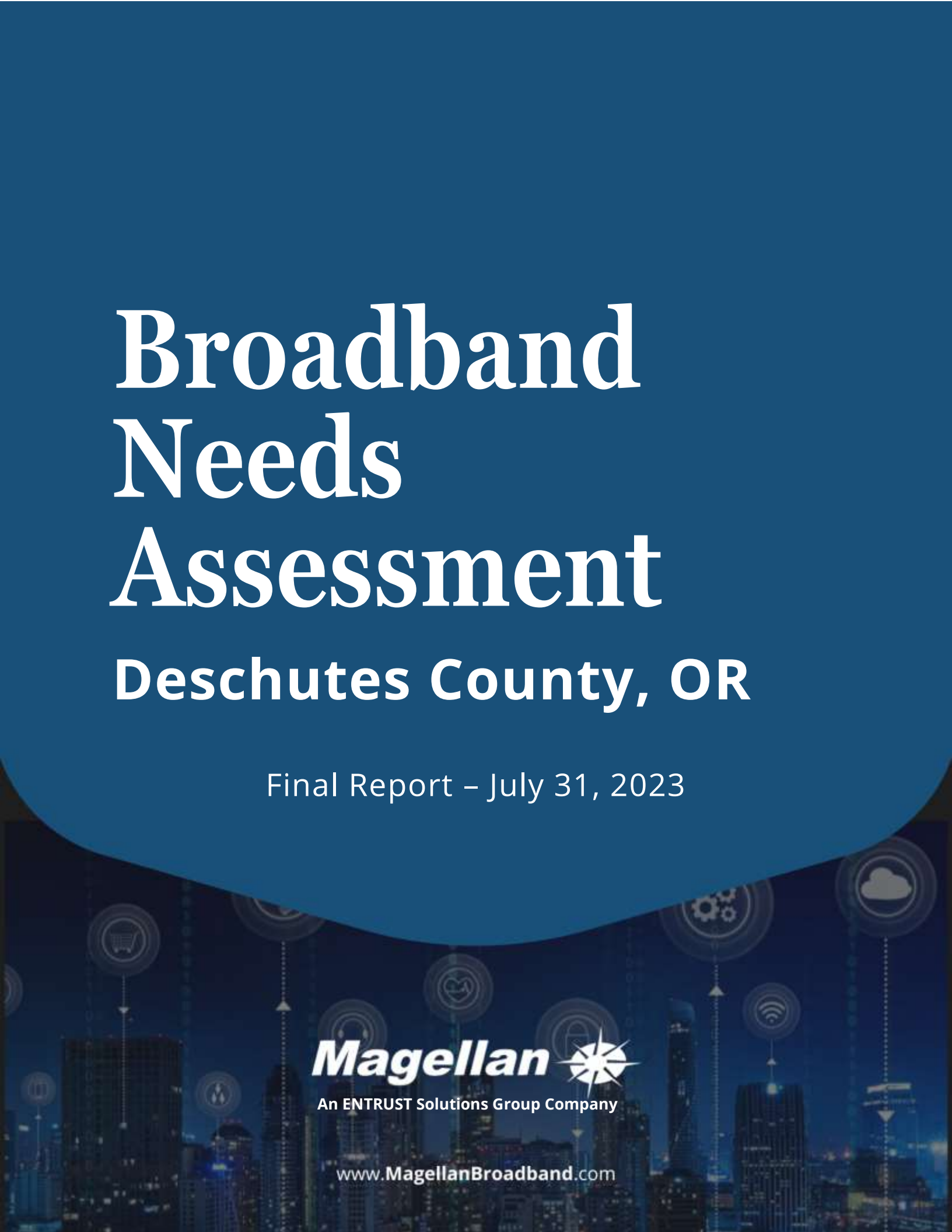
Broadband Needs Assessment

Deschutes County, OR

Final Report – July 31, 2023



Magellan

An ENTRUST Solutions Group Company

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Executive Summary

Deschutes County has multiple network service providers and substantial privately owned network infrastructure. Despite this, there are clear gaps in network infrastructure and broadband services. Broadband, which has come to mean always-on, high-speed internet access, is required for all aspects of modern life. Education, healthcare, shopping, and work are increasingly online, which means those without broadband are excluded from much of today's economy and society.

The Oregon Broadband Middle-Mile Infrastructure Planning Group[1] recommended 100 Mbps download and 20 Mbps upload as the minimum standards for broadband. This standard aligns with other western states and is higher than the outdated federal standard, which the state adopted in 2018. Regardless, it is far below the emerging standard of 1 gigabit per second (1,000 Mbps) and does not approach the expected speed requirements of the near future. Traditional services such as voice telephone and video television programs are increasingly delivered across the internet. Activities such as remote work and video surveillance have become more common with improved connectivity. New applications are emerging regularly. All of this suggests that connectivity requirements are going to continue to grow.

The broadband gaps in Central Oregon appear to be in rural residential areas, beyond the edges of incorporated cities. Data collected from internet service providers by the Federal Communications Commission indicates this and it is supported by responses to the Faster Internet Oregon survey (see page 20 for details). These areas have only legacy twisted pair wire infrastructure, satellite, and some wireless services. None of these can economically meet the current state broadband standards. More remote rural locations have only satellite, which can be relatively costly and/or slow. There are also gaps in infrastructure outside the region that could cause widespread outages in the case of a major seismic or wildfire event.

Steps to closing these gaps include focused investments in infrastructure and services along with establishing means to guide and track broadband development.

[1] The Oregon Broadband Middle-Mile Infrastructure Planning Group was an ad hoc committee formed at the request of state representatives and senators in 2021. A copy of the group's report and recommendations is available online at https://www.linkoregon.org/wp-content/uploads/2021/08/middle-mile-futures-report-v1-0-2021-07-20-distro2.pdf. The current official standard for the State of Oregon is 25 Mbps download and 3 Mbps upload, following the national standard set by the FCC in 2015.

Specifically, this study considers the feasibility of (a) fiber to the home in rural residential areas, particularly those with relatively low-income residents, (b) ways to increase network resilience, and (c) wireless broadband to remote rural locations. There are potential partners and a variety of funding sources for all of these solutions. Efforts must be focused because the areas to be developed are rather large and resources are limited.

The two key steps to closing the gaps are organizational. First, regional stakeholders should designate an organization to coordinate, support, and monitor broadband development. Second, there should be task forces established to work on each of the prospective priority areas. Building on those two steps, Magellan recommends adopting consistent broadband-friendly policies, approaching broadband in a similar manner to economic development, collecting data on broadband assets, availability, and demand, and seeking public and private investment in network infrastructure and services. This report provides extensive background information and specific findings from community outreach to guide and support these recommendations.

1. Introduction

Central Oregon Intergovernmental Council (COIC) contracted with Magellan for a broadband needs assessment for Deschutes County in early 2022. A key task for the study was to establish current and future service level standards. The current Federal Communications Commission (FCC) minimum standard for fixed (wired) broadband is 25 megabits per second (Mbps) for download and 3Mbps for upload, commonly referred to as "25/3." The State of Oregon adopted this as its official standard in 2018. California and Washington recently adopted 100/20 as a target for universal broadband. Not only is 25/3 generally considered inadequate, DSL service seldom achieves this speed. Consequently, 10/1 has become a minimal floor, determining eligibility for some USDA programs. Meanwhile, gigabit service—the "gold standard" for retail broadband—is reasonably widespread, especially if cable's 940 Mbps service counts, albeit in limited areas with affluent, dense consumer bases.

Only community members can definitively state what they require, therefore our analysis focuses on practical realities related to broadband. This memo establishes a minimum standard of broadband service that should be available everywhere in Deschutes County based on economic and technical reality. The same approach is used to set a minimum standard of service for commercial areas, neighborhoods within the urban growth boundaries, schools, health care, employment centers, etc. Similarly, total regional "trunk capacity" into and out of Deschutes County is ultimately a market reality determined by private capital investment, internet service providers' development, and ultimately, consumer demand. Therefore, we consider demographic as well as economic and technical realities to determine minimal and target goals for long-haul and middle-mile network capacity.

Local commercial and residential service standards and regional network capacity are summarized as projections for 2033 and 2043. It should be noted that predictions for internet capacity as well as other technology topics are notoriously difficult to make.[2] Therefore, we essentially make a "straight line" projection, which should be taken as a baseline benchmark or minimum target. In making these projections, we review relevant background information and provide details about several of the realities that constrain the availability, capacity, and cost of network services, particularly broadband, in Central Oregon.

[2] See, for example, "7 Tech Predictions That Totally Missed the Mark" (Erik Devaney, Hubspot blog, June 10, 2021, https://blog.hubspot.com/marketing/failed-tech-predictions) for a litany of the some of the most notable ones.

As shown in Figure 1, it is important to consider community needs and opportunities as drivers of and constraints on public investment. This approach ensures public funding has broad benefits and they are spent in an efficient, fair, and open manner.

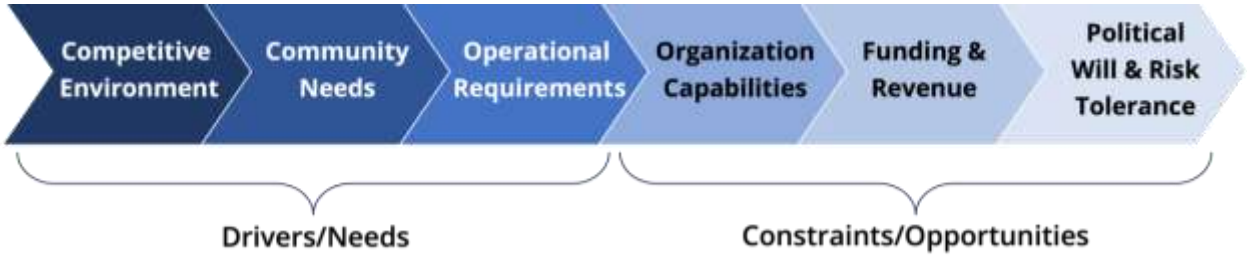

Figure 1. The key factors in broadband development

Public-private collaboration seems necessary to fill in Deschutes County's broadband gaps. Therefore, an approach to acquiring and governing public broadband investment is also a major component of this report. The goal is to ensure robust, varied options for agribusinesses and their rural neighbors. The content of this report can be used to support grant applications in conjunction with private partners.

DEMOGRAPHIC BACKGROUND

Deschutes County, Oregon has 3,017.6 square miles of land area and is the 11th largest county in Oregon by total area. Given a 2020 population of just under 200K, Deschutes is more densely populated than the state—65.7 people per square mile contrasted with 41.4 for all of Oregon—but less dense than the country, which averages 94 people per square mile. As summarized in Table 1, Deschutes County has grown and developed substantially over the last decade.

Table 1. Basic demographic and economic statistics for Deschutes County, OR[3]

Statistic	Most Recent	10 Years Ago
Total Population	198,253	157,733
Total Households	83,763	64,678
Median Household Income	$79,796	$46,984
Bachelor's Degree or Higher	41.2%	30.3%
Total Employer Establishments	7,821	5,877

[3] Sources: *American Community Survey* and *County Business Patterns*, U.S. Census Bureau. Statistics are either for 2021 and 2011 or 2020 and 2010. 2013 was the first year data on internet was collected.

Employment Rate	59.0%	54.0%
Households with Internet	92.4%	78.0%
Households with broadband	78.8%	56.9%
Households with no internet	6.3%	17.2%

The fundamental point is that demand for broadband has undoubtedly increased, driven by population, income, and education. Just like any consumer service, it is inevitable that people want better broadband for lower prices. Unlike other services, broadband has network effects that drive the benefits of connectivity and the costs of being disconnected. As more activities go online, connectivity becomes more beneficial while those without access face additional costs. Local population change along with increasing digitization throughout society create impetus for broadband investment. Population growth alone suggests that performance and geographic coverage need to improve in Deschutes County.

BROADBAND BACKGROUND

Basic, 25/3 broadband is delivered via digital subscriber line (DSL) by traditional telephone companies ("telco"). In Deschutes County, this was CenturyLink, which is now part of Lumen Technologies. Generally, the telcos' old, twisted-pair, copper lines don't meet the service's technical requirements, they are not maintaining or upgrading DSL, and speeds decrease over distance—DSL reaches 18,000 feet (less than 3.5 miles) at most. Consequently, areas with older telephone network infrastructure, especially those away from the central office, have little or no DSL.

Basic broadband can also be delivered wirelessly via radio spectrum, including cellular mobile data as well as fixed wireless broadband and Wi-Fi. There are many types of radio-based internet access and several providers in Deschutes. Cellular includes 3G (which has generally been phased out), 4G, and 5G, along with underlying protocols such as LTE.[4] Citizens Broadband Radio Service (CBRS) is a parallel system that uses open, unlicensed spectrum, as does Wi-Fi. Generally, all of these are shared media: More users connected to an access point or in a cell means each user gets less bandwidth.

