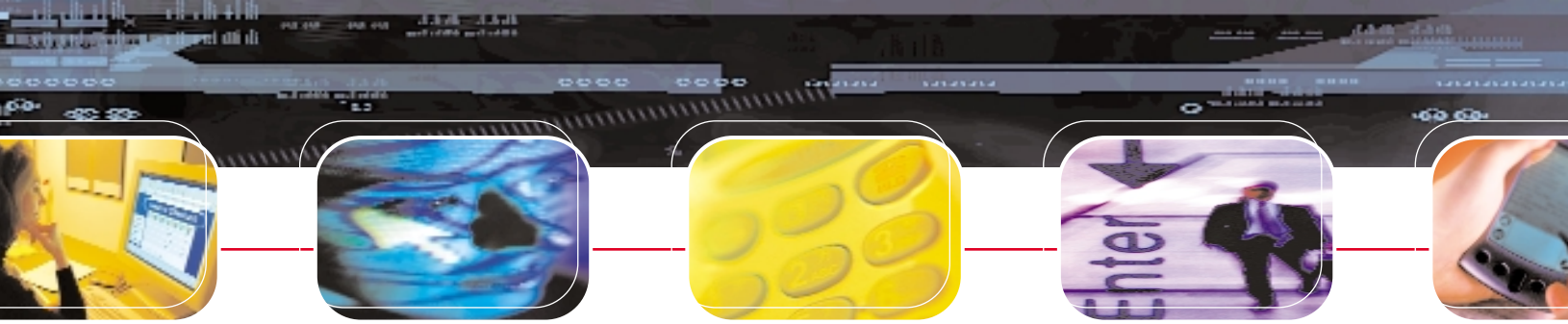
A Vision for 21st Century Wired & Wireless Broadband

building the foundation of

The Networked World



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CSPP

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Executive Summary

The Networked World

As with the advent of the railroads, the creation of our interstate highway system, and the roll out of universal electrical service, the Computer Systems Policy Project (CSPP) believes the promise of the Networked World—where everything and everyone is connected at all times through computer and communications technology—will engender one of the greatest paradigm shifts of the 21st century. While today's information services and communications are largely based on relatively low-speed, wired access to the Internet, tomorrow's will be enabled by seamless interaction among various devices and applications connected via advanced wired and wireless broadband networks.

In CSPP's last report, *Living in the Networked World*[1], we explained how the Networked World would revolutionize the very fabric of our society. Education, health care, government and national security will ultimately be based on entirely new paradigms created by next-generation technologies, enabling societies around the globe to learn from one another and helping people in all corners of the world to achieve a better quality of life.

But we are at a crossroads in this nation. Realizing the enormous potential of this new age will require bold vision and leadership by our policymakers and the business community. The tragic events of September 11, 2001 and our current economic conditions have created a time of unforeseen vulnerability in America. Our nation's challenge will be to rekindle economic growth by fully capitalizing on the new ways of living and working enabled by the Networked World, while protecting our core values and our national security.

A Vision of Speed and Mobility

Building speed and mobility into the foundation of the Networked World will be critical to achieving these goals. Our current national telecommunications infrastructure is not robust enough for the future. While tremendous investment has been made in laying fiber in backbone networks, the typical dial-up modem connection to the Internet remains a bottleneck. In addition, network access speed is not keeping up with advances in computer processing speed (which doubles approximately every 18 months)[2] or the power of innovative applications. Deployment of "last-mile" network connections has slowed. And today's typical digital subscriber line (DSL) and cable modems speeds, at less than 1 Mbps, are not fast enough to realize the full potential of emerging applications.

Additionally, improvements in the management and allocation of this nation's spectrum are necessary. Future generations of devices will roam seamlessly between various radio environments, taking advantage of the lowest cost and highest speed available in a given area, while providing full access to information. By 2004, more users will access the Internet using wireless devices than wired technologies. But without policy changes, the U.S. mobile wireless industry will face a shortage of spectrum in the next three to five years, reducing access to next-generation technologies for millions of consumers and businesses, and jeopardizing U.S. national leadership in electronic commerce.

If we are to take full advantage of the economic, social and security benefits of the Networked World, effective broadband deployment and spectrum management should be a major priority for this country. ***In the past, the two have been bifurcated; CSPP proposes that together, the wired and wireless networks make up the basic platform of a robust Networked World infrastructure and should support future IT applications that can dramatically improve our quality of life. Therefore, in this paper, we outline a vision of a next-generation broadband platform that includes both wired and wireless applications to stimulate investment, create new jobs, and respond to the current need for economic growth and increased security.*** Together, by addressing the challenges of broadband deployment and wireless access, we can ensure the many benefits of the Networked World.

Summary of Findings and Recommendations

Accessible, affordable broadband deployment (both wired and wireless) will bring substantial improvements in the lives of all Americans. Our systems of education, healthcare and business, as well as our public safety and security, can all be enhanced by dramatic developments in technology and its applications.

To fully realize this potential, U.S. policymakers need to look beyond the current debate over deployment of first-generation broadband technology and set ambitious, long-term national goals for our telecommunications infrastructure's speed and mobility. Broadband deployment must be able to support the robust applications of the future. The U.S. government must outline a bold vision to reap the economic and social rewards of the Networked World.

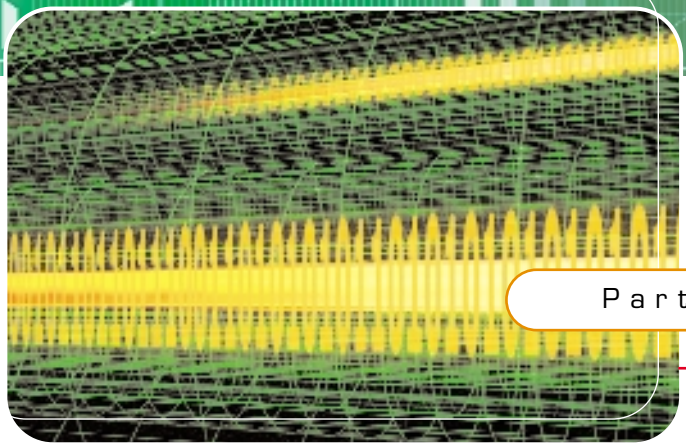
To accomplish this, the Computer Systems Policy Project recommends:

1. **Adopt a National Vision**—The U.S. needs to establish a comprehensive, national vision for the next ten years regarding how to transform the basic foundation of the Networked World—our information infrastructure—into a robust, universally-available network capable of supporting advanced broadband and mobile services.

2. **Enact Regulatory Reform**—Government at all levels should take steps to eliminate barriers to widespread, advanced wired and wireless broadband deployment, including elimination of regulatory burdens, creation of a National Spectrum Management Policy Group, facilitating physical site access for equipment, and creating investment incentives.

3. **Commit to Further Research and Development**—Realizing the next phase of the Information Age will require applications that are in demand by both consumers and businesses alike. The public and private sectors must work together to develop transformative applications that rely on a robust wired and wireless broadband network.

4. **Promote Industry Action**—The information technology industry must also take responsibility for driving development of the 21st Century Networked World Infrastructure by resolving technical issues, creating richer content and encouraging consumer confidence in technology products.



Part I

CSPP's Vision for the Networked World

Introduction

While the Internet and its applications have brought important changes in the way we do business and communicate with one another, there are still dramatic leaps ahead. The fully enabled Networked World of the future will have:

Increased mobility
Greater ubiquity
Higher speeds
Improved applications

… compared to the Internet as we know it today.

