (visited Aug. 2, 2000) <http://www.fcc.gov/wtb/auctions>.

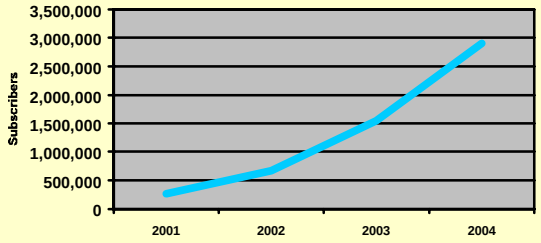
[286] In early 1999 NEXTLINK Communications acquired two LMDS companies for $695 million; in June 1999 Qwest and a group of private capital firms acquired Advanced Radio Telecom, a 39Ghz lincensee, for $251 million. Dain Rauscher Wessels, *Bullish on Broadband* at 77. *Cf*. Strategis Group, *US Wireless Broadband* at 208.

upperband fixed wireless providers.[287]

200. Wireless high-speed providers are the newest terrestrial entrants into the high-speed market. While current deployments reach less than 1% of households and businesses, terrestrial wireless has the potential to reach residential consumers and business unserved by cable or DSL and the potential to compete with cable and DSL for the potentially lucrative small to medium business market. Recent acquisitions, consolidations and investments suggest significant growth expectations for both lower band and upper band wireless providers in the next few years. Indeed, analysts predict wireless high-speed will reach 4.4 million subscribers by 2004, which would represent 12.4 % of high-speed access.

201. Satellite: High-speed service is available today by satellite, with Hughes' DirecPC being the primary provider of residential satellite high-speed service. In February 2000, Gilat Communications and Microsoft announced the development of "Gilat to Home," which is projected to offer residential two-way satellite advanced service by the end of 2000.[288] A variety of other satellite providers project deployment of systems capable of providing residential and business advanced services over the next several years.[289]

Figure 29 - Analysts' Forecasts for Satellite High-Speed Subscription



Source: See Appendix D

202. Subscriber projections for satellite high-speed systems vary significantly.[290] According to one publicly available source, residential subscription to high-speed satellite services is currently approximately 60,000.[291] Projected subscription rates by 2004 vary from 1.2 to 4.6 million.[292] (See Figure 29.) One analysts projects that satellite penetration of homes not reached

[287] Dain Rauscher Wessels, *Bullish on Broadband* at 15-17.

[288] *MSN and Gilat Satellite Networks Introduce First Consumer Two-Way Satellite High-Speed Internet Access Service*, Joint Press Release (Feb. 16, 2000). Subsequently, Direc-PC announced it too would begin two-way residential advanced service by the end of the year. *Hughes Network Systems Announces Upcoming Two-way DirecPC Satellite Internet Access*, Company News Release, Hughes Network Systems (Apr. 27, 2000).

[289] These companies include: Hughes (Spaceway), AstroLink, iSKY, CyberStar, SkyBridge, Teledesic and PanAmSat. ING Barings, *The Satellite Communications Industry*, March 2000 at 24, Exhibit 2-7 (ING Barings, *March 2000*); Merrill Lynch *Global Satellite Marketplace* at 101.

[290] ING Barings predicts that the number of residential subscribers will increase from close to 100,000 estimated in 1999 to over 39 million by the end of 2008. ING Barings, *March 2000* at 13. Banc of America Securities foresees subscription of 13 million by 2008. *See*, Banc of America Securities, *Satellite Communications Industry Overview* at 60. According to Gilat, 27 million households will only have a satellite option. *See*, James M. Gifford, *Firms Merge Broadband Internet, Satellite TV*, Space News at 12 (July 10, 2000).

[291] *Satellite Broadband Strategy Dominates SBCA*, Communications Daily (July 24, 2000).

[292] Thomas W. Watts and William W. Pitkin, Jr., Merrill Lynch *Global Satellite Marketplace* at 36 (Apr. 1999) (Merril Lynch *Global Satellite Marketplace*).

by cable systems could reach 58% by 2003, but that for households served by cable modem infrastructure, satellite penetration is expected to reach only about 8%.[293] Some analysts predict that satellite high-speed systems will become the dominant means of delivering high-speed data and Internet to users outside urban areas and in areas of low subscriber density, and, within ten years, may capture between 5 and 10% of high-speed access subscribers.[294] ING Barings estimates total investment in U.S.-based satellite high-speed projects over the next ten years to be $28.55 billion.[295] Aggregate revenue estimates for the next eight to ten years range from $15 to over $30 billion.[296]

V. IS DEPLOYMENT REASONABLE AND TIMELY?

203. As we note above, section 706 requires that the Commission assess whether the deployment of advanced telecommunications capability to all Americans is reasonable and timely. In order to make that determination, we have examined various aspects of the deployment of, and market for, advanced services. These factors break down into the following three categories. First, we examine subscription to high-speed services, focusing both on how it has changed over the last year and how it is projected to change in the future. As we discuss at greater length below, subscription rates to advanced services have increased dramatically over the past 12 months, and projections are for the growth to accelerate further over the coming years. Second, we examine investment in the infrastructure to support advanced services. In this regard, we find that industry has poured huge amounts of capital into the development of networks to provide advanced services. Third, we review trends in the alternatives available to consumers of advanced services. This includes both assessing the number of providers offering service through a particular technology and the different technological options that consumers have for obtaining advanced services. This final inquiry reveals both that competition among providers within certain technologies is emerging and that there is the potential for several different technological options for providing advanced services.

204. Using the above analytical framework, we conclude that the deployment of advanced telecommunications capability to all Americans is reasonable and timely at this time. Providers are rapidly building the infrastructure for two major types of advanced services – DSL services and cable-based services. Large-scale entry by other providers deploying fixed wireless and satellite technologies is also likely.[297] Great amounts of capital, even by the standards of the communications industry, have poured into the infrastructure for advanced services.[298] Demand,

[293] Merril Lynch *Global Satellite Marketplace* at 36.

[294] Merril Lynch *Global Satellite Marketplace* at 99-101.

[295] ING Barings, *March 2000* at 24.

[296] In addition, ING Barings Broadband Growth Forecast predicts $20 billion in service revenue by 2009. ING Barings, *March 2000* at 13. Banc of America Securities predicts revenue of $15 billion by 2008. *See*, Banc of America Securities, *Satellite Communications Industry Overview* at 60 (October 1999); Merrill Lynch *Global Satellite Marketplace* at 101.

[297] *See supra* paras. 42-59.

[298] *See supra* paras. 185 - 202.

measured by the rates of subscription to high-speed services, is increasing rapidly[299] and shows no sign of losing momentum.[300] Additionally, the growing interest in, and use of, the Internet should further enhance demand for advanced services. Our Broadband Survey shows that there is at least one subscriber to high-speed service in many small town zip codes[301] and in some zip codes that include thinly populated areas.[302] Although subscribership in sparsely populated areas is not nearly what it is in more densely populated areas, based on comments in this proceeding, a variety of strategies for bringing high-speed to these areas show some promise.

205. Despite our conclusion that deployment is reasonable and timely overall, we realize that not all Americans have access to advanced services today. Indeed, the data support the troubling conclusion that market forces alone may not guarantee that some categories of Americans will receive timely access to advanced services. These concerns may warrant two types of actions. First, recognizing that any roll out of new infrastructure necessarily reaches some customers first and others only substantially later, we may want to take action to speed deployment to the latter group. The importance of the services dependent on advanced telecommunications capability infrastructure may make it unacceptable for some customers to wait until market forces reach them. Second, we may want to take action to stimulate deployment of advanced services to places or customers that market forces alone could fail to reach.

206. We stress that it is still early in the development of the high-speed market, and even earlier in the development of the services and infrastructure with speeds of over 200 kbps in both directions. Although only 1.0% of residential and small business customers are using advanced services today, many more have it available to them. So, while there are many customers who currently do not have access to advanced services, they are not the only ones who have not subscribed to advanced services. Thus, the advanced service market has not yet reached the point of, for example, the market for voice telephone service, where those few who are not subscribing to the service are solely, uniquely and substantially disadvantaged with respect to the rest of society. Rather, because of the nascent stage of the advanced services market, we have an opportunity to take the steps necessary to prevent problems from developing. We can use this opportunity to better understand why advanced services are available in certain areas today and where market forces alone will not deploy them so that we may develop appropriately responsive public policies.

207. We have analyzed the available data from different angles. First, we have looked at the availability of different segments of infrastructure – backbone, on-ramps and the middle mile, last mile facilities and last 100 feet facilities. In addition, we have examined access to advanced services by different types of customers (*e.g.*, business and residential), in different geographic locations, and, to some extent, by customers at different income levels.

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[299] *See supra* paras. 69, 73.

[300] *See supra* paras. 0, 191, 197, 201.

[301] *See supra* note 122 (defining "small town").

[302] We consider "thinly populated territories" to be locales with zip codes that are below the 10th percentile of zip codes ranked by population density. In such zip codes, the population density is less than 5.842 persons per square mile. 0.9% of the United States' population live in such zip codes. *See supra* paras. 77 - 82 (discussing the relationship between subscribership and deployment).

