Availability of Advanced Telecommunications Capability in the United States

Fourth Report to Congress

September 9, 2004

Federal Communications Commission

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Chairman Michael K. Powell
Commissioner Kathleen Q. Abernathy
Commissioner Michael J. Copps
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Statement of Chairman Michael K. Powell

Broadband empowers people over centralized institutions. Consumers are increasingly choosing how to communicate instead of having that choice dictated to them by regulators or monopoly providers. Personalized applications are riding atop the robust deployment efforts of the stakeholders described in our *Fourth 706 Report.* It is in that context that I am very pleased to support the Report's finding that the overall goal of section 706 is met, and that first-generation advanced telecommunications capability is being deployed on a reasonable and timely basis to all Americans.

This Report will serve as a milestone that we have indeed turned the corner on the digital migration. Innovative entrepreneurs are replacing yesterday's single-purpose networks with different types of high-speed, full-service digital networks, using such technologies as Wi-Fi, fiber-to-the-home, broadband over power lines, and satellite. By making licensed and unlicensed spectrum available for wireless broadband uses, we have seen an explosion of wireless access points using technologies (such as EvDO and WiMax) that allow unfettered Internet access around the country.

Since I became Chairman, 36 million Americans have signed up for high-speed service. Across America, the availability of ubiquitous, reliable broadband access is changing the way we work and live. Overall, 48 million adults use high-speed connections in the home, representing growth of 60 percent from a year earlier. And, as the Report catalogues and USA Today recently trumpeted, "Internet-based phone services are taking off by offering cut-rate prices and funky features." Disruptive VoIP services are acting as a demand-driver for broadband connections, lighting the industry's fuse, and exciting a moribund market.

The Commission has taken key steps to promote broadband deployment. We removed unbundling requirements on newly deployed fiber-to-the-home, where there is competition from cable, which clears the way for telephone companies to deploy infrastructure to serve the broadband and video needs of the 21st century. On my travels across the country, I continue to be amazed by the new services designed for rural Americans. Our efforts to unlock the potential of the rural healthcare program by expanding the Commission's eligibility criteria are generating results. In the past year, I witnessed the transformative potential of telemedicine. Since the issuance of our last Report, the Commission has adopted a variety of measures to introduce regulatory flexibility for rural licenses to increase wireless access to consumers. The Commission also has proposed amendments to make efficient use of the 3650 MHz band, which may effectively support telemedicine in rural or underserved areas as well as on Native American Tribal Lands. We will continue our ongoing program of on-site forums for exploring how best to make affordable broadband access available to rural America.

Our work, however, is not done. Americans deserve information at the speed of light—and it is the country's next challenge to deploy a network that is at least as capable as any other nation's. The Commission's role—and my mission—is to continue to champion and facilitate higher-speed, more capable platforms that can run the applications of tomorrow. As regulators, we must embrace the reality that the torrent of change from new broadband technologies has arrived, is unstoppable, and will accelerate over the years ahead. We have a clear vision for this migration to advanced platforms: stimulate investment in next-generation architectures, apply a light hand and let entrepreneurs bring the future to the people. This Report shows that our digital migration vision is working for America.

Statement of Commissioner Kathleen Q. Abernathy

Broadband communications networks and the innovative services they support hold unlimited promise for American consumers. During my tenure at the FCC, I have been privileged to see first-hand how broadband is changing the lives of Americans, including the way we work, learn, receive health care, and play.

Broadband networks are an important driver of economic growth. For small businesses, a broadband connection creates a link to millions of potential customers without having to pay rent on a expensive storefront, and it facilitates business-to-business relationships that lower the cost of obtaining capital, supplies, or other necessities. Broadband also fuels job creation as businesses can establish call centers and other back-office operations in remote locations, far from their headquarters, because the high-speed connections can make geographic distance irrelevant.

Broadband also is a boon to education. As a result of broadband networks (which have been heavily financed by the E-Rate program), school children in virtually every community—including traditionally underserved rural areas and inner cities—can gain access to the same on-line resources as children in the best-funded schools. Broadband also makes health care more accessible and affordable. Telemedicine allows patients to be diagnosed and treated by specialists hundreds of miles away, often avoiding the need to travel long distances, be separated from family members, or take days off from work.

Given these and many other benefits, the FCC has made it our top priority to encourage the deployment of broadband facilities and services. With respect to wireline networks, the Commission took bold action to boost investment incentives by strictly curtailing the application of heavy-handed regulatory requirements to next-generation fiber facilities. The Commission likewise has worked to maintain an investment-friendly environment for cable modem services. On the wireless front, the Commission has allocated new licensed and unlicensed spectrum for broadband services, provided increased flexibility in existing spectrum bands, and established secondary markets to facilitate more efficient use of spectrum. Moreover, the Commission has taken steps to foster the development of broadband over powerline systems and to facilitate the deployment of new broadband satellite services.

I am pleased that this Report to Congress shows that we are meeting our objectives. The vast majority of Americans now have access to broadband services. And the divide between urban and rural areas, and between high-income and low-income populations, is shrinking dramatically. While the overall rate of *subscription* to broadband services lags far behind the *availability* of such services, our job as regulators is to make sure consumers have the opportunity to purchase broadband services. As with any new technology, the penetration rates will climb as content and price become more attractive to consumers. In any case, subscription rates *are* climbing rapidly, particularly in light of how young the technology is. This positive trend will undoubtedly continue: more and more networks are expanding their reach (cable, DSL, wireless, powerline, and satellite), and competition is forcing prices down and service quality up, thus increasing value for consumers. We must continue to work tirelessly to bring the benefits of broadband to *all* Americans, and this report demonstrates that we are well on the path toward achieving that goal.

Statement of Commissioner Michael J. Copps, Dissenting

America's competitors around the world are implementing comprehensive broadband plans. Countries like Japan, Korea, and Canada have left us far behind. This is unacceptable. Broadband is our central infrastructure challenge. High-capacity networks are to the Twenty-first century what roads, canals and railroads were to the Nineteenth and highways and basic telecommunications were to the Twentieth. Our economy and our future will be driven by how quickly and completely we deploy broadband.

That is why Congress charged the FCC with promoting broadband deployment for all Americans—whether they live in rural areas, inner cities or tribal lands; whether they are affluent or of limited income; whether they live with or without disabilities. Recently, we heard an announcement from the very top of our government that our goal is universal broadband access by 2007. But we are not making acceptable progress toward that goal. Yes, there are good stories in these glossy pages. Schools and libraries enjoy broadband access like never before. New technologies offer new promise. Strides are being made in some rural communities. Companies are working hard.

Still, one glaring fact stands out: the United States is ranked eleventh in the world in broadband penetration! This Report somehow finds that this is acceptable, and that our efforts are resulting in timely deployment. I think our efforts are insufficient and that broadband deployment is insufficient, so I dissent to this Report.

When consumers in other countries get so much more bang for their broadband buck than we do, something has to change. Nothing puts our challenge into more vivid relief than Chart 18 in this Report. In Japan, for as little as $10, consumers get broadband service at 8,000 kbps. In Korea, consumers get 10,000 kbps for the same price that we pay for 1,500 kbps. Consumers elsewhere get great prices for revolutionary speeds. Why, then, is the FCC still collecting data about 200 kbps service and calling it broadband? Our dated definition of broadband speed should have been dropped by the wayside long ago. We also claim that broadband is available to everyone in a zip code if it is offered to only one person in that zip code. This half-hearted effort at analyzing availability should be scrapped. Correcting these approaches for the *next* Report is neither reasonable nor timely.

We should also study in exhaustive detail the broadband strategies of other countries to discover what works and what applicability such strategies may have for our country. We should study why numerous municipalities across America are floating bonds to develop their own broadband networks. We should look at what universal service means in the IP age. We need a better handle on all these things—if we want to pull ourselves out of the broadband ditch and into the digital stratosphere.

The history of great infrastructure developments in this country is a tale of private sector-public sector partnership. In broadband, business will lead the way—as it should. But there is a role for government, too—a statutorily mandated role totally in keeping with how this country historically built its infrastructure. When we find ourselves eleventh in the world, something has gone dreadfully wrong. When Congress tells us to take immediate action to accelerate deployment, we have an obligation to do it. When the highest reaches of government aim for universal broadband by 2007, we need a strategy to meet that goal. I see none here.

Statement of Commissioner Kevin J. Martin

Encouraging the deployment of broadband services to all Americans has been my top priority during my tenure at the Commission. Broadband services are essential to the economy of the 21st century, dramatically reducing the costs of exchanging information and enabling local businesses to connect to world markets. Access to broadband services is especially important to rural America, providing business, educational and healthcare opportunities to remote parts of the country.

Since the issuance of our last 706 report, the Commission has taken some key steps to promote broadband deployment. For example, we removed unbundling requirements on newly deployed fiber-to-the-home, where there is competition from cable, which makes it easier for telephone companies to deploy infrastructure to provide the broadband and video services of the 21st century. The Commission also provided regulatory relief for new hybrid fiber-copper facilities, deregulating the fiber and new packet-based technologies that provide broadband services today. In addition, the Commission adjusted the TELRIC or "wholesale" prices for all new investment in equipment. Companies seeking to push fiber further to the home and deploy new infrastructure will now have the opportunity.

I agree with the Commission's conclusion that "advanced telecommunications capability" is currently being deployed on a "reasonable and timely basis." The availability of that capability is increasing, and I am pleased that subscribers to services the Commission characterizes as "high-speed" were reported in 93 percent of all zip codes in the United States. While more consumers are now able to enjoy the speed and applications that a true broadband connection offers, the Commission should continue its efforts to eliminate barriers to infrastructure investment and to accelerate broadband deployment.

I am particularly pleased with the progress of deployment of "high-speed" services to rural and other underserved areas.[1] Two years ago, our data showed that fewer than 40 percent of the most sparsely populated zip codes had at least one subscriber to "high-speed" services while more than 90 percent of the most densely populated zip codes had a least one such subscriber. Today, over 70 percent of the sparsely populated zip codes have a subscriber with "high-speed service." While I am pleased by the rapid progress made to narrow this deployment gap, there is a need for continued efforts to ensure comparable access for consumers in rural America.

I am also pleased that today's report recognizes that the 200 kbps standard is a "first-generation" definition of broadband and that future section 706 reports will collect data and report on next-generation as well as first-generation broadband. This proposal should enable the Commission to better monitor the migration to next-generation networks and services and provide us with a better understanding of the deployment of advanced services in the marketplace.

Finally, we should move forward on several pending proceedings to help spur continued broadband deployment. Regulatory uncertainty and delay function as entry barriers, limiting investment and impeding deployment of new services. While there is much more to be accomplished, I look forward to working on these issues and hope to ensure that advanced telecommunications capability continues to be deployed on a reasonable and timely basis.

[1] *See* Statement of Commissioner Kevin J. Martin, *Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, CC Docket No. 98-146,* Report, *17 FCC Rcd 2844 (2002).*

Statement of Commissioner Jonathan S. Adelstein, Dissenting

While there is good reason for optimism about the transformative power of broadband, I must dissent from the core holding of this Report. Congress directed this Commission to determine whether advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion, and to advise if more action is needed. Unfortunately, there are serious warning signs that we are falling behind. Most notably, the U.S. was recently ranked 11th in the world for broadband penetration, and other sources suggest that we are trailing our closest competitors among the industrialized nations. Broadband providers in the U.S. have made remarkable strides, but a country of our ingenuity and historic leadership in telecommunications must do better.

Our country is increasingly reliant on the power of instantaneous telecommunications. From telecommuting to distance learning to telemedicine, broadband is bridging the distances between us and transforming communities. As these powerful communications tools evolve, the deployment of broadband is ever more critical to the health of our economy and quality of life.

This Report highlights encouraging stories of broadband deployment that can serve as models to assist other communities in meeting their broadband needs. It documents the remarkable commitment and investment of service providers to bring broadband to their customers. Many innovative companies are staking their futures on broadband. These providers are courageously taking risks despite uncertainty about the regulatory framework they will face.

Given our increasing reliance on high speed communications, I am concerned about mounting evidence that we are falling behind in broadband deployment. Data in the Report show that the global leaders not only have higher penetration, but offer higher speeds at lower prices. These findings seriously suggest that our current definition of "first-generation" broadband is woefully out of step with the global leaders, and that we should already be tracking the deployment of next-generation broadband services.

I am also concerned about the prospects for rapid deployment to communities traditionally unserved by market forces alone. If we are soon to achieve universal access to broadband, we need to give providers serving those hardest-to-reach consumers more tools, and we must protect and advance programs like universal service that have facilitated build-out to so many communities.

I have seen firsthand how important broadband is to rural communities, those on tribal lands, and persons with disabilities. Broadband gives businesses in Rural America the tools they need to compete across the globe. Access to telemedicine and distance learning, and the vast array of resources available through the Internet, gives rural Americans the same opportunities that others enjoy. Broadband services also play an increasing role in giving persons with disabilities functional equivalence. For these reasons, we must re-double our efforts.

While we continue to improve this Report, it ultimately remains hindered by the lack of critical data that would allow us to gauge more accurately and comprehensively broadband availability. Despite long-standing acknowledgement of the limitations of the overbroad zip code data, we again make conclusions about critical segments of our population without all the facts. Given that lack of information, strong indications that we are trailing in the global marketplace, and the importance of broadband to our overall economic health, I cannot conclude that broadband deployment is reasonable and timely.

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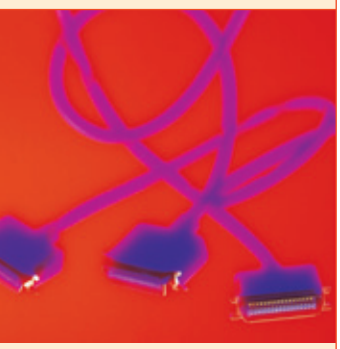

Section 706 of the 1996 Telecommunications Act directs both the Commission and the states to encourage deployment of advanced telecommunications capability to all Americans on a reasonable and timely basis. In conjunction with this objective, Congress directed the Commission to conduct regular inquiries concerning whether advanced telecommunications capability is being deployed to all Americans on a reasonable and timely basis and, based on our findings, to take action to accelerate deployment, if necessary.

This report concludes the Commission's fourth inquiry into the availability of advanced telecommunications capability in the United States. Like the previous three reports, this *Fourth Report* concludes that the overall goal of section 706 is being met, and that advanced telecommunications capability is indeed being deployed on a reasonable and timely basis to all Americans.

This report also documents the significant development of new Internet-based services, and new access technologies, that has taken place since the issuance of our last report. The best-known of these new Internet-based services is the commercial deployment of voice communications over the Internet Protocol network—or, as it has come to be known, VoIP. The remarkable growth in Internet access is highlighted by the expansion of Wi-Fi Internet access and the explosive growth of both commercial and noncommercial hotspots. Wi-Fi joins an increasingly lengthy list of other wired and wireless methods of accessing the Internet, a list that also includes WiMax, personal area networks, satellite technologies, fiber-to-the-home, and broadband over power lines, in addition to more familiar cable modem and digital subscriber line (DSL) services.

Given the proliferation of new advanced telecommunications networks and services, it is not surprising that the *Fourth Report* documents that subscribership to these networks and services has increased significantly since the issuance of our last report. Specifically, subscribership to high-speed lines—defined as 200 kilobits per second (kbps) or greater transmission speed in at least one direction—has almost tripled from 9.6 million in June 2001 to 28.2 million in December 2003, and subscribership to advanced services (200 kbps or greater transmission speed in both directions) more than tripled in this same period, from 5.9 million lines to 20.3 million lines.

Perhaps more important than these statistics, however, is the fact that the *Fourth Report* also documents the continuation of a positive trend that first emerged in our last report: namely, the increasing availability of advanced telecommunications capability to certain groups of consumers—those in rural areas, those with low incomes, and those with disabilities—who stand in particular need of advanced services. Consumers in these groups are of

This *Fourth Report* concludes that the overall goal of section 706 is being met, and that advanced telecommunications capability is being deployed on a reasonable and timely basis to all Americans.

special concern to the Commission in that they are the doubly vulnerable: that is, although they are most in need of access to advanced telecommunications capability to overcome economic, educational, and other limitations, they are also the most likely to lack access precisely *because* of these limitations. The *Fourth Report* demonstrates that we are making substantial progress in closing the gaps in access that these groups traditionally have experienced.