While these services can cover substantial distances, the practical limit is about 10 miles. Newer technologies provide near-line-of-sight connections, but foliage and

[4] The "G" stands for "generation." 6G is in early development. "LTE" stands for "long term evolution" but is a bridge standard between original cellular data standards and 5G.

other obstacles can greatly limit them. Fixed wireless can practically provide speeds over 100 Mbps, depending on distance and technology, and nominally up to 400 Mbps. Actual bandwidth tends to be 10 Mbps to 50 Mbps download and upload between 1 Mbps and 5 Mbps. Millimeter wave (mmWave) fixed wireless is capable of download speeds over 1 Gbps (or 1,000 Mbps) but only works at short distances with few physical barriers. AT&T and Verizon have a presence but only provide 4G LTE fixed wireless internet service which offers much slower speeds. Satellite is also radio-based but with facilities in the sky so current providers—Hughesnet, Starlink, and Viasat—cover most everywhere with some key limitations. Wireless services commonly have data usage caps and overage fees.

Any of these can connect directly to a user's device or can be used as a "backhaul." For example, cellular can be used for internet access by Wi-Fi hotspots and calls from a cellular phone can be made over a Wi-Fi connection. There are also proprietary radio systems, especially for microwave-based point-to-point connections. While several of these are nominally capable of speeds faster than 25/3, end users get 20 Mbps download at best with relatively lower upload speeds.

Cable broadband has traditionally nominally achieved higher speeds due to its physical and technical characteristics: coaxial cable can carry much higher frequency electrical signals for longer distances than twisted pair used by DSL. Traditional cable companies like ("cableco")—TDS (formerly Bend Broadband) in most of Deschutes—use the DOCSIS (Data Over Cable Service Interface Specification) standard for broadband internet service. The first version, established in 1997, delivered 40/10. The most common version, DOCSIS 3.1, provides up to 1,000/35, and the more recent DOCSIS 4.0 can deliver 10,000/6,000. A fundamental issue for DOCSIS is that, as a multi-access protocol, the bandwidth is shared by all users on a local, neighborhood-level node. Therefore, a greater amount of users means less bandwidth is available to each user.

That's impressive but the newest version of passive optical network (what we commonly refer to as "fiber") can deliver up to 25,000/25,000 (25 Gbps symmetrical), which may be eclipsed by 50 Gbps service before it becomes commercially available. Generally, fiber-based broadband services use the Gigabit Passive Optical Network (GPON) standard. The basic PON standard from 2003 was 2.4 Gbps (2,400 Mbps) down and 1.2 Gbps up. The standard has been revised to deliver 10 Gbps and, most recently, 25 Gbps. While PON isn't a multi-access protocol, all users behind a splitter share that capacity via dynamically sized, multiplexed channels. Technical improvements are rapidly increasing fiber's capacity.

Beyond the technical specifications and standards, network architecture is a fundamental determinant of service levels. There are generally four architectures: mesh, ring, star, and tree. The mesh architecture is the least common, generally limited to wireless networks, consisting of multiple interconnected nodes. A ring architecture, as it sounds, has nodes that are connected to two others in a closed manner. This architecture is common in fiber networks. Star architecture, with a central node that connects every other node on the network, may be the most common. Tree architecture, which is like a star but with all nodes sharing a branch or bus that connects to a trunk, is used for DOCSIS and Ethernet.

None of these architectures are exclusive. Indeed, they are commonly combined. Backbone or core networks typically are built as rings for maximum reliability. Rings are interconnected in meshes. Access is typically via infrastructure laid out in stars. Star architecture is also common in fiber and point-to-point wireless. Mesh is typically wireless but the access points that form nodes in a wireless mesh network are often connected to fiber, too. This brings us to two key points about network architecture:

- ***Networks are hierarchical***. They are interconnected via networks of networks. Specifically, the top level of the internet is comprised of Tier 1 providers that interconnect with each other. Such major providers have *long-haul* networks that span continents, connecting their major centers. "Lower level" local and regional networks are interconnected via the Tier 1 providers. Networks within buildings and at major facilities, including cellular networks, connect to regional, *middle-mile,* or *metro networks*. Consumers connect to a local, *last-mile network*, which includes distribution and access.
- ***Networks have different logical and physical structures***. Indeed, the functionality of a network may be very different from its architecture. For example, multiple users can be on an online conference via totally different physical networks—cable, cellular, fiber, etc. This is part of the virtualization megatrend in which the function of technology is decoupled from its physical structure via software.

Networks discussed in this report are critical for the modern economy and institutions. It should therefore be considered as long-term civic infrastructure. As architected and constructed this infrastructure should be of use beyond 30 to 50 years. Thus, standards of service and middle mile bandwidth should be architected to support the anticipated data traffic growth over that time frame.

Residential Applications and Architecture

For years the broadband industry has offered the Triple Play Bundle of voice, TV, and Internet access. With the onset of streaming video, namely Netflix, consumers began "cutting the cord" and only buying internet access from cable or telephone providers. This trend has accelerated and is having substantial and disruptive impacts throughout the broadband and video industries. We expect this trend to continue, and internet-only households will dominate the market. Traditional 'home phones' and 'cable TV' will continue to be offered by the ISPs, but they will be transparently delivered over IP (Internet Protocol) and broadband. This industry transition is illustrated in Figure 2.

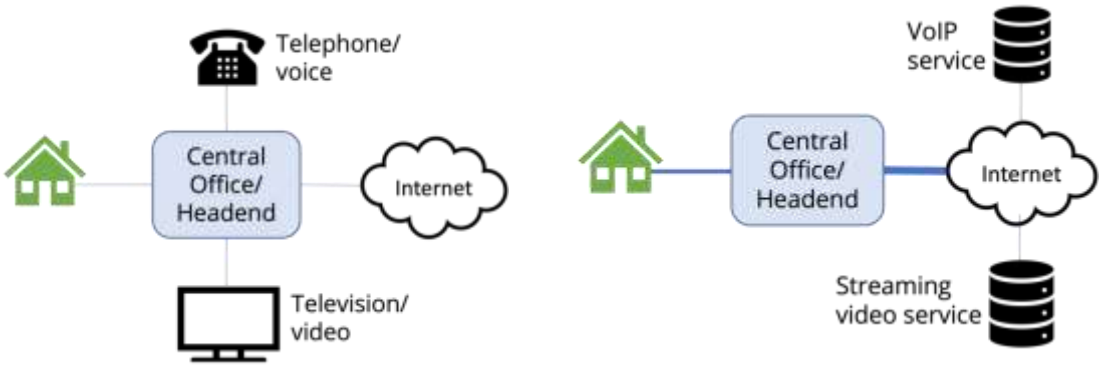

Figure 2. Local cable and telephone services have fundamentally transformed their underlying architecture around broadband.

Over the next few years, we expect cable companies to upgrade their hybrid-fiber coax networks to a new standard called 'DOCSIS 4.0' and will offer data rates as high as 5 Gbps downstream and multi-gigabit upstream. All of these rates are "up to" or "best effort" consumer-grade and are subject to daily peaks and valleys of usage. Actual data rates of all networks will depend on congestion at every stage of the network from the home's Wi-Fi network to the internet exchange point at that given moment.

Over the 30+ year lifespan of the passive infrastructure (conduit and dark fiber), ISPs will plan for each generation of electronics to last approximately 10 years. Thus, within the expected lifecycle of the fiber infrastructure, we can expect at least three upgrades. For residential deployments, the technology standard deployed today is called XGS-PON. This is a 10 Gbps architecture and is the next generation upgrade from 2.5 Gbps GPON. The timeframe for each generation, from concept through research and development to widespread deployments also takes 7-10 years. Each generation involves a wide array of technologies and a complex

ecosystem of vendors, ISPs, and international organizations. Semiconductors and electronic devices are just the beginning. ISPs will conduct years of internal lab testing and field testing to ensure the new systems are “carrier-grade” that can withstand the rigors and scale of this critical infrastructure.

25 Gbps, 50 Gbps, and 100 Gbps PON technologies and systems are under development by system vendors around the world. These emerging standards need to go through the normal engineering development process, multi-vendor interoperability testing, international standardization, and ISP testing. This is currently underway and should be ready for the first equipment refresh cycle.

Much of the Central Oregon area is rural and it served with either legacy DSL described above or fixed wireless options. Fixed wireless access (FWA) options are based on Line-of-Sight (LoS) point-to-point radio connections. The FWA ISP (also called a Wireless ISP or WISP), deploys a radio device at the home or business and creates a connection to another radio attached to an antenna 5-10 miles away. The connection from the antenna to the internet is often fiber or it can also be a separate wireless connection. Distance, terrain, and foliage will impact the actual data rates. Data rates have been limited to 20 Mbps or less. However, there are new technologies entering the market that will be capable of 100’s Mbps data rates. The national mobile network operator T-Mobile is offering an FWA service based on their mobile 5G network and claims data rates of over 100 Mbps in denser urban and suburban environments.

We expect a steady increase in wireless transmission rates over time driven by several factors. Wireless electronics benefit from the general trend of computing power doubling every two years with minimal cost increase. This is because information is encoded and decoded as radio signals by computers. As computing power increases, more sophisticated radio wave modulation and more advanced signal processing algorithms can be implemented to improve the capacity of the available spectrum. Also, additional radio frequency spectrum will likely become available over time from the FCC.

2. Current Infrastructure and Services

The broadband service offerings and coverage described in this section should be considered the best-case scenario. Fiber is expensive to build, and wireless must work around the terrain. Providers have an inherent bias for overestimating coverage to avoid regulation and discourage competitors. Offering a service in an area does not mean the provider can provision the service to a specific location. Providers may not know exactly what can be delivered until a customer orders the service. The coverage and offered speeds should be seen as baseline goals, rather than definitive indications of supply.

RETAIL BROADBAND

In Deschutes County, the broadband market is dominated by the legacy cable and telephone incumbents, as is the case in most places. Most consumers and small businesses have access to consumer-grade broadband "up to" gigabit service from cable company TDS (formerly Bend Broadband) and DSL from Lumen (formerly CenturyLink) that nominally provides about 75 Mbps. TDS offers internet packages with starting 300 Mbps and up to 1Gbps downstream rates (see Table 2).

The upstream rates are currently limited to approximately 35 Mbps. This is because cable infrastructure was created to broadcast TV channels from a central location—the cable "headend"—to many end users. Analog television signals flow on cable as radio waves, just like over the air. Those cables have limited capacity (i.e., spectrum) that must be divided between downstream and upstream. With cable television, very little traffic was sent "upstream" from subscribers to the headend. Coaxial cable has 750 MHz[5] or 1.2 GHz of radio frequency (RF) bandwidth. Only about 5 to 32 MHz were allocated for upstream traffic in frequencies that are highly susceptible to electromagnetic interference. Most of today's cable broadband infrastructure builds on this approach to allocating analog capacity. In layman's terms this means that for every "lane of traffic" going from the headend to

[5] Hertz, or Hz, named after 19th Century German physicist Heinrich Hertz, is a measure of electromagnetic radio wavelengths, which travel at the speed of light. A 1 Hz radio wave is 186,000 miles long—the energy peaks are that far apart—a 1 MHz (1,000 Hz) radio wave is 186 miles long, and a 1 GHz wave is 0.186 miles long. Digital data is encoded in these waves. Thus higher frequency waves can carry more digital data, the transmission of which is measured in bits per second (bps, 1 Mbps = 1,000 bps).

customers, there is only about four one-hundredths of a lane going back to the headend and out to the internet.

Table 2. Broadband services offerings in Deschutes County verified by Magellan[6]

Provider	Max Mbps	MRC[7]	$/Mbps/ Month	Contract
TDS (Bend Broadband)	300	$45	$0.15	1 year
	600	$60	$0.10	
	1,000	$80	$0.08	
Lumen (CenturyLink)	50	$65	$1.30	NA
	80	$65	$0.81	

The legacy telephone company and incumbent local exchange carrier (ILEC) is CenturyLink, which is now a part of Lumen Technologies. Their offerings are copper-based DSL which costs $65/mo. This includes a non-optional $15/mo. equipment rental fee. Lumen specifies a range of 50-80 Mbps for downstream rates. Upstream rates are not published by are likely 5% of the downstream rates. DSL data rates depend on the length and quality of the local loop, which is twisted pair, copper wire, and other factors so it generally achieves only about 20% of the nominal speed. Lumen nominally offers near gigabit broadband but appears to have very limited coverage.

Table 3. Retail internet services in Deschutes County according to BroadbandNow[8]

Provider	Type	Max Mbps	Coverage	Area
Blue Mountain Networks (Sureline Broadband)	Fixed Wireless	2,000	92.7%	Bend
			100%	Redmond
			99%	Sisters
			99.8%	La Pine
			93.7%	Sunriver
EarthLink	5G	100	39.9%	Bend
			19.5%	Redmond

[6] Services are not available at all locations.

[7] MRC stands for "monthly recurring costs."

