APPENDIX B. UNDERSTANDING BROADBAND

BROADBAND EXPLAINED

Broadband, also called 'high-speed Internet,' is the umbrella term referring to Internet access that is always on and is faster than dial-up Internet access. The National Telecommunications and Information Administration (NTIA) defines broadband as, "advanced communications systems capable of providing high-speed transmission of services such as data, voice, video, complex graphics, and other data-rich information over the Internet and other networks."[1] As our technology capabilities are continually changing, it is important to define what broadband is so that stakeholders can determine where broadband is currently available, and how it can be made more widely available to more people.

Broadband is defined in terms of how fast the user's computer can download and upload information from the Internet. Download speed is the rate that a computer receives data from the Internet while upload speed is the rate a computer can send data. The speed at which information can be transmitted depends on bandwidth. Bandwidth is the transmission capacity of an electronic pathway. That capacity can be described in terms of how much data, measured in bits, can be transmitted per second, and is reported in kilobits (Kbps), megabits (Mbps), and gigabits (Gbps). NTIA defines broadband as providing a minimum speed of 768 Kbps download and 200 Kbps upload. Most broadband technologies have different downloading and uploading speeds, with upload speed typically being more limited. As technology and applications continually change, there are many different types of broadband services as well as resulting speeds and functions while using the Internet.

Although NTIA defines broadband at a 768 Kbps minimum download threshold, download speeds up to 3 Mbps have limited functionality. At up to 3 Mbps Internet users are able to use web-based email, send and receive small to medium-sized documents, and browse the web. However, operating multiple functions may cause potential slowness, making it difficult to conduct necessary business and education operations. Today, in order to use many Internet applications successfully, a minimum download speed of 3 Mbps is required. From 3 Mbps to 6 Mbps download speed, and 1.5 Mbps to 3 Mbps upload speed, users can send and receive photos and word documents through email, conduct multiple functions simultaneously, and access small window videoconferencing, such as Skype. At 6 Mbps to 10 Mbps download and 3 Mbps to 6 Mbps upload, users can send and receive large documents and files, such as small videos, and can access their company's network while traveling or working from home with a speed of operation that is similar to being in the office. Also, higher quality videoconferencing can be conducted allowing businesses to communicate with clients, partners, and employees. At 10 Mbps to 25 Mbps download and 6 to 10 Mbps upload, telemedicine and telehealth applications are possible and remote education, professional development, and workshops can occur in high definition (HD) quality. At 25+ Mbps download and 10+ Mbps upload, real time HD medical imaging and consultation can occur.[2] As Internet technology and applications continuously emerge and evolve it takes much more than the minimum broadband threshold to operate successful businesses, and provide relevant education and quality medical care.

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[1] *"*Broadband: As defined by the NH Broadband Mapping and Planning Program," *New Hampshire Broadband Mapping and Planning Program*, February 15, 2012, http://iwantbroadbandnh.com/planning-and-assistance. (accessed July 17, 2013).

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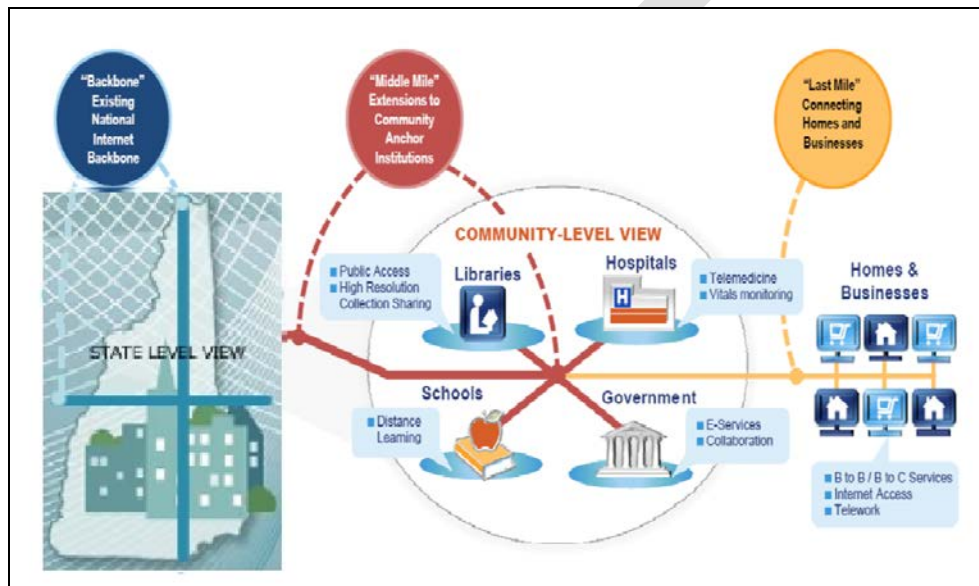
The New Hampshire Broadband Mapping and Planning Program (NHBMPP) developed a matrix to assist stakeholders in understanding the many levels of broadband available in the state of New Hampshire today, and the typical functions a user might be able to perform within a range of download and upload speed tiers. Using these tiers, the NHBMPP has established broadband availability categories ("un-served," "underserved," and "served") to describe access to broadband service. The table on the next page is a condensed version of the NHBMPP matrix.

