Developing Broadband in Maine: Needs Assessment

Volume I

Prepared by James W. Sewall Company for the ConnectME Authority
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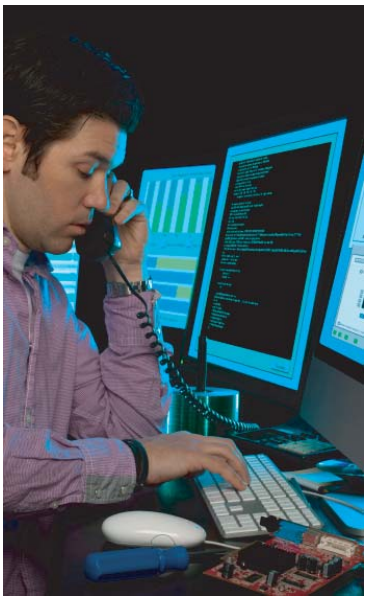

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ConnectME Authority

Developing Broadband in Maine: Needs Assessment
Volume I

The ConnectME Authority Broadband Planning Project

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1.0 Executive Summary

Task

This Needs Assessment is one deliverable in the ConnectME Authority's Broadband Planning Project. It establishes a baseline measure of broadband availability and use in Maine, and identifies barriers to the adoption of broadband technologies throughout the State. It will be used to plan the Authority's strategies for increasing broadband awareness and uptake, and to provide the baseline against which such implemented strategies can be evaluated.

Method

The data upon which this assessment is based was acquired in several ways. A statewide statistical survey mailed to over 10,000 residences and 3,500 businesses yielded an unusually high response rate of 26 percent and 17 percent respectively, numbers that demonstrate a widespread understanding of the importance of broadband. These quantitative data were supplemented with qualitative feedback gathered at six public forums held throughout the State. Federally defined community anchor institutions (medical facilities, public schools, libraries, safety facilities, and so on) were surveyed individually, as were the Native Indian Tribes. Non-proprietary broadband service provider data were drawn from the Authority's Broadband Inventory and Mapping Project that is proceeding in parallel with this study. Survey data concerning Maine's primary educational institutions and the health industry were drawn from recent third-party studies. Additional raw and comparative data were secured from a number of governmental and other sources as described herein. Assessment analyses were based on rigorous economic modeling as well as expert content analysis by Team and Authority members.

Baseline Summary Results

A summary of key results follow. Details and supporting data are in the body of the report.

Broadband Availability and Use

Maine Locations:

- 91.1 percent of Maine street locations currently have access to some form of broadband connection from at least one service provider.
- Maine municipalities are served by an average of 4.3 broadband service providers.

Maine Households:

- 89.6 percent of surveyed Maine households currently have some form of internet connection from at least one provider, although this connection may not be at broadband levels.
- 72.7 percent of surveyed Maine households currently subscribe to broadband.

Maine Businesses:

- 90.1 percent of surveyed Maine businesses currently have some form of internet connection, although this connection may not be at broadband levels.
- 85.7 percent of surveyed Maine businesses currently subscribe to broadband.

In assessing these percentages, however, it is critical to match consumer and business needs with required levels of broadband service. Percentages of availability and use reduce significantly at higher speed levels. For example, the number of Maine locations served at the FCC's Tier 3 level (3-6 Mbps), the minimum level identified by the Authority for recommended project funding, is reported by the FCC to be available at fewer than 40 percent of Maine locations, and speeds meeting Tier 5 levels (10 Mbps) are available at fewer than 10 percent of Maine locations.

Consumer-Identified Barriers to Broadband Use

- The greatest single barrier to broadband adoption for surveyed households is lack of perceived need or value in owning a computer (44.7 percent), with cost as second (21.3 percent).
- The greatest single barrier to broadband adoption for surveyed Maine businesses is lack of perceived need or value (39.1 percent), with cost as second (28.3 percent).

Demographic Factors Driving Broadband Use

- Demographic factors that affect broadband use together with Maine's national ranking in these categories show that Maine tends to rank high in those areas that retard broadband uptake and low in those areas that accelerate it.

- Factors concomitant with increased broadband use in Maine are households with one or more children under the age of 18, households with more than three people, and small businesses in the finance and insurance industry. Maine's ranking relative to all US states is 48th out of 50 in the percentage of households with one or more children under 18, the percentage of households with more than three people, and the percentage of small businesses in the finance and insurance sector.
- Factors concomitant with decreased use in Maine are households with annual incomes of less than $15,000, households comprised of people over the age of 64, and small businesses with fewer than five workers. Maine's ranking relative to all US states is 18th out of 50 in the percentage of households with annual incomes of less than $15,000, 5th out of 50 in the percentage of households with one or more people over the age of 64, and 9th out of 50 in the percentage of establishments with one to four employees.

Common Themes

In analyzing the data and information collected, four major themes emerge.

1. There is an increasing general need and demand for higher levels of broadband service driven by social, economic, and technological factors.
2. While Maine has good coverage for basic broadband service, current service levels are too low to realize most advantages broadband will offer.
3. There is a lack of perceived value in computer use and internet adoption among significant levels of the consumer and business communities.
4. Maine's demographics present a challenge to broadband advancement.

Next Steps

To address these issues we offer a number of recommendations to focus discussions concerning the development of the Authority's forthcoming Strategic Broadband Plan. In brief, we recommend:

- The Authority expand its focus from unserved residential consumers to include businesses, agencies, and community anchor institutions in order to coordinate better planning and growth.
- The Authority lead a sustained marketing campaign that builds awareness on the benefits of broadband and that focuses on groups with low adoption rates.
- The Authority work more closely with service providers to build incentives that increase awareness and adoption.
- The Authority work with State Government to encourage regulatory reform more attuned to current technologies and business requirements.

2.0 Introduction

The demand for available and affordable high-speed internet services (broadband) has increased in almost all aspects of daily life, from commerce and finance to health care, education, and emergency response. The distribution of broadband access and adoption, however, continues to be uneven nationwide, preventing families, businesses, and service institutions from realizing the full benefits and opportunities the technology offers.

Developing broadband equity is first and foremost an economic challenge. The costs of bringing broadband to unserved and underserved populations, particularly in rural areas, are often too high for private-sector firms alone to justify the investment. Public investment is thus crucial to expanding the availability, subscribership, and beneficial use of broadband across all geographies, markets and consumer groups.

2.1 FEDERAL BROADBAND INITIATIVES

Recognizing broadband's critical role in the national economy, Congress unanimously approved the Broadband Data Improvement Act (BDIA) of 2008 to improve the availability, quality, and affordability of broadband services across the US.[1] Under this act, the State Broadband Data and Development (SBDD) Program, now called the State Broadband Initiative (SBI), was created in 2009.

The SBI program, funded under the 2009 American Recovery and Reinvestment Act (ARRA) and administered by the Department of Commerce National Telecommunications and Information Administration (NTIA), is driving statewide initiatives to assess broadband availability, take rates (use of services) and barriers to adoption, and to promote educational and technology support to small businesses and community anchor institutions. These initiatives, which vary depending on local needs, are designed to expand services to unserved and underserved communities, remove barriers to adoption, and build infrastructure. Assessment data now being collected by the states are forming the basis for NTIA's public interactive national broadband map.[2]

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[1] http://www.broadband.gov/plan/.

[2] http://broadbandmap.gov/technology.

In addition, in 2009 Congress directed the Federal Communications Commission (FCC) to develop a National Broadband Plan to ensure that every citizen has access to broadband.[3] In collaboration with the NTIA, the FCC has released a "beta version" of the Plan, a living document that proposes such wide-ranging goals as connecting 100 million households to affordable high-speed service; providing ultra-high-speed broadband to anchor institutions in every community and affordable broadband to rural communities, schools and vulnerable populations; moving broadband adoption rates from roughly 65 percent to more than 90 percent; ensuring that the US leads the world in mobile innovation; promoting competition by ensuring greater transparency and removing barriers to entry; and enhancing the safety of citizens by providing every first responder with access to a nationwide, wireless interoperable public safety network.

2.2 THE BROADBAND CHALLENGE IN MAINE

2.2.1 The ConnectME Authority

To address Maine's broadband challenge, the State Legislature established the ConnectME Authority in 2006.[4] The Authority's mission—to increase and improve the delivery of high-speed internet and wireless communications systems—specified that the Authority identify areas unserved or under-served by broadband and expand availability with sufficient bandwidth, synchronicity, reliability, and security to meet the needs of Maine businesses and agencies, educational institutions and consumers.

With $5 million in ARRA grant funding acquired through the SBI, together with its own dedicated funds acquired through communications surcharges,[5] the Authority has undertaken four major projects: the Maine Broadband Mapping and Inventory Project, the Broadband Planning Project, the Broadband Capacity Building Project, and the Broadband Technical Assistance Project. In addition, the Authority has funded from its own budget more than $4.5 million in grants for more than 50 major broadband infrastructure buildout ("last mile") projects to develop service to unserved communities across the State.[6]

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[3] http://www.broadband.gov/plan/.

[4] http://www.mainelegislature.org/legis/statutes/35-A/title35-Asec9206.html

[5] The Authority is funded by a 0.25 percent surcharge on instate retail communications services.

[6] http://www.maine.gov/connectme/grants/GrantProgram.htm.

Broadband Mapping and Inventory Initiative

The Authority's first ARRA project has been to identify the statewide location of existing broadband infrastructure and to track changes in its condition and ownership. To assist in this effort, in July 2009 the Authority selected Sewall as its GIS mapping consultant. Working with the Authority and Maine's broadband service providers, Sewall launched a three-year project to identify, map and regularly update the locations of broadband services, georeferencing information on the method of delivery and speed of services. For this project, now in its second year, Sewall has collaborated with providers, state and federal agencies, and local communities to create a geodatabase for the Maine Office of GIS's searchable system map indicating where broadband service is available from one or more broadband technology platforms. This map enables community leaders, consumers, and businesses to access information on service options for specific locations of interest. The map will also enable the Authority to allocate resources to areas of need with greater speed and accuracy.

The mapping from this project is a key data resource for assessing the availability of, and need for, broadband services as documented in the ConnectME Authority Planning Project.

The Broadband Planning Project

The Authority has commissioned Sewall and Team partners Packard Judd Kaye Strategic Marketing Group; Jeff Letourneau, Executive Director of Networkmaine; and Todd Gabe, Professor of Economics at the University of Maine to staff its Broadband Planning Project.

The initial phase of this four-year project establishes a detailed, reliable statewide baseline of existing broadband availability, adoption, and barriers to adoption for benchmarking broadband expansion (Task A). The baseline is presented in this assessment, which draws upon survey data gathered from stakeholders across the State, including residential and business consumers, service providers, community anchor institutions (CAIs), technology-dependent industries (e.g., telemedicine), State agencies, and Native Indian Tribal entities. The survey data are aligned with location information on service availability and service speeds derived from the ConnectME Authority Mapping Project. Socio-economic analysis is provided to identify both residential consumer characteristics (age, income, educational attainment, occupation) and business characteristics (industry and employment size) that affect broadband adoption. Analyses from the surveys are compared with national and regional data and preliminary recommendations on expanding adoption statewide are presented.

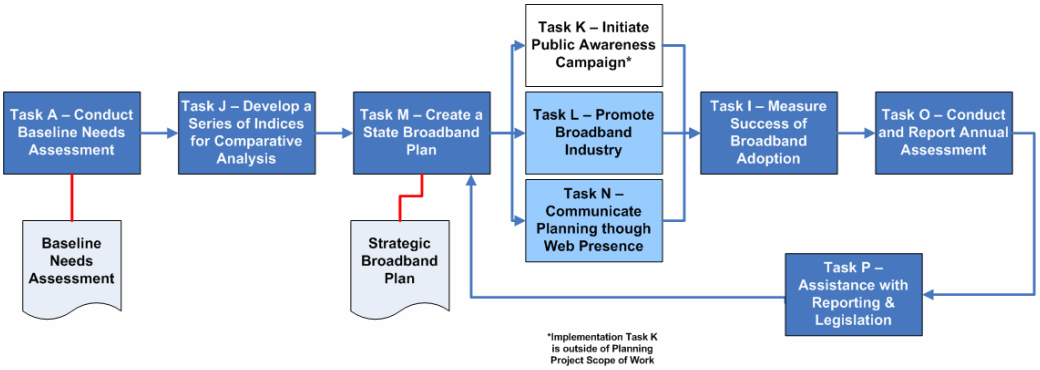

Figure 2-1: ConnectME Authority Broadband Planning Project Workflow

On the basis of this information, the Sewall Team will work with the Authority to develop a Strategic Broadband Plan for Maine (Task M) and to design a broadband public awareness campaign (Task K). The Plan, which will also align with the FCC's National Broadband Plan, will propose strategies, programs and mechanisms for tracking and measuring progress in the program's subsequent years. The Sewall Team will assess the effectiveness of the Plan's deployment annually through 2014. Findings will be published in progress reports and a final report due the second half of 2014 will describe areas of success and remaining challenges.

Broadband Capacity Building

With Authority funding, the Maine State Planning Office (SPO) has convened a broadband capacity building task force that will manage the implementation of the Maine Strategic Plan referenced above. The SPO will integrate the broadband capacity building activities into existing State initiatives, including the Quality of Place, Mobilize Maine and Health Information Technology (HIT) projects.[7]

Broadband Technical Assistance

Under the leadership of the Maine Department of Education Adult and Community Education Program, the Broadband Technical Assistance Project will expand the Maine Adult Regional Technology Initiative (MARTI) by providing intensive, ongoing training and mentoring in the use of technology in the classroom to adult educators across the State.[8]

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[7] http://www.maine.gov/spo/specialprojects/qualityofplace/; http://www.mobilizemaine.com/; http://www.maine.gov/dhhs/oms/HIT/hit_index.html

[8] https://sites.google.com/site/martilearns/.

Grant Awards

In five separate grant award rounds since 2007, the Authority has funded over 50 grants worth over $4.5 million to municipal and business organizations for "last mile" infrastructure projects to provide high-speed internet service to customers in unserved areas of Maine.[9]

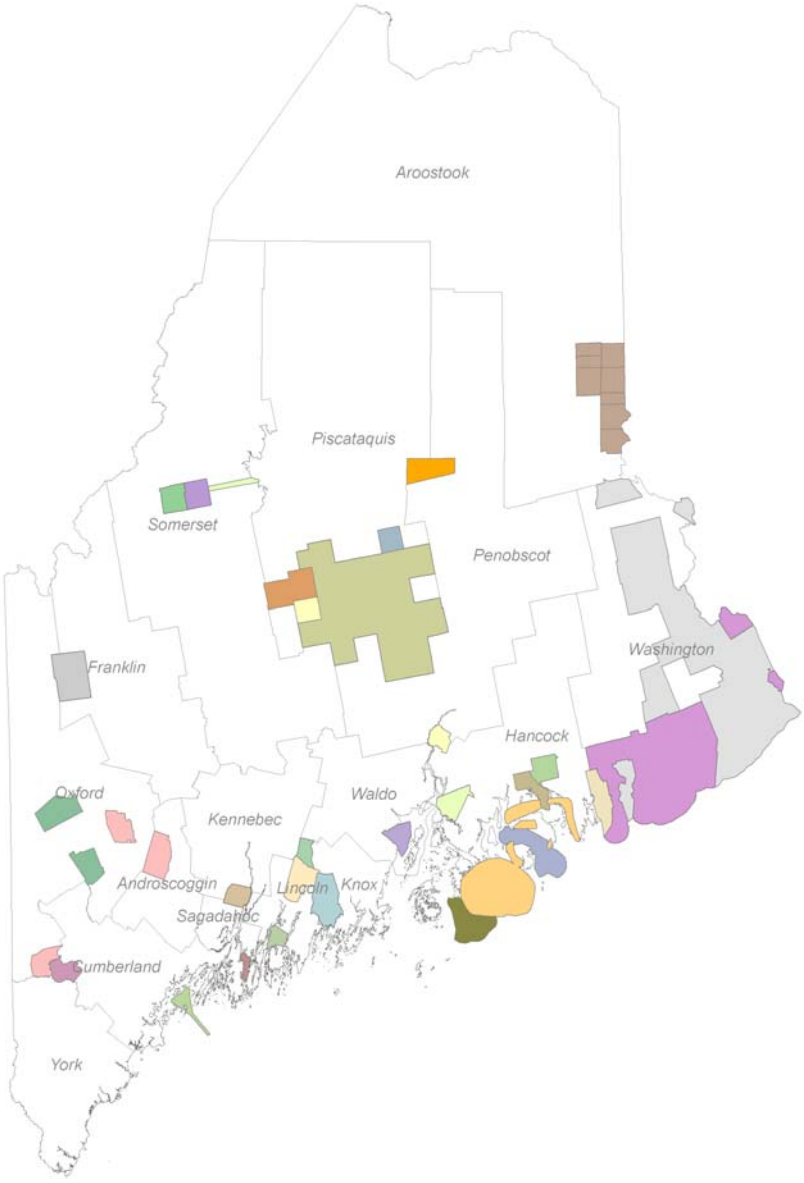


Figure 2-2: Locations of Projects Awarded ConnectME Authority Grants

[9] http://www.maine.gov/connectme/grants/GrantProgram.htm

2.3 THE NEEDS ASSESSMENT

This needs assessment is a deliverable (Task A) in the ConnectME Authority's Broadband Planning Project (RFP-CME #18B-201005697; Contract #CT-18B-20100729-0652). The assessment establishes a baseline measure of broadband availability and use, as well as barriers to the adoption of broadband technologies in Maine. It will be used to plan strategies (Task M) for the Authority to increase broadband awareness and uptake, and to provide the baseline against which the implemented strategies will be evaluated.

2.3.1 Defining Broadband

A meaningful assessment of broadband must begin with a clear, quantifiable definition. Given the rapid evolution of broadband and its broadening social, economic, and political impacts, the term has multiple and changing definitions that depend on context. For this assessment, we define broadband according to two criteria: (1) transmission speed and (2) type of technology. *In our analysis of broadband availability, transmission speed is the defining factor. In our analysis of broadband adoption, type of technology is the defining factor.*

Broadband Transmission Speed

Broadband levels of service are generally understood to provide higher speeds of data transmission, allowing more content to be carried through the telecommunications line, or transmission "pipeline." Connection speed is determined by bandwidth—the amount of data that can be transmitted at any given period of time—and by latency—the amount of time it takes to transmit the data. In brief: the broader the bandwidth, the faster the connection. The FCC defines broadband in a tiered approach with distinct levels based on upload and download speeds.

Table 2-1: FCC's Seven-Tier Broadband Classification

FCC Speed Tier	Upload/Download Speeds	Broadband (Y/N)
• 1st Generation Data	200 Kbps to < 768 Kbps	No
• Tier 1	768 Kbps to < 1.5 Mbps	Yes
• Tier 2	1.5 Mbps to < 3 Mbps	Yes
• Tier 3	3 Mbps to < 6 Mbps	Yes
• Tier 4	6 Mbps to < 10 Mbps	Yes
• Tier 5	10 Mbps to < 25 Mbps	Yes
• Tier 6	25 Mbps to 100 Mbps	Yes
• Tier 7	> 100 Mbps	Yes

For purposes of this assessment, broadband understood as transmission speed is defined as transmission speeds at and above Tier 1. In May 2011, the ConnectME Authority approved adopting the FCC's seven speed tiers definition of broadband with a preference for funding projects that provide service at Tier 3 or better.

Broadband Technologies

Broadband can also be defined by specific technologies that achieve higher speeds of data transmission. As shown in Table 2.2, speeds beginning at 768 Kbps can currently be achieved with one of five technologies: DSL, cable, fixed wireless, T-1, and fiber optic. In assessing broadband adoption, broadband is defined as high-speed internet service via one of these technologies. Table 2.3 shows minimum and recommended speeds for specific types of applications.

Table 2-2: Broadband Technologies

Technology	Broadband (Y/N)	Download Speeds
• Dial-up	No	Up to 56 Kbps
• Mobile	No	56 Kbps – 1.5 Mbps
• Satellite	No	200 Kbps – 2 Mbps
• Electric power line	No*	256 Kbps – 3 Mbps
• DSL	Yes	768 Kbps – 6 Mbps
• Cable	Yes	1 Mbps – 10 Mbps
• Fixed wireless	Yes	1 Mbps – 10 Mbps
• T-1	Yes	1.5 Mbps
• Fiber optic	Yes	Up to 150 Mbps

** Electric power line services are not available in Maine and are thus not considered in this study*

Table 2-3: Examples of Minimum and Recommended Speeds for Types of Applications[10]

Application	Minimum Dedicated Speed*	Recommended Speed
• Telegaming	40 Kbps	400 Kbps
• Electronic banking	40 Kbps	400 Kbps
• Video telephony	70 Kbps	200 Kbps
• Audio on demand	110 Kbps	700 Kbps
• Voice over IP (VoIP)*	128 Kbps	512 Kbps
• Videoconferencing	110 Kbps	800 Kbps
• Home shopping	40 Kbps	1.5 – 7 Mbps
• Electronic newspapers	40 Kbps	2 Mbps
• Teleworking	110 Kbps	1.5 – 7 Mbps
• E-Learning	110 Kbps	1.5 – 7 Mbps
• Telemedicine	110 Kbps	1.5 – 7 Mbps
• Digital television	1 Mbps	7 Mbps
• Near video on demand	1 Mbps	1.5 – 7 Mbps
• Movies on demand	1 Mbps	1.5 – 7 Mbps

** Additional bandwidth is required for other simultaneous activities*

[10] http://srdc.msstate.edu/ecommerce/curricula/connecting_communities/module2_6.htm

3.0 The Maine Baseline

To assess broadband needs in Maine, the Sewall Team surveyed Maine broadband suppliers and consumers on broadband availability, use, drivers of adoption and barriers to adoption. For supplementary and comparative purposes, the Team also collected relevant information from existing industry, federal and state sources, including map data from the ConnectME Authority Broadband Mapping and Inventory Project. The results were used to conduct economic modeling of broadband availability and demand for services to determine socioeconomic factors influencing both provider deployment and consumer adoption.

Final analyses are integrated into a baseline profile in this section with preliminary strategies and recommendations for raising broadband subscribership in the State.

3.1 BROADBAND IN MAINE—SUMMARY STATUS

Summary information on Maine's status and differentiation in the broadband industry includes the following:

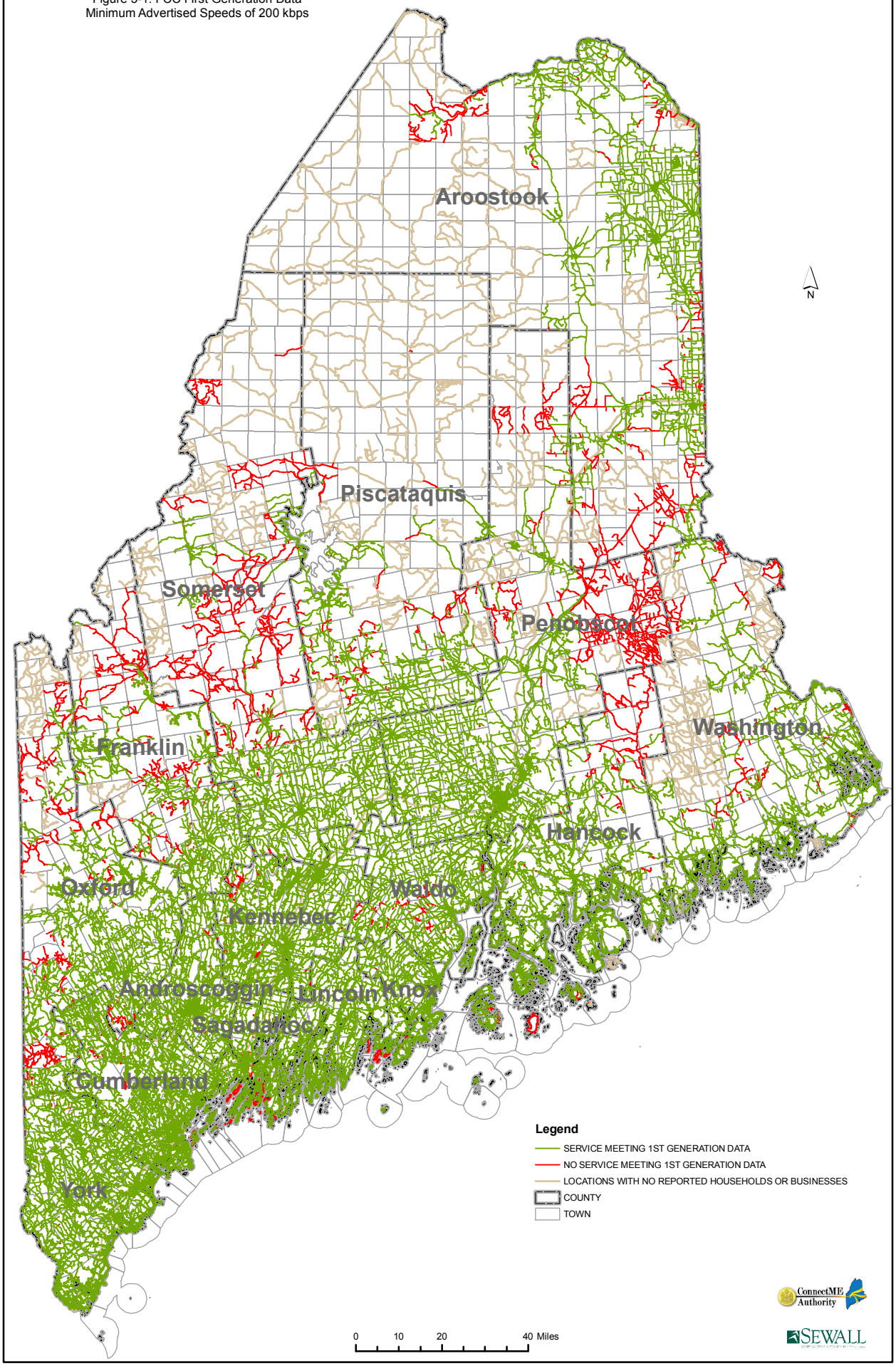
1. *Broadband Availability*. 91.1 percent of Maine locations[11] have access to one or more broadband technologies that achieve the FCC's Tier 1 speed definition of 768 Kbps to l.5 Mbps downstream and upstream. When minimum speeds for broadband are based on higher capacity FCC speed tiers, the percentages of Maine locations with access to acceptable broadband level services are dramatically reduced (see Figures 3-1 to 3-8).

[11] Location information is based on E911 address data. A location is defined as a range of addresses along a street or road that may or may not have occupied houses (households) or businesses.

Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

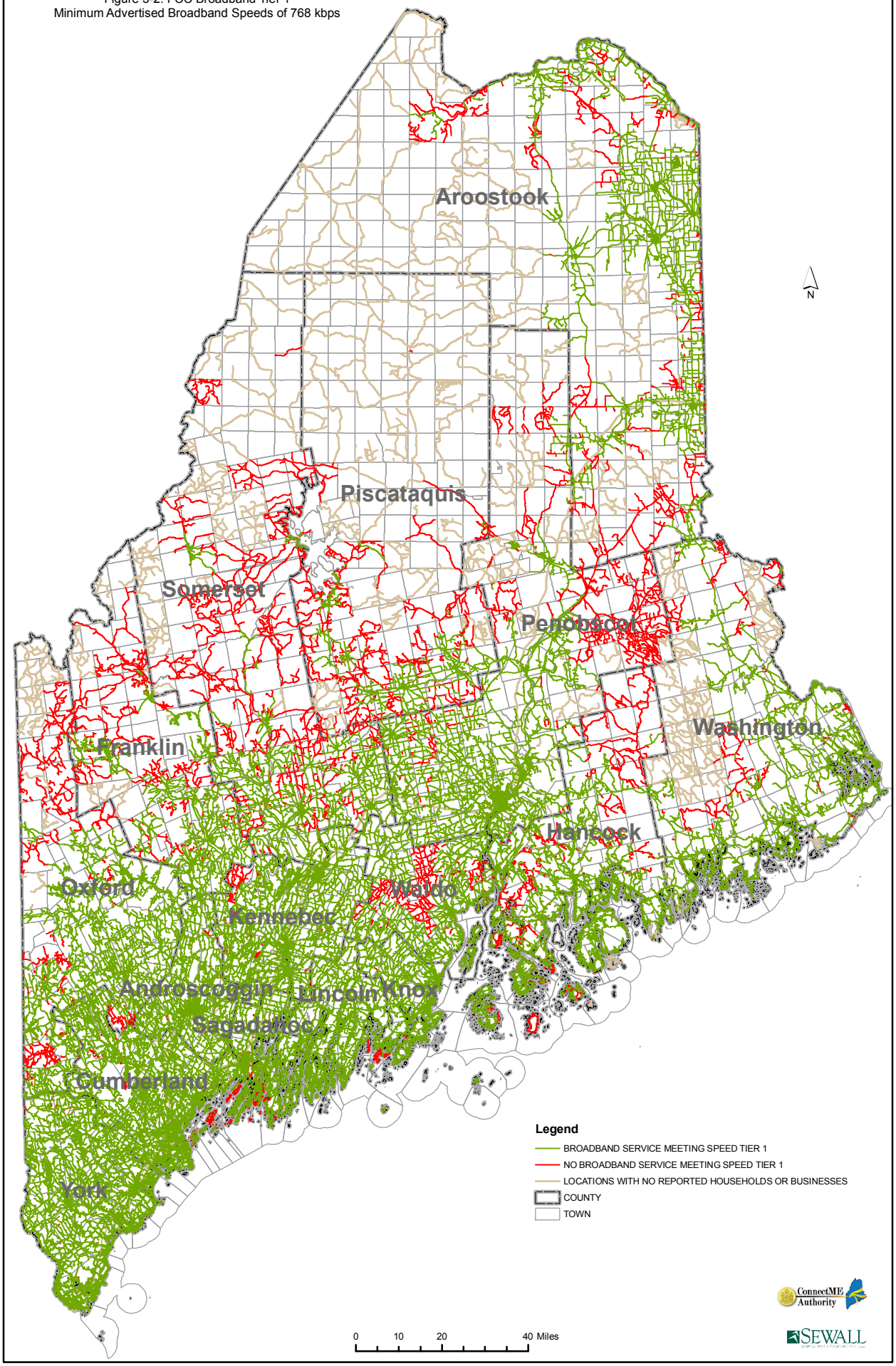
Figure 3-1: FCC First Generation Data
Minimum Advertised Speeds of 200 kbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

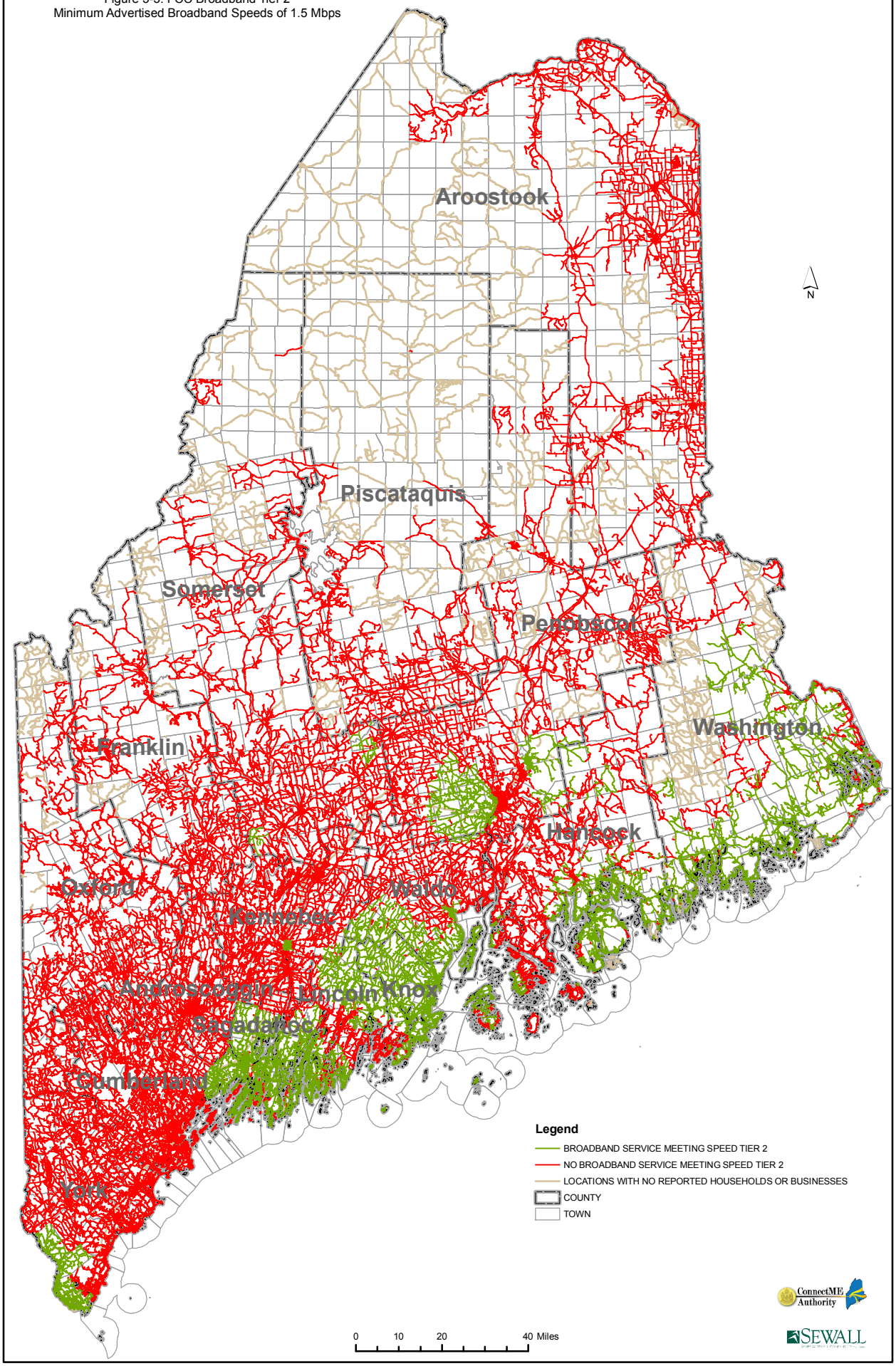
Figure 3-2: FCC Broadband Tier 1
Minimum Advertised Broadband Speeds of 768 kbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