With respect to service to rural areas, the *Fourth Report* substantiates the significant efforts made by rural telephone companies, cable television providers, and wireless providers to make advanced telecommunications facilities available in rural areas. The report also documents advances in access to advanced telecommunications facilities for low-income populations.

Broadband-based Internet services have also become a critical communications tool for the deaf and hard-of-hearing, through the use of Internet Protocol Relay (IP Relay) and Video Relay Service (VRS), two forms of telecommunications relay services (TRS) that rely on the Internet. This report shows that there has been more than a 640 percent increase in IP Relay usage and more than a 2,000 percent increase in VRS in the past two years.

These statistics, taken as a whole, do not simply document the development of advanced telecommunications networks and services; they also demonstrate certain truisms about future trends as well. They show us that having multiple advanced broadband networks can complement one another in bringing advanced telecommunications capability to all consumers. For example, in urban and suburban areas, wireless broadband services may "fill in the gaps" in wireline broadband coverage, while wireless and satellite services may bring high-speed broadband to remote areas where wireline deployment may be costly. Having multiple advanced networks will also promote competition in price, features, and quality-of-service among broadband-access providers. This price-and-service competition, in turn, will have a symbiotic, positive effect on the overall adoption of broadband: as consumers discover new uses for broadband access at affordable prices, subscribership will grow; and as subscribership grows, competition will constrain prices and incent the further deployment of new and next-generation networks and ever-more innovative services. Minimal regulation of advanced telecommunications networks and services is needed to ensure that this happens. In sum, the *Fourth Report* begins to demonstrate that the much-sought "killer app" that will spur subscribership to advanced telecommunications networks actually lies in those networks today. The Commission will continue to monitor the development and deployment of these networks in the future to ensure that all Americans have affordable access to them and to the significant advantages they can offer.

These, then, are the salient findings of the *Fourth Report*. The Fourth Notice of Inquiry framed these issues in the form of several specific questions. For ease of reference, the following sections present

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these questions and correlate the answers with the findings in the report.

1. What is broadband?

In the *Fourth Report,* we use the terms "advanced telecommunications capability" and "advanced services" to mean services and facilities with an upstream (customer-to-provider) and downstream (provider-to-customer) transmission speed of 200 kbps or greater. Such facilities and services are referred to as "broadband" throughout this report, and, as the report details, they include both wireline (telephone company and cable) as well as a growing list of wireless facilities, both licensed and unlicensed. This report focuses on services and facilities that provide 200 kbps upstream and downstream transmission speeds. In contrast, we use the term "high-speed" to describe services with more than 200 kbps capability in at least one direction.

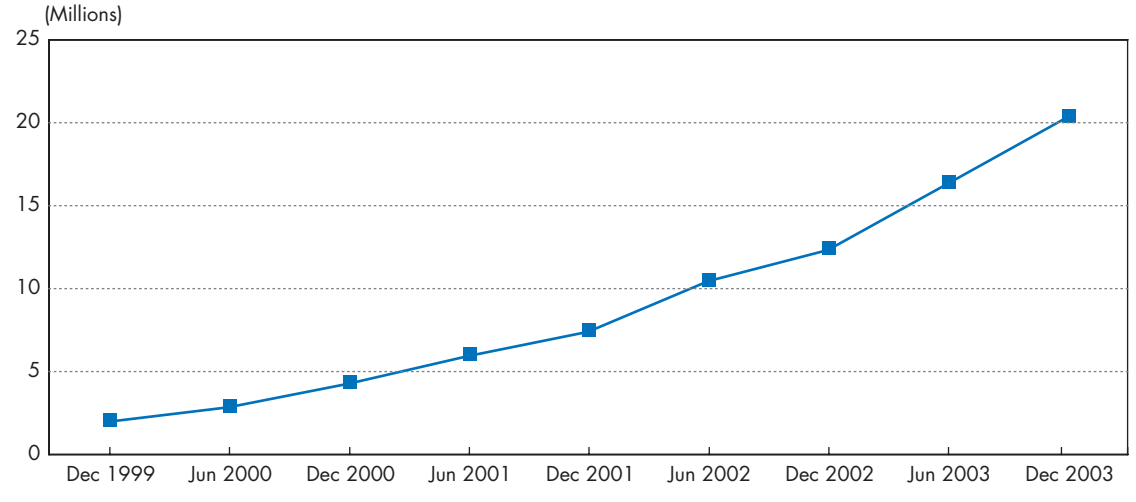
Our existing definitions are not static. Indeed, the success of first-generation broadband—at speeds of approximately 200 kbps—has prompted demand for ever-faster broadband networks and connections, and today most broadband providers are offering service well in excess of the minimum 200 kbps speed. The Commission currently has under consideration rule changes that will enable us to gather more information about these "next-generation" broadband networks and services for purposes of future reports.

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

The deployment of advanced services has steadily increased since the *Third Report.* As noted above, subscribership to advanced services has tripled since our last report. The number of residential and small business subscribers to high-speed services has more than tripled during the same period, from 7.8 million lines in June 2001 to 26 million lines in December 2003.

Special constituencies are benefiting from increased availability of advanced services. As noted above, rural and low-income areas have experienced dramatic gains in broadband availability, and the use of broadband-based TRS services by the hearing-impaired has likewise grown exponentially. In addition, more than 95 percent of public libraries and 92 percent of public school classrooms have Internet access. Use of broadband connections in schools with high minority enrollment increased from 81 percent to 95 percent between 2000 and 2002. During this same period, schools with the highest poverty concentration using broadband connections to access the Internet increased from 75 percent to 95 percent.

Chart 1: Advanced Services Lines



Source: FCC

Subscribership to advanced services has tripled since the *Third Report*.

3. Is broadband being deployed in a reasonable and timely fashion?

We conclude that the deployment of first-generation advanced telecommunications capability to all Americans is reasonable and timely. The challenge for the future is to ensure that this trend continues and is complemented by reasonable and timely deployment of higher-speed broadband.

We expect that subscribership to broadband services will increase in the future as new applications that require broadband access are introduced into the marketplace, and consumers become more aware of such applications.

What Is Broadband?

In section 706 of the 1996 Telecommunications Act, Congress defined the term "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." Because broadband is the more common term, we will use that throughout this report.

Broadband differs from dial-up Internet access in several important ways. First, it provides higher speed data transfer, usually referred to as a "high-speed connection." Second, unlike dial-up access, broadband provides a connection that is "always on" so users can receive as well as send data without having to reconnect to the network. Third, and of increasing importance, broadband provides low latency, the ability to send and receive data packets with little, or no noticeable, delay. Low latency is critical for increasingly popular uses of broadband, such as Voice over Internet Protocol (VoIP), interactive gaming, streaming media, and collaborative computing, which are spurring demand today.

Most discussions about the advantage of broadband over dial-up Internet access focus on the speed of the data connection. Broadband providers market their services to dial-up customers by comparing how much faster broadband connections are and how broadband users do not have to wait to download web pages to listen to music or watch a video clip. The desire for a faster connection is the primary reason most new residential broadband subscribers switch from dial-up, according to a Pew Internet and American Life Project report in April 2004. The Pew study notes that the "always on" characteristic also is important in subscriber satisfaction. As more broadband subscribers use VoIP, interactive media, and other applications that require low latency, this characteristic, too, will become an important characteristic in customer satisfaction.

In prior section 706 reports to Congress, the Commission focused on the speed of the connection as the defining characteristic of broadband and recognized that, as new applications took advantage of ever faster connections, the speed defining "broadband" would evolve over time. In those reports, the Commission defined "advanced telecommunications capability" and "advanced services" as services and facilities with both customer-to-provider (upstream) and provider-to-customer (downstream) transmission speeds (in technical terms, "bandwidth") of more than 200 kbps. The Commission has defined the phrase "high-speed" as services and facilities with more than 200 kbps capability in at least one direction.

The Commission's definition of first-generation broadband as 200 kbps in each direction is a speed at which consumers can download image-rich web pages without waiting for the screen to "paint" the page. At this speed, broadband users also can play interactive games, use VoIP applications, listen to on-line

The competitive nature of the broadband market, including new entrants using new technologies, is driving broadband providers to offer increasingly faster service at the same or even lower retail prices.

music, and watch compressed video clips. The ability to send ("upload") web pages and multimedia was also seen as an important characteristic, even though most residential uses of the Internet require very asymmetric connections (*i.e.*, the "download" rate far exceeds the "upload" data rate). Therefore, the Commission's definition of first-generation broadband has been 200 kbps in each direction.

Our section 706 reports to Congress, including this one, focus on the timely deployment of first-generation broadband. The Commission recognizes, however, that the success of first-generation broadband deployment and adoption is creating demand for ever faster broadband networks and connections as well as for networks that support low latency applications. Indeed, as this report describes, most broadband providers are offering service well in excess of the minimum speed of 200 kbps—typically in the 1 megabit per second (Mbps) range or faster—although, given the asymmetric use of most residential subscribers, fast upload rates do not appear to be as necessary as fast download rates.

As this report finds, the competitive nature of the broadband market, including new entrants using new technologies, is driving broadband providers to offer increasingly faster service at the same or even lower retail prices. In addition, as this report notes, service providers such as incumbent local exchange carriers have begun constructing very high speed fiber optic residential broadband networks. While this *Fourth Report* focuses on first-generation broadband deployment, future section 706 reports will collect data and report on next-generation as well as first-generation broadband. Now that first-generation broadband is available to the vast majority of U.S. households, it will become important to monitor the migration to next-generation networks and services.

In a separate rulemaking proceeding, the Commission is examining ways to improve its Form 477 local competition and broadband data gathering form. One of the potential changes to Form 477 is to require carriers reporting data to break down high-speed connections into more granular "speed tiers" for reporting purposes, to better allow us to track what is happening in the marketplace. Because that proceeding is still ongoing, we decline at this time to alter the definition of advanced services for this report.

Developments in Last-Mile Technologies Since the *Third Report*

Broadband services are provided using a variety of technologies, network architectures and transmission paths. In this section, we examine the technologies used to provide broadband, highlighting the changes and advances in the delivery of broadband that have been made since our last report.

Cable Technologies

Cable modems allow subscribers to access high-speed data services over cable systems that are generally designed with hybrid fiber-coaxial (HFC) architecture. Cable modem service is primarily residential service, but may also include some small business service. Sample prices for cable modem service range from $35 to $80 a month, including the lease of the modem.

Overall, the cable industry has maintained the course outlined in the *Third Report* by continuing to upgrade and improve cable systems and broadband service offerings and by extending the offering of such broadband services to at least 90 percent of homes passed by cable systems. The cable industry expects that industry-wide facilities upgrades enabling the provision of broadband Internet access to residential customers will be completed soon.

At the same time that the cable industry has expanded the reach of upgraded broadband facilities, cable operators have increased download transmission speeds from 200 kbps to as much as 6 Mbps. For example, Comcast announced in October 2003 that it would double the downstream speeds of its cable modem service to 3 Mbps at no additional cost to subscribers, and in July 2004 added a 4 Mbps option. TimeWarner is offering a plan with speeds of up to 6 Mbps downstream. RCN increased its 3 Mbps "MegaModem" service to 5 Mpbs in response to customer demands, and Cox added 4 and 5 Mbps downstream options.

Cable companies have also continued to upgrade equipment used to deliver broadband services. The CableLabs Certified Cable Modem Project, also known as Data Over Cable Service Interface Specification or DOCSIS, has continued to develop the critical interface requirements for cable modems and cable modem termination systems used for high-speed data distribution and connection to the Internet. In general, DOCSIS-certified modems are compatible with and interchangeable across similarly certified DOCSIS-equipped cable headends. The first specification, DOCSIS 1.0, allowed cable operators to deliver baseline high-speed Internet services on a "best effort" basis simultaneously over the same plant as core video services. The next specification, DOCSIS 1.1, was designed to provide quality of service so that cable operators can offer such products as Internet Protocol (IP) telephony and tiered services. In January 2002, CableLabs completed specifications for its latest standard, DOCSIS 2.0, which is designed to address issues concerning the upstream

Wi-Fi joins an increasingly lengthy list of wired and wireless methods of accessing the Internet, such as cable modem, WiMax, DSL, broadband over power lines and fiber-to-the-home.

portion of the cable plant (the transmission from the subscriber to the Internet), allowing 30 Mbps capacity in both directions. Adelphia has deployed more than 200 of the DOCSIS 2.0 cable modem termination systems for its high-speed Internet customers.

PacketCable, another CableLabs project, develops specifications for delivering advanced, real-time multimedia services over two-way cable plant. The project addresses issues such as device interoperability and product compliance with the PacketCable specifications. As such, the specifications enable a wide range of services, including IP telephony, multimedia conferencing, interactive gaming, and general multimedia applications.

The cable industry also is reported to be pursuing a project entitled "Next Generation Network Architecture" (NGNA), which is in part a competitive response to wireline broadband providers and in part a response to Direct Broadcast Satellite's (DBS) Digital Video Recorder (DVR) technology. The NGNA project, spearheaded by Comcast, Cox and Time Warner, who together serve between 38 and 40 million cable customers, is attempting to squeeze more carriage capacity over this upgraded plant through means of various compression technologies and customer premises equipment. Cable services provided today are a mix of analog and digital channels, with two-thirds of the channel capacity of most cable systems dedicated to transmitting approximately 80 basic and expanded basic channels, together with pay-per-view offerings. The NGNA project seeks to define the features of a next-generation all-digital cable network, which could have broad implications for functionality and cost. The effort involves rethinking cable's basic technologies, including everything from encryption strategies to set-top boxes that can be dramatically upgraded via software uploads, to create more carriage capacity by completely migrating cable service from analog-to-digital transmission so that all services could be provided utilizing IP.

Cable systems may migrate to digital by utilizing NGNA to reclaim analog spectrum and installing transitional customer premises equipment in or on analog-only homes. Executives say that the effort will utilize existing fiber plant, and does not call for tearing up the system and replacing trunk lines, as the initial fiber upgrades did. Because a cable operator can typically fit approximately ten standard definition digital channels into the space previously occupied by one analog television channel, one NGNA concept is for cable operators to digitize all their analog signals at the head end and provide every customer with a digital cable box, tripling the amount of space available for other services. Another concept is the use of simple "outlet digital adaptor" or "video network interface unit" devices at the subscriber's premises, which provide a transparent means to send and convert digital signals to analog customers who do not use set-top boxes. These devices enable cable operators to convert their systems to all digital transmission at a fraction of the cost of a digital set-top box. Operators have expressed confidence that the digital adaptor will have enough intelligence to support a remote control

Developments in Last-Mile Technologies Since the *Third Report*

and an onscreen menu, letting subscribers use video-on-demand systems.

Copper Technologies

The technology that local telephone carriers predominantly use for providing high-speed data services is the digital subscriber line (DSL) service offering. DSL is a copper-based service that allows the telephone carrier to add certain electronics to the telephone line to enhance the copper loop that provides the customer voice service so that it serves as a conduit for both voice and high-speed data traffic.