Tiers of Service	Download Speed	Upload Speed	Typical Functions / Use *(functions additive to level above)*
un-served	< 768 Kbps	< 200 Kbps	• Email (client/served-based)
underserved	768 Kbps to < 1.5 Mbps	200 Kbps to < 768 Kbps	• Web-based email • Limited web browsing • Send/receive small documents not concerned with speed of download/upload • Single user Internet device
underserved	1.5 Mbps to < 3 Mbps	768 Kbps to <1.5 Mbps	• Medium social media use • Send/Receive medium-size documents/files • Limited streaming content, buffering a concern • 1-3 simultaneous Internet devices possible
served	3 Mbps to <6 Mbps	1.5 Mbps to <3 Mbps	• Send/Receive medium to large-size documents or files • Streaming content, downloading High Definition (HD) content, speed a concern • Low quality, small window videoconferencing
served	6 Mbps to <10 Mbps	3 Mbps to 6 Mbps	• Send/Receive large documents or files (small videos) • Streaming HD • Virtual Private Network (VPN) access for remote work at speed critical to job function • Multi-player online gaming
served	10 Mbps to <25 Mbps	6 Mbps to <10 Mbps	• HD quality, large frame videoconferencing • Remote synchronous education, professional development facilitated simultaneously at multiple locations • Tele-health applications possible
served	25+ Mbps	10+ Mbps	• Send/Receive medium to large databases • Real-time HD medical imaging and consultation, remote patient monitoring

Appendix B. Understanding Broadband- DRAFT

HOW IT WORKS

Broadband infrastructure consists of the Internet "backbone" which is hosted by large commercial, government, academic, and other high-capacity network centers. The "middle mile" refers to the segment linking a network operator's core network to the local network plant. In order to transport the Internet to homes and businesses, known as the "last mile," it can be most cost-effective to increase the reach of the "middle mile" through community anchor institutions. Community anchor institutions are typically municipal libraries and Town offices, hospitals and schools, emergency services and public safety operations, and large businesses that have the means and capacity to access broadband-based services. The majority of home and small business users rely on the last mile hosts, Internet service providers (ISPs), to obtain broadband services.[i]

Source: http://www.whitehouse.gov/sites/default/files/20091217-recovery-act-investments-broadband.pdf

There are many different broadband delivery technologies. These technologies can be separated into two major categories of wired and wireless broadband. Wired technologies include Digital Subscriber Lines (DSL), Cable Modem, Fiber Optics, Leased Lines (T1), and Broadband over Powerline (BPL). Wireless technologies include mobile wireless (3G, 4G, LTE, WiMax), Wi-Fi, satellite, and Wireless Internet Service Providers (WISP).[ii] Wired broadband technologies bring a wire connection to the home or business. Often, a Wi-Fi router is used by the subscriber to share the Internet connection wirelessly among different devices within the home, such as a laptop computer or tablet.

Digital Subscriber Lines (DSL) and Cable Modem are wired technologies commonly used by residential and small businesses. DSL uses copper phone lines to deliver direct, one-on-one connections to the Internet, allowing users to not have to share bandwidth with neighbors. Users must be located within 18,000 feet (3.4 miles) of a phone company's central office, which means service is often unavailable in rural areas.[iii] The most common DSL connections are asymmetric, with networks offering more bandwidth and faster speeds for download compared to upload, since residential users predominately are downloading more information from the Internet than uploading. Symmetric types of DSL provide equal bandwidth for uploading and downloading speeds, which is sometimes marketed as "Business DSL" as companies often have greater needs for uploading, or transmitting data.

