Draft for Public Review—March 20, 2014

Regional Broadband Plan

Upper Valley Lake Sunapee
Regional Planning Commission

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EXECUTIVE SUMMARY

Upper Valley Lake Sunapee Regional Planning Commission, advised by a group of broadband stakeholders representing multiple interests from 19 communities in the region, developed this regional broadband plan to better understand current broadband (or high-speed Internet service) availability in New Hampshire, to identify the challenges and barriers to universal access, and to plan for increased broadband adoption and utilization over the next six years.

This plan establishes four performance-based goals to achieve the regional vision of "fast, reliable and affordable broadband service through a competitive marketplace throughout all parts of the Upper Valley Lake Sunapee region" and "a future with rural regions having equal opportunity to access broadband services as metropolitan areas."

2020 Broadband Goals for our Region

1. Provide affordable broadband service that would support telework and tele-education (10 Mbps download, 6 Mbps upload) in all areas of the region.
2. Build "Gigabit Communities" – expand "big broadband" (1 Gbps download/ upload) to all community anchor institutions and city/town centers, with extensions to residential and outlying areas.
3. Encourage marketplace entry of competitive, innovative service providers.
4. Work towards parity in broadband service availability across the rural areas of our region, the downtowns and village centers of our region, and metropolitan areas in the Northeast.

Broadband Availability in the Upper Valley Lake Sunapee Region

Broadband provided at a 6 Mbps/1.5 Mbps level of service is needed to accomplish typical computer-based functions, such as using multiple Internet devices at the same time, sending documents/files and streaming content. In the 27 municipalities of the Upper Valley Lake Sunapee region, there are substantial gaps in coverage at this level of service. The southeastern part of the region (Acworth, Unity, Lempster, Goshen, Washington and Newbury), the northeastern part (Springfield, Grafton, Dorchester, Orford and Piermont) and parts of Grantham and Croydon are underserved, meaning that the highest advertised broadband service speed is less than 6 Mbps/1.5 Mbps. Above and beyond the general mapping of broadband availability, residents have reported gaps in service in nearly all towns of the region.

As of September 2013, very-high broadband speeds (1 Gbps or higher) are only available in a few spots – one census block in Hanover, three census blocks in Claremont, four census blocks in Washington and eleven census blocks in Lebanon. This is slowly changing, with the roll-out of fiber-to-the-home initiatives undertaken by TDS Telecom and New Hampshire FastRoads, LLC, but there remains a long way to go before the goal of "Gigabit Communities" is fully realized.

Key Challenges to Broadband Expansion

A number of geographic, economic and regulatory barriers exist that make it difficult for the Upper Valley Lake Sunapee region to have universal broadband. The low population density creates a low return on investment for wired broadband expansion, while hilly terrain presents physical barriers to wireless broadband deployment. Financing options and funding sources are limited for expanding broadband to unserved and underserved areas, which is compounded by utility pole attachment issues that increase the costs of expanding wired broadband and create delays in deployment.

Unlike other northern New England states, New Hampshire lacks state-level leadership, which has led to slower, smaller broadband expansion efforts as well as slow progress on financing and regulatory reforms to facilitate additional expansion. Municipalities in the region, lacking the leverage and clout of larger entities and more populated regions, have struggled to have their need for better broadband heard and understood at the state level.

The high cost of broadband service creates a barrier for adoption, particularly for lower-income households. Households not utilizing the Internet are at a disadvantage to access services in a world that increasingly provides services online.

Recommended Courses of Action

- Expand financing options and funding sources for expanding both telework-supporting and gigabit broadband.
- Remove barriers to entry into the marketplace by competitive, innovative service providers.
- Enable municipalities in our rural region to plan proactively for broadband service expansion and improvements.
- Build statewide leadership capacity to promote broadband.
- Overcome barriers of affordability and digital illiteracy.

The Upper Valley Lake Sunapee Regional Planning Commission was originally formed as an economic development organization in 1963. In 1969, the NH Legislature authorized municipalities to create regional planning commissions to provide opportunities for coordination among municipalities to seek direct input from citizens to create advisory regional plans.

INTRODUCTION

The New Hampshire Broadband Mapping and Planning Program (NHBMPP) is a comprehensive, multi-year initiative that began in 2010 with the goal of understanding where broadband is currently available in New Hampshire, how it can be made more widely available in the future, and how to encourage increased levels of broadband adoption and usage. Funded through the National Telecommunications and Information Administration (NTIA), the NHBMPP is part of a national effort to expand broadband access and adoption.

The NHBMPP is managed by the GRANIT (Geographically Referenced Analysis and Information Transfer) System within the Earth Systems Research Center at the University of New Hampshire (UNH), and is a collaboration of multiple partners. These include: the NH Office of Energy and Planning (OEP), NH Department of Resources and Economic Development (DRED), UNH Cooperative Extension (UNHCE), UNH Information Technology (UNHIT), and the state's nine regional planning commissions (RPCs).

The NHBMPP is comprised of several components, including a broadband availability inventory and mapping effort and a suite of planning and technical assistance initiatives; refer to Appendix A.

PLAN SCOPE AND PROCESS

The regional broadband plan is intended to serve as a comprehensive document that describes broadband availability in the Upper Valley Lake Sunapee region and identifies ways to increase broadband adoption and utilization. The plan serves as a guidance document for communities, policy makers, businesses, institutions, and residents to better understand the availability and need for and utility of broadband now and into the future.

Regional plans in New Hampshire are advisory in nature, purpose, and effect. Nothing within the plan changes the structure or authority of local governments or the state government. Rather, the plan is intended to strengthen local decision making by providing information, analysis, and recommendations.

In 2011, Upper Valley Lake Sunapee Regional Planning Commission, along with its NHBMPP partners, embarked on a four-year planning effort with the objective to use the information and momentum from the mapping activities to create plan for increased broadband adoption and utilization.

UVLSRPC invited members of the public from a broad range of sectors to participate in a Broadband Stakeholders' Group, which met quarterly. The group played a vital role in assessing the need for improved broadband capacity, availability, and affordability and in recommending strategies to improve broadband service and its utilization. UVLSRPC held forums and interviews to seek public input from a wider audience.

UNDERSTANDING BROADBAND

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."[i]

NTIA defines broadband as providing a minimum speed of 768 Kbps download and 200 Kbps upload. This is a minimum definition, and many typical computer-based functions are not supported at this low level (Table 1[ii]). As technology progresses, the need for faster, more robust broadband increases.

Table 1. Broadband speeds required to support common computer-based functions

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
	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
	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
	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
	25+ Mbps	10+ Mbps	• Send/Receive medium to large databases • Real-time HD medical imaging and consultation, remote patient monitoring

Source: New Hampshire Broadband Mapping and Planning Program http://www.iwantbroadbandnh.org

HOW BROADBAND 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. The majority of home and small business users rely on the "last mile" hosts, Internet service providers (ISPs).[iii]

Broadband delivery technologies, i.e. how individual homes, businesses or facilities are connected to the Internet, can be separated into two major categories of wired and wireless broadband (Figure 1[iv]). Within a home, business or facility, a Wi-Fi router may used by the subscriber to share the Internet connection wirelessly among different devices, such as a laptop computer or tablet. Appendix B provides further detail.

Figure 1. Types of Broadband Technology

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.[v]

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.

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.[vi] In 2010, it was estimated that there were almost 200 million Americans with access to broadband at home, up from 8 million in 2000.[vii] 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.

Further information about the importance of broadband in each sector of the economy is included in Appendix B.

REGIONAL BROADBAND OVERVIEW

REGIONAL VISION

- Fast, reliable and affordable broadband service through a competitive marketplace throughout all parts of the Upper Valley Lake Sunapee region.
- A future with rural regions having equal opportunity to access broadband services as metropolitan areas.

HISTORY OF BROADBAND PLANNING IN THE UPPER VALLEY LAKE SUNAPEE REGION

The Regional Broadband Plan builds on local master planning efforts – the Master Plans of Acworth, Cornish, Grantham, Lebanon, Lempster, Newport, Orford and Plainfield have specifically identified the need for improved broadband service and articulated that broadband service is a necessary service to encourage economic development, provide for efficient governmental services and support education.

In addition, the Plan builds upon the work done by the WCNH.net consortium of eight towns founded in 2005 – member towns are Orford, Lyme, Hanover, Enfield, Springfield, Sunapee and Newbury. WCNH.net worked over several years to research options for improving broadband service and developed a plan for creating a fiber-based community network that would provide robust broadband to residents, businesses and institutions in the west-central region of New Hampshire; the network would be open-access so that multiple providers could offer broadband service.

In 2010, WCNH.net joined forces with the New Hampshire Community Development Finance Authority, the Monadnock Economic Development Corporation and the 34 towns of the Monadnock region to form New Hampshire FastRoads, LLC. The 247-mile FastRoads fiber-optic network has brought a modern "big" broadband telecommunications infrastructure to the region, including connections to over 237 community anchor institutions and to homes in Rindge and Enfield. The FastRoads network was a

component of the University System of New Hampshire's "Network New Hampshire Now" project, which was awarded federal grant funding through the federal Recovery Act Broadband Technologies Opportunity Program administered by the U.S Department of Commerce. Several leaders from WCNH.net are active on the Board of Directors for FastRoads. The initial 247-mile network is now complete and five Internet service companies are providing service over the network; plans are being made to construct further network build-out.

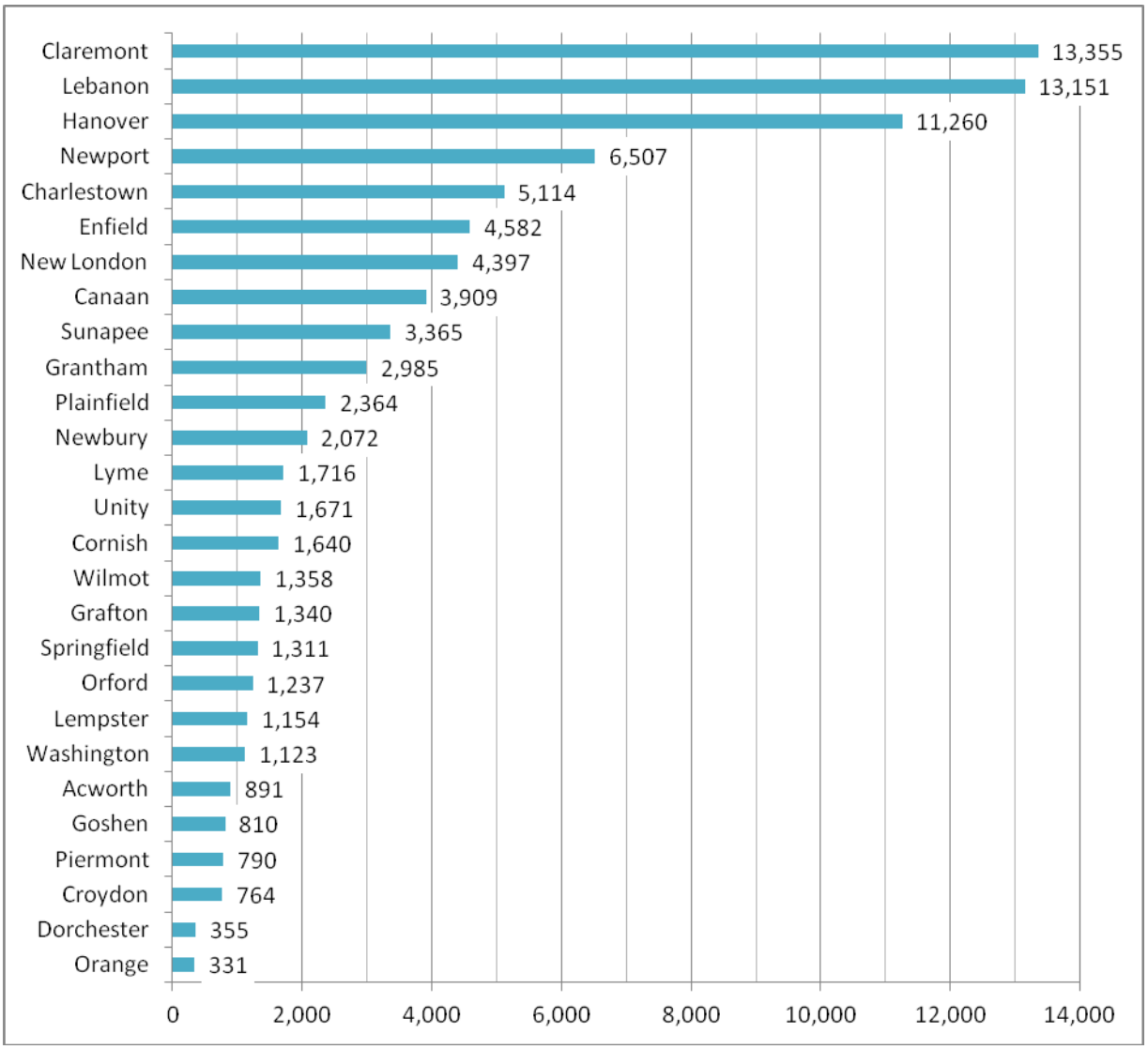

Figure 2. 2010 population of Upper Valley Lake Sunapee communities (US Census Bureau, 2010 Census)

REGIONAL OVERVIEW

89,522 people reside in the Upper Valley Lake Sunapee Regional Planning Commission (2010 Census). Roughly half of the region's population live in the four largest communities, and the other half live in the twenty-three small and very small towns of the region (Figure 2). Fifteen of the region's twenty-seven communities have populations under 2,000 and there are six towns with fewer than 1,000 residents..

Population density in the region ranges from a low in Dorchester of 7.94 people per square mile to a high of 327.63 in Lebanon; the region's average is 86.3 people per square mile. This region has much lower population densities than many other regions; for comparison, Manchester's population density is 3,241.82 people per square mile, Keene is 630.91, Exeter is 715.72 and Durham is 628.51. The population density of the region is not expected to change considerably over the next twenty-five years; population growth projections through 2040 for Grafton, Merrimack and Sullivan Counties are nearly flat (Figure 3).

The largest employers in the region are located in seven different towns and represent a wide diversity of industries, with particular emphasis on health care, education (K-12 and higher education), and manufacturing (Table 2). Some employees live in the same town where they work, but it is common for employees to live in an outlying community; the average commuting time is 22.5 minutes in Grafton County, 24.8 minutes in Sullivan County, and 25.8 minutes in Merrimack County (American Community Survey 2009-2011 3-year average).

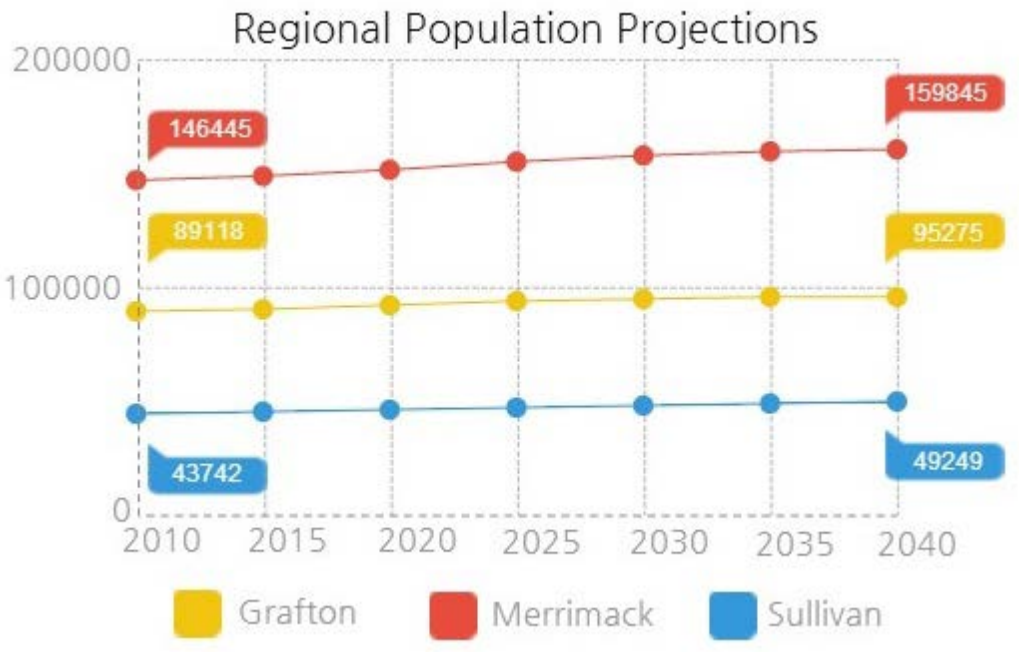

Figure 3. County Population Projections, 2010-2040 (NH Office of Energy and Planning, 2013)

Table 2. Largest businesses in the Upper Valley Lake Sunapee region (compiled from NH ELMI economic statistics, 2014)

Employer	Product/Service	City	Employees
Dartmouth College	Education	Hanover	1,000 - 4,999
Dartmouth Hitchcock Medical Center	Health Care services	Lebanon	1,000 - 4,999
Hypertherm Inc.	Manufacturing	Hanover	1,000 - 4,999
Ruger Firearms	Manufacturing	Newport	1,000 - 4,999
Tom Tom North America	Mapping	Lebanon	500 - 999
Alice Peck Day Memorial Hospital	Health Care services	Lebanon	250 -499
Hanover Inn	Hospitality	Hanover	250 -499
Thermal Dynamics	Manufacturing	West Lebanon	250 -499
William P Clough Extended Care	Health Care Services	New London	250 -499
Becket School	Education	Orford	250 -499
CRREL	Defense Research	Hanover	250 -499
Walmart Supercenter	Retail	Claremont	250 -499
Whelen Engineering Co.	Manufacturing	Charlestown	250 -499
Dartmouth Printing Co.	Printing Services	Hanover	250 -499
Kendal at Hanover	Health Care Services	Hanover	250 -499
Rollerblade USA Inc.	Recreation Equipment	West Lebanon	250 -499

REGIONAL BROADBAND AVAILABILITY

LEVELS OF BROADBAND SERVICE

"Basic" broadband (as defined by NTIA as 786 kbps download, 200 kbps upload) is available nearly everywhere; there are very few "unserved" areas remaining in the region. In a 2013 phone survey of residents of the Southwest and Upper Valley Lake Sunapee regions conducted by the UNH Survey Center, 1% of survey respondents reported that they rely on dial-up Internet service and 16% reported that they do not have Internet service at home. Of the 16% without Internet service, only 7% gave the primary reason for not having Internet as "It is not available where I live."

88% of survey respondents reported that they have wired service to their home (DSL, cable or fiber). Where there are gaps in wired service, residents and business owners rely on fixed wireless (5%), satellite (3%) or cellular service (3%). The availability of "basic" broadband remains an issue in two related areas: (1) pockets of unserved roads in rural areas with low population density and (2) gaps or "dead zones" in cellular service coverage due to terrain and limited cell tower deployment, primarily in rural areas.

The NTIA's minimum definition of broadband no longer supports typical computer-based functions, such as using multiple Internet devices at the same time, sending files and streaming content. Therefore, the New Hampshire Broadband Mapping and Planning Program established a multi-tiered system for levels of service:

- Unserved – Below the minimum NTIA broadband definition (<768 kbps down/<200 kbps up)
- Underserved for Broadband Intensive Applications and Uses - < 6 Mbps down/<1.5 Mbps up
- Served for Broadband Intensive Applications and Uses - >6 Mbps down/>1.5 Mbps up.

The Upper Valley Lake Sunapee region is unevenly served by a level of broadband service allowing for intensive Internet applications (Figure 4). The 6 Mbps/1.5 Mbps level of service is available in more than two-thirds of municipalities in the region, but in nearly all towns, residents have reported gaps in service. The southeastern part of the region (Acworth, Unity, Lempster, Goshen, Washington and Newbury), the northeastern part (Springfield, Grafton, Dorchester, Orford and Piermont) and parts of Grantham and Croydon are underserved, meaning that the highest advertised broadband service speed is less than 6 Mbps/1.5 Mbps.

Looking ahead to future needs, the Federal Communications Commission's National Broadband Plan calls for gigabit service (1 Gbps or higher down/up) to all community anchor institutions by 2020.[viii] Figure 5 shows that 1 Gbps speed is only available in a few spots – one census block in Hanover, three census blocks in Claremont, four census blocks in Washington and eleven census blocks in Lebanon. Again, the southeastern and northeastern parts of the region, as well as parts of Croydon and Grantham, have the lowest speeds of broadband available.

The maps provide a generalized overview of broadband availability (as provided by Internet service providers to UNH, as of September 2013) and likely overstate the true availability of broadband at higher speeds, for several reasons:

1) The maps are based on data aggregated to the census block level, not the address level (if one address has fast speed available, the whole census block is considered served);

2) Higher speeds may only be available to business customers, not residential customers;

3) There is no indication of the cost of these services and whether they would be considered affordable to the region's residents and businesses.

