TOWN OF SKYKOMISH, WA

Broadband Feasibility Study

Magellan ADVISORS

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. Executive Summary

The Town of Skykomish is in a challenging economic and geographic position for broadband. Its rural location, low population density, and limited economic base—including internet services—suggests the costs of broadband would be too high and rate of return too low to justify investment by privately-owned internet service providers. These factors have resulted in the Town and its surrounding area being underserved by broadband options, an issue which has long been a concern and has recently come to the forefront due to the need for increased connectivity during the COVID-19 pandemic. Fortunately, there are a number of circumstances that reduce these challenges, and even transform them into broadband drivers.

Magellan Advisors gathered extensive data about infrastructure and service in the area, as well as local demographic and economic characteristics. We interviewed numerous stakeholder representatives about their needs and opportunities for broadband. With the support of the Town, we surveyed households and organizations to gather information about their current connectivity and how they use the internet. The survey included an integrated speed test as well as questions about costs and performance. We designed basic fiber and wireless networks to assess the feasibility of building new infrastructure.

Skykomish's location on a major east-west corridor—US Hwy 2—through the Cascades, a destination area for outdoor recreation, means that it has substantial network infrastructure and economic justification for more. There is also substantial demand for broadband for work and education. Healthcare, public safety, transportation, tourism, and utilities could all benefit from better, faster, and more reliable connectivity in the Upper Sky Valley. Skykomish sits in the midst of an area that is attracting more, younger residents and visitors who can live and travel where they please because they can work anywhere there is broadband.

Limited past investment in network access infrastructure means there is little to overbuild. Recent infrastructure projects—including a massive clean-up of spilled oil by BNSF Railway, which runs through the Valley—included underground conduit, which could be used to reduce network infrastructure improvement costs. Long-haul fiber runs along electric transmission lines, the highway, and railroad, and there are existing towers supporting

microwave links. All of these could be used as “back-haul” to better connect Skykomish to the rest of the world.

The Frontier telephone network infrastructure in the area was recently purchased by Ziply. The company’s stated plans are to replace most of its local infrastructure with fiber. It currently offers true broadband at competitive prices in other areas and company representatives indicated that this is their intention for Skykomish. This is a very positive development but the area will still have only one option for broadband. And, because Ziply does not plan to build to the east of Skykomish, this does little to alleviate the situation in the eastern portion of the Upper Sky Valley.

The Town of Skykomish could leverage its assets and work with its neighbors to develop other options. This could include working with King County to pursue funding opportunities for building additional infrastructure to encourage Ziply and others to continue expanding their service area and offerings. Washington State House Bill 1336, which passed the state’s House in February 2021 and is currently in committee in the Senate, would allow public entities to provide telecommunications services to end users, opening the possibility for Skykomish or other towns in the Upper Sky Valley to consider taking a more aggressive role in expanding broadband directly.

Magellan Advisor’s developed two (2) high-level conceptual designs, one using the available conduit assets as well as new aerial fiber and another using the available conduits assets as well as new underground fiber. All options would reach all locations withing the Town, enabling all residents and businesses to obtain fiber connections.

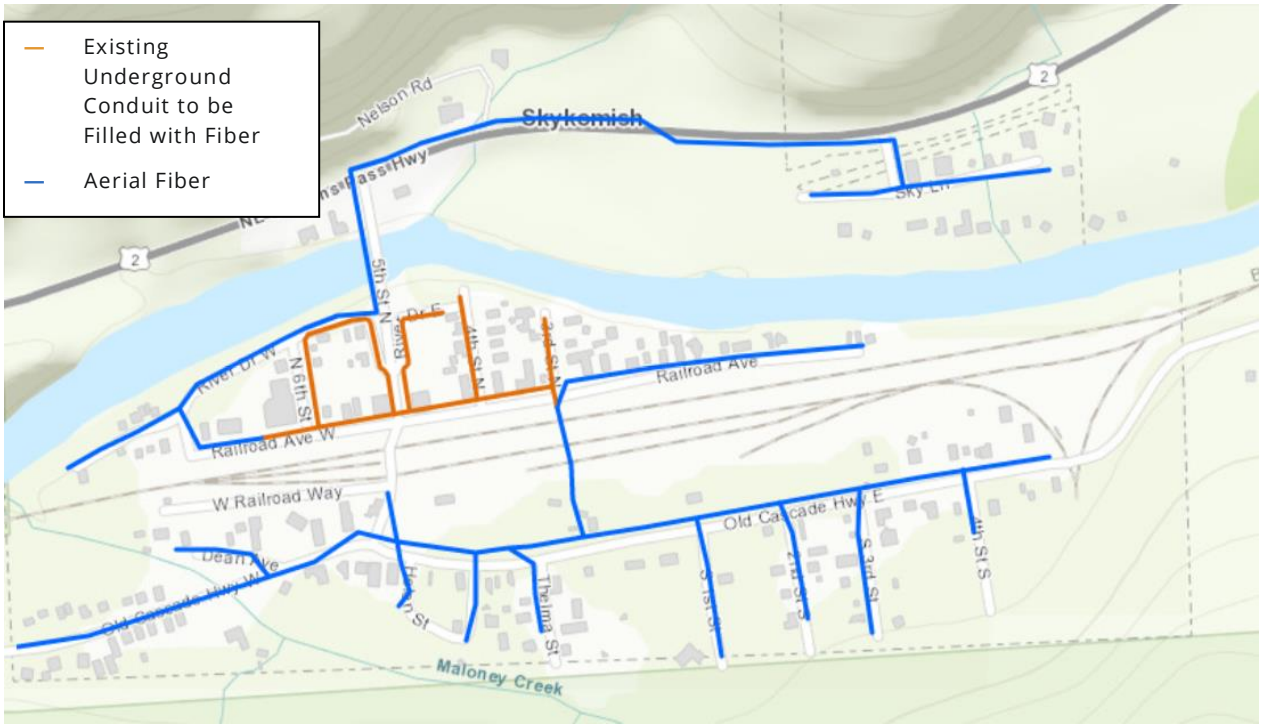


Figure 1-1. Hybrid Aerial-Underground Network Design

The underground-only design shown in Figure 1-2 uses the same assumptions for underground infrastructure as the hybrid design.

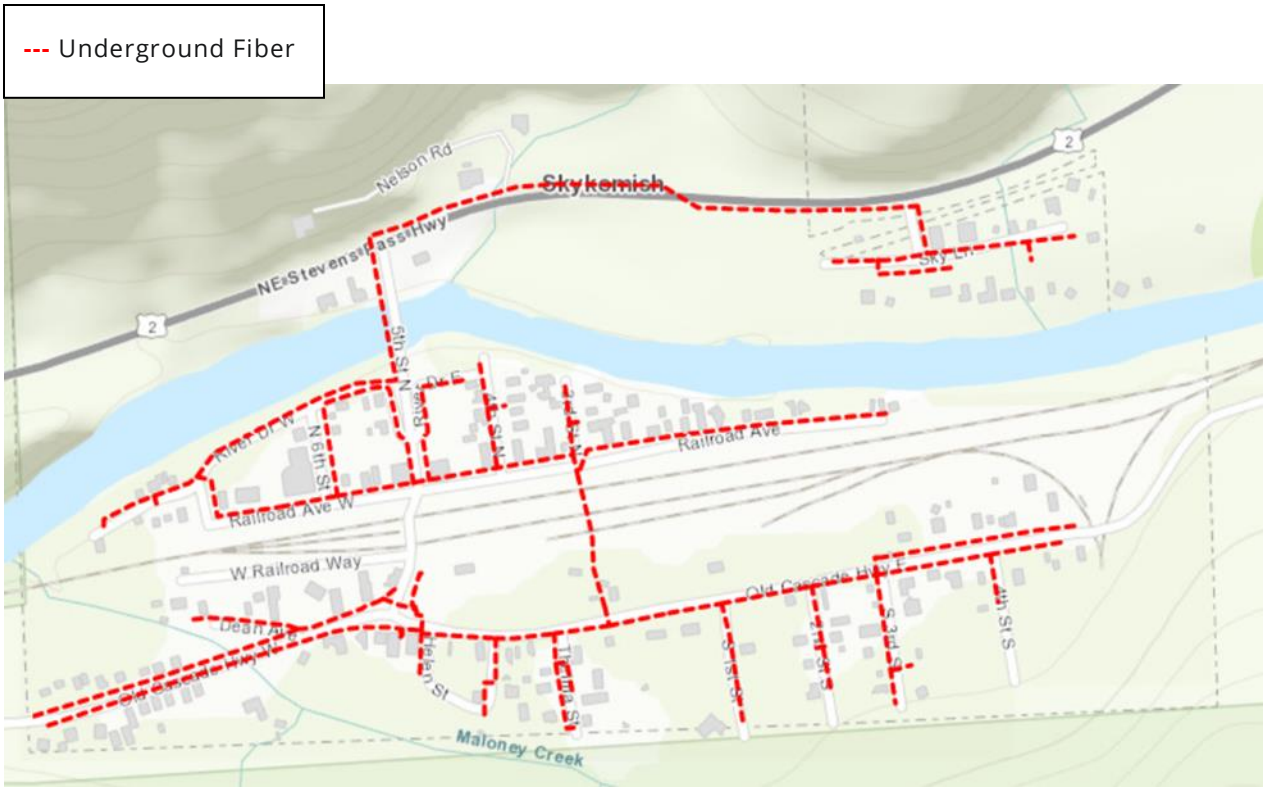


Figure 1-2. Underground-Only Network Design

If the Town of Skykomish were to build these options without a partner, we estimate that the hybrid approach would cost approximately $500,000, while the underground-only approach would cost around $1.5million. Although some of the underground infrastructure is in place, the overall cost of the hybrid design is approximately a third of the underground-only approach. This is largely due to the need to substantially expand the existing conduit to make it useful. The assets would also need to be proofed and field verified at an additional cost to ensure they are fit for use.

Table 1-1. Construction Cost Estimates

Network Option	Aerial	Underground	Total Cost
1: Hybrid	12,981 ft.	2,950 ft.	$537,498.11
2: Underground-only	0 ft.	18,599 ft.	$1,547,601.23

Magellan also developed a design for a public Wi-Fi system that would cover the downtown area and the ballpark on the east side of the town, including

internet connectivity via high-speed long haul microwave systems. We estimate the costs for the Wi-Fi network to be approximately $50,000.

The costs of these networks do not consider operations and maintenance, which requires significant capacity. The Town would need to create a new department or enterprise to maintain the assets and provide customer service for any of these network designs or contract with a third party to do so.

The most cost effective solution is for the Town to work with Ziply to facilitate their network upgrades but also maintain a neutral stance and encourage other providers to invest in the area. Should Ziply's upgrades not meet the needs of the Town or to bring in additional options for broadband, Skykomish should pursue other opportunities including connecting to long-haul fiber that run through the Town and funding additional broadband infrastructure through state grant programs. The Town should work with other communities and stakeholders in the area to attract additional investment, establish access points to long-haul fiber, drive connectivity deeper into the area, and organize with the County and other communities to create a "Smart Valley" that enables people to live, work, learn, and play in the area more effectively, safely, and sustainably.

RECOMMENDATIONS

1. Continue to engage Ziply representatives in discussions about the extent, resources, and timing of their infrastructure upgrades and service roll-out, estimated to be completed by the third quarter of 2021.
2. Pursue funding options for additional broadband infrastructure and programs for support underserved members of the community, access, and digital literacy programs for youth and elderly through state programs such as Public Works Board and Community Economic Revitalization Board, potentially in partnership with Ziply, King County or other parties.
3. Develop a "community Wi-Fi" network for new and existing access points, including captive portal and management server/service. The Town should consider an partnership arrangement in which Ziply or another new entrant provides the Wi-Fi in exchange for the use of Town assets or other similar agreements.
4. Negotiate terms to use Town conduit and other assets, including in-kind and/or monetary compensation, operations, ownership, etc.

5. Consider options for building a Town-owned fiber or wireless network contained in this Plan as a future opportunity to be pursued in the event that Ziply's network upgrades do not meet the needs of the Town or to provide additional options in the future. Investigate opportunities for connecting network infrastructure to existing long-haul fiber networks.
6. Conduct an engineering assessment ("proofing") of conduit, poles, and tower assets to ascertain their usability and any necessary improvements needed to become fiber ready. Any agreement for Ziply (or other provider) to use the conduit should put this task, and cost, squarely on them.
7. Establish a regional "Upper Sky Smart Valley" task force to explore technology needs and opportunities in economic development, education, emergency preparedness/response, environmental monitoring, health, public safety, recreation, tourism, and utilities.

2. Background

SKYKOMISH AND THE UPPER SKY VALLEY

Located in northeastern King County, physically accessible only via neighboring Snohomish County, Skykomish sits in the middle of the Upper Skykomish River valley (the Upper Sky Valley), between Index, to the west at the mouth of the valley, and Stevens Pass to the east, which is a popular ski area. Other communities in the Valley include Baring, Halford, Miller River, Scenic, and Timberlane.

Skykomish itself is a town of 66 households, with 220 residents, in 157 housing units.[1] The median housing value was $275,000, well below the County and state but more than the national median of $240,500. The primary industries in terms of employment are education, accommodation and food services, arts, entertainment, recreation, and professional services. Estimated median annual household income was $45,500, which is less than half the median income for the County and over a third less than the state. At 59 years median age, Skykomish's population is relatively older, and the Town is home to many retirees. The average commute time was 40 minutes, well over the County average of 30 minutes and the national average of 27 minutes.

Skykomish sits in the southern portion of the Mount Baker-Snoqualmie National Forest. Along with the Stevens Pass ski area, the area has extensive outdoor recreation assets, including a major trailhead for the 2,600 mile long Pacific Crest Trail and other trail systems. US Hwy 2 runs through the town and valley between Everett and eastern Washington, paralleling Interstate 90. BNSF Railroad has a route through the valley, parallel to the highway, with a railyard in the Town. The State of Washington Department of Transportation operates a small airport and work center just east of Town.

In the early 2000s the Town was literally dug up to mitigate damage from years of leaking diesel oil at the railyard. Structures in the Town were temporarily moved for the process then replaced. About the same time, the Town rebuilt its sewer system, which is operated by the Town's Utility

[1] Unless otherwise noted, all demographic and economic statistics are sourced from the U.S. Census Bureau's *American Community Survey*, 2019 5-year estimates, via https://data.census.gov/cedsci/.

Department. Underground conduit was installed during both projects, but was limited to sections along 5th Street from south of the tracks to the intersection of 5th and East Old Cascade Hwy, along East Old Cascade to the Town boundary, the downtown area along 3rd, 4th, 5th, and 6th streets, and small sections beneath the railroad and along the 5th Street bridge. Because of the segmented nature of the conduit system, it is incomplete for creating a Town-wide underground fiber network.

Other communities in the Upper Sky Valley are the historic mining and logging towns of Sultan, Startup, Gold Bar, Index, and Baring, to the west of Skykomish along Highway 2. Stevens Pass, to the east of Skykomish, is located on a crest of the Cascade Range and is home to the Stevens Pass Ski Area Key Businesses, a popular destination for skiers, mountain bikers, and other outdoor enthusiasts.

Areas outside of Skykomish were included in the outreach for this study to gain an understanding of the broadband issues throughout the region and potential options for working together to address them. With the development of additional housing tracts and expansion of the Steven's Pass Ski Area planned for the future, considerations for broadband should extend to the current and future needs of the entire Upper Sky Valley, including locations outside of Ziply's service territory. This additional housing and increased population density could prove to be an attractive opportunity for new entrants.

BROADBAND BACKGROUND

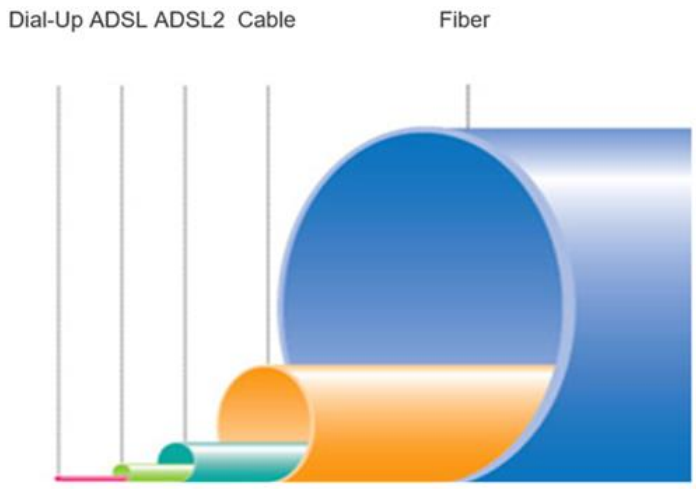
The term "broadband" refers to high-speed internet services that provide users access to online content including websites, television shows, videoconferencing, cloud services, or voice conversations. Although demands for this high-speed data are rapidly increasing, the Federal Communications Commission (FCC) defines broadband speeds as at least 25 Mbps downstream and 3 Mbps upstream. Cable, DSL, fiber, and wireless are the prime broadband delivery systems used to meet these demands by connecting users to the internet.

Fiber-optic cables (or just "fiber") are strands of glass the diameter of a human hair that carry waves of light. Unlike other connections that carry electrons across copper wire, fiber supports fast, reliable connections by using photons across glass, giving it the capacity to carry nearly unlimited amounts of data across long distances at spectacularly fast speeds. Because of this speed and reliability, fiber is considered the gold standard for

supporting broadband across the full spectrum of devices and applications. Fiber's usability and resiliency have brought it to the forefront of broadband, making it a highly desired asset for all entities, public and private, that own or control it. The availability of a reliable, cost-effective fiber connection creates opportunities for the communities it serves.

Figure 2-1 illustrates the relative difference between common internet connection methods, comparing access technologies from basic dial-up service through DSL, cable, and fiber. Whereas traditional broadband technologies have an upper limit of 300 Mbps, next-generation broadband that utilizes fiber-optic connections surpasses these limitations and can provide data throughputs of 1 Gbps and greater.

Figure 2-1. Physical Bandwidth Capacity Comparisons



Dial-Up – 56Kbps
- Legacy Technology
- Shared Technology

ADSL – 10Mbps
- First Generation of DSL
- Shared Technology

ADSL2 – 24Mbps
- Second Generation DSL
- Shared Technology

Cable – 150Mbps
- Data Over Cable (DOCSIS 3.0)
- Shared Technology

Next Generation Fiber – 1Gbps
- Passive Optical, Active Ethernet
- Shared and Dedicated Technology

BROADBAND BENEFITS

Broadband supports community needs including telemedicine, aging in place, distance learning, and telecommuting. The COVID-19 pandemic has accelerated the long-term trend of digitalization of business processes, the economy overall, and everyday life. Perhaps the obvious example is the boom in virtual meetings but there are many other trends developing or accelerating as well, including an increase in remote telework and distance learning.

