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

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| In the Matter of | ) | |
| | ) | |
| Inquiry Concerning the Deployment of | ) | CC Docket 98-146 |
| 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 | ) | |

# THIRD REPORT

**Adopted: February 6, 2002** **Released: February 6, 2002**

By the Commission: Chairman Powell, Commissioner Abernathy, and Commissioner Martin issuing separate statements; Commissioner Copps dissenting and issuing a statement.

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## I. INTRODUCTION

1. In this Third Report, the Commission concludes its third inquiry into the availability of advanced telecommunications capability in the United States.[1] Overall, we find that advanced telecommunications is being deployed to all Americans in a reasonable and timely manner. We are encouraged that the advanced services market continues to grow, and that the availability of and subscribership to advanced telecommunications has increased significantly. We also conclude that although investment trends have slowed recently, investment in infrastructure for advanced telecommunications remains strong. We are also encouraged by technological and industry trends, which indicate that alternative and developing technologies will continue to be made available to consumers. Furthermore, we emphasize our commitment to providing the appropriate regulatory framework that will help promote deployment for all Americans.

2. Congress directed the Commission and the states, in section 706 of the Telecommunications Act of 1996, to encourage deployment of advanced telecommunications capability to all Americans on a reasonable and timely basis. The widespread deployment of advanced services has become a central communications policy goal for the Commission.[2] In

[1] This inquiry is required by section 706 of the Telecommunications Act of 1996 (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.

[2] *See* 47 U.S.C. § 254(b)(2) and (6), added to the Communications Act of 1934 (47 U.S.C. §§ 151, *et. seq.*) by the 1996 Act. On August 10, 2001, the Commission issued a Notice of Inquiry (NOI) under section 706 of the 1996 Act into "whether advanced telecommunications capability is being deployed to all American in a reasonable and timely fashion." Pursuant to the statute, the Commission must issue its Report 180 days after issuance of the NOI. *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*

(continued....)

conjunction with this objective, Congress 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.[3] The Commission's first and second inquiries concluded that the deployment of advanced telecommunications capability was reasonable and timely on a general, nationwide basis.[4]

3. The Commission's *Second Report* cautioned, however, that certain groups of consumers might be particularly vulnerable to not receiving timely deployment of advanced telecommunications capability.[5] In particular, the Commission identified several groups of consumers as being particularly vulnerable, including low-income consumers, those living in sparsely-populated areas, minority consumers, consumers living on tribal lands, persons with disabilities, and those living in the U.S. territories.[6] Over the last 18 months, we have monitored each of these groups, and we are pleased to report that the availability of advanced services appears to be more widely available among almost all of the segments of consumers than it was at the time of our *Second Report*. Nevertheless, we will continue to monitor deployment to determine whether these consumers continue to enjoy reasonable and timely deployment of advanced services.

4. In conducting this third inquiry, the Commission used its previous inquiries as a framework for our information collection and analysis. First, we solicited information relating to four primary questions: 1) What is advanced telecommunications capability? 2) Is advanced telecommunications capability being deployed to all Americans? 3) Is deployment reasonable and timely? 4) What actions can accelerate deployment?[7] Second, we gathered 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.[8] Third, we continued our dialogue with the Joint Federal-State Conference on Advanced Services (Joint Conference).[9]

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*Telecommunications Act of 1996*, CC Docket No. 98-146, Notice of Inquiry, 16 FCC Rcd 15515 (2001) (*Third Notice of Inquiry*).

[3] § 706(b) of the 1996 Act.

[4] 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*); Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, CC Docket No. 98-146, Report, 15 FCC Rcd 20913 (2000) (*Second Report*).

[5] *Second Report*, 15 FCC Rcd at 20918.

[6] *Id.*

[7] *Third Notice of Inquiry*, 16 FCC Rcd at 15515.

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

[9] *Federal-State Joint Conference on Advanced Telecommunications Services*, Order, 14 FCC Rcd 17622 (1999). The Federal-State Joint Conference on Advanced Services, which is comprised of federal and state representatives, was convened by the Commission on October 8, 1999, to further the vision of section 706 of the 1996 Act.

5. As noted by the Commission in the *Second Report*, section 706 directs the Commission to focus on the *availability* of advanced telecommunications capability.[10] Accordingly, in this Report we consider various market, investment, and technological trends in order to assess whether infrastructure capable of supporting advanced services is being made available to all Americans. We examine where advanced services are being deployed, so that, where necessary, we can develop appropriate public policies that may stimulate the deployment of advanced services to unserved locations or consumers. In addition, we believe that it is appropriate to emphasize availability because we do not believe that adoption rates should necessarily drive government responses. Although regulators can play an important role in educating consumers about the availability and capability of advanced services, consumers and service providers, interacting in the marketplace, are ultimately best suited to determine how and when advanced services should be produced and purchased. Consumer responses to advanced services applications and technologies are continuing to evolve, and we believe that market participants should resolve challenges through technological innovations, marketing, creative financing and other skills.

6. In the following sections, we address the four basic questions asked in the Commission's *Third Notice of Inquiry*.[11] We also make our judgment as to whether deployment of advanced services to all Americans is reasonable and timely by looking at three major factors: availability, and how it has changed since the *Second Report*; levels of investment and projections of future growth with advanced telecommunications capability; and finally, various advances in advanced services technology. Although we reach the conclusion in this Report that the deployment of advanced telecommunications capability is reasonable and timely, we emphasize that the further deployment of advanced services is one of the Commission's highest priorities. Accordingly, we are actively engaged in removing barriers and encouraging investment in advanced telecommunications. In this Report, we highlight some of our current efforts to establish a rational regulatory framework for these services, to promote investment through competition and the administration of our universal service support mechanisms, make efficient use of available spectrum and ensure that lack of access to the public rights-of-way do not slow deployment.

## II. EXECUTIVE SUMMARY

7. This Report answers the four basic questions we set forth in the *Third Notice of Inquiry*.

### 1. What is advanced telecommunications capability?

- Consistent with prior Reports, we will use the terms "advanced telecommunications capability" and "advanced services" to describe services and facilities with an upstream (customer-to-provider) and downstream (provider-to-customer) transmission speed of more than 200 kbps in this Report.

[10] *See Second Report*, 15 FCC Rcd at 20916-20917.

[11] *See Third Notice of Inquiry*, 16 FCC Rcd at 15515.

- We will also use the term "high-speed" to describe services with over 200 kbps capability in at least one direction. In addition, we will maintain our prior finding 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.

### 2. Is advanced telecommunications capability being deployed to all Americans?

- In determining whether advanced telecommunications capability is being deployed to all Americans, we discuss the data reported by providers who participated in our data collection program. While our data focuses on subscribership, we believe that it is a useful tool to determine where services are being made available, given that customers can only subscribe where high-speed networks have been deployed. In addition, we consider industry and analyst assessments of investment and various competitive market trends. Finally, we take note of various emerging technologies and how they may affect availability.

- Comparison with data on high-speed subscribership included in the *Second Report* suggests that there has been appreciable growth in the deployment of high-speed services to residential and small business consumers in the past eighteen months. Moreover, these figures reveal that high-speed services are available in many parts of the country and suggest that certain factors -- such as population density and income -- continue to be highly correlated with the availability of high-speed services at this time.

- Subscribers to high-speed services were reported in each of the fifty states, the District of Columbia, Puerto Rico, and the Virgin Islands and in 78 percent of all the zip codes in the United States. Our data further indicate that 97 percent of the country's population lives in those zip codes where high-speed subscribership was reported. We conclude that there were a total of approximately 7.8 million high-speed (including advanced services) residential and small business subscribers, as of June 2001. Approximately 4.3 million of these residential and small business customers subscribed to services that meet the Commission's definition of advanced services.

- With respect to investment, overall, analysts observe that carriers have continued to invest in this sector in a substantial way resulting in increased availability of various high-speed and advanced services platforms for consumers throughout the nation. They predict this trend will continue.

- There have been a number of developments in the technologies capable of supporting advanced services since the *Second Report*. Many of these technologies, including satellite and 3G wireless, appear to have significant potential for expanding the availability of advanced telecommunications to more Americans.

### 3. Is deployment reasonable and timely?

- Overall, we conclude that the deployment of advanced telecommunications capability to all Americans is reasonable and timely. We are encouraged by the expansion of advanced services to many regions of the nation, and growing number of subscribers. We also conclude that investment in infrastructure for most advanced services markets remains

strong, even though the pace of investment trends has generally slowed. This may be due in part to the general economic slowdown in the nation. In addition, we find that emerging technologies continue to stimulate competition and create new alternatives and choices for consumers.

- While we focus on the availability of advanced services in this Report, we acknowledge that subscription rates may influence business and investment decisions and may consequently have an effect on the further deployment of advanced telecommunications. We consider a variety of factors which may be relevant to the overall subscription rate for advanced services, including: computer ownership, cost, the lack of applications which require advanced telecommunications capability, and marketing techniques.

- We believe that the successful deployment of advanced telecommunications capability in other nations may be instructive to our efforts to provide access to advanced telecommunications services to all Americans. We acknowledge, however, that some of the results may be of limited value due to unique circumstances in a particular nation. A recent report indicates that in June 2001 the United States had a broadband penetration rate of 3.24 per 100 inhabitants. Only three other nations had higher broadband penetration rates -- Korea at 13.91, Canada at 6.22, and Sweden at 4.52.

### 4. What actions by the Commission will accelerate deployment?

- We have initiated an effort to establish an appropriate regulatory framework to promote investment in infrastructure and increase access to advanced telecommunications services for all Americans. This effort is largely encompassed in four proceedings before the Commission.

- First, the *Cable Modem NOI,* which considers the definitional question of the regulatory classification under the Act of cable modem service; second, the *Broadband NPRM*, which will initiate an inquiry relating to the statutory classification of wireline broadband Internet access services; third, the *Incumbent LEC Broadband Telecommunications Services NPRM* which examines the appropriate regulatory requirements for the incumbent LECs' provision of domestic broadband telecommunications services, including what regulatory safeguards and carrier obligations, if any, should apply when a carrier that is dominant in the provision of traditional local exchange and exchange access services provides broadband service; and fourth, the *Triennial Review NPRM*, which considers the incumbent LECs' wholesale obligations under section 251 to make their facilities available as unbundled network elements to competitive LECs.

- We will promote investment in advanced services infrastructure through our examination of competitor access to remote terminals, our examination of national performance measures, and our consideration of enhancement of our rules on the use of cable inside wiring.

- We will continue to examine the role of our universal service policies through the Joint Boards inquiry into the definition of core services that are eligible for universal service support, and our continuing efforts to improve the Schools and Libraries and Rural Health Care Programs.

- We are examining ways to make more radio spectrum available for advanced services, as well as ways to enable the increased use of radio spectrum, such as the use of DBS spectrum, through our proposals to encourage a secondary market for radio spectrum.

- We are considering the appropriate roles and practices of federal, state, and local governments with respect to rights-of-way management, consistent with applicable legal constraints.

## III. WHAT IS ADVANCED TELECOMMUNICATIONS CAPABILITY?

8. In this section, we address the first question asked in our Third Notice of Inquiry: What is advanced telecommunications capability? On a basic level, consumers have generally come to expect that advanced telecommunications capability will allow fast access to a wide range of information and services. More specifically, section 706(b) of the 1996 Act describes 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."[12]

9. At this time, we believe that the 200 kbps and 2 Mbps transmission speeds (in technical terms, 'bandwidth') previously designated by the Commission continue to serve as appropriate benchmarks to assess the deployment of advanced services.[13] As a result, we have continued using the current data collection using those speeds as measuring points for our progress.[14] In addition, consistent with prior Reports, we will use the terms "advanced telecommunications capability" and "advanced services" to describe services and facilities with an upstream (customer-to-provider) and downstream (provider-to-customer) transmission speed of more than 200 kbps in this Report.[15] We will also use the term "high-speed" to describe services with over 200 kbps capability in at least one direction.[16] Thus, high-speed is a larger

[12] § 706(b) of the 1996 Act.

[13] *See Local Competition and Broadband Reporting*, CC Docket No. 99-301, Report and Order, 15 FCC Rcd 7717, 7752-7753 (2000) (*Data Gathering Order*)( "...[W]e require respondents to report two items of information about the portion of total lines and wireless channels they provide that are particularly "fast." We decide we need this information to assist us in evaluating the evolving market for such services. We require respondents to report, specifically, the percent of broadband lines and wireless channels they provide with information carrying capacity greater than 200 Kbps in both directions, and also the percent of broadband lines and wireless channels they provide with information carrying capacity greater than 2 Mbps in both directions. We understand that, in future years, the appropriate definition of broadband service may change as technology improves and consumer demand grows for more features and functions from residential broadband service. We believe that services at speeds over 200 Kbps and 2 Mbps are currently available through traditional wireline offerings -- though most often deployed to businesses -- and we conclude that the information we require respondents to report will enable us to detect the evolution of supply and demand for such future generations of broadband.")