1. Deployment of Backbone Facilities

208. We find, in accordance with the majority of commenters[303] and the recent report of the National Telecommunications and Information Administration (NTIA) and the Rural Utilities Service (RUS),[304] that there is ample deployment of backbone and other fiber facilities that provide backbone functionality. In general terms, fiber capable of supporting advanced telecommunications is available nationwide. There has been extensive fiber deployment even in some largely rural states, such as Iowa and South Dakota. Many existing fiber routes have "dark fiber" and other capacity that has been installed but is not being used for commercial purposes. In addition to fiber backbone facilities, satellite systems provide equivalent high-speed transport for commercial entities. Many nationwide businesses use high-speed satellite capacity for credit card verification and inventory control, and recently for Internet access. Despite setbacks by new satellite providers in the past year, many analysts are confident that in the future, both business and consumers will rely heavily on satellite systems for high-speed services.[305]

209. There is no indication that rural areas as a whole have inadequate access to backbone or functionally equivalent facilities. This does not mean that backbone facilities pass through – or even close to – all rural areas. But we agree with the NTIA/RUS Report and other parties that this does not generally affect rural access to advanced services.[306] Much of the existing infrastructure, even if it is not backbone, can allow traffic to travel at high speeds to reach the backbone. As discussed below, however, cost may be a barrier.

2. Middle Mile Facilities.

210. We conclude, based on a number of indicators, that sufficient middle mile functionality exists. First, extensive facilities for middle mile transport exist. Thus, incumbent local exchange carriers have widely deployed high speed, inter-office fiber. Indeed, significant amounts of dark fiber exist between incumbent LEC central offices.[307] The KMI map, Figure 1, depicts much of the nation's middle mile fiber facilities. We also note that terrestrial wireless and satellite providers appear to be starting to provide middle mile transport services. Second, innovative compression and modulation techniques continue to expand the capacity of existing fiber links. Third, the geographic distribution of high-speed service subscribers, indicated by our

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[303] Alcatel USA, Inc., comments at 9-10; AT&T comments at 19; MCI comments at 1, 3-5; Commercial Internet Exchange reply comments at 5 & n.11 (noting that one company, UUNET, recently announced plans to upgrade its network to full linE-rate OC-192 speeds, at which speed one circuit can transmit the entire Library of Congress from Washington to New York in seven seconds).

[304] *NTIA/RUS Report* at 8-9.

[305] *See supra* paras. 185 - 202.

[306] One study asserts that there is a lack of Internet backbone routers or hubs in several relatively rural states, and that this amounts to inferior Internet access there; however, that study addresses only the Internet backbone and does not examine backbone transport. *See* Erik R. Olbeter & Matt Robison, *Breaking the Backbone: The Impact of Regulation on Internet Infrastructure Deployment* (July 27, 1999) (Olbeter & Robison). *See also* iAdvance comments passim; GTE comments at 11-13. Regarding the Internet hub analysis, we find convincing the critique of Olbeter & Robison found in AT&T's reply comments at 15-16 & Attachment thereto (Dr. George S. Ford, *A Response to Olbeter & Robison's "Breaking the Backbone"*). *See also* NTIA/RUS Report at 17 (characterizing as "myth" the assertion that these states lack Internet backbone access).

[307] *See supra* Section IV.B.2.

Broadband Survey data, demonstrates the wide availability of middle mile support for these services. Lastly, our conclusion regarding the sufficiency of middle mile capabilities draws additional support from the existence of growing numbers of narrowband Internet subscribers – currently over 34% of US households[308] – who rely on these same middle mile facilities to support their transmission needs.[309]

211. Notwithstanding the ubiquitous availability of middle mile functionality, it appears that, in certain areas, the potential for a bottleneck exists with respect to this portion of the network. Thus, in the *Dark Fiber Order*, we found that incumbent LECs were the only carriers with ubiquitous inter-office transport facilities.[310] In response to that finding, we unbundled dark fiber and inter-office transport. It remains unclear, however, whether competitive providers have chosen to enter the middle-mile market by purchasing inter-office transport as an unbundled network element. Indeed, in certain areas, the demand for such services may not be high enough to cause a competitor to incur the transaction costs necessary to negotiate such a purchase.

212. If these alternative sources of middle mile transport – either LEC competitors or wireless or satellite providers – continue to develop and are available throughout the country, a competitive market likely will develop and no single provider or category of providers will have bottleneck control over these facilities. If, on the other hand, such ubiquitous competition does not develop in the market for middle mile transport, there may well be areas in which a single provider retains control over a necessary portion of the network. In that event, the price of service could begin to be an issue. We will continue to monitor the development of competition in the middle mile.

3. Deployment of Last Mile Facilities

213. Throughout the country, the deployment of last-mile facilities to support advanced services is expanding rapidly. Subscribership and deployment to residential, business and public customers continues to grow quickly. Subscribership, while clearly greater in densely populated areas, is spread across the country, at least to some degree. Subscribers to advanced services exist in every state, the District of Columbia, and Puerto Rico.

214. Of course, many customers do not have access to a single provider. These customers are also spread across the country and even include many residents in densely populated or affluent areas. It is the smallest towns and the most thinly populated areas, however, in which there is the least deployment. Given the early stage of deployment of advanced telecommunications capability and the data about it, we are not yet able to identify with precision the factors that indicate which customers will not have access to, or will have very late access to, advanced services. We are, however, able to identify customers who are particularly vulnerable to not being served, soon or ever, by the operation of market forces alone. These customers are

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[308] Vernois Schuler & Associates Communications Industry Forecast at 332. While most of these on-line connections are narrowband, this fact evinces the existence of sufficient transport infrastructure to carry data traffic from virtually everywhere in the country.

[309] AT&T reply comments at 15-16 & Attachment thereto (Dr. George S. Ford , *A Response to Olbeter & Robinson's "Breaking the Backbone"*). *See also NTIA/RUS Report* at 17 (characterizing as "myth" the assertion that rural states lack Internet backbone access.)

[310] *Dark Fiber Order*, 15 FCC Rcd 3696, 3853.

more fully discussed below. Then, in the next section of this report, we discuss what we, other government entities, and private organizations are doing to speed deployment to them.

a. Business Customers

215. Neither the comments in this proceeding, nor the field hearings, indicated that business customers outside of the rural areas discussed below, lack access to high-speed service at the speeds that they need. Indeed, our survey data indicate that 35% of the reported high-speed lines are serving business customers. Moreover, this does not take into account the substantial number of private lines that also serve business customers.

216. There is, however, a growing and strong concern that lack of infrastructure is preventing certain communities from attracting new businesses, particularly desirable high tech businesses. This is a different concern than meeting the needs of existing business customers, and will likely need different solutions. In addition, this concern with attracting new businesses is not captured by our data gathering effort, which focused on locations of current subscribers to services. Given our analysis of rural areas below, it is likely that rural areas are particularly vulnerable to not having adequate telecommunications infrastructure for healthy economic development. The basic issue was well stated in a recent publication of the Federal Reserve Bank of Kansas City: "In the near future, enhanced connectivity and information infrastructure will prove crucial to the health of the rural economy. Telecommunications will be critical not only for rural development — attracting and retaining residents and businesses — but for basic sustainability in an ever-changing economic environment."[311]

b. Residential Customers

217. Overall, deployment of advanced services to residential customers is reasonable and timely, although we discuss later in this report those groups of residential customers that the data indicate are particularly vulnerable to not receiving advanced services in a timely fashion. In the past year the number of residential customers buying advanced services has tripled to approximately 1.0 million subscribers.[312] These subscribers appear to be surprisingly spread out around the country. Advanced telecommunications capability is available now and continues to be deployed to a significant number of residential customers in communities of all types – affluent and low income, inner city,[313] suburb, small town and thinly populated countryside.[314] Cable providers, LECs, and utilities show every sign of continuing their deployment of advanced telecommunications infrastructure for residential customers. Additionally, there is a real prospect, in the next several years, of significant deployment of advanced telecommunications capability by

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[311] *See* Brian Staihr, *Rural America's Stake in the Digital Economy, The Main Street Report* (May 2000) (visited July 25, 2000) <http://www.kc.frb.org/RuralCenter/mainstreet/MSE_0500.pdf> (Dr. Staihr is the Senior Economist, Center for the Study of Rural America, Federal Reserve Bank of Kansas City).

[312] Residential includes both residential and small business customers.

[313] *See supra* Section V.B.2.

[314] *See supra* Section V.B.4 & V.B.5; OPASTCO comments at 2, 6 (subject to certain qualifications, rural Americans are getting ATC in a reasonable and timely fashion), 3-4 (some rural communities have sufficient backbone for present needs); NCTA comments at 4 ("High-speed Internet service is becoming available in rural areas . . . and inner city neighborhoods.").

wireless technologies, both terrestrial and satellite-based. These new technologies can overcome the technical limitations in legacy cable and telephone plant[315] and can reach some of the most rural communities.