According to Global Workplace Analytics in 2018, telecommuting continues to grow year after year. In fact, some analysts predict that 30% of workers in industrialized countries will be telecommuting within just a few years. When allowing telecommuting, employers benefit by saving money and by

increasing productivity. The benefits of working from home are plentiful, but telecommuters need high quality next generation broadband in order to take full advantage of this arrangement. Housing prices can also increase with as the availability of broadband enables remote work. A study by the Fiber-To-The-Home Council and the University of Colorado showed that single family homes that boast a FTTH connection are worth, on average, 3.1% more than their fiber-less counterparts.

Remote aspects of healthcare, both monitoring and acute care, increase demand on bandwidth through the use of robotics and haptic devices. All telehealth fields are growing, including teletherapy and telepsychiatry, with universities and colleges needing real time access to licensed counselors for interventions. Policies in remote imaging, cardiology, and transmission of Electronic Health Records are expected to increase demands further with needs for low latency becoming increasingly critical.

The availability and affordability of broadband has also become a driver for decisions about where companies locate their headquarters, manufacturing facilities, distribution centers and satellite locations. To attract and retain industry, infrastructure that supports a competitive environment for affordable, reliable, redundant broadband services must be readily available in areas where office, technology, and industrial parks and other major commercial developments exist today or are being planned and built.

As technology becomes more integrated into daily life, government operations have also become increasingly reliant on transmitting and receiving large amounts of data via broadband internet connections. Many cities invest in advanced communications (broadband) infrastructure not only to enhance local internet services, but also to support their own operational needs and other public agencies, utilities, and transportation districts in their area. The opportunities range from public Wi-Fi to connected Supervisory Control and Data Acquisition (SCADA) networks, electric grids, traffic cameras and signalization systems, smart light pole grids for monitoring and control, vehicle sensors, and smart parking and wayfinding.

3. Needs Assessment

Over the course of the project, Magellan Advisors worked with the Town of Skykomish's team to organize a series of interview sessions with a diverse group of community stakeholders. Seven (7) discussion sessions were held, and participants included representatives from:

- Business Owners
- Community Groups including the Skykomish Historical Society and Sky Tech Committee
- King County Emergency Management
- King County Library
- King County Real Estate
- Sky Valley Chamber of Commerce
- Skykomish School District
- Town of Skykomish Fire Department
- Town of Skykomish Utilities
- US Forestry Service
- Councilmembers, HOA Board members, and homeowners from surrounding communities including Index and Timber Lane

These group interviews were conducted online due to COVID-19 restrictions. The format was an open discussion with attendees about their current internet service, needs for connectivity now and into the future, and overall trends in the community as they relate to internet services. Several themes emerged from these sessions including distance learning, remote work, and telehealth needs, limited availability of reliable high-speed options, public safety implications, tourism, and the need for connectivity to support a growing community.

DISTANCE LEARNING, REMOTE WORK, AND TELEHEALTH

The most common theme among all stakeholder participants was the need for broadband to support everyday uses such as working remotely, distance learning, and telehealth. Around the world, the COVID-19 pandemic has accelerated the need for residents and businesses to conduct daily activities from their homes through broadband enabled applications, and the Upper Sky Valley is no exception to this shift. Focus group participants from all groups noted the need for better connectivity to support these uses.

Distance Learning

A major concern was supporting students for online learning applications. Many residents reported that their current bandwidth does not allow them to support multiple users at the same time and with multiple children in school, this presents a major issue.

The Skykomish School District itself has a satellite connection through the K20 network, which serves schools throughout the state. Startouch is the school districts current Internet Service Provider (ISP), which connects the school via microwave link to the telecommunications tower on Maloney Peak from an antenna on the school's roof. This system performs fairly well, but reaching students in the community has been a challenge. One resident reported that Ziply did not have enough ports to connect people that needed to be connected back in September when school went remote.

The Town had at least two students that couldn't get connected, so the District recently installed an on the exterior of the building to get access for homes immediately around the building in an attempt to reach students. This effort was effective in reaching two houses in which students had a need for connectivity. Students can access the school's Wi-Fi if they are in front of the building or at the community center, and there is also a satellite on the community center that connects with school satellite to provide additional options for connectivity. However, having to perform schoolwork from a parking lot or community center is certainly not ideal and presents a challenge to students and parents alike.

Many students learning from home are currently relying on a hotspot combined with Ziply DSL service, switching back and forth between the two. Due to the bandwidth issues, one resident noted that Ziply recommended that all TVs and games remain off when using online learning tools, but this process necessitates resetting all passwords every time devices are used, which has been an inconvenience to the family.

The school cannot stream instruction from classrooms or teachers homes due to low bandwidth among the community. King County Libraries do offer some online programming including storybooks, health & wellness, STEM programming for children, film programs. They would like to do more technology-enabled programs but are limited by the available bandwidth in the region.

Digital equity is also a major challenge, especially during the pandemic. Many families in the Upper Sky Valley struggle to afford internet services.

The Office of Superintendent offered grants for internet for families but because available services in the aera didn't meet the minimum bandwidth requirements of the grant program, the schools were unable to provide these subsidies. The schools also recently passed a technology levy, the funds from which it used to ensure that every student has a laptop. However, as one participant noted, the laptops will go unused if students do not have internet to connect them to.

Overall, remote learning was the most pressing issue for participants across all focus groups. As one attendee noted:

> We don't know how long this pandemic is going to last, we don't know if there is another one coming up, and we need to be able to handle this for our children.

Remote Work

In addition to distance learning, the COVID-19 pandemic has also accelerated the shift toward working from home across a plethora of professions. In the Upper Sky Valley, this trend has been challenging for residents due to the need for additional bandwidth. The pandemic has compounded Residents and business owners have noticed a slow-down in their internet service as more people are working from home.

One participant, for example, works remotely as a software engineer and states that two key things that are missing are the ability to hold stable, decent quality video call meetings and the standard day-to-day tasks like loading webpages. He points out that overall productivity is at an unacceptable level for working out of Skykomish for more than a couple days' time. Another participant is paying double fees for internet service so she can work remotely through a hotspot and a Ziply DSL connection, amounting in extremely high costs of $165 per month.

Others simply can't use the technologies that have become commonplace among remote working professionals; one participant reported that she was recently on a conference call with someone from Index that was unable do video conferencing at all. She worries about the professional implications of being unable to connect to colleagues and potential customers via online tools and notes that "that is not the professional image we want to portray." Many residents of Skykomish have taken to parking in front of the library

when they need to connect, a practice that is unsustainable over the long term.

Several participants would like to launch e-commerce businesses or use online tools to plan community events such as festivals and art classes but find themselves limited due to connectivity concerns. Continuing education and lifelong learning for professionals are also constrained, negatively impacting the potential growth of the Valley's economy. helping people keep connected in their professions.

Telehealth

In addition to distance learning and remote work, telehealth is a major need for residents in the Upper Sky Valley. The closest hospital to Skykomish is more than an hour and half's drive, making remote care a critical need for those with chronic conditions and other health issues. One participant recognized that as the population ages, people are being forced to sell their homes and move to locations that are closer to healthcare providers. Remote healthcare and virtual visits simply are not possible without adequate bandwidth to support them.

LIMITED CONNECTIVITY FOR SUPPORTING COMMUNITY NEEDS

Many of the resident stakeholders report that while they do currently have non-broadband, low-speed connections (most of which are DSL), they have few options for switching to a high-speed option. Community gathering places such as the Whistling Post and the growing Skykomish Hotel have needs for more bandwidth to support wifi for guests and visitors, while owners of vacation rentals see a need for more connectivity for visitors from out of town. Some families that are new the area reported not being able to get service at all; as one participant pointed out, "anyone new in town has to wait their turn."

Several residents and business owners have contacted the incumbent service providers, including Ziply, and some have been informed that they simply do not have the infrastructure or the network capacity to serve their homes and businesses. Many others note that Ziply has worked to upgrade and improve the service, especially within Skykomish itself, but there are concerns about whether those upgrades can be extended to support growing bandwidth needs across the community.

Reliability was also a concern; nearly all attendees reported frequent interruptions in their current internet service, particularly during severe

weather such as snow and ice storms and high winds. Outages happen regularly for some customers and last anywhere from a couple of hours to a of couple days. Storms are a weekly occurrence in the Upper Sky Valley, which gets 120 inches of precipitation a year compared to 40 in Seattle.

Public Safety

Perhaps the most concerning of issues discussed by stakeholders were the implications that lack of connectivity have for public safety and emergency response. Due to the remoteness of the Town of Skykomish and surrounding areas, potentially dangerous situations such as avalanches, fires, and lost hikers and skiers could be more deadly due to lack of communications infrastructure.

Residents and local officials are keenly aware of these issues and report strong consensus among the community about the need to improve communication methods. Prior to the COVID-19 pandemic, many discussions were already being held about emergency management, and many of the proposed solutions included technology to improve communications. Currently, there is an old analog siren system in place to warn of emergencies as well as some radio-based solutions that often require a walk or drive to a tall peak to get connectivity. With unreliable internet connectivity, there are few options for upgrading these systems to something more modern and effective.

Last year, the Town of Skykomish was completely cut off for about a week due to a severe winter storm. Residents banded together to make sure that everyone had provisions, but with communications lines down, the situation could have been much more dire. Public Safety officials also have concerns about public alerting such as emergency warnings and amber alerts. In the past, officials had to set up evacuation messages before heading up into the Upper Sky Valley to be sure they were ready to go because they were unsure whether they would have that ability once up there. As one official pointed out, “we’re here to keep the public safe and if we can’t tell them something, we can’t get to them.”

Connectivity issues also complicate search and rescue efforts. With a thriving ecotourism industry, many hikers embark on day or overnight trips in the Upper Sky Valley while tourists rent cabins in remote areas. Forest service roads off the Hwy 2 corridor don’t have communications, so people have to

hike out and get in a vehicle and drive up to an hour to get cell service in the case of an emergency.

A lot of the cabins do not have connectivity and visitors cannot use Wi-Fi or cell service. This can delay response to houses in the event of an emergency as well. As more visitors seek the outdoor escape of the Upper Valley in the wake of the COVID-19 pandemic, the woods and river are being used a lot more, with people venturing farther out and staying a lot longer. Some people don't know the area, and many do not have phones that work for the area. Emergency officials are expecting more and more flooding in town and in the outlying areas due to climate change, which could cause further concerns about search and rescue operations.

Lack of cellular service is also a big issue. In several areas, even on main corridors, travelers cannot even make a phone call or text. The biggest frustration is delay in response. On average, state police have a 45 minute response time but has been up to an hour and a half. Drivers may come across car accident and they have to leave to find cell coverage but the person who leaves may not have much information since they are no longer at the scene of the accident. Emergency responders point out that once they get there, it is hard to call for additional resources, including calling the hospital to do triage, which they often are forced to delay until they get phone service or ask dispatch to do it.

Tourism

Interaction with the environment is a big part of life in Skykomish, which prides itself on being a "Portal to Adventure" that connects people to nature. The Upper Sky Valley, and particularly Skykomish, have seen growing tourism even amid the COVID-19 pandemic. Although the area has long been popular with hikers, skiers, and families seeking to escape the hustle and bustle of the city, the pandemic has brought an increasing number of tourists to the area looking for refuge among the forests and valleys of the region.

However, despite the allure of escaping the city, visitors still want to be connected. As Mayor Sladek, owner of the Cascadia Inn noted, even people who have been coming to Skykomish for years liked the wifi when it started being offered, and the top 2 or 3 questions when people are making plans to come and stay are consistently whether there is somewhere to get food,

what's the wifi situation, and what's the level of service (is it good enough to do work?).

Similarly, people who are interested renting cabins ask about the quality of internet and many decide to go elsewhere because internet isn't good enough. As one rental property owner pointed out, "they're coming from Seattle with high expectations and when they hear DSL, they say forget about it." Skiers and snowboarders in Stevens Pass on the weekends are also mostly professionals that need to stay connected.

In addition to offering connectivity to visitors, there are many other efforts underway to attract more tourism to the area that rely on technology to get the word out. The Skykomish Historical Society, for example, is working on developing an interactive tour of Skykomish that includes a walking tour, roaming tour, or driving tour to attract more young people and spark interest in the area's history. Groups like the Skykomish Garden Club, Skykomish Open Air Market, Friends of Skykomish, and the Chamber of Commerce rely on social media to promote their events.

The Skykomish Environmental Institute, envisioned as a learning center to connect visitors with nature, could also be supported by broadband-based applications and an active online presence. For visitors that come to ski, the Town has considered running buses between Skykomish to Steven's pass; with proper connectivity, visitors could see real-time departure times to plan their trip accordingly.

Needs for connectivity among visitors to Skykomish are only going to continue to grow over the coming years. Wifi and broadband enabled applications have become an expectation, and without the ability to support them, Skykomish's major industry may be negatively affected in the future. As one participant noted,

> "The Town exists due to the railroad, logging, and mining, all extracting resources. The challenge is finding a way to replace those industries and that opportunity for income. We have to go from extracting resources from the land to enjoying the intrinsic beauty of the land. The real challenge is how to monetize an intangible asset. We have to provide the experience for people who want to come out here and enjoy that intangible asset, that

> quality of life. We have to provide the facilities to do that, and one of them is broadband."

Supporting a Growing Community

Related to the common need for broadband to support applications such as remote work and distance learning as well as the uptick in tourism was the observation of a growing trend of new residents moving to the Upper Sky Valley in the wake of the COVID-19 pandemic. As remote work has become more ubiquitous, residents note that whereas young professionals and families who live in the greater Seattle area previously only visited on weekends and holidays, there is now increasing interest in establishing permanent residence within the region.

Whereas in the past, the population of Skykomish consisted largely of retirees, several young families have started to flock to the area. As one participant pointed out, the pandemic has shined a light on the choices people can make in terms of where they want to raise their families, and many of them seem to be choosing rural communities where class sizes are small and nature is abundant.

Many stakeholders expressed excitement about the prospect attracting these families who could establish businesses, enroll their children into local schools, and become engaged with the community. The benefits of new permanent residents are extensive, from increasing property values to supporting local businesses. The school system could be bolstered by having more students enrolled, leading to increased diversity and investment in tech-based programs while retaining smaller class sizes compared to schools in large cities.

However, connectivity must be available to support professionals who seek to establish residence in Skykomish while maintaining jobs in major cities like Seattle. The town of Sultan, for instance, has over 500 new homes being built and they're selling quickly, but buyers recognize the need to be able to work from home. Similarly, Timber Lane has had interest from prospective buyers, but many have been dissuaded by the lack of connectivity there. Despite the quality of life benefits that come with moving to Skykomish and its surrounding areas, broadband is still a non-negotiable utility for many home buyers.

As the recovery from the COVID-19 pandemic begins, Skykomish and the Upper Sky Valley are prime for an infusion of new investment if the proper

amenities are available to attract people who want to work, learn, and age from home. Although the recovery will not be easy, broadband will be key. As one participant stated,

> "If we can provide the infrastructure that people need to play and enjoy life while still being able to do work and be productive, we're going to be set to bounce back."

4. Internet Survey Results

In addition to the seven (7) community discussion sessions, Magellan Advisors surveyed locations in the Upper Sky Valley regarding their current internet access and related issues. The survey was conducted via online[2] and paper survey instruments. The online instrument could be completed online for any location and included a speed test for those locations with broadband. The paper instrument was specifically for locations without internet access. The Town promoted the survey by various means, including social media, email, and direct distribution of the paper instrument.

SURVEY RESPONSES

The survey had a total of 228 responses, including 98 partial responses, for households, rentals, and organizations. Some responses were duplicates. In those cases, we included the most complete and/or most recent responses. Ultimately, there were a total of 158 useable responses, as summarized in Table 3-1. Not all items/questions were answered by all respondents, so most have substantially fewer than 158 responses.

Table 3-1. Overview of Upper Sky Valley Internet Survey Responses

	All	Household		Rental		Organization	
Total Responses	158	73	46.2%	77	48.7%	8	5.1%
Percent Completed	73.4%		71.2%		75.3%		75.0%
Partial	42	21	50.0%	19	45.2%	2	4.8%
Completed	116	52	44.8%	58	50.0%	6	5.2%

The survey was promoted publicly by the Town via various methods, including physically handing out fliers. It was not a "scientific" survey of a randomly selected sample of locations. Also, the absolute number of respondents and population of the area are both too small for reliable statistics. The results can be considered representative of the area within these limitations. To this end, while we provide specific statistics, we use approximate language within the text.

[2] Using Alchemer survey platform. For details on the survey, contact the Magellan Advisors team. For more on the platform visit https://www.alchemer.com/.

As this is a rural area with multiple small clusters of buildings, we asked about the "community" of each response. As illustrated in Figure 3-1, about half of responses came from within the Town of Skykomish, followed by Timberlane, which is just east of the Town. All respondents in Skykomish and Tye River indicated that they had broadband connections.

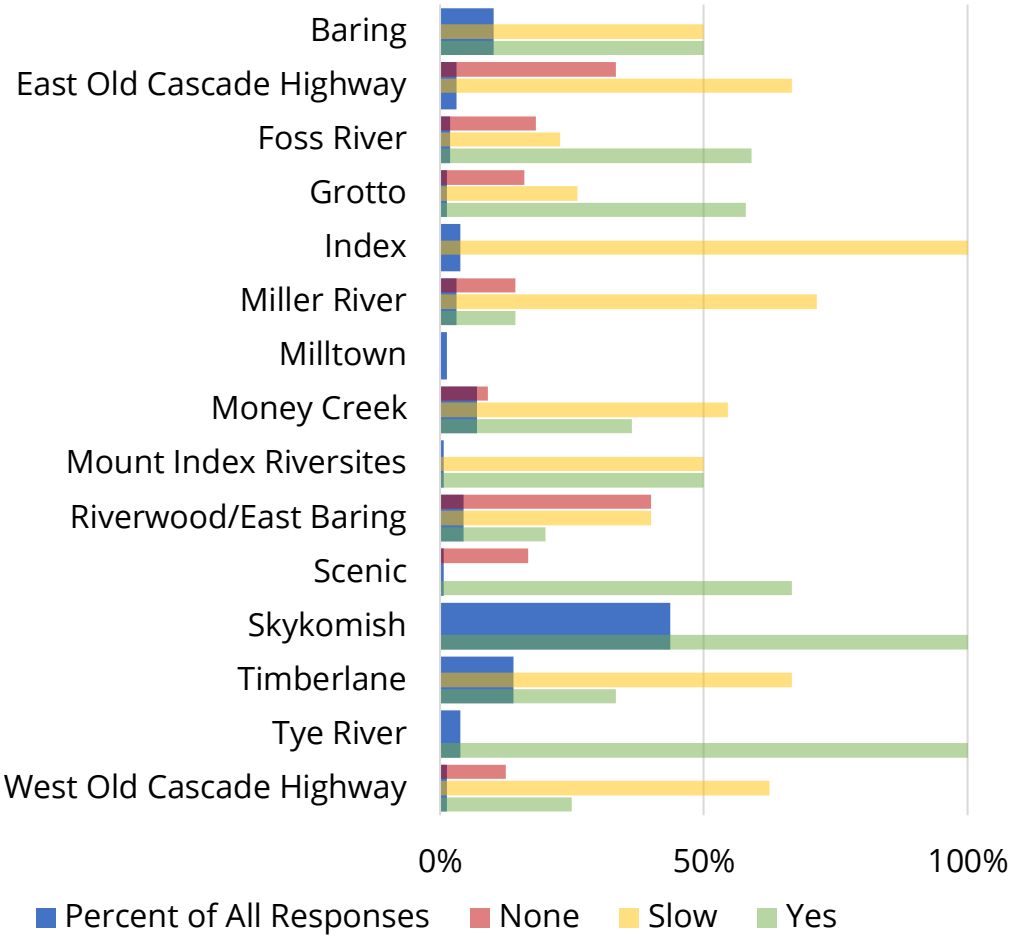


Figure 3-1. Percentage of Responses and Types of Internet Service by Community

Generally, respondents had higher levels of educational achievement than Census data suggests,[3] overall. The survey asked about the highest level of education for members of the household (shown in Figure 3-2), whereas Census data pertains to individuals. Educational achievement is generally understood to be positively correlated with spending on and use of

[3] Unless otherwise stated, all general statistics for the area are taken from the U.S. Census Bureau's American Community Survey, 2019 5-year estimates, which can be found online at https://data.census.gov/cedsci.

technology. The implications are that (1) demand, particularly willingness to pay, may be overstated but (2) needs of lower income households may be understated.

