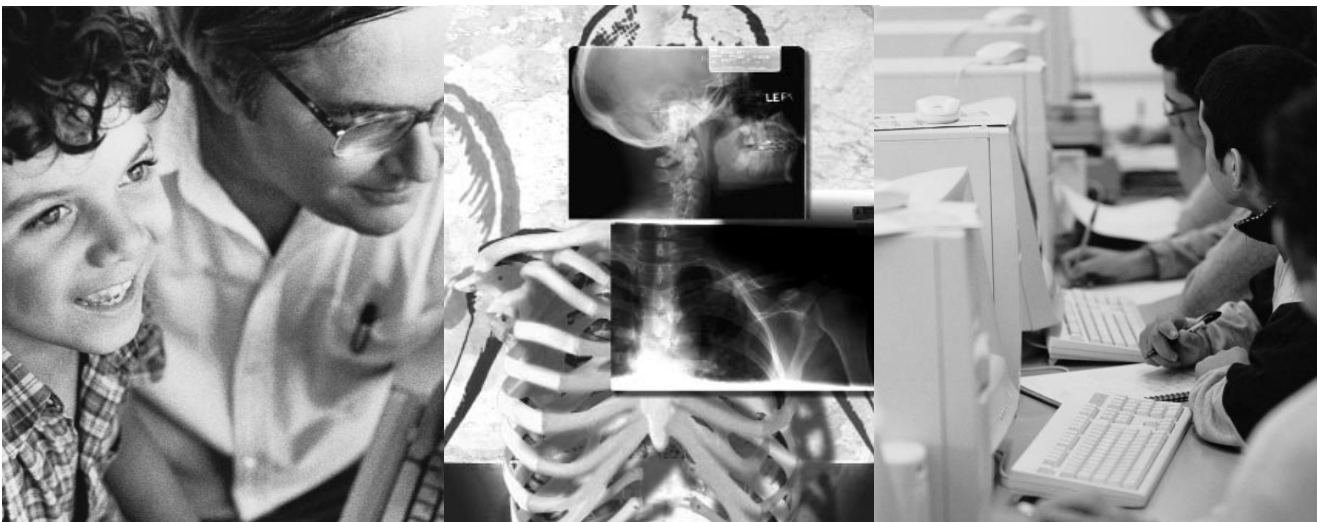


One Gigabit or Bust™

Killer Apps—Proving the Need for One Gigabit



February 25, 2003 • San Diego Supercomputer Center • University of California, San Diego

About CENIC and the NGI Roundtable

CENIC is a not-for-profit corporation serving California Institute of Technology, California State University, Stanford University, University of California, University of Southern California, California Community Colleges and the statewide K–12 school system. CENIC’s mission is to facilitate and coordinate the development, deployment and operation of a set of robust multitiered advanced network services for this research and education community.

CENIC’s NGI Roundtable addresses critical technical, policy, economic and implementation challenges facing the delivery of one gigabit broadband to all Californians by 2010. The NGI Roundtable brings together the interests of research, education, commerce, state and local government, and the general public to address the issues surrounding the implementation of robust end-to-end broadband capabilities to every educational institution, business and home in California.

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Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the State of California.

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Introduction

On February 25, 2003, CENIC hosted its second NGI Roundtable Workshop, “Killer Apps—Proving the Need for One Gigabit,” at the San Diego Super-computer Center at the University of California, San Diego campus. The NGI Roundtable event drew a multidisciplinary group of thought leaders representing views from both the private and public sector, including industry, government and academia.

The 42 attendees took part in the one-day event to collaborate and discuss breakthrough applications that demand high bandwidth and will spur the development of one gigabit broadband throughout California by 2010. These high bandwidth applications are key to fulfilling CENIC’s challenge of delivering one gigabit broadband to all Californians by 2010, a project also known as One Gigabit or Bust™.

The NGI Roundtable event drew a multidisciplinary group of thought leaders representing views from both the private and public sector, including industry, government and academia.