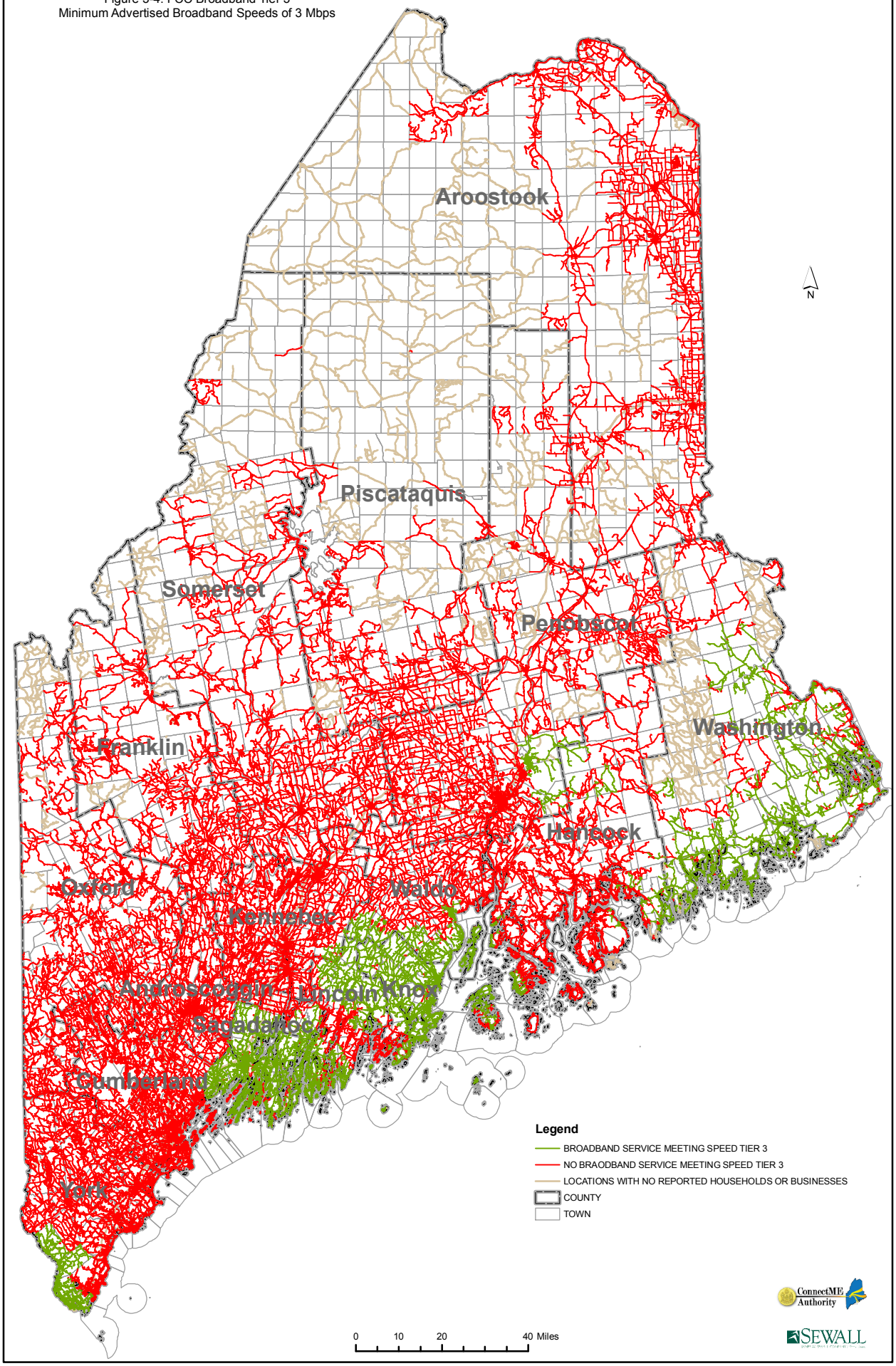
Figure 3-3: FCC Broadband Tier 2
Minimum Advertised Broadband Speeds of 1.5 Mbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

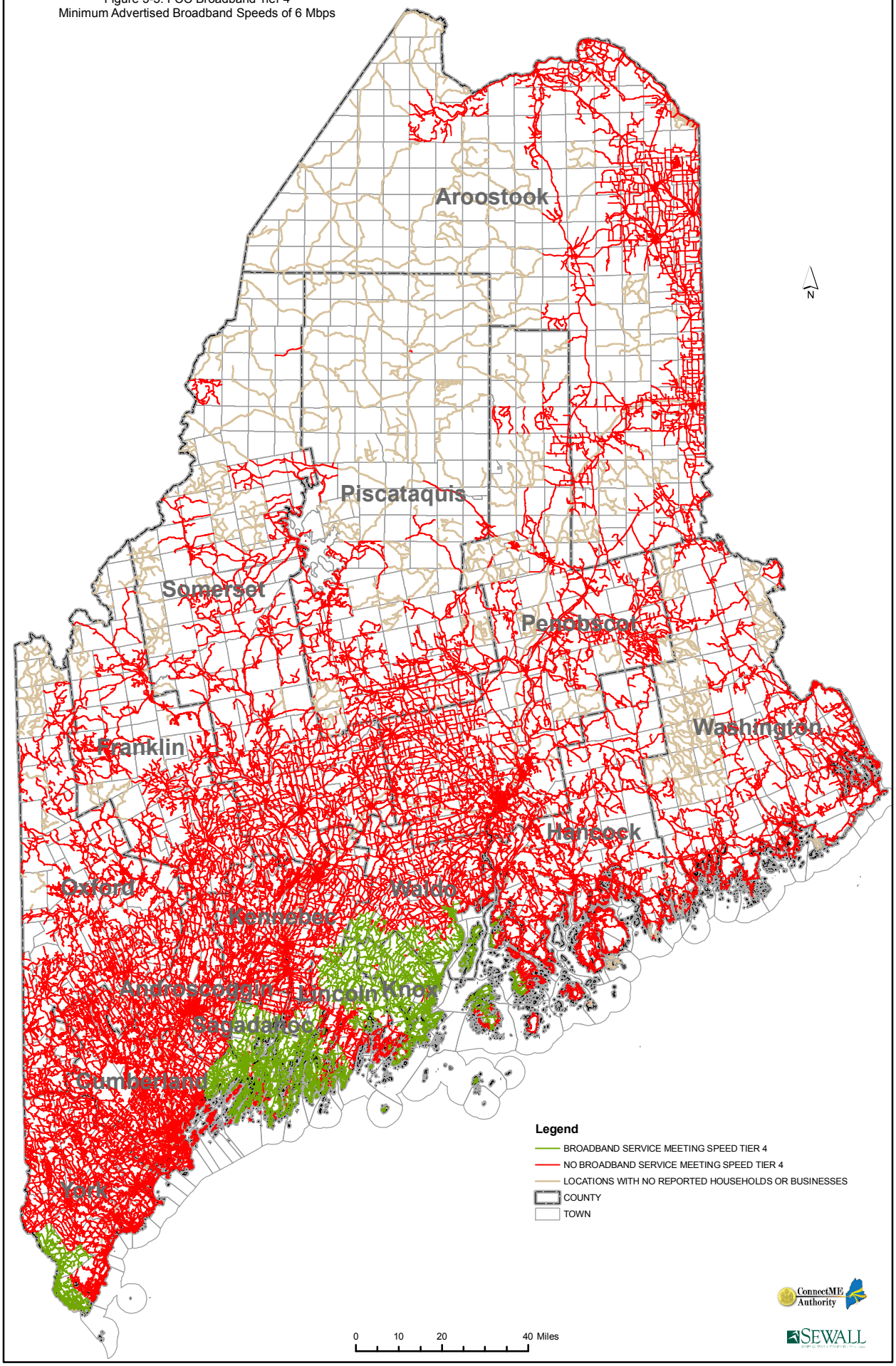
Figure 3-4: FCC Broadband Tier 3
Minimum Advertised Broadband Speeds of 3 Mbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

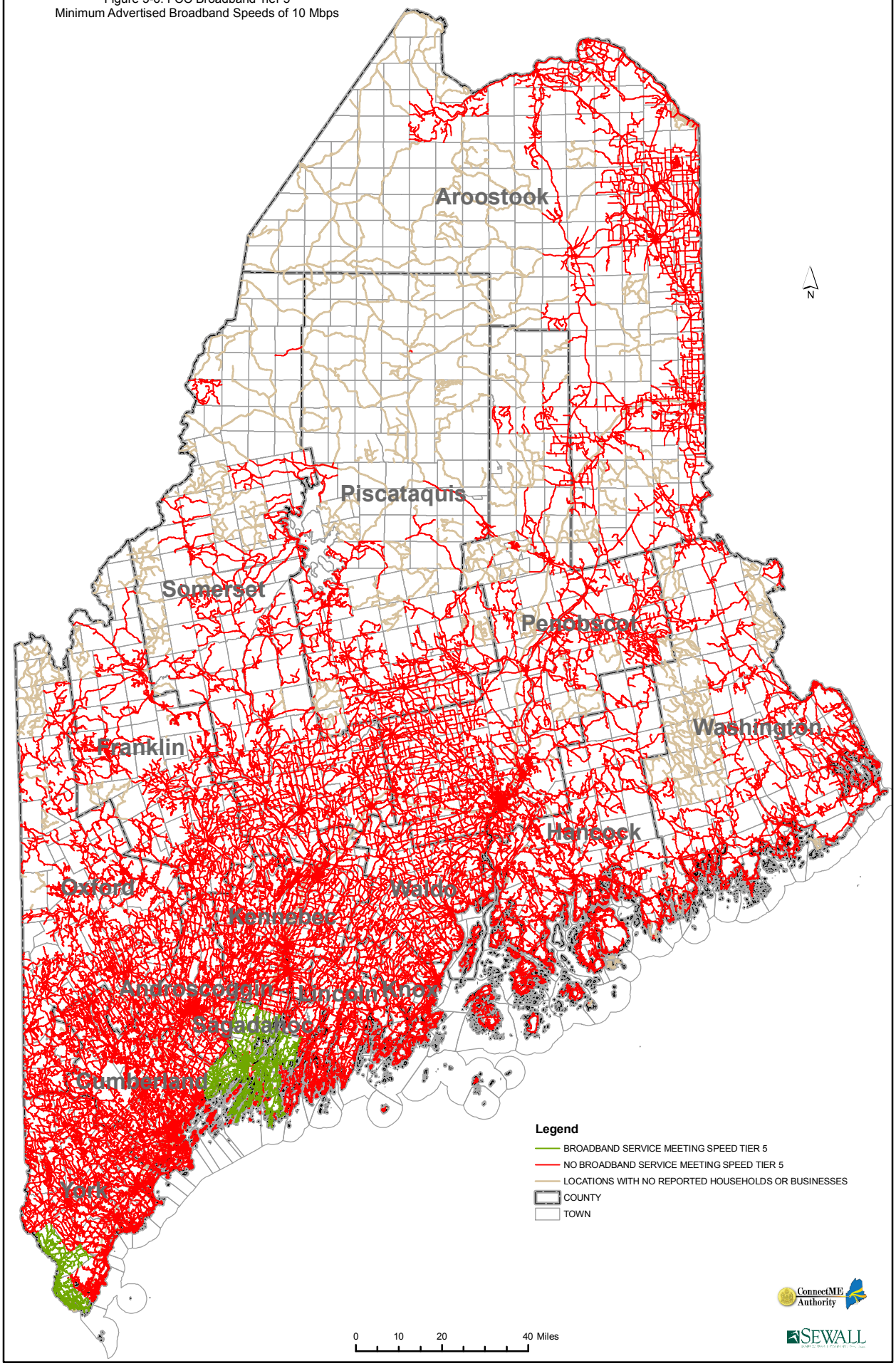
Figure 3-5: FCC Broadband Tier 4
Minimum Advertised Broadband Speeds of 6 Mbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

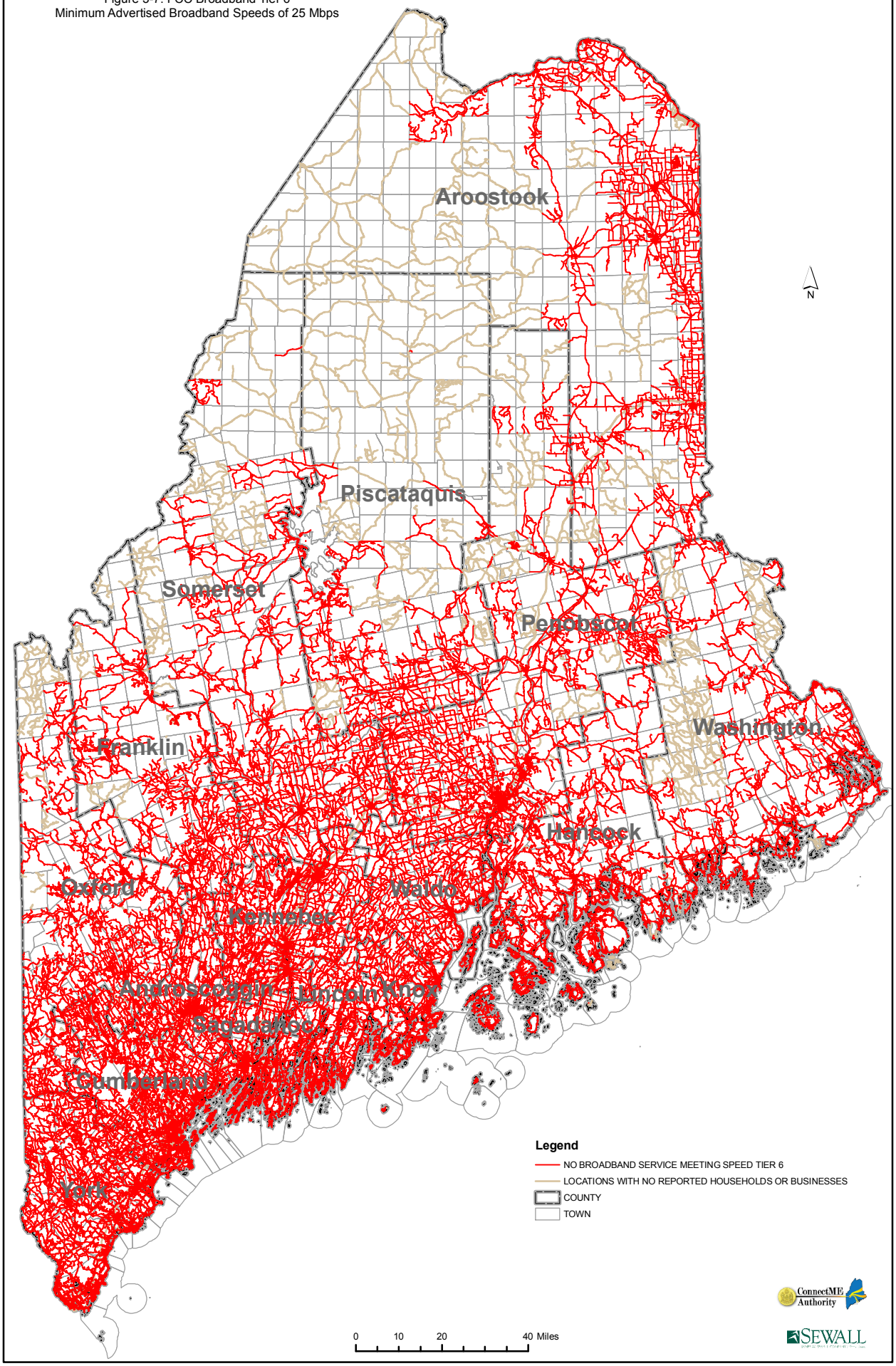
Figure 3-6: FCC Broadband Tier 5
Minimum Advertised Broadband Speeds of 10 Mbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

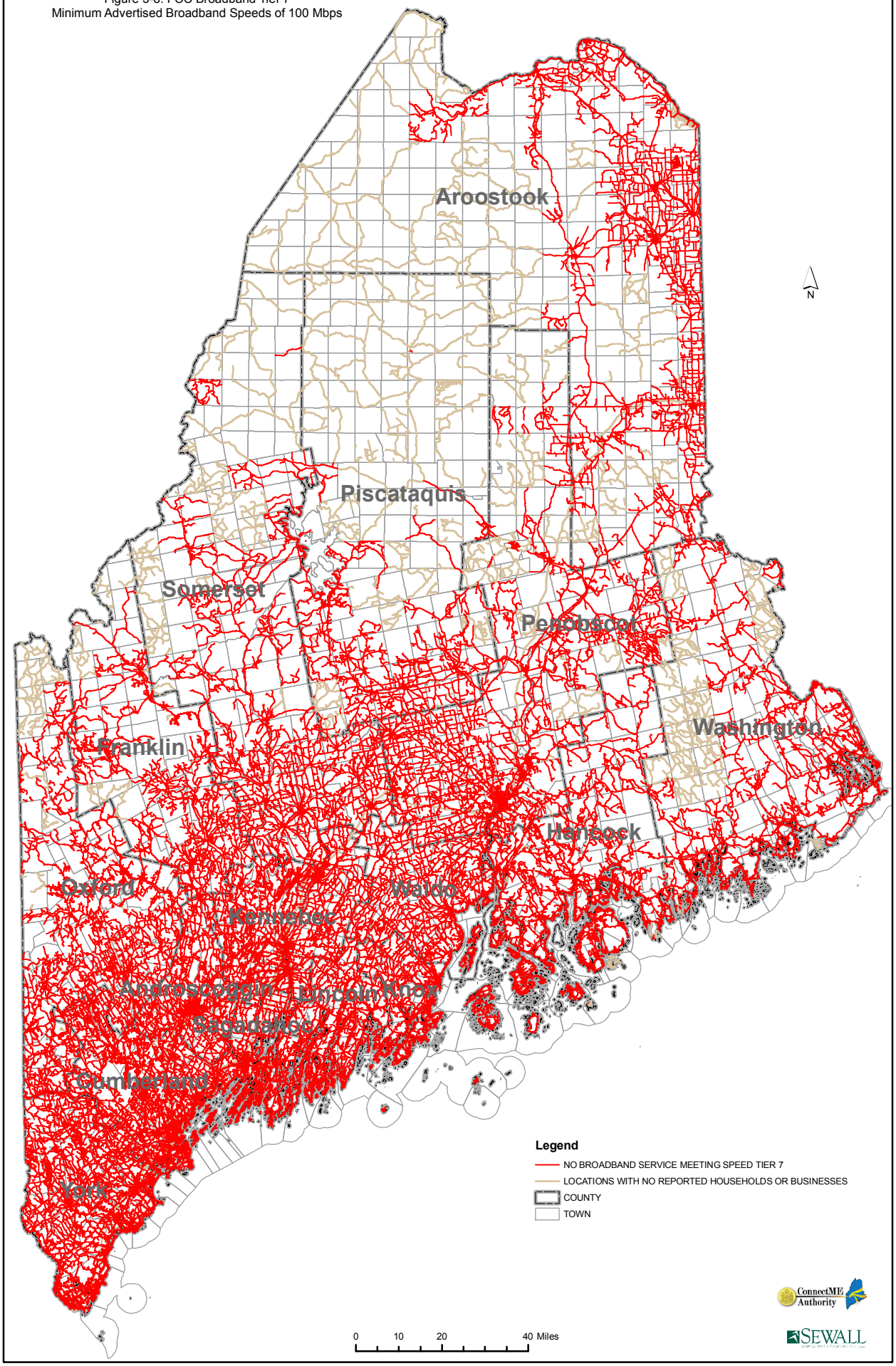
Figure 3-7: FCC Broadband Tier 6
Minimum Advertised Broadband Speeds of 25 Mbps



Maine Broadband Service Coverage
Wired and Fixed Wireless Services

(As modeled from provider submissions thru 4/14/2011)

Figure 3-8: FCC Broadband Tier 7
Minimum Advertised Broadband Speeds of 100 Mbps



Maine fares well in comparison with other states across the nation in terms of Tier 1 broadband availability (at least 768 Kbps). According to the FCC percentages in Figure 3-9, over 70 percent of consumers in Maine have this level of access. According to our survey, 91.1 percent of Maine locations have at least this level. Broadband coverage is thus not the most-critical concern. What is of concern is the speed of that coverage and the related broadband adoption rates.

2. *Broadband Speed*. As of April 2011, average broadband download capacity in Maine is 768 Kbps, which lags significantly behind the national norm of 3.9 megabits per second (Mbps), ranking Maine 43rd in internet speeds in the nation. Maine's percentages of connections by downstream speed are comparable to, and are in some cases higher than, those for New Hampshire and Vermont except for the higher range speeds (Figure 3-9).[12] In the category where downstream speeds are at least 10 Mbps, Maine lags behind both states and the national average.

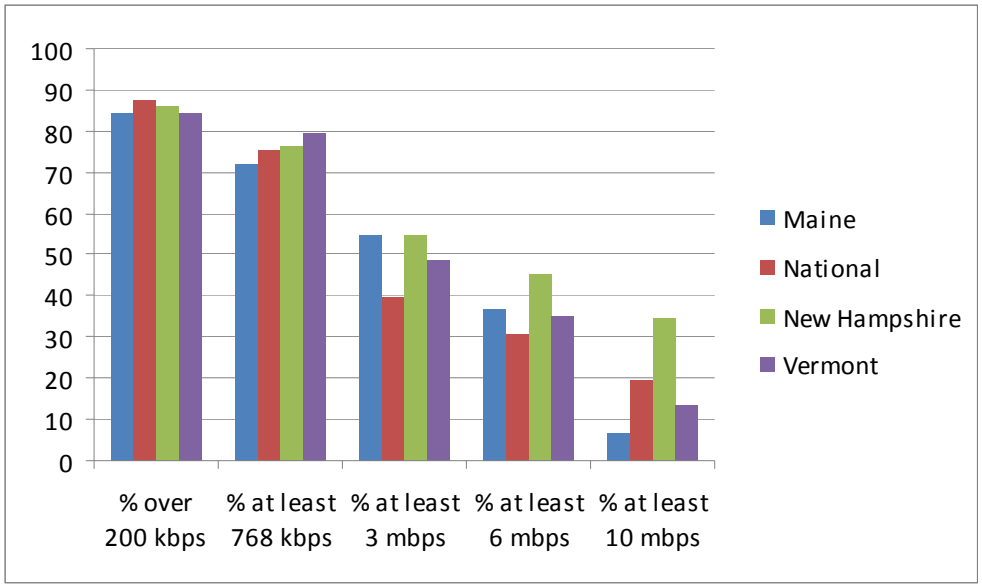


Figure 3-9: Percentage of Connections by Downstream Speed (FCC Report)

Maine ranks 43rd in terms of the percentage of broadband connections with a download speed of 10 Mbps or greater (6.3%). This dramatic drop in availability based on download speeds suggests that Maine's broadband infrastructure is built on old technologies that are generally not able to scale up to higher speeds. In comparison, many of the other northeastern states are toward the top of the national ranking (see Figure 3-10).

[12] See the FCC report *Internet Access Services: Status as of June 30, 2010.*

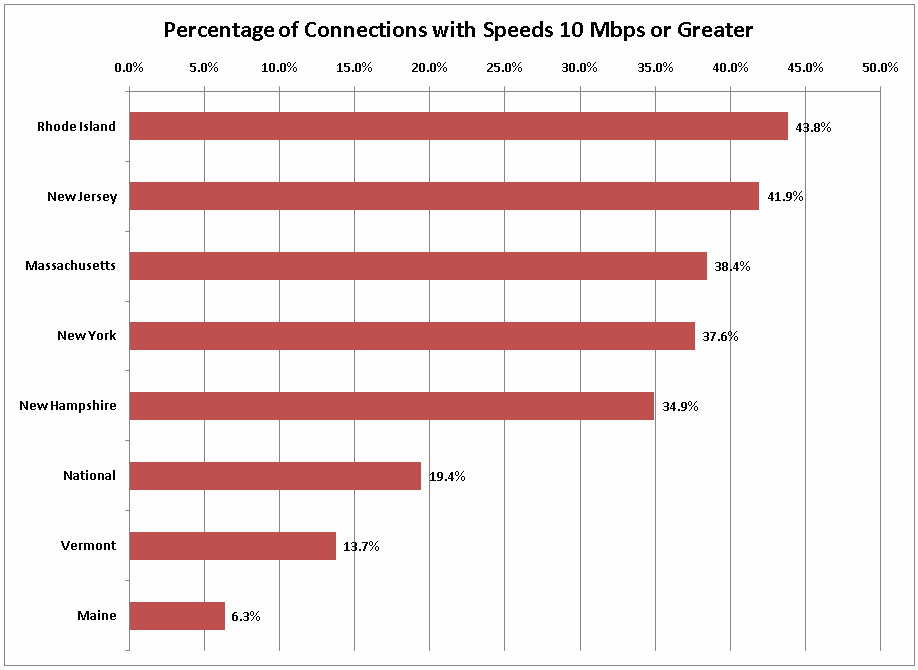


Figure 3-10: Percentage of Connections with Speeds 10 Mbps or Greater (Tier 5)[13]

3. *Broadband Adoption*. Based on the technologies used, 72.71 percent of households and 85.74 percent of businesses in Maine have adopted broadband at Tier 1 or greater level. This baseline is more aligned to the national average of adoption—67 percent for households and 95 percent for small to medium-sized businesses[14]—than to the FCC-reported baseline (reported by census block) for Maine—42 percent for households and 67 percent for businesses (Figure 3-11).

   The 30 percent variance between the results of our survey and the FCC rates can be attributed in part to the FCC reporting requirements. Fixed wireless service providers who operate in unlicensed spectrums are not

[13] FCC report *Internet Access Services: Status as of June 30, 2010*.

[14] The national average, cited in the *National Broadband Plan*, is based on: John Horrigan, *Broadband Adoption and Use in America*, OBI Working Paper no. 1, 2010; NTIA Digital Nation: *21st Century America's Progress Toward Universal Broadband Internet Access*: 4 (2010), and Lee Rainie, "Pew Internet & American Life," *Internet, Broadband and Cell Phone Statistics*: 1 (2010).

required to file a Form 477.[15] In Maine, several service providers fall into this category.[16]

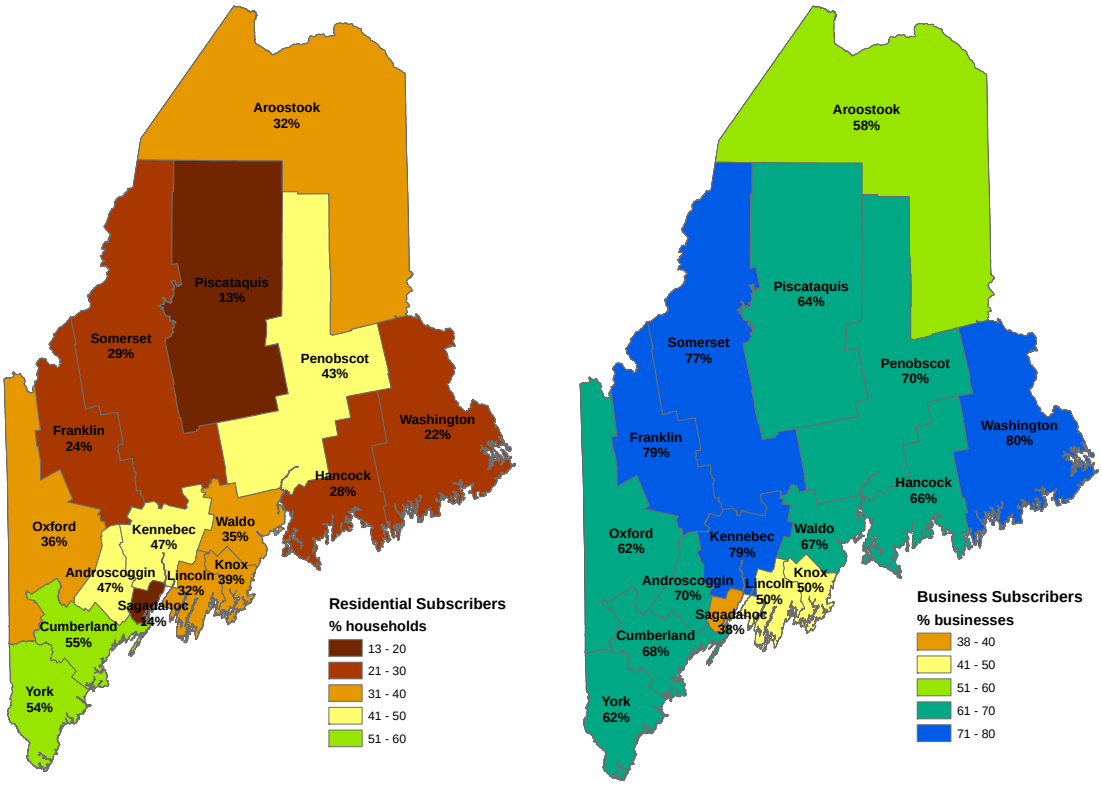


Figure 3-11: Residential and Business Adoption by County from FCC Form 477

4. *Broadband Infrastructure*. Maine ranks 45th in deployment of broadband telecommunications, 41st in the number of IT professionals in non-IT industries, and 35th in high-tech jobs as a percentage of all jobs.[17]

   Maine currently has 34 end user internet service providers (ISPs) serving the State. Municipalities are served by an average of 4.3 broadband providers, none of which is a nationally scaled provider. Without a national

[15] FCC Form 477 collects information about broadband connections to end user locations, wired and wireless local telephone services, and interconnected Voice over Internet Protocol (VoIP) services, in individual states.

[16] At least seven providers are not accounted for in the Form 477 data the Sewall Team has received (Aroostook Internet, Aroostook Technologies, Chebeague.net, Midcoast Internet Solutions, Pioneer Broadband, Premium Choice Broadband, RedZone Wireless).

[17] See http://www.itif.org/files/2007_State_New_Economy_Index_Small.pdf report

scale, Tier 1[18] ISP with large capacities, customer bases, numbers of routes, and settlement-free access to the entire internet, Maine is not part of the national internet backbone. Hence the internet is accessed through middlemen, referred to as Tier 3 ISPs, who must pay for connectivity to the internet backbone, thereby raising costs to the consumer. Without a national provider (at least in terms of wired services), Maine does not benefit from national initiatives driven either by the private or public sector, or national research and education networks such as Internet2 and National Lambda Rail.[19] As access-network providers, not backbone providers, Maine's service providers are generally too small to be engaged in such initiatives.

As of this writing, of Maine's 34 current end user ISPs, only one—Union River Telephone—has deployed or is deploying a next generation access (NGA) network across the majority of its territory to both residential and business consumers. NGA networks are wired access networks that consist wholly or in part of optical elements and that are capable of delivering broadband access services with enhanced characteristics such as higher throughput as compared to those provided over already existing copper networks.[20]

3.2 PROFILE OF MAINE BROADBAND

A distinct profile of Maine broadband as of April 2011 emerges from the survey findings when viewed in aggregate. Key points for comparison on broadband availability, use, gaps, drivers and barriers to adoption are summarized below by stakeholder group, including service providers, households and businesses, community anchor institutions (CAIs), the telemedicine community, Native Indian Tribes, and State agencies.

3.2.1 The Stakeholders—Providers and Consumers

Broadband Service Providers

Availability. Based on data from the Maine Broadband Inventory and Mapping Project and population data from the 2000 US Census, providers in Maine serve 91.1 percent of locations with at least Tier 1 coverage (download and upload speeds of at least 768 Kbps—Figure 3-2). As broadband speed and capacity

[18] A Tier 1 network is an internet protocol (IP) network that can reach (peer with) every other Tier 1 network on the internet without purchasing transit or paying settlement. A Tier 2 network is an IP network that peers with some networks, but still purchases IP transit or pays settlement to reach at least some portion of the internet. A Tier 3 network is an IP network that solely purchases transit from other networks to reach the internet.

[19] http://www.internet2.edu/ and http://www.nlr.net/.

[20] See http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010H0572:EN:NOT

increase, availability decreases (Figures 3-2 to 3-8). According to our modeling of consumers, the share of population located outside of urbanized areas and urban clusters has a negative effect on availability (Section 4.1.1). Service providers currently pursue and secure business in the most populated parts of the State.

Gaps and Barriers to Service Expansion. Cost, technical issues, policy and regulations, and location are cited as key barriers to expanding availability (Table 4-5). Cost barriers, measured in terms of return on investment, include lack of capital and the high cost of equipment indicative of Maine's smaller broadband access-network providers, cost of electricity, and lack of affordable middle-mile service. Maine's geography, both in terms of its topography and in relation to the national internet backbone, and low population densities also inhibit the development of higher-level service.

To expand services, providers need greater backhaul capacity (middle mile bandwidth) and access to transmission technology. As it is, providers are concerned about low subscribership where service already exists and a low perceived value for raising the level of service in a market that doesn't support investment.

Gaps and Barriers to Adoption. Service providers identified Maine consumers' lack of awareness of the benefits of broadband as a primary barrier to adoption (Table 4-6). Affordability, lack of technology or of technical assistance, fear of the technology and an aging population were other reasons cited. Service providers identify public sector investment for newer technologies, incentives for rural penetration, and increased marketing to consumers as critical to expansion. However, the ConnectME Authority's current focus on the unserved last-mile does not generally address these barriers.

Forum Notes:
One forum attendee described solar panels that she and her husband had installed on their Washington County home to reduce energy costs. The system's effectiveness and efficiency can be evaluated via internet connection. But without adequate internet access, this rural couple is unable to utilize this diagnostic service and does not know whether their system is functioning optimally.

Residential Consumers

Availability. Economic modeling of data from the Maine Broadband Inventory and Mapping Project shows that broadband services are more widely available in municipalities with a greater percentage of the population residing in urbanized areas and in places with younger residents, higher shares of residents with a college degree, and higher median household incomes (Section 4.1.1). Although the median household income of a Maine municipality is a determinant of broadband availability, the analysis of the household-level data suggests that income is a limiting factor for

computer use and broadband subscribership only for the lowest household income category of less than $15,000 per year.

Use and Drivers. Modeling of household survey data indicates that household size and age characteristics including the presence of senior citizens and children under the age of 18 have a significant impact on computer use and broadband subscribership (Section 4.2.2). The presence of children in a household increases the likelihood of owning a computer and spending 20 or more hours online each week. Households with at least one person with a graduate degree are more likely to subscribe to some sort of broadband internet and use a greater variety of software applications. The presence of only senior citizens in a household decreases the likelihood of subscribing to a broadband service. Significantly, survey results identify a relationship between the frequency of "homeboundness" and hours of internet access by respondent and by household. Internet use increases as days of homeboundness increase (p. 4-20).

Gaps. Attendees at the public forums indicated that the lack of broadband access at home impacted their ability to access important services, particularly educational opportunities. Increasingly, academic research is conducted online, teachers without home access cannot conduct educational activities (e.g., retrieve online lesson plans), and students without home access cannot complete assigned activities.

Barriers to Adoption. Not having a computer in the home is the primary barrier to adoption with cost coming in second. Of the residential respondents who did not have a computer in the home, the highest percentage indicated lack of interest as the main reason, cost a second, and lack of knowledge on computer use a third (Figure 4-9). Cost was cited as the primary barrier to subscribing to faster service.

Business Consumers

Availability. Economic modeling of data from the Maine Broadband Inventory and Mapping Project shows that the types of businesses (i.e., industry categories) in the local economy are associated with broadband availability. More specifically, shares of local employment in the agriculture, forestry, fishing and hunting; construction; and public administration sectors tend to be associated with reduced access to broadband. The analysis shows a positive relationship between the availability of broadband and the share of local employment in the wholesale trade, retail trade, finance and insurance, and educational services industries. Finally, the modeling shows that the presence of CAIs and large businesses—those with 100 or more workers—does not have a significant effect on the availability of broadband services in Maine (Section 4.2.3).

Use and Drivers. According to the economic modeling, very small businesses (less than 5 employees) are less likely to exhibit heavy use of computers, to subscribe

to a broadband service or to employ an IT worker (Table 4-116). Heavy use of computers and a higher incidence of broadband adoption is exhibited in organizations with 5 to 100 employees. Organizations from 51 to 100 employees are most likely to subscribe to a fiber optic or T-1 broadband service and have an employee with IT-related duties. The age of the organization has no bearing on heavy computer use or of broadband, or employment of IT staff. The survey shows, however, that newer organizations use a greater variety of software applications.

Among small business survey respondents, a positive relationship exists between the frequency with which computers are used and the percentage of business' purchases of goods and services acquired from outside of Maine (p. 4-30). Significantly, a positive relationship also exists between the frequency with which computers are used and the percentage of a business' revenue generated from outside of Maine, indicating a potential access to out-of-state revenues that can be better realized through increased broadband subscribership.

County of location is a determinant of heavy use of a computer, of broadband, and a variety of computer software. An example is Hancock County, where quality of place influences the market for real estate (Table 4-20).

Gaps. A consensus voiced in the public forums is that if Maine is on dial-up only, it cannot compete (Section 4.2.3).

Barriers to Adoption. According to business respondents, a primary reason they do not connect to the internet is perceived lack of need (Figure 4-18). A second barrier is cost to acquire internet connectivity. Cost was also identified as a barrier to upgrading to faster internet service.

Community Anchor Institutions

Availability. Of the CAIs participating in the survey, schools and libraries along with higher education institutions have 100 percent broadband service (Table 4-23). Nongovernmental community support organizations showed the greatest lack of broadband availability, with public safety facilities—over half of which are volunteer fire departments—the second greatest. Lack of broadband access was cited as a primary barrier to adoption. CAIs who have connections use multiple providers and/or technologies to gain access to the internet.

Drivers and Gaps. CAIs indicated access to broadband for internal operations, particularly video conferencing, video-based training and research, and video surveillance, as a critical need.