218. By all major indicators, both residential subscribers and investment in facilities to serve them will continue to increase. Investment of billions of dollars in deploying ATC to residential customers will continue.[316] Rivalry among providers will increase.[317] New technologies will continue to become available.[318] Consumer demand will continue to grow.[319]

219. We also note that the percentage of residential customers that subscribe to advanced services surpasses the penetration levels of some comparable consumer communications technologies at the same stage in their histories. Specifically, at the end of 1999, there were 1.0 million residential customers for advanced services. That represents a residential penetration of 1.0% at the end of the third full calendar year of commercial offering. This is ahead of where cable television (.3%), the telephone (.2%) and color television (.2%) were at the same stage in their histories. On the other hand, advanced services are behind where post-World War II over-the-air black-and-white television (2.2%), video cassette tape players (3.3%), compact disks (4%), direct broadcast satellites (8.3%), and radios (10%) were at the same stage in their histories. It is not clear, however, which of these technologies is the most similar to advanced telecommunications capabilities. Nor can we discern whether the deployment of these other technologies would have been reasonable and timely within the meaning of section 706. Accordingly, the product comparisons, taken as a whole, can neither disprove nor further support the overall conclusion of reasonable and timely deployment.

c. Rural Areas

220. We reach the troubling conclusion that, in all likelihood, market forces alone will not guarantee that many rural Americans will have access to advanced services. In examining trends in rural areas, we note an important distinction that can affect access to high-speed services. Some rural customers are in rural population centers – areas that have a small total number of customers, but where homes and businesses are relatively densely clustered. Others fall in more sparsely populated, outlying areas, where both the overall number and the density of customers is low.[320] We conclude that many rural Americans, particularly those outside of rural

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[315] See *supra* paras. 33, 38, (discussion of loop length, fiber, load coils, bridge taps, and cable's shared architecture).

[316] *See supra* paras. 185 - 202. *See also* Cox comments at 2 (many kinds of companies are spending billions of dollars to reach US homes at an extraordinary speed); ALTS comments at 3-5 (CLECs will press deployment further).

[317] BellSouth comments at 2, 4 (competitors are deploying technologies faster than Congress could have envisioned in 1996; the last mile market is becoming intensely competitive); Commercial Internet Exchange comments at 6-10 (several providers are bringing several technologies to large portions of American homes). S*ee also* Bell Atlantic comments at 1.

[318] *See supra* paras. 185 - 202.

[319] *Id.*

[320] *Cf. NTIA/RUS Report* at ii, 30.

population centers and in the U.S. territories, are particularly vulnerable to untimely access to advanced services if left to market forces alone. As discussed above, our Broadband Survey data shows a positive correlation between population density and the presence of high-speed subscribers; as also mentioned above, we do not have subscription data for U.S. territories other than Puerto Rico. Areas with low population density are much less likely to have subscribers to high-speed services than are urban or suburban areas.[321] Furthermore, the data indicates that there is substantial disparity in access to advanced services even between those living in rural population centers and those living outside them.[322] There is at least one subscriber to high-speed service in 57% of our sample of small town zip codes,[323] compared to 19% of the zip codes that include sparsely-populated outlying areas.[324]

221. Our conclusion -- that many rural customers are particularly vulnerable to not receiving timely access to advanced services -- is further supported by our analysis of the limitations of the various technologies available. Consumers in a significant number of small towns are finding high-speed and, in some instances, advanced services increasingly available from multiple technologies. Consumers in small towns may have access to DSL, cable, fixed wireless services, and high-speed satellite services. For example, two-thirds of the rural telephone companies and cooperatives are offering advanced services or plan to offer them.[325] In fact, there are some small towns which today have access to more than one of these service options.

222. On the other hand, many customers in outlying areas may be too far from a central office for DSL and may live in areas that are too sparsely populated to be served by a cable operator. While wireless technologies may overcome some of these limitations they are not widely operational at the speeds of advanced services, they have certain technical limitations. Similarly, satellite services are pervasive but also have their limitations. For example, many rural residents live a substantial distance from a brick and mortar retail outlet that stocks the necessary hardware. Also, because of satellite's reliance on a telephone return path, rural subscribers may be required to pay a toll for dial-up access to their ISP, or they may be required to incur an additional expense to subscribe to dial-up Internet service provided through a toll-free number.

223. In sum, the majority of Americans who live in rural areas, do not have readily available, lowest-cost access to advanced or even high-speed services today. In fact, some rural areas still do not even have access to the Internet through a local call.[326] It is the smallest towns and the most thinly populated areas in which there is the least deployment. Accordingly, we conclude that many rural Americans are particularly vulnerable to not receiving timely access to

[321] *See supra* note 122 (defining "small town").

[322] *See also* AT&T comments at 29. *See also First Report*, 14 FCC Rcd at 2427-28, 2434-35 (regarding small towns that had high-speed services two years ago).

[323] *See supra* note 122 (defining "small town").

[324] *See supra* note 302 (definition of "thinly-populated territories").

[325] NECA comments at 2, 5; NTCA comments at 5 (121 members are offering, or planning to offer, some form of DSL service in some part of their service areas); NRTA comments at 2 (its members plan, or have actually started, to provide high-speed capability to customers where market forces and regulatory incentives make it "economically feasible"); OPASTCO comments at 2-5 & note 6.

[326] *See supra* section IV.D.5 (Wilsondale Case Study).

advanced services.

d. Tribal Territories

224. Tribal territories are usually rural but present particular issues that warrant their treatment separately. The lack of even basic infrastructure and access to phone services in many such territories is well documented and may present particular challenges to the deployment of advanced services.[327] However, high-speed services are available in some tribal areas. Our Broadband Survey shows that there is at least one subscriber to high-speed services in 44% of the zip codes that contain tribal territories.[328] This amounts to deployment well below the national average of 59% of all zip codes.[329] Additionally, we note that many of these 44% of zip codes likely are not coextensive with the tribal areas they include. Accordingly, the high-speed subscribers within the area may well not be Indians, and the 44% figure may overstate this population's access to advanced services.

e. Elementary and Secondary Schools

225. The public commitment to connecting schools and libraries has resulted in elementary and secondary schools and classrooms within schools, having increased access to advanced services.[330] While no data specifically addresses services with speeds of 200 kbps in both directions, available data on high-speed connections to schools is encouraging. One study, performed by Quality Education Data, Inc. (QED), determined that, as of April 1999, at least 52% of public schools had high-speed or ISDN connections to the Internet.[331] Furthermore, a survey by the National Center for Educational Statistics (NCES) found that 63% of public schools had dedicated-line access to the Internet, and another 23% had "other connection types," some of which likely qualified as high speed.[332]

226. Our E-rate program has directly contributed to this level of connectivity, as over

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[327] *See Federal-State Joint Board on Universal Service, Promoting Deployment and Subscribership in Unserved and Underserved Areas, Including Tribal and Insular Areas*, CC Docket No. 96-45, Twelfth Report and Order, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, FCC 00-208, para. 2 (rel. June 30, 2000). Many libraries, for example, have only one 28.8 kbps connection to the Internet.

[328] Forty-seven percent of Indians who live in zip codes that include tribal territories live in zip codes with high-speed services.

[329] *See* supra para. 92.

[330] *See e.g., supra* paras. 172 - 176.

[331] Quality Education Data, Inc., *Internet Usage in Public Schools 1999* (4th Ed. 1999) (*Internet Usage in Public Schools*). It is difficult to determine from this study what percentage of public school connections fall within our definition of high-speed service. Five percent of the 52% represents ISDN lines that would fall below 200 kbps. Additionally, 36% of the respondents to the NCES Survey did not know what type of Internet connection their school had. We presume that a substantial portion of these schools also had high-speed connections.

[332] Office of Educational & Research Improvement, U.S. Dep't of Education, Pub. No. NCES 2000-086, *Internet Access in U.S. Public Schools and Classrooms: 1994-99* at 3 (2000) (*NCES Study*). Here again, from this data, it is difficult to ascertain how many schools have high-speed or advanced services. The NCES Study includes in the figure for dedicated lines some number of lines with speeds of 56 kbps. Similarly, within NCES's "other connection types" were ISDN lines, which also do not meet our definition of high-speed service.

14,900 schools and libraries used the E-rate for high-speed services. In year two of the program, the most recent year for which this data is available, about 5,500 applications representing about 9,600 schools and libraries sought discounts on high-speed Internet services. Similarly, about 3,000 applicants representing more than 5,300 schools and libraries applied for discounts on high-speed video conferencing services.[333] This study also indicates that the disparity between rural schools' and urban schools' access to high-speed services is not as great as the disparity that exists between rural and urban areas in overall subscription to high-speed service. Rural schools are, however, the least likely to have high-speed or ISDN connections, with 42% having these connections, compared to 58% for urban schools and 49% for suburban schools.[334] Income also appears to affect the availability of high-speed connections to public schools. Data collected by the NCES shows that the richest schools more often have dedicated connections to the Internet. The NCES data indicates that 72% of the richest schools, those with less than 11% of students eligible for free or reduced-price lunch, have dedicated connections, while 50% of the poorest schools, those with 71% or more of the students eligible for free or reduced-price lunch, have these connections.[335] This data confirms that the E-rate's emphasis on giving priority to poor and rural schools is correctly targeting the areas most in need of such support.

227. Our E-rate program is not the only resource to schools for access to advanced services. Schools have used funds from school budgets, a range of other grant programs, as well as receiving free services from industry and other philanthropic efforts.[336] For instance, the State of Maine, through public funding and a state E-rate program, has achieved 100% high-speed connections for its schools.[337] In addition, some deployments of cable infrastructure to schools and libraries has occurred pursuant to agreements entered into by cable companies with the Commission.[338]

228. To date, classroom connections have been a primary objective of our E-Rate

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[333] The application for E-Rate support includes some voluntary questions about the speed of the services being requested, and the speed of existing services. This data is collected from this voluntary section of the application.