During the workshop, CENIC asked participants four discussion questions and divided them into synergistic groups to determine potential answers.

Attendees examined the following questions:

- Given one gigabit to every home and business in California *and* human nature, how can we build a better world?
- How do we develop human potential as rapidly as we develop technological potential? How can the institutions of today’s society adapt quickly enough?
- How do we convince/mitigate the Luddites who claim that we don’t need one gigabit?
- How do we evolve from today’s world?

The resulting discussions and suggestions for high bandwidth applications, as well as additional research, are represented in this paper. This paper examines current and potential applications from community development, education, entertainment, healthcare, national and local security, research and transportation sectors that are only possible through a ubiquitous gigabit Internet.

Executive Summary

Deploying advanced broadband networks is critical for California and the nation. Without the ongoing development of broadband, especially gigabit networks complemented by wireless broadband, the U.S. is in danger of losing its place as a technological leader.

CENIC has expressed support of advanced networks through its One Gigabit or Bust initiative, and it is not alone in its broadband quest. A number of elite, influential groups have also publicized their belief that efforts to expand broadband must be increased.

One advocacy group, The Computer Systems Policy Project (CSPP) has stated, "To reach the full potential of the Networked World, the members of CSPP urge lawmakers to adopt a bold national vision for the 21st century infrastructure and call on all levels of government to take steps to eliminate barriers to advanced broadband deployment." The group forecasts that by the end of 2010, 100 million homes and small businesses should be offered 100 megabit service.¹

The IEEE has stated that U.S. national productivity, homeland security and international competitiveness may well depend on the deployment of broadband ... capable of gigabit speeds.

TechNet, another high profile association of high tech CEOs, also called on President Bush and policy makers to make broadband a national priority and set a goal of making affordable 100 megabit broadband connections available to 100 million American homes and small businesses by 2010.²

In addition, both the National Research Council and the IEEE advised the government to take active steps to promote increased or accelerated broadband deployment, including at the public level. Specifically,

the IEEE has stated that U.S. national productivity, homeland security and international competitiveness may well depend on the deployment of broadband in the form of Ethernet networks over fiber infrastructures capable of gigabit speeds.³

From inception, CENIC has encouraged the development of advanced services networks. Having established these networks in university and research environments, CENIC would like to see the general public, schools and businesses experience the rewards of high bandwidth networks.

Invariably skeptics pose the question, "What would the public do with one gigabit?" While most current applications do not test broadband networks, present-day small pipes along the last mile stymie developers. Gigabit networks can unleash our collective imagination and encourage all manner of "what if" scenarios.

This paper describes current and proposed bandwidth intensive applications that demand gigabit networks. The applications proposed here are relevant to seven sectors: community development, education, entertainment, healthcare, research, national and local security and transportation.

The onset of advanced, communication-rich networks and the multilayered applications that run on them promise to break conventional boundaries and propel our world to a true Information Age.

However, to reach the next development stage, we must overcome a number of technical, financial and social barriers. The NGI Roundtable Workshop attendees identified key obstacles that are preventing California from reaching its potential as a global technology leader and proposed the next steps for achieving one gigabit networks by 2010.

Defining One Gigabit

Achieving CENIC's vision of One Gigabit or Bust, which would increase the functionality and performance of the nation's wireline and wireless information infrastructure, holds enormous potential for continued U.S. economic growth. One Gigabit or Bust will accelerate the pace of innovation and development in California and unleash unlimited prospects for new and exciting applications. With these stakes in mind, it's important to clarify what one gigabit is—and is not.

One gigabit is not a technology. It is not a transmission speed. It is not merely high bandwidth. It is not about capacity. One gigabit is about the capabilities that the capacity enables.