Distributed intelligent devices and increased processing capability have allowed government, business and residential users to manipulate, store and process ever-increasing amounts of information. However, to fully optimize this power, the devices of the future must be networked via next-generation broadband. "Connectivity" must be ever-present, mobile and fast to support advanced technologies and take advantage of new applications. For instance, the purchase and download of a standard-length DVD movie over a 56 Kbps modem takes *13 days* but via a Fast Ethernet (100 Mbps), it can be done in *10.4 minutes.*[3]

As CSPP detailed in *Living in the Network World*, we have already developed a "network of networks" architecture that has delivered rich new applications via the Internet. When we last reported, the analog narrowband networks of the past were giving way to the digital "broadband" networks of the future.

Today, however, we have hit a plateau in the Networked World's evolution. The bursting of the dot-com bubble and subsequent economic downturn has slowed the tremendous growth of previous years. Particularly, investment has virtually halted with regard to the "last-mile" deployment to the home. And while investment continues in deployment of wireless technologies that allow consumers to bring the Internet "with them," uncertainty regarding the availability of sufficient spectrum has cast a pale over full-scale deployment. The further loss of consumer confidence resulting from the September 11 terrorist attacks has added to this stagnation. Now, more than ever, the revitalization of the telecom and computer sectors, and new growth for the economy, are dependent on stimulating demand for and investment in next-generation technology products and services. The applications of the future will depend

A Glossary of Wired & Wireless Broadband Terms

3G: Third generation wireless technology, or 3G, is the umbrella term for the technologies that will provide major additional mobile capabilities delivered over licensed spectrum by telecommunications carriers. Such capabilities are expected to include: enhanced multimedia (voice, video, and data); popular modalities (web browsing, paging, telephony, facsimile, and video-conferencing); routing flexibility; always-on capability; high bandwidth; and global roaming. The Universal Mobile Telecommunications Service (or UMTS) is a 3G service. Such 3G services that are being deployed today are just the beginning of advanced technology applications, with generations beyond 3G being developed.

802.11: (Also known as Wireless Ethernet or WiFi.) An infrastructure standard for wireless local area networks. This standard allows for companies to expand market penetration of wireless products while minimizing interoperability problems. While the 802.11 standard is not universally used, it is a leading standard in the wireless local area network market sector.

Bandwidth: The width of a band of electromagnetic frequencies, bandwidth is used to describe the transmission capacity of a network connection. The bandwidth of a data line is expressed in bits per second (bps) or as the range of frequencies along which it can transmit in kilohertz (KHz).

Bluetooth: Bluetooth is a computing and telecommunications industry specification for wireless personal-area networks (WPANs), which describes how mobile phones, computers, and personal digital assistants can easily interconnect with each other and with home and business phones and computers using a short-range wireless connection.

Broadband: While there is no universally accepted definition of "broadband," it is typically used to describe data transmission lines capable of transmitting large amounts of data along various frequencies at high speeds (typically 256 Kbps or higher).

Cable Modem: While high bandwidth coaxial cables historically have been used to transmit cable television signals, cable modems allow these cables to transmit computer data via the Internet.

DSL: Digital Subscriber Lines (DSL) allow the transmission of many forms of data, voice, and video for limited distances over the standard twisted-pair copper wire that is widely used to connect home and business telephone lines to local telephone networks central offices.

WLAN: A wireless local area network (WLAN) uses low-power radios to connect users to local area networks.

on a foundation of robust, fast and mobile networks, but deployment of this infrastructure has stalled.

If this plateau can be surpassed, the benefits will be enormous. The fast and effective deployment of next-generation broadband capability should be seen as fundamental economic policy. Federal Reserve Chairman Alan Greenspan has stated that a large share of U.S. economic gains of the past decade have been due to increased productivity spurred by the Internet and information technology. In the digital age, ubiquitous broadband deployment means more jobs, higher growth, lower inflation, and tremendous new investment that will strengthen our economy for the long-term.

From Railroads to Megabits: The Economic Impact and Opportunity of Broadband

Just as the railroads of the 19th century spurred the development of this great land and highways supported 20th century growth, the telecommunications networks of the 21st century are doing the same. The Internet grew exponentially during the 1990's. According to the Department of Commerce, more than 40 percent of American households now have access to the Internet, while about 45 percent of all Americans have Internet access at home and/or outside the home.[4] But while Internet use and applications have boomed, in an era where data rather than goods are being transported, we must

continue to develop the "tracks" that have been laid in order to reap the rewards of the Networked World.

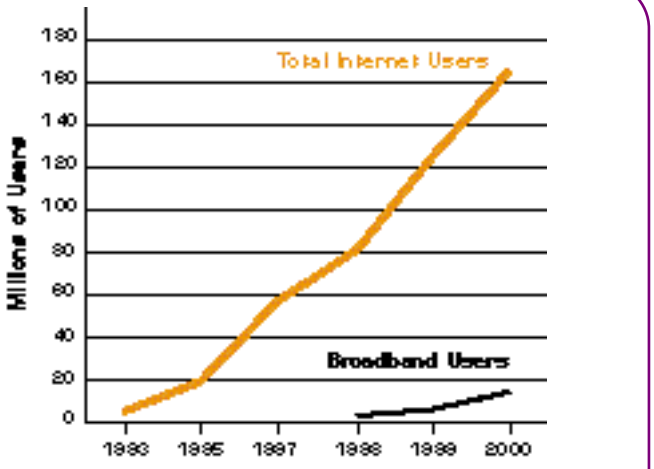
Today, most residential users access the Internet through the same telephone line employed for traditional voice communication. While the highest speed modem used with a traditional telephone line, known as a 56K modem, offers a maximum data transmission rate of about 45,000 bits per second (bps), broadband access will provide the higher delivery volume and speed required by the applications of the future. Since 1992, computing power has increased 4778 percent, allowing users to process enormous amounts of data quickly. In contrast, modems employed by typical Internet users have grown in speed by only 268 percent. ***Therefore, while computing power and speeds have increased tremendously, and will continue to grow, the network responsible for carrying that data has languished and has not kept pace with boosts in processing power.***

To overcome this disparity, continued investment in the 21st Century Networked World Infrastructure is critical. Past experience with substantial improvements in infrastructure such as railroads and interstate highways suggests that the benefits from broadband will be larger than we expect and likely result in a myriad of developments we cannot today anticipate.

For example, electricity transformed manufacturing operations; telephone networks changed the ways in which businesses were organized; and the railroad:

> [a]ppears as the sine non of America [sic] economic growth, the prime force behind the westward movement of agriculture, the rise of the corporation, the rapid growth of modern manufacturing industry, the regional location of industry, the pattern of urbanization, and the structure of interregional trade.[5]

Reaching these milestones and continuing the momentum of rail development has required innovation in all aspects of railroad engineering, including the design of tracks and signaling systems. In 1831, the Mohawk and Hudson celebrated its opening in Albany, New York with a train consisting of three coaches headed by the *DeWitt Clinton*, a 6,758 pound, 11.5 foot locomotive that averaged 15 mph. Today, Amtrak's Acela train reaches speeds up to ten times as fast. Imagine if companies had continued to create faster, more efficient trains but they were limited to an antiquated rail system.