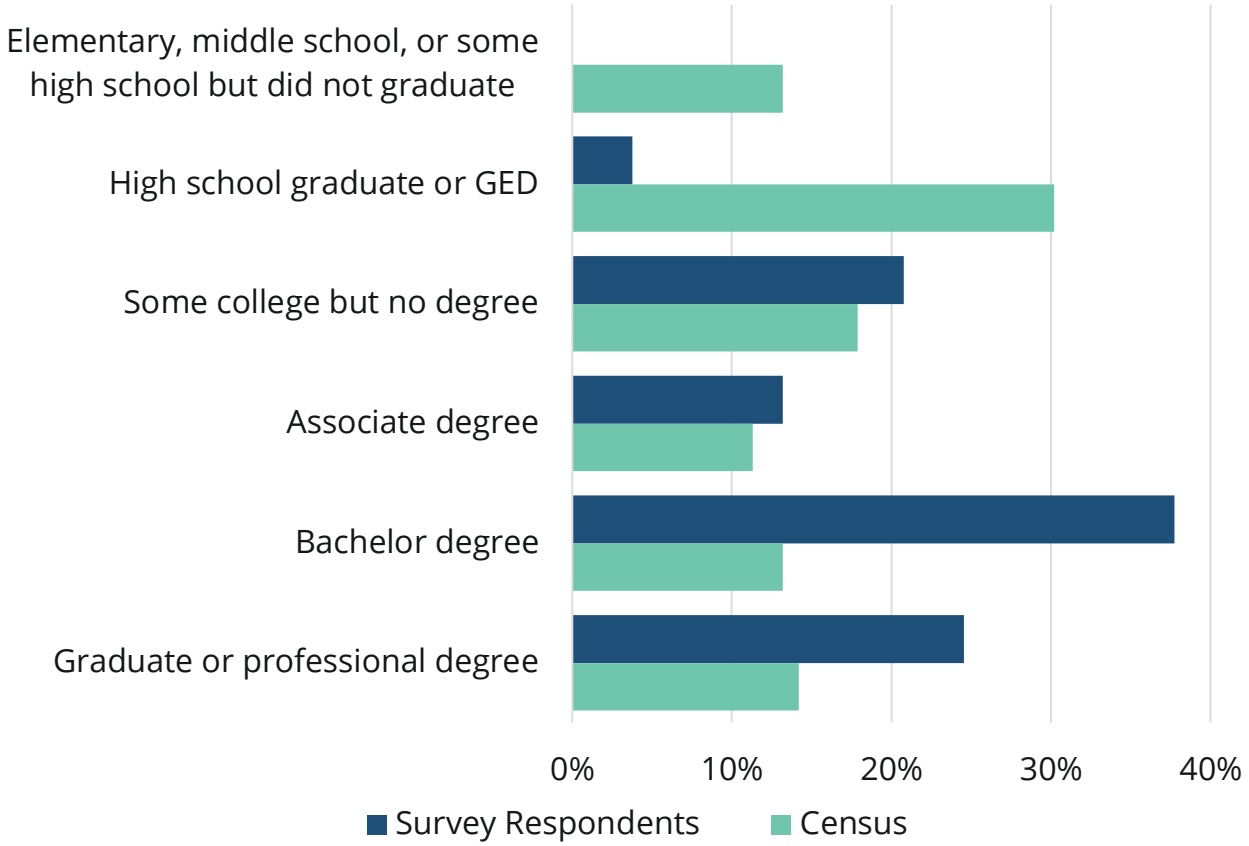


Figure 3-2. Percentage of Survey Respondents and Census by Educational Achievement

Similarly, as shown in Figure 3-3, the survey had relatively strong response from management, office, and service occupations, compared to the population. Response rates were relatively low for skilled trades, retired persons, and especially those in production or transportation occupations. It is likely that many survey respondents do not officially live in the area—the largest percentage of response were for rental, second, or vacation homes, which would cause many of the discrepancies between survey respondents and Census statistics.

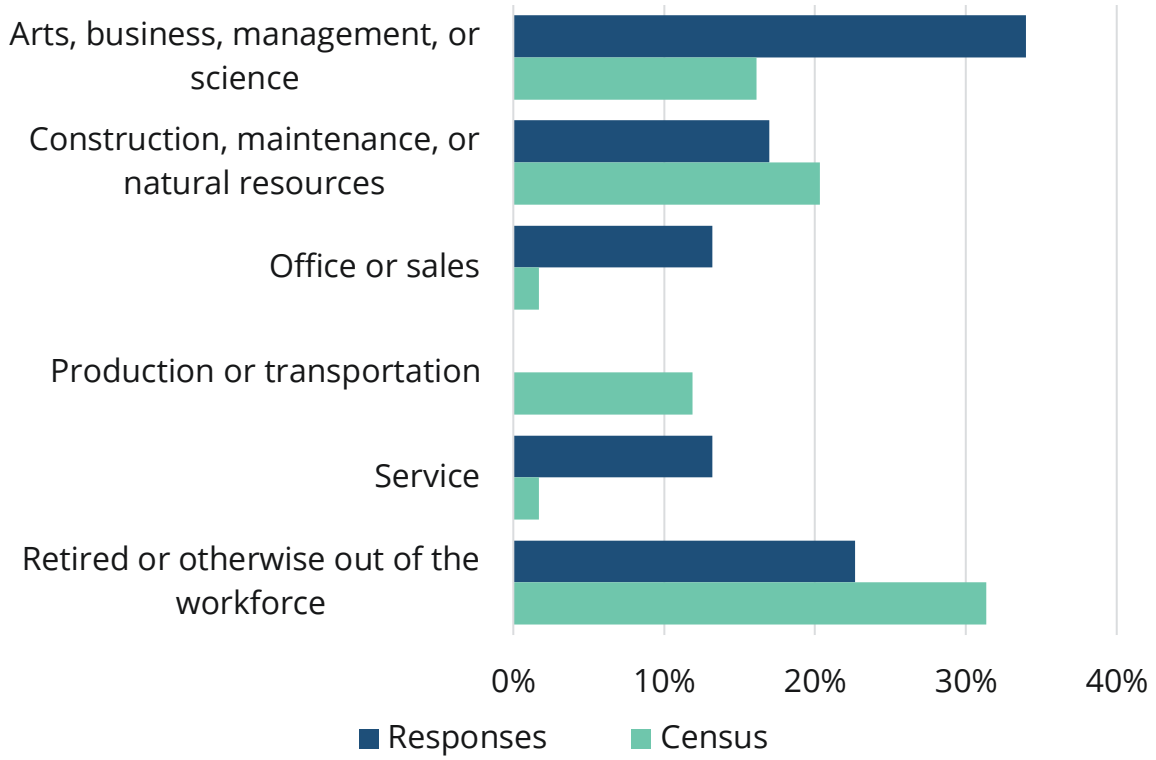


Figure 3-3. Occupational Area by Percentage of Survey Respondents Compared to Census Statistics

Although the average household size of survey respondents was 2.6 people, the Census Bureau found households in Skykomish to average around 1.5 people for owner-occupied units and 1.88 persons in rental units. Median age for the area was 58.5, according to the Census Bureau while the calculated median age for responding households was 50.6 years. Therefore, respondents were likely younger and more apt to have children at home than would be expected based on local demographics.

INTERNET ACCESS

About half of respondents had nominal broadband internet service (see Figure -4), while over a third had no internet access at the location in question. The average monthly recurring cost was just over $80 for all services and just shy of $60 for broadband, as summarized in Tables 3-2 and 3-3.

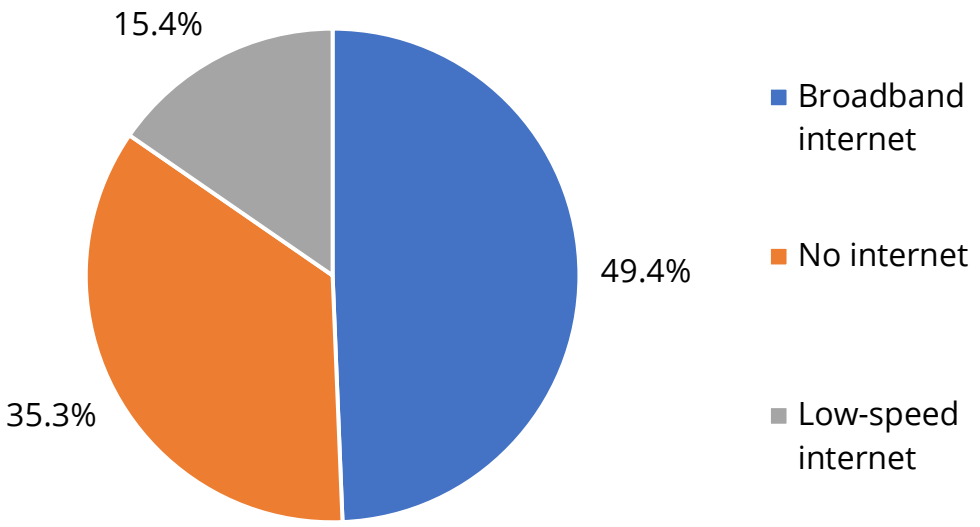


Figure 3-4. Percent of 156 Responses by Type of Internet Connection

Note the substantial differences between what respondents said they were contracted to receive and the speeds they actually received.[4] The average actual speeds were close to the Federal standard of 25 mbps download and 3 Mbps upload (25/3) benchmark for broadband. The fact that the median speed (halfway between fastest and slowest) is substantially lower suggests that most responses were well below broadband speeds.

Table 3-2. Broadband Speed Statistics for Survey Responses (Mbps)

	Contracted		Actual		
	Down	Up	Down	Up	Latency
Responses	40	39	50	50	50
Maximum	900	900	186.19	49.56	676
Mean	47.85	58.45	23.18	4.48	116.36
Median	10.00	5.00	9.65	1.13	66.50
Mode	10.00	1.00	#N/A	0.84	30.00
Minimum	1.00	1.00	0.08	0.29	9.00

[4] Connection upstream bit rate, downstream bit rate, and latency are automatically recorded via Measurement Lab's Network Diagnostic Tool (NDT), the leading open, independent speed test.

Indeed, as shown in Figure 3-5, two-thirds of respondents had aggregate throughput (upload plus download speeds) of less that 28 Mbps. No respondents had speeds over 300 Mbps, aggregate.

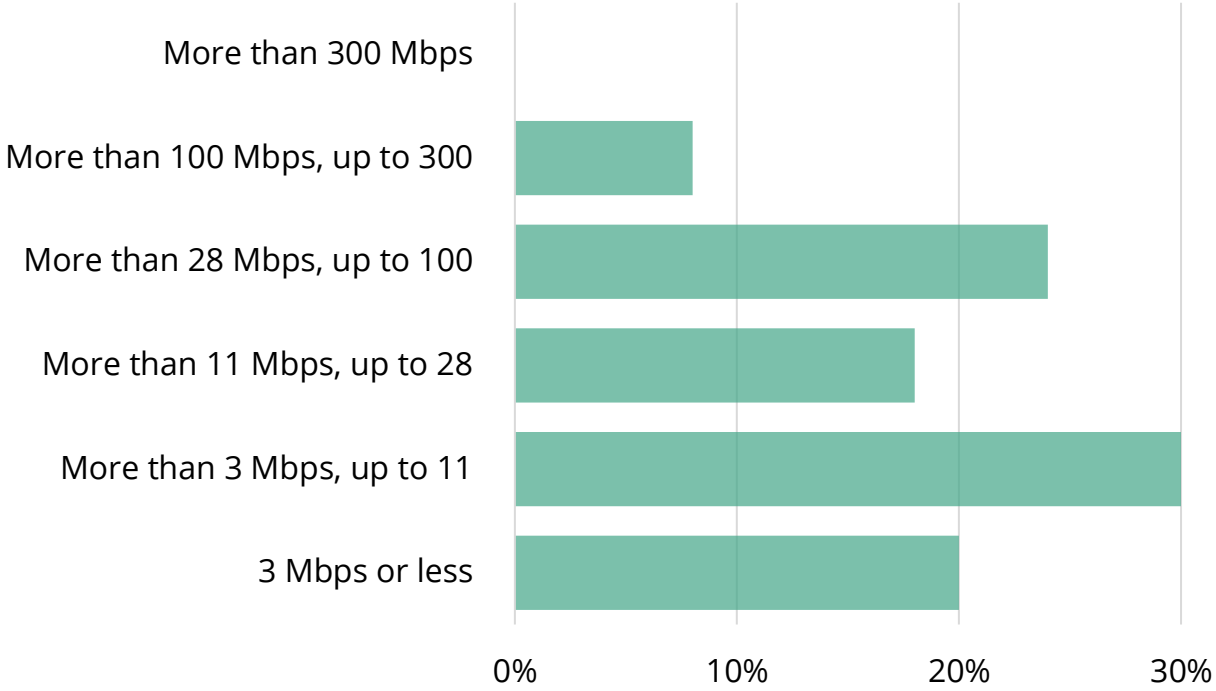
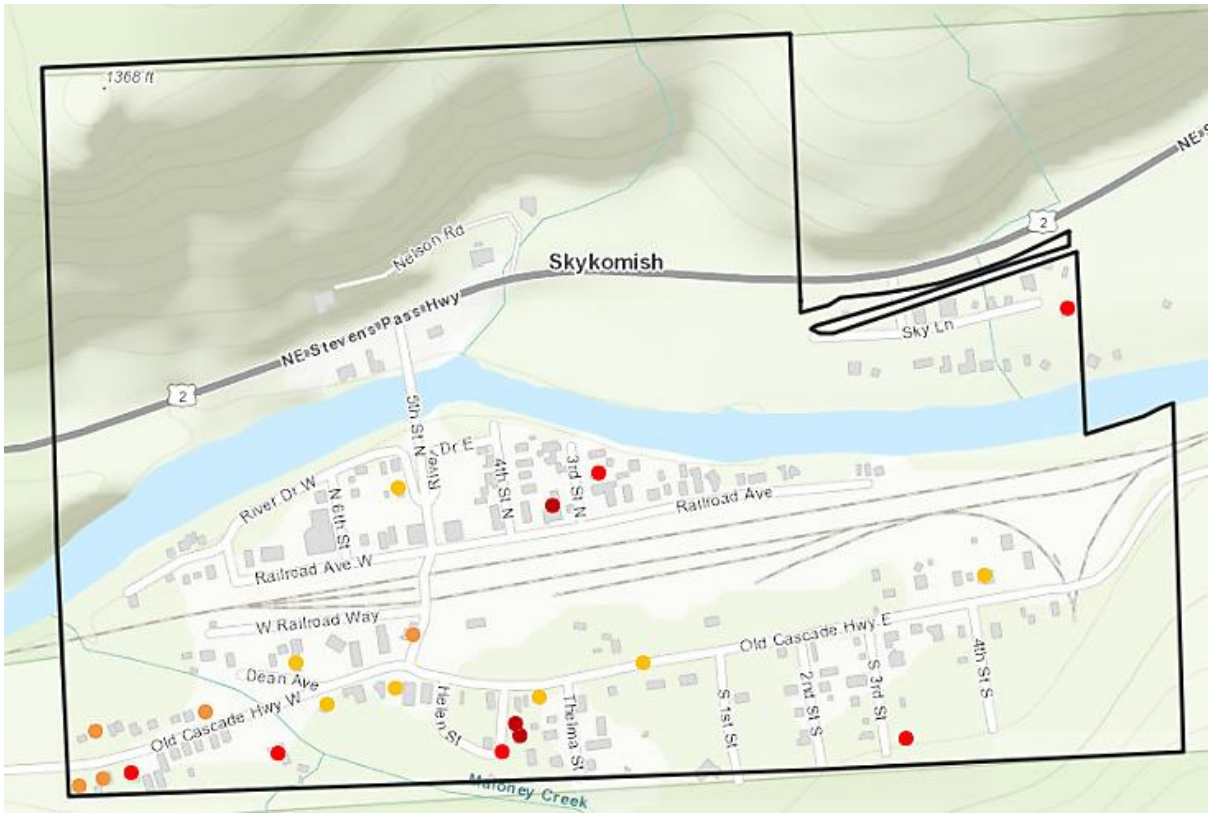


Figure 3-5. Aggregate Throughput (download plus upload speed) by Percentage of 50 Responses

As shown in Figure 3-5, speeds in the Town were generally low. More than half of responses did not meet the minimal threshold speed for rural internet, 11 Mbps, and 70% had "broadband" that did not meet the minimum 25/3 Mbps criteria. Only three of 50 speed tests within the Town were faster than 50 Mbps, and only one have over 100 Mbps. Only 30% of sites had connections that could be truly called broadband.



- 3 Mbps or Less
- More than 3 up to 11 Mbps
- More than 11 up to 28 Mbps
- More than 28 up to 100 Mbps

Figure 3-6. Aggregate Throughput of 50 Responses

As illustrated in Figure 3-6, the majority of respondents experienced reduced speeds on a daily basis. Over a third experienced day-long outages every few months. All respondents experienced brief outages at some time. Reliability, followed closely by speed, were the major sources of dissatisfaction, as shown Figure 3-13.

