

Let's Build
Smart Infrastructure for our **Future**



**Benefits of Advanced Broadband Networks,
Why this Matters**

Report written by

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Many municipalities across the country are deploying next-generation, high-bandwidth telecommunications networks as a means of stimulating economic growth and development.

Our world is changing; and it is doing so rapidly. Technology is impacting every part and parcel of our lives -- from where and how we conduct work, to whether or not we thrive economically and socially. It has impacted the way we live, our entertainment, our culture, the way government services are provided and accessed, the way healthcare is being delivered, and the way we educate our children and provide education to better improve our workforce. With the introduction and accelerated advancement of technologies, having access to affordable, redundant and abundant broadband is quickly becoming the most critical infrastructure of our time, just like electricity and transportation were in the early 1900's. Advanced broadband infrastructure has the potential to create more jobs, increase the community's competitive ability globally, create new technologies, increase opportunities for the region's companies, enhance public safety, provide better and less expensive healthcare, and provide greater educational opportunities throughout our community. In a recent meeting/webinar and report produced by Brookings in May of this year, fiber was added as a critical infrastructure.¹

Advanced broadband networks are creating seismic changes in local, state, national and global societies, as well as markets, business and in institutions around the world. Access to social media and the Internet, has shifted governments, threatened national and local boundaries, inspired revolutions, and has changed us culturally. The Internet and its associated technologies have impacted wealth, work, education, government, health, public safety, and education. Having equal access to advanced broadband networks bridges the digital divide and creates better equality between the haves and the have-nots.

Like the introduction of electricity, advanced broadband networks are fundamentally changing our world in ways that were not expected or anticipated. Much like electricity, advanced broadband networks are the enabling technology in which all things are impacted. Electricity was invented to turn on the lights, but empowered – literally, the transformation to an industrial society. Advanced broadband networks are now the enabling technology to transform us yet again, to a global technology and information society; the new Knowledge Economy. (See *Captive Audience* by Susan Crawford).

¹ Joseph Kane and Robert Puentes, "Beyond Shovel Ready: The Extent and Impact of U.S. Infrastructure Jobs," Brookings Institution, (May, 2014) available at <http://www.brookings.edu/research/interactives/2014/infrastructure-jobs#/M10420>

Just as it was impossible to know in advance the impact that electrification would provide the critical infrastructure to power all of our modern appliances, computers, health monitoring systems, manufacturing facilities, computers, radio and television, and financial markets; so too, is it impossible to predict the impact and reach of advanced broadband networks. We do not yet know the far reaching impacts that the Internet will have on our lives and on generations to come. However, it is certain that NOT having access to advanced broadband networks would be equivalent to being in the dark without electricity!

The incumbent providers of phone service, Internet and cable TV services are not building best-in-class broadband networks fast enough. The model by which these services are being provided needs to shift dramatically to enable faster deployment of advanced services, affordable broadband and abundant capacity to support our current and future needs for bandwidth.

SPEED MATTERS. Global network traffic has quadrupled from 2009 to 2014. Both commercial and residential Internet bandwidth consumption are doubling every year.

Bandwidth refers to the capacity, or speed of the networks to carry traffic. The question is often presented, “How fast is fast enough?” and “What should be the definition of broadband?” The Federal Communications Commission (FCC) has proposed in the National Broadband Plan that broadband be defined as 50 Mbps “downstream” (to the consumer) and 20 Mbps “upstream” (from the consumer into the network) by 2015.² Given the growth trends in bandwidth needs and network traffic, this definition is conservative and barely meets the minimum needs for bandwidth consumption today and certainly does not address the needs that are forthcoming.

In the early days of the Internet, text messaging, email and web sites were not data-rich or bandwidth intensive and the average consumer did not need more than 7 Mbps of bandwidth. When YouTube burst upon the scene in 2005, this dramatically changed things. One video download was the equivalent of downloading 30,000 web pages. Since that time, videos and picture-rich content have been downloaded and uploaded on a regular basis by the masses. The applications we use on the Internet are becoming much more feature-rich and bandwidth intensive and our existing networks cannot keep up with the demand for networks that support these applications.

² Federal Communications Commission, *Connecting America: The National Broadband Plan* (Mar. 17, 2010). Available at <http://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf>

The Fiber to the Home Council (FTTH) stated its position clearly in a brief to the FCC. “Even today, with most users still operating on last-generation broadband technologies, the capabilities of advanced video, cloud-based services, and other bandwidth-intensive applications are growing at a pace beyond what our existing networks are capable. Cisco and other scientific companies talk about the network in terms of “terabytes” of capacity in the network center, or “core.”³ According to the Cisco 2012 Zettabyte Report, businesses today routinely require symmetrical gigabit service between their locations.”⁴

Also referenced in the Cisco 2012 Zettabyte Report, global Internet traffic grew 45 percent during 2009 alone and has doubled every year since then. Both commercial and residential Internet bandwidth consumption are doubling every year, as video, cloud computing, advanced storage solutions, telemedicine, telecommuting, video conferencing, etc., are becoming more prevalent from end users. Applications are becoming more bandwidth intensive and as more devices – tablets, Smartphones, computers, appliances – are being used both in the home and for business applications. *Research conducted by Cisco states by 2016, there will be nearly three Internet Protocol or IP-connected devices per person.* Internet-connected televisions, radios, set-top boxes, Blu-ray players, Netflix, cameras and picture frames now receive or deliver movies, TV and photos through the Internet.