[8] https://broadbandnow.com/

Provider	Type	Max Mbps	Coverage	Area
			68.2%	Sisters
			2.4%	La Pine
			52%	Sunriver
HughesNet	Satellite	25	100%	Bend Redmond Sisters La Pine Sunriver Brothers
Lumen (CenturyLink)	DSL	100	94.3%	Sisters
		140	90.7%	Sunriver
	Fiber	940	98.7%	Bend
			96.2%	La Pine
			98.3%	Redmond
PrineTIME Internet Solutions	Fixed Wireless	12	99.7%	Bend
			100%	Redmond
			86.8%	Sisters
Starlink	Satellite	200	100%	Sisters La Pine Sunriver Brothers
T-Mobile	5G	33 to 182	37.5%	Bend
			48.4%	Redmond
			59%	Sisters
			28.8%	Sunriver
			22%	La Pine
TDS Telecom	Fiber	1,000	91%	Bend
			96.8%	Redmond
			87.2%	Sisters
			80.6%	La Pine
			82.9%	Sunriver
Viasat	Satellite	100	100%	Bend Redmond Sisters La Pine Sunriver

Provider	Type	Max Mbps	Coverage	Area
		50	100%	Brothers
Webformix	Fixed Wireless	40	98.4%	Bend
			100%	Redmond
			93.6%	Sisters
Yellowknife	Fixed Wireless	15	100%	Bend
			100%	Redmond
			99.5%	Sisters
			100%	La Pine
			100%	Sunriver
			79%	Brothers

Multiple providers nominally serve some portion of Deschutes County, as summarized in Table 3. According to BroadbandNow.com, Sureline offers up to 2 Gbps via fixed wireless to western Deschutes. That seems unlikely but Sureline's parent company Blue Mountain Networks (https://bluemountainnet.com/), based in Madras, OR, may serve portions of the county. PrineTIME (http://prinetime.net/), Webformix (https://www.webformix.com/), and Yellowknife (https://www.ykwc.com/) are regional companies that offer wireless services in the area but with lower and more realistic speeds.

Other than the major providers, the incumbents, LS Networks (LSN) is the largest local service provider. BendTel (http://www.bendtel.com/) provides fiber connections and related services for enterprises and limited residential services. International fiber network company Zayo has a substantial base in Deschutes. Regional provider FatBeam has recently expanded in the area.

Earthlink resells other providers' services, including T-Mobile fixed wireless access, as it has no network assets of its own in Deschutes . Earthlink and T-Mobile nominally offer different speeds to somewhat different areas, but this is likely just due to discrepancies in the providers' information rather than actual network coverage. Generally, the service levels should be seen as best-case or what the provider would like to provide rather than what consumers can actually get. As the old internet saying goes, "your mileage may vary."

HughesNet and Viasat are legacy satellite internet providers with facilities 23,000 miles up, in geosynchronous orbits. Starlink uses more, smaller satellites that orbit less than 350 miles above the Earth. Starlink also has more downlinks to more earth stations. Consequently, Starlink can provide faster connections. It is challenged to serve dense areas due to the capacity of individual satellites. This is likely the reason for limited service areas, particularly in Deschutes County.

FCC Broadband Coverage Estimates

The FCC produces maps based on data from internet service providers (called "477" data due to the form used to report it). The next four figures, taken directly from the FCC maps, provide an overview of broadband availability from the federal perspective.[9] Providers indicated that all residential units in practically all occupied areas of Deschutes have basic broadband available. The coverage drops off for faster, 100/20 broadband, shown in Figure 5.

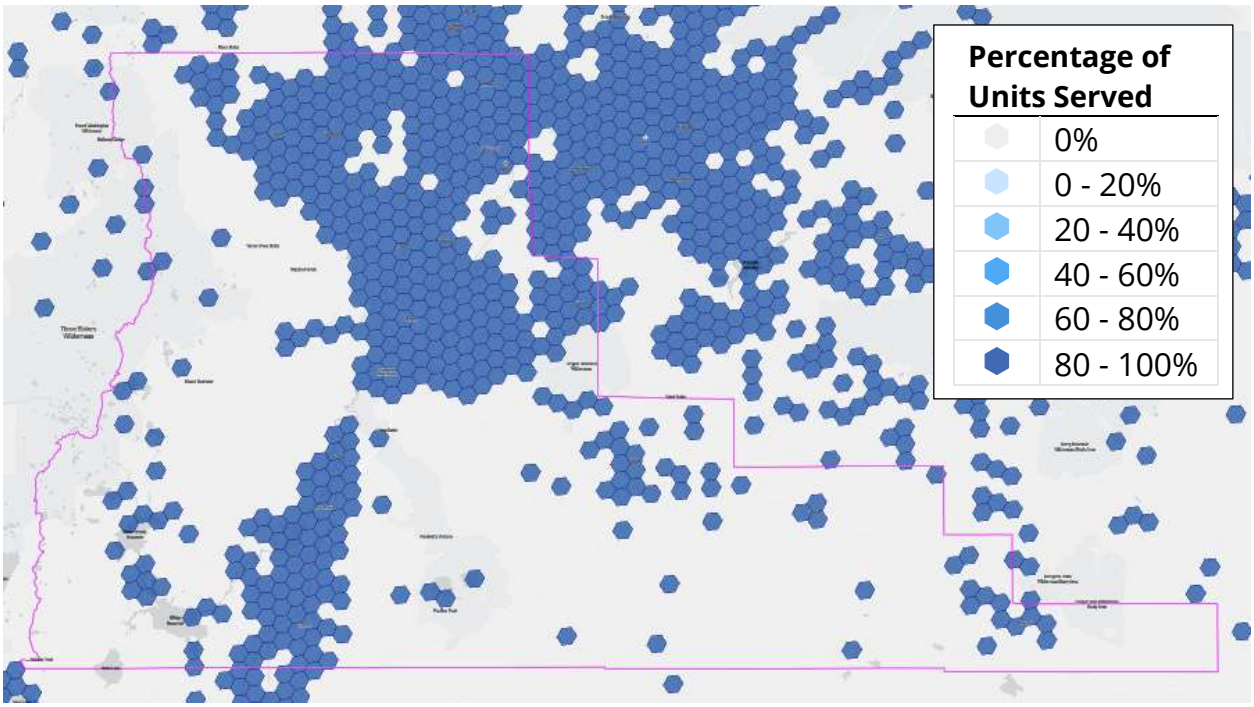

Figure 3. Availability of 25/3 or faster internet service in Deschutes County

[9] Visit https://broadbandmap.fcc.gov/area-summary/fixed?geoid=41017&type=county&zoom=8.17&vlon=-120.888113&vlat=44.029759 for the interactive map.

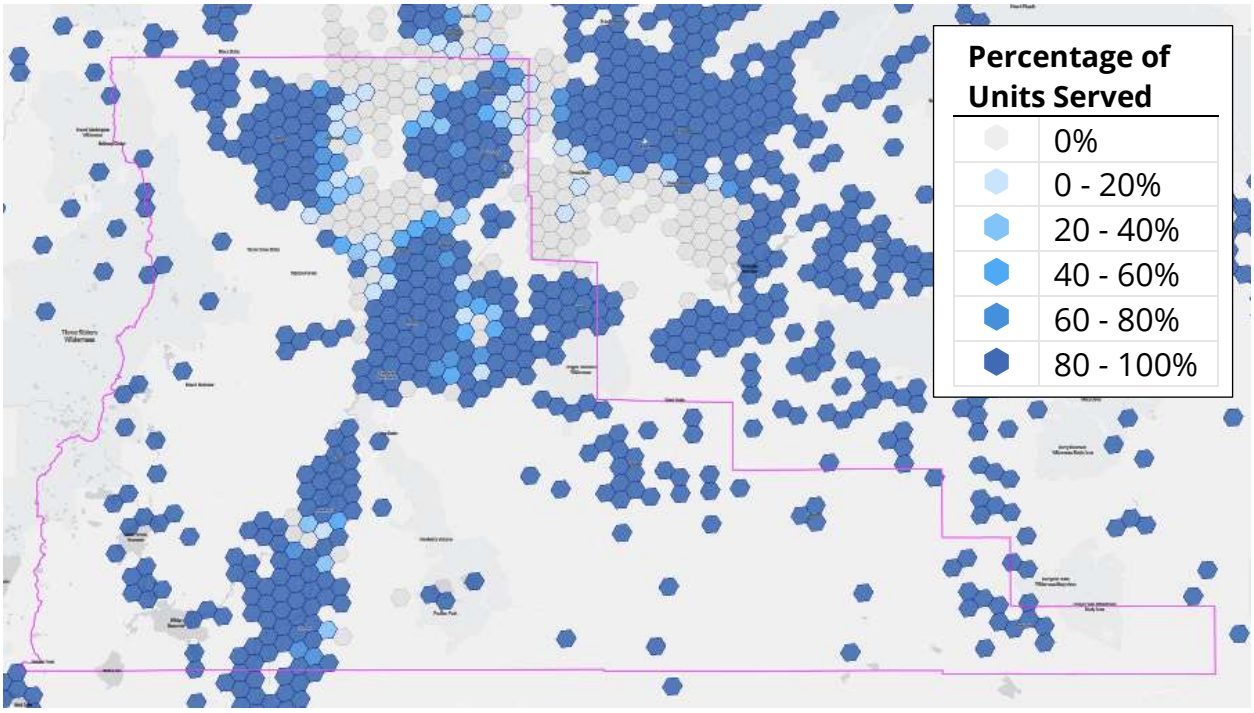

Figure 4. Availability of 100/20 or faster internet service in Deschutes County

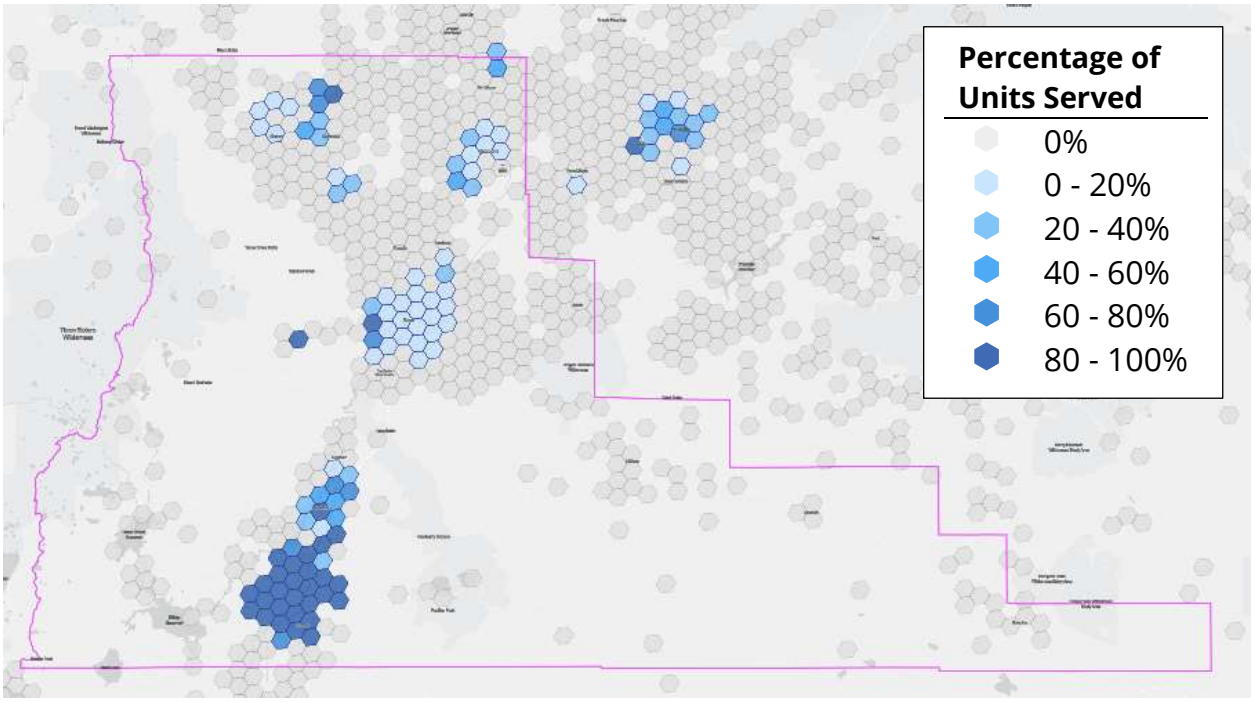

Figure 5. Availability of 1,000/100 or faster internet service in Deschutes County

