21ˢᵗ Century Infrastructure

How Broadband Internet has Shaped and is Shaping Utah

The mission of Utah Foundation is to promote a thriving economy, a well-prepared workforce, and a high quality of life for Utahns by performing thorough, well-supported research that helps policymakers, business and community leaders, and citizens better understand complex issues and providing practical, well-reasoned recommendations for policy change.

21st Century Infrastructure

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Broadband internet has been widely influential on the twenty-first century. It allows professors to teach college-level courses to rural high school students in several schools at the same time, it makes telepsychiatry services possible, and it has made Netflix ubiquitous in homes across the nation. The future of broadband internet will encompass an increasing number of services for residents and businesses. Utah has been leading the country in some areas of the internet and it proliferation:

- **The University of Utah was one node of the ARPAnet in 1969, which is considered to be a predecessor of the internet.**
- **Utah charted new ground with its municipal providers, including iProvo, Spanish Fork Community Network, and UTOPIA.**
- **The Utah Education and Telehealth Network is a backbone in helping schools – and their surrounding communities – get connected to broadband service.**
- **The Utah Department of Transportation has been a big partner in helping internet service providers lay new internet infrastructure.**
- **The public-private interplay in internet proliferation is continuing to develop, helping ensure that communities update transportation and internet infrastructure simultaneously.**
- **Utah is now home to two Google Fiber cities: Salt Lake City and Provo. This will help raise their stature as "connected" communities as well as increase competitive services from Centurylink, Comcast, and others.**
- **US Ignite is looking toward Utah to develop a "metro internet" to increase internet speeds for twenty-first century applications.**

Because of these factors, Utah is one of the top states in the nation for broadband availability. Yet, while 95% of Utah households have access to broadband services, only 35% of households actually purchase this level of service. The reason for this disparity and other important broadband-related topics are examined in this report.

Broadband Access as a Percent of Population
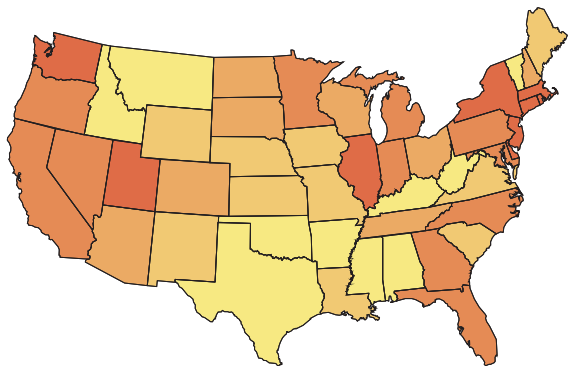
0-68%   69-79%   80-86%   87-94%   95-100%

Source: FCC.

INTRODUCTION

Utah has a long history of internet communication. It began in 1969 with the University of Utah becoming one of the four data-processing sharing hubs of the ARPAnet, which is often considered a predecessor of the modern-day internet.[1]

Since then, the age of the internet had expanded communication of all kinds. Not only is it used for personal and business communication, but also for real-time emergency response systems, analyses of traffic congestion, education, air pollution monitoring, entertainment, health care, and an ever increasing number of applications.[2] The future will likely have even more to offer, from surgeons performing operations remotely with advanced robotics thousands of miles away to online, 3-D, immersive gaming experiences. These future types of communication will likely require even more advanced high-speed internet networks.

This report provides an overview of broadband internet. It examines how broadband is related to Utah's economy and Utahns' everyday lives. And it raises important questions about broadband, specifically with regard to accessibilty and adoption, governments' roles in internet proliferation, and the future of broadband and the internet.

BROADBAND DEFINED

But what exactly is meant by "broadband?" The term is simply a standard of internet speeds. Broadband is a benchmark determined and periodically updated by the Federal Communications Commission (FCC). It is based on the download and upload speeds demanded by consumers and supplied by providers. The FCC most recently increased the minimum broadband download speed to 25 megabits per second (Mbps), and the minimum upload speed to 3 Mbps (see Figure 1).[3]

Figure 1: FCC Broadband Standards Over Time

	1999	2010	2015
Download Speed	200 kbps	4 Mbps	25 Mbps
Upload Speed	200 kbps	1 Mbps	3 Mbps

Note: One megabit per second (Mbps) is the equivalent of 1,000 kilobits per second (kbps).
Source: FCC Broadband Deployment Reports.

