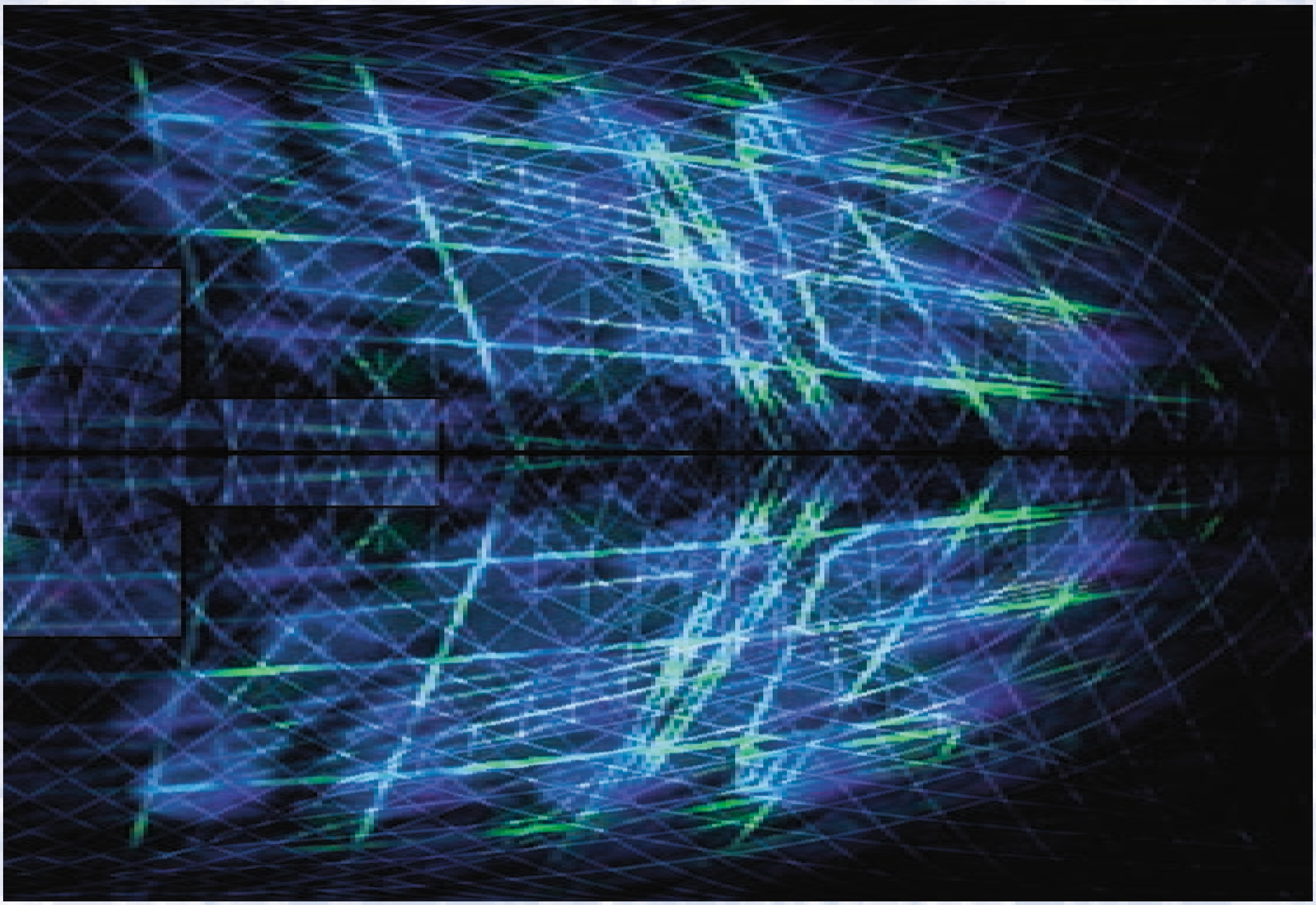
ONE GIGABIT OR BUST™ INITIATIVE

A BROADBAND VISION FOR CALIFORNIA



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Gartner and CENIC thank the CENIC Next Generation Internet Steering Committee members as well as the project interviewees for taking the time to express their opinions and concerns.

CENIC also acknowledges the ongoing support it receives from the California Technology, Trade and Commerce Agency.

Report Objectives

This report has been commissioned by the Corporation for Education Network Initiatives in California (CENIC). CENIC is a not-for-profit corporation that serves the networking needs of all of California's educational entities, from K–12 to the research universities.

The State of California has awarded a grant to CENIC to focus on speeding one-gigabit broadband to all Californians by 2010, or, in California shorthand, One Gigabit or Bust™. CENIC engaged Gartner to evaluate the economic potential of an acceleration of next generation broadband deployment in California. In addition, Gartner was asked to interview many of the top broadband thinkers, policy makers and consumer advocates within California and throughout the United States with a view toward understanding the opportunities and challenges a next generation broadband initiative in California might face.

The specific objectives of this report are to:

- Estimate the economic benefit to the state
- Scope the project in terms of what needs to be done
- Outline the important items to be considered in strategy formalization
- Identify the next steps to be undertaken

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The abbreviated version of this report is titled *One Gigabit or Bust Initiative — A Broadband Vision for California Summary Report*, and can be downloaded or read online at http://www.cenic.org, or a hard copy can be requested via e-mail to editor@cenic.org.

A Call to Action

Deploying advanced broadband networks is critical for California—and the nation.

California is on the threshold of a multibillion-dollar opportunity. A $376-billion upside in gross state product (GSP) by 2010 is made possible with the implementation of a focused One Gigabit or Bust broadband initiative. Moreover, 2 million new jobs could be created.

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 makes possible.

Only 20 years ago, the average business desktop to computing device required a mere 9.6 kilobits per second (Kbps) of bandwidth. Today the average business desktop is networked using 100 megabits per second (Mbps)—an exponential increase of 10^5 the power. If we apply a similar increase to the U.S. Federal Communications Commission (FCC) definition of today's broadband at 200 Kbps, we'll require a speed of 20 gigabits within 20 years. Consequently, one gigabit broadband to every education institution, business and home by 2010 is a realistic goal.

Ironically, some of the biggest supporters of next generation broadband could become the greatest obstacles to its deployment. During the report interview process, Gartner repeatedly found conflicts of objectives among the various parties. Each group is a proponent of next generation broadband deployment, but only on its terms.

One Gigabit is not a technology. One Gigabit is about the capabilities that the capacity makes possible.

Gartner asserts that given key players' duplicity in motives, it will be impossible to deploy ubiquitous next generation broadband without both exceptionally strong leadership and commitment to a common goal.

It is Gartner's recommendation that CENIC's Next Generation Internet (NGI) Roundtable take on the responsibility for bringing together the leaders of broadband initiatives to form a leadership team that will focus on the One Gigabit by 2010 goal and establish an action plan.

The NGI Roundtable should be inclusive: government, private industry, consumer advocates, education and research and service/application providers all are entities that must commit themselves to the task.

California has the most to gain from action and the most to lose from inaction.

Today, high technology, entertainment, biotechnology, agriculture, health care and many more industries call California home. California has the most to gain from action and the most to lose from inaction. Other states and countries will welcome those industries and are taking steps to attract them.

Now is the time to choose California's future.

A. Executive Summary

This report has been commissioned by the Corporation for Education Network Initiatives in California (CENIC). CENIC's Next Generation Internet (NGI) Roundtable is catalyzing a statewide intellectual hotbed and first-of-a-kind technology test bed for solutions to speed the deployment of ubiquitous one gigabit (one billion bits per second) in the "first mile." The goal of one gigabit represents more than a thousand-fold increase from today's commercial Digital Subscriber Line (DSL) and cable data networks.

CENIC asked Gartner to evaluate the economic potential of an acceleration of broadband deployment in California and to interview many of the top broadband thinkers and participants within the State and the nation to understand the opportunities and challenges a broadband initiative might face.

The economic analysis of the potential impact of a next generation broadband initiative in California was based on a positive correlation between GDP and teledensity that was observed by the International Telecommunications Union (ITU). Although the original ITU study was based on narrowband communication (the dominant communication at the time), Gartner believes that the new productivity tools enabled by a broadband infrastructure can generate an increased level of economic activity.

Gartner analyzed a baseline forecast of the rise in Gross State Product (GSP) with a level of penetration of broadband increasing from 10 percent per capita to approximately 20 percent per capita over a 10-year forecast period (2000-2010). A second analysis evaluated a 50 percent per capita penetration of broadband over the 10 years stimulated by a broadband initiative. The result was a potential increase of $376 billion in California's (GSP) and a potential increase of two million jobs.

At the culmination of the interview process, several things were apparent to the Gartner team. There is no common definition of broadband or the characteristics of broadband. Second, many interviewees were unsure of the need for a gigabit of bandwidth in the absence of an obvious "killer application." Closely related to the issue of the "killer app" was the question of who should pay—private industry, government or the consumer? Finally, while many were dissatisfied with the lack of progress in the deployment of today's broadband, there was no consensus on who should lead a next generation broadband initiative.

During the interviews, Gartner repeatedly found conflicting objectives by the various parties that would potentially benefit from the deployment of next generation broadband. Each group was a proponent of next generation broadband but only on their terms. Because of this, a next generation broadband initiative will require exceptionally strong leadership.

Key obstacles were identified that must be addressed in order to achieve the Gigabit goal, including:

- Lower the cost per bit of data in the distribution and core of the network
- Solutions for cost-effective "First Mile" connectivity
- Solutions for digital rights management
- Address the inequities of the digital divide

Gartner has identified the lack of leadership as the largest roadblock on the path to ubiquitous next generation broadband.

The interviews also allowed us to test what Gartner refers to as the mythological obstacles facing a next generation broadband initiative. Perhaps the biggest of these was the quest for the "Killer Application." Very few people could see one specific application that would justify investment in next generation broadband (although entertainment clearly required large quantities of bandwidth). We submit that next generation broadband must be viewed as a new communications platform. It is the layers of applications of voice, video and data that are enabled that form the "killer applications."

Other myths included: waiting for a new technology solution (which presumably would be cheaper), the existence of a glut of bandwidth and the need to wait for funding.

Gartner has identified the lack of leadership as the largest roadblock on the path to ubiquitous next generation broadband. If California is to realize the potential economic stimulus that next generation broadband can contribute, it must have leadership that can:

- Understand the interests of all stakeholders and forge a common goal
- Understand the complex technology issues that must be resolved, knowing which must be addressed and those that are red herrings
- Develop partnerships and collaboration between stakeholders
- Navigate the treacherous political waters and survive the boom-or-bust funding cycles

Although concerns about funding are valid, Gartner submits that they can be overcome with creativity. This report outlines several actions that should be spearheaded as part of the next generation broadband initiative that can improve broadband deployment without opening government purse strings. They include:

- Establish standards and guidelines for next generation broadband infrastructure deployment to all new residential housing
- Encourage collaborative efforts of the State, counties and municipalities
- Establish a clearinghouse for best practices in today's broadband deployment
- Create "regulatory free" zones to entice investment by incumbents
- Participate in finding a solution to intellectual property issues
- Encourage the ability for next generation broadband to be a substitute for basic telephony service
- Encourage and sponsor research that lowers the cost per bit achieved
- Participate in research to validate enhanced personal communications as the "Killer App"

Gartner recommends that the NGI Roundtable begin the process of defining the goal for next generation broadband deployment and establishing an action plan. The steps themselves are not unique or unknown; however, following them in the context of a specific statewide initiative will be unique. California has all of the components of a successful initiative; however, reaching consensus on the goal and driving toward it will take a determined team. The process (which is discussed in more detail in Section I. Next Steps) would include the following steps:

- Development of a specific definition of next generation broadband and a timeline for deployment
- Identification of a leader or leadership team
- Construction of implementation scenarios
- Development of specific costs associated with the scenarios
- Coordination of regulatory policy between federal, state and local entities
- Public and private partnerships
- Development of consumer technology literacy standards, programs and education
- Demand aggregation
- Formation of commercial test beds

And for specifically targeted rural and lower economic areas:

- Tax credits
- Deployment grants
- Education programs
- Dutch auctions to provide services
- Universal broadband service funding

This report outlines several actions that should be spearheaded as part of the next generation broadband initiative that can improve broadband deployment without opening government purse strings.

B. Introduction

Many questions prevail regarding the economic benefits of broadband; what broadband is, or should be; what are the goals in the deployment of broadband; what are the actual obstacles preventing the deployment of broadband; and, what should we do next? The lack of consensus in the answers to these questions has become a roadblock to the deployment of broadband as people postpone action or take inappropriate action.

One of the major goals of CENIC is to “facilitate and coordinate the development, deployment and operation of a set of seamless and robust intercampus communications services.” Pursuant to that goal, CENIC recently launched its Next Generation Internet (NGI) initiative to address the issues surrounding the implementation of broadband capabilities to every educational institution, business and home in California.

Success of the NGI One Gigabit or Bust™ initiative is dependent upon bringing together the common interests of a wide range of users and industry participants, many of whom have diverse views and objectives.

The Methodology

In an effort to create a platform for exploring potential solutions in the deployment of broadband in California, CENIC asked Gartner to undertake two tasks. The first was to evaluate the economic potential of an acceleration of broadband deployment in California. This analysis was to be based on a correlation of GDP and broadband utilization developed by Gartner. The second task was to interview many of the top broadband thinkers and participants within the State and the nation to understand the opportunities and challenges a broadband initiative might face.

One of the major goals of CENIC is to “facilitate and coordinate the development, deployment and operation of a set of seamless and robust intercampus communications services.”

The overall objective [of this study] is to provide decision makers with accurate and timely information about the potential economic benefits of implementing One Gigabit

For the first task, Gartner evaluated the analysis that it constructed and made appropriate modifications for California.

For the second task, Gartner created three interview teams to explore the current social, political and technological issues and challenges to broadband deployment, and to assess impacts. One set of interviews focused on the technology issues, another on public policy and economic issues and the third on the regulatory environment. Table 1 shows the interview teams, the types of interviews conducted and with whom, and broad topics covered during the interviews. *(See Attachment B for a list of interviewees.)*

Specific Study Objectives

The overall objective is to provide decision makers with accurate and timely information about the potential economic benefits of implementing One Gigabit as well as the key issues and how resources should be organized.

The specific objectives of the initial effort are to:

- Scope the project (high level) in terms of what needs to be done
- Outline the important items to be included in strategy formalization

Table 1. Stakeholder Interviews

Key Issues Reviewed	Key Interviews
Team 1. Regulatory Issues	
Current California regulatory environment	CPUC commissioners / advisors / senior staff
Rulings / legislation and case studies pertinent to the Next Generation Internet (NGI) project	Academia, legislators / advisors, industry associations
Assess regulatory and policy agendas	Industry participants (telecom, cable, wireless)
Evaluate benefits, issues, key barriers relative to NGI project	Consumer advocates and public policy advisors
Team 2. Policy Issues / Economic Impact	
Review / assess economic models / case studies	Economists, policy leaders
Evaluate opportunities relative to NGI project	Industry participants (telecom, cable, wireless)
Assess specific growth opportunities	Industry leaders (healthcare, finance, education)
Equity issues and solutions	Leaders from urban / rural development groups
Team 3. Technology and Competitive Environment	
Current communications environment	Technology leaders, academia
Current competitive environment	Industry participants
Comparative broadband projects	Leaders of broadband initiatives in other regions
Current and future user needs / requirements	
Technology and business trends	
Leadership models	

- Estimate the economic benefit to the State
- Identify the next steps to be undertaken

Gartner was selected to assist in the task due to our extensive knowledge and experience gained from having assisted many clients through similar processes with successful outcomes.

C. The Broadband Opportunity

Telephony and cable[1] deployments are now effectively at saturation, with both industries eyeing each other for potential expansion. Voice revenue, with a $425 billion worldwide market in 2002 (of which nearly $160 billion was generated in the United States), is experiencing aggressive competition from competitive service providers and cellular phone providers. California's share of this market is more than 10 percent. Satellite and cable system "overbuilders" are successfully competing for a share of the $50 billion in total North American cable revenue. While these revenue opportunities are impressive, they do not even begin to capture the revenue potential of moving to the next stage of the Information Age that can be accomplished through a next generation broadband initiative.

At the same time, convergence of technologies is allowing users to access and exchange information and content in ways that were not possible before. Industries such as media and communications that once had clearly defined boundaries are seeing business models converge and perhaps collide as technologies change the possibilities. Change is painful and absent a clear solution, many companies will choose to defend the current business model rather than exploit new opportunities.

In the midst of these pressures, we find that traditional regulatory and policy goals and objectives are increasingly becoming irrelevant after having achieved their goals of near-ubiquitous deployment of quality basic telephony services. At the same time, we find high-speed data services have become *the* growth opportunity for wire-line service providers (the local phone companies and cable companies).

The key question for all stakeholders has become "What are the goals and objectives for the deployment of next generation broadband services?"

Definitions of Broadband—Today's and Next Generation

Lately, broadband has become a generic term representing high-speed data services. It is quickly becoming an adjective rather than a noun. There is now much confusion regarding the definition of broadband. The commonly accepted characteristics are its "high"—at least compared to a modem—downstream speed (the speed in which information is sent to a user) and its "always on" connectivity attributes. We do not find broadband defined by its upstream speed, performance capabilities or the capabilities it enables. We believe these glaring omissions render the current definition irrelevant.

Recently, people have also begun suggesting broadband deployment as a goal. But its incomplete definition makes you wonder, "How do you know when you have achieved broadband nirvana? Is it like a higher plane of enlightenment—you know it when you get there?"

In the interviews, Gartner asked "What do you consider broadband to be?" Although the study's interviewees certainly agreed broadband should be high-speed and always on, the interviews revealed a wide difference of opinion as to the specifics of what broadband is or should be. Based on our interviews, we assert there is a fundamental need to expand the definition of broadband to reflect a useful speed target, symmetry in the upstream and downstream bandwidth, and Service-Level Objectives (SLOs).

Gartner also found near unanimity when we asked interviewees, "What should be the goal for the deployment of broadband?" Nearly everyone reported it should be equitably if not ubiquitously available, regardless of race, economic level, geographic boundaries or other discriminatory barriers.

It is interesting to note that although many people have no idea what broadband is, they feel that it should be available to every person in California. Let's first look at what people think next generation broadband should be and then at the issue of ubiquitous availability.

Today's Broadband

The Federal Communications Commission (FCC) established the most common definition for broadband as the term "advanced telecommunications capability" to describe services and facilities with an upstream (customer-to-provider) and downstream (provider-to-customer) transmission speed exceeding 200 kilobits per second (Kbps). The FCC uses the term "high-speed" for those services with more than 200 Kbps capability in at least one direction. The term "high-speed services" includes advanced telecommunications capability." In other words, "high-speed" is anything with a speed of more than 200 Kbps in a single direction. Although the FCC didn't directly define broadband, the service providers have used the term in marketing services such as DSL and cable to the extent that broadband has evolved to become synonymous with the term "high-speed."

The FCC standard speed of 200 Kbps was selected due to its being fast "enough to provide the most popular applications, including Web-browsing at the same speed as one can flip the pages of a book." Although possibly relevant at an earlier time, this conservative definition does not come close to approaching the functional requirements of next generation broadband. Table 2 shows the incremental content capability of a data stream into the home as the data rate increases. Compact-disk-quality music requires one full Megabit per second—or five times high-speed's 200kbps. Basic streaming broadcast quality video requires 1.5M. Higher quality video requires even greater bandwidth.

Table 2. Broadband Capabilities

Speed	Functionality
100 Kbps	Fast Internet and e-mail, games, voice
1 Mbps	Music
1.5 Mbps	Broadcast-quality MPEG II video
10 Mbps	One (limited) HDTV channel and two basic channels
50 Mbps	Full HDTV support; off-site computing storage

Source: Gartner Dataquest, June 2002

Next Generation Broadband—One Gigabit per Second

"It's not about capacity. It's about the capabilities made available by the capacity."
—Nitin Shah, Chief Strategy Officer, ArrayComm

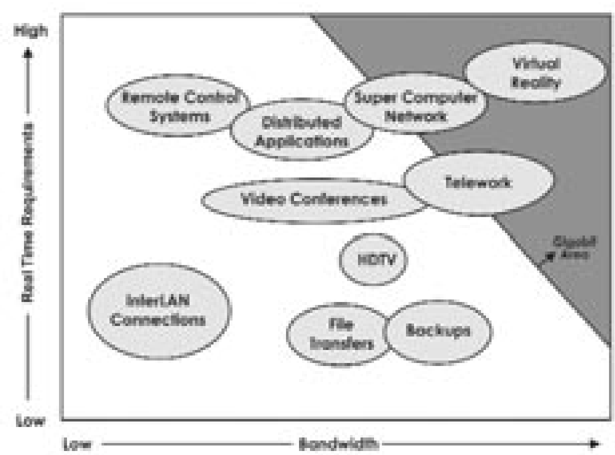
A goal of one Gigabit modeled on historical growth patterns is modest. Only 20 years ago, the average business desktop-computing device required a mere 9.6 Kbps of bandwidth (the average home computing device was virtually non-existent). Today the average business desktop is networked using 100 Mbps—an exponential increase of over 10^5 power. A similar increase applied to the FCC's 200 Kbps broadband standard results in an anticipated speed of 20 Gigabits within 20 years. The historical evolution of bandwidth requirements supports the Gigabit goal.

In today's world of interactivity, Gartner advocates that true broadband does not begin until the network can deliver sustained 10-Mbps symmetrical data rates to the home, and requires at least 50 Mbps to deliver on its full promise of today's known applications. But that defines today's world. To meet the goals of a visionary next generation broadband, 50 Mbps is not enough. Gartner asserts one Gigabit per second (Gigabit) of throughput per home will be required to support next generation broadband applications.

Based on this logic, we believe a Gigabit will be required to support applications that include: the use of network appliances that use the network for storage and application hosting; multiple-party voice/video and data chat sessions; massive multi-party online learning, telework and gaming; and hundreds of device connections within the home. At a minimum, one Gigabit will be required for emerging applications such as holographic image projection for use in virtual meetings, telemedicine and distance learning.

For these reasons, as well as the need to make next generation broadband infrastructure investments lasting and meaningful, Gartner asserts the speed of next generation broadband can reasonably be a goal of one Gigabit per household. We also recommend a series of broadband essentials that must be part of any broadband initiative.

Figure1. Bandwidth



Source: Gartner 2003

Broadband Essential: Ubiquity

To realize the potential economic benefits of broadband utilization, broadband must be integrated and utilized within the communications infrastructure. This means that broadband must be readily available ubiquitously. But, what comes first—ubiquitous demand or ubiquitous availability?

Rationally, ubiquitous availability should only follow ubiquitous demand. If not, assurances of a guaranteed rate of return must be made to entice service providers to invest in front of demand—an "if you build it, they will come" incentive.

In the rational case, ubiquitous demand for next generation services must be evident to the capital markets prior to investment and deployment, much like the evident demand for lighting predating urban electrification[2]. Certainly, if next generation broadband or even today's broadband had an evident ubiquitous demand, the competitive market would deploy ubiquitous broadband. To date, we have not seen that level of activity. In fact, it is apparent that some foot-dragging is happening in seeking ubiquitous broadband deployment from many factions including some service providers and regulators. The reasons are varied: economic, lack of standards, too expensive for consumers and lack of awareness are but a few.

In order for market demand alone to drive ubiquitous deployment of broadband service, providers and investors require strong evidence of demand. This is often referred to as a "killer application" or applications that would cause the majority of consumers to demand broadband service. Gartner believes that one of the weaknesses of this logic is the view that broadband is an optional service beyond traditional voice communications services. It is not. By viewing broadband as a single service rather than as a new platform for integrated services including voice, video and data, it is very difficult to justify the investment required for ubiquitous gigabit connectivity. Taking the view that broadband is the next generation communications *platform,* we believe the "killer app" enabled by integrating these services can be described as enhanced personal communications. A next generation broadband platform for today's basic telecommunications creates both a lower incremental cost structure for today's services as well as an efficient platform for new video and data applications. The key obstacles to this approach are contending with the extensive embedded investments in traditional voice networks (particularly in the access portion of the network) and the disruption of the existing business models of incumbent service providers and others.

Is it appropriate to continue to proceed in the "rational" manner, letting the market drive broadband investments, or is there a "reasonable" approach to ubiquity where the market drives the bulk of deployment and finding solutions for unserved or underserved gaps becomes the focus of public policy? Based on the interviews in this study, Gartner recommends the latter approach.

Broadband Essential: Symmetry

Next generation broadband applications require symmetric bandwidth—equal amounts of bandwidth both to and from the user.

The FCC's definition of high-speed services introduced the concept of asymmetrical bandwidth—that is, the speed *to* the user being greater than the speed *from* the user. This concept was certainly valid when we were reading Web pages like a book. But asymmetrical bandwidth doesn't suit next generation broadband applications, which involve more peer-to-peer communications—where everyone is an information provider.

Gartner's contention that the "killer app" of next generation broadband is interpersonal communications supports symmetrical bandwidth as an essential attribute. Just as in any conversation between two or more people, each participant is both a source and destination of data. In this next generation broadband environment, users will need to transmit a multi-content, real-time signal (voice, video and data) upstream at the same time that they are viewing a multi-content, real-time signal of the distant participant(s). Next generation broadband must include equal bandwidth—in both directions—to accommodate this need. While data only applications can generally accommodate transmission delay (i.e., latency) voice transport (conversations) or video with embedded voice do not.