[14] *See Local Competition and Broadband Reporting*, CC Docket No. 99-301, Second Notice of Proposed Rulemaking, 16 FCC Rcd 2072 (2000) (*Data Gathering Second NPRM*).

[15] *First Report*, 14 FCC Rcd at 2406-2408; *Second Report*, 15 FCC Rcd at 20919-20921. As we previously noted, our inclusion of all technology used for delivery of advanced and high-speed services in our assessment of advanced telecommunications capability does not implicate any determination by this Commission as to the treatment of these services for regulatory purposes under the Act. *Second Report*, 15 FCC Rcd at 20928. Many of these questions are the subject of other proceedings currently before the Commission. *See infra*, paras. 148 - 168.

[16] *Id.*

category than advanced telecommunications, and high-speed consists of those services and facilities with a transmission speed of more than 200 kbps in at least one direction. We also maintain our prior finding 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.[17]

10. We acknowledge that there is reasonable debate over what speed should be considered as advanced telecommunications capability and what speeds will be demanded by consumers in the long run.[18] We emphasize that the speeds we have designated for data collection and as points of reference for this Report are not intended to be viewed as an ultimate goal. Instead, they are intended to measure what is happening in the current market, not to drive the market. Nor do these definitions drive any regulatory result outside of this Report, beyond giving us a relatively static point at which to gauge the progress and growth in the advanced services market from one Report to the next. As stated in our prior Reports, we anticipate that our measure of advanced telecommunications capability and advanced services may change as technology continues to evolve.[19] In fact, we recognize that products are beginning to emerge that require high-bandwidth capability, such as high-definition video.[20] At this time, however, consumer expectations relating to these products are continuing to develop.[21] The Commission has launched a number of proceedings that will consider the advanced telecommunications market including any necessary definitional issues.[22] We anticipate that these proceedings may inform whether it will be appropriate to adjust the points at which we gauge advanced telecommunications capability in the future.

11. In the *First Report*, the Commission stated several reasons for choosing 200 kbps as a benchmark.[23] First, it appeared that Congress intended advanced telecommunications

[17] *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); *Second Report*, 15 FCC Rcd at 20921.

[18] *See, e.g.*, NRTC Comments at 1 ("NRTC believes that the FCC should revise its current definition to encourage the growth of faster-than-dial-up, packet-switched Internet technologies that do not fall under the current "advanced telecommunications capability" definition."); Intertainer, Inc. Comments at 1 ("...we would suggest that the definition of "advanced telecommunications capability" ...be revised to a bandwidth in excess of 700 kilobits per second.")

[19] *See First Report*, 14 FCC Rcd at 2407-2408; *Second Report*, 15 FCC Rcd at 20921.

[20] *See, e.g.*, Intel Comments at 3 ("...transmission of video requires higher speed access than is available to most households with current generation of broadband access."); Corning Comments at 5 ("Corning...recommends that the FCC define advanced telecommunication capability as 4 Mbps upstream and downstream.").

[21] *See* Progress & Freedom Foundation Comments at 15 ("Perhaps more bandwidth than the 200 kbps in both directions that the Commission identified a few years ago will be required, although no one knows with any certainty what elements will make up this new value proposition."); Michael Ching and Tal Liani, Merrill Lynch, *Broadband Access – Speed is of the Essence,* May 15, 2001, at 10 ("Video over the Internet represents only a miniscule amount of the traffic being carried over the Internet. But if it were to gain wider acceptance, or if any other high intensity application were to gain traction, this would substantially increase bandwidth requirements.").

[22] *See infra* paras. 151-154.

[23] *First Report*, 14 FCC Rcd at 2406. We note that the Commission used the terms "broadband" and "broadband services" in the *First Report*. In the *Second Report*, the Commission determined that the terms "broadband" and

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capability to be faster than Basic Rate ISDN service, which operates at a data rate of 144 kbps and was widely available at the time of the 1996 Act.[24] Second, 200 kbps is enough to provide the most popular applications, including web-browsing at the same speed as one can flip the pages of a book.[25] Finally, the Commission required that both upstream and downstream paths have this capability because section 706(b) uses the words "originate *and* receive."[26] Following adoption of the *First Report*, the Commission established a comprehensive reporting requirement for providers of high-speed and advanced services in order to track the growth of advanced telecommunications capabilities.[27] Consistent with the initial measuring point designated in the *First Report*, service providers are required to provide the Commission with information about lines that are capable of providing service at 200 kbps in one direction, 200 kbps in both directions, and 2 Mbps in both directions. In the *Second Report*, the Commission was able to use this data to help examine the growth of availability of 200 kbps, or faster, speeds in both the upstream and downstream paths of the last mile.[28]

12. We recognize that the speed at which we define advanced telecommunications capability has major implications for our analysis of deployment. Were we to use a transmission speed higher than 200 kbps to define advanced telecommunications capability, we would find a correspondingly lower level of availability. The level of availability of higher transmission speeds, in turn, may have implications for adoption rates. As mentioned, certain applications, such as some video products, require transmission speeds in excess of 200 kbps. Some argue that such applications, or others that require speeds in excess of 200 kbps, are the kind of content that will lead consumers to adopt advanced telecommunications capability in greater numbers. As technology continues to evolve, and with it, consumer expectations, it may be appropriate to adopt a higher threshold for advanced telecommunications capability and revisit our analysis of deployment. We will continue to closely monitor this issue.

## IV. IS ADVANCED TELECOMMUNICATIONS CAPABILITY BEING DEPLOYED TO ALL AMERICANS?

13. In this section, we address the second question that we asked in our Third Notice of Inquiry: Is advanced telecommunications capability being deployed to all Americans? As an initial matter, we provide a brief overview of the networks used to provide advanced services and the technologies employed in those networks. The network components and technologies are

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"broadband services" had come to include a much broader range of services and facilities and decided to use the terms "advanced telecommunication capability" and "advanced services." *Second Report*, 15 FCC Rcd at 20930.

[24] *First Report*, 14 FCC Rcd at 2406, n.13.

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

[26] Section 706(b) of the 1996 Act; *First Report*, 14 FCC Rcd at 2406-07 & n.17.

[27] *See Data Gathering Order*, 15 FCC Rcd at 7717. The Commission requires semi-annual reports 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. *See also* Local Competition and Broadband Reporting Form, OMB 3060-0816 (Sep. 2001) (Form 477).

[28] *Second Report*, 15 FCC Rcd at 20920.

discussed in greater detail in an attached appendix.[29] We then discuss the data reported by providers who participated in our data collection program.[30] This information is a tool that we use to help assess the availability and location of high-speed capable infrastructure. Following the presentation of data, we discuss industry and analyst assessments of investment and various competitive market trends. Finally, we provide an overview of emerging technology and how it may affect availability.

### A. Overview of the Networks Used to Provide Advanced Services

14. Advanced services are provided using a variety of public and private networks that rely on different network architectures and transmission paths.[31] Some of these networks 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.[32]

15. 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: long haul communications transport facilities,[33] middle mile, last mile, and last 100 feet. In addition, we refer to the points of connection between these components of the network as connection points. These 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.

16. Long haul communications transport facilities provide a long-distance, high-capacity, high-speed transmission path for transporting massive quantities of data.[34] Most long

[29] *See* Appendix B.

[30] *See* Form 477.

[31] *See Second Report*, 15 FCC Rcd at 20922-20939.

[32] 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.

[33] In our prior Report, we used the term "backbone" to refer to "long haul communications transport facilities." This led to some confusion as to whether we were referring to high-speed physical transport specific to the Internet backbone. The Internet backbone uses high-speed fiber infrastructure, but so do other applications, including conventional voice. *See Second Report*, 15 FCC Rcd at 20923-20924. In this Report, we use the term long haul communications transport facilities to refer to high-speed physical transport, that includes, but is not limited to, facilities used to support the Internet backbone.

[34] *See* Appendix B at paras. 2-4; *Second Report*, 15 FCC Rcd at 20922.

haul transport facilities consist of fiber optic lines, either buried under the ground or laid under the sea. In addition, some of these facilities can be provided using satellite systems and radio spectrum. As its name suggests, middle mile facilities provide relatively fast, large-capacity connections between long haul facilities and last mile.[35] 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. The last mile is the link between the middle mile and the last 100 feet to the end-user's terminal.[36] A last mile with advanced telecommunications capability provides speeds in excess of 200 kbps in each direction. Last miles may consist of hybrid fiber-coaxial cable,[37] copper wire,[38] or wireless channels used in terrestrial[39] or satellite systems.[40] Some last-mile segments -- for example those on certain satellite 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. The last 100 feet is the link between the last mile and the end-user's terminal.[41] 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. Finally, 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 national communications transport facilities), so that data can move across the network.[42]

### B. Presentation of Commission's Data Collection

17. In this section of the Report, we discuss data obtained through the Commission's data collection program.[43] This program requires any facilities-based firm that provides 250 or more high-speed service lines (or wireless channels) in a given state to report basic information about its service offerings and customers twice yearly.[44] As part of the Commission's data collection, providers report the total number of high-speed lines (or wireless channels) -- broken down by type of technology -- for each state in which they exceed the reporting threshold. For each of these "technology subtotals," providers report additional detail concerning the percentage of lines that are connected to residential and small business users (as opposed to large business and institutional users) and the percentage of lines that meet the Commission's definition of advanced services (as opposed to one-way high-speed lines), along with the number of lines that

[35] *See* Appendix B at paras. 5-8; *Second Report*, 15 FCC Rcd at 20922.

[36] *See* Appendix B at para. 9; *Second Report*, 15 FCC Rcd at 20923.

[37] *See* Appendix B at paras. 10-23.

[38] *Id.* at paras. 24-30.

[39] *Id.* at 31-44.

[40] *Id.* at 45-49.

[41] *See* Appendix B at 50; *Second Report*, 15 FCC Rcd at 20923.

[42] *See* Appendix B at 51; *Second Report*, 15 FCC Rcd at 20923.

[43] *See Data Gathering Order*, 15 FCC Rcd at 7717 (adopting FCC Form 477 as a vehicle for collecting this information). The Commission has requested comments on whether various modifications should be made to this data collection. *See Data Gathering Second NPRM*, 16 FCC Rcd 2072.

[44] *See* Form 477, available at <http://www.fcc.gov/formpage.html>. Filings of December 31 data are due the following March 1, and filings of June 30 data are due the following September 1.

are capable of providing speeds of 2 Mbps.[45] Finally, these providers also report a list of the zip codes where they have at least one customer of high-speed service.[46]

18. Using data from Commission's data collection, in combination with publicly-available data from high-speed service providers themselves, financial analysts, and the Census Bureau, we are able to develop our understanding of the current deployment of high-speed services. The snapshots derived from our data collection 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. In this Report, we compare data as of June 30, 2001, with similar information, as of December 31, 1999, presented in the *Second Report*. Comparison with data on high-speed subscribership included in the *Second Report* suggests that there has been appreciable growth in the deployment of high-speed services to residential consumers in the past eighteen months. We detail these findings, below.

19. Some participants in the Commission's data collection request non-disclosure of all or portions of their data, asserting that it contains competitively-sensitive information.[47] In the *Data Gathering Order*, the Commission agreed to publish in its regular reports high-speed data only once it has been aggregated such that it does not reveal individual company data.[48] Accordingly, the data is presented here, and in the statistical summary that we are releasing simultaneously with this Report, in a manner that does not reveal individual company data.[49]

20. There may be limitations to the conclusions we are able to draw based on data from the Commission's data collection program. Indeed, the Commission is currently considering whether certain modifications should be made to its data collection program, in order to develop more fully our understanding of the deployment and availability of advanced telecommunications.[50] In particular, the Commission sought comment on how to best collect data on the availability of advanced services to discrete geographic areas and among distinct

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[45] Providers also reported information about: the percentage of lines that were provided solely over their own facilities (as opposed to over leased facilities) and the percentage of lines that they billed directly to the end user (as opposed to another provider or reseller).