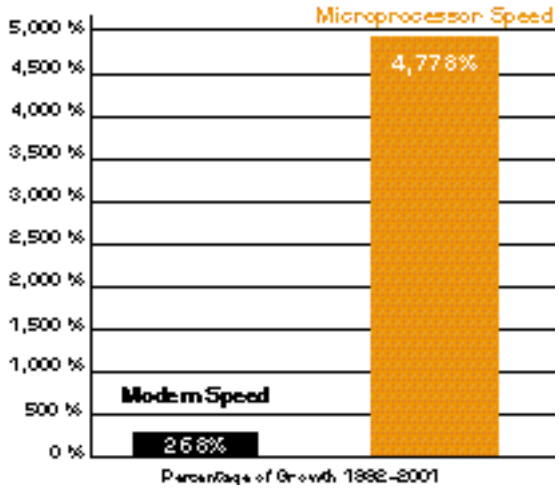


Growth in Internet Use in the United States
1993–2000

SOURCE: Morgan Stanley; NUA Internet Surveys; Neilsen/Net Ratings; IntelliQuest; Federal Communication Commission (FCC).

What good are trains that can travel at 150 miles per hour if they are hindered by tracks that can't support their speed?

Similarly, in 1893, Charles and Frank Duryea of Springfield, Massachusetts built the first gasoline-operated vehicle in the U.S. Their car reached speeds of up to 20 mph. As cars became more popular and technologically advanced and as Henry Ford began to roll-out the Model T, there were few good roads in the United States and little rhyme or reason to their development. In 1925 and again in 1956, the federal government created policies for integrating and expanding the national highway system. Together with the states, it built roads not to accommodate an automobile that would travel 20 mph, but in anticipation of the better, faster cars of the future.



Growth in Modem and Microprocessor Speed
1992–2001

SOURCE: Intel Corporation

In contrast to the creation of the modern rail and highway system, developments in information technology don't take place over a period of years—they occur every few months. Therefore, our plans to support these advances and take advantage of them must have foresight and vision.

The economic benefits alone will be enormous. Even after the dot-com collapse, McKinsey estimates that in 2005 U.S. broadband application revenue could exceed $32 billion annually. This is equivalent to the size of the U.S. broadcast industry.[6] A recent study by Brookings economist Robert Crandall estimates that "the universal adoption of broadband connections by U.S. households could eventually provide benefits to the U.S. economy in the range of $400 billion per year."[7] The same report concluded that the net present value of accelerated broadband deployment could be as much as $500 to $700 billion.[8] But without action to speed deployment, some estimates suggest that current and next-generation broadband capability will not be available nationally until the years 2010 and 2030, respectively.

The U.S. must do better because the benefits from widespread, affordable, next-generation broadband will be significant. The advances in medicine, education, national security, commuting, home entertainment and shopping will bring dramatic improvements to our quality of life. For example, Crandall notes that if broadband technologies improved the efficiency of the retailing/wholesale sector by only a plausible three percent, the annual societal gains would be $58 billion. Similarly, if the increased telecommuting made possible by advanced broadband deployment were to cause even small reduc-

Today's Internet

is equivalent to a

Model T Ford

tions in traffic congestion, this could generate outsized savings. Reducing busy hour traffic by one percent in Atlanta alone would save almost $100 million a year. The potential gains from these and other sectors such as home entertainment, health care, education, and telecommunications are enormous.

In addition to wired broadband deployment, the effective management and use of the nation's spectrum can help fuel U.S. economic growth and global competitiveness by providing multiple services to the largest number of users. Without additional spectrum to put more communications and IT applications into the hands of more end-users, the U.S. cannot maintain and advance its position as a leader of the 21st century global economy. The Council of Economic Advisors has said that telecommunications and the Internet are among the most important sectors of the New Economy. As noted in its October 2000 report, telecommunications represented three percent of GDP in 1998, having grown at a seven percent per year annual rate over the previous 10 years. Wireless carriers employ over 150,000 people in the United States and generate $44 billion in annual revenue. The annual consumer benefit from today's wireless telephone services is estimated at $53-111 billion. The consumer benefits from next-generation wireless services alone will likely be of this order of magnitude.[9]

Conversely, as noted in an economic report by SEBAGO Associates, the inefficient allocation of spectrum, including an absence of international harmonization, carries substantial economic costs. Based on forecasts of wireless carrier revenue from investment banks, employment in the U.S. wireless service provider industry has the potential to more than double over the next eight years—increasing from roughly 184,000 to more than 400,000 by 2008. Jobs in the wireless industry, furthermore, pay wages about

20th Century Applications

Train

Start-up (1831)
15 mph

Fully-Developed (1990)
150 mph

Car

Start-up (1893)
20 mph

Fully-Developed (1960)
60-70 mph

21st Century Infrastructure

Internet

Start-up (1998)
modem speed: 56K

Fully-Developed (2010)
100 Mbps

Comparison of Start-up Technology vs. Fully-Developed Infrastructure

78 percent higher than the national average. By 2008, an estimated 65,000 jobs in the industry—or about one-quarter of the projected potential increase—will be tied to wireless data services.

Without adequate spectrum resources, such potential job growth is unlikely to occur,[10] nor will the U.S. share in the full benefits of the next generations of wireless services over the coming five to ten years. Today, U.S. wireless corporations are pouring their resources into advanced, third generation mobile technology (3G), but they need assurances that enough cost-effective radio spectrum will be available. The movement towards greater bandwidth for wireless technology parallels the need for fast, effective wired broadband rollout and will provide the speed and mobility necessary to make broadband services an integral part of our lives.

Transforming Our Way of Life: Taking Networked Applications to the Next Level

In addition to the economic benefits of building a strong foundation for the Networked World, effective national, next-generation wired and wireless broadband deployment will greatly impact our personal lives, our health and our safety. How will advanced communications be used to improve the performance of our economic, social and cultural systems? What will the next phase of broadband make possible that doesn't currently exist? What will the allocation of additional spectrum, which will provide seamless mobility between environments, mean for new products and services?

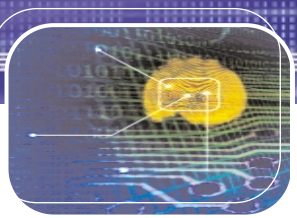
Public Health, Public Safety and Security

The rapid deployment of networked information technologies could help to resolve some of the very serious challenges that face our country and that have been exacerbated in the aftermath of September 11. We are dealing with an antiquated public health care system; a public safety net that is full of technological holes and a security challenge that has no equal in world history. These challenges can be more easily met through the effective deployment of networked information technologies.

Imagine a public health care system that links together every county, state and federal facility so that the study, diagnosis, and treatment of diseases would be accelerated through networked applications and medical databases. Imagine, too, that public safety officials had access to instantaneous emergency response information and could interoperate their equipment no matter which jurisdiction they found themselves in. For instance, through various infection assessment, tracking, and instant reporting tools, healthcare organizations across the country will be able to better respond to and treat bioterrorism epidemics. Utilizing future technologies, our intelligence communities could talk with each other in comprehensive and secure ways, as well as monitor electronically the security of the very network over which they operate.

These broadband and mobile applications would revolutionize the way that government approaches these real world problems. The vast benefits of secure, privately built networks, dedicated in part to the public needs of our citizens cannot be overstated.





Changing the Way We Work and Live

In addition to public health and safety needs, advanced broadband technologies will continue to transform our daily lives if effectively deployed. Among their potential applications are:

E-Business

The impact of a ubiquitous broadband platform on e-business applications will have dramatic implications for both businesses and consumers. New and innovative supply chain management techniques allow for seamless, touchless manufacturing efficiencies that lower costs and speed production, while simultaneously reducing inventory costs. And mobile wireless e-business applications can further enhance worker efficiency, bringing information resources wherever they are needed. A Net Impact study projected that advanced Internet solutions could bring about a 40 percent U.S. productivity increase over the next decade. To date, the deployment of e-business solutions has yielded a cumulative cost savings of $155 billion to U.S. organizations and is expected to produce another $373 billion in cost savings by approximately 2005.[11] There can be little doubt that the development of robust e-markets in every sector of the economy, among firms large and small, will sharply increase the demand for very-high speed networks among businesses.