"Billions have been invested in asymmetric networks that will be wasted. These are networks that were designed when traffic was to be a push model. The shift to Peer to Peer will require a shift to symmetry."
—Dewayne Hendricks, The Dandin Group

From a technical perspective, as networks integrate today's voice, Internet, data networks and video networks into one integrated "pipe"; having symmetry will be imperative for high-quality delivery of latency-sensitive voice and video applications. Next generation broadband speed must be symmetrical—having equal speed upstream and downstream.

Broadband Essential: Quality

To achieve ubiquitous deployment as an integrated platform for voice, video and data, the next generation network envisioned here must achieve the same Service-Level Objectives (SLOs)[3] enjoyed as part of today's Public Switched Telephone Network (PSTN)—including reliability and availability. Once next generation broadband is perceived as the comparable platform for today's basic telephony services, it will drive ubiquitous deployment.

If next generation broadband does not provide capability comparable to the PSTN, it will continue as an "optional" service with ubiquitous deployment delayed indefinitely.

The need to provide service levels that allow next generation broadband to be a substitution to the PSTN is a requirement some providers may vigorously resist. From their perspective, if next generation broadband became a suitable substitute, it would cannibalize the majority of their existing circuit-switched voice revenues as well as render large portions of their infrastructure obsolete. This is true—the transition could be harrowing for these companies. Nevertheless, it will happen. For them, failing to recognize this means they will lose any competitive advantage they currently have, and continue to be disadvantaged against the mobility features of wireless providers and the cost differentials of IP-centric competitors.

Regulators—and in particular the California Public Utilities Commission (CPUC), which monitors service quality levels today—should recognize the need for PSTN-equivalent service levels. As service providers move to next generation broadband platforms, the CPUC should look for creative incentives for both incumbent carriers and competitive entrants to provide PSTN equivalent SLOs on next generation services. Past quality standards in initiatives such as the Interstate Highway System and PSTN have served the public interest exceedingly well.

In summary, next generation broadband should be defined as ubiquitously providing a Gigabit of symmetrical bandwidth for voice, video and data with service levels equivalent to the PSTN. Defined in this manner, Gartner asserts next generation broadband will generate ubiquitous demand with a number of service providers competing to provide ubiquitous availability.

Who Wants High-Speed Data Services?

For both wireline and wireless providers, today's growth market is high-speed data services. Even as an "optional" product, demand for high-speed services such as DSL and cable data service is often outstripping supply.

A recent Gartner Dataquest primary research survey of the U.S. household market spanning the 28-month period from February 2000 to June 2002[4] indicates that as of June 2002, nearly two-thirds (60 percent) of all U.S. households indicated that they were accessing the Internet from home. This is a significant increase in penetration from 48 percent of U.S. households in February 2000. *(The complete text of the research results is in Attachment C.)*

Even more astounding is the near tripling of online households that access the Internet via a broadband connection. Today's broadband connectivity increased from 10 percent of online households in February 2000 to 28 percent of online households in June 2002, *a whopping nine percent average monthly growth rate over the period.*

Following are some of the key findings ascertained from the results of the Gartner Dataquest primary research survey:

- The State of California has 63 percent of its households accessing the Internet. This online household penetration rate is three percentage points higher than the national online household penetration rate of 60 percent.
- Access to the Internet via today's broadband among the California online households (36 percent) is higher than the national level (28 percent) and is the highest among the three states in the Pacific Region (34 percent).

Gartner Dataquest's findings of continued high demand are supported by the findings of the Nielsen/NetRatings primary research, which reports

Table 3. Total Gross Domestic Product (GDP) in Year 2001 (billions of U.S. dollars)[6]

Ranking	Country	GDP in Billions	Broadband Penetration per 100 Households in 2001	Forecasted Broadband Penetration in 2006[7]
1	United States	$10,171,400	11.3	36.0
2	Japan	4,245,191	3.93	34.0
3	Germany	1,873,854	5.1	21.6
4	United Kingdom	1,406310	1.4	21.0
	CALIFORNIA	**1,341,000**	**14.0**	**37.0**
5	France	1,302,793	2.5	20.7
6	China	1,159,017	.03	3.0
7	Italy	1,090,910	1.8	13.7
8	Canada	677,178	21.3	43.6
9	Mexico	617,817	3.8	9.0
10	Brazil	502,509	2.9	7.1
11	India	477,555	.01	.06
12	South Korea	422,167	51.0	77.0

"[Today's] broadband access at home continues to post double-digit growth with a 59 percent year-over-year increase, marking more than 33.6 million Internet users who accessed the Web via high-speed in December 2002."[5]

SBC's "2002 Fourth Quarter Earnings Statement" corroborates the insatiable demand in the following quote: "[In the Fourth Quarter, SBC] added 245,000 DSL Internet subscribers, bringing its total to 2.2 million, up 65 percent from year-ago levels. This is the fourth consecutive quarter of sequential DSL subscriber growth for SBC, which remains the nation's largest DSL provider."

While some pundits had forecast that a saturation point had been reached in terms of households that were Web-enabled and those that would opt for high-speed access, Gartner Dataquest and others' research has proven these pundits wrong over and over. In fact, neither the economy nor the relatively high price points for DSL and cable modem have slowed adoption or demand for these access services. *All indications are that high-speed service demand continues to outstrip supply.* Clearly, California wants high-speed data services.

How California Compares

California is competing in a global economy and broadband is quickly becoming a requirement to compete effectively. According to the UCLA Anderson Forecasting Project, California is now the fifth largest economy in the world.

Table 3 describes the current standings of the major global economic entities and compares today's broadband penetration levels with penetration forecasted in 2006. Gartner's hypothesis would submit that entities that fail to increase their broadband penetration and utilization will see their economic position decline.

Figure 2 shows how countries are moving with respect to today's broadband adoption (recently announced fiber deployments are not included in projections). This graph plots broadband penetration against GDP per capita. It shows that the gap is widening in broadband penetration between the wealthier markets in Asia, with Australia well to the left and Hong Kong and South Korea out to the right.

In 2002, California had a penetration of 22.68 percent of households subscribing to today's broadband services (DSL and cable modems), up from 14 percent in 2001. Clearly, California sets the bar on both penetration and GDPC when compared to other countries. It is important to note the only other country with penetration similar to California is South Korea. Not choosing to rest on its laurels, South Korea is embarking on an ambitious national program to replace high-speed services through the deployment of next generation broadband using fiber to the home. *See Attachment E for a more thorough discussion of success factors in South Korea's deployment.*

Although California is currently a leader in both broadband service deployment and per capita Gross State Product (GSP), now is the time to decide where to go from here. There is a risk of falling behind in the new race for next generation broadband deployment.

A Broadband Revolution

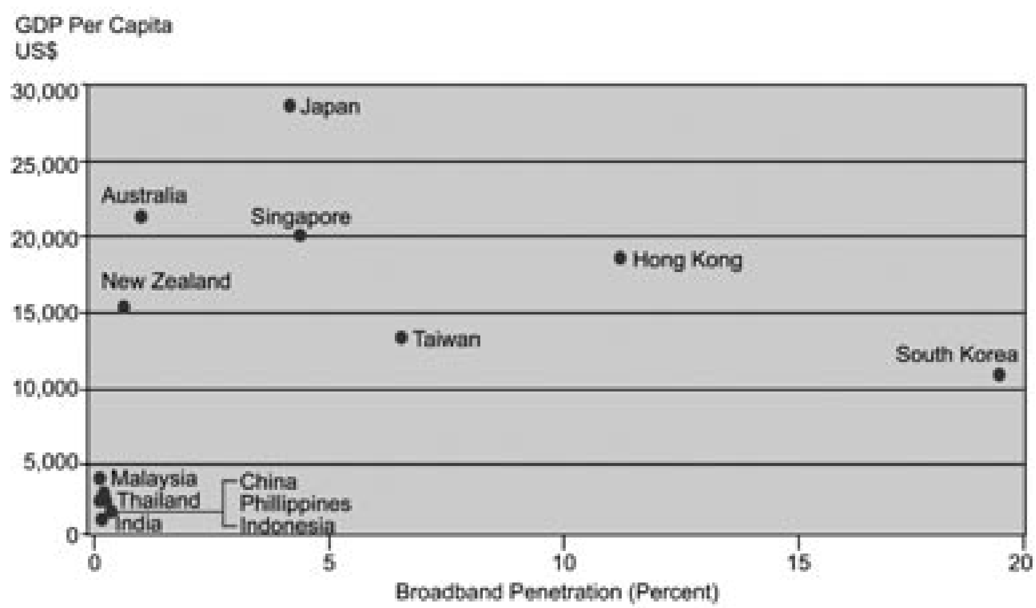
In Gartner's interviews, there was widespread support for the concept of the universal benefit of next generation broadband. Commonly cited benefits included the potential impact on education, health and telework—all of which contribute to an improved quality of life. Other interviewees cited benefits such as e-business, entertainment distribution and gaming—all contributing to an increased economic benefit. The benefits we found intriguing were the uncommonly cited benefits.

Our interviewees included many visionaries and people on the front line in the deployment of next generation broadband. Beyond today's high-speed services, these individuals have an unobstructed view into the crystal ball. Their views revealed a developing perspective that next generation broadband will result in dramatic changes in the way we communicate, the economics of networking, improvements in our quality of life; all while we have fun. The following sections present some of our findings.[8]

A Revolution in Communications

Next generation broadband will lead to an evolution in communications eclipsing the development of the telephone itself. A strong statement, but one that is true. The telephone's breakthrough application was its ability to simultaneously transmit the audio of two parties in real time over long distances. Next generation broadband's breakthrough application is its ability to simultaneously transmit the audio, video, images and data of multiple participants in real time over long distances. The images initially include full-motion video of the participants, and will eventually include holographic images intermingling participants within a virtual room. The ability to immerse oneself in multi-sensory, multi-party, multi-media conversations will change the way we live, work and learn. The technology to do this and more is steadily advancing.

Figure 2. Broadband Penetration and GDP per Capita in Asia/Pacific



Source: Asia/Pacific Midyear Broadband Update: Running with the Wind, 3 October 2002 Gartner Research

Researchers at Stanford Linear Accelerator Center (SLAC) Computer Services recently managed to transmit 6.7 Gigabytes of data from Sunnyvale, California, to Amsterdam, The Netherlands, in less than one minute. The transmission—made across, the Internet2 network at an average speed of more than 923 megabits per second—was more than 3,500 times faster than a typical home broadband connection. Les Cottrell, Assistant Director of SLAC (which is already trying to break its own record) described the effort as one that might soon bring high-speed data transfer to practical, everyday applications. "Imagine...being able to download two full-length, two-hour movies within a minute," CNN quotes Cottrell. "That changes the whole idea of how media is distributed."[9]

Company to Pursue Holographic Communications

TULSA, Oklahoma—February 13, 2003—First Keating Corporation (OTC: FKTG) today announced that its common stock has begun trading on the Over The Counter (OTC) market. First Keating has approximately 36 million shares outstanding owned by approximately 300 shareholders. First Keating seeks to identify, promote and develop the use of holograms in business and personal communications.

The revolution can today be seen at college campuses such as the University of California at San Diego. Students are now communicating through the use of multi-party chat sessions that include video images of the participants, audio conferencing and data sharing enabled by the 100Mbps broadband connections that many students have within their dorm rooms. This new collaborative communication is being used for group projects, homework and communication between friends. This next generation broadband-enabled collaborative communication represents a fundamental change in interpersonal communication. What previously could only be accomplished in a face-to-face meeting of multiple participants can now be accomplished via next generation communications.

Gartner believes students are learning new communications skills that allow them to experience a highly interactive and collaborative environment. These collaborative tools will give today's students the skills in collaborative interaction with virtual teams that will give them a competitive advantage similar to the advantage enjoyed by the youth in the eighties, who adopted the personal computer more quickly than older workers.

A Revolution in the Economics of Networking

Next generation broadband bandwidth will dramatically change the economics of networking. Today's model of feature-rich personal computers (PCs) interconnected via limited bandwidth will be reversed into limited computing "plug and play" devices inter-

Broadband Can Mean More Small Business

Katie Anglin is one of many interior decorators nationally offering their services over the Internet. With the increased number of homes that have access to e-mail and broadband connectivity, it is becoming practical to send large graphic files such as photos of rooms or design samples and other "bandwidth hogging" content over the Internet. Her Web site proclaims: "Professional help for rearranging your space is just an e-mail away." Katie, whose business is in Pasadena, California, was one of several interior designers profiled in "Decorating Ideas: Country Digest," December 2002. One designer in Chicago was contacted by a California homeowner who had seen her work profiled in a national magazine and wanted the same thing done in her home. The entire job was carried out via the Internet and the telephone.

Linda McSweeney is a local artist in Danville, California. She has had moderate success with her small business of faux finishing and fine art. In May of 2002, Linda began offering her equine paintings for sale on eBay and was amazed at the response. Art collectors on eBay took notice of her paintings of Arabian horses and she has become an "overnight" success with her paintings, which are often the subject of bidding wars. Her available market is now bounded only by the reach of the Internet. Since an important part of her advertising on eBay is a photo of the painting, which must be as high a quality as possible, broadband connectivity makes it easier for her to post her photos and also makes viewing them more enjoyable than via a dial-up connection. Would she do it without broadband? Her answer—No!

connected via abundant bandwidth. This reversal will allow the deployment of an infinite number of networked devices capable of dramatically changing our lives. But, we are getting ahead of ourselves.

George Gilder has coined the term "Telecosm"[10] to describe the world of infinite bandwidth.

> *"After a cataclysmic global run of thirty years, it (the microcosm) has given birth to the age of the telecosm—the world enabled and defined by new communications technology. Chips and software will continue to make great contributions to our lives, but the action is elsewhere. To seek the key to great wealth and to understand the bewildering ways that high tech is restructuring our lives, look not to chip speed but to communication power, or bandwidth. Bandwidth is exploding, and its abundance is the most important social and economic fact of our time."*[11]

For some, next generation broadband portends the elimination of the PC altogether. At a very basic level, a next generation broadband connection enables the elimination of costly elements of a PC by using the network to perform tasks such as storage, application hosting and operating systems. Using a network device could save the average user one-half the cost of a computer while providing a level of mobility unheard of in a tethered PC.

Although saving money on a PC is attractive, for the majority, next generation broadband will enable the deployment of tens or hundreds of "micro" computing devices that will revolutionize the way we live. Many of these will be embedded in components of our environment as part of service or product delivery mechanisms.

According to Glenn Schuster, Vice President of Marketing of Ubicom, a manufacturer of wireless network processors, " We have over 500 designs ongoing for these types of embedded devices. We can enable virtually any device to connect via Ethernet for about $10 and to wireless connectivity via Wi-Fi (802.11b) for under $25. Once you have a home network, connecting the devices is cheap. Five to six billion microprocessors are manufactured each year and they can all be networked."

If the Internet refrigerator sounds "over the top" to you, consider the implications of a failure in the refrigerator section of a large grocery store or commercial warehouse. In Denmark, Danfoss, a manufacturer of commercial refrigeration units, is using wireless connectivity over Internet protocol to monitor temperature and compressor performance. Old networks that performed this task were based on proprietary networking technology and point-to-point fixed networks. Using the Internet reduces the cost and adds the flexibility of being able to monitor the network from virtually any device (PC, pager, cell phone, etc.) that is connected to the Internet.

General Electric has a field trial in Southern California for networked washing machines. Since so many microprocessors are in today's machines, as many as 25% of the service calls only require resetting the machine. This trial allows remote diagnostics and in some cases remote repair. The remote diagnostics also allow the technician to determine which part requires replacement in advance of sending a truck to the premise. In the non-networked environment it is a common problem that the technician does not have the right part on the truck. In the networked environment if the problem cannot be corrected remotely, the correct part can be stocked on the service truck ensuring that only one $50-$150 trip is made. GE estimates this could save it millions of dollars of operating cost.

> By Lisa M. Bowman
> Staff Writer, CNET News.com
> 7 April 2003, 2:26 PM PT
>
> **Worried that you forgot to close the garage door this morning?**
>
> If you live in the Tinker Creek subdivision in Roanoke, Virginia, you could soon log on from work and find out, and even shut the door remotely if you needed to. IBM said Monday that it has partnered with Commonwealth Builders to provide home-automation technology in 170 new homes, the first real-world, mainstream application of Big Blue's home-networking strategy. The homes will cost about $220,000 apiece, according to IBM. People who have the new systems will be able to control devices like their heaters and stoves remotely and check that their doors are locked.

"The notion of billions of devices communicating with each other or people that are controlling them, I think is very similar to what we see. It could result in a significant fraction of traffic on the Internet." —Vint Cerf, Internet Pioneer, Senior Vice President, MCI.[12]

Microcomponents Infest the Home

A typical household is teeming with processor chips running products that make our lives easier, safer and more entertaining. Electronic data processors are everywhere. They are around the office and in the ubiquitous PC, and you're sure the bank has one. But microprocessors (MPUs), microcontrollers (MCUs) and digital signal processors (DSPs) are in almost anything running on electricity these days. There could easily be 100 of these semiconductor chips in your home, but could you find them?

The more typical processor is the embedded processor. It is in the telephone you buy, but you buy the phone because it has caller ID, 25 stored phone numbers and a display that times the conversation—all features performed by an MCU. Embedded processors are all over the house. The television may be tuned by an MCU. Video games are run on a pretty sophisticated MPU with assistance from another processor in the graphics section and possibly a third generating the audio. Stereo systems often use DSPs to shape the audio to fit the room acoustics. MCUs time and control cooking in the microwave oven, and thermostats change settings by day and hour according to the same MCU as drives the LCD. Satellite receivers, irons, garage door openers, power tools and everything remote control will typically have one. Exercise equipment, toys and even some battery chargers use MCUs. Cellular phones are packed with sophisticated electronics, including an MCU and DSP. A timer that turns off the lights at night could have a 50-cent MCU in it.

All those things in your house that let you bring your work home with you, or resemble what you have in the office, contain processors. Copiers, fax machines, printers, scanners, multifunction peripherals, personal digital assistants (PDAs), DSL or cable modems, LAN switches and uninterruptible power supplies all operate under the watchful eye of a processor.

Gartner Dataquest has assessed the number of MPUs, MCUs and DSPs that reside in a typical American household with a normal provisioning of electronic equipment. Consideration was given for general household items, mobile devices (such as wireless phones), the automobile and a home computer system, as well as multipliers for quantities of people and cars associated with the house. Separately, a small office/home office (SOHO) was tallied. Based on this assessment Gartner estimates that in 2001, a normal home had approximately 100 programmable processing devices. In 2006, a normal home is expected to have 196 devices.

Why Are Programmable Processors Important to Broadband? Flexibility and Low Cost.

Programmable processors are incredibly flexible. The same processor chip that can operate a phone can run an automobile engine or a printer. The program written for the processor tells it what to do, making it determine touch tones, speed up the engine or form the next letter on a piece of paper. New capabilities can be added with relative ease, and the same fundamental hardware design can be reused, serving the base model all the way up to the full-featured version just by adding blocks of more powerful software. Another bonus, since these processors are multipurpose, is the low cost. These tiny devices increasingly programmed for connectivity will contribute to the need for next generation broadband connectivity in the First Mile.

Source: Gartner 2003

A Revolution in Our Quality of Life

The ubiquitous availability of next generation broadband will allow us to use computational devices to bring/send information to us at any time in any place. This ability will provide us an opportunity to use communications and computing wherever we are, at any time, for any purpose. It also allows us to layer multiple services and applications over an integrated infrastructure increasing efficiency and ultimately reducing costs and making services more affordable and pervasive. Excellent examples of the potential benefits of ubiquitous access are MIT's Project Oxygen—Pervasive, Human-Centered Computing[13] and Charmed Technology's[14] wireless everywhere. Products based on these visions of ubiquitous human-centered computing envision the replacement of the PC with computing devices optimized for individuals' needs.

Swift transmission of information eliminates the major bottleneck of scientific innovation: the long delay between the moment an idea is written down and the moment it is read by another scientist. With the present electronic networks, a researcher can make a document, including all relevant data, illustrations and references, available on a public computer, announce its availability to hundreds or thousands of scientists working in the same domain, and start getting their reactions within a few hours.

Next generation broadband also has the potential to increase our security from environmental and terrorist threats. Today's broadband is being used by public safety organizations for: the instant transmission of rich geographic data presented in detailed images by Geographical Information Systems (GIS); fingerprints to query national fingerprint databases; images used to identify people; and video for command and control centers. Next generation broadband is also used to collect data from remote sensors deployed within smart buildings designed to inform people of the extent of damage resulting from an incident. The problem faced by national security organizations is the need to get data to and from sources required quickly. James Watkins of the State of California Office of Emergency Services states, "We assume we will be able to get large amounts of information to and from where it needs to be quickly; however, the logistics and problems of getting it to the right place are many. Ubiquitous next generation broadband could resolve these emergency management needs."

Telework for Quality of Life and Saving Gas

Telework is not a new phenomenon; the number of teleworkers in the U.S. varies with the definition of telework, but has been growing steadily. ITAC surveys estimate approximately 28 million people in the U.S. were teleworking in 2001. This is an area that has truly realized the positive impact of broadband. Broadband availability makes downloading large files quick and easy. Having access to the Internet at home also is paying off for businesses. Looking across all working adults, those workers with Internet access at home (including those with access at both work and home) spend 5.3 hours per week at home on work activities.[15]

Personal security is another area where the availability of a next generation connection could create real value for consumers, security companies, and the police or fire department. Typical home and business alarm systems tend to generate false alarms. Responding to a false alarm not only uses resources that may be urgently needed elsewhere but also drives up cost for community police and fire services. To offset this cost, many consumers must pay fees as high as $350 per incidence for false alarms. In other communities such as the City of Los Angeles, police departments are announcing plans to discontinue responding to any alarms. As security becomes even more of a concern, affordable security systems that have the ability to offer the consumer or the alarm company to remotely make a visual inspection might offer a higher-value solution to this increasing problem.

Telecommunications is also becoming a land-use issue. Realtors are reporting that an important decision factor in home purchases is broadband availability. This is validated by more Multiple Listings Services (MLS), used by realtors including a category for cable and DSL availability. In Northern California, the Bay East Board of Realtors added this category to its MLS two years ago in response to questions asked by prospective buyers. (The Bay East Board of Realtors has about 7,000 members who cover most of Alameda and Contra Costa County and will soon be adding 2,000 more realtors in the remainder of Contra Costa County.)

A Revolution in Entertainment

Online gaming has emerged as the next growth frontier. PC gaming now generates larger revenues than the movie industry. Nintendo's Mario character alone has generated US$10 billion in revenues.[16] The country's most successful online game, "EverQuest," now has more than 435,000 subscribers—this is larger than the population of Detroit! "Ultima Online" has 220,000 subscribers. Electronic Arts hopes to reach 400,000 subscribers for its recently released "Sims Online" by December 2003. In Korea, online PC gaming has proven so popular that three television stations are dedicated to the "sport" full-time. Both bandwidth and latency are two critical elements for today's online gamers. Next generation broadband enables massive real-time gaming unlike any other media.

Plato observed, "Let early education be a sort of amusement." Fun also has a very practical side to it that cannot be ignored, as digital gaming is gaining momentum in a number of sectors as a platform for education in the traditional K–12, as well as in business and military applications. While simulations have been used for years, combining simulation and games add important elements such as goals and competition. In “Wyndhaven,” fifth graders might find themselves on the surface of Mercury, with the task of launching a research satellite into orbit. There will also be puzzles to be solved and new places to build. The student will interact with other students, teachers, parents, other members of the community and Artificially Intelligent (AI) synthetic characters in real-time.[17] At issue in the educational environment is the process of gaining accreditation for use in the classroom as well as teacher training and support.

Game-based learning, distance learning, collaborative study groups are all techniques still in the nascent stages of development that will benefit from the combination of next generation infrastructure and network-enhanced applications.

Some real-life examples outside of education include a military application called *Joint Force Engagement,* or JFE, which is used to prepare officers from the various military branches for participation in joint task force operations. JFE is packaged and presented just like any off-the-shelf game—the only thing on the box that gives it away is the “This product is the property of the U.S. Government” in the lower right hand corner on the box. *Marine Doom* is played as a networked game. Four-member fire teams are given four separate computers in the same room. Their goal is to coordinate their movements to eliminate an enemy bunker.[18] Recent press announcements indicate that the military is now using game-based learning to educate military commanders about dealing with terrorist activity.

Companies including DaimlerChrysler, Kraft Foods Inc., Nokia Oyj’s U.S. phone unit and SABMiller Plc’s Miller Brewing are using so-called advergames to give 145 million U.S. computer-game players a closer connection to products than traditional television or magazine advertising allows. They say it works. Development costs for the games are as little as 99 cents for each time a product appears on the screen, less than the $15 per time a consumer sees a product in a television ad.[19]

A Revolution in Education

Education is one of the primary beneficiaries of next generation broadband. California long ago recognized the benefit and has been active in projects such as the CENIC Digital California Project (DCP). DCP is a state-funded effort to build and operate the next generation network infrastructure required to enable the K–12 education community to utilize advanced services.