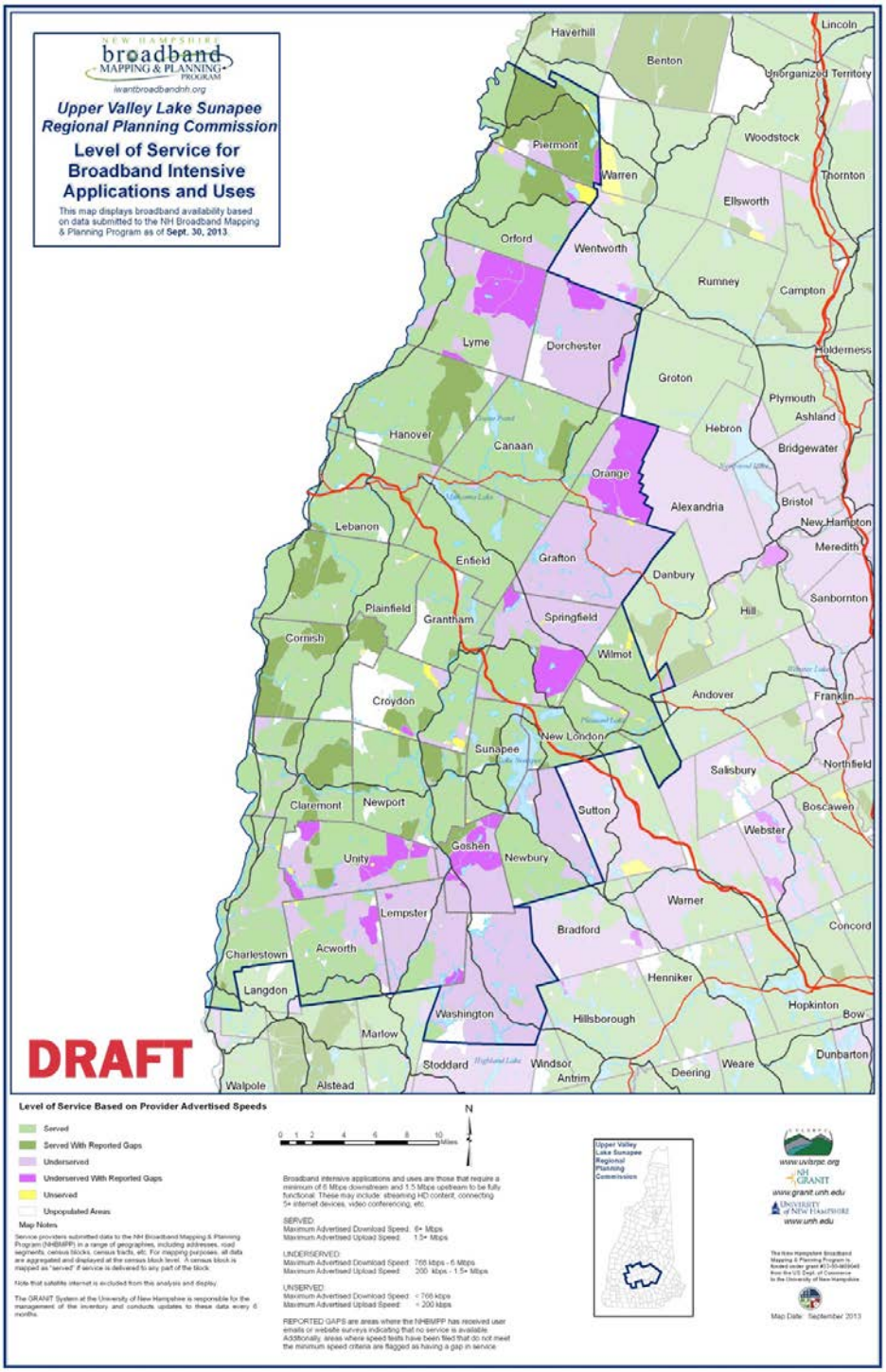

Figure 4. Level of Service for Broadband Intensive Applications and Uses

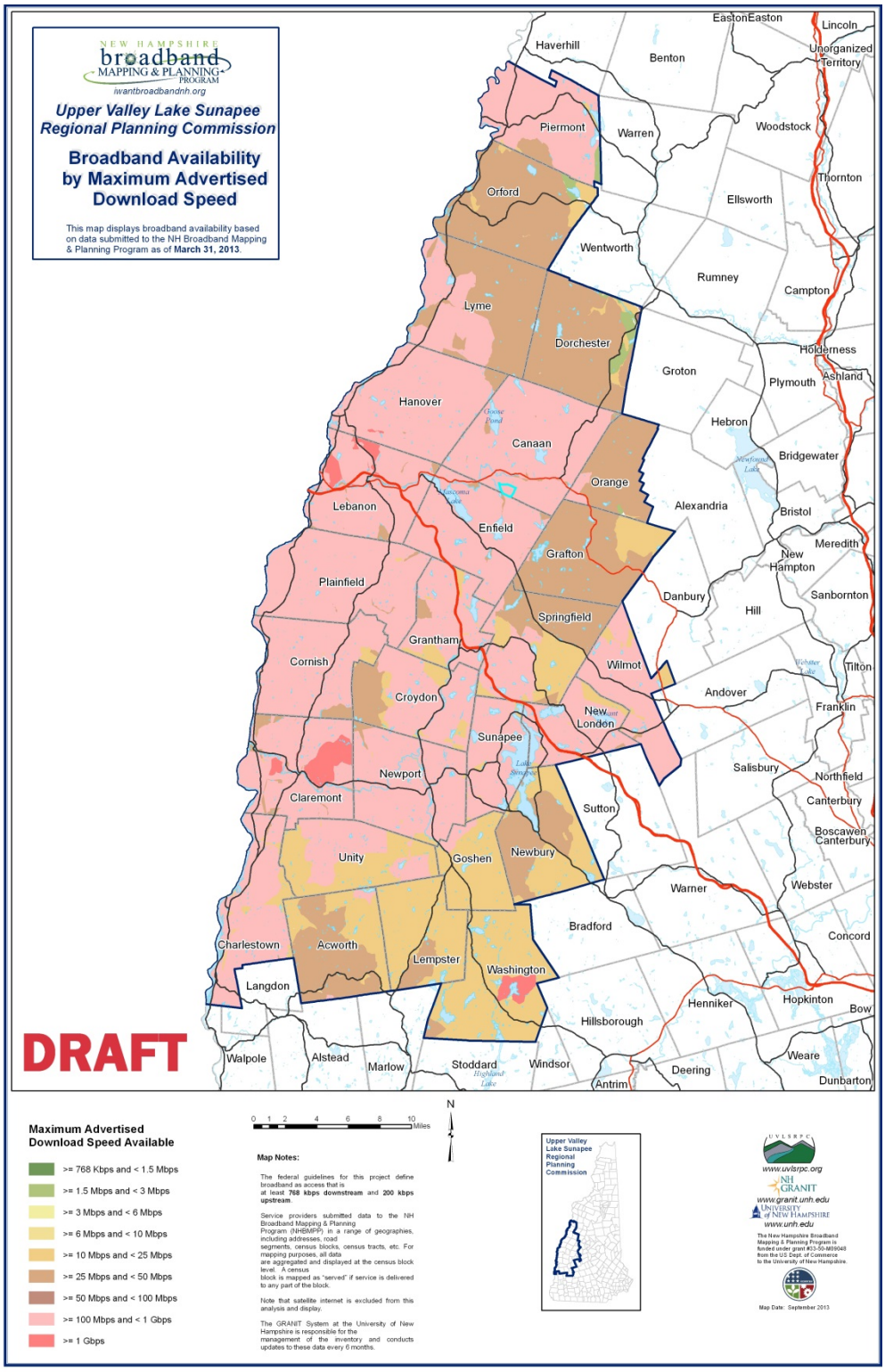

Figure 5. Broadband Availability by Maximum Advertised Download Speed

LEVEL OF COMPETITION

In New Hampshire, more than sixty companies provide broadband Internet services to residences, businesses or both. The technology used to deliver broadband varies (e.g. cable, DSL, fiber, T-1 lines, fixed wireless, cellular and satellite) and the speed tiers and pricing structures offered also vary widely. Wired and fixed wireless service commonly provide unlimited data service at a given speed tier, although the delivered service speed may vary considerably from the advertised maximum speed. Cellular and satellite service providers commonly set monthly data caps or "throttle" service speeds for heavy users, which stymies the full utilization of broadband services for residents and business owners who rely on these technologies.

Based on NHBMPP mapping from September 2013, the highest degree of competition in the broadband marketplace (considering all types of technology, speeds and pricing) is in the municipalities of Lebanon, Hanover, Enfield, Plainfield and Claremont (Figure 7). The southeastern and northeastern parts of the region, as well as parts of Croydon and Grantham have lower levels of competition.

While there may be several choices within a community, there is not necessarily a competitive choice because each provider offers a different type of service at a different price point. The 2013 survey found that 43% of survey respondents in the Southwest and Upper Valley/Lake Sunapee regions reported that they are using their current Internet service provider because they consider it to be the only option available. For those who do have a dialup or satellite connection, 59% say that it is the only option available. Consumers can find out which providers offer which levels of service by entering their address at the National Broadband Map website (http://www.broadbandmap.gov); Figure 6 provides an example of the variation in the service speeds available.

Towns without cable franchise agreements (between the municipality and the cable company that authorizes the company to provide service in the town) tend to have lower levels of competition and lower maximum speeds. As of January 2014, New London is the only municipality in the Upper Valley Lake Sunapee region with two cable franchise agreements: one with Comcast, one with TDS Telecom. Figure 8 shows the status of municipal cable franchise agreements in the region.

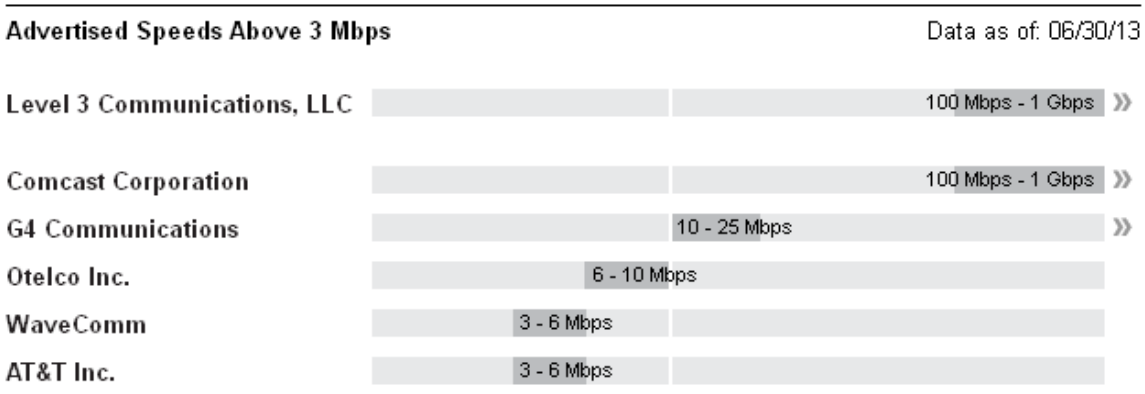

Figure 6. Screenshot of search results for the census block around 10 Water Street, Lebanon, NH from the National Broadband Map, http://www.broadbandmap.gov, accessed Feb. 26, 2014.

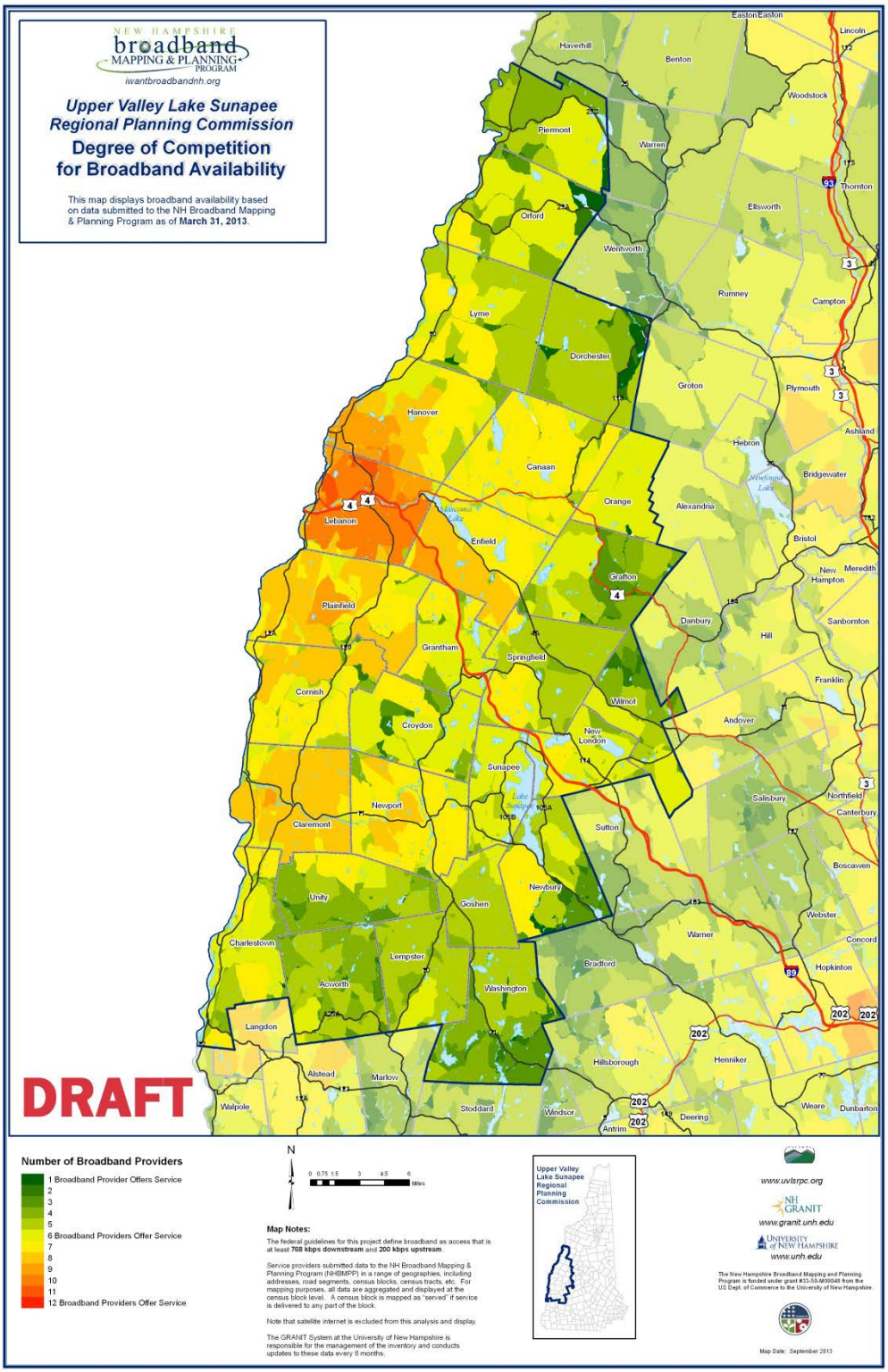

Figure 7. Degree of Competition for Broadband Availability

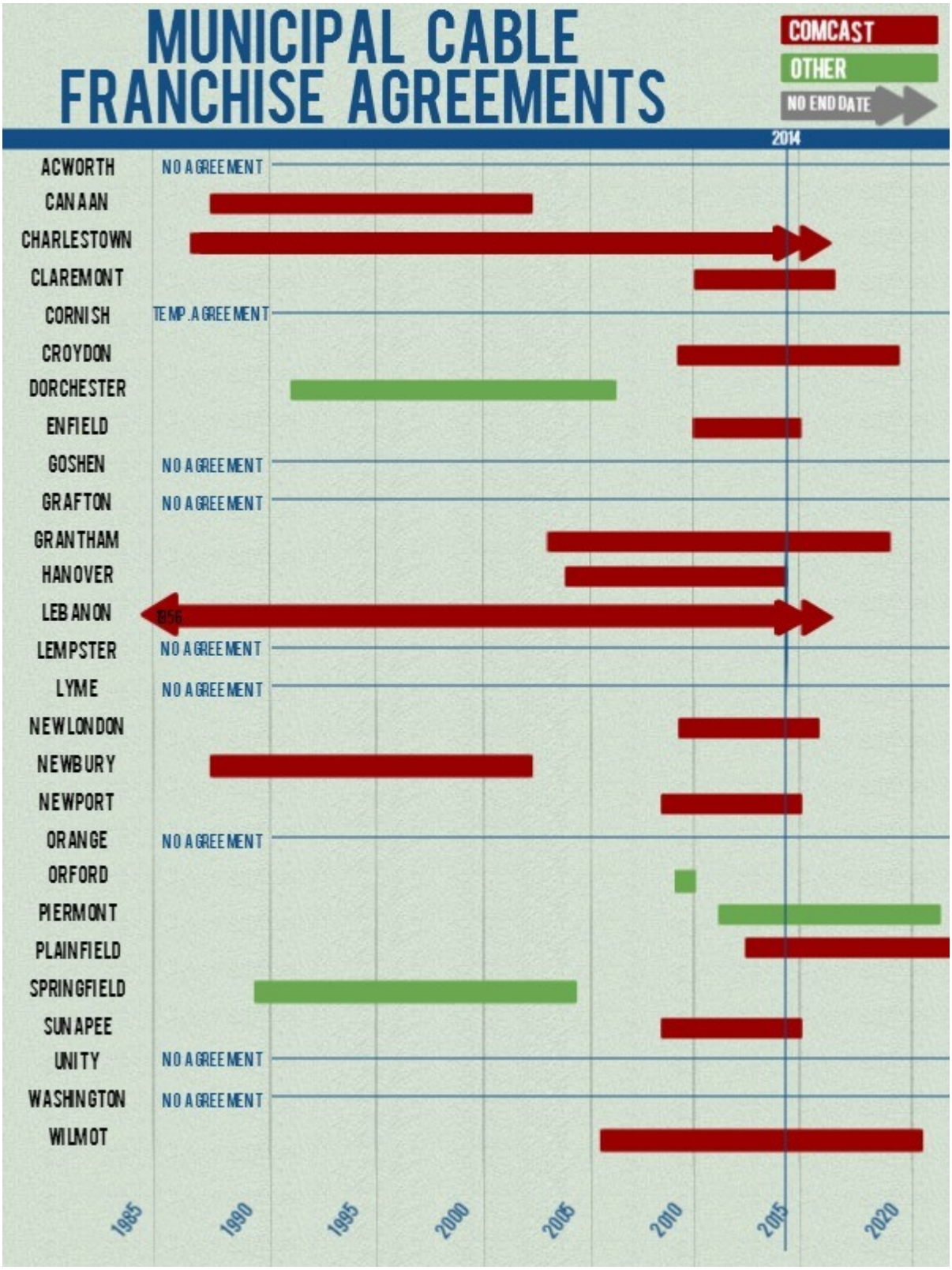

Figure 8. Municipal cable franchise agreements (CFA) in the Upper Valley Lake Sunapee region

INVESTMENTS IN BROADBAND EXPANSION

Significant improvements have been made over the last five years to bring basic broadband service to unserved areas; the gaps where people must rely on dial-up, satellite or cellular service are gradually shrinking. At the same time, incremental progress is being made to roll out fiber-optic broadband service capable of providing high-capacity bandwidth up to 1 Gbps speeds, but much more work remains to be done to provide broadband capable of serving the region's needs in the future.

Fairpoint Communications recently completed its expansion of broadband service to 95% of their customers by December 31, 2013. This was a requirement of the New Hampshire Public Utilities Commission's approval of Fairpoint's 2008 purchase of Verizon's land-line telephone service areas. To fulfill the 95% requirement, Fairpoint has extended broadband service to more than 100,000 additional homes and business in 215 communities around the state over the past five years, a total investment of $72 million. This includes service expansions in the Upper Valley Lake Sunapee region that were previously reliant on dial-up or satellite Internet service, including neighborhoods in Canaan, Croydon, Dorchester, Enfield, Goshen, Grantham, Hanover, Lebanon, Lempster, Newbury, Newport, Orange and Sunapee.[ix]

In addition, Fairpoint is in the process of spending an additional $3.3 million in further broadband expansion efforts. $2.8 million of service quality penalty monies incurred during 2009 through 2011 are being invested through an agreement with the New Hampshire Public Utilities Commission, and Fairpoint Communications is contributing $500,000 on its own. It is estimated that an additional 2,500 homes and businesses will receive DSL broadband service. Areas in the Upper Valley Lake Sunapee region that have recently had service extensions include sections of Charlestown, Claremont, Enfield, Goshen, Grafton, Lyme, Newport, Orange, Piermont, Unity, Wilmot. Looking ahead, Fairpoint received $848,000 in Connect America Funds that it will leverage to bring broadband access or higher speeds to areas of eighteen towns over the next three years, including parts of Lyme and Newbury.[x]

DSL is the most common technology used in Fairpoint's broadband expansion, although the Seacoast and greater Nashua areas of the state have a "much faster fiber-optic service called FAST, which has speeds of up to 50 Mbps."[xi] The Town of Newbury reports that their town offices are served by fiber optic service through Fairpoint, and two other companies are rolling out fiber-optic networks in other parts of the region. TDS Telecom is advertising on its website a Fiber-to-the-Home initiative in the Towns of New London and Wilmot and the Twin Lake Villa section of Springfield, as well as other towns outside of the Upper Valley Lake Sunapee region. New Hampshire FastRoads, LLC, has constructed Fiber-to-the-Home in two census blocks in the Town of Enfield and a fiber-optic backbone through parts of Orford, Lyme, Hanover, Lebanon, Enfield, Springfield, New London, Sunapee, Newport, Claremont, Goshen and Lempster. Five service providers are now offering service over the fiber-optic network and FastRoads is entering the planning for the next phases for construction.

REGIONAL DEMAND FOR BROADBAND

The Upper Valley Lake Sunapee Region is seeking fast, reliable and affordable broadband service throughout all corners of the region; this sentiment was echoed time and again by community officials, residents, business owners, education, etc.

The broadband stakeholders group identified that the many different users of broadband have unique needs: for family, for business, for schools and students, for telework, for healthcare delivery, for visiting nurse associations, for municipalities, for non-profits. This plan presents the needs and demands by sector based on feedback from surveys (including the 2013 phone survey conducted by UNH Survey Center), two public forums and fifteen sector-specific interviews.