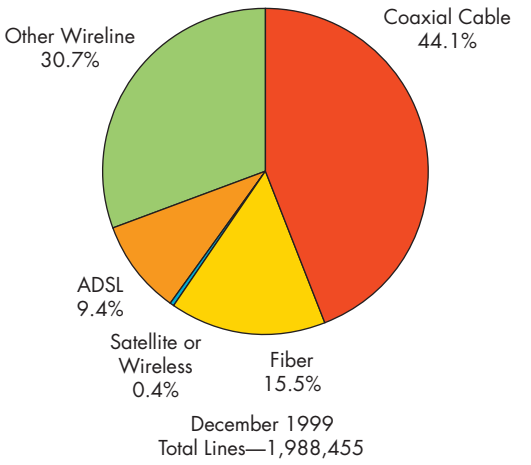
There are a number of variations of DSL service. The DSL service primarily used by residential customers is asymmetric DSL (ADSL). ADSL provides speeds in one direction (usually downstream) that are greater than the speeds in the other direction. Since the *Third Report*, carriers have increased the speeds typically offered in their ADSL services. For instance, a number of carriers are now offering download speeds of 1.5 Mbps and 3.0 Mbps and upload speeds as high as 768 kbps. Sample prices for 1.5 Mbps/384 kbps service range from $34.95 a month with certain promotions to $64.95 per month for a service that can serve multiple computers in a house. Prices for an even faster download speed of 3.0 Mbps range from $44.95 to $99.95 depending upon the upload speed, which ranges from 384 kbps to 768 kbps. Installation for ADSL services typically range from free to $99.95, because many carriers are using self-installation kits that permit the customers to install the ADSL services themselves. A number of rural telephone companies are providing video services using DSL.

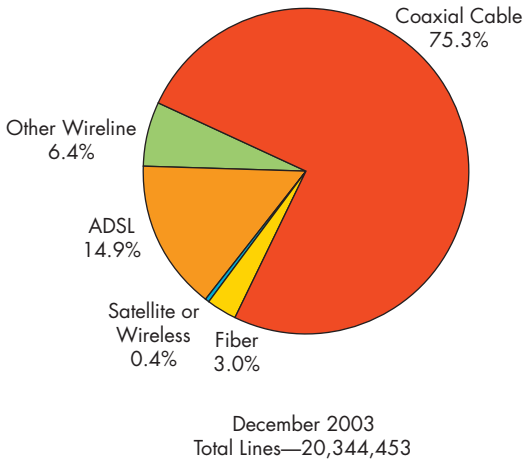
Fiber Technologies

In the last several years, carriers have begun constructing entirely fiber optic cable transmission facilities that run from a distribution frame (or its equivalent) in an incumbent local exchange carrier's (LEC's) central office to the loop demarcation point at an end-user customer premise. These loops are referred to as fiber-to-the-home (FTTH) loops. FTTH technology offers substantially more capacity than any copper-based technology. For example, Wav7 Optics provides a FTTH system today using commercially available equipment that delivers transmission speeds up to 500 Mbps shared over a maximum of 16 subscribers. This system can also provide up to 500 Mbps symmetrically to one subscriber if desired. The speed an actual user will experience depends upon the time of day and the number of users online. A typical FTTH system can deliver up to 870 MHz of cable television video services (for high-definition television) or IP video services along with multiple telephone lines and current and next-generation data services at speeds in excess of 100 Mbps.

There are three basic types of architectures being used to provide FTTH. The most common architecture used is Passive Optical Network (PON) technology. This technology allows multiple homes to share a passive fiber network. In this type of network, the plant between the customer premises and the

Chart 2 : Advanced Services Lines by Technology





Source: FCC

headend at the central office consists entirely of passive components—no electronics are needed in the field. The other architectures being used are home run fiber or point-to-point fiber, in which subscribers have a dedicated fiber strand, and active or powered nodes are used to manage signal distribution, and hybrid PONs, which are a combination of home run and PON architecture.

Although FTTH technology is still in its infancy, the deployment of FTTH is growing substantially. Moreover, the equipment costs for FTTH have decreased significantly. As of May 2004, carriers have deployed FTTH technology to 128 communities in 32 states. In addition, companies plan to deploy FTTH further in the future. For example, Verizon has accelerated its FTTH deployment, with the goal of passing 1 million homes by the end of 2004. Verizon's FTTH deployment will create a new network, overlaying the existing circuit-switched feeder and distribution network throughout an entire central office serving area. The FTTH network will be capable of transmitting up to 622 Mbps and receiving 155 Mbps (shared by the customers on each fiber), in addition to a separate path on the same fiber for video. Verizon has announced a limited deployment of FTTH technology, offering customers 5 Mbps/2Mbps from $34.95 a month, 15 Mbps/2 Mbps from $44.95 and a 30 Mbps/5 Mbps service at a price to be announced later. SBC has also announced plans to implement a limited FTTH deployment in greenfield applications in 2004, and to implement FTTH to approximately 300,000 premises in 2005.

Competitive carriers are also building FTTH facilities. For example, Eagle Broadband, Inc. is currently building FTTH facilities in a number of communities, including the town of Truckee, California and the Lake Las Vegas Resort in Nevada. In these communities, Eagle is offering a "four play" of bundled digital offerings including voice, video, high-speed Internet access and security monitoring. In addition, FTTH Communications, Inc. is a residential home developer that provides FTTH technology to its communities in the upper Midwest states. For instance, FTTH Communications developed Evermore, located in Rosemount, Minn., which has about 1,200 living units of mixed use, single-family homes, townhomes and senior housing. FTTH Communications provides services delivered over a fiber optics system built into the developments, called

Women and the Web

Women rely on the Internet to manage all facets of their work, family and social lives, according to a recent study titled "Real Women. Digital World. The Untold Story of Women & The Web" by Yahoo! Inc., a leading global Internet company, and Starcom MediaVest Group, one of the largest media communications companies in the world. The research found that, because working women are spending more time at work than they were a year ago, the Internet has become a central activity within women's lives, enabling the compression of time and becoming an integral means of managing life and accomplishing the many daily tasks. According to the article, using the Internet trails only work, sleep and spending time with family.

The research found that, of the women polled, women are on the Internet approximately 3.3 hours per day. "Women are doing a huge amount of multitasking," said Kate Sirkin, senior vice president, global director of strategic intelligence, Starcom MediaVest Group Worldwide. "You're on a conference call, checking flights, [and so forth] and if we don't do that, work's taking over. There's no way you could live your life if you didn't multitask."

Among the key findings of the study, many women use the Internet to bank, email and send instant messages to friends and family, plan travel and events, coordinate their personal lives, and play games. The research revealed that, while some of the content sought by women online, such as health and beauty, is typically found in women's magazines, other areas, such as news, sports, financial services and games, are also highly frequented online destinations by women.

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FiberPath. The system is designed to converge multi-line telephone, entertainment, video and high-speed data services all over one fiber optic connection. This connection not only allows FTTH Communications to provide multiple services to individual customers, it also allows it to offer community connection services, such as a community intranet and community cable station.

Fiber-to-the-home deployments highlight carrier creativity. For instance, Renaissance Integrated Solutions has created a broadband solution based on repairing failing sewer systems with a trenchless technology known as "pipe bursting." Renaissance's solution simultaneously replaces existing main line and lateral sewer and water pipes with two separate conduit systems: one for long-term sewer and water use, and one for a ubiquitous fiber optic conduit system. Because sewer systems run to every building, this solution would effectively facilitate a FTTH system where it is installed.

In addition to FTTH technologies, some carriers are constructing fiber-to-the-curb (FTTC) facilities that do not run all the way to the home, but run to a pedestal located within 500 feet of the subscriber premises. Copper lines are then used for the connection between the pedestal and the network interface device at the customer's premises. Because of the limited use of copper, FTTC technologies permit carriers to provide high-speed data in addition to high definition video services. BellSouth has used FTTC extensively, deploying to approximately one million homes at the end of 2003.

Unlicensed Wireless Technologies

Since the Commission first allocated spectrum in the 902-928 MHz band for use on an unlicensed basis under Part 15 of the rules, there has been an increasingly rapid expansion of products and markets in bands designated for unlicensed use. This Industrial, Scientific, and Medical band was the first to experience the large scale introduction of devices such as cordless phones, security alarms, wireless bar code readers, and data collection systems. A number of original equipment manufacturers continue to provide equipment for point-to-point and point-to-multipoint systems for such applications as Supervisory Control and Data Acquisition. In addition, there are several providers of wireless local area network equipment in this band including Alvarion Networks with local access data rates of up to 3 Mbps for non-line-of-sight applications. In addition, Waverider provides access equipment with data rates of up to 2 Mbps.

Wi-Fi. Wi-Fi, short for Wireless Fidelity, is a term that is used generically to refer to any product or service using the 802.11 series standards developed by the Institute of Electrical and Electronics Engineers (IEEE) for wireless local area network connections. Wi-Fi networks operate on an unlicensed basis in the 2.4 and 5 GHz radio bands and provide multiple data rates up to a maximum of 54 Mbps. The bandwidth is shared among multiple users. Wi-Fi enabled wireless devices, such as laptop computers or personal digital assistants (PDAs), can send and receive data from any location within signal reach of a Wi-Fi equipped base station or access point (AP). Typically, mobile devices must be within approximately 300 feet of a base station.

The expansion of Wi-Fi access to the Internet has recently seen the explosive growth of hotspots on a commercial and noncommercial basis. A public wireless "hotspot" is an area where a computer or PDA equipped with a wireless local area network card can connect to the Internet through wireless access points. Networks of hotspots consisting of a number of access points have also been constructed to cover larger areas such as entire airports. Driven by low cost devices operating on an unlicensed basis, the expan-

sion of hotspot access points has become rampant as build-out continues with the assistance of numerous entities including small- and large-scale businesses, public institutions, and individual entrepreneurs. Providers use the technology for everything from enterprise networks to purely ad hoc provision of access points for either non-commercial use or for their potential to attract customers. For instance, both Starbucks and McDonald's are using Internet access to attract patrons, and some colleges and universities, such as Dartmouth College, are deploying ubiquitous Wi-Fi networks. Even entire municipalities—from large metropolitan areas such as Seattle to smaller communities such as Chaska, Minn.—are providing Wi-Fi access on either a no-fee basis or on a modest fee-for-service basis.

Industry analysts predict the continued growth of Wi-Fi access points and Wireless Internet Service Providers. Major telecommunications providers, including T-Mobile and Verizon, provide Internet services via substantial hotspot networks. In addition to the large number of access points available in urban areas—to the point that tens of access points may be accessible from a single geographical location—a major factor contributing to the success of Wi-Fi has been its ability to provide wireless Internet access in rural and remote areas such as Alaska and western Virginia. Improvements in broadband access have also been accomplished by the integration of Wi-Fi capabilities across multiple vendors and complementary capabilities across the various spectrum bands and standards. Key to these efforts has been the implementation of Wi-Fi in integrated circuits and devices such as Centrino by Intel, Airport Express by Apple, and mobile platforms provided by Broadcom and Atheros.

The last-mile provision of advanced services for residential use via Wi-Fi has also become a commercial success story for multiple vendors. This is evidenced by the integration of Wi-Fi capabilities into commercial data devices such as laptop computers and personal digital assistants. One analyst, In-Stat/MDR, reports the "Wi-Fi hardware market achieving staggering growth in 2003,…expecting 22.7 million NIC [network interface card] and AP units rolled out in 2003, a 214% increase from 2002's 7.2 million units shipments." This success has been driven by the availability and low cost of IEEE Standard 802.11b, 802.11a, and 802.11g embedded products. Even as the standards-based products were rolled out with speeds of 11 Mbps and 54 Mbps, numerous vendors introduced enhancements to double access speeds to a maximum of 108 Mbps. Foremost in the decision to roll out more advanced mobile capability is the complementary nature of demand-driven mobile and fixed broadband services. Carriers continue to search for an appropriate economic model for providing consumers Wi-Fi connectivity, ranging from free access to paid services coupled with the provision of fixed versus mobile services.

WiMax. WiMax, short for "Worldwide Interoperability for Microwave Access" refers to any broadband wireless access network based on the IEEE 802.16 standard. WiMax includes fixed systems employing a point-to-multipoint architecture operating between 2 GHz and 66 GHz. WiMax is capable of transmitting network signals covering in excess of 30 miles of linear service area, which is much greater than Wi-Fi's coverage area. It provides multiple shared data rates of up to 75 Mbps.

At the same time that Wi-Fi networks are reaching a more mature state, WiMax has the potential to alter and further accelerate the evolution of broadband services. Coincident with the integration of Wi-Fi into devices, Intel has announced the integration of WiMax into its next generation chipsets for mobile devices. Analysts suggest that WiMax, although still in an early state, could complement or even supplant the development of Wi-Fi networks in the long run. It is anticipated that new standards for wireless networks will incorporate both roaming and handoff capabilities, which will further enhance the potential for broadband fixed and mobile applications in both licensed and license-exempt spectrum.

Personal Area Networks. In addition to the technologies for fixed and mobile wireless broadband access already mentioned, we highlight the potential inherent in devices for personal area networks on a localized basis. Currently, the Commission's Part 15 Rules provide for limited-range use of ultra-wideband (UWB) communications, but the potential of gigahertz bandwidths is extremely attractive for large bandwidth applications. New devices are currently under development for broadband applications, including new UWB products with data transfer rates of up to one gigabyte per second. Products operating at 20-120 Mbps are currently demonstrating multiple simultaneous data

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and video streams, with commercial shipping due to start in the third quarter of 2004. Products with capabilities in the gigabit per second range are expected by 2006. Industry groups are trying to settle on a common standard for communications devices using UWB technology. In addition to UWB, both Bluetooth and Zigbee technologies are being integrated into devices for short range broadband use, including remote printing and other connectivity applications.

Licensed Wireless Technologies

Mobile wireless broadband services allow consumers to access the Internet and other data services at high speeds from a cell phone, a PDA, or a wireless modem card connected to a laptop computer. Mobile broadband services are also commonly referred to as third generation, or "3G," services or advanced wireless services. At the time of the *Third Report*, mobile broadband services had not yet been deployed to consumers in the United States. Since that time, however, several mobile wireless carriers have begun to deploy high-speed mobile Internet access technologies, and many have announced plans to launch or expand these technologies further in the future.

In October 2003, Verizon Wireless began offering high-speed mobile Internet access service in Washington, D.C. and San Diego, Calif., using Code Division Multiple Access (CDMA) 1x EV-DO technology, commonly referred to as EV-DO. EV-DO technology increases maximum data transfer speeds to 2 Mbps, and typical, user-experienced download speeds range from 300 to 500 kbps. With the EV-DO service, mobile subscribers can access the

Southern California Tribal Digital Village

Miles away from downtown San Diego, California, in an isolated and vast geographic area near the Mexican border, more than 12,000 Native Americans have access to broadband services comparable to those available in urban San Diego. In 2001, the Southern California Tribal Chairman's Association, Hewlett-Packard, and the University of California-San Diego began working together to create a broadband network linking 18 different Native American reservations using Wi-Fi, or IEEE 802.11b, technology. Now fully operational, the completed network is called the Southern California Tribal Digital Village (TDV).

Developing the TDV network was technically challenging. The rocky, mountainous terrain and deep valleys made it difficult to achieve a line-of-sight between network access points, which is necessary for this type of wireless broadband technology. Also, not only is the area that the network needed to cover remote, but the 17 different tribal communities are scattered across 150 miles. The resourcefulness of the creators of the TDV and the inherent flexibility of the wireless technology overcame these technical challenges. One example of the flexibility in the technology is the fact that solar power and, in one case, even a car battery, power the network access points. "We just kept building towers and pretty soon we had everybody connected," said Jack Ward, director of TDV and one of the authors of the Hewlett-Packard grant application.

"[Hewlett-Packard's e-inclusion] program seeks to provide people access to greater social and economic opportunities by closing the gap between technology-empowered and technology-excluded communities, focusing on sustainability for the communities and HP," said Janiece Evans-Page, Global Director of e-inclusion at Hewlett-Packard. "TDV's vision for expanding a wireless network to connect a broadly distributed rural, underserved community and enhance education, communication and cultural experiences quickly became a shared vision for HP."