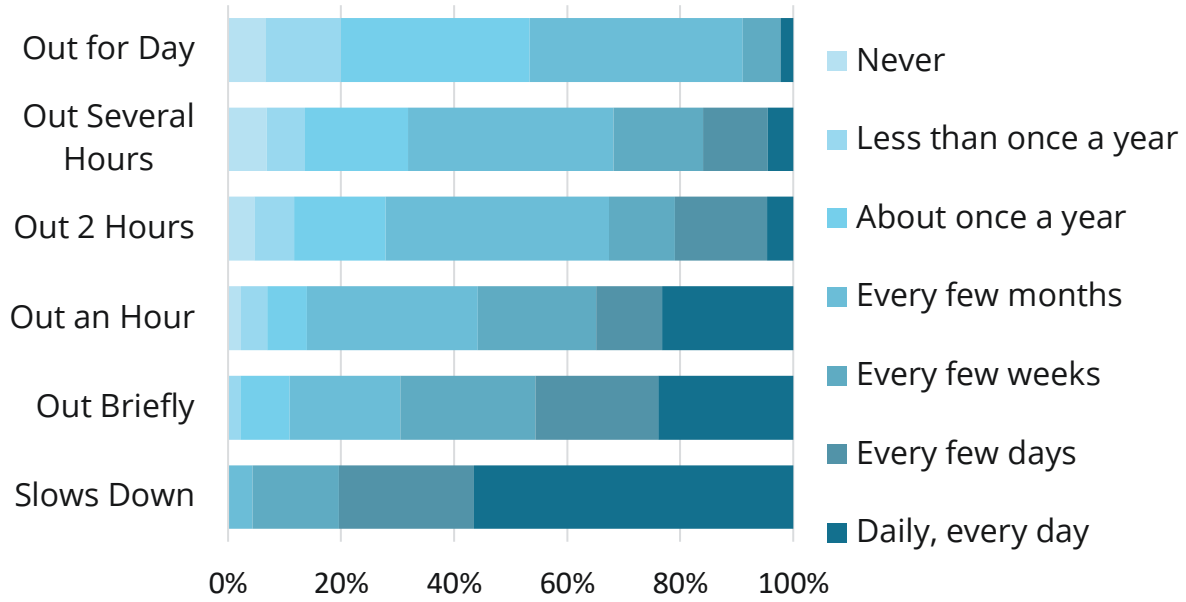


Figure 3-7. Frequency of Service Interruptions By Percentage of 46 Responses

SERVICE COSTS AND WILLINGNESS TO PAY

Monthly costs for just broadband services averaged about $60. The statistics in Table 3-3 suggest that the range of prices is narrower than as is the case for speed, and the majority of respondents pay substantially less than average.

Table 3-3. Broadband Cost Statistics for Survey Responses

	Aggregate Throughput (Mbps)	Monthly Recurring Cost		
		Services	Broadband	Cost/Mbps
Count	50	51	55	49
Max	197.2	$315.00	$175.00	$79.30
Mean	27.66	$80.26	$57.43	$13.78
Median	11.45	$57.00	$50.00	$6.83
Mode	N/A	$35.00	$35.00	N/A
Min	0.61	$22.98	$1.00	$0.03

The monthly cost per Mbps is a standard metric for comparing providers, which is not relevant since there is only one provider. The average and median costs for bandwidth are a good bit higher than what we see elsewhere, particularly in places with fiber-based broadband. In those cases, each Mbps costs cents per month—often less than $0.20 per Mbps per month—and maximum costs are in the upper teens or low twenties.

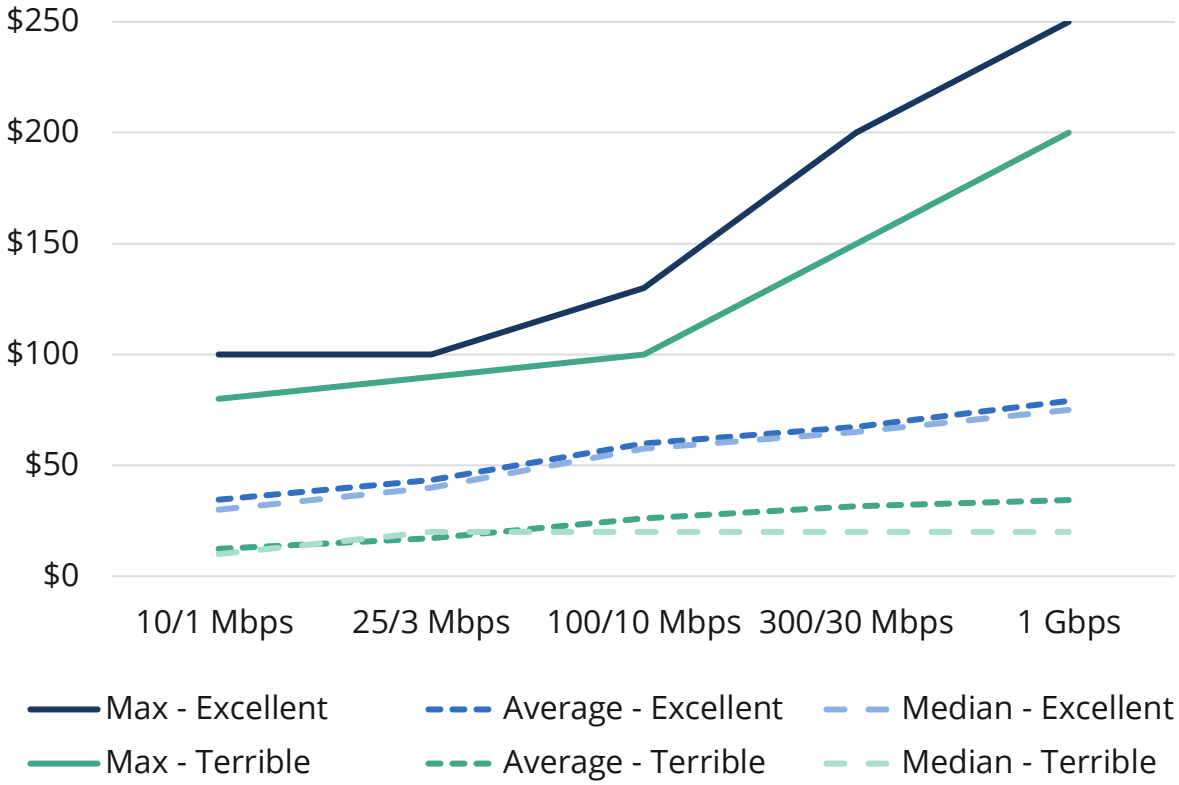


Figure 3-8. Willingness to Pay for Broadband Service by Percentage of 120 Responses, Comparing Excellent Service to Terrible Service

Respondents were willing to pay about $30—and as much as $100—per month for sub- broadband speed connections as long as the service was good. That dropped to $10 for bad service. Relative willingness to pay for bad service decreased as speed expectations increased. Respondents were willing to pay up to $250 for 1 Gbps broadband, and most were willing to pay over $75 per month. But they indicated they would only pay $20 per month for 1 Gbps broadband if the service were terrible.

Note that average and median willingness-to-pay tracked closely, particularly for excellent service. This suggests consistent consumer willingness-to-pay with little variance.

BROADBAND USES

Interpersonal communication and general interest were, unsurprisingly, the most common uses of internet among respondents' households among those that had internet, as shown in Figure 3-9. Over three-quarters of respondent households that had access used the internet at least once a week for entertainment. Remote work/telecommuting, online learning, and hobbies or special interests were also common uses for over half of

respondents' households. Special interests and online buying were common uses. Business, gaming, and selling were the least common uses.

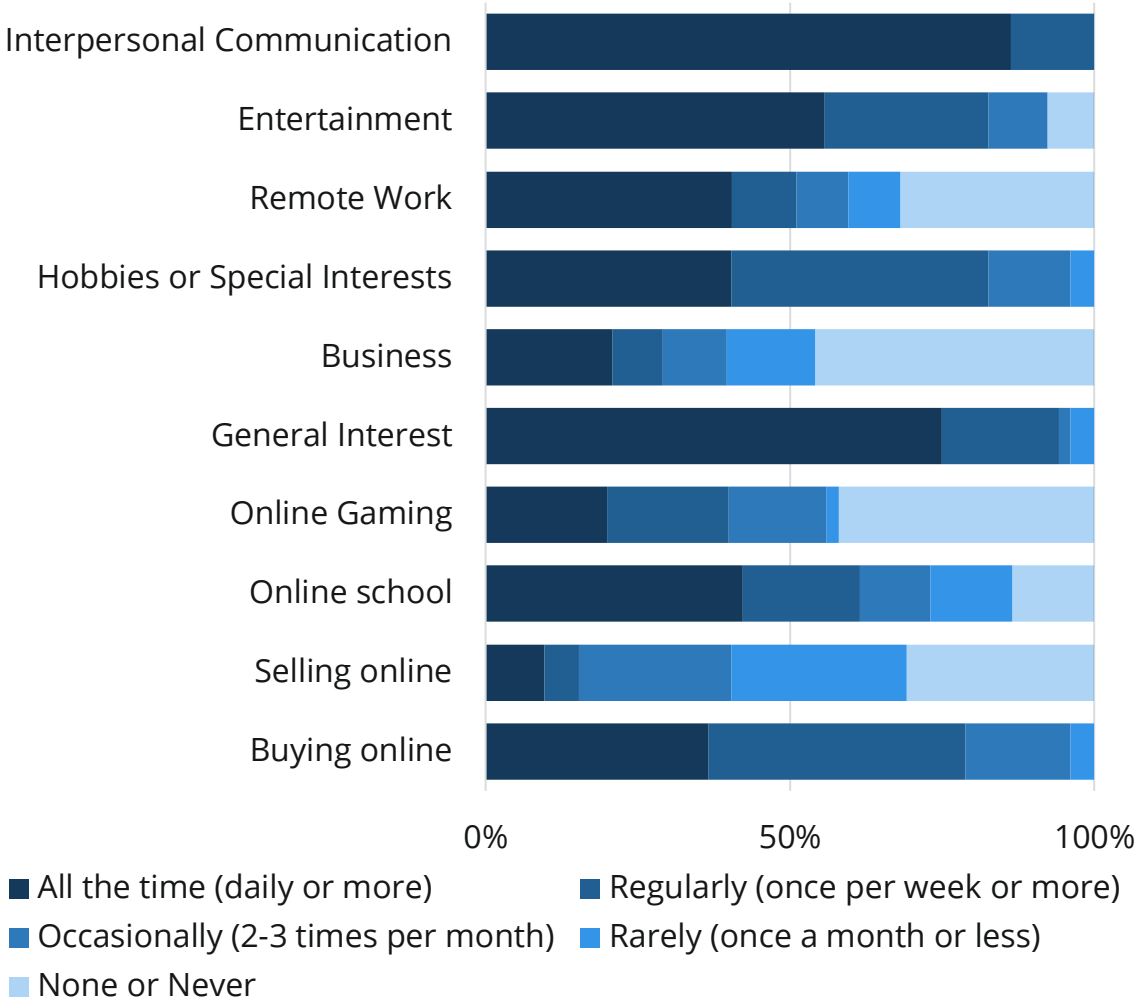


Figure 3-9. Frequency of Uses by Percentage of 52 Respondents

To put uses of internet in context and understand potential for additional benefits/demand, the survey asked about general activities by members of the household. As shown in Figure 3-10, doing work and operating a business from home were as frequent among respondents as doing school work and online training among houses that had internet connections. These activities, particularly operating a business, were comparatively less frequent online activities, as described above.

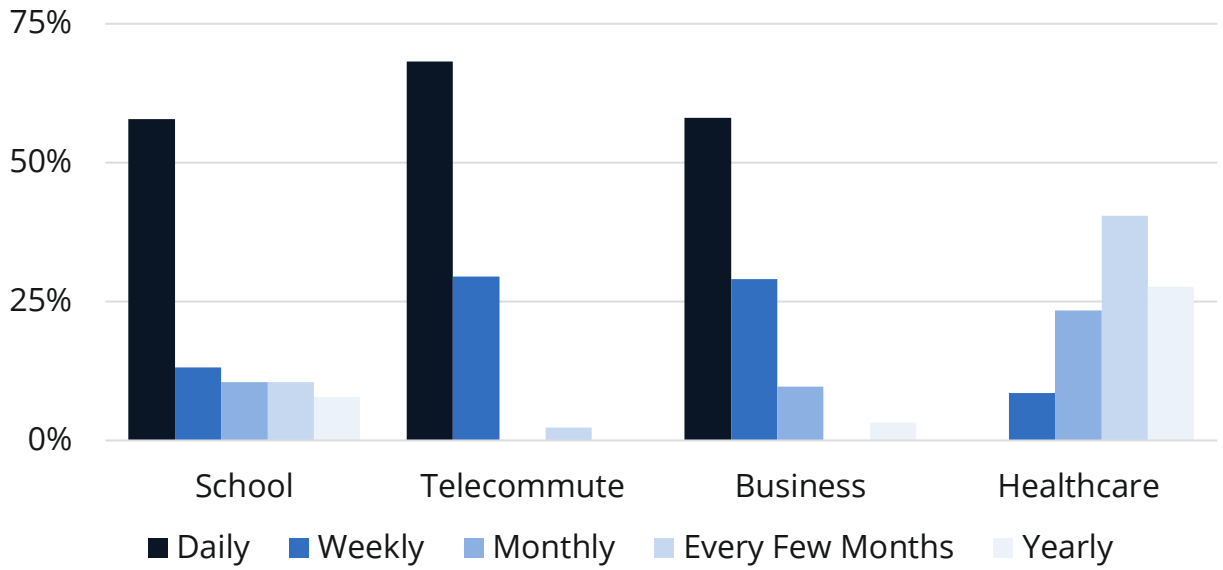


Figure 3-10. Frequency of Household Activities by Percentage of 47 Responses

More respondents indicated members of their household consulted healthcare professionals than other activities, although they did so less frequently than they engaged in other activities. Specifically, none consulted healthcare professionals on a daily basis but over 90% did so at least once a month.

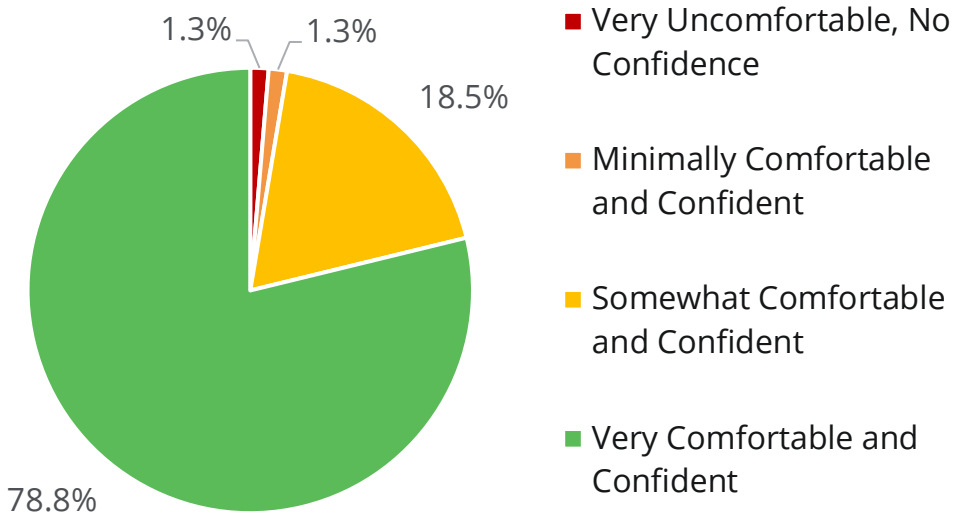


Figure 3-11. Level of Comfort with Internet by Percentage of 151 Responses

Comfort with internet technology does not seem to be an issue. As shown in Figure 3-11, effectively four fifths of respondents indicated feeling very comfortable and confident with internet. Almost another 20% were

somewhat comfortable. Less than 3% felt minimally or less confident with internet.

FEELINGS ABOUT BROADBAND

Over half of respondents felt that internet access was of critical importance to them. Comments from respondents indicated that remote work or telecommuting and online learning were the major reasons for this, particularly due to restrictions related to the COVID-19 pandemic. Reliability and speed were the most important attributes as rated by survey respondents.

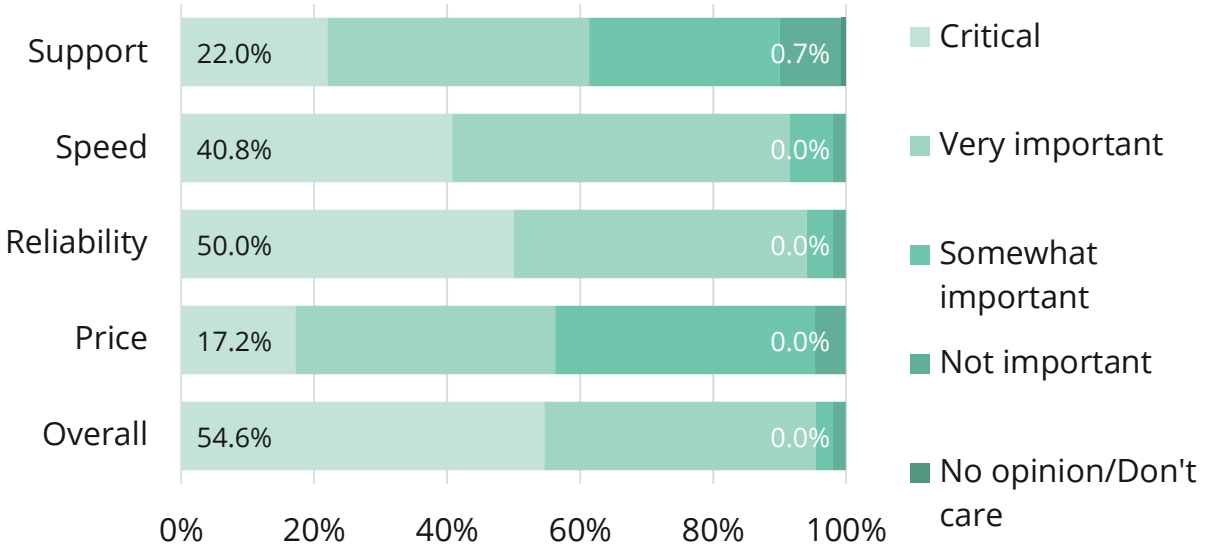


Figure 3-12. Importance Ratings of Broadband Service by Percentage of 151 Responses

About two-thirds of respondents were dissatisfied overall with their broadband. Over two-fifths of respondents were either neutral or somewhat satisfied with the price of broadband. The only aspect of broadband services that received a "very satisfied" rating was customer service and support. In contrast, as enumerated in Figure 3-13, approximately a third of respondents were "very dissatisfied" with most aspects of their broadband.

