

Broadband Infrastructure: Moving at the Speed of Light



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Information technology has become an undeniable aspect of modern life since the advent of high-speed Internet. Broadband connections, defined in the United States as a transfer of data at a minimum of 768 kilobits per second, are now integrated in everything from traffic signals to health-care facilities, from corporate headquarters to elementary schools. In the private sector, broadband Internet access, or the lack thereof, becomes an issue of social inclusion and equality, as citizens are nearly always monetarily responsible for their connection. As many job applications and some government forms are exclusively available on the Internet, the lack of domestic connectivity can greatly impact an individual's economic stability. The City of El Paso is on average with comparable cities in the United States in terms of its citizens' access to broadband Internet. However, areas remain in both the city and the county that are completely without connection. Local governments and schools have recently collaborated on a charitable project called Digital El Paso that aims to bridge the "digital divide." With the potentially incoming funds from the American Recovery and Reinvestment Act of 2009, El Paso looks to fully resolve these issues.

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Today, technology is changing at an ever-increasing pace and broadband Internet access is quickly becoming an indispensable tool in every aspect of life. From commerce, to networking, to national security, virtually every corner of the world is affected by the demand for information. According to Barbara Walker of Cisco Systems, having broadband Internet access is no longer just an option; it is becoming a necessity, a resource people require in order to thrive in a technology-driven society. Broadband Internet access is becoming so important that it is argued that Fiber to the Premise (FTTP) infrastructure coupled with broadband access should be implemented as the fourth necessary utility along with gas, electricity and water.¹

While it would be relatively easy to include optic fiber with the installation of the other utilities, there are significant obstacles to installing optic fiber in existing developments. Optic fiber is often buried under streets, and there is a significant amount of unused conduit under the streets of El Paso that could be utilized for FTTP. Though the City of El Paso has made efforts to do so, the Texas Department of Transportation (TxDOT) has not granted them access to the available area, commonly referred to as right of way. Currently, the city does not have the authority to install optic fiber cabling in these streets and will not have the authority until TxDOT grants them permission to install fiber.²

In fact, during the mid-90's, at a time when a huge buildup of fiber optic arterials took place, El Paso did not take part in installing fiber optic cables traveling throughout the main broadband ports. This decision has ended up taking a toll on El Paso because of the excessive demand for Internet access.³ Beginning in the early 2000's, the world has seen a tremendous increase in broadband penetration and usage. Broadband penetration refers to the percentage of people who have access to broadband in a certain area. According to Scarborough Research, a demographics research firm, broadband penetration has increased by nearly 300 percent over seven years.⁴

There are several examples of communities experiencing increasing economic strength and development with the implementation of a comprehensive broadband base. The most notable example was a case study of Lake County, Florida. The study compared Lake County to seven other geographically, culturally and economically similar counties throughout Florida. According to estimates, for every dollar invested in expanding broadband accessibility the local economy saw a three-fold return on that investment.⁵

There are several agencies, on a local and a national level, that oversee and regulate communications within their jurisdiction. The Communications Act of 1934 established the Federal Communications Commission (FCC). The FCC is "charged with regulating interstate and international communications by radio, television, wire, satellite and cable."⁶ This

¹ Walker, Barbara. Territory Account Manager. *Cisco Systems*. Personal Interview. June 12, 2009

² Gordier, Gerald. Chief Information Officer. *City of El Paso*. Personal Interview. June 25, 2009

³ Walker, *Personal Interview*

⁴ Scarborough Research. 2008. "The need for Internet speed: broadband penetration increased by more than 300% since 2002." http://www.scarborough.com/press_releases/Broadband%20FINAL%204%2015%2008.pdf (June 11, 2009)

⁵ Ford, George S. and Thomas M. Koutsky. 2005. "Broadband and Economic Development: A Municipal Case Study from Florida." *Free Press*. April. http://www.freepress.net/files/broadband_and_economic_development_aes.pdf (June 2009)

⁶ Federal Communications Commission. 2009. "About the FCC." <http://www.fcc.gov/aboutus.html> (June 2009)

designation encompasses an extremely wide field of jurisdiction. The Telecommunications Act of 1996 was the first major amendment of the Communications Act in over six decades. This act opened the market to any who wished to enter the communications business by dissolving communications monopolies. Theoretically, this would increase competition, which would lead to better market pricing and innovation.⁷ Five years later, the U.S. Congress passed the Internet Freedom and Broadband Deployment Act of 2001. This bill took steps to deregulate the broadband industry by allowing local-exchange carriers to offer nation-wide high-speed data access.⁸

The current presidential administration is working to expand broadband access in the United States. A portion of the American Recovery and Reinvestment Act of 2009 is dedicated to improving the nation's technological infrastructure. This bill will set aside nearly \$7.2 billion dollars for broadband projects that will help unserved, underserved and rural communities.⁹ The impact this bill will have on future broadband expansion will be discussed in more detail later on in the report.

Introduction to Broadband

Before analyzing the significance of broadband Internet access, it is important to have a solid understanding of the terms associated with this technology. The following is a list of commonly used terms.

Digital Subscriber Line

This type of Internet connection uses existing two-wire telephone lines connected to the consumer by use of a modem. This type of connection uses frequencies not utilized by voice transmissions and sophisticated modulation techniques to pack data on the telephone. Digital Subscriber Lines (DSL) usually divided into two categories: Asymmetric Digital Subscriber Lines (ADSL) and Symmetric Digital Subscriber Lines (SDSL).¹⁰ The difference between these connections is the speed of data upload/download. In ADSL connections download speeds are significantly faster than upload speeds. In SDSL connections the speed of upload/download are equal, hence the designation *symmetric* digital subscriber line.¹¹

Cable & Wireless Internet

This type of connection uses a cable modem to access broadband Internet. Rather than using telephone or power lines, this type of connection works by using TV channel space for data transmission. The coaxial cable that is utilized provides greater bandwidth for much faster speeds.¹² Secondly, wireless Internet does not utilize a physical connection, but rather radio frequency bands to broadcast data. One downfall to this type of connection is that the access area