The TDV is in the process of upgrading its 10 major towers with the goal of increasing the data rates from current speeds of 3-5 mbps to 45 mbps. In addition, the TDV has grown to 21 tribal communities. The next step, said Ward, is to start connecting homes to the TDV. And the plans

Internet via a wireless modem card connected to a laptop computer or PDA. Verizon Wireless has announced that it plans to expand its EV-DO network, while Sprint PCS has announced it expects to roll out EV-DO technology in selected markets during the second half of 2004. In July 2004, AT&T Wireless announced the commercial availability of Wideband CDMA (WCDMA), or Universal Mobile Telecommunications System (UMTS), technology in Seattle, San Francisco, Phoenix and Detriot. UMTS is the next migration step for some wireless carriers and allows maximum downstream data speeds of up to 2 Mbps, and typical user-experienced speeds of 220-320 kbps.

While the mobile data services discussed above are offered using a cellular network architecture, fixed wireless broadband services have traditionally been deployed using a point-to-point or point-to-multipoint network architecture that requires a direct line-of-sight between the transmitter and the receiver. However, since the *Third Report*, many wireless carriers have begun to deploy Orthogonal Frequency Division Multiplexing (OFDM) technology, which allows carriers to offer wireless broadband services without a direct line-of-sight between the transmitter and the receiver. Many of the wireless broadband services offered using OFDM technology also eliminate the need for subscribers to attach an antenna to their rooftop and instead allow them to access the Internet with "plug-and-play" modem devices connected to a personal or laptop computer. Customers can transport these devices to other locations where the network is available. Another advantage of such services is that they often eliminate the need for a carrier to send

don't stop there. "If the system becomes robust enough," Ward said, "we're thinking about becoming an ISP to provide economic opportunity and service to rural communities beyond the Indian communities."

Tribal members constructed the network, from building the communications towers to aligning the radios used for communication between different access points. Mike Peralta, a member of the Luiseno tribe and now TDV's network administrator, was tutoring children and teaching GED classes before the project began. Originally hired to work on web design, Peralta now understands how the network is engineered. "We used the project to train local people," Ward said. "We thought that even when the money went away, at least the knowledge would be there."

With the TDV partnership, tribal members can access information about community events, health care, and job opportunities using an electronic community bulletin board. They can take classes at the University of California-San Diego online—an important benefit because tribal members previously had only limited access to higher learning opportunities. The network also enables Native American cultural preservation through a web link to a specialized cultural library and through the First Voices program—in which numerous recordings in Native American languages are uploaded to the web, making them accessible for others to learn. Even the physical network itself enhances educational opportunities. The TDV Shadow Project is a mentoring program that takes six young people in the tribal communities and provides them with technical training on how to maintain the wireless network, in addition to providing training in computer skills. "The Internet and technology have created a consciousness change," Ward said. "It's no longer something they read about or see on TV. It's now starting to become part of their everyday life."

With limited existing telecommunications infrastructure, rural and remote geographic areas like the tribal lands that are part of the Tribal Digital Village present particularly difficult challenges to the deployment of broadband services. Connecting these tribal communities has enabled a wide range of educational and cultural activities, transcending large geographic distances. "It's opening people's eyes to the opportunities that are out there," said Peralta. "We haven't yet realized the full potential."

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technicians to install equipment at an end user's house or building. The monthly prices for these services vary by carrier and range from $24.95 to $129.99, with the more expensive plans typically offering download speeds up to 3 Mbps. In April 2004, Nextel Communications began offering wireless broadband service in Raleigh-Durham, N.C. Several other carriers offer OFDM-based, non-line-of-sight wireless broadband services in small communities—including Info-Link.net in Minnesota, Evertek in Iowa, Gryphon Wireless in Nebraska, BeamSpeed in Arizona, and Rioplex Wireless in Texas.

Several carriers use the spectrum above 10 GHz—specifically the 24 GHz, 39 GHz, and local multipoint distribution system (LMDS) bands, often referred to as the "upperbands"—to offer fixed wireless broadband services. Upperband technologies require a direct line-of-sight between the transmitter and the receiver. The major upperband carriers, including Teligent and XO Communications, have begun to focus on providing backhaul transport and private line telecommunications services to other carriers and large business customers. Many upperband providers have also begun leasing spectrum on a point-to-point or geographic area basis to other fixed and mobile carriers. For example, in May 2004, IDT Corp. announced the reorganization of its fixed wireless division to focus on providing private line, wholesale, and backhaul services, as well as leased spectrum, to other telecommunications companies, including mobile and fixed wireless carriers. In January 2004, XO Communications completed a trial of fixed wireless broadband service using LMDS spectrum in San Diego and Irvine, Calif. The company is offering a range of services, including VoIP, high-speed Internet access, and other data services, at speeds ranging from one to 20 Mbps, to small and medium sized businesses in conjunction with its metropolitan fiber networks.

Broadband over Power Lines

Another mechanism for delivering broadband services that made its commercial debut in 2003 is broadband over power lines (BPL). BPL systems use existing electrical power lines as a transmission medium to provide high-speed communications capabilities by coupling radio frequency energy onto the power line. The United Power Line Council notes that BPL can currently provide symmetric speeds of 3 Mbps, and next-generation chipsets are being developed to provide 100 Mbps. BPL travels over medium-voltage (up

Scott Sandal and South Dakota Network

When South Dakotans residents Scott and Heidi Sandal found out they were expecting their first child, they considered moving back to the Sandal family ranch in Howes, S.D. Sandal wanted to keep his job, however, as an application software engineer at Wells Fargo in Sioux City 365 miles from Howes.

"Commuting is not an option from our home," Sandal said. "My ability to return to the family ranch was based on three factors being met: agreement from my wife, agreement from my employer, and the availability of broadband."

Sandal's wife and employer agreed, leaving broadband access the only issue. Fortunately for the Sandals, the local telecommunications provider, Golden West, was in the process of laying new fiber optic lines to rural communities in western South Dakota, including Howes.

As a result, Scott Sandal did not have to make the choice between his job and what was best for his family. He also is able to contribute to the community of Howes. He volunteers as a firefighter and serves on the school building committee and the Meade County cooperative extension board. "My dream did come true," Sandal said. "Thanks to Golden West Companies, broadband via ADSL technology was made available right to my family's ranch."

to 40,000 volts) transmission lines. Initial trials of BPL have begun in Manassas, Va.; Allentown, Penn.; and Cincinnati, Ohio. While some challenges to the implementation of BPL remain, the technology has the potential to take advantage of the large-scale deployed infrastructure of the power grid to provide broadband services to some customers not yet served by DSL or cable modem services.

Satellite Technologies

High-speed Internet access over satellite remains a nascent technology. As of December 2003, satellite and wireless technology accounted for approximately 1.3 percent of total high-speed lines in the United States. Moreover, none of the satellite-based Internet access services satisfy the Commission's definition of advanced services, which calls for a minimum transmission speed of 200 kpbs downstream and upstream.

As of mid-year 2003, the two major providers of high-speed Internet access through two-way satellite technology, DirecWay, an affiliate of Hughes Network Systems (HNS), and Starband, an independent operator, had slightly more than 200,000 subscribers combined. Both HNS and Starband provide Internet access to individuals primarily in small office/home office environments and small businesses that are not currently served by wireline broadband providers or cable companies. Starband charges a one-time fee, ranging from $199.99 to $699, for equipment and a monthly fee, ranging from $49.99 to $99.99 per month, for its StarBand 360 Internet access service. DirecWay charges $600 for installation and equipment and a $60 per month for the service. A number of companies have announced plans to launch satellites that will increase the speed of Internet access and also lower the cost of ground equipment. In another development, the Boeing Corporation recently launched Connexion, a real-time, high-speed two-way in-flight Internet access service for passengers on board aircraft using satellite technology.

On July 17, 2004, WildBlue Communications announced the launch of its first Ka-band satellite payload aboard Telesat's Anik F2 satellite. WildBlue expects to begin providing two-way wireless high-speed Internet access in early 2005. WildBlue expects the service to be particularly attractive to the estimated 25 million homes and small businesses that do not have access to other broadband Internet options.

And Howes is not the only South Dakota community benefiting from the upgraded network. Golden West is part of a larger organization known as the South Dakota Network (SDN). Created in 1989 by several independent telephone companies, the purpose of SDN is to provide more telecommunications options for rural customers by creating a fiber network. Today, 27 independent telephone companies are part of the SDN, which now serves as a platform hub for Internet access and digital television in addition to long distance services. In addition to residential customers, the SDN serves health care facilities, banks, businesses and government agencies.

"For a large area of western South Dakota, Golden West has laid the foundation for rural growth and economic development," Sandal said. "More telecommuting opportunities such as mine will rejuvenate rural economies."

The SDN gives rural communities access to uniquely reliable telecommunications capabilities. Because of the network's redundant capacity, businesses that use the SDN are ensured service; if a fiber optic line is cut, the information can be immediately rerouted. "We have structured our company so one phone call plugs you in to total business communications," Mark Shlanta, CEO of SDN, says in a message to customers on SDN's web site. "You can get the broadband services and the equipment you need to make it work."

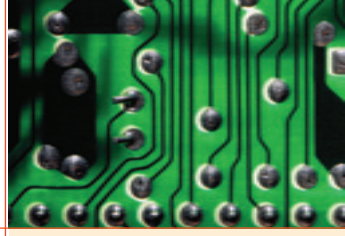
New Developments in Services and Applications

The rise of the Internet has fundamentally changed the ways in which consumers today communicate by increasing the speed of communications, the range of communicating devices, and the platforms over which they can send and receive information. This growth has been possible because the Internet employs an open network architecture using a common protocol—the Internet Protocol, or IP—to transmit data across multiple interconnected packet networks in a manner fundamentally different from how signals transit in a circuit-switched network. As opposed to the end-to-end path that is required for a circuit-switched network, an IP network segments data into packets, which are individually addressed and then transmitted over a series of physical networks which may be comprised of copper, fiber, coaxial cable, or wireless facilities. When transmitting packets between two points, the IP network does not establish a permanent or exclusive path between the points, but rather routes the packets individually and decides which route to use for each packet.

The growth of the Internet has been accompanied by an explosion in consumer access to new services and applications. One of the most exciting new developments is the transmission of voice communications over a network using IP—also referred to Voice over IP or VoIP. Although early attempts to offer IP telephony were unsuccessful due to limited reliability and voice quality, today technology has improved sufficiently to permit IP networks to carry voice communications. Indeed, cable operators, wireline carriers, and wireless providers have announced that they have begun to deploy, or intend to deploy, IP networks to transmit IP telephony services to their subscribers.

Several cable companies are adding voice services over the DOCSIS platform using PacketCable or other VoIP standards. For example, in November 2003 Cablevision launched its "Optimum Voice," a digital voice-over-cable service, throughout its service area of more than 4 million homes. The service offers subscribers of Cablevision's high-speed Internet access service features including unlimited calling across the United States and Canada for a flat rate of $34.95 per month. Time Warner Cable today provides its Digital Phone VoIP service in its cable systems in seven states. Charter reaches 5,000 VoIP customers in two states. These cable companies and others plan to extend the reach of their VoIP offerings in the coming year.

A number of other companies have also begun offering IP telephony services to residential end users. For example, pulver.com operates an Internet application called Free World Dialup (FWD) that facilitates such members engaging in free peer-to-peer communications, exchanging voice, video or text. Free World Dialup subscribers use a Session Initiation Protocol (SIP) phone or personal computer to make "calls" to other FWD members that do not utilize the public



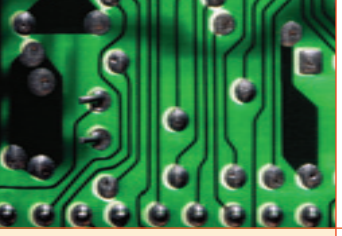
Voice over IP, games, and photo and video messaging are just some of the services driving greater broadband usage.

switched telephone network (PSTN). Similarly, AT&T and Vonage offer IP telephony services that permit a subscriber with a broadband connection to place telephone calls to, and receive calls from, both other broadband subscribers and end users relying on traditional PSTN facilities. The VoIP provider supplies software and a multimedia terminal adapter (MTA) that permits its customers to use analog phones to place calls using their broadband Internet connections. When a VoIP customer communicates with a subscriber of ordinary telephone service, the VoIP provider converts its customer's IP packets into a digital format for transfer through a media gateway to the PSTN and vice versa. The price of Vonage's IP telephony service currently ranges from $14.99 for 500 minutes anywhere in the United States and Canada for residential customers to $49 for unlimited calling within the United States and Canada for small businesses. AT&T's CallVantage includes unlimited local and long distance for $19.99 a month for the first six months and $34.99 a month when the promotional period ends.

Wireless service providers have also begun providing IP-based mobile data applications. While second-generation mobile communications systems used circuit-switched networks to provide voice service, next-generation network overlays are now providing enhanced multimedia entertainment and data services—such as games, ring tones, photo and video messaging, and web surfing—built on packet switching and IP routing. For example, Verizon Wireless has launched its "Get it Now" service, which allows customers to download games, ring tones, and entertainment and productivity applications to their phone. This service offers the "Get Going" line of applications, which can be used to get real-time airport status and flight information, create and send expense reports, and locate a site on a map when visiting a new city. Similarly, Sprint PCS is offering a service that allows customers to see live video on their mobile phones. Sprint's MobiTV service is priced at $9.99 per month and features real-time video from news channels MSNBC and CNBC, California Music Channel-USA, and other channels including the Discovery Channel.

Software developers are embedding traditional IP-enabled data services with voice features. For example, both America Online's and Microsoft Windows XP's instant messaging applications include a voice feature, as do many chat applications. Many PC and console games, such as Microsoft's Xbox, permit their owners to play against other players via peer-to-peer Internet connections. Many of these games permit the gamers to speak with each other via the Internet as they play.

There are numerous adaptive and assistive technologies currently available that have greatly improved access to telecommunications for people with hearing and speech disabilities. For example, Video Relay Service (VRS) is an innovative web-based form of telecommunications relay service (TRS) that enables deaf and hard-of-hearing people



who use sign language to communicate with voice telephone users through video equipment. The video link allows a communications assistant to view and interpret, using sign language, the party's signed conversation and relay the conversation back and forth with a voice caller. Sign language users with a computer, a high-speed Internet access line, and a low-cost web camera can use VRS. Moreover, Internet Protocol Relay (IP Relay) permits people who are deaf or hard-of-hearing or have difficulty speaking to communicate through the Internet, rather than through a text telephone (TTY). IP Relay service allows the user to connect to a TRS facility via a computer (or other similar device) through the Internet. The call is then relayed by the communications assistant to the receiving party via voice through the public switched telephone network. This service allows exciting new options for people who are deaf or hard-of-hearing.

The past few years have seen dramatic growth in the use of the two Internet-based TRS services, VRS and IP Relay. For example, in June 2002, consumers used 710,354 IP Relay minutes and 35,443 VRS minutes. In May 2004, consumers used 4,567,870 IP relay minutes and 733,040 VRS minutes. **See Chart 3**. In that two-year period, consumers used six times more IP Relay minutes, while the usage of VRS increased more than twenty-fold.

Forks, Washington and CenturyTel Partnership

A chance encounter between two local officials in 1999 was the start of a collaborative effort to secure broadband access for Forks, Washington. Prior to 1999, the hospital, the schools and the city government in Forks each had independently attempted to obtain congressional support for projects associated with advanced telecommunications services. City Attorney/Planner Rod Fleck and the school superintendent, both having appointments with the same U.S. Senator about their individual projects, met and decided to work together. A few months later, the city, the school, and the local hospital arrived at the office of local exchange provider CenturyTel united in an effort to bring shared telecommunications services to the remote city of Forks.

Forks is a small, rural lumber town on the northwestern peninsula of Washington State. Since suffering economic depression in the mid-90's, the community has struggled to regain its footing. Now, with group efforts that began in 1999 and are still continuing today, Forks has a redundant fiber loop that encompasses Washington State's Northwestern peninsula (servicing more than 560,000 people throughout a broad area of isolated rural communities) and a computer center that has expanded the city's technological potential for businesses and city residents.

"Nowhere does it say that one's zip code should be a bar to one's educational opportunities, to their business opportunities, or their ability to get health care services," said Fleck.