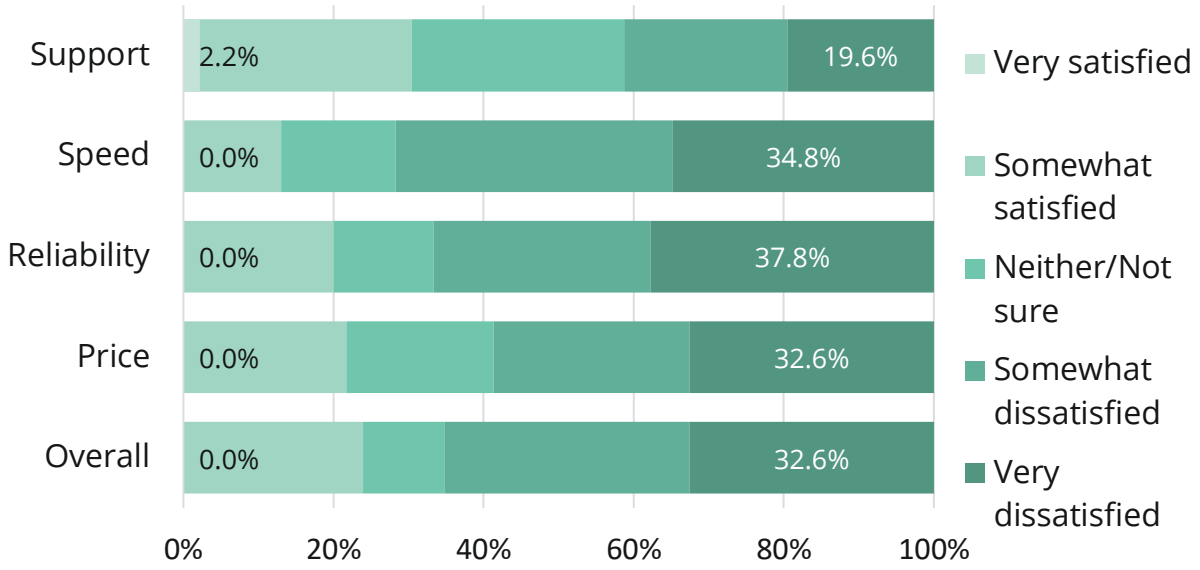


Figure 3-13. Level of Satisfaction with Broadband Service by Percentage of 46 Responses

LOCATIONS WITHOUT BROADBAND

The overwhelming reason for not having broadband was lack of availability. Figure 3-14 shows the number of ranked responses for not having broadband, from most to least important.

"Broadband is not available" to the location received over four times more "most important" rankings than the second highest ranked reason, "available service is too slow." Connections are so slow in many locations that broadband is effectively not available. Cost does not seem to be an issue, nor are substitutes for broadband. While a significant number of respondents indicated they did not need broadband, more rated it as a non-issue.

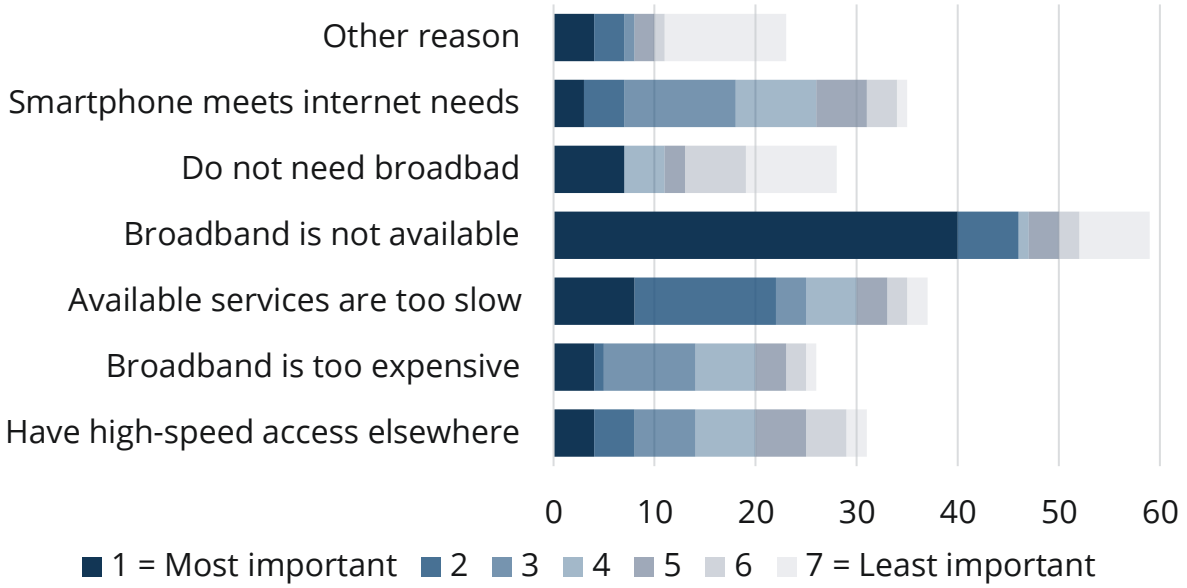


Figure 3-14. Number of 239 Rankings of Reasons for Not Having Broadband by 34 Respondents

RENTAL LOCATIONS

Responses for rental houses outnumbered those for primary households. Respondents were asked about the expected impact of having broadband on the amount they could rent out their houses, see Figure 3-15.

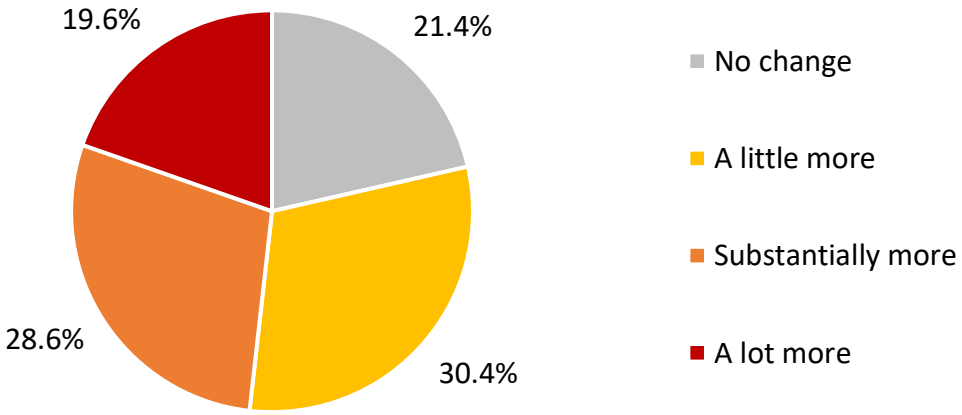


Figure 3-15. Impact of Broadband on Rentals by Percentage of 56 Responses

Nearly half of respondents felt they could substantially increase rentals with broadband. Based on responses estimating the days per year locations were rented and number of persons in a typical rental, we estimate that broadband to these locations would result in an increase of over 700 person-days ("heads in beds") per year for the area.

CONCLUSIONS

There is clearly an under-supply of broadband in the Skykomish area. Availability is low and where service is available and performance misses the mark. There is only one provider. Speeds are slow, coverage is limited, and costs are high.

There is strong, if diffuse, demand for broadband. Survey results suggest consumers are willing to pay rates well above rates in urban areas but the number of homes per mile is, of course, much lower in the Skykomish area.

Survey results suggest substantial benefits could come from better broadband. Improved connectivity can be expected to substantially reduce commuting, increase tourism and other economic activity, and improve access to education, healthcare, and other essential services.

5. Asset Inventory

TOWN OWNED INFRASTRUCTURE

The Magellan Advisors team utilized information from the following sources to prepare the asset inventory:

- Gray and Osborne project drawings – Phase 2A, Sewer Collection System Force Main and Pump Station Electrical, Phase 3A Sewer Collection System
- Ecology Washington – BNSF Clean Up drawings and documentation
- Phone conferences with Clinton Stanovsky, Brad Petrovich, Mayor Henry Sladeck, Council Members Shelly Farnham and Larry Johnson

The linear footage and location for the buried conduit assets are based on the available documentation from the sewer collection system contractor and engineering firm. All of the town's assets (conduit, vaults, pedestals and sweeps) need to be field verified and/or evaluated for serviceability prior to use.

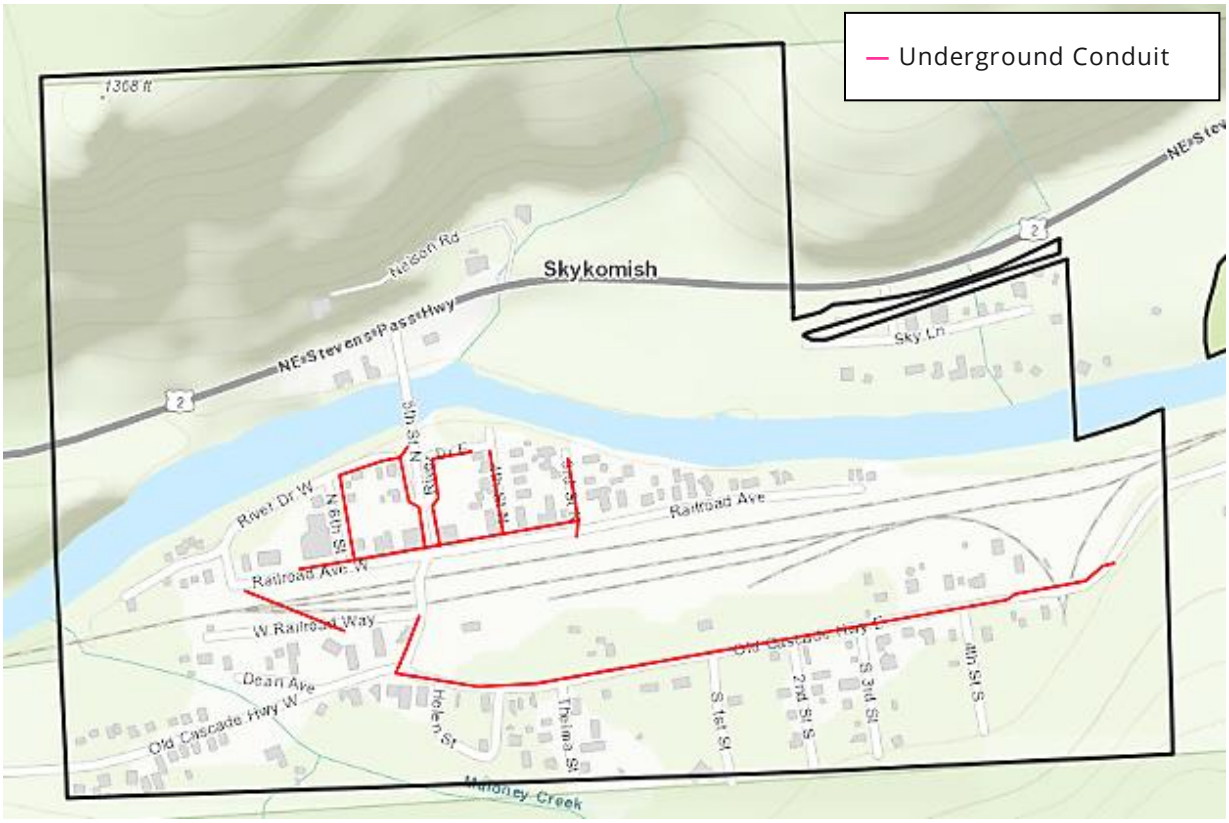


Figure 4-1. City-Owned Fiber and Conduit

The Town of Skykomish owns a system of 2" and 3" conduit that was buried following the railroad spill clean-up and in phase 2 of the recent sewer collection, force main, and pump station construction project. As illustrated in Figure 4-1, the conduit is divided between West Cascades Hwy and downtown Skykomish.

There was 540 linear feet of 2" communications conduit installed along 5th Street from south of the tracks to a 4'x4' communications vault at the intersection of 5th and East Old Cascade Hwy (which is West Cascade Hwy immediately to the west of this intersection). A 2,300' section of 3" conduit was installed from the 4'x4' communications vault, along East Old Cascade, to the Town boundary. It had stubs at intersections but did not extend to buildings other than the fire hall.

The 2,900 feet of 2" conduit in the downtown area terminates at the majority of the buildings (23) along 3rd, 4th, 5th, and 6th streets. There was a 2" conduit segment extending 380 feet beneath the railroad from a pump station at the corner of West Railroad Drive and West Railroad Avenue to the generator enclosure on South Railroad Avenue, near the Library. It does not seem to connect with the other conduit.

A 175 foot section of 2" communications conduit was installed across Hwy 2 to the north end of the 5th Street bridge. There is a duct beneath the 5th St bridge that terminates at the bridge abutments. It is unclear if there is any room in the duct and no apparent access point for it.

The Town also owns a small communications tower for radio communications at the Skykomish Fire Department, 105 E Old Cascade Hwy. This connects via microwave to the Puget Sound Emergency Response Network (PSERN), which has 6 towers within the Upper Sky Valley, including Stevens Pass Valley, Wellington, Scenic, Sobiesky Mountain/Maloney Point, and Deception Falls.

PRIVATE NETWORK INFRASTRUCTURE AND SERVICES

Ziply Fiber is the only retail broadband provider in the area. Frontier Communication was the region's incumbent telephone company and primary internet service provider until their Chapter 11 bankruptcy filing in 2020. Shortly after, Ziply acquired Frontier's infrastructure in the area, including the cell tower and central office in downtown Skykomish and the copper-

based network. Ziply stated[5] that it would replace this infrastructure with fiber beginning in the Spring of 2021. Ziply's service area ends just east of Town.

Ziply Fiber[6] serves more than 1.6 million residential and business locations in the Pacific Northwest. Services offerings include residential broadband via fiber and DSL, TV, and telephone. Ziply also provides commercial broadband, private network, other communications and cloud-based services in Washington, Oregon, and Montana. They advertise symmetrical gigabit fiber broadband for $60/month, which nominally equates to $0.06 pre Mbps per month or 1/100 the median cost consumers were paying during this study.

Other Network Service Providers

StarTouch[7] provided connectivity to the Skykomish school and other major enterprises in the area, anecdotally including the Stevens Pass Ski Resort. Based in Bellingham, WA, StarTouch operates a microwave-based long haul and middle-mile network deployed on nearly 400 towers in Washington, Oregon, Idaho, Nevada, California, and Arizona. The company has focused on wholesale Metro Ethernet for cellular/telecommunication carriers, internet service providers (ISPs), multi-dwelling unit (MDU) communities, businesses, and governmental projects. Its website indicates the company will be providing residential internet service in January 2021. It provides collocation services at the Westin Carrier Hotel in Seattle, and leases space on its towers.

Silver Star Telecom[8], based in Vancouver, WA, nominally serviced the Upper Sky Valley, as well as the rest of the state and Oregon. We identified no Silver Star assets or customers in the area. Satellite connectivity was available via HughesNet[9] and Viasat.[10] At the time of this study SpaceX was just starting

[5] Town Hall meeting on January 21, 2021

[6] https://get.ziplyfiber.com/

[7] https://www.startouch.com/

[8] http://www.silverstartelecom.com/

[9] https://internet.hughesnet.com/

[10] https://www.viasat.com/

up its Starlink[11] internet service, serving other areas in Washington state but not the Upper Sky Valley.

Long Haul Network Assets

Long haul networks provide wholesale transport of dark fiber but do not provide the access infrastructure to directly connect customers. While broadband services in the area are limited, there appear to be several options for "backhaul" high-capacity connections out of Skykomish using the available long haul networks. As shown in Figure 4-2Figure, several carriers had long haul assets in the Upper Sky Valley, specifically coming through Skykomish. Although not clearly shown on the map, these were actually two separate routes: an aerial cable along Cascade Hwy and an underground route along the BNSF railroad. Ziply owns all of the fiber on poles, having acquired Noel Communications as well as Frontier's assets in the area.

[11] https://www.starlink.com/

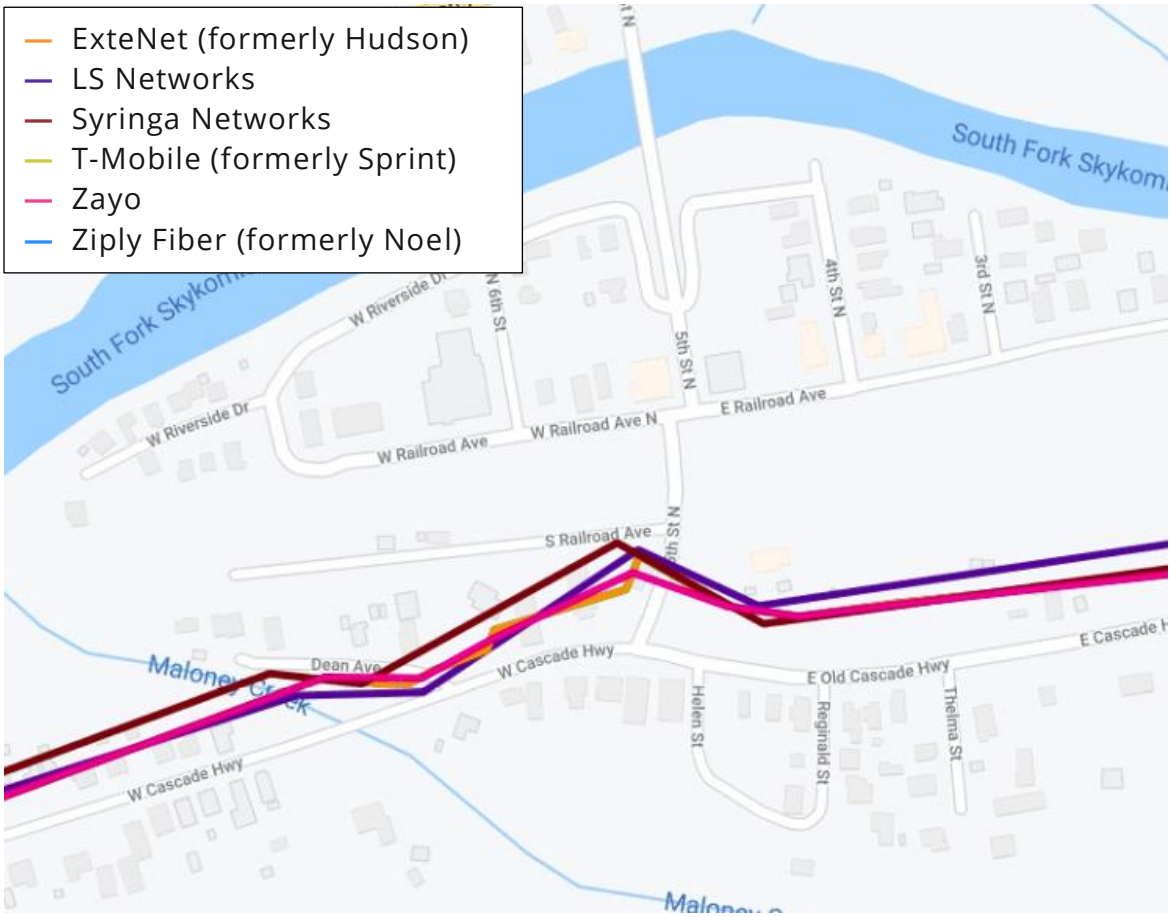


Figure 4-2. Long Haul Network Routes Through Skykomish (source: Fiber Locator)

ExteNet (formerly Hudson Fiber Network),[12] LS Networks,[13] Syringa,[14] T-Mobile (formerly Sprint),[15] and Zayo[16] had fiber assets buried in the railbed. Anecdotal evidence identified an access point for some of these routes near the Library, where 5th St crosses the tracks. We were unable to verify this. ExteNet and Zayo lease rather than own their portion of the fiber. T-Mobile does not, to the best of our knowledge, provide fiber-based services but is positioning as an internet service provider rather than just a mobile phone company. Frontier (now Ziply) was not included in the Fiber Locator system.