⁷ Federal Communications Commission. 2009. "Telecommunications Act of 2009." <http://www.fcc.gov/telecom.html> (June 2009)

⁸ House Committee on the Judiciary. 2001. "Internet Freedom and Broadband Deployment Act of 2001." <http://www.cbo.gov/doc.cfm?index=2898&type=0> (June 2009)

⁹ White House. 2009. "Technology." <http://www.whitehouse.gov/issues/technology/> (June 16, 2009)

¹⁰ Webopedia. 2009 "xDSL Definition." <http://sbc.webopedia.com/TERM/x/xDSL.html> (July 2009)

¹¹ Webopedia. 2009 "SDSL Definition." <http://sbc.webopedia.com/TERM/S/SDSL.html> (July 2009)

¹² Webopedia. 2009. "Cable Modem Definition." http://webopedia.com/TERM/C/cable_modem.html (July 2009)

is geographically limited, due to lack of signal strength or the presence of obstacles that may be in the area.¹³ These obstacles can include anything from building materials to microwave ovens.¹⁴

Fiber Optic Connection

An optical fiber is a glass or plastic fiber that carries various wavelengths of light waves from one end to the other. Fiber optic connections are currently some of the fastest and most reliable mediums for transferring information, from video, music, television and broadband Internet.¹⁵ A downside to this technology is that it is significantly more expensive to implement than other traditional forms of data transfer. The initial cost of fiber is anywhere from 10 to 15 percent more expensive than comparable copper equipment.¹⁶

Broadband & Bandwidth

The Organisation for Economic Co-Operation and Development (OECD) typically defines broadband as having download data transfer rates equal to or faster than 256 kbps.¹⁷ In the United States, the FCC defines broadband as anything above 768 kbps.¹⁸ This term can be used synonymously with rate of data transfer. This is typically measured in bits per second (bps) or Bytes per second (Bps).¹⁹

Where the United States Stands

The United States lags behind as a nation in terms of cost and quality of Internet services provided. The majority of people in the United States do have access to broadband Internet but for whatever reason cannot/will not pay for such service. The percentage of citizens that have access to broadband Internet in the United States is over 50 percent, but usage is, in fact, much lower.²⁰ The percentage of citizens who use broadband falls just under 26 percent.²¹

While the majority of citizens do have broadband access, improvements in this sector are needed to remain competitive with international leaders, such as Denmark, Korea and Japan. For example, the fastest advertised connections in the United States are close to 10 mbps, while in

¹³ Webopedia. 2009. "Wireless Internet." <http://webopedia.com/TERM/W/wireless.html> (July 2009)

¹⁴ Webopedia. 2008. "How Wireless Networks Work"

http://www.webopedia.com/DidYouKnow/Computer_Science/2008/wireless_networks_explained.asp (July 2009)

¹⁵ Webopedia. 2009. "Fiber Optics Definition." http://webopedia.com/TERM/F/fiber_optics.html (July 2009)

¹⁶ Rosenberg, Paul. 1999. "Fiber Versus Copper: The Battle for Supremacy." *Ec&M*.

http://ecmweb.com/mag/electric_fiber_versus_copper/ (June 2009)

¹⁷ OECD. 2009. "OECD Broadband Subscriber Criteria."

http://www.oecd.org/document/46/0,3343,en_2649_34225_39575598_1_1_1_1,00.html (June 2009)

¹⁸ Back, Elliot. 2008. "FCC Definition for Broadband 768 kbps." <http://elliottback.com/wp/fcc-definition-for-broadband-now-768kbps/> (June 2009)

¹⁹ Tech Target. 2009. "Bandwidth definition."

http://searchenterprisewan.techtarget.com/sDefinition/0,,sid200_gci211634,00.html (June 25, 2009)

²⁰ OECD. 2009. "OECD Broadband Statistics; Households With Broadband Access."

<http://www.oecd.org/dataoecd/20/59/39574039.xls> (June 2009)

²¹ OECD. 2009. "OECD Broadband Statistics; OECD Broadband Subscribers per 100 Inhabitants."

<http://www.oecd.org/dataoecd/21/35/39574709.xls> (June 2009)

Japan, average speeds are upwards of 90 mbps. The OECD average is 17.4 mbps.²² Compared internationally, there is much room for improvement in terms of this country's broadband infrastructure and connectivity

A fiber optic connection is the fastest and most reliable way to access broadband Internet. The percentage of broadband connections in the United States that are fiber optic is four percent; the OECD leader is Japan, which has a total of 48 percent optic fiber connections.²³

National Initiatives

Although the United States lags behind other countries in broadband penetration, it has begun to increase the level of broadband accessibility throughout the nation. The American Recovery and Reinvestment Act of 2009, also known as the 2009 Stimulus Package, called for \$7.2 billion to help expand broadband infrastructure. The purpose for creating a new broadband network is to increase Internet accessibility in rural areas and improve homeland security. President Barack Obama (D) has stated that a comprehensive national broadband plan and improved technologies in healthcare can lead to economic stability and prosperity.²⁴

Both the U.S. Congress and the FCC are key players in promoting and creating a national broadband plan. Congress has created the Broadband Technology Opportunities Program (BTOP) to regulate how the money for broadband infrastructure is spent. The FCC has provided funding and guidance to several broadband expansion projects throughout the United States.

Broadband Technology Opportunities Program

The U.S. Congress created the BTOP to fund broadband infrastructure projects throughout the nation. It will provide \$4.7 billion to \$7.2 billion to public safety agencies and areas that have limited access to broadband connections. BTOP regulates who gets funding based on the services each broadband program will provide. This funding will increase innovation and adoption of broadband technologies. BTOP also aims to fund programs that upgrade existing technologies at public computer centers, such as libraries and community colleges.²⁵ The program encourages a mixture of government funding and private investment. BTOP states that no more than 80 percent of funding for any broadband infrastructure project can come from federal funds.