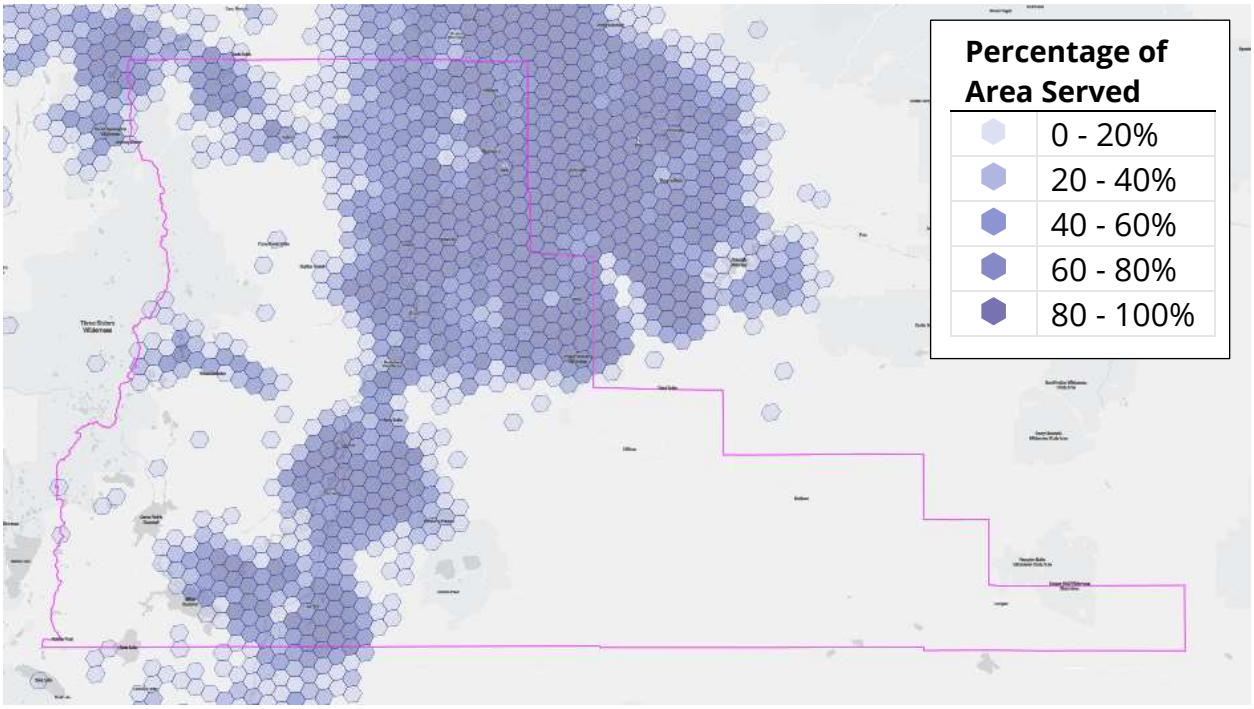

Figure 6. Availability of 35/3 Mbps 5G-NR fixed wireless internet service outdoors in Deschutes County

Gigabit services are widespread in the south of the County, in and around La Pine, as shown in Figure 6, but otherwise limited to central Bend and portions of Sisters. As noted elsewhere (Deschutes Broadband Stakeholder Input memo 02-08-2023), many use cellular internet. Figure 6 shows 5G-NR (fifth generation New Radio cellular) service that exceeds the minimal standard for broadband is available—at least outdoors—throughout populated areas but largely non-existent in East County, along US Hwy 20, around Brothers.

Faster Internet Oregon Estimates

Faster Internet Oregon (FIO) is a coalition of organizations from across the state, including Economic Development Districts, Education Service Districts, and Link Oregon.[10] Started as an initiative in Eugene for localized internet service data, FIO seeks to gather data about and map actual home Internet speeds across Oregon to determine where broadband is available and how it performs. The participation goal is 10% of all households.

[10] Link Oregon is a non-profit that provides network services to educational institutions and other public agencies.

To this end, FIO offers its internet speed test accompanied by a survey that asks for the location of the service being tested. It tests the end-to-end performance, which determines users' online experiences. The service provider is identified automatically via IP address (each provider has a set of IP address they assign to subscribers). This is a convenience survey so can only be said to represent those that took it, rather than statistically representing the population. The results of the survey are illustrated and summarized below in Table 4 and Table 5.

The FIO participation goal for Deschutes is just over 8,000. Total tests to date are 688 for 661 locations, 565 of which were fixed broadband and 96 mobile. About a fifth of respondents had sub-25 Mbps download speeds, as shown in Table 4. About three quarters had over 25 Mbps and over a quarter got more than 150 Mbps. Upload speeds, summarized in Table 5, tended to be much slower because most services are asymmetrical. Over half of the tests had at least 10 Mbps upload. About a fifth yielded less than 3 Mbps upload, while about a tenth had 25 Mbps or faster.

Table 4. FIO survey download tests results by speed bands; legend for Figure 8[11]

	Broadband	Responses	Percent of Total
●	No Service	5	0.7%
●	0-25 Mbps	149	21.6%
●	25-11 Mbps	278	40.3%
●	100+ Mbps	257	37.3%

[11] Source for tables 4-8: https://expressoptimizer.net/public/publicreport.php?state=Oregon &type=county&name=Deschutes%20County, as of June 7, 2023.

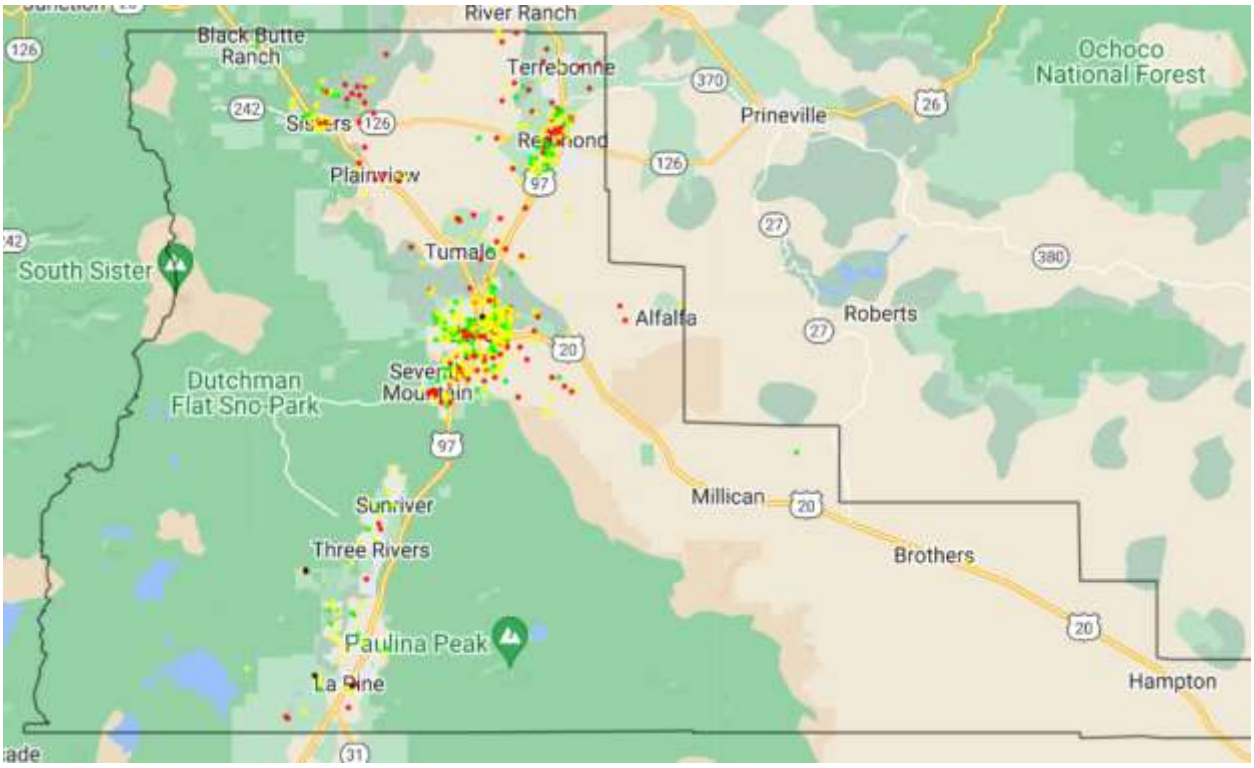

Figure 7. The geographic distribution of FIO results by speed bands (refer to Table 4)

Table 5. FIO survey upload test results by speed bands

Broadband	Responses	Percent of Total
No Service	5	0.7%
<3 Mbps	139	20.2%
3-25 Mbps	472	68.5%
25-100 Mbps	40	5.8%
100+ Mbps	33	4.8%

Table 6. Overall FIO speed test results for Deschutes County

	Maximum	Median	Minimum
Download	925.7	72.4	0.24
Upload	660.7	10.3	0.02

The fastest results were shy of a full gigabit per second download, as shown in Table 6. The overall average exceeded emerging 100/20 standards for broadband. Note that the median speeds were substantially lower than the averages, indicating most results were also below average. Table 7 and Table 8 compare test results for fixed and mobile (cellular 4G LTE) services, which

are most meaningful when contrasted with the overall statistics in Table 6. The speed ranges hide some of the key details, particularly as the median overall download test results is in the middle of the 25 – 150 Mbps range. This suggests most fixed broadband subscribers have less than 100 Mbps.

Table 7. Number and percentage of fixed broadband results for 584 locations

Download			Upload		
Speed Range	Responses	Percentage	Speed Range	Responses	Percentage
No Service	5	0.9%	**No Service**	5	0.9%
0-25 Mbps	98	16.8%	**<3 Mbps**	82	14.0%
25-100 Mbps	239	40.9%	**3-25 Mbps**	434	74.3%
100+ Mbps	242	41.4%	**25-100 Mbps**	34	5.8%
			100+ Mbps	29	5.0%

Table 8. Number and percentage of mobile internet results for 105 locations

Download			Upload		
Speed Range	Responses	Percentage	Speed Range	Responses	Percentage
0-25 Mbps	51	48.6%	**<3 Mbps**	57	54.3%
25-100 Mbps	39	37.1%	**3-25 Mbps**	24	22.9%
100+ Mbps	15	14.3%	**25-100 Mbps**	14	13.3%
			100+ Mbps	10	9.5%

Table 9. Reasons for not having broadband by percentage of four (4) responses indicating no service

Reason	Percent
Not Available	50.00%
Too Expensive	25.00%

Two of the four responses from locations with no internet indicated it was not available. See Table 9. One felt it was too expensive. FIO does not collect information about internet service costs.

Table 10. Number of responses and average download and upload speeds for providers sorted by download speed[12]

Company	Count	Down	Up
1. Centurylink Communications	3	303.49	55.63
2. LS Networks	5	238.18	279.76
3. BendTel	5	214.59	156.61
4. Fatbeam	6	178.11	98.88
5. TDS TELECOM	430	163.01	20.75
6. T-Mobile USA	8	122.64	18.67
7. Quantum Communications (LS Networks)	6	110.35	145.40
8. Peak Internet	1	103.09	20.27
9. SpaceX Starlink	8	94.68	7.91
10. Comcast Cable Communications	3	56.84	12.68
11. Sureline Telecom (Blue Mountain Networks)	2	45.52	22.68
12. Yellowknife Wireless Company	32	45.47	26.18
13. CenturyLink	138	45.02	14.14
14. ViaSat	2	41.76	2.43
15. Verizon Business	10	38.90	5.01
16. AT&T Mobility	3	35.78	10.74
17. US Cellular	2	19.18	7.94
18. Hughes Network Systems	1	13.07	2.00
19. Webformix	6	12.72	1.57
20. Prinetime Internet Solutions	1	9.41	1.18
21. Windstream Communications	2	3.44	0.58

CenturyLink (Lumen Technologies) had both the fastest and 13th fastest results, listed in Table 10. Providers were automatically identified based on IP address. Apparently, Lumen has two different IP address spaces for their services in Deschutes County. Most CenturyLink services were associated with lower speeds, so we assume their fiber and DSL services are essentially different networks. TDS was the fifth fastest overall and had by far the most tests. T-Mobile also faired reasonably well. Thirteen of the 21 tested providers averaged speeds below the emerging 100/20 standard. Four of the eight providers with download speeds greater than 100 Mbps provide retail

[12] Source for tables 10-12: https://expressoptimizer.net/projects/Oregon/speedtestmap.php, as of June 7, 2023.

broadband services. Yellowknife had a notable number of responses as a local company, which were widely geographically distributed.

Table 11. Number of responses and average download and upload speed for cloud service providers/virtual private network connections (VPN)

Company	Count	Down	Up
Akamai Technologies	3	254.28	11.86
Cloudflare	9	151.75	20.25
Amazon.com	2	137.52	66.77
H4Y Technologies	3	102.68	56.15
Cascade Divide Colo	1	89.05	89.23
Netskope	1	86.72	93.04
Google	2	51.49	7.31
M247 Ltd	1	40.68	4.33
Tefincom S.A.	3	34.82	14.27
PT. TELKOM INDONESIA	2	25.49	8.91
tzulo, inc.	1	25.46	1.93
ResortInternet	1	24.98	9.97
ZSCALER, INC.	4	24.18	30.31
Ipxo	1	15.48	5.46

Some FIO speed tests came from networks owned by cloud services providers, presumably via virtual private network (VPN) connections, and major non-provider organizations. Interestingly, the speeds for most cloud providers are quite low, including less than 200 Mbps aggregate bandwidth for the Cascades Divide Co-Location facility. In contrast, a government agency, Crook County,[13] had the fastest overall test results. Beyond that the results for non-provider organizations are surprisingly slow. As noted early in this sub-section the FIO test is for overall performance experienced by end users.

[13] Results were by respondents stated physical address and the enterprise that owns the IP address acquired during the test. We do not know how or why a device with an IP address owned by Crook County, particularly one with relatively high-speed connection, was associated with a location in Deschutes County.