E-Commerce

High-performance broadband connections will allow a number of key applications that could render the e-commerce experience more appealing to consumers including the integration of telephony, voice recognition and data environments that will make real time customer responses possible as well as pictorial, graphical and transaction displays. With high-bandwidth connections to the home, it will be possible to begin to create an environment that the shopper experiences as being more like a store. Being able to shop via your mobile phone will make the process even more convenient and less location-dependent. Wireless technology will eventually enable you to use your mobile phone to gain pushbutton entry to anything from a cinema to an airport check-in. Virtual tickets will be purchased over the mobile Internet. As you go to a concert or baseball game, your 'ticket' will be instantly validated by a compatible device at the gate.

E-Learning

Increased use of the Internet as a teaching medium has led to the development of new learning techniques and basic approaches to education. Educators are teaching differently—and students are learning more efficiently—as a result of the increased use of Internet-based educational applications. As universal access to broadband services develops, a wide range of learning opportunities will be become more available to all students, regardless of subject or location. It will be possible for colleges and universities to offer numerous on-line courses with richer, more useful teaching materials including appropriate multimedia elements—images, animations, video clips and, simulations. Current-day online course materials look dull and anemic compared to the vivid, robust and interactive materials that next-generation broadband will permit.



E-Health

The emergence of Internet-based heath care applications is leading to new techniques for treatment and approaches to basic medical care that are fundamentally altering the practice of medicine. The Internet is changing the entire face of health care by incorporating new treatment paradigms and health care business models. Broadband has the potential to deliver health care, health education and information over large and small distances by linking health professionals, patients, and researchers with common interests in real time, permitting collaborative diagnosis. In addition, homecare monitoring will become possible, reducing hospital overcrowding and unnecessary trips to your doctor. Broadband enables residents of rural communities to access specialty care. For example, small community hospitals do not often have a large enough caseload to justify a radiologist on staff. Yet, with enough bandwidth, teleradiology allows these rural hospitals to diagnose and treat broken bones (see case study). In addition, wireless LAN technology can improve treatment and reduce medical errors by bringing patient records and medical databases directly to a doctor's PDA right at her patient's bedside.

E-Government

Federal, state and local governments are making increasing use of Internet-based applications to operate more efficiently and productively. This, in turn, is changing the ways in which citizens are able to interact with and participate in government. Government must move quickly to adopt broadband applications and reduce the duplication of services and increase efficiency as a result of sharing resources and expertise offered by government, educational and community organizations and individuals, within communities and across regions. By increasing the level of community services available, residents will have more of an opportunity to participate fully and directly in the democratic processes of governance. E-voting and interactive town hall meetings are simply a few of the ways in which government will benefit from the growth of broadband applications.

E-Appliances

The next few years will see the deployment of massive numbers of Internet "appliances"— mobile phones and a wide range of devices embedded in cars, homes, kitchen appliances, transportation systems, and vending machines that use wireless technology to communicate. For example, this will enable maintenance providers to receive "calls" from appliances to perform preventive repairs before problems occur. With next-generation mobile services, users will be able to send and receive messages that incorporate a mix of text, voice, photos, animations, sound and video clips, providing a much richer user experience. Eventually, many mobile devices will be fitted with their own integral video cam.

E-Location

The new generation of mobile devices will be 'location-aware'— in other words, they'll have the capability to identify your precise physical location (with proper privacy protections), either through in-built Global Positioning System (GPS) in the handset or through a process of 'triangulation' between network base stations.

Case Study: The Impact of Broadband Applications on Health Care Delivery Systems

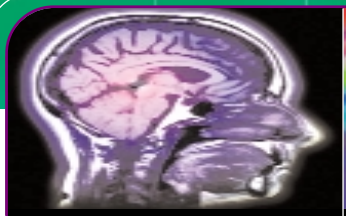
The influence of recent IT-related advances on U.S. health care systems provides a very visible example of the improvements in service, significant cost savings, and increases in productivity that full broadband deployment can generate.

One of the greatest benefits to date of increased IT take-up by the health care industry is the use by hospitals in rural areas of broadband networks to connect local patients with specialists in urban areas. The incorporation of advanced IT applications into the day-to-day practice of medicine is making it possible for patients who live in less populated parts of the country to receive the same high level of care as those who reside in major cities. For example, through state-of-the-art video and data networks, patients are able to consult with specialists from anywhere in the country, while related medical data and images are simultaneously transmitted over the same network. These technologies not only allow participating hospitals to deliver services more economically, but also provide patients with access to high quality specialty medical resources regardless of their location. The same types of systems can be used to enable doctors to hold training and consultation sessions with their colleagues throughout the country, without the need for travel and resulting time away from the hospital. The benefits to patients to be realized through the further deployments of networked information technologies in the health care field truly are immense. Transferring ten MRI studies to a remote location via a 56k dial-up modem takes almost 40 hours. Over a fast Ethernet (100 Mbps) connection, the same task takes only 1.3 minutes.[12]

But the far-reaching changes that broadband will bring to the practice of medicine extend well beyond consultation and training applications. While the concept of "telemedicine" has been around for a while, universal broadband deployment will allow remote surgery applications where robotic devices execute the precise movements of a surgeon who may be hundreds or even thousands of miles away. Originally envisioned as a way to respond to medical trauma on the battlefield or in space, the idea of a "doc-in-a-box" was developed in 1989. In the last two years, however, what was initially viewed as a technology for use only by the military or NASA has come to be viewed as within the realm of possibility for high-tech, day-to-day patient care.

At the same time, the increases in productivity that can result from the expanded use of information technologies can cut costs for the health care industry. A recent survey conducted by Gartner, Inc. to consider the impact of increased IT-related investment by hospitals suggests that health care organizations should view such investments as cost cutting tools that boost business value and improve overall customer access to care.[13] Specific improvements made possible through the use of advanced IT applications included:

- Reliance on computer-based patient records systems to reduce the number of clerical errors;
- The use of health care and medical intranet sites to foster improved procurement and industry management;
- By 2005, increased reliance on enabling technologies (such as speech- and handwriting-recognition technologies and wireless networks) to further increase the productivity of medical professionals.



Time to download **10 MRI Results**	Time to download **One Standard DVD Movie**
Speed with Current Infrastructure (56K)	Speed with Current Infrastructure (56K)
	
40 hours	**13 days**
Speed with Developed Infrastructure (100 MBPS)	Speed with Developed Infrastructure (100 MBPS)
	
1.3 minutes	**10.4 minutes**

The Impact of Speed
on Current Technology Applications

SOURCE: NARUC National Summit on Broadband, 2001

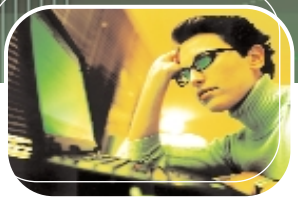
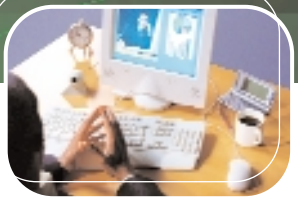
Proprietary applications will use this information to provide you with information that is relevant to your location—for example, an airline service might determine your location two hours prior to departure and send you a voice-instructed map, information about check-in locations, etc.

