Sibley County and Fairfax, Minnesota

Benefits of Broadband
November 15, 2010

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Community Benefits of Broadband

This report will look at the issue of the benefits of bringing real broadband to the rural communities of Sibley County and the Fairfax area.

A. How Much Broadband is Enough?

Today the bandwidth situation in the County is very mixed. Some of the cities have DSL and cable modem service, although none of them have speeds as fast as in the twin cities. One town, Winthrop, has DSL that has just recently been upgraded to 1 Mbps. As you leave the towns there is no cable modem service and the DSL speeds drop quickly the further you travel from town. Finally, a lot of the rural areas are still stuck with dial-up service.

How much bandwidth does America realistically need to satisfy current and predictable future needs? Industry experts almost universally agree that household Internet usage within the foreseeable future will outstrip the capabilities of the current technologies available in the area.

While many households are satisfied with today's download speeds, we are already beginning to see sophisticated users demand more bandwidth. In the near future experts all agree that households are going to demand far faster speeds than are currently being delivered. We have already seen the rapid evolution from early dial-up access increasing to 56 Kbps dial-up increasing to cable modems and DSL. There is no reason to believe that we have reached the end game in terms of the need for faster broadband. Consumers are finding more and more uses for broadband. Users are routinely swapping pictures, video files, and other large files. Gamers are using the Internet for live play across the street and around the world. The Internet is quickly becoming the prime mechanism for delivering videos to households and it was recently reported that NetFlix, You Tube and Flickr account for over 20% of download traffic on the web. Of even more interest is where technology is going. Several manufacturers are working on 3-D video technology that will enhance the gaming and movie experience (and require gigantic data files compared to today).

Estimates by the experts have the overall size of the data on Internet growing from 50% annually to almost exponential growth during the next decade. We don't know which of these experts are right, but there is almost nobody predicting a growth rate much slower than 50% in overall internet traffic per year.

Predictions by some of the experts include:

- In May 2008 the Chief Technology Officer of Charter Communications said, "ISP traffic is increasing at more than 50% every year. So it is not far-fetched to see 100 Meg products becoming the norm in 5 or 10 years, and we expect our customers will find exciting ways to use that capacity." In the same interview, the Chief Technology Officer of Comcast agreed, "For the

short term, 100 Mbps is a marketing advantage – in the longer term, who knows? People didn't need 1 Mbps when we started delivering it." [1]

- Cisco is predicting even faster growth. In Jun 2009 they predicted that the web would grow to 2/3 of a zettabyte (one trillion megabytes) by 2013, meaning over a five-fold increase in web traffic from 2009 to 2013. They predict that by 2013 that video will make up 90% of web traffic, and it is this prediction about video that makes their estimate higher than most other predictions.

- Cisco also studies actual web usage each year. In their latest report, the Cisco VNI Usage Study they show some interesting statistics:
    - The average broadband connection generates 14.9 GB of Internet traffic per month, up from 11.4 GB per month in 2008 - this is an increase of 31 percent when averaged out across the global subscriber base.
    - Peer-to-peer (P2P) file sharing is now 25 percent of global broadband traffic – in 2008 it was 38 percent of total traffic. It is important to know that despite this significant drop in percentage, the overall about to traffic generated by P2P in absolute terms is still growing – it is just growing more slowly than visual networking and other advanced applications such as online video.
    - Online video is now the category of usage on the web. The subset of video that includes streaming video, flash, and Internet TV represents 26 percent of total traffic generated, compared to 25 percent for P2P.
    - The top 1 percent of broadband connections are responsible for more than 20 percent of total Internet traffic.
    - The top 10 percent of connections are responsible for over 60 percent of broadband Internet traffic, worldwide.
    - In an average day, Internet "prime time" ranges from approximately 9 p.m. to 1 a.m. around the world. This contrasts to broadcast TV prime time, which is generally from 7 p.m. to 11 p.m. across most global markets.[2]

- Professor Andrew Odlyzco of the University of Minnesota currently sees a 50-60% increase per year in Internet traffic, but believes the growth rate is slowing over time.[3]

- Bret Swanson and George Gilder predict fast growth through 2015: "From YouTube, IPTV, and high-definition images, to "cloud computing" and ubiquitous mobile cameras—to 3D games, virtual worlds, and photorealistic telepresence—the new wave is swelling into an *exaflood* of Internet and IP traffic. An exabyte is 10 to the 18th. We estimate that by 2015, U.S. IP traffic could reach an annual total of one zettabyte (10^{21} bytes), or one million million billion bytes."[4]

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[1] Brian Santo, "It's the End of Cable as We Know It (And We Feel Fine)," *CED* (May 1, 2008), http://www.cedmagazine.com/Article-End-of-Cable-As-We-Know-It.aspx.

[2] From Cisco: http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/Cisco_VNI_Usage_WP.html

[3] Andrew Odlyzco, *Minnesota Internet Traffic Studies Home Page*. http://www.dtc.umn.edu/mints/home.php.

[4] Bret Swanson and George Gilder, "Estimating the Exaflood: The Impact of Video and Rich Media on the Internet: A zettabyte by 2015?" *Discovery Institute* at 2 (January 2008). http://www.discovery.org/scripts/viewDB/filesDB-download.php?command=download&id=1475.

- In its most recent report to Congress on the status of deployment of advanced telecommunications networks, the FCC stated: "Providers assert that within the next several years, consumers can expect connections providing symmetrical service at 10 to 20 Mbps. Within five to ten years, these connection speeds should increase to 100 Mbps, and some providers predict that premium services may provide consumers with 1 gigabit per second (Gbps) access within a decade. Even higher-speed connections may be deployed to businesses, with some providers predicting the availability of 10 Gbps business services". [5]

If the growth rates predicted by this diverse group of experts materializes, then all would agree that DSL and cable modems, as they exist today, will be unable to supply households with the bandwidth needed to fully utilize the services and benefits of the Internet. Only fiber can give households access to full web functionality within a few years from now.[6]

It is interesting to see executives at cable and telephone companies talking about 100 Mbps and 1 Gbps connectivity during the next decade, since their current technologies have no hope of ever delivering those kinds of speeds. The following table shows CCG's best estimate at the commercially available bandwidth that is available today and in the future with the primary commercial technologies. It is clear that fiber is today, and will remain for the foreseeable future as the most robust technology.

Data Download Delivery Speeds

	Today	**10-years**	**25-years**
FTTH	2,400 Mbps	10,000 Mbps	25,000 Mbps
DSL[7]	Up to 50 Mbps	Up to 100 Mbps	Up to 200 Mbps
Cable modem	Up to 50 Mbps	Up to 100 Mbps	Up to 200 Mbps
Wi-Max	20 Mbps	70 Mbps	200 Mbps
BPL	3 Mbps	50 Mbps	100 Mbps

[5] FCC, *Fourth Report to Congress on the Availability of Advanced Telecommunications Capabilities in the United States*, p. 45.

[6] An interesting article about why bandwidth is important is in an article, "Fiber to the Home: Advantages of Optical Access." From Broadband Properties, February, 2007. http://www.broadbandproperties.com/2007issues/feb07issues/ftthprimer_feb.pdf

[7] DSL requires bonded pairs, that is, using more than one copper pair to achieve the speeds listed in the table. The problem in the real network is that very few neighborhoods have been built with the extra copper pairs needed to provide this service to more than a few customers.

B. U.S. Broadband Standings in the World

For the last century the U.S. has been a major technological leader in the world. We have enjoyed a technical advantage in a large number of fields due to our political system, our infrastructure and our educational system.

However, as is witnessed by the large number of jobs being outsourced from the U.S. to the rest of the world, our advantages are disappearing. Broadband is the infrastructure of the 21st century. In the last century one of our major assets as a nation was in interstate highway system. While it seems trite to mention the information highway, broadband really is the new equivalent of the interstates. Nations that have broadband have the economic advantage today.