Table 12. Number of responses and average download and upload speed for enterprises

Company	Count	Down	Up
Crook County Oregon	1	697.92	357.95
High Desert Education Service District	3	196.94	179.07
St. Charles Health System	1	142.76	12.20
City of Bend	5	48.02	7.49
State of Oregon	1	12.24	9.56
Pacificsource Health Plans	1	6.31	4.90

INTERNET SERVICE PROVIDERS

Incumbent Cable and Telephone Companies

Lumen Technologies

Lumen is a large global telecommunications company, based in Monroe, LA, servicing major international corporations with network, cloud, managed IT, and edge computing services. CenturyLink can trace its origin back to 1930 and since then has gone through many iterations and has bought, sold, merged, and divested many territories across the U.S. throughout the years. In October of 2016, they bought Level 3 Communications for $25 Billion giving them a national long haul fiber network.

in August 2021, they sold their assets in Alabama, Arkansas, Georgia, Illinois, Indiana, Kansas, Louisiana, Michigan, Mississippi, Missouri, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and Wisconsin to Apollo Global Management (A private equity firm) for $7.5 Billion. They retained assets in 16 states, including Florida, Nevada, and the states formerly served by Qwest (USWest) in Arizona, Colorado, Idaho, Iowa, Minnesota, Montana, Nebraska, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

In Deschutes County, and most of Oregon, they are the Incumbent Local Exchange Carrier (ILEC) and they offer DSL-based services over their legacy copper network. In November 2022, Lumen announced 32 metropolitan areas where they are committed to upgrading to fiber, branded Quantum Fiber. The Portland, Oregon metro area was included. Outside of the Portland area, they are focused on the denser areas along Route 5. The issue for Bend and Deschutes County is when Lumen will upgrade their copper network to fiber. Given their national footprint, corporate focus on large enterprises, and a finite amount of construction capital this area may not see a fiber upgrade by Lumen for some time.

TDS Telecom

TDS Telecom is a subsidiary of Telephone and Data Systems, a Fortune 1000 company that provides wireless and wireline broadband, TV, and voice services. TDS started as an independent rural telephone company that got into the cellular business early with US Cellular. It has roughly 6 million customers, 3,300 employees, and 1.2 million wired broadband connections across its national footprint through TDS Telecom. TDS Telecom grew through the acquisition of independent telcos across the central US to the point that it now has a presence throughout the country. TDS Telecom acquired Bend Broadband, which was a local cable television company, in 2014.

TDS is planning to upgrade its entire footprint over time to either FTTP or DOCSIS 4.0[14] and to deploy fiber-to-the-premises using the 10 Gbps XGS-PON standard in new build areas. TDS recently announced a national 5G mobile service under a Mobile Virtual Network Operation (MVNO) with their sister company US Cellular, which will be bundled with internet, phone, and video services. TDS views Deschutes County as a growth area. They plan to overbuild La Pine with fiber, although they nominally provide gigabit service in the area already according to BroadbandNow.[15] TDS is interested in applying for grants to expand its network into rural areas adjacent to its existing footprint and is willing to work with public entities in Oregon and Deschutes County for this purpose.

Other Network Service Providers

BendTel

BendTel is a local small business that provides facilities-based fiber internet and voice services. They promise “maximum reliability” and speeds up to 10 Gbps via fully redundant routes. BendTel has the only local Class 5 telephone switch in Central Oregon, operates secure and fully redundant colocation facilities, and has backhaul to multiple Tier 1 networks in Portland and Seattle. They have recently begun offering residential internet in very limited areas.

Blue Mountain Networks

Blue Mountain Networks is a result of the merger of East Oregon Telecom, Gorge Networks, Sureline, and Access Communications. They are an unsubsidized rural

[14] Company representatives do not expect DOCSIS 4.0 hardware to be available until 2026-2028.

[15] As of the date of this memo. See above or visit https://broadbandnow.com/Oregon/La-Pine?zip=97739 for details.

telecom provider and serve some of the less dense areas in Oregon. They offer both fixed wireless access and fiber connectivity. In Deschutes County, in 2022, they applied for and received franchise agreements in Bend and Redmond and are currently reviewing their plans for these cities. They are also in the design phase of a middle-mile connection between Sisters and Camp Sherman. Once completed, they plan to deploy FTTP in Camp Sherman immediately and in Sisters possibly in the future.

Their deployment strategy in existing areas is to deploy FTTP if aerial infrastructure is available. They will not overbuild in areas that have underground assets that lack available conduit space. In areas that do not meet their fiber requirements, they will deploy FWA via small cells.

Fatbeam

Fatbeam is a 12-year-old provider of fiber-based network solutions to enterprise, healthcare, government, and education customers in eight Western US States. In Deschutes County, they have limited fiber in Bend. They are interested in expanding their fiber network in the city of Bend as well as to adjacent areas and nearby smaller cities. Fatbeam applied for NTIA grants but has not been awarded anything yet. They are willing to work with the cities, counties, and other ISPs on joint grant applications to develop broadband for underserved areas.

Link Oregon

Figure 8. Link Oregon fiber routes and major sites

Link Oregon is a non-profit enterprise that provides high-capacity, high-reliability fiber connections to the state's public and non-profit sectors. It has various leased fiber routes into and through Deschutes County. Link Oregon leases fiber running east, north, and south from Bend, and reaches public schools, particularly rural ones, including Burns, where there is an OSU experiment station. Link Oregon operates a 400 Gbps ring with an interconnection point at the Vault Data Center in Bend.

LS Networks

LS Networks was founded 16 years ago by local electric coops to focus on providing connectivity to rural communities in the Pacific Northwest. Today, they have over 7,000 fiber route miles in the area. See Figure 9. They provide dark fiber and active services to ISPs, data centers, schools, governments, healthcare organizations, and businesses. In 2021, LS Networks was acquired by a private investment firm, and they are now interested in exploring last-mile fiber opportunities and joint grant applications. In Deschutes County, they are interested in smaller under-served cities beyond Bend and Redmond.

Figure 9. LS Network routes through Oregon (Source: LS Networks)

SpaceX Starlink

SpaceX Starlink service, discussed above, is included here because it won concessions under the FCC's Rural Digital Opportunities Fund (RDOF). RDOF subsidizes services to specific geographic areas based on an auction bidding process. The Phase 1 auction occurred in late 2020 and resulted in $9.2B of subsidies being awarded to 180 companies, including Starlink for portions of Deschutes County. Unfortunately, the FCC revoked Starlink's award because it determined that the company could not meet the program's performance targets.

Zayo

Zayo is one of the largest fiber providers in the U.S. They have over 15 million fiber miles and serve 400 global markets. Zayo's infrastructure is extensive across Oregon with over 3K route miles across some of the unserved market sections. They are committed to supporting the Broadband initiatives in Oregon. Their model is to provide middle mile connections to local ISPs. They do not have any new planned routes in Oregon but are open to discussing possible routes between Bend and Salem.

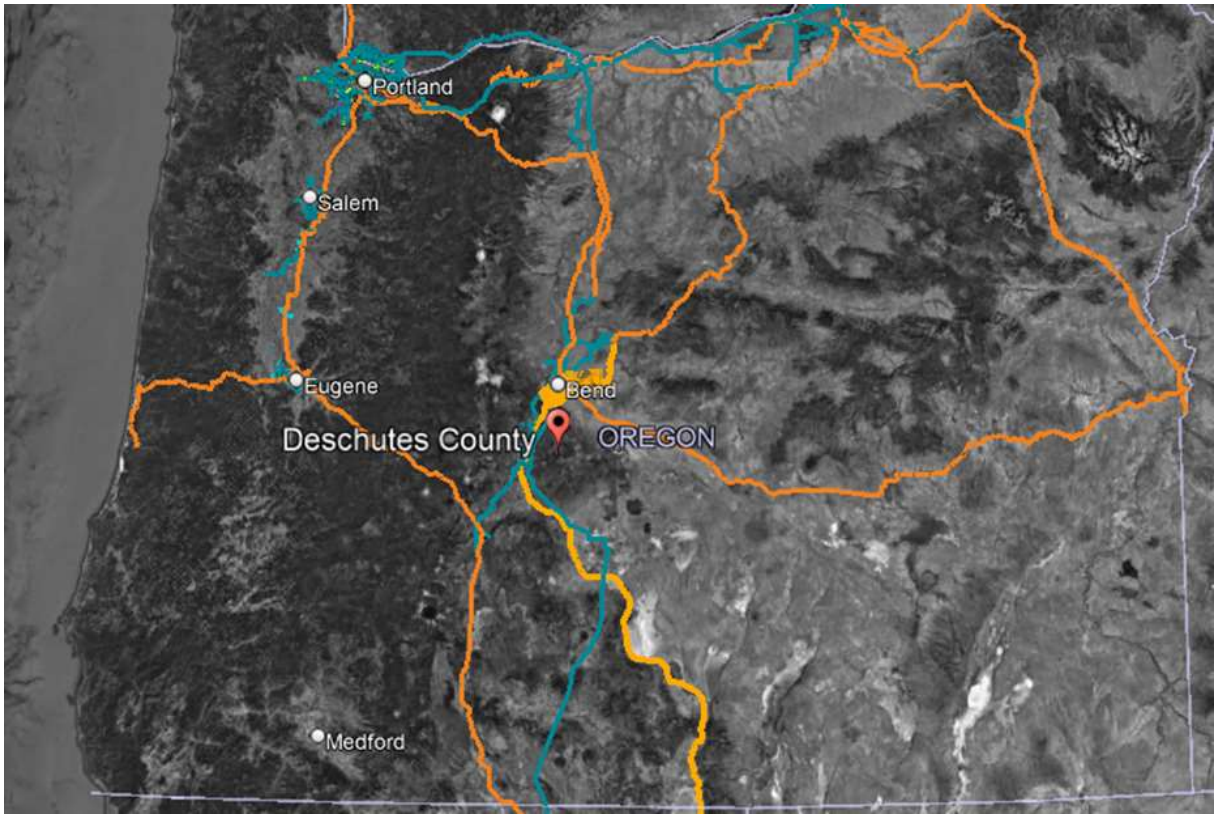

Figure 10. Zayo fiber routes through Oregon (Source: Zayo)

Ziply Fiber

Ziply Fiber is based in Kirkland, WA, and serves Oregon, Washington, Idaho, and Montana. They were founded in 2020 when an investment group (WaveDivision Capital) bought Frontier Communications' northwest assets. Today, they do not have a presence in Deschutes County. They are studying expanding along Route 20 east from Idhana to Bend through Black Butte Ranch, Sisters, and Tumalo. They noted that the current environment did not support this new route, but they continued to review it.

Data Centers

Deschutes County has at least three carrier-neutral co-location facilities. The Vault (20845 Sockeye Pl, Bend, OR 97701) data center was acquired by TDS along with BendBroadband, spun off, and is now operated by Oneneck IT Solutions,[16] a separate TDS business. Cascade Divide,[17] located at 207 SW Columbia St, and

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

[17] https://cascadedivide.com/

BendTel,[18] 130 NW Greenwood Ave, are the other, locally owned and operated, data centers in Deschutes County. BendTel directly cross-connects with Lumen's Bend central office at 100 Kearney Ave.

Cellular and Radio Sites

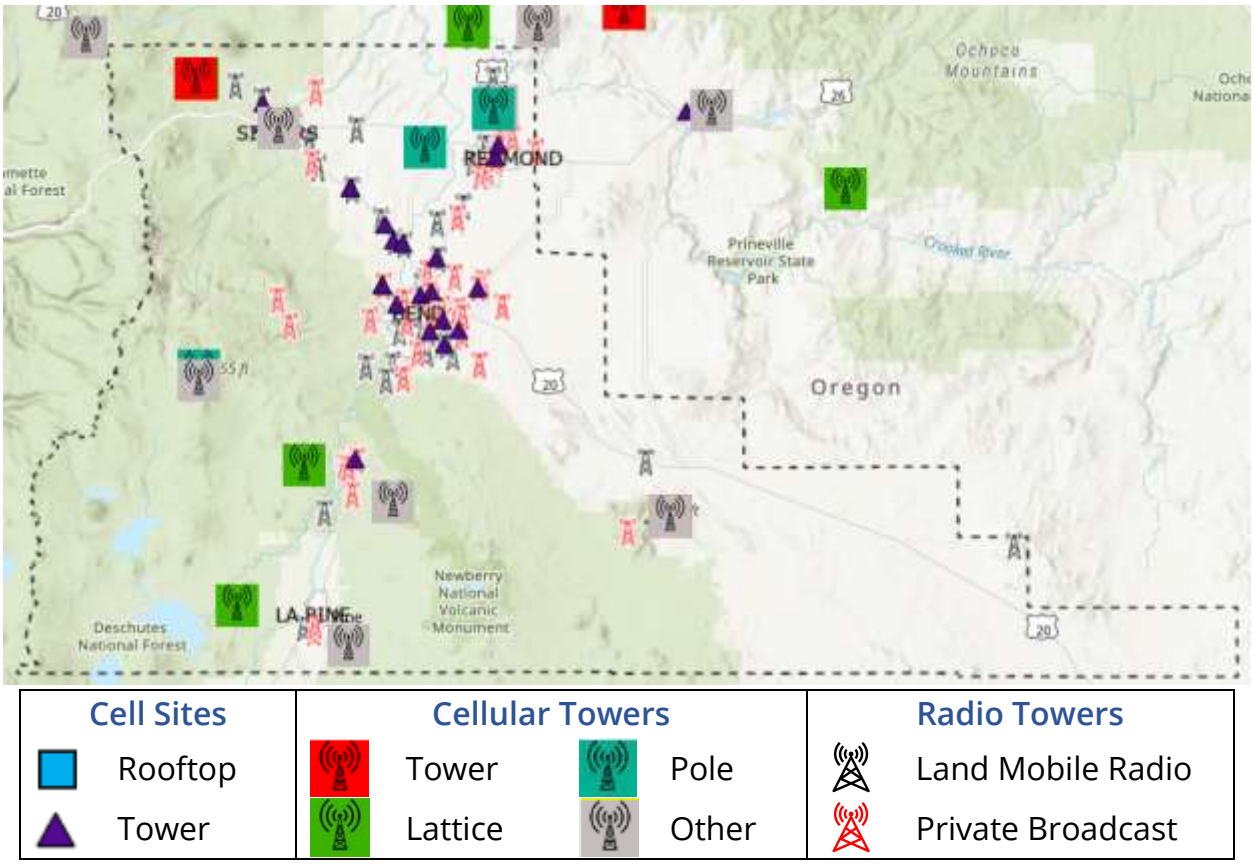

Figure 11. Cellular and radio towers in Deschutes County

There are approximately 115 cellular/radio sites in Deschutes County, Figure 11 many of which have antennas/base stations from multiple organizations. Some are traditional broadcast and land-mobile radio (for public safety, public works, and other public and private purposes). Most are for cellular services, which include data/internet as well as traditional telephone/voice services.