According to FTTH's brief to the FCC referenced above, “the average monthly traffic in 2014 on the Internet has been equivalent to 32 million people streaming Avatar in 3D, continuously for the entire month.” In 2014, video downloads and uploads comprised 50 percent of all Internet traffic. In the coming years, the sum of all forms of Internet Protocol (IP) video (Internet video, video on demand, video files exchanged through file sharing, video-streamed gaming, and videoconferencing) will reach 86 percent of the total Internet traffic. Applications supported by cloud-based services through multiple devices have created the need for always-on connectivity and advanced broadband network bandwidth.

³ Fiber to the Home Council, “America's Petition to the Federal Communications Commission for Rulemaking to Establish a Gigabit Communities Race-to-the-Top Program,” July 23, 2013.

⁴ Cisco, “The Zettabyte Era” (May 30, 2012).

<p>Changing Pattern of Technology Adoption</p>	<p>Early Internet Days...</p> <p>Universities Finance Enterprise SP</p> 	<table border="1"> <thead> <tr> <th>Application</th> <th>Rate</th> </tr> </thead> <tbody> <tr> <td>Personal communications</td> <td>300 to 9,600 bits/sec or higher</td> </tr> <tr> <td>E-mail transmissions</td> <td>2,400 to 9,600 bits/sec or higher</td> </tr> <tr> <td>Remote control programs</td> <td>9,600 bits/sec to 56 Kbits/sec</td> </tr> <tr> <td>Digitized voice phone call</td> <td>64,000 bits/sec</td> </tr> <tr> <td>Database text query</td> <td>Up to 1 Mbit/sec</td> </tr> <tr> <td>Digital audio</td> <td>1 to 2 Mbits/sec</td> </tr> <tr> <td>Access images</td> <td>1 to 8 Mbits/sec</td> </tr> <tr> <td>Compressed video</td> <td>2 to 10 Mbits/sec</td> </tr> <tr> <td>Medical transmissions</td> <td>Up to 50 Mbits/sec</td> </tr> <tr> <td>Document imaging</td> <td>10 to 100 Mbits/sec</td> </tr> <tr> <td>Scientific imaging</td> <td>Up to 1 Gbit/sec</td> </tr> <tr> <td>Full-motion video</td> <td>1 to 2 Gbits/sec</td> </tr> </tbody> </table>	Application	Rate	Personal communications	300 to 9,600 bits/sec or higher	E-mail transmissions	2,400 to 9,600 bits/sec or higher	Remote control programs	9,600 bits/sec to 56 Kbits/sec	Digitized voice phone call	64,000 bits/sec	Database text query	Up to 1 Mbit/sec	Digital audio	1 to 2 Mbits/sec	Access images	1 to 8 Mbits/sec	Compressed video	2 to 10 Mbits/sec	Medical transmissions	Up to 50 Mbits/sec	Document imaging	10 to 100 Mbits/sec	Scientific imaging	Up to 1 Gbit/sec	Full-motion video	1 to 2 Gbits/sec
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Service	Bandwidth	Number of Devices	Bandwidth Home Area Network	Bandwidth Residential Gateway to Network
TV	2 to 20 Mbps	3.5	2 to 70 Mbps	2 to 70 Mbps
DVR	2 to 20 Mbps	2	2 to 40 Mbps	0
Home Theater	1 to 6 Mbps	1	1 to 6 Mbps	0
Internet Browsing	1 to 20 Mbps	1 to 5	1 to 100 Mbps	1 to 10 MBPS
Printer	.5 to 1 Mbps	1 to 5	.5 to 5 Mbps	0
Digital imaging	1 to 20 Mbps	1 to 3	1 to 60 Mbps	0
On-line Gaming	.2 to 1 Mbps	1 to 3	.2 to 3 Mbps	.2 to 1 Mbps
Video Capture	.1 to 1 Mbps	1 to 10	.1 to 10 Mbps	.2 to 3 Mbps
Portable Audio	.1 to 20 Mbps	1 to 3	.1 to 60 Mbps	0
Total	70 to 100 Mbps		12.5 to 354 Mbps +	4 to 84 Mbps +

New Tools Enable Innovation



Table 1 Changing Patterns of Technology Adoption

While Internet bandwidth use is doubling, cellular networks are also greatly overextended.