In 1990 the U.S. was the world's leader in broadband deployment. We were the first to deploy widespread DSL and cable modems. However, since then, the world has caught up and surpassed us. Until recently, the U.S. still has the most consumers connected to broadband. However, China has now surpassed us in total consumer connections.[8] However, the quality, price per megabit and penetration rate per hundred consumers in the U.S. has dropped below much of the rest of the world. Consider the following statistics:

- In terms of broadband subscribers per 100 residents, the U.S. ranks 15th according to OECD, 18th according to the International Telecommunications Union, and 25th according to Point Topic. The US is 12th in terms of the percentage of homes with access to broadband access at 63%. This low showing is due to the fact that rural America has less than 40% of homes with access to broadband of any type. Perhaps the most surprising statistic is that the US is 28th in terms of the number of households who have access to a computer (desk top, laptop, handheld) at 61%. [9]

- In the average advertised download data speeds, the U.S. ranks 13th in the world according to current OECD statistics. This is troubling since it's pretty universally understood that the speeds advertised by many of the incumbent providers in the U.S. are much faster than actual speeds realized by consumers. In early 2008, AT&T reported the results of measuring cable modem speeds from an unnamed competitor. "AT&T purchased cable Internet service for over 150 homes in the service area of an unnamed competitor. The advertised broadband speeds were in the neighborhood of 6 Mbps to 8 Mbps, and AT&T installed gear in each home to test and take samplings of the actual throughput and speeds. The result was quite different from what the cable company advertised. While AT&T saw peak speeds in the 3 - 4 Mbps range, average throughput was closer to 400 kbps. Peak might be something that occurs at 3am, when the network is lightly

[8] Reuters. March 13, 2008. China Overtakes US as top Web market. http://www.reuters.com/article/internetNews/idUSSHA29750720080313.

[9] From OECD website: http://www.oecd.org/document/54/0,3343,en_2649_34225_38690102_1_1_1_1,00.html

loaded," said Stankey. "Even at peak, the performance on these types of transactions was well below the 6 or 8 Mbps access speeds." [10]

- In average monthly overall price paid by consumers the U.S. ranks 22nd in the world according to the OECD. When looking at price per megabit the U.S. ranks 19th. For example, Japan delivers 20 Mbps for around $30 per month. In the U.S. a typical 1.5 Mbps DSL connection is $30 to $40. Thus, our DSL costs over $20 per megabit while Japanese bandwidth is available for around $1.50 per megabit.

- The Information Technology and Innovation Foundation has developed a new composite standard that combines household penetration (subscribers per household), speed (average download speed in Mbps), and price (lowest monthly price per Mbps). The United States ranks 15th on this standard. [11]

The real issue is the quality of bandwidth available to customers. In the U.S. typical DSL speeds are 1.5 - 3 Mbps downstream and 256 – 512 Kbps upstream. Cable modems tend to deliver around 3 Mbps downstream (at peak times) and 512 Kbps upstream. The bandwidth in other countries far surpasses U.S. bandwidth. For example, in Japan there is ubiquitous availability of 20 Mbps connectivity. Further, the Japanese are half way through a three-year project to increase bandwidth everywhere to 100 Mbps. South Korea also has nearly ubiquitous 20 mbps bandwidth. Cities like Paris, Vienna and Amsterdam have announced projects to bring fiber to every home and business.

In 2002, the United States Department of Commerce published an extensive report on the multiple benefits that ubiquitous access to affordable, high-bandwidth broadband would produce for America.[12] The report noted that "the current generation of broadband technologies (cable and DSL) may prove *woefully insufficient* to carry many of the advanced applications driving future demand. *Today's broadband will be tomorrow's traffic jam, and the need for speed will persist as new applications and services gobble up existing bandwidth*."[13] The report then went on to encourage governments at all levels to act aggressively to stimulate broadband demand.

The Brookings Institute has estimated that America's broadband decline could lead to an estimated $1 trillion loss in economic productivity over the next decade.[14]

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[10] Eric Bangeman, "AT&T talks serious smack about cable broadband speeds," *Ars Technica* (February 28, 2008), http://arstechnica.com/old/content/2008/02/att-talks-serious-smack-about-cable-broadband-speeds.ars

[11] Robert Atkinson, Daniel Correa and Julie Hedlund, "Explaining International Broadband Leadership," *Information Technology and Innovation Foundation* at 6 (Mayc2008), http://www.itif.org/files/ExplainingBBLeadership.pdf.

[12] U.S. Dept of Commerce, *Understanding Broadband Demand: A Review of Critical Issues* September 23, 2002).

[13] *Id*. at 6 (emphasis added).

[14] John Reinan, "Broadband Gap Looms as Net Loss for U.S.," Minneapolis Star Tribune, February 22, 2006

Earlier this year the FCC adopted a new National Broadband Plan that has set forth goals to promote high-speed Internet everywhere in the US. [15] This plan recognizes that the US is falling behind the rest of the world in broadband. Following are the primary recommendations from this plan:

- Support entrepreneurship and America's small and medium-sized businesses.
- Small Business Administration (SBA) resource partner programs should provide enhanced information technology (IT) applications training.
- Current federal small and medium enterprise (SME) support programs should use broadband and online applications to scale their services and give small businesses access to a virtual nationwide network of experts.
- The government should develop a public-private partnership to provide technology training and tools for small disadvantaged businesses (SDBs) and SMEs in low-income areas.
- Congress should consider additional funds for the Economic Development Administration (EDA) to bolster entrepreneurial development programs with broadband tools and training.
- Deliver high quality federally-supported job training and placement services virtually
- The Department of Labor (DOL) should accelerate and expand efforts to create a robust online platform that delivers virtual employment assistance programs and facilitates individualized job training.
- Remove barriers and promote telework within the federal government.
- Congress should consider eliminating tax and regulatory barriers to telework.
- The federal government should promote telework internally.
- Enable local and regional economic development.
- The federal government should develop regional and community broadband benchmarks for use as a central component within economic development planning and programs.
- EDA should create an easy-to-use, dynamic online information center that gives regional development managers access to integrated federal, state, local and Tribal data.
- The National Science Foundation (NSF) should use its technology transfer grants to spur regional innovation and development as well as greater collaboration across universities

It is now clear that Japan and its far eastern neighbors are leading the charge in broadband. These countries are positioning themselves to take the greatest advantage of increased efficiency and innovation, which will cost more U.S. jobs. If the United States is to regain and retain its competitive position in the world economy, it must develop better ways to keep within hailing distance of the world's leading countries in per capita broadband penetration, access to high-bandwidth broadband, and cost per unit of bandwidth. A quick glance at the countries with cheaper and better broadband than the US tells where our jobs are headed - India, South Korea, China, Singapore, Ireland etc.

In his book, *The World is Flat*[16], Thomas Friedman was looking at the rapid development of technology in India and shed the light on America's role in the upcoming century:

[15] Website for the National Broadband Plan: http://www.broadband.gov/

[16] T. Friedman, The World is Flat: A Brief History of the 21st Century at pp 10-11. (Ferrar, Strauss and Giroux – New York, 2005)

> *"The dynamic force in [the current stage of globalization] – the thing that gives it its unique character – is the newfound power for individuals to collaborate and compete globally. And the lever that is enabling individuals and groups to go global so easily and seamlessly is not horsepower, and not hardware, but software – and all sorts of new applications – in conjunction with the creation of a global fiber-optic network that has made us all next-door neighbors. Individuals must, and can now ask: 'Where do I fit into the global competition and opportunities of the day, and how can I, on my own, collaborate with others globally.' . . We are entering into a phase where we are going to see the digitations, virtualization and automation of almost everything. The gains in productivity will be staggering for those countries, companies and individuals who can absorb the new technological tools. And we are entering into a phase where more people than ever before in the history of the world are going to have access to these tools – as innovators, collaborators, and alas, even as terrorists. You say you want a revolution? Well, the real information revolution is about to begin."*

With America's leadership in manufacturing and commerce largely eroded, it is vital for us to retool our businesses, institutions and residents to ensure that we will have a seat at the head of the global table. Broadband is key to keeping us competitive.

C. Why Broadband is Important

We could write an entire paper describing why broadband is important to any community in the US. Certainly communities believe that broadband is important when considering that over 900 communities proposed to get a fiber system from Google earlier this year. There are many clear advantages of having ubiquitous broadband. In this section of the report we will look specifically at the ways that broadband can benefit government, education, healthcare, business, homes, and economic development.

Government

Many governments across the country are using broadband to improve service to constituents. This movement is often referred to as e-government. CCG has worked in dozens of communities and we have compiled the following list of benefits for governments if they had access to more broadband.