[334] *Internet Usage in Public Schools 1999* at T-74.

[335] *NCES Study* at 3. As noted above, *see supra* note 332, some portion of these figures represents facilities that fall below our definition of high-speed.

[336] Cox Communications, Inc., comments at 15 ("the cable industry alone is currently providing high-speed Internet access to more than 5,700 schools and libraries nationwide," which is more than twice last year's number); NCTA comments at 18 & Attachment C, "Cable's High-Speed Education Connection, Years 1-3" (list of hundreds of towns). MediaOne Group, Inc., comments at 12-13 (MediaOne has connected more than 1,000 schools and libraries to the Internet and provided them with large amounts of hardware, training and technical support, and service without charge); Massachusetts Field Hearing at 8. Comcast reply comments at note 9 (referring to "its initiative to provide free high-speed connections and monthly Internet service to schools," and to "a range of discounted commercial services that are available through the federal 'E-rate' program."), note 10 (Comcast, without Universal Service funds, has offered free cable modem service and equipment to more than 700 schools and 70 libraries -- every one in its service areas -- and each free modem provides a free connection for up to five computers). AT&T comments at 32-33 (AT&T gives free service to many schools). Hughes Network Systems & Hughes Communications Galaxy, Inc., comments at 5.

[337] Massachusetts Field Hearing at 120.

[338] *See, e.g., In the Matter of Social Contract for Comcast Cable Commun., Inc*., Order, 13 FCC Rcd 3612 (1997).

program. The E-Rate has been very successful in meeting this objective. Since its inception, classroom connectivity has increased to 63%.[339]

229. While we are pleased with the progress schools have made so early in the deployment of these technologies, we believe it may be appropriate to focus on high-speed connections in general, and high-speed connections to instructional classrooms within schools in particular. In addition, in communities where through the E-rate the school has the only high-speed connection to the Internet, or sometimes the only Internet connection at all, there is a unique opportunity for all members of the community to gain access to the school facilities and to expand deployment beyond the student population.

f. Rural Health Care Facilities

230. In the field hearings, we heard much concern that the potential of advanced services for improving the quality of rural health care is not yet being fulfilled. In the Alaska, Massachusetts, and Nebraska hearings we heard testimony on how video conferencing can enable doctors in rural areas to consult specialists and libraries in faraway cities, to conduct support groups, to teach preventive health to school students, to teach emergency care to rescue squads hundreds of miles away, and to attend Continuing Education courses. In Washington, DC we saw a demonstration on how inner city health care can improve through community based health care centers with high-speed connections to a hospital. Witnesses testified that advanced telecommunications capability has the potential to revolutionize home health care, greatly improve the diagnosis, follow-up, and counseling of children, persons with disabilities, and the chronically ill. Through telemedicine, patients and their families are spared long travel, absence from work, and separation from their homes and communities.[340]

231. We believe that encouraging telemedicine applications of advanced services is warranted. In addition to the direct benefits in improved health care which would result, telemedicine facilities may also be able to increase demand for advanced services and act as an anchor tenant in communities that would otherwise have low demand, thereby improving the economics of serving them.

232. Through this proceeding, a 1999 evaluation of our Rural Health Care universal service program (Rural Health Care Program)[341] conducted by the program administrator at our request, and our proceeding on unserved areas,[342] we have identified barriers to increased use of telemedicine. The evaluation identified as an impediment to wider availability of telemedicine, the statute's exclusion of for-profit entities from eligibility for the Rural Health Care Program. It also

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[339] *Internet Access in US Public Schools and Classrooms*; *NCES Study* at 2.

[340] Nebraska Field Hearing at 96-131. In one survey of patients who had been served by telemedicine, 79% said its quality was the same as in-person care and 20% said it was better.

[341] The Rural Health Care Program is a universal service program authorized by the 1996 Act. *See* 47 U.S.C. 254(h). The program is administered, at our direction, by the Universal Service Administrative Company.

[342] *Federal-State Joint Board on Universal Service; Promoting Deployment and Subscribership in Unserved and Underserved Areas, Including Tribal and Insular Areas*, Further Notice of Proposed Rulemaking, 14 FCC Rcd 21177 (1999) (*Unserved Areas NPRM*).

found that a barrier to the Rural Health Care Program's ability to provide greater support for telemedicine arose from the statutory requirement that the program provide support only for any differences in the rates between urban and rural areas.[343]

233. Complexity in coordination between the E-rate program and the Rural Health Care Program was raised as a barrier to both efficiently using facilities, and bringing services to areas without them.[344] In our unserved areas NPRM, commenters identified the way in which we calculate the distance over which telemedicine services can be supported as a barrier for insular areas.[345] Under the current rules, the distance over which services are supported is the distance between the rural health care facility and the nearest city within the jurisdiction with a population of 50,000 or more. Some insular areas, such as Guam and the U.S. Virgin Islands, do not contain a city of that size within the jurisdiction. In addition**,** both the hearings and our evaluation identified costs other than the costs of telecommunication services as a barrier to increased use of telemedicine. For instance, lack of financial support for equipment, and the fact that few telemedicine services are eligible for reimbursement under the Medicare program were cited as major barriers to the availability of telemedicine.[346]

g. Persons with Disabilities

234. Persons with disabilities can benefit, perhaps more than any other group of Americans, from advanced services. Advanced services can bring this population significant educational, employment, and recreational opportunities.[347] Through signing and lip-reading, advanced services can bring to persons with disabilities basic communications capabilities that are not available to them today,[348] but which are everyday commonplaces for fully-abled persons. There appears no doubt, however, that persons with disabilities do not have as much access to advanced services as fully abled persons. Lack of computer ownership and training, lack of accessible content and equipment, low incomes among people with disabilities and the cost of adaptive equipment are among the reasons for this lack of access. [349]

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[343] The USAC evaluation showed that for many services there is little difference between the rates charged for services in rural and urban areas. The fact that urban health centers do not need to purchase T1 service at all in order to consult with a specialist, while rural health centers do is not reflected in the calculation of support. *See Universal Service Administrative Company Report to the FCC: Evaluation of the Rural Health Care Program*, CC Docket Nos. 96-45, 97-21 (March 5, 1999) (*USAC Evaluation*).

[344] *See eg.*, Alaska Field Hearing at 32.

[345] *See c*omments in *Unserved Areas NPRM* by: Office of the Advancement of Telehealth at 6,7; Government of Guam comments at 3,4; Northern Mariana Island comments at 5,6; ; Northern Mariana Island reply comments at 7,8.

[346] Nebraska Field Hearing at 129; USAC Evaluation at 39.

[347] Kaye, H.S., *Computer and Internet Use Among People with Disabilities*, "Disability Statistics Report" at 13; U.S. Department of Education, *National Institute on Disability and Rehabilitation Research* at 1 (Mar. 2000) (visited July 25, 2000) <http://www.dsc.ucsf.edu/UCSF/pdf/REPORT13.pdf> (*Dept. of Educ. Study*).

[348] Gallaudet University & University of Wisconsin comments at 2.

[349] It is well established that persons with disabilities are much less likely to have access to a personal computer than fully abled persons. *Dept. of Educ. Study* at 5, 13. WGBH Educational Foundation comments at 2. *See also* (continued….)

235. The infrastructure itself can also have an impact on the accessibility of advanced services. In adopting rules implementing section 255's requirements that telecommunication services, equipment and networks be designed to meet the needs of people with disabilities, we determined: (1) that service logic and databases associated with routing telecommunication services are an integral part of the telecommunications network; (2) that they have a material impact on a network's accessibility to people with disabilities; and (3) that they are covered by the section 255 rules.[350] We have already seen the negative impact the development of digital wireless networks has had on TTY users, who are currently unable to use digital wireless technologies. To be useful to a person with a hearing disability, for example, facilities must not only be capable of operating at high bit rates, but must also transmit closed captioning. We wish to ensure that access to advanced services is incorporated as these services are designed and developed.

236. Current requirements will help ensure for persons with disabilities that advanced services are useable to some degree. For instance, pursuant to the Act, telecommunications carriers are obligated to refrain from installing network configurations that do not comply with our accessibility rules.[351] In addition, many equipment manufacturers are required to comply with our rules requiring equipment designed to be accessible for people with disabilities. These rules, however, do not apply to all types of providers and manufacturers involved in the development and delivery of advanced services and advanced telecommunications capability. As a result, we believe there is a risk that networks and services will be developed that are not accessible to people with disabilities.

h. Low Income Areas

237. Our Broadband Survey data reveals an appreciable correlation between income and availability of high-speed services. Specifically, our analysis reveals that of the zip codes with the lowest household income, only 42% include a high-speed subscriber. On the other hand, data show that, of zip codes with the highest household income, 91% include a high-speed subscriber.[352] Refining this analysis even further reveals that where the median household income is $75,000 or higher, high-speed subscription occurs in 94% of the zip codes, but when median household income falls under $10,000, high-speed subscription falls to 30%. Our survey data thus leads us to the disquieting conclusion that the market may not guarantee low income consumers affordable access to high-speed services.