Three major themes cross-cut all sectors and are evidence of how quickly "online business" has become mainstream and is transforming how all sectors conduct business:

- **Telework/Tele-education**: Employees are increasingly working beyond the four walls of their employers' headquarters, e.g. at home, satellite locations, and travelling for business locally and globally. Both employers and employees face challenges to achieving a connected workforce because there is limited high-capacity broadband service in residential and rural neighborhoods. Educational institutions also seek tele-education opportunities, either online learning as a supplement to the classroom or curricula delivered fully online.
- **Doing More Business Online**: All businesses and organizations interviewed reported that they have a growing dependence on online interaction with external companies or organizations. It is essential to have sufficient broadband service to conduct online business with suppliers, customers, accounting/billing services, electronic medical records firms, off-site IT/security back-ups and partnering organizations, such as Inter-Library Loan, Code Red reverse 911 system and state agencies.
- **Online Training and Professional Development**: Accessing training and professional development online, including keeping up to date with training to use ever-changing technology. There is a particular need for training in organizations that rely on volunteers, such as local government, social services and public safety.

EDUCATION SECTOR

The Upper Valley Lake Sunapee Region is home to 48 K-12 schools (39 public and private) and 8 institutions of higher education. Public school districts with schools in the region cumulatively educate over 12,500 K-12 students, and colleges and universities educate more than 6,800 post-secondary students and 2,100 graduate students.

The nationwide State Educational Technology Directors Association recommends that all K-12 schools have an external connection of 1 Gbps per 1,000 students and staff by the 2017-2018 school year.[xii]

The NetworkNHNow project, of which New Hampshire FastRoads is a part, resulted in substantial progress towards these goals; several K-12 schools and colleges were connected to a statewide fiber-optic broadband network capable of providing gigabit speeds in 2013. K-12 schools and libraries are eligible for the federal E-Rate program, which provides reduced-cost telecommunications services through a bidding process. The FCC announced in February 2014 that the E-Rate program will be reformed to direct more of the E-Rate funding to broadband connections and less to other telecommunications services.

Strengths	**Weaknesses**
• IT professionals at most school districts • Priority on Internet security • School districts have technology plans • Teachers are integrating technology into the classroom • Summer institutes to train staff on technology in classroom	• Lack of budget and time for Internet security training for staff and students • Updates are done piece-meal, not district-wide • Technology plan implementation is challenging
Opportunities	**Challenges**
• Broadband expansion initiatives to students' homes are allowing more students to connect to online course/homework information • Skype and online formats for snow days and flu outbreaks are starting to be used • Broadcasting lectures, classes, guest speakers; also job interviews • Virtual field trips • Professional development • Streamline administrative tasks	• Cost and need for continuous upgrades, as technology and broadband demand changes rapidly • Difficult to demonstrate to the community that technology upgrades are an investment, money well-spent • Some parent resistance to telework and use of technology for assignments from home during snow days and other closures • Varying policies about student use of personal wireless devices

HEALTHCARE SECTOR

Dartmouth-Hitchcock Medical Center, Alice Peck Day Hospital, New London Hospital and Valley Regional Hospital are the four acute-care hospitals in our region. The healthcare sector also include many smaller facilities, including rehab and dialysis centers, assisted-living facilities, medical laboratories, home health agencies, and walk-in clinics.

Electronic medical records and telehealth are two innovations in healthcare that rely on robust broadband. New England Telehealth Consortium is building the infrastructure necessary to support telehealth across Maine, New Hampshire and Vermont with a $24.5-million grant from the Federal Communications Commission Rural Health Care Pilot Program; as of October 2013, 200 of the 400 healthcare facilities had been connected, including Alice Peck Day, New London Hospital and Valley Regional Hospital. In addition to participating in the Telehealth Consortium, Dartmouth Hitchcock Medical Center established an Office of Telehealth in 2012 to advance the integration of interactive technology into medical treatment, including remote emergency medicine, consultations, and televisits. Figure 9 gives an example of the broadband speeds needed to transfer medical files in a timely fashion.[xiii]

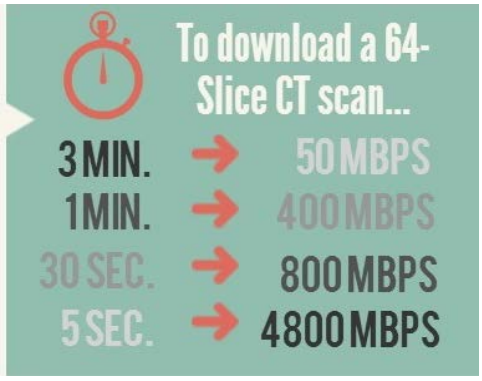

Figure 8. Download rates for CT scan.

Strengths	**Weaknesses**
• Providing Internet access to staff and patients/residents • Most facilities reported having a IT strategic plan and dedicated staff • Active in ensuring Internet security	• Want more robust Internet service (fiber-based, business class) • Want to build more network redundancy • Limited resources for staff training
Opportunities	**Challenges**
• Electronic medical records – backup or remote access • Staff training and professional development • Improved billing • New England Telehealth Consortium • Foresee interest and need for video-conferencing	• Remote access is important but requires broadband at the home • Foresee increased demand for bandwidth - Cost of improved service is a barrier • Limited options for service; some services aren't available • Cost of upgrading hardware • More services provided by vendors via the Internet

COMMUNITY SUPPORT/GOVERNMENT SECTOR

The Community Support/Government Sector includes a range of local governments, libraries and social service organizations with great variation in the size of the population they serve and their current use of technology and the internet in their daily operations.

Broadband offers the opportunity to operate government with unprecedented transparency. The most complete municipal websites include town news and announcements like meeting agendas and minutes, and also the ability to pay fees for dog licenses, car registration, utility bills and property taxes online. All but two municipal governments have an official website, and two-thirds have an online public meeting calendar.

Twelve provide property assessment information on their website. Many, but not all, municipalities with cable franchise agreements broadcast public meetings via public access TV. There is a trend toward posting meeting audio and video on the web to provide "anytime, anywhere" access to municipal meeting proceedings, provided residents have broadband service.

Public libraries play an important role in providing free access to computers and the Internet for their users; many also provide digital literacy support or training to library patrons. The George H. Stowell Free Library in Cornish leaves its wireless router on while the library is closed, so that people may access the Internet from the parking lot.

Strengths	**Weaknesses**
• Report that facilities have adequate IT support (IT staff or consultants) • Ongoing monitoring of server to ensure adequacy • Interest in using technology and improving broadband service	• Outdated computers • Uneven level of staff expertise in technology • Lack of awareness of various technology options • Limited funding for upgrades to technology and broadband service
Opportunities	**Challenges**
• Anticipate more job functions to migrate online • Anticipate future demand for videoconferencing • Staff training via webinars • Faster speeds would improve productivity and workflow • Providing more computers or more robust broadband service in public facilities for public access	• Keeping staff (and volunteers) well-trained due to employee turnover and rapidly changing technology • Reducing the generation gap in staff expertise with technology • Rapidly changing technology • Difficult to find resources to fund upgrades and best technology • Struggle to keep website updated

PUBLIC SAFETY SECTOR

The Public Safety sector encompasses a range of services in the UVLSRPC region, including small volunteer fire departments to large fully staffed police, fire and EMS departments. There are two regional dispatch services that coordinate emergency communications for multiple communities. The Upper Valley Regional Dispatch Center in Hanover serves 25 towns in the bi-state region for their dispatch needs which can include: Fire, Police, EMS, Highway, Water and Sewer Departments. New London's dispatch service acts as a regional dispatch for the Lake Sunapee area.

Broadband is an ever increasing necessity to the public safety sector as emergency response relies more and more heavily on technology. The NetworkNHNow project made substantial upgrades to the public safety microwave communications network located on mountaintops across New Hampshire, including Moose Mountain and Mount Kearsarge. In 2013, New Hampshire received a $1.1-million grant to help develop the FirstNet network, which is the first nationwide high-speed network that is dedicated to public safety. The network will provide public safety officials with the speed for communications and tactical response that they need in emergency situations.

Strengths	**Weaknesses**
• Staff using social media, web-based communications • Online professional development • Using cell service amplifiers to improve mobile unit operations	• Small towns struggle with lack of IT support, lack of broadband advocates being proactive • Need more training for staff • Need to sync multiple devices
Opportunities	**Challenges**
• Remote access to databases • Mobile command post operations • Mobile access to files, digital mapping and location – would streamline response times	• Poor cell service limits utilization of mobile units • Need local advocates to push for improved broadband and make IT investments a priority • Lack of options for broadband service • Cost of upgrades

BUSINESS SECTOR

The Business Sector includes a wide variety of establishments in the UVLSRPC Region, from small, independent companies to large manufacturing companies with plants and offices around the world that are headquartered in the region. As of 2001, there were a total of 46,768 jobs in the UVLSRPC region. This creates a wide set of diverse needs, with large companies and high-tech businesses, in particular, requiring high-capacity bandwidth and inter-building/inter-office networking and connectivity.

Telework is now a pervasive phenomenon; in 2012, the Bureau of Labor Statistics found that 23% of workers in the United States "did some or all of their work at home."[xiv] Workers with higher levels of education are more likely to work at home than those without a high school diploma – 38% of workers 25 years of age or older with a bachelor's degree or higher did some or all of their work at home in 2012. Broadband is an essential service for employees to work from home and be connected to their employers, coworkers and clients around the world.

Even though broadband is a necessity for conducting business affairs, 26% of small businesses surveyed by the UNH Cooperative Extension in 2012 indicated that they do not have sufficient connectivity. The businesses also reported that their greatest technology-related challenge is keeping up with technology as it changes.

Strengths	**Weaknesses**
• Staff using social media and web-based communication for both marketing and product training • Utilize internet product ordering for streamlined process. • Ability to track product and customer orders and shipments. • Large firms reported having a IT strategic plan and dedicated staff	• Need additional staff training • Difficult to keep hardware and software current • Need standardized hardware and software for all employees • Small firms do not have the resources to adequately implement an IT strategic plan.
Opportunities	**Challenges**
• Remote access for all employees • Increase remote product training and webinars. • Mobile access for customers that can handle high numbers of devices. • Increase capacity for supply-chain management	• Lack of options for broadband service • Employees need adequate broadband at their homes for remote access • Cost of upgrades

RESIDENTS – BROADBAND TO THE HOME

A 2013 phone survey conducted by UNH Survey Center for the nine Regional Planning Commissions found that 84% of residents of the Upper Valley Lake Sunapee and Southwest regions of New Hampshire reported having Internet access at home. 16% of residents reported not having any Internet access at home. Of those with Internet access, 1% used dial-up, 3% used satellite, 3% used cellular, 5% used fixed wireless, 75% used cable or DSL, and 1% had fiber.

The lack of broadband availability in rural areas creates an inequality between those who are served and those who are not. Of those who have internet access, many are underserved due to the lack of robust broadband (Figure 9). Of the served population in the UVLSRPC Region, 7% are using technology that does not provide reliable high-speed broadband connectivity. Of those who reported using dial-up or satellite, 59% reported that it was their only option available. The lack of options is a challenge to residents who seek faster, more reliable and affordable broadband at home.

For those who are served with reliable broadband, the monthly cost is substantial. The monthly cost for 47% of those with service is $50 or more a month with 16% paying over $100 a month. Of the 16% who do not have internet at their home, 23% do not have service because the service is too expensive.

While most residents consider their service adequate (88%) and would not be willing to pay more for faster internet speeds (84%), a significant minority (9%) find their service to be inadequate. 12% of survey respondents would be willing to pay 25% more per month for faster speeds and 3% would be willing to pay 50% more per month.

Even though 88% of survey respondents consider their service to be adequate, more than half are sufficiently concerned about the availability of broadband in their communities -- 51% of respondents in the Southwest and Upper Valley Lake Sunapee region favored using municipal funds to improve broadband access and 35% stated their willingness to pay higher fees or taxes.

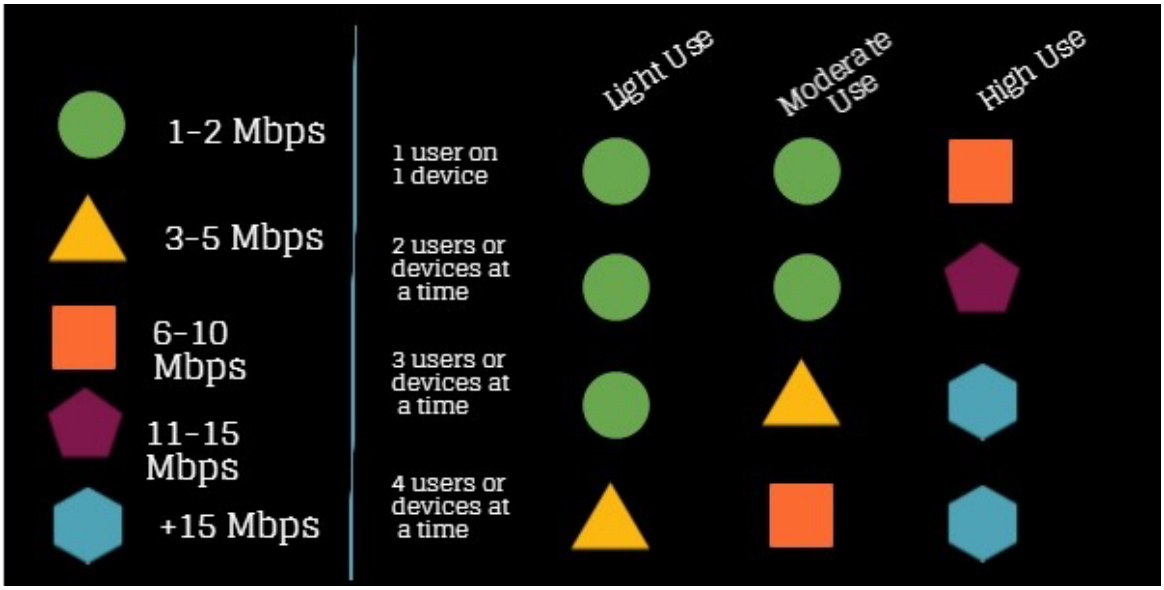

Figure 9. Minimum download speeds needed for adequate performance for household use[xv]

CHALLENGES AND OPPORTUNITIES

Low population density creates a low return on investment for broadband expansion. The FCC summarizes the challenge of rural density, "Because service providers in these [rural] areas cannot earn enough revenue to cover the costs of deploying and operating broadband networks, including expected returns on capital, there is no business case to offer broadband services in these areas."[xvi] In the Upper Valley Lake Sunapee region, broadband service gaps exist for both wired broadband service and cellular service. Low population density also contributes to the low level of competition in the broadband marketplace, particularly for wired broadband service.

The region's terrain presents physical barriers to wireless broadband deployment. The Upper Valley Lake Sunapee region contains a major watershed divide between the Connecticut and Merrimack river basins as well as many smaller mountains, hills and valleys that act to block wireless signals.

Opportunities to Overcome these Challenges:

- Enhance funding or financing opportunities for broadband expansion.
- Encourage expansion of fixed wireless or cellular service, which has a lower per-household cost in rural areas than wired service.
- Monitor the research and development of TV white space and other emerging technologies that may overcome line-of-sight barriers posed by terrain.

Case Study: Tamworth Wireless Cooperative

The Town of Tamworth, population 2,856, is nestled in the White Mountains south of Mount Chocurua. The town's most recent master plan survey identified broadband as its #1 need. There was service in the village center but not in outlying areas, and the low density of the population made wired service cost-prohibitive. In neighboring Sandwich, Gunnar Berg had set up a fixed wireless network called Cyberpine, and a group of Tamworth residents were interested to create a similar network in their town. They studied the terrain and planned a wireless network that would link a church (that had an existing Internet connection) to a fire tower and then to two other towers. The ensuing network signal would cover 200 homes in the outlying areas of town. In 2010, they formed the Tamworth Wireless Cooperative and received $100,000 in start-up costs from the Tamworth Community Foundation. In their second year, 113 of the 200 households have subscribed and the venture became self-sustaining.

Financing options and funding sources are limited for expanding broadband to unserved and underserved areas. The New Hampshire Fast Roads project has substantially improved levels of service in portions of the Upper Valley Lake Sunapee region by leveraging federal funds with local match and loans; Fairpoint has taken advantage of the Connect America Fund for some broadband expansion in our region. Despite these investments, the insufficient broadband speeds shown on regional maps make it clear that further investment is needed. Dedicated, ongoing federal funding for broadband expansion is in short supply, there is no state funding for broadband expansion, and municipalities are currently limited in how they can raise funds for broadband expansion.

Opportunities to Overcome this Challenge:

- Support reform of the Connect America Fund.
- Support state legislation that permits or promotes innovative financing of broadband:
    - Allowing municipalities to bond for broadband.
    - Providing tax credits for companies that extend service to underserved areas.
    - Creating a state Broadband Authority and Broadband Services Fund.
- Investigate innovative financing strategies on a local level, such as:
    - Utilizing cable franchise fees.
    - Investment from private foundations or local businesses.
    - Direct municipal appropriations.

What is the Connect America Fund?

All telecom providers contribute to the Universal Service Fund (USF), originally set up to ensure universal phone service. The FCC has begun reforms to the USF and created the Connect America Fund to shift the focus to broadband expansion with the goal of universal broadband service.

NH Senator Ayotte introduced legislation in 2013 that would guarantee that rural states, like New Hampshire, would receive at least 75 cents for ever dollar that is contributed to the fund. This would significantly increase the funding that New Hampshire receives and thus the expansion opportunities.

Case Study: Northern New England State Broadband Authorities

In June 2007, the Vermont General Assembly established the Vermont Telecommunications Authority (VTA) with the mission to ensure all residences and businesses in all regions of the states have access to affordable broadband, mobile voice and data communications. With a staff of ten employees, VTA awards grants for expansion efforts throughout the state.

MBI, a division of the MA Technology Collaborative, was established with the August 2008 signing of the Broadband Act by Governor Patrick. With fifteen staff members, the MBI has the authority to invest $40 million in state bond funds in necessary and long-lived infrastructure assets. (i.e. conduit, fiber-optic cable and wireless towers.)

In July 2007, Maine established the ConnectME Authority as a component unit of Maine state government. Staffed by three state employees, the mission of ConnectME is to facilitate the universal availability to all Mainers. Through eight grant rounds, ConnectME has awarded over $9 million in grants for broadband expansion projects.

- Continue to inventory broadband availability statewide, so that informed decisions can be made about where funding should be targeted.
- Develop "Gigabit Community" marketing campaigns for those communities on the FastRoads backbone network to encourage local investment to spur last-mile fiber optic build-out.

Case Study: Moultonborough Technology Communications Fund

In 2007 the Town of Moultonborough, NH passed a warrant article to establish and Technology Communication fund "to promote development of communications infrastructure to underdeveloped parts of Town". The fund is funded through the franchise fees paid to the town by their cable provider, which is about $22,500 per year. Recognizing that fast, reliable Broadband is a necessity to most in town, there has been significant discussion in regards to how to use the $160,000 that as been set aside since 2007. The discussions have centered on determining the most effective way of extending internet service; whether cable build-out or to provide broadband service to underserved areas.

Case Study: ECFiber

ECFiber, (the East Central Vermont Community Fiber Network) is a group of 23 local municipalities, from West Windsor to Montpelier, who is building a high-speed fiber-optic network. Vermont state law allows municipalities to build, own and operate telecom facilities for public use, but prohibits using local tax revenue to develop internet infrastructure. ECFiber is legally constituted as a municipality through an Inter-Local Contract, which allows ECFiber to raise capital by issuing tax-free promissory notes to individual investors. (Note: Due to differences in state law, NH municipalities could not replicate this financing strategy; however, there may be other innovative financing strategies that could be utilized for a similar municipally-owned network.)

In January 2011, ECFiber raised nearly $1 million to start constructing the fiber network, and has sought additional investment as the fiber buildout continues. As of October 2013, ECFiber had raised more than $5 million, and constructed 180 miles of "lit" fiber. ECFiber's successful track record has enabled them to compete for state funding to augment local investment.

Utility pole attachment issues increase the costs of expanding wired broadband and create delays in deployment. New Hampshire Fast Roads, LLC has reported that a full 20% of their project cost went to pole attachment licensing and make-ready work; in contrast, Stan Williams reported that, for ECFiber in Vermont, pole attachments were not a significant obstacle. New Hampshire regulations provide for lengthy time periods for the pole owners to respond to and act on requests for third-party pole attachments.

Opportunities to Overcome this Challenge:

- Amend state pole attachment regulations and enabling legislation.
- Create a statewide Inventory of utility poles and pole attachments.

An absence of leadership at the state level slows progress on current broadband expansion efforts as well as the financing and regulatory reforms to facilitate additional expansion. There is no state champion for broadband, nor is there state-level investment. The State Broadband Director's position is funded through the

American Recovery and Reinvestment Act, and is set to expire in December 2014. The Telecommunications Advisory Board, true to its name, is advisory in nature only. New Hampshire is the only northern New England state without a statewide broadband authority.

Opportunities to Overcome this Challenge:

- Create and fund a statewide Broadband Authority with a clear mandate to improve the level of broadband service in New Hampshire.
- Encourage inter-municipal or regional coordination on broadband expansion efforts.

Municipalities in the Upper Valley Lake Sunapee region, in particular the many small towns run primarily by volunteers, lack the leverage and clout of larger entities. Coordination on the municipal level and inter-municipal or regional level may improve the community's ability to plan for the future and negotiate with broadband service providers. Many municipal cable franchise agreements are out-of-date and municipalities lack in-house legal expertise to renegotiate these agreements. Only ten of the twenty-seven municipalities in the region have unexpired agreements and the length of the contract term varies from 5 years to 15 years, which misses an opportunity to keep the agreement up-to-date with rapidly-changing technology.