The BTOP also aims to aid every state in the nation by providing a minimum of one federal grant to each state. This program gives funding priority to projects based on the services they provide. Priority will be given to projects that reduce the cost of broadband, increase

²² OECD. 2009. "OECD Broadband Statistics; Average Advertised Broadband Download Speeds by Country." <http://www.oecd.org/dataoecd/10/53/39575086.xls> (June 2009)

²³ OECD. 2009. "OECD Broadband Statistics; Percentage of Fibre Connections in Total Broadband Among Countries Reporting Fibre Subscribers." <http://www.oecd.org/dataoecd/21/58/39574845.xls> (June 2009)

²⁴ *White House*, "Technology."

²⁵ National Telecommunications and Information Administration. 2009. "Broadband Technology Opportunities Program." <http://www.ntia.doc.gov/broadbandgrants/index.html> (June 16, 2009)

broadband speeds or increase subscribers²⁶ One of the main goals of the BTOP is to develop a nationwide broadband inventory map. This map will show fiber networks throughout the nation in order to facilitate the creation of a new infrastructure and to analyze the areas that need broadband access. Along with mapping physical broadband infrastructure, an inventory would catalogue nationwide efforts to increase broadband accessibility.²⁷

Opponents to Broadband Expansion

Although the United States is taking steps to improve broadband infrastructure, there are many who critique the government's involvement in the broadband industry. One of the arguments made against the government's construction of broadband networks is the speed at which technology advances. There is a possibility that by the time the U.S. government finishes building its multi-million dollar optical-fiber networks, new technologies will emerge that will not be dependent on the new physical infrastructure.

Robert Crandell, economist for the Brookings Institute, voiced concern that if new technologies provide broadband access without the need for physical infrastructure such as optic fiber, the effort of the United States government to build and pay for this infrastructure would be misappropriated. Michael Katz, former chief economist for the FCC, has also stated that the government should not rush broadband policies. He suggests that the government take its time planning broadband policy to prevent it from spending money on projects that would have been financed by private companies.²⁸ A broadband policy that is not planned out properly can make it difficult for municipalities to access funds for the federal government. One of the problems with the current broadband policy is the lack of definitions for the words "unserved" and "underserved." Since these words have not been clearly defined, it is difficult for cities to determine if they are eligible for federal funds.²⁹

The institute for Policy Innovation published a report that outlined the large capital investment required to build municipal broadband networks. The \$7.2 billion that the government is trying to spend to create these networks is minimal compared to the investment private corporations have made, \$120 billion in the past two years.³⁰ The financial risks of creating a broadband network are very high and if the project is not financed properly it could lead to severe economic losses. A study published by the Heartland Institute, a non-profit research organization that focuses on promoting free-market solutions to social and economic problems, outlines the financial struggles municipalities have faced in maintaining their broadband networks. The study states that 52 municipalities throughout the U.S. have used up to

²⁶ Associated General Contractors of America. 2009. "Broadband Technology Opportunities Program." http://www.agc.org/cs/advocacy/legislative_activity/economic_stimulus_draft/infrastructure_spending_chart/broadband_technology_opportunities_program (June 11, 2009)

²⁷ Connected Nation. 2009. "Broadband Mapping: A Tactical Tool to Advancing Public Policy." *The Alliance for Public Technology*. http://www.apr.org/events/2009/connectednation_031809.pdf (June 29, 2009)

²⁸ Sanchez, Julian. 2009. "Broadband stimulus passes, but many questions linger." *Ars Technica*. February 11. <http://arstechnica.com/tech-policy/news/2009/02/broadband-stimulus-passes-but-many-questions-linger.ars> (June 8, 2009)

²⁹ Cooper, Peter. Chief Technology Officer. *El Paso County*. Personal Interview. (June 30, 2009)

³⁰ Giovanetti, Tom. 2009. "Comments to the FCC Regarding Broadband Plan Notice of Inquiry." *Institute for Policy Innovation*. June 8. www.ipi.org (July 8, 2009)

\$840 million in taxpayer money over the past 20 years to create broadband networks. Of those municipalities, 71.9 percent have a negative cash flow of over \$93 million.³¹

City Initiatives

Long before the United States government expressed its desire to expand broadband access throughout the nation; various cities took it upon themselves to create broadband networks to meet the needs of their citizens. The following will analyze the strategies taken by Seattle, San Francisco and Atlanta to design these networks. By looking at these cities' financial feasibility reports, Community Scholars will determine the options El Paso has to finance such projects and understand the benefits of creating a citywide broadband network.

There are three ways to set up optic fiber cable in a municipality. One of the options is to solicit a service provider to build the network and provide retail services to the community. Because of the investment made by the provider, it would have control of the broadband market in the region. A second option would be to have the city government set up a fiber optic network and allow various Internet service providers to provide their retail services to the community. The city would charge the Internet service providers a fee for the use of the fiber optic network the city created. The third possibility is a mixture of the two; the city builds a fiber optic network and in turn becomes the sole provider of Internet to the community for five to ten years.³²

Seattle, WA This city is at the forefront of technological innovation and broadband infrastructure. In order to set up optic fiber cable lines through the city of Seattle, the CCG Consulting Firm was contracted to analyze the financial feasibility of the project. Seattle's financial feasibility report could help in understanding the cost of implementing optic fiber cable throughout the city of El Paso and determine what actions are needed to maintain a cost-effective network in El Paso.³³

It was estimated by the CCG Consulting Firm that in order to finance the cost of building a fiber optic network, the company providing the Internet service would have to acquire 2,000 new customers each month for the first years of the program. In order to reach this goal, pre-sign up programs will be needed. A pre-sign up program begins during the construction period in order to ensure consumers will pay for the Internet services before the project is completed. According to CCG, pre-sign up programs are a great success and have helped cities acquire 20 percent of the consumers in the local market with little to no marketing cost.

New customers can also be recruited by offering them lower prices for more efficient Internet, telephone and cable television services. The model created by the CCG Consulting Firm assumes that an Internet service provider can offer customers a 20 percent discount in prices compared to already existing services. For example, the existing cost of a broadband connection with speeds of 8 Mbps for downloading and 768 Kbps for uploading for Comcast Co.