[46] 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 or type of customer. Nor did the Commission require firms to report data concerning states where they provided fewer than 250 high-speed lines. Therefore, our data concerning areas where there are many small providers may understate deployment. In each of our four data collections to date, about 40 entities have made voluntary filings, representing less than 0.1 percent of total reported high-speed lines.

[47] *Cf.* 47 C.F.R. § 0.459(d).

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

[49] *High-Speed Services for Internet Access: Subscribership as of June 30, 2001* (Ind. Anal. Div. rel. Feb. 6, 2002) (Appendix C), available at <http://www.fcc.gov.Bureaus/CommonCarrier/Reports/FCC-StateLink/comp.html>. 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 FCC Form 477 that filers identify as competitively-sensitive and proprietary. *Petition for Declaratory Ruling on Local Carrier and Broadband Reporting Requirement*, CC Docket 99-301, Petition for Declaratory Ruling, filed May 15, 2000. We do not address Hughes' petition here. In this Report, and in the statistical summary released simultaneously, the Commission uses statistical methods, such as suppression and aggregation, to ensure that individual company-filed broadband data obtained from the Commission's data collection program will not be revealed through the use of released information.

[50] *See Data Gathering Second NPRM*, 16 FCC Rcd at 2072.

demographic groups.[51] At the same time, the Commission sought comment on ways to eliminate any unnecessary or unduly burdensome aspects to the data collection program.[52]

### 1. Geographic Distribution of High-Speed Deployment

21. Overview and methodology. 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.[53] Subscribership necessarily reflects a combination of factors including: availability of infrastructure, service offerings that are tailored to meet consumer's needs, and affordable pricing. We believe that our data is a useful tool in determining where services are being made available, given the close association between deployment and subscription, and can help us identify issues of concern for further exploration. For instance, the data show areas where at least one customer receives high-speed service *in the last mile* to the customer premises. As a result, 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 high-speed services.

22. 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, 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.[54] 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.[55] Once that work has taken place, most customers served by that central office typically can obtain DSL service without great additional difficulty.[56] The presence of satellite service also indicates the likely availability of the signal to nearby customers.[57]

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[51] *Id.*

[52] *Id.*

[53] As noted above, the most recently collected zip code data depict where actual high-speed subscribers are located as of the end of June 2001.

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

[55] We note, however, that LECs must also "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. The amount of conditioning necessary may influence a carrier's ability to provide advanced services to customers served by the same central office.

[56] 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.

[57] We note that high-speed satellite services are currently being offered in all 50 states. *See* Q&A StarBand Facts (visited Feb. 5, 2002) <http://www.starband.com/faq/starbandfacts.htm#available2> ("The StarBand service is currently available only in the 48 contiguous U.S., Alaska and Hawaii.").

23. Zip code data from our data collection 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 that is high-speed capable. By collecting data on actual subscribers, we capture part of the overall infrastructure (namely, the last mile) that is currently used to provide high-speed services.[58] 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, 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 our future data collections, including in the zip code data.[59]

24. The results of our data collection give two perspectives into the geographic distribution of high-speed services. First, we are able to calculate the number of high-speed and advanced service lines in each state, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands -- all of which report at least some level of high-speed service.[60] 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 and to some extent facilities in any given zip code.

25. In order to minimize the burden associated with the data collection, the Commission did not require providers to report the *number or type* 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 full 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 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.

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[58] For example, the map derived from FCC Form 477 data in Appendix C illustrates the location of high-speed subscribers and 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. *See* Appendix C.

[59] We note that high-speed providers will complete and file FCC Form 477, again, on March 1, 2002, and semi-annually thereafter during the term of the program. The Commission adopted a five-year sunset provision, which will terminate the program in 2005 unless the Commission takes affirmative steps to preserve the program. *See Data Gathering Order*, 15 FCC Rcd at 7746.

[60] 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 that are provided in the District of Columbia and the territories and possessions as well as the fifty states. In the FCC Form 477 filings to date, broadband data has been filed for the fifty states, the District of Columbia, Puerto Rico and the Virgin Islands.

26. The scope of our data collection reflects the Commission's understanding that a data collection that required highly detailed reporting at such fine geographic levels would have created an appreciable regulatory burden for the firms providing high-speed service and a significant administrative burden for firms with a national scope, given that there are over 30,000 zip codes in the United States. State commissions and private institutions may be best positioned to collect highly detailed data in discrete geographic areas and among particular communities of the population. As noted above, we are exploring that question and, more generally, whether some of this additional granularity should be incorporated into our data collection.[61]

27. High-Speed Subscribers Across the Country. Results of our most recent data collection indicate that there was at least one customer for high-speed service in each of the fifty states, the District of Columbia, Puerto Rico, and the Virgin Islands and in 78 percent of all the zip codes in the United States. The number of high-speed lines reported in each state varies significantly, with reported high-speed subscribership ranging from a high of 1.7 million lines in California to a low of less than 15,000 lines in four states.[62] Reported line counts on a state-by-state basis appear in the statistical summary, prepared by the Industry Analysis Division of our Common Carrier Bureau, that we also release today.[63] Similarly, in some states there are many providers reporting -- with 20 or more reporting in 12 states -- and in other states there are only one or two providers reporting. The state-by-state number of reporting providers also appears in the statistical summary released today.[64]

28. Again, looking broadly for the presence of high-speed services, the data we collect show that 78 percent of the zip codes in this country have at least one subscriber to high-speed services.[65] Those zip codes are shown in the map that appears in Appendix C.[66] The map shows that high-speed service is deployed in many areas in the United States. Our analysis further shows that nearly all of the population of the United States tends to be concentrated in those 78 percent of zip codes where high-speed subscribers are located. More precisely, 97 percent of the country's population lives in those zip codes where high-speed subscribership was reported.

29. To better gauge where competition for high-speed services may be developing, the map in Appendix C also shows the number of high-speed providers reporting data for given zip codes. As indicated by the shadings in the map, there are competing suppliers -- sometimes as many as 18 in a zip code -- in the major population centers of the country. Multiple providers of high-speed services reported having subscribers in 58 percent of the nation's zip codes in June

[61] *See Data Gathering Second NPRM*, 16 FCC Rcd 2072.

[62] In addition, we do not report the number of high-speed lines in two states, Puerto Rico, and the Virgin Islands in order not to reveal individual provider data.

[63] *See* Appendix C. Again, we note that some charts and tables contain data that have been aggregated or suppressed to prevent the release of information that may be deemed competitively-sensitive.

[64] *Id.* As noted above, we expect that there many 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.

[65] *Id.* at Tbl. 9.

[66] The map follows Tbl. 9 in Appendix C. Areas with shading indicate the presence of at least one high-speed subscriber in a zip code. *Id.*

2001, compared to 34 percent eighteen months earlier.[67] During that period, the share of zip codes in which five or more providers reported having customers increased from 6 percent to 19 percent.

30. Residential and Small Business Subscribership.[68] We note that growth in subscribership for residences and small businesses is consistent with the high level of availability indicated by the Commission's data. Results of the Commission's data collection show that there were a total of approximately 7.8 million high-speed residential subscribers, as of June 30, 2001.[69] We estimate that approximately 4.3 million of these residential customers subscribed to services that meet the Commission's definition of advanced services.[70] By comparison, we stated in the *Second Report* that there were approximately 1.8 million high-speed residential subscribers at the end of 1999. We estimated that approximately 1.0 million of these residential customers subscribed to services that meet the Commission's definition of advanced services.[71] As a result, penetration of advanced services quadrupled from 1.0 percent of households at the end of 1999 to 3.8 percent at the end of June 2001.[72] Looking more broadly at all high-speed services (i.e., not only advanced services), the residential penetration rate was 7.0 percent at the end of June 2001.

[67] These figures are the percentage of zip codes in which more than one high-speed service provider reported having at least one customer. *See id.* for additional detail.

[68] The data from the Commission's data collection program concerning deployment of high-speed lines to residential customers includes not only residential users, but also home office and small business users. *See Data Gathering Order*, 15 FCC Rcd at 7760. Thus, in this Report, we combine small business and residential customers and refer to them collectively as "residential customers." We note that we similarly combined small business and residential customers in the *First and Second Reports*. *First Report*, 14 FCC Rcd at 2409; *Second Report*, 15 FCC Rcd at 20941. The Commission's data collection program generally collects 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.

[69] At the end of June 2001, of the 7.8 million residential customers who subscribed to high-speed services, approximately 5.0 million subscribed to services using hybrid fiber-coaxial (HFC) technology (such as cable modem service), approximately 2.5 million subscribed to ADSL services, while the balance subscribed to other media, including satellite and fixed wireless services. *See* Appendix C, Tbl. 3.

[70] *See* Appendix C, Tbl. 4. Of the 4.3 million residential and small business subscribers to advanced services, there were approximately 3.1 million residential customers subscribed to cable-based services and approximately 0.9 million residential customers subscribed to ADSL, with the balance subscribing to other media. These figures show cable companies increasing their residential advanced services subscribership by 261 percent in eighteen months and local exchange carriers increasing their residential DSL subscription to advanced services by 683 percent. We note that our estimates of residential ADSL subscribers do not include any symmetric forms of DSL, which are typically purchased by business customers.

[71] *Second Report*, 15 FCC Rcd at 20941.

[72] As of March 2001, there were about 107 million households in the United States FCC Industry Analysis Division, *Telephone Subscribership in the United States*, Tbl. 1 <http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/subs0301.pdf> (Nov. 2001). At all pertinent times, there have been about 4 million small businesses (establishments with 1-4 employees) in the U.S. U.S. Census Bureau, Statistical Abstract of the United States 559, No. 881 (1999) & 547, No. 872 (2000).

31. Business Subscribership.[73] In accord with the growth in availability of high-speed and advanced services, our data also indicates that the number of large businesses that subscribe to high-speed and advanced services has increased. In the Commission's data collection, providers reported there were approximately 1.8 million high-speed service (including advanced service) lines in service to large business and institutional customers at the end of June 2001.[74] We estimate that almost all of these lines satisfy our definition of advanced services;[75] thus, we conclude that there were approximately 1.7 million advanced service lines in service to business customers at the end of June 2001.[76] By comparison, in the *Second Report* we estimated there were approximately 1.0 million high-speed in service to business customers at the end of 1999, and that approximately 0.9 million of those lines satisfied our definition of advanced services.[77]

### 2. Demographic Variables

32. In this section, we use zip code data from our data collection 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.[78]

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[73] The Commission's data collection allows only a partial view into deployment of high-speed services to large business and institutional customers. *Second Report*, 15 FCC Rcd at 20943. For methodological reasons, the Form 477 does not collect data about all of the high-speed service offerings that are targeted at large business and institutional users. It collects 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" broadband 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 those high-speed services.

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

[75] Filers of Form 477 do not report directly 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 assume 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 get the most precision, estimates are conducted at the individual Form 477 level. Staff conduct 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 percent of total advanced service lines reported.

[76] The number of advanced service lines in service to large business customers is, for each technology category, the difference between total advanced service lines (*see* Appendix C, Tbl. 2) and the estimated number of advanced service lines to residential and small business customers (*see* Appendix C, Tbl. 4). Of the estimated 1.7 million advanced service lines in service to larger business customers at the end of June 2001, slightly over 82,000 were ADSL service, almost 950,000 were other wireline services, and almost 650,000 were other media, including optical carrier, services. By comparison, in the *Second Report* we estimated that of the 0.9 million advanced service lines for larger business customers, advanced services delivered over approximately 70,000 ADSL lines, 560,000 other wireline service lines, and slightly over 300,000 other media, including optical carrier, services. *Second Report*, 15 FCC Rcd at 20944.

[77] *Second Report*, 15 FCC Rcd at 20943.

[78] We emphasize that the data in this section are presented in a preliminary and descriptive fashion. Many of the statistics discussed here indicate how or to what extent 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. Demographic data was obtained from *Demographic Power Pack, Current Year Survey*, MapInfo Corporation (2000 issue).

33. We acknowledge that reliance on marketplace forces may yield deployment that varies by demography at any given point in time. Yet the language and sprit of the Act require that we promote advanced services deployment within a framework that relies significantly on market forces. Information relating to various demographic variables does not, by itself, determine whether deployment is reasonable and timely. As a result, if we are to rely on a market-based system to provide advanced telecommunications capability, the evaluation of whether deployment is reasonable and timely must account for some demographic variation. Thus, some amount of demographic variation in deployment, particularly if it is not persistent, may not be inconsistent with reasonable and timely deployment. Nevertheless, we agree that it is important to continue to monitor demographic relationships in order to identify drivers of deployment in the event government or non-governmental action is warranted.