Appendix B. Understanding Broadband- DRAFT

Cable Modem, which is typically faster than a common, asymmetric DSL connection, uses the cable network to deliver broadband to users. Cable networks are a shared connection, so speeds can slow during peak usage times due to congestion when people in the same neighborhood are online. Fiber optic systems use lasers across very thin strands of glass creating reliable, resilient technology that has an extremely high capacity for speeds and data transmission. There is a high cost associated with laying out the fiber network but once in place the system can be easily upgraded and maintained, with lower operating costs than DSL, cable, or wireless networks.[iv] Building out the fiber network is currently the most effective means to provide the highest capacity broadband Internet.

Wireless broadband is available through many technologies, including mobile wireless (3G, 4G, LTE), Wi-Fi, satellite, and Wireless Internet Service Providers (WISP). Unlike wired technologies, which bring wires directly to a location, wireless technologies use radio frequencies through transmitters and receivers to deliver broadband. Wireless broadband can be categorized as wireless networks or satellite. Cell phones, and other mobile devices, use mobile wireless licensed technologies such as 3G, 4G, LTE, WiMax, and other networks. Wi-Fi or 'hotspots' are designed to broadcast the Internet for several hundred feet. They are used by public and private networks, including businesses for their employees or retailers for their customers, who connect to the Internet using built-in Wi-Fi cards in their mobile devices (e.g. laptops, tablets, or cell phones, etc).

Wireless Internet Service Providers (WISP) are designed to cover large areas using point-to-multipoint networks to broadcast wireless data up to 20 miles. A signal is broadcast from a base station and is received by a fixed wireless antenna mounted on a customer's premises. A combination of a Wi-Fi Hotspot and a WISP can enable a Neighborhood Internet Service Provider (NISP) or a Wi-Fi Hotzone. A Wi-Fi Hotzone can cover an area such as a neighborhood, shopping mall, or campground.[v] WISP networks can provide "last mile" solutions and broadband availability to rural areas where it is often cost-prohibitive to build wired networks.
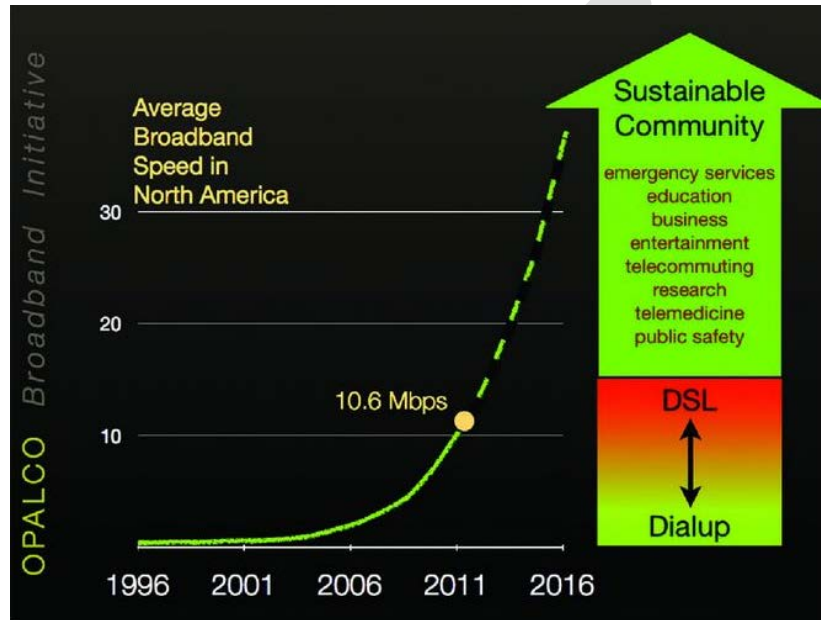
Satellite Internet users send and receive information via small dishes installed on the premises to a satellite in space which retransmits the signal to a network operation center that is connected to the Internet. Satellite-based Internet connection can be interrupted by objects and weather, and broadband upload speeds are typically slower than wired or other wireless networks.[vi] While wireless broadband can offer mobility and access for rural locations, wireless connections are unlikely to overtake the wired network which is likely to maintain higher speeds and lower costs, especially when compared to a ubiquitous fiber network. Wireless and wired broadband networks can be thought to complement each other to create available broadband Internet connections.[vii]