Barriers to Adoption. The primary barrier to adoption for local government offices, non-government support organizations, and public safety facilities is broadband-

level service availability. Where service is available, cost of service and the level of quality are major deterrents. Outdated equipment and lack of technical support are other key factors.

Schools and Libraries

Although schools and libraries are defined as CAIs, survey results on this group are assessed separately.

Availability. Essentially all Maine's schools have broadband connectivity, but 56 percent are still served by copper-based lines at a relatively low level of connectivity rather than with fiber optic connections. This design is not scalable to meet future bandwidth demand (Section 4.2.6).

Use and Drivers. High-speed broadband connectivity has become essential to Maine's schools and libraries with video-based distance learning and web conferencing a key driver. In limited instances, district-area-networks have enabled efficient sharing and consolidation of IT resources and have successfully modeled how economies of scale drive down the costs of services.

Forum Notes:
A Somerset County schoolteacher spoke of the challenges faced by both instructors and students. Although he had excellent internet access at school, he lacked access from his home where he created lesson plans, graded student work, and enhanced his own subject-related knowledge base. As with many other teachers, this type of work must be done from home as there are not sufficient hours during the work day. Without more than dial-up access, his lesson plans and assignments were sometimes limited and he was not able to confirm all of the online resources referenced in student papers. He noted that many students in the State who are given a laptop cannot use them to access critical resources on the internet from home due to lack of available internet service.

Gaps. Schools and libraries servicing island communities receive the lowest levels of broadband connectivity. A major gap in libraries and smaller schools throughout the State is technical support.

Barriers to Adoption. Primary barriers to adoption for schools and libraries are price and availability. The size of the funding assessment (MTEAF and federal School and Library Universal Service programs) defines the amount of broadband internet delivered. Without sufficient bandwidth, schools and libraries cannot leverage their connectivity to its fullest potential. To acquire additional bandwidth, however, they must demonstrate heavy utilization of the existing bandwidth. High utilization levels can cause poor performance and long delays with some applications, which then discourage use and reduce utilization.

The lack of fiber infrastructure in both middle and last mile is also a barrier to adoption as the bandwidth required by schools and libraries cannot be delivered other than by fiber optic connections. Goal #4 of the National Broadband Plan calls for delivering 1,000 Mbps to every CAI within the next decade.[21] Meeting this requirement for large regions of the State, in our opinion, will require another

[21] http://www.broadband.gov/plan/.

Three Ring Binder sized investment.[22] The investment needed to install broadband infrastructure that is scalable to meet the bandwidth demand over the next 20 years to every household and business in Maine could be in the hundreds of millions of dollars.

Telemedicine Community

Availability. Some 88 percent of medical providers, dental providers, and hospitals have access to broadband (Section 4.2.7), but only 18 percent of the group surveyed uses telemedicine services.

Use and Drivers. Broadband connectivity is used in all aspects of delivering healthcare. The requirements for connectivity depend on the application, but speed and reliability are required in most cases. Tele-homecare is a significant driver for connectivity for residential consumers and has the potential to reduce the cost of delivering healthcare to Maine's aging population.

Gaps and Barriers to Adoption. A primary barrier is the delay of the NETC network implementation, which has stalled the plans of many healthcare providers to deliver telemedicine services. This barrier should lessen as the NETC network starts deployment. Another barrier specific to realizing an electronic health records exchange for small practices is the lack of IT knowledge and support, and an understanding of the value that broadband connectivity can bring. A third barrier is existing healthcare and insurance regulations that create obstacles to using tele-health primarily in restrictions on reimbursements.

Forum Notes:
The director of adult education from one of Maine's more rural counties noted his mission to prepare his students for educational, labor force and technological literacy. Without more than dial-up internet access, many of his students are unable to pursue educational opportunities online, research and apply for jobs, and develop basic technological skills that would make them viable candidates for desirable employment. These students' competitive disadvantage grows by the day as their "connected" peers advance without them.

Native Indian Tribes

Availability. Though not all residents of tribal lands share equally in options for broadband service, there is availability of at least one form of basic broadband service on all tribal lands. Higher speed and bandwidth capable service can generally be acquired by community anchor institutions and businesses located on reservation or trust lands (Section 4.2.8).

Use and Drivers. The consumers of broadband service among the Native Indian population have the same governmental, community, business, and personal drivers that define their interest in broadband services as the State's general population. Subscription rates are slightly lower in the reservation communities than in other regions of the State. The reason appears to be perceived value

[22] http://www.maine.gov/connectme/summit/docs/3ringbinderMFC.pdf

against cost of service, especially when cost of service takes a greater percentage of income in comparison to other state populations.

Gaps. The most reported gap is consistent quality of service. Users reported impacts to system performance that appear to correlate to bandwidth. This problem was most evident with higher use applications like streaming content or online game play. Business users and potential business users see access to more affordable service rates and increased high speed capacity as their primary business driver. In today's economy, better telecommuting capacity should enable tribal businesses to take advantage of economic opportunities presented to Native American communities nationwide.

Barriers to Adoption. The key barriers to adoption by individual subscribers are cost of computer ownership and cost of internet service. For those in the lowest income level, access generally is through organized support services like community groups, schools, and libraries.

A high percentage of those interviewed perceive no value in broadband. For this segment as with other segments of the population, more education on the socioeconomic value of internet use may encourage them to subscribe. Technology assistance programs or other system incentives like discounts or tax deductions for items like home energy management systems may also encourage adoption.

State Agencies

Availability. Remote parks or campgrounds excepted, Maine State offices and facilities have broadband connectivity (Section 4.2.9).

Use and Drivers. The State uses broadband to meet a wide array of internal operational and public service needs, with the use of video for conferencing cited in particular. Reporting, incident mapping and recordkeeping, and connecting to other sites are also important uses. Broadband internet access is critical to delivering online services to the public for such activities as registering motor vehicles, purchasing licenses, and paying tax bills. The need to increase capacity becomes greater with data intensive uses such as video conferencing and the transfer of health records. Expanding wireless connectivity to handheld devices for ease of use is an indicated need.

Forum Notes:
A State employee who attended a forum spoke of her ability to work from home one day each week. Her employer approved this arrangement to help her reduce significant fuel costs commuting to Augusta and to retain a valuable professional. With dial-up internet access, the employee started her home-based days earlier than others to allow time to access necessary web sites and download large files needed for work. Despite starting at 6:00 am, some sites and files remained inaccessible. She questioned her ability to fulfill her responsibilities in this fashion and, with the transportation costs, her ability to retain her current position.

Barriers to Adoption. Cited barriers to meeting increasing demands for bandwidth are lack of resources and the fact that internal policies within state government may not be conducive to cost-efficient resource sharing. It should be noted, however, that with the limited information provided concerning the State agencies, it is difficult to provide a more accurate picture of their barriers to broadband adoption.

3.2.2 Common Themes

A comparison of stakeholder responses shows a strong common themes. These include:

Lack of Perceived Value

There is a perceived value gap that hinders broadband adoption across all stakeholder groups. This perception is influenced by the ratio of the cost of the broadband service to the bandwidth delivered. Also the combination of multi-media communications and limited bandwidth can result in poor experience for a consumer with slow broadband connections. Higher bandwidth levels allow for more uses, both in terms of applications and concurrency, and create a better use experience for the consumer, thereby increasing the perceived value.

There is also an awareness gap across all stakeholder groups. It is difficult for consumers to assign a value or worth to what they have never experienced. For many, the term "broadband" is all that is known. Faster speeds described with acronyms like "Mbps" or "Kbps" is usually meaningless to the consumer, and marketing terms like "turbo" do not convey a true value proposition. Marketing efforts that focus on the size of the "pipe" is akin to an electric company marketing on the basis of the number of amps available on an electrical entrance. Yet once obtained, high-speed broadband, a rapidly evolving and disruptive technology, impacts most aspects of daily life to the point where most people cannot imagine how they got along without it.

Broadband Demand Continues to Increase

Broadband is, or can be, used in all aspects of daily life and business. Education, communications, government, entertainment, commerce, and healthcare are all positively impacted by the availability of high speed broadband. Real-time applications (voice and video communications) and large image, video and other data files have become the norm. A simple YouTube video can be tens of megabytes in size with medical imagery measured in gigabytes. With the adoption of digital cameras, family photo collections now often measure in the multiple thousands of pictures stored on multiple terabyte hard drives that cost less than $100. When one realizes that in just three years a single application, Netflix's unlimited streaming service, grew to generate 20 percent of all internet traffic in

the US during peak times[23], it is probable that the demand for high speed broadband is going to continue to grow exponentially.

Advancements in consumer appliances and business tools will increase the need for broadband connectivity. As more devices become "internet enabled," the perceived value of broadband will increase especially for those with the lowest level of adoption—the elderly and businesses and medical practices with less than five employees. Televisions, picture frames, cell phones, game consoles, DVD players and many other consumer appliances now are able to make use of, and sometimes require, broadband internet access. Modern HVAC systems, lighting controls, security systems, and diagnostic tools used in daily business operations often can be controlled, monitored, or upgraded over a broadband connection. The greater the utility of a service, the greater its perceived value.

Forum Notes:
A businesswoman who attended the Skowhegan forum spoke of the benefits of high-speed internet in her professional and personal worlds. She warmly spoke of weekly breakfast with her very young grandchildren living out of state via Skype. She and her distant family routinely shared a virtual breakfast table and family conversation.

The impact of Wi-Fi on broadband adoption cannot be discounted as more devices become internet enabled. Removing the wires from the last 100 feet of a broadband connection has removed much of the technical and physical complexity of connecting devices to the internet. The widespread availability of open Wi-Fi networks is also increasing broadband adoption rates. Near ubiquitous availability is creating a culture where always being connected is expected, especially among younger people.

Low Speed Broadband a Detriment

The bandwidth levels available today on Maine's broadband networks are too low to significantly affect behavior in a positive way.

3.3 STRATEGIES AND RECOMMENDATIONS

Based on our assessment of the survey results and the common themes that have emerged, we provide the following preliminary strategies and recommendations to increase broadband availability and adoption throughout Maine. These will be developed in the forthcoming Strategic Plan.

[23] http://www.sandvine.com/news/pr_detail.asp?ID=288

The ConnectME Authority

- Expand its focus to its entire charge (businesses and agencies, educational institutions) rather than just unserved residential consumers
  - Reassess function and mission using the data gathered by the mapping and planning initiatives to guide the process

- Broaden its focus from end mile development to include higher-level services
  - Adopt a flexible broadband standard similar to the FCC's and raise the current funding standard in the State from 768 Kbps down/200 Kbps up to 4 Mbps down/1 Mbps up, as described in the FCC's National Broadband Plan

- Consider whether and how all projects funded by the Authority could adopt an open access, non-discriminatory model to be defined by the Authority

- Work with service providers to on deployment methods that allow multiple service providers to enter a market

- Assist broadband champions in promoting the benefits of broadband to low adoption groups
  - Demonstrate benefits that improve something that target group members are already doing or deliver something that they want or need
  - Mobilize regional technology teams to establish unique deployment strategies that bridge availability gaps and reduce or eliminate barriers
  - Maximize the value of Maine State Library's BTOP Public Computer Center (PCC) award and the BTOP-funded Washington County Education and Employment through Sustainable Broadband Adoption Project through more effective marketing

- Target public awareness campaigns to residential consumers who do not own a computer or use the internet
  - Provide both informational and experiential means to increase perceived usefulness and perceived ease-of-use
  - Encourage "trial-ability" that includes an experiential component
  - Focus on value, not cost
  - Encourage household opinion leaders/drivers (e.g., children in household) to expand their range of broadband activities, reinforcing existing use and highlighting benefits achieved by encouraging others to use broadband. We live in an era in which peer-to-peer consumer influence is gaining greater favor and credibility. It is important to target opinion leaders by ensuring a

constant flow of appropriate resources with which they may influence others. Such resources should focus on expanding their range of broadband-based activities, reinforcing existing use, and highlighting the benefits achieved by encouraging others to adopt broadband.[24]

- Target public awareness campaigns to business owners who do not use internet or broadband
  - Emphasize quantifiable ROI of internet connectivity, driving home the business value of computer ownership, use, and internet connectivity
  - Focus on value, not cost
  - Support training to leverage existing internet-based tools to reach new markets (e.g., marketing tools such as Google Adwords, Groupon, Amazon and e-Bay storefronts; social networking sites such as Facebook and Twitter)
  - Apply standard marketing approach of facilitating consumer passage through the psychological phases through which consumers progress to make a purchase decision: Awareness => Interest => Desire => Action—citing the relationship between business computer use and revenues
  - Target subset of campaign to geographic areas of low business adoption, such as Oxford County

- Target awareness campaign to municipal governments that have low broadband availability in their communities
  - Encourage inclusion of broadband initiatives as part of their economic development efforts
  - Emphasize the impact broadband availability has on real-estate values
  - Increase awareness of availability of funds through the ConnectME Authority and federal programs

[24] This recommendation is supported by, e.g., the Everett Rogers Diffusion of Innovations, a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures (Everett M. Rogers, *Diffusion of Innovations*, 5th ed., New York: Free Press, 2003). According to the theory, product adopters are categorized as (1) innovators; (2) early adopters; (3) early majority; (4) late majority; and (5) laggards. A single consumer may fall into different categories for different products. It is noted in research that early adopters have the highest percentage of opinion leaders and it is those consumers whose status should be leveraged.

Service Providers

- Provide cost incentives such as waived installment fees, trial periods, and discount computers

- Sponsor or offer training/educational opportunities about the value broadband can deliver

- Work with local community leaders to increase and aggregate demand

State Government

- Leverage the existing Maine.gov revenue model of value-added services by funding the development of additional free information and services to promote broadband use and adoption to all citizens through the State of Maine web presence.

- Drive regulatory reform
    - Encourage investments in Next Generation Access networks by conducting a comprehensive cost/benefit analysis of a telecommunications regulatory model where the physical infrastructure (poles, conduits, fiber optic cables, etc.) are regulated and owned by a wholesale NGA operator(s) while separate service operators provide the retail services (voice, video, data). This structural separation model would reduce wasteful overbuilding of infrastructure, increase competition where market demand exists, and increase access in regions with few market drivers. In this model, high-cost universal service funds should be made available to the regulated NGA network operators along with the obligation to provide universal service.
    - Review current state-level healthcare and insurance regulations to ensure that broadband enabled changes in healthcare process and procedures can be fully realized.

- Foster the creation of an international backbone through Maine to New Brunswick in conjunction with the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP). The creation of a broadband corridor, or eCorridor, through Maine and the maritime provinces could provide the shortest path between the financial markets in the US and Europe. Such an eCorridor would reduce backhaul costs for the local broadband service providers and strengthen Maine's IT sector bringing the benefits of an IT literate workforce to Maine's other industry sectors.

4.0 Survey Results

Detailed survey results and analyses on broadband availability, use, drivers and barriers to adoption are presented in this section, with a focus first on the supply side—end user service providers—and second on the demand side—households and businesses, CAIs, the telemedicine community, Native Indian Tribes, and State agencies. For survey methodology and processes, see Section 6.0.

4.1 BROADBAND SERVICE PROVIDERS

Availability and use of broadband depends on the investment decisions of service providers and the demand for services by local households, businesses, and community organizations. When deciding to deploy broadband infrastructure, providers consider the cost of reaching potential customers as well as the likelihood that they will subscribe to available services. A municipality's geographic location and population settlement patterns—which affect the cost of delivery—and characteristics of local households, businesses and community organizations—which affect the need for, and interest in, services—are likely to be key determinants of broadband deployment.

To determine broadband availability in Maine and the socioeconomic factors that influence broadband deployment, the Sewall Team analyzed results from economic modeling using broadband service provider data from the ConnectME Authority Broadband Mapping and Inventory Project and municipality-level population data from the 2000 US Census. Additional findings were obtained from a survey of service providers on their expansion plans (Section 4.1.2).

4.1.1 Economic Modeling Summary of Broadband Availability

This study analyzed the availability of broadband services in Maine, defined as the FCC Tier 1 minimum download and upload speed of 768 Kbps or greater (Section 2.3.1). Five categories of broadband service technologies in Maine municipalities were considered, including DSL, cable, T-1, fiber optic, and fixed wireless. In addition, three categories of broadband service technologies—cable, DSL and fixed wireless—were considered separately because these technologies have, by far, the greatest availability in Maine municipalities.

Using information on a sample of 494 Maine municipalities, our findings indicate that 91.1 percent of Maine locations have access to one or more of the five technologies (Table 4.1). Access varies widely across Maine, ranging from 99 percent of the locations in Androscoggin, Lincoln and York counties to 48.9 percent availability in Piscataquis County. Looking at individual technologies, results indicate that 84.7 percent, 36.4 percent and 15.7 percent of Maine locations have access to broadband via cable, DSL, and fixed wireless services respectively.

Table 4-1: Availability of Broadband Service in Maine

	% of locations with access to broadband				Average
Region	**Any Type**	**Cable**	**DSL**	**Fixed Wireless**	**Number of Suppliers**
Statewide (n=494)	**91.1%**	84.7%	36.4%	15.7%	4.3
County					
Androscoggin (n=14)	**98.9%**	95.9%	49.8%	0.0%	4.3
Aroostook (n=67)	**84.1%**	64.4%	18.4%	58.7%	4.4
Cumberland (n=26)	**94.4%**	93.8%	36.1%	0.5%	4.3
Franklin (n=23)	**73.3%**	61.1%	30.4%	0.0%	3.5
Hancock (n=36)	**81.4%**	70.3%	19.9%	39.3%	4.0
Kennebec (n=30)	**98.0%**	97.7%	25.3%	3.6%	4.0
Knox (n=18)	**96.9%**	87.2%	41.5%	86.6%	5.9
Lincoln (n=20)	**99.3%**	94.5%	46.0%	50.8%	4.4
Oxford (n=37)	**90.6%**	83.9%	47.2%	0.0%	3.6
Penobscot (n=61)	**88.8%**	76.9%	46.0%	24.4%	5.0
Piscataquis (n=19)	**48.9%**	40.6%	18.7%	0.0%	3.4
Sagadahoc (n=10)	**93.3%**	89.4%	37.0%	31.5%	4.7
Somerset (n=33)	**61.2%**	52.0%	25.2%	0.0%	3.8
Waldo (n=26)	**75.6%**	53.6%	35.5%	25.0%	3.7
Washington (n=45)	**91.1%**	60.0%	19.9%	76.0%	3.8
York (n=29)	**99.1%**	98.8%	42.8%	0.0%	4.6

Note: Information on the number of broadband suppliers and the percentage of locations with access to broadband is from the Maine Broadband Inventory and Mapping Project conducted by Sewall for the ConnectME Authority. These figures are weighted by municipality population size as of the 2000 US Census.

The analysis also shows that the most important factors explaining the differences in broadband availability across Maine municipalities are the age of the population, educational attainment, and median household income. In addition, the analysis indicates that aspects of a municipality's geographic situation—the county of location and its proximity to other places with access to broadband—are key determinants of broadband availability. Finally, our results suggest that the shares of local employment involved in wholesale trade, retail trade, finance and insurance, and educational services tend to have a positive effect on broadband availability.

Table 4-2: Factors Affecting Broadband Availability in Maine Municipalities

Factor	Providers	Any Type	Cable	DSL	Fixed Wireless
Population Density	No Effect	No Effect	**Positive** (1 of 3)	**Positive** (1 of 3)	No Effect
Rural Population[25]	**Negative** (2 of 2)	No Effect	**Negative** (3 of 3)	No Effect	No Effect
Median Age	**Negative** (2 of 2)	**Negative** (3 of 3)	**Negative** (3 of 3)	**Negative** (3 of 3)	**Negative** (1 of 3)
Educational Attainment	No Effect	**Positive** (2 of 3)	No Effect	No Effect	**Positive** (3 of 3)
Median Income ($1,000s)	**Positive** (2 of 2)	**Positive** (1 of 3)	**Positive** (1 of 3)	**Positive** (3 of 3)	**Negative** (1 of 3)
Housing Value ($1,000s)	No Effect	No Effect	**Positive** (1 of 3)	No Effect	No Effect

Notes: A positive / negative effect means that an increase in the magnitude of the factor is associated with an increase / decrease in the measure of availability. The information shown in parentheses is the number of regression models in which the factor has a statistically significant effect (at the 10-percent significance level or lower). "No effect" means that the factor does not have a statistically significant effect on the measure of availability.

Focusing on the socioeconomic characteristics of local residents, we find that the median age of the population has a negative effect on broadband availability and that educational attainment and median household income generally have a positive effect on access to broadband (Table 4-2). This suggests that, other things being equal, telecommunications companies have made greater investments in Maine municipalities with younger and more educated residents—who might have a greater initial interest in broadband—and places with higher levels of household income—which is presumably a sign of greater ability to pay for broadband services.

In addition, the results indicate that the percentage of the population residing outside of urbanized areas and urban clusters is negatively associated with the availability of broadband in Maine municipalities. This suggests that the settlement patterns of the population, which affects the cost of infrastructure deployment, also affects broadband availability. As noted earlier, a municipality's geographic

[25] This report uses the US Census Bureau's classification of "rural" as a population density of less than 500 people per square mile; and of "urban" as a population density of at least 1,000 people per square mile, and at least 500 people per square mile in blocks surrounding an urbanized area.

situation—the county of location and access to broadband in surrounding areas—is a key determinant of the availability of DSL and fixed wireless technologies (Table 4.1).

Table 4-3: Effects of the Presence of Large Businesses and Community Anchor Institutions on the Availability of Broadband Services in Maine Municipalities

Variable	Any Type	Cable	DSL	Fixed Wireless
Large Businesses	No Effect	No Effect	No Effect	No Effect
Community Anchor Institutions	No Effect	No Effect	No Effect	No Effect

Notes: "No effect" means that the selected variable does not have a statistically significant effect on the measure of availability.

Table 4-4: Summary of OLS Regression Results: Effects of Local Industry Specialization on the Availability of Broadband Services in Maine Municipalities

Industry Category	Any Type	Cable	DSL	Fixed Wireless
Agriculture, Forestry, Fishing and Hunting	**Negative** (2 of 2)	**Negative** (2 of 2)	**Negative** (2 of 2)	**Mixed**
Construction	**Negative** (2 of 2)	**Negative** (2 of 2)	No Effect	No Effect
Manufacturing	**Positive** (1 of 2)	No Effect	**Positive** (1 of 2)	**Mixed**
Wholesale Trade	**Positive** (2 of 2)	**Positive** (2 of 2)	No Effect	No Effect
Retail Trade	**Positive** (2 of 2)	**Positive** (2 of 2)	No Effect	No Effect
Transportation and Warehousing	No Effect	**Negative** (2 of 2)	No Effect	**Positive** (1 of 2)
Utilities	No Effect	No Effect	**Negative** (2 of 2)	No Effect
Information	No Effect	No Effect	**Positive** (2 of 2)	**Negative** (1 of 2)
Finance and Insurance	**Positive** (2 of 2)	**Positive** (1 of 2)	**Positive** (2 of 2)	**Positive** (1 of 2)

Table 4-4: Continued

Industry Category	Any Type	Cable	DSL	Fixed Wireless
Real Estate	**Positive** (1 of 2)	**Positive** (1 of 2)	No Effect	No Effect
Professional, Scientific and Technical Services	No Effect	**Positive** (2 of 2)	No Effect	No Effect
Management of Companies and Enterprises	No Effect	No Effect	No Effect	No Effect
Administrative, Support and Waste Management Services	No Effect	No Effect	No Effect	**Positive** (1 of 2)
Educational Services	**Positive** (1 of 2)	**Positive** (2 of 2)	No Effect	No Effect
Healthcare and Social Assistance	No Effect	**Positive** (2 of 2)	No Effect	No Effect
Arts, Entertainment and Recreation	**Negative** (1 of 2)	No Effect	No Effect	No Effect
Accommodation and Food Service	No Effect	No Effect	No Effect	**Negative** (1 of 2)
Other Services	No Effect	**Positive** (1 of 2)	No Effect	No Effect
Public Administration	**Negative** (1 of 2)	**Negative** (1 of 2)	**Negative** (2 of 2)	No Effect

Notes: A positive / negative effect means that an increase in the percentage of industry employment is associated with an increase / decrease in the measure of availability. The information shown in parentheses is the number of regression models in which the percentage of industry employment has a statistically significant effect (at the 10-percent significance level or lower). "No effect" means that the percentage of industry employment does not have a statistically significant effect on the measure of availability. "Mixed" means that the percentage of industry employment has a positive effect in one regression, and a negative effect in the second regression.

Looking at the characteristics of local businesses, we found that the presence of "large" employers (i.e., 100 or more employees) and CAIs does not have a statistically significant effect on broadband availability (Table 4-3). The shares of local employment in wholesale trade, retail trade, finance and insurance and educational services tend to have a positive effect on broadband availability (Table 4-4). These results suggest that, along with population characteristics, the types of businesses present in a municipality influence the investment decisions of telecommunications companies.

A detailed economic analysis is provided in Section 5.0.

4.1.2 Service Provider Survey Results

Of the 28 end-user service providers contacted, 19 (68 percent) participated in the survey either by phone or in writing, providing the Sewall Team with information on their plans to expand service coverage, their barriers to expansion, and their barriers to adoption where service is available (see questionnaire in Appendix A). They also provided recommendations for increasing service expansion and adoption.

Expansion Plans

Of the service providers who provided responses to the survey, 65 percent have plans to expand their broadband service in the next 12 months.

Barriers to Service Expansion

As indicated by service provider response, barriers to service expansion can be grouped into four categories: cost, technical issues, policy and regulations, and location. The percentage of providers surveyed indicated the following barriers:

Table 4-5: Service Provider Barriers to Service Expansion

Cost	
• Low return on investment (low expected take rate)	68%
• Lack of funding/capital	53%
• High cost of equipment, utilities, and middle-mile service	37%
Technical	
• Need for greater backhaul capacity (wired, wireless)	21%
• Lack of access to pole attachments (wired)	16%
• Lack of available spectrums (wireless)	16%
• Lack of utilities (wired, wireless)	11%
• Technology of transmission (wired, wireless)	5%
• Lack of access to remote terminals (wired)	5%
Policy & Regulations	
• Cumbersome rules regarding pole attachments	11%
• Restrictive municipal ordinances governing towers	11%
• Lack of clear, consistent definition of broadband	5%
Location	
• Issues related to Maine geography and climate	16%
• Low population densities found in rural Maine	11%
• High number of camps and seasonal homes	11%

Barriers to Service Adoption

According to the providers surveyed, barriers to consumer service adoption where broadband service is available can be grouped into three categories: cost, education/awareness, and tools. As with the modeling results, service providers identified income and age as determinant factors.

Table 4-6: Barriers to Service Adoption

Cost	
• Affordability, costs too high	74%
• Use of free public WiFi service	5%
• Pirating of neighbor's service	5%
Education/Awareness	
• Not a priority, lack of awareness of benefits	68%
• Lack of technical assistance	42%
• Age of population	37%
• Non-use at work	11%
• Fear of technology	5%
Tools	
• Inadequate computer or no computer	53%

Service Provider Recommendations

Service providers were asked for recommended actions to increase expansion and improve adoption. Their recommendations are grouped into four categories: funding, marketing, education, and policies and regulations.

Table 4-7: Service Provider Recommendations

Funding
• State should offer subsidies and incentives for rural penetration • State should allocate funding for newer technologies to support greater speeds • State should support efforts to improve access for online education and online patient monitoring • State should subsidize new consumer subscriptions for lower-income populations • State or federal government should subsidize PC purchases and internet fees for households below national poverty level • State should fund grants that offer higher-cost solutions/higher cost per potential subscriber
Marketing
• Providers should try to engage communities, working to get residents actively involved • Providers should offer a trial or test drive • State should take steps to promote broadband • Providers should increase marketing • Marketing should promote content relevant to aging population, e.g., e-health
Education
• State and service providers should offer technical assistance and increased access to training • State and service providers should expand internet training classes
Policies & Regulations
• State/federal governments should change medical insurance regulations so that online visits are reimbursable • State government should work with municipalities to revamp tower ordinances • State government should reform pole access so as to allow ISPs to attach to poles and to make the attachment process more equitable and timely • FCC should resolve questions surrounding the Universal Service Fund • Maine PUC should keep rural exemptions in place

Summary of Service Provider Findings

In summary, service providers who participated in this survey indicated:

- The majority have plans to expand their broadband service coverage in the next year
- Nearly all cited lack of funding or low return on investment as the biggest deterrents to expanding service
- The reasons for non-adoption are affordability, not a consumer priority, inadequate computers, and lack of technical knowledge, echoing those barriers listed by potential consumers
- A wide range of ideas to increase expansion of service and improve adoption include:
  - using public monies to offset some of the costs of infrastructure expansion, computer ownership, and service subscriptions
  - stepping up public awareness and marketing campaigns
  - offering training and technical assistance
  - adapting regulations and policies to be more receptive to consumer and service provider needs

4.2 BROADBAND CONSUMERS

Results of the first-year surveys and analysis of the data gathered on broadband consumers, including residential and business consumers, CAIs, the telemedicine community, Native Nations and State agencies, are provided in the following sections. Specific attention is paid to availability, use, needs and drivers, and barriers to adoption of broadband statewide.

4.2.1 Residential and Business Consumers

Of the residential and business consumers surveyed by mail and online questionnaires, the total number of completed responses used in this assessment was 3,436 (2,842 residential[26] and 594 business). A breakout of the percentage of returns by county for both households and businesses is provided in Table 4-8.

[26] The modeling analysis of residential consumers used 2,834 responses as 8 of the total received (2,842) were incomplete.

Table 4-8: Residential & Business Consumer Survey Response Rate

Name of County	Households RESPONSE	Businesses RESPONSE
Androscoggin	37%	20%
Aroostook	28%	23%
Cumberland	27%	20%
Franklin	28%	18%
Hancock	30%	23%
Kennebec	27%	14%
Knox	38%	19%
Lincoln	22%	14%
Oxford	17%	11%
Penobscot	26%	19%
Piscataquis	33%	7%
Sagadahoc	17%	13%
Somerset	23%	14%
Waldo	22%	15%
Washington	25%	20%
York	22%	11%
Average Response	**26%**	**17%**

4.2.2 Residential Consumers Survey Summary Results

The results of the residential consumer surveys provide baseline information on household computer and internet use, and barriers to and drivers of adoption. These results together with the findings of the economic modeling analysis work to define the current status and future potential of broadband subscribership in Maine.

From these results, the following residential consumer details have emerged. (For the residential consumer survey questionnaire, see Appendix A. Complete survey results to each question of the residential consumer questionnaire with charts and graphs are provided in Appendix B.)

1. *Computer and Internet Use.* Of the households surveyed, 86.5 percent have a computer in the home (see Figure 4-1); 10.2 percent have a laptop computer from school (Figure 4-2). 89.6 percent of households with a computer have a connection to the internet (Figure 4-3).

Is there a desktop or laptop computer in your home?

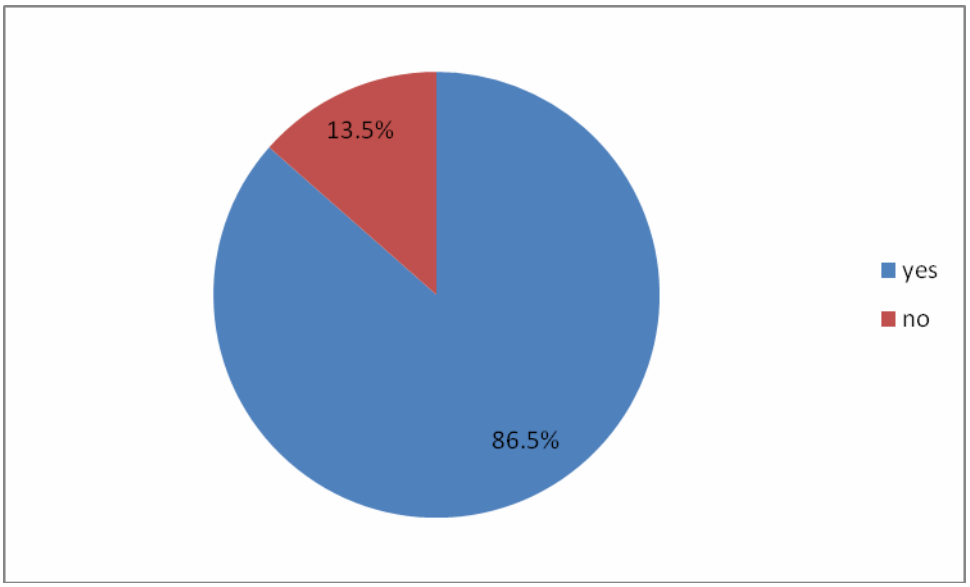


Figure 4-1: Computer Use in the Home (Survey Question #1)

Is there a child in the household who brings a laptop computer home from school?

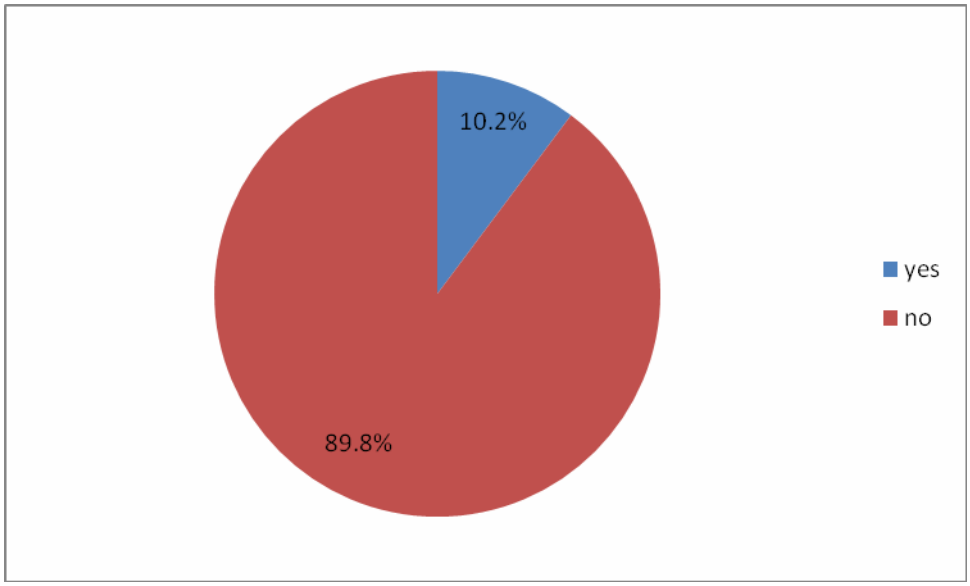


Figure 4-2: Use of School Laptops in the Home (Survey Question #2)

Does anyone in your household use a computer to connect to the internet from your home?

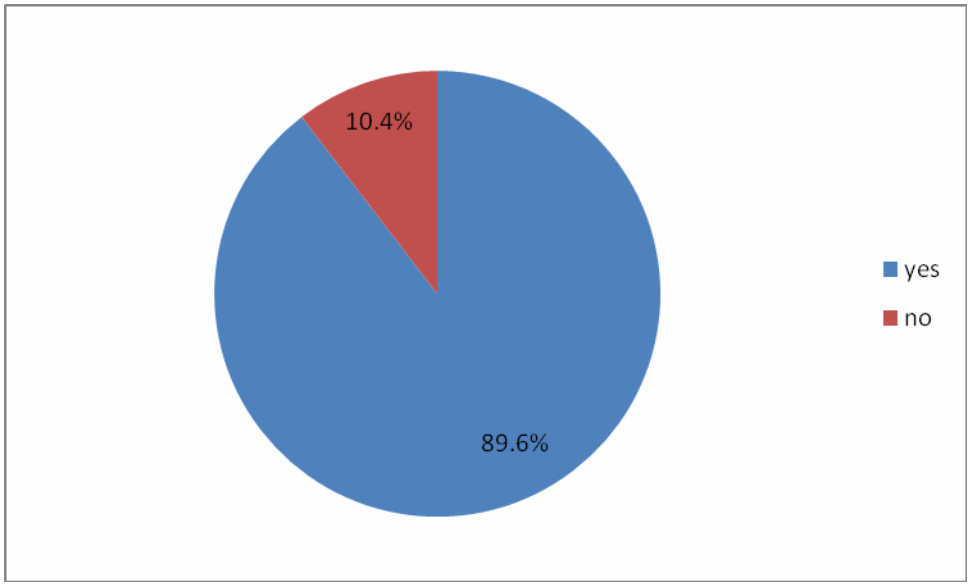


Figure 4-3: Use of Internet in the Home (Survey Question #6)

Of the households that do not have a computer, 41.2 percent indicated they would like to get one (Figure 4-4), and 30.3 percent plan on doing so in the next 12 months (Figure 4-5).