In addition to explosive growth in Internet consumption from homes and businesses, mobile Internet use has also advanced dramatically. Smartphone applications are spurring higher consumption of multimedia services. With tablet computers and smartphones having easy access to games, e-books, TV programs, email, shopping, banking and social media sites, wireless service providers have been scrambling to upgrade their networks.

The need for advanced broadband connectivity must include both a consideration for fiber, connecting our businesses, offices and establishments, homes; as well as wireless and cellular, allowing for mobile and portable access as we travel, move about and commute.

All-Fiber networks are imperative, critical and necessary to stimulate economic development and growth. Municipalities, communities and regions that want to impact economic development must build 21st Century infrastructure.

Communities that do not have adequate bandwidth do not support this growth, in fact; people are leaving the communities in our region because there is not adequate broadband infrastructure available. Simple applications such as webinars, online education, accessing web-based applications and databases cannot be conducted in our communities because the Internet available is too slow.

Below is a Statement from Chris Yates, founder of The Hive in Paonia:

“Since opening the Hive co-working space earlier this year we have learned the critical importance of having broadband access in our community. While local residents have grown used to slow connection speeds, visitors to the Hive consistently express their disappointment at the slow or inconsistent bandwidth in the local area to the extent that they literally have to leave town to get work done. I have given tours to numerous visitors through our facility who are considering a move to our community, all of whom are either contract workers, self-employed, or the founders of small companies or start-ups. Most of them who decide not to move here make the decision because our bandwidth is too poor for them to conduct business. I can think of several people in the last few months who would have brought jobs and new services to our valley including a government contractor doing GIS mapping work, a video producer, a small business that manufactures a product and sells it exclusively online, and several others. None of these people are here now, and all mainly due to the lack of broadband. I believe that broadband access throughout our region is the single most important next step we could take to improving the local economy and our overall quality of life.”

From Carrie Silvernail with Remax Mountain West in Cedaredge:

“....the current level of Internet is not sufficient. Webinars stall out while “buffering” and sometimes we get kicked off of the application we are using online because the service is too slow. Many web-based applications are utilized all day long, sometimes speed slows down or we have to re-boot our router and all work is lost. If broadband services were improved, we could provide online education and training, provide our real estate contracts online, obtain e-signatures and provide better contract management. My agents and clients would not have to drive in to an office location to connect to webinars.”

Carrie Andrew, the Director of the Norwood Public Library writes:

“If we had better Internet service, we could use the Internet for all material circulation needs as our databases are hosted offsite as part of a statewide consortium. We, the staff, would use it for webinars and streaming video for educational purposes. If we had advanced broadband service, we could offer distance learning classes, video conferencing and other features that require larger bandwidth.”

From Beuford Durmon, Lake City Medical Center:

“The current level of service is inconsistent and slow. We use the Internet for reference to medical applications, transmission of large x-ray files. We need it for inter-facility communications and referrals, online education, telemedicine, education webinars and teleconferencing. If we had better Internet, our patient portal work better, we would have better patient communication.”

Dan with Lake City Community School says:

“The service we have is not sufficient. We have about 75 devices using these two DSL connections during the day. We require students to use our proxy 24/7. If Internet service was improved we would use it for remote backup services, government reporting, device management and class room management

Communities meetings conducted by NEO Fiber throughout the region were well attended. Community members throughout the region stated they are unable to conduct their business properly because of slow Internet services.

Municipalities, communities and regions that have deployed all-fiber networks have already seen the tremendous economic impact of building symmetrical gigabit networks. These communities have fostered an environment of innovation, economic development and growth, collaboration, and creative activities. *According to a 2012 survey of economic development professionals, 60 percent said that 1 Gigabit of service had a “definite impact” on new businesses that moved to an area (see Table 2).* As having access to advanced broadband services is the number one priority for large businesses as they are looking for commercial real estate, the communities that have built gigabit-enabled fiber networks have already benefited economically by attracting businesses and industries to re-locate to their communities.

	Definite Impact	Indirect impact	Too soon to tell	No Impact	Difficult to measure	Total
New businesses moved to your area	60.35% 137	16.30% 37	14.98% 34	3.52% 8	4.85% 11	227
Revived depressed communities	26.22% 59	22.67% 51	29.33% 66	11.11% 25	10.67% 24	225
Individuals' income earning increases	24.23% 55	22.03% 50	29.96% 68	6.61% 15	17.18% 39	227
Revived depressed business districts	26.87% 61	22.03% 50	29.52% 67	13.66% 31	7.93% 18	227
Local companies more profitable, competitive	36.12% 82	33.04% 75	20.26% 46	5.29% 12	5.29% 12	227
Increase in home-based businesses	53.95% 123	15.35% 35	19.30% 44	3.51% 8	7.89% 18	228