One gigabit is:

- enriching and broadening students' learning environments
- increasing teachers' professional development opportunities
- increasing the number of credentialed teachers
- reducing damages during and after man-made and natural disasters
- creating safer communities
- advancing medical care
- exposing critical research to a broad audience
- creating compelling entertainment
- introducing new business development opportunities
- triggering more active community development through civic participation
- diminishing environmental damages caused by overcrowded highway infrastructure

One gigabit is about transforming our personal, professional and civic lives. It is about giving each person and every home the capacity to be an information producer and information user. When each California home, business and school achieves one gigabit, the new information-centric, constantly connected world will surpass our wildest dreams improving everyone's quality of life—not just the educated or affluent.

One gigabit is about transforming our personal, professional and civic lives. It is about giving each person and every home the capacity to be an information producer and information user.

One gigabit will reduce routine tasks, giving us more quality time in our personal and professional lives. Like the Internet, one gigabit will allow us to do whatever we do better, faster and more effectively.

Already, practical and valuable applications are taking advantage of one gigabit networks. For the most part, these applications are confined to academia and research communities. CENIC strives to broaden the reach of these existing applications, as well as enable new applications, throughout California so that all segments of the population can reap the benefits of a broadband world.

Applications Prove the Demand

It is important to note that applications discussed under the Healthcare and Research headings in this paper are already in use. These early examples of large image libraries and rich multimedia reveal the benefits of combining advanced networks and bandwidth-heavy applications. The example noted under the Education heading, the University of California College Prep Initiative, is also already in place. Supplementing this initiative with one gigabit and additional mediacentric applications would greatly increase the program's ability to prepare California students for higher learning.

Education

Distance Learning

The University of California College Prep Initiative (UCCP) provides online college preparatory courses to students attending high schools with few or no Advanced Placement (AP) programs.⁴ In many California school districts, rural and low-income students have limited opportunities to enroll in AP, pre-AP or Honor courses due to lack of funding or a limited number of qualified teachers. Through UCCP, students can enroll at no charge in high quality, media-rich, online college preparatory courses. The online courses are vital to the success of students competing for admission to leading universities.

Dependent on the bandwidth and breadth of CENIC's CalREN, UCCP uses online courses, CD-ROMs and textbooks to deliver AP, honor and pre-AP classes to 220 schools in 55 of California's 59 counties. Technology leaders Cisco Systems and IBM have also contributed their expertise to UCCP. Cisco developed an e-learning engine for the development and management of course materials. And students use the University of California gateways program developed by IBM to register, login and access their courses.

The efforts of these companies and UCCP have increased the number of students enrolled in college preparation courses. Since the launch of UCCP in 1998, student participation has grown from 44 students in the spring of 1999, to 2,869 in the fall of 2002.

According to an early report from the nonprofit research agency WestEd, which analyzed UCCP's

activity, a proportionately greater number of smaller and more rural schools are using UCCP. And, WestEd concluded there were "clear benefits" for students in average performing schools and "some benefits" for students in low performing schools.⁵

Early examples of large image libraries and rich multimedia reveal the benefits of combining advanced networks and bandwidth-heavy applications.

But all is not smooth sailing for UCCP. According to WestEd, technology-related problems presented a considerable concern to almost every participating UCCP school. Log-in difficulties and slow Internet connections were the most prevalent problems. These problems, along with others, caused great frustration among students and caused many to fall behind in their coursework or drop their courses altogether.

One gigabit connectivity would alleviate technological frustrations and allow curriculum creators to add more bandwidth-intensive applications. The addition of video applications, 3-D environments and more real-time interactions between student and teachers would enrich students' learning environment and amplify UCCP's success rates.

If One Gigabit or Bust prevails, the learning environment will be greatly enriched, most likely raising UCCP enrollment and leveling the playing field so that more students across California can enter leading universities.

Professional Development

Hiring credentialed teachers is an ongoing problem for California schools. After the "No Child Left Behind Act of 2001," California has struggled to increase the number of credentialed teachers to stay within federal mandates. Hiring credentialed teachers in the state's low income and rural districts has been especially difficult. An effective distance learning application is one means to raise the number of credentialed teachers in rural areas.

Driving distances to professional development centers and conflicting schedules may be barriers preventing these teachers from gaining their credentials. Online study could give teachers the flexibility to access their coursework when it is convenient for their schedules. And rather than driving miles to a university or college for classes, teachers could gain credentials online from their homes or schools.