34. Again, by examining the Commission's data, we seek to gain understanding about the availability of advanced telecommunications infrastructure. 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.[79] Despite these limitations, the zip code data provide a simple, and to our knowledge, unique source of information about where high-speed services are being delivered and where high-speed-capable last miles are deployed.

35. Population Density. Our data suggest that there is a great disparity in high-speed subscribership at different population densities with high-speed services reported more often in high-density areas than in less dense areas. Table 11 shows the percentage of zip codes with high-speed subscribers by deciles based on population density.[80] As it indicates, high population density has a strong positive correlation with the presence of high-speed subscribership and low population density has a strong negative correlation. Nearly all the most densely populated zip codes (well over 90 percent) have one or more high-speed subscribers, but fewer than 40 percent of the most sparsely populated zip codes have high-speed subscribers.[81] 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.[82]

36. Reporting of high-speed subscribership increased notably between December 1999 and June 2001 in more sparsely populated zip codes. The increase was 17 percentage points (from 19.9 percent to 36.8 percent) for the least densely populated zip codes, compared to

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

[80] *See* Appendix C, Tbl. 11. 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.

[81] *Id.* See Table 11 for a more detailed illustration of the relationship between population density and the presence of high-speed service. As illustrated there, 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.

[82] For example, the National Telephone Cooperative Association (NTCA) reports that small, rural telephone companies are deploying broadband to rural America in a reasonable and timely manner. In addition, the NTCA states that almost 80 percent of respondents to a recent survey of its members are offering high-speed services to all public centers in the carrier's service territory. *See* NTCA Comments at 2.

2 percentage points (from 96.1 percent to 98.1 percent) for the most densely populated zip codes. For zip codes in the mid-range of population density, the reported improvement was 24 percentage points.[83]

37. In our collection of data as of the end of June 2001, the largest number of high-speed providers reported in any single zip code was 18. Though the 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.[84] 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 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 to business users in these areas does not necessarily indicate availability of high-speed to any residents of these areas.

38. Household Income. Table 12 shows the percentage of zip codes with high-speed subscribers by deciles based on median household income.[85] Of the highest income zip codes, 96 percent have high-speed subscribers, while of the lowest income zip codes, 59 percent have high-speed subscribers.[86] By contrast, eighteen months earlier these percentages were 91 percent and 42 percent, respectively. Again, as we observed with the population density data, some of the low-income zip codes that have high-speed subscribers include businesses 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 may actually be less prevalent than suggested here.

39. Small Towns. Publicly available demographic data, in conjunction with our data collection, allow some general insight into the presence of providers of high-speed services in small towns. In particular, by constructing a sample of zip codes that appear to contain small towns,[87] we estimate that 86 percent of zip codes in small towns have at least one high-speed services subscriber. These data do not allow us, however, to estimate with confidence the percentage of the U.S. small-town population that resides in such zip codes. In addition, results of our data collection indicate that, even in rural areas, population centers are different than outlying areas. As of June 2001, 61 percent of the population of the most sparsely-populated zip

[83] This improvement is the average improvement for zip codes in the fifth and sixth deciles of zip codes. *See* Appendix C, Tbl. 11 for additional detail.

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

[85] *See* Appendix C, Tbl. 12.

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

[87] 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 75 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 percent of the population density of the small town's zip code. Our zip code data do not distinguish among communities within a zip code.

codes resided in a zip code in which there was at least some high-speed subscribership. The comparable figure eighteen months earlier was 39 percent.[88] For zip codes in the mid-range of population density, 95 percent of the population resided in zip codes with high-speed subscribership as of June 2001, compared to 78 percent eighteen months earlier.[89]

40. Indian - Tribal Areas. Our data also show that there is at least one subscriber to high-speed services in 71 percent of the zip codes that contain tribal territories.[90] This remains below the national figure of 78 percent, described above.[91]

41. As noted above, demographic information can provide useful insight to the Commission on deployment drivers to various categories of consumers. Because the availability of many products and services vary with these same demographic variables, however, we do not rely on this information alone to determine whether advanced telecommunications capability is being made available in a reasonable and timely manner.

### 3. Survey Data By Last Mile Technologies

42. We report, below, available figures on high-speed services by last mile technology based on our data collection and, where indicated, 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, the data may reflect different strategies for deployment and the strengths and weakness of these last mile technologies. For example, our data collection shows 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 still tend to be delivered to large business and institutional customers.

43. We also report 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.

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[88] These figures are for the least densely-populated decile of zip codes. *See* Appendix C, Tbl. 11.

[89] *Id.* These figures are the average for the fifth and sixth zip code deciles.

[90] For purposes of this proceeding, we consider "tribal areas," "tribal lands," or "tribal territories" to be American Indian Reservations, as identified by the Bureau of Indian Affairs (BIA). American Indian Reservations are legal entities having boundaries established by treaty, statute, and/or executive or court order over which a federally recognized American Indian tribal group has jurisdiction. American Indian Reservations do not include any of the other types of "Indian lands" such as Alaska Native Village Statistical Areas, Alaska Native Regional Corporations, Public Domain Allotments, Trust Lands, and other designated statistical areas. The source of the BIA Indian reservation boundaries are the Census Bureau TIGER/Line files. The 2000 version of the TIGER/Line Files can be found at <http://www.census.gov/geo/www/tiger/tiger2k/tiger2k.pdf> (visited Feb. 5, 2002).

[91] *See supra* para. 27.

### a. Cable HFC Systems

44. According to our data collection, high-speed lines delivered over cable HFC systems in the last mile account for 54 percent of the total high-speed lines as of the end of June 2001, compared to the 51 percent we reported in the Second Report.[92] More specifically, cable companies report almost 5.2 million high-speed lines in service using cable modem technology at the end of June 2001, compared to 1.4 million at the end of 1999. Of the 5.2 million lines reported for June 2001, 64 percent meet the Commission's definition of advanced services, compared to 62 percent eighteen months earlier. As noted above, our data show the number of advanced service lines provided over cable technology to residential customers nearly quadrupled between December 1999 and June 2001.

45. Combining our data with publicly-available sources about the availability of cable modem-ready plant, the 5.2 million cable high-speed lines reported represents a penetration rate of approximately 8 percent of cable modem capable homes as of mid-year 2001.[93] By contrast, in the Second Report, we reported a cable modem penetration rate of approximately 3 percent as of the beginning of 2000.[94] Residential and small business subscribers, not surprisingly, account for over 96 percent 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.

46. In addition, our data collection shows that high-speed services using cable technology (such as cable modems) are reported in 49 states and the District of Columbia.[95] As we illustrated in the *Second Report*,[96] publicly available information indicates that cable systems capable of providing cable modem service[97] tend to be located in more densely populated areas,

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[92] *See Second Report*, 15 FCC Rcd at 20952. The FCC Form 477 collects 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."

[93] NCTA estimates that, as of July 2001, more than 60 million households were passed by high-speed cable modem service. NCTA Comments in the *Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, CS Docket No. 01-129, Eighth Annual Report, FCC 01-389 (rel. Jan. 14, 2002) (*2001 MVPD Competition Report*), at 27. However, based on Morgan Stanley year-end estimates, cable modem service was available to as many as 68 million households as of July 2001. *See also* Richard Bilotti, Benjamin Swinburne, and Megan Lynch, *The Marquis de Broadbandbury – Part Deux*, Morgan Stanley Dean Witter, Jul. 3, 2001, at 46 (*Morgan Stanley – Broadband Part Deux*). Penetration is the number of subscribers divided by homes passed by cable modem-ready plant.

[94] *See Second Report*, 15 FCC Rcd at 20952.

[95] *See also* Appendix C, Tbl. 6.

[96] *See Second Report*, 15 FCC Rcd at 20954.

[97] As we noted in our *Second Report*, the Commission entered into "social contracts" with several large cable operators between 1995 and 1997, which generally required operators to upgrade the majority of their systems to at least 550 MHz and to ensure that at least 50 percent of their subscribers were served by systems having a capacity of at least 750 MHz. 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. *See Second Report*, 15 FCC Rcd at 20953, n.126.

especially in the East, the Midwest, and on the West Coast. Publicly available sources estimate that cable modem service is now available to about 70 percent of U.S. homes.[98]

47. Although cable modem service typically delivers information to end-user customers at speeds in excess of 2 Mbps, essentially none (0.3 percent) of these connections carry information from customers to the Internet at those speeds.[99]

### b. ADSL and Other Traditional Wireline Technologies

48. In this section we have divided traditional wireline technologies into three categories. First, we look at ADSL[100] service, the most popular residential offering. Second, we examine other traditional wireline services, including both T1 and symmetric DSL (SDSL)[101] 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. As a consequence of its high rate of growth from a relatively small base, ADSL accounted for 28 percent of all high-speed lines as of the end of June 2001, compared to 13 percent eighteen months earlier.[102] Other traditional wireline high-speed services accounted for 11 percent of all high-speed lines, compared to 22 percent at the end of 1999.[103] Optical fiber accounted 5 percent of all high-speed lines, compared to 11 percent eighteen months earlier.[104]

49. ADSL. Our data collection shows that there were 2.7 million ADSL lines in service in the United States at the end of June 2001, compared to just under 0.4 million eighteen

[98] *See Morgan Stanley – Broadband Part Deux* at 46 (estimating 73 percent availability as of the end of 2001); NCTA estimates, based on separate Morgan Stanley estimates, that cable modem service could be available to as many as 81 million households (of about 106 million total households) at the end of 2001. NTCA Comments in the *2001 MVPD Competition Report* at 27; Communications Daily, Nov. 2, 2001, at 10, cites a Yankee Group estimate that cable modem service would reach 66 percent of U.S. households at the end of 2001 (compared with 45 percent for DSL services).

[99] Based on discussions with cable modem service providers, we understand that the services marketed to consumers generally offer "upload" speeds that do not exceed 1 Mbps. This is a clarification to information presented in the *Second Report*. *See Second Report*, 15 FCC Rcd at 20953.

[100] 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. Asymmetric refers to the asymmetry of up end download speeds.

[101] 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.

[102] This includes all lines purchased to deliver transmissions at speeds in excess, in at least one direction, of 200 kbps.

[103] We note that the number of traditional wireline high-speed lines increased from almost 610,000 lines in December 1999 to almost 1.1 million in June 2001. The overall percentage of traditional wireline high-speed lines in service decreased only relative to the tremendous growth in other types of technology, such as cable and ADSL.

[104] These are lines in service to end-user customers in which optical fiber extends completely to the subscriber's premises. Again, we note that the number of optical fiber high-speed lines increased from about 312,000 lines in December 1999 to almost 456,000 in June 2001. The overall percentage of optical fiber high-speed lines in service decreased only relative to the tremendous growth in other types of technology, such as cable and ADSL.

months earlier.[105] Approximately 37 percent of these 2.7 million lines meet the Commission's definition of advanced services. These services were reported in 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands. The number of reporting providers was 86, compared to 28 providers eighteen months earlier.

50. Of the approximately 2.7 million reported ADSL lines, estimates provided by the reporting providers indicate that 92 percent (about 2.5 million lines) serve residential or small business customers. A reported 88 percent of these lines are sold directly to end-user customers, compared to the 90 percent figure we reported in the *Second Report*.[106] Approximately 93 percent are delivered solely over facilities owned by the reporting provider, as we also reported in the *Second Report*.[107] Almost none (0.2 percent) of the ADSL lines were reported to provide an information carrying capacity in excess of 2 Mbps in both directions.

51. Our data collection shows that incumbent LECs serve approximately 93 percent of ADSL subscribers, while the competitive LECs serve about 7 percent.[108] In the *Second Report* we illustrated that DSL deployment closely mirrors reported DSL subscribership. By contrast to the *Second Report*, in which we noted that competitive LECs appeared to be adding customers for DSL services at a faster rate than incumbent LECs,[109] publicly available data indicate that incumbent LECs added customers at a faster rate than competitive LECs between the third quarter of 2000 and the third quarter of 2001.[110] Publicly available sources estimate that ADSL service is now available to about 45 percent of U.S. homes, compared to about 25 percent of homes at the end of 1999.[111]

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[105] By comparison, and as an example of publicly available estimates, research firm TeleChoice reports 3.3 million DSL lines in service in the U.S. at the end of June 2001. *See TeleChoice DSL Deployment Summary – Updated 11/27/01* (visited Feb. 5, 2002) <http://www.xdsl.com/content/resources/deployment_info.asp> (TeleChoice Deployment Statistics). Note, however, that our count includes only ADSL lines purchased to deliver transmissions at speeds that exceed, in at least one direction, 200 kbps. The 250-lines-per-state reporting threshold in our data collection also tends to reduce our count, as smaller LECs that provide DSL service may not meet the reporting threshold.