WHY BROADBAND IS IMPORTANT

Broadband is in 2014 what electricity was to New Hampshire in the 1930's - a necessity. As a predominantly rural state, the availability of high-speed internet is one of the most significant factors that will impact the ability of communities to achieve economic growth and maintain quality of life. In a relatively short period of time, fast and reliable broadband has become essential for economic and community development and is critical infrastructure for public safety, education, health care, business and government operations.[viii]

Communities today face many challenges: a competitive global marketplace; an aging population; the need for a better-educated and better-prepared workforce; and, access to health care. These issues are magnified in rural areas as the distance between households and services makes it difficult to access certain resources and opportunities. The financial resources traditionally available to overcome these challenges are often unavailable to rural communities and regions. New solutions are required. Broadband can help community leaders find innovative solutions to these challenges.

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There is no doubt that we live in an information society, and broadband connects us to opportunities and services. Whether this is training for a new skill, a new language, or completing an online course - broadband facilitates the access of information in many different forms.[ix] In 2010, it was estimated that there were almost 200 million Americans with access to broadband at home, up from 8 million in 2000.[x] While this is an impressive increase, there are still many Americans with insufficient access to broadband services. In New Hampshire, access varies from good coverage and availability in denser areas of the state to areas of un-served and under-served communities in the northern, western and eastern parts of the state. This variability can lead to disparities in economic opportunity, education, community vitality, public health and safety, and quality of life.

BROADBAND IMPORTANCE BY SECTOR

EDUCATION

Broadband is an important tool to enhance access to and improve the quality of education at all levels in New Hampshire and beyond. Broadband-enabled teaching and learning has the potential to extend learning beyond the limits of the classroom, provide more customized learning opportunities, and increase the efficiency of school systems. [xi] The availability of a wide range of internet based resources such as distance learning programs, online learning modules, and digital textbooks allows students to engage in multimedia lessons, take virtual trips, and communicate with classrooms in other parts of the world. These tools offer educators a platform to share curricula and provide adult learners easy access to professional development or educational opportunities online.

However, as teaching and broadband technology become increasingly intertwined, students lacking access to adequate broadband both in school and at home will be unable to keep up with educational trends and potentially, be less prepared than their peers in more 'connected' areas. The State Educational Technology Directors Association recommends that K-12 schools have access to broadband

speeds of 100 megabits per second for every 1,000 students and staff by the year 2014 and 1 gigabyte per second by 2017.[xii] Although most schools provide some level of internet access, too often the speeds of these connections fall short of what is considered appropriate or necessary.[xiii] This need for improved broadband connections in schools will only increase over time; especially, as educators transition to web-based content and resources and more states require online assessments and testing.

Not only does the availability of reliable broadband technology offer advances in education, it is imperative to the economic welfare and long-term success of our state and nation.[xiv] Participation and competition in the global economy is increasingly dependent on twenty-first century skills, including the ability to effectively use technology and navigate the digital world.[xv] Providing access to learning opportunities that address these skills can help empower students to actively engage in an increasingly technology-driven and digital culture.

HEALTH

With increasing and changing health needs, ranging from rising health care costs, to managing chronic illnesses, to meeting the needs of an aging population, and a shortage of specialists in rural locations, broadband Internet plays an important role in how these issues are addressed. Many emerging technologies and approaches to health care are dependent on broadband connections to improve health care outcomes while also controlling costs and extending the reach of health care providers.[xvi] Individual patients, providers, and the overall public health of a community benefit from more efficient, innovative, and informed health care systems as new technologies are adopted.

Telehealth, the broader term incorporating telemedicine, is the transfer of electronic medical data (images, sounds, live video and patient records) from one location to another. It includes the use of electronic information and telecommunications technologies to support long distance clinical care, patient and professional health related education, public health, and health administration.[xvii] New Hampshire, with rural geography, scarcity of local specialty medical services, and high percentage of elderly residents, can benefit from telehealth systems.[xviii] Broadband Internet is necessary to continue supporting current and emerging telehealth applications for patients, providers, hospitals, and health care businesses.