Opportunities to Overcome this Challenge:

- Encourage municipalities to inventory and address local broadband needs in the master plan.
- Encourage municipalities to establish telecommunications committees.
- Provide technical assistance and training to municipal telecommunications committees, including model master plan chapters, telecommunications ordinances and other resources.
- Encourage inter-municipal or regional coordination on broadband expansion efforts.
- Consider inter-municipal agreements for shared specialized attorney services for cable franchise agreement negotiation.
- Consider a shorter term (e.g. 5 years) when a municipality's cable franchise agreement is next negotiated.

The high cost of broadband service creates a barrier for adoption, particularly for lower-income households. In the Upper Valley/Southwest region, 51% of households without home Internet service making less than $20,000/year reported that cost was the primary reason why they don't have Internet access at home. The cost challenge is not limited to the lowest income households: Nearly one in five households without home Internet access making between $40,000 - $59,999/year stated that the most important reason why they didn't have Internet access at home was the cost of service is "too expensive."

Opportunities to Overcome this Challenge:

- Encourage the utilization of Comcast's Internet Essentials program for low-income households.
- Encourage other providers to offer similar low-cost programs for low-income households.
- Promote increased competition in the marketplace to decrease cost of service and provide more service options and pricing tiers.

Households not utilizing the Internet are at a disadvantage to access services in a world that increasingly provides services online. In the Upper Valley/Southwest region, 25% of survey respondents who do not have Internet service at home gave the primary reason as "Don't Need It." This was the most common reason given by survey respondents age 60 or older.

Opportunities to Overcome this Challenge:

- Continue digital literacy education and public computer access initiatives to assist people to utilize the Internet to access information and services online.

FINDINGS AND RECOMMENDATIONS

REGIONAL GOALS – 2020

1. Provide affordable broadband service that would support telework and tele-education (10 Mbps download, 6 Mbps upload) in all areas of the region.
2. Build "Gigabit Communities" – expand "big broadband" (1 Gbps download, 1 Gbps upload) to all community anchor institutions and city/town centers, with extensions to residential and outlying areas.
3. Encourage marketplace entry of competitive, innovative service providers.
4. Work towards parity in broadband service availability across the rural areas of our region, the downtowns and village centers of our region, and metropolitan areas in the Northeast.

STRATEGIES – HOW TO REACH OUR GOALS

A. Expand financing options and funding sources for expanding both telework-supporting and gigabit broadband.
    1. Support reform of the federal Connect America Fund (part of the Universal Service Fund) to allow more funds to be available to New Hampshire broadband providers for expansion.
    2. Pass state legislation that promotes new options for broadband financing, such as tax credits for companies that extend service to underserved areas and permitting municipalities to bond for broadband expansion.
    3. Share case studies and information on innovative financing strategies at the community level, such as utilizing cable franchise fees, investments from private foundations or local businesses, and direct municipal appropriations.
    4. Continue to inventory broadband availability statewide, so decision-makers have up-to-date information on where funding should be targeted.

B. Remove barriers to entry into the marketplace by competitive, innovative service providers.
    6. Reform state legislation and policy governing utility pole attachments and the use of public rights-of-way to streamline providers' access to poles and underground conduit.

7. Create a statewide inventory of utility poles and pole attachments.
8. Study the state cable franchise law (RSA 53-C) to determine whether barriers exist for the entry of more than one cable provider into a municipality.
9. Provide technical assistance to municipalities updating telecommunications ordinances to facilitate fixed wireless and cellular service expansion in a context-sensitive manner.
10. Facilitate research, development and deployment of emerging broadband technologies, such as TV white space.

C. Enable municipalities in our rural region to plan proactively for broadband service expansion and improvements.
    11. Encourage municipalities to establish telecommunications or broadband committees; provide technical assistance , including model master plan chapters, telecommunications ordinances, and other resources.
    12. Encourage municipalities to develop a broadband chapter in the master plan; provide technical assistance.
    13. Support inter-municipal or regional coordination on broadband expansion efforts, including expansion of the FastRoads consortium.
    14. Consider inter-municipal agreements for shared specialized attorney services for cable franchise agreement negotiation.

D. Build statewide leadership capacity to promote broadband.
    15. Create and fund a State Broadband Authority with a clear mandate to improve broadband service in all regions of New Hampshire and to work collaboratively with neighboring states.
    16. Provide sufficient funding to enable state agency staff to participate in or liaison with industry-specific broadband consortia and initiatives, such as the New England Telehealth Consortium, FirstNet, Digital Resources Consortium, ConnectNH and the UNH Broadband Center for Excellence.

E. Overcome barriers of affordability and digital illiteracy.
    17. Encourage the utilization of Comcast's Internet Essentials program for low-income households with school-aged children.
    18. Encourage other providers to offer similar low-cost programs for low-income households.
    19. Continue digital literacy education and public computer access initiatives to assist people with using the Internet to access information and services online.

IMPLEMENTATION

HIGHEST PRIORITIES FOR ACTION

Recent investment in broadband by both private service providers and the NetworkNHNow project supported by federal and local funding sources have made a difference in expanding broadband service to more residents and businesses in the Upper Valley Lake Sunapee region. At the same time, reforms to telecommunications law, policy and programs at the federal level are underway, to encourage broadband deployment.

Now, there is great potential to build upon this momentum to expand robust broadband services to all corners of the region. The broadband stakeholders' group identified five key strategies that are the highest priorities for action:

- Support reform of the federal Connect America Fund (part of the Universal Service Fund) to allow more funds to be available to New Hampshire broadband providers for expansion.
- Pass state legislation that promotes new options for broadband financing, such as tax credits for companies that extend service to underserved areas and permitting municipalities to bond for broadband expansion.
- Reform state legislation and policy governing utility pole attachments and the use of public rights-of-way to streamline providers' access to poles and underground conduit.
- Provide technical assistance to municipalities updating telecommunications ordinances to facilitate fixed wireless and cellular service expansion in a context-sensitive manner.
- Support inter-municipal or regional coordination on broadband expansion efforts, including expansion of the FastRoads consortium.

IMPLEMENTATION MATRIX

A more detailed matrix of strategies, their impact and partners critical to their implementation is included on the following pages.

*** Matrix Key**

Phase: Short = <1 yr., Medium = 2-4 yrs; Long = >4 yrs.; Ongoing

Level of Action: ● Primary level of action; ○ Secondary level of action

Relevant Sectors: ● Primary Sector Affected; ○ Secondary Sector(s) Affected

Priority Rating	Phase*	Strategy	Level of Action*	Relevant Sectors*						Potential Partners
				Economic	Education	Government	Health	Public Safety	Residential	
Course of Action: Expand financing options and funding sources for expanding both telework-supporting and gigabit broadband										
High	Short/ Medium	Support reform of the federal Connect America Fund to allow more money to be available to New Hampshire companies for broadband expansion.	○ State ● Nation	●	●	●	●	●	●	NH federal delegation, NH Telecom Advisory Board (TAB)
High	Short/ Medium	Pass state legislation that permits or promotes broadband financing.	○ Local ○ Region ● State	●	●	●	●	●	●	NH Legislature, NH CDFA,, Municipalities, Service Providers
	Medium	Share case studies and information on innovative financing strategies at the community level.	○ Local ○ Region ● State	●	●	●	●	●	●	UNH Center for Broadband Excellence, UNH Cooperative Extension, RPCs
	Ongoing	Continue to inventory broadband availability statewide, so decision-makers have up-to-date information on where funding should be targeted.	● State ● Nation	●	●	●	●	●	●	UNH, NH DRED, NH TAB, FCC, NTIA, NH federal delegation
Course of Action: Remove barriers to entry into the marketplace by competitive, innovative service providers.										
High	Medium	Reform state legislation and policy governing utility pole attachments and the use of public rights-of-way.	● State	●	●	●	●	●	●	NH Public Utilities Commission, NH Legislature
	Medium	Create a statewide inventory of utility poles and pole attachments.	○ Local ● State	●	●	●	●	●	●	NH Public Utilities Commission, Municipalities

Priority Rating	Phase*	Strategy	Level of Action*	Relevant Sectors*						Potential Partners
				Economic	Education	Government	Health	Public Safety	Residential	
	Medium	Study the state cable franchise law (RSA 53-C) to determine whether barriers exist for the entry of more than one cable provider into a municipality.	○ Local ● State	●	●	●	●	●	●	NH Legislature, Municipalities
High	Ongoing	Provide technical assistance to municipalities updating telecommunications ordinances to facilitate fixed wireless and cellular service expansion in a context-sensitive manner.	○ Region ● State	○	○	●	○	○	●	NH Office of Energy and Planning, NH Municipal Association, RPCs
	Medium/Long	Facilitate research, development and deployment of emerging broadband technologies, such as TV white space.	○ State ● Nation	●	○	○	○	●	●	UNH Broadband Center for Excellence, FCC
Course of Action: Enable municipalities in our rural region to plan proactively for broadband service expansion and improvements.										
	Short/ Medium	Encourage municipalities to establish telecommunications or broadband committees' provide technical assistance.	○ Local ● Region ● State	○	○	●	○	○	●	NH Office of Energy and Planning, NH Municipal Association, RPCs
	Short/ Medium	Encourage municipalities to develop a broadband chapter in the master plan; provide technical.	○ Local ● Region ● State	○	○	●	○	○	●	NH Office of Energy and Planning, NH Municipal Association, RPCs
High	Ongoing	Support inter-municipal or regional coordination on broadband expansion efforts, including expansion of the FastRoads consortium.	○ Local ● Region ○ State	●	●	●	●	●	●	Regional Economic Development Councils, RPCs
	Ongoing	Consider inter-municipal agreements for shared specialized attorney services for cable franchise agreement negotiation.	● Local	○	○	●	○	○	●	Municipalities

Priority Rating	Phase*	Strategy	Level of Action*	Relevant Sectors*						Potential Partners
				Economic	Education	Government	Health	Public Safety	Residential	
Course of Action: Build statewide leadership capacity to promote broadband.										
	Medium	Create and fund a State Broadband Authority.	● State	●	●	●	●	●	●	NH Legislature, Governor's Office, NH Telecom Advisory Board
	Medium	Provide sufficient funding to enable state agency staff to participate in or liaison with industry-specific broadband consortia and initiatives.	● State	●	●	●	●	●	●	NH Dept of Education, NH Dept of Safety, NH DRED, NH Legislature, Governor's Office
Course of Action: Overcome barriers of affordability and digital illiteracy.										
	Ongoing	Encourage the utilization of Comcast's Internet Essentials program for low-income households with school-aged children.	● Local	○	●	○	○	○	●	Schools, libraries
	Ongoing	Continue digital literacy education and public computer access initiatives to assist people with using the Internet to access information and services online.	● Local ● Region ● State ● Nation	●	●	●	○	○	●	Schools, UNH Cooperative Extension, continuing education programs, libraries, community centers
	Medium	Encourage other providers to offer similar low-cost programs for low-income households.	● State ● Nation	○	●	○	○	○	●	NH Telecom Advisory Board, Service Providers

CONCLUSION

This plan aims to be realistic in setting targets for broadband expansion to all homes and businesses in the region, with a long-term goal of the Upper Valley Lake Sunapee Region becoming a Gigabit Region, with service at 1 Gbps download/upload speeds, and achieving parity among rural areas, downtowns and village centers and metropolitan areas.

2020 Broadband Goals for our Region

1. Provide affordable broadband service that would support telework and tele-education (10 Mbps download, 6 Mbps upload) in all areas of the region.
2. Build "Gigabit Communities" – expand "big broadband" (1 Gbps download, 1 Gbps upload) to all community anchor institutions and city/town centers, with extensions to residential and outlying areas.
3. Encourage marketplace entry of competitive, innovative service providers.
4. Work towards parity in broadband service availability across the rural areas of our region, the downtowns and village centers of our region, and metropolitan areas in the Northeast.

Recommended Courses of Action

The plan identifies five broad courses of action to achieve these goals and further focuses on five high-priority strategies.

- Expand financing options and funding sources for expanding both telework-supporting and gigabit broadband.
    - Priority Action: Support reform of the federal Connect America Fund (part of the Universal Service Fund) to allow more funds to be available to New Hampshire broadband providers for expansion.
    - Priority Action: Pass state legislation that promotes new options for broadband financing, such as tax credits for companies that extend service to underserved areas and permitting municipalities to bond for broadband expansion
- Remove barriers to entry into the marketplace by competitive, innovative service providers.
    - Priority Action: Reform state legislation and policy governing utility pole attachments and the use of public rights-of-way to streamline providers' access to poles and underground conduit.
    - Priority Action: Provide technical assistance to municipalities updating telecommunications ordinances to facilitate fixed wireless and cellular service expansion in a context-sensitive manner.
- Enable municipalities in our rural region to plan proactively for broadband service expansion and improvements.
    - Priority Action: Support inter-municipal or regional coordination on broadband expansion efforts, including expansion of the FastRoads consortium.
- Build statewide leadership capacity to promote broadband.
- Overcome barriers of affordability and digital illiteracy.

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[iii] State of New Hampshire, Department of Resources and Economic Development and The Telecommunications Advisory Board, State of New Hampshire Broadband Action Plan: Appendix A, 2008, http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf . (accessed July 17, 2013).

[iv] "Wireless Internet 101," Institute for Local Self-Reliance, http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed June 2013).

[v] "Building Community Capacity through Broadband (BCCB) Initiative," *University of Wisconsin Extension*, November 2010, http://www.uwex.edu/broadband/documents/BCCBUWEXFAQ_rev_11_18_10withmap.pdf. (accessed June 2013).

[vi] David Salway, "Why is Increasing Broadband Adoption so Important to Society?," *About.com Guide*, http://broadband.about.com/od/barrierstoadoption/a/Why-Is-Increasing-Broadband-Adoption-So-Important-To-Society.htm. (accessed July 2013).

[vii] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

[viii] Federal Communications Commission, Connecting America: The National Broadband Plan, March 17, 2010.

[ix] Compiled from Fairpoint Communications press releases from January 31, 2013 to December 30, 2013. http://www.fairpoint.com/global/fp-newsroom/ Accessed Feb. 26, 2014.

[x] Ibid.

[xi] Brooks, David. "Fairpoint makes broadband available to 95% of NH customers, meeting state guideline." Nashua Telegraph. March 1, 2014.

[xii] Fox, C., Waters, J., Fletcher, G., & Levin, D. 2012. The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs. Washington, DC: State Educational Technology Directors Association

[xiii] Federal Communications Commission. 2010. Health Care Broadband in America: Early Analysis and a Path Forward. Omnibus Broadband Initiative Technical Paper #5. Washington, DC..

[xiv] Bureau of Labor Statistics. June 20, 2013. American Time Use Survey – 2012 Results (news release). http://www.bls.gov/news.release/pdf/atus.pdf Accessed Mar. 5, 2014.

[xv] Federal Communications Commission. Household Broadband Guide. https://www.fcc.gov/guides/household-broadband-guide Accessed Mar 5, 2014.

[xvi] Federal Communications Commission. "National Broadband Plan: Connecting America." March 2012.

APPENDIX A:

NH BROADBAND MAPPING & PLANNING INTRODUCTION[1]

Prepared By: Southwest Region Planning Commission, July 2013

PROJECT BACKGROUND

The New Hampshire Broadband Mapping and Planning Program (NHBMPP) is a comprehensive, multi-year initiative that began in 2010 with the goal of understanding where broadband is currently available in New Hampshire, how it can be made more widely available in the future, and how to encourage increased levels of broadband adoption and usage. Funded through the National Telecommunications and Information Administration (NTIA), the NHBMPP is part of a national effort to expand broadband access and adoption.

The NHBMPP is managed by the GRANIT (Geographically Referenced Analysis and Information Transfer) System within the Earth Systems Research Center at the University of New Hampshire (UNH), and is a collaboration of multiple partners. These include: the NH Office of Energy and Planning (OEP), NH Department of Resources and Economic Development (DRED), UNH Cooperative Extension (UNHCE), UNH Information Technology (UNHIT), and the state's nine regional planning commissions (RPCs).

PROGRAM COMPONENTS & OBJECTIVES

The NHBMPP is comprised of several components, including a broadband availability inventory and mapping effort and a suite of planning and technical assistance initiatives. Following are brief descriptions of these components as well as an overview of the broadband planning initiative.

MAPPING

In 2010, UNH GRANIT, the RPCs, and other partners began an inventory and mapping effort aimed at better understanding the current availability of broadband throughout the state through several projects and activities, which include:

- Collecting data semi-annually from the public and commercial entities that provide broadband services in New Hampshire on the location, type and speed of broadband technology available;

[1] This document represents a working draft and may change as more information is updated regarding the status of ongoing NHBMPP activities and projects.

- Refining the information collected on broadband availability by initiating a series of verification efforts, including map verification with community collaborators, online speed tests and user surveys, a statewide cell phone reception study, and other related activities;
- Surveying and mapping broadband availability at community anchor institutions (CAIs) such as schools, libraries, hospitals, public safety facilities, and municipal buildings;
- Developing the first public master address file of households located in rural census blocks;
- Collecting and hosting a statewide inventory of cable franchise agreements; and,
- Sharing information and data on broadband availability with the NTIA and the Federal Communications Commission (FCC) on a semi-annual basis for inclusion in the National Broadband Map.

TECHNICAL ASSISTANCE AND TRAINING

UNHCE has taken the lead on developing and administering technical assistance and training opportunities to help businesses, local governments, organizations and individuals better understand the importance of and applications for broadband in today's world. The activities undertaken by UNHCE through the NHBMPP include:

- Assessing the broadband training and technical needs of stakeholder groups including educational institutions, small business, municipalities, healthcare providers and organizations to determine topics stakeholders would like to receive training on and applications that would be of use to stakeholders;
- Developing tools and learning modules on topics related to broadband utilization and adoption such as "Leveraging Broadband to Promote Economic Development", "Putting your Business on the Digital Map", and "Three Free Ways to Promote Your City/Town/School via the Web"; and,
- Delivering workshops, training and technical assistance to broadband stakeholder groups to support increased broadband adoption and use.

CAPACITY BUILDING

A third component of the NHBMPP, capacity building, is focused on the development of tools and resources necessary to implement broadband projects within communities and regions across the state. The Director of Broadband Technology, (DRED), and project staff from UNHCE and UNHIT, are working together to enhance broadband capacity by:

- Encouraging collaboration to establish best practices in policy management, financial resources, and advocacy for business and residential broadband;
- Tracking and reviewing legislation related to broadband and telecommunications;
- Working with the NH Telecommunications Advisory Board, to analyze and assess the state's broadband infrastructure and promote access to affordable and reliable advanced telecommunications services;
- Researching successful community broadband solutions and funding options, including and aggregating them into a toolkit on broadband solutions and funding for NH; and,

- Establishing a Resource Team, who will work with RPCs and broadband stakeholder groups (BSGs) to identify communities prepared to initiate their broadband plans and provide assistance with community broadband decision making.

PLANNING

In 2011, NHBMPP partners engaged in a four-year effort aimed at incorporating the information and momentum gained during the mapping activities to better understand current broadband availability in New Hampshire and plan for increased broadband adoption and utilization through outreach, community engagement, and surveying activities.

As part of an effort to gain a better understanding of broadband at the regional level, each RPC developed a broadband stakeholder group (BSG), comprised of individuals representing a wide range of sectors, which met quarterly. The BSGs have played a vital role in assisting RPCs in assessing the need for improved broadband capability, availability, and affordability. The BSGs helped the RPCs develop a list of broadband needs and barriers to broadband adoption and utilization. They also assisted with developing goals, objectives, and strategies to overcome barriers in each region.

A major undertaking of the broadband planning component was a sector-based analysis. This activity involved developing and facilitating focus group meetings, structured interviews, and other methods to identify broadband needs and challenges specific to various sectors, including healthcare, education, local government, economic development, and public safety. Each RPC conducted focus groups or interviews with representatives from these sectors to better understand the importance of broadband accessibility to each sector.

Additionally, each RPC held public forums throughout the course of the project. These forums were an opportunity to share information regarding ongoing broadband efforts in the region, progress of the NHBMPP, and to receive feedback from community members regarding broadband availability.

Information gathered from the activities described above led to the development of nine regional broadband plans in NH. Each RPC reviewed and analyzed data collected through the mapping efforts, outreach activities, sector- based analysis, as well as public forums to develop comprehensive documents that highlight the current landscape of broadband availability in the state and identify ways to increase broadband adoption and utilization. The regional broadband plans serve as guidance documents for communities, policy makers, businesses, institutions, and residents to better understand the availability and need for and utility of broadband now and into the future. All nine plans are to be compiled into a statewide broadband planning document by the NH OEP.

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.

[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).

[2] "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).

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 below is a condensed version of the NHBMPP matrix.