The deployment of next generation broadband at educational facilities is a critical component of any next generation initiative. Today’s students, for the most part, come into the education system speaking the “digital language” thanks to games, access to computing technology and the Internet, and the abundance of information appliances that are available outside the classroom. The challenge for educators is to use these tools to provide interesting and productive learning experiences. This means more than hardware and infrastructure; it involves development of curriculum, and technical training and support for teachers and administrators. Game-based learning, distance learning, collaborative study groups are all techniques still in the nascent stages of development that will benefit from the combination of next generation infrastructure and network-enhanced applications. As we have seen in the past with Yahoo!, Mosaic and Napster, to name a few, this is a fertile ground for application development, one that both government and private industry must nurture.

A Revolution in Healthcare

Healthcare is another significant area of opportunity for deployment of next generation broadband. As costs continue to increase due to the increasing aging population, healthcare providers need to look for ways to deliver quality care more efficiently and effectively. More consumers are now educating themselves on diseases and treatment protocols via the Internet. Ubiquitous next generation connectivity and new information mapping techniques allow applications to become more useful than static articles. An example that came up in one of the interviews was the California Health Survey. The questionnaire was part of a large interactive online survey. The responses to the survey were fed into a relational database that will allow users to interact with the information and actually manipulate it instead of merely reading static reports. So, as a result, a person trying to determine if they were in a cancer cluster could actually access the data rather than hope that the person creating the report had selected that specific data to display. The availability of a next generation broadband connection makes it reasonable to work with files or databases that might be quite large. When this is coupled with knowledge mapping techniques, it is but one powerful example of going the next step in empowering people with access to information.

Taking High-Speed Action on Bioterrorism

The heightened awareness of our vulnerability to acts of bioterrorism is driving healthcare agencies to find improved means of both detection and action. The San Mateo (California) Public Health Services Department has linked with Kaiser Hospital locally to utilize online notification of detection of any evidence of bioterrorism in patients who are seen in Kaiser's emergency room. They are using a system developed by Sandia Laboratories in Livermore, which is offered free. The system requires a high-speed connection between agencies and replaces the traditional method of faxing information to the health services agency.

Five years ago, California had 78 rural hospitals. Since then, nine have closed and 11 more have filed for bankruptcy. More still have cut services to avoid closing their doors.

Physician shortages also sparked interest in telemedicine. Urban areas had twice the number of specialists per capita as rural California counties, and 50 percent more primary care physicians per capita. "There was such a disparity between urban and rural California that made telemedicine one attractive solution to improve access to care," said Lauri Paoli, executive director of the California State Rural Health Association. At the same time, more rural communities got broadband Internet access.

Medicare, Medicaid and private insurers—once reluctant to pay for telemedicine—started to reimburse doctors for the virtual visits.

For Rushell Peasnall, telemedicine worked just as the doctor ordered

Peasnall, insured by a Blue Cross Medi-Cal managed-care plan in Modesto, talked to her primary care doctor about gastric bypass surgery—a weight-loss operation. She needed to see a hormone and metabolism specialist to get the surgery approved by Medi-Cal. A videoconference with UC Davis endocrinologist Jason Wexler saved Peasnall a drive to San Jose, the only place she could find another specialist who would accept Medi-Cal patients. "They basically told me I had a choice of driving all these hours in my beat-up car that might die during the trip, or driving 20 minutes to this other doctor who would sit me down in front of a TV to talk to the endocrine guy," Peasnall said. "I am so used to being a second-class citizen as far as getting doctors to even look at me. This TV medicine is really something."[20]

In 1999, telemedicine got a big boost when one Medi-Cal HMO, Blue Cross, partnered with the State to set up a vast telemedicine network for its members enrolled in Medi-Cal and Healthy Families. The insurer invested as much as $50,000 at sites in 22 counties to buy videoconferencing equipment, medical cameras, software, hardware and all the other needed technical gear.

When it was initially introduced a few years ago patients were seen via telemedicine in a week or so, but now it's so popular it can take as long as three months for that visit.

The revolution will indeed include new miraculous capabilities but, perhaps more importantly, it will also include millions of ordinary tasks and events that are made better, easier or more productive by next generation broadband.

D. Potential Economic Opportunity of Ubiquitous Broadband Utilization

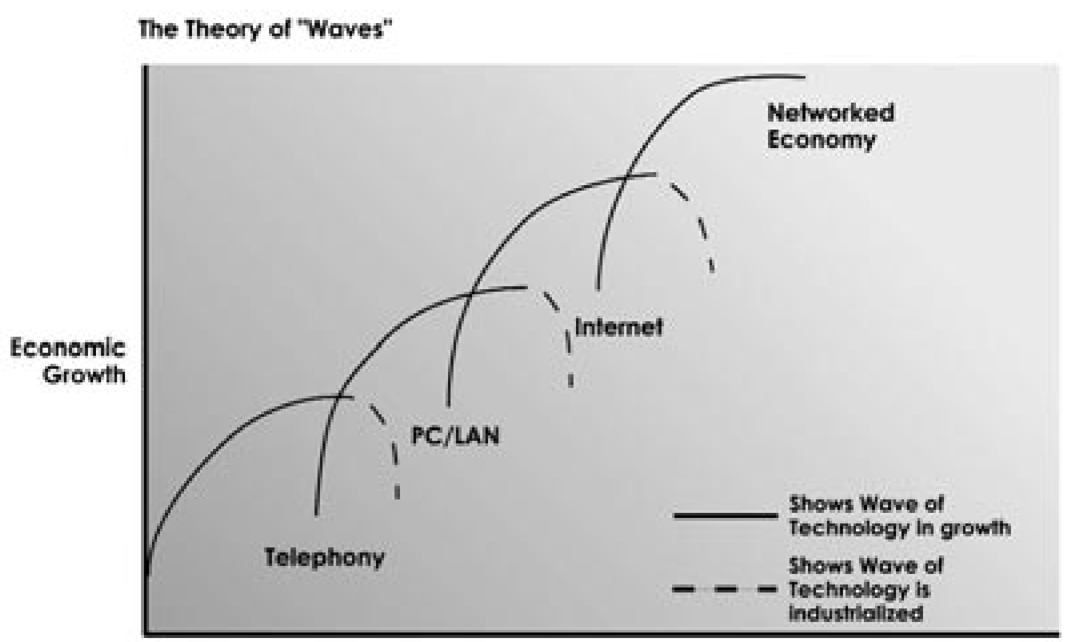
Perhaps one of the most daunting tasks for the telecommunications industry and public policy makers continues to be quantifying the impact of deploying an access infrastructure to enable a ubiquitous end-to-end broadband network. The promise that is held out by proponents of the broadband Internet is certainly one of improved economic growth and prosperity as expressed through economic studies. Regardless of the results of these studies, service providers and policy makers are still struggling to make the business case for ubiquitous broadband deployment.

As one interviewee stated "economic studies are like the cartoon of the drunk and the lightpost—economic studies like the lightpost are mostly useful for support. Studies are useful for talking points—but it is more important to have practical ideas to improve the status quo." Even so, having a view of the economic possibilities is helpful in engaging people to set about the task of creating the practical ideas.

Although he was not specifically referencing broadband, U.S. Federal Reserve Board Chairman Alan Greenspan echoed many in the industry when he noted that real-time access to information has been key to economic recovery. In his remarks to the U.S. Congress on 27 February 2002, he pointed out that in the past, "Businesses did not have real-time data systems that enabled decision makers in different enterprises to work from essentially the same set of information. In those earlier years, imbalances were inadvertently allowed to build to such an extent that their inevitable correction engendered significant economic stress. That process of correction and the accompanying economic and financial disruptions too often led to deep and prolonged recessions. Today, businesses have large quantities of data available virtually in real time. As a consequence, they address and resolve economic imbalances far more rapidly than in the past."

This economic theory of waves, illustrated in Figure 3, is held by many and ascribes to the notion that each individual "wave" of technology drives a window of economic growth that becomes the basis of another subsequent wave of economic achievement.

Figure 3. The Theory of Waves



Source: Gartner 2003

Teledensity, as we will discuss, has been a widely acknowledged contributor to GDP but the benefit of teledensity fell off as economies became industrialized. The same was true for PC/LAN—big initial impact initially during adoption but no more. The Internet did the same thing—disintermediation, supply chain automation, etc., all drove growth initially and then the growth was absorbed into the trend. The next wave will be when everything is connected, which Gartner believes will be the most significant driver of long-term productivity.

A number of studies have attempted to quantify the specific value of widespread deployment of broadband technology. One study commissioned by Verizon Communications and co-authored by the Brookings Institution, published in July 2001, suggested that universal deployment of broadband services will result in "huge network effects for consumers" including falling prices. The economic benefit was assessed on the future of broadband increasing from its eight percent in 2001 when the study was conducted to levels ranging from 50 percent to 94 percent. According to the Brookings study,[1] the economic benefit for the U.S. could be as much as US$500 billion per year.

The study also addressed the overall impact that IT has had on the U.S. GDP. "In the first half of the 90s, the U.S. GDP grew at 2.4 percent per year, whereas in the second half GDP grew at a rate of 4.1 percent per year. At the same time the annual rate of price decline for computers more than doubled in the second half of the decade from 15.8 to 32.1 percent. A consensus is now developing that the surge in economic growth is attributable to investment in information technology, which in turn is attributable to the price decline in information technology equipment."[2]

Gartner's View of Potential Broadband Economic Impact

Gartner's basic assumption of a positive correlation between the level of broadband penetration in a country/state and that of the Gross Domestic Product per Capita (GDPC) in that country/state is based on a study first highlighted in an International Telecommunications Union (ITU) document.

The ITU's original study found the basis for a broad correlation between communications (as a means of information diffusion) and the level of GDPC, not just between voice communications (telephone) and the GDPC. The relationship between the level of penetration of telephones and the GDPC was used as a proxy to illustrate a point. As an illustration, the ITU study has shown several countries with different levels of communications capabilities (as noted by the different levels of telephone penetration) and the GDPC in that country.

By this illustration, the ITU was able to demonstrate the existence of a positive correlation between the penetration of telephones (as a proxy for the level of communications capabilities in a country) and the GDPC. Figure 4 provides a graphic illustration of the correlation.

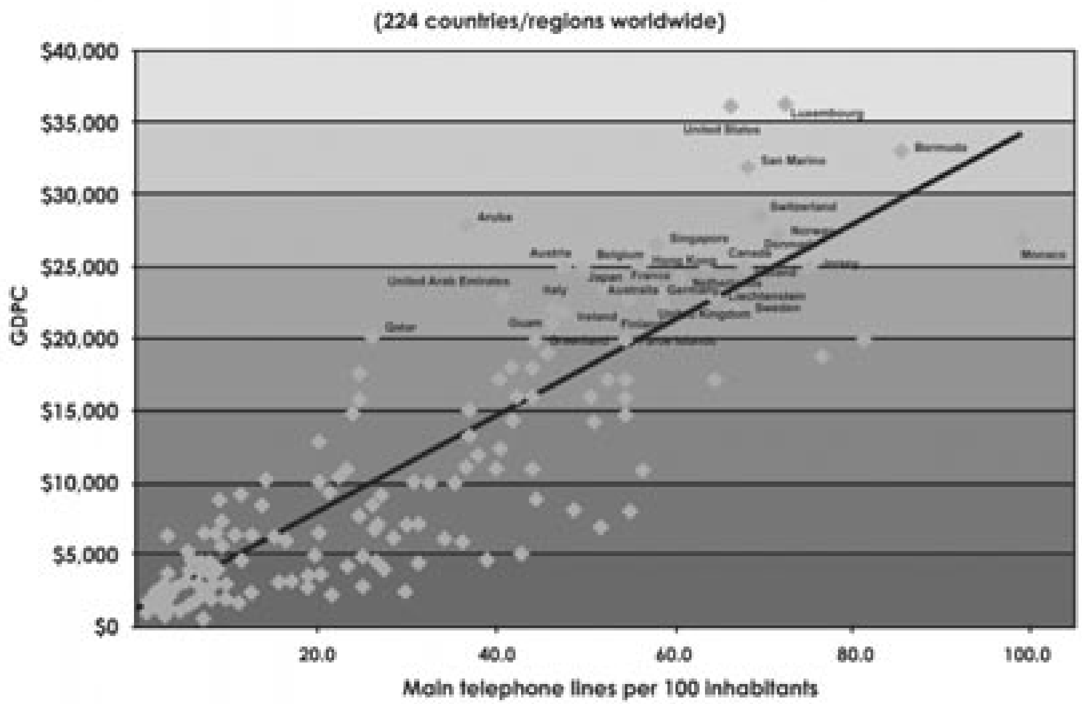
A consensus is now developing that the surge in economic growth is attributable to investment in information technology, which in turn is attributable to the price decline in information technology equipment.

Although the original ITU study could not specify the substantial increased level of economic activity that can be generated and supported through broadband communications (because it was developed when narrowband communication was the dominant means of information transportation), the possibilities for substantial increases in commerce activity and effectiveness of organizations and individuals have been shown through numerous other studies.

Hence, this correlation between means and goals can be simply illustrated as follows:

- One industry player installing a new telephone line would not make much difference in the improvement of productivity. However, if all other enterprises within a sphere of activity also have telephony service, then the levels of productivity of each participant will improve substan-

Figure 4. The Coincidence of GDP per Capita and Teledensity suggests that one could be a good surrogate for the other.



Source: Gartner 2003

tially. The company that does not have these facilities would fall behind its competition.

- With no other competitor using telephony services, the first few companies within a sphere of activity that install advanced communications capabilities can significantly enhance their competitive edge as the more-efficient players in the marketplace stand to reap the economic benefits of such advantage.
- This situation can be extended to economic regions (or states or countries), not just standalone enterprises. For those regions that are competing-cooperating with each other for winning the economic battles, they are facing even bigger barriers or inefficiencies in information transportation. Regions that can eliminate these inefficiencies better and faster than others stand to attract more resources (human and other assets) from other regions, and would be able to utilize them better.

To sum it all up, the ITU study illustrated that there exists a positive correlation between the level (or degree of sophistication) of communications and the level of economic activities. As long as information plays an integral role in the economy, this correlation increases with the level of sophistication deployed.

The level (or degree of sophistication) of information transportation is positively correlated to the level of productivity. Any action to increase the level (or degree of sophistication) of information transportation or to eliminate those inefficiencies serve to increase the productivity. This concept is captured in the model developed by Gartner, which illustrates that specifically in sophisticated societies such as the U.S., the level of productivity would rise substantially with the availability of new tools. This is especially true since the U.S. has already raised its level of effectiveness with the full use of the existing means of communications.

In the case of developing countries, the availability of sophisticated communications would not have as much impact because the society and infrastructure have not developed to the point of being able to take advantage of the sophistication now available. For example, equity/capital markets are still undeveloped, education is still far behind, and industry is not at a stage of being able to use the new sophisticated means of communications.

In the long-range game of economic cooperation and competition among a number of players (enterprises, region, states, countries), those players who adopt better means before others do can acquire a strategic advantage in term of reaching their goals. Gartner initially developed this approach as part of an effort to estimate the impact of broadband on the U.S. as a nation. The report, *The Payoff of Ubiquitous Broadband*, was published in July 2002 and estimated an annual incremental impact of $500 billion.

In this engagement, Gartner has taken this hypothesis and created a potential outcome for the State of California. Gartner Dataquest cautions that this is just one way to look at the macroeconomic benefits that could be realized. However, it serves the purpose of helping people visualize in quantifiable terms the overall benefits accruing from such a venture. The business plans of private entities will focus at a micro level on the particular benefits they will specifically accrue as a result of their participation. The incentives that are created as a result of this model will have a positive impact at a macro level on the business case that makes broadband more viable for early deployment by demonstrating potential flow-through benefits to the State and community. As interviewees pointed out, more-rigorous models will be developed to actually prove in a case for a specifically focused broadband initiative. Indeed, such a model must be crafted around the scenarios that are under consideration in order to identify the most promising solution and its cost, as well as to support the business case for moving forward. Even such a model must make estimates of potential economic impact because technology is only an indicator of possibilities, not a predictor of actual outcomes.

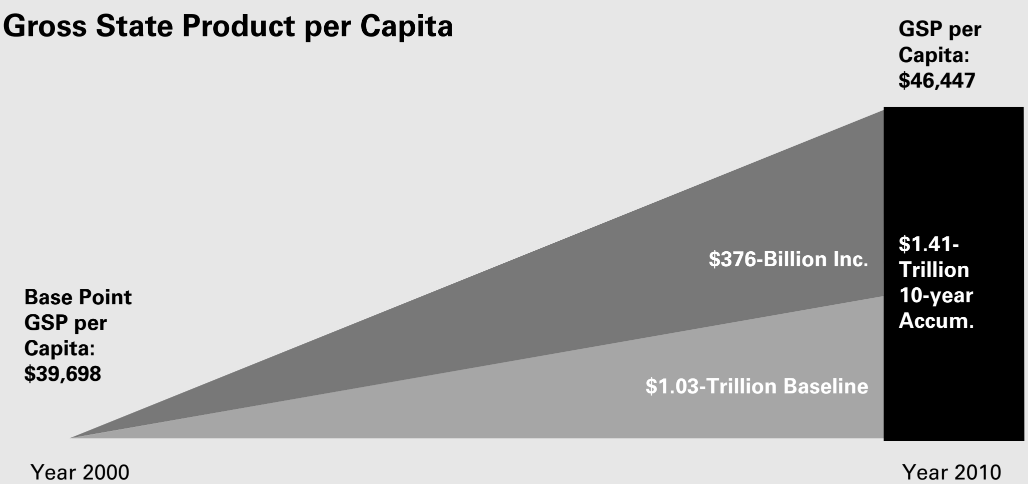
A $376 Billion Opportunity for California

The Methodology

Gartner derived a correlation slope by taking separate forecasts of the rise in Gross State Product (GSP) in California over 10 years, due to a number of factors, and a separate forecast that indicated that the level of penetration of Broadband (BB) access will rise from the current 10 percent per capita[3] to approximately 20 percent per capita[4] in the 10-year period, given the present rate of absorption. Gartner further stipulated that with an initiative to encourage the penetration of Broadband, this rate of penetration could achieve 50 percent per capita by 2010, with a resulting increase in GSP per capita due to a substantially increased level of interaction between the users.

For the purposes of this analysis, Gartner did not run calculations at penetration levels other than 20 percent per capita and 50 percent per capita. Gartner believes that the highest rate of penetration that could reasonably be achieved would be for broadband to replicate California PSTN penetration which would be the current 73 percent per capita,

Figure 5. Gross State Product per Capita



Source: Gartner 2003

at which point broadband would be a "universal service." This would be a highly unlikely scenario over the study horizon without some extraordinary efforts and funding beyond the recommendations in this document (given that we are focused on the impact of utilization of this new infrastructure rather than placement of capability).

Based on this analysis, it is Gartner's contention that this level of improved GSP per capita could be significant and additional through the introduction of next generation broadband communications. Broad utilization of applications using peer-to-peer, always on, bandwidth on-demand symmetrical bandwidth will enable productivity beyond that achieved through the availability of the past's limited mode of voice and data communications capabilities. The model results show an increase of $376B in incremental GSP over a 10-year period or on a per-capita basis an increase from $39,698 in year 2000 to $46,447 in 2010. Without the increased broadband utilization coincident with a broadband initiative the GSP per capita would increase to $40,947 in 2010. Figure 5 illustrates the growth potential as well as the 10-year accumulated GSP of $1.41 trillion.

To evaluate the potential impact of this increase in GSP per capita and employment growth on industries in California, Gartner evaluated actuals and forecasts[5] for employee growth in California by Standard Industry Code (SIC[6]).

- The Industry base was analyzed and each segment of the industry was given a relative score for the potential effect of broadband on that particular industry segment. For example, the Mining sector of industry is much less likely to be affected by the introduction of broadband access then the financial sector or the manufacturing sector.
- Dependent on the score achieved, and the current strength of the sector in terms of total employment in that sector, a growth factor was applied that would be proportional to the relative score of that sector.
- This resulted in highlighting which segments of industry would have the most potential for growth, given the specific demographics of the State.

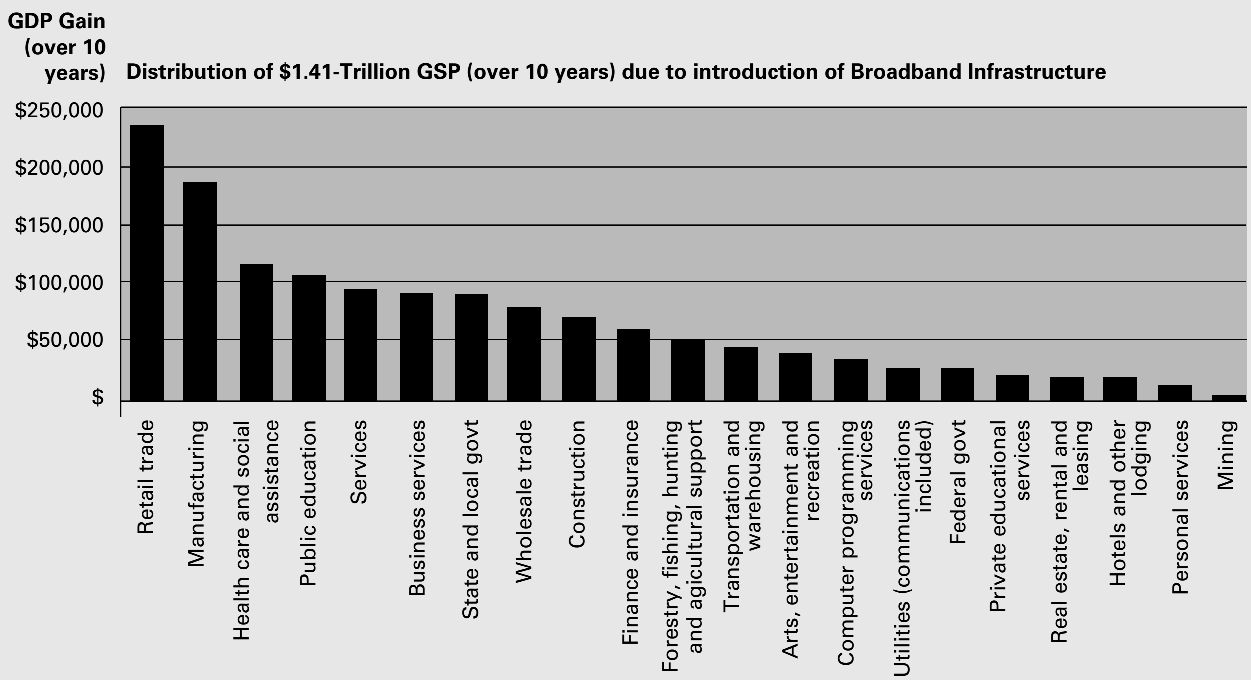
The resulting potential increase in California jobs created by the introduction of a ubiquitous broadband infrastructure through this method is estimated to be nearly two million over the study period.

Figure 6 shows the impact of applying these benefits to the industry segments to see the level of employment growth and increased GSP in each industry segment.

The resulting potential increase in California jobs created by the introduction of a ubiquitous broadband infrastructure through this method is estimated to be nearly two million over the study period. Figure 7 illustrates the incremental job growth stimulated by the increase in availability and utilization of broadband applications in comparison to the forecasted baseline growth.

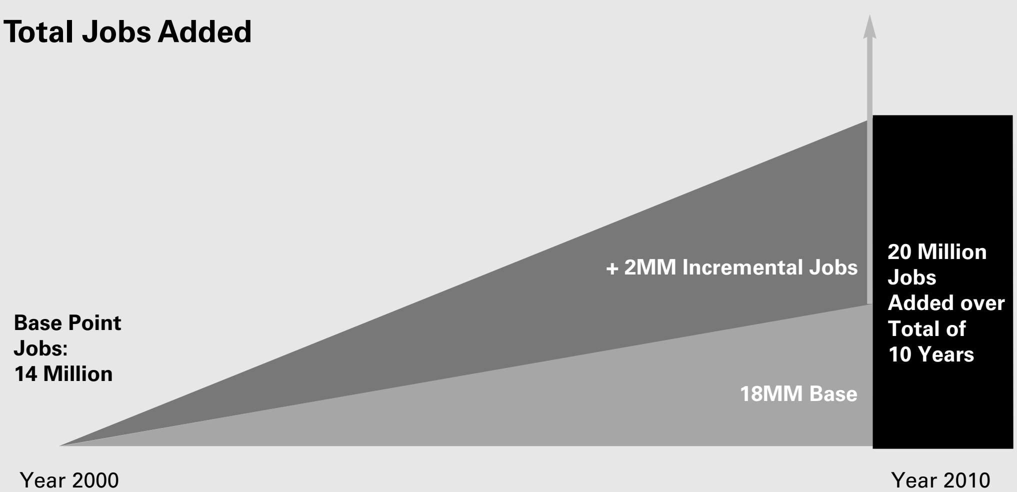
To summarize, this analysis corroborates the numerous other economic studies that have shown a positive economic impact linked to broadband deployment. All of these studies support the position that both private industry and government agencies should recognize the need to accelerate broadband deployment. Although at the macroeconomic level, this analysis establishes a correlation of positive economic opportunity for the State of California, the benefits in reality may be greater or smaller. As nearly every interviewee in this study observed, economic studies are important inasmuch as they create a comfort level and point to a direction. Some benefits—such as quality of life—are too intangible to quantify and yet they are the benefits that really matter. However, Gartner submits that without an initiative to further develop this opportunity, California will lose its competitive edge in comparison to other regions in the United States and globally that are taking action.