238. The correlation we note between income and access to advanced services is

(Continued from previous page)
American Foundation for the Blind reply comments at 2. Persons with disabilities are disproportionately poor, *see Dept. of Educ. Study* at 5, and thus face unusual difficulty in obtaining the services and terminal equipment necessary for even narrowband Internet access.

[350] *See Implementation of Sections 255 and 251(a)(2) of the Communications Act of 1934: Access to Telecommunications Service, Telecommunications Equipment and Customer Premises Equipment by Persons with Disabilities*, WT Docket No. 96-198, FCC 99-181, Report and Order and Further Notice of Inquiry, paras. 37-42 (rel. Sept. 29, 1999).

[351] 47 U.S.C. § 251(a)(2).

[352] Our preliminary analysis examined the approximately 30,000 zip codes in the United States in 10 percent increments. This division has median annual household incomes of $53,500 ranking in the top decile of 3000 zip codes, and median household incomes of $21,600 in the lowest decile.

consistent with other studies indicating that telephone service penetration, computer ownership and Internet access are highly correlated with income. For example, households with incomes above $75,000 have telephone penetrations rates of 98.5%[353] computer ownership rates of nearly 80%,[354] and Internet access rates of 60.3%.[355] At the other extreme, of households with annual incomes of less than $5000, only 80.3% have telephone service,[356] only 16% own a computer,[357] and only 8.1% use the Internet.[358] These trends in access to other communications technologies further support our conclusion that low-income individuals are particularly vulnerable to not having affordable access to advanced or high-speed services.

i. Inner City, Low Income Areas

239. Our Los Angeles case study raises interesting questions about barriers to subscribership in the inner city, low income areas. The maps in Appendix C demonstrate that the poorest areas in LA County are largely served by upgraded cable systems as well as by wire centers where some DSL service is available. We believe that the availability of broadband facilities in these areas may be largely attributable to the fact that they are adjacent to business and industrial areas where demand for advanced services is at its highest. This proximity does not necessarily mean, however, that low-income, inner-city residents have meaningful access to advanced services. Indeed, several different barriers may prevent such access. First among these barriers may be the poor quality of existing plant in these neighborhoods. A second such barrier likely relates to the state of facilities in the last 100 feet. Both the quality of, and access to, inside wiring within multiple dwelling or multiple tenant buildings in inner cities can pose a significant barrier to obtaining high speed service. Furthermore, it may well be that prices for advanced services are beyond the means of all or most of these households; that these households do not own computers; or that advanced services providers are not marketing their services to this population.

j. Minority Populations

240. Our Broadband Survey data, collected by zip code, does not provide the detail necessary to reveal whether subscribers are members of minority groups. Consequently from that data, we cannot draw conclusions about the availability of high-speed services to discrete minority groups. On the other hand, our Los Angeles case study offers anecdotal evidence of deployment of advanced telecommunications capability to areas with a high proportion of minority residents.[359] As was the case with inner-city, low-income areas, however, it appears that much of

[353] *See* Federal Communications Commission, *Telephone Subscribership in the United States*, Report, Table 4 (rel. June 22, 2000) (*2000 Telephone Subscribership Report*).

[354] U.S. Department of Commerce, National Telecommunications and Information Administration, *Falling Through the Net: Defining the Digital Divide* at Chart I-12 (1999) (Dep't of Commerce, *Falling Through the Net*) (1998 data).

[355] *Id.* at Chart I-21 (1998 data).

[356] *See 2000 Telephone Subscribership Report* at Table 4.

[357] Dep't of Commerce, *Falling Through the Net* at Chart I-21.

[358] *Id.* at Chart I-21 (1998 data).

[359] *See supra* para. 57.

the deployment in these sections of Los Angeles likely serves high demand business districts that are adjacent to minority areas. We are therefore also reluctant to base conclusions regarding deployment to minorities on that case study.

241. Looking more broadly at certain statistics about minority households, we conclude they support the conclusion that market forces alone may not ensure that inner-city, low-income consumers access to advanced services. At the same income levels, minority households have significantly lower rates of phone penetration than non-minority households. For instance, in the households with income of less than $5,000 a year, 69.5 % of those headed by blacks and 72.8% of those headed by Hispanics have telephone service, while 79% of households headed by whites have phones.[360] The same is true with respect to computer ownership. At annual incomes of less than $15,000, 17.5% of white households own a computer, while 6% of black households and 9.4% of Hispanic households do. Only at the highest income levels, over $75,000, do the disparities shrink to 80% of white households, 78% of black households, and 74.8% of Hispanic households.[361] Households using the Internet are similar. At income levels under $15,000, 8.9% of white households, 1.9% of black households, and 3.8% of Hispanic households use the Internet. At income levels over $75,000, 60.9% of white households, 53.7% of Black households, and 48.1% of Hispanic households do.[362] Based on these factors, we conclude that minority customers are vulnerable to not having access to advanced services in as timely a fashion as most other Americans.

4. The "Last Hundred Feet"

242. While there are substantial issues regarding access to inside wires and other facilities necessary for the last hundred feet, there does not appear to be a lack of infrastructure. Nevertheless, we acknowledge that barriers to deployment of advanced services may arise from providers' inability to gain access to space inside multiple dwelling units, to rooftop space for wireless facilities, or to existing inside wires for the purpose of traversing the last hundred feet to the customer.[363]

243. These access questions are under active consideration in a proceeding in which the Commission is considering whether requiring that building owners who allow any telecommunications carrier access to facilities that they control should be required to grant comparable access to other carriers on a nondiscriminatory basis.[364] The proceeding also examines whether the Commission should forbid telecommunications service providers, under

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[360] *See 2000 Telephone Subscribership Report* at Table 4.

[361] Dep't of Commerce, *Falling Through the Net* at 18.

[362] *Id*. at 27.

[363] *See* ALTS comments at 2, 8-9; Wireless Communications Association International, Inc., comments at iii, 28-36; Competition Policy Institute reply comments at 6-7; GSA reply comments at 8-9; National Ass'n of Telecom. Officers & Advisors *et al* reply comments; PCIA reply comments at 8-9. *See also Notice*, para. 48 & note 79; *First Report*, 14 FCC Rcd at 2450-51. *But see* Real Access Alliance reply comments.

[364] *Promotion of Competitive Networks in Local Telecommunications Markets*, Notice of Proposed Rulemaking and Notice of Inquiry, 14 FCC Rcd 12673, 12701, para. 53 (1999) (*Competitive Networks NPRM*).

some or all circumstances, from entering into exclusive contracts with building owners.[365]

VI. ACTIONS TO ACCELERATE DEPLOYMENT OF ADVANCED TELECOMMUNICATIONS CAPABILITY

244. We conclude in this Report that, overall, the deployment of advanced telecommunications capability to all Americans has progressed in a reasonable and timely manner. In this section, we consider means by which we can stimulate the further deployment of advanced services.

245. Our analysis indicates that three main factors appear to be linked to the deployment of advanced telecommunications capability. The first, not surprisingly, is the existence of sufficient demand for advanced services in a particular locality. This factor can be affected by, among other things, the density of the locality's population, the income level of its residents, and the presence, in the locality, of commercial (or other high-demand) activity. The second factor is the existence of competition among advanced service providers in the locality. Thus, in both Waltham and Muscatine, it appears that additional competitive providers began deploying advanced telecommunications capability once an initial provider had entered the market. Additionally, it is axiomatic that the existence of competition among providers increases the breadth and quality of service offerings, while reducing the price of service. Third, local efforts, such as community demand aggregation, the use of anchor tenants and strategic planning, can increase the level of infrastructure deployment. Below, we discuss the steps that we have taken, and those we will take in the future, to affect each of these three factors and thereby to encourage continuing and additional investment in advanced telecommunications capability.

246. Given the Commission's role in the telecommunications marketplace, the bulk of the steps we identify attempt to increase competition in the market for advanced services. Indeed, we believe that competition, not regulation, holds the key to stimulating further deployment of advanced telecommunications capability. We have focused the majority of our efforts on promoting facilities-based competition in the last mile, middle mile, and last 100 feet—the portions of the network in which the greatest barriers to truly competitive markets remain.

247. Our analysis of how demand affects deployment notes that both rural and poor areas are particularly vulnerable to not having timely access to infrastructure with advanced telecommunications capability. Because the development of the advanced services market remains in a very early stage, however, we believe that there is time for us to examine further the factors that affect infrastructure investment and develop policies that will ensure access to needed services, but that are not inappropriately linked to universal service mechanisms for voice telephony.

248. Beyond policies of this Commission, other federal agencies, state and local governments, and non-governmental entities all have developed initiatives designed to spur the deployment of high-speed services by stimulating demand, competition or local efforts. We discuss these initiatives as well.

[365] *Id*. at 12707, para. 64.

A. Recent Commission Actions

249. Since enactment of the 1996 Act, the Commission has carried out its statutory mandate by adopting a variety of policies designed to promote competition, remove barriers to investment, and ensure the deployment of advanced telecommunications capability to all Americans.[366] As Congress directed, we have examined demand for advanced services and the current state of deployment, and we have undertaken various efforts to encourage more rapid and widespread deployment of advanced services. We have traveled throughout the country co-sponsoring, along with state regulators, hearings in order to learn about the deployment of advanced telecommunications in varying geographical areas. We have conducted an ongoing federal-state dialogue regarding effective programs to encourage further deployment, and we have explored community efforts to bring high-speed services to all Americans. Our actions have focused on opening up bottlenecks in the market; encouraging the deployment of service to underserved areas; making spectrum available for advanced telecommunications services; and measuring the progress of deployment in all areas of the country. Highlights of our significant actions are detailed below.