To illustrate the benefits of current broadband speeds, downloading a typical 90 minute, low-quality movie at 56 kilobits per second (the upper limits of dial up modems in the early 1990s) would have taken nearly 28 hours.[4] By contrast, at 25 Mbps the same movie would take under four minutes. The current 25/3 Mbps standard is considered to be a sufficient speed for multiple, simultaneous internet uses in a home.[5]

WHY CARE ABOUT BROADBAND?

Broadband and the Economy

President Obama has stated that "affordable, reliable access to high-speed broadband is critical to U.S. economic growth and competitiveness. High-speed broadband enables Americans to use the internet in new ways, expands access to health services and education, increases the productivity of businesses, and drives innovation throughout the digital ecosystem."[6] To this end the federal government has been putting up billions of dollars in internet investments, including over $35 million in Utah.[7] It has also established the Broadband Opportunity Council to "identify and address regulatory barriers that may unduly impede either wired broadband deployment or the infrastructure to augment wireless broadband deployment; encourage further public and private investment in broadband networks and services; promote the adoption and meaningful use of broadband technology; and otherwise encourage or support broadband deployment, competition, and adoption in ways that promote the public interest."[8]

The rationale behind developing a robust internet infrastructure is to establish an environment that potentially improves the economy by attracting business, improving productivity, increasing quality of life, improving education, and creating jobs in industries that pay higher than median wages.[9] As of 2010 (the latest data available), more than one in ten Utah companies were classified as "high-tech," which places Utah as having the sixth highest high-tech concentration in the nation.[10] Having a technological infrastructure in place that permits the rapid movement of large amounts of data is as essential for an expanding economy as the highway, rail, airport, and shipping networks that allow the rapid transport of people and products around the globe. Utah's technological infrastructure is vital in sustaining companies with a clear reliance on high-capacity networks such as cloud-based services like those that provide Software-as-a-Services (SaaS), cloud storage, and data analytic capabilities. Moreover, the networks are just as essential for other companies who rely on Utah's technological infrastructure to transmit large amounts of data to branches or headquarters in other states.

Broadband and Households

Business and the economy at large are not the only stakeholders that stand to benefit from investment in high-bandwidth infrastructure. It also supports new consumer-targeted industries, ranging from hailing taxis to remotely controlling the temperature inside homes.

Technology has become a ubiquitous part of consumers' lives. As consumer products continue to rely more on cloud-based services, available bandwidth will continue to be of increasing importance. Furthermore, the past decade has seen explosive growth in social media. With its varied platforms, social media has become an essential part of modern day social fabric.[11] Not only has the social media industry exploded over the past decade, but the growth of traditional media transmitted through broadband services continues to expand as well.

Additionally, consumers are becoming increasingly reliant on high-capacity networks as they choose to do away with land-based telephones and cable or satellite television. Instead, they are using services available online such as Netflix, which itself accounts for over one-third of all internet download traffic in peak evening hours.[12] Consumers will draw an ever larger benefit from high-capacity networks as those consumers become increasingly "connected" and internet-based services become more convenient.

BROADBAND ISSUES

The next section of this report includes a number of issues that Utahns interested in broadband should be thinking about, including access and adoption, the digital divide, the role of governments and public-private partnerships in broadband proliferation, and the future potential of high-speed networks.