[18] http://www.bendtel.com/

Long-haul and Middle-mile Networks

There is substantial fiber in Deschutes County but most of it is metro or middle-mile fiber serving businesses, schools, and cell towers and long-haul fiber connecting major cities and data centers. See Figure 12 and Figure 13.

Figure 12. Long-haul fiber routes through Deschutes County

Key features of the long-haul infrastructure are (a) major routes to the south and east, extending north to the Columbia River area, and (b) local "long-haul" fiber between Bend and Redmond, between La Pine and Sunriver, and into/through Prineville. Several providers share the major long-haul routes, although they are primarily Lumen assets to the east—a fiber from Bend to Boise originally built by Enron—and Zayo assets to the south.

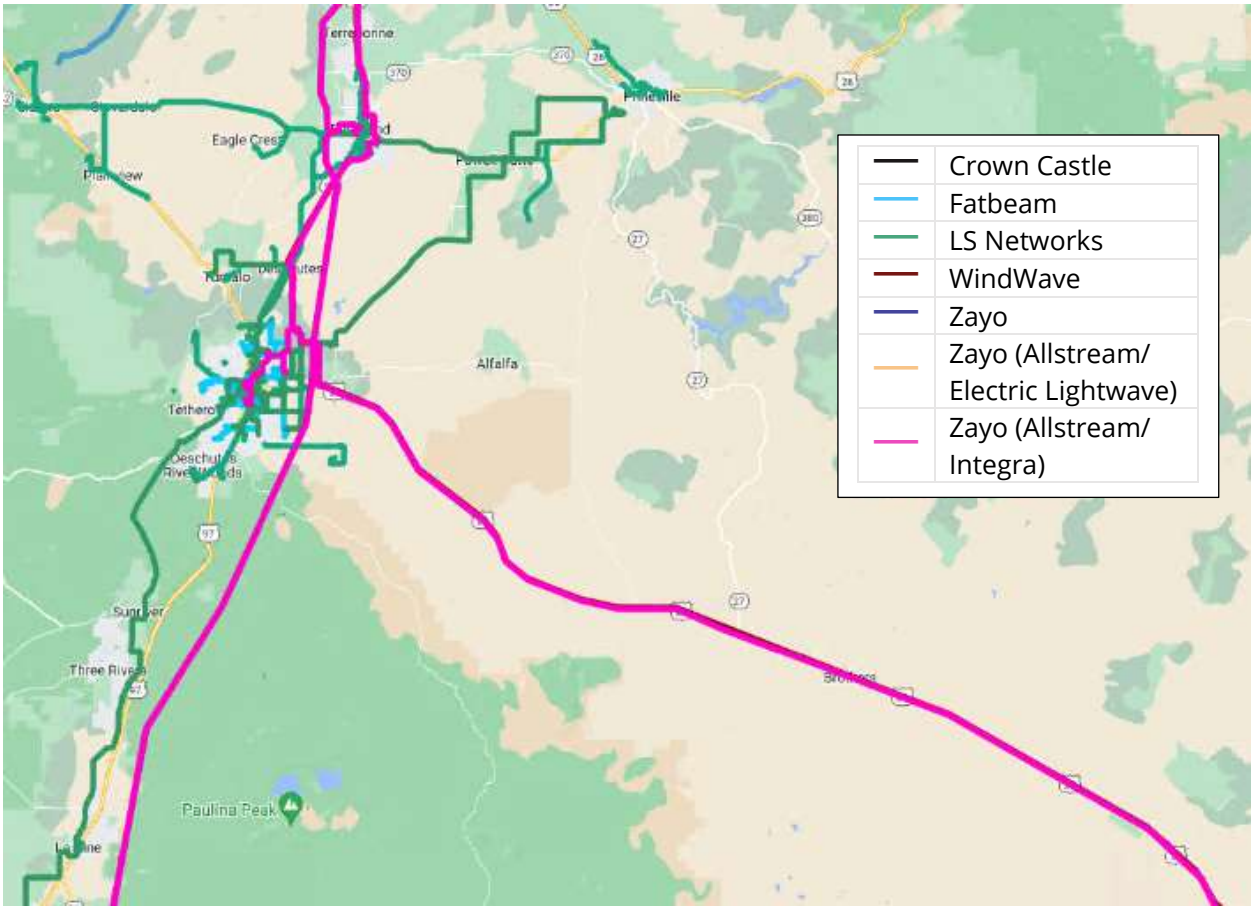

Figure 13. Metro/middle-mile fiber routes in Deschutes County

Most middle-mile providers are discussed above. Crown Castle is a real estate investment trust that leases its 40K cell towers approximately 85K route miles of fiber to service providers. It provides services to enterprise customers under some circumstances. WindWave Communications, based in Boardman, OR, has some infrastructure in Deschutes but does not appear to provide services in the area.

PUBLIC SECTOR ASSETS

Public-owned network assets in Deschutes County are rather limited. Information provided by the local government agencies indicates that none of them own any conduit, fiber, or similar horizontal assets. Documents on the City of Bend's website indicate it has conduit for interconnecting some traffic signals. Bend uses microwave links to connect several sites. It has at least six radio sites and six new or potential sites, including a site near the Juniper Ridge industrial and business park that is slated to replace a site on Boyd Acres Rd.

Deschutes County has fiber on three of its campuses, and it uses dark fiber from Fatbeam and TDS to connect three sites (Health Services, Public Works, and the Sheriff's Office) as well as TDS's central office/co-location facility. Information provided by the City of Redmond indicates that it has dark fiber between its city hall and police station and water pollution control facility. It is not clear whether this fiber is owned by the city or by a private company.

Deschutes County has four campuses. The two largest, including the courthouse, sheriff's office, jail, and 9-1-1 center, are in Bend. The other two are in La Pine and Redmond. The County also has sites in Sisters, Sunriver, and Terrebonne. Several of the sites are schools. Generally, the County leases circuits to connect all its sites to their data center in Bend (14 NW Kearney Ave). Including connections to each campus, the County has 34 network connections for which they pay approximately $111.3K per year.[19] The median speed of the circuits is 40 Mbps and the median monthly recurring cost is $250. Excluding dark fiber and dedicated internet access we have capacity and cost information for 20 of these connections. Assuming those connections for which we did not get download speeds are symmetrical, the county pays an average of $9.37 per Mbps per month, which is very high even for enterprise connections with service level guarantees. Median monthly recurring cost (MRC) per Mbps is $6.95 but the costs for some connections are as high as $24.50 per month for each Mbps of capacity. The higher-speed connections are more economical, costing as little as $0.22 per Mbps per month.

The City of Bend identified 22 locations requiring connectivity, five of which had two connections. Two of these sites had fiber-based dedicated internet access, one at 2 Gbps and the other at 1 Gbps, each of which cost $990 per month. Twelve sites had 1 Gbps metropolitan Ethernet connections for $250 per month, and two (City Hall and the City's data center) had 10 Gbps metro-E connections for $500 per month. The City Utility Department had a 500 Mbps metro-E connection that cost $500 per month along with a 1 Gbps metro-E connection. Three water utility sites were connected via a 450 Mbps microwave. One water site was connected via a low-speed radio link and seven water utility sites had no connection. Bend is spending a total of $78,360. Assuming all connections are symmetrical, and not including the dedicated internet or microwave connections, the city pays $0.17 per Mbps per month for bandwidth, which is competitive for enterprise connections with guaranteed bandwidth and service-level agreements.

The City of Redmond has a total of 74 sites, including three at the airport, a future public safety building, and water/wastewater sites, that they would like to connect,

[19] Magellan received cost information for 25 of the 34 connections.

although only 18 of those are priorities (low priority sites include a cemetery, parks, and pump stations). Evidently, 11 of these sites are connected currently. Two of these are dark fiber and one is dedicated internet access. Information on capacity and cost was provided for three of these sites, for which the average monthly cost per Mbps was $0.89, which is moderately high.

City of La Pine has a City Hall, a public works building, and a number of wastewater lift stations. The City of Sisters has two major facilities—City Hall and Public Works. All of the cities appear to own their streetlights. The three school districts in Deschutes County—Bend-La Pine, Redmond, and Sisters—have 60 facilities, including administrative offices. There are several charter schools and college/university facilities in the county, too. There are two dozen fire stations around the County, operated by 10 fire districts, counting the US Forest Service. ODOT has three facilities in the county, including a major regional facility in Bend. The next section contains more information about these stakeholders and their requirements.

3. Stakeholder Inputs

The Central Oregon Intergovernmental Council (COIC) contracted with Magellan to undertake a comprehensive broadband needs assessment for Deschutes County, including soliciting and analyzing direct feedback and input from community stakeholders. Stakeholder input is critical for building political will and identifying connectivity needs and opportunities. This memo provides an analysis of stakeholder focus group sessions held during December of 2022 resulting in input from 42 representatives from 28 organizations, including the various public agencies. ***The information below is directly from stakeholder representatives.*** The results do not represent the opinions or views of Magellan or COIC. The results are summarized in the first section, followed by a description of our methodology and then the full results write-up.

The Magellan team worked with the COIC team during the autumn of 2022 to identify the full range of community stakeholders. Generally, stakeholders are anyone who has an interest in the success (or failure) of an initiative, organization, or project. For broadband planning, we consider stakeholders to organizations in an area, particularly those that serve and support local businesses and residents. A list of these types of major organizations, including their representatives' contact information, was developed by the COIC team and supplemented by the Magellan team. For practical purposes, we narrowed these down to nine groups for which we convened online focus groups:

- Economic Development, December 5, 2022
- Education, December 6, 2022
- Healthcare & Social Services, December 12, 2022
- Land Development and Use, December 12, 2022
- Public Safety, December 13, 2022
- Support Industries and Small Business, December 13, 2022
- Government Administration, December 14, 2022
- Transportation and Utilities, December 14, 2022
- Citizens and Community Groups, December 15, 2022

The focus groups were scheduled several weeks in advance. Stakeholder representatives were contacted via email from the COIC's administrative offices to request their participation. They were then invited to the relevant focus group via email. Those stakeholder representatives that could not attend were offered the options of (a) attending a different session, (b) having a one-on-one online interview, or (c) sending an associate. Most chose to send an associate, some opted for interviews, and some simply did not respond.

Magellan led the focus groups and took notes on the discussions, which generally covered:

1. Current connectivity, including any issues or problems
2. Connectivity needs of clients, customers, members, and partners
3. Goals and plans for the near future, including upgrades, that would impact connectivity needs
4. Major issues and trends expected to impact operations and technology requirements
5. The County's potential role in increasing broadband availability and improving performance

We also asked participants who else should be asked for input and requested their assistance promoting the Faster Internet Oregon speed test survey. By the end of the process, we got input from 42 representatives from 28 organizations, including various public agencies. ***The information below is directly from stakeholder representatives.*** The results do not represent the opinions or views of Magellan or COIC.

ECONOMIC DEVELOPMENT

Participants in the Economic Development session included representatives from Bend, Sisters, Redmond, and regional and state economic development organizations. The group discussion coalesced around four main themes directly related to broadband needs:

1) *Substantial new industrial & residential land development across the County*
2) *Challenging broadband access and reliability in rural/outlying areas*
3) *Employment growth sectors require fiber connectivity*
4) *Growth of remote workforce requiring high-speed residential services*

There is a substantial amount of land currently being planned for industrial, manufacturing, and residential development within the County. Bend reported 120 acres in Juniper Ridge and 150 acres north of Talus under development, but with no public role in ensuring broadband connectivity, options, or competition. Redmond reported 750 acres south of the fairgrounds in the early planning stages for industrial uses, 135 acres north of Highway 126, and 156 acres of industrial areas as part of an exchange with State Lands. La Pine has 160 acres in a planned industrial park, and another 325 acres entitled for more than 500 residential homes. However, broadband solutions in these areas are largely being relegated to the private developers and the incumbent Internet Service Providers (ISP), with no public role in coordinating broadband infrastructure, competition, or options.