California's rural areas present excellent testbed opportunities for gigabit connectivity and online virtual learning centers that would combine video, data and voice to offer career enhancement courses to teachers. But in order for these virtual learning centers to be successful, online course applications must be more powerful and immediate. Teachers will need real-time, bidirectional interaction with their professors and peers. Current chat software is useful, but interaction must be more immediate and meaningful. As in a real classroom, participants must be able to see and hear each other, and voice inflection, facial expressions, and physical characteristics must be accurately portrayed during online exchanges.

Gigabit networks combined with rich online professional development courses could encourage more

Gigabit networks combined with rich online professional development courses could encourage more California teachers to seek credentials in much-needed areas.

California teachers to seek credentials in these much-needed areas. NGI Roundtable participants agree that California schools must strive for excellence because if our population is not educated, the state will lose potential business opportunities from companies seeking a literate workforce.

Healthcare

California Orthopaedic Research Network (CORN)

Launched in 2002, CORN encourages lifelong learning among orthopaedic surgeons and demonstrates the medical potential of advanced networks.

CORN participants at the University of Southern California, Stanford University, University of California Los Angeles and University of California San Diego access a variety of bandwidth intensive applications for education, research and day-to-day interaction. These applications include streaming video for viewing surgery in real time, access to large multimedia image collections, and the use of haptics to add the sense of touch to remote interactions.⁶

Examples of CORN's successes include:

- The Visible Human Project makes available high-resolution, cross-sectional images of the male and female human body. These images are used for teaching anatomy and for research on visualization and modeling.
- Videoconferencing supports research collaborations between researchers in California, Wisconsin and Sweden.
- Multicast streaming video broadcasts lectures, surgical demonstrations and conference presentations, as well as live surgical procedures streamed from a UCLA operating room.
- Faster downloads of multimedia library images provide rotating views of dissections.
- A combination of robotics and telecommunication links enables physical interaction between doctors over large distances for education and surgical care.

CORN's initial accomplishments have led to increasing engagement in the uses of high-performance networking throughout the telemedicine, telerobotics and other medical research communities. With this growing interest, CORN will extend its network, renaming it Western Orthopaedic Research Network (WestORN). The expanded network will include California plus 13 additional western states, Canada and Mexico. Further expansion to Argentina, Bolivia, Brazil, Chile, Peru and Uruguay will follow in the coming months.

CORN's early success is transferable to other specialties and proves the demand for pervasive gigabit connectivity in healthcare. Creating similar high bandwidth applications for other specialties, as well as general practitioners, would enable lifelong learning and improved patient care.

National and Local Security

In April, as part of a new alert system, the San Jose police began sending email to neighborhoods, churches and businesses when a significant crime or suspicious activity occurred in their area. These emails alert interested citizens and groups about potential local security threats. Following the example of the state's—and now the nation's—Amber Alert, which broadcasts missing children reports across electronic freeway signs, San Jose police want to disseminate important, potentially life-saving, information quickly to a broad audience.

With email and electronic freeway signs already spreading essential information, a gigabit network and a multilayered, real-time, security information-centric application that is accessible to the general population would provide an even greater awareness when danger lurks in a community.

A similar type of application would also be appropriate for larger scale disasters that endanger the nation. However, such an integrated disaster response system for the home, community, region and state demands a ubiquitous gigabit network.

At the community level, a disaster response system would enable command centers to share information among response units and provide full information to individual homes. The system would include automated information abstraction for communicating “up the chain” at each organizational level. Through this system, every home would be able to see “the big picture” both for decision-making, as well as to regulate expectations. This disaster response system would be in a sense a “disaster channel” analogous to the Weather Channel—but much more robust.

The disaster response system would also provide real-time forecasts during disaster recovery. Coupling an accurate geologic mapping database, such as the United States Geological Survey database, with the disaster response system would be useful for community disaster planning, including determining proper, safe land use and zoning.