E-Entertainment

Next-generation applications will provide enhanced high-tech entertainment beyond interactive program guides, such as Interactive TV or iTV. Video-on-demand will be available for delivery to various devices and ultimately will likely include movies, news stories, children's shows, situation comedies, old sporting events, adult films and the like. Additionally, lifelike video games and educational tools will be enjoyed.

The Ins and Outs of Broadband Technologies: Wired and Wireless Services

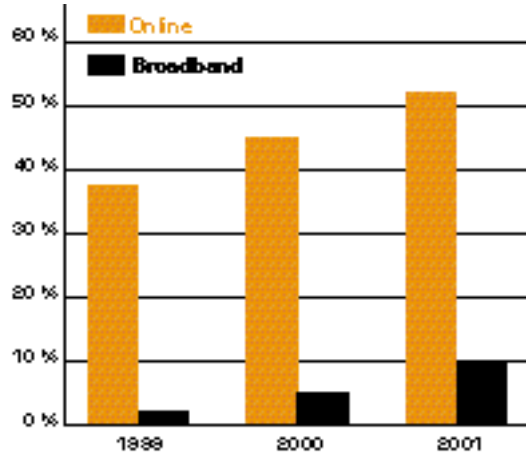
How will all of these developments be enabled and what exactly does "broadband" mean? Broadband, or high-speed Internet access, is provided by a number of technologies that give users the ability to send and receive data at volumes and speeds much greater than current Internet access over traditional telephone lines. As Federal Communications Commission Chairman Michael Powell has recognized, broadband comes in many shapes and sizes. While broadband is most frequently used as a synonym for "fast," broadband is not a speed. It is a medium that offers infinite possible uses and applications for businesses and consumers. Chairman Powell has offered a definition of "broadband" that is very helpful to the discussion. He


describes the functionality of broadband as (1) a digital architecture; (2) the ability to support IP and other multi-layered protocols; (3) an "always on" functionality; and (4) scalability to greater capacity and functionality as new applications emerge.[14]

As the Chairman further noted, one should conceptualize broadband capability as a function that can ride on many different electronic platforms. Thus, we agree that broadband is neither copper, nor fiber, nor coaxial cable, nor, for that matter, air. While it is all of these and more, it is most certainly "higher bandwidth." In 1999, when the Federal Communications Commission issued its report on broadband services, it defined broadband as "having the capability of supporting, in both the provider-to-customer (downstream) and the customer-to-provider (upstream) directions, a speed in excess of 200 kilobits per second (Kbps) in the last mile." This bandwidth size is approximately four times as large as telephone Internet connections over a common 56 Kbps modem. But broadband access also provides a continuous, "always on" connection and a "two-way" capability, the ability to both receive and transmit data at high speeds.

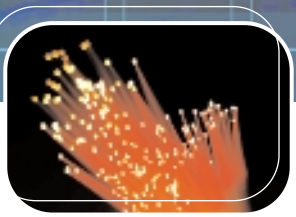
Regardless of the current definitions of broadband, the data transmission methods currently considered broadband will be inadequate to satisfy consumer and business demand for next-generation, valued applications. Speed is critical. Video-on-demand provides a useful example. Advanced services that are capable of providing 200 Kbps transmissions speeds will not be able to provide even television-quality video-on-demand, which requires 750 Kbps or more.[15] To provide streaming video using DVD-quality video, a provider would need to achieve transmission rates of almost 4 Mbps, and high definition video requires 19.8 Mbps.[16] Some experts set the frontier for high-speed access to high-quality, digital, skip-free audio and video as high as 100 Mbps.[17] Deployment of broadband should not only focus on last-mile build out of current DSL and cable modem technology, but also on expanding data transmission rates of broadband to encompass applications such as video-on-demand that consumers and businesses would value.



Online Penetration Trend in U.S. Households
1999–2001

SOURCE: Market Maps, LLC; CENTRIS





A critical mass of high-bandwidth broadband users will be instrumental to the development of innovations and applications that will expand broadband penetration to the mass market. Similar to previous technological advancements involving cable television and personal computers, the lead users will be "first adopters" with the capability to purchase initial "killer apps" and receive data over broadband communications. Experts estimate that 20 million broadband connections are the bare minimum for broadband critical mass,[18] but that goal remains elusive. Penetration and transmission speeds remain inadequate to bring broadband's amazing potential to fruition.

I. Wired: DSL, Fiber and Cable Modems

In part, the data used to measure the progress of broadband deployment do not tell the whole story. For example, pass-by rates might seem to indicate that many consumers and businesses can readily access high-quality broadband technology. According to J.P. Morgan, nearly 45 percent of American households have access to DSL services and 73 percent of households are passed by cable companies that offer cable modem services.

Pass-by rates may indicate a high potential for broadband penetration, but transmission speeds are slow. For example, if a high percentage of the customers in a given cable modem service area subscribed to the services, the transmission rates would fall substantially.[19] In addition, the varied and sometimes low speeds of some DSL lines restrict the willingness of the marketplace to more readily embrace broadband technology. Of the 200 million fixed access lines in the U.S., only half are within the necessary proximity to central offices for optimal data rates of 1.5 Mbps downstream. Furthermore, economic constraints have resulted in some central offices not being sufficiently equipped to provide proper transmission levels. As a result, less than 50 percent of all access lines are capable of receiving DSL at any speed, and an even smaller percentage could receive service at the 1.5 Mbps rate.[20]

Typical downstream speeds for the various technologies are as follows:[21]

- Cable: 500 Kbps - 1 Mbps
- ADSL: 384 - 640 Kbps
- Fixed wireless: 1 - 2 Mbps
- Satellite: 400 Kbps - 1 Mbps

In other words, a competitive environment for next-generation, advanced broadband access is not yet a reality for many U.S. customers. Only one third of U.S. homes can choose between cable and DSL,[22] and with only 16,000, or approximately 0.0056 percent of American homes having fiber optic access to the Internet,[23] the 100 Mbps frontier remains a long way off. Huge stretches of this country have no choice of broadband providers. According to an NTIA/USDA survey, a little under five percent of towns with populations of 10,000 or less have cable modem service as compared to more than 65 percent of all cities with populations greater than 250,000. Likewise, DSL is found primarily in cities with populations above 25,000. Given this data, it is clear that penetration rates are low and that we must address equity of access issues to rural areas of the U.S.

Broadband

is viewed as an important

communications service

Slowing growth in demand is also an issue. Only 12 percent of on-line households currently subscribe to high-speed services—with residential DSL and cable modem users totaling less than nine million subscribers as of June 30, 2001.[24] Between the first and second quarters of 2001, the number of new subscribers dropped precipitously—growth in cable modem users fell from 28 percent to 16 percent, and growth in DSL users fell from 45 percent to 12 percent.[25] Both growth rates fell below recent projections despite evidence that many narrowband users have expressed an interest in broadband service.

One cause for this lack of demand may be price; thus, increased competition between and among providers is important and in the national interest. In some cases, companies face an investment inflection point regarding the decision to deploy fiber and broadband electronics in the last mile. To get from today's world in which less than half of U.S. households can get DSL service at any speed, to a world two years out in which 80 percent could get 1.5 Mbps, will likely require the telephone companies and their competitors to deploy fiber and electronics worth tens of billions of dollars. For example, SBC's Project Pronto requires a $6 billion investment to lay more than 12,000 miles of fiber sheath, equip 1,400 central offices, and install or upgrade 25,000 neighborhood broadband gateways. This program would impact one-third of the country's access lines. Eighty percent of SBC's customers would receive downstream speeds of 1.5 Mbps, with more than fifty percent guaranteed transmission rates of 6.0 Mbps.[26]

According to a report by the National Research Council,[27]

> [current] developments indicate that broadband access is valued by a broad base of Internet users, not just a small group of technology lovers, and that broadband is viewed as an important communications service." The report finds that "with new applications, wider penetration and broadband's use as a convergent platform for multimedia content delivery, much wider demand and use can occur."