Figure 6. Distribution of Gain in Gross State Product by Industry



Source: Gartner 2003

Figure 7. Total Jobs Added



Source: Gartner 2003

E. The Broadband Obstacles

The Gartner model reveals an economic opportunity for the State of $376 billion dollars over 10 years. So, the obvious question is why isn't next generation broadband being deployed ubiquitously now? Based on our interviews, we believe the answer lies in the numerous real and mythological obstacles that appear, in aggregate, to be overwhelming. There is also a lack of leadership largely because of the complexity of the issue. And, because we are human, there is overwhelming urge to resist the inertia of change.

Developing a Clear Vision on How to Drive Ubiquity

A good view of connectivity issues faced by rural California can be found in the New Valley Connexions report issued in May 2000. The report cited two challenges for the San Joaquin Valley. One was that, although fiber ran the length of the Valley along Highway 99, it was difficult to get affordable connectivity to today's broadband services. "As many as two-thirds of the Valley's 3.3 million people were limited to slow dial-up connections, and for some rural areas even dial-up did not work reliably."[1] The second issue was that fact that where services were available, they were not being used effectively. Only a small portion of the workforce had the skills to use technology and there were few opportunities for people in low-income communities to learn the new skills. Producing one-half of California's agricultural output and covering 14 percent of its land, the San Joaquin Valley has significant challenges including an economy that is dependent on a single industry: agriculture and a per-capita income nearly 30 percent lower than the State average.

The Great Valley Center has undertaken the task of creating the partnerships with state and county entities to address these issues at a grassroots level. The program, Advanced Communications Connectivity for E-Commerce Strategic Success (ACCESS) is a three-phase project, which began in June 2001. Phase I involved nine counties and included a detailed community assessment of readiness for technology, which involved local workshops with more than 700 participants. Another aspect of Phase I was educating people on applications. Phase II was about developing "action initiatives" with teams developing more than 70 ideas and action plans for each idea. The counties are now embarked on Phase III—the implementation of the action initiatives. ACCESS represents only one of the many programs that are being initiated at the local level to deal with technology and economic issues in the San Joaquin Valley.

The San Joaquin Valley is not the only rural area facing an uphill battle. Inland Empire is working on regional economic development in Riverside and San Bernardino Counties. Its mission is to attract business—there is currently a collaborative initiative to measure the region on various attributes—which will feed into a regional visioning project for the next 20 years. In this region there is tremendous lack of high-speed connectivity. There are 27K square miles of federal land with Native American tribes and lands that are not connected in terms of schools or businesses. An economist just moved to Redlands and could not get high-speed access. Two software businesses were moving into the region but decided not to because of lack of connectivity. The freeway congestion is significant and trying to build the region with the lack of infrastructure is problematic. In our interview it was speculated that this is because it is considered a second tier market by SBC and Verizon. There is some cable data capability now and one wireless startup but nothing is consistent. When interviewed by Gartner regarding a next generation broadband initiative, Teri Ooms, the President and CEO of the Inland Empire Economic Partnership, stated that "without this type of initiative, it will likely

Without this type of initiative, it will likely take three to five years to have some level of ubiquity. We may possibly have services in the majority of the region in two to three years...but this region will always be left behind the major markets.

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These are the very regions that are expected to carry the California economy over the next 20 years and yet they are being left behind even in terms of today's broadband infrastructure.

According to the "Advanced Telecommunications in Rural America, The Challenge of Bringing Broadband Service to All Americans,"[2] while more than 56 percent of all cities with populations exceeding 100,000 had DSL available, less than five percent of cities with populations less than 10,000 had such service. Deployment of both cable modems and DSL service in remote rural areas is far lower.

It is our opinion that market forces alone will not solve the issues facing these regions. In order to ensure that technology is available for all regions on an equitable basis, it is important to coordinate these grassroots efforts.

Humboldt County is seeing a decline in resource-based industries and is looking at technology-based industries as a tool to rebuild in education, agriculture and rural redevelopment. Healthcare is becoming a major issue with an aging population. They have and recognize the demand for more telecommunications but do not have the "middle mile"—the infrastructure to connect their northern coastal region to the rest of the world. Residents of Humboldt are a mere 21 miles away from high-speed connectivity to the rest of the world. At issue—CalTrans unanticipated requirement that SBC pay $6.40 per linear foot per one-inch conduit for right-of-way access, which adds up to about $2M. The past practice has been to use an "incremental cost recovery" model in pricing right-of-way; however, in times of budget crunches, practices change. In addition, Level3, WorldCom and AT&T have paid much higher fees in other parts of the State. The situation has gone on for over a year and is now in court where it will likely languish for more years. The CPUC has ruled it out of their jurisdiction. Legislators see it as a hot potato in times of budget cuts and it is too small an issue for national policy-makers. Neither SBC nor CalTrans is willing to budge on what could be a precedent-setting issue. All this time, the businesses and residents of Humboldt County wait.

Dichotomy of Interests

Ironically, some of the biggest supporters of next generation broadband are also the greatest obstacles to next generation broadband deployment. During interviews, Gartner repeatedly found conflicts of objectives by the various parties who would potentially benefit from the deployment of next generation broadband, including:

- Some manufacturers of PCs believe next generation broadband networking will drive the next wave of PC deployment. They believe next generation broadband will result in the purchase of computers containing massive storage used for archiving pictures, movies and other files that constrained bandwidth have precluded sharing. Aware that a substantial portion of the files are copyright-protected and perhaps shared without explicit permission, computer makers are asserting the need for content providers to modify their business model to accommodate next generation broadband distribution in recognition of the inevitable sharing of Intellectual Property.

Taxonomy of Agendas

Group	Agenda	Outcome with No Broadband Focus	Outcome with Focus
Service Providers	Both cable and telcos want change only in the context of current business models and some use regulation as an excuse or delaying tactic. Both cable and telcos are struggling with changes to their business models and competition from alternate providers and technologies.	Communications providers will continue using the regulatory environment as a means of delaying drastic changes to investment strategies and business models. Both Internet-protocol-based networks and fiber to the user threaten cable and telcos' business models.	Will be challenged to participate in the next-generation network planning and deployment or face being excluded.
State Legislators	Have the willingness to advance a popular broadband agenda, but many may not understand what broadband is or what it means. They may lack the technical knowledge to create a long-term vision. Legislation is often reactionary to a perceived need.	Will continue advocating legislation that promotes clearly defined, narrowly focused and short-term agendas. They'll avoid legislation that requires funding or revenue reduction. They'll struggle to understand the implications of technology.	Will take advantage of a defined vision and will focus legislation to contribute to the vision, as needed.
State Regulators	View that they've dealt with broadband in previous proceedings. They're concerned about the utility—and are focused on identifying the cost versus the benefits.	Will continue focusing on enforcement of existing regulatory frameworks and on actions that fit within the context of current state regulatory norms. Absent specific legislative direction at the state level, will not address next-generation broadband.	Will welcome a vision to focus their regulatory agenda. A collaborative vision would eliminate contention and the protracted nature that many regulatory proceedings experience today.
Consumer Advocates	Understand that their constituents may not recognize the specific value of these issues. They say that broadband access is not a luxury and providers over state costs.	Will continue struggling to educate constituents and policy makers. Services for constituents will continue to be viewed as discretionary and as a result, will not address the specific needs of these user communities.	Will focus on educating about the benefits of the defined vision, knowing their constituents will pay for perceived value. Will seek assistance to bridge the gaps and will be involved in R&D.
Economic Development Groups	Face an uphill battle—especially outside the first-tier markets—getting providers to invest. Must deal with issues beyond the technology itself such as technical literacy.	Will compete with other regions for state and corporate support. Success will be limited to the attractiveness of the market and the determination of local leaders. Experience gained may or may not be shared with others.	A focused broadband vision would promote collaboration, leading to an improved mechanism for success.

Taxonomy of Agendas

Group	Agenda	Outcome with No Broadband Focus	Outcome with Focus
Municipalities	Are frustrated and view broadband as an economic development necessity and are looking for ways to protect existing revenues and create new revenue sources. Some are taking matters into their own hands.	Will continue trying to address problems locally without an integrated plan or vision of what is possible. Many will attempt to develop their own networks and will fail, damaging the credibility of municipal actions.	Will allow for a collaborative process among municipalities utilizing best practices to meet common interests. Will lead to focused policies.
Academics & Technologists	Are living with technology and understand the future opportunity in terms of technological change. Their view is often too visionary for the short-term planning horizon of both policy makers and service providers.	Will continue exploring opportunities and applications. Funding will continue to follow the bust-and-boom cycles of the economy. Implementation of outcomes will be predicated on market pull.	Efforts will be more focused as well as more broadly and consistently supported.
Content Providers	Are happy with their current controlled distribution mediums and view broadband as another threat to their control over intellectual property.	Will continue using regulation and the courts to protect their current business models.	Will change the business models to take advantage of the new applications and services that will result from ubiquity.
Consumers & Small Businesses	Are looking for quality services at affordable rates.	Will continue to be left behind as content and service providers cater to higher-volume, cheaper-to-serve, greater-margin customers.	Will expand the number of consumers and businesses that enjoy the benefits of new services and a competitive market.

- Others are unwilling to market next generation broadband appliances that use network-based, storage, application hosting and portal capabilities—effectively negating a key benefit of next generation broadband: substitution of bandwidth for a personal computer. Larry Smarr, Director, California Institute for Telecommunications and Information Technology, observed, “Next generation broadband is economically feasible when you consider the ability to trade a $1,000 PC for the $1,000 cost to bring next generation broadband to a home. This technology will last for ever; a PC lasts maybe three years.”
- The incumbent telephone companies say they would love to have today’s broadband deployed ubiquitously on their network, but not at the expense of cannibalizing their existing PSTN lines. In the late 90s, telephone companies experienced the growth in second lines used for dial-up connections to the Internet. Now, many of those lines are being disconnected and replaced by today’s cable data and DSL services. Not all of the DSL lines are provided by incumbents.
- The incumbent telephone companies are engaged with regulators to stop the wholesaling of their network infrastructure to competitors at heavily discounted rates, which in turn are used

to lure customers off incumbents' existing lines as well. To protect their interests, both sides have hired the best regulatory lawyers and lobbyists to represent their interests, resulting in increased uncertainty in the market.

- Cable companies have outstripped the telcos in deployment of high-speed data via their cable modem technology. However, they want to restrict what Internet Service Provider you use.
- Content producers would love to see next generation broadband be available for the sale of copyrighted material, but not at the cost of eroded profit margins. Rather than concede that the emergence of digital distribution has eliminated the profits previously obtained through the packaging and distribution of music and videos, content producers are fighting hard to shut down any element of the information infrastructure that enables copying of unauthorized copyrighted material. Recording Industry Association of America (RIAA) recently went as far as filing a lawsuit against four college students who were running file-swapping servers. They are asking for maximum damages.
- The technology that has the greatest potential for providing high-speed services to the greatest number of people—broadband wireless—continues to be stymied by the FCC and by inefficient utilization of spectrum. Huge chunks of desirable licensed spectrum go virtually unused rather than being reassigned.
- Regulators and service providers look at these technologies in the context of existing services and business models. This leads to the industry participants on all sides continuing to manipulate regulation to delay unfavorable changes.

In summary, each of these groups is a proponent of next generation broadband deployment, but only on their terms. According to these companies, next generation broadband deployment should be provisioned in such a way that their existing business plans are unaffected. Gartner asserts that given key players duplicity in motives, it will be impossible to deploy ubiquitous next generation broadband without exceptionally strong leadership.

The "Taxonomy of Agendas" table represents the potential outcomes of these motives absent a broadband focus and with a focused next generation broadband initiative. In this taxonomy of agendas, views are colored by self-interest in the context of business models, financial resources, political support or funding, and are closely coupled with the level of technological understanding. There is no consensus on the definition of broadband, identification or need of a killer application or where leadership for any level of broadband initiative should reside.

Other Obstacles

We face other obstacles that need to be addressed if we are to achieve the ubiquitous Gigabit goal. These include:

- We must lower the cost per bit of data at the high speeds required in the distribution and core of the network.
- We must find solutions for cost-effective "First Mile" connectivity.
- We must address the issue of protecting the owners of intellectual property; next generation broadband will not survive on the illegal distribution of copyrighted material.
- We must recognize the digital divide and address inequities that exist.

Fact–We Must Lower the Cost per Bit

The primary technological obstacles are the need to lower the cost of providing next generation broadband services and the need to recognize that new technologies are needed to support next generation broadband service to every end user.

Most of today's high-speed networking technologies are based on the point-to-point networking of granular streams of synchronous, low-speed voice traffic. This networking technology predates the emergence of data networking entirely. With their design completely based on voice networking, this infrastructure was not designed to handle the high-speed, bursty nature of data traffic and to do so is very expensive.

DSL technologies lowered the cost of providing high-speed services through the use of packet-based networking. That is, data is routed through the network much the same way a letter is routed through the U.S. Mail on the basis of the originating and destination address without regard to the specific path the letter/packet takes. This change allowed portions of the network to be shared when they were not being used. This contrasts with the practice of dedicating portions of the network to specific users regardless of their usage. Although a leap forward in cost and performance, DSL will not scale to provide next generation broadband access to the network-new technologies will be required. Two technologies that show the most promise are Ethernet in the access loop and Passive Optical Networking (PON) using fiber.

New technologies based on Ethernet in the access loop have been dramatically lowering the capital and operational costs of a carrier network. Many of the newer carriers such as On Fiber[3] and Yipes[4] embraced this networking technology during the deployment of their networks in the business market. Their networks are based on the use of Optical Ethernet in the Metropolitan Area Networking[5] (MAN), whereby customers are connected to the network via fiber transmitting Ethernet data. The use of Ethernet over fiber in the MAN is as simple as connecting a PC to a Local Area Network via a Category-5 wire.

Although progress is being made in the access loop, substantial progress also needs to be made in the core networking technologies. Today's switches and routers only have 10-Gigabit backbone connections-they cannot scale to handle the hundreds and thousands of Gigabit connections required per switch. Here, optical switching technology holds the promise of scaling the next bandwidth peak. Optical switching eliminates the conversion between light used to transmit data on fiber and the electronic impulses required to switch data. Optical switching can switch using native light. The impact is predicted to be comparable to when the transistor eliminated the need to use analog vacuum tubes in electronic circuits.

Getting new, low-cost access networks and optical networking technologies deployed is a challenge, but by no means impossible. States such as Georgia and Michigan are leveraging their purchasing power to require the deployment of low-cost access networks. California's CENIC is currently building its own optical network infrastructure to establish a multi-tiered advanced network services fabric to serve all research and education in California. This will provide the entire California research and education community with the most cost-effective advanced services network available.

Optical networking research and development is happening at all of the major networking companies and research universities. Equipment trials are currently being performed on the CENIC network, Canada's CANARIE network and others.

> In Loudoun County, Virginia, a bedroom community located 50 miles south of Washington D.C., four residential developments are deploying over 10,000 Fiber-To-The-Home (FTTH) connections.[7] The FTTH connection will be used to provide a basic package of services that includes a 100Mbps-fiber connection, phone service and 130 channels of digital cable.

Fact–We Must Find Solutions for Cost-Effective "First-Mile" Connectivity

Our interviews revealed unanimity that the lack of connectivity in the First Mile—defined as the connection from your home to the carrier network—is the primary obstacle to today's and next generation broadband deployment. Homes and businesses do not have the fiber interconnectivity required for next generation broadband.

The answer for new construction is simple, easy, profitable and being seized by progressive developers and municipal planners-simply deploy the fiber during the build-out of utilities. By doing so, the average cost per home to deploy fiber is well under $500. Should the developer choose to provide services over the fiber, the developer is often able to sell the system at a considerable profit.[6]

According to a new study released during the FTTH Conference 2002, FTTH installations are expected to leap by 330 percent in 2003 from 72,100 homes passed to 315,000 homes passed, ultimately reaching between 800,000 and 1.4 million homes by 2004.[8]

FTTH deployment could be even greater if FTTH standards were in place so that a builder could have greater confidence that FTTH investments didn't have a risk of becoming a "white elephant." Lennar Home Builders has been very active in partnering with service providers in the deployment of broadband services to the 27,000 homes Lennar built last year. Lennar also deploys broadband service in conjunction with its cable TV systems in selected master planned communities.

Alan Hyden, Vice President and Customer Care Representative, has found, "There are a few competitive service providers who are willing to partner in the deployment of fiber to the home. However, Lennar hesitates to partner because of the difficulty in finding a financially stable partner with a sustainable business model, coupled with the risks of installing non-standards-based equipment. We would deploy more fiber if we could be certain our home buyers and our investments would not be stranded." With the proper standards and guidelines, fiber deployment could become the norm in new construction.

The answer isn't as easy for existing homes that must also be wired with fiber. As was mentioned earlier, fiber offers many advantages: first and foremost is the usable investment life of at least 20 years. Assuming an average cost of $1,500 to wire an existing home, the monthly per home cost of fiber deployment amortized over 20 years is $6.25; only 12.5 percent of the typical $50 revenue currently earned from a DSL customer. (note: This calculation does not attribute the maintenance cost savings of fiber infrastructure.) What is needed is an economic model that allows the return of capital over a 20-year horizon. This is an issue in where State legislators and regulators need to craft the solution. Capital markets will not provide 20-year financing without assurances of minimal risks.

> [It is important to note, from the customers' perspective, the $6.25 per month cost will be more than offset by the ability to place long-distance calls for substantially less per minute.[9] Users would no longer be billed for minutes of use on a network that is "always on" or for features that could be enabled via shareware on PCs.[10]]Incumbent service providers seem more concerned with the loss in revenue that next generation broadband portends than they are with the capital cost of infrastructure deployment. This new infrastructure holds significant challenges for the service providers' business model.

As part of its report entitled "Broadband Services as a Component of Basic Telephone Service," the CPUC developed estimates of the preliminary costs to overlay Asymmetrical Digital Subscriber Line (ADSL) technology. The estimates of average cost per access line were collected from large and midsize ILECs regulated under the New Regulatory Framework (NRF) and rural companies under traditional Rate of Return regulation. The resulting costs produced basic rates that increased between 276–552 percent or a range of $30–45[13] and a cost of $5.3B over five years, far different from the $6.25 per-month cost per home. Gartner submits that a clear identification of real cost will be an important and difficult action item within any next generation broadband initiative.

In Asia/Pacific Markets, Voice over IP is already being utilized by service providers to deliver services. Gartner Dataquest estimates that the retail VoIP revenue in Asia/Pacific is expected to leap from 14 percent in 2001 to approximately 40 percent of the total international voice telephony by 2006. The rapid growth of VoIP services in Asia/Pacific can be attributed to the gradual dismantling of monopolies in the telecommunications sector in most markets.[11] While the penetration in the U.S. Consumer market is still in very early stages,[12] some competitive service providers are beginning to enter the market.

On 13 February 2003, EarthLink announced the launch of EarthLink Unlimited Voice, the first comprehensive Voice-over-IP (VoIP) solution from a nationwide Internet service provider (ISP). The new Internet service includes free unlimited local, regional and long-distance calling for a flat rate and such features as voicemail, caller ID, call waiting, call return and call forwarding. Earthlink DSL and Cable customers can enjoy all of the features and calling for $39.99 per month in addition to their DSL or Cable connection (which is priced between $41-46.00 per month.) The average Consumer bill for local service is $27.00 per month and the average bill for long distance is $31.00 (according to Gartner Consumer Research, Dec. 2002) in addition to the broadband connectivity.

Fact–We Must Protect Intellectual Property

Interviewees noted that, "Piracy enabled by peer-to-peer applications is the current killer app" of today's broadband networks and, "tens of millions of people risk going to jail to share movies and music."

At its peak, the most infamous peer-to-peer application, Napster, was reportedly responsible for 50 percent of Internet traffic. Some say the initial demise of Napster was a key contributor to the telecom industry meltdown. Why was Napster so successful? Because it allowed for the distribution of copyrighted music—intellectual property—for free.

The first users of the technology found the "freeness" to be the driver for sharing. Today's users are not so cost-conscious—they use peer-to-peer applications because it is the easiest way to get the music, movies, sitcoms, etc., that they desire.

Those who have paid thousands of dollars for music CDs (many of which may have been purchased on the strength of one song) may feel like giving a rebellious cheer for the people who are able to download music for free. Beyond rebellion, there is a growing proportion of people who feel copyright protection is onerous. During our interviews, Gartner found some advocates of the concept of the "genie being out of the bottle" with regards to the ability of individuals to share content peer-to-peer having become permanent. These advocates argue the owners of content need to establish a new business model that recognizes and accommodates peer-to-peer sharing and the realities of digital distribution.

Regardless of these opinions, California has the most to lose should copyright protection no longer be enforceable. The content industry is now the United State's second largest export, and California's largest. The music, film, software and gaming industries have always been about the development and control of content. Should copyright protection fail, the State's economy will be detrimentally impacted as the value of its largest product falls precipitously. We must find a way to protect copyrighted material to both accelerate the growth of next generation broadband and protect vital California industries. Because California has so much to gain or lose from resolution of intellectual property management issues, the importance of the identification of a solution should be addressed as a part of the next generation broadband initiative. Until then, our largest industries may view the digital distribution enabled by next generation broadband as more of a threat than a benefit.

Robert Zitter, SVP of HBO, suggests, "We need to find a way to accommodate the unrestricted peer-to-peer sharing of non-copyrighted material while protecting the interests of intellectual property owners. Government could have a large impact on the successful deployment of next generation broadband by focusing on the copyright issue."

Fact–We Must Recognize the Digital Divide and Be Inclusive

According to "A Nation Online: How Americans Are Expanding Their Use of the Internet," U.S. Department of Commerce, February 2002, a number of groups are more likely not to be Internet users. The "Offline Population" includes:

- People in households with low family incomes—75.0 percent of people who live in households where income is less than $15,000 and 66.6 percent of those in households with incomes between $15,000 and $35,000.
- Adults with low levels of overall education—60.2 percent of adults (age 25+) with only a high school degree and 87.2 percent of adults with less than a high school education.
- Hispanics—68.4 percent of all Hispanics and 85.9 percent of Hispanic households where Spanish is the only language spoken.
- Blacks—60.2 percent of Blacks."[14]

More than one interviewee cautioned us not to assume that lack of affordability is a key issue—people make decisions on value—the gigabit is not the value—it is what people can do with it. "Poor people" are already spending dollars—access to information is no longer a luxury.

In fact looking at the "A Nation Online" report referenced earlier there is reason to also see the glass as "half-full."

- Between December, 1998 and September, 2001, Internet use by individuals in the lowest income households (those earning less than $15,000 per year) increased at 25 percent annual growth rate as compared to an 11 percent annual growth rate for individuals in the highest-income households (above $75,000 per year).
- Computers in schools substantially narrow the gap in computer usage rates for children from high- and low-income families.
- Between August 2000 and September 2001, Internet use among Blacks and Hispanics increased at annual rates of 33 and 30 percent, respectively. Whites and Asian Americans experienced growth rates of approximately 20 percent.
- Over the 1998 to 2001 period, growth in Internet use among rural households has been at an

average annual rate of 24 percent and the percentage of Internet users in rural areas (53 percent) is now nearly even with the national average (54 percent).

- The highest growth rate among different types of households is for single mothers with children (29 percent).

These statistics speak to the fact that the Internet is becoming more inclusive. The challenge is to ensure that as Internet's "narrowband" applications mature to "broadband" applications we do not lose the ground that has been gained in these often underrepresented groups.

The Gartner definition of the digital divide is as follows:[15]

- The digital divide is the gap in opportunities experienced by those with limited access to technology, especially the Internet. This includes, but is not limited to, accessibility challenges in the following areas:
  - Economic: being unable to afford a computer
  - Educational: not knowing how to use a computer
  - Physical: disability, such as blindness, that causes difficulty when using graphical environments
  - Cultural: membership of a community that prohibits or restricts access to technology

These divides are real and will not be solved solely by the deployment of broadband. In our research, we found that a substantial portion of people believe these issues need to be resolved as a part of a next generation broadband initiative. Gartner agrees, but suggests that we put the issues into perspective. These same divides faced the deployment of automobiles, electricity and telecommunications. The challenge is to be able to overcome the divides, NOT allow the divides to overcome us.

Based on our interviews in the study, Gartner suggests the following be considered when crafting solutions:

- Look for opportunities to increase the utilization of infrastructure through pooling or sharing of capacity for applications that reach rural or economically disadvantaged areas.
- Be inclusive in R&D—technology developed for games and entertainment may usefully be shared in healthcare and education.
- Create or incent programs that address technical literacy and: 1) consider cultural diversity; and 2) utilize Universal Design principals.
- Make the connectivity part of every child's education by ensuring that teachers receive training and support and all schools are networked internally and externally and have technical support.
- Expand and nurture grassroots coalitions at the local level; people and communities should not be seen as simple consumers of information, but should be put in a position to contribute, creating content, providing feedback, tailoring content and channels to specific needs. This requires training on content management technology, the establishment of parts of government or community sites that can be directly modified by users, as well as forums and moderated chat rooms.

Mythological Obstacles

We call the following obstacles mythological because we believe them to be imaginary and without foundation. In the following section the lance is tilted at the windmill in an attempt to slay the imaginary dragons.