250. *Convened a Federal-State Joint Conference.* We convened a Federal-State Joint Conference to provide a forum for an ongoing dialogue between this Commission, the states, and local and regional entities on the deployment of advanced telecommunications capability.[367] Ensuring that advanced telecommunications services will be made available to all Americans is an effort that will be undertaken on various levels—federal, state, local, and regional. The Federal-State Joint Conference on Advanced Telecommunications Services furthers that goal by facilitating the cooperative development of federal, state, and local mechanisms and policies to promote the widespread deployment of advanced services.

251. *Strengthened Our Collocation Rules*. In March 1999, we adopted new rules facilitating the ability of competitive LECs' to provide facilities-based advanced services by placing equipment in incumbent LEC central offices.[368] We specifically required incumbent LECs to expand their collocation offerings to include cageless and adjacent collocation, as well as other physical collocation arrangements.[369] We also required incumbent LECs to allocate the costs of preparing a premises for collocation among potential collocators, rather than making the first collocator in a premises responsible for all site preparation charges.[370]

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366 47 U.S.C. § 157(a).

367 *Federal-State Joint Conference on Advanced Telecommunications Services*, FCC 99-293, Order (rel. Oct. 8, 1999).

368 *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, First Report and Order and Further Notice of Proposed Rulemaking, 14 FCC Rcd 4761 (1999) (*Advanced Services First Report and Order*), *aff'd in part and remanded in part sub nom. GTE Service Corp. v. FCC*, 205 F.3d 416 (D.C. Cir. 2000) (*GTE v. FCC*).

369 In a caged physical arrangement, a competitive LEC leases and has direct physical access to caged space at an incumbent LEC structure for its equipment. Cageless physical collocation eliminates the cage surrounding the competitive LEC's equipment. In adjacent physical collocation, the competitive LEC's equipment is located within a controlled environmental vault or similar structure that the competitive LEC or its contractor constructs on property leased from the incumbent LEC.

370 *Advanced Services First Report and Order* at paras. 50-55.

252. In August 2000, we required that, where a state has not set its own standard or if carriers have not agreed to an alternative standard, an incumbent LEC must provide physical collocation, including cageless collocation, no later than 90 calendar days after receiving a collocation application. In addition, we clarified that an incumbent LEC must allow a competitive LEC to construct a controlled environmental vault or similar structure on land adjacent to an incumbent LEC structure that lacks physical collocation space.

253. *Encouraged the Resale and Unbundling of Advanced Services*. In a variety of decisions, we have unbundled the service elements necessary for competitors to deliver DSL services or have ensured that services are available at a wholesale discount for resale by competitive providers.[371] Ensuring that resellers are able to acquire at wholesale rates the same advanced services sold by incumbent LECs facilitates the ability of competitive carriers to enter the advanced services market.[372] In November 1999, we determined that services sold at retail by incumbent LECs to residential and business end-users are subject to the discounted resale obligation of section 251(c)(4) of the Act.[373] We similarly clarified that DSL services used to provide high-speed Internet access are not subject to the discounted resale obligations of the Act when sold in bulk to ISPs.[374] Additionally, in December 1999, we determined that incumbent LECs are subject to the unbundling obligations in section 251 in connection with the offering of DSL-based advanced services.[375]

254. *Encouraged Competitive Delivery of DSL Services Through Line Sharing*. In November 1999, we required incumbent LECs to provide unbundled access to the high frequency portion of the local loop, thus requiring "line sharing." This will permit competitive LECs to compete with incumbent LECs by providing DSL-based services through existing telephone lines.[376] Additionally, we adopted spectrum management policies that will significantly benefit the rapid and efficient deployment of DSL-based technologies. Our rules encourage the voluntary development of industry standards while limiting the ability of any one class of carriers to impose unilateral and potentially anti-competitive spectrum compatibility rules on other DSL providers.[377]

255. *Established Criteria For Waiving LATA Boundaries Where They Create a Barrier*. We adopted a two-part test that we will apply to requests for LATA boundary modification where such modification is necessary to encourage the deployment of advanced

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[371] *See Deployment of Wireline Services Offering Advanced Telecommunications Capability*, FCC 99-330, Second Report and Order, para. 3 (rel. Nov. 9, 1999) (*Advanced Services Second Report and Order*); *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, Order on Remand, 15 FCC Rcd 385, 389, paras. 2-3 (1999) (*Advanced Services Order on Remand*).

[372] *Advanced Services Second Report and Order* at para. 20.

[373] *See Advanced Services Second Report and Order* at para. 20.

[374] *Id.*

[375] *Advanced Services Order on Remand* at paras. 2-3.

[376] *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, Third Report and Order and Fourth Report and Order, 14 FCC Rcd 20912, 20913, para. 4 (1999).

[377] *Id.*

services.[378] We will grant such LATA modification petitions when the modification is necessary to encourage the deployment of advanced services on a reasonable and timely basis and when the modification would not materially affect the BOC's incentive to enter the interexchange marketplace pursuant to section 271.[379] Although no applications have been filed thus far, we intend to grant qualifying requests to ensure that advanced telecommunications services are provided to all Americans on a reasonable and timely basis.[380]

256. *Ensured that Competing Providers Receive Non-Discriminatory Access to Facilities and Services*. In approving the recent mergers of SBC/Ameritech and Bell Atlantic/GTE, we adopted merger conditions requiring both firms to establish one or more separate affiliates to provide all advanced services within their traditional service areas. Separate affiliates provide a structural mechanism to ensure that competing advanced services providers receive effective, nondiscriminatory access to the facilities and services of the merged firm's incumbent LECs that are necessary to provide advanced services.

257. *Encouraged Deployment of Wireline and Wireless Service to Tribal Areas*: On June 30, 2000, the Commission moved to promote telecommunications subscribership and infrastructure deployment within American Indian and Alaska Native tribal communities.[381] Recognizing that telephone penetration levels on tribal lands fall below the national average, the Commission modified the low-income universal service programs to target additional support to consumers living in those areas. Additionally, we expanded the bidding credits available to winning wireless auction bidders that provide service on certain tribal lands.[382] These steps are intended to create financial incentives for carriers to serve, and deploy facilities in, areas that previously may have been regarded as high risk and unprofitable. By enhancing tribal communities' access to affordable telecommunications services, the Commission aims to increase their access to education, commerce, government, and public services.

258. *Established a Data Collection Effort*. In March 2000, we established a comprehensive reporting requirement for providers of high-speed services in order to seek greater insight into the development of high-speed markets within particular geographic areas.[383] In doing so, we required semi-annual reports, for the next five years, by any facilities-based firm that provides at least 250 high-speed service lines or wireless channels in a given state or that has at least 250 high-speed customers in a given state. This data will permit the Commission to track advances in high-speed deployment.

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[378] *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, Fourth Report and Order and Memorandum Opinion and Order, 15 FCC Rcd 3089 (2000).

[379] *Id.* at 3092, para. 18.

[380] 14 FCC Rcd at 20918, para. 25.

[381] *Federal-State Joint Board on Universal Service; Promoting Deployment and Subscribership in Unserved Areas, Including Tribal and Insular Areas*, Twelfth Report and Order, Memorandum Opinion, and Order, and Further Notice of Proposed Rulemaking, FCC 00-208 (rel. June 30, 2000).

[382] *See Extending Wireless Telecommunications Services to Tribal Lands*, WT Dkt. No. 99-266, Report & Order and Further Notice of Proposed Rulemaking, FCC 00-209 (rel. June 30, 2000).

[383] *See Local Competition and Broadband Reporting*, Report and Order, 15 FCC Rcd 7717 (2000).

259. *Encouraged Further Competition in the International Submarine Cable Market*. In response to recent growth in the number and capacity of submarine cables, we presented proposals to further streamline our licensing processes and promote competition in the Internet-driven submarine cable market. These proposals reflect our recognition of the need to move with the swift pace of the market and to tailor Commission licensing processes to encourage rapid, facilities-based entry by multiple firms that can bring increased capacity to the market.

260. *Promoted Wireless high-speed service*. In May 1999, we completed a successful auction of LMDS licenses that can be used to provide a variety of advanced wireless services, including two-way high-speed services and high-speed Internet access.

261. Additionally, in June 2000, we removed the eligibility restriction imposed upon incumbent LECs and cable operators with respect to LMDS spectrum that is used primarily for the deployment of fixed wireless high-speed applications.[384] Imposed in 1997, the restriction prohibited incumbent LECs from having an attributable interest in a LMDS license that overlaps with ten percent or more of the population in their service areas. This change will improve the availability of LMDS services, including advanced services, particularly in rural areas.

262. We also are taking steps to ensure that multiple service providers are able to gain access to the last 100 feet of the network, thus encouraging competition in the market for high-speed wireless services. For instance, in the *Competitive Networks NPRM*, we sought comment on our tentative conclusion to prohibit carriers from entering into exclusive contracts with building owners, thus preventing scenarios in which a monopoly or duopoly can stifle competition by preventing competitors from accessing the facilities necessary for deployment of alternative services.