Would you (or others in your household) like to have a computer in your home?

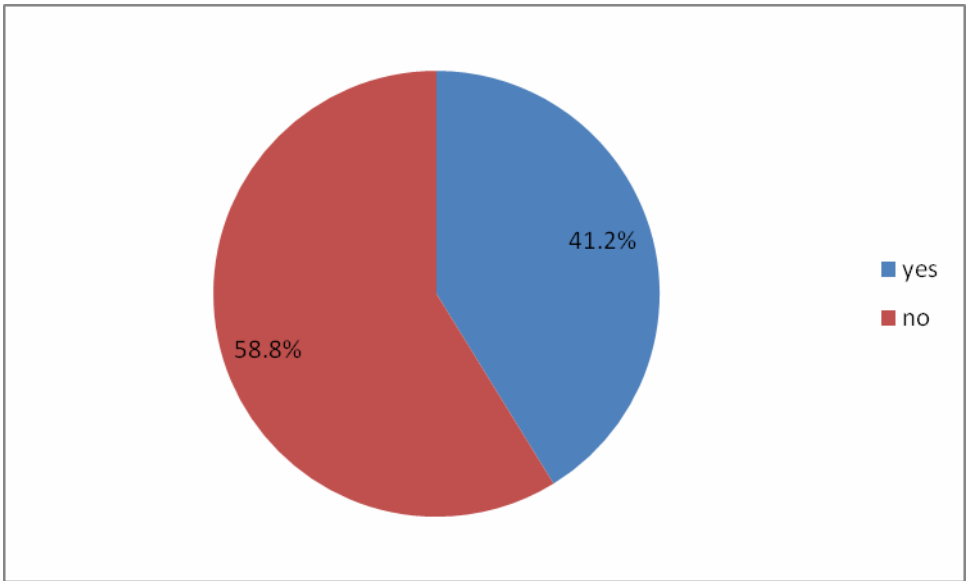


Figure 4-4: Desire to Have Computer in the Home (Survey Question #4)

Do you (or others in your household) plan on getting a computer for use in your home in the next 12 months?

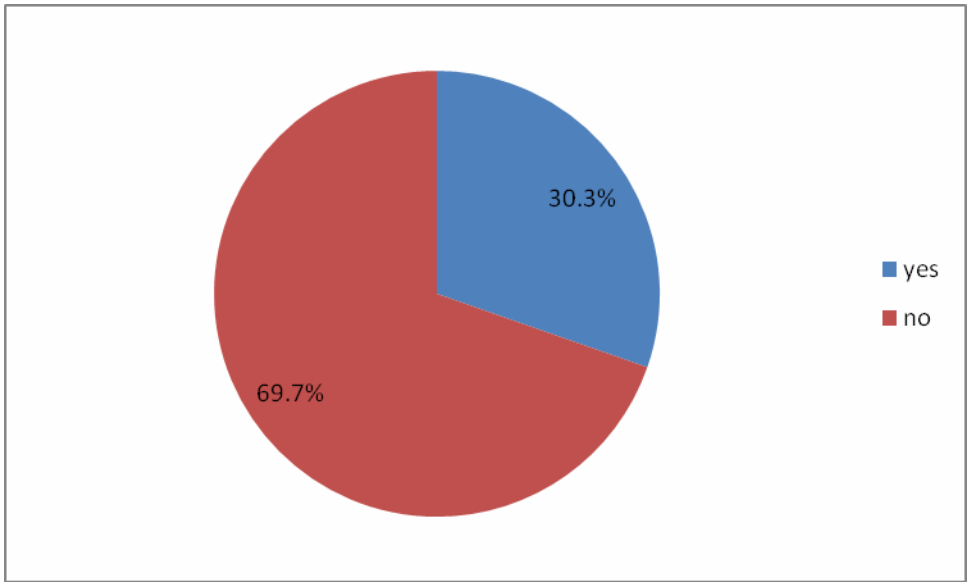


Figure 4-5: Intent to Obtain Computer for the Home (Survey Question #5)

Of the households that do not connect to the internet, 71 percent would like to (Figure 4-6), but only 26.3 percent plan to connect in the next 12 months (Figure 4-7).

Would you (or others in your household) like to connect to the internet from a computer in your home?

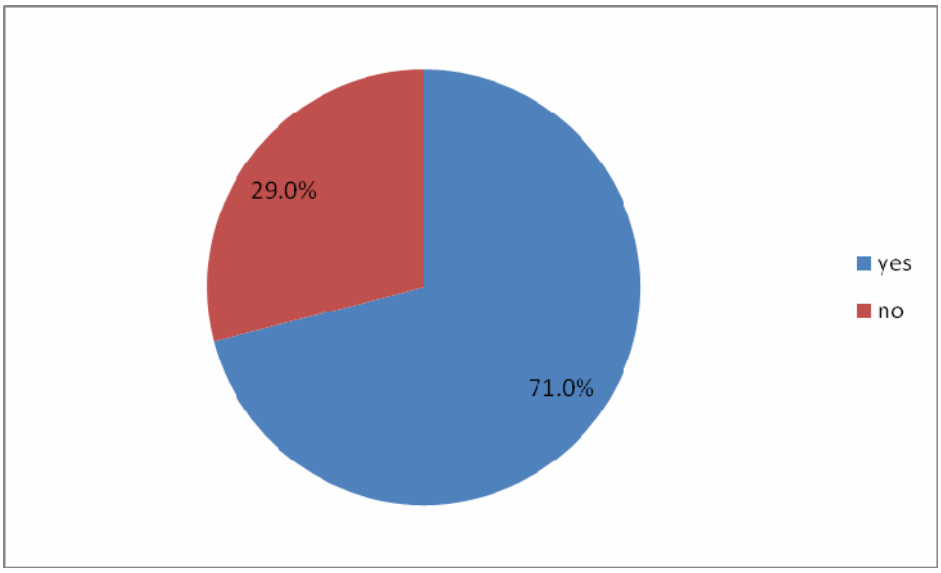


Figure 4-6: Desire to Connect to the Internet from Home (Survey Question #8)

Do you (or others in your household) plan on setting up internet service for a computer in your home in the next 12 months?

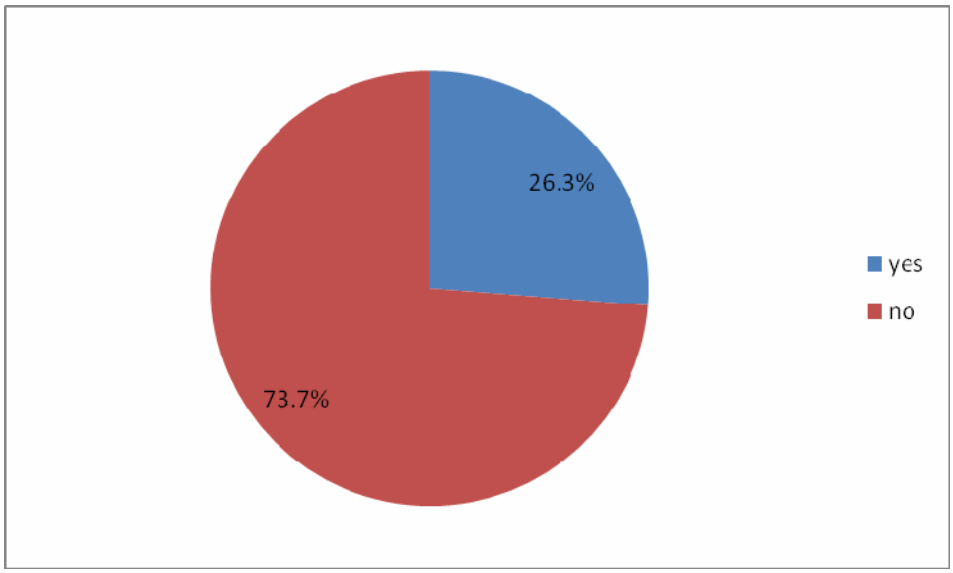


Figure 4-7: Intent to Set Up Internet Service (Survey Question #9)

A major reason respondents use the internet in their homes is for communications and social networking (Figure 4.8). 81.6 percent indicated that they, or others in their household, use the computer for email, Facebook and social networking. 73.3 percent use the computer for checking news, weather, and sports; 70.2 percent for online shopping, banking, or bill paying; and 58.2 percent for word processing. In addition, 52.7 percent use the computer for looking up information about businesses or other organizations, and 50.4 percent for looking up health-related information or for communicating with health providers.

By contrast, only 22.7 percent of respondents use the computer for working at home for an employer; 20.7 percent for searching/applying for a job, and 16.1 percent for conducting a home-based business.

The percentages of respondents who use the computer for educational purposes were also lower: 17.8 percent for educational/school assignments for children, 15.7 for online training for adults, and 13.8 for educational assignments for adults.

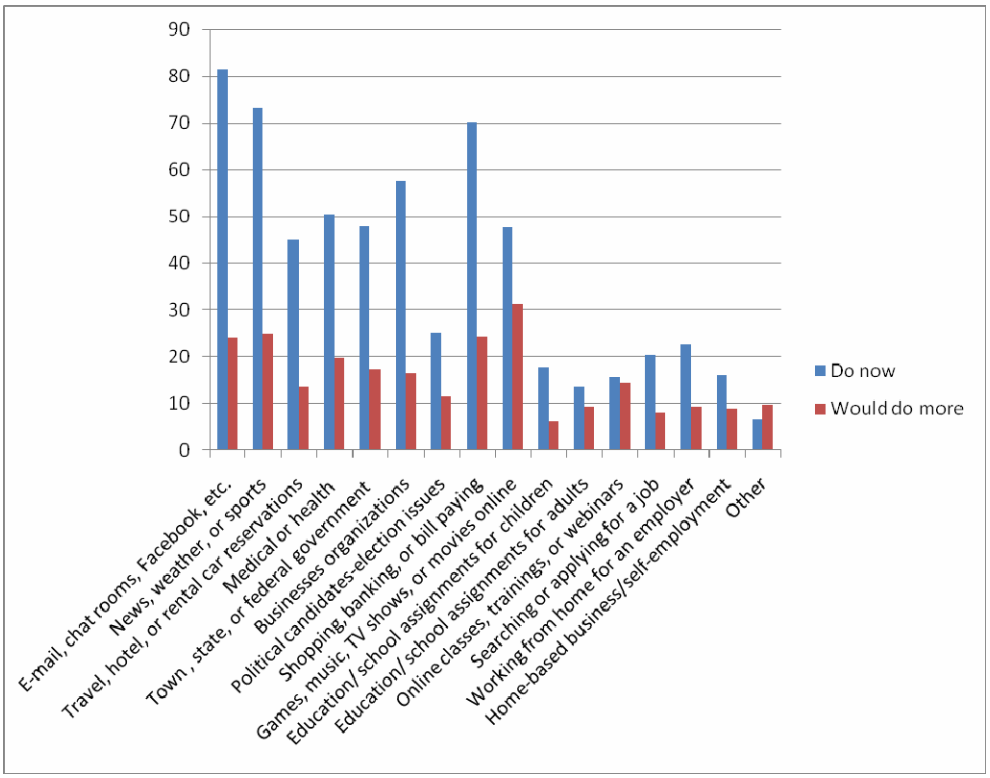


Figure 4-8: Current and Future Residential Use of Computer (Survey Questions 20-21)

If respondents had access to higher-speed internet, 31.3 percent indicate they would use the computer more for games, movies and other entertainment; 25.0 percent for checking news, weather, and sports; and 24.3 percent for online shopping, banking or bill paying. 19.8 percent would use the internet for researching health-related information and communicating with health providers. For educational purposes, 14.5 percent would pursue online classes for adults, 9.3 percent would access educational assignments for adults; and only 6.3 percent would access educational assignments for children.

The percentages for using higher-speed internet access for earning an income are also low. 9.3 percent indicated they would use the internet to work from home for an employer, 9.0 percent to run a home-based business, and 8.0 percent to look/apply for a job.

2. *Barriers to Computer Ownership.* Of the residential respondents who do not have a computer in the home, 44.7 percent said the single main reason for not owning a computer is because they are "not interested" or "don't need" one (Figure 4-9). This answer had the highest frequency, with cost coming in second at 21.3 percent. An additional 10.1 percent listed the main reason as "I/we don't know how to use a computer that well." Viewing non-computer owners as a potential target market for eventual broadband adoption, it is noteworthy that 54.8 percent gave reasons ("don't need and can't use well") that can be addressed through increased awareness and education.[27]

What is the main reason you (or others) do not have a computer in your home?

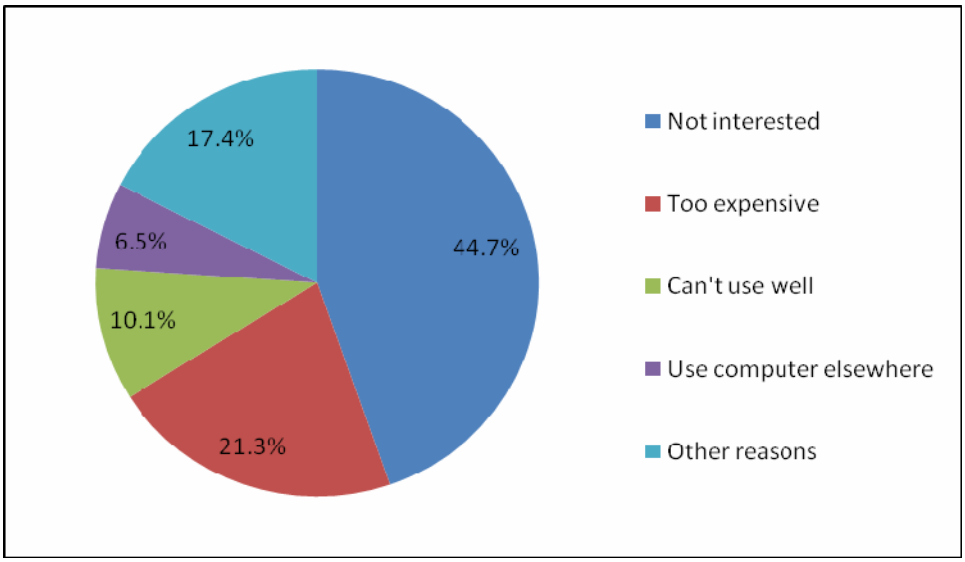


Figure 4-9: Main Reason for Not Having a Computer (Survey Question #3)

3. *Barriers to Internet Use/Broadband Adoption.* Aside from not owning a computer, cost of connection is identified as the primary barrier to adoption (Figure 4-10).

[27] The Technology Acceptance Model, an information systems theory that models how users come to accept and use a technology, explains that when users are presented with a new technology two key factors influence their decision about how and when they will use it: perceived usefulness and perceived ease-of-use. Research underpinning this theory shows that the combination of perceived usefulness and ease of use, taken together, lead to intent to use and ultimately use behavior. See Wayne D. Hoyer and Deborah J. Macinnis, *Consumer Behavior* (Cengage Learning, 2009), pp. 431-434.

What is the main reason you (or others in your household) do not connect to the internet from a computer in your home?

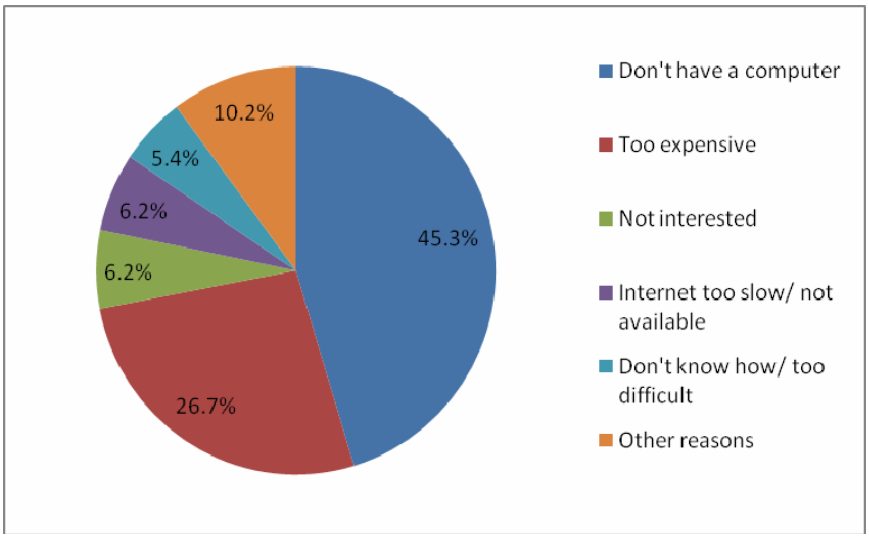


Figure 4-10: Main Reason for Not Having Internet in the Home (Survey Question #7)

In response to a check-all-that-apply question, "Why don't you subscribe to a faster internet service?" internet users (55%) answered, "The monthly bill for faster internet service would be too expensive" (Figure 4-11).

Why don't you subscribe to a faster internet service? (check all that apply)

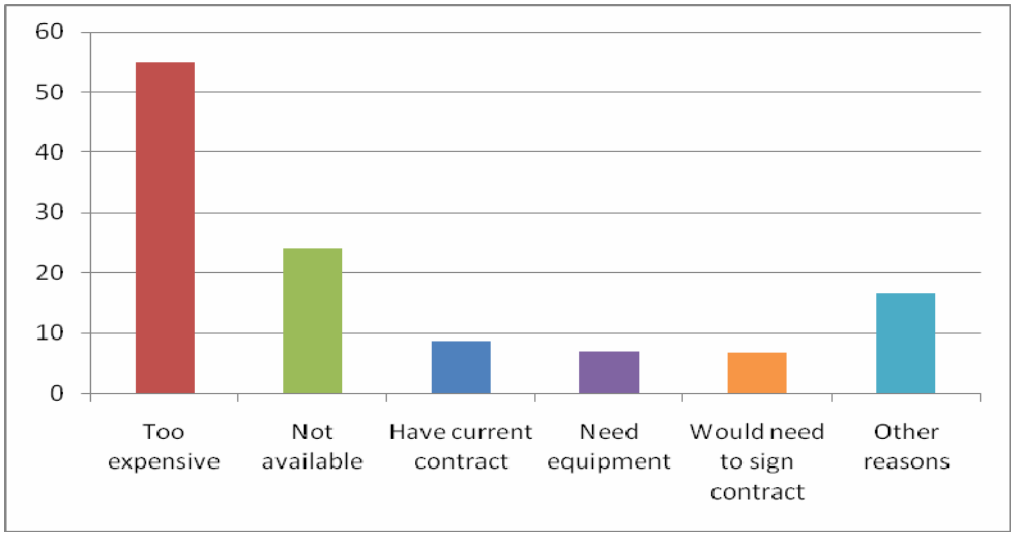


Figure 4-11: Reasons for Not Having Faster Internet Service (Survey Question #16)

Cost as a barrier is also indicated in the economic analysis, which shows the impact annual income has on the presence of a computer in the home and on broadband internet use. Income is a limiting factor, however, only for the lowest household income category of less than $15,000 per year (Table 4-10). 70 percent of the households in the $15,000 to $24,999 category have broadband internet.

About 17.5 percent of the survey respondents have annual incomes of $100,000 or more, whereas 19.4 percent make less than $25,000 per year. According to the US Census, these household income categories account for 18.3 percent (compared to 17.5 percent in the survey) and 26.3 percent (versus 19.4 percent in the survey) of all Maine households, respectively (Table 4-9).[28]

Table 4-9: Household Survey Respondents by Annual Income

Annual household income	Number of respondents	% of respondents
Less than $15,000	220	8.83%
$15,000 to $24,999	263	10.55%
$25,000 to $34,999	297	11.92%
$35,000 to $49,999	369	14.81%
$50,000 to $64,999	364	14.61%
$65,000 to $79,999	289	11.60%
$80,000 to $99,999	255	10.23%
$100,000 to $149,999	280	11.24%
$150,000 or more	155	6.22%
Total	2,492	100.00%

Table 4-10: Computer and Broadband Use of Households by Annual Income

Annual household income	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Less than $15,000	72.48%	**62.44%**	5.16%	4.99	33.17%
$15,000 to $24,999	83.65%	**70.00%**	3.46%	6.20	40.89%
$25,000 to $34,999	83.84%	**68.28%**	2.76%	5.80	38.46%
$35,000 to $49,999	90.22%	**73.08%**	2.75%	6.63	43.38%
$50,000 to $64,999	87.29%	**75.00%**	3.93%	6.99	44.19%
$65,000 to $79,999	88.89%	**72.54%**	2.11%	6.87	45.96%
$80,000 to $99,999	94.09%	**80.16%**	2.38%	7.15	43.25%
$100,000 to $149,999	92.83%	**79.35%**	1.81%	7.55	44.36%
$150,000 or more	88.31%	**75.16%**	1.96%	7.45	44.37%
All households	86.45%	**72.71%**	3.03%	6.59	41.94%

[28] The US Census statistics for Maine households are from the *2005-2009 American Community Survey 5-Year Estimates*.

Of those respondents who identified cost as an adoption barrier, we speculate that cost is an "absolute" financial barrier to some, but a perceived financial barrier to others. Adoption strategies that focus upon value as opposed to cost can influence those groups. Non-internet-using residential consumers in Maine for whom cost is a perceived but not absolute barrier should be a key target market for increased broadband uptake.

Attention to avoided costs should also be an important part of any awareness campaign. Examples where internet use is financially required or reduces costs are increasingly plentiful. For example, many large employers now only accept online applications; more banks, insurance companies, and other businesses assess a fee for paper and/or phone transactions; and FAFSA (college financial aid) applications have moved to a fully online format.

4. *Drivers.* Household size and age characteristics such as the number of people in the household and the presence of (only) senior citizens and one or more children under the age of 18 have a statistically significant impact on computer use and broadband subscribership. The presence of children in a household increases the likelihood of owning a computer, having internet access, and the household spending 20 or more hours online each week. The presence of children also increases the number of computer applications used as compared to households without children under the age of 18. Households that are made up solely of senior citizens, on the other hand, are less likely to have a computer or subscribe to a broadband service, or to spend 20 or more hours online per week. They also have fewer applications on the computer than other households. Our results also show that household size is not associated with the presence of a computer in the household. Larger households with a computer, however, are more apt to to spend 20 hours or more online per week and use a wider variety of computer applications.

   Table 4-11 shows the distribution of survey results by household size and age characteristics. Table 4-12 shows computer and broadband use by these same characteristics.

Table 4-11: Household Survey Respondents by Selected Size and Age Characteristics

Household size	**Number of respondents**	**% of respondents**
3 or fewer people	2,209	82.03%
More than 3 people	484	17.97%
	2,693	100.00%
Presence of children	Number of respondents	% of respondents
No children under the age of 18	2,044	76.44%
One or more children under 18	630	23.56%
	2,674	100.00%
Presence of senior citizens	Number of respondents	% of respondents
Household contains no one over age of 64	2,041	76.33%
Household contains only people over age of 64	633	23.67%
	2,674	100.00%

Table 4-12: Computer and Broadband Use of Households by Selected Size and Age Characteristics

Household Characteristic	**Computer In home**	**Broadband Internet**	**Fiber optic or T-1 Internet**	**Number of Computer apps**	**20 hours or More on-line**
Household size					
3 or fewer people	85.18%	**70.92%**	3.21%	**6.17**	37.53%
More than 3 people	97.11%	**83.64%**	2.48%	**8.82**	64.02%
Presence of children					
No children under 18	84.58%	**70.52%**	3.37%	**6.00**	37.25%
One or more children under 18	96.18%	**82.75%**	2.40%	**8.68**	58.80%
Presence of senior citizens					
Household contains no one over 64	92.79%	**78.23%**	3.15%	**7.43**	48.26%
Household contains only people over 64	69.62%	**57.45%**	3.11%	**3.96**	22.05%
All households	86.45%	**72.71%**	3.03%	**6.59**	41.94%

As primary users of the internet, children can function as peer-to-peer opinion leaders, driving the expansion of existing broadband activities in their and other households. A simple example would be developing online communications with grandparents through the exchange of email and "visits" using Skype™. In this way, consumer-to-consumer influence can help bring older adults on board.

Another noteworthy driver of broadband adoption is "homeboundness." 12 percent of residential respondents reported at least one person in the household unable to leave the home due to an ongoing physical, mental, or emotional condition (Figure 4-12). Over 22 percent reported one or more people at least occasionally homebound.

How often is someone in your household unable to leave the home due to an ongoing physical, mental, or emotional condition?

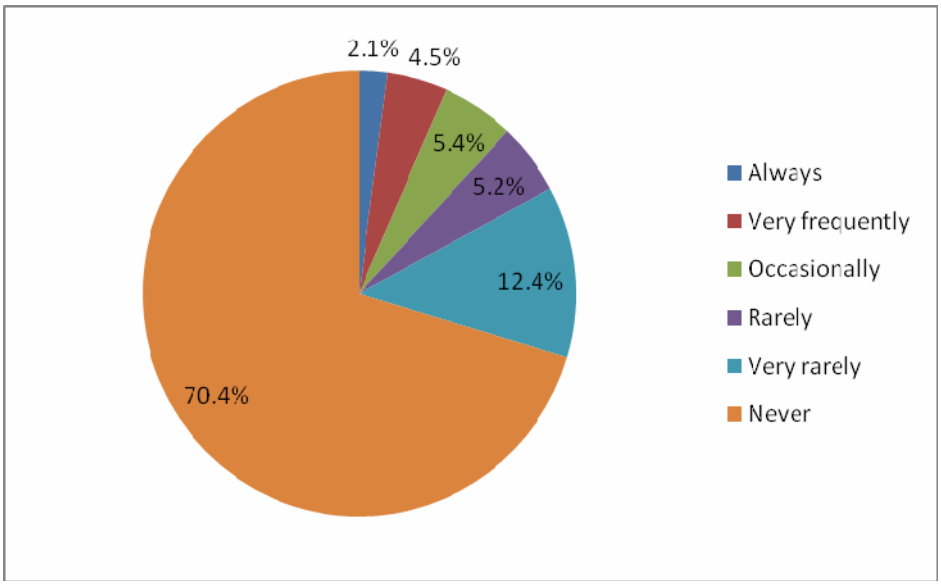


Figure 4-12: Difficulty Leaving the Home (Survey Question #32)

This question was included in the survey because of the high percentage of older adults in the State of Maine and the negative impact of weather and rural geography/infrastructure on out-of-home mobility.

Survey results identify a significant relationship between frequency of homeboundness and hours of internet access by respondent alone and by household as a whole. Both results demonstrate higher internet usage as days of "homeboundness" increase. Given the large number of older adults in Maine and weather/geographic impact on leaving the home, this is an important finding. Homebound households should be a major target market for the statewide awareness campaign to reduce social isolation, increase access to medical/emergency resources, conduct household business, etc.

Due to small sample numbers of homebound households, other significant findings did not surface. As this is an important target market, further research is called for.

Educational attainment has no effect on the presence of a computer in the home, but it does influence the number of ways in which computers are used (see number of computer applications in Table 4-13). In addition, the results show that households with at least one person with a graduate degree are more likely than others to subscribe to a broadband internet service. We also find that a household's county of residence has some influence on computer and broadband internet use in Maine, even after accounting for differences in income, household size and age characteristics and educational attainment (Table 4-14).

Table 4-13: Computer and Broadband Use of Households by Educational Attainment

Highest level of education in household	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Some high school	68.63%	**58.82%**	3.92%	**4.65**	26.00%
High school / GED	80.27%	**67.30%**	3.78%	**5.54**	36.26%
Some classes beyond high school	84.18%	**70.76%**	3.92%	**6.37**	41.67%
Two-year, trade, certificate or technical school	88.42%	**72.35%**	1.76%	**6.35**	39.48%
Four-year college or university	88.79%	**73.76%**	2.93%	**6.83**	44.44%
Advanced (graduate) degree	90.46%	**78.58%**	2.76%	**7.52**	46.14%
All households	86.45%	**72.71%**	3.03%	**6.59**	41.94%

Table 4-14: Computer and Broadband Use of Households by Maine County

County	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Androscoggin	83.92%	**73.59%**	5.28%	6.32	39.42%
Aroostook	81.93%	**65.06%**	2.41%	5.80	38.99%
Cumberland	88.81%	**84.09%**	1.69%	7.38	44.98%
Franklin	92.65%	**68.18%**	3.03%	6.46	42.42%
Hancock	86.57%	**59.85%**	1.52%	6.74	38.46%
Kennebec	84.47%	**70.04%**	4.67%	6.20	43.31%
Knox	87.07%	**74.45%**	2.73%	7.05	47.62%
Lincoln	81.94%	**68.06%**	1.39%	6.47	29.41%
Oxford	77.11%	**71.95%**	8.54%	5.67	37.97%
Penobscot	88.85%	**67.74%**	2.58%	6.25	42.62%
Piscataquis	75.56%	**46.51%**	4.65%	4.95	26.83%
Sagadahoc	96.08%	**74.51%**	0.00%	7.92	40.43%
Somerset	83.64%	**61.32%**	4.72%	5.72	40.38%
Waldo	91.04%	**59.70%**	1.49%	6.24	40.00%
Washington	87.50%	**56.45%**	6.45%	6.00	38.71%
York	87.40%	**80.00%**	2.13%	6.91	44.72%
All households	86.45%	**72.71%**	3.03%	6.59	41.94%

Compared to households located elsewhere in Maine, those in Cumberland County are more likely to have a computer in the home and a broadband internet connection. Households in Cumberland County also use a greater number of computer applications. On the other hand, for example, a household's location in Kennebec County has a negative and statistically significant effect—as compared to the rest of the State—on these three indicators of computer and broadband use.

Finally, the continuing demand for online communications together with a potential demand for online entertainment and for telemedicine services (Figure 4-8) are identified drivers of broadband adoption.

Forum Notes:
A Piscataquis County resident listed many disadvantages of not having high-speed internet access. He would soon start paying an extra fee since he is unable to abide by his bank's new "paperless banking" process. His college freshman son had to go to a public place to submit his FAFSA application online. Unable to pay his bills online, he incurs extra postage expense monthly; and his family cannot enjoy watching Netflix movies online for a fraction of the cost of going to the theater. Several others added the increase in online-only job application and resume submission to this resident's list of drawbacks. These sentiments were echoed repeatedly at forums throughout the State.

Public Forum Results on Residential Consumers

Results from the public forums held at six different locations within the State qualitatively support the general findings of the surveys. Although respondents show a relatively low current use and demand for the internet for educational activities, public forum discussions have indicated a growing need for broadband access for teachers and students.

4.2.3 Business Consumer Survey Results

The results of the business consumer surveys provide information on office computer and internet use and the barriers to, and drivers of, adoption in Maine small businesses. These results comport with the findings of the economic modeling analysis and help define the current status and future potential of broadband subscribership for businesses in Maine.

The following business consumer details have emerged. (For the business consumer survey questionnaire, see Appendix A. Complete survey results to each question of the business consumer questionnaire with charts and graphs are provided in Appendix B.)

1. *Computer and Internet Use.* Survey results show that 47.7 percent of responding businesses use a computer almost all of the time, 8.3 percent indicated they had not used a computer at all in the previous week (Figure 4-13), and 9.9 percent reported that there was no computer connecting to the internet on site (Figure 4-14).

How often was a computer being used at your business last week (during the time that the business was open or operating)?

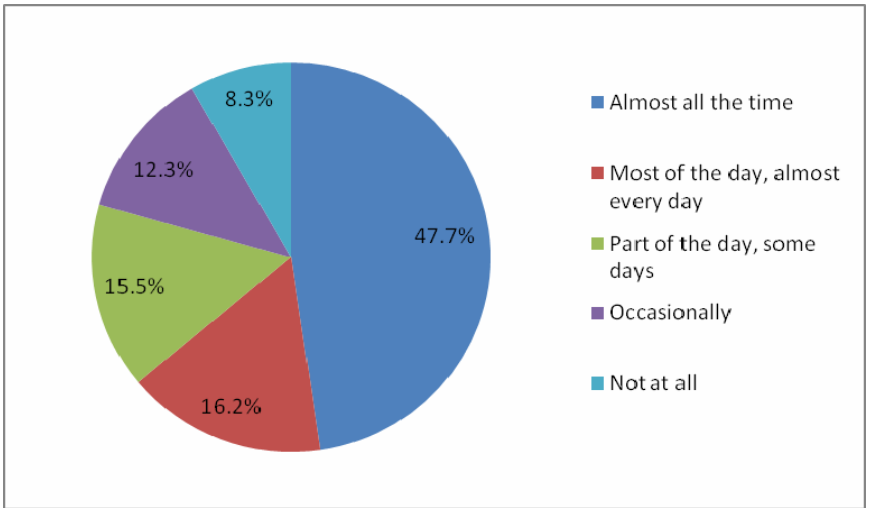


Figure 4-13: Frequency of Computer Use for Businesses (Survey Question #1)

Is at least one computer at your business connected to the internet?

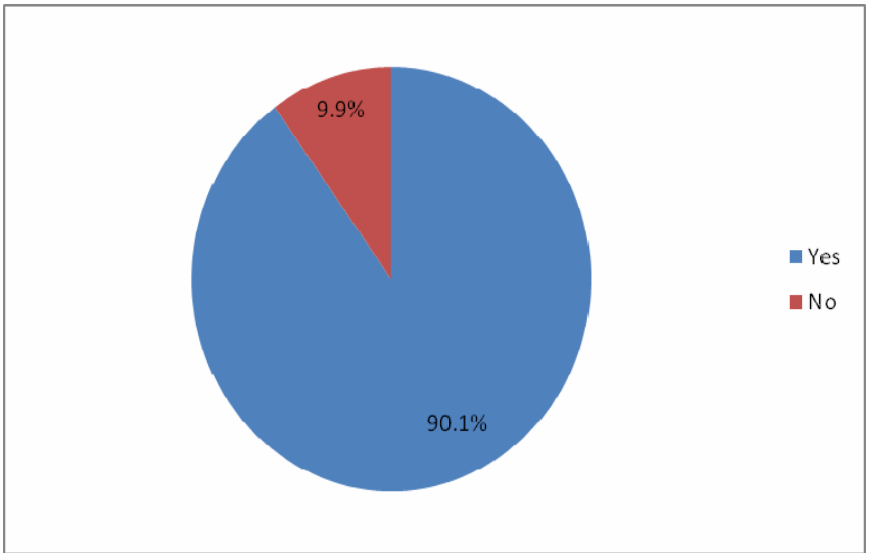


Figure 4-14: Internet Connection for Businesses (Survey Question #3)

It is noteworthy that 40.4 percent of business respondents who do not connect to the internet would like to (Figure 4-15), but only 10.6 percent plan to set up internet service in the next 12 months (Figure 4-16). (Similarly, 71 percent of households who do not connect to the internet would like to, but only 26.3 percent plan to in the next 12 months.)

Would your business like to connect a computer to the internet?