³¹ Heartland.org. 2008. "State and Local Broadband Initiative Failures."

http://www.heartland.org/article/23502/State_Local_Broadband_Initiative_Failures.html (July 8,2009)

³² CCG Consulting LLC. 2007. "Financial Feasibility of Building and Operating a Fiber Network in the City of Seattle." *City of Seattle*. <http://www.seattle.gov/broadband/docs/080422FeasibilityReport.pdf> (June 8, 2009)

³³ CCG Consulting LLC, "Financial Feasibility of Building and Operating a Fiber Network in the City of Seattle."

customers with cable television is \$52.95 a month. The new network will give citizens a connection with the speed of 10 Mbps for downloading and uploading for \$39.99 a month. This assumption is based on the fact that Internet providers will offer their services in a bundle of cable television, telephone and broadband Internet using the newly created optic fiber network. These savings would pump \$2 billion to the local economy over 20 years as calculated by CCG. It is important to understand that the success of creating this new network will be highly dependent on the demand of the people who are being provided with these new telecommunication services.³⁴

San Francisco, CA Like Seattle, San Francisco has published reports on the feasibility of creating a fiber optic network throughout the city. One of the unique aspects of the San Francisco plan is that the city plans on creating a fiber-to-the-premise (FTTP) network for both government and public use. An FTTP network requires that fiber be connected from an aggregate point directly to a home or business.

The cost of deploying fiber independent of the city conduit was estimated to be \$12.3 million and the return of investment would take 22 years. The cost of completing a network that connects fiber to every home and business in San Francisco was estimated to be \$560 million. The network would be created and used under what the study called a “wholesale model.” This model would require the city to build the network and then lease it to private corporations. The private corporations can then provide broadband access to customers with the newly built infrastructure. This model was chosen by the study because it encourages competition between different providers, thus driving down the price of broadband services.³⁵

Atlanta, GA Georgia’s capitol is the only one of the three cities discussed that did not focus on creating a fiber network throughout the city; it has created one of the largest wireless networks in the nation. The City of Atlanta decreased the financial risk of creating a broadband network by creating a partnership with private companies.³⁶ Atlanta partnered with Clearwire Corporation, a wireless broadband provider, to create a citywide network called CLEAR WiMax.³⁷ Clearwire used WiMax wireless systems to create a wireless network that covers over 1,200 sq. miles and provides broadband access to over three million people.³⁸ WiMax wireless stations provide wireless broadband access in a 30-mile radius.³⁹

Residential unlimited broadband access starts at \$40 a month, and bundled packages can help decrease this cost. Bundled packages that include unlimited broadband access, voice over

³⁴ CCG Consulting LLC, “Financial Feasibility of Building and Operating a Fiber Network in the City of Seattle.”

³⁵ Columbia Telecommunication Corporation. 2007. “Fiber Optics for Government and Public Broadband: a Feasibility Study.” *City and County of San Francisco*.
http://www.sfgov.org/site/uploadedfiles/dtis/tech_connect/SFFiberFeasibility.pdf (June 24, 2009)

³⁶ City of Atlanta. “City of Atlanta Wireless Initiative Overview”
http://apps.atlantaga.gov/wirelessatlanta/Wireless_Atlanta_Initiative.ppt#296,2,Atlanta Led the Municipal Wireless Broadband Trend (June 22, 2009)

³⁷ WiMax.com. 2009. “WiMax Internet Services Now Commercially Available in Atlanta”
<http://www.wimax.com/commentary/blog/blog-2009/june-2009/wimax-internet-service-now-commercially-available-in-atlanta-0616> (June 22, 2009)

³⁸ Karkaria, Urvaksh. 2009. “Clearwire service a go in Atlanta.” *Atlanta Business Chronicle*. May 14.
<http://www.bizjournals.com/atlanta/stories/2009/05/11/daily85.html> (June 22, 2009)

³⁹ WiMax.com. 2009. “What is WiMax” <http://www.wimax.com/education> (June 22,2009)

Internet protocol (VOIP) and satellite cable would cost \$89.95.⁴⁰ The equivalent to these services, digital cable, high-speed broadband and unlimited nationwide digital phone, would cost an El Pasoan \$99.99 a month through Time Warner Cable.⁴¹ This is more than a 10 percent decrease in price and can lead to savings of \$120 a year for subscribers.

Current State of El Paso

Although the Paso Del Norte region currently does not have a broadband program like those in Seattle, San Francisco and Atlanta, El Paso County has submitted grant proposals to expand broadband access using money from the American Recovery and Reinvestment Act.⁴² Broadband penetration percentages measure the number of citizens that are part of the Internet market and have broadband access. Depicted below are the broadband penetration percentages of major cities throughout the U.S., according to a local market analysis conducted by Scarborough Research.

Table E.1: Broadband Penetration Percentages in the U.S.

| City | Percentage (%) |
|-------------------|----------------|
| San Francisco, CA | 62 |
| Austin, TX | 59 |
| Seattle, WA | 59 |
| El Paso, TX | 40 |
| Knoxville, TN | 40 |
| San Antonio, TX | 40 |
| Memphis, TN | 39 |
| Albuquerque, NM | 34 |
| United States | 50 |

Source: Scarborough Research

El Paso’s broadband penetration level is the same as that of other major cities such as San Antonio, TX and Knoxville, TN, and surpasses cities such as Albuquerque, NM and Memphis, TN.⁴³ El Paso is also lower than the United States’ national percentage of households with broadband access of 50 percent.⁴⁴

If El Paso wishes to become competitive with leaders such as Seattle and San Francisco and attract new markets, it must create a comprehensive broadband infrastructure policy.⁴⁵ The benefits of implementing a policy that increases accessibility to broadband Internet are not limited to the business sector. There are three areas of analysis that must be considered when examining the creation of broadband infrastructure policy: social, residential and business.

⁴⁰ WimaxAtlanta.net. “WiMax Products.” <http://wimaxatlanta.net/products/> (June 22, 2009)

⁴¹ Time Warner Cable. 2009. “Bundles.” <http://www.timewarnercable.com/ElPaso/learn/bundles/default.html> (July 1, 2009)

⁴² Cooper, *Personal Interview*

⁴³ Scarborough Research, “*The need for Internet speed: broadband penetration increased by more than 300% since 2002.*”

⁴⁴ OECD, “*OECD Broadband Statistics; Households With Broadband Access.*”

⁴⁵ Scarborough Research, “*The need for Internet speed: broadband penetration increased by more than 300% since 2002.*”

Public Applications

Socially, improved broadband can lead to an increase in the efficiency of law enforcement programs and revolutionize the medical sector by paving the way for telemedicine. Augmenting these programs would raise the quality of living for all El Pasoans.