Community Development

Gigabit networks hold the promise of a more inclusive community government that will shape a region's economic development to align more closely with the population it serves. This type of community networking requires civic decision-making and dispute resolution tools to create a social-decision support system available to the entire population.

Ubiquitous broadband networks would enable such tools and at the same time increase citizen participation. Instead of a few community-minded individuals determining long-term economic development initiatives, a community network would increase involvement by raising awareness and including more individuals.

At their best, community-networking initiatives are diversely partnered efforts that share in the long-term risks and rewards facing contemporary society. Partnerships may include local and county governments; school districts; community colleges and universities; libraries; chambers of commerce and businesses; neighborhood associations; manufacturing, agriculture and environmental groups; nonprofits and other civic organizations. Community networking in the

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broadband era can offer real opportunities to foster integrated public-private cooperation, lifelong learning, distributed scientific research, greater civic participation, new economic venturing and cultural and environmental well-being.

Enabling collaboration should build more sustainable twenty-first century communities. However, a

number of high bandwidth applications will be needed to facilitate the exchange of information among different groups and individuals. Participants will require: multiuser, convergent media discussions; synchronous high resolution video transmission; GIS mapping and planning; healthcare monitoring, imaging and diagnosis; creative art and entertainment production/distribution; bandwidth intensive business and science research transactions; international

Traffic snarls cause unknown hours of lost productivity for businesses, as well as harm the environment. These problems could be alleviated with a regional traffic scheduling application that is available to all business personnel and individuals.

community-to-community exchanges; and eventually real-time, real-world decision-support simulations.

Transportation

Southern California's overcrowded traffic conditions are nationally recognized. Traffic snarls cause unknown hours of lost productivity for businesses, as well as harm the environment. These problems could be alleviated with a regional traffic scheduling application that is available to all business personnel and individuals.

A traffic support system could contain up-to-date information of all participants' planned travel. By combining mapping technology and analytical tools, the system would alert travelers, in real time, of the least crowded roads and the best times to drive to work, run to the grocery store or shop at the mall. The dynamic support system would provide up-to-date transportation information and maps so that individuals could better schedule their daily activities.

Combining this roadway traffic application with public transportation schedules and routes could greatly reduce the stress on California's overwhelmed highway infrastructure. Gigabit connectivity would be key to providing access to all California drivers and allowing the transfer of real-time traffic modeling images.

Ubiquitous gigabit networks would also reduce traffic problems by taking cars off the road. With broadband to the home, more businesses would encourage their staff to telecommute and work from home. Schools could offer more distance learning opportunities, minimizing the need for students to drive to classes. Plus a gigabit network could encourage more home-based businesses.

Research

The Biomedical Informatics Research Network (BIRN)

The Biomedical Informatics Research Network (BIRN) is a National Center for Research Resources initiative aimed at creating a testbed that addresses biomedical researchers' need to access and analyze data at a variety of levels of aggregation located at diverse sites throughout the country.⁷

Four university research departments take advantage of BIRN's advanced networking resources. The Center for In Vivo Microscopy at Duke University, the Laboratory of Neuro Imaging at UCLA, the MRI Center at Caltech, and the National Center for Microscopy and Imaging Research at UCSD combine their efforts and work together to do research on mice with Experimental Allergic Encephalomyelitis (EAE), a disorder that has similar characteristics to the human disease multiple sclerosis.

Researchers compare observations of mice with EAE obtained through magnetic resonance imaging (MRI), and other noninvasive techniques, to computer models of the disease based on tissue samples, then correlate the data with similar data from humans who manifest multiple sclerosis.

Since many experimental approaches and techniques dealing with molecular and cellular correlates of diseases, or the testing of therapeutic strategies, can only be carried out by using computer models of the disease, linking data from the computer models to human data is a powerful way to relate the two.

Thanks to the high-speed network connections among the university research sites, various images can be rapidly incorporated into a set of federated databases, from which contents of the data can be selected and inspected. The data can be analyzed in a common coordinate space, and the scientists can discuss and agree on the representation of new data in each experiment, with the broader perspective conferred by the whole enterprise.