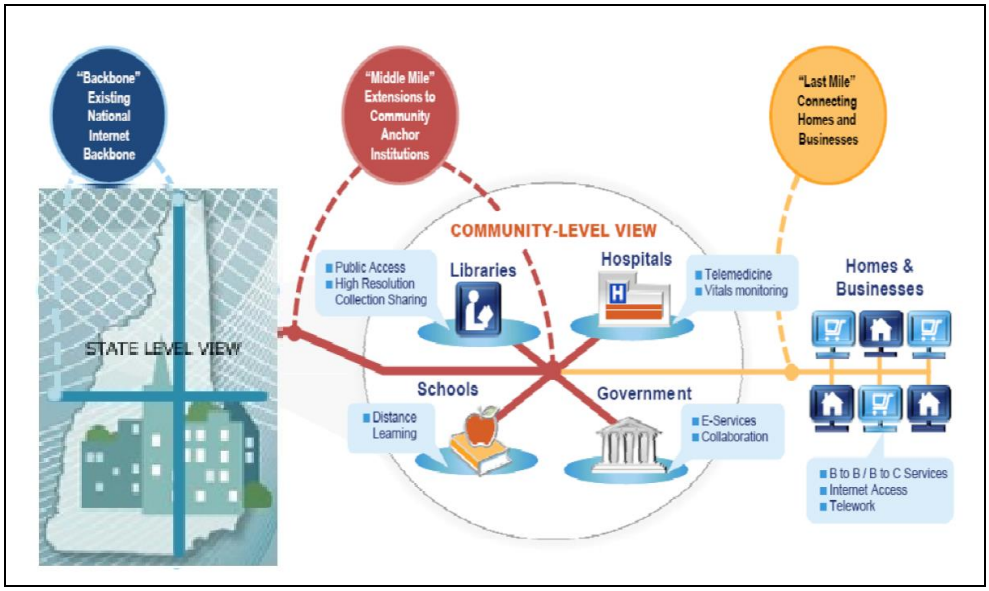
Tiers of Service	Download Speed	Upload Speed	Typical Functions / Use *(functions additive to level above)*
un-served	< 768 Kbps	< 200 Kbps	• Email (client/served-based)
underserved	768 Kbps to < 1.5 Mbps	200 Kbps to < 768 Kbps	• Web-based email • Limited web browsing • Send/receive small documents not concerned with speed of download/upload • Single user Internet device
	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
	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
	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
	25+ Mbps	10+ Mbps	• Send/Receive medium to large databases • Real-time HD medical imaging and consultation, remote patient monitoring

Source: New Hampshire Broadband Mapping and Planning Program http://www.iwantbroadbandnh.org

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.[3]



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).[4] 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

[3] State of New Hampshire, Department of Resources and Economic Development and The Telecommunications Advisory Board, State of New Hampshire Broadband Action Plan: Appendix A, 2008, http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf . (accessed July 17, 2013).

[4] "Wireless Internet 101," *Institute for Local Self-Reliance*, http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed June 2013).

service is often unavailable in rural areas.[5] 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.

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.[6] 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.[7] 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

[5] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).

[6] "*Broadband 101," Institute for Self-Reliance,* http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed on July 17, 2013).

[7] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).

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.[8] 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.[9]

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.[10]

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.

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.[11] In 2010, it was estimated that there were almost 200 million Americans with access to broadband at home, up from 8 million in 2000.[12] 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.

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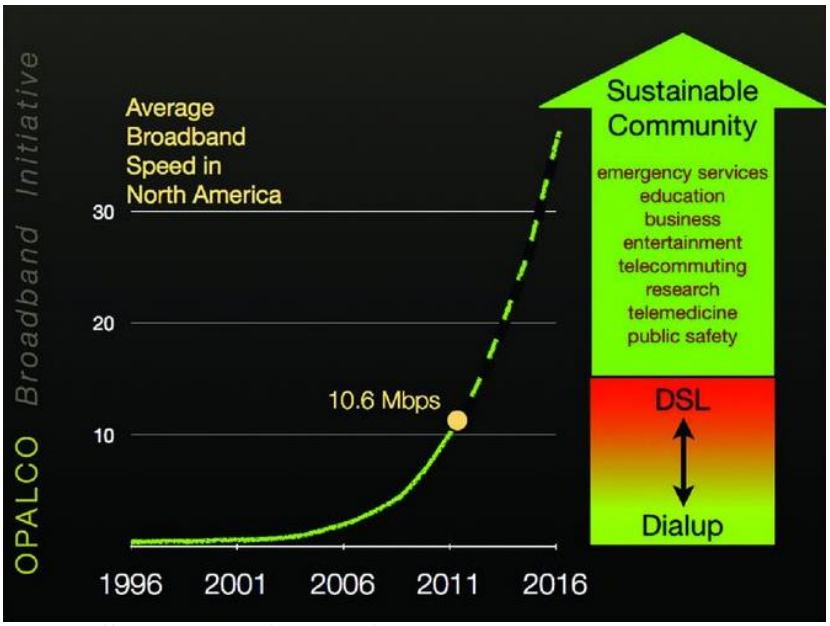
[8] Shuffstall, Bill, Monica Babine, and Andy Lewis, "Connecting Communities," *The National e-Commerce Extension Initiative*, http://www.connectingcommunities.info/. (accessed July 2013).

[9] "Wireless Internet 101," *Institute for Local Self-Reliance*, http://www.ilsr.org/content-types/fact-sheets-resource-archive/?contenttype=fact-sheets-resource-archive&initiative=broadband. (accessed June 2013).

[10] "Building Community Capacity through Broadband (BCCB) Initiative," *University of Wisconsin Extension*, November 2010, http://www.uwex.edu/broadband/documents/BCCBUWEXFAQ_rev_11_18_10withmap.pdf. (accessed June 2013).

[11] David Salway, "Why is Increasing Broadband Adoption so Important to Society?," *About.com Guide*, http://broadband.about.com/od/barrierstoadoption/a/Why-Is-Increasing-Broadband-Adoption-So-Important-To-Society.htm. (accessed July 2013).

[12] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).



Source: http://www.opalco.com/broadband/do-we-really-need-faster-internet-service-2013-05-01/

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. [13] 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

[13] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013); United National Educational, Scientific, and Cultural Organization, Technology, *Broadband and Education: Advancing the education for all agenda*, Jan. 2013, http://unesdoc.unesco.org/images/0021/002196/219687e.pdf. (accessed July 17, 2013).

per second by 2017.[14] 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.[15] 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.[16] 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.[17] 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.[18] 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.[19] New Hampshire, with rural geography, scarcity of local specialty medical services, and high percentage of

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[14] C. Fox, J. Walters, G. Fletcher and D. Levin, "The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs," *State Education Directors Technology Association*, 2012, http://www.setda.org/web/guest/broadbandimperative. (accessed July 17, 2013).

[15] C. Fox, J. Walters, G. Fletcher and D. Levin, "The Broadband Imperative: Recommendations to Address K-12 Education Infrastructure Needs," *State Education Directors Technology Association*, 2012, http://www.setda.org/web/guest/broadbandimperative. (accessed July 17, 2013).

[16] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

[17] Charles M. Davidson and Michael J. Santorelli, *The Impact of Broadband on Education*, A Report to the U.S. Chamber of Commerce, Dec. 2010, http://www.uschamber.com/sites/default/files/about/US_Chamber_Paper_on_Broadband_and_Education.pdf. (accessed July 2013).

[18] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

[19] Louis Kazal Jr. and Anne Conner, "Planning and Implementing a Statewide Telehealth Program in New Hampshire", 2005, http://www.endowmentforhealth.org/uploads/documents/resource-center/Planning%20and%20Implementing%20a%20Statewide%20Telehealth%20Program%20in%20NH.pdf

elderly residents, can benefit from telehealth systems.[20] 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.[21] 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.

[20] Louis Kazal Jr. and Anne Conner, "Planning and Implementing a Statewide Telehealth Program in New Hampshire", 2005, http://www.endowmentforhealth.org/uploads/documents/resource-center/Planning%20and%20Implementing%20a%20Statewide%20Telehealth%20Program%20in%20NH.pdf

[21] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

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.[22] 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.[23] 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.[24] Investment in broadband is showing benefits for small businesses and local economies, as well. A Connect Iowa study of the

[22] R. Crandall and H. Singer. "The Economic Impact of Broadband Investment." *National Cable and Telecommunications Association*, 2010.

[23] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

[24] The Pew Internet and American Life Project , Sept. 2012, available at http://www.pewinternet.org/ .

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.[25]

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.[26] 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.

[25] Anna Read and Damon Poter, "Building High-Speed Communities," *APA Planning Magazine*, March 2013.

[26] Federal Communications Commission, *Connecting America: The National Broadband Plan*, 2010, http://www.broadband.gov/plan/11-education/#_edn16. (accessed July 17, 2013).

APPENDIX C: BROADBAND TRAINING MODULE

INTRODUCTION - PLANNING - REGULATING - EXPANDING - OPTIONS

What is Broadband?

Broadband (as defined by the New Hampshire Broadband Mapping and Planning Program)

What are the Acronyms and Terminology?

(source: State of New Hampshire Broadband Action Plan, June 30, 2008, Appendix A - Glossary of Terms http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf)

Backbone or Transport Layer

A backbone network or network backbone is a part of computer network infrastructure that interconnects various pieces of network, providing a path for the exchange of information between different LANs or subnetworks. A backbone can tie together diverse networks in the same building, in different buildings in a campus environment, or over wide areas. Normally, the backbone's capacity is greater than the networks connected to it.

A large corporation that has many locations may have a backbone network that ties all of the locations together, for example, if a server cluster needs to be accessed by different departments of a company that are located at different geographical locations. The pieces of the network connections (for example: ethernet, wireless) that bring these departments together is often mentioned as network backbone. Network congestion is often taken into consideration while designing backbones.

Backbone networks should not be confused with the Internet backbone. (source: http://en.wikipedia.org/wiki/Backbone_network)

The Internet backbone refers to the principal data routes between large, strategically interconnected networks and core routers in the Internet. These data routes are hosted by commercial, government, academic and other high-capacity network centers, the Internet exchange points and network access points that interchange Internet traffic between the countries, continents and across the oceans of the world. Internet service providers (often Tier 1 networks) participate in Internet backbone exchange traffic by privately negotiated interconnection agreements, primarily governed by the principle of settlement-free peering. (source: http://en.wikipedia.org/wiki/Internet_backbone)

Bandwidth

The transmission capacity of an electronic pathway such as a communications line, computer bus or computer channel. In a digital line, it is measured in bits per second or bytes per second (see Mb/sec). In an analog channel or in a digital channel that is wrapped in a carrier frequency, bandwidth is the difference between the highest and lowest frequencies and is measured in Hertz (kHz, MHz, GHz).

Broadband

(1) High-speed transmission. The term commonly refers to Internet access via cable and DSL, which is as much as 400 times faster than analog dial-up. The term has always referred to a higher-speed connection, but the speed threshold varies with the times. Widely employed in companies, the 1.5 Mbps T1 line was often considered the starting point for broadband speeds, while the FCC defines broadband as a minimum upload speed of 200 Kbps.

The T1 line is no longer the coveted connection for Web surfing. Home users with cable modems experience download speeds up to four times that of T1 and more (see cable modem). For example, in 2007, Comcast offered home users a premium service of 1 Mbps upload and 16 Mbps download. Fiber-based offerings from telephone companies are even greater.

After the turn of the century, South Korea leapfrogged the U.S. in Internet access, offering DSL up to 50 Mbps and calling their 1.5 Mbps service "light." See broadband router, wireless broadband, T1, cable modem and DSL.

(2) Transmitting data by modulating a carrier wave in order to differentiate it from other signals in the air or in a single line. For example, frequency division multiplexing (FDM) is used to carry hundreds of channels of analog and digital TV in a single coaxial cable. In this context, broadband is used in contrast with "baseband," which is data that has not been modulated or multiplexed (see baseband and TDM). In most cases, the term "broadband" is used for high-speed transmission as in definition #1 above.

Cable modem

A modem used to connect a computer to a cable TV service that provides Internet access. Cable modems can dramatically increase the bandwidth between the user's computer and the Internet service provider. Download speeds have reached 6 Mbps and beyond, but the connection is asynchronous. In order to prevent users with lower-cost cable access from hosting high-traffic Web servers, the upload speed is considerably slower, from 10 to 20 times slower. Cable operators also routinely change IP addresses assigned to users to prevent Web hosting (see DDNS).

DSL
(Digital Subscriber Line) A technology that dramatically increases the digital capacity of ordinary telephone lines (the local loops) into the home or office. DSL speeds are based on the distance between the customer and Telco central office. There are two main categories. Asymmetric DSL (ADSL) is for Internet access, where fast downstream is required, but slow upstream is acceptable. Symmetric DSL (SDSL, HDSL, etc.) is designed for connections that require high speed in both directions.

Fiber-optic
Refers to systems that use optical fibers. Fiber- optic communications networks have transformed the world. Barely starting in the late 1960s but gaining serious momentum in the 1980s, the phone companies began to replace their copper long distance trunks with fiber cable. Eventually, all transmission systems and networks are expected to become fiber based, even to the home. In time, the electronic circuits in computers may be partially or fully replaced with circuits of light, in which case fiber pathways would be used throughout the system.

Fixed Wireless
Refers to point-to-point transmission through the air between stationary devices. Fixed wireless is typically used for "last mile" connectivity to buildings.

Kbps
One thousand bits per second. Kbps is used as a rating of relatively slow transmission speed compared to the common Mbps or Gbps ratings.

Last Mile
The connection between the customer and the telephone company, cable company or ISP. The last mile has traditionally used copper-based telephone wire or coaxial cable, but wireless technologies offer alternative options in some locations. Also called "first mile."

Mbps
Mbps means megabits per second and is used for transmission speeds in a network or in internal circuits.

Middle Mile (source: http://en.wikipedia.org/wiki/Middle_mile)
In the broadband Internet industry, the "middle mile" is the segment of a telecommunications network linking a network operator's core network to the local network plant, typically situated in the incumbent telco's central office, (British English: telephone exchange) that provides access to the local loop, or in the case of cable television operators, the local cable modem termination system. This includes both the backhaul network to the nearest aggregation point, and any other parts of the network needed to connect the aggregation point to the nearest point of presence on the operator's core network.

Middle-mile provision is a major issue in reducing the price of broadband Internet provision by non-incumbent operators. Internet bandwidth is relatively inexpensive to purchase in bulk at the major Internet peering points, and access to end-customer ports in the incumbent operator's local

distribution plant (typically where local loop unbundling is mandated by a telecom regulator are also relatively inexpensive relative to typical broadband subscription costs.

However, middle-mile access, where bought from the incumbent operator, is often much more expensive than either, and typically forms the major expensive of non-incumbent broadband ISPs. The alternative, building out their own fibre networks, is capital-intensive, and thus unavailable to most new operators. For this reason, many proposals for government broadband stimulus initiatives are directed at building out the middle mile. Two examples are the Network New Hampshire Now and Maine Fiber Company in the Northeast US, both funded largely by the National Broadband Plan (United States) to connect all community anchor institutions.

Open access initiatives such as duct sharing, utility pole sharing, and fiber unbundling are also being tried by regulators as mechanisms to ease the middle mile problem by reducing costs to non-incumbents. This sometimes leads to controversies, such as the NRECA opposition to pole attachment tariff changes [1] motivated by the US plan.

Mobile Wireless
Refers to transmission through the air from a base station to a moving device such as a cell phone.

Cellular vs. Wi-Fi
Cellular carriers offer optional, digital data services for Web browsing, e-mail and other text and data applications. The data service is separate from the carrier's voice plans, often costing considerably more than a basic voice subscription. The cell phones must support the data service, which is also available for laptops and other portable devices with the installation of the appropriate modem.

Wi-Fi networks are available to the public in many cities and municipal areas. Individual venues such as airports and coffee shops also provide service (see hotspot). Typically fee based by the hour or day, some municipalities provide free service (see Muni Wi-Fi).

Location is the key issue in real estate and also the primary concern with wireless systems. For travelers who need ubiquitous connectivity, there are many gaps (white spaces) in Wi-Fi coverage. Although cellular data rates (EDGE, EV-DO, HSPA, etc.) are typically slower than Wi-Fi, cellular carriers offer the most inclusive coverage when traveling, very often equivalent to using a cell phone for voice.

Satellite Broadband (source: http://www.fcc.gov/guides/getting-broadband)
Just as satellites orbiting the earth provide necessary links for telephone and television service, they can also provide links for broadband services. Satellite broadband is another form of wireless broadband and is particularly useful for serving remote or sparsely populated areas.

Downstream and upstream speeds for satellite broadband depend on several factors, including the provider and service package purchased, the consumer's line of sight to the orbiting satellite, and the weather. Satellite service can be disrupted in extreme weather conditions. Typically a consumer can expect to receive (download) at a speed of about 1 Mbps and send (upload) at a speed of about 200 kbps. These speeds may be slower than DSL and cable modem, but the download speed is still much faster than the download speed with dial-up Internet access. New facilities, scheduled for

eployment in 2012, are expected to support consumer broadband services for several million customers at speeds up to 12 Mbps for downloads and 3 Mbps for uploads.

Obtaining satellite broadband can be more costly or more involved than obtaining DSL or cable modem. A user must have:

- a two or three foot dish or base station - the most costly item;
- a satellite Internet modem; and
- a clear line of sight to the provider's satellite.

To find out if satellite broadband is available to your home, contact broadband satellite companies or your state's public service commission.

Exceeds Expectations

To some fanfare at the Consumer Electronics Show in January 2012, ViaSat, which bought satellite broadband provider WildBlue in 2009, unveiled its new service, Exede. With $400 million in a new satellite, plus ground stations and terrestrial fiber networks, the company wants to change the image, and the expectations associated with, satellite broadband. Not to be outdone, HughesNet Gen4 has also upped its increased speeds to 15 Mbps. While it remains to be seen whether rural America will adopt, the new satellite services provide new options for areas without access to fiber, cable or wireless broadband services. [source: http://broadbandbreakfast.com/2012/12/the-year-in-broadband-2012-the-top-10-events/]

"Let's take a step back and look at the basic contours of the landline U.S. telecom and cable market. In general, there are three types of wired networks that serve America's phone, cable, and Internet consumers. Copper wire (traditional phone lines, DSL, slow speeds); cable (faster speeds, mostly for downloading); and fiber (potentially unlimited speeds, data is transmitted through pulses of light). In over 75% of the country, the only broadband choice for Americans will soon be cable, according to Crawford. Consumers are fleeing their relatively slow DSL service so rapidly that 94% of new broadband subscriptions in the third-quarter of 2012 went to faster cable service." [source: http://business.time.com/2013/01/09/is-broadband-internet-access-a-public-utility/]

DOCSIS 3.0

Early in the year, cable giant Comcast announced that it had completed its DOCSIS 3.0 expansion for its entire footprint in the United States. DOCSIS 3.0 is the name for the next version of cable modem technology. The move brings the possibility of promised speeds of 100 megabits per second to all of Comcast's 52 million household subscribers, although consumers need to subscribe to them. Additionally, consumers need DOCSIS 3.0 hardware in order to take the service, and somewhere between 43 percent and 77 percent of the nation's cable subscribers had that upgrade. The cable industry's push for DOCSIS 3.0 stands in contrast with Verizon's decision to stop the expansion of its Fiber Optic Service and AT&T's November 7, 2012, announcement that it will begin to favor investments in wireless technology over uVerse investments. Traditional telephone

giants may be leaving the wireline field to their former cable competitors. [source: http://broadbandbreakfast.com/2012/12/the-year-in-broadband-2012-the-top-10-events/]
(For an alternative to the descriptions from Connecting Communities below, see Getting Broadband on the FCC web site)

How is Broadband Delivered?
There are many different types of broadband delivery technologies. Each of them delivers similar services to consumers and businesses. The broadband technologies can be separated into two categories.