- Teleworking. City managers and municipal employees everywhere wish for the ability to telework from home when needed. This would require more bandwidth at the City, but also more bandwidth at their home. With teleworking, employees could have access at home to all data files, and ideally would be able to make and receive VoIP calls using their normal City phone numbers from home as well.
- Video Conferencing. There was also a general desire to have video conferencing. Today video conferencing is limited to specialized video conferencing centers that have expensive equipment designed for this purpose. However, with real bandwidth, almost any computer can become a video conferencing center. Cameras have become inexpensive so the only issue to overcome for video conferencing is bandwidth. Cities came up with a host of ways they would use video conferencing if available:
    - Meetings with Legislators.
    - Meetings with vendors
    - Meetings with other government entities

  - Ability to attend meetings from home or from elsewhere within the City.
  - Video conferencing in the library to allow citizens to have job interviews and other important meetings.
  - Conduct interviews with prospective employees.
- Video Surveillance. Real broadband brings the ability to put up permanent or temporary surveillance cameras as needed throughout the community.
- Communicate Electronically. Cities want the ability to communicate electronically, meaning the ability to send large data files to constituents and others in their work life. This would include:
  - Answering citizen's questions.
  - With other city employees.
  - With vendors – the ability to send large files such as maps, blue prints, data files.
  - With larger constituents such as developers, landlords and large businesses.
  - With boards, commissions and other external government entities.
  - With job applicants.
  - With attorneys – want the ability to send electronic evidence files of pictures, test results, videos and other evidence instead of in hard-copy formats.
- Make Government Meetings More Accessible to Constituents. Provide live streaming video of council and other important government meetings.
  - Allow replay of meetings afterwards.
  - Make meeting video streams available at library.
- Economic Development.
  - Provide video tours of the area for interested businesses.
  - Provide easier access to mapping and geologic data.
  - Provide easier access to census and other key data.
- Streamline Public Processes.
  - Automate the building permit process.
  - Automate zoning verification.
  - Automate building inspection including allowing floorplans to be electronically sent to field.
  - Automate job applicant testing.
  - Automate citizen payments for various permits and other fees.
  - Automate business and landlord licensing.
  - On-line registration for recreation events and classes.
- Operational Improvements.
  - Computer aided dispatch.
  - Plow routing and efficiency.
  - Automate vehicle maintenance data.
  - SCADA monitoring of pools and irrigation systems.
- Improvements at the library.
  - More bandwidth.
  - Expand offerings to include streaming videos of story time, author visits, classes, etc.
  - Expand catalog to be accessible by hand held devices.
  - Give public access to City and County data such as GIS.
- Public safety.
  - Floorplans available real time to firefighters and police.
  - Police officer briefings – officers can meet from their cars.

  - Monitor parolees and probationers.
  - Real time monitoring of firefighter biosigns
- Information Systems.
  - Create off-site back-up of City data.
  - Be able to send large data files, for example, GIS data.

Economic Development

The purpose of municipal economic development is to generate new jobs and increase the tax base of a community. It is the general goal of economic development to attract, retain or expand commercial and industrial business. Although financial incentives are often highlighted by the news media, most economic development efforts undertaken by cities involve the provision of basic infrastructure to support the needs of new or expanding business.

Economic research shows that public infrastructure investment is a powerful driver of business productivity, investment, and economic growth. In addition to basic infrastructure like streets, sewer and water, cities often promote the quality of schools, access to affordable health care and the availability of cultural amenities in their efforts to attract new business.

Below we provide a summary of several studies and well as real life examples that demonstrate a relationship between the availability of high-speed broadband and enhanced local economic vitality. The studies we reference have focused on whether there is a digital divide, on regulatory impacts and investment incentives, and on the factors influencing where broadband is available. Given how recently broadband has been adopted, there is little empirical research analyzing its economic impact. The primary problem in determining this impact is that broadband does not act on the economy in isolation, but as a complement to other information technologies, such as computers and various software applications.

Two recent studies, both presented in 2005, provide some answers to the question of the relationship between the availability of broadband and economic vitality. Scholars from MIT – William H. Lehr, Carlos A. Osorio, and Sharon E. Gillett along with Marvin A. Sirbu from Carnegie Mellon University studied the economic impact of broadband using a comparative analysis of availability and use of broadband over time in different geographic areas. Their study yielded two relevant conclusions:

Broadband access enhances economic growth and performance, and the assumed economic impacts of broadband are real and measurable. Research revealed that between 1998 and 2002, communities in which mass-market broadband became available by December 1999 experienced more rapid growth in employment, number of overall businesses, and in the IT-intensive sectors;

Wage levels were not significantly impacted by broadband; however, the effects of broadband availability by 1999 can also be observed by higher property values in 2000.

The study focused on the use of broadband, not just the availability. The authors recommended that in order to succeed in growing your community's economic base through mass market of broadband, the goal should be dually focused on the use of the technology as well.

A second study by George S. Ford & Thomas M. Koutsky, an economist and attorney, employed an econometric model to compare economic growth in Lake County, Florida, with other similar Florida counties. In 2001 Lake County began offering private businesses and municipal institutions access to an extensive, publicly owned fiber optic system. After comparing economic growth in Lake County to comparable counties since the introduction of broadband, Lake County was found to have 100% greater growth in economic activity, or twice the rate of comparison counties.

The Lake County study observed that publicly provided broadband infrastructure may better serve the overall community than simply relying on private telecommunications firms. Similarly, other theoretical studies have argued that municipalities invest in broadband infrastructure to serve a diffuse "public purpose" (better educated public, more business opportunities, etc.) that private providers acting alone may ignore since these external benefits cannot be captured as corporate profits.

The Bureau of Economic Advisors estimates that for each $1.00 invested in broadband, the economy benefits nearly $3.00 – but unless a private communications provider can gain the lion's share of that economic benefit, its incentive will be to under-invest in broadband infrastructure. Economic theory indicates that in the presence of large externalities (costs or benefits of an activity), which broadband internet probably produces, public ownership of resources may be desirable.

While these early studies appear to provide support for the position that the availability of broadband infrastructure will generate economic benefit for a community, it is also clear that broadband is only one of many factors that influence business decisions. Many other community qualities and assets contribute to the environment for business development and attraction.

Recently, following the publication of Richard Florida's book "The Rise of the Creative Class," cities across the country have been revitalizing their economic development efforts with a focus on providing infrastructure and amenities that will be attractive to the "creative class" - the type of people who start and staff innovative, fast-growing companies.

Broadband has been one of the basic offerings seen as vital to attracting these workers and entrepreneurs. In studies by the cities of Seattle, New York and Philadelphia, all conclude that their future economic well-being is tied to providing a robust, affordable broadband infrastructure. In particular, each cites the need to provide broadband, not as a luxury, but as a fundamental part of basic infrastructure, much like electricity was at the turn of the 20th century.

The availability of fiber combined with marketing efforts to industries considered "IT-Intensive" are the necessary ingredients to speed up the occupation of the City-owned industrial park. At the end of this section is a list of "IT-Intensive" industries, as classified by the U.S. Department of Commerce.

Fiber technology enables businesses to operate more efficiently. The increased speed and ease of every day work helps profits and encourages businesses to expand. A real-life example of this result was reported within the Lake County, Florida study. The study cited a letter received by the City of Leesburg from a heating and air conditioning business that credited the fiber network as a major contributing factor for their ability to expand.

> *"Recently, we expanded our businesses to new markets farther away from our 'base' here in Fruitland Park [Fla.]. The ease of this expansion is largely due to the Fiber Network the City has had the presence of mind to build." Letter from Charles Thompson, Munn's Air, to Ron Stock, City Manager, City of Leesburg, Florida, March 8, 2005.*

Additionally, the foremost example of the broadband "haves" and "have-nots" is evidenced in Iowa. Waterloo, Iowa and Cedar Falls, Iowa, collectively referred to as The Cedar Valley, share a labor statistical area and were identical in their economic statistics prior to the City of Cedar Falls launching a city-wide broadband network. According to a 2004 report entitled The Economic and Community Benefits of Cedar Falls, Iowa's Municipal Telecommunications Network by Doris Kelly of Black and Veatch, the City of Cedar Falls has achieved significant economic benefits from their fiber system that began partial operations in 1996 and was fully operation by 1997. Since 1996, approximately eleven companies have relocated from Waterloo to the Cedar Falls Industrial and Technology Parks. During this same time, Cedar Falls has retained all their businesses, with several companies expanding their presence within the business parks.