Table 2 Fiber's direct impact on attracting new businesses to a community.⁵

After Chattanooga deployed their Gigabit network, the city attracted numerous high-tech firms, and entrepreneurs to relocate their company facilities, including Amazon, Alstom, and Volkswagen amongst others. Several venture capital firms were established in Chattanooga after their Fiber to the Home network was built because this fostered a business climate that was perfect for innovation and creativity. When surveyed, 42 percent of economic development professionals claimed that 1 Gigabit of service actually attracts new businesses to an area (see Table 3). Since building its gigabit network, Chattanooga has created over 7,000 new jobs and attracted billions of dollars in capital investment in a city once referred to as the "dirtiest city in America."⁶

⁵ Craig Settles, *Building the Gigabit City*, (e-book). Available at

http://portal.calix.com/portal/calixdocs/mktg/w/gig/Building_the_Gigabit_City.pdf

⁶ Chattanooga's "GigTank" website, available at <http://www.thegigcity.com/gigtank/>

▼	2-4 megabits per second (Mbps)	10-12 Mbps	20-25 Mbps	100-120 Mbps	500 Mbps	1 Gigabit	Total
Attract new businesses to your area	3.10% 7	4.87% 11	9.73% 22	26.55% 60	13.27% 30	42.48% 96	226
Help local companies grow	4.87% 11	7.52% 17	20.35% 46	29.20% 66	9.29% 21	28.76% 65	226
Increase home-based businesses	5.80% 13	13.84% 31	26.79% 60	25.89% 58	12.95% 29	14.73% 33	224
Individuals' income earning increases	8.64% 19	16.82% 37	23.18% 51	25.91% 57	11.36% 25	14.09% 31	220
Revive depressed business districts	6.31% 14	11.71% 26	18.92% 42	27.48% 61	12.61% 28	22.97% 51	222
Revive depressed communities	7.14% 16	16.52% 37	17.86% 40	27.23% 61	12.95% 29	18.30% 41	224

Table 3 Broadband's impact on economic outcomes from the perspective of speed.⁷

In 2012, the Chattanooga Electric Power Board (EPB) established GigTank, an application-incubation facility. The goal of GigTank is to build applications to utilize the capabilities of gigabit networks. According to its website, "GigTank is a startup accelerator connected to a living, metro-wide fiber optic network. Hosted by the Company Lab, this annual program attracts entrepreneurs from across the globe to Chattanooga, the home of America's first widely-available gigabit Internet service. With Internet speeds that run 100x faster than the national average, Chattanooga offers entrepreneurs the opportunity to innovate on the broadband platform of the future." This year, GigTank is focusing on three start-up tracks accelerating seed stage startups in the additive manufacturing (3D printing), smart grid and healthcare industries by connecting these new companies with the tools, capital and connections to go to market.

Chattanooga itself has experienced great success with its smart grid system that is running on the city's all-fiber network. The smart-grid system promotes energy efficiency throughout the city, remotely monitoring the system's power consumption, load balancing and power substations. It allows the electric system to re-route around failures and downed power lines in storms and outages, restoring services within minutes. Prior to the smart-grid system

⁷ Settles, *Building the Gigabit City*.

implementation, typical outages may have lasted four to five hours and many neighborhoods may not have had services restored until residents notified Chatanooga's EPB of the outage. Today, with the new smart-grid system in place over the all-fiber network, EPB can restore service in minutes. Savings realized by better management of the city's power system and improved operations has paid for the cost of deploying the Fiber to the entire community system.⁸

Similar to Chattanooga's GigTank program, entrepreneurs have developed gigabit-ready applications through the US Ignite Partnership.⁹ US Ignite is a non-profit, public-private organization that is supported by the White House Office of Science and Technology and the National Science Foundation. US Ignite is focusing on creating applications in the following disciplines of national priority:

- Education and Workforce
- Energy
- Health
- Public Safety
- Transportation
- Advanced Manufacturing

In addition to creating transformative applications, US Ignite connects people and resources, coordinates test beds, provides efforts towards scalability and providing these applications to the masses, informs the public and takes these applications to market. One cutting-edge application being developed by researchers at the University of Massachusetts, and supported by US Ignite, is the Collaborative Adaptive Sensing of the Atmosphere ("CASA") program. CASA uses predictive storm-tracking technology and "data 5 to 10 times more detailed than current radar systems" to provide citizens with advanced notification of severe weather events. These applications, as well as all of the other applications developed by US Ignite, are only possible with having access to a minimum of 100 Mbps of bandwidth. US Ignite is participating with municipalities and communities that have built out fiber networks and are offering this type of bandwidth to their constituents.