The city was faced with a choice between pulling together resources to build its own system, and finding a less expensive, more far-reaching way to provide access. "We realized we could not do it alone," said Fleck, "Our group has been an advocate for the 'work with your provider' approach to the needs of rural communities."

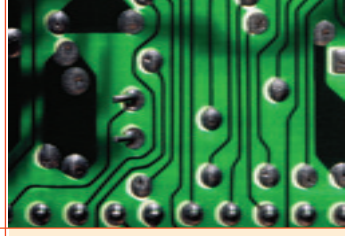
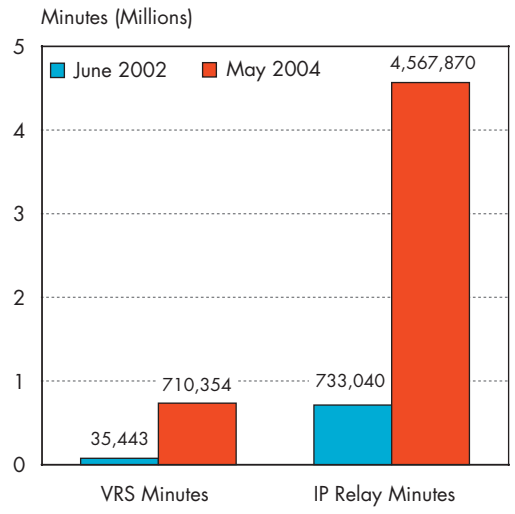


Chart 3: Internet-Based TRS Services



Source: FCC

CenturyTel, impressed by the community's collective effort, selected the town of Forks for the Integrated Community Network (ICN) pilot project. The ICN process is an economic strategy that uses the combined resources of businesses and public institutions to provide advanced telecommunications services at less cost to the individual. Simply put, more people get better access for less money.

"What impressed CenturyTel the most was that it wasn't me calling them or the schools or others in the city," said Fleck. "It was all of us calling them to the table. And they said, 'these guys are serious.'"

To get advanced telecommunications services, the community first needed a main technology center. CenturyTel, which owned an unused office building in Forks, leased the building to the city for $1 a year. Called the ICN building, its purpose was to serve as an 'incubator' for local businesses (entrepreneurs could use the offices and technology in the building to get business started), an after-hours learning facility and a community technology center. After three years, the community was able to buy and remodel the ICN building, with the help of $100,000 from the Veteran Affairs, Housing and Urban Development appropriations bill. It reopened in July.

The ICN committee started the Sappho Gap project: an ambitious program to obtain redundancy over a rugged 30-mile stretch of sparsely populated land. With the help of $1.7 million awarded by the Washington Community Economic Revitalization board and a $6 million investment on the part of CenturyTel, the project was completed in the summer of 2004.

The community center now runs programs like *Tech Tuesdays* and the *Virtual High School*, which teach adults and children technological literacy. The goal is to make Forks competitive and relevant in today's society. "We have to ensure that all parts of our great state have access to what has become the basic communication requirement of this century—a modernized telecommunications infrastructure," Fleck said.

Is Broadband Being Deployed to All Americans?

As many observers have noted, broadband holds great promise for the future of America and the world. Increased access to broadband will bring substantial social and economic benefits. Broadband can offer consumers many compelling advantages, such as enabling workers to telecommute more easily and productively than they otherwise would be able to do without a broadband connection. Consumers will also have greater access to health and educational resources. Patients will be able to use telemedicine to interact virtually with physicians, and students in rural areas will be able to benefit from expanded course offerings.

Nevertheless, those benefits accrue only if infrastructure is available, deployed in service packages that meet consumer needs and is affordable. Subscribership data provides one of the most useful measures of broadband deployment. As a result, we analyze available subscribership data below.

Broadband deployment has steadily increased since the *Third Report*. As set forth in **Chart 4** summarizing Commission data, subscribership to advanced services providing connections to the

Chart 4: Advanced Services Lines

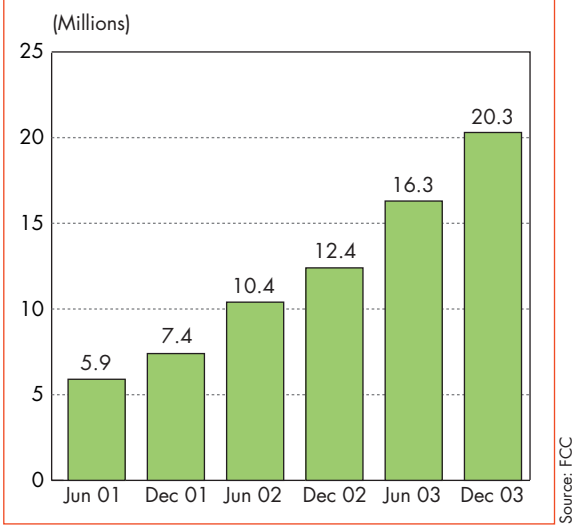
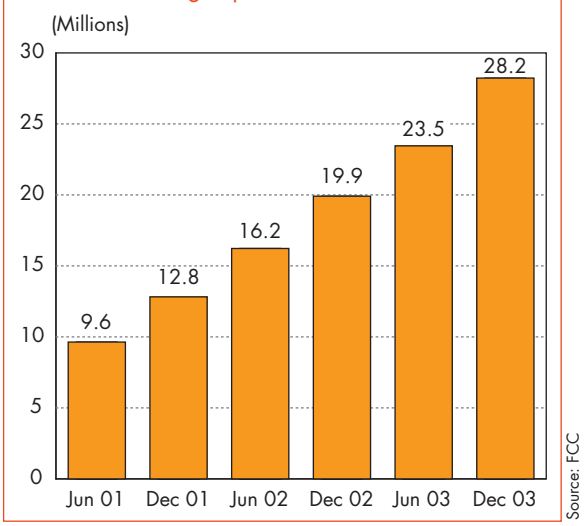


Chart 5 : High-Speed Lines



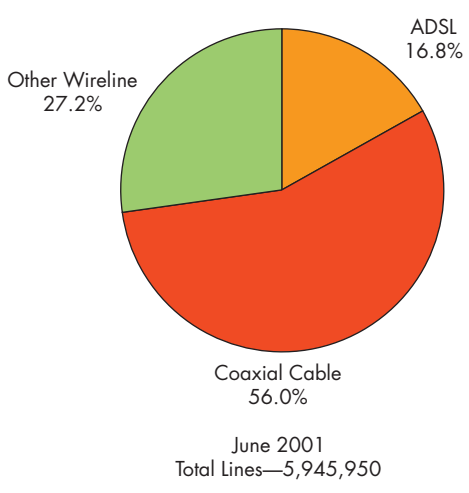
Broadband can offer consumers many compelling advantages, such as enabling workers to telecommute more easily and productively than they otherwise would be able to do without a broadband connection.

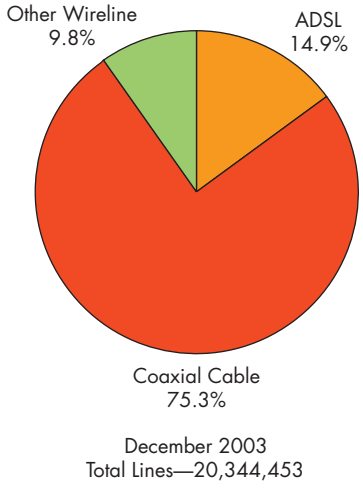
Internet at speeds exceeding 200 kbps in both directions has more than tripled since our last report, from 5.9 million lines in June 2001 to 20.3 million lines in December 2003. Similarly, as set forth in **Chart 5**, high-speed lines providing connectivity of more than 200 kbps in at least one direction has almost tripled from June 2001 to December 2003, from 9.6 million lines to 28.2 million lines. Moreover, the Leichtman Group reports that the twenty largest cable and DSL providers in the United States—representing about 98 percent of the market—added a combined total of more than 2.34 million subscribers in the first quarter of 2004. Net broadband additions for the first quarter of 2004 were the largest per quarter gain to date.

As was true in our last report, cable modem and ADSL service providers provide the vast majority of advanced service lines, with cable representing 75.3 percent, ADSL representing 14.9 percent, and other technologies representing 9.8 percent in December 2003. The relative position of cable and ADSL was 56 percent and 16.8 percent in June 2001. See **Chart 6.**

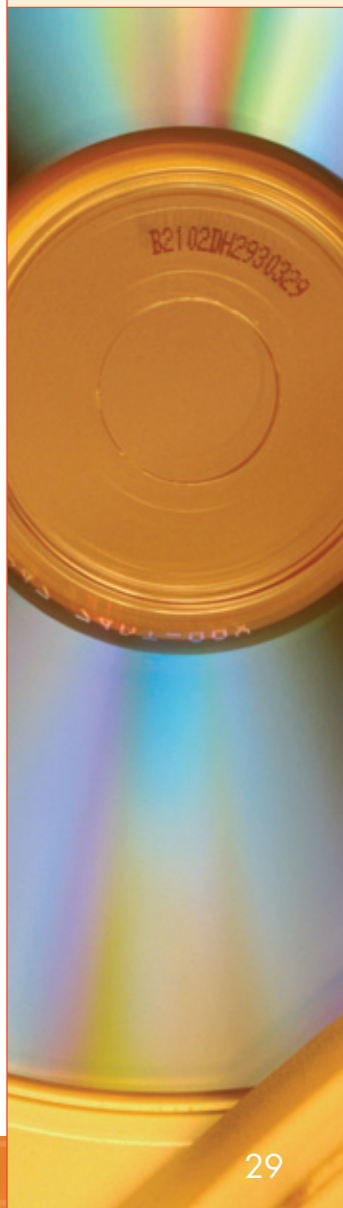
Looking more broadly at high-speed lines, the Commission's data indicates that cable modem service represented 58 percent of lines, with ADSL representing 34 percent of lines as of year-end 2003. More recently, the Pew Internet and American Life Project (Pew Project) reported in April 2004 that 42

Chart 6: Advanced Services Lines by Technology





Source: FCC

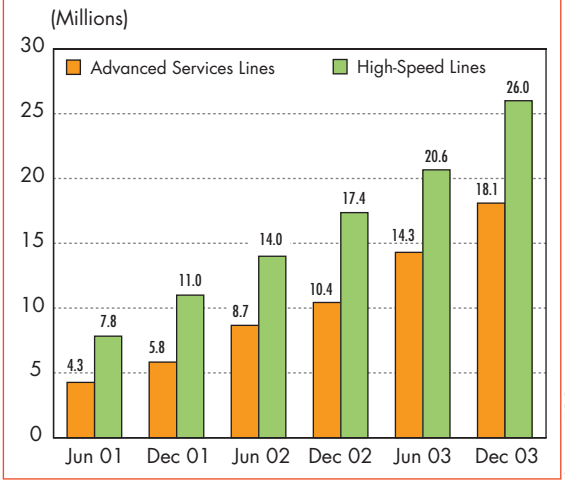


percent of broadband users at home connected via DSL, compared to 28 percent a year previously.

Focusing specifically on residential and small business subscribers, the Commission's data indicate that the number of high-speed lines more than tripled, to 26.0 million in December 2003, from 7.8 million in June 2001. See **Chart 7**. With respect to advanced services lines, in December 2003, there were 18.1 million lines serving residential and small business customers, compared to 4.3 million lines in June 2001.

As of December 2003, only 6.8 percent of zip codes in the U.S. reported no high-speed lines, compared to 22.2 percent of zip codes with no reported lines in June 2001. There also has been a steady growth in the percent of zip codes reporting four or more providers of high-speed lines, from 27.5 percent in June 2001 to 46.3 percent in December 2003. See **Chart 8**. While we recognize that the presence of reported subscribers in a zip code does not necessarily mean service is available throughout the zip code, these figures do provide some evidence that there has been steady progress in the deployment of broadband since our last report.

Chart 7: Residential and Small Business Advanced Services and High-Speed Lines



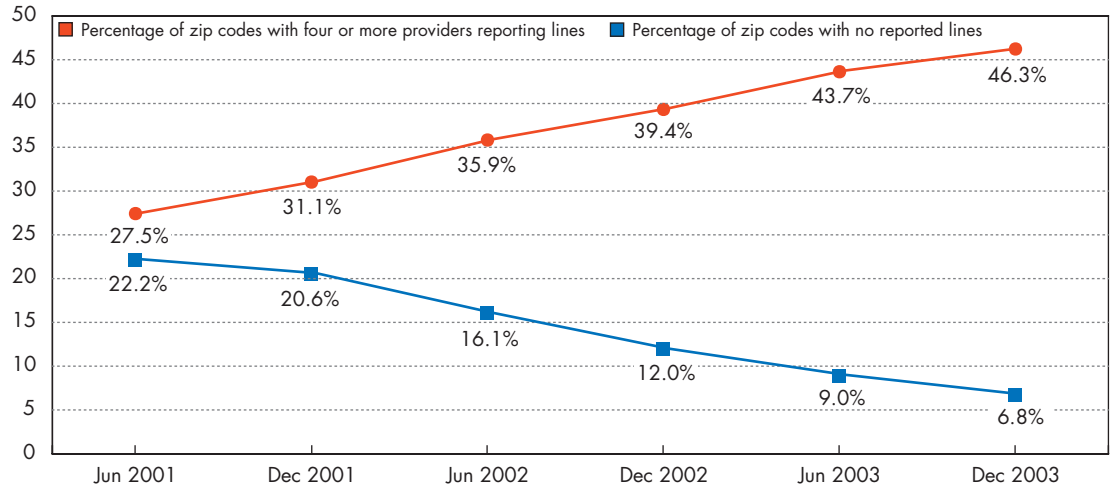
Source: FCC

Strides Made in Advanced Services Deployment in Rural Communities

Both the Commission's data and other sources indicate that the deployment of advanced services capability has increased in rural areas. As was true in our prior report, high-speed service is reported in virtually all of the most densely populated zip codes. Just as importantly, there has been dramatic growth during the same period in high-speed service to less populated zip codes. With respect to the lowest density zip codes (fewer than six persons per square mile), as depicted in **Chart 9**, there were reported lines in 73 percent of zip codes in December 2003, compared to 37 percent in June of 2001.

These findings are reinforced by surveys conducted by the carriers that serve the most rural areas of the United States. For example, the trade association that files access tariffs on behalf of small rural telephone companies, the National Exchange Carrier Association (NECA), indicates that the number of its companies "deploying DSL services increased from 557 in 2001 to 814 in 2003," accounting for nearly 79 percent of NECA member companies equipped

Chart 8: Percentage of Zip Codes with High-Speed Providers



Source: FCC

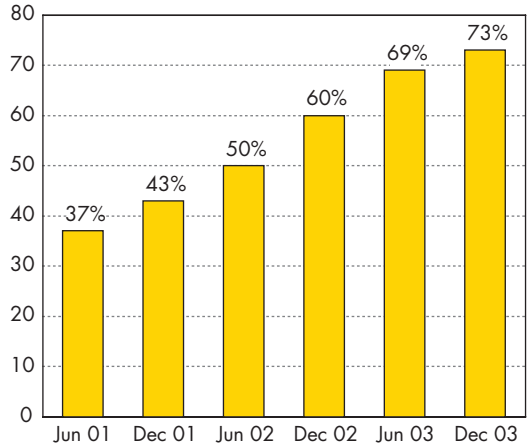
Both the Commission's data and other sources indicate that the deployment of advanced services capability has increased in rural areas.

for DSL in 2003. NECA states that this represents a steady increase in the availability of DSL to rural customers over prior surveys.

The Independent Telephone & Telecommunications Alliance (ITTA), an organization of 12 midsize incumbent local exchange carriers offering a diversified range of services, including broadband capability, asserts that its members and other rural carriers have made great strides in bringing broadband to rural areas. For instance, one ITTA member, CenturyTel, offers DSL and other broadband services to almost 70 percent of its access customers, including customers in remote and sparsely populated areas.