The successes of Cedar Falls are evident in the comparison of new construction valuations. Cedar Falls new construction valuation lagged behind Waterloo in 1996 by 45% or $26 million ($58 million in Waterloo compared to $32 million in Cedar Falls). By the end of 2002, Cedar Falls had set a construction record topping out at $101 million; while Waterloo's construction valuation declined to $53 million, its lowest total in eight years. An additional measure of Cedar Falls vitality is the price of the land in their industrial parks, which increased as much as 50% from 2002 to 2004.

The report indicates the City of Cedar Falls has increased the number of businesses in their business parks from 25 to 140 from 1990 through mid-2004. The 140 businesses employ 4,250 persons and occupy in excess of four million square feet of building space. Major employers within the parks include businesses that rely heavily on direct fiber connection. The author also comments, however, that "It would be extremely difficult to verify that these developments are the direct result of the City's broadband delivery system. Yet, one cannot disregard the direct link between the 'Dawn of a New Age' and the City's ability to meet the increasing demand for access and dissemination of information."

Another study depicting the economic benefits of broadband was done for the South Dundas Township in Ontario. The study was authored by Strategic Networks Group at the request of the U.K.'s Department of Trade and Industry. The township constructed a fiber system that became operational in June of 2001. Strategic Networks Group conducted surveys of businesses in April, 2003, achieving a 75% response rate. They attributed the addition of 62.5 new jobs, $2.8 million in commercial/industrial expansion and $140,000 of increased business revenues and decreased costs to the availability of the fiber network.

The availability of high-speed broadband lowers entry barriers for new firms and encourages self-employment. High-speed broadband opens markets and brings together market participants, thereby generating greater access to products while lowering transaction costs.

Many municipalities have constructed, or encouraged the construction of high-speed fiber networks for wide-spread use within their community. These cities were motivated by the lack of the private telecomm offering the internet services their city needs to compete in a global marketplace. A few of the

cities include Bristol, Virginia; Dalton, Georgia; Jackson, Tennessee; Tacoma, Washington; and The Dalles, Oregon.[17] A little about each City follows.

Bristol, Virginia – Bristol launched a municipally owned fiber system in 1999 to commercial and public sector entities, by 2001, the citizens were clamoring for the service as well. The Bristol Virginia Utilities expanded services to the entire city and to neighboring cities within Russell County. According to Jerry Brown, Director of Bristol's Community and Economic Development Department, he credits the municipally owned fiber system as critical in their ability to retain businesses within their city. Furthermore, with the expansion of the system into the underlying county, Virginia Congressman Rick Boucher credits the FTTU network instrumental in attracting more than 700 jobs to a single site in the county (quoted in campaign material). Bristol's penetration rate exceeds 60 percent and is viewed as an engine of economic development for the entire region of Southwest Virginia.

The Dalles, Oregon – Since 2004, the City of The Dalles, population 11,872, has operated a 17 mile municipal fiber optic network. Prior to the installation of the municipally owned fiber network, the city lost out on a health care company call center. The center did not locate in The Dalles because the local telecom company's network was too expensive. The Portland Business Journal reported on February 28, 2005 that Google, Inc. has executed a purchase agreement with the Port of The Dalles bringing hopes of up to 100 high-paying jobs to The Dalles. The City believes that without their affordable fiber system (which was developed in phases to take advantage of federal appropriations), Google would not have been interested in locating their business within The Dalles.

Tacoma, Washington – Tacoma, Washington began operating a fiber optic network in 1998 through the Tacoma Power, the city-owned electrical utility. They chose "Click! Network" as their brand name for the triple play of services. The publicly owned utility leases the right to use the network to private internet providers. The city of Tacoma has more competitive rate options for internet and cable television, which helps the pocketbook. An August 16, 2000 *Seattle Post* article by John Cook states that 100 start-up technology companies set up shop in Tacoma during the preceding 18 months ("Digital economy may spark Tacoma's renaissance"). The article further quotes a new business to the city, AtomicTangerine, "It makes establishing a business that much easier when you don't have to worry about getting a big (fiber-optic) pipe into a building."

Dalton, Georgia – In 2003, Dalton, Georgia's municipally owned utility introduced a triple-play fiber optic network to all homes and businesses within the city limits. They currently have a 60% take rate. In a cover story from the May, 2006 issue of the LastMile, Vice President of Telecommunications at Dalton Utilities is quoted -- "As other cities have shed businesses in the new global economy, Dalton hasn't lost any in the last eight years I've lived here. We've had business consolidations, but no real shedding. We're still economically strong, and I like to think that broadband had something to do with that."

[17] For a list of municipalities deploying FTTH as of 4/2008 see white paper at the FTTH Council, "Municipal Fiber to the Home Deployments", David St. John. April, 2008. at http://www.ftthcouncil.org/?t=143&||web_records::_R_CategoryID=2

Jackson, Tennessee – Jackson, Tennessee began offering a fiber optic network in May, 2004 through its municipally owned utility. They utility created the infrastructure after hearing from business and consumer leaders that the private telecommunications and cable companies were not acting to provide advanced services necessary for business expansion. The network is open to competitive providers of telecommunications and data services. The utility surpassed their 10,000 customer mark 18 months ahead of schedule in late 2005.

Access to high-speed broadband at an affordable price is crucial to a community's economic development efforts. The American Public Power Association considers history as repeating itself with the current broadband marketplace as compared to the introduction of electricity in the 19th century. Electricity was first considered a luxury, but communities realized the need for the service in order to grow their economy. Many communities with lower populations needed to foster the development of electricity into their community, which included establishing their own utility companies.

One such community, Scottsburg, Indiana, was documented in a PBS NOW broadcast in 2005. Scottsburg's Mayor Bill Graham conducted a survey of businesses in 2003 and heard that many were inclined to leave the small town because of slow and inadequate internet connections. The Mayor wasn't going to let that happen so he contacted the local telecommunication providers and begged them to provide high speed internet. Their reply was that they couldn't justify the business expense for such a small community. The City of Scottsburg had no choice but to step in with the broadband to save their community. The City's broadband network saved businesses from leaving their community, including an automotive repair center with 60 plus jobs

Reedsburg, Wisconsin – The Reedsburg Utility Commission launched triple-play fiber optic services in 2003 to every home and business in the community. According to Dave Mikonowicz, Reedsburg Utility Commission Superintendent, "The first day that the system was offered, nearly a thousand customers signed up. In a community of only 3800 homes, this is a strong vote for next-generation telecom. Clearly Reedsburg residents know that providing state-of-the-art voice, video, and data communication is the key to its future prosperity." Furthermore, the utility just announced in a July 26, 2006 Press Release that they are now offering bi-directional or symmetrical broadband speeds. In this press release they state, "High Speed Internet access has become an increasingly important role in our day to day routines and businesses, and is just one of the amenities that people relocating to the area expect to find. According to the Annual Power Broker Report and Survey Real Trends 500, consumers in search of relocating are driven and attracted to locations with High Speed Internet access. Reedsburg has become a noticeable area to live and do business in because of these amenities and the quality of life Reedsburg has to offer."

Princeton, Illinois – This small town in Illinois constructed a 12-mile fiber-optic network in late 2004. The town's utility went into the broadband business after hearing from a major employer looking to relocate outside of their town because the internet capabilities were not current with marketplace demands. From an on-line article in Midwest Business, dated November 7, 2005, the superintendent of the town's utility states that since the installation of the fiber network, the major employer has made a $6.5 million investment in its facility and the available fiber network was definitely a factor in that decision (article titled "Municipal Broadband in Illinois Draws Dollars Along with Telecom's Ire").

IT-Intensive Industries:

In the *Digital Economy 2003*, the U.S. Department of Commerce developed "IT-Intensive" industries to determine ITs' effects on reviving and spreading productivity growth. They ranked 55 industries of the U.S. private non-farm business sector based on intensity in their use of IT equipment. The industries were then divided into two groups, either IT-Intensive or Less IT-Intensive, each group accounting for 50 percent of aggregate Gross Domestic Product (GDP). This separation was instituted in order to measure the performance of GDP growth and employment based on IT usage through 2001. Exhibit A contains a list of the "IT-Intensive" industries and the appropriate Standard Industry Classification (SIC) code. The SIC code system has been replaced by the North American Industry Classification Systems (NAICS), and an approximate translation is included. The NAICS classifications were revised in 2002, which added the Internet Publishing & Broadcasting industry. The list of IT-Intensive businesses below may assist the City in targeting their marketing efforts.