[106] *See Second Report*, 15 FCC Rcd at 20956.

[107] *Id.*

[108] *See* Appendix C, Tbl. 5, for shares of lines provided by various types of carriers, for the other line technology categories discussed in this Report.

[109] *See Second Report*, 15 FCC Rcd at 20956.

[110] For example, data compiled by TeleChoice indicate that customers of the incumbents LECs and the competitive LECs both increased by over 40 percent during the third quarter of 2000. Each group of providers experienced declining rates of growth in succeeding quarters, but competitive LEC customer growth was down to 6 percent in the third quarter of 2001, compared to 16 percent for incumbent LECs. In the first quarter of 2001, the number of competitive LEC customers actually declined. *See* TeleChoice Deployment Statistics, *supra* note 105.

[111] Yankee Group estimates DSL availability to 45 percent of U.S. homes at the end of 2001. *See supra* note 98. Morgan Stanley estimates 49 percent as of the end of 2001 and reports 25 percent availability as of the end of 1999. *See supra* note 98. Also, the Pinkham Group reports that over 70 percent of U.S. households are served by an incumbent LEC central office equipped to offer DSL service, but that over one third of these same households can not utilize DSL due to distance and technical limitations, which implies an availability rate of about 46 percent. *See Broadband Market Study - DSL Current Deployment and Availability Q3, 2001* (visited Feb. 5, 2002) <http://www.pinkhamgroup.com/c_reports.htm>.

52. Other Wireline. Providers reported 1.1 million high-speed lines in this category, which includes services such as T1 and SDSL services, compared to 0.6 million lines reported in the *Second Report*. Of that total, 100 percent of these lines meet the Commission's definition of advanced services. These services were reported in every state, the District of Columbia, Puerto Rico, and the Virgin Islands.

53. Approximately 87 percent of high-speed lines over other traditional wireline technologies were reported to serve larger business and institutional users. Reporting providers indicate that 68 percent of their lines are billed directly to end-users, with the balance billed to other providers or retailers. A reported 75 percent of these lines are provided over the reporting provider's own facilities, indicating that the provider uses its own "local loop" facilities (or the wireless equivalent) to deliver the service to its customer.[112] Finally, our data show that 16 percent of these lines deliver an information carrying capacity in excess of 2 Mbps in both directions.

54. Optical Carrier (i.e., Fiber to the End-User Premises). Approximately 460,000 high-speed lines over optical fiber systems are reported in our data collection, compared to the range of 250,000 to 350,000 lines that we reported in the *Second Report*.[113] Essentially, all of these lines meet the Commission's definition of advanced services, and 26 percent are reported to be faster than 2 Mbps in both directions. A very small percentage (0.6 percent) of these lines are reported to be in service to residential customers. Almost all (81 percent) are billed directly to end-user customers and virtually all (98 percent) are delivered over facilities owned solely by the reporting provider.

### c. Terrestrial Fixed Wireless Technologies

55. We do not release, at this time, specific line counts for high-speed services delivered over terrestrial fixed wireless technologies. These numbers are aggregated with totals for high-speed lines delivered over satellite technology to address confidentiality concerns.[114] In lieu of a precise subscribership total, we report that terrestrial fixed wireless technology accounts for between 50,000 and 150,000 high-speed lines. By contrast, in the *Second Report* we reported that wireless service represented fewer than 50,000 subscribers.[115] Of these lines, 89 percent are reported to meet the Commission's definition of advanced services. Most of the reported terrestrial fixed wireless high-speed lines (85 percent) serve residential or small business customers. According to our data collection, virtually none (0.1 percent) are reported to deliver information carrying capacity in excess of 2 Mbps in both directions.

56. Confidentiality concerns preclude us from providing more detailed analyses from the collected terrestrial fixed wireless data and from producing a map based on zip codes where

[112] As an example of a "facilities-based" provider that does not use its "own facilities" to deliver service, as reported in our data collection, a competitive LEC might deliver SDSL service to its customer by placing its own electronic equipment on a local loop that it leases from an incumbent LEC as an unbundled network element (UNE) loop.

[113] *See* Appendix C, Tbl. 1; *Second Report*, 15 FCC Rcd at 20958.

[114] To prevent the release of information that may be deemed competitively sensitive, we may aggregate or suppress data in some charts and tables that we release. In other cases, data may be presented as a range of numbers rather than as an exact number.

[115] *See Second Report*, 15 FCC Rcd at 20958.

terrestrial fixed wireless subscribers exist. Publicly available information, however, indicates that terrestrial fixed wireless high-speed systems are scattered throughout the country. In addition, our data collection indicates that the nine companies with high-speed terrestrial fixed wireless subscribers reported such subscribers in a total of 25 states.

57. Public estimates of the extent of terrestrial fixed wireless high-speed deployment differ markedly and some industry analysts' estimates generally exceed our reported figure.[116] For instance, Strategis Group estimates that there were roughly 100,000 terrestrial fixed wireless high-speed subscribers in the United States as of mid-2001.[117] Cahners In-Stat believes there are currently about 300,000 terrestrial fixed wireless subscribers, including businesses, in the United States.[118]

58. Within the MDS sector, Yankee Group estimated that there were approximately 20,000 MDS-based high-speed Internet access subscribers in the United States at the end of 2000,[119] and that this number will have grown to 87,000 by the end of 2001.[120] Yankee Group also believes that MDS systems currently reach 55 percent of the United States population.[121] Based on various public information sources, it appears that at least 28 companies were offering high-speed Internet access via MDS in approximately 44 separate markets as of the end of 2000.[122]

59. In addition, many local and regional ISPs use unlicensed spectrum to offer terrestrial fixed wireless high-speed Internet access in a small number of markets apiece. Estimates of the number of companies using unlicensed spectrum for this service vary. One equipment manufacturer estimates there are around 800,[123] while another believes there are 50 to 100.[124] One industry analyst estimates there are just under 200.[125] Based on obtainable,

[116] 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.

[117] Alex Salkever, *Broadband's Next Wave: Wireless?*, Business Week Online, May 17, 2001 (citing Peter Jarich of Strategis Group).

[118] Eve Tahmincioglu, *For High-Speed Access to the Web, a Dish-to-Dish Route*, New York Times, Oct. 11, 2001, at G9 (citing Cahners In-Stat Group).

[119] Michael Bartlett, *Fixed Wireless System To Join Broadband Access Race – Study*, Newsbytes, Aug. 29, 2001 (citing Yankee Group).

[120] Denise Pappalardo, *Worldcom Adds Wireless MMDS Area*, Network World, Aug. 20, 2001, at 23 (citing Lindsay Schroth, an analyst at The Yankee Group).

[121] Michael Bartlett, *Fixed Wireless System To Join Broadband Access Race – Study*, Newsbytes, Aug. 29, 2001 (citing Lindsay Schroth, an analyst with Yankee Group).

[122] *See 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*, Sixth Report, 16 FCC Rcd 13350, 13452 (2001).

[123] *Unlicensed Update – The Service Providers*, Broadband Wireless Business, June/July 2000, at 25 (citing Tom Walusek, BreezeCOM). According to Walusek, the 800 includes ISPs with only one functioning link. *Id.*

[124] *Id.* (citing Scott Plumlee, C-Spec).

[125] *Id.* (citing Andy Fuertes, Allied Business Intelligence).

publicly-available information, the Commission estimates there are at least 241 different companies using unlicensed spectrum to provide high-speed terrestrial fixed wireless Internet access in approximately 503 different counties.[126]

### d. Satellite Technologies

60. Our data collection confirms that provision of high-speed services over satellite technology is still in the early stages of deployment with less than four providers reporting. High-speed service over satellite technology accounted for between 50,000 and 150,000 high-speed lines as of June 2001.[127] We note that virtually all of these lines are provided to residential and small business users, and are billed directly to end-user customers. We also note that none of these lines satisfies the Commission's definition of advanced services. Again, confidentiality concerns prevent us from providing information from our data collection on the geographic distribution of satellite service subscribers. Publicly available information, however, indicates that there are satellite high-speed subscribers in every state. StarBand Communications announced that by the end of 2001 it had installed nearly 40,000 paying subscribers in all 50 states, and Hughes Network Systems said it had over 100,000 subscribers for its DIRECTWAY satellite service.[128]

## C. Investment in High-Speed Access Technologies

61. Overview. This section reviews the analyses and predictions of various industry analysts with respect to investment in the high-speed and advanced services sector. Overall, analysts observe that carriers have continued to invest in this sector in a substantial way resulting in increased availability of various high-speed and advanced services platforms for consumers throughout the nation. According to one analyst, about 75 percent of households will have high-speed Internet access available from either DSL or cable modem service by the end of 2001, up from 60 percent in 2000.[129] Another analyst estimates as of the first quarter of 2000, that 81 percent of households had available DSL or cable modem service.[130] The analyst further estimates that 94 percent of households will have available DSL or cable modem service by 2005.[131] In addition, it appears that other services, such as fixed wireless and satellite, have significantly expanded availability to a large percentage of the United States. For example, high-

[126] *See 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*, Sixth Report, 16 FCC Rcd 13350, 13444 (2001).

[127] Fixed wireless and satellite high-speed services, together, represent 200,000 high-speed lines as of the end of June 2001, compared to 50,000 at the end of 1999. *See* Appendix C, Tbl. 1.

[128] *StarBand Wraps Up 2001 as American's Leading Consumer Satellite Internet Provider*, Press Release, Jan. 7, 2001 (visited Feb. 5, 2002) <http://www.starband.com/whoweare/pr/010702.htm>; *DIRECTWAY Subscribers Break 100,000 Mark*, Press Release, Jan. 9, 2002 (visited Feb. 5, 2002) <http://www.hns.com/corporate/news/pr/pr9999487460002.htm>.

[129] *See Broadband Will be Available to 75 percent of US Homes by Year-Says New Yankee Group Report*, Yankee Group News Releases, Nov. 1, 2001 (*Yankee Group Release*).

[130] *Morgan/McKinsey Broadband Report* at 43.

[131] *Id.* at 52.

speed satellite services are now available in all 50 states,[132] and MMDS systems currently reach 55 percent of the population.[133] The percentage of the population reached by MMDS is expected to grow to 90 percent by the end of 2004.[134] Analysts generally predict this trend will continue. Likewise, they observe that subscription to these services is increasing at a significant rate and predict it will continue to do so in the future. Increases in subscribership suggest a stronger incentive to invest to make high-speed and advanced services available to even more consumers.

62. As the Commission noted in the *Second Report*, industry investment in infrastructure to support high-speed and advanced services has increased dramatically since 1996.[135] Analysts forecasted at that time that this upward trend would continue, spurred by the introduction of competition into the market.[136] Although analysts still generally expect this trend to continue, they observe that there has been a recent slowdown in investment caused by the economic downturn generally and, more particularly, over-building by carriers, over-manufacturing by vendors, over-capitalization by financial markets, coupled with unrealistic market expectations by investors.[137] They conclude that, although it will take some time for the industry to absorb excess bandwidth capacity and increase utilization of existing assets, the recent slowdown in investment has not been caused by a slowdown in consumer demand.[138] In addition, they conclude that the current contraction in the competitive LEC market, in particular, will likely continue in the near term because the economic opportunity for targeting small-to-medium business markets as an entry strategy, which is where competitive LECs have focused much effort, is not as great as originally expected.[139]

63. The Commission also noted in the previous *Report* that an equally significant factor driving infrastructure investment was the rapidly rising demand for high-speed services.[140] This factor continues to be true. Access to computers and high-speed Internet access has grown dramatically. According to a government survey, 53.9 million households (or 50.5 percent of all

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[132] *See, e.g.*, Q&A StarBand Facts (visited Feb. 5, 2002) <http://www.starband.com/faq/starbandfacts.htm#available2> ("The StarBand service is currently available only in the 48 contiguous U.S., Alaska and Hawaii.").

[133] Michael Barlett, *Fixed Wireless System to Join Broadband Access Race – Study*, Newsbytes, Aug. 29, 2001 (citing Lindsay Schroth, an analyst with Yankee Group).

[134] *Id.*

[135] *See Second Report*, 15 FCC at 20983.