[12] https://extenetsystems.com/

[13] https://www.lsnetworks.net/

[14] https://www.syringanetworks.net/

[15] https://www.t-mobile.com/

[16] https://www.zayo.com/

The Bonneville Power Authority leases fiber deployed in its transmission routes,[17] one of which is roughly parallel to Hwy 2 but crosses it approximately 2 miles east of Skykomish. Cost of this fiber depends on where it terminates but is approximately $30 per mile per month for a single strand.[18] We know that Verizon has fiber on the north side of the railroad because there are splice enclosures with the company's logo across the street from from Ziply's central office. Other companies, specifically EverGem,[19] are planning to build network routes across the region. The Upper Sky Valley is one of only a few east-west corridors for long haul routes through the Cascade Range.

[17] https://www.bpa.gov/transmission/Doing%20Business/telecommunications/Pages/default.aspx

[18] The annual cost for a single strand of fiber from Skykomish to Everett, for example, would be approximately $18,000 per year.

[19] https://evergem.com/

6. Business Model Options

Selecting the right broadband business model for local government is highly dependent on several factors that will suggest the most appropriate option for the organization. For example, understanding the community needs, knowing the competitive market factors that define what infrastructure options fit well within the community, and determining organizational and operational capabilities of the local government all play into the selection process. Equally important is an understanding of the financial commitments and risk and reward that participating organizations are willing to support to fund and sustain a successful broadband initiative.

The commonly implemented business models fall on a continuum that ranges from low risk, low investment options to higher risk, high investment options. Figure 5-1 (below) illustrates this continuum. Moving along the continuum of business model options involves increasing degrees of risk and reward: risks in terms of financial, operational, and regulatory risk; rewards in terms of community benefits, revenue generation, and over potential for profit. Moving "up" the continuum generally requires increasing levels of investment and implies greater local government participation in the delivery of broadband services.

Public policy and infrastructure only options are considered "passive" business models, where the government does not operate a broadband network as compared to "active" models such as Government Services Providers, Open Access Providers, and Retail Provider Options, where the government operates a broadband network. Public-private partnerships are not classified as a specific business model but instead fall along the continuum because these partnerships take many forms. Local governments must determine which business models meet their organization's risk/reward tolerance to achieve the community's broadband goals.

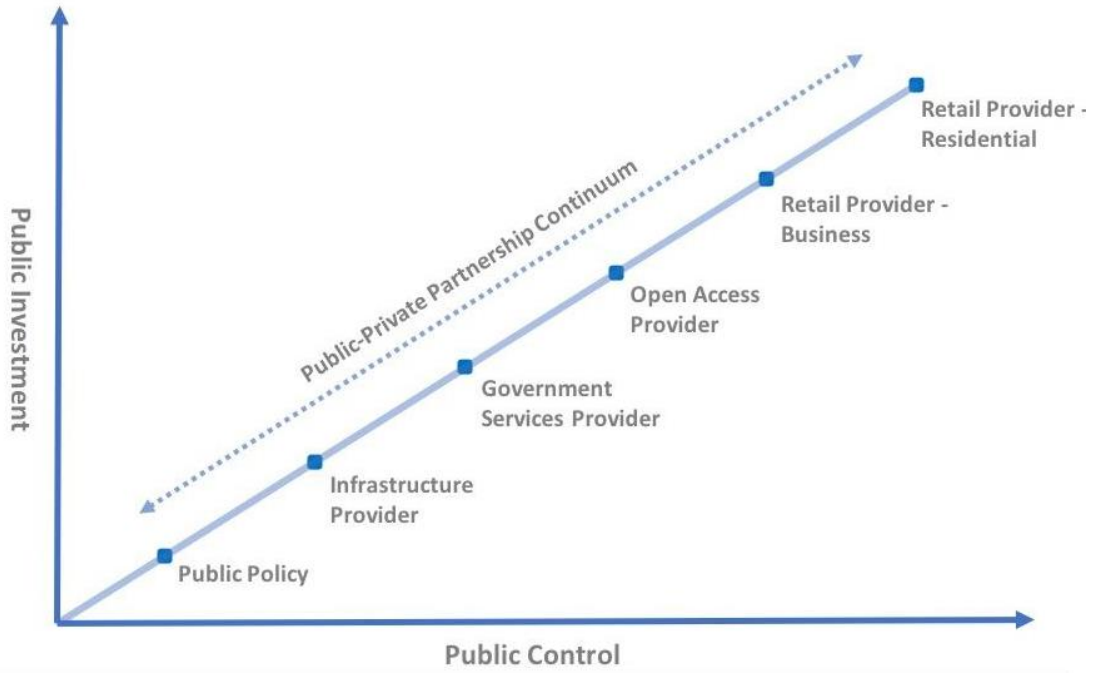


Figure 5-1. Continuum of Municipal Broadband Business Models

Local governments generally implement broadband-friendly public policy with any of the business models, as these policies will complement all other business model options. Conversely, a local government would not likely implement a retail model and public-private partnerships together, as these would lead to competition between the local government and one or more private partners.

Policy Participation Only

This is the most passive model and includes permitting, right of way access, construction, fees, and franchises that regulate the cost of constructing and maintaining broadband infrastructure within its jurisdiction. This option is not considered a true business model but does significantly affect the local broadband environment and is therefore included as one option.

Infrastructure Provider

Municipalities lease and/or sell physical infrastructure, such as conduit, dark fiber, poles, tower space, and property to broadband service providers that need access within the community. These providers are often challenged with the capital costs required to construct this infrastructure, particularly in high cost urbanized environments. The Broadband Utility infrastructure

provides a cost-effective alternative to providers constructing the infrastructure themselves.

Government Services Provider

These organizations are generally limited to the community anchors that fall within their jurisdiction, including local governments, school districts, higher educational organizations, public safety organizations, utilities, and occasionally healthcare providers. Many of these anchors require connectivity and often, the municipal network provides higher capacity at lower costs than these organizations are able to obtain commercially.

Open-access Provider

Municipalities that adopt open-access generally own a substantial fiber-optic network in their communities. Open-access allows these municipalities to "light" the fiber and equip the network with the electronics necessary to establish a "transport service" or "circuit" to service providers interconnecting with the local network. The concept of open-access is designed to enable competition among service providers across an open network that is owned by the municipality. The municipality retains neutrality and non-discriminatory practices with the providers who operate on the network.

Retail Service Provider – Business Only

Municipalities that provide end users services to business customers are considered retail service providers. Most commonly, municipalities provide voice and Internet services to local businesses. In many cases, a municipality may have built a fiber network for the purposes of connecting the city's primary sites that has been expanded to connect local businesses, in effort to support local economic development needs for recruitment and retention of businesses in the city.

Retail Service Provider – Business & Residential

Municipalities that provide end user services to businesses and residential customers are considered retail service providers. Most commonly, municipalities provide services to their businesses and residents through a municipally owned public utility or enterprise fund of the city. As a retail service provider that serves businesses and residents, the municipality is

responsible for a significant number of operational functions, including management of its retail offerings, network operations, billing, provisioning, network construction, installation, general operations, and maintenance.

Public-Private or Public-Public Partnership

A broadband public-private or public-public partnership (P3) is a negotiated contract between a public entity (i.e. Lucas) and private or public entity to fulfill certain obligations to expand broadband services in a given area. P3s leverage public broadband assets, such as fiber, conduit, poles, facilities with private broadband provider assets, and expertise to increase the availability and access to broadband services.

There are several guidelines that the Town should consider when evaluating opportunities for partnerships with telecommunications providers. Generally, as discussed above, Skykomish should seek provider partners who will actively participate in community and economic development as well as work with the Town to achieve its network vision.

Non-Exclusivity: The Town should not enter into any exclusive agreements. Non-exclusivity allows for a more competitive environment in which the Town can partner with multiple entities to get the most benefit from use of assets.

Cost Savings for Operations: Proposals that include connecting municipal or other public facilities to reduce telecommunications expenditures could be highly advantageous. Many partners in similar agreements have been willing to connect municipal facilities at no cost, sometimes even handing over ownership of assets such as fiber strands. Such arrangements should be strongly considered.

Benefit to the Community: Ultimately, partnerships with the private sector are strongest when they provide as many benefits as possible to the community. Providers may be willing to provide no- or low-cost services to areas in need, small businesses, or public spaces such as libraries that benefit students with no broadband at home. Support for public amenity applications such as wi-fi may also be offered. Community benefits such as these should be weighed heavily during the evaluation process.

Construction Methods and Timelines: Some partners may propose quick, minimally invasive construction methods to speed deployment and lower costs. Magellan strongly recommends that Skykomish's Public Works take part in discussions about the specifics of these construction methods and

that timeframes for deployment are specifically stipulated in contracts to ensure that the Town's streets are properly restored and that the community is not inconvenienced by drawn out construction.

Revenue Sharing: Partners may offer revenue sharing for the use of Town-owned assets. The percentage will vary depending on the terms of the agreement; Magellan has seen anywhere from 5% to 60% in favor of the Town. In any case, as with all proposals, revenue sharing estimates should be heavily vetted including assumptions for take rates and ramp periods and should be evaluated against fair market rates for the use of Town-owned assets.

PARTNERSHIP OPPORTUNITIES FOR SKYKOMISH

The Town of Skykomish has several partnership options. A key consideration is how to capitalize on public infrastructure and where to target any public investment. The Town's conduit system, although incomplete, could be a useful asset for providers. At least portions of it are already in use. A fundamental decision for the Town is how to manage the asset. The Town could lease it to Ziply (or other provider) with the understanding that others may be allowed to use it, too. Or the town could essentially give it to Ziply for its exclusive use.

Partnerships are defined by shared benefit, so any use of the conduit that involves below fair market value should involve something in exchange. For example, the Town may ask Ziply to support tourism and visitors with public Wi-Fi for the area, in return for exclusive lease. Or the Town could sell the conduit system to Ziply for a nominal amount in exchange for extending access to Timberlane.

While Ziply is making an important investment in the area, it is still effectively a monopoly. Therefore the Town may look for other providers, particularly for middle-mile infrastructure and for wireless services. The Town could take Ziply's investment as a given and seek other investors. Just as they undoubtedly want to have multiple options for where to by fuel, residents may want other connectivity options. This would mean managing the conduit as a carrier-neutral asset, possibly expanding and interconnecting it with other providers' infrastructure.

For example, the Town could establish an access point for fiber in the BNSF easement, establish a connection to BPA fiber, or seek out a new market entrant to build a fiber route along Hwy 2. Any such partnership would require substantial investment on the Town's part and may not be

economically justifiable based on the local market. Consequently, the Town would likely need to actively cultivate new demand, particularly via increased small business development, telecommuting, and tourism to attract a partner.

The third partnership opportunity is for the Town to partner with other communities and anchor industry and institutions to develop new applications and uses in the area. A regional Wi-Fi network with a captive portal[20] to engage users in the local economy is a particular opportunity. Collaboration on emergency preparedness, response, and public safety is a general opportunity, particularly in parallel with Puget Sound Emergency Response Network (PSERN). Specifically, anchor industries and institutions could collaborate on applications for environmental monitoring, outdoor recreation, public hazard notification, and wilderness rescue. Such partnership on network applications may drive additional private investment in infrastructure and services.

[20] A captive portal is a webpage that a user must view and interact with before being given access needs to a public network. It is mainly used for authentication purposes and is usually in place for free Wi-Fi hot spots, business centers, airports, lounges and lobbies. A captive portal also can restrict users on a public network on the basis of usage and services they can render. Source: https://www.techopedia.com/definition/5047/captive-portal

7. Conceptual Network Designs

Magellan Advisors developed three conceptual network designs for a Town of Skykomish broadband network—two for fiber and one for Wi-Fi. The purpose of these designs is to inform executive decision-making about where the Town might invest its resources and the general scale of the effort required to get better broadband. All of these designs are for local infrastructure and would require backhaul transport for bulk internet access and other network services. There are several options for this, described in the "Private Network Infrastructure and Services" sub-section, above, and via long-haul microwave, described in the wireless design, below.

FIBER NETWORK DESIGNS

The purpose of the conceptual network designs is to connect each of the Town's residences, businesses, and municipal sites and facilities to increase the availability of broadband. The network is designed to support economic development and improve connectivity throughout the entire region for telework, telehealth and distance learning. Considering the available information, Magellan Advisor's developed two (2) high level conceptual designs for the Town of Skykomish. Both would reach the entire Town, enabling all locations within Skykomish to be physically connected via fiber.

The hybrid network design (Figure 6-1) would utilize the downtown portion of the Town's system of 2" and 3" buried conduit, small communications tower, and existing Puget Sound Energy (PSE) power poles. Note that this design does not use the conduit south of Old Cascade Hwy or north of the river. The hybrid model assumes that the Town's buried conduits are useable and Puget Sound Energy's poles have room to accommodate the required telecommunications pole attachments and fiber optic cable.

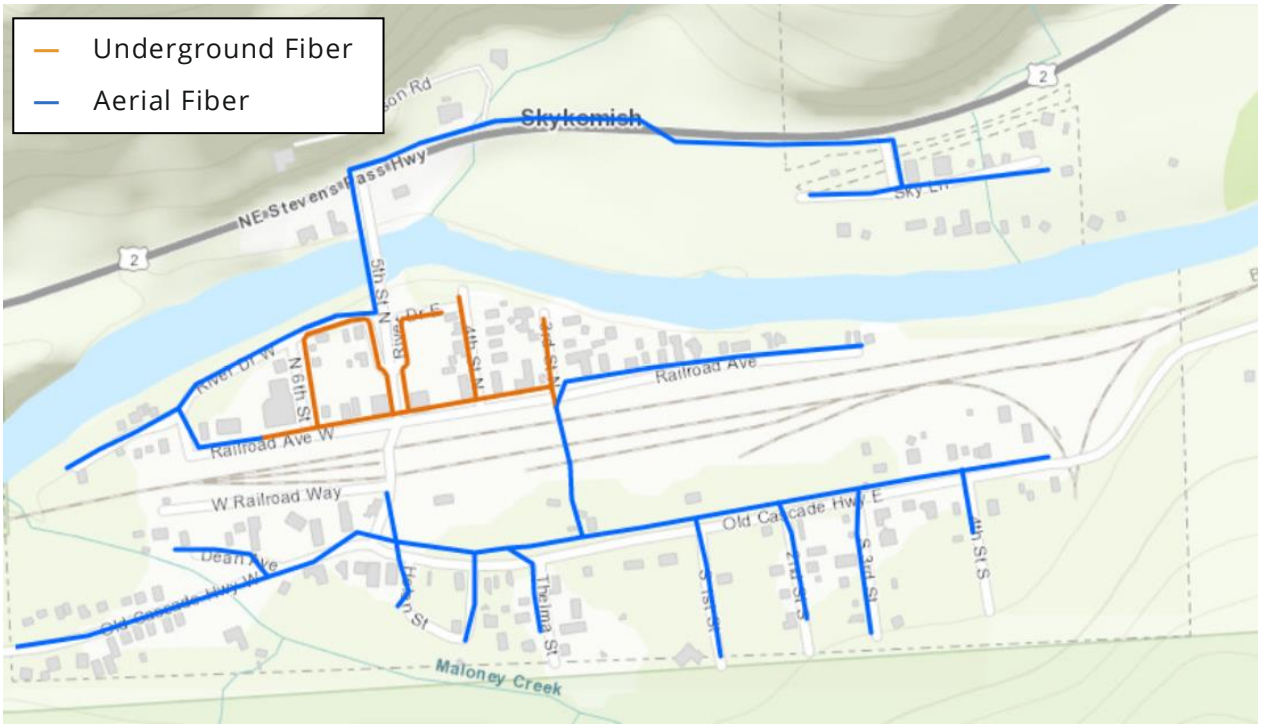


Figure 6-1. Hybrid Aerial-Underground Network Design

This design includes 96-strand fiber buried in two (2) 2" conduits at a minimum depth of 24” with hand holes every 250 feet, and 288 count splitter cabinets. We assumed burying the conduit and fiber would involve 50% rock adder, 75% for tree trimming and 50% pole make-ready at $1,000 per pole. The aerial cable was assumed to be deployed via strand and lash, rather than all-dielectric self-supporting (ADSS) cable, in the communications space. The estimated costs include soft surface restoration and standard maintenance of traffic.