263. In June 2000, we established a filing window for applicants to apply for authority to provide two-way MDS services. We expect that the resultant authorization of two-way MDS operations will speed the deployment of advanced services by permitting service providers to offer a variety of fixed wireless high-speed services more rapidly.[385]

264. *Adopted the Over-the-Air Reception Devices Rule*. As directed by Congress, the Commission in 1996 adopted the Over-the-Air Reception Devices Rule (OTARD) concerning restrictions on viewers' ability to receive video programming signals.[386] OTARD prohibits certain restrictions on the installation, maintenance, or use of antennas used to receive video programming. The rule applies to video antennas including TV antennas, wireless cable antennas, and direct-to-home satellite dishes less than one meter in diameter, or any size in Alaska. Providers that offer high-speed access and video programming (*i.e.*, DirecPC and MDS operators) to avoid restrictions on the installation of the antennas or other devices necessary for

[384] *See Rulemaking to Amend Parts 1, 2, 21,and 25 of the Commission's Rules to Predesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service for Fixed Satellite Services*, Third Report and Order and Memorandum Opinion and Order, FCC 00-223 (rel. June 27, 2000).

[385] *See Mass Media Bureau Provides Further Information on Application Filing Procedures and Announces Availability of Electronic Filing for Two-Way Multipoint Distribution Service and Instructional Television Fixed Service*, Public Notice, DA 00-1481 (rel. June 30, 2000).

[386] 47 C.F.R. § 1.4000.

such service.

265. We are confident that the effect of these programs has been and will be to increase the level of competition in the markets for all types of advanced services. With a foundation of competition in these markets, particularly with regard to the last mile, the middle mile, and the last one hundred feet, we believe that the deployment of advanced telecommunications capability to all Americans will follow.

266. In addition, several other entities—both public and private—are working to implement initiatives designed to spur the deployment of advanced telecommunications services. In highlighting some of these efforts, we recognize that widespread deployment of advanced services will occur more rapidly if we work with other federal agencies, state and local governments, and private entities. State public utility commissions and governments, for instance, have implemented a variety of approaches to promote access to advanced telecommunications capability. Similarly, several federal agencies conduct programs focused on encouraging high-speed deployment: For example, the NTIA operates a Technology Opportunities Program, which awards grants to public and non-profit entities; the Rural Utility Service of the Department of Agriculture provides loan for telecommunications infrastructure; and the Department of Education provides technology training to working-class families.[387]

B. Commission Actions Under Consideration

267. In accordance with our statutory mandate, we are committed to ensuring that advanced services become available to all Americans. Above, we have reached the disturbing conclusion that market forces alone may not ensure that various categories of Americans – including rural, low-income, people with disabilities and minority populations – will receive access to advanced services in a timely manner. In addition, we believe we should further promote high-speed services to classrooms and to telemedicine facilities. While much of our analysis in this report has focused on the presence of infrastructure with advanced telecommunications capability, we believe that true access to this technology must also take into account affordability of the services provided over the infrastructure. We believe the recommendations outlined below, many of which are already are underway in separate dockets, will promote access to these services by consumers we have identified as being particularly vulnerable to untimely access. The following recommendations accomplish this by encouraging competition, promoting infrastructure investment and addressing the affordability of advanced services.

- We are considering a modification of our collocation rules to ensure competitive access to incumbent LEC remote premises.[388] As fiber is pushed further into the local loop and customers are increasingly served through remote terminals, we recognize the need to ensure that competition is not stifled by the ability of incumbents to control access to remote devices where DSL technology may be installed.

- We are also considering streamlining the approval process for both fixed wireless high-speed equipment and customer premises equipment. Previously, we streamlined the process to

[387] *See NTIA/RUS Report* at 36-38.

[388] *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, CC Docket No. 98-147, Order on Reconsideration and Further Notice of Proposed Rulemaking, FCC 00-293 (rel. Aug. 4, 2000).

permit manufacturers to self-verify that point to point fixed wireless high-speed equipment complied with Commissions rules.[389] We also previously established processes for private telecommunications certification bodies to certify equipment as compliant with Commission rules.[390] We proposed to permit point to multipoint equipment, typically used for services such as LMDS, to be self-verified.[391] In addition, we have proposed to streamline and privatize the equipment approval process for customer premises equipment currently regulated by Part 68 of our rules.[392] Streamlining equipment approval processes permits more rapid production and deployment of high-speed equipment, further spurring investment in advanced technologies.

- We will continue to work closely with the states to consider whether changes can be made to the current high-cost mechanism to encourage the deployment and maintenance of the network infrastructure necessary to support advanced telecommunications capability.

- Working with the states, we will begin considering whether we should create a universal service mechanism to promote broadband deployment and what such mechanisms should be. In examining this issue, we will look closely at whether the various state and local initiatives can be replicated elsewhere.

- The Joint Board recently recommended that we reexamine the Commission's rule governing the transfer of universal service support when one carrier purchases local telephone exchanges from another carrier.[393] Under our current rules, the purchasing carrier receives the same per-line support that the selling carrier was receiving for the exchanges at the time of the sale.[394] In reviewing this rule, we will consider whether alternative transfer rules might encourage rural carriers to purchase rural exchanges from large incumbent LECs and to upgrade the acquired facilities to accommodate the provision of advanced telecommunications services.

- In developing a comprehensive approach to access charge reform for rate-of-return telephone companies, which are generally the small, rural incumbent carriers and to universal service reform for the rural carriers, we will consider developing an incentive-based approach for

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[389] *See Reorganization and Revision of Parts 1, 2, 21, and 94 of the Rules to Establish a New Part 101 Governing Terrestrial Microwave Fixed Radio Services*, Report and Order, 11 FCC Rcd 13449 (1996).

[390] *See 1998 Biennial Regulatory Review—Amendment of Parts 2, 25, and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements, and Begin Implementaiton of the Global Mobile Personal Communications by Satellite (GMPCS) Arrangements*, Report and Order, 13 FCC Rcd 24687 (1998).

[391] *See Reorganization and Revision of Parts 1, 2, 21, and 94 of the Commission's Rules to Establish a New Part 101 Governing Terrestrial Microwave Fixed Radio Services*, Memorandum Opinion and Order and Notice of Proposed Rulemaking, 15 FCC Rcd 3129 (2000).

[392] *2000 Biennial Regulatory Review of Part 68 of the Commission's Rules and Regulations*, Notice of Proposed Rulemaking, FCC 00-171 (rel. May 22, 2000).

[393] *Federal-State Joint Board on Universal Service*, Recommended Decision, FCC 00J-1 (released June 30, 2000).

[394] 47 C.F.R. §54.305.

these companies to use current revenues for investment in high-speed infrastructure.[395]

- We will also continue our commitment to the E-rate. Based on annual demand, the E-rate mechanism is currently funded at the maximum amount permitted under Commission rules, $2.25 billion. In addition, we will consider reviewing the program to determine whether it can do even more to promote high-speed connections in schools, libraries and through those locations, to the surrounding communities.

- We will consider reviewing our rules to determine whether we can do more to support high-speed connections to eligible rural health care facilities in insular areas.

- We will initiate a proceeding on the issue of multiple Internet service providers' access to cable operators' infrastructure for delivery of advanced services.[396] The purpose of the new proceeding will be to establish the national policy on this question and bring certainty to the marketplace.

- We are also committed to promoting flexible spectrum use, including facilitating the ability of providers to combine different spectrum bands to tailor wireless high-speed services to the needs of particular localities. Combining different bands could be an efficient and cost-effective means to provide seamless end-to-end service. We can create opportunities for the market to determine how to best use spectrum for high-speed infrastructure in at least three unique ways: flexible spectrum allocations and auctions, increased spectrum availability through secondary market transactions and development of new technologies.[397]

- In addition to the spectrum currently allocated and used for wireless high-speed services discussed above, we have proposed the allocation and/or auction of several hundred megahertz of spectrum throughout the communications spectrum range. The spectrum currently proposed for allocation at 3650-3700 MHz could be used for both fixed wireless high-speed last mile services and high-speed middle mile connections[398]; and spectrum at 4940-4990 MHz is suitable for medium distance high-speed middle mile connections.[399] We are considering allocating for unlicensed services, certain spectrum at 51-71 GHz, which is

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[395] *Ex parte* letter from David Cohen, United States Telecom Association, filed on behalf of USTA, NRTA, NCTA, and OPASTCO, to Magalie Roman Salas, Secretary, Federal Communications Commission (Mar. 17, 2000).

[396] The United States Internet Industry Association (USIIA) filed a petition with the FCC on July 7, 2000, requesting that the Commission require cable operators offering cable Internet service to open their platform to competitors. *See Telecommunications Service Via "Cable Internet," United States Internet Industry Association ("USIIA"), Petitioner*, Petition for Declaratory Rulemaking, and Institution of Rulemaking with Respect to Tariffs for Cable Internet Interconnectivity, filed Jul. 7, 2000.

[397] *See Principles for Reallocation of Spectrum to Encourage the Development of Telecommunications Technologies for the New Millennium*, Policy Statement, 14 FCC Rcd 19,868 (1999) (*Spectrum Reallocation Policy Statement*).