Myth–We Must Wait for the Killer Application

Common mythology holds that we must wait for the killer application before next generation broadband is deployed. This mythology is grounded in the widespread belief that deployment of next generation broadband will not be funded in advance of demand, and that next generation broadband should be deployed by private industry. Although we concur completely with the aversion to building a field of dreams, we assert the wait for a killer application is over and the next killer application has been sighted on the horizon.

In our interviews, regardless of how technologically savvy the individual was, very few people could see one specific killer application that justified next generation broadband. Some very prescient people have grown so weary of the quest that they boldly assert a killer application is not a needed prerequisite to next generation broadband deployment. Others have grasped at "straw" applications that would be enabled by next generation in the hopes that the demand for these applications could be the catalyst for broadband deployment.

The most commonly identified "straw" application that individuals felt would obviously require bandwidth beyond either DSL or cable was video, generally in the context of entertainment. When asked what next generation broadband would do better than other available technologies, a common response was: download a movie in 16 seconds. Although the ability to distribute entertainment rapidly may initially appear to be next generation broadband demand driver, this hasn't been proven in past market tests. Nor is it the type of application likely to loosen the purse strings of regulators or legislators.

We have two concerns regarding the wait for the killer app. First, we believe that in the eternal argument of, "Which came first, the killer app or the enabling technology?," both come simultaneously. You must first have a killer app that provides immediate economic viability for some level of infrastructure deployment. Then, the infrastructure itself acts as the catalyst for the emergence of a new killer app. This could be viewed as similar to software releases that build one upon the other. The initial code is the hurdle.

Using the personal computer (PC) as an example, Thomas Watson of IBM is infamous for his quote: "At most, the world needs about five computers." We would be hard pressed to find a better example of an inability to see the catalytic effect of a new technology. Most people agree that the original killer apps for the PC were spreadsheets and word processing. Most also agree the killer app for networking was e-mail. These applications provided the economic justification for the purchase of the original computing and networking infrastructure. Now, computing and networking have been eclipsed by the Internet as the prevalent economic justification for the purchase of both PCs and networking-the new killer app. The Internet wasn't a killer app until both the PC and networking were deployed at a level of ubiquity for application development. So you have the enabling killer app—the application that justifies initial infrastructure deployment; and you have the enabled killer app—the application that emerges from ubiquitous infrastructure.

As noted earlier in this report, next generation broadband as a new communications platform is the enabling killer app; the enabled killer app is interpersonal communications. Interpersonal communications has always been, and always will be, the killer app.[16] Personal communications was the reason for the development of the following applications:

- Language—language itself was developed to communicate
- Writing—at the earliest we communicated via written scrolls
- Telegraph, phonograph, telephone, computer networks, etc.

The killer app for next generation broadband will simply be the ability to communicate better. With next generation broadband, we will be able to have a multimedia, and soon multi-sensory, conversation with one or more people—something that can only be done in-person today.

The impact of this communication medium cannot be understated. Already in next generation broadband-connected universities across the U.S., students are developing collaborative social skills that will be essential in the information economy. These same students can be expected to revolutionize business processes once they apply their unique skills in the business community. Those who are not used to collaborating, being online virtually or leveraging mobility tools, will be at a disadvantage.

Myth–We Must Wait for the New Technology Solution

The second-most-popular mythological obstacle is the perceived need to wait for the elusive new technology that would somehow cheaply and simply solve the "First-Mile" connectivity challenge.

Wireless technologies were often mentioned in the interviews as easy-to-deploy, high-speed access that would be faster than DSL and cable and cheaper to deploy. Although many tech-savvy interviewees found wireless interesting, they also acknowledged that it would not meet the long-term next generation broadband bandwidth needs and would never be able to replicate the capacity of fiber. Nevertheless, wireless broadband will be an important technology to address the high-cost/hard-to-reach locations isolated by today's wireline broadband limitations or cost.

Microwave, one interviewee opined, could carry a Gigabit but not as a ubiquitous access technology

This does not mean that Fixed Wireless, Wi-Fi, DSL or cable data should be abandoned as access technologies, just that they should be recognized as interim or complimentary technologies. They will serve a practical need of increasing the average amount of bandwidth per user and undoubtedly foster more next generation broadband applications.

Gartner believes, and our interviews confirmed, that fiber provides the only proven method of providing a Gigabit of bandwidth per user. Although one interviewee did present a case for some cable networks being able to provide a gigabit, Gartner asserts it would be on a shared basis and probably asymmetrical as well. Fiber has the advantage of being capable of deployment today using today's networking technologies, and then being upgraded over the course of a 30-year functional life. It can immediately be deployed with no concerns of technological obsolescence. Fiber is the only technology with these assurances.

Both wireline and wireless carriers have embraced bundling high-speed data services as a key product differentiator. The U.S. market for cellular and Personal Communication System (PCS) services is extremely large, with more than 128 million subscribers and a cumulative investment of more than $105 billion by the end of 2001, according to the Cellular Telecommunications & Internet Association (CTIA). Wireless providers are not only exploring ways to deliver data services over their core infrastructure, they are also exploring the use of Wireless LAN technologies to augment their data capability using variations of the 802.11 wireless networking protocol also known as Wi-Fi.

For wireline carriers, deploying high-speed services is a survival strategy for remaining in the competitive market. Unfortunately, Gartner believes the deployment of today's broadband services by wireline carriers is but a quick fix. Gartner believes wireless providers can and will offer equivalent services with the added advantage of mobility and ubiquity. Certainly, in many European countries mobile is already the basic telephone service for many users. Countries like China, without the burden of embedded wired infrastructure, are able to leapfrog countries such as the U.S. with next generation fiber and wireless infrastructure. In this future environment, we believe wireless carriers will become dominant providers of voice services, just as we currently see happening within Europe and developing countries.

To survive and thrive Gartner believes wireline carriers must use the current investment opportunity to deploy an unassailable competitive advantage. Now is the time to make an investment wireless providers cannot match because of wireless technology limitations. Now is the time to exchange today's survival strategy of high-speed services for a success strategy based on next generation broadband service platforms. Clearly, we believe enabling integrated next generation broadband services is the key to survival for wireline providers.

New technologies that will lower the cost per bit of bandwidth do need to be developed. As stated previously, cost-per-bit barriers are real obstacles. But for now, fiber can be deployed immediately with minimal risk of technological obsolescence.

Myth–There Is a Glut of Bandwidth, So We Don't Need More

There appears to be a misunderstanding of exactly where the glut of bandwidth exists. In many places and in many situations, there is indeed a glut of capacity in the backbone. The shortage—and indeed the bottleneck—exists in the First Mile.

Myth–We Must Wait for Funding

People ask, "If private industry won't fund broadband, why should government?" We agree with many of the interviewees that the government should not be responsible for the funding of broadband deployment (although there were one or two interviewees who brought up the example of the government funding the highway system). The germane question is "Why isn't private industry funding the deployment?" The answer is simple: they are busy deploying today's high-speed services as fast as they can. They aren't even considering next generation broadband deployment.

Incumbent telephone companies are deploying DSL at record rates. Cable TV companies have invested billions of dollars to provide cable modems. We believe both are currently limited only by their ability to supply and market the service. The trouble is, neither DSL nor cable modems are capable of giving us the Gigabit speed required for long-lasting next generation broadband. Nor are they capable of delivering the kinds of services and applications envisioned that would stimulate the economy. The investment being made in today's infrastructure will become a "white elephant" over time, just as ISDN was eclipsed by DSL and analog cable was replaced by digital. Telephone companies and cable TV companies are making investments in technologies that meet today's demand while offering short-term returns on investments. They are not investing in long-term infrastructures such as fiber to the home.

"We need to investigate broadband's social impact and needs. The issue isn't just technology and economics. There are many ways to fail; a lot needs to line up in order to succeed. We may need to address a reorganization of education, government and governance. Each of these areas will be substantially impacted through the deployment of broadband. The impact of the free flow of information is unknown."
—Richard Lowenberg, Director, Davis Community Network.

The challenge is to ignore the myths and instead focus on the issues that we know to be facts as the basis for developing a strategic broadband initiative for California.

F. Broadband Leadership and Organizational Roles—A Recommendation

What is needed to accomplish this next generation broadband initiative most of all is leadership—both from the top-down and the bottom-up.

Leadership from the bottom-up means that innovators and early adopters will need to take responsibility for the deployment of next generation broadband within their communities, showing its potential to others. In the Internet, the motto of "rough consensus and running code" has driven many of the innovations we see today, primarily from the bottom-up. Waiting for the federal government, private industry, or state government to take responsibility for the community is not wise and leads to long waits for deployment.

The top-down leader must pull all the players together to make sure things can and will happen. A vision driven by goals and objectives needs to be established. Roles and responsibilities need to be identified. Action plans need to be developed and coordinated and progress monitored. Everyone has a role and a responsibility.

The Search for Next Generation Broadband Leadership

The lack of a leadership may be the largest roadblock on the path to next generation broadband. California needs leadership that can:

- Understand the interests of all stakeholders and bridge differences in objectives to forge a common goal
- Understand the complex technology issues that must be resolved, knowing which issues must be addressed, and those that are red herrings
- Develop partnerships and collaboration between the hundreds, possibly thousands, of stakeholders
- Navigate the treacherous political waters and survive the boom or bust funding cycles.

In the interviews, leadership was another question without consensus, although many agreed that for a statewide initiative to be successful, key political figures, such as the governor, needed to support it. There was also a strong sentiment that leadership should transcend political cycles as well as budget cycles. Interviewees felt that the role government entities, such as the CPUC, the governor and the legislature, need to play is one of strong support and facilitation rather than taking on project leadership. The suggested roles for these entities varied. More than one person felt that these organizations need to "think outside of the box" and use their ability to create and provide incentive for change, even perhaps overriding local regulations when necessary.

In any multi-party, multi-objective endeavor, collaboration is crucial. When asked "what is the appropriate role for government in the rollout of broadband services?," interviewees repeatedly stated that government can best help itself by collaborating among the different governmental departments and agencies. Gartner was told government should be active in celebrating successes, sharing best practices, aggregating demand and facilitating collaboration. We were referred to examples such as the Greater Austin Area Telecommunications Network (GAATN) in Texas.[1] GAATN was founded through the collaborative efforts of the Austin Independent School District, Austin Community College, City of Austin, Lower Colorado River Authority, Travis County, the State of Texas represented by the Department of Information Resources and the University of Texas at Austin. The network consists of more than 320 miles of 12-strand fiber with 11 SONET rings serving 173 sites. According to Patrick Jordan Chair of the GAATN Board of Directors:

> "Community of Interest can best be achieved by finding a community of interest within local municipalities, utilities, educational facilities, etc. Conducting facilitated meetings to explore win/win opportunities with the community of interest. Documenting local strengths and needs to assure the network provides the function requirements of the stakeholders. Setting aside boundaries and/or creating jurisdictions that can effectively govern the network. And by planning for at least 25 years, building a survivable management organization that is self-sustaining."

Several of the interviewees suggested CENIC could initiate the consensus building. Leaders lead by doing, and CENIC has been very active in doing the right things to support the deployment of ubiquitous next generation broadband access. CENIC has been a leader in California by:

- Interconnecting universities as well as primary and secondary schools with a next generation optical network called CalREN;
- Supporting research networks that are attempting to lower the cost of access; and
- Sponsoring discussion of the goals and objectives for the deployment of next generation broadband through its NGI Roundtable.

Taking the lead in the achievement of a consensus would appear to be a natural role for CENIC. The NGI Roundtable may make an excellent consensus-building forum.

Role of Policy Makers/Legislators

It was obvious, as well, that interviewees felt that all levels of government, from the Governor to rural municipalities, need to be involved.

More than one interviewee referenced the work done by NSF and DARPA when framing the type of vision that is needed. Nothing today was seen as having a similar vision.

Other roles outlined for policy makers/legislators/regulators were:

- Become purchaser of services (anchor tenant)
- Continue R&D sponsorship
- Eliminate right-of-way barriers (municipalities as well as several state agencies such as CalTrans have a role in this)
- Eliminate regulatory barriers to competitive entry
- Eliminate cumbersome bureaucracies that could slow this next generation broadband initiative
- Enact new rules and regulations designed to promote next generation broadband deployment and that recognize intermodal competition and level playing fields
- Create "regulatory free zones" where adequate competition existing between companies and technologies eliminates conventional regulation
- Require new developments and redevelopments to, at a minimum, place conduits that could be utilized by multiple providers to place a fiber infrastructure

In 1958, President Dwight Eisenhower created the Advanced Research Projects Agency (ARPA) to jump-start U.S. technology and find safeguards against a space-based missile attack. (Later the "D" was added to the acronym for "defense" and it became DARPA.) This initiative led to the development of the ARPANET seven years later, and then to the NSFNET and the Internet we know today.

The National Science Foundation's (NSF's) enlightened management facilitated the Internet's first period of explosive public growth. Starting in 1979, the NSF funded development of the CSNET to link computer science departments in universities not connected to the ARPANET, an experience that familiarized them with the benefits of internetworking. In 1985, there were three critical decisions that shaped the development of NSFNET. That it would:

- Be a general purpose research network
- Act as the backbone for connection of regional networks
- Use TCP/IP

The initial NSFNET consisted of a network backbone built with 56kbps lines. While 56kbps sounds awfully slow (and cost about $18K per year for the connection that today costs about $180.00 per year)—compared to today's Internet, the load was correspondingly less as well—there was no multimedia yet, and simple contour graphics were as complex as most communications got.

- In 1987 a much faster 1.5Mbps network was established for communication between the original supercomputing centers, plus seven additional research networks. The upgraded NSFNET connected more than 170 TCP/IP enabled networks in all and traffic began to double approximately every seven months.
- In 1990, military-sponsored ARPANET was dissolved, and the research network was passed to the NSFNET.

Pressure began to build to allow commercial use of the network, which was prohibited by NSFNET. In response to the demand, a number of parallel networks were formed to allow commercial traffic, including the UUNET network ALTERNET, Performance Systems International (PSI) network PSINet, CERFNet, and NEARNet. The umbrella organization Commercial Internet Exchange (CIX) Association was formed by CERFnet, PSINet, and AlterNet to promote commercial use of Internet networking.

- In 1994, the traffic on NSFNET broke the 10 trillion bytes-per-month level.

On 30 April 1995, the NSFNET was officially dissolved, although it retained a core research network called the Very High Speed Backbone Network Service (vBNS), which formed the basis for the Internet2 project. At its peak, the NSFNET connected more than 4,000 institutions and 50,000 networks across the United States, Canada and Europe.

Excerpt from LivingInternet.com (www.livinginternet.com)

- Facilitate the development and enforcement of service-level standards
- Facilitate the development of new, advanced equipment and interconnection standards by standards bodies
- Allocate spectrum in a way that provides an incentive for investment
- Evaluate tax incentives or narrowly defined, specifically targeted subsidies for companies serving rural or poor areas
- Create new uses and sharing opportunities for the California Teleconnect, High-Cost Assistance and Lifeline funds—as appropriate—to advance technical literacy, particularly through schools and adult education programs
- Facilitate the creation and deployment of commercial test beds and accommodate any required changes to promote ubiquitous deployment stemming from the test markets.

There were also issues relative to applications, such as licensing and reimbursement issues, that limit the growth of initiatives such as e-health. Attachment G references some of the "best practices" from other regions.

Legislators should look for opportunities to eliminate or streamline laws and regulations that prevent these types of initiatives. We should look to the level of success that governmental involvement contributed to South Korea:

> "By having a clear vision and strategy, the government ensured a high degree of confidence and certainty for private-sector companies. Although it is difficult to quantify the impact of the government's involvement, it seems very unlikely that South Korea would be the world's leading next generation broadband nation without it."[2]

First mile connectivity solutions require actions by developers, municipalities, policy makers and regulatory bodies.

The deployment of infrastructure—either conduit or fiber—during the construction of new residential developments should become mandatory. The U.S. currently has fiber included in the construction of 70 of residential developments[3] in 20 states. Only nine of these are within California. In 2002, only four of 20 were in California.

Role of Municipalities

Municipalities have not been waiting for the rollout of today's next generation broadband services. The requirement to support e-government applications, Graphic Information Systems, public safety systems and the day-to-day business of the government add up to substantial bandwidth requirements. In fact, long-term cost reduction has caused cities such as the Austin, Texas; Roanoke, Virginia; and Portland, Oregon, to be at the forefront of deploying today's broadband to interconnect city facilities. Counties such as King County, Washington, have deployed self-sustaining broadband networks that interconnect county offices, educational facilities and libraries.

These municipal networks typically leverage fiber that was granted to the municipality by a Competitive Local Exchange Carrier (CLEC) or cable company during the deployment and/or upgrade of infrastructure. Properly deployed and operated, these networks can dramatically increase the services at a cost substantially lower than that charged by Incumbent Service Providers. This is achieved through the deployment of optical Ethernet technologies that merge multiple existing networks into a single converged network.

The success of these municipal networks has resulted in lobbying against this by service providers. They have challenged the appropriateness of municipalities owning and operating broadband networks. The questions raised include ones of appropriate use of core competencies, public funding of infrastructure used to bypass the telephone network, and the detrimental effect that selling of excess capacity would have on open market competition.

In Texas and elsewhere, this lobbying has resulted in legislation that prohibits the use of municipal networks beyond city-owned facilities, precluding their use for providing broadband services to the public often in areas that the incumbent has no interest serving. It's our opinion that the determination of whether this should be allowed should be based on the community needs—not the narrow interest of one provider. Despite all of the restrictions, municipal networks continue to be successfully deployed and are a bright light on the horizon of next generation broadband deployment.

In California, many municipalities are investigating the feasibility of deploying municipal networks. This interest should be nurtured and municipalities should be empowered to take the front line in the deployment of next generation broadband. Many of them are documenting their processes and outcomes. Some have created guides. The challenge is to capture the collective experiences of these trailblazers and share best practices that capture both the successes and the failures. Doing this will not only help jump-start other regional projects it will allow successes to be replicated and enhanced and failures to be avoided. These next generation broadband cookbooks should include financial models, technical models, operations models, etc.

Rights-of-Way

Another critical area involving municipalities is the granting of right-of-way permits for burying cables, conduit systems or other substructures. Some communities charge only for the cost of managing and rendering the required permits, while others see this as a tax revenue source that can help close deficit budgets. Regardless of the approach implemented, it behooves each community to examine their policies to ensure that they do not create a barrier to ubiquitous next generation broadband deployment. Consider the following:

- Communities can expect a boost to their economies as a result of next generation broadband deployment.
- If a municipality charges service providers too much for right-of-way permits, it also runs the risk of being bypassed by next generation broadband.
- If a community charges too much and refuses to renegotiate its position, it also runs the risk of state legislation that may cap permit fees, preempt municipalities' ability to assess fees, or mandate some other difficult-to-administer process or procedure.

Right-of-way issues also impact other entities that own or control land use and these also need to be reviewed and addressed (i.e., CalTrans, Department of Forestry, etc.).

Open Internet Free Zones

Public wireless local-area networks known as "Wi-Fi Hot spots" and "community networks" using wireless 802.11a,b, or g are sprouting up all across the world. Hot spots are being deployed in locations such as airports, hotels, restaurants, cafés and convention centers that charge for Internet access via Wi-Fi connectivity.

Some Wi-Fi networks are being deployed by community grassroot organizations with the goal of providing Wi-Fi connectivity in open spaces at no charge. These networks are growing rapidly as communities deploy Wi-Fi connectivity in apartments, parks and building locations that overlook public spaces. Some municipalities, such as Long Beach, California,[4] are choosing to deploy citywide hot spots.

The number of hotspots is increasing dramatically. On 10 April 2002, British Telecom announced plans to install approximately 400 hot spots by June 2003 and as many as 4,000 sites by June 2005. The access points would be situated around key public sites such as hotels, railway stations, airports, bars and coffee shops. More than 3,700 hotspots are currently in the United States. They appear in such unexpected locations as a barbershop on Long Island, a chowder house in Seattle, a pub in California's Lake Tahoe and a pool hall on Maui. In addition, such companies as Starwood Hotels, Marriott International Inc. and Connexion by Boeing are enabling customers to enjoy an unwired mobile computing experience while sitting in a hotel lobby or while flying at 30,000 feet.[5]

Gartner recommends municipalities consider the immediate deployment of hot spots within their communities. Community hot spots are an effective method of providing immediate broadband access within communities—an incremental step to ubiquity. We believe the interest generated by hot spot deployment will lead to greater awareness and desire for ubiquitous next generation broadband connectivity.

Application Deployment

Gartner research finds that government Web sites are the second-highest destination for Web surfers. During interviews for this study, interviewees had a common response to questions regarding government's role: develop e-government applications that use the bandwidth. We have found that a key method for achieving that goal is through the deployment of a Web portal. Web portals offer a Web "front door" for the government to the public. The public uses the portal to direct them to the services offered by the agency. The success of portals has caught even the larger proponents by surprise. Our clients report portal traffic growing at over 10 percent compounded monthly. Clients are reporting portals have become so useful that they are a leading destination for internal traffic as well. Government Portals are a "hot" next generation broadband application.[6]

Proactively Attract High-Speed Service Providers

Gartner asserts that each municipality should develop a strategic plan for the deployment of high-speed services within its community. The plan should consist of:[7]

- Needs assessment of Public, Business and Developer requirements
- Governmental needs assessment and anchor tenant capabilities
- Collaborative demand aggregation investigation with adjacent municipalities, counties, educational institutions, utilities
- Investigation into existing infrastructure assets including county, state and education assets
- Plan to establish goals and objectives
- Negotiations with service providers to meet the aggregated needs

Gartner has repeatedly found through our clients that an effective presentation of aggregated demand to service providers will convince the service provider to commit to meeting the goals and objectives of the municipality.

Role of Education

The Internet has shown us that the universities are key to research and development in a collaborative, sharing mode. California's research centers, corporate organizations, and institutions of higher education have cradled the growth of high technology in the United States for many decades. Many of the early innovations in both computer hardware and software originated in the State, and CENIC, an educational organization, continues that tradition in the field of network technologies.

CENIC sits at the forefront of an evolving research and education information infrastructure where there are no boundaries—only unlimited potential for new and exciting applications. The California Research and Education Network (CalREN) serves more than one million students and faculty members at more than 40 California institutions of higher education with a wide variety of advanced network services. CENIC's Digital California Project is extending California's high-performance network resources into all 58 counties in order to provide California's 6,000,000 K-12 students and teachers with access to an exciting new generation of Internet resources.

CENIC is currently creating a new optical foundation, CalREN, to serve the networking needs of all of California's universities, research institutions, community colleges and K-12 schools. This powerful optical backbone greatly enhances CENIC's ability to provide the highest-quality advanced network services to all of CENIC's constituents.

As mentioned in many of the interviews, not only is the education system a critical component of society's infrastructure, it is also a key test bed for new ideas. Those we interviewed have advised us to look at what students are doing today in the classrooms and dormitories via the CalREN network. This is the looking glass into the future.

As we move forward with deployment of next generation broadband technologies, we must ensure that schools not only have technology and the support required to utilize it, but also that standards for technical literacy are established to ensure that there is equity. All students must graduate equipped to live and work in a next generation-networked society.

Role of Industry

Make no mistake: private industry should be the party responsible for the design, deployment and operations of the next generation broadband network. No one is better equipped for these tasks—period. The procurement tools, capital constraints, and operational inexperience of government create giant challenges to government deployment and operation of a next generation broadband network.

But unfortunately, private industry often has not been engaged into the process and, equally unfortunately, has not shown an interest in meeting the needs of many municipalities. However, the highest level of success is achieved when private industry is engaged early—and is properly encouraged to achieve the public goals of a government organization.