- Wired broadband is delivered through some type of wire to the home or office; and
- Wireless broadband uses radio waves to deliver the service

WIRED

- **Digital Subscriber Lines (DSL)**
  Major providers include Verizon, SBC, Bellsouth, Qwest.
  - Uses plain old phone lines (POTS)
  - Voice and data over the same line
  - Speed 1.5-8 Mbps (mega bits per second) and provides adequate speeds for residents and most small businesses
  - Requires location near central phone office or switch (18,000 feet) - service is often unavailable in rural areas
  - Phone lines are everywhere but not all of them are able to support DSL
  - Direct one-on-one connection; bandwidth is not shared with neighbors
  - The process of installing DSL takes longer and is potentially rockier than the process of installing cable modem access
  - DSL offers options and features that are useful for businesses
- **Cable Modem**
  Major providers include AT&T, Comcast, Cox, Time Warner. ISP's that use the pipes of the major cable companies also offer services - e.g. AOL, MSN.
  - Faster than DSL
  - Uses the same cable television lines that deliver pictures and sound to your TV set
  - Shared connection - speeds can slow down when many people in the same neighborhood are online
  - Easy to install - Since it's a relatively mature technology, installing the service doesn't typically require a long wait and the installation process is smooth and simple
  - It's easy to determine whether the service is available in your area
  - Coverage areas are mostly residential, so businesses often can't get the service
- **Leased Lines (T1)**
  A 1.544 Mbps point-to-point dedicated, digital circuit provided by the telephone companies. The monthly cost is typically based on distance. T1 lines are widely used for private networks as well as interconnections between an organization's PBX or LAN and the Telco. The first T1 line was tariffed by AT&T in January 1983. However, starting in the early 1960s, T1 was deployed in intercity trunks by AT&T to improve signal quality

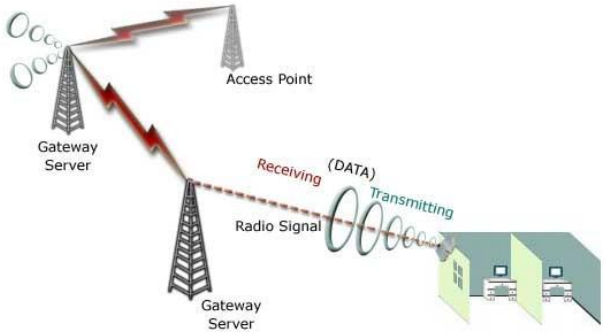
and make more efficient use of the network. (source: State of New Hampshire Broadband Action Plan, June 30, 2008, Appendix A - Glossary of Terms http://www.nheconomy.com/uploads/Broadband-Action-Plan-Appendices.pdf)

- **Fiber Optic Cable**
  Fiber cable can deliver extremely high bandwidths. Several phone companies are building fiber to the home networks in densely populated communities where they can justify the high cost of building out the network. Some rural communities including Saint Peter, MN and Columbus, KS are served by fiber to the home. Rural Pickens County, GA worked with a local cable company to build a fiber ring to serve the schools and industrial parks in the county.
    - Delivered over fiber optic cables
    - Very high bandwidth
    - High cost to build fiber network
    - Low maintenance
- **Broadband Over Powerline (BPL)**
  BPL delivers broadband over the power lines. It is being piloted in several communities. Financial analysis of these pilots indicate each transformer needs to serve 4-6 homes to deliver the service at prices comparable to DSL or Cable. Manassas Virginia is the first City in the nation to offer broadband internet service through the power lines (BPL). Users will be able to access the internet by plugging a modem into any electrical outlet in the City, whether it is from room to room or in an office across town. Business owners will enjoy the ease, flexibility, and portability that internet delivery through the power lines offers. It costs approximately $29 per month for residential use. The provider (COMTek) expects to announce that it has reached the 1000th customer milestone in Manassas during the summer of 2006.
    - Delivered through power lines
    - Almost all homes and businesses are connected to the power grid
    - Still in early stages of development
    - Potential interference with radio signals
    - Speeds similar to DSL and cable

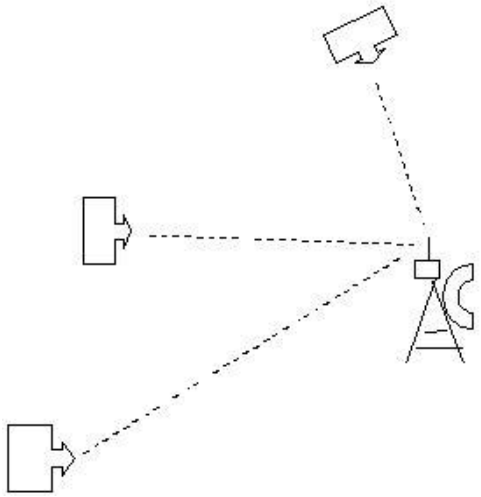
WIRELESS

- **Satellite**
    - Available most places, including hard-to-reach rural areas
    - Satellite service is available everywhere in the U.S. It's especially popular with people who want high-speed service but can't get DSL or cable modem access in their areas
    - Slower than cable or DSL. WildBlue download speeds up to 1.5 Mbps and upload speeds up to 256 Kbps.
    - Trees and heavy rain affects signal
    - Need unobstructed view of southern sky
    - Professional installation is required by the FCC
    - Though it's still considered high-speed service, satellite speeds are slower than cable or DSL, and users sometimes experience downtime

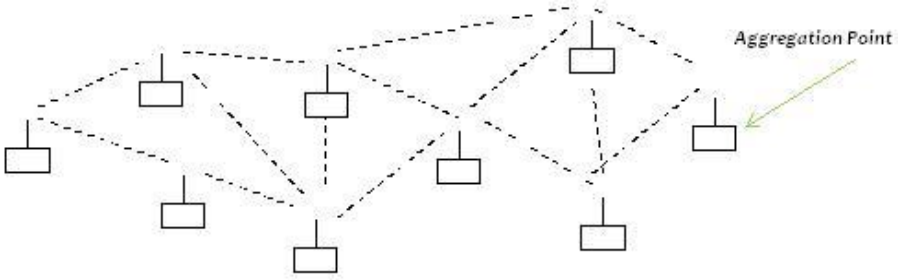
- **Fixed Wireless Networks**
  Fixed wireless networks serve many rural communities where phone or cable companies aren't delivering broadband. Wireless networks can be installed quickly and are relatively inexpensive to deploy. Some local governments are installing wireless, but more commonly a private WISP (Wireless Internet Service Provider) delivers the service. Wireless broadband delivered to a home or business location is called fixed wireless. Mobile wireless service is becoming common. Wireless can deliver broadband at speeds equivalent to DSL and cable at comparable or a little higher cost. It can also be configured to deliver higher speeds required by some businesses. There are many different types of wireless networks.
  - **Point-to-Point Fixed Wireless**
    Uses part of the radio spectrum to send and receive signals. Typically made up of on-the-ground antenna-to-antenna systems.
    - Requires indoor or outdoor antenna on the home
    - Coverage is about 5 miles from the transmitter or access point
    - High bandwidth
    - Usually licensed
    - Backbone or transport layer
    - Line of site



  - **Point-to-Multipoint Fixed Wireless**
    Point to multi-point refers to the portion of a wireless network that delivers the service to a user. A radio in the network transmits and receives signals from an antenna (CPU - Customer Premise Unit) at the home or business. Although the signal can be delivered over long distances from the tower, the CPU needs to have a clear line of sight to the tower. The line of sight requirements causes problems in hilly terrain and tree leaves interfere with the signal.
    - Broadband delivery to premise
    - Consumer or business grade
    - One antenna to many sites
    - Line-of-sight
    - Large coverage area
    - Licensed or unlicensed



- **Mesh Fixed Wireless**
  Mesh networks are another type of broadband network that work well in downtowns. The nodes provide service over a 200-300 foot radius. Each node transmits to other nodes in the network moving the data to and from the end user.
    - Nodes (radios)
        - Connect to user
        - Transmit to aggregation point
    - Typically unlicensed
    - Favor urban areas or hot zones



- **Wi-Fi** (Wireless Fidelity) ("Hot Zones", "Hot Spots")
  Example: Antenna on a grain elevator sends a signal to local café (access point). Users within 300 feet of the café can pick up the signal. What do you need to connect to a public WiFi hot spot? A laptop and a WiFi card (PCMCIA Wireless Network Card). A WiFi card costs about $50.
    - Wi-Fi access points found at cafés, homes, campuses, businesses
    - Access is limited to 50-300 feet
    - Coverage limited by location and number of transmitters
    - Relatively cheap for providers to set-up
    - End-user equipment cheap and easy to install
- **WiMAX**
    - Wi-Fi on steroids
    - Can cover a large area 30 miles

    - Still in early stages of development
    - Can support ultra-broadband, a large pipe with lots of bandwidth and speed - just what you would need to run your own real-time online video channel.
- **Mobile Wireless Service (Cell, G3,G4)**
  Third generation (3G) and fourth generation (4G) mobile wireless technologies allow consumers to access a variety of different mobile services and functionalities, such as web browsing, e-mail, access to application ("app") stores, video conference or chat, mapping and navigation systems, mobile commerce, and the downloading of content. A range of different mobile devices include built-in 3G or 4G wireless connectivity, including smartphones, tablets, e-readers, and netbook and laptop computers. Several mobile network technologies are generally considered to be 3G or 4G, including EV-DO, WCDMA, HSPA, HSPA+, LTE, and mobile WiMAX. (source: http://www.fcc.gov/topic/3g-4g-wireless)
- **WISP**
  A wireless Internet service provider (WISP) is an Internet service provider with a network based on wireless networking. Technology may include commonplace Wi-Fi wireless mesh networking, or proprietary equipment designed to operate over open 900 MHz, 2.4 GHz, 4.9, 5.2, 5.4, 5.7, and 5.8 GHz bands or licensed frequencies in the UHF band (including the MMDS frequency band). (source: http://en.wikipedia.org/wiki/Wireless_Internet_Service_Provider)

How Much Does Broadband Cost?

It depends on . . .

- How fast you want to go
- Residential or business use
- Pricing of the provider

DSL and high-speed wireless business rates can range from $30 to $100 per month at speeds from 128 kbps to 3 Mbps upstream and 3-6 Mbps downstream. 2-way satellite ranges from $70-80 per month. Cable broadband is normally "bundled" with voice and video services at prices comparable to DSL. Many customers initially subscribe at a lower speed and move upward as their need for speed increases. Businesses may pay more for their connections due to guaranteed quality of service agreements.

The good news about the cost of broadband:

- A broadband connection does not require a second phone line (which you will have to pay for in addition to your dial-up service).
- A broadband connection almost always includes a wide range of ISP services (e.g., content, multiple e-mail addresses, hosting, storage, etc.), whereas with dial-up, these often cost extra.
- A broadband connection is "all you can eat"; whereas some dial up connections still restrict usage to a monthly allotment of minutes.

(Source: http://srdc.msstate.edu/ecommerce/curricula/connectingcommunities/files/3_1typesofbroadband.ppt)

APPENDIX D: NEW HAMPSHIRE BROADBAND MAPPING PROTOCOL

Prepared By: NHBMPP, September 2013

INTRODUCTION

The New Hampshire Broadband Mapping & Planning Program (NHBMPP) is funded through the Department of Commerce's National Telecommunications and Information Administration (NTIA) State Broadband Initiative (SBI), formerly known as the State Broadband Data Development (SBDD) program. In 2010, grants were issued to each of the 50 states, 5 territories and the District of Columbia to compile and maintain a mapped inventory of broadband availability at the state level. The state data sets are regularly submitted to the NTIA for incorporation in the national broadband map, thereby contributing to national, regional, and state efforts to understand the current broadband landscape and to plan for future broadband expansion, access, and adoption.

BROADBAND AVAILABILITY

The NHBMPP began mapping statewide broadband availability in January of 2010, with data collection and processing scheduled at 6-month intervals throughout the project end date of December 2014. All map data development is governed by NTIA guidelines and standards, which are enforced to accommodate the merging and analysis of data from NH with comparable data sets from the other 55 grantees.

The first NHBMPP mapping task was to generate a listing of the active internet service providers (ISPs) in the state. An initial list of approximately 70 ISPs was compiled from existing plans and documents as well as local knowledge. The list is continually reviewed and updated as required, and currently includes over 60 known active providers.

At the start of each biannual map update, NHBMPP staff contacts each active ISP and requests broadband service coverage information. The data requested by the NHBMPP comprises the footprint of the provider coverage area(s), the technology delivering service to that footprint, and the advertised download and upload data transmission speeds for the footprint. Per NTIA guidelines, the footprint represents both areas that are currently served and areas that could be served within 10 business days.

NHBMPP focuses on building strong relationships with providers, and actively encourages the provision of data by accommodating data submissions in a variety of forms, and by providing technical support to facilitate submission when requested. The coverage data received by the NHBMPP arrives in formats ranging from detailed maps with speed information to customer addresses to highlighted paper maps to full digital databases that align with the national broadband map format.

The ISP data submissions are processed by the NHBMPP, standardized to conform to NTIA programmatic requirements, verified with the providers, and submitted to NTIA during the spring and fall of each year. Key details of the data processing and standardization include:

- Wireline broadband technology (cable, DSL, T-1, fiber) data are processed into the NTIA standardized format of US Census blocks for areas where the blocks are less than two square miles, and US Census road centerlines for rural areas where the census blocks are greater than two square miles. (The US Census data are derived from the 2010 TIGER files.) If a provider indicates than an address within a Census block or along a road segment is served, the entire block or road is considered served. This may result in an overstatement of coverage footprints in some areas of the state.
- Coverage footprints may also appear to be overstated due to the fact that some providers are submitting data on residential and business class services combined, without differentiating between the two classes. This means that the speed associated with a given census block may reflect the high-speed services delivered to businesses within that block rather than typical speeds available to residential customers. This is more likely to result in an overstatement of speed tiers achievable than it is an overstatement of the coverage footprint itself.
- Wireless broadband technology (cellular, fixed-wireless, satellite) data are processed to represent the actual region that the signal covers. For cellular and satellite providers, the provider submission to NHBMPP is typically the coverage footprint. For fixed wireless, the submission typically comprises the tower location and height, and associated antenna details (make, model, power, signal direction, and span). The NHBMPP then utilizes specialized software (Cellular Expert) to process these inputs and to generate a signal propagation model describing the coverage area.
- Providers are submitting maximum advertised download and upload streams to the NHBMPP, as per NTIA guidance. The NHBMPP recognizes that these may be higher than actual speeds experienced by consumers. However, the NHBMPP verification efforts detailed below, and specifically the collection of speed test records, helps to mitigate this issue.
- The NHBMPP invites participation from all providers. However, not all ISPs have opted to submit data in each data collection cycle. This may result in an understatement of coverage footprints for some areas and some technologies.

While the NHBMPP is required to process the coverage information in the aggregated format, each state does have the opportunity to advance and enhance the level of mapping locally. The NHBMPP collects a suite of complementary data in order to verify the service information supplied by the ISPs. These include user speed tests submitted to the project website (iwantbroadbandnh.org), broadband use and availability surveys also submitted to the project web

site and/or collected at project meetings, and direct email feedback. The program has also conducted a number of technology-focused verification inventories, including the following:

- Statewide drive test to collect cellular service data. In the summer of 2012, every US interstate and state route in New Hampshire was driven and each of the 5 cellular provider networks was tested for a data signal using signal propagation software on a provider cell phone.
- Town verification maps to provide feedback on the wireline technologies service areas (DSL and cable). In the summer/fall of 2013, paper maps were provided to each of the 234 cities/towns in the state, requesting that community members with knowledge of the broadband landscape review and submit corrections to the NHBMPP, as appropriate.

Where any of these verification methods indicates that service may not be available in an area reported as served, that area is marked for additional inquiry. Direct contact with the appropriate provider is made to confirm that the mapped data are correct based on project standards. If the finding is that the block is appropriately mapped but there are interior service gaps, the census block (or road segment) is flagged as being partially served. In some cases, broadband service to NH residents was offered or improved based on these reports and direct provider feedback.

COMMUNITY ANCHOR INSTITUTIONS

Broadband connectivity information for New Hampshire's 4,000+ Community Anchor Institutions (CAIs), including schools, libraries, municipalities, hospitals, and public safety entities, is collected on the same biannual schedule as the broadband coverage data. At the project outset, the nine regional planning commissions (RPCs) compiled listings of each CAI in their jurisdiction, mapped their location, and conducted phone and email surveys with each institution. Since that time, the broadband connectivity information collected has been updated and maintained every 6 months through utilization of a web based reporting tool, as well as direct contact by the RPCs to the CAIs. As recently reported by NTIA, these data have been used by policymakers, researchers and other stakeholders, as well as the Network NH Now broadband expansion project, in planning for broadband expansion in NH and nationally.

DATA MANAGEMENT

All of the data collected as part of the inventory and verification process are managed in a geographic information system (GIS), which allows for extensive data analysis and reporting. These data are analyzed in concert with other spatial data available in the GRANIT database in order to identify areas of the state that are served, unserved, and underserved. Due to the ever-changing

speed requirements of online applications, areas of New Hampshire that are designated as underserved are subject to ongoing review.

The data collected by the NHBMPP and its partners are available in multiple venues. Key data sets of broad interest may be downloaded through the GRANIT web site (www.granit.unh.edu). Other data may be requested directly from the NHBMPP (contact@iwantbroadbandnh.org). In addition, the basic broadband availability data and the CAI inventory are available for online viewing through an interactive map hosted on the NHBMPP website (www.iwantbroadbandnh.org).

Through direct provider contact as well as community engagement and feedback, the NHBMPP has been able to generate the most accurate and comprehensive broadband inventory available to date. Additionally, this engagement has increased the dialogue between stakeholders on resolving issues around broadband availability, accessibility and adoption.

However, the NHBMPP recognizes that in some cases, broadband access and adoption is more a matter of affordability than one of availability. While pricing information is not currently being inventoried, steps have been taken to collect these data and efforts will continue in the future.

In addition to the coverage data currently being collected, rural address points are also being inventoried across the state, and will be publically available to support more granular level mapping in the future. These data may be used to inventory specific addresses for their broadband availability in order to pinpoint those areas of the state with no service or when service is limited. Collecting the speed tests at the address level will yield a higher resolution of mapping in order to identify the gaps in service in the census block.

The NHBMPP has developed the matrix below to assist in understanding the diverse levels of broadband available in the state 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 ("served", "underserved", and "unserved") to describe access to broadband service. These categories are based solely on the maximum speeds available to the end-user or end-device. While some states are also considering the number of providers servicing a given area when determining access levels, e.g. a degree of competition, the NHBMPP has not chosen to incorporate those analyses in this availability category distinction.

When using the matrix to evaluate access, determine the category by assessing both the download and upload speeds. Most broadband technologies (cable, wireless, satellite, etc.) are not capable of sending and receiving data at the same speed, with upload speed typically being more limited.

As broadband functions, applications and technologies are continually changing, these analyses do not seek to supersede other national and/or state efforts to establish a standard definition for "broadband". Only 15 years ago, a 56 kbps connection was sufficient to conduct most business on

the internet. Today, in order to use many internet applications successfully, a minimum download speed of 3 mbps is required. This trend towards increasing requirements for bandwidth capacity will certainly continue into the future, and the matrix of uses presented herein will evolve as well.

THE FUTURE OF MAPPING BROADBAND IN NH

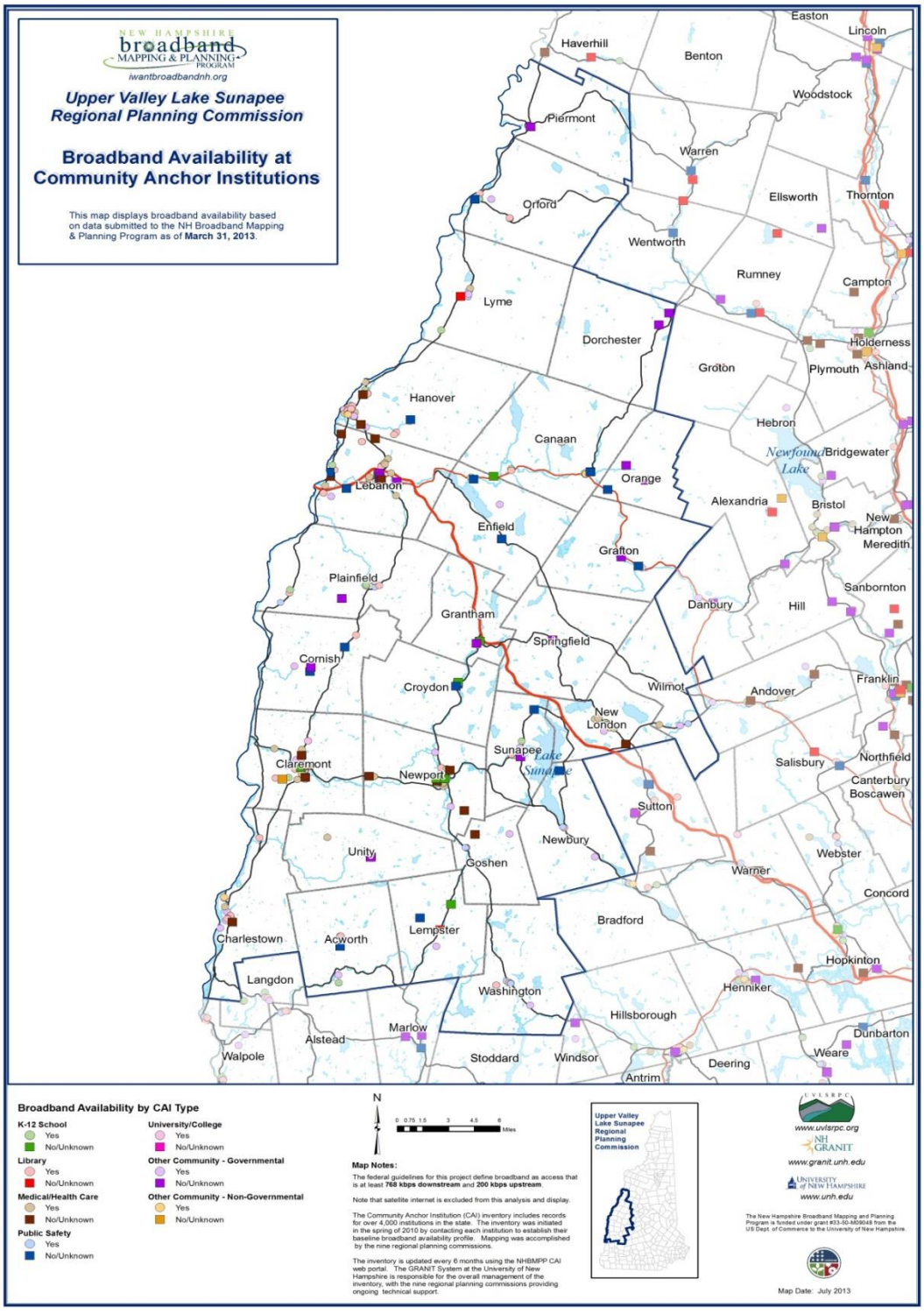
At the conclusion of the NTIA-funded program in 2014, responsibility for national broadband availability mapping will transfer to the Federal Communications Commission (FCC). Currently, there is a federal requirement for providers to submit to the FCC their service information at the US Census tract level. Starting in 2015, the FCC requirement will change to reflect the US Census block level geography that has been used by the NHBMPP and its counterparts around the country.