II. Spectrum

Freedom to be mobile is a critical element of a fully Networked World. Wireless systems and technologies can be a cost effective last-mile link to the home, provide access to information in a wide area mobile environment or offer very high-speed access in local area "hot spots." The fully realized Networked World will include "Internet to go"—high-speed access to the network whether one is in a car, on a plane, hiking in the mountains, or sailing around the world. It is the lack of spectrum availability that threatens its potential.

All wireless communications travel through air and space on designated frequencies, or wave patterns, in a section of the electromagnetic spectrum known as the radio spectrum. The full electromagnetic spectrum includes much more than that which is used for communications; in fact, it includes everything that travels in waves—from radio signals, to visible light, to extremely high-frequency waves such as gamma and cosmic rays. However, physical properties limit the usefulness of spectrum for various communications to a relatively small segment of this limited resource.

This small segment must be divided between a number of very different services and uses, including commercial services such as

cellular, licensed terrestrial fixed services, and fixed and mobile services delivered via satellite. Wireless services also are provided using spectrum that is not licensed, but which instead is open to multiple users on a shared basis, such as for wireless LANs operating under the 802.11 standards and Bluetooth-enabled devices. In addition to various commercial services, spectrum is used by companies for their internal communications and by local and state governments. Finally, a significant portion of U.S. spectrum is allocated solely for the federal government, which uses it for a variety of national defense and other important purposes.

The Future of Wireless—Challenges and Opportunities

As services develop and evolve, the demand for additional spectrum continues to increase, despite the implementation of ever more efficient technologies. The need for spectrum for commercial services, such as PCS and cellular, which continue to grow at an extraordinary rate and are used by over 120 million Americans, is particularly acute. As these services evolve into the next generation, Americans will enjoy unprecedented access to information. The next generation of commercial mobile services will offer data rates of up to 2 Mbps and will provide the first experience of high-speed mobile access. We will begin to see an integration of these systems with wireless LANS (WLAN) that provide high-speed wireless access in the workplace and at home using unlicensed spectrum to cover localized "hot-spots." While the current 802.11b wireless LAN standard allows for speeds up to 11 Mbps, new 802.11a extended technologies provide 54 Mbps with future versions promising speeds upwards of 100 Mbps. The use of unlicensed spectrum to provide broadband access could be an exciting option in some communities or other areas where these "hot-spots" could be expanded, or a number of them could be established and linked to very-high-speed Internet connections.

Other innovations include wireless personal-area networks (WPAN), which could deliver current WLAN speeds in personal devices such as mobile phones and PDAs. Future products will roam seamlessly between these various radio environments taking advantage of the lowest cost and highest speed available in a given area, while providing full access to information.

One of the greatest challenges we face in taking advantage of these developments is the lack of a comprehensive regulatory structure for managing the spectrum in a way that encourages efficient use and ensures that sufficient spectrum, both licensed and unlicensed, is available to meet the diverse needs of users. The U.S., unlike most other countries, divides the management of spectrum between two agencies. The Federal Communications Commission (FCC) has authority over private sector use for commercial services and by state and local governments, while the National Telecommunications and Information Administration (NTIA) oversees use by federal government agencies, including the Department of Defense (DoD).

This divided spectrum oversight has made it difficult to develop a comprehensive spectrum allocation philosophy and has led to disparate management of the resource. For instance, while numerous steps have been taken to apply market forces to private sector use of spectrum to ensure that it is used as efficiently as is economically possible, no such steps have been taken to encourage efficient use by federal agencies. The spectrum management structure also makes it

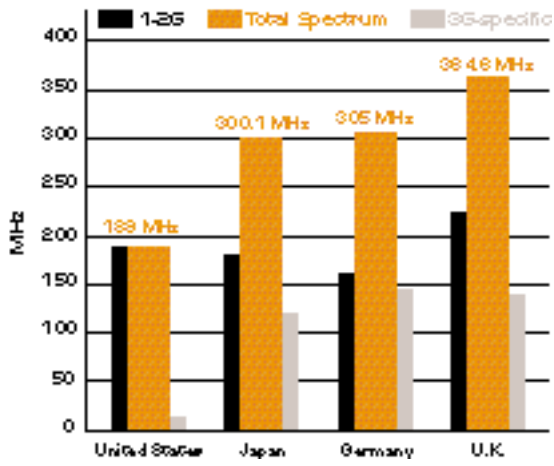
difficult to determine when regulatory changes are warranted that would move spectrum from NTIA to FCC oversight or vice versa. For instance, despite policies requiring government users to use commercial services to meet their communications requirements whenever possible and the continued explosive growth of demand for commercial services, no comprehensive plan has been developed to shift spectrum accordingly.

U.S. Spectrum Policies Compared to the Rest of the World

In addition to the challenges at home, U.S. spectrum policies are out of step with global policies. The U.S. currently lags behind much of the developed world by as much as 33 to 50 percent in the availability of spectrum for commercial mobile services. While other nations have put more spectrum into the marketplace, and are developing forward looking plans to provide stability and growth to the wireless industry, the U.S. struggles to meet spectrum requirements on an ad hoc basis that is driven by industry crises and drives away investment. This results in the American public having a lower grade of services than those in other countries.

Available Commercial Mobile Spectrum

The failure of the United States to align its spectrum allocation goals with global policy and use has negative consequences for industry and consumers. The United States currently represents approximately 15 percent of the global wireless market, and this percentage is decreasing as wireless services are deployed around the world. Failure to align spectrum with global markets increases the cost of equipment by limiting the ability of manufacturers to take advantage of production economies of scale. The most advanced technology development is generally aimed at the largest markets first. Accordingly, smaller markets lag in the availability and variety of products. Delays in introducing advanced wireless products and services can be costly to U.S. firms seeking to provide complementary products and services and to companies wanting to implement wireless e-business solutions to enhance productivity.



Commercial Mobile Spectrum Available in Comparative Countries

SOURCE: Motorola; OECD Report, 2001

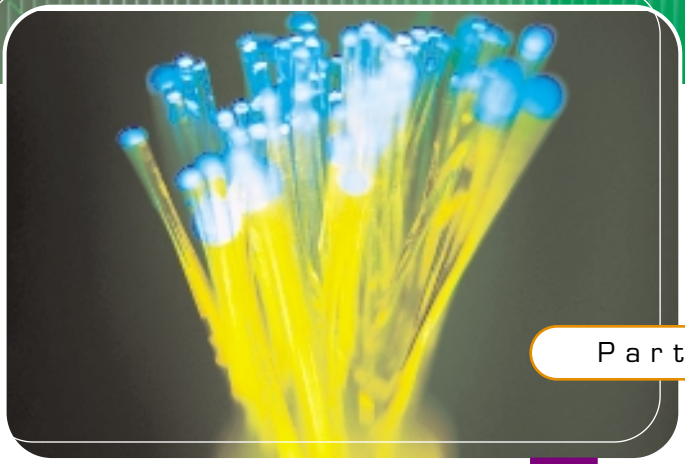
Spectrum Allocation to Encourage Growth

Getting spectrum to those who need it the most, in a way that promotes efficient use and rapid deployment of services is critical to fueling continued economic development. In recent years, changes have occurred worldwide in how spectrum is licensed. As the rate of technological change has increased, countries have sought ways to maximize the economic incentives for licensees to use the spectrum efficiently. As the inherent value of the spectrum resource has become apparent, many governments have also looked to increasing the short-term revenue gain, rather than focusing on longer-term economic policies. This has resulted in two basic mechanisms for licensing spectrum to commercial users—auctions or comparative selections (beauty contests).