National Digital Mammography Archive (NDMA)

Funded by the National Library of Medicine under the Bio-Medical Applications for the Next Generation Internet program, the National Digital Mammography Archive (NDMA) synchronizes nationwide databases from hospitals at research universities including University of Pennsylvania, University of Chicago, University of North Carolina and University of Toronto to achieve digital storage, search and retrieval of mammography archives.

At 160 megabytes per exam, the annual volume could exceed 5.6 petabytes per year, and the minimal daily traffic per day is expected to be 28 terabytes.

NDMA is a working testbed to demonstrate the feasibility of combining a national breast imaging archive with network infrastructure to support digital mammography using technology from Internet2, a consortium of 200 universities. NDMA aims to improve access and performance of breast cancer screening by providing an imaging archive that supports storage, retrieval and distribution of breast images for clinical and research purposes, and ensuring privacy and confidentiality with multilevel security embedded throughout the system.

Research of this magnitude demands gigabit networks because images are very large, ranging from 120 megabytes to 200 megabytes per study. The volume of data per breast center site will exceed

capacity for management or storage given these factors:

- There are 58 million women needing mammograms in the U.S. With a targeted 60 percent compliance, there would be 35 million screening exams per year.
- At 160 megabytes per exam, the annual volume could exceed 5.6 petabytes per year, and the minimal daily traffic per day is expected to be 28 terabytes.

Other factors also demand a high-bandwidth network. First, the scheduling of traffic for archiving current exams and prefetching prior studies requires a quality-of-service not available on conventional networks. Second, accommodating unscheduled exams and instant access to expert consultation requires network bandwidth not available on standard Internet. In addition, all transmissions of images and information containing individually identifiable patient data must be encrypted across public networks.

Additional data intensive research applications⁸ include:

- Alma
- Griphyn
- Neptune
- Genomes to Life
- Sloan Digital Sky Survey
- Neon
- LHC
- Atlas
- Lygo
- NEES
- OptiPuter
- NCMIR
- GEON: Geoscience Data Sets
- JuxtaView
- Lake Tahoe tidal wave threat analysis

Entertainment

Video-on-demand, HDTV and multiplayer online games are bandwidth intensive applications that are of great interest to consumers and entertainment companies.

When combined with pervasive gigabit networks, the demand for these entertainment applications could explode because multiplayer online games have a viral component that will continue to expand the subscriber base as more people sign-up to play. While video-on-demand coupled with gigabit networks will offer the entertainment industry another distribution channel, HDTV will provide an interactive element and shopping component that supplies advertisers with another sales channel and e-commerce opportunities.

Revenue sharing and digital copyright concerns have prevented the industry from presenting these offerings to the market—even though the public has shown significant interest in purchasing similar applications. Ubiquitous broadband, coupled with copyright regulations and standards, could spark the development of multiple segments of new businesses to support new channels, and lead to new jobs and additional revenue for California.

Most Requested Application: Videoconferencing

Advanced videoconferencing capabilities are a recurring theme among CENIC's technology futurists. Next-generation videoconferencing is the foremost application requested to make many of these proposed One Gigabit or Bust scenarios truly successful.

Members from every sector at CENIC's NGI Roundtable agreed that next-generation platforms would benefit greatly from videoconferencing technology, but the technology must be much more advanced than current offerings, which are plagued by jerky motions, poor resolution and network delay.

Some of the quality issues could be eliminated with gigabit connectivity. The application is extremely bandwidth intensive. Very high quality, low latency video uses 30 megabits. Immersive video, which allows multiple parties to see one another, has even higher bandwidth requirements. Ten parties in an immersive videoconference, for example, require 300 megabits. And if the videoconference demands high definition resolution, the bandwidth requirement is significantly higher than 30 megabits.