Emergency Applications

The consolidated appropriations bill for the 2008 fiscal year allocated \$1.2 million for the El Paso Police Department to create the El Paso Broadband Mobile Network. This network would connect the police with national, state and local first responders. A network like this would facilitate the flow of information between these agencies and in turn increase the safety of the El Paso population in case of a natural disaster or a terrorist attack.⁴⁶

Although broadband access is not closely associated with law enforcement, it is important to understand the role it has played in the past in providing aid to citizens during national emergencies. During the September 11, 2001 attacks, 95 percent of phone calls made at 11 a.m. did not connect and 300,000 telephone landlines were cut off. The City of New York was unable to warn its citizens of the dangers because television sets and first-response radios failed. The only form of communication available between first-responders during this time was Internet access. Of all the Internet addresses in New York, only 2 percent of them remained off line for prolonged periods of time. During Hurricane Katrina, 38 critical public safety points failed preventing 911 calls from being received by the local authorities.⁴⁷ Shortly after Katrina, rescue workers started using high-speed Internet connections to send information to crews aiding the areas that were most affected by the hurricane.⁴⁸

IP networks and Internet accessibility have been successful in the past in ensuring rapid first response communication sharing in times of an emergency. When the Interstate 35 West Bridge collapsed in Minneapolis on August 1, 2007, IP networks that provided Wi-Fi to the city allowed the city government to respond to the situation promptly and effectively. The city's Information Technology staff used the Wi-Fi network to provide maps to the public and to law enforcement personnel dealing with traffic and recovery efforts. When the cellular network for the city failed, citizens were allowed to use the Wi-Fi network free of charge for a 24-hour period. Citizens with Wi-Fi enabled telephones were able to make phone calls and receive updates on the situation.⁴⁹

The City of El Paso has begun using broadband connections to facilitate communication between first-responders. According to Ted Marquez, Assistant City Engineer for Traffic at the City of El Paso, 80 to 86 percent of all traffic signals in the city are connected through broadband

⁴⁶ Reyes Committee, Inc. 2008. "Key El Paso Initiatives Included in House in Omnibus Funding Bill."
http://www.reyesforcongress.com/press_detail.php?id=26 (June 10, 2009)

⁴⁷ Benton Foundation. No Date. "Using Technology and Innovation to Address Our Nation's Critical Challenges."
http://www.benton.org/initiatives/broadband_benefits/action_plan/public_safety_and_homeland_security
(June 10, 2009)

⁴⁸ IEEE Xplore. 2005. "Hurricane Katrina Reveals Strength of Emerging Technologies."
http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?tp=&arnumber=1516080&isnumber=32475 (June 16, 2009)

⁴⁹ *Benton Foundation*, "Using Technology and Innovation to Address Our Nation's Critical Challenges."

to the city's Traffic Management Center (TMC). These connections allow city engineers to control and monitor traffic from the TMC, located in city hall. In case of a traffic accident or natural disaster, city engineers can redirect traffic and communicate with local first-responders to help ensure the safety of the citizens.⁵⁰

The El Paso Police Department is also using broadband to improve the way they serve El Paso. The computers inside police vehicles are connected wirelessly to various law enforcement databases by Verizon Wireless Cards. This wireless technology allows law enforcement officers to have immediate access to police records and identify perpetrators and previous offenders almost instantaneously. This technology also enables them to write police reports from the field in a time-efficient manner that allows them to continue their law enforcement work.⁵¹ Furthermore, many of the radios used by police officers are still working under an analog connection, which use frequencies that can be accessed by the public. The El Paso Police Department is looking to make a progressive step to safer more reliable digital connections.⁵²

Medical Broadband

Telecommunication is also revolutionizing the health industry. Telemedicine is the application of information technology to the existing medical system. A telemedicine network would allow specialists to review records and analyze test results for patients who may not have geographic access to medical facilities. Telemedicine can also help provide services to patients who have chronic diseases or who are of elderly age and require a doctor to make house calls. This new technology has the capacity of creating virtual house calls, allowing doctors to treat and diagnose these patients without leaving the hospital or their offices, saving time and resources.⁵³

The FCC is currently funding 69 incentive programs for the expansion of broadband infrastructure throughout 42 states. The FCC's \$417 million Rural Health Care Pilot Program (RHCPP) funds these incentives. The FCC has already funded a program that will connect 180 sites throughout Nebraska, South Dakota, North Dakota, Minnesota, Iowa and Wyoming with fiber optic cable. These connections have speeds of 44.7 Mbps and improve the quality of teleradiology and long distance education. Closer to the El Paso region, the FCC has given the University of New Mexico (UNM) a \$15.5 million grant to design the Southwest Telehealth Access Grid. The program will connect more than 500 sites through the U.S. Southwest. This grid will be connected to two major national backbones Internet2 and the National Lambda Rail.⁵⁴

⁵⁰ Marquez, Ted. Assistant City Engineer for Traffic. *City of El Paso*. Personal Interview. June 23, 2009

⁵¹ Aguirre, Jose. Information Services Manger. *City of El Paso*. Personal Interview. June 15, 2009

⁵² Gordier, *Personal Interview*

⁵³ Holmes, Sue. 2008. "FCC Grant to Create Broadband Network to Help Expand Telemedicine in the Rural West." *Blue Cross Blue Shield Association*. March 18. <http://www.bcbs.com/news/national/fcc-grant-to-create-broadband-network-to-help-expand-telemedicine-in-the-rural-west.html> (June 10, 2009)

⁵⁴ Douglas, Page. 2008. "Massive Southwest Telehealth Grid Promises Benefits for Teleradiology." *Diagnostic Imaging*. April 9. <http://www.diagnosticimaging.com/display/article/113619/1180542> (June 11, 2009)

Business Sector

It is essential for every city develop and grows their business sector to become economically successful. Most companies will look towards finding a city that will supply consistent customers, reliable employees, and proper utilities for their development.