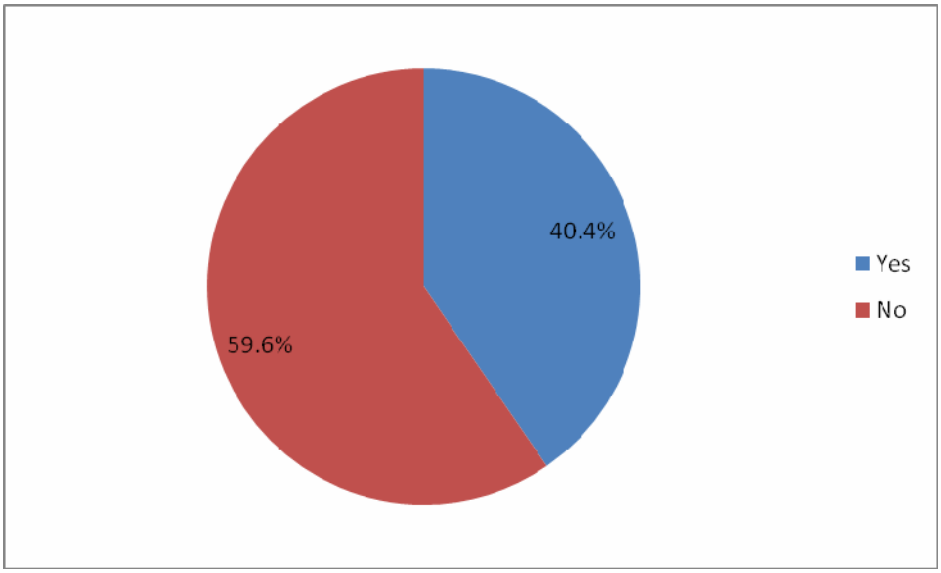


Figure 4-15: Desire of Businesses to Connect to Internet (Survey Question #5)

Does your business plan on setting up internet service in the next 12 months?

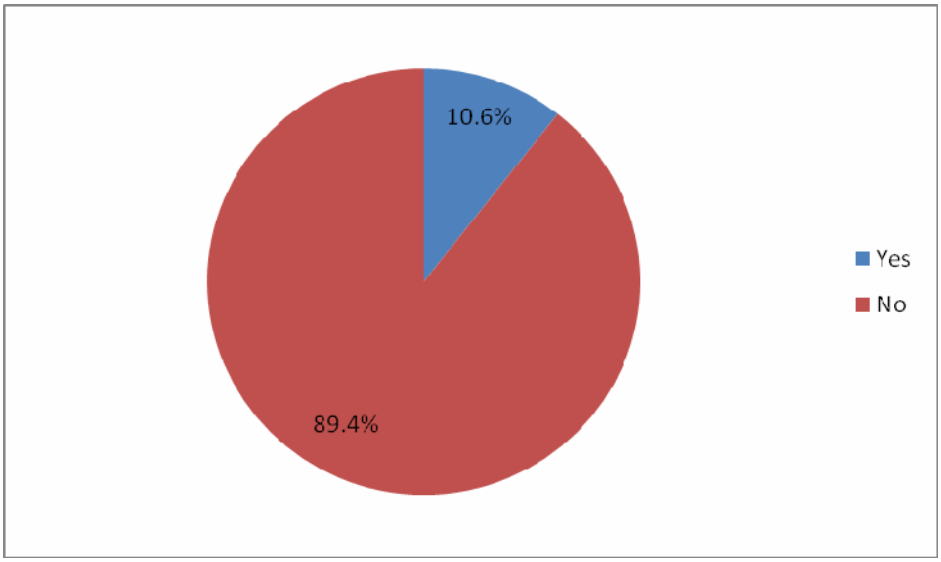


Figure 4-16: Plan of Businesses to Connect to Internet (Survey Question #6)

Respondents indicated that the major reason they are currently using a computer in their business is for email or other online communications (83.3 percent). Use of the computer is also for conducting business (77.7 percent), recordkeeping (63.7 percent), financial management (57.9 percent), word processing (54.8 percent), conducting online research (51.2 percent), and creating/maintaining a web site (40.0 percent).

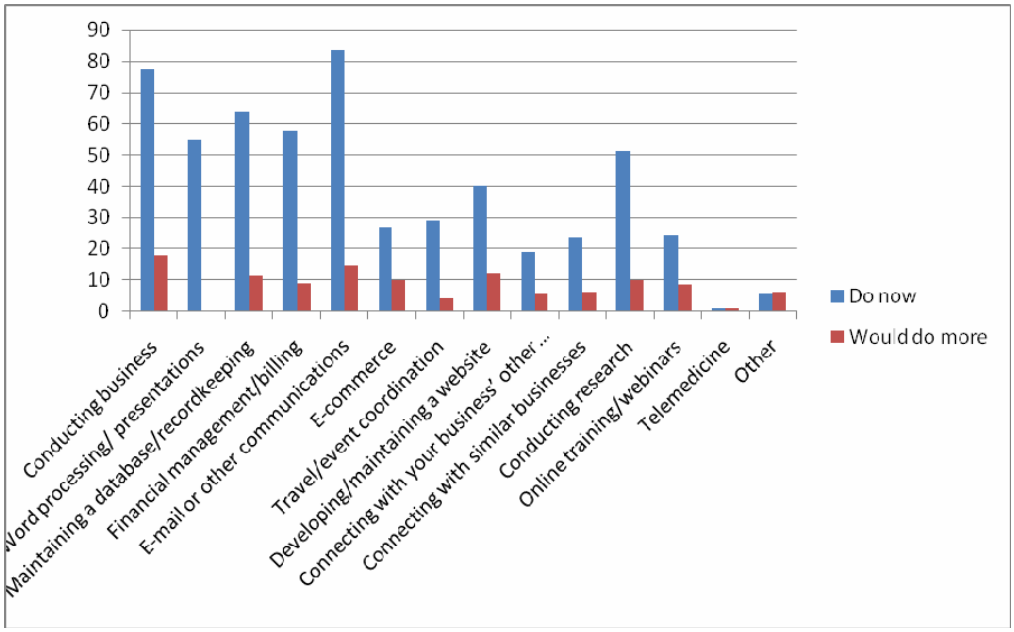


Figure 4-17: Current and Future Business Use of Computer (Survey Questions #18-19)

Fewer respondents indicated they use the computer for e-commerce (27.1 percent), online training (24.1 percent), connecting with similar businesses (23.7 percent), conducting business (22.3), and connecting to other business locations (19.2 percent).

If provided with access to higher-speed internet, the largest percentage of respondents (58.3 percent) indicated that the service was sufficiently fast and they would not do anything different online. 18.0 percent indicated they would use the computer more to conduct business, 14.7 percent indicated they would do more online communications, and 12.0 percent more web site activities.

2. *Barriers to Adoption.* 39.1 percent reported "the business does not need the internet" as the primary reason for not using it. Cost of internet access was the secondary reason (Figure 4-18). It should be noted that only 2.2 percent reported that "adequate internet service is not available" and only another 2.2 percent noted that available internet service is too slow for the business.

What is main reason your business does not connect at least one computer to the internet?

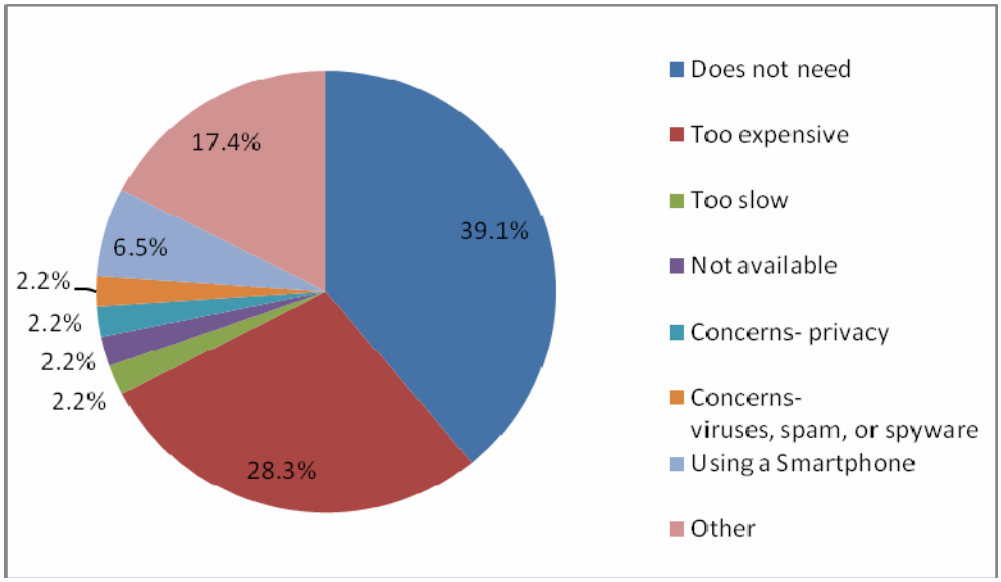


Figure 4-18: Main Reason for Businesses Not Having Internet (Survey Question #4)

Similarly, 30.3 percent of internet-using business respondents identified cost as a barrier to upgrading to faster internet service (Figure 4-19). This is a valuable finding for an awareness campaign that will respond to "unneeded" and "cost" objections with concrete evidence of the value (both quantitative and qualitative) of internet connectivity.

What is the main reason your business doesn't subscribe to a faster internet service?

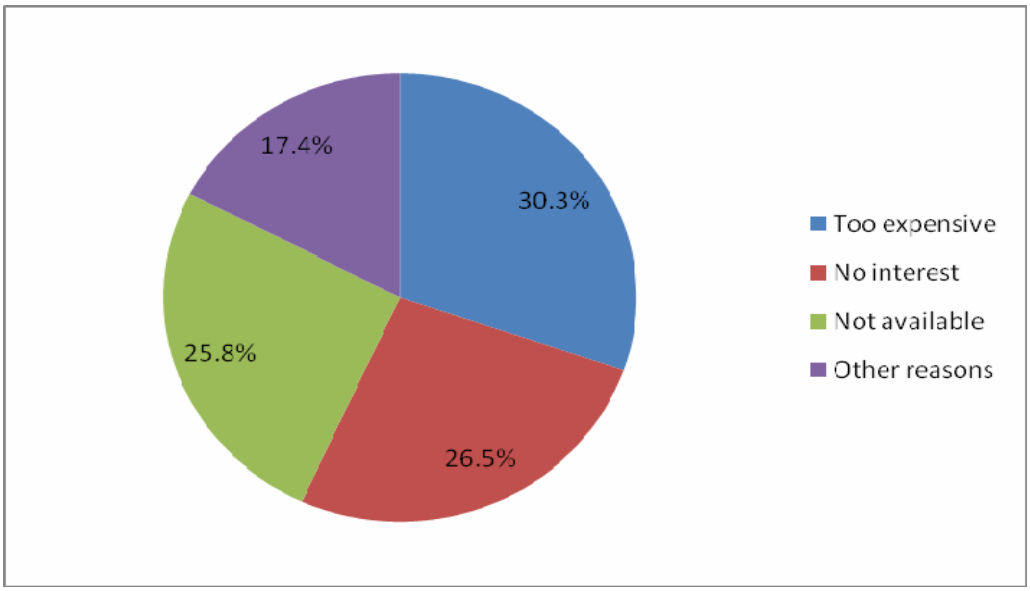


Figure 4-19: Reason for Not Having Faster Internet Service (Survey Question #14)

Just as cost may be a psychological barrier for many residential respondents, it is possible that many businesses can indeed manage the cost financially, but do not perceive the returned value.

3. *Drivers*. Economic modeling of the business data indicates that an establishment's size (i.e., number of employees) and industrial category are key drivers of computer use and broadband subscribership. For example, businesses with fewer than five employees—a sizable percentage of all Maine businesses (Table 4-15)—are less likely than larger operations in our sample to subscribe to a broadband internet service, to subscribe to a fiber optic or T-1 service, or to use computers extensively in the company's day-to-day operations (Table 4-16).[29]

Table 4-15: Business Survey Respondents by Employment Size Category

Size category	Number of respondents	% of respondents
Fewer than 5 employees	325	57.93%
5 to 10 employees	115	20.50%
11 to 25 employees	79	14.08%
26 to 50 employees	29	5.17%
More than 50 employees	13	2.32%
Total	561	100.00%

Table 4-16: Computer and Broadband Use of Maine Businesses by Employment Size Category

Size category	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Fewer than 5 employees	48.15%	**80.56%**	3.70%	4.93	21.30%
5 to 10 employees	78.26%	**89.57%**	7.83%	5.82	28.95%
11 to 25 employees	93.67%	**97.47%**	12.66%	6.80	49.37%
26 to 50 employees	89.66%	**93.10%**	13.79%	6.75	44.83%
More than 50 employees	91.67%	**100.00%**	46.15%	8.15	69.23%
All establishments	63.88%	**85.74%**	7.64%	5.53	29.69%

Focusing on industrial categories (Table 4-17), our results show that small businesses in the finance, insurance and real estate (FIRE) sector are more apt than establishments in other industries to exhibit heavy computer use and to

[29] According to the 2008 County Business Patterns data from the US Census Bureau, establishments with fewer than five workers account for 57.2 percent of employers in Maine.

have a fiber optic or T-1 internet connection. Establishments in the FIRE sector, as well as service providers, also tend to use the computer for a greater variety of applications than other types of businesses (Table 4-18).

Table 4-17: Business Survey Respondents by Major Industrial Category

Industrial category	Number of Respondents	% of respondents
Agricultural services, forestry, & fishing	6	1.01%
Mining	0	0.00%
Construction	69	11.62%
Manufacturing	30	5.05%
Transportation & public utilities	21	3.54%
Wholesale trade	29	4.88%
Retail trade	170	28.62%
Finance, insurance, & real estate	38	6.40%
Services	227	38.22%
Unclassified establishments	4	0.67%
Total	594	100.00%

Table 4-18: Computer and Broadband Use of Maine Businesses by Major Industrial Category

Industrial category	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Agricultural services, forestry, & fishing	NA	NA	NA	NA	NA
Mining	NA	NA	NA	NA	NA
Construction	47.83%	**86.96%**	5.80%	4.83	26.09%
Manufacturing	66.67%	**93.33%**	10.00%	6.03	33.33%
Transportation & public utilities	76.19%	**90.48%**	0.00%	4.62	28.57%
Wholesale trade	75.86%	**93.10%**	17.24%	5.90	31.03%
Retail trade	62.05%	**82.14%**	4.17%	4.98	26.95%
Finance, insurance, & real estate	84.21%	**100.00%**	23.68%	6.84	44.74%
Services	64.44%	**83.93%**	6.70%	5.93	29.60%
Unclassified establishments	NA	NA	NA	NA	NA
All establishments	63.88%	**85.74%**	7.64%	5.53	29.69%

On the other hand, Maine's small retailers and construction businesses lag behind companies in other industrial categories based on two of the five indicators of computer and broadband internet use.

Similar to the results for households, we find that the county of location (Table 4-19) has some effect on computer and broadband internet use, even after controlling for establishment size, years of operation and industry (Table 4-20).

Table 4-19: Business Survey Respondents by Maine County

County	Number of respondents	% of respondents
Androscoggin	53	8.92%
Aroostook	44	7.41%
Cumberland	145	24.41%
Franklin	15	2.53%
Hancock	34	5.72%
Kennebec	48	8.08%
Knox	19	3.20%
Lincoln	15	2.53%
Oxford	18	3.03%
Penobscot	74	12.46%
Piscataquis	3	0.51%
Sagadahoc	12	2.02%
Somerset	19	3.20%
Waldo	15	2.53%
Washington	17	2.86%
York	63	10.61%
Total	594	100.00%

Table 4-20: Computer and Broadband Use of Maine Businesses by County

County	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Androscoggin	59.62%	**92.31%**	7.69%	5.52	35.85%
Aroostook	65.12%	**79.55%**	11.36%	5.09	27.91%
Cumberland	69.93%	**89.51%**	9.79%	5.75	33.10%
Franklin	73.33%	**93.33%**	6.67%	5.80	46.67%
Hancock	85.29%	**94.12%**	8.82%	6.67	42.42%
Kennebec	64.58%	**85.42%**	10.42%	6.09	27.08%
Knox	68.42%	**89.47%**	0.00%	5.95	21.05%
Lincoln	46.67%	**86.67%**	0.00%	4.47	13.33%
Oxford	27.78%	**66.67%**	5.56%	4.39	11.11%
Penobscot	64.38%	**81.08%**	1.35%	5.10	25.68%
Piscataquis	NA	**NA**	NA	NA	NA
Sagadahoc	50.00%	**75.00%**	25.00%	4.08	16.67%
Somerset	47.37%	**73.68%**	15.79%	5.26	26.32%
Waldo	60.00%	**86.67%**	0.00%	5.93	20.00%
Washington	64.71%	**70.59%**	0.00%	4.82	12.50%
York	59.02%	**90.16%**	8.20%	5.62	36.07%
All establishments	63.88%	**85.74%**	7.64%	5.53	29.69%

Compared to establishments located in other Maine counties, for example, businesses operating in Hancock County are more likely to exhibit heavy computer use and employ a wider variety of computer applications. On the other hand, establishments located in Oxford County tend to lag behind other Maine companies based on four of the five indicators used in the analysis.

The age of the establishment appears to have little impact on whether it exhibits heavy computer use, adopts broadband internet or whether it has an employee with computer-related responsibilities (Table 4-21). Businesses in the youngest age category use a wider range of computer applications, however, than establishments that have been in operation for five or more years.

Table 4-21: Computer and Broadband Use of Maine Businesses by Years of Operation

Years of operation	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Less than 5 years	no effect	no effect	no effect	**positive**	no effect
5 to 10 years	no effect	no effect	no effect	no effect	no effect
11 to 25 years	no effect	no effect	no effect	no effect	no effect
More than 25 years	no effect	no effect	no effect	no effect	no effect

Significantly, among small business survey respondents, there is a positive relationship between frequency with which computers are used and percentage of business' purchases of goods and services from outside of Maine; between frequency with which computers are used and sales revenue; and between frequency with which computers are used and percentage of a business' revenue generated from outside of Maine.[30] Although these results do not identify a causal relationship, they are nonetheless compelling in terms of their marketing potential. One can argue in favor of an assumed causal relationship in both directions.

The interpretation supporting increased computer use as a means to increase revenues in general and from out of state in particular has value for an awareness campaign.

Public Forum Results on Businesses

In the public forum discussions, businesses also indicated they used the internet for:

- Online access to government proposals, bid applications
- General business communication and exchange of data
- General facilitation of economic development

[30] The Pearson Correlation associated with the conjunction of Question 1 and Question 34 over 490 respondents is .191; with the conjunction of Question 1 and Question 35 over 455 respondents is .313; and with the conjunction of Question 1 and Question 36 over 481 respondents is .163. The correlation is significant at the 0.01 level (2-tailed).

The general consensus was the world of commerce and education is going paperless, and if Maine is on dial-up it cannot compete.

4.2.4 Comparison of Household and Business Drivers

The modeling of the household and business survey data reveals several key drivers of computer and broadband internet use, listed in Table 4-22.

Table 4-22: Drivers of Computer and Broadband Internet Use by Maine Households and Small Businesses

Factors that increase use:	Maine's ranking relative to all US states
Households with one or more children under the age of 18	48th out of 50 in % of households with one of more children under 18
Households with more than 3 people	48th out of 50 in % of households with more than 3 people
Small businesses in the finance and insurance industry	48th out of 50 in % of small businesses in the finance and insurance sector
Factors that decrease use:	**Maine's ranking relative to all US states**
Households with annual incomes of less than $15,000	18th out of 50 in % of households with annual incomes of less than $15,000
Households comprised of people over the age of 64	5th out of 50 in % of households with one or more people over the age of 64
Small businesses with fewer than 5 workers	9th out of 50 in terms of % of establishments with 1 to 4 employees

Maine's household demographics—especially size and age characteristics—do not support high computer and broadband internet use. Maine ranks 48th nationally both in terms of the percentage of households with children and the percentage of households with more than three people.[31] This means that Maine has an under abundance of the types of households that are more likely to use computers and have a broadband internet connection. It is also the case that Maine has one of the highest percentages of households that are made up of senior citizens (5th nationally) and the State is 18th nationally in households with annual incomes of less than $15,000. This means that Maine has an overabundance, especially in the case of older households, of the types of households that are less likely to use computers and have a broadband internet connection.

[31] Information used to compare Maine to other states in terms of household characteristics is from the US Census 2005-2009 American Community Survey 5-Year Estimates.

The information shown in Table 4-22 suggests that Maine's unfavorable demographics for household computer and broadband internet use extend to its companies as well. Ranking 48th nationally compared to other states, Maine has a smaller percentage of its businesses with fewer than 100 employees in the finance and insurance industry, an important broadband consumer.[32] Maine tends to lag behind the rest of the country across many sectors of professional service providers. This means that Maine has an under abundance of small businesses in sectors that are more likely to use computers and have a broadband internet connection. On the other hand, Maine ranks 9th nationally in terms of the percentage of establishments with between one and four employees. This means that Maine has an overabundance of establishments that are less likely to use computers and adopt broadband internet technologies.

Forum Notes:
A recurring theme at the forums was the importance of high-speed internet access at seasonal rental properties. One Waldo County real estate agent and a number of individual camp owners throughout the State spoke of difficulty renting their properties without such access. These properties commanded far lower rental fees, were rented for shorter periods of time, and, in some cases, remained vacant for extended stretches. As one Sebec Lake property owner stated, "Renters can't stay very long if they have to drive to McDonald's every time they need to catch up on work email."

4.2.5 Community Anchor Institutions (CAIs)

The surveys of Maine CAIs were intended to determine broadband service availability for CAIs across the State, supplementing data from existing surveys including the Maine School and Library Network Survey and the Maine Health Information Technology (HIT) surveys of medical and dental providers as well as hospitals.

Availability

Currently there are 4,496 CAI records in the Maine Broadband Inventory and Mapping Project database. This number, though representative, is not the total number of CAIs statewide. YMCAs are not included, for example. Table 4-23 shows the record counts by CAI type for those institutions confirmed to have broadband service, those institutions confirmed to not have broadband service, and those institutions whose broadband service is unknown.

[32] The industrial sector used in the regression analysis is finance, insurance and real estate, which is a broader category. The information used to compare Maine to other states in terms of business characteristics is from the US Census Bureau, County Business Patterns data.

Table 4-23: CAI Broadband Availability

CAI Type	Broadband - Yes	Broadband - No	Broadband - Unknown	Total
Library	**202**	0	137	339
Medical & healthcare	**639**	17	251	907
Other community support-government	**427**	2	726	1,155
Other community support-nongovernment	**65**	32	125	222
Public safety	**475**	96	277	848
School (K-12)	**623**	0	321	944
University, college, other postsecondary	**29**	0	52	81
Total	**2,460**	**147**	**1,889**	**4,496**

Of the 96 public safety facilities without broadband, 60 are volunteer fire departments. The two institutions listed under "other community support-government" as not having broadband service are both town halls (Penobscot and Edinburg). Of the 32 "other community support-nongovernment" facilities listed without broadband, 20 are airfields or landing strips.

Drivers and Gaps

For CAIs, broadband internet access is required to meet both internal and external needs. Internal needs focus on day-to-day office functions such as video conferencing, video based training, research, video surveillance, off-site data backups, State and federal government reporting, incident mapping and record keeping, and connecting with other sites. External needs consist primarily of providing online services, including motor vehicle registrations, license purchasing, live streaming of government meetings, social media offerings, tax billing collection, and access to town records.

Barriers to Adoption

Based on our telephone survey, the initial barrier to adoption for local government offices, non-government support organizations, and public safety facilities is availability. For the 1,097 CAIs in these categories that participated in the survey thus far, nearly 12 percent do not have broadband. Results from schools and libraries are presented separately in Section 4.2.6.

Where service is available, 8 percent of the CAIs indicated cost and quality service as deterrents to having viable broadband service. Other common factors listed as adoption barriers were outdated equipment (4 percent) and lack of technical support (3 percent).

Summary of CAI Results

- 92 percent of CAI types that participated in the surveys, not including schools and libraries, have broadband service
- Perceived value (cost vs quality of service) of broadband is low among CAIs
- Daily functions of the CAIs are driving the increase in need for broadband

4.2.6 Schools and Libraries

The survey of Maine's K12 schools and libraries, considered as separate entities from other CAIs in this assessment, integrated questions from the business consumer questionnaire on computer and internet use with existing information from Networkmaine's database of MSLN participants, who receive high-speed broadband at no cost.

Availability

According to Networkmaine's annual survey of Maine School and Library Network (MSLN) participants, 100 percent of Maine schools and libraries have broadband service; 44 percent are served by fiber optic connections allowing for near limitless scalability in broadband capacity. Consequently, that means 56 percent are still served using traditional copper-based lines, which raises concerns about near term scalability.[33]

School Notes:
According to an MSAD75 literacy specialist: "[MSLN] is allowing MSAD75 staff to access Infinite Campus, the district's student information system, in order to provide ready access to academic data for response to intervention (RTI). Teachers are able to input the reading scores of every child at least three times or more per year, and thus document the accuracy, fluency, and overall comprehension of student reading skills. Teachers are able to access an entire history for students, complete with what instruction has been most successful. By having access to this type of data, teachers are better equipped to identify students before they fall behind. Previously, hours were spent digging through files to determine this data. Because of [MSLN], critical information is now available at the click of a button."

Use and Drivers

High speed broadband connectivity has become as essential a utility for Maine's schools and libraries as electricity and water. Innovative learning environments are enabled by high speed broadband connections and 1-to-1 computing initiatives such as Maine's Learning Technology Initiative (MLTI). Broadband also allows teachers to engage students in rigorous, technology-infused learning activities beyond what can be delivered at the local level preparing them to be competitive in the 21st century global economy. For example, the National Science Foundation (NSF)-funded Innovative Technology Experiences for Students

[33] Scaling broadband capacity on copper-based lines requires the bonding together of multiple "copper pairs." The existing carrier-owned copper plant was not designed to deliver more than a very small number of copper pairs (usually between two and four) to any one location, especially in rural areas. Today, many of the schools and libraries that have copper-based broadband services have that service delivered on seven or more copper pairs for the lowest level of connectivity available through the MSLN Project (10 Mbps, FCC Broadband Tier 5). This design is not scalable in either a technical or practical sense.

and Teachers (ITEST) projects like the EcoScienceWorks Project[34] and the Inquiry-based Dynamic Earth Applications of Supercomputing (IDEAS) Project[35], along with the Maine EPSCoR Sustainability Solutions Initiative (SSI),[36] are focused on engaging middle and high school students and teachers in university-level research. Since Maine consistently ranks last in the nation in earned doctorates in science or engineering,[37] the overall goal for Maine EPSCoR workforce development is to foster the current and next generations of science professionals. Some specific SSI workforce development activities of the SSI research and education project directly benefit from high-speed broadband connectivity. Examples include the Maine EPSCoR High School Research Internship Program[38] and the Maine Science, Technology, Engineering and Mathematics (STEM) Collaborative.[39]

SSI aims to help remove impediments to interaction between K-12 and the research community and allow for the development of programs such as a pilot "Virtual Researcher in the Classroom" scheduled for June 2013. Maine's K-12 schools and libraries have over 400 videoconferencing units on mobile carts and licensing for over 500 laptops for software based videoconferencing clients. When one adds this large videoconferencing presence with the Maine Learning Technology Initiative (MLTI) and high-speed broadband connectivity, one can see that there is enormous potential for STEM education and creating the next generation IT-literate workforce.

With the investments already made by the Maine Department of Education in one-to-one computing and the high-speed broadband connectivity provided by Networkmaine through the MSLN project, the tools are now available to use cutting-edge solutions available on the internet. For example, cloud computing–based solutions like Google Apps for Education and Studywiz, which require high-

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[34] EcoScienceWorks is an NSF ITEST project for seventh- and eighth-grade science teachers and students in Maine. Its major goal is to develop computer-based curriculum for the MLTI that will spur student interest in computer modeling in science. http://www.fbr.org/swksweb/esw.html

[35] IDEAS connects researchers at the University of Maine with students and middle school teachers, both at the University (during a summer workshop) and at participating schools (during the academic year) to utilize computer modeling and visualization of geological processes in the classroom. IDEAS currently has 60 participating teachers as well as 180 students. http://arch.eece.maine.edu/ideas/index.php/Main_Page

[36] http://www.umaine.edu/sustainabilitysolutions/.

[37] NSF 2006 survey.

[38] http://www.umaine.edu/epscor/.

[39] http://www.mainestem.org.

speed broadband, facilitate a more collaborative learning environment while removing the cost and burden associated with maintaining the software and servers to deliver such applications locally.

Software as a Service (SaaS) solutions like Infinite Campus, contracted for by the Maine Department of Education and implemented by schools across the State, provide a state-wide student information system for better tracking of students that move between districts, better trend analysis over time, and faster intervention with at-risk students.

Video-based distance learning also plays a major role in Maine's schools as is demonstrated by the number of USDA/RUS Distance Learning and Telemedicine Grants to Maine's schools over the past few years.[40] The ability to access researchers and other remote experts and deliver virtual fieldtrips to Maine's students has proven to be extremely valuable in augmenting the traditional classroom experience. These grants have provided for distance learning technology to almost 400 schools state-wide and total over $5 million in new investments.[41] However, due to limited bandwidth, most schools have been limited to just one video conference running at any time and even then often at lower video quality. High-speed broadband delivered over fiber-based connections, where available, has enabled higher quality video and the use of the technology by multiple classes simultaneously, thereby increasing both the perceived and delivered value of video-based services.

The success of the Public Computer Center BTOP grant received by the Maine State Library (MSL) depends on the availability of high-speed broadband at the libraries. This project will upgrade public computer centers at as many as 107 public libraries statewide and increase the number of publicly available broadband workstations by as much as 41 percent by deploying approximately 500 new workstations. It will also enhance training opportunities by deploying 11 video conferencing regional hubs and three mobile computer labs to enable hands-on training in rural locations.[42]

The Maine State Library, in partnership with Maine InfoNet, offers online access to downloadable audio books and e-books through local libraries using a library lending model. The Library has three rooms of Adobe Connect Pro to provide web conferencing to Maine libraries for webinars and web meetings. With the higher

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[40] http://www.livec.org/map.aspx

[41] http://www.rurdev.usda.gov/SupportDocuments/dltawards-me.pdf

[42] MSL's partners in this project include: Maine Information Network; Access to Justice; Maine Department of Labor, Center for Workforce Research and Information; and Maine InfoNet.

bandwidth now available at the libraries, VoIP and video can now be included as part of the web conferences.

Gaps

The State Educational Technology Directors Association (SETDA), entitled *High-Speed Broadband Access for All Kids: Breaking Through the Barriers,* called for a minimum of 100 Mbps per 1000 students by the end of 2011.[43] With 68 percent of its schools and libraries having broadband connections with a capacity less than 25 Mbps, Maine has not met this goal.

To deliver the broadband capacities currently required, copper-serviced schools and libraries must have their broadband service upgraded to a fiber optic transport. Such an upgrade in infrastructure will take significant investments, measured in the tens of millions of dollars by both the broadband providers and the public sector.

Many of Maine's libraries and smaller schools lack the technical support they need to take full advantage of their connectivity. Networkmaine operates a Circuit Rider program[44] to attempt to fill this gap.[45]

Schools and libraries servicing Maine's island communities are able to receive only the lowest levels of broadband connectivity offered through the MSLN project (10 Mbps, FCC Broadband Tier 5). As these anchor institutions are often the "internet access point" for the community, being able to deliver higher speed connections to these institutions is critical.

Barriers to Adoption

Primary barriers to adoption are price and availability. While the Maine Telecommunications Education Access Fund (MTEAF) and federal School and Library (E-Rate) Universal Service programs have removed the financial barriers for individual K-12 schools and libraries, pricing is still a major barrier at the MSLN project level. Although schools and libraries receive broadband internet access at no cost, the service is not free. The size of the MTEAF assessment, now approximately $3.8 million per year, ultimately limits the amount of broadband internet access for the schools and libraries. Bandwidth is therefore rationed to

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[43] http://www.setda.org/c/document_library/get_file?folderId=270&name=DLFE-211.pdf

[44] See http://www.msln.net.

[45] Through this program, Networkmaine provides on-site assistance to resolve local technical problems that preclude the fullest possible utilization of the services provided through the MSLN Project. Due to the lack of funding the Circuit Rider Program is currently staffed with a single technician who is responsible for providing on-site support across the entire State.

schools and libraries based on what can be afforded rather than on what is needed.

Many schools and libraries aren't leveraging their connectivity to its full potential because they don't have the bandwidths required. SETDA recommends connecting all of a district's schools together in a district-area-network. Doing so allows for more efficient sharing and consolidation of IT resources while allowing the district to deliver better services and opportunity to its teachers and students. However, this model requires a level of connectivity similar to what is called for in the SETDA report referenced earlier. Funding available through the MTEAF and E-Rate programs is not sufficient to purchase this level of bandwidth at currently available pricing levels.

Furthermore, schools and libraries are not allocated additional bandwidth by the Networkmaine Council unless they demonstrate that they are already heavily utilizing their existing bandwidth allocation. But high utilization levels can cause poor performance and long delays. Services and processes are quickly abandoned if they have poor performance and long delays, which reduces bandwidth utilization. It is a vicious, self-defeating cycle.

Another barrier to adoption is the lack of middle and last mile fiber infrastructure.[46] Although Maine Fiber Company's Three Ring Binder Project goes some way towards closing the middle mile gap, it does not reach large regions of the State including much of western Maine and the island communities. Maine's broadband service providers have also made investments in expanding their fiber optic infrastructures; however, most of these investments have been focused on the more urban parts of the State. These investment decisions are influenced by both market drivers (adoption rate, population density, etc.) and current regulatory restrictions (rural exemption).

With 56 percent of the K-12 schools and libraries still being serviced by copper-based local loops, service providers will not be able to scale their offerings to the bandwidth levels needed by these institutions in a timely fashion. It takes months, sometimes years, and substantial investments to build out fiber-optic-based

[46] 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 that provides access to the local loop, or, in the case of cable television operators, the local cable modern 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. The "last mile" or "last kilometer" is the final leg of delivering connectivity from a communications provider to a customer. The actual distance of this leg may be considerably more than a mile, especially in rural areas.

infrastructure. It may take at least another Three Ring Binder–sized investment to bring fiber-based services to all schools and libraries in Maine.

4.2.7 Telemedicine Community

Availability

According to Maine Health Information Technology (HIT) surveys of medical providers, dental providers and hospitals, 88 percent of respondents have access to broadband, 9 percent are unsure about their internet access, 2 percent have access using technologies with less than broadband speeds, and 1 percent do not have internet access (Figure 4-20).[47]

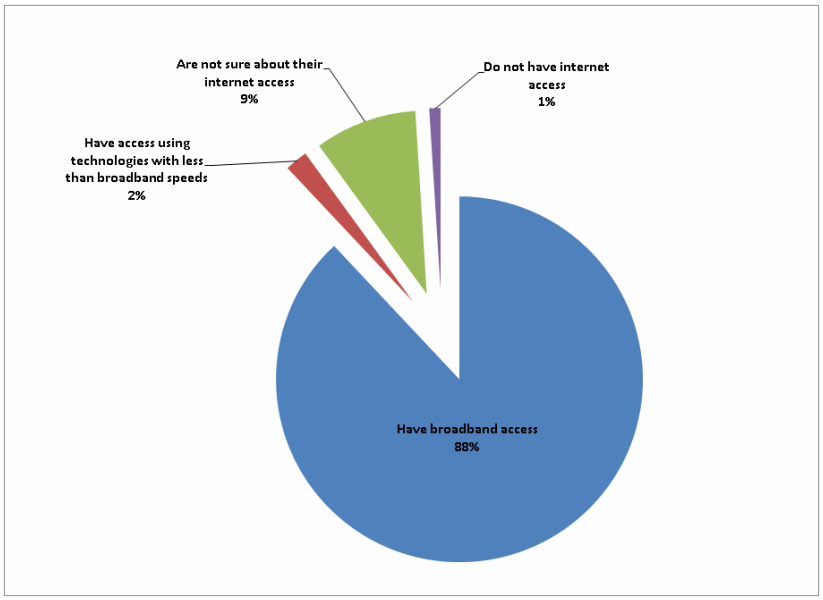

Figure 4-20: Medical Access to Internet and Broadband (HIT Survey)

Use and Drivers

Of the 18 percent that do use telemedicine services, the requirements for broadband connectivity vary depending on the application.

[47] Maine Health Information Technology (HIT) Survey, 2011.