[398] *See Amendment of the Commissions Rules with Regard to the 3650-3700 MHz Government Transfer Band*, Notice of Proposed Rulemaking and Order, 14 RCC Rcd. 1295 (1998).

[399] *See in the Matter of the 4.9 GHz Band Transferred from Federal Government Use*, Notice of Proposed Rulemkaing, 15 FCC Rcd 4778 (2000).

capable of supporting short distance terrestrial high-speed service.[400] Additional spectrum at 1710-1750 MHz and 2110-2150, and some government transfer spectrum planned for allocation can also support high-speed services.[401]

- The auction process for spectrum at 700 MHz will commence in the Spring of 2000. Recovered from analog broadcasters operating on channels 60-69, this spectrum can support high-speed middle mile, last mile, and last one hundred feet services, depending upon system configurations. Auctions are also planned for more 24 MHz (formerly DEMS) spectrum.[402]

- Although its use requires no action on our part, we note that unlicensed spectrum at 900 MHz, 2.4 GHz spread spectrum, and the 5.8 GHz UNII band are all capable of supporting high-speed middle miles, last miles, and last 100 feet, depending upon design configurations.[403] Although unlicensed operations have no legal protection from electromagnetic interference, this "free" spectrum is uniquely affordable and suitable for non-critical high-speed communications.

- We are also examining how best to encourage the development of secondary markets for spectrum. Such markets have the potential to significantly reduce the cost of spectrum based services.[404]

- We are committed to examining the potential of new technologies such as ultra-wideband and software defined radios, both of which enable increased use of spectrum.[405] We will also review existing regulations and licensing policies for satellite and wireless systems that share spectrum bands to ensure that spectrum can be made available to all parties in an efficient and effective manner. In doing so, we will address the full range of public interest issues associated with licensing these services, including benefits to consumers and the impact on other services.[406] In the 18 GHz Proceeding, for instance, we designated spectrum for primary use by satellite systems so that we could adopt a blanket licensing regime for satellite earth stations. This action will facilitate mass market deployment of the next generation of satellite

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[400] *See Amendment of Part 2 of the Commission's Rules to Allocate Additional Spectrum to the Inter-Satellite, Fixed, and Mobile Serivces and to Permit Unlicensed Devices to Use Certain Segments in the 50.2-50.4 GHz and 51.4-71.0 GHz Bands*, Notice of Proposed Rulemkaing, 14 FCC Rcd 12473 (1999).

[401] *Spectrum Reallocation Policy Statement*, 14 FCC Rcd 19868.

[402] *See Amendments to Parts 1, 2, 87 and 101 of the Commission's Rules To License Fixed Services at 24 GHz*, WT Docket No. 99-327, Report & Order, FCC 00-272 (rel. Aug. 1, 2000).

[403] Last 100 feet configurations tend to employ low power short-range omnidirectional antenna, whereas middle-mile configurations tend to employ maximum power (1 watt) with high-gain point-to-point directional antenna.

[404] *See Spectrum Reallocation Policy Statement*, 14 FCC Rcd 19868.

[405] *See Amendment of Part 15 of the Commission's Rules Regarding Spread Spectrum Devices*, Notice of Proposed Rulemaking, 14 FCC Rcd 13046 (1999); *Inquiry Regarding Software Defined Radios*, Notice of Inquiry, 15 FCC Rcd 5940 (2000).

[406] *See, e.g., Onsat Petition for Declaratory Order, Waiver and Request for Expedited Action*, File No. SAT-PDR-19990910-00091, Public Notice Report No. SA- 00026 (rel. Sept. 23, 1999); *Commission Launches Earth Station Streamlining Initiative*, Public Notice, DA 99-1259 (rel. June 25, 1999); *FWCC Requests Concerning Licensing and Loading Standards for Earth Stations in the Fixed-Satellite Service*, RM-9649, Public Notice Report No. 2334 (rel. June 11, 1999).

high-speed service.[407]

- We will also consider granting waivers of the commercial mobile radio service (CMRS) spectrum aggregation limit to CMRS providers where the limit proves to be an impediment to the deployment of Third Generation (3G) or other advanced services. [408]

- The FCC currently permits Direct Broadcast Satellite providers to utilize up to 50% of their capacity for ancillary services.[409] Such ancillary services could include high speed digital services. We will consider further relaxing limits on use of ancillary services.

- We will continue to adopt pro-competitive policies governing the use of cable wiring inside multiple dwelling units. To facilitate competition from alternative providers, we have established rules that govern the disposition of the incumbent cable operator's wiring once it no longer has a right to serve multiple dwelling units.[410] We are currently considering whether additional measures are necessary to enhance the ability of service providers to use existing cable wiring to offer traditional and advanced services to residents of multiple dwelling units.[411]

- We will use the enforcement authority available to us to ensure that any advanced services or components of advanced services that are covered by our section 255 rules fully comply with those disability access requirements.

- We will continue to assess the accessibility of advanced services networks to people with disabilities in order to determine if further regulatory action is warranted. For example, we are currently inquiring into the accessibility of IP telephony to persons with disabilities and will soon release our report on that issue.

- Recognizing that whether persons with disabilities have access to advanced services infrastructure increasingly includes evolving equipment and technologies, we are monitoring the new types of equipment networks so that our policies and rules remain current with

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[407] *See Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz Frequency Bands for Broadcast Satellite Service Use*, Report and Order, FCC 00-212 (rel. June 22, 2000).

[408] *See 1998 Biennal Regulatory Review—Spectrum Aggregation Limits for Wireless Telecommunications Carriers*, Report and Order, FCC 99-224, para. 82 (rel. Sept. 22, 1999). Carriers are generally permitted to hold attributable interests in up to 45 MHz of CMRS spectrum, with a higher limit of 55 MHz in rural areas.

[409] *See DBS Auction Order,* 11 FCC Rcd 9712, para. 17 (1995). *See also Petition of United States Satellite Broadcasting Company, Inc. for Declaratory Ruling Regarding Permissible Uses of the Direct Broadcast Satellite Service,* 1 FCC Rcd 977, 977 (1986).

[410] *See* 47 C.F.R. §§ 76.804-76.805; *see also* 47 C.F.R. §§ 76.801-76.802 (disposition of wiring within a residence).

[411] *See Telecommunications Services - Inside Wiring*, Report and Order and Second Further Notice of Proposed Rulemaking, 13 FCC Rcd 3659 (1997) (*Cable Home Run Wiring R&O*).

emerging technologies and do not simply react to them.[412]

- We will consider improving the data we collect on broadband services so that we may better understand deployment within zip codes, the speed of connections available to individual classrooms, the role of small service providers, and private line networks.

C. Additional Actions

268. During the course of our field hearings and analyses, we have received an array of recommendations that may have considerable potential to encourage investment in and stimulate demand for advanced telecommunications capability. We believe that these recommendations should be considered by the appropriate authorities.

➢ *Compile and Disseminate Additional Data.* In addition to the data we collect states and other entities may find it useful to collect other information regarding providers in their states.

➢ *Programs Designed to Stimulate Demand*. Demand for services drives deployment of advanced telecommunications capability, and, thus, programs designed to increase consumers' interest in, and use of, advanced technologies and services will likely spur further deployment. There are several types of programs that may be able to help increase consumer demand.

- Grant programs to assist state, local, and tribal governments, health care providers, schools, and community-based organizations with technology purchases and training (*e.g.*, NTIA's Technology Opportunities Program).
- Technology education programs to increase consumer use of the many resources available on the Internet, such as access to health care information and education.
- Programs to stimulate computer ownership and home Internet access.
- Technology skills and career programs.
- Technology education programs designed to teach business customers how e-commerce and Internet technology can affect their businesses.
- Programs to promote telemedicine applications.
- Tax credits for businesses with high telecommunications demand to local in rural and other underserved areas.

➢ *Reduce the Cost of Deployment*. Programs designed to reduce the cost and risk of deploying advanced telecommunications capability should increase incentives for investment in necessary infrastructure. Programs that have been suggested include the following:

- Low-interest loans for service providers and builders of infrastructure to support advanced telecommunications capability.

[412] Additional expert advice in this area is provided to us by the FCC's Technological Advisory Council, which was convened in 1999. *See FCC Requests Nominations for Membership on the Technical Advisory Council*, Public Notice, DA-98-8024 (rel. Dec. 1, 1998).

- Loan guarantees for builders of infrastructure to support advanced telecommunications capability.
- Tax credits for service providers investing in high-speed facilities.
- Sales tax credits for equipment used to deliver advanced telecommunications capability.

➢ *Integrate Telecommunications and Economic Development Policies*.

- Develop a better understanding of the role of telecommunications infrastructure in business expansion and location decisions.
- Incorporate telecommunications policy into economic development plans at the state and local levels.

Increase Funding for Technological and Telecommunications Research and Development, Particularly for Technological Solutions to Serving Remote and Low Demand Areas.

VII. ORDERING CLAUSE

269. Accordingly, IT IS ORDERED that, pursuant to section 706 of the Telecommunications Act of 1996, this Report is ADOPTED

FEDERAL COMMUNICATIONS COMMISSION

Magalie Roman Salas,

Secretary