The National Telecommunications Cooperative Association (NTCA), a non-profit association representing more than 550 small and rural telephone cooperatives and commercial companies, also recently conducted a survey to gauge the deployment rates of advanced services by its member companies. Specifically, the 2004 survey revealed that 92 percent of the respondents offer broadband to some part of their customer base. According to NTCA, this is a dramatic increase from 58 percent in 2000.

Chart 9: Percentage of Lowest Density Zip Codes with Reported Lines[1]



[1] Zip Codes with fewer than six persons per square mile.

Source: FCC

Respondents to this survey indicated that they use a variety of technologies to provide broadband to their customers. Ninety-two percent of the member companies reported that they use DSL, and 22 percent reported that they use unlicensed wireless, compared to only 29 percent offering DSL and none offering wireless broadband in 1999.

The Organization for the Promotion and Advancement of Small Telecommunications Companies (OPASTCO), a national trade association representing more than 560 small telecommunications carriers serving rural areas in the U.S., also conducted a survey of its membership in 2004. The survey found that, on an average, respondents have been able to make broadband available to 88 percent of their customers. Nearly all respondents (more than 99 percent) reported being able to deliver "advanced services", *i.e.*, speeds of at least 200 kbps in both directions, to their customers. The OPASTCO survey also found that almost all of the respondents use DSL technology to deliver broadband to their subscribers.

The American Cable Association (ACA), a not-for-profit trade association that represents independent cable television businesses and smaller cable systems, including systems with less than 1,000 lines, estimates that about 580 ACA member companies now offer broadband service to residential and business customers. For instance, Carson Communications, one of the ACA's smallest members, serving approximately 5,000 subscribers in rural northeast Kansas, now offers cable modem service and broadband wireless services to more than 89 percent of its rural subscriber base.

Although the Wireless Internet Service Provider (WISP) market is still in its infancy, according to industry estimates, approximately 2,000 to 3,000 WISPs are serving the nation's rural areas from the Catskill Mountains in New York to Coffman Cove, Alaska. WISPs are using a wide range of both licensed and license-exempt diverse technologies to provide broadband service to rural consumers and businesses. For instance, Odessa Office Equipment, a rural-office-

supply company-turned WISP based in Odessa, Washington, serves thousands of customers in a 3,000-square-mile area of northwestern Washington via 2 megabit Wi-Fi technology using barns, streetlight poles and houses as wireless tower sites. Additionally, GCI, a telecommunications and cable services provider in Alaska, provides its WISP services to rural customers at prices comparable to urban services. GCI uses unlicensed wireless technology (IEEE 802.11) interconnected with satellite backhaul to bridge the "last mile" for its rural service areas.

The universal service fund, which helps preserve and advance universal service for all Americans, supports the deployment of facilities that can be used to provide broadband in rural communities. Rural carriers receive more than $1 billion annually in universal service support for their underlying copper loop network. In addition, since 1998, the universal service fund has disbursed more than $55 million to support broadband connections to rural health facilities. The Universal Service Administrative Company (USAC), which administers the universal service fund, estimates that the fund will provide more than $28 million in Funding Year 2003 alone to help provide assistance for rural health care connections in remote communities, and potentially an even larger amount in Funding Year 2004.

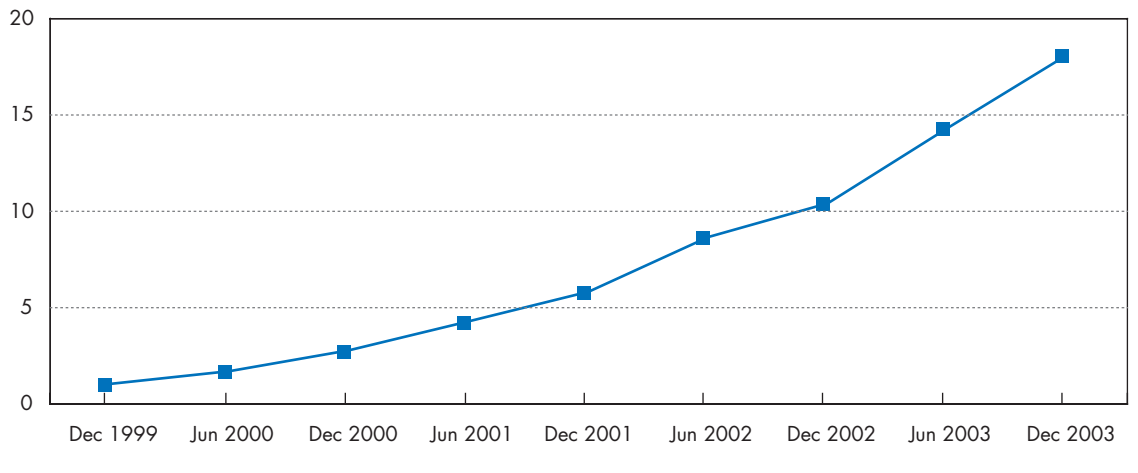
Available information thus indicates that there has been significant progress in deployment of broadband infrastructure in rural areas since our last report. But we are aware that consumer adoption of broadband, at least at present, is lower than actual deployment of infrastructure. A study conducted by the Pew Project, in February 2004, on rural areas and the Internet indicates that while broadband adoption is growing in urban, suburban, and rural areas, a larger percentage of consumers use broadband in urban and suburban areas compared to rural areas. The report lists various factors for the difference in broadband penetration between rural areas, and urban and suburban areas. The Pew Project suggests that a major factor for this gap is demographic, noting that rural residents as a group are older, less wealthy, and have lower levels of educational attainment, which are factors associated with lower broadband usage.

Broadband at Home and Work

Broadband is increasingly available to customers at home and work. The Commission's data show that residential and small business customers subscribed to 18 million lines as of December 2003—a significant increase from 1 million lines in December 1999. See **Chart 10**. As **Chart 11** illustrates, most residential and small business customers receive advanced services via coaxial cable.

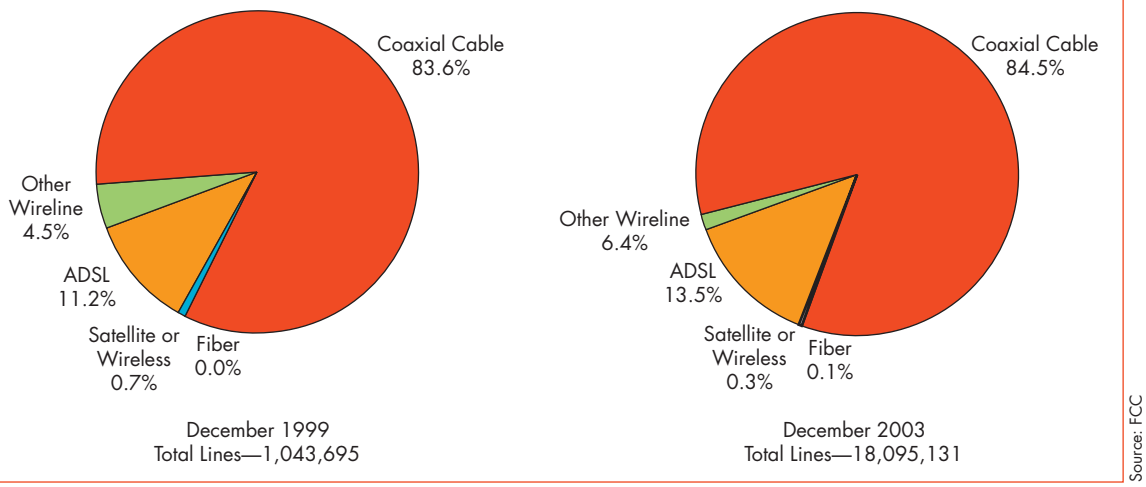
In March 2004, the Pew Project found that 55 percent of all adult Internet users have access to broadband connections either at home or work. At the end of February 2004, more than a third of those users had broadband connections at home. Overall, 48 million adults had high-speed connections in the home in February 2004, representing growth of 60 percent from a year earlier. The Pew Project study also noted that among Internet users who have been online for 10 or more years, 56 percent of residential users have high-speed connections, which may suggest that consumers are

Chart 10: Residential and Small Business Advanced Services Lines



Source: FCC

Chart 11: Residential and Small Business Advanced Services Lines by Technology



Source: FCC

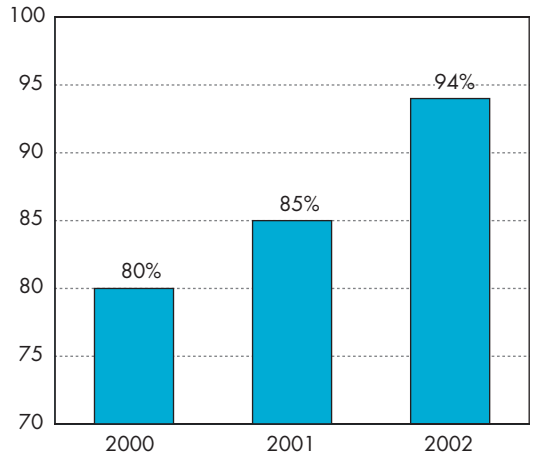
more likely to subscribe to broadband if they have used the Internet for a longer period of time.

Although use of high-speed connections at home has increased, the Pew Project's survey suggests that people are more likely to use high-speed connections at work. The survey indicated that 64 percent of people who are employed full or part-time go online in the workplace. Of this group, 67 percent of people who are employed full or part-time go online using a high-speed connection.

Children are Using Broadband in their Classrooms

Broadband is directly affecting students today. In March 2004, NetDay, a national, non-profit, education technology organization, conducted a survey of 210,000 students from kindergarten through 12th grade to learn more about the impact of technology on students' lives. NetDay's report on the survey results found that students are technology savvy, feel strongly about the positive value of technology and rely upon technology as an essential and preferred component of every aspect of their lives. The report indicated that as students get older, their use of technology becomes more sophisticated. However, the younger students are progressing at a faster rate than older students. Specifically, the report found that students are using online communications for a variety of activities, including school projects, tutoring, gaming, and emailing friends.

Chart 12: Percentage of Public Schools Reporting Using Broadband Connections



Source: Department of Education

Almost all schools have access to the Internet. The Department of Education has documented the steady increase in the number of schools with Internet access, and the number of instructional classrooms with Internet access. For instance, in 2002, 99 percent of public schools had access to the Internet, compared to 35 percent in 1994. Moreover, in 2002, 92 percent of public school classrooms had access to the Internet, compared to 3 percent in 1994 and 77 percent in 2000. In 2002, 94 percent of public schools reported using broadband connections for Internet access, compared to 80 percent in 2000 and 85 percent in 2001, as shown in **Chart 12**. In 2002, as in previous years, the use of broadband connections is directly related to school size; 90 percent of small schools reported using broadband connections to access the Internet, compared with 100 percent of the large schools.

Is Broadband Being Deployed to All Americans?

Most notably, the use of broadband connections in schools with the highest minority enrollment increased from 81 percent to 95 percent between 2000 and 2002. Similarly, during the same time period, the percentage of schools with the highest poverty concentration (as measured by the percent of students eligible for free or reduced-price lunch) using broadband connections to access the Internet increased from 75 percent to 95 percent. Thus, the evidence suggests that broadband is becoming more widely available in our nation's schools.

The universal service fund subsidizes the cost of both the broadband services that access the Internet and the deployment of infrastructure that is used to access the Internet in our nation's schools. Since 1998, nearly $7 billion has been disbursed to support the purchase of telecommunications services, Internet access, and internal connections by schools, and an additional $827 million has supported such purchases by consortia that include both schools and libraries.

Low-Income Populations Have Increased Access to Advanced Services Since the *Third Report*

It generally appears that low-income populations subscribe to advanced services at lower levels than high-income populations. In 2002, more than 75 per-

Maniilaq Health Center in Kotzebue, Alaska

Dr. Michael Orms had a patient who was bleeding internally due to an ectopic pregnancy, and she needed emergency surgery to save her life. For residents of Kotzebue, Alaska, a community of more than 3,000 people located 26 miles above the Arctic Circle, access to these types of specialized medical services usually meant a flight via an air ambulance to Anchorage. But heavy fog had settled in, so it wasn't safe to fly.

Fortunately, the Maniilaq Health Center in Kotzebue is equipped with a wireless "telecart" fitted with a video camera that can be manipulated by the attending physician to send high-quality, real-time sound and video between the Health Center and Anchorage. Dr. Orms, who is not a surgeon, performed the procedure under the guidance of an experienced Anchorage surgeon who manipulated the video camera on the Health Center's telecart to, as Dr. Orms said, "remotely look over my shoulder" to successfully perform the surgery.

Organized and timely emergency response is particularly important in Alaska's far north regions, where the distances to be traveled and extreme weather conditions often prevent medical personnel from reaching and treating critically injured patients. Here, real-time contact with injured patients via videoconferencing enables physicians at a central medical facility to diagnose and treat patients by providing guidance to medical personnel "on the scene" in outlying Village clinics.

The Maniilaq Health Center is a state-of-the-art facility that houses an emergency room, an ambulatory care clinic, dental and eye care clinics, a pharmacy, and an in-patient wing with 24 beds. The Health Center is the hub of a virtual private network supported by broadband satellite and terrestrial wireless links that facilitate the provision of quality health care services to residents of the 11 Alaska Native communities that make up the Northwest Arctic Borough. The nearest health care facility offering comparable service is more than 500 miles away. Broadband services are provided by Inutek.net., a consortium organized in 2001 by the Maniilaq Association, GCI and OTZ Coop, the Northwest Arctic Borough's local exchange service carrier.

The ten village clinics are staffed by village residents that have been trained as Health Aides in Maniilaq's Community Health Aide/Practitioner Program. Each Village clinic is connected to the Maniilaq Health Center by a broadband-capacity satellite link that provides videoconferencing and other digital transmission services, such as record storage and retrieval, between Village clinics and the Health Center in Kotzebue. The Health Center, and each Village clinic, is equipped

cent of U.S. households with incomes of more than $50,000 had Internet access, but the share was 38 percent for those with household incomes of less than $30,000, according to a survey by the Pew Project. However, the gap in broadband subscribership between lower- and higher-income populations is steadily decreasing. The Commission's data collection program gathers and analyzes information on broadband subscription rates by zip code with zip codes ranked by household income. Our data indicate that the gap between subscribership in the highest income zip codes ($53,494 and higher) and the lowest income zip codes ($21,644 and lower) has shrunk from about 37 to 17 percentage points, primarily due to increases in subscribership among low-income zip codes. In particular, our most recent data indicate that, in December 2003, approximately 99 percent of the highest income zip codes reported high-speed lines and almost 82 percent of the lowest income zip codes reported high-speed lines. By contrast, the *Third Report* indicated that as of June 2001, of the highest income zip codes, 96 percent had high-speed subscribers, while of the lowest income zip codes, 59 percent had high-speed subscribers. These statistics suggest that there has been considerable growth in access to broadband for low-income populations since our last report.

A survey conducted by the Pew Project in 2004 indicates that 3 percent of those people who use the

with a telecart, which enables doctors to diagnose medical problems and devise treatment regimens to be implemented by clinic personnel. Telemedicine technology also is employed on a regular basis to train Health Aides and to help them perform routine procedures under a doctor's supervision. It also supports "teleradiology," the means by which a radiograph can be digitized, stored, and forwarded to the Alaska Native Medical Center.

Investment in telemedicine technologies can be costly. The State of Alaska estimates that typical "up front" costs to install a network providing the level of connectivity available in Maniilaq's system are upwards of $20,000. In 1999, the 11 health care facilities in the Maniilaq system and about 225 other communities received telecarts like that used by Dr. Orms as part of a $30 million federal interagency telecommunications project to support health care in rural Alaska known as the Alaska Federal Health Care Access Network. Broadband service in Alaska requires the use of satellites and is estimated to cost approximately $13,000 per month.