Perhaps the key part of this next generation broadband initiative would be for California to lead the way to an information services economy (described in Figure 8). Ubiquitous next generation broadband connections, favorable and supportive regulations, and teaming with the talents found in California can lead to an information services economy. The vision must be allowed to evolve, but begins the key components of an information services economy, that is:

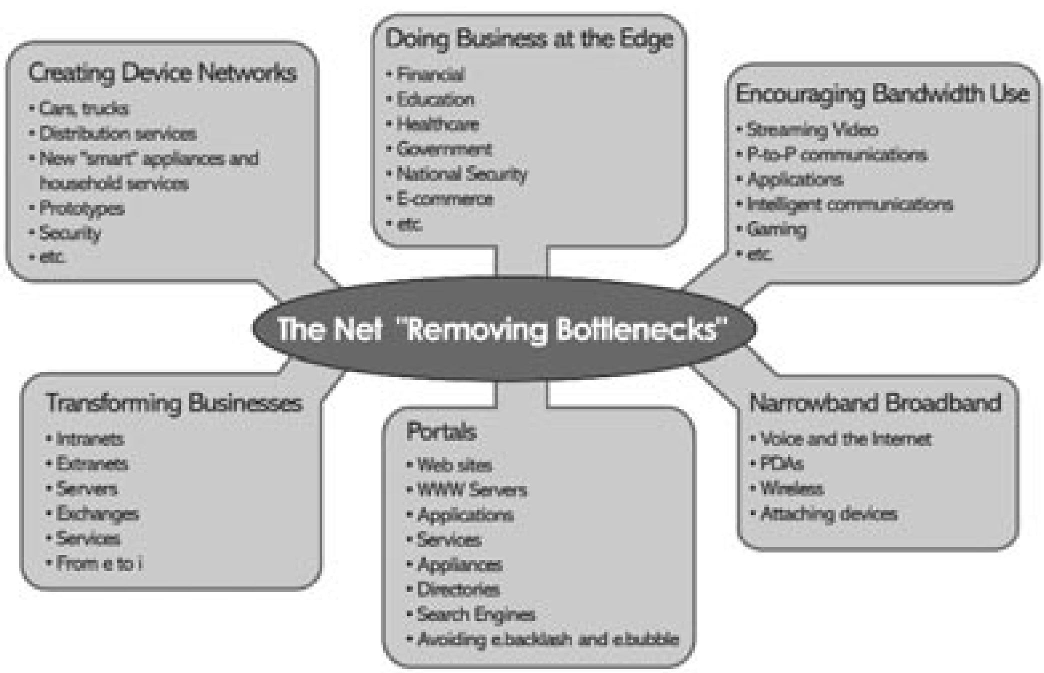
- Transaction oriented
- Involves communities of interest
- Considers the time value of information
- Is effective and reliable
- Is convenient
- Requires the "Action" is at the edge

(Referring to Figure 8) Using next generation broadband deployment as the keystone, leadership can bring together key participants from the IT industry, financial industry, relevant sectors of the government, community leaders, participants from the telecom, cable and power industries, the CPUC and others, to develop test beds. The purpose of the test beds would be to trial new devices, test new ways of doing business, and evaluate information interfaces, appliances and applications. Focused on the consumer and designed to change how we live, these test beds can provide early identification of applications with broad appeal as well as technology "glitches" that may impede progress. The application specific objectives of test beds should be developed by the key participants but should start with:

- Identifying roadblocks and barriers
- Setting standards
- Defining requirements and engineering and constructing solutions
- Identifying the need for incentives/motivations
- Testing and improving upon technologies/applications
- Training/advancing consumer awareness
- Developing equality
- Advancing public interest initiatives
- Identifying economic impacts
- Readying the test areas for commercialization

Test beds should be set up in as many areas as possible to accommodate the diverse geographic and demographic characteristics of the State.

Figure 8. Use of the Edge: Promoting Technology and Application Solutions



Source: Gartner 2003

G. Broadband Regulatory Environment and Recommendations

Whether we choose to admit it or not, regulation continues to play a critical role in the communications industry and has had a significant impact on broadband investment. As important as it is, the intricacies of the regulatory environment based on legal briefs and precedent have been known to put people to sleep. However, Gartner believes that it is important for participants in any broadband initiative to have a basic understanding of the key regulatory issues and potential outcomes so that they can take action to develop forward-looking policies that have a positive impact on broadband.

National Telecommunications Policy at a Stalemate

In a symbolic gesture, President Bill Clinton signed the 1996 Telecommunications Act into law using the same pen that former President Dwight D. Eisenhower used to authorize the interstate highway system in 1957. At the time, the Act was heralded as the vehicle to bring increased competition and innovation to the telecommunications market. Seven years later, the U.S. telecom market is in disarray. Billions of dollars in market capitalization have been lost, all but a few national competitive data providers are gone and well-established firms such as WorldCom, Lucent and Nortel are fighting for survival.

Not all of this can be blamed on regulation, however; from Gartner's perspective the regulatory actions have never encouraged innovation or true competition, only litigation. In fact, several hours after the historic signing of the telecom act, the three major long-distance carriers filed a lawsuit against what was then Ameritech (now part of SBC) for stifling competition. Rather than focusing on innovation, the telecommunications industry has instead continued to focus on litigation in the federal and state courts as well as in contentious regulatory proceedings in both state and federal jurisdictions.

Although there are many issues, the key issues impacting broadband have been the terms and conditions for access to the "First Mile" and the amount of regulation for new services such as cable modem and DSL.

The Telecommunications Act of 1996 was primarily about creating local competition for voice communications (as consumer broadband services such as DSL were not deployed at the time), the Act envisioned three paths to local service competition: resale of an incumbent's service; overbuild of separate competitor facilities; and leasing of unbundled elements of the incumbent's network. It is the third path, leasing of Unbundled Network Elements (UNEs), that has caused the greatest antagonism and directly impacted broadband investment. The first issue is how the prices are set. The FCC developed a formula of Total Element Long Run Incremental Costs (TELRIC), which established costs based on forward-looking investment. It asks what it would cost to provide the element with the best technology available today, ignoring the historical cost of the carrier's existing facilities. The incumbents argue that failing to reflect the historical costs of building the network causes the resulting prices to be below the floor of their true costs. Competitors in the local market (AT&T, WorldCom and Sprint) have successfully used the leasing of facilities to successfully capture market share from the incumbents. This is a key issue for the incumbents and means that incumbents will not invest capital in speculative services (such as broadband) while they are fighting to protect their core market (voice). Attachment F provides more insight on this complicated and contentious issue.

The second issue relative to sharing or leasing is old copper vs. new fiber or hybrid fiber facilities. The incumbents have argued that "new wires" should not have to be shared or leased. Absent an affirmative ruling in their favor on this issue, the response of the incumbents has been to halt investment and deployment of new facilities that might have to be shared with competitors.

The issue of regulation of new services such as DSL and cable is the other key issue that threatens broadband investment. To the extent that the services are placed under traditional regulatory pricing and rules, investment will be discouraged.

While there have been recent regulatory decisions at the FCC on all of these issues, the ensuing legal action by participants has only added to the contention and uncertainty in the market. Unfortunately, Gartner does not foresee any action by the FCC going unchallenged in the courts. As a result, any changes in national policy are on hold, incumbent service providers are still reluctant to invest in broadband infrastructure and there is no incentive for true facilities based competition. This is important for participants in any California broadband initiative to consider when crafting the action plan.

Is There a Role for the CPUC?

The California Public Utilities Commission's (CPUC) primary responsibility is ensuring that customers have reliable telephone services at reasonable rates and are protected from fraud. However, it is also expected to establish programs and policies that contribute to a strong California economy. This study identifies a potential economic opportunity of $376B in California associated with the utilization of a broadband infrastructure. The interviews pointed to the societal impact that new broadband applications can bring. It is clear that a broadband initiative will contribute to a stronger California economy.

The CPUC must be a partner in a next generation broadband initiative in California. This was supported by our interviews in which the CPUC was consistently cited as having the opportunity and to some the responsibility to play a role in helping to create a successful broadband initiative. The CPUC is viewed as being closer to consumers than the FCC and in a position to focus public policy directly on meeting the needs of Californians.

However, many interviewees felt that the CPUC would need to go beyond its traditional enforcement role in order to have a positive impact. Some interviewees felt that the commission had dealt with the issue of broadband deployment in the proceedings ordered by California Senate Bill 1712. Others felt that the proceedings were too narrowly focused and the commission had missed an opportunity to have a positive impact in their report "Broadband Service as a Component of Basic Telephone Service." Many interviewees felt that the CPUC should revisit the issue outside the narrow context of the Universal Service Fund. Still others felt that the analysis suffered from lack of attention by the commission due to the California energy crisis.

The CPUC can help create a public policy agenda that will focus on how to establish creative programs to bolster broadband deployment and utilization. This does not mean it should abandon its traditional enforcement role in other areas; rather, it also needs to focus strategically on what is needed to reap the positive economic benefits of next generation broadband. Gartner maintains that the CPUC should take the following steps in order to encourage next generation broadband investment and deployment in California. Attachment G provides more detail.

Figure 9. Regulatory Road Map

Goal	Action	Outcome
Work for a broadband vision	Look beyond current applications and services	Lightwave friendly Lightweight regulator Local initiatives Logical layers of unbundling
Bring the converged industry together	Involve the converged industry (tech companies & media owners)	Unified agenda focused on broadband vision
Develop flexible regulatory model	Let the market dictate the level of regulation	**Access:** urban, suburban, rural **Interconnection:** negotiated agreements **Services/Apps:** Deregulated **Focus on:** Awareness, Applications, Access

Source: Gartner 2003

Be the Catalyst for an Industry Solution

Look to the industry for the solution—not the conventional telecom/cable industry, but the new converging information industry that is driving the next stage of economic growth. Many of these new participants are either headquartered in California or have a large presence in the State. For example, the High-Tech Broadband Coalition, TechNet and the Telecommunications Industry Association (TIA)—all neutral third parties but having an interest in expanding next generation broadband capabilities—have positions and recommendations to offer. Convene an "en banc" to re-evaluate the long-term infrastructure needs of Californians. Technology and applications have changed since the last CPUC review in the early nineties.

Investigate How to Address the Digital Divide and Technical Literacy

The essential part of any forward-looking policy is to allow the marketplace to perform and to only evoke government policies and initiatives to act as a catalyst or to create the desired goals where the marketplace has failed.

A key component should be that it relies on a stated and practicable next generation broadband initiative that everyone can support. This calls for the regulator to bring in all the interested parties to negotiate next steps in a time-specific manner, and concludes with developing rules, policies and solutions only where and when needed.

In the early eighties, the FCC deregulated inside wire and consumers were given ownership of their household wiring. The intent was for homeowners to be able to connect their own telephones via modular jacks. The CPUC recognized that if consumers had to install modular jacks themselves it would take a great deal of time before the benefits of this ruling would be enjoyed by the majority of California consumers. The commission took action and created a modularity program that required the telephone companies to notify consumers that they could apply for as many as three modular jacks to be installed in their homes free by the telephone company. The response was so great that the timeline for the program had to be extended. Some might argue that the program was too expansive and should have been more targeted; however, this is one example of thinking beyond the rulings. What interim steps can the CPUC take?

Until the CPUC formulates its next generation broadband regulatory actions, there are a number of things it can do to begin to achieve the goals of a next generation broadband initiative.

Examine Current Policies

One key effort would be to examine the CPUC's current policies to ensure they are in line with this new initiative. For example, the CPUC may want to:

- Re-evaluate any CPUC orders denying next generation broadband or advanced network expenditures from being included in an independent company's (still under rate of return regulation) rate base; continue to support—or even encourage—access to federal high-cost assistance funds, Rural Utilities Service (RUS) loans and the like
- Continue to lobby the FCC to take a more forward-looking policy approach that gives states the flexibility to enact policies that address the needs of the State
- Work to encourage the deployment of other technologies (powerline communications, Wi-Fi, unregulated infrared spectrum, new devices, etc.)

Regulatory/Legislative Initiatives Outside California

There will continue to be proceedings and legislation at the federal level that the CPUC should monitor and, where appropriate, provide input. Table 4 catalogs some of the activity that Gartner believes will have an impact on broadband deployment and utilization and provides an overview of how regulators should approach this opportunity.

Table 4. Participate in Related Regulatory Initiatives

Rural utilities service	Originally for rural electrification expanded to include modernization of communications facilities, now includes a broadband loan program for 2003 of $1.4B.
Wireless number portability	The deadline for wireless carriers to implement local-number portability has been delayed three times. This will give users the ability to keep their numbers when changing wireless providers and in doing so will make the market more competitive.
Wi-Fi	Proponents of broadband wireless connectivity have asked the FCC to allocate additional spectrum to allow for more providers. Legislation has been introduced.
Mobile satellite services for rural and hard-to-serve areas	FCC ruled to permit mobile satellite service companies to provide terrestrial wireless service in satellite spectrum. Could be an interim solution for hard-to-serve areas with wireline solutions.
FCC's triennial review and other broadband services	The FCC's ruling on 20 February 2003 is already under challenge by all sides. Nevertheless, the CPUC should continue to be involved to ensure that the out comes are in synch with State broadband initiatives.
Congressional activities	Expect renewed congressional interest in broadband initiatives in light of the failure of the FCC to effectively set a national broadband policy.

H. Who Pays— A Recommendation

At the end of all the discussion the big issue is always "who pays?" The State government and local municipalities are all under budget constraints. The private sector is still reeling from the economic downturn, which has been especially hard on the communications and networking sector.

Consumer advocates, State regulators and regional development advocates expressed doubt that consumers would be either willing to pay rates that recovered the cost of next generation broadband deployment or a surcharge that would subsidize equitable deployment to geographies that may be difficult to serve or low income groups.

Although these concerns are valid, Gartner believes they are shortsighted and lack creativity. The current economic environment and telecommunications investment climate may be difficult, but it needs to be noted that the State consistently goes through cycles of boom and contraction. This is to be expected given the State's high dependence on the aerospace, entertainment, biotechnology, computer software and agriculture industries. Now is the time to begin the next expansion.

Gartner believes much can be accomplished prior to opening government purse strings. Through the actions outlined in this report, California can achieve the results delineated below.

Once these and the other actions outlined in this report are accomplished, Gartner believes next generation broadband deployment will have become self-catalytic. That is, next generation broadband deployment will reach a level at which cost decreases and increased benefits feed upon themselves to achieve ubiquitous deployment by virtue of market forces alone.

Results	Action
Immediate deployment of next generation broadband infrastructure to all new residential housing	Establishment of standards and guidelines for broadband deployment
Immediate leveraging of today's broadband assets that are available—but underutilized	Begin and encourage collaborative efforts of the State, counties and municipalities
Short-term increase in deployment by assisting municipalities	Establishment of a clearinghouse for best practices in today's broadband deployment
Medium-term increase in demand for broadband	Create "regulatory free zones" to entice incumbent investment
Medium-term increase in demand for broadband	Participate in finding a solution to intellectual property issues
Long-term ubiquitous deployment of next generation broadband	Encourage the ability for next generation broadband to be an effective substitute for basic telephony service
Long-term, mass-market acceptance of broadband	Encourage and sponsor research that lowers the cost-per-bit achieved
Short-term increase in demand	Participate in research substantiating that personal communications is the next killer app

I. Next Steps

The purpose of this study was to help CENIC determine a starting point for the Next Generation Internet (NGI) Roundtable in the context of the "One Gigabit or Bust" initiative. The objective was twofold: to assess the potential economic impact that a broadband initiative could have on the State of California and also to conduct a series of interviews with key stakeholders to identify key issues and opportunities that the Roundtable should consider.

The economic analysis was an extension of a study originally completed by the International Telecommunications Union (ITU) that observed a correlation between GDP and teledensity. Gartner has extended this correlation to examine the economic benefit that might be derived from utilization of broadband. The result for California was an incremental $376 billion of GSP over 10 years and two million incremental jobs.

It is our recommendation that the NGI Roundtable begin the process of defining the goal for next generation broadband deployment and establishing an action plan. This plan will become the basis for the next generation broadband vision.

- A vision that will lead California to the next level of economic growth
- A vision that will keep California a world leader
- A vision that all interested parties can enthusiastically support

The NGI Roundtable should be comprised of representatives of all parties: government, private industry, consumer advocates and service/application providers as the appropriate entities for the task.

To assist in the definition of the goal, Gartner advocates a "strawman" goal of providing one gigabit of connectivity to each home and business in the State. Although many interviewees had difficulty grasping the concept of a gigabit without specific application examples, Gartner believes a gigabit of connectivity to be a reasonable requirement given the application evolution anticipated over the useful life of the infrastructure and the time frame that will be required for implementation.

Based on the interviews, Gartner has identified the following action steps that the NGI Roundtable should undertake:

- **Identification of a leader or leadership team.** Based on the scope of this project and feedback from the interviewees, it is unlikely that one person or organization alone can drive this project to completion. Layers of implementation effort will be necessary to drive all of the components of this initiative. As stated, both bottom-up and top-down commitment is required. Top-down participants should include the following:
    - Senior-level technology leaders from both the private and public sectors
    - Key public policy influencers within the state and local governments
    - Key leaders within Consumer advocacy groups and local and regional economic development efforts

  Bottom-up efforts must capitalize on the many local and regional programs in a way that helps achieve the overall state goal and also allows them to share implementation successes and failures.
- **Development of a business plan that includes a specific definition of broadband, a description of the deployment goal and a timeline for completion.** This report has offered a definition for next generation broadband and asserts that a gigabit is a reasonable goal. However, the definition and the goal must be adopted by the group that will be responsible for implementation. Once the goal has been set, the challenge will be to integrate it statewide. The detailed timeline is also critical so that specific goals are clear and progress gets measured and shared.
- **Construction of implementation scenarios.** This is an important step in the implementation process and maps specific actions and measurements to the project timeline. Regional plans and programs represent excellent starting points. Several economic development groups have begun this effort. Certainly, CENIC's programs will also play a key role. At the State level, the Governor's Office of Planning and Research is charged with creation of a plan for all infrastructure in California by 31 December 2003. The *Equity, Economy and Environment* plan represents a key opportunity to articulate the State goal and the implementation steps.

- **Development of specific costs.** The implementation scenarios must have some level of cost estimates, which are tracked against actuals. In this exercise, the impact of scale deployment as well as plans for shared facilities or aggregation of demand can be assessed and proposed.
- **Demand aggregation and anchor tenancy.** Government infrastructure and purchasing power must be leveraged to offer scale of demand and also incentives to providers so they'll participate in the initiative. In addition, subsidy funds should allow applicants to aggregate demand in a way that helps the broadest level of targeted organizations participate.
- **Coordination of regulatory/legislative policy between federal, state and local entities.** The adoption of a cohesive regulatory action plan for the State across all entities is a daunting task but will be a key success factor for the next generation broadband initiative. Small issues like the disputes in local right-of-way cost will set precedents well beyond the initial dispute that will be detrimental to the larger goal. Differences in policy between jurisdictions or authorities will be arbitraged and will delay or undermine progress toward the goal. CPUC should evaluate the current policies and regulations in the context of the initiative. The State legislature and the Governor's Office of Planning and Research have roles to play in helping the implementation team provide for the CPUC a direction consistent with the plan. No new building or redevelopment project should move forward without the requirement that fiber (or at a minimum conduit) is placed and accessible.
- **Public and private partnerships for all aspects of the project (research, infrastructure deployment, standards, applications, problem solutions and so forth).** California has a strong track record in this area. CENIC is managing programs that make excellent examples of partnerships between the research community, private corporations and government entities that focus on practical outcomes. Technology underpins California's economy and it provides a wealth of resources that can be productively harnessed to drive the success of this initiative.
- **Development of consumer technology literacy standards, programs and education.** This was brought up many times in the interviews. Without technical literacy, the digital divide will remain in place. Gaps must be specifically identified and matched with programs. Many local and regional groups are already attempting to deal with this issue. Technology firms and organizations such as TechNet have the resources and the willingness to participate in such efforts. It demonstrates "enlightened self-interest" on their part, because they will ultimately benefit from the growth of these markets.
- **Continued formation and utilization of commercial broadband market test beds.** These should be expanded and utilized to address specific community needs designed in as many diverse areas of the State as possible. Consumers should be brought in at early stages of development and universal design principles should be applied to help ensure that the needs of all segments of consumers are being addressed.

And, for **targeted** rural and lower economic areas, consideration of:

- Tax credits
- Deployment grants
- Education programs
- Dutch actions to provide services
- Universal broadband service funding

California Has a Choice—Lead, Follow or Get Out of the Way

Today, high technology, entertainment, biotechnology, agriculture and many more industries call California home. California has the most to gain from action and the most to lose from inaction. Other regions will welcome these industries and are taking steps to attract them.

Now is the time to choose California's future.

Attachment A— CENIC Next Generation Internet Steering Committee

* Gretchen Beyer, Vice President of Public Policy, TechNet
* Bob Campbell, Vice President, SBC Communications Inc.
* Tal Finney, Interim Director, Governor's Office of Planning and Research, State of California
* Keith Frandsen, Vice President of Corporate Development, Science Applications International Corporation
* Laura Ipsen, Vice President, WorldWide Government Affairs, Cisco Systems, Inc.
* David Lema, President and CEO, David R. Lema & Associates
* John Silvester, Vice Provost for Scholarly Technology, University of Southern California and Chairman of the Board, Corporation for Education Network Initiatives in California
* Larry Smarr, Director, California Institute for Telecommunications and Information Technology
* Tom West, President, Corporation for Education Network Initiatives in California
* Carol Whiteside, President, Great Valley Center

Attachment B—Project Interviewees

Ender Ayanoglu
Director
Center for Pervasive Communications and Computing

Ruzena Bajcsy
Director
Center for Information Technology Research in the Interest of Society

Dan Blumenthal
Director
Center on Multidisciplinary Optical Switching Technology

Bob Campbell
Vice President
SBC Communications Inc.

Vint Cerf
Vice President
MCI

Grant Chaney
Chief Information Officer
Ministry of Innovation and Science
Government of Alberta

Fred Chang
President and Chief Executive Officer, SBC Technology Resources
SBC Communications Inc.

Randy Chinn
Chief Consultant
California Senate Energy, Utilities and Communications Committee

Eduardo Cusicanqui
Technology and Resource Development Manager
National Council of La Raza

Gregory Duncan
Senior Vice President
NERA

Margaret Felts
President and Chief Financial Officer
California Telephone Association

Fassil Fenikile
Advisor to Commissioner Duque
California Public Utilities Commission

Tal Finney
Interim Director
Governor's Office of Planning and Research

Tessie Guillermo
President and Chief Executive Officer
Community Technology Foundation of California

Linda Gustafson
Office of Ratepayer Advocates
California Public Utilities Commission

Barbara Hale
Director, Office of Strategic Planning
California Public Utilities Commission

Dewayne Hendricks
Chief Executive Officer
Dandin Group

Greg Hidley
Director Engineering Computing
University of California, San Diego

Alan Hyden
Vice President and Customer Care Representative
Lennar Builders

Nikil Jayant
Professor
Georgia Institute of Technology

Tom Kalil
Special Assistant to the Chancellor for Science and Technology
University of California, Berkeley

Kevin Kearns
Director
King County INET

Jonathan Lakritz
Advisor to Commissioner Wood
California Public Utilities Commission

Robert Lehman
Office of Regulatory Affairs
California Public Utilities Commission

Tom Long
Advisor to Commissioner Lynch
California Public Utilities Commission

Richard Lowenberg
Executive Director
Davis Community Network

Tim McCallion
President, Pacific Region
Verizon

Milo Medin
Member
TechNet's Chief Executive Officer Broadband Taskforce

Jeff Newman
Partnership Manager
California Technology, Trade and Commerce Agency

Teri Ooms
President and Chief Executive Officer
Inland Empire Economic Partnership

Larry Rowe
Professor
University of California, Berkeley

Mark Savage
Legal Counsel
Public Advocates

Jeffrey A. Schwall
Chief Executive Officer
Time Warner, San Diego

Nitin Shah
Chief Strategy Officer
ArrayComm

Michael Shames
Executive Director
Utility Consumers' Action Network

John Silvester
Vice Provost for Scholarly Technology
University of Southern California

Larry Smarr
Director
California Institute for Telecommunications and Information Technology

Nancy Sullivan
Director, Data Management Division
California Department of Education

Mark Vandervelden
Regulatory Analyst, Office of Strategic Planning
California Public Utilities Commission

James Watkins
Chief Information Officer
Governor's Office of Emergency Services

Carol Whiteside
President
Great Valley Center

Carl Wood
Commissioner
California Public Utilities Commission

Robert Zitter
Senior Vice President
Home Box Office

Attachment C—Consumer Research

"U.S. Mass Market Loves Broadband More Than Ever;" Gartner, 3 October 2002, Schoener, Sabia.

Research in this document is based on Gartner Dataquest surveys of 45,000 U.S. households and their adoption of the Internet and the connections used to access the Internet:

    - In February 2000, 40,000 mail-based panel interviews were conducted
    - In June 2002, 5,000 mail-based panel interviews were conducted

- Cable modem and DSL together dominate the household broadband market, representing an 88 percent market share—a substantial increase from the approximately 70 percent share in February 2000.
- With DSL growing almost twice as fast as cable modems over the study period (albeit from a smaller base), DSL now captures 34 percent of the broadband market share among online households.
- More cable modems than DSL lines were installed over the 28-month period; however, the ILEC aggressive deployment and marketing of DSL is evident in the DSL/cable modem growth ratio of 0.7 over the period.
    - Without government intervention and only market factors at play, the online household Internet gap has been perceptively narrowed across the nine census regions of the U.S. Gartner Dataquest asserts that household Internet penetration has not yet reached saturation.
- Online household penetration rates for eight of the nine census regions cluster between 56 percent and 62 percent, a tight range when compared with the 16-percentage rate spread that existed in February 2000.
- Experiencing the fastest online household average monthly growth rate over the study period, 1.9 percent, three-quarters of the households in the New England region are now online.
- Household Internet adoption trends indicate a coastal bias in online penetration rates and faster growth rates in the eastern portion of the country vs. the western.
    - The adoption of broadband access and the choice of broadband modalities across the nine census regions are influenced by broadband availability and provider marketing differences and clearly indicate a significant level of pent-up demand remains.
- Broadband penetration rates exceed 30 percent of online households in three regions: Pacific (34 percent); New England (33 percent); and East South Central (31 percent).
- Even the two regions with the lowest broadband penetration of online households have achieved more than 20 percent penetration: East North Central (22 percent) and Mountain (23 percent). The popularity of satellite in the Mountain region and fixed wireless in East North Central underpin this penetration.
- The upside potential for household broadband access remains enormous as only 28 percent of online households had this mode of connectivity in June 2002 and 40 percent of all U.S. households remain unconnected to the Internet from home.
- Regionally, this percentage of broadband households among all households ranges from a low of 14 percent in the Mountain region to 25 percent in the New England region.
    - While cable modem is still the dominant broadband modality among broadband households, DSL is challenging this dominance in selective regions.
- In three regions, the DSL and cable modem shares of the broadband market are approaching parity: West North Central, Pacific and East South Central. DSL growth in these regions was equal to or better than that of cable modems over the 28-month period.
- DSL growth over the 28-month period was 80 percent that of cable modem growth in the South Atlantic region.