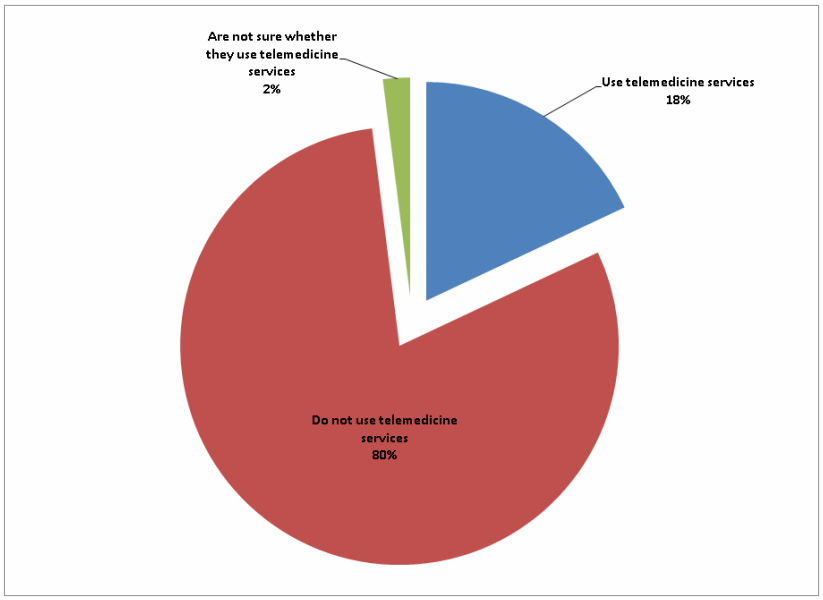

Figure 4-21: Use of Telemedicine Services (HIT Survey)

One key application is the transmission of medical images. In this application, high bandwidth and low latency are the most important characteristics as they determine the speed at which images can be transmitted. Speed requirements vary depending on the type of imaging used or if video applications are included. For example, a single image can vary from 2 Megabytes for a simple black and white x-ray to 3 Gigabytes or more for a 64 slice CT scan. In an environment where the loss of minutes can be critical, the higher the connection speed the better. While PACs (picture archival and communications systems) operated within a hospital on its local area network can cost effectively provide speeds from 1-10 Gbps, sending hundreds of images to an outside reading center requires very large and often prohibitively expensive connections. Other applications, such as tele-mental health counseling, may not require the same speed level but do require symmetric bandwidth to support two-way video. High definition tele-presence systems also require low latency, low jitter, and bandwidth at 2-3 Mbps per session.

Tele-ICU services allow multiple hospitals to share highly specialized nurses and physicians to care for intensive care patients. Tele-ICU centers often use redundant connections to guard against loss of connectivity. In this case, the amount of bandwidth needed is dependent on the type of telemetry being transmitted, but what is key is that broadband connectivity is always available.[48] No outage, however brief, is acceptable.

[48] See 2010-8_A+Second+Set+of+Eyes+An+Introduction+to+TeleICU_Critical+-1.pdf

A second driver for broadband connectivity in the healthcare industry is home-based care, or tele-homecare. According to the Maine Telehealth Collaborative tele-homecare delivers numerous benefits.[49] These benefits include:

- Improving patient outcomes by providing daily monitoring
- Reducing home care costs by reducing the number of unnecessary in-home visits
- Reducing number of unnecessary emergency room visits and re-hospitalizations
- Reducing hospital length of stay (LOS) by providing daily patient monitoring and education
- Providing a sense of security, particularly for rural patients and caregivers.
- Providing staffing relief
- Providing primary care physicians and patients direct access to patient information

Such societal benefits are generally not taken into consideration when a service provider determines whether to provide service in an area. For these reasons, government and the broadband industry both have a role to play in encouraging broadband expansion.

Barriers to Adoption

A significant percentage (42%) of Maine's healthcare industry has not identified a need for telemedicine service (Figure 4-22). And, without health-related IT expertise readily available, many of Maine's small clinics and practices lack the understanding of how to leverage telemedicine to increase the quality of care for their patients.

For example, the lack of knowledge and IT support in small practices has been a significant barrier to realizing the full benefits of Electronic Health Records (EHR) and Health Information Exchange (HIE). Many small practices therefore still use paper-based medical records. To assist in the transition to EHR, HealthInfoNet[50] has received American Recovery and Reinvestment Act funds to create the Maine Regional Extension Center (MEREC) that provides education and technical assistance to help health care providers select, implement, and achieve meaningful use of certified EHR technology. These efforts are a positive first step but more needs to be done to demonstrate the value that broadband connectivity can bring to small practices.

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[49] See http://www.mainetelehealth.org/.

[50] http://www.hinfonet.org.

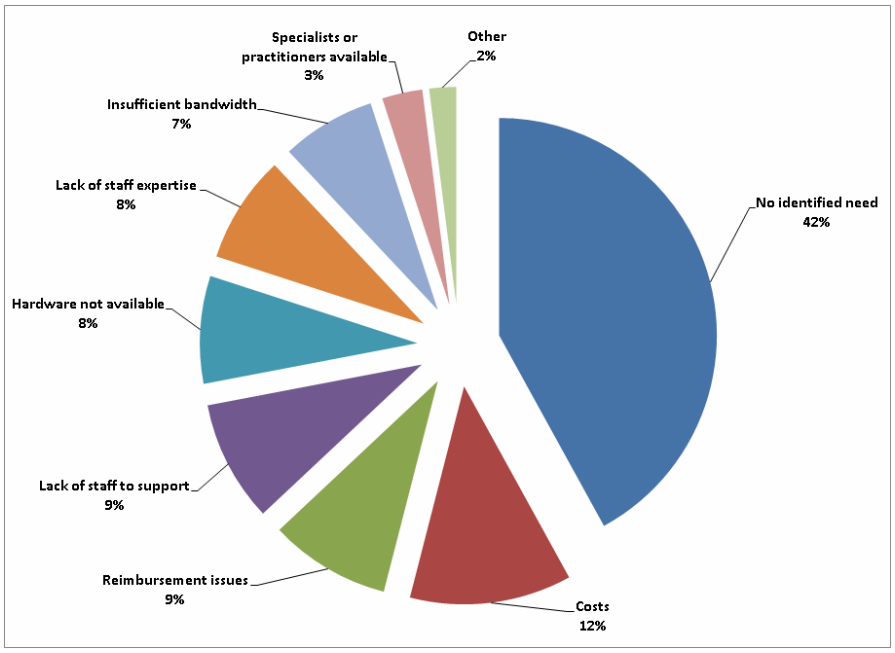

Figure 4-22: Barriers to Adoption of Telemedicine Services

Workforce development initiatives will be needed to address the paucity of Maine's IT knowledgeable workforce. As a first step, the University of Maine System recently announced in its biennial State of the University report to the State Legislature a partnership with Maine's business community to double the number of IT graduates in the next four years.[51]

Delays in the implementation of the New England Telehealth Consortium (NETC) network have stalled the adoption of broadband by Maine's healthcare community. Many healthcare providers have put plans on hold as they wait for this project to start building the network proposed in its Rural Health Care Pilot Program (RHCPP) proposal. The RHCPP is viewed by some as bordering on failure due to overly bureaucratic oversight by the Universal Service Administrative Company (USAC) and lack of proper planning, communications, and measurements by the FCC. The GAO, on congressional request, recently released a report[52] highly critical of the FCC and its handling of the RHCPP. While the NETC initiative is years behind schedule, NETC has recently released a series of RFPs for the implementation of the envisioned network with the expectation that deployment should start in 2011. Once deployed, NETC's network will go a long

[51] http://www.maine.edu/pdf/3-30-11UMSChancellorStateoftheUniv.pdf.

[52] See http://www.gao.gov/new.items/d1127.pdf.

way towards increasing the broadband adoption rate in this critical sector as it will significantly reduce the cost of broadband for its participants.

The role of existing healthcare and insurance regulations and reimbursement policies, and the obstacles they create in using telemedicine to deliver healthcare, should also be reviewed.[53] Changes in these regulations can have as great an impact on telemedicine as any changes in telecommunications regulations. Removing restrictions on reimbursements based on the physical location of a patient in relation to the provider would have a major impact on broadband adoption and improving healthcare. For example, during the First Regular Session of the 124th Legislature (2009), Maine's Insurance Code (Title 24-A) was amended to include insurance coverage for medical care provided through tele-health services:

> A carrier offering a health plan in this State may not deny coverage on the basis that the coverage is provided through telemedicine if the health care service would be covered were it provided through in-person consultation between the covered person and a health care provider.

This one sentence has done as much to enable the expanded use of telemedicine in Maine as any advancement in technology by allowing for reimbursement for health care services delivered at a distance.

Summary of Telemedicine Results

- Lack of high-speed broadband availability is increasing the cost of health care in Maine. Without widespread availability of high-speed broadband, Mainers experience a higher rate of hospitalization and a lack of convenient access to medical services and specialists that could otherwise be available.
- Lack of readily available IT support is limiting the use of broadband technologies in smaller practices.
- The healthcare industry is making the assumption that high-speed broadband is universally available as it rethinks how to deliver its services, potentially widening the digital divide.

4.2.8 Native Indian Tribes

As part of its mission described in the National Broadband Plan, the FCC has established a division responsible for policy and programs designed to close the perceived gap in basic telecommunications and broadband service throughout tribal lands and native communities. The FCC's Office of Native Affairs and Policy (ONAP) was launched in August 2010 to "handle ongoing consultation and

[53] National Broadband Plan, Recommendations 10.1-10.3.

coordination with American Indian Tribes, Alaska Native Villages, Native Hawaiian Organizations, and other Native and Tribal entities, and will be the official Commission contact point for these activities. It will also engage in work with Commissioners, bureaus, and offices, as well as with other government agencies, private organizations, and the communications industries, to develop and implement FCC policies regarding Tribal Nations and Native communities."[54]

According to the FCC, there are more than 4.1 million American Indians and Alaska Natives in the United States, and more than 565 federally recognized tribes with their own unique political and tribal structures. Nationwide, Native American tribes could be the most underserved group with only 68 percent having access to telephones and less than 10 percent to broadband. According to the FCC, the actual percentage, based on anecdotal evidence may be even lower at just 5 to 8 percent. By comparison, approximately 65 percent of all Americans use broadband.

There are five federally recognized Native Indian tribes with reservation and trust lands within Maine: the Aroostook Band of Micmac Indians, the Houlton Band of Maliseet Indians, the Penobscot Nation, the Passamaquoddy Tribe at Sipayik (Pleasant Point), and the Passamaquoddy Tribe at Motahkmikuk (Indian Township). Compared to many other regions of the United States, these five tribal governments are more closely integrated into the social and infrastructure systems of Maine. For example, Maine is unique in the 50 states in that elected representatives of the Indian Nations hold seats within the Maine legislature with power to introduce legislation. Because of this integration, the three populated reservations operating within the State, the Penobscot Nation at Indian Island, the Passamaquoddy Tribe at Pleasant Point, and the Passamaquoddy Tribe at Indian Township, realize benefits from proximity to the existing and developing broadband infrastructure within the State as well as from program support provided by the Bureau of Indian Affairs.

The tribes report 7,629 tribal citizens per the 2000 census information. There are 420 residents of Indian Island, 462 residents at Pleasant Point and 657 reported at Indian Township. Because of their current use of the internet for proactive self-governance programs and to deliver access to services, these communities share many traits with the neighboring non-tribal communities. However, there are some key differences that contribute to low broadband subscribership levels.

According to the 2000 census information, the reported median household income for tribal communities is significantly below the State average. Reported poverty levels are 49.5 percent for residents of Indian Island, 31.1 percent for residents of

[54] Statement of Policy on Establishing a Government-to-Government Relationship with Indian Tribes.

Pleasant Point, and 38.5 percent for residents of Indian Township. In contrast, the rest of Maine is reported to have 7.8 percent of the population living at or below the poverty level. The median age of the population in tribal communities is the same or younger than other communities in Maine.

Availability

As is the case for Maine generally, broadband availability on tribal lands varies significantly in both coverage and technologies delivering service. A review of data reported by broadband providers overlaid with the geographic limits of the reservation and trust lands reveals the profile in Tables 4-24 and 4-25.

Table 4-24: Percentage of Tribal Lands with Available Broadband Service

Percentage of Tribal Lands with Available Broadband Service*		
Aroostook Band of Micmac Indians		98%
Houlton Band of Maliseet Indians		65%
Penobscot Nation	Indian Island	100%
	Remaining Lands	21%
Passamaquoddy Tribe	Pleasant Point	100%
	Indian Township	100%
	Remaining Lands	12%

**Defined based on lands with addressed street segments per E911. Not intended to be an absolute measure of last mile service.*

Table 4-25: Profile of Service Providers, Technologies, and FCC Speed Tiers

Profile of Service Providers, Technologies, and FCC Speed Tiers			
Tribe	**Service Providers**	**Technologies**	**Speed Tiers**
Aroostook Band of Micmac Indians	Aroostook Internet, Aroostook Technologies, Fairpoint Communications, GWI, Pioneer Broadband, Polaris Cable, Time Warner Cable	Fixed Wireless DSL Cable T-1	1st Generation Tier 1
Houlton Band of Maliseet Indians	Fairpoint Communications, GWI, Polaris Cable	Fixed Wireless DSL Cable	Tier 1
Penobscot Nation	Axiom Technologies, Cornerstone Communications, Fairpoint Communications, GWI, Mid-Maine Communication, Pioneer Broadband, Polaris Cable, Premium Choice Broadband, Time Warner Cable	Fixed Wireless DSL Cable T-1 Fiber Optic	1st Generation Tiers 1, 3
Passamaquoddy Tribe at Pleasant Point	Axiom Technologies, Fairpoint Communications, Pioneer Broadband, Time Warner Cable	Fixed Wireless DSL Cable T-1	Tiers 1, 3
Passamaquoddy Tribe at Indian Township	Axiom Technologies, Fairpoint Communications, Time Warner Cable	Fixed Wireless DSL Cable T-1	Tiers 1, 3

Much of the coverage and option for service in the Native Indian communities is therefore better than many other regions of the State. However, though the majority of the tribal lands have at least Tier 1 (basic data) coverage, not all potential subscribers have the same variety of options, as is also the case for a large percentage of the State's general population.

Use

Though no current information is available concerning specific use by individual Native Indians not residing on tribal lands in Maine, we were able to gather information about community anchor organizations and those living on reservation lands. All tribes reported at least Tier 1 level access for all community leadership and support organizations managed by tribal government. These include schools, government agencies, emergency and police services, and health care facilities. Each tribal government provides access to information and support systems by means of established tribal sponsored websites. These systems are designed to assist tribal members in acquiring access to services, promote commerce, and provide a link to community organizations like the Boys and Girls Clubs or libraries.

Subscribership rates among the residents of Native Indian lands are believed to be lower than the national average for all Americans, even though basic access appears high. As with other segments of Maine's population, internet subscriber levels and use patterns are higher among those who own computers or online gaming devices. They appear to increase incrementally for families with school age children.

Support groups such as the Penobscot Boys and Girls Club include programs designed to educate youngsters on the use of computing and network technologies. Children participating in these programs not only have access through the organization but are also taught about economic opportunities that are available in computing and networking careers.

Drivers and Gaps

Tribal residential consumers of broadband reported drivers that mirror Maine's general population, including education, financial management, communication, videoconferencing, entertainment, telecommuting, and telemedicine. The most reported gap item was consistent quality of service. Users reported impacts to system performance that appear to correlate to bandwidth. This problem was most evident with higher use applications like streaming content or online game play.

Business users see access to more affordable service and increased capacity as their primary drivers. Adoption and use provides an opportunity for these businesses to take advantage of the programs and special contracting

considerations available through state and federal agencies more effectively than other tribes who typify the nationwide FCC profile.

Among the community agencies and support groups, drivers align with the National Broadband Plan. These include increased economic opportunity, improved education access, healthcare bridges between home patients and clinic staff, energy system improvements and efficiency gains, and better public safety communications.

Barriers to Adoption

The primary barrier to adoption among those living on reservation lands is cost of computer ownership and cost of internet service. For those in the lowest income level, access is provided through organized support services like community groups, schools, and libraries. Subsidized programs through the tribal governments and in some cases the Bureau of Indian Affairs fill a portion of the gap.

In addition, a high percentage of those interviewed perceive no value in broadband. For this segment, more education about the economic value available through internet use may encourage more to subscribe. Technology assistance programs or other system incentives like discounts or tax deductions for items like home energy management systems may also encourage this group to become adopters.

Summary of Key Findings

Analysis across reservation and trust lands indicates Native Indian Tribes of Maine have a higher level of access to broadband services than the majority of Native Americans in other parts of the country.[55]

Other key points are:

- Assistance may be needed for those without the finances to take advantage of available infrastructure.
- Higher costs for business level services may negatively impact economic development in tribal regions.
- Consumer education on the value of broadband based technologies may bring late adopters to the broadband table.
- Funding for high tech training may be leveraged at the federal level to assist in realizing economic growth while helping to fill a work force need in Maine.

[55] This point leads one to speculate that a national agenda focused on developing basic access in areas where availability and use level is lower suggests that the tribes within Maine may have trouble competing nationally for funding and other assistance.

4.2.9 State Agencies

The results of the survey of State agencies are not as comprehensive as the results gathered from other surveys in this assessment. The several agencies contacted during the survey each referred our questions to the Maine State Office of Information Technology (OIT), which provides centralized technical resources to State agencies.

Availability and Use

The majority of State facilities have access to and use broadband internet service. The few exceptions are remote parks or campgrounds such as Rangeley Lake State Park.

State agencies use broadband to meet a wide array of internal operational and public service needs. Internally, for example, employees enter timesheet information into the Time and Attendance Management System, and security personnel use video to monitor an entrance at a state facility. Outward facing components accessed through Maine.gov include AdvantageME procurements, online vehicle registration, the purchase of hunting and fishing licenses, campground reservations, absentee ballot requests, and payment of court fines and fees. In addition, a mobile Maine.gov is available for smartphone devices. It provides on-the-go access to agency directories, maps of nearby government facilities, 511 travel data, polling places, lottery numbers, and news.[56]

Drivers and Gaps

Most current drivers for State broadband deployment center on increasing bandwidth and upgrading speeds to lessen network congestion. Currently, some tasks such as system back-ups are restricted due to the strain on the network.

The need to increase capacity will become greater as data intensive uses become more prevalent. Some uses that are expected to increase the need for higher speeds are interactive online constituent feedback and communication services, video conferencing, live internet streaming of meetings and events, transferring health records, data sharing with federal and State counterparts, mobile services, and expanding wireless connectivity.

Barriers to Adoption

The two greatest barriers to expanding access and increasing network capacities are limited or no carrier availability in remote areas and funding.

[56] For more information on Maine.gov, see the *2010 InforME Annual Report*.

Summary of State Agency Results

The Maine State Office of Information Technology indicated that with few exceptions:

- Maine's State offices and facilities have broadband level internet access
- The State provides many services to its residents via its online presence and is continuing to add to these offerings
- Funding

5.0 The Economic Model

The economic modeling analysis in this assessment consists of two studies designed to gain a better understanding of the barriers to broadband adoption in Maine. Since barriers can arise as a result of the behaviors of service providers as well as users of broadband services, this economic analysis considers:

1. Deployment decisions of telecommunications companies
2. Demand for broadband services by Maine household and small business consumers

5.1 AVAILABILITY OF BROADBAND SERVICES

5.1.1 Introduction

Broadband use (i.e., the number of subscribers) in a region depends on the investment decisions of telecommunications companies and the demand for services by local households, businesses and community organizations. When deciding on where to deploy broadband infrastructure, telecommunications companies consider the cost of reaching potential customers as well as the likelihood that they will subscribe to available services. This suggests that a municipality's geographic location and population settlement patterns—which affect the cost of delivery—and characteristics of local households, businesses and community organizations—which affect the need for (and interest in) services—are likely to be key determinants of broadband deployment.

This study to examine the availability of broadband services in Maine is based uon data from the Maine Broadband Inventory and Mapping Project current through April 1, 2011. This report thus produces a "snapshot" of availability at a single point in time and will be updated periodically as new data are compiled for the project. Socioeconomic data (e.g., median age and educational attainment of the population) for Maine municipalities are from the 2000 US Census. Zip Code Business Patterns of the US Census Bureau is the source of information on the number of local establishments that employ 100 or more workers.

Although the Mapping Project catalogs service technologies according to eleven categories,[57] this study considers five categories of broadband: DSL, cable, T-1, fiber optic, and fixed wireless. For purposes of this study, satellite and terrestrial mobile wireless technologies are not defined as broadband and are excluded from consideration (Section 2.3.1). Electric power line is also excluded as the Mapping Project has not yet identified any services using this technology in Maine. In addition, technologies with subset categories—DSL, cable, and fixed wireless—are grouped together.[58]

Using information on a sample of 494 Maine municipalities, we look at the percentage of locations in an area with access to one or more of the five selected broadband technologies, as well as access to cable, DSL and fixed wireless services separately. The local characteristics used to examine differences in broadband availability across municipalities include population density, the percentage of residents who reside outside of urban centers (i.e., rural population), median age and educational attainment of the population, median household income, and the average value of residential housing structures. In addition, we consider the connection between the availability of broadband services and local business characteristics such as the number of "large" establishments (i.e., 100 or more employees) located in the municipality, the number of community anchor institutions, and the share of local employment by industrial category (e.g., construction, manufacturing, finance and insurance, and educational services).

Findings presented in the study show generally that the most important factors explaining differences in broadband availability across Maine municipalities are the share of the population located in rural areas, the median age of the population, educational attainment and median household income. In addition, the analysis indicates that aspects of a municipality's geographic situation—the county of location and its proximity to other places with access to broadband—are key determinants of broadband availability. Finally, our results suggest that the shares of local employment in wholesale trade, retail trade, finance and insurance, and educational services tend to have a positive effect on broadband availability.

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[57] Eleven categories are listed in the technical appendix of the SBDD Mapping Notice of Funds Availability (NOFA), including asymmetric xDSL, symmetric xDSL, other copper wire (e.g., T-1), cable modem-DOSCSIS 3.0, cable modem-other, fiber optic, terrestrial fixed wireless-unlicensed, terrestrial fixed wireless-licensed, electric power line, satellite, and terrestrial mobile wireless.

[58] DSL includes asymmetric xDSL and symmetric xDSL, cable includes cable modem-DOCSIS 3.0 and cable modem-other, and fixed wireless includes terrestrial fixed wireless-unlicensed and terrestrial fixed wireless-licensed.

Table 5-1 shows information on the percentage of locations in Maine with access to the selected broadband technologies considered in the analysis. Using data from the Maine Broadband Inventory and Mapping Project and population data from the 2000 US Census, we estimate that 91.1 percent of Maine locations have access to one or more of the selected broadband technologies. Looking at individual technologies, we estimate that 84.7 percent, 36.4 percent and 15.7 percent of Maine locations have access to broadband via cable, DSL and fixed wireless service respectively.[59]

Table 5-1: Availability of Broadband Service in Maine

Region	% of locations with access to broadband				Average Number of Suppliers
	Any Type	Cable	DSL	Fixed Wireless	
Statewide (n=494)	**91.1%**	84.7%	36.4%	15.7%	4.3
County					
Androscoggin (n=14)	**98.9%**	95.9%	49.8%	0.0%	4.3
Aroostook (n=67)	**84.1%**	64.4%	18.4%	58.7%	4.4
Cumberland (n=26)	**94.4%**	93.8%	36.1%	0.5%	4.3
Franklin (n=23)	**73.3%**	61.1%	30.4%	0.0%	3.5
Hancock (n=36)	**81.4%**	70.3%	19.9%	39.3%	4.0
Kennebec (n=30)	**98.0%**	97.7%	25.3%	3.6%	4.0
Knox (n=18)	**96.9%**	87.2%	41.5%	86.6%	5.9
Lincoln (n=20)	**99.3%**	94.5%	46.0%	50.8%	4.4
Oxford (n=37)	**90.6%**	83.9%	47.2%	0.0%	3.6
Penobscot (n=61)	**88.8%**	76.9%	46.0%	24.4%	5.0
Piscataquis (n=19)	**48.9%**	40.6%	18.7%	0.0%	3.4
Sagadahoc (n=10)	**93.3%**	89.4%	37.0%	31.5%	4.7
Somerset (n=33)	**61.2%**	52.0%	25.2%	0.0%	3.8
Waldo (n=26)	**75.6%**	53.6%	35.5%	25.0%	3.7
Washington (n=45)	**91.1%**	60.0%	19.9%	76.0%	3.8
York (n=29)	**99.1%**	98.8%	42.8%	0.0%	4.6

Notes: Information on the number of broadband suppliers and the percentage of locations with access to broadband is from the Maine Broadband Inventory and Mapping Project, conducted by Sewall for the ConnectME Authority. These figures are weighted by municipality population size as of the 2000 US Census.

59 These figures are based on broadband availability information, measured at the municipality level, for 494 Maine cities and towns. The average values are weighted by population size using data from the 2000 US Census.

A multi-step process was used to arrive at the estimates presented in Table 5-1. We started with municipality-level information from the Broadband Inventory and Mapping Project on the percentage of locations with access to broadband. This information is available for 918 places (e.g., municipalities and unorganized territories) in Maine and for five types of broadband technologies. For each of the 918 places, Sewall provided data on the percentage of locations with access to any type of broadband, as well as the percentages of locations with access to cable, DSL or fixed wireless broadband services.

The next step involved connecting the broadband availability information from the Maine Broadband Inventory and Mapping Project to municipality-level population data from the 2000 US Census. We were able to identify "matches" for 494 municipalities. Although this means we omitted from consideration 424 places from the Inventory and Mapping Project, the 494 Maine municipalities included in the analysis accounted for 99.3 percent of total statewide population as of 2000. Thus the dataset used in our analysis provides almost complete coverage of the places where people reside in Maine.

Table 5-1 reveals a wide variation in broadband availability across Maine counties. The highest shares of locations with access to any type of broadband are found in Lincoln (99.3 percent), York (99.1 percent), Androscoggin (98.9 percent) and Kennebec (98.0 percent) counties. These places have almost universal access to broadband in one form or another. Regions of the State with the lowest shares of locations with broadband availability include Piscataquis (48.9 percent), Somerset (61.2 percent), Franklin (73.3 percent) and Waldo (75.6 percent) counties.

5.1.2 Factors Affecting Broadband Availability in Maine

Table 5-2 presents a summary of the local characteristics used in the study to examine differences in broadband availability across Maine municipalities. The first two variables—population density and rural population—are measures of population settlement patterns. It is expected that places with sparse populations (i.e., low numbers of people per square mile) and/or large shares of the population residing outside of urbanized areas and urban clusters will have higher costs of broadband deployment and, thus, lower shares of locations with access to broadband services.

The next two variables shown in Table 5.2—median age and educational attainment—are socioeconomic characteristics of the population. They are used in the analysis as proxies for a local population's interest in broadband services, which might affect the investment decisions of telecommunications companies. The variables median income and housing value are measures of income and wealth, respectively, which might affect a household's ability to pay for broadband services.

Table 5-2: Factors Expected to Influence Broadband Availability in Maine

Variable Name	Definition	Source	Mean	Standard Deviation
Population Density	Population per square mile, 2000	2000 US Census.	97.2	219.8
Rural Population	Share of the population located outside of urbanized areas and urban clusters, 2000	2000 US Census.	0.89	0.27
Median Age	Median age of the population, 2000	2000 US Census	40.6	4.21
Educational Attainment	Average educational attainment (i.e., number of years completed) of the population aged 25 and older, 2000	2000 US Census	12.8	0.77
Median Income	Median household income, 1999	2000 US Census	$34,620	$8,865
Housing Value	Median value of owner-occupied housing units, 2000	2000 US Census	$85,984	$33,398
Large Businesses	Count of establishments employing 100 or more workers	Zip Code Business Patterns, 2000	2.05	7.84
Community Anchor Institutions	Includes organizations such as local schools, universities, libraries, healthcare facilities and government offices	Maine Broadband Inventory and Mapping Project, 2009	8.82	17.5

Notes: For all of the variables expect large businesses, mean values and standard deviations are based on 494 municipality-level observations. For the variable large businesses, the summary statistics are based on 340 municipality-level observations.

Table 5-3 shows regression results on the factors that affect the number of broadband suppliers in Maine municipalities. A Poisson regression model is used due to the nature of the dependent variable, which is a count of the number of broadband suppliers. The marginal effects reported in the table are interpreted as the change (i.e., positive values indicate an increase; negative values denote a decrease) in the number of suppliers that are associated with a one-unit increase in the magnitude of a given explanatory variable (e.g., median age, rural population).

Along with the variables described previously in the report (and defined in Table 5.2), the model shown in the right-hand column of results includes an additional explanatory variable, labeled as "number of suppliers, elsewhere in county." This variable is a measure of the county-wide average number of broadband suppliers, not including the city or town of interest. This variable is used in the regression analysis to account for geographical patterns in the deployment of broadband infrastructure. Given the nature of some broadband networks, it is likely to be more cost effective to expand services in areas located in proximity to existing infrastructure.

Table 5-3: Poisson Marginal Effects: Factors Affecting Number of Broadband Suppliers in Maine Municipalities

Variable	Poisson Marginal Effects	
Constant	5.088*** (2.617)	3.767** (2.424)
Population Density	-0.0002 (0.0004)	-0.0003 (0.0004)
Rural Population	-1.420*** (0.388)	-1.421*** (0.391)
Median Age	-0.072*** (0.022)	-0.069*** (0.023)
Educational Attainment	0.152 (0.179)	0.188 (0.180)
Median Income ($1,000s)	0.026** (0.013)	0.024** (0.013)
Housing Value ($1,000s)	-0.003 (0.004)	4.29E-05 (0.005)
Number of Suppliers, Elsewhere in County	NA	0.320* (0.185)
Chi-Squared Test Statistic **p-value**	81.61 0.000	84.81 0.000

*Notes: Standard errors are shown in parentheses. The superscripts *, ** and *** indicate statistical significance at the 1-percent, 5-percent, and 10-percent significance levels, respectively.*

The regression results indicate that, other things being equal, the share of the population located outside of urbanized areas and urban clusters (i.e., rural population) has a negative effect on the number of broadband suppliers in Maine municipalities. More specifically, a 10-percentage point increase in the value of

rural population (e.g., an increase from 25 percent to 35 percent) is associated with a decrease of about 0.14 broadband suppliers. The Poisson regression results also reveal a negative relationship between the number of broadband suppliers and the median age of the population; e.g., an increase in the median age of five years is associated with about one-third fewer broadband suppliers.

On the other hand, the results show a positive relationship, other things being equal, between the number of broadband suppliers and median household income. A $10,000 increase in median household income is associated with about 0.25 additional broadband suppliers in a Maine municipality. Likewise, the average number of suppliers—elsewhere in the county—has a positive effect on the number of broadband companies in a given municipality. The regression results do not reveal a statistically significant relationship between the number of broadband suppliers and the other variables used in the model: population density, the average educational attainment of residents (aged 25 and older) residing in a municipality, and the median value of owner-occupied housing units.

Table 5-4 shows ordinary least-squares (OLS) regression results on the factors that affect the availability of (any type of) broadband service in Maine municipalities. Here, the dependent variable measures the percentage of locations in a municipality with access to broadband. The second two sets of regression results in this table account for geographic patterns in the availability of broadband services. The center column of OLS results controls for county-level "fixed effects," which are differences in broadband availability among counties that are not explained by the other explanatory variables used in the model. The regression model shown in the far right column includes an additional variable that measures the average percentage of locations elsewhere in the county with access to broadband.

Table 5-4: OLS Regression Results: Factors Affecting the Availability of Broadband Services in Maine Municipalities

Variable	OLS Regression Results		
Constant	68.91 (37.46)	NA	11.75 (35.65)
Population Density	0.013 (0.009)	0.007 (0.008)	0.003 (0.008)
Rural Population	-9.612 (7.017)	-9.033 (6.609)	-8.743 (6.558)
Median Age	-1.840*** (0.361)	-1.958*** (0.351)	-1.632*** (0.338)
Educational Attainment	4.586 (2.915)	5.701** (2.881)	6.068** (2.730)
Median Income ($1,000s)	0.516** (0.220)	0.311 (0.225)	0.164 (0.210)
Housing Value ($1,000s)	0.113 (0.073)	0.038 (0.077)	-0.021 (0.070)
Availability of Broadband Services, Elsewhere in County	NA	NA	0.732*** (0.086)
County-level Fixed Effects	NO	YES	NO
Adjusted R-squared	0.266	0.355	0.293

*Notes: Analysis focuses on the percentage of locations in a municipality with access to any type of broadband technology. Standard errors are shown in parentheses. The superscripts *, ** and *** indicate statistical significance at the 1-percent, 5-percent, and 10-percent significance levels, respectively.*

Regression results show that the variable median age has a negative effect on the availability of broadband services, and that median income (1 of 3 regressions) and educational attainment (2 of 3 regressions) have a positive effect on the percentage of locations with access to any type of broadband service. In addition, a positive relationship exists, other things being equal, between the availability of broadband in a given municipality and its availability elsewhere in the county. The adjusted r-squared values—ranging from 0.266 to 0.355—indicate that the variables included in the regression models explain about one-third of the variation in broadband services across Maine municipalities.

In Table 5-5, we present OLS regression results on the factors affecting the availability of cable broadband services in Maine municipalities. The share of the municipality's population located outside of urbanized areas (e.g., negative effect),

the median age of the population (e.g., negative effect) are the primary determinants of cable broadband availability. In addition, we find that the number of residents per square mile (i.e., population density) and the median value of owner-occupied housing units (i.e., housing value) have a positive effect on cable broadband availability in one of the three regression models. These models explain between 27 percent and 36 percent of the variation in the availability of cable broadband across Maine municipalities.

Table 5-5: OLS Regression Results: Factors Affecting the Availability of Cable Broadband Services in Maine Municipalities

Variable	OLS Regression Results		
Constant	94.91* (44.45)	NA	56.10 (42.86)
Population Density	0.019* (0.010)	0.011 (0.010)	0.008 (0.010)
Rural Population	-25.33*** (8.326)	-23.25*** (8.044)	-22.76*** (7.966)
Median Age	-2.291*** (0.429)	-2.317*** (0.427)	-2.004*** (0.412)
Educational Attainment	2.172 (3.459)	3.131 (3.507)	4.043 (3.317)
Median Income ($1,000s)	0.846*** (0.262)	0.451 (0.274)	0.342 (0.261)
Housing Value ($1,000s)	0.192** (0.087)	0.031 (0.094)	0.022 (0.087)
Availability of Cable Broadband, Elsewhere in County	NA	NA	0.621*** (0.090)
County-level Fixed Effects	NO	YES	NO
Adjusted R-squared	0.266	0.355	0.329

*Notes: Analysis focuses on the percentage of locations in a municipality with access to cable broadband technology. Standard errors are shown in parentheses. The superscripts *, ** and *** indicate statistical significance at the 1-percent, 5-percent, and 10-percent significance levels respectively.*

Table 5-6 shows OLS regression results on the factors affecting the availability of DSL broadband services in Maine municipalities. Here, we find that the explanatory variables used in the analysis are—collectively as a group—very poor at explaining the variation in access to DSL broadband found across Maine. The r-squared value of 0.086 in the first column of regression results indicates that the

model explains less than 10 percent of the variation in DSL broadband availability across Maine.

The final two columns of regression results, however, show that knowing where a place is located—either in terms of its county of location or the availability of DSL broadband in nearby areas—provides a much better idea about access to DSL broadband in a given municipality. In addition, median age has a negative effect on the availability of DSL, and median income and population density (1 of 3 regressions) have a positive effect. The r-squared values shown in the final two columns of results indicate that accounting for the geographic situation of a place, along with the other explanatory variables, explains over 20 percent of the variation in DSL broadband availability across Maine municipalities.