Because of today's limited broadband networks, videoconferencing is the least useful communication tool available. A phone call or email is much more

effective than video, yet video has the promise to overtake all communication methods. To make interactions effective—between teachers and students, doctors and patients, researcher and researcher, gamer and gamer—the interaction must become more immediate.

For videoconferencing to reach its full potential, the technology will need gigabit connectivity and enhanced capabilities. More personalization must be added, especially for education. Research shows that students are more prone to learn if they feel emotionally involved with their teacher and peers. Facial expressions and voice inflections, essential in personal interactions, must be captured and reproduced. Participants want to see hair color and make eye contact. The quality must be as good, or better, than TV.

For videoconferencing to reach its full potential, the technology will need gigabit connectivity and enhanced capabilities.

In addition, videoconferencing must become interactive and support bidirectional communication between all participants rather than only one group transmitting information. Participants are more apt to learn and pay attention if they can submerge themselves into a seamless environment.

One new application that may add these capabilities to videoconferencing is Tele-Immersion, which is being researched at Brown University, University of North Carolina at Chapel Hill and University of Pennsylvania.⁹ Tele-Immersion will enable users at geographically distributed sites to collaborate in real time in a shared, simulated environment as if they were in the same physical room.

The technology is the ultimate synthesis of computer vision, networking and graphics. It involves the real time scanning of a scene, the transmission of the scan with minimal latency, and the scan's rendering at a remote site.

Existing Barriers

After discussing potential broadband applications, NGI Roundtable attendees were asked to name obstacles that are delaying one gigabit connectivity. The broad scope of the resulting list revealed the incredible amount of work needed to reach the goal of One Gigabit or Bust. Clearing these obstacles in the coming years will be key to achieving one gigabit connectivity by 2010.

The public's willingness to accept status quo. Resisting change is a common human condition. Most people willingly accept their current, familiar conditions and design workarounds rather than make an effort to confront and resolve difficulties. Workarounds and making do with today's broadband limitations are daily activities for most people.

The public must be made aware of the benefits of gigabit connectivity and shown how advanced communication services can improve their personal and professional lives. Once citizens are gigabit believers they may be willing to support taxes for broadband development and elect officials who endorse broadband initiatives.

Government regulations. For the most part, the government has treated the Internet as an unlegislated frontier and left regulations and control to market forces. Ironically, the lack of regulation has been the Internet's greatest asset, as well as a recurring encumbrance. In some cases the lack of regulation stalled broadband development because there was no precedent to follow. And in other cases, long-standing regulations restricted broadband's advancement by applying old legislation to modern questions. To overcome these problems, the government must take a more active role in introducing legislation that encourages the ongoing advancement of gigabit networks.

The speed at which technology is advancing. Industry's inability to absorb technology quickly into current business channels is slowing mass adoption. Technology moves at such a fast pace that businesses cannot stay abreast of its advancements. Introducing new technology to employees and business partners takes too much time and requires an incredible amount of resources. The business community needs support and aid to stay abreast with technology's progress.

Elected officials. Elected officials could be valuable advocates of one gigabit if they were better educated on the benefits. Many are unaware that ubiquitous broadband could stimulate the economy by creating new business opportunities and improve citizens' daily lives. Exposing elected officials to the advantages of a state with gigabit connectivity and gaining their support would have a considerable impact on attaining one gigabit connectivity by 2010.

Consumer privacy. Consumers are wary that sharing personal information will lead to government or business invading their privacy. Medical histories, political affiliations and buying habits are all electronically recorded. When considering making these types of personal data readily available, or sharing them with the government or business partners, many privacy groups are concerned that the information

Exposing officials to the advantages of a state with gigabit connectivity and gaining their support would have a considerable impact on reaching one gigabit connectivity by 2010.

would be abused. The laws regarding how consumer information can be used are widely debated and will require further legislation to establish consumer privacy.

Digital rights, trademark laws and copyright laws. Napster's legal difficulties cast a glaring light on the need to protect artists' and entertainment houses' rights to their original material. Until regulations are approved and technologies designed that protect creators and content owners from abuse of material and lost revenue, the Internet will not be a successful distribution channel for videos, music, books, etc.