- The highest cable modem penetration rates are in the northeast regions of the country (New England, Middle Atlantic and East North Central), evidencing the head start that cable modem providers leveraged in these regions. DSL growth in these regions over the period was approximately half that of cable modems.
  - Recent DSL growth trends clearly indicate that DSL providers are beginning to add customers at a faster pace than their cable modem provider counterparts.
- From July 2001 to June 2002, the DSL to cable modem growth ratio was 1.43, a significant increase from the 0.54 growth ratio reported during the earlier February 2000 to June 2001 time frame.
- Four out of the nine census regions reported more DSL than cable modem growth over the past year: Middle Atlantic, West North Central, South Atlantic and East South Central, reflecting the aggressive deployment and market efforts of the RBOCs serving these regions—BellSouth and Verizon, primarily.
  - When examining the household broadband Internet access market from a telecom carrier vs. a cable company perspective, the telecom carriers are in a strong market position if they leverage their ISDN customer base and existing relationship to expand their DSL product.
- Combining ISDN and DSL, telecom carrier broadband penetration bests that of cable penetration in three regions as of June 2002: West North Central, East South Central and Pacific. South Atlantic region is also closing the telecom/cable gap.
- ISDN, with an 8-percent broadband market share in June 2002, remains "good enough" for customers who may not want to change modalities or cannot get another broadband modality.
  - Satellite and fixed wireless modalities, while each having only a two-percent broadband market share overall, do evidence popularity in some regions.
  - Households in the Mountain and South Atlantic regions have opted for satellite, while fixed wireless is popular with households in the East North and West South Central regions. The widely spread pockets of demand, spread-out metropolitan areas and an older telecommunications infrastructure in these regions support the adoption of these broadband alternatives.

Attachment D—Ethernet in the Metropolitan Area Network

Over the past few years, Gartner has seen a substantial increase in the deployment of Ethernet network access loops. These loops replace the traditional T-1 and Fractional T-1 services current offered by Service Providers.

During the past year, the 802.ae standard for 10-Gigabit Ethernet was ratified by the IEEE in June. Standard work was accomplished on the 802.3af standard, which will define how to send power over Ethernet networks. Progress was also made in the 802.3ah standard, which defines various physical layers for Ethernet in the First Mile, including fiber and copper. The stage is set to dramatically lower the cost of provisioning broadband through Ethernet in the MAN.

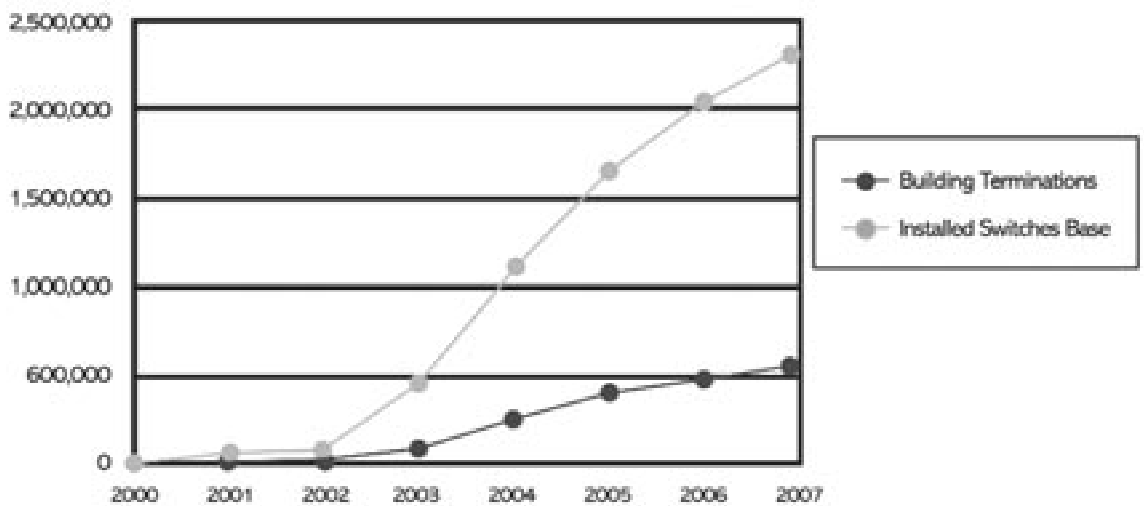
Ethernet in the MAN offers the following advantages:

- **For carriers—low and lowering cost:** Overall capital costs and the total cost of ownership can be significantly reduced in comparison to traditional architectures. Ethernet's simplicity, combined with universal interoperability, has allowed the different iterations of Ethernet to follow an aggressive cost-reduction curve for many years. Ethernet switching costs typically decrease 30 percent year over year. This dramatic cost curve is unmatched in mainstream WAN technologies such as time division multiplexing (TDM), ATM and SDH, or SONET. In addition, start-up costs for this new class of provider are significantly lower, as they can scale their Ethernet infrastructure more easily than traditional architectures.
- **For users— "10 Mbps for the Price of a T1/E1":** Already, some Ethernet service providers are pitching their prices at 50 percent to 90 percent below the price of traditional high-speed services such as digital leased lines and SONET or SDH for equivalent bandwidth. By following the Ethernet price curve, even lower WAN costs are on the horizon; not merely a price reduction, but rather order-of-magnitude changes in a short time period. Consequently, Ethernet services not only reduce networking costs, but also enable enterprises to consider new options that previously were not economically viable. For example, large corporations are rethinking their data center strategies, now that a major component of their cost equation—bandwidth—has been repriced. Similarly, medium-sized businesses that had not formulated a disaster recovery strategy because of prohibitive bandwidth costs, can now think otherwise.
- **Bandwidth flexibility:** In most cases for these services, the enterprise site is connected to the MAN network via fiber that can readily support 10 Gbps (faster speeds are possible using high-speed fiber or dense WDM [DWDM]). Any data rate up to the fiber rate can, theoretically, be supported. That means that the switches define the actual data rate transmitted, not the underlying transmission media. With a 1-Gbps or 10-Gbps port on the switch, any rate up to this port speed can be supported. Hence, in a well-engineered network, provisioning data rates is a modest network adjustment, as no physical change is required.
- **Greater manageability:** By using common technologies with comparable speeds on both sides of the LAN/WAN boundary, much of the complexity of managing the WAN is eliminated. The need for client-owned WAN routers comes to an end, to be replaced by a new breed of optimized Ethernet switches. Capital purchases will be primarily in the campus LAN, and the interconnection to services will migrate to native LAN technologies. Enterprises will need to transition their internal processes to focus on selecting and managing service levels, not technology.

This first study of switch ports in the WAN estimates that North America, where these services began in late 1999, will be the largest market for these services over the next five years, during which the following will happen:

- By 2007, the number of buildings equipped with Ethernet terminations will reach more than 500,000, growing from slightly less than 6,500 buildings in 2001 (0.8 probability).
- By 2007, more than two million switch ports will be installed on metropolitan Ethernet networks; more than half of these will be in North America. This will account for less than two percent of the total number of switch ports shipped worldwide, including LAN shipments (0.8 probability).

Figure 11. Ethernet Building Terminations and Installed Switch Base— Worldwide, 2000–2007



Source: The Future of Ethernet MAN Deployment; Gartner, 8 May 2002, Shanker, Keenem, Chetham

- Gartner expects regions outside North America and Western Europe to record the highest growth rates—a compound annual growth rate (CAGR) of 77 percent between 2003 and 2007—led by the already brisk growth in countries such as South Korea and China (0.8 probability).

Gartner's view has been recently supported by market research by IDC.[1] IDC predicts that the market for metro Ethernet equipment will quadruple over the next five years. In 2002, despite the worldwide telecom spending crunch, sales of metro Ethernet rose by over 70 percent, to $837 million.

Attachment E—Broadband Deployment in South Korea

South Korea is recognized as the country having the most extensive deployment of broadband services at the highest average speed. Over 10 million broadband connections, or 60 percent of the population, have been deployed at an average of 10 Mbps per user.

South Korea's broadband deployment cannot be compared to California. First, the country is smaller with a much higher density of residents. Nearly 40 percent of all housing is apartments and 70 percent of all the country's residents live within the seven largest cities. Over a quarter of the country's population live in the capital city of Seoul. These factors tend to make the deployment of broadband more economical. In addition to these advantages, South Korea has undertaken several initiatives that have accelerated the deployment of broadband while achieving the national goal of ubiquity. Most notably, they allowed Kepco, the public power utility, which had developed a network of fiber-optic cables for its own, to lease the unused 90 percent of its capacity to upstart providers providing a cheap and instant last-mile solution.

The South Korean government announced that the country had just passed 10 million broadband connections, as of 5 November 2002. In a congratulatory ceremony on 6 November 2002, President Kim Dae-jung said the success of the broadband Internet would accelerate the nation's move toward a knowledge-based economy in the 21st century. According to the Ministry of Information and Communication (MIC), broadband Internet has generated 17 trillion won (US$1 = 1,218.8 won) in production, 5.8 trillion won in value-added services, and created 590,000 jobs between 1998 and 2002. The MIC also said on 6 November that it estimates telecommunications companies in the country to invest 13.3 trillion won (about US$10.9 billion) by 2005 on high-speed broadband networks to cope with a rise in the number of subscribers in the future.

- In general, prices have remained stable for the past two years at around US$19 to US$33 per month, depending on the access technology. However, there has been widespread use of giving "free" months away for signing new or long-term contracts.
- KT, the former incumbent and leading broadband carrier, has been spending as much as 30 percent of its revenue on new equipment to support its rapid rollout of broadband infrastructure.
- All of the government units, down to the smallest townships, have broadband connections to Internet, and over 10,000 elementary, middle and high schools receive free broadband Internet services.

Communication Ministry Set to Provide W80 Billion to Broadband Internet Firms

The South Korean government will extend a total of 80 billion won in loans to broadband Internet service providers in order to help spread the service across the nation according to the Ministry of Communications.

MIC said it will provide 37.18 billion won in loans to the No. 2 broadband carrier, Hanaro Telecom Inc.; 24.11 billion won to cable network operator, Powercomm; 11.9 billion won to state-run telecom giant, KT Corp.; and 6.51 billion won to fixed-line carrier Dacom Corp.

"As of the end of last year, the high-speed Internet service has reached the smallest administrative units in local areas and the government will help carriers set up the service in remote and other remaining areas," a ministry official said.

MIC said that it will offer the loans to carriers the moment they file applications, a change from the previous policy of extending the loans after investments were made.

The move comes as MIC weighs an option to designate the broadband service as "universal" telecommunications business, something similar to today's fixed-line telecom service, in 2004 at the earliest.

With fresh networking technologies sweeping the globe, South Korea is widely regarded as a frontrunner in offering broadband services to households. According to ministry estimates, around 10 million households will be hooked up to the broadband network by the end of this year.

The projection means that about 70 percent of all South Korean households will have access to broadband networks, up from the current 55 percent.

The ministry forecast that more than 90 percent of households in South Korea will be able to enjoy what it called “ubiquitous” broadband service in the near future, outpacing other advanced and Internet-savvy countries.

- Gartner anticipates that the bulk of this capital expenditure will go into investing in higher-speed services than those already available. Instead of the current asynchronous DSL (ADSL) and cable modem services, which have a top theoretical speed of around 8 Mbps, it wants to see the average user have access to around 20 Mbps. This would entail the bulk of broadband users connecting through a mixture of fiber-to-the-building or Fiber-to-the-Curb coupled with very high DSL (VDSL) or Fast Ethernet. KT already has a service called Ntopia, which offers up to 13 Mbps to the home, for a similar price to existing lower-speed DSL services.
- At present 10 million households are subscribing to an average of 3-megabit per second broadband Internet services. However by 2005, we aim to supply 13.5 million households with an average 20-megabit per second broadband Internet service.[1]
- The deployment of Broadband set the stage for the emergence of “PC Bangs,” Net cafés juiced up with high-speed connections. The PC Bangs have network connections at about 11 to 12 Mbps. These cafés have proven to be tremendously popular among young people. They have flocked to the PC Bangs, drawn by network games. PC Bangs became immensely popular as their number rose from about a hundred in early 1998 to more than 21,000 at the beginning of 2001.

Attachment F—Impacts of the FCC's Interconnection Rules

Initial Effects

Despite good intentions, the FCC's actions backfired. Consider the following concerning the FCC's Interconnection rules:

- The FCC's "benchmark" rates were significantly below the comparable carrier access charges, local exchange rates contained in federal and state tariffs, and those resulting from the negotiated and arbitrated agreements.
- The FCC's interconnection rules not only presumed guilt before a crime was committed, but they also unraveled the product of months of negotiations. A Gartner survey conducted in early 1997 found that state regulators had approved over 400 negotiated interconnection agreements and had arbitrated another 80 agreements, with another 75 agreements pending approval.
- The FCC's overextended rules opened the door to extended litigation involving state regulators, the incumbents, the new entrants, several district appeals courts and the U.S. Supreme Court.
- Most negotiated interconnection agreements concerning rates were put on hold or were put into effect as interim procedures pending the finalization of the legal challenges.
- The issues that were raised in interconnection negotiations—both before and after the FCC's Interconnection Order—have been exceedingly broad. Today, there are more than 400 Unbundled Network Elements (UNEs) available in most jurisdictions, which render the UNE construct nearly unworkable for both the incumbent and the competitor. They are based on TELRIC and cover every element of incumbent infrastructure from links, ports, sublinks, switching, switching elements, transport and components of transport to operations support systems (OSSs), signaling networks, nonrecurring charges and recurring charges.
- End user benefits are questionable. These provisions of FCC's UNE policies have opened the door for competitors, incumbents and new entrants to redefine the major components of provisioning local telecom services. Because these negotiations/arbitrations were conducted by the parties that are attempting to carve out their share of the long-distance and local exchange markets, it is not clear to what extent the end-user customer was being considered in these debates. It is even more unclear that the typical residential end user will ever benefit.

Why Don't UNEs Work?

Let's face it, despite good intentions, FCC's overarching policies to regulate competition just have not worked. But why? Gartner research demonstrates the following:

- There is no money to be made for companies relying on the UNE/UNE-P construct, even for AT&T. And companies that build their business cases around such a regulatory mandate are finding, and will continue to find, that this will only result in failure. Some of the reasons are as follows:

- There is limited money to be made in the Plain Old Telephone Service (POTS) world. Most states have frozen residential basic exchange rates at levels at or below cost. Gartner estimates that in the U.S., the average cost of providing basic residential service (including an element of free local calling) is approximately $20 per month. But in many states, the basic residential rate has been frozen at or below $15 per month because of heavy lobbying by consumer groups to preserve affordable and "universal" service (a policy essential in a regulatory regime based solely around enforcement). It is not difficult to see that competitors are not attracted to markets where they take a loss on each unit sold, regardless of the other services they may bundle together. They must rely on discounts on resold loops provided by the incumbents and even with these discounts, the potential margins are minimal. It is also not hard to understand that it is the regulators themselves (state regulators and the FCC) that have created this regulatory barrier to competitive entry through a pricing policy that includes subsidy. Following divestiture, long-distance rates declined not because of competition but because subsidy was removed from the pricing. Rate rebalancing is a reality that regulators will have to face eventually if they wish to promote local competition.

- In California, much of this rate subsidy is made up for the incumbent carriers through the high-cost assistance and lifeline-assistance components of California's Teleconnect Fund. Most competitors in California do not compete in areas or markets where they can benefit from this fund.
- More regulation produces less network. "Over-regulation" of UNEs in the U.S. has had the unintended outcome of bringing the deployment of broadband infrastructure to a halt.[1] No one has the incentive to invest in the network. The incumbent will not invest where the return on investment does not meet shareholder expectations. The new entrant does not have to invest if UNEs are available and displace the need for capital expenditure. This is true in all but the most-profitable markets.
- Competitors' costs of acquiring customers. Gartner estimates that the cost of acquiring customers adds another $5 to the CLECs' costs. These costs include such things as marketing costs (promotion and placement costs), service center costs, billing and provisioning costs, and so on. In addition, higher customer churn makes it difficult for carriers to recover their costs. This estimate does not include the $50, $75 or $100 initial rebate promotions being offered in certain markets.
- The FCC based its policy on local competition on its perceived experience in the long-distance market. But growth in long-distance market was not a result of introducing competition, it was a result of significant price reductions brought about by reducing subsidies. The local exchange rates have no subsidies and, in fact, are being subsidized through rate averaging and implicit and explicit subsidies.
- The local network is CAPEX-intensive. Unlike the long-distance network, which is designed around concentrating traffic and transporting it via high-capacity pipes point-to-point, the local exchange network requires significant capital expenditure (CAPEX) and is expensive to operate. It requires a feeder and distribution network linking every home and business (and most potential homes and businesses) to the public network. AT&T and the other CLECs are ill equipped to build-out such a network, especially with the limited margins available to them. They look at discounted unbundled network elements so that the ILECs can build and support the network and, by doing so, provide the competitor with the necessary profit margins.

Longer-Term Effects of the FCC's Interconnection Rules

Gartner maintains that the longer-term effects of continuing with unchanged UNE policies will not only stymie network investment, especially in broadband facilities needed for this initiative, but eventually will lead to a deterioration of the current network serving Californians and will result in upward pressure for rate increases.

Attachment G—Flexible Regulations Model

Gartner has developed an evolutionary regulatory model that would eliminate the stalled broadband access deployment situation in the U.S. and California and, indeed, address the converging markets of the next stage of the Information Age. It would also go a long way toward bringing the world economy out of its slump by advancing to the next stage of the information economy. We call this model FlexReg.[1] Its overarching goal is to permit regulatory policy to change and evolve easily as technology and societal needs change. It is intended to do away with the rigid regulatory regimes of the past that did not permit regulatory policy to evolve gracefully. The current regime is based upon 1934 tenets and a slow-changing technological environment. Regulation needs to be much more flexible, future-proof and prospectively oriented. The new construct must be less beholden to the past and must be able to address differences in demographics and markets as well as changes in those characteristics—thus the term "Flexible Regulations." This is a construct that the industry in partnership with government legislators, regulators and policy makers will need to wrestle with over the next five years to fashion and subject to ongoing review to ensure that it continues to meet future needs. This model can be crafted to meet the unique needs of California and allows for unique regulatory policies for:

- Services and applications vs. access to the broadband network
- Central business districts where high-speed broadband is competitively provided today
- Inner-city locations that can be costly to serve and where margins may be slim
- Suburban areas where a multitude of solutions exist and must be allowed to happen
- Rural areas and other high-cost-to-serve areas to ensure the elimination of redlining and to avoid a rural/urban digital divide.

Attachment H—Best Practices from Other Regions

Some European governments have begun to bring together governmental, educational, private-sector and nonprofit resources to develop and implement strategies to deal with the digital divide. For instance:

- In Ireland, projects to support the provision of advanced communication and e-commerce infrastructure in different regions can apply for up to 40 percent of project costs. In total, more than 200 million euros are available from European Union (EU) and Irish public funds.
- Sweden has invested about SKR5.8 billion to partner with industry in the development of regional and local line connections in rural areas with fewer than 3,000 inhabitants, and to develop broadband networks.

Formalize Best Practices

The exchange of best practices inside the EU is favored by the e-Europe initiative and progress is described at http://europa.eu.int/information_society/eeurope/ benchmarking/index_en.htm.

Other examples:

- In Ireland, seminars sponsored by government departments are regularly held to exchange best practices between regions and with other countries.
- In Greece, under the OP Information Society Program, an IS Observatory with high-level experts is tasked with identifying and disseminating best practices and encouraging the exchange of experiences.

Bring Access, Technology Training and Content to Low-Income Citizens

Many people view universal, home Internet access as the key to eradicating the digital divide, but this goal will not be attained in the short term. European and Latin American governments are taking steps to: 1) reduce the cost of Internet connection, without distorting competition; and 2) favor lower-income communities. Bridging the digital divide means not only providing access to technology, but also ensuring that people have the ability to use it.

- In Portugal, to provide more than half of its citizens with home Internet access, tax incentives have been introduced for people buying a computer or enterprises giving computers for home use to their employees, and low-speed access is made available for free, or at a nominal price. This is combined with broadband access, which is available at flat rates through cable, ADSL and—in the future—UMTS. Post offices and municipal buildings are also being equipped with free Internet access for citizens.
- In France, more than 7,000 open Internet access points are being deployed in places that are accessed by low-income citizens, such as local employment agencies, youth centers, local missions and community centers. Basic training will also be provided in more than one-third of these centers. Part of this is being paid for out of a fund the EU has created for this purpose as part of the European Union's "Working Party on Telecommunications and IT Issues." The United Kingdom is providing low-cost recycled computers for 100,000 low-income families by setting up schemes to improve access.
- Argentina has opened an Internet access dialing code that consumers can use to avoid costly local usage rates. And Columbia and Chile have ordered incumbent carriers to offer discounted Internet access connections, all designed to stimulate Internet usage.

Make the Internet Part of Every Child's Education

European governments are spending a great deal of money to ensure that all schools have Internet access and this objective is slowly being attained: all schools are connected to the Internet in Ireland; in Denmark, the United Kingdom and Portugal, all secondary schools are connected; and several other countries have exceeded 90 percent connection. However, connectivity is not enough. To properly leverage this investment, schools must focus on strategies that provide better Internet access for students outside the classroom, increase the technology proficiency of teachers, and implement portals for delivering services and educational content to parents.

For example:

- In the final part of its development program for educational technologies, Italy has made available equipment and training activities for teachers, combined with distance-learning initiatives run by the national TV broadcasting company and the use of European structural funds.
- In Ireland, the renewed Information Age schools initiative focuses primarily on providing ongoing training for teachers, curricular development and support, not only on providing high-speed access to classrooms.
- The Swedish ITIS initiative provides in-service training, a multimedia computer and an e-mail address for more than 60,000 teachers.
- In the United Kingdom, the "Excellence in Cities" program is establishing more than 80 city learning centers in major city schools to provide pupils and adults in the community with connections, infrastructure, content and training.

Make People Contribute

People and communities should not be seen as simple consumers of information, but should be put in a position to contribute, creating content, providing feedback, tailoring content and channels to specific needs. This requires training on content management technology, the establishment of areas on government or community portals that can be accessed and modified by users as well as forums and moderated chat rooms.

Attachment I—Glossary of Terminology

802.11 Standards issued by the Institute of Electrical and Electronics Engineers (IEEE) for wireless LANs (WLANs). Various specifications cover transmission speeds from 1 Mbps to 54 Mbps. The three main physical-layer standards are 802.11a, 802.11b and 802.11g.

802.11a Standard for the physical layer of WLANs operating at 5GHz. It has eight radio channels. The maximum link rate is 54 Mbps per channel, but maximum user throughput will be about half this and the throughput is shared by all users of the same radio channel. Data rates fall off as the distance between the user and the radio access point increases. Frequency bands allowed for 802.11a (also called Wi-Fi5) differ in different parts of the world. *See Wi-Fi.*

802.11b Standard for the physical layer of WLANs operating at 2.4GHz. It has three radio channels. The maximum link rate is 11 Mbps per channel, but maximum user throughput will be about half this and the throughput is shared by all users of the same radio channel. Data rates fall off as the distance between the user and the radio access point increases. *See Wi-Fi.*

802.11d Supplement to the MAC layer in the base 802.11 WLAN standard. It aims to promote worldwide use of 802.11. It will allow access points to communicate information on the permissible radio channels and at acceptable power levels to user devices. The current 802.11 standards cannot legally operate in some countries, and the purpose of 802.11d is to add features and restrictions to WLAN systems that would allow them to operate within the specific regulatory guidelines of these countries.

802.11g A physical-layer standard for WLANs in the 2.4GHz radio band. It provides three available radio channels with a maximum link rate of up to 54 Mbps per channel. Support for complementary code keying (CCK) modulation makes 802.11g backwardly compatible with 802.11b. The addition of orthogonal frequency-division multiplexing (OFDM) and packet binary convolution coding (PBCC) modulation schemes into the draft standard achieves higher link rates.

ADSL (Asynchronous Digital Subscriber Line) A technology that is utilized by wireline service providers that can provide both traditional voice and data services over copper lines.

Analog A signaling method that uses a continuously variable waveform. Standard telephone lines carry voice and data in analog form.

Analog modems Electronic devices that provide modulation and demodulation functions for data signals transmitted over telephone lines. They convert digital data to analog data for transmission over leased lines or the analog public switched telephone network (PSTN).

Analog Modem Standards Modem standards are set by the International Telecommunications Union (ITU). The ITU defines the electrical characteristics to be met by the various standards. The V.xx series of standards pertain to the connection of digital equipment to the Public Switched Telephone Network (PSTN). The following are analog modem standards: V.90, V.34, V.32bis, V.33, V.32, V.26/V.27/V.29, V.22bis and trio (V.21,V.22 and V.23).

Bandwidth The term Bandwidth refers to one of two things:

1. A range within a band of frequencies or wavelengths.
2. The amount of data that can be transmitted in a fixed amount of time: For digital devices, the bandwidth is usually expressed in bits per second (bps) or bytes per second. For analog devices, the bandwidth is expressed in cycles per second, or Hertz (Hz).