Table 5-6: OLS Regression Results: Factors Affecting the Availability of DSL Broadband Services in Maine Municipalities

Variable	OLS Regression Results		
Constant	64.28* (33.55)	NA	19.46 (31.79)
Population Density	0.012 (0.008)	0.013* (0.007)	0.009 (0.007)
Rural Population	-0.003 (6.284)	1.048 (5.923)	1.647 (5.875)
Median Age	-1.055*** (0.323)	-0.919*** (0.315)	-0.769** (0.304)
Educational Attainment	-1.735 (2.611)	0.061 (2.582)	-0.413 (2.453)
Median Income ($1,000s)	0.593*** (0.194)	0.451** (0.202)	0.331* (0.187)
Housing Value ($1,000s)	0.078 (0.066)	0.026 (0.069)	-0.011 (0.062)
Availability of DSL Broadband, Elsewhere in County	NA	NA	0.767*** (0.090)
County-level Fixed Effects	NO	YES	NO
Adjusted R-squared	0.086	0.236	0.202

*Notes: Analysis focuses on the percentage of locations in a municipality with access to DSL broadband technology. Standard errors are shown in parentheses. The superscripts *, ** and *** indicate statistical significance at the 1-percent, 5-percent, and 10-percent significance levels respectively.*

Table 5-7 shows OLS regression results on the factors that affect the availability of fixed wireless broadband services in Maine municipalities. As in our analysis of the deployment of DSL broadband technology, we find knowing where a municipality is located is a key determinant of the availability of fixed wireless broadband. The center column of results in Table 5-7 shows that the regression model accounting for county-level fixed effects has an r-squared value of 0.506. This means that the variables included in the model, along with the knowledge about the county in which a municipality is located, explain almost one-half of the variation in the availability of fixed wireless broadband services across Maine. In addition, the regression results—similar to the analysis of "any type" of broadband service—that access to fixed wireless broadband is positively associated with the educational attainment of the local population.

Table 5-7: OLS Regression Results: Factors Affecting Availability of Fixed Wireless Broadband Services in Maine Municipalities

Variable	OLS Regression Results		
Constant	-92.92** (40.53)	NA	-63.10** (35.33)
Population Density	-0.010 (0.009)	0.0001 (0.007)	-0.005 (0.007)
Rural Population	2.379 (7.592)	-4.632 (5.630)	-6.330 (5.615)
Median Age	0.332 (0.392)	-0.505* (0.299)	-0.304 (0.290)
Educational Attainment	10.59*** (3.154)	7.677*** (2.454)	7.041*** (2.333)
Median Income ($1,000s)	-1.935*** (0.238)	-0.143 (0.192)	-0.209 (0.058)
Housing Value ($1,000s)	-0.020 (0.079)	0.075 (0.066)	-0.012 (0.058)
Availability of Fixed Wireless Broadband, Elsewhere in County	NA	NA	1.983*** (0.049)
County-level Fixed Effects	NO	YES	NO
Adjusted R-squared	0.045	0.506	0.480

*Notes: Analysis focuses on the percentage of locations in a municipality with access to fixed wireless broadband technology. Standard errors are shown in parentheses. The superscripts *, ** and *** indicate statistical significance at the 1-percent, 5-percent, and 10-percent significance levels, respectively.*

Table 5-8 presents a summary of our regression results on the factors affecting broadband availability in Maine municipalities. They generally suggest that the most important determinants of broadband access are the percentage of the population in a municipality who reside outside of urbanized areas and urban clusters, the median age of the population, educational attainment, and median household income.

The first two of these factors tend to reduce access to broadband services, while educational attainment and median household income generally have a positive effect on the availability of broadband. In addition to these three explanatory variables, we also find that—especially in the cases of DSL and fixed wireless broadband services—the county in which a municipality is located is an important factor explaining the availability of broadband. These findings are indicative of strong geographic patterns in the deployment of broadband infrastructure.

Table 5-8: Summary of Regression Results: Factors Affecting Broadband Availability in Maine Municipalities

Factor	Providers	Any Type	Cable	DSL	Fixed Wireless
Population Density	No Effect	No Effect	**Positive** (1 of 3)	**Positive** (1 of 3)	No Effect
Rural Population	**Negative** (2 of 2)	No Effect	**Negative** (3 of 3)	No Effect	No Effect
Median Age	**Negative** (2 of 2)	**Negative** (3 of 3)	**Negative** (3 of 3)	**Negative** (3 of 3)	**Negative** (1 of 3)
Educational Attainment	No Effect	**Positive** (2 of 3)	No Effect	No Effect	**Positive** (3 of 3)
Median Income ($1,000s)	**Positive** (2 of 2)	**Positive** (1 of 3)	**Positive** (1 of 3)	**Positive** (3 of 3)	**Negative** (1 of 3)
Housing Value ($1,000s)	No Effect	No Effect	**Positive** (1 of 3)	No Effect	No Effect

Notes: A positive / negative effect means that an increase in the magnitude of the factor is associated with an increase / decrease in the measure of availability. The information shown in parentheses is the number of regression models in which the factor has a statistically significant effect (at the 10-percent significance level or lower). "No effect" means that the factor does not have a statistically significant effect on the measure of availability.

5.1.3 Local Business Characteristics and Broadband Availability

In addition to the socioeconomic characteristics of Maine municipalities considered previously in this analysis, it is likely that characteristics of the local business community might also influence the broadband investment decisions of telecommunications companies. This section of the report examines the effects of local industry specialization, and the presence of large businesses and community anchor institutions on the availability of broadband services in Maine municipalities.

Table 5-9 presents a summary of OLS regression results on the relationship between broadband access and local industry specialization. Industry specialization is measured, using data from the 2000 US Census, as the share of the employed civilian population aged 16 years and older working in a given industrial sector. Higher values of this variable indicate that a municipality has a greater local specialization in an industry.

In Table 5-9, we report the effects—either positive or negative—that the industry specialization variables have on the availability of broadband services. For each of the 19 major industrial categories, we estimated eight regression models: two focusing on the availability of any type of broadband, and two models examining the availability of cable, DSL and fixed wireless broadband technologies.

The first of the two regression models includes the industry specialization variable along with the local socioeconomic characteristics used in the previous analysis (see first column of results shown in Tables 5-3 to 5-7). The second regression model includes the industry specialization variable, the socioeconomic characteristics used in the previous analysis, and the county-level fixed effects (see center column of results shown in Tables 5-4 to 5-7). The information presented in Table 5-9 reports the number of regressions in which the industry specialization variable has a statistically significant effect (10 percent significance level) on the selected measure of broadband availability.

Table 5-9: Summary of OLS Regression Results: Effects of Local Industry Specialization on the Availability of Broadband Services in Maine Municipalities

Industry Category	Any Type	Cable	DSL	Fixed Wireless
Agriculture, Forestry, Fishing and Hunting	**Negative** (2 of 2)	**Negative** (2 of 2)	**Negative** (2 of 2)	**Mixed**
Construction	**Negative** (2 of 2)	**Negative** (2 of 2)	No Effect	No Effect
Manufacturing	**Positive** (1 of 2)	No Effect	**Positive** (1 of 2)	**Mixed**
Wholesale Trade	**Positive** (2 of 2)	**Positive** (2 of 2)	No Effect	No Effect
Retail Trade	**Positive** (2 of 2)	**Positive** (2 of 2)	No Effect	No Effect
Transportation and Warehousing	No Effect	**Negative** (2 of 2)	No Effect	**Positive** (1 of 2)
Utilities	No Effect	No Effect	**Negative** (2 of 2)	No Effect
Information	No Effect	No Effect	**Positive** (2 of 2)	**Negative** (1 of 2)
Finance and Insurance	**Positive** (2 of 2)	**Positive** (1 of 2)	**Positive** (2 of 2)	**Positive** (1 of 2)
Real Estate	**Positive** (1 of 2)	**Positive** (1 of 2)	No Effect	No Effect
Professional, Scientific and Technical Services	No Effect	**Positive** (2 of 2)	No Effect	No Effect
Management of Companies and Enterprises	No Effect	No Effect	No Effect	No Effect
Administrative, Support and Waste Management Services	No Effect	No Effect	No Effect	**Positive** (1 of 2)
Educational Services	**Positive** (1 of 2)	**Positive** (2 of 2)	No Effect	No Effect
Healthcare and Social Assistance	No Effect	**Positive** (2 of 2)	No Effect	No Effect
Arts, Entertainment and Recreation	**Negative** (1 of 2)	No Effect	No Effect	No Effect
Accommodation and Food Service	No Effect	No Effect	No Effect	**Negative** (1 of 2)

Table 5-9: Continued

Industry Category	Any Type	Cable	DSL	Fixed Wireless
Other Services	No Effect	**Positive** (1 of 2)	No Effect	No Effect
Public Administration	**Negative** (1 of 2)	**Negative** (1 of 2)	**Negative** (2 of 2)	No Effect

Notes: A positive / negative effect means that an increase in the percentage of industry employment is associated with an increase / decrease in the measure of availability. The information shown in parentheses is the number of regression models in which the percentage of industry employment has a statistically significant effect (at the 10-percent significance level or lower). "No effect" means that the percentage of industry employment does not have a statistically significant effect on the measure of availability. "Mixed" means that the percentage of industry employment has a positive effect in one regression, and a negative effect in the second regression.

In general, the OLS regression results suggest that the types of industries present in a municipality affect the availability of broadband services. More specifically, the shares of local employment in the agriculture, forestry, fishing and hunting; construction, and public administration sectors tend to reduce access to broadband. On the other hand, we find a positive relationship, other things being equal, between the availability of broadband and the share of local employment in the wholesale trade; retail trade; finance and insurance; educational services industries.

In Table 5-10, we show a summary of OLS regression results on the effects of the presence of large businesses and community anchor institutions on the availability of broadband services in Maine municipalities. Similar to the previous analysis, we estimated eight regression models for each of these variables. The information shown in Table 5-10 indicates the sign of direction of the effect—either positive or negative—and the number of regressions in which the variable has a statistically significant effect (10 percent significance level) on broadband access.

As defined in Table 5-2, the variable large businesses is the count of establishments employing 100 or more workers. Since this information is measured at the zip code level, we needed to match Maine municipalities—the geographic unit of analysis for the other variables—to zip codes. We were able to identify "matches" for 340 municipalities out of the 494 considered in the previous analysis. Although the sample size decreased by over 150 municipalities, the remaining areas still account for 91.1 percent of the total Maine population as of 2000. Community anchor institutions, which were identified in each municipality as part of the Maine Broadband Inventory and Mapping Project, include organizations such as local schools, universities, libraries, healthcare facilities and government offices.

Table 5-10: Summary of OLS Regression Results: Effects of the Presence of Large Businesses and Community Anchor Institutions on the Availability of Broadband Services in Maine Municipalities

Variable	Any Type	Cable	DSL	Fixed Wireless
Large Businesses	No Effect	No Effect	No Effect	No Effect
Community Anchor Institutions	No Effect	No Effect	No Effect	No Effect

Notes: "No effect" means that the selected variable does not have a statistically significant effect on the measure of availability.

Regression results summarized in Table 5-10 indicate that the presence of large businesses does not have significant effect, one way or another, on the availability of broadband services in Maine municipalities. Similarly, the number of community anchor institutions located in a municipality does not have a statistically significant effect on the availability of broadband.

5.1.4 Summary

This study analyzes the availability of selected types of broadband services in Maine municipalities. Using information from the Maine Broadband Inventory and Mapping Project conducted by Sewall for the ConnectME Authority, we find that 91.1 percent of Maine locations have access to at least one form of broadband considered in the analysis. Broadband availability varies across Maine, from 48.9 percent of the locations in Piscataquis County to 99.3 percent in Lincoln County. Access to the specific types of broadband (e.g., cable, DSL, fixed wireless) also varies widely. For example, 98.8 percent of locations in York County have access to cable broadband, compared to just 40.6 percent in Piscataquis County.

Regression analysis presented in the report identifies the factors associated with the availability of broadband services in Maine municipalities. Focusing on the socioeconomic characteristics of local residents, we find that the median age of the population has a negative effect on broadband availability and that educational attainment and median household income generally have a positive effect on access to broadband. This suggests that, other things being equal, telecommunications companies have made greater investments in Maine municipalities with younger residents and more educated residents—who presumably have a greater interest in broadband—and places with higher levels of household income—which is presumably a sign of greater ability to pay for broadband services.

In addition, the results indicate that the percentage of the population residing outside of urbanized areas and urban clusters is negatively associated with the availability of broadband in Maine municipalities. This suggests that the settlement patterns of the population, which affects the cost of infrastructure deployment, also affects broadband availability. Along the same lines, we also found that a municipality's geographic situation—the county of location and access to broadband in surrounding areas—are key determinants of the availability of DSL and fixed wireless technologies.

Looking at the characteristics of local businesses, we found that the presence of large employers and community anchor institutions does not have a statistically significant effect on broadband availability. The shares of local employment in wholesale trade; retail trade; finance and insurance; and educational services tend to have a positive effect on broadband availability. These results suggest that, along with characteristics of the local population, the types of businesses present in a municipality influence the investment decisions of telecommunications companies.

5.2 DEMAND FOR COMPUTER AND BROADBAND SERVICES

The purpose of this study is to examine the determinants of computer and broadband internet use by Maine households and small businesses (i.e., establishments with fewer than 100 employees). Information used in the analysis comes from surveys of 2,834 Maine households and 594 small businesses operating in the state conducted under the direction of Sewall as part of its Broadband Mapping and Inventory Project in early 2011.

5.2.1 Introduction

Broadband use (i.e., number of subscribers and types of services purchased) in a region depends on the demand for services by households, businesses and community organizations, as well as the technology deployment decisions of telecommunications providers. When deciding on the types of broadband services to purchase, if any, households and businesses consider their needs for high-speed internet as well as their ability to pay the monthly subscription fees. This suggests that household characteristics such as income, educational attainment and the presence of children; and business characteristics such as establishment size and industry are likely to be key determinants of broadband adoption and, more generally, computer use in Maine.

Focusing on households, we look at whether or not a computer is available in the home, the type of internet connection (e.g., "residential" broadband, or business-oriented services such as a fiber optic or T-1 line) used, the number of ways in which household members use the computer, and whether or not members of the household access the internet for more than 20 hours per week. In our analysis of

small businesses in the state, we look at whether or not computers are used heavily in their day-to-day operations, broadband internet adoption decisions, the number of ways in which computers are used, and whether or not companies have an employee with IT-related responsibilities.

Survey results show that 72.7 percent of Maine households have some sort of broadband internet, and 3.0 percent of Maine households have a fiber optic or T-1 internet connection. Information from the business surveys conducted at the same time indicates that 85.7 percent of Maine companies (with fewer than 100 employees) have some sort of broadband internet, and 7.6 percent have a fiber optic or T-1 line.

Economic modeling of the household survey data suggests that household size and age characteristics such as the number of people in the household, and the presence of (only) senior citizens and one or more children under the age of 18 have a statistically significant impact on computer and broadband internet use. Household income has an impact on the presence of a computer in the home and broadband internet use, although the analysis suggests that income is a limiting factor for computer and broadband internet use only for the lowest household income category of less than $15,000 per year. Educational attainment has no statistically significant effect on the presence of a computer in the home, but it does influence the number of ways in which computers are used. Finally, we find that a household's county of residence has some impact on computer and broadband internet use in Maine, even after accounting for differences in income, educational attainment, and household size and age characteristics.

Economic modeling of the small business survey data indicates that an establishment's size (i.e., number of employees) and industrial category are key drivers of computer and broadband internet use. For instance, we find that businesses with fewer than five employees –a sizeable percentage of all Maine businesses –are less likely than larger operations in our sample to have any type of broadband internet access, to have a fiber optic or T-1 connection, or to use computers extensively in the company's day-to-day operations.[60] Focusing on industrial categories, our results show that businesses in the finance, insurance and real estate (FIRE) sector are more apt than establishments in other industries to exhibit heavy computer use and to have a fiber optic or T-1 internet connection; establishments in the FIRE sector, as well as service providers, also tend to use the computer for a greater variety of applications than other types of businesses. Similar to the results for households, we find that the county of location has some

[60] According to 2008 County Business Patterns data from the US Census Bureau, establishments with fewer than five workers account for 57.2 percent of the employers in Maine

effect on computer and broadband internet use, even after controlling for establishment size, years or operation and industry.

5.2.2 Computer and Internet Use by Maine Households

Key Indicators

Our analysis of computer and broadband internet use by Maine households is based on a dataset of 2,834 respondents to the survey completed in early 2011. Surveys were sent to a total of 10,869 households, which means the household survey had a 26.1 percent response rate.[61] Although the survey asked a wide range of questions on a variety of computer- and internet-related topics, this report focuses primarily on five indicators of household computer and broadband internet use.

The first indicator is simply whether or not there is a desktop or laptop computer in the home. For this indicator, labeled as "computer in home," we find that 86.5 percent of Maine households have at least one computer. The second indicator, labeled as "broadband internet," captures whether the household subscribes to a broadband internet service.[62] The next indicator of internet use, labeled as "fiber optic or T-1 internet," gets at whether the household subscribes to a "non-residential speed" broadband connection. As noted above, 72.7 percent and 3.0 percent of Maine households subscribes to some type of broadband connection or specifically a fiber optic / T-1 line, respectively. The fourth indicator of computer use, labeled as "number of computer apps," is a count of the number of ways in which members of the household use a computer (or smart phone). The household survey included 16 different options, not including an "other" category, such as "word processing / typing," "checking the news, weather, or sports," and "searching or applying for a job." The average household survey respondent reported using a computer (or smart phone) for about 6.6 different applications, out of a maximum of 16 options. The final indicator of household computer or internet use, labeled as "20 hours or more on-line," is whether or not household members collectively accessed the internet for more than 20 hours per week. Our survey results show that 41.9 percent of Maine households are connected to the internet for at least 20 hours per week.

Analysis of Household Surveys

The economic modeling of household computer and broadband internet use examines the effects of annual income, educational attainment, household size and

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[61] The actual response rate, after accounting for surveys that were not delivered due to inaccurate addresses, would be higher than this percentage. We do not know the number of surveys that were undeliverable

[62] The specific broadband technologies included in the survey are DSL, cable, fixed wireless, fiber option and T-1..

age characteristics, and county of residence on the five indicators described above. Tables 5-11 to 5-14 show the distribution of survey results by these household attributes.

Table 5-11: Household Survey Respondents by Annual Income

Annual household income	Number of respondents	% of respondents
Less than $15,000	220	8.83%
$15,000 to $24,999	263	10.55%
$25,000 to $34,999	297	11.92%
$35,000 to $49,999	369	14.81%
$50,000 to $64,999	364	14.61%
$65,000 to $79,999	289	11.60%
$80,000 to $99,999	255	10.23%
$100,000 to $149,999	280	11.24%
$150,000 or more	155	6.22%
Total	2,492	100.00%

Table 5-12: Household Survey Respondents by Educational Attainment

Highest level of education in household	Number of respondents	% of respondents
Some high school	52	1.91%
High school / GED	376	13.79%
Some classes beyond high school	394	14.45%
Two-year, trade, certificate or technical school	519	19.04%
Four-year college or university	796	29.20%
Advanced (graduate) degree	589	21.61%
Total	2,726	100.00%

Table 5-13: Household Survey Respondents by Selected Size and Age Characteristics

Household size	**Number of respondents**	**% of respondents**
3 or fewer people	2,209	82.03%
More than 3 people	484	17.97%
	2,693	100.00%
Presence of children	Number of respondents	% of respondents
No children under the age of 18	2,044	76.44%
One or more children under 18	630	23.56%
	2,674	100.00%
Presence of senior citizens	Number of respondents	% of respondents
Household contains no one over the age of 64	2,041	76.33%
Household contains only people over the age of 64	633	23.67%
	2,674	100.00%

Table 5-14: Household Survey Respondents by Maine County

County	**Number of respondents**	**% of respondents**
Androscoggin	286	10.09%
Aroostook	167	5.89%
Cumberland	602	21.24%
Franklin	69	2.43%
Hancock	135	4.76%
Kennebec	264	9.32%
Knox	119	4.20%
Lincoln	72	2.54%
Oxford	83	2.93%
Penobscot	315	11.12%
Piscataquis	45	1.59%
Sagadahoc	51	1.80%
Somerset	110	3.88%
Waldo	68	2.40%
Washington	65	2.29%
York	383	13.51%
Total	2,834	100.00%

Our survey results show that about 17.5 percent of Maine households have annual incomes of $100,000 or more, whereas 19.4 percent make less than $25,000 per year. According to the US Census, these household income categories account for

18.3 percent (compared to 17.5 percent in the survey) and 26.3 percent (versus 19.4 percent in the survey) of all Maine households, respectively.[63]

Survey results summarized in Table 5-12 indicate that 50.8 percent of our sample have at least one member of the household with a four-year college degree, compared to only 1.9 percent of the survey respondents coming from households where the person with the highest level of formal education does not have a high school diploma or GED. Although the Census figures are not directly comparable because they deal with individuals (and not households), they indicate that 26.1 percent of Maine residents aged 25 and over have a college degree, whereas 10.7 percent do not have a high school degree.

The household size figures shown in Table 5-13 focus on the percentage of households with three or fewer people, but analysis of the survey data –not shown in the report –reveals that households in our sample have an average of 2.37 people; this is almost identical to the Census figure of 2.36 people per Maine household. The survey shows that 23.6 percent of Maine households have one or more children, which is lower than the US Census estimate of 29.7 percent of Maine households with children. Although not reported in Table 5-13, our analysis indicates that 33.9 percent of the survey respondents are in households with at least one person aged 65 years and over; the comparable US Census figure for Maine is 25.5 percent.

Table 5-14 shows the percentage of survey respondents by county of residence. Some of the counties appear to be slightly over- or underrepresented in the sample; however, the overall geographic distribution of survey respondents is remarkably similar to county-level population estimates from the US Census.[64] Taking all of these factors into account, it appears that our sample of survey respondents are representative of the Maine population in terms of geographic location and household size, although older (e.g., households with at least one person over the age of 64) and more affluent (e.g., those with incomes that exceed $25,000) households are slightly over-represented in the sample.

Tables 5-15 to 5-18 present summary statistics on the five indicators of computer and broadband internet use for selected household attributes. For the indicators "computer in home," "broadband internet," "fiber optic or T-1 internet," and "20 hours or more on-line," the figures represent the percentage of households that

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[63] The US Census statistics for Maine households are from the *2005-2009 American Community Survey 5-Year Estimates.*

[64] The county-level population figures are estimates for 2009 from the GCT-T1-R US Census file.

meet the criteria. For instance, the results shown in Table 5-15 indicate that 70 percent of the households in the $15,000 to $24,999 annual income category have broadband internet, while Table 5-17 shows that 96.2 percent of households with at least one child under the age of 18 have a computer. For the "number of computer apps" indicator, the results shown in Tables 5-15 to 5-18 are the average number of ways (out of a list of 16 options included in the survey) that computers are used by household members. For example, the information shown in Table 6-16 suggests that households with at least one person having a four-year college degree use an average of 7.5 computer applications.

Table 5-15: Computer and Broadband Use of Households by Annual Income

Annual household income	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Less than $15,000	72.48%	62.44%	5.16%	4.99	33.17%
$15,000 to $24,999	83.65%	70.00%	3.46%	6.20	40.89%
$25,000 to $34,999	83.84%	68.28%	2.76%	5.80	38.46%
$35,000 to $49,999	90.22%	73.08%	2.75%	6.63	43.38%
$50,000 to $64,999	87.29%	75.00%	3.93%	6.99	44.19%
$65,000 to $79,999	88.89%	72.54%	2.11%	6.87	45.96%
$80,000 to $99,999	94.09%	80.16%	2.38%	7.15	43.25%
$100,000 to $149,999	92.83%	79.35%	1.81%	7.55	44.36%
$150,000 or more	88.31%	75.16%	1.96%	7.45	44.37%
All households	86.45%	72.71%	3.03%	6.59	41.94%

Table 5-16: Computer and Broadband Use of Households by Educational Attainment

Highest level of education in household	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Some high school	68.63%	58.82%	3.92%	4.65	26.00%
High school / GED	80.27%	67.30%	3.78%	5.54	36.26%
Some classes beyond high school	84.18%	70.76%	3.92%	6.37	41.67%
Two-year, trade, certificate or technical school	88.42%	72.35%	1.76%	6.35	39.48%
Four-year college or university	88.79%	73.76%	2.93%	6.83	44.44%
Advanced (graduate) degree	90.46%	78.58%	2.76%	7.52	46.14%
All households	86.45%	72.71%	3.03%	6.59	41.94%

Table 5-17: Computer and Broadband Use of Households by Selected Size and Age Characteristics

Household Characteristic	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Household size					
3 or fewer people	85.18%	70.92%	3.21%	6.17	37.53%
More than 3 people	97.11%	83.64%	2.48%	8.82	64.02%
Presence of children					
No children under 18	84.58%	70.52%	3.37%	6.00	37.25%
One or more children under 18	96.18%	82.75%	2.40%	8.68	58.80%
Presence of senior citizens					
Household contains no one over 64	92.79%	78.23%	3.15%	7.43	48.26%
Household contains only people over 64	69.62%	57.45%	3.11%	3.96	22.05%
All households	86.45%	72.71%	3.03%	6.59	41.94%

Table 5-18: Computer and Broadband Use of Households by Maine County

County	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Androscoggin	83.92%	73.59%	5.28%	6.32	39.42%
Aroostook	81.93%	65.06%	2.41%	5.80	38.99%
Cumberland	88.81%	84.09%	1.69%	7.38	44.98%
Franklin	92.65%	68.18%	3.03%	6.46	42.42%
Hancock	86.57%	59.85%	1.52%	6.74	38.46%
Kennebec	84.47%	70.04%	4.67%	6.20	43.31%
Knox	87.07%	74.45%	2.73%	7.05	47.62%
Lincoln	81.94%	68.06%	1.39%	6.47	29.41%
Oxford	77.11%	71.95%	8.54%	5.67	37.97%
Penobscot	88.85%	67.74%	2.58%	6.25	42.62%
Piscataquis	75.56%	46.51%	4.65%	4.95	26.83%
Sagadahoc	96.08%	74.51%	0.00%	7.92	40.43%
Somerset	83.64%	61.32%	4.72%	5.72	40.38%
Waldo	91.04%	59.70%	1.49%	6.24	40.00%
Washington	87.50%	56.45%	6.45%	6.00	38.71%
York	87.40%	80.00%	2.13%	6.91	44.72%
All households	86.45%	72.71%	3.03%	6.59	41.94%

Tables 5-19 to 5-22 report a summary of results from regression models that examine the effects of the household characteristics on indicators of computer and broadband internet use. The number of ways in which members of the household use computers is examined using a Poisson regression model—appropriate for count variables—and the other four indicators are analyzed using a logit framework, which is appropriate for variables that have values limited to zeros and ones.

The regression models are designed to isolate the effect of the variable of interest (e.g., a particular income or educational attainment category, or presence of children), while controlling for the influences of the other household characteristics. As an example, the first column of results in Table 5.19 summarizes the effects of the nine household income categories on the presence of a computer in the home. Although not shown in the table, these regression models also control for the educational attainment categories, household size (i.e., whether or not it has more than three people), the presence of children, whether or not the household is made up of only senior citizens, and the county of residence. We estimated this model nine times in our analysis of the effects of income on the presence of a computer; each regression included only one of the household income categories. Thus, the first regression looked at whether households with annual incomes of less than $15,000 were more or less likely to have a computer, the second regression examined whether households with annual incomes of between $15,000 and $24,999 were more or less likely to have a computer, and so on until the ninth household income category.

The cells in Tables 5-19 to 5-22 are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of household computer and broadband internet use. Cells are indicated as "no effect" in cases where the household attribute does not have a statistically significant effect. For example, looking at the far right column of Table 5-19, we can conclude that – controlling for educational attainment, family size, the presence of children, whether or not the household is made up of only senior citizens, and the county of residence –none of the household income categories have a significant effect, one way or another, on whether or not members of the household spend 20 or more hours per week on-line.

It is important to note that if a particular category has a significant effect on an indicator of computer or broadband internet use, then the remaining categories—collectively as a group—have the opposite effect on the indicator. For instance, the results pertaining to the effects of household income on the presence of a computer in the home can be interpreted as either "households with annual

incomes of less than $15,000 are less likely to have a computer at home" or "households with annual incomes of $15,000 or more (again, this includes all of the categories of $15,000 and above) are more likely to have a computer at home."

Table 5-19: Summary Regression Results: Effects of Household Income on Computer and Broadband Use in Maine

Annual household income	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Less than $15,000	**negative**	**negative**	no effect	**negative**	no effect
$15,000 to $24,999	no effect	no effect	no effect	**positive**	no effect
$25,000 to $34,999	no effect	no effect	no effect	**negative**	no effect
$35,000 to $49,999	**positive**	no effect	no effect	**positive**	no effect
$50,000 to $64,999	no effect	no effect	**positive**	no effect	no effect
$65,000 to $79,999	no effect	no effect	no effect	no effect	no effect
$80,000 to $99,999	**positive**	no effect	no effect	no effect	no effect
$100,000 to $149,999	no effect	no effect	no effect	no effect	no effect
$150,000 or more	no effect	no effect	no effect	no effect	no effect

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of household computer and broadband Internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text

Table 5-20: Summary Regression Results: Effects of Educational Attainment on Computer and Broadband Use of Maine Households

Highest level of education in household	**Computer In home**	**Broadband Internet**	**Fiber optic or T-1 Internet**	**Number of Computer apps**	**20 hours or More on-line**
Some high school	no effect	no effect	no effect	**negative**	no effect
High school / GED	no effect	no effect	no effect	no effect	no effect
Some classes beyond high school	no effect	no effect	no effect	no effect	no effect
Two-year, trade, certificate or technical school	no effect	no effect	**negative**	**negative**	no effect
Four-year college or university	no effect	no effect	no effect	no effect	no effect
Advanced (graduate) degree	no effect	**positive**	no effect	**positive**	no effect

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of household computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text.

Table 5-21: Summary Regression Results: Effects of Household Size and Age Characteristics on Computer and Broadband Use in Maine

Household Characteristic	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Household size					
3 or fewer people	no effect	no effect	no effect	**negative**	**negative**
More than 3 people	no effect	no effect	no effect	**positive**	**positive**
Presence of children					
No children under 18	**negative**	no effect	**positive**	**negative**	**negative**
One or more children under 18	**positive**	no effect	**negative**	**positive**	**positive**
Presence of senior citizens					
Household contains no one over the age of 64	**positive**	**positive**	no effect	**positive**	**positive**
Household contains only people over 64	**negative**	**negative**	no effect	**negative**	**negative**

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of household computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text.

Table 5-22: Summary Regression Results: Effects of County of Location on Computer and Broadband Use of Maine Households

County	Computer In home	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	20 hours or More on-line
Androscoggin	no effect	no effect	**positive**	**negative**	**negative**
Aroostook	no effect	**negative**	no effect	**negative**	no effect
Cumberland	**positive**	**positive**	no effect	**positive**	no effect
Franklin	**positive**	no effect	no effect	no effect	no effect
Hancock	no effect	**negative**	no effect	no effect	no effect
Kennebec	**negative**	**negative**	no effect	**negative**	no effect
Knox	no effect	no effect	no effect	**positive**	no effect
Lincoln	no effect	no effect	no effect	no effect	no effect
Oxford	no effect	no effect	no effect	no effect	no effect
Penobscot	no effect	**negative**	no effect	**negative**	no effect
Piscataquis	no effect	**negative**	no effect	no effect	no effect
Sagadahoc	no effect	no effect	no effect	**positive**	no effect
Somerset	no effect	**negative**	no effect	**negative**	no effect
Waldo	no effect	**negative**	no effect	no effect	no effect
Washington	no effect	**negative**	no effect	no effect	no effect
York	no effect	**positive**	no effect	no effect	no effect

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of household computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text.

Results from the economic modeling analysis shown in Table 5-19 suggest that households with annual incomes of less than $15,000 are less likely to have a computer in the home or to subscribe to a broadband internet service. In addition, these lowest income households tend to use fewer computer applications than households with annual incomes of $15,000 or more. Other results pertaining to the effects of household income indicate that moderate income households are more apt –compared to those in the higher or lower income categories –to have a computer in the home and a fiber optic / T-1 connection. Likewise, households in the $35,000 to $49,999 and $15,000 to $24,999 annual income ranges tend to use computers for more different applications than those in the other income categories.

Moving to Table 5-20, we see that households with at least one person with a graduate degree are more likely than others to have some sort of broadband internet. Furthermore, the results show that households in which the highest level of education is more than "some high school" and, in another regression, not equal to "two-year, trade, certificate or technical school" tend to use a greater variety of computer applications. Additionally, the results show that households in which at least one member has an advanced degree use a greater number of computer applications than households in the lower educational categories.

The results shown in Table 5-21 indicate that the presence of children in the household increases the likelihood of having a computer and broadband internet connection, and spending 20 hours or more on-line per week; the presence of children also increases the number of computer applications used as compared to households without children under the age of 18. Households that are made up solely of senior citizens, on the other hand, are less likely to have a computer or broadband internet, and to spend 20 or more hours on-line per week; they also use fewer applications on the computer than other households. Finally, the results presented in Table 5-21 suggest that household size is not associated with the presence of a computer in the household. Larger households, however, are more apt to have broadband internet and to spend 20 hours or more on-line per week; they also tend to use a wider variety of computer applications.

Looking at Table 5-22, we see that a household's county of residence has, in some cases, an impact on computer and broadband internet use that is in addition to the influences of income, educational attainment, and the household size and age characteristics. Compared to households located elsewhere in Maine, those in Cumberland County are more likely to have a computer in the home and a broadband internet connection; households in Cumberland County also use a greater number of computer applications. On the other hand, a household's location in Kennebec County has a negative and statistically significant effect –as

compared to the rest of the state –on these three indicators of computer and broadband internet use.

5.2.3 Computer and Internet Use by Small Businesses

Key Indicators

Our analysis of computer and broadband internet use by Maine businesses with fewer than 100 employees is based on a dataset of 594 respondents that completed surveys in early 2011.[65] Surveys were sent to a total of 3,552 small businesses in the state, which means that we had a response rate of 16.7 percent.[66] Similar to our analysis of the household surveys, we focus our attention on five indicators of computer and broadband internet use by Maine small businesses.

The first indicator, labeled as "heavy computer use," indicates whether or not computers are used in the business "almost all of the time" or "most of the day, almost every day." Survey results show that 63.9 percent of the small business respondents fit this description. The next two variables, labeled as "broadband internet" (85.7 percent of Maine small businesses) and "fiber optic or T-1 internet" (7.6 percent of Maine small businesses), are identical to those used in the household survey. The next indicator, labeled as "number of computer apps," is similar to the one used in the previous analysis, although the maximum number of computer (or smart phone) applications is 13, not including an "other" category. Respondents to the business survey indicate using an average of 5.5 computer applications (e.g., "E-commerce," "financial management / billing," and "connecting with similar businesses"). The final indicator of computer and broadband internet use of Maine small businesses, labeled as "IT specialist," is whether they have an employee with computer-related responsibilities. Survey results show that 29.7 percent of Maine small businesses have such an employee.