With areas of the County anticipated to grow over the coming years, there is still a stark divide between broadband access and reliability between major urban areas—particularly Bend—and the more outlying/rural areas of the County, including La Pine and Redmond. Bend did not report any instances in which broadband availability negatively impacted business attraction or retention; however, La Pine and Redmond reported intermittent service outages and/or the inability to secure high-speed fiber connections, particularly for new businesses. A new dermatology clinic in La Pine required high-speed broadband but could not obtain it without significant additional construction costs. Businesses are relying on inferior alternatives to obtain internet access outside the City of Sisters, utilizing satellite or wireless when fiber cable is not an option.

Every region in the County has substantial areas of land being planned for industrial and residential development. The economic growth sectors targeted by the cities and the County for business attraction and expansion are advanced industries that require high-speed, reliable (and redundant) broadband connectivity. The region attempted to lure an aerospace company, but they needed high-level connectivity, which challenged the business attraction strategy for the County. Aviation manufacturing is another growth sector, particularly within the Bend airport, but redundant, high-speed fiber access is required. And, even in Bend, redundancy cannot always be guaranteed. Cities reported also targeting advanced manufacturing companies for new growth, and there is significant interest from data mining companies in La Pine, both of which require redundant, symmetrical speeds of 2 Gbps that cannot currently be met by the incumbent service providers.

The targeted economic growth sectors across the County – aerospace and advanced manufacturing – require redundant, high-speed fiber connectivity that is difficult to obtain outside of Bend.

The pandemic accelerated the growth of a remote workforce in the County, driving demand for residential connectivity. Participants noted that pre-2019, a full 12% of the Deschutes County workforce was working remotely. That number has increased exponentially since COVID-19, driven not only by local employers allowing more flexibility but even more by new residents moving to the County coming from tech sectors in California and Washington. The growth of remote work, particularly for people moving to outlying areas of the County, has increased the demand for residential high-speed broadband to drive the local economies.

EDUCATION

Several administrative and technical staff from the region's educational institutions participated in the Education session, including representatives from the Oregon State University (OSU) Bend Campus, Central Oregon Community College, the OSU Cascades campus, and the Bend, La Pine, and Redmond school districts. Three themes that arose from the discussion:

1) *Increasing bandwidth speeds on campuses are generally keeping up with demand, but redundancy is not always available*
2) *Primary/secondary students outside of the city core, struggle with broadband availability and costs*
3) *Continued growth of both remote workers and remote learning at higher education institutions requires better residential connectivity*

The education campuses generally reported sufficient bandwidth speeds, achieved through lit and dark fiber provided through TDS, LS Networks, and FatBeam. Redmond School District is in the process of switching from TDS to LS Networks, which will allow them to increase from 750 MB to a 10 GB circuit. However, redundancy was reported as a pressing need by most participants. Bend and La Pine schools reported that an E-Rate project with Fat Beam in the mid-2010s built out a dark fiber network connecting all 30 school campuses.

Redundancy was a repeated concern, as the institutions are solely relying on the incumbent ISPs' networks to provide resiliency and redundancy. The OSU Cascades campus is planning a 60-acre Innovation District development project that will include more than 50 buildings (education and housing) but are unsure about how to ensure last-mile redundancy. Bend and La Pine schools reported that the E-Rate/Fat Beam project provides "some" redundancy with a ring inside Bend. However, there is no lateral redundancy between campuses, nor in La Pine.

> *"If students don't have good internet service at their home, they don't have good cellular service either. And even if there is broadband infrastructure, some families cannot afford a $60-80 per month internet bill."*

Although the primary and secondary schools are no longer providing remote instruction, the COVID-19 pandemic highlighted the already-existing challenges for broadband access and affordability among students and their families, particularly in areas outside of the city cores.

At the height of the pandemic, the school districts were providing hotspots in underserved communities to ensure that students had connectivity at home so they could participate in remote classes. Bend and La Pine loaned out more than 1,200 hotspots to students; Redmond loaned out 1,400. The districts quickly realized that many of these homes in outlying areas without good internet access also had limited cellular coverage, which negated their intended impact. The Redmond SD representative specifically cited Alfalfa, Crooked River Ranch, and the area around Smith Rock as broadband/cellular deserts. Affordability is also a challenge for many students and their families. Redmond School District reported that even though there is broadband service within the City core, many families struggle to afford a $60-80 internet bill.

As with the Economic Development session, the higher education participants also cited the growth of remote work (and remote learning) as driving the need for better residential connectivity, particularly in outlying areas. To attract their required workforce, the campuses are increasingly offering the option for at least partial remote work, but broadband speeds and access—even in La Pine—are a challenge. And while the primary/secondary schools have moved back to in-person learning (and almost all in-person staffing), higher education continues to offer remote, or at least hybrid, classes for a student body that is dispersed across the County.

GOVERNMENT ADMINISTRATION

The group discussion included representatives from economic development, the City of Bend, and the City of La Pine. They almost exclusively focused on two critical challenges directly related to workforce attraction and retention:

1) *Housing affordability*
2) *Broadband connectivity*

There was near universal agreement among the participants that the high cost of housing is challenging the cities and County's ability to attract and retain a qualified workforce. Average home prices in Bend are $700K to $800K, described as "unaffordable" for public workers. Even in La Pine home prices exceed $400K. The lack of affordability is making it difficult for public agencies to recruit talent – which exacerbates the agencies' lack of capacity to address long-term planning and strategic growth plans. One participant described the cost of housing as "the millstone around the economy's neck."

La Pine conducted a high-level economic development study that found that agriculture-based industry jobs are disappearing and that new emerging industries

should be the target for future growth – including the knowledge-based employment sector. Yet, to attract those new emerging industries, cities need to be able to provide high-speed broadband connectivity.

The search for affordable housing is driving potential employees into outlying areas and towns, but the movement of a remote workforce into more rural areas is increasing the demand for high-speed broadband connectivity in locations where internet service is challenging.

Housing costs and broadband connectivity directly impact the ability to attract and retain a workforce.

At the La Pine City Hall, a speed test showed download at 67 Mbps, and upload at 12 Mbps. Speeds further from the city center were even worse, and it was reported that areas outside of the cities have just 10 Mbps DSL as their only internet option. Many residents in rural areas will use point-to-point antennas, but these require a line-of-sight to operate and are prone to service interruptions.

Even in places where broadband infrastructure existed, it is aging out and reaching its end of life. Bend was utilizing dark fiber for connectivity between City assets, part of a previous franchise agreement that gave the City rights to use the fiber. But the cables are old and frequently subject to damage and interruption. Neither the City nor the service provider who owns the old fiber knows the precise location and splice points, so repairs are difficult and delayed. As a result, the City is migrating off these dark fibers and instead subscribing to lit services, which will improve reliability but increase costs.

HEALTHCARE & SOCIAL SERVICES

The health and social services conversation included representatives from Pacific Source Health Plan, St. Charles Medical Center, and the County's Public Health/Emergency Coordination department, who shared two specific observations related to broadband access in the County:

1) *Internet connectivity is a determinate of personal and public health, but outlying areas of the County have poor broadband*
2) *There are limited providers and high-speed fiber circuits, fewer than needed to ensure uninterrupted connectivity for healthcare facilities*

Among all participants in this session, there was universal consensus around the critical role that internet access plays in public health and concern around areas of the County with limited connectivity that inhibits residents' ability to manage their well-being. The County reported that national studies increasingly correlate high-

speed internet with one's health. The pandemic only accelerated the movement toward telehealth and the need for remote access – for both patients and caregivers in the field. Tablets had to be converted into offline applications/information forms so that healthcare insurers were able to gather required information in the field when there was no connectivity for online data access.

With an increased reliance on social media and online mediums to relay important public health information during emergencies, the County also sees a need to improve remote/rural connectivity to ensure that all residents have timely access to critical information. These emergency communications are especially important for lower socio-economic groups that can be more vulnerable yet have less information and challenging internet connectivity.

Access to high-speed internet is increasingly correlated with public and personal health.

The health insurers and hospitals also have a significant remote workforce, particularly around La Pine and south/east county, and they require high-speed broadband to effectively function from home. St. Charles has over 2,000 remote caregivers on staff, many with connectivity challenges.

However, even within major city areas, such as Bend, there is a critical need for circuit redundancy to ensure uninterrupted connectivity for healthcare providers and insurers. Both reported using cloud servers, including some peering centers on the U.S. east coast through Amazon and Azure, which require 24/7 10 Gbps connectivity to access and exchange data on patients.

St. Charles has 12 clinics on TDS, all of which are having issues with speeds and service interruptions. The clinic in Sisters had service drops 10+ times per week. They were looking at Starlink satellite service as an option given the dearth of reliable, fiber connectivity. They are also looking to convert their clinics from a private WAN network to a retail consumer broadband service to reduce costs.

Yet even in Bend, there are no diverse, redundant circuits to provide the gigabit+ speeds required, and they are forced to rely on a single provider. All participants cited a need for more ISPs within Central Oregon.

LAND DEVELOPMENT & USE

Representatives from the region's builder's and realtor's associations, along with the Deschutes County Planning Department, participated in the focus group, focusing on three main themes:

1) *Population growth coupled with housing costs are pushing new development to outlying areas*
2) *New residents from metro/urban areas outside of the state have high expectations of high-speed broadband connectivity*
3) *Aerospace and light industrial are targeted growth sectors*

The region's population growth has only increased since the pandemic, putting tremendous pressure on an already-tight housing market that is pushing up prices in the cities' cores. The Realtor Association reports 12-13 people per day are moving to Bend, and that their clients moving to the area consistently ask about internet speeds as a main factor in their home buying decisions. This urban growth and high costs mean that home affordability is migrating to the outlying areas, though even these areas are seeing extreme prices.

The Central Oregon Association of Realtors reports that many new residents in the County are remote workers that have an expectation and need for high-speed broadband.

Migration from the city centers and a new reliance on remote work means that the need for high-speed internet access in outlying areas is increasing, though not always in areas with the necessary broadband infrastructure. New residential development in unincorporated County areas cannot exceed a density of 1 unit per 10 acres, which makes it difficult, if not impossible, for conventional internet service providers to achieve the level of customers and revenues needed to sustain services.

New Deschutes County residents are coming from major metro areas in California and Washington, which has necessitated daily, direct flights from Bend to Seattle and San Francisco to account for the influx of remote tech workers. But new residents from metro/urban areas are bringing their expectations of high-speed broadband with them, which is increasing the demand for fiber connectivity. Many of these new residents are living and working from home, which requires gigabit broadband.

As with the Economic Development participants, this focus group echoed the aerospace and light industrial employers as targeted growth sectors, including early-stage drone delivery services and "uber" air services that are looking at the Redmond & Bend airports. These industries require redundant, high-speed fiber connectivity, and business attraction strategies can be stymied by the lack of broadband infrastructure.

PUBLIC SAFETY

Participants included representatives from the County's Sheriff's office, the County's IT department, the region's 9-1-1 dispatch center, and the Bureau of Land Management's Emergency Services division. There were three central needs identified:

1) *Inter- and intra-agency circuit redundancy and fault-tolerance to ensure uninterrupted services*
2) *Internet and cellular coverage in outlying/rural areas for emergency response and outgoing public communications*
3) *Increased bandwidth speeds as systems begin migration to the cloud*

All agencies identified a pressing need for diversity, redundancy, and fault-tolerance within their networks to ensure 24/7, uninterrupted service. 9-1-1 hosts the Computer Aided Dispatch (CAD) records management system for all the public agencies in the County. 9-1-1 does not have inter-agency connectivity—they each rely on individual consumer circuits to their respective locations. While dispatch has a 500 Mbps secondary circuit as a backup, they reported that service outages sometimes impact both their primary and secondary circuit and are always looking for geo-redundant options to add reliability, including low-orbit satellite since fiber is not always available.

An immediate focus has been to identify strategies to interconnect the various public agencies directly to dispatch; at the same time, they are looking at how to interconnect with neighboring counties for cross-jurisdictional response. Radio towers in the County use a microwave backhaul, and in the last 3-4 years the County has tried to encourage ISPs to build fiber to the tower sites. However, the lack of power at the tower sites has thus prevented direct fiber connections.

The County requires inter-agency redundancy and is looking at connectivity with neighboring counties to better respond to cross-jurisdictional emergencies like wildfires.

The County reported the same issues with ensuring redundancy for their critical facilities; they are currently using two carriers for diversity and have a gigabit service as their primary. However, the secondary circuit speeds range from 5 Mbps to 100 Mbps, far below the minimum bandwidth required to efficiently operate and provide emergency response.

Although TDS has the most saturation, it is a mix of fiber and copper, and there is no direct connection between Bend and Redmond. In fact, even TDS, the incumbent

provider, has asked if the County has dark fiber between Bend and Redmond to add to TDS's network. The Fairgrounds serve as the County's secondary Emergency Operations Center and a critical regional evacuation center. Additionally, it is expected to play host to the anticipated CORE3 inter-agency emergency response training facility. However, it is essential to note that the planned CORE3 facility is intended for an adjacent property, not within the fairgrounds. The presence of a rail line in Redmond creates a geographical challenge, effectively "slicing" the city in half and potentially hindering smooth communication with the Fairgrounds.