⁸ Mike Smalley, "Broadband and the Smart Grid," (2008) available at http://www.carinatek.com/PDFs/BBP_AugSep08_SmartGrid.pdf

⁹ US Ignite, available at <https://us-ignite.org/about/what-is-us-ignite/>

Kansas City offers another example. When Google issued a Request for Proposal for the “Think Big with a Gig” program to host gigabit test-beds and have Google build within their city, over one thousand communities across the country submitted applications.¹⁰ Google selected the bi-state Kansas City metropolitan region. Kansas City has already seen an uptake in new high-tech start-ups due mostly to Google’s FTTH efforts. Through Homes for Hackers and the Kansas City Startup Village, entrepreneurs have built a community of innovators enticed by the possibilities presented by the Google Fiber network.¹¹ A prominent venture capitalist has even purchased a home in a Kansas City “fiberhood” to allow entrepreneurs to live for free in Kansas City and build gigabit-ready applications. High-tech companies recognize the benefits of these networks and are willing to relocate just to have access to them.

Since Google’s roll-out of gigabit services in Kansas City, it has made plans to build Fiber to the Home in Austin and has recently purchased an existing system in Provo, Utah. Google last year announced plans to build FTTH in 34 municipalities across the country upon cooperation and attainment of a checklist put out by Google.

Other communities that have built fiber networks have shown economic growth by attracting manufacturing, high-tech and technology companies in large part because of their investment in all-fiber networks. These include:

¹⁰ Topeka, Kansas, even changed their name to Google in hopes of being selected as the test-bed.

¹¹ Kansas City Startup Village, available at <http://www.kcstartupvillage.org>; and Homes for Hackers, available at <http://homesforhackers.com>.

Municipal FTTH Networks	New Companies, due in part, to All Fiber Infrastructure
Auburn, IN	Cooper Tire Expansion
Bristol, TN	Media General
Bristol, VA	Northrup Grumman CGI
Chelan County, WA	Yahoo
Douglas County, WA	Sabey Corporation
Grant County, WA	MSN (Microsoft) Ask Jeeves Intuit
Independence, OR	Metal fabrication companies
Kutztown, PA	Film production companies
LENOSIWSCO, VA	Data Centers
Mason County, WA	Louisville Slugger Sims Technology companies Online engineering firms
Morristown, TN	Colgate Palmolive
Powell, WY	Alpine Access Virtual Call Center

12

These communities understand that symmetrical gigabit networks are essential for economic development and innovation.

¹² Fiber to the Home Council, "Municipal Fiber Deployments: Next Generation Broadband as a Municipal Utility," available at www.ftthcouncil.org/d/do/69

In Addition to Economic Development, All-Fiber Networks Enable Telecommuting.

The number of people working from home or telecommuting has increased enormously in the past few years and will increase exponentially in the future. According to a study conducted by the Global Workplace Analytics¹³, telework grew nearly 80% from 2005 to 2012. In 2010, based on its own limited survey, *WorldatWork* estimated that 16 million employees worked at home at least one day a month, a number that increased almost 62% between 2005 and 2010. Extrapolating from 2010 to 2014 would put the current number of those who telecommute at least one day a month at approximately 25 million.

According to the study, in twenty-five percent of the nation's 20 largest metro areas, more people now telecommute than use public transportation as their principal means of transportation to work. More importantly, according to Global Workplace Analytics, the estimated based upon the current labor force composition is that 64 million U.S. employees hold a job that is compatible with at least part-time telework (50% of the total workforce). 79% of U.S. workers say they would like to work from home at least part of the time (*WorldatWork Telework Trendlines 2009*) and 87% of federal employees say they want to work from home (2013 Federal Viewpoint Survey).

There are significant economic benefits from telecommuting and working from home. According to the Global Workplace Analytics website, "If those with compatible jobs and a desire to work from home did so just half the time (roughly the national average for those who do so regularly) the national savings would total over \$700 Billion a year." Other data points from the website are:

- A typical business would save \$11,000 per person per year
- The telecommuters would save between \$2,000 and \$7,000 a year
- The oil savings would equate to over 37% of our Persian Gulf imports
- The greenhouse gas reduction would be the equivalent of taking the entire New York State workforce permanently off the road.
- The Congressional Budget Office's estimate of the entire five-year cost of implementing telework throughout government (\$30 million) is less than a third of the cost of lost productivity from a single day shut-down of federal offices in Washington DC due to snow (\$100 million).