[136] *Id.*

[137] *U.S. Communications Infrastructure at a Crossroads: Opportunities Amid the Gloom*, McKinsey & Company, Goldman, Sachs & Co., Aug. 2001, at 1, 5-7, 11, 37-40. (*McKinsey/Goldman Infrastructure Report*); *TeleChoice Sees Slower but Still Substantial Growth in DSL Market* (visited Feb. 5, 2002) <http://xdsl.com/content/tcarticles/wp081101.asp>; *Yankee Group Forecasts 2002 DSL Revenues at Over $3.3 Billion*, Yankee Group New Releases, Jan. 11, 2002.

[138] *Id.*

[139] *Sizing Up the CLECs: A Companion Piece to Broadband 2001*, J.P. Morgan Securities, Inc., Equity Research, Apr. 2, 2001, at 1 (*Morgan CLEC Report*)

[140] *Second Report*, 15 FCC Rcd at 20983.

households) had Internet access as of September 2001.[141] The percentage of homes with household Internet access increased rapidly from the 44.5 percent penetration rate in August 2000.[142] Analysts predict that the number of on-line households will continue to increase. Currently, the vast majority (80.0 percent) are narrowband connections, but the percentage of high-speed connections should increase, so that in the next five years, 55.7 percent of access connections are projected to be high-speed or advanced. Analysts predict for residential high-speed or advanced service subscribership to increase from 1.9 million at the beginning of 2000 to 40 million at the end of 2005.[143] By 2004, analysts expect 28.9 percent of households will access the Internet through cable modem services, 21.1 percent through DSL and 5.7 percent through wireless and satellite technologies.[144]

64. Analysts predict that new and unforeseen capacity hungry applications that require advanced service platforms will drive demand, and in turn deployment, in the future. One report forecasts that in 2005, the average broadband household will download about 70 megabits of files, consume more than 20 minutes of streaming per day, and download three two-hour long movies per month.[145] As these new services come on line, analysts expect that the use of the Internet will evolve. For example, they speculate that Internet dot-com web-page traffic will decline in relative importance as new demand such as enterprise driven machine-to-machine and streaming (audio and video) traffic rises.[146]

65. Cable: Recent investment in cable infrastructure has been significant. In 2000, the cable industry spent a total of $15.5 billion on the construction of new plant, upgrades, rebuilds, new equipment, and maintenance of new and existing equipment.[147] This represents a 45.9 percent increase over the $10.6 billion spent in 1999.[148] Analysts expect that operators will have spent an estimated $14.7 billion in 2001.[149] Moreover, it appears that the amount invested in cable infrastructure has remained at high levels over the past several years and has resulted in increased availability of cable modem service. As of year-end 2000, cable modem service was

[141] U.S. Department of Commerce, Economics and Statistics Administration, National Telecommunications and Information Administration, *A Nation Online: How Americans Are Expanding Their Use of the Internet* (Feb. 2002) (*A Nation Online*).

[142] *Id.*

[143] *Broadband 2001, A Comprehensive Analysis of Demand, Supply, Economics, and Industry Dynamics in the U.S. Broadband Market*, J.P. Morgan Chase & Co. and McKinsey & Company, Inc., Apr. 2, 2001, at 1. (*Morgan/McKinsey Broadband Report*); TeleChoice Deployment Statistics, *supra* note 105; *Morgan Stanley – Broadband Part Duex* at 46.

[144] *Id.*

[145] *IP! – Summary: How Changes in the Internet are Disrupting the Telecom Services Industry*, JPMorgan H&Q and McKinsey & Company, May 11, 2001, at 1, 16-19, 28-29 (*JPMorgan/McKinsey IP Report*)

[146] *Id.*

[147] Paul Kagan Assocs., Inc., *Estimated Capital Flows in Cable TV*, The Broadband Cable Financial Databook 2001, Jul. 2001, at 138. "New builds" are the construction of new cable plant where none existed before, primarily newly built homes. "Rebuilds" are improvements to existing systems that do not retain much of the old system plant and equipment. Instead, they consist of mostly new plant and equipment. "Upgrades" are improvements to existing cable systems that do not require the replacement of the entire existing plant and equipment.

[148] *Id.*

[149] *Id.*

available to 58.5 million homes, as compared to 35.5 million in 1999.[150] In 2001, cable modem services are estimated to be available to 77.5 million homes.[151] Recent progress in network upgrades has allowed cable operators to provide two-way service to the vast majority of cable modem ready homes.[152] One analyst predicts that by 2003 investment spending is expected to result in the upgrade of substantially all of the U.S. cable infrastructure (more than 99.9 million homes) to enable the delivery of new bandwidth-intensive services.[153] According to one analyst, once the upgrade is completed, the capital expenditures will likely remain high, but should decline.[154]

66. Subscribership to cable modem service is also increasing. At the end of 2000 there were approximately 3.9 million cable subscribers.[155] By year-end 2001, an industry analyst estimates that cable modem subscriptions will almost double, to 7.5 million subscribers.[156] In addition, that same analyst expects that over the next five years, cable modem subscriptions will continue to increase dramatically, reaching an average estimate of 28-30 million by 2006 and forecast penetration rates for cable modems to increase to 40 percent by 2006.[157]

67. Analysts expect that deployment of other cable-based advanced services will accelerate in the next few years. For example, analysts expect that subscriber demand for video-on-demand (VOD) services, which allow viewers to access TV programming "on demand" from a remote video server and have full VCR functionality, such as pausing, rewinding, and fast forwarding, will increase substantially over the next few years.[158] Analysts predict VOD services may reach 60 percent of total basic cable subscribers, or 42 million units by 2005-06.[159] According to one analyst, VOD will generate revenues of: more than $65 million by year-end 2001; $420 million in 2002; $970 million in 2003; $1.43 billion in 2004; and will reach $1.98 billion by year-end 2005.[160] According to another analyst, VOD subscribers are forecasted to grow from 17,000 in 2001 to 365,000 in 2006.[161]

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[150] *Morgan Stanley – Broadband Part Duex* at 46.

[151] *Id.*

[152] *See* NCTA Comments in the *2001 MVPD Competition Report* at 26; *see also* Comcast Comments in the *2001 MVPD Competition Report* at 7; *CableLabs DOCSIS Primer* (visited Feb. 5, 2002) <http://www.cablemodem.com/docsisprimer.html>.

[153] Richard Bilotti, Benjamin Swinburne, and Megan Lynch, *Broadband Cable Television, The Past is Prologue to the Future...* , Morgan Stanley Equity Research, Oct. 4, 2001, at 33 (*Morgan Stanley Broadband Cable Report*).

[154] *Id.* at 42.

[155] *See Morgan Stanley – Broadband Part Duex* at 46.

[156] *Morgan Stanley Broadband Cable Report* at 28-30.

[157] *Id.*

[158] Spencer Wang, John Martin, Thomas Sheehan, Mark Holmes, *Return on Bandwidth (ROB) Analysis: Interactive TV and Cable Television*, ABN-AMRO, Jun. 2001, at 30 (*ABN-AMRO Report*).

[159] *Morgan Stanley Broadband Cable Report* at 16.

[160] *Video-on-Demand Will Generate Revenues of Nearly $2 Billion in 2005*, Yankee Group News Releases, Jun. 25, 2001.

[161] *ABN-AMRO Report* at 33.

68. DSL: Analysts project continued growth for DSL advanced services technologies and investment. While widespread deployment of DSL began later relative to deployment of cable modem service, overall deployment of DSL is catching up. Analysts differ, however, as to which technology will ultimately take the lead. DSL deployment began in response to the 1996 Act and the presence of competitive access providers.

69. Overall, carriers are investing substantially in the nation's telecommunications network, including the deployment of DSL technologies. In 2000, incumbent LECs invested almost $29.4 billion in infrastructure.[162] As substantial portion of this investment is in high-speed or advanced data services. For example, Verizon estimates that 25 percent of capital expenditures in 2001 have been on "telecommunications data" up from 22 percent in 2000.[163] Competitive LECs' have made substantial capital expenditures, spending about $17 billion in 1999, $22.6 billion in 2000, and an estimated $14.2 billion in 2001.[164] Venture capital funding for competitors has also been significant. For example, competitive LECs, integrated communications providers, DSL, and fiber companies received $3.4 billion of such funding during the first three quarters of 2000.[165] One analyst predicts, however, that competitors will face economic challenges as funding for infrastructure investment has become scarce.[166] It notes that with some stock prices down 90 percent or more from their highs, the industry has lost an estimated $100 billion in equity capitalization from its peak.[167]

70. There have been tremendous recent increases in availability of DSL due to investments in deployment. For example, one analyst estimates availability to 51.5 million homes in 2001, as compared to a reported 37.6 million in 2000 and 25.8 in 1999.[168] Incumbent LECs have increased the number of customers who now have the opportunity to obtain DSL service from 44 percent in 1999 and to an estimated 64 percent in 2001.[169] Some incumbent LECs have been aggressively investing in their networks to make more homes "DSL addressable." Incumbent LECs have chosen a variety of rollout strategies for DSL as a consequence of differences in outside plant. One such strategy, for example, is SBC's Project Pronto, at a cost of $5 billion.[170] Likewise, Covad Communications had deployed a network that

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[162] Multimedia Telecommunications Association, *2001 Multimedia Telecommunications Market Review and Forecast* at 65 (this is total capital investment, only portions of which are allocable to the provision of DSL).

[163] *See* Verizon Communications, 2000 Annual Report (2001) (visited Feb. 5, 2002) <http://investor.verizon.com/annual/00VZ_AR.pdf>. In addition, Qwest reports that of total capital investment in 2001, 11 percent was for "local broadband" and 15 percent was for "data." The company projects that in 2002, 9 percent will be for local broadband, and 20 percent will be for data. *See* Afshin Mohebbi, Presentation at Qwest 2001 Investment Community Conference (Dec. 13, 2001) (visited Feb. 5, 2002) <http://www.qwest.com/about/investor/meetings/Mohebbi.pdf>.

[164] Unpublished estimate provided by New Paradigm Resources Group, Chicago, Illinois (Jan. 2002).

[165] Association of Local Telecommunications Services, *Report on the State of the Local Telecom Industry* (2001) (visited Feb. 5, 2002) <http://www.alts.org/Filings/022001AnnualReport.pdf>.

[166] *Morgan CLEC Report* at 8.

[167] *Id.* at 14.

[168] *Morgan Stanley – Broadband Part Duex* at 46.

[169] *Morgan/McKinsey Broadband Report* at 40-42.

[170] *Id.* at 68-69, 82.

currently reaches approximately 40 to 45 percent of all homes and businesses in the United States.[171]

71. Subscription grew as well in 2000 by 1.9 to 2.4 million subscribers, representing annual growth of over 427 percent compared to 1999 subscription rates.[172] While DSL growth has been robust, it has slowed somewhat recently. One analyst notes that during the first two quarters of 2001, growth in DSL subscriptions has slowed to 14 to 20 percent due to three factors: competitive service provider failures, increased service pricing, and the general downturn of economic conditions.[173] Another analyst anticipates, however, that surviving service providers will continue to add customers.[174] In particular, an analyst predicts that over the next three years, residential DSL subscription will grow to 13.4 million in 2004, a 21.2 percent penetration rate.[175]

72. Wireless: The fixed wireless industry provides television programming (in the Multi-channel Multi-Point Distribution Service (MMDS) and Local Multi-Point Distribution Service (LMDS)), Internet access, data transfer services, interactive services and advanced telecommunications services over a terrestrial microwave platform. Despite the setbacks that the fixed wireless industry has faced during the past year, including financial problems and halting of deployment plans by major operators, analysts believe that the industry still has the potential to grow and become a successful vehicle for offering high-speed services.[176] One analyst estimates that the number of fixed-wireless high-speed subscribers in the United States will grow from 100,000 today to 4.7 million by 2005, and that fixed-wireless technology will account for 15 to 20 percent of the U.S. high-speed market at that time.[177] Another analyst estimates there are currently about 300,000 fixed wireless subscribers, including businesses, in the United States, and that that figure will grow to two million by 2005.[178] In addition, one analyst reports that MMDS systems currently reach 55 percent of the U.S. population, but will be available to 90 percent of the population by 2004.[179] At the end of 2000, there were approximately 20,000

[171] Covad Communications, Form 10-Q Consolidated Balance Sheet (Nov. 2001) (visited Feb. 5, 2002) <http://www.covad.com/companyinfo/investorrelations/documents/COVD-10-Q-11-14-2001.pdf>.

[172] *Morgan Stanley – Broadband Part Duex* at 46.