Next Steps

To close the day, NGI Roundtable attendees were asked to prioritize three next steps that would move their sector toward achieving one gigabit by 2010. The participants broke into five groups representing community development, entertainment and private sector; education; health and research; national and local security; and transportation. Each of the smaller, self-selected groups collaborated together to define three next steps that their sector(s) should take to bring about ubiquitous one gigabit.

Community Development/Entertainment/Private Sector

1. Develop mechanisms to consolidate application demand across multiple industry segments.
2. Explore the possibility of a sin tax that goes exclusively to broadband infrastructure development.
3. Create a secure environment that protects ownership of digital property.

Education

1. Assess the impact of current programs utilizing high speed networking in order to demonstrate return on investment. This assessment will put a value on technology for the nontechnologist.
2. Educate public, government and academia so that everyone has a better understanding of current accomplishments. Define a set of best practices clarifying what works now and what does not. Showcase the successes of high-speed networking with a statewide success story road rally that would explain the benefits of one gigabit and incite others to pursue one gigabit.
3. Break down the multiyear approval process for curriculum in the public school system.

National and Local Security

1. Connect emergency managers to CENIC by identifying participants, obtaining executive sponsorship, determining cost and obtaining funding.
2. Launch a pilot project of broadband wireless to first responders by obtaining executive sponsorship, selecting pilot communities, determining cost, identifying funding sources and obtaining funding.
3. Create more secure networks by researching selected topics areas, analyzing potential attack

scenarios such as Denial of Service, determining cost and finding funding, and creating fail-safe and auto reconfiguration technologies.

Health and Research

1. Increase research in privacy and confidentiality issues, and make privacy and confidentiality compatible with high performance network applications.
2. Change the privacy and confidentiality laws to allow freedom of networking for information.
3. Follow the lead of GE and other companies and make data accessible to each consumer, owner or patient.

Transportation

1. Raise awareness among elected officials of the potential for improving the quality of life in Southern California.
2. Reduce energy dependence on foreign oil.
3. Systematically enhance distance learning. Advance distance learning to be more personalized and interactive.

A Call to Action

With each group's next steps in mind, CENIC composed a set of action items designed to help propel California toward one gigabit connectivity by 2010. The action items were drawn from the five groups' lists, as well as suggestions that arose during the course of the day's discussion. CENIC may use these action items as potential topics for upcoming NGI Roundtable Workshops, as counsel when acting in an advisory role, and as concepts for future CENIC projects.

Taking a grassroots approach that encompasses multiple tactics for educating the public and private sectors, and gaining bottom-to-top support headlined the attendees' agenda for advancing one gigabit.

Other suggested solutions that would lead to gigabit connectivity include:

- Engage and support early adopters who share the one gigabit vision
- Find champions that will help promote the advantages of one gigabit
- Gain taxpayer buy-in so that the public will support a tax to deploy broadband networks
- Provide "What's in it for me?" stories and examples that explain one gigabit benefits
- Build and encourage multisector partnerships at the public and private levels and at the local, state and federal levels
- Identify and fund gigabit network pilot projects that utilize bandwidth-intensive applications and prove the value of gigabit connectivity
- Endorse a national security or global security mandate that utilizes gigabit connectivity
- Set standards and compliance laws that protect consumer privacy and confidentiality while still giving adequate access to consumer data
- Educate elected officials about the value of one gigabit capabilities
- Create new standards for faster wireless protocols for last-mile wireless connectivity
- Gain FCC approval for additional radio spectrum that will lead to wireless last mile connectivity
- Develop bidirectional, highly personalized, immediate videoconferencing capabilities
- Protect the ownership of digital property through digital rights, copyright and trademark laws
- Encourage every individual to be an information provider and provide them with the necessary tools to create and disseminate information
- Deploy free network access stations in public, easy-to-reach locations
- Provide individuals with multiple choices so that they can use and access the network through tools that suit their unique preferences

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