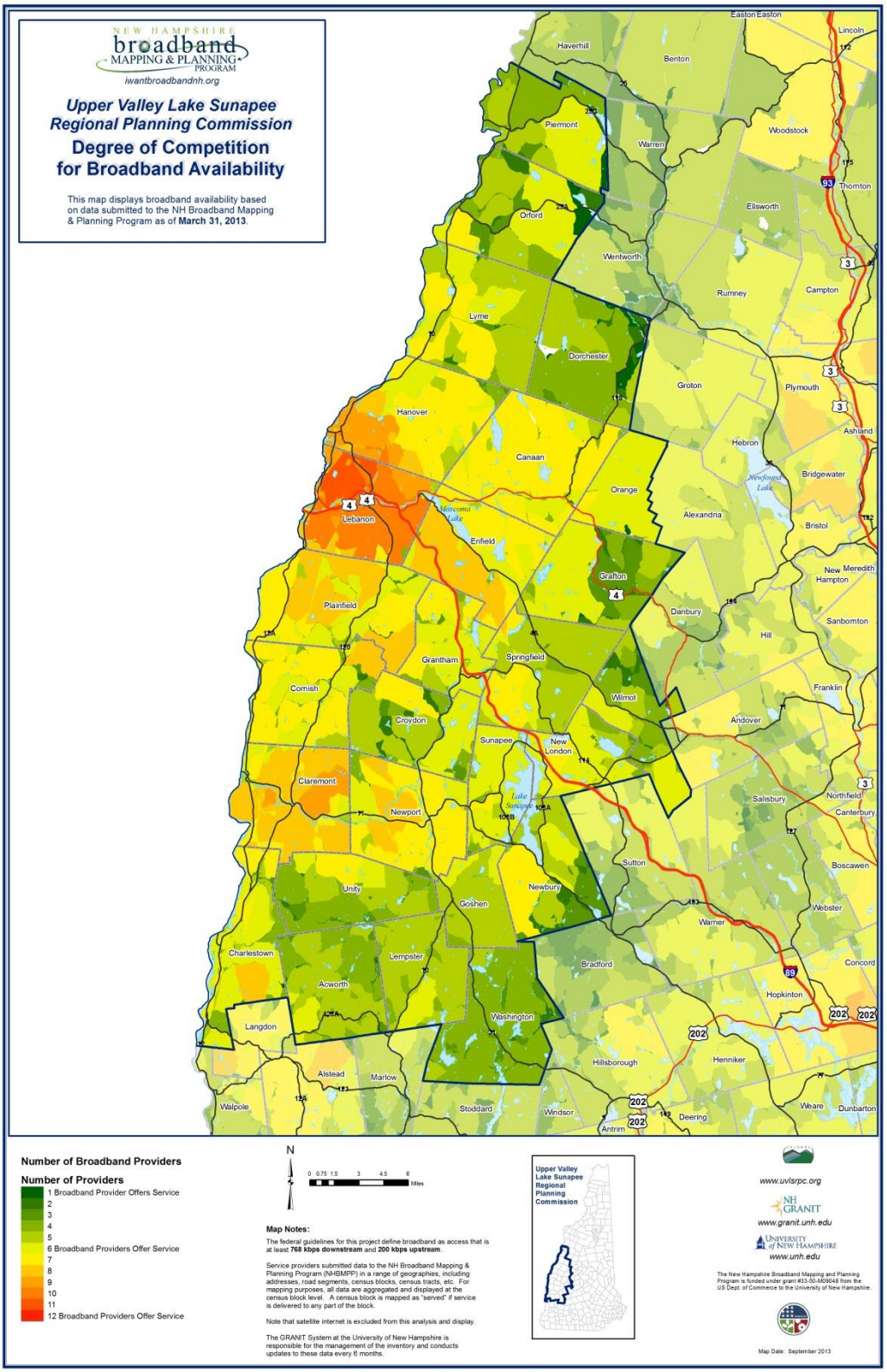
The NHBMPP hopes to secure funding and resources to continue this important broadband inventorying effort. One key data stream that we hope to continue is the collection of speed test data, as this represents actual speeds experienced by users around the state. These data may then be able to enhance the census block information collected by the FCC in order to indicate the areas in which actual transmission speeds experienced by users are lower than those reported by providers

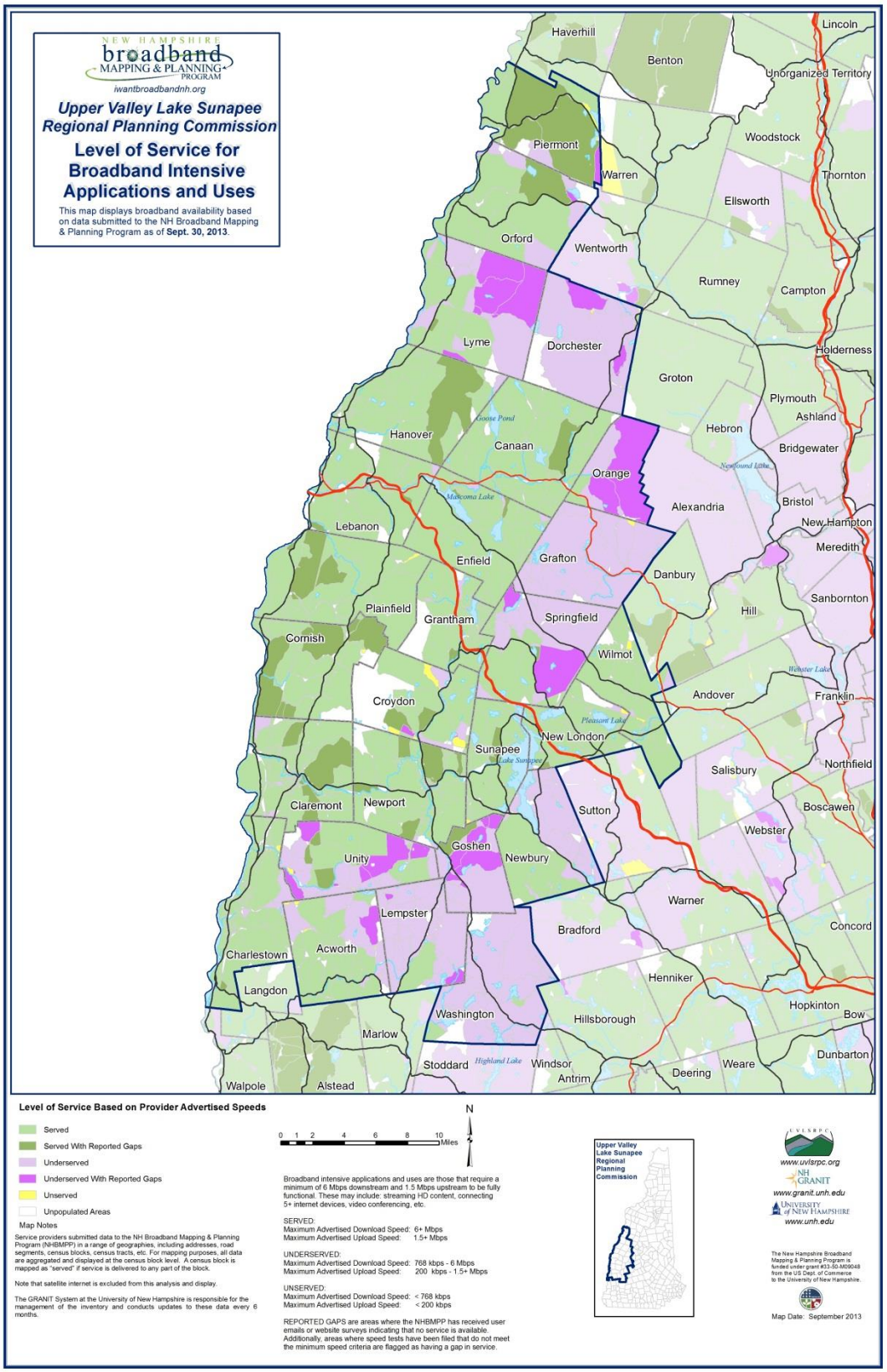
Category	*Download Speed*	*Upload Speed*	*Typical Functions/Use (functions additive to level above)*
Unserved	**< 768 Kbps**	**< 200 Kbps**	• Email (Client/Server-based; POP)
Underserved	**768 Kbps to < 1.5 Mbps**	**200 Kbps to < 768 Kbps**	• Web-based email • Limited web browsing and shopping • Minimal social media use • Sending/Receiving small documents/files (photos, word processing, invoices) but not concerned with speed of download/upload • Not interested in streaming content • No VPN needed for business applications • Use of internet not integrated in daily life function • Single user internet device • Don't require multiple functions to be running simultaneously (e.g. web browsing, streaming video/music, downloading content)
	1.5 Mbps to < 3 Mbps	**768 Kbps to <1.5 Mbps**	• Web browsing and shopping • Medium social media use • Sending/Receiving medium-sized documents/files (photos, word processing) • Limited streaming content; buffering a concern Standard Definition (SD) content • VPN access possible, but speed of operation not critical to job function • Internet integrated in daily life, and "always" connected • 1-3 simultaneous internet devices possible • Multiple functions working simultaneously possible (e.g. web browsing, streaming video/music, downloading content) but not concerned with potential slowness of downloads and uploads • VoIP (Voice over IP, i.e. telephone over the Internet)
Served	**3 Mbps to <6 Mbps**	**1.5 Mbps to <3 Mbps**	• Medium to high social media use • Sending/Receiving medium to large-sized documents or files (photos, word processing) • Streaming SD content; buffering not a concern; downloading High Definition (HD) content (movies, video) speed a concern • 3-5 internet devices possible • VPN access needed, speed of operation important but not critical to job

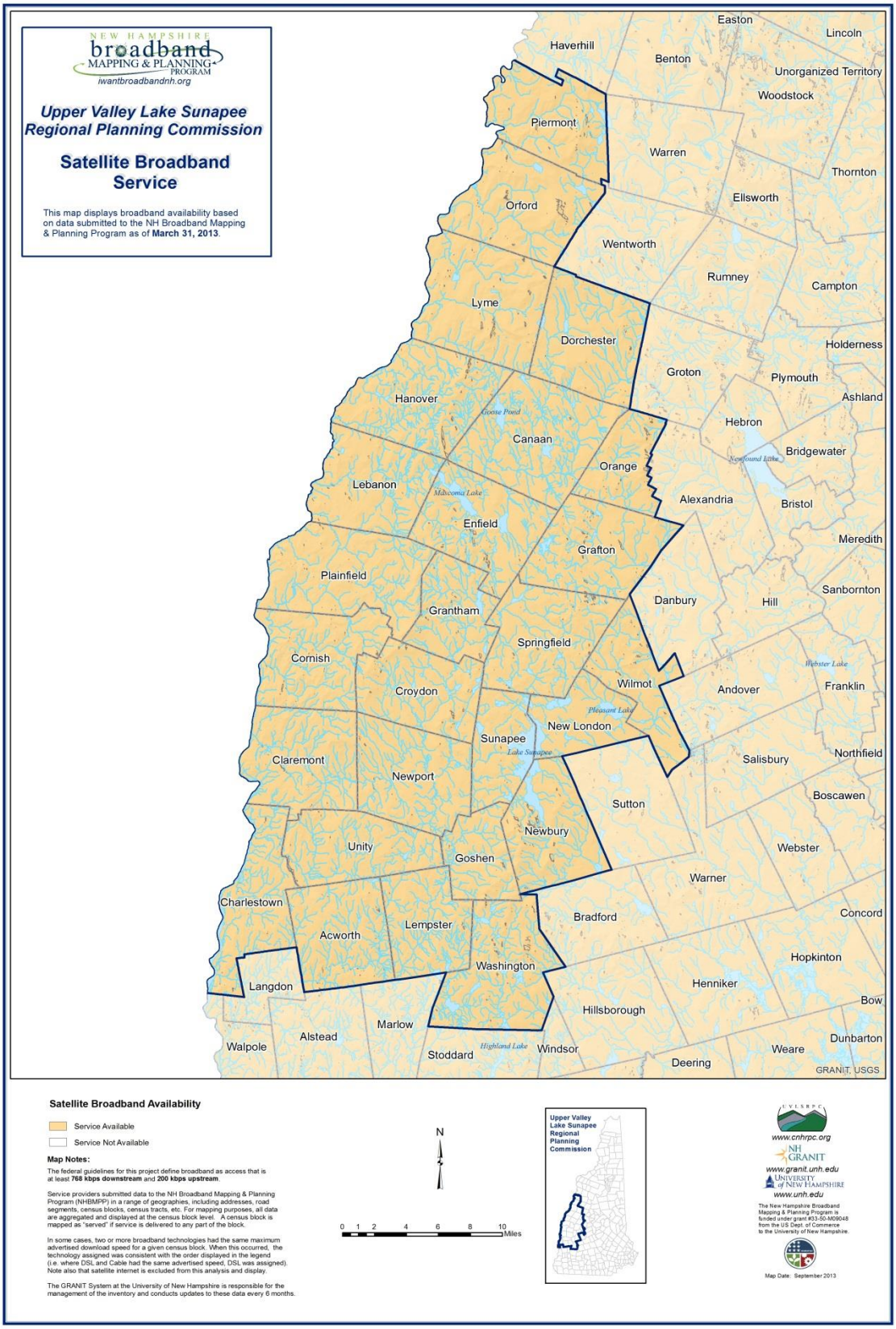
			function • Multiple functions performing simultaneously required (e.g. web browsing, streaming video/music, downloading content), but not concerned with potential slowness of downloads • Low quality, small window frame videoconferencing (Skype) • Cloud-based computing and data storage
	6 Mbps to <10 Mbps	**3 Mbps to 6 Mbps**	• Heavy social media use • Sending/Receiving large documents or files (photos, word processing, small videos) • Streaming HD content (movies, video); buffering not a concern • 5+ internet devices possible • VPN access needed, speed of operation critical to job junction • Higher quality, codec-based videoconferencing • Multi-player online gaming
	10 Mbps to <25 Mbps	**6 Mbps to <10 Mbps**	• Sending/Receiving large files and small to medium-sized databases • HD quality, codec-based, large frame videoconferencing; multiple (bridged) sites/users • Remote synchronous education, professional development, workshops, etc., facilitated simultaneously at multiple classrooms and/or other locations • Telehealth/telemedicine applications possible
	25+ Mbps	**10+ Mbps**	• Sending/Receiving medium to large-sized databases • HD quality, codec-based, large frame videoconferencing (Telepresence) connecting multiple (bridged) sites/users • High speed end to end network and business to business applications • Telemetry-based applications (rely critically on the ability of broadband to continuously monitor and multiplex data, i.e. remote patient monitoring, sensing systems, etc.) • Real-time HD medical imaging and consultation (remote dermatology, etc.) • “Internet 2” connectivity and applications