A look at recent licensing activity demonstrates the impact that licensing can have on development of an industry. During 2000, European governments alone raised more than €130 billion through auctions for next-generation licenses. However, after the dust had settled, European telecommunications firms realized the mountain of work, and debt, they needed to overcome to successfully unveil 3G. In addition to the licensing fees, experts believe that an additional $150 billion would be needed to build a European-wide infrastructure. Stock prices for virtually all the European telecommunication firms have dropped since the auctions closed, marking the end of long-run economic growth. The amount of money invested in the European bidding wars exceeds the current value of the entire European telecommunications industry. Faced with the realities of the impact of excessive fees on the industry, France recently reduced the fee that each operator will pay for 3G spectrum from $4.6 billion to $570 million, plus one percent of future revenue. Indeed, the aftermath of the European auctions have made it clear that excessive license fees have consequences for all stakeholders.

Lack of certainty regarding availability of additional spectrum in the future puts U.S. operators in a "win-or-die" situation that could drive auction prices in the U.S. even higher than those in Europe. Ways must be found to mitigate the cost of obtaining spectrum (e.g., use of auction revenue to clear encumbered spectrum, tying auction payments to when spectrum is cleared, and accelerated depreciation for wireless licenses). Asian countries have taken a lead in advanced wireless rollout, while keeping a careful eye on the European auction mishaps. Japan began delivering 3G cellular phone services Oct. 1, 2001, with South Korea and Hong Kong not far behind. Hoping to avoid the problems faced by the European markets, Hong Kong decided to allow companies to bid on royalty percentages of future earnings. While auctions can be a fast and efficient way to allocate spectrum to companies best able to use it, the U.S. must take a careful look at its licensing policies to ensure that they promote rather than retard development of services.

In addition to assessing policies for allocating licensed spectrum, the U.S. must also ensure that sufficient unlicensed spectrum is available to support wireless LAN and other applications. The availability of unlicensed spectrum can encourage the development of innovative devices and network access alternatives. For Internet access applications where full mobility and ubiquitous coverage across a large geographic area is not necessary, wireless LANs using unlicensed spectrum could provide a viable broadband access option by providing the opportunity to connect in a number of areas. Portable users who need to stop and log in periodically in different locations might use unlicensed spectrum, and it might also provide the final limited-distance broadband link to a fixed location.



Part II

REACHING THE Full Potential of Next-Generation Broadband

Challenges

A number of factors appear to be thwarting the continued deployment of broadband and wireless technologies and jeopardizing the ability of the U.S. to fully embrace the Networked World. If our nation is to reap the benefits of the next phase of the Information Age, we must work together to address these impediments and develop visionary government policies to overcome these barriers.

For instance, growth in ***consumer and business demand*** for broadband technologies has slowed. Layoffs, stock market drops, and the economic uncertainty following September 11 have caused consumers and business organizations to retrench and reprioritize their discretionary spending. For customers, their perception regarding the return on investment in next-generation technologies remains shaky. According to a study commissioned by the Information Technology Association of America, 32 percent of respondents with dial-up Internet connections felt that it would be too expensive to upgrade to faster service.[28]

As demand for advanced technologies has decreased, so has access to the ***funding*** that made the Internet boom so dramatic. The future growth of a broadband infrastructure will depend on the return of traditional investment sources, as well as the identification of new sources of capital. In a broadband briefing paper, the International Telecommunications Union[29] pointed to the dot-com market crash as a reason that venture capital firms, which normally would have undertaken infrastructure investments, have shied away.

Just as we face challenges at home, ***international competition*** threatens U.S. leadership in the Networked World. Many foreign nations are surpassing the U.S. by aggressively promoting broadband deployment through carefully crafted national policies in an effort to capture the economic and social benefits of this new infrastructure. As a whole, the world broadband market will likely grow 350 percent by 2004. Governments across the world are beginning to step into the fray to encourage deployment within their countries.

Policymakers must

set ambitious goals to drive demand and deployment

According to a recent OECD report, the U.S. ranked fourth worldwide—behind Korea, Canada and Sweden—in the adoption of high-speed Internet access and is falling farther behind every day. Without an aggressive national policy and cooperation with industry, the U.S. will fall out of the "Top 10" countries in terms of service coverage by the year 2005.

While challenges such as stagnant demand and increased international competition cannot be discounted, the most critical impediment to next-generation, mobile, high-speed broadband deployment and adoption is the lack of a strategic, national vision by our government. Policymakers have failed to anticipate the effects of convergence or to recognize the potential impediments of legacy regulation on new broadband investment. Policymakers also have not always pursued technology-neutral approaches to encouraging broadband deployment. ***Government policy*** must make the build-out of the robust 21st Century Networked World Infrastructure a national economic development priority.

Furthermore, we are now at a crossroads where mobile communications and the Internet are merging. By 2004, more people will access the Internet using mobile devices than wired devices. This will allow greater productivity and provide new ways for people to interact. This new, flexible connection will transform the way we live and is a critical component of the Networked World. However, as mobile data rates increase and a host of new services become available, we face a crisis—lack of spectrum and the harmonization of existing and future spectrum with the rest of the world. Unless policy changes are made, the U.S. mobile wireless industry will run out of spectrum in the next three to five years. While government and industry are working to address the immediate need for spectrum, we must also look to the longer term and lay the foundation for the continued growth of mobile services.

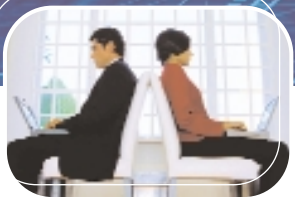
A statement by NTIA provides insight into the far-reaching consequences of U.S. failure to provide sufficient spectrum and leadership in deploying 3G services:

> The Europeans and Asians view 3G development as their opportunity to surpass the United States' previous dominance in telecommunications and electronic commerce. Their lead on 3G and current generation wireless web access has given their manufacturers a significant advantage in shaping the communications technologies of tomorrow, and consequently, is shaping the nature of electronic commerce and Internet content.[30]

CSPP's Recommendations for Action

In order to overcome the challenges that prevent us from fully embracing the Networked World, the U.S. needs to establish a ***national plan*** to transform its information and telecommunications network to ***robust, secure, next-generation broadband capability***. Currently, Congress is enmeshed in a polarizing debate over the deployment of 1st-generation broadband technology. This stalemate has caused the government to focus on the short-term, rather than on a long-term vision of the potential of advanced broadband services.

CSPP believes that policymakers must look beyond the current debate and set ambitious wired and wireless broadband goals to drive demand and deployment. As such, we recommend:



1. National Vision

The President and the Administration should articulate by the end of 2002 a clear, 10-year vision for this nation's wired/wireless infrastructure and adopt them as part of a national strategy for 21st century economic development.

We recommend that the Administration work with the President's Council of Advisors on Science and Technology (PCAST), which has agreed to make infrastructure development a priority, to develop recommendations on how government can support the nation's efforts to reach the following goals:

Speed: By year-end 2003, 80 percent of U.S. homes should be able to get at least 1.5 Mbps capacity and 50 percent of U.S. homes should be able to get 6 Mbps from at least two providers. Further, CSPP proposes that by the end of the decade 100 million homes and small businesses should be able to get up to 100 Mbps affordable broadband capacity.