Analysis of Business Surveys

The economic modeling of computer and broadband internet use by Maine small businesses examines the effects of establishment size (i.e., number of employees), years of operation, major industrial category and county of location on the five indicators described above. Tables 5-23 to 5-26 show the distribution of survey respondents by these attributes. Since we only collected information from businesses with fewer than 100 employees, it would be misleading to compare the survey respondents to the overall population of Maine businesses in terms of employment size, years of operation, or industry. However, looking at the

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[65] The survey method consisted of a single mail survey, which provided instructions on alternatively accessing and completing the survey on-line

[66] The actual response rate, after accounting for surveys that were not delivered due to inaccurate addresses, would be higher than this percentage. We do not know the number of surveys that were undeliverable

population of Maine businesses with fewer than 100 employees, we find that its geographic distribution is very similar to that of the survey respondents.[67]

Table 5-23: Business Survey Respondents by Employment Size Category

Size category	Number of respondents	% of respondents
Fewer than 5 employees	325	57.93%
5 to 10 employees	115	20.50%
11 to 25 employees	79	14.08%
26 to 50 employees	29	5.17%
More than 50 employees	13	2.32%
Total	561	100.00%

Table 5-24: Business Survey Respondents by Years of Operation

Years of operation	Number of respondents	% of respondents
Less than 5 years	34	5.96%
5 to 10 years	95	16.67%
11 to 25 years	199	34.91%
More than 25 years	242	42.46%
Total	570	100.00%

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Table 5-25: Business Survey Respondents by Maine County

County	Number of respondents	% of respondents
Androscoggin	53	8.92%
Aroostook	44	7.41%
Cumberland	145	24.41%
Franklin	15	2.53%
Hancock	34	5.72%
Kennebec	48	8.08%
Knox	19	3.20%
Lincoln	15	2.53%
Oxford	18	3.03%
Penobscot	74	12.46%
Piscataquis	3	0.51%
Sagadahoc	12	2.02%
Somerset	19	3.20%
Waldo	15	2.53%
Washington	17	2.86%
York	63	10.61%
Total	594	100.00%

[67] We used County Business Patterns data from the US Census Bureau to determine the number of businesses with fewer than 100 employees in each Maine county

Table 5-26: Business Survey Respondents by Major Industrial Category

Industrial category	Number of Respondents	% of respondents
Agricultural services, forestry, & fishing	6	1.01%
Mining	0	0.00%
Construction	69	11.62%
Manufacturing	30	5.05%
Transportation & public utilities	21	3.54%
Wholesale trade	29	4.88%
Retail trade	170	28.62%
Finance, insurance, & real estate	38	6.40%
Services	227	38.22%
Unclassified establishments	4	0.67%
Total	594	100.00%

Tables 5-27 to 5-30 present descriptive statistics on the five indicators of small business computer and broadband internet use, and the regression results are shown in Tables 5-31 to 5-34. The cells in these tables are indicated with a "NA" in cases where there are fewer than 10 observations upon which to calculate a summary statistic (i.e., Tables 5-27 to 5-30) or a regression parameter (i.e., Tables 5-31 to 5-34). Otherwise, the interpretation of the information presented in these tables is similar to the results shown for the household survey.

Table 5-27: Computer and Broadband Use of Maine Businesses by Employment Size Category

Size category	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Fewer than 5 employees	48.15%	80.56%	3.70%	4.93	21.30%
5 to 10 employees	78.26%	89.57%	7.83%	5.82	28.95%
11 to 25 employees	93.67%	97.47%	12.66%	6.80	49.37%
26 to 50 employees	89.66%	93.10%	13.79%	6.75	44.83%
More than 50 employees	91.67%	100.00%	46.15%	8.15	69.23%
All establishments	63.88%	85.74%	7.64%	5.53	29.69%

Table 5-28: Computer and Broadband Use of Maine Businesses by Years of Operation

Years of operation	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Less than 5 years	70.59%	91.18%	5.88%	6.15	29.41%
5 to 10 years	54.74%	86.32%	5.26%	5.49	28.72%
11 to 25 years	62.12%	86.43%	8.04%	5.62	26.26%
More than 25 years	67.63%	85.06%	7.88%	5.52	33.06%
All establishments	63.88%	85.74%	7.64%	5.53	29.69%

Table 5-29: Computer and Broadband Use of Maine Businesses by County

County	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Androscoggin	59.62%	92.31%	7.69%	5.52	35.85%
Aroostook	65.12%	79.55%	11.36%	5.09	27.91%
Cumberland	69.93%	89.51%	9.79%	5.75	33.10%
Franklin	73.33%	93.33%	6.67%	5.80	46.67%
Hancock	85.29%	94.12%	8.82%	6.67	42.42%
Kennebec	64.58%	85.42%	10.42%	6.09	27.08%
Knox	68.42%	89.47%	0.00%	5.95	21.05%
Lincoln	46.67%	86.67%	0.00%	4.47	13.33%
Oxford	27.78%	66.67%	5.56%	4.39	11.11%
Penobscot	64.38%	81.08%	1.35%	5.10	25.68%
Piscataquis	NA	NA	NA	NA	NA
Sagadahoc	50.00%	75.00%	25.00%	4.08	16.67%
Somerset	47.37%	73.68%	15.79%	5.26	26.32%
Waldo	60.00%	86.67%	0.00%	5.93	20.00%
Washington	64.71%	70.59%	0.00%	4.82	12.50%
York	59.02%	90.16%	8.20%	5.62	36.07%
All establishments	63.88%	85.74%	7.64%	5.53	29.69%

Table 5-30: Computer and Broadband Use of Maine Businesses by Major Industrial Category

Industrial category	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Agricultural services, forestry, & fishing	NA	NA	NA	NA	NA
Mining	NA	NA	NA	NA	NA
Construction	47.83%	86.96%	5.80%	4.83	26.09%
Manufacturing	66.67%	93.33%	10.00%	6.03	33.33%
Transportation & public utilities	76.19%	90.48%	0.00%	4.62	28.57%
Wholesale trade	75.86%	93.10%	17.24%	5.90	31.03%
Retail trade	62.05%	82.14%	4.17%	4.98	26.95%
Finance, insurance, & real estate	84.21%	100.00%	23.68%	6.84	44.74%
Services	64.44%	83.93%	6.70%	5.93	29.60%
Unclassified establishments	NA	NA	NA	NA	NA
All establishments	63.88%	85.74%	7.64%	5.53	29.69%

Table 5-31: Summary Regression Results: Effects of Employment Size on Computer and Broadband Use of Maine Businesses

Size category	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Fewer than 5 employees	**negative**	**negative**	**negative**	**negative**	**negative**
5 to 10 employees	**positive**	**positive**	no effect	**positive**	no effect
11 to 25 employees	**positive**	no effect	no effect	**positive**	**positive**
26 to 50 employees	**positive**	no effect	no effect	**positive**	no effect
More than 50 employees	no effect	no effect	**positive**	**positive**	**positive**

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of small business computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text

Table 5-32: Summary Regression Results: Effects of Years of Operation on Computer and Broadband Use of Maine Businesses

Years of operation	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Less than 5 years	no effect	no effect	no effect	**positive**	no effect
5 to 10 years	no effect	no effect	no effect	no effect	no effect
11 to 25 years	no effect	no effect	no effect	no effect	no effect
More than 25 years	no effect	no effect	no effect	no effect	no effect

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of small business computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text.

Table 5-33: Summary Regression Results: Effects of County of Location on Computer and Broadband Use of Maine Businesses

County	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Androscoggin	no effect	no effect	no effect	no effect	no effect
Aroostook	no effect	**negative**	no effect	no effect	no effect
Cumberland	no effect	no effect	no effect	no effect	no effect
Franklin	no effect	no effect	no effect	no effect	no effect
Hancock	**positive**	no effect	no effect	**positive**	no effect
Kennebec	no effect	no effect	no effect	no effect	no effect
Knox	no effect	no effect	no effect	no effect	no effect
Lincoln	no effect	no effect	no effect	**negative**	no effect
Oxford	**negative**	**negative**	no effect	**negative**	**negative**
Penobscot	no effect	no effect	**negative**	no effect	no effect
Piscataquis	NA	NA	NA	NA	NA
Sagadahoc	no effect	no effect	**positive**	no effect	no effect
Somerset	no effect	no effect	no effect	no effect	no effect
Waldo	no effect	no effect	no effect	no effect	no effect
Washington	no effect	no effect	no effect	no effect	no effect
York	no effect	no effect	no effect	no effect	no effect

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of small business computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text.

Table 5-34: Summary Regression Results: Effects of Major Industrial Category on Computer and Broadband Use of Maine Businesses

Industrial category	Heavy Computer use	Broadband Internet	Fiber optic or T-1 Internet	Number of Computer apps	IT specialist
Agricultural services, forestry, & fishing	NA	NA	NA	NA	NA
Mining	NA	NA	NA	NA	NA
Construction	**negative**	no effect	no effect	**negative**	no effect
Manufacturing	no effect	no effect	no effect	no effect	no effect
Transportation & public utilities	no effect	no effect	no effect	**negative**	no effect
Wholesale trade	no effect	no effect	**positive**	no effect	no effect
Retail trade	no effect	no effect	**negative**	**negative**	no effect
Finance, insurance, & real estate	**positive**	no effect	**positive**	**positive**	no effect
Services	no effect	no effect	no effect	**positive**	no effect
Unclassified	NA	NA	NA	NA	NA

Notes: Cells in the table are indicated as "positive" (or "negative") in cases where the attribute has a positive (or negative) and statistically significant effect (at the 10 percent significance level or lower) on the selected indicator of small business computer and broadband internet use. Cells are indicated as "no effect" where the attribute does not have a statistically significant effect. Regression models are described in the text.

The regression results displayed in Table 5-31 suggest that employment size is a determining factor of computer and broadband internet use for Maine businesses. Focusing on businesses in the size category of fewer than five employees, which accounts for 57.9 percent of our sample and about 57.2 percent of all Maine businesses (see footnote 18), we see that these very small businesses are less likely than establishments with between 5 to 100 employees –that is, the other size categories included in the analysis –to exhibit heavy computer use, have a broadband or fiber optic / T-1 internet connection, or employ a worker with specific IT-related duties. Moreover, these very small establishments tend to use fewer computer applications than Maine companies that employ between 5 to 100 employees.

Information reported in the first column of Table 5-31 indicates that Maine businesses with between 5 and 50 employees are more likely to exhibit heavy computer use, whereas companies in the largest employment category (i.e., between 51 and 100 workers) are not statistically different than the other establishments included in the sample. Firms in the largest size category, however, are statistically different than companies with 50 or fewer employees in that they are more likely to have a fiber optic or T-1 internet connection, as well as an employee with IT-related duties.

Moving to the analysis of the effects of establishment age on computer and broadband internet use, we see that the number of years that a company has been in operation appears to have very little impact on whether it exhibits heavy computer use, the adoption of broadband internet, or whether it has an employee with computer-related responsibilities. The regression results indicate, however, that businesses in the youngest age category use a wider range of computer applications than establishments that have been in operation for five or more years.

The results shown in Table 5-33 suggest that—after controlling for an establishment's employment size, the number of years it has been in operation and its major industrial category—the county of location has some bearing on a company's computer and broadband internet use. For example, compared to establishments located in other Maine counties, businesses operating in Hancock County are more likely to exhibit heavy computer use and employ a wider variety of computer applications. On the other hand, establishments located in Oxford County tend to lag behind other Maine companies based on 4 of the 5 indicators used in the analysis.

Finally, as shown in Table 5-34, the use of computer and broadband internet by small Maine establishments differs systematically by major industrial category. For example, businesses in the Finance, Insurance, and Real Estate industrial category are more likely than firms in other industries to exhibit heavy computer use and have a fiber optic or T-1 broadband connection; they tend to use a greater number of computer applications, as well. On the other hand, Maine's small retailers and construction businesses in our sample lag behind companies in other industrial categories based on 2 of the 5 indicators of computer and broadband internet use.

5.3 SUMMARY AND CONCLUSIONS

The purpose of this modeling study was to examine the determinants of computer and broadband internet use by Maine households and businesses with fewer than 100 employees. Our analysis focuses on several key indicators of computer and broadband internet use –appropriate for each target population –such as the presence of a computer in the home (e.g., household analysis), heavy computer use in the operation's day-to-day activities (e.g., business analysis), and the use of a broadband internet connection (e.g., household and business analysis).

Information used in the economic modeling is from surveys, conducted in early 2011, of 2,834 Maine households and 594 small businesses operating in Maine. Survey results indicate that 72.7 percent of Maine households have some sort of broadband internet, while 3.0 percent of Maine households have a fiber optic or T-1 internet connection. Information from the business survey indicates that 85.7

percent of Maine companies (with fewer than 100 employees) have some sort of broadband internet, while 7.6 percent have a fiber optic or T-1 line.

Economic modeling of the household and business survey data reveals several key drivers of computer and broadband internet use, listed in Table 5-35.

Table 5-35: Drivers of Computer and Broadband Internet Use by Maine Households and Small Businesses

Factors that increase use:	Maine's ranking relative to all US states
Households with one or more children under the age of 18	48th out of 50 in % of households with one of more children under 18
Households with more than 3 people	48th out of 50 in % of households with more than 3 people
Small businesses in the finance and insurance industry	48th out of 50 in % of small businesses in the finance and insurance sector
Factors that decrease use:	**Maine's ranking relative to all US states**
Households with annual incomes of less than $15,000	18th out of 50 in % of households with annual incomes of less than $15,000
Households comprised of people over the age of 64	5th out of 50 in % of households with one or more people over the age of 64
Small businesses with fewer than 5 workers	9th out of 50 in terms of % of establishments with 1 to 4 employees

Looking at how Maine compares to other US states in terms of these household characteristics, it is apparent that Maine's household demographics –especially its size and age characteristics –do not support high computer and broadband internet use. Maine ranks 48th nationally both in terms of the percentage of households with children and the percentage of households with more than three people.[68] This means that Maine has an under abundance of the types of households that are more likely to use computers and have a broadband internet connection. It is also the case that Maine has one of the highest percentages of households that are made up of senior citizens (5th nationally) and the state is almost in the top one-third (18th nationally) based on the percentage of households with annual incomes of less than $15,000. This means that Maine has

[68] Information used to compare Maine to other states in terms of household characteristics is from the US Census 2005-2009 American Community Survey 5-Year Estimates.

an over abundance, especially in the case of older households, of the types of households that are less likely to use computers and have a broadband internet connection.

The information shown in Table 5-35 suggests that Maine's unfavorable demographics for household computer and broadband internet use extend to its companies as well. Ranking 48th nationally as compared to other states, Maine has a relatively small percentage of its businesses with fewer than 100 employees in the finance and insurance industry.[69] Across many sectors of high-end and professional service providers, Maine tends to lag behind the rest of the country. This means that Maine has an under abundance of small businesses in sectors that are more likely to use computers and have a broadband internet connection. On the other hand, Maine ranks 9th nationally in terms of the percentage of establishments with between 1 and 4 employees. This means that Maine has an over abundance of establishments that are less likely to use computers and broadband internet technologies.

[69] The industrial sector used in the regression analysis is finance, insurance and real estate, which is a broader category. The information used to compare Maine to other states in terms of business characteristics is from the US Census Bureau, County Business Patterns data.

6.0 Survey Methodology and Process

To develop an accurate profile of broadband in Maine, the Sewall Team surveyed Maine broadband suppliers and consumers on broadband availability, use, drivers of adoption and barriers to adoption. For supplementary and comparative purposes, the Team also collected relevant information from existing industry, federal and state sources, including map data from the ConnectME Authority Broadband Mapping and Inventory Project. The results were used to conduct economic modeling of broadband availability and demand for services to determine socioeconomic factors influencing both provider deployment and consumer adoption. Descriptions of the general survey approach, specific survey activities, and methods used follow.

6.1 SURVEY APPROACH

The Sewall Team implemented a two-part approach to surveying broadband stakeholders in the State: (1) conduct new surveys of Maine providers and consumers through telephone interviews and postal mail and online instruments; and (2) collect data and information from existing sources from inside and outside of Maine. Economic modeling and other analyses of Maine providers and consumers used both information sources.

Table 6-1: Survey Approach

New Surveys	Existing Surveys
• Service providers • Residential consumers • Businesses • Community anchor institutions • Native Indian Tribes • Maine State agencies	• Schools & libraries • Telemedicine community • Federal & state agencies

From October 2010 to April 2011, the Team surveyed Maine service providers by telephone or mail to determine their plans, barriers to expanding service coverage, and barriers to adoption. This information supplemented the Team's survey of Maine consumers on broadband availability, use, drivers of adoption, and barriers to adoption. Consumers included residents and businesses surveyed by mail and online questionnaires; community anchor institutions (CAIs) and Native Indian

Tribes surveyed by telephone and online questionnaires; and State agencies surveyed by telephone interview. To complement the information gathered in the surveys, public forums were held at six different locations in the State.

Additional information on broadband availability, use and adoption barriers was collected from recent surveys of Maine schools and libraries and of the telemedicine community. Federal and state broadband survey reports provided supplementary data on entities outside of Maine for comparative analyses. Lastly, US Census Bureau, InfoUSA, and ConnectME Authority Mapping and Inventory Project data were used to assist in the economic modeling process.

Economic modeling of broadband availability was conducted to determine deployment decisions of service providers. A second economic modeling activity using data from the Mapping Project and respondent data from the residential and business surveys was conducted to determine demand for broadband services by household and small businesses in Maine (Section 5.0).

Specific methods and processes used in the survey activities are described in the following sections. Survey results and results of the economic modeling are provided in Section 4.0.

6.2 SURVEY ACTIVITIES

6.2.1 Service Provider Survey

The Sewall Team surveyed 28 end-user service providers out of a total of 34 in Maine to determine their future plans, main barriers to expanding service coverage, and main barriers to adoption where service is available (Table 6-2). Each service provider was contacted by phone and asked to participate in the survey, either by phone interview or by email. A sample service provider survey is provided in Appendix A.

Table 6-2: Maine Service Providers Surveyed

Maine Service Providers Surveyed	
Aroostook Internet	NEPSK, Inc. (d/b/a Polaris Cable)
Aroostook Technologies Inc.	Otelco Inc.
AT&T Inc.	Oxford Networks
Axiom Technologies	Pioneer Broadband
Bee Line, Inc.	Premium Choice Broadband
Biddeford Internet Corporation (d/b/a GWI)	Redzone Wireless
Chebeague.net	Sprint Nextel Corporation
Comcast Corporation	Telephone and Data Systems, Inc.
Cornerstone Communications	Time Warner Cable Inc.
Deutsche Telekom AG (d/b/a T-Mobile)	U S Cellular
FairPoint Communications, Inc.	Union River Telephone Company
Harron Communications LP (d/b/a MetroCast Cable)	UniTek, Inc., DBA UniTel
Lincolnville Telephone Company	Verizon Communications Inc.
Midcoast Internet Solutions	Xpress America Internet

6.2.2 Residential and Business Surveys

During August-September 2010, the Sewall Team developed two written surveys to enable the systematic collection of baseline data from both Maine residents and small businesses. These instruments were designed to be brief and used primarily closed-ended questions so as to minimize the burden placed on the targeted survey populations, in hopes of maximizing the response rate. Governmental entities and non-profits were surveyed separately by telephone. Existing health information technology (HIT) survey data provided by the Office of the State Coordinator for HIT was used for the medical community.[70]

These baseline surveys were distributed in December 2010 following a period of review by relevant project stakeholders and performance of field testing with small random samples of 20 Maine residents and 20 small businesses not selected to participate in the project survey itself. Field testing was conducted via postal mail and informed subsequent survey revisions.

Final survey protocols included necessary statements and instructions for potential residential respondents insuring confidentiality, anonymity, and the fact that participation is voluntary. The business survey similarly abided by federal institutional review board (IRB) standards but was not anonymous. Respondents had the option of participating by completing a written survey and returning it via a self-addressed, postage paid envelope or by participating over the internet by completing an equivalent protocol prepared on SurveyMonkey®. It was projected that final versions of either the resident or small business surveys would require approximately 10-15 minutes to complete. Both sets of surveys were coded to eliminate the possibility of multiple responses from one respondent.

Final survey instrumentation included probes that collect data in the following domains:

- Basic demographic profiles of the targeted groups
- Current behavior (use patterns, attitudes and opinions) with regard to computer use, smartphone use, and broadband adoption
- Current knowledge with regard to broadband adoption
- Intended behavior (anticipated use patterns, attitudes and opinions) with regard to future computer use, smartphone use, and broadband adoption

Target sample size for the residential survey was 10,000 and 3,250 for the business survey. To compensate for an anticipated 8 percent failed mail deliveries, 10,869 residential surveys were mailed each of two times and 3,552 business surveys were

[70] The executive summary of this report is provided in Appendix C.

mailed once. Sample residential and business survey questionnaires are provided in Appendix A of this report.

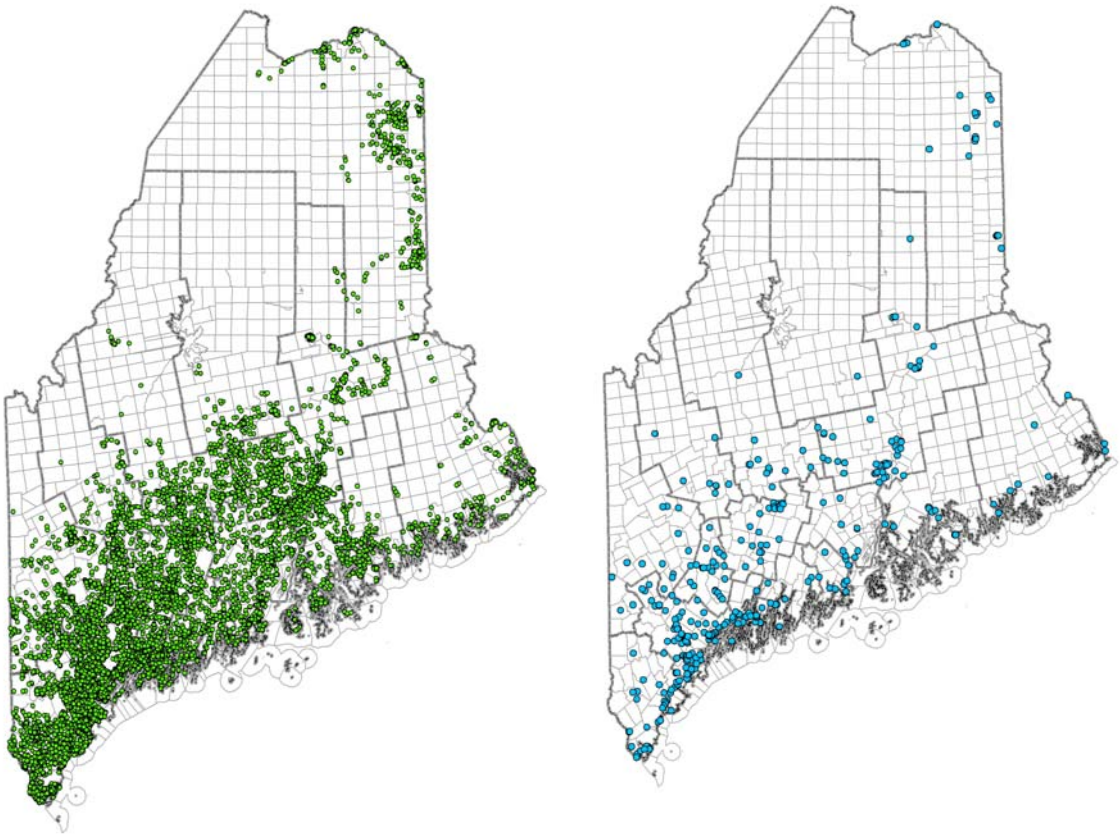

Figure 6-1: Residential and Business Survey Targets

Survey samples were drawn from the following databases:

- *Residential.* A sample of 10,869 Maine households was drawn from a current InfoUSA database of more than 460,000 Maine residents. The sample size is adequate to perform the required statistical analyses with a projected response rate of 15-20 percent. The sample was selected using weighted, stratified, and randomized methodologies so as to insure balanced representation from all 16 counties and sensitivity to variation in residential population density within counties

- *Business.* A sample of 3,552 small businesses (defined as fewer than 100 employees) was drawn from a current InfoUSA database of more than 40,000 businesses of this size in Maine. The sample size is adequate to perform the required statistical analyses with a projected response rate of 15-20 percent. The sample drawn was selected using weighted, stratified,

and randomized methodologies so as to insure balanced representation from all 16 counties and sensitivity to variation in small business population density within counties

In advance of the survey mailing, a limited PR campaign was implemented to heighten awareness, understanding, and acceptance of the soon-to-arrive surveys, and included press releases to print media outlets throughout the State.

The total number of completed questionnaires used for analyses was 3,436 (2,842 residential and 594 business). The economic modeling used 2,834 residential responses as 8 of the total received were incomplete.

Table 6-3: Residential and Business Survey Return

Type of Survey	Postal Mail Submission	Online Submission	Total Return
Residential	2,601	241	2,842
Business	538	56	594
Total Return	**3,139**	**297**	**3,436**

Select received surveys/envelopes were excluded from the analysis (received, but not represented in figure above) and fall into a number of categories:

- Paper and electronic surveys that were returned blank
- Paper and electronic surveys that were returned with written messages but not otherwise completed
- Paper and electronic surveys that were returned complete, but not consistent with directions (e.g., checking multiple answers for "check one only" questions)
- Empty envelopes
- Duplicates (either two paper surveys from one respondent or both paper and electronic from one respondent)
- Surveys received after the extended deadline (week of February 21st)

The data acquired via the residential and business surveys satisfy multiple purposes. One critical application is economic modeling as explained in Section 5.0. A second is increased understanding of consumer thinking and behavior as it relates to internet use in general and broadband adoption in particular (Section 4.0). Over the course of the four years of this project and repeated surveys, a comprehensive and evolving picture of consumer behavior will emerge. Third, analysis of the data will inform the development of the Authority's broadband awareness campaign. In particular, findings regarding business and residential consumer attitudes and behavior will be used to affect behaviors leading to broadband adoption and to counter misconceptions that serve as barriers to adoption.

Leveraging Consumer Perception

The Authority's broadband awareness campaign will be based as much on consumer perception of broadband, as indicated by the surveys, as on the actual status of broadband in Maine. It is often and aptly stated that consumer perception is reality for marketers, whether that perception is objectively accurate or not. Marketers therefore focus on influencing perception and, ultimately, consumer behavior.

In market research, consumers are asked for their knowledge and opinions about a product or service to understand their thinking and resulting behavior. In this vein, Maine residents and small business owners were asked, for example, to report on what types of internet service options exist at their location. This is not an attempt to acquire data on service coverage but rather to assess the level of awareness among these target markets. Similarly, it is valuable to understand what value they do and don't think broadband offers and what it is worth to them.

This distinction between perception and reality can be seen in marketing campaigns as well and is reflected in the use of the terms "features" and "benefits." In the broadband context, 3 Mbps speed is a factual feature. Understandably, the average consumer has limited interest in the details of such features. Benefits, in comparison, might be the ability to make a living in Aroostook County by operating a successful online business or getting a college degree online while continuing to live and work in Oxford County. Marketers focus their campaign efforts largely upon benefits as these are more influential in altering consumer thinking and action.

6.2.3 Public Forums

During each of the four project years, a series of public forums will be scheduled at different locations within designated regions of the State. The research intent of the forums is to collect qualitative data that complements the quantitative input from the mail/internet surveys. The forums also function to heighten public awareness of the State broadband initiative and of the importance of citizen and business participation in broadband development.

Sites for the first-year forums, convened during September-November 2010, were identified based on locales and venues that had the greatest likelihood of attracting adequate initial levels of community participation. In future years, alternative sites within each region will be chosen. These future sites will extend further into more rural communities to seek additional representation.

Table 6-4: Public Forum Sites--2010

Forum Location	County Representation
1. Portland	York, Cumberland, Androscoggin, Sagadahoc, Kennebec
2. Bangor	Piscataquis, Penobscot
3. Presque Isle	Aroostook
4. Skowhegan	Oxford, Franklin, Somerset
5. Machias	Washington, Hancock
6. Belfast	Lincoln, Knox, Waldo

During the forums, public comment was solicited to address the following questions:

- Why is the take rate so low in Maine?
- Why do residents and business owners use the internet, and from where, e.g., home or work?
- What are the barriers to access, e.g., cost, lack of installed fiber optic cable, etc.?
- If faster internet access were available, how would use expand and for what purposes?
- What are the drawbacks to inadequate internet access?

Some of the forums were conducted in advance of the direct mail surveys, and the Team used the general themes that emerged from the forums to help craft specific questions for the written surveys. The forum facilitator introduced the session with an overview of the project, why public participation was important, and why the comments and discussion that emerged from the forums were important to the written surveys yet to come. Participants were asked to fill out a simple two-page, anonymous questionnaire devised to provide demographic information, along with the participant's residential or business zip code (See Appendix A for a sample forum questionnaire).

Given the demands of the project timeline during year one, public forums were planned such that their administration overlapped with the administration of the mail/internet survey.

6.2.4 Community Anchor Institution Surveys

To satisfy the required collection of community anchor institution (CAI) data for the ConnectME Authority Mapping and Inventory Project, an extensive effort was undertaken to determine broadband service for each of Maine's 4,496 community anchor institutions. Phone surveys were conducted to find out whether an institution had broadband-level internet service and, if so, the type of service and

the identity of the provider. The institutions were requested to take part in a supplemental online survey to derive more information on their internet uses and needs. Each of these supplemental records is linked to the original phone survey record. The survey results from this effort help define the broadband availability statewide for this important consumer group. A sample of the phone survey questionnaire is provided in Appendix A.

Schools and Libraries

Networkmaine, a unit of the University of Maine System that provides high-bandwidth internet connectivity to the research and education community, surveyed Maine School and Library Network (MSLN) participants as part of Networkmaine's yearly enrollment for network services through the MSLN project. MSLN, now a service of Networkmaine, is a consortium of roughly 1000 schools and libraries across the State through which participants access internet, local loop circuits and other related services. Networkmaine made the survey questions for this project mandatory as part of the MSLN enrollment process to ensure that the participants, who receive high-speed broadband service at no cost, provided the data requested. As the MSLN project is funded using a combination of both federal and state-level universal service funds, the participation rate is over 95 percent. Responses to the survey questions, provided by the applicants, were tabulated into a report and delivered to the Sewall Team without modification. A copy of this report, including the questionnaire, is provided in Appendix B.

6.2.5 Telemedicine Survey

Both the federal and Maine State governments are acutely aware of the social benefits of increasing access to healthcare and are especially interested in ensuring that health care providers have access to broadband internet services. They are also interested in understanding barriers to adoption within the healthcare community. For these reasons, healthcare organizations, which include both CAIs and businesses, are treated as separate entities in this assessment based on survey data provided by the Office of the State Coordinator for HIT. These data were used to avoid conducting a duplicate survey effort.

6.2.6 Native Indian Tribes Surveys

A significant component of the National Broadband Plan is focused on improving access to broadband for America's more than 4.1 million American Indians and Alaska Natives represented across 565 federally recognized tribes. To that end, the FCC formed the Office of Native Affairs and Policy (ONAP) in August of 2010.[71]

[71] See http://www.fcc.gov/indians/.

The objective of this survey of Native Indian Tribes within Maine's borders is to determine the level of service, use, and adoption as compared to that of (1) tribal lands nationwide and (2) other populations within the State. The methodology to establish the baseline for this segment included a review of service availability within the populated regions of tribal lands. Using mapping of reservation and trust lands acquired from the tribes as a base and mapping of broadband availability from the ConnectME Authority Mapping and Inventory Project as an overlay, spatial analysis was conducted to establish a relative percentage of coverage based on locations shown to have available broadband service.

To review existing use, needs not currently met, and drivers for and barriers to increased adoption, the Team utilized the CAI survey questionnaire (Appendix A) in telephone interviews. Basic research of demographics factors was performed to identify potential socioeconomic factors that might differ from the general Maine population. IT managers for the tribal anchor agencies such as schools, emergency services, community agencies, and governing bodies were interviewed by telephone.

6.3 USE OF OTHER EXISTING DATA

In addition to the data collected from the residential and business surveys and the public forums, existing data was collected from a variety of other sources.

- Data collected from the service providers through the ConnectME Authority Inventory and Mapping Project and through FCC Form 477 were used to establish broadband availability metrics and comparisons

- US Census Bureau data were used in the economic modeling for both residential and business demographics

- Addresses for the residential and business surveys were drawn from InfoUSA's mailing address database

- Information from Networkmaine's Maine School and Library Network database was used for address verification and to determine the current provider, capacity, and medium for each school's and library's broadband connection

- Existing health information technology (HIT) survey data provided by the Office of the State Coordinator for HIT was used for the healthcare community assessment

- Demographic and telecommunications use information for Native Indian Tribes was acquired from the Bureau of Indian Affairs, the FCC Office of

Native Affairs and Policy, the Native American Broadband Association, and, where available, the tribal leadership organizations of the Penobscot Nation, Houlton Band of Maliseet Indians, Passamaquoddy Indians at Indian Township, Passamaquoddy Indians at Pleasant Point and the Aroostook Band of Micmac Indians

- White papers and reports generated by government agencies, industry members and experts were used to build a comparison between Maine's baseline and the baseline of other states and countries (See Appendix C for a selected list).

6.4 ECONOMIC MODELING PROCESSES

Economic modeling in this assessment consisted of two activities designed to gain a better understanding of the barriers to broadband adoption in Maine. Since barriers can arise as a result of the behavior of service providers as well as users of broadband services, the economic analysis considered: (1) deployment decisions by telecommunications companies; and (2) demand for broadband services by Maine household and small business consumers.

6.4.1 Availability of Broadband Services in Maine

The purpose of the first economic modeling activity was to examine the availability of broadband services in Maine. A total of five broadband technologies were considered, including cable, DSL, fixed wireless service, fiber optic and T-1, with an emphasis on cable, DSL and fixed wireless service. Using information on a sample of 494 Maine municipalities, which covered about 99 percent of the State's population as of the 2000 US Census, the analysis focused on the percentage of locations in an area with access to one or more of the five broadband technologies, as well as a separate analysis of access to cable, DSL and fixed wireless services. The local characteristics used to examine differences in broadband availability across municipalities include population density, the percentage of residents who reside outside of urban centers, median age and educational attainment of the population, median household income, and the average value of residential housing structures. In addition, the modeling examined the relationship between the availability of broadband services and local business and industry characteristics such as the number of "large" establishments (i.e., 100 or more employees) located in the municipality, the number of CAIs, and the share of local employment by major industrial category (e.g., manufacturing, retail trade, healthcare and social assistance).

The types of technologies analyzed separately in the analysis—cable, DSL and fixed wireless services—are often thought of as "residential class" broadband, which may not offer the speeds and symmetry that are required for business applications. The reason for this emphasis is that a very small number of Maine

business consumers use technologies that provide "business class" service. The analysis that examined the percentage of locations in an area with access to "any" of the five types of broadband technologies, however, considered a wide range of residential and business class services. The modeling did not examine the availability of internet access via satellite or terrestrial mobile wireless technologies.

Satellite is excluded in the ConnectME Authority's definition of broadband due to the high latency (delay in transmission) inherent in the technology, which is not able to support real-time applications like voice over IP (VOIP). Mobile wireless is also excluded from consideration. A small subset of Maine's population uses mobile wireless service as a fixed-location broadband solution when no broadband level service offering is available at home or business. Its inclusion in the report would overstate the availability of fixed-location broadband services and skew the results.

Economic modeling of broadband availability in Maine used information from the US Census Bureau as well as the Maine Broadband Inventory and Mapping Project. The analysis was based on data that Sewall provided to the NTIA on April 1, 2011. The economic modeling will be updated on at least an annual basis to incorporate future versions of the broadband availability data set as they become available.

6.4.2 Demand for Computer and Broadband Services

The purpose of the second economic modeling activity was to examine the determinants of computer and broadband internet use by Maine households and small businesses (establishments with fewer than 100 employees). The analysis of Maine households focused on computer availability in the home, the type of internet connection (e.g., "residential" broadband, or business-oriented services such as a fiber optic or T-1 line), the number of ways in which household members use a computer, and whether members of the household access the internet for more than 20 hours per week. Modeling of small businesses in the State examined whether computers are used heavily in their day-to-day operations, broadband internet adoption decisions, the number of ways in which computers are used, and whether companies have an employee with IT-related responsibilities.

The household-level characteristics that were used to examine differences in broadband use across residential consumers include annual income, educational attainment, and selected household size and age characteristics. The establishment-level characteristics that were used to examine differences in broadband use across business consumers include establishment size, years of operation, and major industrial category.

Modeling of the demand for computer and broadband services by residential and business consumers used information from the Broadband Planning Project. Specifically, the analysis of computer and broadband internet use by Maine households is based on a dataset of 2,834 respondents that completed surveys. Analysis of computer and broadband use by Maine businesses is based on a dataset of 594 establishments with fewer than 100 employees. The economic modeling of computer and broadband use will be updated annually to incorporate future versions of these surveys.