Additionally, according to a report dated August 27, 2002 by Meredith Singer of the Telecommunications Industry Association titled "The Economic and Social Benefits of Broadband," there are additional applications that benefit from the deployment of broadband: Telemedicine, Teleworking, E-Government, Agriculture, Distance Learning, Public Safety, and others including small business assistance, information gathering, tourism, e-commerce and entertainment.

Lastly, the U.S. Census Bureau publishes reports on E-Commerce. In their most recent report ("U.S. Census Bureau E-Stats," May 25, 2006) they highlight "Manufacturers led all industry sectors, with e-commerce accounting for 23.4 percent of total shipments – up substantially for the third straight year." The report is for the year 2004 and is available at
www.census.gov/eos/www/papers/2004/2004reportfinal.pdf

At CCG we must note that any list from a few years ago can be quickly dated. Our observation from talking to businesses in all sorts of communities is that a majority of businesses are coming to rely on broadband as a basic requirement for conducting business. Thus, while the large businesses referred to in the following table are certainly still businesses needing a lot of broadband, there are now myriads of smaller businesses that need relatively as much broadband per employee as these IT intensive industries. We believe the business need for broadband is becoming ubiquitous.

IT-Intensive Industries
Reported by U.S. Department of Commerce (Digital Economy 2003)
Codes reported as SIC, approximate translation to NAICS

Industry Name	SIC	NAICS	NAICS Super Sector Name
Business services	73	532, 541, 561	53 - Real Estate & Rental & Leasing
			54 - Professional, Scientific & Technical Services
			56 – Admin/Sup & Waste Mgmt & Remed Serv
Chemicals and allied products	28	325	31-33 – Manufacturing
Coal mining	12	212	21 – Mining
Depository institutions	60	522	52 - Finance & Insurance
Electric, gas and sanitary services	49	221	22 – Utilities
Electronic and other electric equipment	36	334	31-33 - Manufacturing
Holding and other investment offices	67	523, 525	52 - Finance & Insurance
Industrial machinery and equipment	35	333	31-33 - Manufacturing
Instruments and related products	38	334, 339	31-33 - Manufacturing
Insurance carriers	63	524	52 - Finance & Insurance
Internet Publishing and Broadcasting	NA	516	51 - Information
Metal mining	10	212	21 - Mining
Motion pictures	78	512	51 - Information
Nondepository institutions	61	522	52 - Finance & Insurance
Oil and gas extraction	13	211	21 - Mining
Other transportation equipment	37	336	31-33 - Manufacturing
Paper and allied products	26	322	31-33 - Manufacturing
Petroleum and coal products	29	324	31-33 - Manufacturing
Pipelines, except natural gas	46	486	48 - Transportation & Warehousing
Primary metal industries	33	331	31-33 - Manufacturing
Printing and publishing	27	323	31-33 - Manufacturing
Radio and television	483, 484	515	51 - Information
Railroad transportation	40	482	48 - Transportation & Warehousing
Security and commodity brokers	62	523	52 - Finance & Insurance
Telephone and telegraph	481, 482, 489	517	51 - Information
Tobacco products	21	3122	31-33 - Manufacturing
Transportation by air	45	481	48 - Transportation & Warehousing
Transportation services	47	488, 561	48 - Transportation & Warehousing
			56 – Admin/Sup & Waste Mgmt & Remed Serv
Wholesale trade	50, 51	423, 424, 425	42 - Wholesale Trade

Education

Broadband can enhance education throughout the community. California created a statewide Broadband Task Force which reported that:

> *Broadband networks ... have enhanced education by providing students and teachers with access to a vast array of resources. Text-based materials, photos and images, videos, animations, interactive lessons, data-manipulation tools, oral history collections, music, and educational gaming programs are just a few of the valuable benefits. Interactive 3-D experiences and visual-simulation software allow critical-care nurses, for example, to effectively train from their homes*

> *and gain simulated "hands-on" experience comparable to those in a hospital setting. And the future holds even more opportunity. The National Science Foundation (NSF) report "Cyberinfrastructure Vision for 21st Century Discovery," predicts that the "future will see increasingly open access to online educational resources including courseware, knowledge repositories, laboratories, and collaboration tools." To effectively realize this future, access to a robust broadband infrastructure is imperative.*[18]

Citizen's educational opportunities can be enhanced both in the local school system and through greater access to E-learning models. Distance learning programs may be an enhancement to the educational environment in the schools, but will also provide for continuing education and opportunities for all ages. As pointed out in High-Speed Learning[19], "The greatest and most profound effect of broadband on the learning process, however, could come from equal and affordable access not just to schools, but homes as well."

One important aspect concerning both use of the system and opportunities for learning was addressed in *Lessons From Blacksburg Virginia*[20]. The Blacksburg Electronic Village (BEV) had its official start in 1993. By 1997 studies showed that more than 80% of Blacksburg residents were using the Internet routinely. This was not a broadband network, but a community network that originally relied on high-speed modems for access.

> *What Blacksburg quickly found was that community education was a necessity if they wished to attract users."The "field of dreams" model has been a stumbling block for many of the communities we have worked with - people change habits slowly, and a key role for the community network effort is to help people become comfortable with making changes in the way they communicate."*

Both businesses and residential users had difficulty envisioning the ways they could use and benefit from, the Blacksburg network. Blacksburg began offering classes to businesses, located in university computer labs, and quickly had to set rules concerning attendance because local companies wanted to send numerous employees. The BEV states that "the majority of the citizens of Blacksburg can now be regarded as computer- and network literate."[21]

High-Speed Learning emphasizes why diverse educational opportunities are so important[22]:

> *While there are some who advocate a "back to basics" approach to education and curriculum, it is becoming increasingly obvious that the United States must prepare its*

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[18] California Broadband Task Force, "The State of Connectivity: Building Innovation Through Broadband: Final Report of the California Broadband Task Force" (January 2008), http://www.calink.ca.gov/pdf/CBTF_FINAL_Report.pdf

[19] Fulton, Katherine. (2006). "High-Speed Learning: How Broadband Is Changing The Educational Landscape". *LastMile*. March, 2006. www.lastmileonline.com/previous-issues/3-06_coverstory.htm. (*High Speed Learning*)

[20] Cohill, Andrew Michael. Community Networks: Lessons From Blacksburg, Virginia. Boston, MA, Artech House, Inc., 1999. Page 336. *(Lessons From Blacksburg Virginia*).

[21] *ibid*, Page 30.

[22] *ibid*

> *students for the rigors of global politics, economics and communications by providing them with the knowledge and perspectives needed to thrive in a complex world. And as districts, educators and governments seek ways to make all of this possible, one word stays at the forefront of the discussion: Broadband.*

Affordable broadband access allows schools to bring a global perspective to students. As described in *Virginia Super Fast Networks*:[23]

> *Louis Fox, director of the Internet2 K20 Initiative, said, "Internet2 has been providing advanced networking for the nation's K-20 community for many years and has been successful in bringing advanced educational programs to Virginia. Through the use of Internet2's advanced networks, students across the state have been able to participate in cutting-edge experiences like Megaconference Jr., a project that uses advanced videoconferencing technology to bring together thousands of students in elementary and secondary schools from around the world for an all-day learning conference."*
>
> *"Also, students can receive live undersea exploration demonstrations from remote locations with famed oceanographer Bob Ballard, take master music classes from world-renowned instructors or use remote-controlled instruments to dissect a biology specimen from 1,000 miles away," Fox said. "Leveraging Internet2 technology and our vast network of resources and partners throughout the world, the opportunities are endless for students to expand their educational and cultural horizons."*

Broadband Networks[24] outlines benefits to public schools that have been achieved with The Digital California Project, a statewide initiative:

> The State's investment in establishing a high speed, broadband network for K-12 education represents a critical piece of the infrastructure necessary for teachers and learners to keep pace with the "anytime, anywhere" universe of information services emerging in the private sector. This infrastructure lays the groundwork for:
>
> - Synchronous (real time) and asynchronous (on demand) interaction and collaboration across distances, enhancing access to professional development workshops, degree and certification programs, virtual tours, field trips, special events, etc.
> - Networking can help address the demand for more teacher professional development at a time when funds are being reduced. Video conferencing and Web-casts, both of which require significant network bandwidth, can improve access while reducing travel and training costs.
> - Greater use of data, text, graphics, voice, and video to supplement textbooks and instruction with multimedia formats that tap into the many different learning styles of students and teachers.