Economic Benefits

Over the years, the number of U.S. residents who have access to high speed Internet has increased dramatically. In a period of six years the number soared from 4.1 million broadband lines to 53.5 million. In spite of these statistics, the United States is still lagging behind other countries in terms of broadband penetration. In order to determine the full effect of any economic benefits in the United States, the Brookings Institute conducted research utilizing 2005/2006 U.S. employment statistics and concluded that with a one percent increase of broadband penetration 300,000 more jobs will be created nationally.⁵⁵

Attracting Business to El Paso

When an El Paso business is planning the construction of a new building, they search for access to water, electricity and gas. With the high demand for Internet access, more people believe that Internet access should be included in the list of “basic” utilities. Bob Cook, President of the Regional Economic Development Corporation (RedCo.), believes that Internet access should be included in all homes. Installing Internet access in all housing will not only be beneficial to the residents but it can create a faster growing business sector in cities as well. According to Gerald Gordier, CIO for the city of El Paso, providing broadband access won’t make the deal alone, but it definitely helps.⁵⁶

Cook added that the development of high speed Internet access throughout the city would be a bonus for future El Paso corporations. He also mentioned that the clients search for the “state-of-the art” technologies, and with the adequate funding from the client, the client may access the appropriate infrastructure from local service providers. For example, El Paso will be the future home to Kolmar Labs, a New York cosmetics and pharmaceutical manufacturer.⁵⁷

This business, like many other businesses that El Paso hopes to attract, requires extensive broadband infrastructure in order to handle information brought about by corporate business. Robert Theroux, CEO and President of Kolmar, believes that El Paso is a desirable location for companies because they can benefit from the business generated from people driving through or visiting from other Texas cities and from California, and they have access to UT El Paso graduates seeking employment in El Paso, an added benefit for the community.⁵⁸

⁵⁵ Crandall Robert, Lehr William, Litan Robert. 2007. “Issues in Economic Policy: The Effect of Broadband Deployment on Output and Employment: A Cross Sectional Analysis of U.S Data.” *Brookings Institution*. July. <http://www3.brookings.edu/views/papers/crandall/200706litan.pdf> (June 25, 2009)

⁵⁶ Gordier, *Personal Interview*

⁵⁷ Cook, Bob. President. *El Paso Regional Economic Development Corporation*. Personal Interview. June 25, 2009

⁵⁸ Kolenc, Vic. 2009. “Kolmar Labs Group mulls move to El Paso.” *El Paso Times*. April 4 (June 25, 2009)

Social Application

Broadband Internet has become integrated in most aspects of the average citizen's life. Beyond its inclusion in the business and public sectors, broadband has become an issue of social inclusion and equality of access to information. In regard to education, more emphasis has recently been placed on instruction through the Internet. Without adequate Internet access, everything from employment opportunities to an adequate education may be out of reach.

Residential

Private networks have increased their number of customers by oversubscribing network capacity. More customers than their service can accommodate. For example, if an output service connection intended for only ten subscribers was supplying over two hundred subscribers, the Internet supplied would be significantly slower than expected. This example of oversubscription will benefit the provider by allowing more customers into their network; however, due to the large number of subscribers in the network, the customer will suffer from the lower quality of the connection.⁵⁹

In the past applications have been limited to data and web surfing, but as the demand for technology has increased, the complexity of applications has grown as well. New services offered include video services and voice transfer over Internet protocol (VOIP).⁶⁰ A study funded by the American Library Association and the Bill & Melinda Gates Foundation concluded that there is a high demand for increasing Internet access, despite the lack of bandwidth available. This is becoming an issue for individuals whose only source of Internet access is that public locations. In many communities, people are starting to depend more on Internet access to look for employment.⁶¹

Education

Schools throughout the nation have enhanced their technology capabilities to benefit students. Many institutions of higher education are reliant on information technology for research and class work. Also, as the professional world becomes technology based, schools bear the burden of ensuring digital literacy for their students' future employment. Both the El Paso Community College (EPCC) and the University of Texas at El Paso (UT El Paso) have made moves to stay ahead of the information technology learning curve.

Research conducted by IBM show that eight out of ten students have noticed enhancement in technological infrastructure and are aware of the need for IT professionals in the near future.⁶² IBM has taken the initiative to prepare future generations for technology-based careers. In 2004, IBM began their Initiative Program with a goal to reach over 2.5 million

⁵⁹ Walker, Personal Interview

⁶⁰ Fligliola, Patricia. 2009. "The Evolving Broadband Infrastructure". *Congressional Research Service*. February 19. http://assets.opencrs.com/rpts/R40230_20090219.pdf (July 1, 2009)

⁶¹ Gardner, W. David. 2007. "US Public Libraries Pressed by Public Demand for Internet Access". *Information Weekly*. September 12.

<http://www.informationweek.com/news/internet/showArticle.jhtml?articleID=201805936> (June 29, 2009)

⁶² IBM. 2009. "IBM and Marist Survey Shows U.S. College Students Want Technology Skills to Compete for Jobs." March 12. <http://www-03.ibm.com/press/us/en/pressrelease/26893.wss> (June 29, 2009)

students attending universities worldwide. This program provides classes involving both hardware and software courses.⁶³

Additionally, a method of transferring information between universities worldwide is referred to as an Internet2 Connection. This type of connection allows universities to transfer research information at a fast and efficient speed.⁶⁴ In 2005, a partnership formed between UT El Paso and the Universidad Autónoma de Ciudad Juárez with the installation of fiber optic cable between the two. Because each university was already connected to other universities, the installation allowed 200 U.S. universities to connect with 78 Mexican universities.⁶⁵

Social Inclusion

There have been some initiatives in El Paso expand wireless access throughout the city. With new technology innovations, it is important for residents to have access to the Internet in order to be aware of how the Internet applications function and how it will best benefit them.