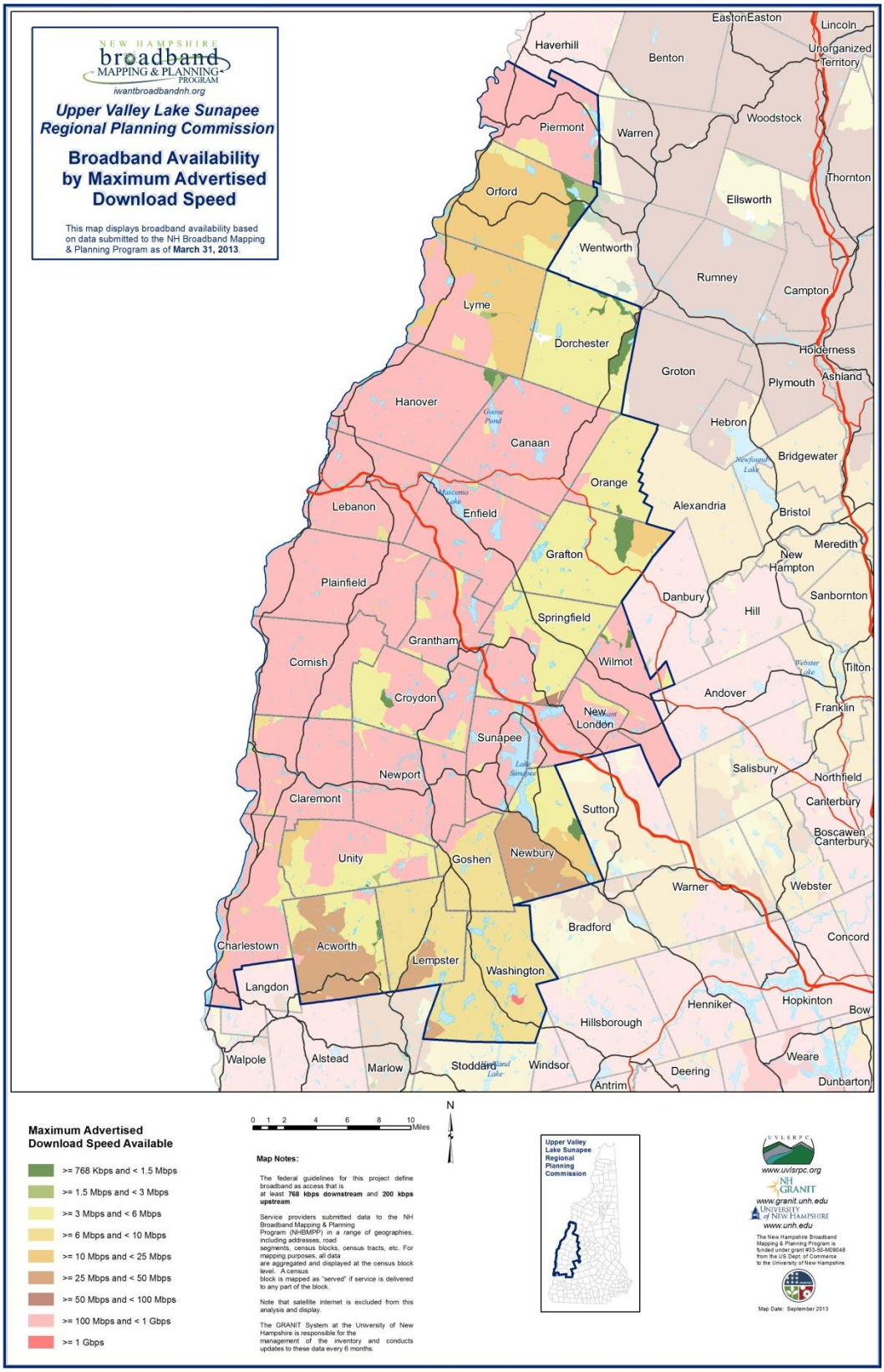
APPENDIX E: BROADBAND AVAILABILTY MAPS

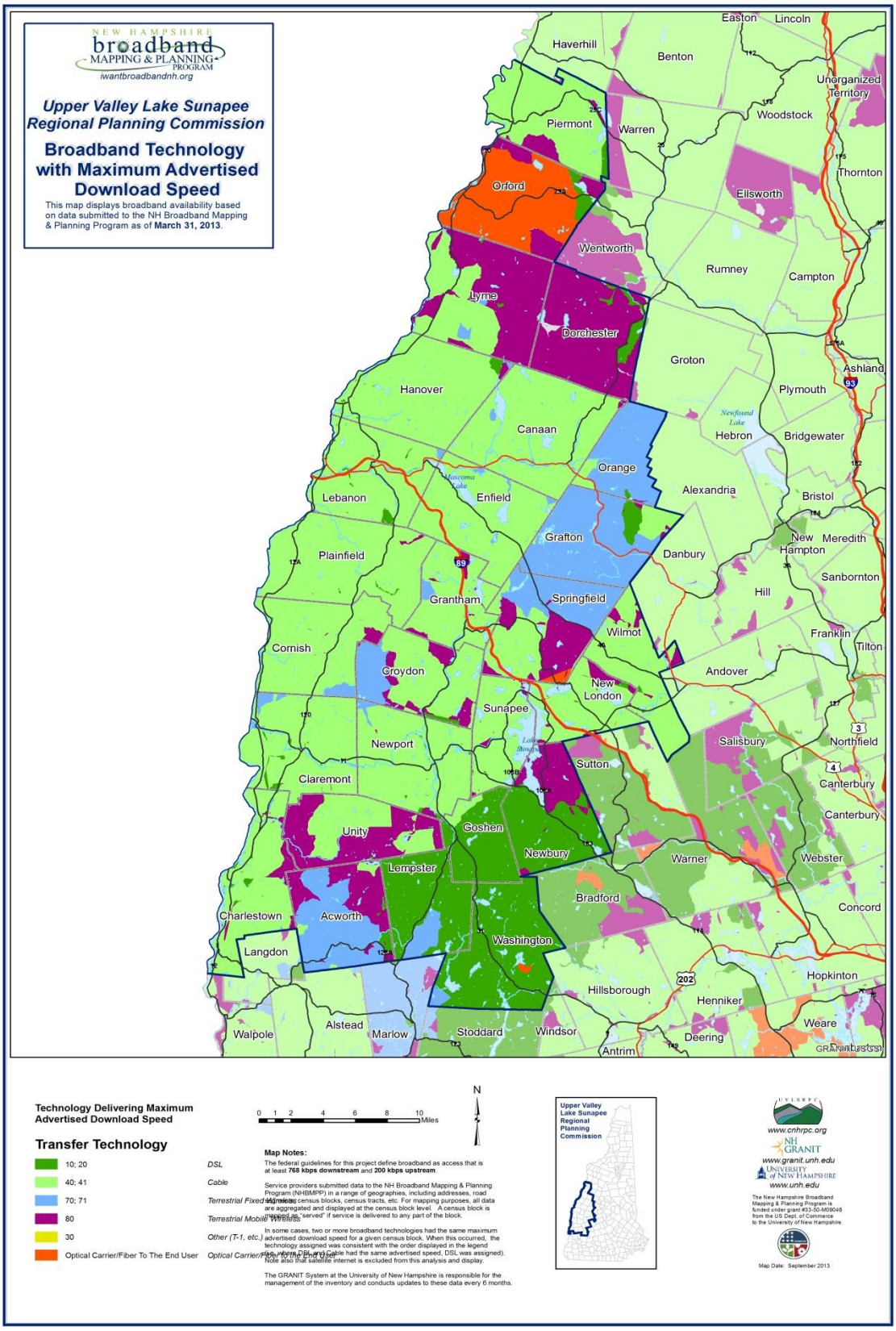


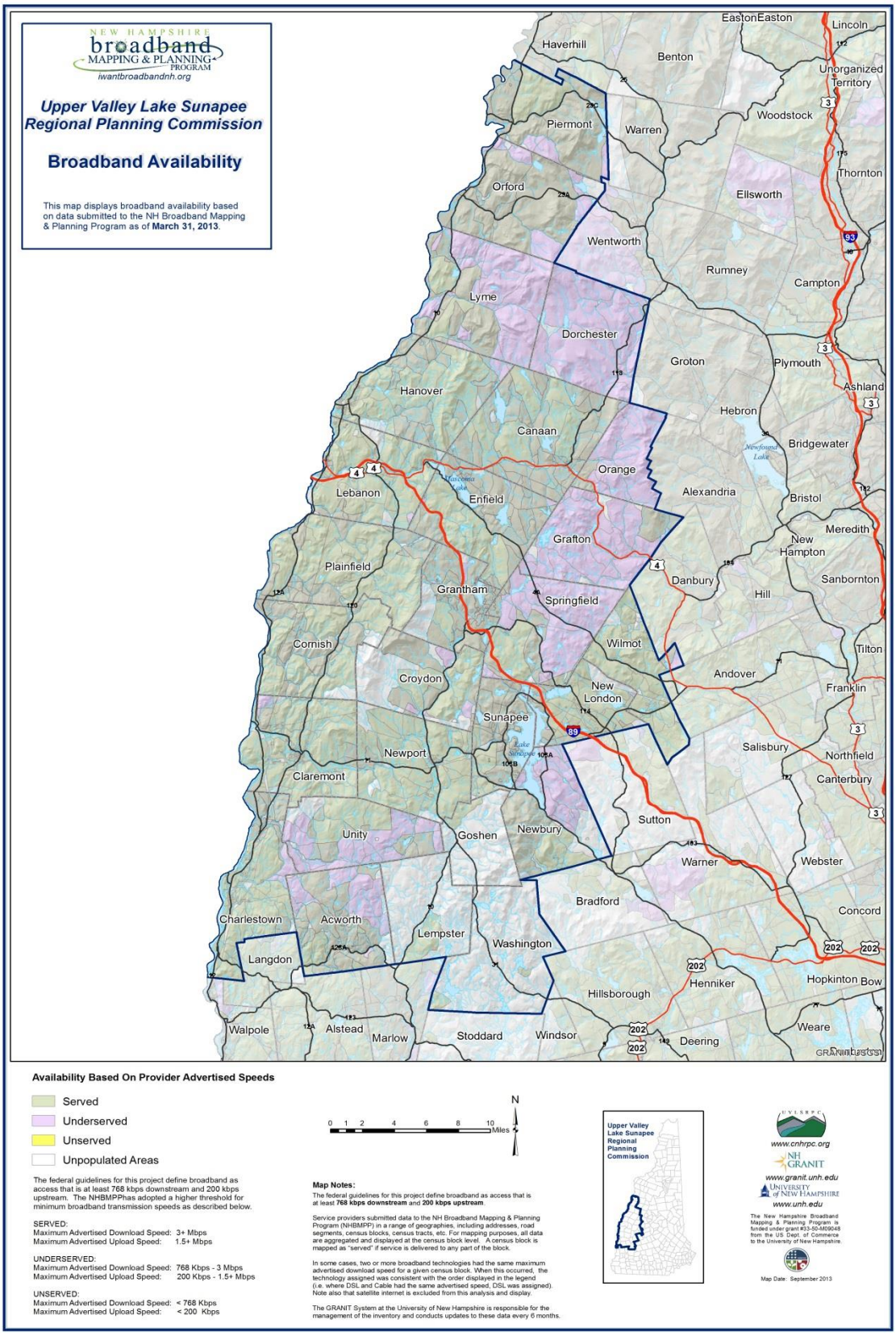

NEW HAMPSHIRE
broadband
MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee
Regional Planning Commission
Degree of Competition
for Broadband Availability
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of March 31, 2013.
Number of Broadband Providers
Number of Providers
1 Broadband Provider Offers Service
2
3
4
5
6 Broadband Providers Offer Service
7
8
9
10
11
12 Broadband Providers Offer Service
N
0 0.75 1.5 3 4.5 6 Miles
Map Notes:
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream.
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
Note that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
Upper Valley Lake Sunapee Regional Planning Commission
www.uvlsrpc.org
NH GRANIT
www.granit.unh.edu
University of New Hampshire
www.unh.edu
The New Hampshire Broadband Mapping and Planning Program is funded under grant #33-50-M09048 from the US Dept. of Commerce to the University of New Hampshire.
Map Date: September 2013
Easton
Haverhill
Benton
Lincoln
Piermont
Warren
Woodstock
Thornton
Orford
Ellsworth
Wentworth
Rumney
Campton
Lyme
Dorchester
Groton
Plymouth
Hanover
Ashland
Hebron
Canaan
Orange
Bridgewater
Newfound Lake
Alexandria
Bristol
Lebanon
Mascoma Lake
Enfield
Grafton
New Hampton
Meredith
Plainfield
Danbury
Sanbornton
Hill
Grantham
Springfield
Cornish
Wilmot
Franklin
Croydon
Andover
Sunapee
New London
Claremont
Salisbury
Northfield
Canterbury
Lake Sunapee
Newport
Sutton
Boscawen
Unity
Newbury
Goshen
Webster
Warner
Charlestown
Lempster
Bradford
Concord
Acworth
Hopkinton
Washington
Langdon
Hillsborough
Henniker
Alstead
Marlow
Walpole
Stoddard
Windsor
Deering
Weare
Dunbarton
Antrim

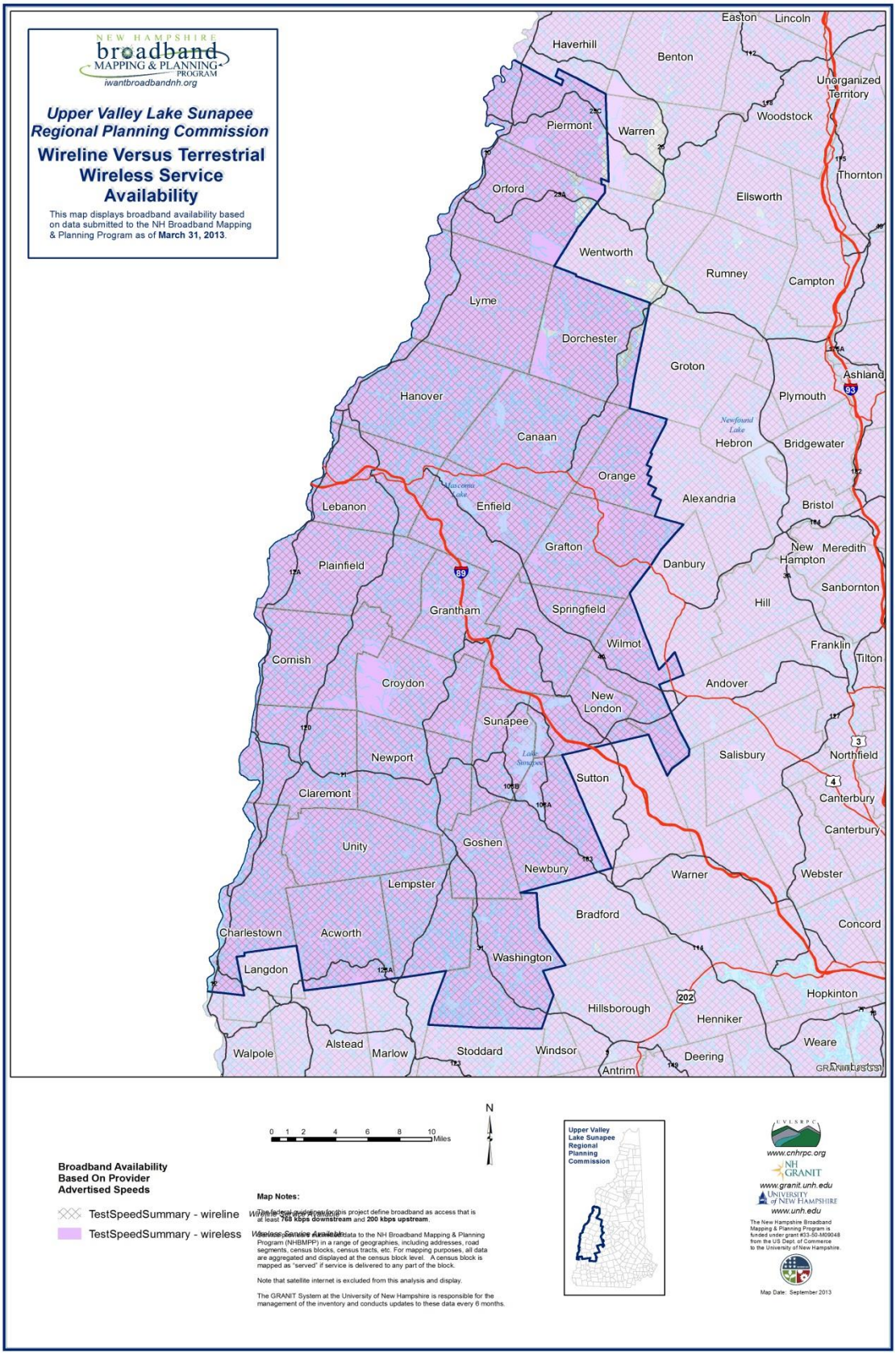

NEW HAMPSHIRE
broadband
MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee Regional Planning Commission
Level of Service for Broadband Intensive Applications and Uses
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of Sept. 30, 2013.
Haverhill
Benton
Lincoln
Unorganized Territory
Woodstock
Piermont
Warren
Thornton
Ellsworth
Orford
Wentworth
Rumney
Campton
Lyme
Dorchester
Holderness
Groton
Plymouth
Ashland
Goose Pond
Hanover
Canaan
Hebron
Bridgewater
Newfound Lake
Orange
Alexandria
Bristol
Mascoma Lake
Lebanon
New Hampton
Meredith
Enfield
Grafton
Danbury
Sanbornton
Plainfield
Grantham
Springfield
Hill
Cornish
Wilmot
Webster Lake
Andover
Franklin
Croydon
Pleasant Lake
New London
Sunapee
Lake Sunapee
Salisbury
Northfield
Claremont
Newport
Sutton
Boscawen
Webster
Goshen
Unity
Newbury
Warner
Lempster
Bradford
Concord
Charlestown
Acworth
Henniker
Langdon
Hopkinton
Bow
Washington
Hillsborough
Marlow
Dunbarton
Stoddard
Highland Lake
Windsor
Weare
Antrim
Deering
Walpole
Alstead
Level of Service Based on Provider Advertised Speeds
Served
Served With Reported Gaps
Underserved
Underserved With Reported Gaps
Unserved
Unpopulated Areas
Map Notes
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
Note that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
N
0 1 2 4 6 8 10 Miles
Broadband intensive applications and uses are those that require a minimum of 6 Mbps downstream and 1.5 Mbps upstream to be fully functional. These may include: streaming HD content, connecting 5+ internet devices, video conferencing, etc.
SERVED:
Maximum Advertised Download Speed: 6+ Mbps
Maximum Advertised Upload Speed: 1.5+ Mbps
UNDERSERVED:
Maximum Advertised Download Speed: 768 kbps - 6 Mbps
Maximum Advertised Upload Speed: 200 kbps - 1.5+ Mbps
UNSERVED:
Maximum Advertised Download Speed: < 768 kbps
Maximum Advertised Upload Speed: < 200 kbps
REPORTED GAPS are areas where the NHBMPP has received user emails or website surveys indicating that no service is available. Additionally, areas where speed tests have been filed that do not meet the minimum speed criteria are flagged as having a gap in service.
Upper Valley Lake Sunapee Regional Planning Commission
www.uvlsrpc.org
NH GRANIT
www.granit.unh.edu
University of New Hampshire
www.unh.edu
The New Hampshire Broadband Mapping & Planning Program is funded under grant #33-50-M09048 from the US Dept. of Commerce to the University of New Hampshire.
Map Date: September 2013


NEW HAMPSHIRE broadband MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee Regional Planning Commission
Satellite Broadband Service
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of March 31, 2013.
Haverhill
Easton
Lincoln
Benton
Unorganized Territory
Woodstock
Piermont
Warren
Thornton
Orford
Ellsworth
Wentworth
Rumney
Campton
Lyme
Dorchester
Holderness
Groton
Plymouth
Ashland
Hanover
Goose Pond
Hebron
Canaan
Bridgewater
Newfound Lake
Orange
Lebanon
Mascoma Lake
Alexandria
Bristol
Enfield
Meredith
Grafton
Plainfield
Sanbornton
Danbury
Hill
Grantham
Springfield
Cornish
Webster Lake
Wilmot
Andover
Franklin
Croydon
Pleasant Lake
New London
Sunapee
Lake Sunapee
Salisbury
Northfield
Claremont
Newport
Boscawen
Sutton
Newbury
Unity
Webster
Goshen
Warner
Charlestown
Bradford
Concord
Lempster
Acworth
Hopkinton
Washington
Henniker
Langdon
Bow
Hillsborough
Marlow
Alstead
Dunbarton
Walpole
Highland Lake
Windsor
Weare
Stoddard
Deering
GRANIT, USGS
Satellite Broadband Availability
Service Available
Service Not Available
Map Notes:
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream.
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
In some cases, two or more broadband technologies had the same maximum advertised download speed for a given census block. When this occurred, the technology assigned was consistent with the order displayed in the legend (i.e. where DSL and Cable had the same advertised speed, DSL was assigned). Note also that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
N
0 1 2 4 6 8 10 Miles
Upper Valley Lake Sunapee Regional Planning Commission
www.cnhrpc.org
NH GRANIT
www.granit.unh.edu
University of New Hampshire
www.unh.edu
The New Hampshire Broadband Mapping & Planning Program is funded under grant #33-50-M09048 from the US Dept. of Commerce to the University of New Hampshire.
Map Date: September 2013


NEW HAMPSHIRE broadband MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee Regional Planning Commission
Broadband Availability by Maximum Advertised Download Speed
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of March 31, 2013.
Haverhill
Benton
Easton
Lincoln
Unorganized Territory
Woodstock
Piermont
Warren
Thornton
Orford
Ellsworth
Wentworth
Rumney
Campton
Lyme
Dorchester
Holderness
Groton
Plymouth
Ashland
Hanover
Goose Pond
Hebron
Canaan
Newfound Lake
Bridgewater
Orange
Lebanon
Enfield
Alexandria
Bristol
Meredith
Grafton
New Hampton
Plainfield
Danbury
Sanbornton
Springfield
Hill
Grantham
Cornish
Wilmot
Webster Lake
Tilton
Croydon
Andover
Franklin
New London
Sunapee
Lake Sunapee
Salisbury
Northfield
Newport
Claremont
Sutton
Canterbury
Boscawen
Canterbury
Unity
Goshen
Newbury
Warner
Webster
Bradford
Concord
Charlestown
Acworth
Lempster
Washington
Langdon
Henniker
Hopkinton
Bow
Hillsborough
Walpole
Alstead
Marlow
Stoddard
Windsor
Deering
Weare
Dunbarton
Antrim
Maximum Advertised Download Speed Available
>= 768 Kbps and < 1.5 Mbps
>= 1.5 Mbps and < 3 Mbps
>= 3 Mbps and < 6 Mbps
>= 6 Mbps and < 10 Mbps
>= 10 Mbps and < 25 Mbps
>= 25 Mbps and < 50 Mbps
>= 50 Mbps and < 100 Mbps
>= 100 Mbps and < 1 Gbps
>= 1 Gbps
0 1 2 4 6 8 10 Miles
N
Map Notes:
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream.
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
Note that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
Upper Valley Lake Sunapee Regional Planning Commission
www.uvlsrpc.org
NH GRANIT
www.granit.unh.edu
University of New Hampshire
www.unh.edu
The New Hampshire Broadband Mapping & Planning Program is funded under grant #33-50-M09048 from the US Dept. of Commerce to the University of New Hampshire.
Map Date: September 2013


NEW HAMPSHIRE
broadband
MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee Regional Planning Commission
Broadband Technology with Maximum Advertised Download Speed
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of March 31, 2013.
Easton
Lincoln
Haverhill
Benton
Unorganized Territory
Woodstock
Piermont
Warren
Thornton
Orford
Ellsworth
Wentworth
Rumney
Campton
Lyme
Dorchester
Groton
Ashland
Hanover
Plymouth
Canaan
Newfound Lake
Hebron
Bridgewater
Orange
Alexandria
Bristol
Lebanon
Enfield
Grafton
New Hampton
Meredith
Plainfield
Danbury
Sanbornton
Grantham
Springfield
Hill
Wilmot
Franklin
Tilton
Cornish
Croydon
Andover
New London
Sunapee
Salisbury
Northfield
Newport
Sutton
Claremont
Canterbury
Canterbury
Unity
Goshen
Newbury
Warner
Webster
Lempster
Bradford
Concord
Charlestown
Acworth
Washington
Langdon
Hopkinton
Hillsborough
Henniker
Alstead
Marlow
Stoddard
Windsor
Deering
Weare
Walpole
Antrim
Technology Delivering Maximum Advertised Download Speed
Transfer Technology
10; 20 DSL
40; 41 Cable
70; 71 Terrestrial Fixed Wireless
80 Terrestrial Mobile Wireless
30 Other (T-1, etc.)
Optical Carrier/Fiber To The End User Optical Carrier/Fiber To The End User
0 1 2 4 6 8 10 Miles
N
Map Notes:
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream.
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is "served" if service is delivered to any part of the block.
In some cases, two or more broadband technologies had the same maximum advertised download speed for a given census block. When this occurred, the technology assigned was consistent with the order displayed in the legend (e.g. if Fiber and Cable had the same advertised speed, DSL was assigned). Note also that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
Upper Valley Lake Sunapee Regional Planning Commission
www.cnhrpc.org
NH GRANIT
www.granit.unh.edu
University of New Hampshire
www.unh.edu
The New Hampshire Broadband Mapping & Planning Program is funded under grant #53-50-M06048 from the US Dept. of Commerce to the University of New Hampshire.
Map Date: September 2013


NEW HAMPSHIRE
broadband
MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee Regional Planning Commission
Broadband Availability
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of March 31, 2013.
Haverhill
Benton
Easton
Lincoln
Unorganized Territory
Woodstock
Piermont
Warren
Thornton
Orford
Ellsworth
Wentworth
Rumney
Campton
Lyme
Dorchester
Groton
Plymouth
Ashland
Hanover
Hebron
Canaan
Bridgewater
Orange
Lebanon
Enfield
Alexandria
Bristol
Meredith
New Hampton
Grafton
Plainfield
Danbury
Sanbornton
Grantham
Springfield
Hill
Cornish
Wilmot
Tilton
Croydon
Andover
Franklin
New London
Sunapee
Salisbury
Northfield
Newport
Claremont
Canterbury
Sutton
Unity
Goshen
Newbury
Warner
Webster
Bradford
Concord
Charlestown
Acworth
Lempster
Washington
Langdon
Hopkinton
Bow
Henniker
Hillsborough
Walpole
Alstead
Marlow
Stoddard
Windsor
Deering
Weare
Availability Based On Provider Advertised Speeds
Served
Underserved
Unserved
Unpopulated Areas
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream. The NHBMPPhas adopted a higher threshold for minimum broadband transmission speeds as described below.
SERVED:
Maximum Advertised Download Speed: 3+ Mbps
Maximum Advertised Upload Speed: 1.5+ Mbps
UNDERSERVED:
Maximum Advertised Download Speed: 768 Kbps - 3 Mbps
Maximum Advertised Upload Speed: 200 Kbps - 1.5+ Mbps
UNSERVED:
Maximum Advertised Download Speed: < 768 Kbps
Maximum Advertised Upload Speed: < 200 Kbps
N
0 1 2 4 6 8 10 Miles
Map Notes:
The federal guidelines for this project define broadband as access that is at least 768 kbps downstream and 200 kbps upstream.
Service providers submitted data to the NH Broadband Mapping & Planning Program (NHBMPP) in a range of geographies, including addresses, road segments, census blocks, census tracts, etc. For mapping purposes, all data are aggregated and displayed at the census block level. A census block is mapped as "served" if service is delivered to any part of the block.
In some cases, two or more broadband technologies had the same maximum advertised download speed for a given census block. When this occurred, the technology assigned was consistent with the order displayed in the legend (i.e. where DSL and Cable had the same advertised speed, DSL was assigned). Note also that satellite internet is excluded from this analysis and display.
The GRANIT System at the University of New Hampshire is responsible for the management of the inventory and conducts updates to these data every 6 months.
Upper Valley Lake Sunapee Regional Planning Commission
www.cnhrpc.org
NH GRANIT
www.granit.unh.edu
University of New Hampshire
www.unh.edu
The New Hampshire Broadband Mapping & Planning Program is funded under grant #33-50-M09048 from the US Dept. of Commerce to the University of New Hampshire.
Map Date: September 2013


NEW HAMPSHIRE
broadband
MAPPING & PLANNING PROGRAM
iwantbroadbandnh.org
Upper Valley Lake Sunapee Regional Planning Commission
Wireline Versus Terrestrial Wireless Service Availability
This map displays broadband availability based on data submitted to the NH Broadband Mapping & Planning Program as of March 31, 2013.
Easton
Lincoln
Haverhill
Benton
Unorganized Territory
Woodstock
Piermont
Warren
Thornton
Orford
Ellsworth
Wentworth
Rumney
Campton
Lyme
Dorchester
Groton
Ashland
Hanover
Plymouth
Canaan
Newfound Lake
Hebron
Bridgewater
Orange
Alexandria
Bristol
Lebanon
Enfield
Grafton
New Hampton
Meredith
Plainfield
Danbury
Sanbornton
Grantham
Springfield
Hill
Wilmot
Franklin
Tilton
Cornish
Croydon
Andover
New London
Sunapee
Salisbury
Northfield
Newport
Lake Sunapee
Sutton
Claremont
Canterbury
Canterbury
Unity
Goshen
Newbury
Warner
Webster
Lempster
Bradford
Concord
Charlestown
Acworth
Washington
Langdon
Hopkinton
Hillsborough
Henniker
Alstead
Marlow
Stoddard
Windsor
Weare
Walpole
Deering
Antrim
0 1 2 4 6 8 10 Miles
N
Broadband Availability Based On Provider Advertised Speeds
TestSpeedSummary - wireline
TestSpeedSummary - wireless
Map Notes:
Wireless Service Available
Upper Valley Lake Sunapee Regional Planning Commission
www.cnhrpc.org
www.granit.unh.edu
www.unh.edu
Map Date: September 2013