[173] *TeleChoice Sees Slower but Still Substantial Growth in DSL Market* (visited Feb. 5, 2002) <http://xdsl.com/content/tcarticles/wp081101.asp>.

[174] *Id.*

[175] *Morgan/McKinsey Broadband Report* at 44; *Morgan Stanley Broadband Cable Report* at 31.

[176] *Fixed Wireless No Wipeout, Despite Recent Troubles*, Network World, Jun. 4, 2001, at 38 (citing Insight Research: "Despite the high-profile failures we've seen, we think this is a temporary setback. ... Providers are definitely going to implement more broadband wireless."); *Wireless Expected To Challenge Cable, DSL For SOHO Customers*, Business Communications Review, Jun. 1, 2001, at 8 (citing Allied Business Intelligence: "Broadband wireless technology is a potential challenger to cable modems and DSL for small office/home office (SOHO) customers.").

[177] Alex Salkever, *Broadband's Next Wave: Wireless?*, Business Week Online, May 17, 2001 (citing Peter Jarich of Strategis Group).

[178] Eve Tahmincioglu, *For High-Speed Access to the Web, a Dish-to-Dish Route*, New York Times, Oct. 11, 2001, at G9 (citing Cahners In-Stat Group).

[179] Michael Bartlett, *Fixed Wireless System To Join Broadband Access Race – Study*, Newsbytes, Aug. 29, 2001 (citing Lindsay Schroth, an analyst with Yankee Group).

subscribers in the United States in the MMDS sector.[180] Another analyst expects that there will be 87,000 subscribers by the end of 2001,[181] and that this number will grow to about 890,000 MMDS fixed wireless subscribers by 2006.[182]

73. Many analysts believe that fixed wireless carriers are awaiting the availability of next-generation technologies that will not require a direct line-of-sight between subscribers' antennas and their receivers before making further deployments because these new technologies will lower their costs and increase their service options significantly.[183] One analyst stated, "MMDS is not readily available because service providers are waiting for next-generation equipment to come to market."[184] Another analyst claims, "Combining cellularization with non-line-of-sight technologies could lower the cost of providing MMDS service significantly."[185] Analysts conclude, however, these technologies will not be ready for full-scale deployment until at least 2003.[186]

74. Given the severe financial reversals of three major fixed wireless carriers (Teligent, Inc., WinStar Communications, Advanced Radio Telecommunications), the phasing out of fixed wireless service by AT&T, and the halting of new deployments while waiting for newer equipment by Sprint Broadband, capital expenditures within the fixed wireless sector have declined during 2001. One analyst predicts, however, that subscriber growth should create a fixed wireless equipment market in the U.S. worth $10.4 billion and a revenue stream of $825

[180] Michael Bartlett, *Fixed Wireless System To Join Broadband Access Race – Study*, Newsbytes, Aug. 29, 2001 (citing Yankee Group).

[181] Denise Pappalardo, *Worldcom Adds Wireless MMDS Area*, Network World, Aug. 20, 2001, at 23 (citing Lindsay Schroth, an analyst at The Yankee Group).

[182] *Id.*

[183] *Wireless Expected To Challenge Cable, DSL For SOHO Customers*, Business Communications Review, Jun. 1, 2001, at 8 (citing Allied Business Intelligence: "Technology breakthroughs that allow for non-line-of sight applications are being introduced, boosting the prospects for multichannel multipoint distribution service (MMDS) and broadband wireless access (BWA) systems."); *The Yankee Group Projects That Worldwide Market for High Frequency Fixed Wireless Solutions Will Grow to $1.9 Billion in 2006*, Business Wire, Nov. 8, 2001 ("[D]espite the disillusionment caused by slow growth in 2001, there is a market for high-frequency (HF) point-to-multipoint products. However, the market for HF PMP solutions is still emerging, and there are issues yet to be resolved by both vendors and carriers that use this technology"); Michael Bartlett, *Fixed Wireless System To Join Broadband Access Race – Study*, Newsbytes, Aug. 29, 2001 (citing Lindsay Schroth, an analyst with Yankee Group: "[L]ine-of-sight restrictions are hampering deployment of MMDS fixed wireless systems." One technology that might help overcome next-generation products overcome these restrictions is orthogonal frequency division multiplexing (OFDM). Schrath believes that OFDM has "spectral efficiency" and that "several vendors are working on next-generation technologies that address the limitations of MMDS fixed wireless systems.").

[184] Denise Pappalardo, *Worldcom Adds Wireless MMDS Area*, Network World, Aug. 20, 2001, at 23 (citing Lindsay Schroth, an analyst at The Yankee Group).

[185] Michael Grebb, *Can Broadband Save MMDS?*, Cablevision, May 28, 2001, at 32 (citing Andy Fuertes, senior vice president of communications technology at Allied Business Intelligence. He also states that with non-line-of-sight technology, "there's the potential for more self-install.... That takes the massive cost of the truck roll out of there." Fuertes predicts that self-installs will be commonplace in MMDS operations within two years.)

[186] Sinead Carew, *Could Fixed Wireless Still Have Its Day?*, ComputerWire, Oct. 30, 2001 (citing Lindsay Schroth, an analyst at Yankee Group); Denise Pappalardo, *Fixed Wireless Takes Some Lumps*, Network World, Nov. 5, 2001, at 33 (citing Maribel Dolinov, senior analyst at Forrester Research); Denise Pappalardo, Worldcom Adds Wireless MMDS Area, Network World, Aug. 20, 2001, at 23 (citing Lindsay Schroth, an analyst at The Yankee Group).

million within five years.[187] Another forecasts that high-speed wireless revenue in North America will increase from $963 million during 2000 to over $14 billion by 2006.[188]

75. Some analysts believe that, while fixed wireless has the potential to compete with DSL and cable modem service, the technology is best-suited for rural and underserved markets where these services are not available.[189] Other analysts claim that the technology will be deployed mainly to residential, not business, customers.[190]

76. During 2001, the Commission authorized the use of MMDS and Instructional Television Fixed Service[191] (ITFS) spectrum for mobile, in addition to, fixed use by licensees. Analysts and industry players generally believe the decision gives fixed wireless carriers and equipment vendors additional flexibility and may help to revive the industry.[192]

77. Satellite: High-speed service is available today by satellite in most areas of the U.S.[193] Hughes provides high speed service under its DIRECWAY and DirecPC brands, and StarBand, which has strategic partnerships with Gilat Satellite Networks, Microsoft Corporation and EchoStar Communications, began operation in 2000 and launched its service in late 2000.[194]

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[187] Alex Salkever, *Broadband's Next Wave: Wireless?*, Business Week Online, May 17, 2001 (citing Peter Jarich of Strategis Group).

[188] *Fixed Wireless No Wipeout, Despite Recent Troubles*, Network World, Jun. 4, 2001, at 38 (citing Insight Research).

[189] Sinead Carew, *Could Fixed Wireless Still Have Its Day?*, ComputerWire, Oct. 30, 2001 (citing Lindsay Schroth, an analyst at Yankee Group: "Fixed wireless is not going to be the market that people thought, but there will still be a place for it," she said. Rather than pitching their wares against DSL or cable, operators should go after niche markets like rural areas outside of the reach of DSL.").

[190] *Fixed Wireless No Wipeout, Despite Recent Troubles*, Network World, Jun. 4, 2001, at 38 (citing Peter Jarich, an analyst with The Strategis Group: "We see the technology as being primarily residential.... We're not seeing business as the right way to go. ... Business users have a range of connectivity options to choose from, and they're more concerned about quality of service and reliability than are residential users."; and citing Chris Whitely of Insight Research: "When businesses decide to go with a fixed wireless link, it's often as a back-up connection, or for less critical traffic only.").

[191] ITFS are wireless services supplied by holders of spectrum created for educational and related community purposes.

[192] Jim Barthold, *Fixed Wireless Eyes Mobile Future*, Telephony, Oct. 1, 2001. (John Schwartz, president of the Instructional Telecommunications Foundation and a representative of The National ITFS Association, stated, "We do have an evolution to make now."; Leo Cyr, president and chief operating officer of Clearwire Technologies, which serves ITFS licensees, said, "It gives you some new service possibilities, especially with portability."; Charles Riggle, vice president of marketing and business development at NextNet Wireless: "This ruling really plays into our hands ... We're uniquely positioned to take advantage."; Peter Jarich, director of Global Broadband Research for The Strategis Group: "It doesn't look like [Sprint PCS and WorldCom] are committed to fixed. ... In fact, everyone wonders if they're [both] going to stick with their MMDS fixed wireless plans or move to deploy 3G.").

[193] We note that high-speed satellite services are widely available in the United States. *See, e.g.,* Q&A StarBand Facts (visited Feb. 5, 2002) <http://www.starband.com/faq/starbandfacts.htm#available2> ("The StarBand service is currently available only in the 48 contiguous U.S., Alaska and Hawaii.").

[194] *See* DIRECWAY, Frequently Asked Questions, (visited Feb. 5, 2002) <http://www.hns.com/direcway/for_home/learn_more/faq.htm.>, and the DirecPC System For Your Home (visited Feb. 5, 2002) <http://www.direcpc.com/athome/serviceplanstxt.html>. *See also* Q&A StarBand Facts (visited Feb. 5, 2002) <http://www.starband.com/faq/starbandfacts.htm>; What is StarBand? (visited Feb. 5, 2002) <http://www.starband.com/whatis/index.htm>; (visited Feb. 5, 2002)

(continued....)

Several satellite providers project deployment of additional systems using the Ka-band that will be capable of providing residential and business advanced services over the next several years.[195]

78. Subscriber projections for satellite high-speed systems vary significantly. Several recent projections estimate subscription rates of from 4 to 5 million by 2005. [196] Several analysts suggest that there are 20 to 30 million U.S. homes that are unlikely to ever have DSL or cable modem access and consequently that satellite-based consumer services should make significant headway in the market for high-speed connectivity.[197] 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 percent of high-speed access subscribers.[198] Salomon Smith Barney projects revenue from high-speed satellite Services to reach $3.6 billion in 2005.[199] Bank of America Securities estimates that high-speed satellite service revenues will grow from $694 million in 2001 to $4.486 billion in 2005 and $7.489 billion in 2008.[200] In 2000, ING Barings estimated total investment in U.S.-based satellite high-speed projects over the next ten years to be $28.55 billion.[201] Aggregate revenue estimates for the next eight to ten years range from $15 to over $30 billion.[202]

### D. Overview of Trends in Developing Technologies

79. Since the *Second Report*, there have been a number of developments in the technologies capable of supporting advanced services. Many of these technologies appear to have significant potential for expanding the availability of advanced telecommunications to more Americans. In addition, some of these developments may improve the speed and the range of

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<http://www.starband.com/whoweare/index.htm>. *See also StarBand Communications Launches Nation's First Consumer Two-Way High Speed Internet Service Via Satellite*, StarBand Press Release, Nov. 6, 2000.

[195] For example, two Ka-band services plan introduction of service in 2003: WildBlue, an independent company with ties to EchoStar and News Corp., and Spaceway, to be provided by Hughes. Armand Musey, *The Satellite Model Book* , Salomon Smith Barney, Jun. 4, 2001, at 24 (*Satellite Model Book*).

[196] Salomon Smith Barney projects broadband satellite service subscribers to grow to 4 million by year-end 2005. *Id.* at 23. Bank of America Securities projects 5 million broadband satellite services subscribers by 2005. Armand Musey, *Satellite Communications Industry Overview,* Bank of America Securities (First Quarter 2001) at 21 (*Satellite Industry Overview*). In 2000, ING Barings predicted that the number of residential subscribers would increase from close to 100,000 estimated in 1999 to over 39 million by the end of 2008. David B. Kesternbaum, Michael K. French, and Eric Lentini, *The Satellite Communications Industry: Efficient Infrastructure 2000*, ING Barings, Mar. 2000, at 13 (*ING Barings*).

[197] *Satellite Model Book* at 23.; Marc E. Nabi, *Eye in the Sky, 2Q01 Preview*, Merrill Lynch, Jul. 3, 2001, at 47.

[198] Thomas W. Watts and William W. Pitkin, *Global Satellite Marketplace 99: Clearing the Hurdles: The Satcom Industry Focuses on Execution,* Merrill Lynch, Apr. 14, 1999, at 99-101 (*Global Satellite Marketplace*).

[199] *Satellite Model Book* at 23.

[200] *Satellite Industry Overview* at 22.

[201] *ING Barings* at 24.