According to the Aspen Institute's Communications and Society Program's recent publication, "The Future of Work", (2011) work is no longer confined to a specific time and place. Open systems, open platforms, shared folders and databases, "crowdsourcing," and collaboration

¹³ Global Workplace Analytics Recent Statistics on Telecommuting available at <http://www.globalworkplaceanalytics.com/telecommuting-statistics>

between employees, contractors, vendors and suppliers happens “in the cloud” facilitating the ability to work anywhere there is a high-speed Internet connection, at any time.¹⁴

Providing the ability for people to work from home or from Internet meeting rooms – i.e. the local coffee shops, libraries, community centers, co-working spaces, incubator locations or virtual offices -- requires access to advanced broadband services. The benefits and cost savings of telecommuting can only be realized when workers have access to abundant broadband. If work is portable, people will choose communities that are rich in culture, art, entertainment, recreation, educational opportunities for kids and adults and are affordable. Work is no longer tied to place. Communities need to change to attract and maintain this new *portable* workforce.

Every “Thing” will be Connected to the Internet -- Medical Devices, Health Monitoring Systems, Our Cars, Our Clothes, Household Systems, Appliances, Energy Controls – the “Internet of Things.”

Every good thing out there is connected to the Internet; the new “Internet of Things.” These things include household systems that monitor security systems, locks, energy use, temperature, and water control. It includes appliances that call automatically for maintenance; make shopping lists, schedule events, order parts, and schedule repair -- all without the need for human intervention or oversight.

The Internet of Things includes medical devices that monitor our health, detect and alarm us when medical issues are present, clothes that detect glucose levels or heart conditions, and hats that monitor our brain activity. Cars are now connected to the Internet, monitoring the car’s status and performance, notifying drivers of traffic delays, alternative routes, hazardous conditions and mechanical issues. Soon cars will drive themselves. Internet-connected cars will provide anti-collision technology, automatically braking and steering clear of accidents or potential accidents. Our coming and going, our location, customer information and applications will all be collected, stored and monitored. Some of this sounds a bit invasive and creepy; however, the reality of all of this is here. Devices are all Internet-enabled. Although we as individuals will need to determine how far and how much data we want to have shared and collected, it is clear that the Internet of Things is only enabled with advanced broadband capacity.

¹⁴ David Bollier, “*The Future of Work, What it Means for Individuals, Markets, and Governments,*” Aspen Institute’s Communications and Society Publication, (2011).

The growing Baby Boomer population and the implementation of the Patient Protection & Affordable Care Act will create new challenges for our healthcare system.

The baby boomers are getting older; the largest portion of our population is aging. Concerns of increased healthcare costs with our aging society will need to be curbed by providing better, smarter, more cost-effective healthcare. Implementation of the Patient Protection and Affordable Care Act is placing new demands on the medical industry to become more efficient, cost effective and nimble, demanding that physicians interact with more patients.

Telemedicine is the use of information technology including the telephone, the Internet and personal computers, for diagnosing, treating and monitoring patients. Telemedicine is adding a new dimension to modern health care. These advances are not only making care more accessible and convenient, they are lowering the costs of medical care, while not sacrificing the quality of care, and in many studies, improving the quality of care. Physicians can consult with more patients, and patients can meet with their physicians in a shorter time period. Less time is spent checking the patient in and leading the patient to the exam room. In terms of economic advantages, telemedicine can save a great deal of time for patients who otherwise would have to leave work. Telemedicine can also eliminate many ER visits, which are often the most costly means of providing healthcare services.

According to the Wellness Councils of America (WELCOA), as many as 70 percent of primary care visits, and 40 percent of emergency room visits to treat acute medical conditions could have been diagnosed and prescribed medication all over the phone.¹⁵ The methodology of providing care has not changed; however, the medium for providing care has. The physician can perform diagnostic testing, interview the patient, check vital signs, etc. remotely using videoconferencing and remote monitoring equipment, and the telephone or internet; instead of providing these services in person.

The American Telemedicine Association highlights various reports on the efficacy, cost savings, improved healthcare and patient benefits of telemedicine.¹⁶ One report highlights the experience of UPMC Health Plan, an integrated delivery and financing system headquartered in Pittsburgh, Pennsylvania, in its efforts to support primary care practices as they converted to patient-centered medical homes. From 2008 through 2010, sites participating in the UPMC pilot achieved lower medical and pharmacy costs; more efficient service delivery, such as lower hospital admissions and readmissions and less use of hospital emergency departments; and a 160 percent return on the plan's investment when compared with nonparticipating sites.

¹⁵ Wellness Council of America, "Collecting Data to Drive Health Efforts," available at <https://www.welcoa.org/resources/collecting-data-drive-health-efforts-classic-edition/>

¹⁶ American Telemedicine Association, numerous case studies available at <http://www.americantelemed.org/about-telemedicine/telemedicine-case-studies>

Presbyterian Healthcare Services based in Albuquerque, New Mexico, adapted the Hospital at Home® model developed by the Johns Hopkins University Schools of Medicine and Public Health to provide acute hospital-level care within patients' homes. In this program, patients show comparable or better clinical outcomes compared with similar inpatients, and they show higher satisfaction levels. Available to Medicare Advantage and Medicaid patients with common acute care diagnoses, this program achieved savings of 19 percent over costs for similar inpatients. These savings were predominantly derived from lower average length-of-stay and use of fewer lab and diagnostic tests compared with similar patients in hospital acute care.