Downtown Wireless Service In 2007, Wi-Fi Internet was installed in El Paso's downtown area. This wireless Internet access was created and is controlled by Digital El Paso, a program initiated to provide Internet access in and around Downtown El Paso and to the neighborhood of Segundo Barrio. Segundo Barrio is a severely economically disadvantaged area in south El Paso, and has been the focus of Digital El Paso's Internet inclusion project.⁶⁶

Digital El Paso is more than an infrastructure project that provides wireless broadband infrastructure to a portion of El Paso; it is primarily concerned with social inclusion. Along with providing wireless access to residents, Digital El Paso created a collaborative between the county, the city and El Paso Community College to provide citizens with training and refurbished computers. The Orion Refurbished Computer Activity (ORCA) focuses on repairing used computers for distribution to people living in Segundo Barrio.⁶⁷ Families can obtain a refurbished computer after they have completed a series of classes required by the organization and designed to ensure their digital literacy.

Residents of the Segundo Barrio, such as the Vázquez-Domínguez, have shown the influence wireless access had on their family since Digital El Paso installed a refurbished computer in their home. The Vázquez-Domínguez family is one of the families in Segundo Barrio that have been positively influenced by the creation of Digital El Paso.⁶⁸ They spoke of the everyday uses of broadband and expressed that a computer with Internet had quickly become a necessary utility. The Internet has provided this family with the means to communicate with

⁶³ IBM, "IBM and Marist Survey Shows U.S. College Students Want Technology Skills to Compete for Jobs."

⁶⁴ UAB. 2002. "What is Internet2?" October 17. http://www.uab.edu/internet2/what_is_internet2_.html (June 29, 2009)

⁶⁵ Peregrino, David. 2005. "Internet2 Connection Opens Doors for US-Mexico Collaboration." *University of Texas at El Paso*. February 5. <http://ia.utep.edu/Default.aspx?tabid=22820> (June 29, 2009)

⁶⁶ Ocasio, Juan Carlos. Network Planning Manager. *County of El Paso*. Personal Interview. June 30, 2009.

⁶⁷ Digital El Paso. 2007. "Orion Refurbished Computer Activity." <http://digitalelpasso.com/orca.htm> (June 29, 2009)

⁶⁸ Ocasio, *Personal Interview*

their family and friends who live in Zacatecas, Mexico, as well as a tool for everyday cooking and housekeeping.⁶⁹

Digital Literacy The installation of broadband throughout the El Paso community has the potential to enhance the social and economic base for businesses. Although these aspects of broadband are beneficial, El Pasoans may not be able to fully derive the benefits if they do not have the digital literacy required to use newer technology.⁷⁰ The Pearson Foundation promotes the use of media in education and promotes digital literacy in various regions of the United States. Recently, their main project has been the development of a digital literacy program for the Hispanic community. The Foundation has set up programs within communities that offer free classes to those who are interested in learning about technology innovations. As of 2008, the Pearson Foundation has also established itself in many school districts, including the Ysleta Independent School District in El Paso, Texas.⁷¹

Infrastructure Costs

As the demand for broadband Internet access rises, the need for installation of optic fiber increases. However, increasing broadband infrastructure in El Paso will come at a high cost. In order to install fiber optic cable to provide Internet access throughout El Paso, would require tearing up roads, installing the optic fiber and rebuilding once again. The funding required for this construction will take a toll on taxpayers. Some of the main traffic corridors of the city streets with fiber optic cable today include Interstate-10, Mesa Street and North Loop.⁷²

Although there is build up of fiber optical cable in certain areas of El Paso, an increase in build out is still needed in order for rural areas to have access to the necessary infrastructure. Bob Cook states that although the area has fiber optic running through El Paso's streets, "we currently do not have sufficient 'off-ramps' that would allow our community to take full advantage of this infrastructure". Off-ramps refer to the distance between the main fiber backbone that stretches the width of the country and the last mile, much like a freeway off-ramp and a neighborhood street.⁷³

Conclusions

1. **The United States government is looking to expand broadband access throughout the nation with funding from the American Recovery and Reinvestment Act.** The American Recovery and Reinvestment Act of 2009, also known as the 2009 Stimulus Package, called for \$7.2 billion to help expand broadband infrastructure in "unserved" and "underserved" areas. The Broadband Technologies and Opportunities Program will regulate who gets funding based on the services each broadband program will provide. BTOP will give funding to projects

⁶⁹ Vázquez-Domínguez. *Residents of El Paso's Segundo Barrio*. Personal Interview. (June 30, 2009)

⁷⁰ Ocasio, *Personal Interview*

⁷¹ Pearson Education and Pearson Foundation. 2009. "Create Digital Literacy Fellowship Program for Hispanic Community." *Pearson Foundation*. June 25. http://www.pearsoned.com/p_2007/0625072.htm (June 29, 2009)

⁷² Walker, *Personal Interview*

⁷³ Cook, *Personal Interview*

that reduce cost of broadband, increase broadband speeds, increase number of subscribers and create a broadband inventory map.

2. **The United States lags behind many countries in terms of broadband speed and accessibility.** According to international figures provided by the Organisation for Economic Co-operation and Development, nations in Europe as well as Asia often offer and provide the citizenry with Internet connections faster than those available in the United States.
3. **Although the United States is taking steps to improve broadband infrastructure, there are many people who critique the government's involvement in the broadband industry.** If new technologies provide broadband access without the need for physical infrastructure such as optic fiber, the effort of the United States government to build and pay for this infrastructure would be in vain. The government should take its time planning out broadband policy to prevent it from spending money in projects that would have been financed by private companies. There are no market failures in broadband and government spending on industries that are not failing would only benefit the economic interests of private companies.
4. **There are three models that can be utilized to create a municipal broadband network: the retail, wholesale and hybrid model.** There are three ways to set up optical cable in a city. One of the options is to have a service provider build the network and provide retail services to the community. A second option would be to have the city government set up an optical-fiber network and allow various Internet service providers to provide their retail services to the community. The city would charge the Internet service providers a fee for the use of the optical-fiber network the city created. The third possibility is a mixture of the two; the city builds an optical-fiber network and in turn becomes the sole provider of Internet to the community.
5. **The City of El Paso has been able to provide a notable percentage of its population with broadband access.** The broadband penetration percentage for El Paso is the same as that of other major cities such as San Antonio, TX and Knoxville, TN, as well as surpassing that of cities such as Albuquerque, NM and Memphis, TN.
6. **Broadband connectivity is useful to provide communication between first-responders in a time of emergency.** Traffic management centers can contact emergency vehicles and update them on the situation. Broadband connections can also lead to increased public security. Police vehicles and ambulances can be equipped with radio frequency identification (RFID) cards that can be recognized by street signals and improve the speed at which first responders reach their destination. License plate recognition technology can also be used by police officers to identify stolen vehicles.
7. **Broadband telecommunication is revolutionizing the health industry.** Telemedicine is the application of information technology to the existing medical system. A telemedicine network would allow specialists to review records and analyze test results for patients who may not have geographic access to medical