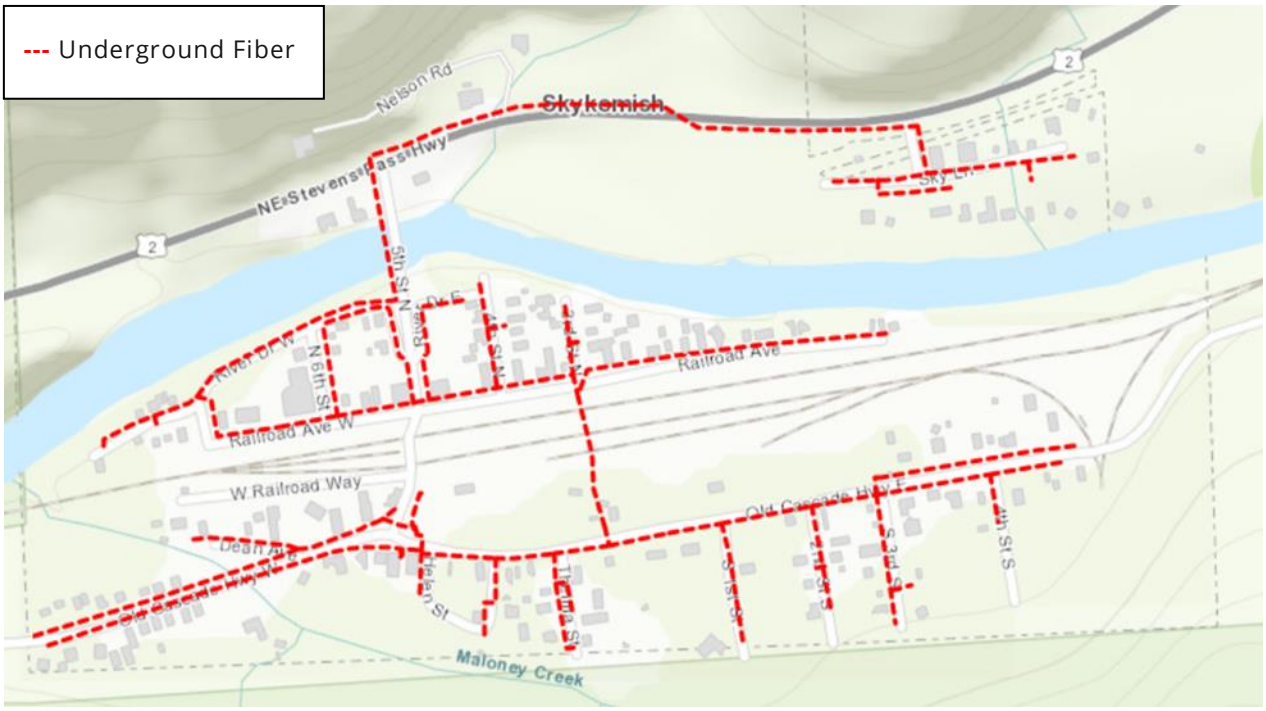


Figure 6-2. Underground-Only Network Design

The underground-only design shown in Figure 6-2 uses the same assumptions for underground infrastructure as the hybrid design. Neither design accounts for any special crossings, permit fees or sensitive build areas, and does not include the cost of network equipment or subscriber connections (i.e., "drops"). An aerial-only deployment is not possible because all utilities in the downtown area are underground; there are no poles.

Table 6-1. Construction Cost Estimates

Network Option	Aerial	Underground	Total Cost
1: Hybrid	12,981 ft.	2,950 ft.	$537,498.11
2: Underground-only	0 ft.	18,599 ft.	$1,547,601.23

The hybrid approach, as shown in Table 7-1, is much more economical, saving over $1 million in construction costs. Although much of the underground infrastructure is in place, the overall cost of the hybrid design is approximately a third of the underground-only approach. This is largely due to the need to substantially expand the existing conduit to make it useful.

PUBLIC WI-FI DESIGN

Magellan also studied the feasibility of a public Wi-Fi system that would cover the downtown area and the ballpark on the east side of the town. We created a preliminary design for this purpose, including internet connectivity via high-speed long haul microwave systems. The target of the long-range microwave is to deliver 10 Gbps internet access to a point in Skykomish. This 10 Gbps internet service would then be distributed in the town via fiber and Wi-Fi connectivity. This design could be expanded to nearby communities, such as Timberlane and be replicated in other parts of the area.

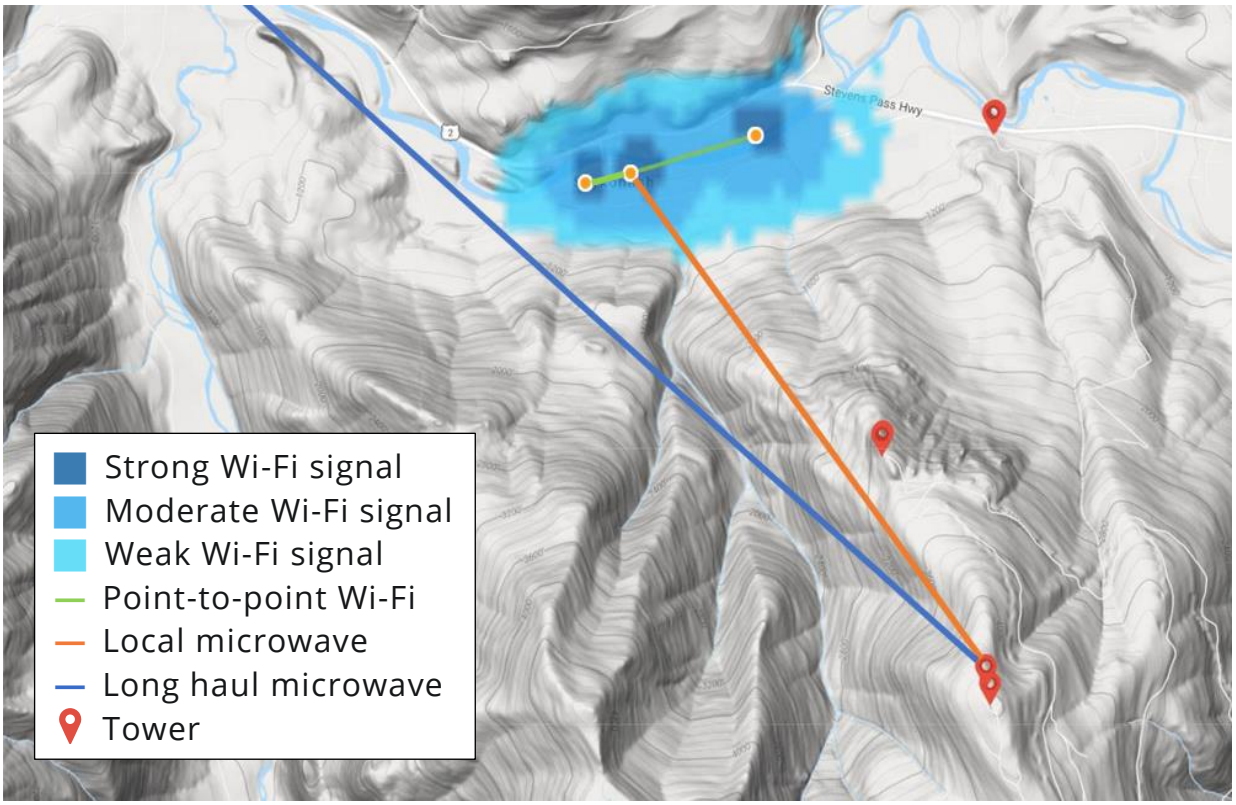


Figure 6-3. Wi-Fi Coverage Map

A Wi-Fi coverage estimate with the high-speed microwave paths is shown in Figure 6-3. We estimate that this design would cover most of Town with an at least moderate-strength Wi-Fi signal. The 3 dots represent omnidirectional Wi-Fi APs located in downtown and at the ballpark, interconnected by point-to-point Wi-Fi links, represented by green lines. The orange line represents a local short-haul microwave link to the towers south of town. The third, blue line represents a long-haul link that goes to Index. This would be used to bring in high speed internet to supply the town and Wi-Fi access points (APs).

Equipment Required and Estimated Cost

The design requires 3 Wi-Fi APs to cover the area shown. A 24 GHz unlicensed microwave link will be used to transmit the internet feed down from the mountain top location to the main part of town. The Wi-Fi access points will be connected with 60 GHz unlicensed band point-to-point radios. Two outdoor routers will be needed at the downtown Wi-Fi AP locations.

The long-haul microwave link would be constructed from the mountain top location to Index where and internet exchange connection is available. This is approximately 20 miles. An E-band microwave system is proposed for that link. It will require 2 microwave radios and 2 outdoor routers. A tower on the mountain South of Skykomish is owned by King County IT department and will be the assumed location for the high-speed long-haul microwave and the 24 GHz link down into Skykomish. If it can be accommodated, this may decrease or eliminate the tower rent that would be paid to a commercial tower vendor.

Table 6-1. Wi-Fi Equipment Cost Estimates

Item	Quantity	Cost	Total
Wi-Fi AP	3	$950.00	$2,850.00
24 GHz Microwave Radio	2	$1,700.00	$3,400.00
60 GHz PTP Radios	4	$200.00	$800.00
E-band 10 Gbps Radios	2	$15,000.00	$30,000.00
Microwave Path Study	1	$2,000.00	$2,000.00
Labor to install Microwave At 3 locations	1	$6,000	$6,000.00
Labor to install Wi-Fi and 60 GHz Radios	1	$2,000	$2,000.00
Total Estimated Cost			**$47,050.00**

Table 6-1 shows the rough order of magnitude (ROM) cost for the equipment and installation. This estimate does not include any tower rent or the continuing cost of internet bandwidth. The distance to Index is at the edge of the long-haul radio single link capability, so further study would need to be done to confirm its use. This design could also be implemented by purchasing back-haul via fiber or microwave from one of the providers listed in the Asset Inventory section, above.

"Community Wi-Fi" Approach: Upper Sky Wi-Fi

Community Wi-Fi involves deploying a logical network across multiple locations—and Wi-Fi access points and/or routers—via a common, shared service set identifier (SSID). For example, anyone could be part of the "Upper Sky Wi-Fi." Any agency, business, and even residence would be able to add this SSID to their Wi-Fi to securely share their connections with the public.

Users would be sent to a "captive portal" as they connect to the Upper Sky Wi-Fi. It would provide local information but block further access until the user provides basic information (email address and home zip code, for example) and accept terms of use. Once registered with Upper Sky Wi-Fi, a user could connect at any location that has Wi-Fi with the SSID set up. While they would share bandwidth to the internet, data on Upper Sky Wi-Fi would be totally separate from and have no access to data on other networks/SSIDs.

This system could be used to push information to residents and visitors. It could even be deployed on remote hotspots connected via cellular, microwave, or satellite, although this would require additional costs and technical issues. Connections could be complementary and/or could involve a fee based on minutes, speed, or amount of data. Community Wi-Fi can also generate advertising revenue via the captive portal.

While this approach does not require new capital spending on Wi-Fi equipment, it would make sense to deploy new access points specifically for the Upper Sky Wi-Fi. Community Wi-Fi does require a substantial amount of content management, partner/user support, and other work.

ONGOING SYSTEM MANAGEMENT

The Town will need to establish a department or enterprise to operate any network resulting from these designs, or contract with a third party to do so. For the fiber networks, this would include deploying and maintaining subscriber connections ("drops") on demand, as well as billing for and provisioning services.

For the Wi-Fi network, this would involve creating and managing the captive portal that would allow visitors to sign up for service, as well as deploying, managing, and maintaining the Wi-Fi access points and the microwave links. We assume the Wi-Fi would be provided for free to enhance visitor services in the Town. As described in the "Partnership Opportunities" sub-section, above, these ongoing activities could be done via a regional partnership that

would replicate the network design(s) throughout the Upper Sky Valley. Operation of this system would require approximately half of a full time equivalent employee, approximately $40K per year. The Town could make arrangements with Ziply to provide the Wi-Fi as a part of a larger partnership agreement.

8. Funding Opportunities

Skykomish is poised for a variety of funding opportunities through state and federal agencies. The following action plan is an outline of funding opportunities including high level tasking for funding opportunities that are available through 2021. Funding opportunities can be updated at any point and the Town should continue to monitor the state and Federal opportunities and adjust their strategy accordingly.

It is important to note that at this time, not all funding rules have been written. In particular, a new administration and Congress are expected to release appropriations for additional broadband funding in response to the recent COVID-19 pandemic, as well as updates to rules and requirements for existing programs such as Community Connect. It is important for Skykomish to continue to work with strategic partners including King County, the Washington State Broadband Office, Public Works Board, Department of Commerce, and potential co-applicant partners such as Ziply to track opportunities that will allow the Town to pursue funding for the buildout of additional infrastructure. Many of the funding programs included here could pursued by the Town of Skykomish in partnership with other public agencies such as King County to assist with connecting areas outside of Ziply's new proposed service area, to the east of the Town itself.

STATE OF WASHINGTON FUNDING

Public Works Board Broadband Grants and Loans

The state's Public Works Board (PWB) distributes grants and loans from Washington's Statewide Broadband Account, which received a $21.5 million transfer from the Public Works Assistance Account (PWAA) for broadband capital projects, less operating costs to staff the program. Grants were available in 2019 and 2020 for broadband feasibility and planning studies, for which $450,000 was distributed across the state in 2019, including funding for this Plan commissioned by the Town of Skykomish.

A Broadband Construction Loan and Grant cycle recently closed, with awards totally nearly $18 million to entities across the state including local municipalities, tribes, and PUDs. This grant and loan program provides up to $2million in funding for broadband construction, although some rural and Tribal areas could receive up to $5million. The program does require a 50% match, although this may be reduced to 10% for rural or tribal areas.

Although the future of this program is highly dependent upon state funding allocations, another funding window may be opening soon, which could support the recommendations of this study. The Town should continue to work with the PWB to determine eligibility for available funding.

State of Washington Community Economic Revitalization Board (CERB)

The Community Economic Revitalization Board has a variety of state funding opportunities that may apply to Skykomish.

CERB's Rural Broadband Loan provides low-interest (1-3%) loan/grant packages to local governments and federally-recognized Indian tribes, financing the cost to build infrastructure to provide high-speed, open-access broadband service, to rural underserved communities, for the purpose of community economic development. CERB offers loans at $2 million maximum per project. Grants are available up to 50% of the total award, determined by the underwriting process and debt service coverage ratio (DSCR). There is a 25% cash match requirement.

CERB also offers a Committed Private Partner (CPP) Program that requires a private entity to commit to a project that will create a significant increase in local jobs, including the deployment of telecommunications infrastructure. CPP offers low-interest loans of up to $3 million maximum per project. Grants are available up to 25% of the total award, determined by the underwriting process and debt service coverage ratio (DSCR). Applicants must provide a cash match of 20% of the total project cost. This may be an opportunity that Ziply could pursue in partnership with the Town. However, there are several economic development-driven requirements including demonstrating that no other funding sources are available for the project.

CERB's programs have a rolling deadline, but the final application due date is **March 29, 2021** for Tier 2 projects. To apply for a CERB grant, Skykomish and, if appropriate, its partner should review all funding guidelines and action items and complete the following tasks prior to an application including:

- Identify the Private Partner
- Identify and secure the Cash Match
- Complete and Submit the Application

For more information about CERB programs, the Town should contact Leslie Wolff (Leslie.Wolff@commerce.wa.gov or 360-259-2671) or Barbara Smith (Barbara.Smith@commerce.wa.gov or 360-764-9820).

FEDERAL FUNDING

The COVID-19 pandemic brought broadband to the forefront of federal attention, resulting in increased funding availability and new program announcements. The COVID-19 Relief bill of 2020 appropriated over $7 billion in broadband funding mainly allocated to the Federal Communications Commission (FCC) and National Telecommunications and information Administration (NTIA). A second Supplemental Appropriations bill similar to the CARES is expected to be introduced soon and pass Congress toward the end of the second quarter of 2021. It is also possible that a transportation and infrastructure funding package will provide additional funding options for broadband sometime before the end of 2021.

However, it should be noted that federal grant programs remain very competitive and often require specific, census-block level mapping demonstrating a lack of broadband across all households and businesses; if just one household or business in a census block has access to speeds about 25/3, in most cases the area is no longer eligible for funding, which will disqualify Skykomish for many of these opportunities. Due to the many requirements and extensive documentation required in these grant applications, Skykomish should be prepared to spend several months gathering information and completing the applications if the Town chooses to pursue federal funding opportunities.

National Telecommunications and Information Administration

The NTIA has recently announced three broadband funding programs, including a Rural Broadband Infrastructure Grant program that could be fruitful for Skykomish. This $300 million program focuses on partnerships between a state, or one or more political subdivisions of a state, and providers of fixed broadband service to support broadband infrastructure deployment to areas lacking broadband, especially rural areas such as Skykomish.

In order to be eligible for funding, applicants must demonstrate that broadband service is not available to 1 or more businesses within the census block, which may be challenging since some businesses and residents are currently being served at speeds greater than 25/3. Priority is given to projects that provide broadband to the largest number of households in the proposed service area, service areas with a population of 50 thousand or less, and those that will provide broadband at minimum speeds of 100/20.

Although the rules for this program are still being reviewed and a notice of funding has not yet been issued by NTIA, we expect that an announcement about available funding and additional guidelines will be issued in mid to late March 2021. The application window for this program will likely be 90 days, meaning that if Skykomish chooses to apply, it must decide on a partner and gather data demonstrating eligibility as soon as possible as the grant application will likely be due in June or July of this year.

FCC Emergency Broadband Benefit Fund

The FCC's Emergency Broadband Benefit fund is intended to assist families with broadband adoption by making connectivity more affordable. The program provides subsidies of up to $50 per month per household and also provides reimbursement for connected devices up to $100 per household. Eligibility requirements for the program include:

- Participation in the free and reduced-price lunch or school breakfast program;
- Experienced a substantial loss of income since February 29, 2020, and documented by layoff or furlough notice, application for unemployment, or verifiable through the National Verifier or National Lifeline Accountability Database;
- Received a Federal Pell Grant;
- At least one member of a household meets the eligibility criteria for participating provider's existing low-income or COVID–19 program (i.e. Comcast Internet Essentials, Fios Forward or the AT&T low income consumer discount program.)

However, this funding mechanism is for internet service providers that apply on behalf of their customers. A partner provider such as Ziply could apply on behalf of households in Skykomish to improve affordability of services.

USDA – RUS Community Connect Program

The United States Department of Agriculture (USDA) Rural Utility Service (RUS) sponsors the Community Connect Program, focused on areas with a population of less than 20,000 that lack access to broadband. In this program, the area in question must not have access to speeds of at least 10/1 as determined by the FCC's Fixed Broadband Deployment map. Unfortunately, Skykomish does not fall into such an area so the Town would

not be eligible for this program, but areas outside of the Town limits may be eligible.

USDA – RUS ReConnect

Like the Community Connect program, RUS's ReConnect program offers three types of funding options for broadband infrastructure – grants, grant and loan combinations, and low interest federal loans – to connect rural families, businesses, farms, ranches, schools, libraries, and public safety facilities to modern, high-speed internet. Funds can be used to construct, improve, and acquire facilities that provide internet services to customers' premises, with reliable technologies that are suitable for the type of rural community and the type of high-speed internet use.

The ReConnect grant is a highly competitive federal opportunity based on scoring points and, like Community Connect, is unlikely to fund Skykomish due to the FCC mapping data that shows the availability of broadband within the Town. As with Community Connect, areas outside of Town limits may benefit from this opportunity.

9. Recommendations & Next Steps

Magellan Advisors recommends the Town of Skykomish actively support Ziply's network rebuild. We do not anticipate the Town will have much capacity to expand or manage its conduit, and therefore recommend the Town offer it to Ziply in exchange for either (a) deeply discounted services, specifically public Wi-Fi, and/or (b) extending connectivity to more remote portions of the area, specifically Timberlane, possibly even Scenic and Stevens Pass. To the extent that Ziply is given control and use of the conduit, they should provide tangible benefits to the Town in kind.