Although the costs are high, the investment in telemedicine technologies also yields significant cost-savings. For example, it reduces the number of MedeVac trips that would otherwise be required to transport patients to the Health Center in Kotzebue or to a fully equipped hospital like the Alaska Native Medical Center in Anchorage. MedeVacing costs are borne by a rural health care provider operating in such areas and can run as high as $40,000 for a single trip. The Health Center has been able to eliminate an estimated two-thirds of its MedeVac trips and associated costs since the advent of its telemedicine capability. In addition, MedeVacing a patient can endanger both the patient and the flight crew if weather conditions are threatening, an especially important consideration in a remote area like the Northwest Arctic Borough, where bad weather is a commonplace.

A year before the woman with the ectopic pregnancy, Dr. Orms performed another surgery to stem heavy internal bleeding until a MedeVac plane could fly the patient to Anchorage. That time, however, the critical nature of the emergency prevented the use of the videoconference. While that patient also recovered fully, Dr. Orms said the experiences were vastly different from a medical and technical standpoint, and that he is grateful for the advantages provided by videoconferencing. He explained that the videoconferencing capability enhances an attending physician's level of confidence and actual performance immeasurably, because a specialist is available throughout the procedure to provide guidance in the event of unexpected complications.

Is Broadband Being Deployed to All Americans?

Internet rely on public places to access the Internet. Low-income populations comprise a significant portion of this segment. According to the survey, 16 percent of low-income populations have broadband access at home or at work. For the remaining low-income individuals, public access points such as libraries represent the most utilized means of accessing the Internet. According to the Gates Foundation, in 2002, 95 percent of public libraries in the United States offered free access to the Internet, often providing a critical online access point for residents of the nation's poorest communities. The universal service fund supports the purchase of telecommunications services, Internet access, and internal connections by libraries. Since 1998, the fund has provided $236 million in support to libraries and $827 million to consortia that include both schools and libraries.

Further, broadband access is readily available at public schools. According to the Department of Education, Internet access using broadband connections has increased from 75 percent in 2000 to 95 percent in 2002 among the schools with the highest poverty concentration. Thus, although low-income populations may lag behind higher-income populations in accessing broadband services, research indicates that broadband services are available to low-income populations through subscription services as well as free public facilities.

Minority Access to Broadband is on the Rise

There has been considerable growth in advanced services usage by minority populations. According to a May 2004 study by the Pew Project of adults 18 and older, 61 percent of non-Hispanic Caucasians, 59 percent of Hispanics, and 52 percent of African-Americans used the Internet as of February 2004. Further, research by the Pew Project indicates that, in 2001, 20 percent of Hispanic adult home Internet users had broadband access, 15 percent of non-Hispanic Caucasian adult home Internet users had broadband access, and 9 percent of African-American adult home Internet users had broadband access. In 2003, 30 percent of non-Hispanic Caucasian adult home Internet users had broadband access, 24 percent of Hispanic adult home Internet users had

The Commission has a special interest in the continued and increasing availability of advanced services for people with disabilities.

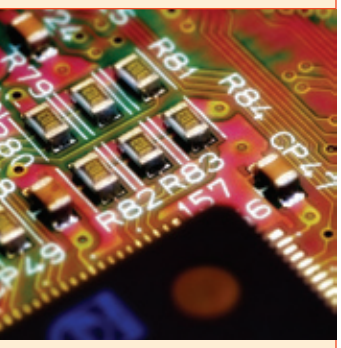
broadband access, and 20 percent of African-American adult home Internet users had broadband access. Moreover, as noted above, the use of broadband in schools with the highest minority enrollment increased from 81 percent to 95 percent between 2000 and 2002.

The Disabled Community is Accessing Broadband Services Despite Barriers

Broadband services have the potential to provide significant opportunities for people with disabilities. As discussed above, the Internet, and broadband specifically, has become a critical communications tool for people who are deaf or hard of hearing, through the use of IP Relay and VRS, two forms of TRS that rely upon the Internet. The past few years have seen dramatic growth in the use of these two Internet-based TRS services. For example, in June 2002, consumers used 710,354 IP Relay minutes and 35,443 VRS minutes. In May 2004, consumers used 4,567,870 IP relay minutes and 733,040 VRS minutes. There has been a more than 640 percent increase in IP Relay usage and a more than 2,000 percent increase in VRS in the past two years.

Beyond these positive trends, the Commission has a special interest in the continued and increasing availability of advanced services for people with disabilities. Such individuals may be doubly vulnerable, both in that they may need access to advanced telecommunications capability to overcome economic, educational, and other limitations, and they may also be the most likely to lack access precisely *because* of these limitations.

Is Broadband Being Deployed in a Reasonable and Timely Fashion?



Section 706 requires that we determine whether advanced telecommunications capability is being deployed to all Americans "in a reasonable and timely fashion." Based on our analysis, we conclude that the deployment of advanced telecommunications capability to all Americans is reasonable and timely, especially toward the lower threshold of 200 kbps. The challenge for the future is to achieve reasonable and timely deployment of higher speed broadband.

As an initial matter, we emphasize that the statute directs us to look at the *deployment* of advanced telecommunications capability, not the *subscribership* of advanced telecommunications capability. The former refers to the availability of facilities capable of providing advanced and high-speed services, while the latter represents the number of consumers that actually choose to purchase advanced or high-speed services. Using information from the Commission's data collection program, we estimate that roughly 20 percent of consumers with access to advanced telecommunications capability do subscribe to such services. One critical prerequisite to using broadband, however, is having a computer in the home. As of June 2004, 71 percent of U.S. households had computers in the home, which may provide some explanation for why penetration of broadband lags behind the deployment of broadband. Other possible reasons for the gap between availability and subscribership to broadband services are: price, lack of content, availability of substitutes, or the availability of broadband at work. Furthermore, many popular Internet applications, such as sending e-mail messages, do not require broadband.

Nonetheless, we believe that subscribership to broadband services will increase in the future as new applications that require broadband access, such as VoIP, are introduced into the marketplace, and consumers become more aware of such applications. As described in the preceding sections of this report, the availability and subscribership of advanced and high-speed services continues to grow steadily throughout the nation.

Rural areas are typically characterized by sparse and dispersed populations, great distances between the customer and the service provider, and difficult terrain. These factors present a unique set of difficulties for providers attempting to deploy broadband services. Yet despite these obstacles, the data described in the preceding section demonstrate that significant progress is being made towards ubiquitous availability of advanced services in rural areas. This is a marked improvement since the *Third Report*.

Similar strides have been made in other significant segments. For example, access to advanced services by low-income populations and minority groups has grown dramatically, and roughly 94 percent of public schools had broadband connections to

Based on our analysis, we conclude that the deployment of advanced telecommunications capability to all Americans is reasonable and timely.

the Internet in 2002. We continue to believe that the availability of advanced services will help make our nation stronger and more effective in the 21st century.

We base these conclusions on our current definitions of "advanced services" as services and facilities with transmission speeds of more 200 kbps both upstream and downstream, and "high-speed" as services and facilities with more than 200 kbps capability in at least one direction. As we noted earlier in this report, broadband will evolve in the future, and we expect that higher transmission speed thresholds may be relevant in future inquiries. As broadband evolves, we will want to explore whether Americans have access to the broadband capabilities necessary to take advantage of new services and applications. We have proposed changes to our Form 477 that, if adopted, will permit us to gather more detailed information on what transmission speeds are available, which would allow us to conduct a more detailed analysis in the future.

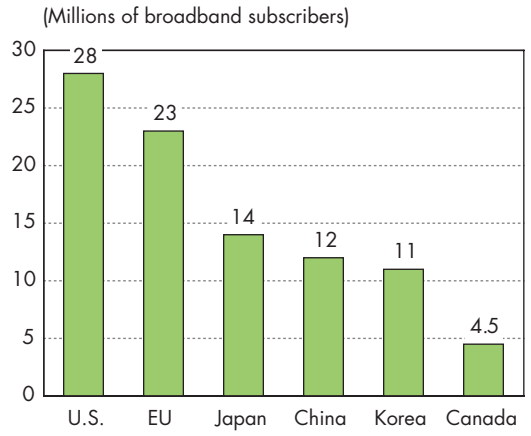
We are committed to ensuring that all Americans can share in the benefits of access to broadband services, and will continue to monitor the nation as a whole, as well as groups of particular interest to us, for progress in the availability of such services. We will also look at other methods we can utilize to collect data and other information that will enable us to analyze the continued progress of deployment of advanced services, particularly among users falling within specialized demographic groups.

Broadband Deployment in Other Countries

One tool to help assess the degree to which broadband is being deployed in the United States on a timely basis is to examine broadband deployment in other countries. There are a number of studies comparing the availability of broadband across countries. For example, among the 30 member countries belonging to the Organisation for Economic Co-operation and Development (OECD), the United States is tied for second in cable modem service and eighteenth in terms of DSL service.

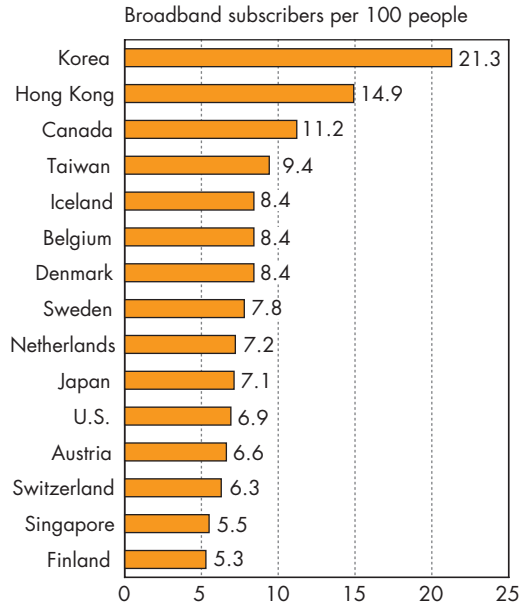
The most comprehensive reports by the OECD and the International Telecommunications Union (ITU) focus on penetration (adoption) rates. There are potential lessons to be learned from understanding what drives broadband adoption in other countries, especially those that exhibit comparatively high penetration rates, as increased adoption will drive future and more advanced deployment.

Chart 13: Largest Broadband Markets in the World



Source: OECD, April 2004

Chart 14: Top 15 Countries with Residential Broadband Subscribers



Source: International Telecommunications Union, data for 2002.

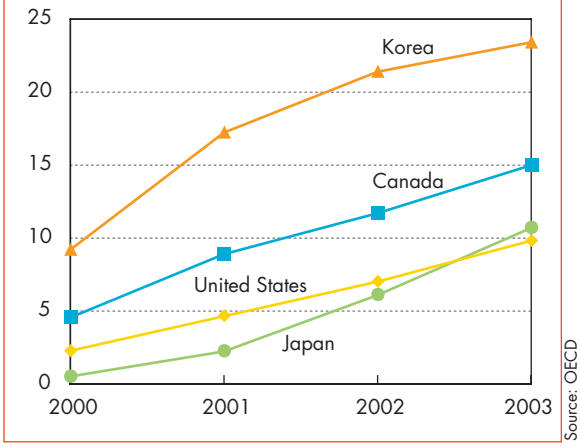
In terms of absolute numbers of broadband subscribers, the United States leads the world.

In terms of absolute numbers of broadband subscribers, the United States leads the world (**Chart 13**). In terms of residential broadband penetration (number of subscribers per 100 people), however, the ITU's 2003 *Birth of Broadband Report* ranked the United States eleventh in 2002, as **Chart 14** shows. The Republic of Korea (South Korea), Hong Kong, China SAR (Hong Kong), and Canada lead the world in penetration levels, while U.S. subscribership levels are close to those in Japan, the Netherlands and Switzerland.

Comparing the U.S. broadband experience with Japan, South Korea, and Canada—three countries which have achieved high subscribership levels—is particularly interesting. **Chart 15** shows each country's level of broadband penetration during the past few years. Among the factors that may contribute to the levels of subscribership in each country are population density, per capita income, government support, and competition.

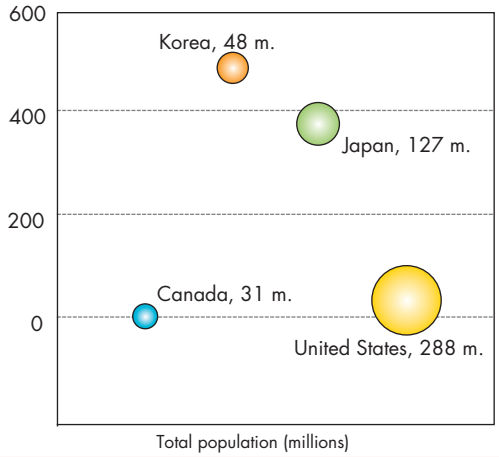
In some cases, higher population density appears to support more rapid deployment and purchase of broadband services because more people live closer to exchanges upgraded for DSL service and more live in apartment buildings with easily upgraded networks. As shown in **Chart 16,** Japan and South Korea both exhibit high population density. While much of Canada's population is densely clustered along its

Chart 15: Broadband Subscribers

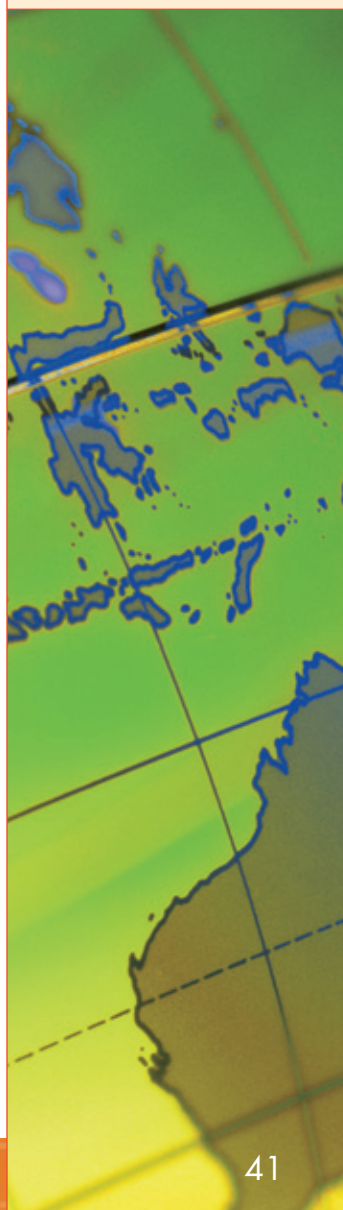


Source: OECD

Chart 16: Population Density (people per square kilometer)



Source: World Bank, 2002



Broadband Deployment in Other Countries

Population density, per capita income and government support play a role in broadband deployment.

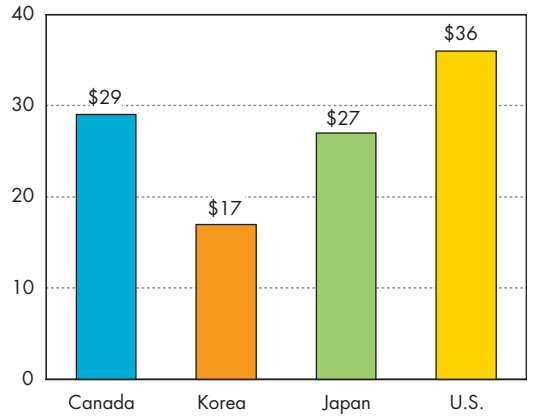
southern border, its average population density is lower than the United States, while its broadband subscribership rate is higher. This suggests that population density alone may not explain broadband subscribership rates.

Looking at income levels across different countries, **Chart 17** shows that the United States, Japan, and Canada all have per capita income above US$25,000 per year, while Korea, is closer to US$17,000 per year. Korea has achieved relatively widespread broadband use even though its per capita income is lower relative to other countries with similar broadband subscribership.

Government support is also a driver of broadband development. In all four countries, the government provides some form of support for broadband service. In the United States, the universal service program subsidizes Internet access, including broadband, to schools, libraries, and rural health care providers. To date, $8 billion has been disbursed to support connectivity for schools and libraries, much of it for broadband. As previously mentioned, more than $55 million has been disbursed to support broadband for rural health care providers, and rural carriers receive more than $1 billion annually in universal service support for their underlying copper loop network. In addition, the U.S. Department of Agriculture's Rural Utilities Service provides loans to companies providing broadband service to communities with fewer than 20,000 people.