Access and Adoption

High download speeds are quickly becoming more widely available. Between 2010 and 2014, household access to 25 Mbps download speeds increased from 51% of Americans to 86%.[13]

Figure 2: Percent of Population with Access to 25 Mbps Download Speeds, U.S.
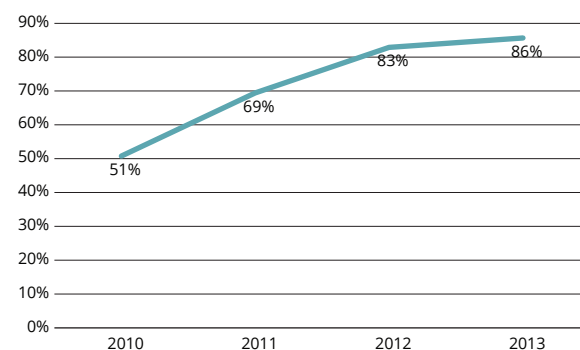
Note: Percentages are at December of each year.
Source: National Telecommunication and Information Administration (NTIA).

While FCC Chair Tom Wheeler has expressed concern about the level of broadband access nationwide (83%), Figure 3 illustrates it is a smaller concern in Utah where 95% of Utahns have broadband access.[14] In fact, this level of access puts Utah in the top 10 states nationwide.[15] The urban makeup of the state itself – with its population concentration along the Wasatch Front – has made physical access to broadband infrastructure easier and more cost effective.[16]

Figure 3: Broadband Access as a Percent of Population

0-68%   69-79%   80-86%   87-94%   95-100%
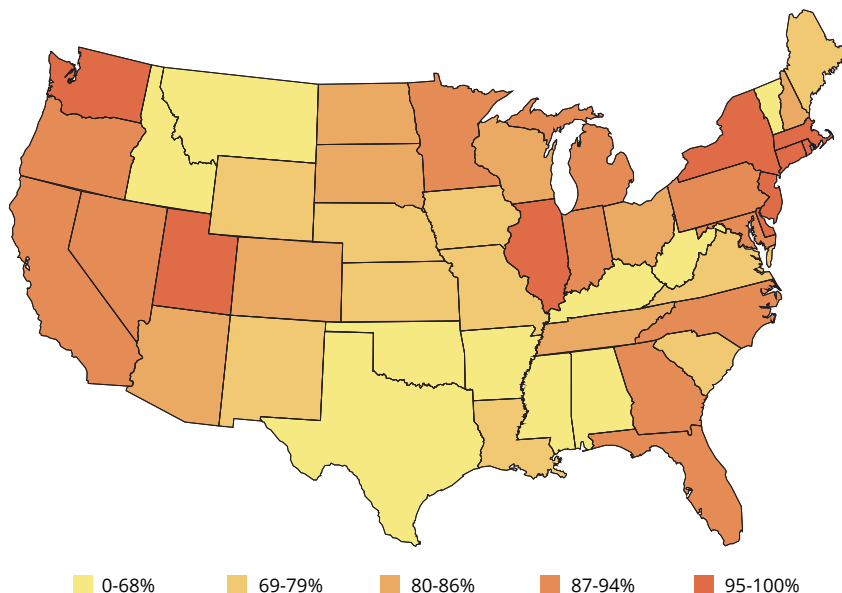
Note: Figure details the current broadband definition of 25 Mbps download and 3 Mbps upload as of December 31, 2013. Alaska and Hawaii which are not shown have broadband proliferation of 62% and 96%, respectively. Rhode Island is the highest at nearly 100% while Montana is the lowest 13%
Source: FCC.

While 95% of Utahns have high-speed internet access, not everyone chooses to adopt those services. In Utah, 86% of households have internet in their homes, compared to 79% in the United States.[17]

As of 2013, many Utahns were subscribing to internet services below the new FCC definition of broadband. While 86% had an internet connection, only 35% of Utahns had services at or above the 25 Mbps download and 3 Mbps upload speed (see Figure 4).[18] On top of that, these are advertised speeds; many consumers find that their actual speeds do not meet the advertised speed.[19] Nonetheless, Utah ranks fourth in the nation with an average connection speed of 15.2 Mbps (the highest being 19.0 Mbps).[20]

The FCC has deemed it important that all Americans have access to broadband speeds. However, since the majority of households have broadband services available but consider a lower level of service to be sufficient, it calls into question whether the current broadband speed is a necessary target for the minimum level of service that should be available to U.S. households.