If for some reason the Ziply network upgrade does not occur, we recommend the Town of Skykomish develop its own Wi-Fi with back-haul provided by a competitive provider and consider investing in local fiber infrastructure. We strongly recommend developing a regional partnership to support the public Wi-Fi and make it a valley-wide asset. We also recommend seeking a third-party—either an existing company or a start-up, possibly as a co-op—to build and operate a fiber-based broadband network using the Town's assets if Ziply does not. This Town-owned network should include considerations for partnering with long-haul infrastructure owners in the region including ExteNet, LS Networks, Syringa Networks, T-Mobile, or Zayo.

Regardless of Ziply's actions, we recommend the Town work with King County to physically survey and document its conduit and other assets in the County's GIS. The Town should work closely with public safety agencies and the Schools to ensure they have high-reliability, high-speed connectivity. We recommend engaging other communities in the area, King County, and the State of Washington—specifically the Governor's Broadband Office and the full range of public land and safety agencies—for improving connectivity.

The Town may consider improvements to its vertical assets for public safety radio and wireless connections to remote areas. Explore the possibility of using County-owned towers. It may be useful for the Town to have a small co-location facility or data center for its own purposes and to support a regional partnership. There appears to be some need for additional GIS related to infrastructure and public safety. Magellan Advisors recommends the Town engage local, County, State, and Federal stakeholders as it considers these improvements.

The Town should consider anchoring a "Smart Valley" initiative that would align technology investments for economic development, education, environment, healthcare, outdoor recreation, public safety, and other purposes. This could involve applications like monitoring river flow/level, traffic flows, water quality, weather conditions, etc. It could also have uses for public safety, including wilderness rescue and wildfire interdiction.

Such an initiative would depend on implementation of the recommendations discussed above but would also create additional, larger benefits from the infrastructure and services. Generally, a "Smart Valley" initiative would involve deploying smaller-scale infrastructure, commonly referred to as the "internet of things" or IoT,[21] throughout the Upper Sky Valley and establishing systems to collect and process data, as well as building more substantial "core" network infrastructure. The Town should pursue funding opportunities in support of these recommendations with the "Smart Valley" as its guiding vision.

NEXT STEPS

8. Continue to engage Ziply representatives in discussions about the extent, resources, and timing of their infrastructure upgrades and service roll-out, estimated to be completed by the third quarter of 2021.
9. Pursue funding options for additional broadband infrastructure and programs for support underserved members of the community, access, and digital literacy programs for youth and elderly through state programs such as Public Works Board and Community Economic Revitalization Board, potentially in partnership with Ziply, King County or other parties.
10. Develop a "community Wi-Fi" network for new and existing access points, including captive portal and management server/service. The Town should consider an partnership arrangement in which Ziply or another new entrant provides the Wi-Fi in exchange for the use of Town assets or other similar agreements.
11. Negotiate terms to use Town conduit and other assets, including in-kind and/or monetary compensation, operations, ownership, etc.

[21] Review publications such as https://www.iotforall.com/ for additional information about IoT and related technologies.

12. Consider options for building a Town-owned fiber or wireless network contained in this Plan as a future opportunity to be pursued in the event that Ziply's network upgrades do not meet the needs of the Town or to provide additional options in the future. Investigate opportunities for connecting network infrastructure to existing long-haul fiber networks.
13. Conduct an engineering assessment ("proofing") of conduit, poles, and tower assets to ascertain their usability and any necessary improvements needed to become fiber ready. Any agreement for Ziply (or other provider) to use the conduit should put this task, and cost, squarely on them.
14. Establish a regional "Upper Sky Smart Valley" task force to explore technology needs and opportunities in economic development, education, emergency preparedness/response, environmental monitoring, health, public safety, recreation, tourism, and utilities.

Appendix A: Glossary of Terms

3G – Third Generation	The third generation of mobile broadband technology, used by smart phones, tablets, and other mobile devices to access the web.
4G – Fourth Generation	The fourth generation of mobile broadband technology, used by smart phones, tablets, and other mobile devices to access the web.
5G – Fifth Generation	The fifth generation of mobile broadband technology, used by smart phones, tablets, and other mobile devices to access the web. It is believed that this technology will significantly increase bandwidth to users, up to 1 Gig.
ADSL – Asymmetric Digital Subscriber Line	DSL service with a larger portion of the capacity devoted to downstream communications, less to upstream. Typically thought of as a residential service.
ADSS – All-Dieletric Self-Supporting	A type of optical fiber cable that contains no conductive metal elements.
AMR/AMI – Automatic Meter Reading/Advanced Metering Infrastructure	Electrical meters that measure more than simple consumption and an associated communication network to report the measurements.
ATM – Asynchronous Transfer Mode	A data service offering that can be used for interconnection of customer's LAN. ATM provides service from 1 Mbps to 145 Mbps utilizing Cell Relay Packets.
Bandwidth	The amount of data transmitted in a given amount of time; usually measured in bits per second, kilobits per second (kbps), and Megabits per second (Mbps).
Bit	A single unit of data, either a one or a zero. In the world of broadband, bits are used to refer to the amount of transmitted data. A kilobit (Kb) is approximately 1,000 bits. A Megabit (Mb) is approximately 1,000,000 bits. There are 8 bits in a byte (which is the unit used to measure storage space), therefore a 1 Mbps connection takes about 8 seconds to transfer 1 megabyte of data (about the size of a typical digital camera photo).

BPL – Broadband over Powerline	A technology that provides broadband service over existing electrical power lines.
BPON – Broadband Passive Optical Network	BPON is a point-to-multipoint fiber-lean architecture network system which uses passive splitters to deliver signals to multiple users. Instead of running a separate strand of fiber from the CO to every customer, BPON uses a single strand of fiber to serve up to 32 subscribers.
Broadband	A descriptive term for evolving digital technologies that provide consumers with integrated access to voice, high-speed data service, video-demand services, and interactive delivery services (e.g. DSL, Cable Internet).
CAD – Computer Aided Design	The use of computer systems to assist in the creation, modification, analysis, or optimization of a design.
CAI – Community Anchor Institutions	The National Telecommunications and Information Administration defined CAIs in its SBDD program as "Schools, libraries, medical and healthcare providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and entities." Universities, colleges, community colleges, K-12 schools, libraries, health care facilities, social service providers, public safety entities, government and municipal offices are all community anchor institutions.
CAP – Competitive Access Provider	(or "Bypass Carrier") A Company that provides network links between the customer and the Inter-Exchange Carrier or even directly to the Internet Service Provider. CAPs operate private networks independent of Local Exchange Carriers.
Cellular	A mobile communications system that uses a combination of radio transmission and conventional telephone switching to permit telephone communications to and from mobile users within a specified area.
CLEC – Competitive Local Exchange Carrier	Wireline service provider that is authorized under state and Federal rules to compete with ILECs to provide local telephone service. CLECs provide telephone services in one of three ways or a combination thereof: 1) by building or rebuilding telecommunications facilities of their own, 2) by leasing capacity from another local telephone company (typically an ILEC) and reselling it, and 3) by leasing discrete parts of the ILEC network referred to as UNEs.

CO – Central Office	A circuit switch where the phone lines in a geographical area come together, usually housed in a small building.
Coaxial Cable	A type of cable that can carry large amounts of bandwidth over long distances. Cable TV and cable modem service both utilize this technology.
CPE – Customer Premise Equipment	Any terminal and associated equipment located at a subscriber's premises and connected with a carrier's telecommunication channel at the demarcation point ("demarc").
CWDM – Coarse Wavelength Division Multiplexing	A technology similar to DWDM only utilizing less wavelengths in a more customer-facing application whereby less bandwidth is required per fiber.
Demarcation Point (“demarc”)	The point at which the public switched telephone network ends and connects with the customer's on-premises wiring.
Dial-Up	A technology that provides customers with access to the Internet over an existing telephone line.
DLEC – Data Local Exchange Carrier	DLECs deliver high-speed access to the Internet, not voice. Examples of DLECs include Covad, Northpoint and Rhythms.
Downstream	Data flowing from the Internet to a computer (Surfing the net, getting E-mail, downloading a file).
DSL – Digital Subscriber Line	The use of a copper telephone line to deliver “always on” broadband Internet service.
DSLAM – Digital Subscriber Line Access Multiplier	A piece of technology installed at a telephone company’s Central Office (CO) and connects the carrier to the subscriber loop (and ultimately the customer’s PC).
DWDM – Dense Wavelength Division Multiplexing	An optical technology used to increase bandwidth over existing fiber-optic networks. DWDM works by combining and transmitting multiple signals simultaneously at different wavelengths on the same fiber. In effect, one fiber is transformed into multiple virtual fibers.
E-Rate	A Federal program that provides subsidy for voice and data circuits as well as internal network connections to qualified schools and libraries. The subsidy is based on a percentage designated by the FCC.

EON – Ethernet Optical Network	The use of Ethernet LAN packets running over a fiber network.
EvDO – Evolution Data Only	EvDO is a wireless technology that provides data connections that are 10 times as fast as a traditional modem. This has been overtaken by 4G LTE.
FCC – Federal Communications Commission	A Federal regulatory agency that is responsible for regulating interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Rock Falls, and U.S. territories.
FDH – Fiber Distribution Hub	A connection and distribution point for optical fiber cables.
FTTN – Fiber to the Neighborhood	A hybrid network architecture involving optical fiber from the carrier network, terminating in a neighborhood cabinet which converts the signal from optical to electrical.
FTTP – Fiber to the premise (or FTTB – Fiber to the building)	A fiber-optic system that connects directly from the carrier network to the user premises.
FTTx – Fiber to the X	All fiber optic topologies from a provider to its customers, based on the location of the fiber's termination point
GIS – Geographic Information Systems	A system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data.
GPON- Gigabit-Capable Passive Optical Network	Similar to BPON, GPON allows for greater bandwidth through the use of a faster approach (up to 2.5 Gbps in current products) than BPON.
GPS – Global Positioning System	a space-based satellite navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
GSM – Global System for Mobile Communications	This is the current radio/telephone standard developed in Europe and implemented globally except in Japan and South Korea.
HD – High Definition (Video)	Video of substantially higher resolution than standard definition.
HFC – Hybrid Fiber Coaxial	An outside plant distribution cabling concept employing both fiber-optic and coaxial cable.

ICT – Information and Communications Technology	Often used as an extended synonym for information technology (IT), but it is more specific term that stresses the role of unified communications and the integration of telecommunications, computers as well as necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information.
IEEE – Institute of Electrical Engineers	A professional association headquartered in New York City that is dedicated to advancing technological innovation and excellence.
ILEC – Incumbent Local Exchange Carrier	The traditional wireline telephone service providers within defined geographic areas. Prior to 1996, ILECs operated as monopolies having exclusive right and responsibility for providing local and local toll telephone service within LATAs.
IP-VPN – Internet Protocol-Virtual Private Network	A software-defined network offering the appearance, functionality, and usefulness of a dedicated private network.
ISDN – Integrated Services Digital Network	An alternative method to simultaneously carry voice, data, and other traffic, using the switched telephone network.
ISP – Internet Service Provider	A company providing Internet access to consumers and businesses, acting as a bridge between customer (end-user) and infrastructure owners for dial-up, cable modem and DSL services.
ITS – Intelligent Traffic System	Advanced applications which, without embodying intelligence as such, aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks.
Kbps – Kilobits per second	1,000 bits per second. A measure of how fast data can be transmitted.
LAN – Local Area Network	A geographically localized network consisting of both hardware and software. The network can link workstations within a building or multiple computers with a single wireless Internet connection.

LATA – Local Access and Transport Areas	A geographic area within a divested Regional Bell Operating Company is permitted to offer exchange telecommunications and exchange access service. Calls between LATAs are often thought of as long distance service. Calls within a LATA (IntraLATA) typically include local and local toll services.
Local Loop	A generic term for the connection between the customer's premises (home, office, etc.) and the provider's serving central office. Historically, this has been a copper wire connection; but in many areas it has transitioned to fiber optic. Also, wireless options are increasingly available for local loop capacity.
MAN – Metropolitan Area Network	A high-speed intra-city network that links multiple locations with a campus, city or LATA. A MAN typically extends as far as 30 miles.
Mbps – Megabits per second	1,000,000 bits per second. A measure of how fast data can be transmitted.
Middle Mile Network	Middle mile is a term most often referring to the network connection between the last mile and greater Internet. For instance, in a rural area, the middle mile would likely connect the town's network to a larger metropolitan area where it interconnects with major carriers.
MPLS – Multiprotocol Label Switching	A mechanism in high-performance telecommunications networks that directs data from one network node to the next based on short path labels rather than long network addresses, avoiding complex lookups in a routing table.
ONT – Optical Network Terminal	Used to terminate the fiber-optic line, demultiplex the signal into its component parts (voice telephone, television, and Internet), and provide power to customer telephones.
Overbuilding	The practice of building excess capacity. In this context, it involves investment in additional infrastructure projects to provide competition.
OVS – Open Video Systems	OVS is a new option for those looking to offer cable television service outside the current framework of traditional regulation. It would allow more flexibility in providing service by reducing the build out requirements of new carriers.

PON – Passive Optical Network	A Passive Optical Network consists of an optical line terminator located at the Central Office and a set of associated optical network terminals located at the customer's premise. Between them lies the optical distribution network comprised of fibers and passive splitters or couplers. In a PON network, a single piece of fiber can be run from the serving exchange out to a subdivision or office park, and then individual fiber strands to each building or serving equipment can be split from the main fiber using passive splitters / couplers. This allows for an expensive piece of fiber cable from the exchange to the customer to be shared among many customers, thereby dramatically lowering the overall costs of deployment for fiber to the business (FTTB) or fiber to the home (FTTH) applications.
PPP – Public-Private Partnership	A Public–Private Partnership (PPP) is a government service or private business venture that is funded and operated through a collaborative partnership between a government and one or more private sector organizations. In addition to being referred to as a PPP, they are sometimes called a P3, or P^3.
QOS – Quality of Service	QoS (Quality of Service) refers to a broad collection of networking technologies and techniques. The goal of QoS is to provide guarantees on the ability of a network to deliver predictable results, which are reflected in Service Level Agreements or SLAs. Elements of network performance within the scope of QoS often include availability (uptime), bandwidth (throughput), latency (delay), and error rate. QoS involves prioritization of network traffic.
RF – Radio Frequency	a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals.
Right-of-Way	A legal right of passage over land owned by another. Carriers and service providers must obtain right-of-way to dig trenches or plant poles for cable systems, and to place wireless antennas.
RMS – Resource Management System	A system used to track telecommunications assets.
RPR – Resilient Packet Ring	Also known as IEEE 802.17, is a protocol standard designed for the optimized transport of data traffic over optical fiber ring networks.

RUS – Rural Utility Service	A division of the United States Department of Agriculture, it promotes universal service in unserved and underserved areas of the country with grants, loans, and financing. Formerly known as "REA" or the Rural Electrification Administration.
SCADA – Supervisory Control and Data Acquisition	A type of industrial control system (ICS). Industrial control systems are computer controlled systems that monitor and control industrial processes that exist in the physical world.
SNMP – Simple Network Management Protocol	An Internet-standard protocol for managing devices on IP networks.
SONET – Synchronous Optical Network	A family of fiber-optic transmission rates.
Streaming	Streamed data is any information/data delivered from a server to a host where the data represents information that must be delivered in real time. This could be video, audio, graphics, slide shows, web tours, combinations of these, or any other real time application.
Subscribership	Subscribership is how many customers have subscribed for a particular telecommunications service.
Submarine Network	Submarine networking is the process by which data is carried on subsea cables to connect continents. Submarine networks carry 95 percent of the world's intercontinental electronic communications traffic.
Switched Network	A domestic telecommunications network usually accessed by telephone, key telephone systems, private branch exchange trunks, and data arrangements.
T-1 – Trunk Level 1	A digital transmission link with a total signaling speed of 1.544 Mbps. It is a standard for digital transmission in North America.
T-3 – Trunk Level 3	28 T1 lines or 44.736 Mbps.

UNE – Unbundled Network Element	Leased portions of a carrier's (typically an ILEC's) network used by another carrier to provide service to customers. Over time, the obligation to provide UNEs has been greatly narrowed, such that the most common UNE now is the UNE-Loop.
Universal Service	The idea of providing every home in the United States with basic telephone service.
Upstream	Data flowing from your computer to the Internet (sending E-mail, uploading a file).
UPS – Uninterruptable Power Supply	An electrical apparatus that provides emergency power to a load when the input power source, typically main power, fails.
USAC – Universal Service Administrative Company	An independent American nonprofit corporation designated as the administrator of the Federal Universal Service Fund (USF) by the Federal Communications Commission.
VDSL – Very High Data Rate Digital Subscriber Line	A developing digital subscriber line (DSL) technology providing data transmission faster than ADSL over a single flat untwisted or twisted pair of copper wires (up to 52 Mbit/s downstream and 16 Mbit/s upstream), and on coaxial cable (up to 85 Mbit/s down and upstream); using the frequency band from 25 kHz to 12 MHz.
Video on Demand	A service that allows users to remotely choose a movie from a digital library whenever they like and be able to pause, fast-forward, and rewind their selection.
VLAN – Virtual Local Area Network	In computer networking, a single layer-2 network may be partitioned to create multiple distinct broadcast domains, which are mutually isolated so that packets can only pass between them via one or more routers; such a domain is referred to as a Virtual Local Area Network, Virtual LAN or VLAN.
VoIP – Voice over Internet Protocol	An application that employs a data network (using a broadband connection) to transmit voice conversations using Internet Protocol.

VPN – Virtual Private Network	A virtual private network (VPN) extends a private network across a public network, such as the Internet. It enables a computer to send and receive data across shared or public networks as if it were directly connected to the private network, while benefitting from the functionality, security and management policies of the private network. This is done by establishing a virtual point-to-point connection through the use of dedicated connections, encryption, or a combination of the two.
WAN – Wide Area Network	A network that covers a broad area (i.e., any telecommunications network that links across metropolitan, regional, or national boundaries) using private or public network transports.
WiFi	WiFi is a popular technology that allows an electronic device to exchange data or connect to the Internet wirelessly using radio waves. The WiFi Alliance defines WiFi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards".
WiMAX	WiMAX is a wireless technology that provides high-throughput broadband connections over long distances. WiMAX can be used for a number of applications, including “last mile” broadband connections, hotspot and cellular backhaul, and high speed enterprise connectivity for businesses.
Wireless	Telephone service transmitted via cellular, PCS, satellite, or other technologies that do not require the telephone to be connected to a land-based line.
Wireless Internet	1) Internet applications and access using mobile devices such as cell phones and palm devices. 2) Broadband Internet service provided via wireless connection, such as satellite or tower transmitters.
Wireline	Service based on infrastructure on or near the ground, such as copper telephone wires or coaxial cable underground or on telephone poles.