BlackBerry A two-way wireless device developed by Research in Motion (RIM). It allows users to check e-mail and voice mail (translated into text), as well as to page other users via a wireless network service. It has a miniature keyboard for users to type their messages. It uses the Short Message Service (SMS) protocol. BlackBerry users must subscribe to a wireless service that allows for data transmission. See Short Message Service.

Bluetooth A wireless networking technology with a range of about 10 meters and a raw data transmission rate of 1 Mbps, Bluetooth supports ad hoc networking of up to 80 devices within a 10-meter radius (supporting voice and data). The Bluetooth Consortium was founded in 1998 by Ericsson, IBM, Intel, Nokia and Toshiba, and is supported by about 700 organizations in the Bluetooth Special Interest Group (SIG). The Bluetooth v.1.0 specification was ratified and published in 1999.

Bluetooth will continue to evolve rapidly. We expect more than 40 million Bluetooth chipsets to ship in 2002, and there will be growing diversity of applications. For example, in the first half of the year, Anoto will bring its Bluetooth-based pen technology to market, and we expect Compaq Computer and other vendors to launch PDAs with built-in Bluetooth support in 2002. The number of laptop computers with integrated Bluetooth capability will also grow significantly. With companies such as CSR able to integrate Bluetooth and low-level firmware into a single chip, pricing is very closely tied to volume. Already chip prices are below $10, and we expect that the price will be at or near $5 by the end of 2002. In 2001, most Bluetooth applications were for cable replacement and point-to-point situations. During 2002, we expect multipoint solutions to appear.

Compared with WLANs, Bluetooth devices need to be closer to each other. Data transmission is slower as well, so the two technologies complement each other for different applications.

Bridge A device that connects and passes packets of data between two network segments.

CO (Central Office) The local telephone company office to which all local loops (subscriber lines) in a given area connect and where switching of calls occurs.

Cable Modems

- *Non-DOCSIS or proprietary:* Nonstandard equipment that does not adhere to industry specifications. This definition includes products that contain features either unique to or above and beyond the industry standard, sometimes proprietary to a specific vendor.
- *Data-Over-Cable-Service-Interface:* Specification (DOCSIS)—A specification developed by the Cable Labs for the industry standard for cable modem. DOCSIS was also accepted as a worldwide standard by the ITU, with regional annexes or technical variations, for Europe and Japan. It is intended to allow cross-manufacturer compatibility among all brands of silicon chipsets, cable modems and associated cable head-end equipment.

Circuit Switching A switching system in which a dedicated physical circuit path must exist between a sender and receiver for the duration of the call. The basis for most voice telephony networks. *(See also Packet Switching)*

CLEC (Competitive Local Exchange Carrier) Refers to the category of competitive service providers that were founded following the Telecom Act of 1996 (i.e., Covad, Northpoint, New Edge Networks)

Client The computer or application program that requests access to the resources or services of another computer (server).

Client/Server The relationship between a workstation and a server in the network.

Client/Server Computing Divides the transaction responsibilities into two parts: client (front end) and server (back end). Also called distributed computing.

Compound Annual Growth Rate (CAGR) The annualized rate of revenue or unit shipment growth between two given years, assuming growth takes place at an exponentially compounded rate. The CAGR between years X and Z, in which Z - X = N is the number of years between the two given years, is calculated as follows:

CAGR Year X to Year Z = [(Value in Year Z/Value in Year X) _ (1/N) - 1]

For example, the CAGR for 1998 to 2003 is calculated as follows:

CAGR 1998 to 2003 = [(Value in 2003/Value in 1998) _ (1/5) - 1]

Customer Provided Equipment (CPE) This device resides at the home, business or end-user location that sends/receives network-based signals.

DSL (Digital Subscriber Line) There is now a plethora of DSL technologies and products, and xDSL incorporates all of the mass-market-oriented products, including ADSL, VDSL, symmetric digital subscriber line (SDSL), and ISDN digital subscriber line (IDSL). ADSL is the most widely deployed. It is a digital technology that enables wideband transmission (up to 9 Mbps toward the subscriber, with a 640-Kbps return channel) over ordinary copper twisted pairs.

Digital A signal that consists of discrete values, with no transition between them (such as 1s and 0s)

Ethernet A LAN specification invented by Xerox, Intel and Digital Equipment Corporation. It runs over a variety of cable types from 10Mbps up to 10Gbps.

Fiber Optic Cable A physical transmission medium capable of conducting modulated light transmission at much higher speeds and greater capacity than wired cable mediums.

Fiber to the Curb (FTTC) Used to describe a variety of network architectures that bring optical fiber closer to the residence (within about 200 meters) with copper or coaxial cable actually coming the remaining distance into the home.

Fiber to the Home (FTTH) Brings fiber all the way to a optical interface at the home.

Frame Relay An industry-standard, switched data protocol.

Gb (gigabit) In data communications, a gigabit is one billion bits, or 1,000,000,000 (that is, 109) bits. It's commonly used for measuring the amount of data that is transferred in a second between two telecommunication points. For example, Gigabit Ethernet is a high-speed form of Ethernet (a local area network technology) that can provide data transfer rates of about 1 gigabit per second. Gigabits per second is usually shortened to Gbps.

1 kilobit = 1,000 bits
1 megabit = 1,000,000 bits
1 gigabit = 1,000,000,000 bits

Gbps (Gigabits per second) A rate of transfer speed

Generations of mobile phone systems A common way of classifying mobile phone technologies. The first generation of mobile phones was based on analog cellular technology. The second generation is digital PCS. The third generation provides digital bandwidth at high speeds (up to 4 Mbps). The second and third generations are often abbreviated as 2G and 3G, respectively. Technologies to upgrade 2G networks—but not to attempt the performance of 3G networks—are often referred to as 2.5G. Developments from the basic GSM networks are designed to handle data and extend the portfolio of networking options.

GIS (Geographical Information Systems) In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e., data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system.

Global Positioning System (GPS) A technology for assessing the precise location of any compatible receiver unit, using satellites to provide 24-hour positioning information regardless of the weather. It works on the principle of triangulation: By knowing its distance from three or more satellites, the receiver can calculate its position by solving a set of equations. While the technology is most commonly known as GPS, the satellite constellation used by the U.S. government (and most commercial GPS equipment) is properly known as the Global Positioning Satellite System (GPSS). Until May 2000, this system suffered from the U.S. government's controlled dilution of precision (DOP), which reduced location accuracy to 100 meters. With this feature now turned off, accuracy has improved to five meters. The Russian government also runs a global positioning system called GLONASS, while Galileo is the name planned for a yet-to-be-created European global navigation satellite system. The U.S. system in accurate to between three and 25 meters in ideal circumstances, but averages an accuracy of about five to 50 meters.

Hybrid Fiber Coax (HFC) A network topology that utilizes fiber in the backbone (large capacity) part of the network and coaxial cable in the distribution (lower capacity) portion to the home or business. Cable companies generally use this design.

ILEC (Incumbent Local Exchange Carrier) Refers to telephony providers that originally held the monopoly position for local telephony services (i.e., SBC, Bell South, Verizon, and Qwest as the owner of US West).

IP (Internet Protocol) A network layer of TCP/IP that enables connectionless service. IP provides the features for addressing, type of service specification, and security. It is a connectionless, best-effort packet switching protocol.

ISDN A network architecture using digital technology to support integrated voice, data and image service through standard interfaces over existing twisted-pair telephone wire. Its major purpose is to integrate access to existing network services (that is, packet switched, circuit switched and dedicated) while providing new services associated with its digital nature. ISDN is based on a certain number of individual bearer or "B" channels and a single data or ''D'' channel used for signaling, either end-to-end signaling between user devices or between such a device and the ISDN service provider network.

ISP (Internet Service Provider) A company that provides Internet access to companies or individuals using dial up or dedicated access.

IT (Information Technology) A term describing the industry and technology, including computer and telephony, used to create, store and use information.

International Telecommunication Union (ITU) An agency of the United Nations headquartered in Geneva. The ITU is the body through which governments and the private sector coordinate global telecommunications networks and services.

Internet A worldwide network of networks. It evolved from U.S. Defense Department projects in the 1950's that were initially focused on ensuring survivability of communications during a hostile attack.

JPEG A compressed graphical image file format often embedded in web pages because the compressed file is small and can be downloaded relatively quickly.

Kb (Kilobit) Approximately 1,000 bits.

Kbps (Kilobits per second) A rate of transfer speed.

LAN (Local Area Network) The hardware, software and peripherals that enable connection of a device to a cable-based or wireless network system that serves a building or a campus environment. LANs connect workstations, printers, and other devices in a single building or relatively limited geographical space. Ethernet is a commonly used LAN technology.

Latency The delay between the time a device requests access to a network and the time it is granted permission to transmit. In networking, the amount of time it takes a packet to travel from source to destination. Together, latency and bandwidth define the speed and capacity of a network. Low latency is critical for voice communications.

Local Loop Cabling (usually copper wire) that extends from a demarcation point into the service provider's central office (CO). We refer to this as the "First Mile;" others also use the term "Last Mile."

Local Multipoint Distribution Service (LMDS) A microwave-based wireless technology that operates at around 28GHz. In the United States and other countries, it is used for fixed high-speed data, Internet access and advanced telephone and entertainment services in metropolitan areas.

MAN (Metropolitan Area Network) A MAN consists of two or more Local-Area Networks (LANs) networked together within the confines of a space roughly corresponding to a metropolitan area.

Mb (Megabit) 1,000,000 bits

Modem (modulator/demodulator) A device that converts digital and analog signals. At the source, the modem converts digital signals to a form suitable for transmission over analog communications facilities. At the destination the modem converts the signal back to digital.

Motion Picture Experts Group (MPEG) Level 3 (MP3) A format for audio compression that offers significant compression while retaining excellent audio quality. It can compress standard audio by approximately 12 to 1. Standard audio, as recorded on a compact disc, is 44.1kHz, 16-bit, two-channel audio. The uncompressed audio results in a transfer rate of 176 Kbps, and requires up to 740 megabytes for a 74-minute CD. Files compressed with MP3 can be transmitted over the Internet even when using a low-bandwidth connection such as a 56-Kbps modem. The size of an MP3 file can vary depending on the amount of compression employed in converting the wave file to an MP3 file. A 128-Kbps sampling rate results in an MP3 file that is approximately one megabyte per minute of music. This sampling rate results in an MP3 recording that is almost indistinguishable from CD-quality audio. Dropping the sampling rate to 80 Kbps or 64 Kbps results in a recording that is still of reasonable quality, but not approaching that of the CD. The compression achieved with MP3 makes it possible to distribute high-quality audio via the Internet.

NAICS (North American Industry Code System) Adopted in 1997 to replace the old Standard Industrial Classification (SIC) system, it is the industry classification system used by the statistical agencies of the United States.

Notebook A notebook is a computer system designed for portability. It comes with an independent, modular, self-contained power supply (i.e., a battery). It typically measures 8.5 by 11 inches and weighs less than eight pounds with the battery and weight-saver modules. Notebooks use flat-panel color screens of Super Video Graphics Array (SVGA) resolution or higher. They offer expansion through PC card technologies and have specialized integrated pointing devices. Notebook types include:

- *Desktop Alternative:* This is a computer system that meets all the criteria for a notebook PC but is designed to replicate the functionality of a desktop. It weighs six pounds or more. The screen can be as large as 16 inches, with SVGA resolution or higher. Target markets include engineers and other users wanting to travel carrying minimal weight.
- *Mainstream:* This is a computer system that meets all the criteria for a notebook PC but is designed to be the best compromise between all-inclusive functionality and light weight. Mainstream notebooks weigh between four and six pounds with the weight-saver and battery modules. Mainstream notebooks often have a single bay for the inclusion of a peripheral, such as a CD-ROM drive.
- *Ultraportable:* This is a computer system that meets all the criteria for a notebook PC but is lighter and may not have an internal floppy disk drive. It typically weighs four pounds or less with the battery and weight-saver modules. The keyboard and screen are often compromised to meet weight targets, and the unit must be augmented with a standard keyboard and mouse for long-term use.

PC (Personal Computer) A PC is a general-purpose computer that is distinguished from other computers by its adherence to hardware and software compatibility. This compatibility drives high unit volumes of commodity-like products that do not require on-site technical support. High-performance features (such as networking, graphics and a virtual multi-user/multitasking operating system) are normally optional and are not integral system features. A PC system is a single unit that includes a CPU, a monitor and a keyboard.

PSTN (Public Switched Telephone Network) The network operated by public telephone operators and other common carriers that provides circuit-switched, packet-switched and leased lines to the public and that may be used to transmit voice or data packets between points. Devices within the public network include public network switching equipment (central office switches) and public network transmission equipment (Synchronous Digital Hierarchy multiplexers, non-SDH multiplexers, cross-connects, digital loop carriers, broadband loops, high-bit-rate DSL [HDSL] and asymmetric DSL). Also included in this category is equipment that uses wireless technology to form part of the public network. Examples include mobile network infrastructure and microwave equipment and satellite systems.

Packet Switching A networking method in which nodes share bandwidth with each other by sending packets. There is no dedicated circuit.

Peer-to-Peer (P2P) A style of networking in which computers communicate directly with one another rather than clearing traffic through managed central servers and networks. During the next decade, personal computing devices, such as super phones, PDAs, toys and e-books, will evolve from their simple, fixed-function, first-generation forms and acquire more computing power and run general-purpose operating systems or application platforms. Personal devices will become personal application platforms. At the same time, all of these devices will incorporate at least one form of short-range wireless networking that will allow the proliferation of personal P2P applications.

Personal-Area Network (PAN) Standards and specifications for devices or applications to dynamically locate and interact with one another. Bluetooth and Jini are examples of emerging PAN technologies. The lifestyle impact of such PANs—together with other emerging technologies such as flexible displays and speech recognition—will be enormous within the next 10 years, leading to a fundamental rethinking of how personal communications and information technology are used in people's everyday lives.

Personal Communications Services (PCS) A low-power, high-frequency cellular technology, operating in the 1.5MHz to 1.8MHz range. In the United States, PCS also operates at 1.9GHz.

Personal Digital Assistant (PDA) A handheld computer that serves as an organizer, electronic book or note taker. It typically uses a stylus or pen-shaped device for data entry and navigation. It may incorporate wireless communications capabilities.

Types of PDA include:

- Clamshell: A computer system that weighs less than three pounds and opens lengthwise to expose a keyboard and screen
- PDA Computer: A handheld data-centric device designed for high portability. PDAs generally run non-Windows operating systems that provide "instant on" capability
- Tablet: A computer system that weighs less than four pounds and that is operated by direct screen contact via a pen or touch interface.

QoS (Quality of Service) A measure of performance for a transmission system that reflects its transmission quality and service availability.

Server A node or software program that provides services to clients.

Short Message Service (SMS) A bidirectional paging function that is built into GSM systems. Each message can be up to 160 ASCII characters long. The network stores messages for several days (typically a maximum of 72 hours) and attempts to deliver the message whenever the target mobile phone is switched on. Confirmation of receipt is available as an option in some networks.

Standard Industry Code (SIC) A grouping of numerical codes used by economists to identify industries. Replaced in 1997 by the North American Industry Code (NAIC).

TCP/IP (Transmission Control Protocol/ Internet Protocol) A common abbreviation for the set of transmission protocols (or rules) that enable the Internet.

TDM (Time Division Multiplexing) A circuit switching signal used to determine a call route.

Ultrawideband (UWB) Also known as pulse radio, UWB an emerging wireless technology that uses pulsed radio techniques to transmit data. The transmitter sends a low-power broadband signal, with each channel ranging from 10 million to 40 million pulses per second. The correlator, which knows the timing code of the transmitter, listens at these intervals and decodes the signal. Time Domain's Larry Fullerton invented the concept. Time Domain's impulse transmitters emit ultra-short Gaussian monocycle pulses with pulse widths of between 1.5 and 2.0 nanoseconds. UWB also has applications in radar systems, including systems that can detect people through walls or rubble.

UNIX Originally developed at AT&T Bell Laboratories, Unix is a 32-bit, multitasking, multiuser operating system. It is often used to run servers.

Virtual Private Network (VPN) A system that delivers enterprise-focused communications services on a shared public network infrastructure, and provides customized operating characteristics uniformly and universally across an enterprise. Technology providers define a VPN as the use of encryption software or hardware to bring privacy to communications over a public or untrusted data network. A common example is a remote teleworker sending/receiving information from a corporate network.

Voice Over IP (VoIP) A method for sending voice over a LAN, MAN, WAN or the Internet using TCP/IP packets instead of traditional circuit switched voice telephony.

Voice Portal A system that uses advanced speech recognition technology and provides access to information on the Internet. Key components of most voice portals are:

- Speech recognition
- Text-to-speech
- Information aggregation
- Categorization software
- Telephony and Internet interfaces
- Administrative interfaces.

Optional components include software to support context-sensitive, personalized assistance (e.g., an intelligent assistant) and support for VoiceXML.

WAN (Wide-Area Network) A data network that extends the reach of the local LAN to other geographically separate LANs through the use of the public network; typically, common carrier lines. A good example of a WAN is the Internet. This definition includes services to integrate and support business use of the Internet, private intranets and community extranets.

Wearable Computers Wearables are devices that can be carried or worn on the human body. They can be used by an individual for networked computing.

Thus, wearable computing includes handheld devices, badges, and personal clothing or jewelry.

Wi-Fi The certification mark issued by the Wireless Ethernet Compatibility Alliance to certify that a product conforms to the 802.11b standard for WLANs at 2.4GHz. (See 802.11b.)

Wireless data communication A form of communication that uses the radio spectrum rather than a physical medium. It may carry analog or digital signals and may be used on LANs or WANs in one- or two-way networks.

Wireless Internet service provider (WISP) At a minimum, WISPs are wireless gateway services that connect the wired Internet to one or more wireless bearer services.

Wireless LAN (WLAN) A LAN communication technology in which radio, microwave or infrared links take the place of physical cables. Three physical-media types of WLAN are available. The first two—direct-sequence spread spectrum (DSSS) and frequency-hop spread spectrum (FHSS)—are based on radio technologies that are not interoperable. The third is based on infrared, a non-radio technology based on light waves. Infrared can coexist with radio-based systems using DSSS or FHSS in one enterprise network. However, internetworking issues between access points prevent an enterprise from mixing and matching WLAN devices from multiple vendors. WLAN standards include IEEE 802.11 and HiperLAN2.

Footnotes

C. The Broadband Opportunity

1. As of Oct. 2001, in California, there were 337 systems, 11,197,147 homes passed, 6,952,648 basic cable subscribers, 99,821 miles of plant. National Cable and Telephone Assn. Statistics

2. Even the overwhelming evident demand for lighting could not economically justify rural electrification. Rural electrification was not accomplished until the Rural Electrification Act.

3. Service Levels commonly reflect *mean time to repair, installation commitments* and *availability measurements.* In a broadband network SLOs include new characteristics such as *jitter, latency, dropped packets, throughput performance* and *access to emergency services* such as 911.

4. Refer to Attachment C; "U.S. Mass Market Loves Broadband More Than Ever," Gartner, 3 October 2002, Schoener, Sabia. Responses from both surveys were weighted and mapped to U.S. census projections for total U.S. households translating to the following number of households online from home within the last month:

- In February 2000, 49.6 million online households
- In June 2002, 63.6 million online households

Both surveys were contracted through outside vendors' U.S. Consumer Mail Panel databases. The objective of the studies was to broadly look at consumer attitudes and technology usage trends as they relate to the telecommunications market in the U.S.

5. "Broadband Access Grows 59 Percent, While Narrowband Use Declines," January 15, 2002—Nielsen/NetRatings (http://www.nielsen-netratings.com/pr/pr_030115.pdf).

6. The ranking is based on gross domestic product data from the World Bank and a California gross state product estimate prepared by the UCLA Anderson Forecasting Project (http://www.worldbank.org/data/databytopic/GDP.pdf).

7. Gartner forecast

8. Also refer to "A Nation Online: How Americans Are Expanding Their Use of the Internet," U.S. Department of Commerce, February 2002 (http://www.ntia.doc.gov/ntiahome/dn/anationonline2.pdf).

9. *San Jose Mercury News*, Good Morning Silicon Valley, 7 March 2003

10. George Gilder, *Telecosm: The World After Bandwidth Abundance*, Touchstone Books, March 2002, ISBN: 0-743-20547-2.

11. http://www.discovery.org/products/books/telecosm/index.html.

12. World Business Review, www.WBRTV.com Show #812A

13. http://oxygen.lcs.mit.edu/index.html

14. http://www.charmed.com/company.php

15. "The 2002 National Technology Readiness Survey." The National Technology Readiness Survey (NTRS) is cosponsored by the Center for e-Service at the University of Maryland's Robert H. Smith School of Business. 4 February 2003

16. "Mario Generates $10 Billion in Revenues" (http://www.pcgameworld.com/story.php/id/419/) compares Mario's revenues with the theatrical revenues of Harrison Ford ($5.6B).

17. http://www.inmet.com/caeti/

18. Marc Prensky, *Digital Game-Based Learning,* (McGraw Hill, 2001).

19. Jeff Green, "Chrysler, Kraft, Nokia Try to Add Sales with Computer-Game Ads," Bloomberg News. 2 February 2003.

20. Sacramento Bee "Telemedicine Aids Rural Health Care" Lisa Rapaport. March 2003

D. Potential Economic Opportunity of Ubiquitous Broadband Utilitization

1. Robert W. Crandall and Charles L. Jackson, The $500 Billion Dollar Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access. 16 July 2001

2. Dale W. Jorgenson, "Information Technology and the US Economy," *American Economic Review* 91(1), March 2001, at Table 2.

3. Note: This analysis is based on per capita penetration not household penetration

4. Based on Gartner and other industry analysts' forecasts

5. Actuals and forecast by SIC from California Economic Development Department (EDD)

6. SIC—Standard Industry Code. Although this is being replaced by North American Industry Classification System (NAICS), the most recent EDD forecast was created by SIC.

E. Broadband Obstacles

1. "Access I Connecting the San Joaquin Valley," *New Valley Connexions*, August 2002.

2. http://www.usda.gov/rus/telecom/telecomact/pdf_files/ntia-rusbroad.pdf

3. http://www.onfiber.com/

4. http://www.yipes.com/

5. Refer to Attachment D for additional information on Ethernet in the MAN.

6. Builders can often obtain $3,000 per subscriber for cable TV only systems. Builders are also able to market the advanced services to homebuyers, resulting in increased sales prices as well.

7. "Fiber Finds a Home in New Developments," TechBuilder (http://www.techhomebuilder.com/Framesets/THBMagFS.html).

8. Fiber-to-the-Home Installations Expected to Reach Approximately One Million by 2004 (http://www.ftthcouncil.org/FTTHInstallations101502.PDF).

9. Gartner asserts carrier class phone calls will never be completely free, but the price will be dramatically less than it is today.

10. Voice mail, three-way calling and other features are currently available using shareware software.

11. "Retail VoIP Opportunities in Asia Pacific" Gartner, September 26, 2002

12. As per Gartner's June 2002 Consumer survey, about 2% of all US households indicated they subscribe to Internet telephony.

13. CPUC report—Broadband Services as a Component of Basic Telephone Service—Attachment F—Costs of Deploying Enhanced Basic Service. August 2002

14. A Nation Online: How Americans Are Expanding Their Use of the Internet, page 73

15. "Five Truths and Five Myths to Cross the Digital Divide." Gartner, 2002

16. Andrew Odlyzko, "Content Is Not King," AT&T Labs-Research (http://www.dtc.umn.edu/~odlyzko/doc/history.communications2.pdf)

F. Broadband Leadership and Organizational Roles—A Recommendation

1. GAATN received a "Best of Texas" award given to Texas government IT projects based on collaboration within or across jurisdictional boundaries to improve service to citizens, the public or State employees. These "Best of Texas" awards are presented by the Center for Digital Government and Government Technology magazine.

2. One of the key conclusions of an investigation into the success of broadband in South Korea, which was led by Brunel University and funded by the United Kingdom Department of Trade and Industry (DTI).

3. U.S. Optical Fiber Communities—2002 With Customers Served Today via Fiber to the Home (http://www.ftthcouncil.org/USOptFiberCommunList2002.pdf)

4. "City opens Internet free-access zone," Federal Computer Week (http://www.fcw.com/geb/articles/2003/0106/web-beach-01-10-03.asp)

5. Intel Corp. Press Release, 4 March 2003

6. City of Portland Portal, winner of the 2001 Top 25 Technology Solutions (http://www.cgis.ci.portland.or.us/dynamic.cfm?content_id=70)

7. "Getting Online: A Guide to the Internet for Small-Town Leaders," (http://www.smallcommunities.org/ncsc/Pubs/Getting%20Online/Chapter_5.htm)

Attachment D—Ethernet in the Metropolitan Area Network

1. http://www.idc.com/

Attachment E—Broadband Deployment in South Korea

1. Lee Sang-chul, South Korean Minister of Information and Communication.

Attachment F—Impacts of the FCC's Interconnection Rules

1. Gartner Perspective, "UNEs: Stifling U.S. Broadband Growth and Ineffective in Promoting Local Competition," [TELC-WW-DP-0146]

Attachment G—Flexible Regulations Model

1. Gartner Perspective, "FlexReg: Telecom Regulatory Model of the Future," [TELC-WW-DP-0193]

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