Chart 17: GDP per capita

Thousands of U.S. dollars (PPP adjusted)



Source: World Bank, 2002

In Korea, government support appears to be the most wide-ranging and includes funding to link public institutions, funding for research and development, and subsidized loans for remote areas. For example:

- Korea Information Infrastructure (KII)-G program links public institutions nationwide.
- KII-T provides funding for research and development for next-generation networks.
- KII-P subsidizes loans for remote areas, defined as localities with fewer than 50,000 people.

There is also government support in Korea for education and consumer outreach.

In Japan, a variety of policies promote deployment of broadband facilities, such as preferred loans for fiber optic network buildout, tax deductions for digitalization of equipment and for corporate use of broadband networks, and subsidies to local governments for building fiber networks.

In Canada, government support appears primarily focused on aiding rural development in the sparsely populated northern regions, through such programs as the Broadband for Rural and Northern Development and the National Satellite Initiative.

Competition is also a driver of broadband availability, subscribership, price, and capacity. The OECD has reported information on broadband offerings available in Canada, Korea, and Japan as of October 2003. In each of these countries, the available speed for broadband service is growing very quickly. Competition has led to a clustering of broadband prices, with typical prices varying by country. **Chart 18** compares a sample of offerings in each country, in terms of the capacity of the broadband service, and the monthly subscription price.

In Korea, the incumbent telecom operator—Korea Telecom (KT)—remains the major provider of DSL services. KT, along with broadband providers

Hanaro and Thrunet together provide service to about 85 percent of the market. KT offers DSL service, while Hanaro and Thrunet offer both cable modem service and DSL over KT's loops. Their service offerings range from about US$40-70, with speeds from 1.5 to 20 Mbps, which is higher than most consumer offerings in the United States.

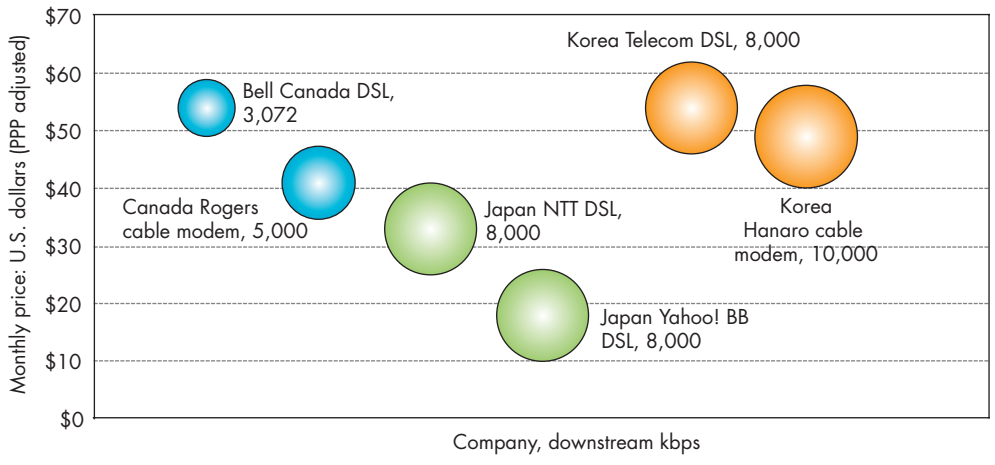
In Japan, incumbent telecom operator NTT East provides DSL and fiber-to-the-home. However, it is competitor Yahoo! BB that is the largest broadband service provider in terms of subscribers. As of June 2004, Yahoo! BB alone had 36 percent of Japan's DSL market. Both Yahoo! BB and eAccess provide DSL service through line-sharing on NTT's local loops. J-com is a cable modem operator. USEN and KDDI are providing service over fiber. Prices range from US$18 for a Yahoo! BB 8 Mbps package to US$130 for NTT East B FLET's fiber service dedicated to a single connection. These six companies have about 70 percent of the Japanese broadband market.

In Canada, incumbents Bell Canada and Telus are major providers of broadband over DSL. Rogers and Cogeco are major cable modem service providers. DSL.ca provides DSL over incumbent local loops. Canopy, Gulf Islands, and PRiS are fixed wireless providers. Among major Canadian providers, prices range from US$27 for Bell Canada's 128 kbps—the speed of rush dial-up service—to US$59 for Cogeco's 5 Mbps service. The subscribers to these eight operators comprise about 66 percent of the Canadian broadband market.

While all four countries have a diversity of population density, per capita income, and government programs, they all have competitive broadband markets. All four countries have competition either among technological platforms or among providers over the same platform. In Japan, the competition is primarily among DSL providers, with rapid growth now of broadband over fiber. There is significant competition between different platforms in the other three countries.

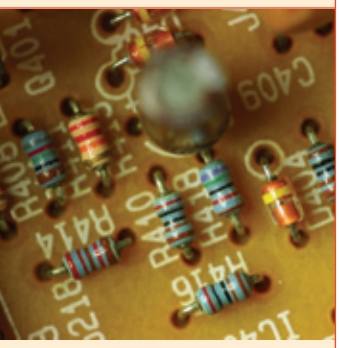
To conclude, there are many reasons why broadband subscribership varies across countries. Such comparisons suggest there are a variety of factors that lead to high broadband subscribership rates. By observing what is occurring in other nations, we will have a more informed understanding of the multi-faceted dynamic broadband marketplace.

Chart 18: Sample Broadband Offers



Source: OECD, October 2003

The Future of Broadband



There are at least three broadband trends likely to shape the future for the next decade. First, broadband adoption will continue. Second, broadband connections will become "faster;" that is, they will be able to transmit increasing volumes of data during a given interval. Third, a wide array of technologies will be able to deliver broadband to consumers and businesses.

We are approaching broadband adoption levels that could serve as a "tipping point" for the rapid creation of advanced services. Widespread broadband Internet access can enable a variety of new and valuable services, including distance learning, remote medical diagnostics, and easier "telecommuting." But these services are likely to become commercially feasible only when broadband access has become sufficiently widespread to provide a customer base that could cover development costs. As these services do become available, however, they will create new incentives for consumers to adopt broadband.

The continuing deployment of broadband and the development of services that rely upon broadband may thus have a synergistic, mutually reinforcing quality: deployment will likely spur the development of services that, in turn, will spur further deployment. In other words, as more people adopt broadband, the market is likely to devote more resources towards the provision of innovative advanced services that encourage more people to adopt broadband. The prospect of this type of "network effect" suggests that the future of broadband is bright.

Consumers will continue to adopt and upgrade broadband services. Broadband is already widely deployed in large businesses. The future of broadband depends, however, on its deployment to the consumers and small businesses whose economic activities generate most of our economic growth. For this reason, we will focus on the future of the consumer market for broadband. Also the distinction between the "deployment" of broadband and the "adoption" of broadband is critical to a proper understanding of the evolving broadband market.

Consumers continue to adopt broadband in increasing numbers. A report from Strategy Analytics predicts that an additional 8.5 million homes will add broadband in 2004, totaling approximately 33.5 million users by the end of 2004, compared to 25 million users in April 2004. Ipsos News estimates that 56 percent of dial-up users are likely to upgrade their Internet connections to high-speed from May through November 2004. Of course, simple mathematics dictate that the rate of growth of broadband deployment will slow as it becomes more widespread. This does not mean, however, that the rate of growth of the market for advanced services will slow over the next decade. The opportunity to provide new services, premium services, and upgrades to existing

The continuing deployment of broadband and the development of services that rely upon broadband may thus have a synergistic, mutually reinforcing quality: deployment will likely spur the development of services that, in turn, will spur further deployment.

services appears to foretell a vigorous and growing broadband market for the foreseeable future.

The trend of increasing consumer adoption of broadband will also be likely to be complemented by another critically important trend: consumers will more fully integrate broadband into their lives. As consumers adopt broadband and realize its benefits, they will expand the reach of broadband within their homes and businesses so that broadband becomes available in all useful locations and to all the devices that might benefit from high-speed networking. Devices like broadband-enabled "media center" home computers illustrate how broadband can become a critical component of home entertainment systems that have not previously been networked. Cell phones, PDAs, cars, gaming systems, and home appliances are other examples of devices that may benefit from networking. Indeed, the popular wireless networking standard, Wi-Fi, provides a means of linking devices in a single location, which has caused the sales of Wi-Fi enabled devices to soar. Consumers and businesses are likely to find a number of unanticipated uses for broadband connections as they become truly ubiquitous.

Broadband access speeds will continue to increase. Providers of broadband access consistently assert that they will continue to increase the speed of the connections that they offer their customers. Such advances are critical to the continued development of broadband.

Providers assert that within the next several years, consumers can expect connections providing symmetrical service at 10 to 20 Mbps. Within five to ten years, these connection speeds should increase to 100 Mbps, and some providers predict that premium services may provide consumers with 1 gigabit per second (Gbps) access within a decade. Even higher-speed connections may be deployed to businesses, with some providers predicting the availability of 10 Gbps business services.

A diverse range of technologies will provide broadband access. One of the most intriguing aspects of the growing market for broadband appears to be the diverse range of technologies and facilities-based platforms capable of providing broadband access. The diversity of advanced telecommunications technologies offers at least two critical advantages.

First, potentially competing access technologies can promote both price and quality-of-service competition among broadband-access providers. This competition may be critical to overall adoption of broadband: as consumers discover new uses for broadband access, competition can ensure that service providers have incentives to shape their offerings to reflect fast-evolving consumer preferences as well as competitive pricing. The prospects of such competition lend credence to calls for restrained regulation of advanced telecommunications technologies and advanced telecommunications providers.

Second, access technologies may also have complementary roles that, taken together, may hasten the overall speed at which broadband access becomes universally available. For example, wireless broadband networks may provide coverage for mobile and

The Future of Broadband

The future of broadband is promising. Over the next decade, broadband will become much faster and more ubiquitous. The market for advanced services is poised for growth and competition.

portable devices and "fill in the gaps" where wireline broadband coverage is unavailable. Additionally, wireless broadband services, along with satellite services, may bring high-speed broadband to remote areas where wireline broadband services are currently infeasible or uneconomical.

Broadband satellite and wireless services appear to be the two types of new access services most likely to be deployed in the near future. New satellite-based broadband services will be launched by SES Americom, EchoStar, and the members of the National Rural Telecommunications Cooperative. Wireless broadband services are projected to become available from a host of smaller WISPs, such as AMA Tech Tel Communications using unlicensed spectrum and Evertek using licensed spectrum, and from larger carriers such as Verizon with its BroadbandAccess service over cellular spectrum and the Intel-supported WiMax service.

Additional access technologies may also play important roles in the future. Entrepreneurs and engineers are now investigating and developing an array of technologies—from powerlines to ultrawideband—to determine whether such technologies would be a viable option for broadband access services.

Government policymakers will be challenged to find innovative ways to support private market mechanisms that will deploy and improve advanced services. The key to meeting this challenge is a policy environment that focuses on all broadband access technologies that provide value to consumers. The Commission will remain challenged to seek out flexible approaches that will allow it to move quickly to remove barriers to the deployment of advanced telecommunications capability.

The number and diversity of the tasks that could be assisted or transformed by two-way, high-speed, global data transmission creates certainty about the importance of broadband, even as it creates uncertainty about how broadband will assist or transform any particular task. This uncertainty is both unavoidable and beneficial. It is unavoidable because the effect of broadband upon any particular task depends not only on the existence of a high-speed "pipe," but also on a complex web of other factors including consumer preferences and the rate at which companies develop, deploy, and improve broadband-enabled devices and services. This uncertainty is beneficial because it encourages companies to invest broadly in broadband applications in order to be able to respond quickly to market signals.

This fluid situation means that broadband adoption could be hindered either by failures to create necessary incentives to encourage the deployment of broadband or by prescriptive regulations that will necessarily fail to keep pace with a fast-changing broadband market. Policymakers can reasonably predict that broadband will move from a high-end luxury item, to a mainstream expectation, and, eventually, to a necessity for civic life.

The future of broadband, though difficult to predict, is promising. Over the next decade, broadband will become much faster and more ubiquitous. The market for advanced services is poised for growth and competition.

Conclusion

The deployment of infrastructure capable of delivering broadband services is critical to the U.S. economy. Broadband has played and will continue to play a vital role in the 21st century. Many U.S. companies depend on broadband connections to run various facets of their businesses, including tracking inventory, monitoring consumer relations, and forecasting product sales. Moreover, the availability of broadband has created greater flexibility and opportunity in the workplace, particularly in the increased use of telecommuting by employees who remain connected to their jobs despite distance and other factors.

In addition to tangible benefits to the economy, broadband has a significant impact on the lives of everyday citizens. For example, high-speed connections to the Internet allow children in rural areas from Alaska to Florida to access the same information as schoolchildren in urban areas, improving their educational opportunities. Telemedicine networks over broadband connections save lives and improve the standard of healthcare in sparsely populated, rural areas. In the future, new and even more exciting applications will be developed that will provide consumers with highly customized, low-cost alternative services delivered in the manner of their choice. It is essential to continue to monitor the progress of the deployment of advanced telecommunications platforms and determine if additional steps are needed to further encourage this growth to all Americans.

Appendix A

List of Parties Filing Comments and Reply Comments in Response to the *Fourth Notice of Inquiry*

Parties Filing Comments

Association of Public Television Stations

AT&T Corp.

California Public Utilities Commission

Comcast Corporation

Corporation for Education Network Initiatives in California

Covad Communications

Current Communications Group, LLC

EchoStar Satellite LLC

General Communication, Inc.

IEEE-USA

Independent Telephone & Telecommunications Alliance

MCI, Inc.

MTCO Communications, Inc.

National Association of Telecommunication Officers and Advisors

National Cable & Telecommunications Association

National Energy Marketers Association

National Exchange Carrier Association, Inc.

National Rural Telecommunications Cooperative

National Telecommunications Cooperative Association

Nortel Networks

Optoelectronics Industry Development Association

Organization for the Promotion and Advancement of Small Telecommunications Companies

Pulse-LINK

Rural Independent Competitive Alliance

Rural Iowa Independent Telephone Association

SBC Communications, Inc.

Schellhardt, Don

SES Americom, Inc.

Sprint Corporation

United Power Line Council

United States Conference of Mayors, National Association of Counties, American Public Works Association, Texas Coalition of Cities for Utility Issues, Mount Hood Cable Regulatory Commission

United States Telecom Association

Verizon

Wireless Communications Association International, Inc.

Parties Filing Reply Comments

AT&T Corp.

City of White Plains

Comcast Corporation

CTIA - The Wireless Association

D'Andrea, Ralph

EchoStar Satellite, LLC

Federal Communications Commission Intergovernmental Advisory Committee

Industry Rights-of-Way Working Group

MCI, Inc.

MTCO Communications, Inc.

National Association of Telecommunications Officers and Advisors and Alliance for Community Media

National Cable & Telecommunications Association

Next G Networks, Inc.

Real Access Alliance

Rural Independent Competitive Alliance

SBC Communications

Schellhardt, Don

SES Americom, Inc.

Telecommunications for the Deaf, Inc.

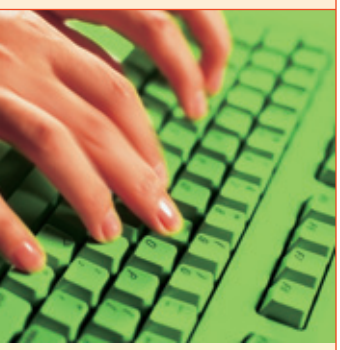
Telecommunications Manufacturer Coalition

Teletruth & New Networks Institute

Town of Colonie, New York

United States Conference of Mayors, National Association of Counties, American Public Works Association, Texas Coalition of Cities for Utility Issues, Montgomery County, Maryland, and Mount Hood Cable Regulatory Commission

The Verizon Telephone Companies



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Appendix B

Fiber Technologies

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