Electronic medical records systems enable providers to collaborate in patient care by accessing treatment information from different locations. Patients can have better access to their medical records and information in an effort to better engage patients and families in managing their health. Video conferencing allows physicians to conduct video consultation and monitor treatment of patients remotely. It also increases the reach of specialized physicians and research.[xix] Broadband Internet connection plays an essential role in the ability to incorporate the latest health technologies that benefit patients, health providers, and health industry businesses.

COMMUNITY SUPPORT / GOVERNMENT

From providing a displaced community member with food and shelter to organizing community initiatives, local governments and community support organizations in New Hampshire deliver a wide variety of valuable services to their constituents. Demands for services are constantly increasing, yet organizational budgets rarely follow that same trend. Broadband connectivity provides the capacity to more efficiently and cost-effectively deliver services while opening up possibilities for new services and facilitating more robust public participation.

Undoubtedly, certain matters will always be best handled through face-to-face contact and technology should augment New Hampshire's tradition of accessibility to the public process. But citizens have come to desire, and sometimes expect, a certain level of online interactivity with government and community

support organizations. Most towns in New Hampshire currently host websites providing immediate, remote access to public notices, event calendars, applications, forms, ordinances and regulations. While constituents benefit from easy access to the information they need, governments and community support organizations save time, money and resources when routine requests are handled online.

Equal in value to the administrative efficiencies associated with broadband technology are the accessibility opportunities broadband creates. Online meetings, surveys, blogs and other modules offer new ways for a larger percentage of the population to watch and participate in community decision-making processes. Similarly, technologies utilized by community support organizations now enable them to administer one-on-one services without travelling.

While new applications allowing for improved public sector interaction and transparency will continually surface, their reliance on perpetually maintained broadband infrastructure will remain a constant.

PUBLIC SAFETY

New Hampshire is a predominantly rural state, where firefighters, law enforcement and emergency medical personnel cover wide geographic areas. These public safety officials are often required to quickly make potentially life-saving decisions in the field, despite the challenges of rugged terrain and natural and man-made disasters. Public safety personnel need the ability to quickly communicate with each other, access online resources (via a PC or mobile device), connect to networks, and quickly transfer important video and data files during emergencies. Broadband access through a combination of wired and wireless technologies can enhance public safety by enabling first responders to make informed decisions and allowing them to communicate with one another effectively, usually resulting in reduced loss of life and property.

ECONOMIC DEVELOPMENT/BUSINESS

The total economic impact of broadband in New Hampshire was estimated at $634 million in 2010 and in 2011, 11,000 net new jobs were created as a result of expanded broadband.[xx] Broadband and economic development are connected in that, as we progress into the future, both are needed for each to be successful. The use of broadband for economic development improves the ability to retain and recruit businesses, increases business profitability, attracts highly skilled workers, improves the efficiency of municipal services, enhances access to healthcare, and contributes to stronger educational attainment. All are key ingredients to a successful economic development strategy.

Jobs depending on broadband and information and communications technology will grow by 25% between 2008 and 2018 or at a rate of 2.5% faster than the average for other occupations and industries.[xxi] To say that broadband technology has not changed the way we do business is to deny the tremendous impact that computers have had on our lives worldwide. In 2011, 73% of New Hampshire households and businesses had access to broadband and, nationally in 2012, 66% of adults have broadband at home, which is up from 3% in 2000.[xxii] Investment in broadband is showing benefits for small businesses and local economies, as well. A Connect Iowa study of the state's small businesses found that Iowa small businesses generate $1.9 billion in online sales and that small businesses with a broadband connection have revenues that are $200,000 higher annually than those which do not.[xxiii]

Broadband and broadband-dependent applications allow small businesses to increase efficiency, improve market access, reduce costs and increase the speed of both transactions and interactions. By using Web-based technology tools, 68% of businesses surveyed boosted the speed of their access to knowledge, 54% saw reduced communications costs and 52% saw increased marketing effectiveness.[xxiv] The use of

broadband by small businesses has proven to be an efficient and cost effective tool. Business statistics have shown that small businesses have consistently been the backbone for job and wealth creation in the US economy. The use of broadband has truly served to enrich that position into the 21st century.

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