- facilities. Telemedicine can also help provide services to patients who have chronic diseases or who are of elderly age and require a doctor to make house calls. This new technology has the capacity of creating “virtual house calls” allowing doctors to treat and diagnose these patients without leaving the hospital or their offices, saving time and resources
8. **On both a local and national level the economy has benefited from the increase in broadband access by attracting business and providing jobs.** Throughout our research we have found that broadband accessibility on a national level has improved the job access for many. The Brookings Institute researches that for a one percent increase in broadband penetration there is a 300,000 job increase. However, due to the United States' broadband capabilities lagging behind much of the world in broadband infrastructure, the economy has not seen the creation of as many jobs as may have been possible.
 9. **Digital El Paso has been a successful pilot program for the residents of Segundo Barrio and is looking towards expanding that initiative.** Digital El Paso has seen countless educational, business, and household advancements for the residents of Downtown since fall of 2006 when Digital El Paso provided Wi-Fi Internet to Downtown residents. With this achievement El Paso hopes to expand its program throughout the city to other underprivileged communities.
 10. **The County and City of El Paso have taken the measures needed to obtain federal funds for the expansion of Digital El Paso.** Although the idea of expanding Digital El Paso throughout the city is beneficial to the community, funding will not permit the city and county to expand the program to date. The American Recovery Reinvestment Act has allowed them to apply for federal money grants that will allow them to carry out Digital expansion.
 11. **El Paso Community College (EPCC) has established an indispensable technology literacy program for the residents of Segundo Barrio.** Since creating the Orion Refurbished Computer Activity (ORCA) for the 79901 zip code region, citizens have been positively affected by the amount of technology literacy they have received throughout the course of the program.
 12. **High cost of tearing up roads for the installation of fiber optics.** If the city goes upon implementing fiber optics throughout the existing El Paso roads, the city may have to look for funding from the citizens of El Paso. In order to obtain the money needed to carry out this project, residents of the city would have to reach into their pockets and pay the requested broadband infrastructure tax dollars.

Recommendations

1. **Increase digital literacy both in schools and throughout the community through community initiatives such as Digital El Paso.** The pilot program that digital El Paso started in Segundo Barrio has been deemed a success. This program not only gave broadband access to the residents of Segundo Barrio, but through project

ORCA, also provided them with the proper training they needed to become proficient with the computer. Now that The Digital El Paso organization is looking to expand the program to the rest of El Paso County it follows that an expansion in the ORCA initiative will be needed as well.

2. **Change city ordinances to require FTTP (fiber-to-the-premise) as the fourth necessary utility.** Throughout our research we have heard talks of changing city ordinances to require developers to install fiber optic cabling when constructing new properties. Doing so will reduce the difficulty of expanding the accessibility of high-speed broadband Internet to consumers.
3. **Increase public support and awareness for broadband initiatives such as digital El Paso.** Before the Digital El Paso initiative started, there was almost no support for the project from the public sector, media, or government. There was much speculation that the project would fail before it reached the point in which it would be deemed a success. Now as Digital El Paso seeks to expand its operation we suggest that they increase awareness of the project so that they may dispel any negative thoughts about the feasibility of the project.
4. **Digital El Paso should continue pursuing funding to provide broadband to unserved and underserved areas.** In order for Digital El Paso to expand its program to the rest of El Paso County, it will need approximately \$7.3 million dollars to complete the project. In order for Digital El Paso to receive these federal funds it must create a plan on how exactly it plans to use the money.
5. **If federal funding is not acquired, El Paso should look to create a municipal network through one of the three models: retail, wholesale and hybrid.** As stated before, Seattle looked into three different options for a municipal broadband network. If the expansion of Digital El Paso does not go through, the leaders of El Paso might want to look into emulating Seattle, should they wish to do so.
6. **Continue to expand the capabilities of broadband in law enforcement and first responder applications.** Broadband is not only important for commerce, and personal use, it is also very useful for law enforcement and medical applications. These applications include expanding connectivity for police cruisers. Doing so will allow law enforcement officers to identify perpetrators more quickly and effectively. Another application is for emergency medical units. This application would allow EMT's and other medical professionals to send patient vitals to the hospital, and receive instructions from doctors.
7. **Consumers should become more aware of the services they purchase including the fact that ISP's might oversubscribe their services.** An interesting fact we came across in our report was that ISP's tended to oversubscribe their internet services counting on the idea that their customers would not fully utilize all of the bandwidth they have purchased. It is important for consumers to understand the Internet subscriptions they are signing up for.

8. **The city should continue to build more off-ramps to fully utilize the technological capabilities of El Paso.** In order to fully utilize its broadband capabilities, El Paso must build more off-ramps from the fiber backbone. Doing so would make El Paso more attractive to high tech companies that need a great amount of bandwidth.
9. **The city should look into developing a fiber inventory map for El Paso.** In doing this, El Paso will gain a comprehensive view on the resources available for their utilization. Once they do this they will be able to start and maintain high tech projects.
10. **El Paso area school districts should look into allowing surrounding neighborhoods to access their Internet.** An idea we came across in our report stated that school districts should open up Internet access on off-attendance hours. The surrounding communities would be able to have access to that Internet at little or no cost.

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