Digital Divides

There are two main digital divides in Utah. Rural communities often have lower accessibility to high-speed services than their urban counterparts, and low-income communities often have more difficulties in affording high-speed services than their higher-income counterparts.

Figure 4: Household Internet Adoption, by Speed, 2013

Download Speeds in Mbps	Upload Speeds in Mbps	Utah	U.S.
No Internet	No Internet	14%	21%
Less than 3	Less than 3	20%	17%
3-10	At least 0.768	15%	10%
10-25	At least 0.768	16%	23%
25 or greater	3 or greater	35%	29%

Sources: FCC, U.S. Census Bureau (ACS 2013).

FCC Chair Tom Wheeler stated that "there is a large, and unacceptable, disparity in broadband access between urban Americans and Americans in rural areas and Tribal lands."[21] While only 8% of urban American do not have access to broadband, over half of rural Americans do not. And while Utah has a higher level of access than the national average, the difference between rural and urban Utahns remain stark (see Figure 5).[22]

**Figure 5: Households with Broadband Access, 2013**

	Utah	U.S.
Urban	98%	92%
Rural	61%	47%
Total	95%	83%

Note: 25 Mbps download and 3 Mbps upload speeds.
Source: FCC.

One reason for the divide is that it is often not profitable for providers to deliver services to small groups of people far from urban centers. Additionally, federal land permitting is difficult in Utah because of the lengthy approval process in running internet infrastructure across federal lands.[23]

Additionally, the cost of high-speed internet creates a digital divide. Lower-income households may have the access to broadband, but they have lower adoption rates.[24] A recent Pew Research Center survey found that 74% of households earning less than $30,000 per year purchase the internet compared to 97% of adults with annual incomes over $75,000.[25]

President Obama has declared that "access to high-speed broadband is no longer a luxury; it is a necessity for American families, businesses, and consumers."[26] There is no doubt the lack of internet access can cause inconvenience in modern life, much like the lack of an automobile. Yet just as there are alternative forms of transportation (such as transit system and bicycles) there are alternative sources of online access (such as public libraries and community centers). Given that many services provided to low-income households are being administrated and provided online, it is clear that there should be a minimum standard of service available to all communities at an affordable price. What is not clear, however, is whether the current broadband standards accurately represent a minimum level of internet capacity that should be available to every American's home. While 95% of Utah households have broadband speeds available, actual broadband
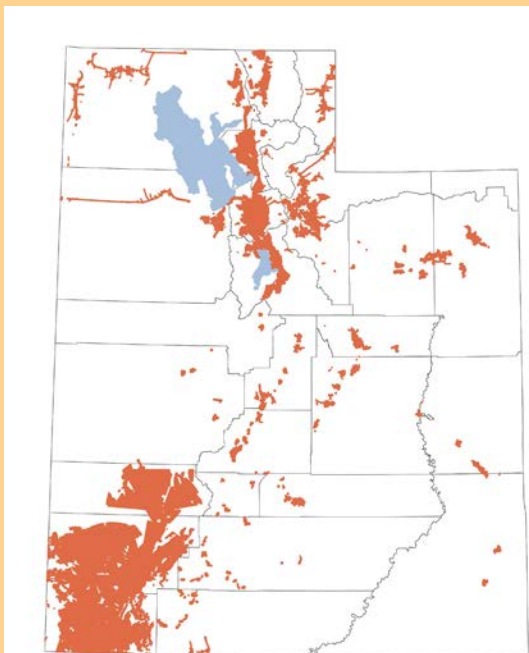
Increased information about broadband access may help close the digital divide. The Utah Broadband Outreach Center works with stakeholders to identify and coordinate access to underserved, or not currently served, communities. The Center's interactive map help increase transparency, allowing customers to shop and compare competing services.

Find which internet carriers provide service to your area using the Center's interactive map: http://broadband.utah.gov/map/

Note: This map shows broadband service over DSL, cable, and fiber, as well as fixed wireless which is common in southwestern Utah.
Source: Utah Broadband Outreach Center.

subscription rates have lagged behind. As noted, just over one-third of Utahns actually purchase this level of service. Returning to the analogy of transportation, while the lack of a car can no doubt increase the hardship experienced by a low-income family, that family does not necessarily need the latest model to alleviate their hardship. Similarly, it is not clear that a level of internet speed below current broadband standards would not be a suitable minimum level of service.