Mobility: CSPP proposes that the U.S. make available in the marketplace 120 MHz of spectrum by 2004, with another 80 MHz made available by 2010, to be harmonized with global spectrum use to the maximum extent possible. In addition, the U.S. should implement a process to make additional licensed and unlicensed spectrum available beyond 2010 in a way that is consistent with an effective, long-term vision for its management.

2. Regulatory Reform

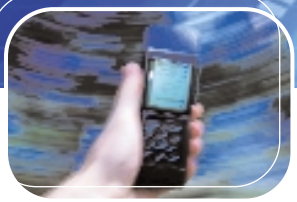
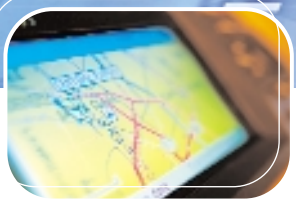
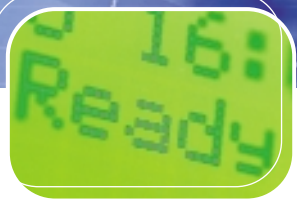
Government at all levels should take steps to eliminate barriers to widespread, advanced, wired and wireless broadband deployment. Action steps include:

- The FCC, state, and local governments, should review all current regulations and work to eliminate barriers to infrastructure investment by the end of 2003. For example:

  —The FCC should expeditiously complete its review of current unbundling and price regulations for last-mile broadband facilities and services.

  —State and local governments should review building and road codes to assure that new "trenching" techniques can be used where appropriate. Installation costs typically represent more than more than 50 percent of the costs of installing new fiber. Innovative ways of laying fiber that are permitted in Europe are not permitted in the U.S.

- The Administration should convene in the next six months an interagency National Spectrum Management Policy Group that has the authority to coordinate between the agencies currently involved in the management of spectrum and that will consult with industry organizations such as the PCAST to determine goals for the long-term management of all spectrum.

This group should work with the NTIA, the FCC and the DoD over the following year to inventory all spectrum bands and evaluate the current intensity of spectrum usage within their respective jurisdictions. The agencies should then adopt by the end of 2003 a comprehensive spectrum management plan covering both federal government and non-federal government spectrum in a way that embraces next-generation technologies.

- Government and the industry should work together to minimize the difficulties that providers face in securing adequate sites and facilitate carriers' access to public rights of ways. This will spur deployment and help U.S. companies keep pace with, or surpass, foreign competition.

  For instance, the FCC or NTIA should review local and federal rights of way practices and develop a list of "best known practices." Many companies, both new entrants and competitors, have raised concerns that in some cases rights of way are not available at reasonable cost and on a timely basis.

- Congress should adopt incentives such as a rural broadband tax credit to increase investment in the infrastructure at all levels.

- Congress should also establish strong federal policies that permit the fastest possible build-out of the Networked World Infrastructure, such as granting the FCC the statutory authority to develop a long-term plan to speed the availability of analog broadcast television spectrum to other uses as the industry transitions to digital broadcast.

3. Research and Development

Realizing the next phase of the Information Age will require continued innovation and technologies that are in demand by both consumers and businesses alike. As such:

- The public and private sectors should invest money in applications that can transform the public health, safety and security networks, as well as lead to increased demand for next-generation products, necessitating a robust infrastructure.

- Industry and government should continue to invest in research and development to boost the speed, mobility and security of the 21st Century Networked World Infrastructure. We propose that the President look to the PCAST to make recommendations on what areas of broadband research and development should be given priority in his fiscal year 2004 budget.

- In addition, both the public and private sector should stay committed to funding programs in information science that help educate the next generation of IT researchers.

4. Industry Action

The information technology industry must also take responsibility for driving development of the 21st Century Networked World Infrastructure. Specifically:

Realizing this enormous potential

will require bold

vision and leadership

- The industry should continue to commit to ease-of-use in its products for consumers and businesses. Industry leaders should work together to address issues of interoperability and interconnectivity of networks to ensure that users can more easily communicate with others.

- The industry should continue to develop richer content that exceeds consumer expectations and drives demand.

- The high-tech industry should be responsive to government partnerships that may provide ways for deploying broadband technologies. One successful example is the use of the *CSPP Networked World Readiness Guide* by various local, state and federal entities, which has helped communities take advantage of information technology applications.

- The industry must continue to work to strengthen the security of networks and information technology infrastructure. The more secure delivery of information will boost consumer confidence and motivate a significant percentage of the marketplace to more quickly adopt new technologies.

- High-tech industry leaders must commit to resolving copyright issues and as such, should continue efforts in the Copyright Protection Technology Working Group to develop a digital rights management strategy that protects content, consumer choice and technological innovation.

Conclusion

The companies of CSPP believe in the promise of the Networked World and the benefits it will bring to people all over the world. As outlined in this paper, education, health care, business and government can be based on entirely new paradigms created by next-generation technologies, enabling societies across the globe to learn from one another and giving people in all corners of the world a better quality of life.

Realizing the enormous potential of this emerging age will require bold vision and leadership. It requires new national goals and objectives, which we have outlined in this paper, and the will to meet them. CSPP stands ready to work with policymakers and the business community to fully capitalize on the new ways of living and working enabled by the Networked World.

Endnotes

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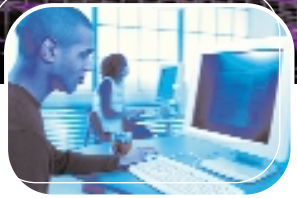
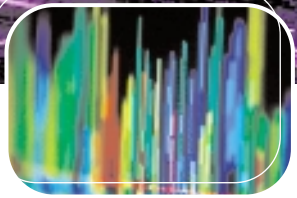
30 NTIA website at http://www.ntia.doc.gov/ntiahome/threeg/3gintro.html





ABOUT CSPP

The Computer Systems Policy Project (CSPP), a public policy advocacy group, is comprised of Chairmen and Chief Executive Officers from America's leading information technology companies. CSPP has a proud history of providing visionary thoughts and recommendations on policies with a transformative impact upon our society. One year ago, the organization unveiled its vision of the next phase of the Information Age in our Report: *Living In a Networked World*. That paper followed previous reports including our 1993 Report *Perspectives on the National Information Infrastructure, CSPP's Vision and Recommendations for Action.*

Michael S. Dell, Chairman and Chief Executive Officer of Dell Computer Corporation, serves as CSPP's Chairman. Ken Kay is the organization's Executive Director. Currently, CSPP is focused on public policy issues including export controls, international trade, digital rights management, privacy and Networked World infrastructure and access.

Founded in 1989, CSPP's members include:

Michael S. Dell, Chairman and Chief Executive Officer of Dell Computer Corporation (Chair of CSPP)

Michael D. Capellas, Chairman and Chief Executive Officer of Compaq Computer Corporation

Carleton S. Fiorina, President, Chairman, and Chief Executive Officer of Hewlett-Packard Company

Christopher B. Galvin, Chairman and Chief Executive Officer of Motorola (Co-Chair of CSPP Networked World Committee)

Louis V. Gerstner, Jr., Chairman and Chief Executive Officer of International Business Machines Corporation

Andrew S. Grove, Chairman of Intel Corporation

Lars Nyberg, Chairman and Chief Executive Officer of NCR Corporation (Co-Chair of CSPP Networked World Committee)

Joseph Tucci, Chairman and Chief Executive Officer of EMC Corporation

Lawrence A. Weinbach, President and Chief Executive Officer of Unisys Corporation

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www.cspp.org

CSPP • 1341 G Street NW • Suite 1100 • Washington, DC 20005