Additionally, patients that are participating in a home health program or telemedicine program experience higher satisfaction as they receive more personal one-on-one care, without taking time from work to travel to a medical clinic and wait for their appointment with the doctor. The source of satisfaction for most patients is the ability to see a specialist trained in the area most closely related to the patient's condition, the feeling of getting personalized care from a provider who has the patient's interest in mind, and the ability to communicate with the provider in a very personal and intimate manner over the telecommunications technologies.

With the Internet of Things for Medical Devices, it is now possible to remotely monitor a patient's health with the use sensors, detectors, actuators and the Internet. Medical remote monitoring devices are connected to the Internet where a patient's vital statistics get transmitted via a gateway onto secure cloud-based platforms where the data is collected, stored, monitored and analyzed. These devices can monitor and alert physicians or loved ones if a patient's vitals fall outside a healthy range. Scanners can monitor inventory levels for pharmaceuticals before a medication runs out and order supplies and inventory ensuring that hospitals and clinics have the needed supplies.

Other medical applications enabled with advanced broadband include medical training and consultation with other physicians and providers, electronic health records, and the ability to log-in and read patient charts, MRIs and X-rays.

Education: Our workforce must continue to evolve through workforce training and education. The manner in which we provide education to our kids and to adults is changing, requiring us to access information and education through distance learning and reverse classroom experiences.

The concept of working for a single company or within a single industry for thirty years until retirement is no longer an economic reality. Workers will change careers an average of seven times during their lifetime. Workers cannot expect to enjoy a “steady job” with a lifelong employer, nor expect that employer to provide the training and skills needed as the work changes. Workers will require on-going training, education and mentorship. Many of these resources for further education and mentoring are now mostly available on-line and virtual. Educational institutions, workforce training, universities, and corporations must provide education when people can use it, rather than at a specific place and time, working around lifestyle, schedules and work/home priorities and pressures.

Homework assignments, testing and accessing educational videos are all on-line. The methodology by which education is happening is changing. Schools are providing the reverse classroom, or flip education; a concept that includes providing a video of the lesson online. Students download the lesson remotely while at home, watch the lecture, can pause, reflect, rewind and watch again. The classroom time is then used for more in-depth study, homework, questions and interaction between the students and teachers. Right here in St. Louis we have a company doing Flip Education, the COO of the company lives in University City. The Company is called “Crazy for Education.” Consider community centers and schools providing the opportunity to watch these videos if you do not have a good internet location.

Public Safety: Our first responders need reliable, ubiquitous coverage, higher standards than what our commercial networks currently have, interoperability between networks and priority access to information and databases.

Emergency response teams have unique needs and higher standards for broadband and communications. Our first responders need networks that are reliable, always on, secure, provide ubiquitous coverage, interoperability between network and priority access to information and databases. Their devices need to be small, lightweight, versatile and autonomous, wearable and portable. The devices need to be capable of sensing the

environment, of tracing and tracking resources and able to convey a wealth of information to other responders, civil protection authorities and to crisis management centers. Sensor-nets can provide for situational awareness for disasters, fires, emergencies, car wrecks and other events, but these sensors require access to high bandwidth and the current wireless networks do not currently support these applications adequately.

Police officers are ready to trade in their handheld radios for use of their iPhones, iPads, and Android devices while on the job. Until recently, this has created a problem for law enforcement agencies as smartphones and tablets haven't been able to connect to conventional Land-Mobile Radio (LMR) networks. U.S. public safety agencies will soon be able to use the FirstNet network that provides priority access for law enforcement, first responder and public safety agencies. This is critical during disasters when cell phone networks can become congested, as FirstNet is a network that will have spectrum dedicated exclusively for public safety entities.

Additionally, most devices for law enforcement include video applications – camera-equipped police and camera-equipped cars, cameras on traffic stops and enforcement of speed sensors and speeding tickets, and live ambulance video-links to hospitals. The existing wireless networks cannot support the applications that are in use today. The 911 system cannot process videos from citizens, but as we are finding during emergencies, the public is often the “eyes and ears” during these crises as citizens are videotaping events as they happen. Having the public be able to record events and send the information to first responders allows for better transparency, honesty and less mistakes.

Digital Inclusion and Civic Engagement; The Great Equalizer between the Haves and the Have-nots....or Not?

Broadband must be ubiquitous or it will further create a digital divide between the haves and the have-nots. When broadband is ubiquitous it can be the great equalizer between different economic classes. In 2014, the International Economic Development Council asked economic development professionals if broadband service could "encourage individual entrepreneurship among under-served constituents," and 35 percent said that it is quite likely and 14 percent said that they had seen it firsthand (see Table 4). Ubiquitous broadband access can help create social equality. However, not having advanced broadband access available to everyone can create further inequalities of wealth and potentially can create further gaps in education, social institutions and government resources. Broadband must be abundant, redundant and available to everyone.