According to the Pew survey, of the 15% of Americans who did not use the internet, a third responded that they had no interest and another third said it was too complicated. One out of five cited the high cost of internet service and connected devices as the reason for not subscribing.[27]

But what about broadband, specifically? The faster the connection speed, the more expensive the plan. In Utah, broadband connectivity tends to range between $30 and $60 per month.[28]

Governmental Involvement in Broadband

How involved should governments be in internet proliferation? Utah recognizes the economic benefits of infrastructure investment. In 2009 it engaged in increased broadband adoption using a federal grant.[29] After that grant expired in 2014, the 2015 Utah Legislature passed HB414 to create the Utah Broadband Outreach Center to continue broadband deployment promotion, education, and stakeholder collaboration.[30] Further, the Utah Legislature allowed local municipalities to engage in network infrastructure since the passage of the Municipal Cable Television and Public Telecommunications Services Act in 2001.[31] Following the passage of the Act, numerous Utah municipalities began internet infrastructure initiatives, including Spanish Fork, UTOPIA communities, and Provo.

The Spanish Fork Community Network has been a success. Most of Spanish Fork's residents are connected under the network, it is successfully paying off its infrastructure bonds, and revenue is left over for city services.[32]

Not all networks have been so lucky. In 2013, Provo sold its iProvo fiber network to Google Fiber for only $1, leaving taxpayers with the municipal bond debt which will result in payments of approximately $30 per person, per year through 2026.[33] However, the sale will save Provo from issuing additional debt for upgrades, and becoming a Google Fiber network city may positively impact the city's economic development.[34] In addition, it may spur healthy competition with other providers. Following Google's entrance into Utah, CenturyLink and Comcast began rolling out their own initiatives to provide gigabit per second – or 1,000 Mbps – broadband, with Comcast doubling Google's speeds at two gigabits per second.

Some have considered UTOPIA to be a high-profile failure in broadband development. The consortium of northern Utah cities deployed an open access network, where a city builds the network but the internet is leased and serviced by independent providers. UTOPIA over-anticipated their number of network subscribers, which has led to a variety of financing problems that have yet to be resolved. While the original deployment has left communities with substantial municipal debt, UTOPIA is no longer losing money. Furthermore, it has provided broadband speeds to communities that may not have had such service otherwise. In addition, many communities are modeling its open access structure, which allows small providers to enter markets without having to build their own cost-prohibitive networks.[35] Other open access cities benefited from UTOPIA's early municipal entry into the industry; "someone had to be first, and the rest of the nation learned a lot from UTOPIA and iProvo."[36]

Other Utah communities are involved in creating robust internet connectivity in other ways. One example is Salt Lake City's commitment to Google Fiber in facilitating planning, streamlining permitting, and

providing right of way access. And in St. George, public and private stakeholders formed a Joint Utility Committee to collaborate on future projects.

Public–Private Partnerships

Like some Utah cities, state departments have also facilitated the buildout of Utah's technological infrastructure through public-private partnerships. One example is the role of the Utah Department of Transportation (UDOT). At the time of the state's preparations for its 2002 Winter Olympics high-speed networking needs and highway infrastructure, UDOT anticipated the need for its own high-speed network to connect traffic signals, road signs, cameras, and other road-sensing devices. The road projects and internet infrastructure were built in tandem. During this buildout, UDOT provided opportunities for private internet providers to lay private networks, greatly reducing their costs since burying cable is often a large expense for creating high-speed, high-capacity networks.