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[23] Trulove, Susan. (2006) "Virginia universities, colleges connect K12 schools to super fast networks" Blacksburg, Virginia. Virginia Tech News. (*Virginia Super Fast Networks*)

[24] Corporation for Education Network Initiatives in California (CENIC). (2003). Broadband Networks In K-12 Public Education; Achieving Last Mile Connectivity to California Schools. Online www.cenic.org/pubs/reports/lastmilejune03.pdf. (*Broadband Networks*)

- The ability to model or simulate "what-if" scenarios to help students understand difficult concepts.
- On-line delivery of instruction by highly qualified teachers for courses where the number of students is too small or a teacher is not available.
- Training students in the use of technology through integration with academic instruction in a meaningful way enhances learning and ensures that students have the skills necessary to be successful in today's knowledge-based workforce.
- Resource sharing and cost savings through joint licensing to leverage resources for maximum benefit.
- Administrative applications and efficiencies.
- Delivery of student support services to help with course selection, college placement, and entrance exam information, as well as career and vocational counseling.
- Student data management to transfer voluminous student information.

Similar opportunities and benefits for the educational community were identified by a group in the United Kingdom in "Opportunities and Barriers to the Use of Broadband in Education":[25]

- Enhance the learning experience
  - Broadband can transform the learning experience for students as it can expose them to a range of exciting and innovative learning content that was previously either inaccessible or unpractical in the narrowband environment. Exposure to new forms of content can have a positive motivational effect and encourage students to want to learn.
- Improve cooperation between educational institutions
  - One of the real benefits of broadband is that it can facilitate and enhance inter-institutional collaboration. For example, broadband can be used to share scarce teacher resources between schools and colleges via high-speed interactive videoconferencing (previously not practical in a narrowband environment), it can also be used to link different institutions to create innovative joint projects that encourage communication and cooperation. In one innovative project, broadband was used to facilitate the often difficult transition for students when they move from primary to secondary schools.
- Deliver new potentialities
  - Broadband can also facilitate new and innovative e-learning opportunities on a wider scale. For example, broadband has been used to enhance modern language learning through conversational language lessons with native speakers in other countries such as in the Ashcombe case study. It has also been utilized in the Nesta Motivate project to provide school students with access to mathematics experts. On a wider scale, it can also facilitate international collaboration with organizations and institutions outside the education sector as an innovative project involving the Birmingham Ballet has demonstrated.
- Improve efficiencies in existing educational provision

[25] Broadband Stakeholder Group, Opportunities and Barriers To The Use of Broadband in Education. (2003). Online, www.broadbanduk.org/reports/BSG_%20Education_%20Report_03.pdf .

  - Broadband can deliver real efficiencies in existing provision by streamlining reporting and administration as well as automating the administration and management of educational institutions (see the Cambridgeshire schools example below). Broadband can also be used to deliver curriculum details and examination results to students in a more efficient way.
- Widen access to education
  - Broadband can also be exploited to widen access to educational material and new learning opportunities by using links from schools to the wider communities, such as libraries, museums, theatres and other cultural institutions as is happening in the Bethnal Green Museum of Childhood.
  - Broadband is also used as a means of widening access in rural areas and providing access to education materials to learners with disabilities or behavioral problems such as in the Notschool.net project identified below.

EDUCAUSE is an association representing the 2,500 colleges and universities in the US. They think broadband is important for the way it can transform the educational experience[26]:

> *Distance learning is perhaps the most obvious, but not the only, educational use of bigger bandwidth. Because the majority of today's students live off campus today, the need for big broadband is important to ensure that they receive the same quality of education as on-campus students. Furthermore, many state colleges, especially those in rural states, have extensive distance learning programs to serve students all across the state. Many community colleges need big broadband to provide their students with the same quality of instruction as larger institutions. There are not enough teachers in enough places to meet the need; while it is not physically possible to provide a teacher of advanced calculus to every community, a high-speed network can extend the boundaries of the classroom anywhere. ...High-quality video can provide meaningful two-way, interactive, real-time educational experiences: a student at home can continue to participate in regular classes; parents can confer with a teacher using a videoconference; study groups can form, with members working on projects together, remotely consulting databases, video libraries, computer simulations, and each other. Virtual field trips can take students and teachers sitting in their classrooms to faraway places, such as touring the Smithsonian National Air and Space Museum, experiencing a tribal dance in Africa, or scouring the depths of the Pacific Ocean in a submarine. Music students can receive lessons from a master instructor hundreds of miles away, who will be able to hear, see, and interact with the student. Homework can be researched using digital archives at the Library of Congress, where 3D objects can be examined from all angles*

In your own communities you have something exciting already happening. All of the students at the GFW school were given iPads at the beginning of this school year. Having broadband at school is going to enhance this sort of opportunity. However, many of these students will be going home in the evening to homes with no broadband or with very slop broadband, and students in homes with broadband will have an immediate advantage over those in homes without. There is a wide array of ways that the public

[26] John Windhausen, "A Blueprint for Big Broadband," *EDUCAUSE* at 10 (January 2008), http://net.educause.edu/ir/library/pdf/EPO0801.pdf

schools in the community are already using broadband today and those applications can be brought into the home to expand the educational opportunity for children in the community.

Learning today is a lifetime endeavor. Many experts predict that the average adult will have to hold multiple different jobs during a work career which will require retraining several times in a person's life. Much training material today requires big broadband and with a fiber network any citizen in the County can bring training resources into their home.

Health Care

Access to broadband networks can benefit both health care providers and consumers. These benefits can include improved quality of services, reductions in cost, dissemination of health information to the public, reduced time in hospitals and more efficient administration.

The *Quello Center Report*[27] states that "distance from specialized service providers becomes a less important factor in determining quality of care. Patients living in the distant regions from hospitals could benefit from the e-health system as well.", and that "Broadband can improve training for healthcare professionals by providing high quality multimedia information for clinical and educational support."[28] Examples are included in *Life Saving Technology*:[29]

> *Dr. Bruce Dunn of Clement J. Zablocki Veterans Administration hospital in Milwaukee was one of the first doctors in the country to create a "telepathology" practice serving a hospital 200 miles away. Through a broadband connection, his computer receives video images from a remote-controlled microscope in a sister hospital in Iron Mountain, Wisconsin, which he uses to diagnose cancers and other diseases in tissue samples.*
>
> *Many more doctors exchange large data files such as x-ray results, which do not require real-time connections but still need high-speed networks. Hospitals have found broadband technologies to be invaluable in non-life-threatening situations as well, saving considerable labor and other resources by using it to handle medical claims, insurance processing and other administrative tasks.*

With regard to cost savings, the *Quello Center Report*[30] maintains that "by reducing delay times to consult patients and to search for data they want with stable and fast broadband connections, doctors could become more time efficient in their diagnosis. With more time efficiency, hospitals or other medical institutions could earn more revenues."

The availability of health information to the public can also benefit the community and reduce costs of health care. As explained further in the *Quello Center Report:*[31]

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[27] *Quello Center Report*, Michigan State University, 2005. Page 12.

[28] *Quello Center Report*, Page 12.

[29] *Life Saving Technology*

[30] *Quello Center Report*, Page 12.

[31] *Quello Center Report*, Page 13.