[202] In addition, ING Barings Broadband Growth Forecast predicts $20 billion in service revenue by 2009. ING Barings, *ING Barings* at 13. *Satellite Industry Overview* at 60; *Global Satellite Marketplace* at 101.

services offered to consumers through various technological platforms. In the following, we take notice of several of these trends and consider technologies that may emerge in the near future.[203]

80. 3G Wireless. Providers are beginning to deploy third generation wireless (3G) systems. Third generation wireless generally refers to high-speed advanced mobile services and the next generation of technologies – beyond the current first generation (analog cellular and paging systems) and second generation (digital systems, such as digital cellular and PCS). These 3G systems are expected to provide support of multimedia services and capabilities, including fixed and variable bit rate traffic; bandwidth on demand; asymmetric data rates in the forward and reverse links; multimedia mail store and forward; and access to advanced services.[204] The International Telecommunication Union (ITU) has developed worldwide standards for 3G wireless devices that specify that these systems must be capable of supporting circuit and packet data at rates of 2 Mbps or higher for indoor traffic, 384 kbps for pedestrian traffic, and 144 kbps or higher in high mobility (vehicular) traffic.[205] In addition, many commercial mobile radio service licensees are beginning to deploy, or have developed plans to deploy, 3G services within their existing spectrum. The successful deployment of 3G wireless services may significantly expand availability of advanced services, especially to consumers that are currently unserved by wireline connections.

81. Cable Modem Standard. The current cable modem specification, DOCSIS 1.0, accounts for almost all cable modem services.[206] Recently, the cable industry began adopting a new standard, DOCSIS 1.1. DOCSIS 1.1 delivers some capabilities to support tiered services, multimedia, telephony and PacketCable; enhanced security; increased upstream performance; and additional features that make data-over-cable platforms easier to manage. The cable industry also recently announced the development of DOCSIS 2.0.[207] DOCSIS 2.0 will add an advanced physical layer for DOCSIS cable modems and headend Cable Modem Termination System (CMTS) products. DOCSIS 2.0 will allow cable operators to provide improved voice over Internet protocol and videoconferencing offerings for homes and businesses. In addition, DOCSIS 2.0 may provide increased transmission reliability and protect against reverse path noise impairments. DOCSIS 2.0 is backward compatible with the DOCSIS 1.0 and 1.1 specifications meaning that cable modems conforming to any of the three specifications will be able to interoperate with cable modem termination systems supporting DOCSIS 2.0. As a result, the implementation of the new cable modem standards may improve reliability on the cable network and expand the types of available applications for consumers who subscribe to cable services.

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[203] We emphasize that this overview is not intended to endorse or advocate any particular platform or system.

[204] *See Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, ET Docket No. 00-258, Notice of Proposed Rulemaking and Order, 16 FCC Rcd 596, 604 (2001). This proceeding is exploring the possible use of frequency bands below 3 GHz to support the introduction of new advanced wireless services, including third generation (3G) as well as future generations of wireless systems.

[205] *Id.*

[206] One exception is proprietary modem services.

[207] KC Neel, *Terayon Gets DOCSIS 2.0 Boost New Cable-Modem Standard Should Increase Bandwidth*, Cable World, Sep. 10, 2001 ("With DOCSIS 2.0, cable operators should be able to gain additional revenues through upstream-intensive applications including voice over Internet protocol, peer-to-peer networking, video conferencing, Web hosting, video-on-demand, online gaming and application services.").

82. Broadband Passive Optical Networking. SBC recently announced that it plans to use broadband passive optical networking (BPON) to provide direct fiber service to smaller businesses and residences.[208] BPON uses splitters to replicate a wavelength division multiplexed signal, which is then distributed over multiple fibers to customers' locations. The BPON system planned for use by SBC can serve up to 38 residences or small businesses. SBC is targeting consumers that currently have multiple T1 lines that are deployed using repeaters. Because T1 signals can interfere with DSL, the company believes that shifting T1 repeater customers to BPON would improve the range and service quality of other DSL customers. By moving fiber closer to the home, consumers will have significantly greater amounts of available bandwidth, capable of supporting emerging applications such as video-on-demand.

83. DSL Extension. DSL extension products have been developed to serve subscribers who are located beyond the range of the central office or who are blocked by a digital loop carrier that cannot be modified with a remote access multiplexer or remote DSLAM.[209] For example, GoDigital Networks recently introduced the Xcel-4a ADSL extender which provides ADSL up to 25 miles from the DSLAM with an estimated downstream transmission speed of 1.5 Mbps and a guaranteed upstream speed of 384 kbps.[210] Because the extender is able to support four DSL customers over a single copper pair, the company estimates that carriers can provide DSL for outlying areas for $600 to $900 a port.[211] In addition, 2Wire recently demonstrated a loop extender technology that uses loop-extender line cards to replace load-coil cards every 6000 feet in a network.[212] According to reports, the technique supports 5.8 Mbps downstream for over 24,000 feet. The installation of loop-extender devices may bring consumers, especially those in low-density areas, within range for DSL services.

84. G.SHDSL. The ITU Telecommunications Standards Sector recently announced a new DSL standard, G.SHDSL.[213] It is a symmetric, multi-rate DSL that may be used to provide symmetrical voice, data, and Internet DSL services. According to reports, the new standard reaches up to 2.3 Mbps in both directions, and can be deployed nearly twice as far from the central office than SDSL, which is limited to 18,000 feet. Because of the high rate of symmetric transfer, vendors providing G.SHDSL anticipate that business customers will be interested in adopting the new standard. As a result, this new standard would not only increase the available bandwidth for consumers, but would also extend DSL capability to consumers that are currently beyond the reach of the central office.

85. Two-way Satellite Platform. Satellite service providers recently started offering residential service on a two-way platform, with both the downstream and upstream paths

[208] *See* SBC Comments at 4; Stephen Lee, *SBC Sees Bright Future for Home Broadband*, InfoWorld Daily News, Oct. 5, 2001; Eric Krapf, *Fiber Access: The Slog Continues*, Business Communications Review, Aug. 1, 2001.

[209] Donny Jackson, *Shifting Gears*, Telephony, Jul. 2, 2001, at 60.

[210] *Id.*

[211] *Id.*

[212] *Id.*

[213] *See* Jim Thompson, *G.SHDSL: New and Improved DSL*, ISP-Planet (Jun. 19, 2001) (visited Feb. 5, 2002) <http://www.isp-planet.com/technology/dsl/ghdsl.html>.

provided by satellite.[214] Previously, only a one-way platform was available for satellite Internet access. A one-way platform provided the downstream path by satellite and the upstream path was often provided by a standard dial-up telephone connection. Two-way platform satellite service provides high-speed service in the downstream direction at speeds ranging up to 400 kbps. Service providers claim that upstream transmissions range between 40 and 60 kbps during off-peak hours.[215] In addition, satellite service providers have also announced plans to deploy a new generation of satellite services that will provide advanced telecommunications services at significantly greater speeds.[216] Some service providers claim that the new generation of satellite service will be capable of downstream speeds of up to 30 Mbps and upstream speeds starting at 512 kbps, up to tens of Mbps.[217] Because satellite services are widely available in most, if not all, of the United States, the successful deployment of the new generation of satellite service has the potential to extend the availability of advanced services to almost all Americans.

86. Helios. Researchers recently tested Helios, an unmanned, solar-powered aircraft that can provide the transmission of advanced services.[218] The plane is designed to fly in the stratosphere for six-month periods of time, and can supply consumers with advanced services at speeds between 1.5 Mbps and 125 Mbps.[219] Helios is promoted to be a possible alternative to wireless towers and satellites. Specifically, developers claim that the Helios transmission services can run more efficiently than wireless towers and the aircraft will cost less than satellites. Conventional communications satellites are estimated to cost about $200 million each, whereas the Helios aircraft are anticipated to cost $10 million each.[220] Researchers believe that Helios could be used to provide advanced services in regions that are currently unserved by wireline technologies, or could stimulate competition in more dense regions as an alternative platform.

87. Free Space Optics. Free Space Optics (FSO) uses laser-guided beams of light to transmit advanced services.[221] Specifically, FSO transmits light pulses through the air to receivers that are less than a kilometer away and within the line-of-sight of a base terminal, which is connected to fiber-optic cable.[222] Developers claim that the system can support point-

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[214] *See* Hughes Comments; StarBand Comments. *See also, e.g.*, Larry Barrett, New High-Speed Net Service from Space, CNET News.com (Jun. 22, 2001) (visited Feb. 5, 2002) <http://news.cnet.com/news/0-1004-200-6354160.html?tag=cd_mh>.

[215] *See* StarBand Comments at 11.

[216] *See* Hughes Comments at 5.

[217] *Id.*

[218] Patrick Houston, *A Bird? No, a Plane. And It's Broadband...Plus More News*, AnchorDesk from ZDWire, Aug. 13, 2001.

[219] Max Smetannikov, *NASA Flies to Broadband Rescue*, Interactive Week from ZDWire, Aug. 14, 2001.

[220] *Id.*

[221] Tony Waltham, *Of Free Space Optics and the Laws of Telecom*, Bangkok Post, Nov. 7, 2001 ("His technology fills a gap, as it were, where a fiber optic or broadband link is desired for point-to-point or point-to-multipoint, even multipoint-to-multipoint communications, but is impractical for geographical or for right-of-way reasons.")

[222] Robert Vosper, *The Magic Potion*, America's Network, Dec. 1, 2001 ("All a company needs to do is plug a 4 foot receiver into its LAN, place it near a window and wait for the receiver to capture a laser beam carrying up to one gigabit of data a section through the air.").

to-point connections at rates up to 1.55 Gbps and costs around $9000.[223] As a result, because FSO does not require spectrum or the installation of wire or cable, the system may be a cost-effective alternative for the provision of advanced services to businesses.

88. I-Burst Wireless Internet. The I-Burst wireless system uses 5-10 MHz of spectrum to provide advanced telecommunications capability within a network coverage area. Consumers can use portable or stationary devices to connect to the network, which is designed to allow users to move between coverage areas, similar to mobile telephone networks.[224] I-Burst is capable of providing connections of about 1 Mbps per user. In 2001, the Commission issued an experimental license to test-market the wireless Internet system.[225]

## V. IS DEPLOYMENT REASONABLE AND TIMELY?

89. We now consider the third question presented in our Third Notice of Inquiry: is deployment reasonable and timely?[226] In determining whether deployment is reasonable and timely, we have examined various aspects of the deployment of, and market for, advanced services. Based upon our analysis, we conclude that the deployment of advanced telecommunications capability to all Americans is reasonable and timely. We find that there is continued and rapid growth in subscription to high-speed and advanced services on a nationwide basis, which is indicative of the increased availability of advanced services. We are encouraged by the expansion of advanced services to many regions of the nation, and growing number of subscribers. Nevertheless, we will continue to monitor deployment to certain categories of consumers so that if deployment to such customers ceases to be reasonable and timely in the future, we will recognize that development early. We also conclude that investment in infrastructure for most advanced services markets remains strong, even though the pace of investment trends has generally slowed. It is important to mention, however, that some of the decline in investment may be simply be the result of the general economic slowdown in the nation. In addition, we find that emerging technologies continue to stimulate competition and create new alternatives and choices for consumers. Based on these findings, we believe that advanced services are being made available in a reasonable and timely manner.

90. We will continue to use this assessment as the basis for the development of public policies that promote and support the ubiquitous deployment of advanced services. In our prior report, we stressed that the high-speed market is still early in development, and it is even earlier in the development of the services and infrastructure with speeds of over 200 kbps in both directions.[227] Although investment trends have gone through a period of transition over the past

[223] Cliff Grassmick, *Louisville, Colo., Firm Offers Solution to Broadband's Last Mile*, Knight-Ridder Tribune Business News, Nov. 30, 2001.

[224] *ArrayComm Keeps I-Burst Trials Under Wraps*, Wireless Today, Sep. 17, 2001; Dee McVicker, *Bandwidth Boom: Wireless Bandwidth for the Net is Way Too Narrow and Real Improvements are Still Years Away*, Internet Week, Sep. 11, 2000 ("I-Burst is like traditional cellular in setup: Mobile users can move freely within a cell coverage area, usually two to six miles in radius. But unlike traditional cellular networks, I-Burst is an open architecture system like the Internet. It could operate as a wireless feature on a handset or it could be added to a laptop or desktop, similar to adding a modem card.")

[225] *See* Experimental License No. 0067-EX-ML-2000 (granted Jan. 29, 2001).

[226] *Third NOI* at para. 19.

[227] *Second Report*, 15 FCC Rcd at 20992.