As a side note, public entities have also traded network access. For example, UDOT and the Utah Transit Agency share portions of their networks with each other rather than building separate overlapping networks.[37]

Another public-private force in expanding Utah's broadband capabilities is the Utah Education and Telehealth Network (UETN). Established in the 1990s by the Utah State Legislature, UETN coordinates telecommunications for public and higher education, applied technology, libraries, government, and other public entities. The network provides high-speed networks to all public school districts in Utah.[38]

UETN assists schools and districts in coordinating with private providers to expand communications infrastructure using federal subsidies. As a result, high-capacity networks have been created using private and public funds with school and municipal locations as community anchors. Private internet providers are subsequently able to offer business and residential service to the same rural communities. This partnership has helped provide broadband to many rural communities that would otherwise not be profitable for private companies to service.[39]

Both UDOT's and UETN's practices of cooperation with broadband providers have been recognized as models of public-private partnerships for other states.[40] One of the Utah Broadband Outreach Center's initiatives is to further increase coordination between public and private entities. This includes employing "dig once" collaborations like those of UDOT, where private companies bury cable at the same time as governments perform road projects. Public-private coordination also includes reducing regulatory barriers and engaging broadband stakeholders during the planning process.[41] Nonetheless, many of Utah's communities are not utilizing these strategies and do not have such policies in place.[42]

Future Potential

FCC Commissioner Jessica Rosenworcel wants to go beyond the new 25 Mbps download threshold, increasing it to 100 Mbps. "I think anything short of [100 Mbps] shortchanges our children, our future, and our new digital economy." While most internet applications can be used at speeds lower than the current 25 Mbps download and 3 Mbps upload FCC broadband standard, future applications may surpass that capacity.

As most consumers download content much more often than they upload, current commercial broadband offerings are focused on providing faster download speeds. However, a future goal is to provide synchronous transfer rates – where upload and download speeds are equal. This is currently the standard high-end

service providers are offering, and is standard for networks such as UETN and UTOPIA. UETN is using synchronous connections for real time, two-way video transfer for educational outreach to rural students and healthcare related services related to telepsychiatry and others.

In addition, there is one effort in Utah to increase internet speeds and security at the same time. Salt Lake City and Provo are two of fifteen cities in the nation that are part of the early deployment of US Ignite's "metro internet." US Ignite is a nonprofit working to link existing networks to large, city-based internet hubs through which communication will flow from city to city. Currently, sending an email from one house to a neighbor across the street might result in the email travelling thousands of miles between networks. A metro internet system would allow that message to instead travel to the city hub and back to the neighbor in an imperceptibly short period of time. While emails speeds need not be that fast, such speeds would help in real time video connections and telemedicine applications.

In addition, the future will likely see more devices connected to the internet, both in homes and public areas. These may lead to "smarthomes" in "smartcities." While today's needs may not warrant some of the gigabit speed infrastructure projects, Utahns may be demanding such speeds in the future. Technological fixes to potential capacity shortages could minimize the increasing need for traditional infrastructure. For instance, new compression technologies may make more efficient use of bandwidth, and advancements in wireless technologies may supplant the need for additional wired bandwidth.

CONCLUSION

The FCC has a statutory mandate to "encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans."[43] As such, the agency has updated broadband standards as it sees fit. However, in looking at broadband adoption across the United States, it remains unclear whether broadband speed and proliferation exceeds the need for internet standards in the average American household. The same holds true in Utah.

Utah's history of investing early and its collaboration among many public and private entities has helped develop an infrastructure that can support the local business climate, including Utah's expanding tech sector which is heavily reliant on high-capacity networks. Underinvesting in this type of infrastructure could have larger ramifications in the economy, but it is not clear what role public investment should play in the expansion of information infrastructure.

It is likely that future internet applications will require exceedingly high-speed internet, far beyond that which is available today. Preparing the infrastructure now may be prudent. Although broadband in Utah is primarily deployed by the private sector, the State of Utah should continue to evaluate what role it takes in ensuring that it, its cities, and its residents have access to speeds appropriate to meet their needs. Aid from the federal government plays a key role in funding educational and rural infrastructure. Utahns will need to decide whether the public sector should, or needs to, be intimately involved in infrastructure expansion. If Utah does intend to take a more proactive role in expanding its high-speed internet infrastructure, a successful policy agenda would likely benefit consumers, businesses, and the economy.

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