> *Easy access to health or medical information on the Internet can reduce the need for and frequency of visits to doctors and hospitals because some types of information can be delivered effectively through websites. Web based images enhance the effectiveness of the Internet in this educational role. Access to medical information might also assist patients by providing guidance on assessment of symptoms and how to monitor vital signs.*

The necessity and length of hospital stays can be reduced with enhanced homecare. "Remote monitoring, diagnosis and consultation can in many cases enable patients to receive treatment at home and avoid the expense and inconvenience of hospital stays."[32] A widely quoted study by Robert E. Litan estimated the economic benefits from the use of broadband technologies for Americans who are over 65, or who have disabilities. In the study, Dr. Litan estimated that the net present value of total benefits for this sub-group will be $927 billion in 2005 dollars over the next 25 years. These benefits include "lower medical costs; delay of institutionalized living; and additional output generated by more seniors and individuals with disabilities in the labor force."[33]

Dr. Litan maintains that broadband technologies will benefit the elderly and disabled through cost savings in medical care, as follows:[34]

> *The cost savings arise because broadband will facilitate the widespread usage of disease management programs that require constant or "real-time" communication between patients and providers of medical care in a way that would be much less convenient or even impossible in a "dial-up" world (for example, through remote monitoring by health care providers and by two-way communications between patients and health care providers, or "telemedicine").*
>
> *Medical monitoring enabled by broadband should also delay (or conceivably eliminate the need for) institutionalized living for some seniors and individuals with disabilities….The VA's integrated chronic disease monitoring program has produced impressive cost savings, cutting hospital admissions by up to 60 percent.*

Health care providers can also help to limit errors and achieve efficiencies to improve the quality of their services. As Dr. Litan explains:[35]

> *…still do not take full advantage of information technology to digitize record-keeping, invoicing, prescription ordering, and other functions. There is no generally available system of portable, easily used patient medical records so that patients need not fill out*

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[32] *Quello Center Report*, Page 13.

[33] Litan, Robert E. (2006). "Broadband for Seniors and Disabled". Broadband Properties. Online, http://www.broadbandproperties.com/2006issues/feb06issues/Litan%20-%20Health%20and%20Medicine.pdf. (*Broadband For Seniors*).

[34] *Broadband For Seniors*.

[35] *Broadband For Seniors*.

> *new sets of forms, including their medical histories, each time they visit a new health care provider."*
>
> *Savings could be realized through widespread online access to patients' electronic medical records; clinical decision support and payer guidelines; prescription and ordering of medical tests; real-time verification of reimbursement eligibility; appointments scheduling and referrals; patient education and interaction (including "email appointments' rather than in-person visits); compliance monitoring; and greater use of the Web for ordering supplies…*

To summarize the benefits of broadband for health care:

- Makes doctors more efficient and allows them to review files, x-rays and other patient material remotely, as needed.
- Telemedicine allows local health facilities to consult real time with experts elsewhere, saving on transporting patients and reducing time for treatment.
- Remote monitoring offers the ability for the elderly to live at home for longer, thus drastically reducing costs and improving the quality of life.
- Nurses and doctors can use two-way connections for examining and talking to patients in their homes.

Businesses

Businesses are become huge users of bandwidth and are becoming more and more reliant on robust networks. Following are some of the key ways that businesses are using bandwidth today.

- Transmitting Large Data Files. Companies today need to send massive data files that consist of such things as drawings, blueprints, videos, and other formats that create large files.

- Redundancy. Companies are so reliant on bandwidth that most of them want redundant paths to the Internet. They want to be able to get services from more than one internet provider to provide reliability when provider networks crash (which they do). Very data intensive companies also seek physical redundancy, meaning they want more than one physical wire path leaving their location to get to the world, to protect from local problems like cable cuts.

- VoIP. Large companies that operate in multiple locations have almost universally adopted VoIP as a way to manage long distance costs and to bring uniformity to corporate communications.

- Disaster Recovery. Businesses are creating large amounts of data and they understand that it would be crippling to lose their data. Thus, firms are using disaster recovery techniques to make sure that corporate data is secure in the case of a disaster at any one location in the company. Disaster recovery involves several techniques. Primary is the storing of data in more than one location, usually at least in one spot that is outside of the company. Disaster recovery also involves systems and software that would allow the company to continue working using external servers should they physically lose their hardware from a fire, flood or other disaster.

- Video Conferencing. Because of the ever increasing cost of travel and due to a drive for efficiency, companies are using more and more video conferences. At any given time there can be multiple video conferences emanating from the same location at the same time, requiring significant bandwidth.

- Training. Training is become a constant need for businesses. Training does not involve only new employees, but all employees need to be trained in new processes and procedures. Without broadband, training involves sending the employees to a distant training center. However, with the use of video conferencing and the use of large interactive training programs, companies can train for a few hours per day and get productivity from workers. These new training processes require significant broadband.

- Cloud Computing. Cloud computing is a relative new business model whereby businesses have abandoned servers and computers in favor of using virtual servers located at large, remote and secure locations. Companies have come to realize that operating their own servers and trying to keep up with new computers and software is costly and sometimes dangerous. Almost every company has had major problems when their server was compromised by a virus or when a key computer crashed and destroyed key data. Thus, cloud computing now offers a set of services that make it easy for companies to manage the IT process:
    - Companies can use 'dumb' terminals to access smart virtual servers accessed through the web. These servers are managed to be secure from viruses and service attacks. The software on these servers is always kept up to date. This model relieves the company from trying to be an expert on computers, security and software and to focus on their core business.
    - Mass computing. Companies can buy time on many computers when they need to process a large application or use a big burst of computing power. One of the primary vendors in this area is Amazon.com.[36]

Home Use

Just a few years ago home Internet use consisted of reading emails, gaming and web browsing. However, the advent of real broadband has greatly expanded the way that households are using bandwidth today. One can imagine that in a decade the following list will seem somewhat quaint as households find many more ways to use broadband.

Entertainment

While people still use the Internet to read emails, entertainment has grown to be much more. The most popular use of broadband today is video. Just one web site, YouTube now uses more bandwidth in a day than the entire internet of 2000. NetFlix is growing quickly and will soon be the biggest download user on the web. Video has become ubiquitous on the web and a large number of commercial web pages now include video. As a migration is made to high definition video, the vast climb in bandwidth is expected

[36] Gary Orenstein, New York Times, Cloud Computing's Three-Horse Race, March 8, 2009. http://www.nytimes.com/external/gigaom/2009/03/08/08gigaom-cloud-computings-three-horse-race-40903.html?em

to continue to grow rapidly. The younger generation has incorporated web video into their lifestyle and on YouTube there are two video's created and uploaded to the system for every three watched. Regular web users have become content creators.

Online gaming is also becoming a major driver of home bandwidth. Gamers understand bandwidth and are always looking for the fastest upload speeds available. Unfortunately for gamers, DSL and cable modem are skimpy with upload speeds. One of the fastest growing categories of online gaming is known as Massively Multiplayer Online games (MMO). This chart (http://www.mmogchart.com/Chart4.html) shows that by the end of 2008 that over 15 million subscribers are actively subscribed to MMO games. MMO games include such games as World of Warcraft (with 10 million subscribers), Lineage, RuneScape, Final Fantasy, Eve Online, Dofus and many others. MMO games allow huge numbers of games to play simultaneously on gigantic game boards.

Even more millions of gamers play games using the interactive versions of games available on the various game boxes. Some game boxes like the Xbox now also allow simultaneous VoIP conversation among games as part of the gaming bandwidth.

Telework

Broadband enables many people to work from anywhere. As American jobs continue to shift from manufacturing to service and information industries, more and more jobs can be done remotely, at least part of the time. Teleworkers are not only those who work full time at home, but increasingly are becoming those who work occasionally from home, or who work from home on weekends.

Teleworkers need bandwidth in order to simulate the environment they have at the office in their home. They want access to the company servers and voice systems to seamlessly be able to work from wherever they are at.

One study shows that commuters drive 53% to 77% percent less on days that they "telecommute" – i.e., work from home using broadband capabilities – than on days when they drive into their offices.[37] Another study estimates that a three-day-a-week telecommuter could save an average of $5,878 a year in commuting costs and would avoid putting 9,060 pounds of pollutants into the environment.[38] Another study estimated that full use of telecommuting opportunities would annually save $3.9 billion in fuel costs and the equivalent of 470,000 in jobs.