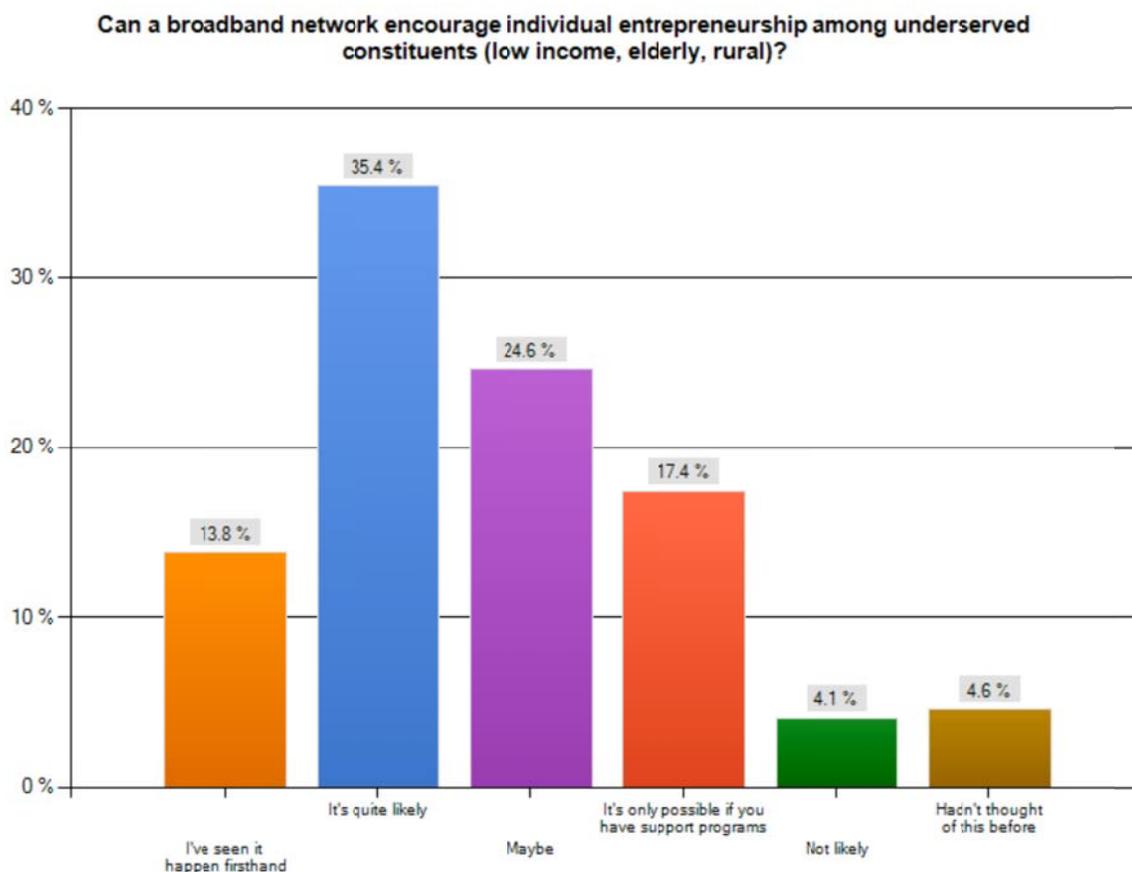


Table 4 Entrepreneurship among underserved constituents.¹⁷

Civic Engagement, Transparency, Access to Government Resources.

Advanced Broadband Networks can transform civic engagement, access to government resources and transparency of government. All government documents, including GIS data, applications, information on initiatives, information on financial contributions etc. are now available on-line. Documents must be able to be in a standardized format, searchable and available where data can be edited and used by other programs. Providing citizens access to this data provides further transparency, community engagement, public input, and public impact on government.

Higher Home Values

Finally, statistics from the FTTH Council state that real estate developments communities that have deployed FTTH networks have instantly improved home sales values by \$7,000 - \$10,000 per home.

¹⁷ International Economic Development Council, "The Broadband-Driven Economy."

NEO Fiber is a broadband consulting firm that is working with Colorado Region 10 in developing an Implementation Blueprint for Broadband. NEO's mission is to assist our customers in all aspects of building and owning Last Mile FTTH and Middle Mile fiber optic networks. We are big supporters of the National Broadband Plan, of municipal broadband and are ambassadors of all that better broadband networks enable, including smart grid and energy management systems, ultra-fast broadband networks, telemedicine and tele-health, distance learning and better education for all, e-government, enhanced homeland security, as well as all of the unforeseeable improvements in and for our lives that broadband networks provide.