One other study reported:

> *[T]o the extent that telecommuting boosts worker productivity, society benefits as the increases in productivity are translated into lower prices (as opposed to higher wages). To date, much of the telecommuting productivity evidence is anecdotal or from self-reported data, but there are good reasons to believe that telecommuting does allow employees in many fields to work more productively. For instance, many workers report that they can accomplish more with fewer*

[37] "Walls and Safirova, "A Review of the Literature on Telecommuting and Its Implications for Vehicle Travel and Emissions"p 19 http://www.rff.org/Documents/RFF-DP-04-44.pdf

[38] Grant Gross, "Survey: More Government Workers Can Telecommute," *InfoWorld*, (February 19, 2008), http://www.infoworld.com/article/08/02/19/More-government-workers-can-telecommute_1.html

> *interruptions at home. Further, telecommuting also allows employees to work when personal or family needs might otherwise force them to be absent from the office. Finally, telecommuting frees employees from, on average, almost one hour of commuting each day. If any of this time is dedicated to working, it translates into greater output. For example, by relying on technologies such as broadband, mobile e-mail, and voice, retailer Best Buy was able to give most of its corporate headquarters employees the option of more flexible working hours, including working at home. As a result, productivity increased by thirty-five percent in departments that implemented the program. More and more Best Buy employees are working outside the office, with forty percent of all employees working remotely on any given day. Similarly, airline JetBlue's entire workforce of reservation agents works from home, using a personal computer and a broadband connection. Taken together, these factors make it reasonable to expect that telecommuting can make some workers more productive, yielding benefits for society.*[39]

Job Training and Re-training

Several experts have estimated that the average US worker will now have 4 to 5 different types of jobs during a career. This means that job training and re-training has to become a normal part of any worker's career. Even today, interactive training videos are among the largest files that are transmitted on the internet. These videos are not simple movies by include an interactive nature where the student interacts with the information presented and also takes tests. These files can easily be a gigabit or larger and will not be readily available to workers without real broadband. Further, many Internet service providers like the telephone and cable companies are placing monthly limits on the amount of bandwidth a customer can download. The combination of slow data speeds and bandwidth limits is going to limit the ability of many communities to retrain their citizens as they are forced to change jobs over their careers.

Elderly

We are now at a point in our history where the baby boomers are starting to age. The country is going to be faced with a crisis of having millions of elderly and caring for this generation is going to swamp the health care industry.

A number of Internet-based technologies and companies are holding out the possibility that the elderly will be able to stay in their homes longer and not need to be sent to institutions. For example, there are now sophisticated monitoring services available that allow doctors and nurses to examine patients daily at home. These same services allow family members to stay in touch and check in on family members frequently. Some of these monitoring programs can constantly monitor vital signs, can report when an elderly person falls down or falters in any way.

These kinds of services are going to require significant broadband because they involve using constant video surveillance. Further, the medical monitoring requires high quality video and not the grainy sort of videos one sees from much commercial surveillance tapes.

[39] Robert D. Atkinson, "Framing a National Broadband Policy". p 158-159.
http://commlaw.cua.edu//articles/v16/16.1/Atkinson.pdf

Disabled

The disabled face the same kind of challenges as the elderly and there are starting to be a number of broadband-based services that give a better quality of life to the disabled. Just as with the elderly, these programs start with monitoring and surveillance where needed. However, in many cases broadband is also used to help operate devices that ease the life tasks for the disabled.

Finally, telework has brought the opportunity for many disabled to work from home with a much better lifestyle than difficult commutes.

Surveillance and Security

The advent of inexpensive video cameras has led to a boom in home surveillance and security. Millions of homes are now operating surveillance cameras that can be accessed from the web so that they can check on their homes when they are absent. These cameras are used not only for general security, but are also being used to watch babysitters and to check on pets and kids.

Video cameras require a significant amount of upload bandwidth since they run a continuous bit stream. Homeowners desire to have video streams with greater clarity, meaning even more bandwidth. As high definition cameras get cheaper, the bandwidth need for cameras will continue to grow.

Device Management

A new phenomenon is the use of the Internet to manage devices. Homeowners are beginning to connect interactive chips for energy management and are able to control thermostats, hot water heaters, and other energy-using devices to save on energy when they are not at home, but to have the home ready on their return. Security systems also can be made to switch lights on and off at random to make the home look occupied.

Some companies are now marketing smart home devices that go even further and that can be used to turn on the oven, the coffeemaker, the alarm clock or any device connected to the system.

All of these systems are being made easy to use by giving control of the connection to cell phones. This is an industry that is just beginning and one can expect the country to embrace these technologies more as we turn to become a greener nation.

Improved Cell Phone Coverage

One advantage of a rural fiber network is that it can be used to enhance rural cellular coverage. There is a new technology called femto cells that act as cellular repeaters. A femto cell will create a pocket of strong cell phone signal for a few hundred yards in all directions.

These cells can work in two ways. In the more traditional way they can act as a repeater to enhance cell phone coverage as long as the device can receive at least some signal from a cellular network.

But of more excitement for a rural network is that the femto cell can be connected to the fiber network and can carry cell phone conversations back to the voice switch in the network. This means that femto cells can bring cellular coverage where it doesn't exist today. In this application the femto cell talks to the voice switch using VoIP so that the switch thinks the customer is sitting in town and not out at a farm. This will work with any cellular provider who will support the technology and currently includes AT&T, Sprint and Verizon.

Fiber-to-the Farm

One of the most interesting aspects of the Sibley County project is that it is trying to bring fiber to the farm. In the statistics quoted above it was mentioned that rural areas have a broadband coverage of less than 40%, meaning that less than 40% of rural homes even have the possibility of being connected to broadband. However, when extended to farms this statistic has to be much lower. There are very few places where farms are covered by cable modem service, and only farms within a few miles of a town have the possibility of getting DSL. A large percentage of farms also cannot get cellular data, which is slower than landline data, but still better than dial-up.

Farms are big business these days and they need broadband as much as any other business. Bringing data to the farms in Sibley County should give those farms an advantage over other faming communities. Since this is a farming community, helping the farms is going to help many other businesses in the County.

Social Media and Web 2.0

The term "Web 2.0" was coined in 2004 by Dale Dougherty. Web 2.0 has come to mean the way that the younger generation and wired businessmen are using the Internet to enhance creativity, information sharing, and, most notably, collaboration among users.

Social media is a terminology developed to describe the way that young people are now using the Internet. One report defines social media as:

> *. . .the set of technologies, applications, and other elements defining the current stage of evolution of the Internet. The term encompasses the change from a "flat" web model to a highly dynamic mix of rich applications. These latest technologies enable a much higher participatory role for users in the generation of information content and a new level of interactivity of users with information and among themselves, among other features. Social media involves a wide range of technologies and services, including blogs (Blogger, Blogflux, etc.); wikis (Wikipedia, Wikia, Wetpaint, etc); social networking sites (MySpace, facebook.com, gather.com, etc.); video and picture sharing sites (YouTube, Flickr, Google Video, etc.); social bookmarking sites (del.icio.us, Digg, reddit, etc.); chat services (Yahoo!Chat, Skype, Windows Live Messenger, Gmail chat, etc.); virtual worlds (Second Life, Active Worlds, There, etc.); as well as podcasts, forums, and others.*[40]

[40] Victor Cid and Laura Bartlett, "Government Outreach in Social Media and Virtual Worlds," in *USA Services Intergovernmental Newsletter* (Fall 2007), http://www.gsa.gov/gsa/cm_attachments/GSA_DOCUMENT/USA_Services_Newsletter_Fall-07_R2-vA11_0Z5RDZ-i34K-pR.pdf

The Web 2.0 is changing the way that most people use the Internet. In the first generation of the Internet, large companies created websites that posted static information. Participation in the web mostly consisted of filling in forms when asking for information or ordering something from the web. However, the Web 2.0 has become a very different place both for individual users and for companies. Following are some of the latest ways that the Web is changing:

- Content Creation. Millions of people now routinely create web content in the form of uploading videos, writing blogs, creating podcasts, editing and adding to wikis.
- Combining Web Applications. The web is getting more powerful as users and companies find ways to combine web applications. For example, almost any database can be overlain on Google maps – a list of French restaurants, people who donated to a political cause, members of a club – to create useful visual data that is very different than the raw maps or the raw databases.
- Personalized News – Users can use web bots and RSS feeds to keep track of news that matters to them. Web bots are tools that will search for articles related to specific topics. RSS feeds allow users to get an automatic update any time a web site of interest changes.
- Data Mining. Companies like Amazon.com and eBay use the data of things you've searched for and what you've bought to make suggestions of things that could be of interest to you. More and more companies are mining data to try to reach out to individuals. There is a big move towards individually aimed advertising where firms will only advertise to those they think would be interesting in their products.
- Architecture of Participation. This is a fancy way of saying that as new websites gain recognition and users, word of mouth quickly drives new users to the website. This explains how new web applications and sites can explode to millions of users in a relatively short period of time.

As the web moves towards greater and greater collaboration and interactivity, the amount of bandwidth needed increases.