Both internet and cellular service are lacking in outlying areas of the County, creating communication issues for public safety outside of the cities. There are cell dead zones along some of the key highways, including the route between Bend and Salem, which is often traversed by law enforcement when transporting prisoners. This problem is especially pronounced during disaster response when operations and incident command need to occur in the field. Carrier On Wheels (COW), or mobile cellular distribution antennas, are used on-site when needed. The COWs were overwhelmed by the large number of devices trying to connect during large fires and could only provide coverage in the immediate area.

This lack of coverage has implications for outward, public communications, warnings, and messaging as well, as residents in outlying areas cannot always receive critical information. As among healthcare providers and insurers, public safety is preparing for a migration to the cloud, which requires direct connections to Portland for access to the Amazon Government Cloud. With future reliance on cloud technology and applications, there will be an increased need for gigabit, redundant circuits.

SUPPORT INDUSTRIES & SMALL BUSINESS

Participants in the session were focused primarily on farm and livestock industries, with representatives from the High Desert Food & Farm Alliance and a livestock instructor from the OSU extension campuses. There were two main issues raised in the discussion:

1) *Coverage in rural areas is non-existent*
2) *Precision agriculture and/or water conservation technologies cannot be implemented without broadband/cellular service*

Rural areas of the County, particularly areas that are major food producers, have virtually no broadband service and extremely limited cellular coverage. One of the participants reported that his residence in a rural area has satellite internet coverage only at a speed of just 3 Mbps. Meanwhile, many of the OSU extension

courses in Redmond focus on food production and offer hybrid or remote learning options. However, livestock courses are all in the field, and typically in areas without any services. More food producers need to conduct business online to sustain revenues, with online sales and a virtual storefront. However, the lack of internet access in these areas is a barrier to business growth.

There's currently a run on 30-year-old tractors that pre-date the newest precision technology – because there isn't the internet service available in rural areas to even access the online owner's manual.

The movement over the past 10-20 years toward precision agriculture and water conservation techniques often relies on broadband (or at a minimum, cellular) connectivity to record GPS coordinates, relay real-time monitoring data, or coordinate with weather forecasts, etc. None of these technologies can be implemented in rural areas of the County where service is non-existent, which means these producers cannot lower their costs, increase revenues, remain competitive, or maximize dwindling natural resources. Currently, 30-year-old tractors are re-selling for a premium because new tractors utilize technology (and even online owner's manuals) that require broadband. While the technology to improve utilization of natural resources exists, in rural Deschutes County there is not the minimum required broadband or cellular connectivity to put these technologies into practice.

TRANSPORTATION & UTILITIES

The session included participants from irrigation districts, the Oregon Department of Transportation (ODOT), incumbent fiber and internet service providers (ISPs), transportation planners, and an internet exchange operator. Three key points of discussion arose:

1) *ODOT is planning for middle-mile fiber along all state highways, envisions a streamlined public procurement process and public-private partnerships*
2) *Significant anticipated growth in County overcoming 20-30 years requires smart traffic management on existing roads, enabled by fiber*
3) *Private ISP expansion limited by a density threshold and permitting concerns*

ODOT was represented by its regional traffic engineer, a planner, the regional manager, and its statewide broadband coordinator. They were enthusiastic about their plans to build a middle-mile fiber network along all state highways and touted new state legislation that will allow third parties to install conduit in ODOT trenches

through a simplified public procurement process. This process, managed by ODOT's Office of Innovative Funding, allows it to use its procurement processes for transportation projects that are built in partnership with other public or private entities.[20]

With population growth anticipated as high as 50% over the coming decades, effective traffic management through new technology will be critical.

ODOT emphasized that they envision public-private partnerships as the future and were eager to continue conversations with the ISPs on the call. They are currently working with Facebook and Zayo (a long-haul fiber carrier) to get fiber connections along all highway corridors.

While the County anticipated significant growth in the next 20-30 years (and the City of Bend projects 50% growth in the next 40 years), ODOT noted that this growth will not necessitate new roads, but rather more effective traffic management. This smart management will be enabled by new technologies that will utilize fiber for connectivity, such as CCTV/cameras, signal control, electronic messaging, and remote, real-time monitoring of road/weather status. This movement toward utilizing technology and fiber aligns with the projected growth of electric and autonomous vehicles. However, fiber is only half of the equation, as power will also be needed to utilize many of these devices.

The private ISPs participating in the discussion had varying levels of interest. Lumen Technologies stated they wish to expand in the County. TDS stated they had to wholly own and control any fiber networks and assets, even if funded through public grants. TDS noted they have passed 125,000+ households in the County and have made investments in the last five years since the acquisition of Bend Broadband. The number of houses/businesses within a specific area had to exceed a density threshold to generate enough revenue for them to consider building new assets. TDS expressed concern that local and state permitting processes could delay projects and unnecessarily increase costs.

CITIZENS AND COMMUNITY GROUPS

This session had just a single participant: a Bend resident who is active in local non-profit and grassroots organizations focused on equity and justice. The discussion focused on the resident's view of broadband as a utility, as a necessity for work and school that every resident in the County should be ensured. It was noted that

[20] https://www.oregon.gov/ODOT/Programs/Pages/OfficeOfInnovation.aspx

systematic change was required to make broadband equitable and accessible and that the quality and speeds of internet service were substantially diminished once one left the vicinity of Bend.

There was concern around the economic opportunities and future of the County. Noting that the primary industries are tourism and hospitality, the participant suggested that new sectors should be targeted for development. If not, the concern was that young people would leave the area looking for more career options.

Deschutes County is in a dynamic stage of growth accelerated by the COVID-19 pandemic and the appeal of living outside of major metropolitan areas. The area has abundant space for greenfield commercial, industrial, and residential development. Bend is anticipated to grow 50% in the next 40 years. Projected growth is not limited to the County seat: La Pine and Redmond are seeing rapid growth as well, with hundreds of acres of new residential and commercial development under planning and construction.

With rapid growth comes new challenges. The influx of tech- and knowledge-industry workers, many from metropolitan areas of Seattle and San Francisco, are driving up demand for housing which cannot keep pace. Housing supply cannot keep up with demand. Average home prices in urban areas are pricing out most workers, including public service employees, pushing them to outlying, rural areas in search of homes that fit their income and lifestyle.

As a portion of the population migrates, the digital divide between the cities and unincorporated areas of the County comes into stark focus. Broadband and even cellular services outside major developed areas are either too slow to meet most technological needs, or simply non-existent. Remote workers, especially the critical public servant workforce, need high-speed connectivity at their homes. Ironically, low-income families who move to more remote areas for lower housing costs face mobility challenges, too, further disenfranchising them. But household connectivity is just the tip of the proverbial iceberg in rural areas of Deschutes County.

Public safety and emergency response are also hindered by the lack of connectivity in rural areas, both from the perspective of limiting internal field communications during wildfire or other disaster response, but also in the ability to share external safety and public health messaging with residents who do not have access to mobile or internet devices. Precision agriculture and water conservation technologies cannot be used in rural areas because there is no connectivity to relay information, GPS data, or actively monitor crops and water basins.

Critically, the region's lack of options for fiber circuits limits the cities' and County's ability to ensure diversity, redundancy, and uninterrupted communications, as the

public agencies solely rely on private, consumer internet services to provide connectivity. The various entities responsible for emergency management and response, as well as hospitals and health facilities, are seeking alternatives to ensure that no single event will disrupt communications. As technology and data move toward more cloud-based applications, this need for secure, redundant high-speed fiber connectivity will only increase.

The general conclusion from stakeholder inputs is that current connectivity is not adequate to meet the needs of the changing population. New residents moving into the County from major metros can only find ultra-fast broadband in limited areas. Long-time residents moving to lower-cost rural areas find limited internet access options, generally at higher costs for lower speeds. The entire range of private industry and public services require reliable and resilient, as well as fast, connectivity. Increasingly, they need it in relatively isolated or remote areas.

The implications are that Deschutes County needs to push network infrastructure deeper into its urban areas as well as farther into remote, rural areas. There are multiple and quite large public benefits of this. Expanded coverage would improve emergency response and public safety and would support a more robust local agricultural sector. Broader, deeper broadband would mean more flexible access to education, healthcare, and work.

The key is to invest in alignment with, response to, and support of community institutions, family, and individual changes, particularly related to growth. Lack of density and return on investment will be major barriers to private investment. Thus, public stakeholders may need to aggregate demand, find bold, innovative private partners, make direct investments in infrastructure, and/or subsidize access. Smart policies to increase coordination and reduce costs of infrastructure development will be essential to addressing stakeholders' issues.

PRIORITY AREA WORKSHOPS

COIC staff, supported by Magellan Advisors conducted two workshops with stakeholders to gather input on priority projects, particularly under-served areas. During the first session, attendees identified school districts as potential partners for identifying broadband projects and other areas of interest. Irrigation districts' need for canal piping, particularly in the Arnold Irrigation District, south of Bend, and the need for intelligent transportation systems infrastructure in collaboration with ODOT were two other notable opportunities.

The importance of building partnerships with other organizations and agencies to leverage infrastructure projects, addressing the needs of new residential and

commercial developments, and coordinating multi-agency infrastructure initiatives were key points of discussion. The need for equity in affordable housing was also acknowledged along with a discussion of various residential development plans.

Participants recommended working through Family Access Network (FAN) advocates to connect with students and families in local school systems. They identified several general priorities: remote/rural healthcare access, digital literacy, support for seniors, Latino/Spanish-speaking populations, farmers and ranchers in rural areas, people with disabilities, and improving the quality of broadband at home through network boosters. They also recognized the importance of educating website creators and users on accessibility and compliance with ADA and equity standards.

While the group did not specify locations for broadband development, they identified various groups and communities, aiming to fill in the maps more comprehensively. They highlighted the need for SCADA systems to monitor water and wastewater systems, particularly in farming fields that rely on broadband connectivity. Additionally, they mentioned the importance of the Central Oregon Internet Exchange to network resiliency and suggested considering socio-economic, low-income, and age demographics to identify high-need areas.

Discussion during the second workshop focused on hotspots and connectivity issues for students and farmers. The school district was in the process of moving away from distributing devices to households because it did not fully solve the broadband issue as usage was limited to the students who received the devices. However, T-Mobile's support through Project 10 Million was expected to address some of the needs beyond what the school district could cover. The High Desert Farm and Food Alliance also provided hotspots to community members in specific zip codes with high rates of food insecurity in Central Oregon.

The Bend-La Pine School District was partnering with ISPs to promote the Affordable Connectivity Program, which subsidizes broadband costs for households that meet the free and reduced lunch thresholds. This initiative could provide up to $100 in savings in some cases. The High Desert Farm and Food Alliance emphasized the significance of broadband access for rural farmers, as it impacted their ability to conduct transactions, access online marketplaces, and generate income. The lack of sufficient broadband connectivity hindered their local food access and small business operations.

The groups noted—literally, via sticky notes on printed, large format maps—opportunities for broadband development in areas of Deschutes County. In the Redmond area, they identified exclusive farm use zoned land, upcoming

developments, and the potential to co-locate fiber infrastructure with canal infrastructure. They also highlighted the plans for a new signal at 35th Street and the presence of farm stands and other rural businesses in Terrebonne.

In the Sisters area, ODOT expressed interest in a fiber connection through the Santiam Pass to Salem. The Three Sisters irrigation district had already implemented canal piping and suggested the possibility of utilizing the canal map to lay fiber conduit. They identified areas with higher address point density, emphasizing the need for broadband access for farmstand transactions and the importance of intelligent transportation systems along US 20 east of Bend. Participants mentioned a planned "Golden Triangle" development in conjunction with the Bend North Corridor ODOT project. ODOT noted that it had fiber infrastructure along the US 20 corridor from Empire to Greenwood.

The City of Bend intended to partner with an ISP to bring fiber to Juniper Ridge, an industrial and institutional area in the northeastern portion of the city. The City said it would conduct FIO speed tests at the airport and mail FIO requests to households in underserved areas.

There were several opportunities to lay fiber conduit during canal piping projects identified by participants. There were opportunities in the Tumalo as COID (Central Oregon Irrigation District) was considering projects to modernize. In the East Bend/Alfalfa area, canals were identified as potential locations for burying fiber lines. In the Arnold Irrigation District, piping projects were underway, offering an opportunity to bury conduit for fiber.

In South Deschutes County, participants said Facebook intended to install long-haul fiber along US 97. Also, ODOT planned to expand a variable speed limit from Sunriver to La Pine, which would require communication and power infrastructure. Participants maintained cellular coverage east of US 97 was inadequate for students who had been given hotspots.

Overall, the session addressed multiple opportunities, priorities, and needs related to broadband connectivity in Deschutes County. While participants didn't specify priority or under-served areas, the discussions highlighted the importance of partnerships, focusing on specific populations and industries, and leveraging existing infrastructure projects to improve broadband access and meet the diverse needs of the community.

4. Existing Gaps and Future Service Levels

Broadband performance and geographic coverage need to improve, based on area demographics and providers' information about their services. Providers have created an expectation, which has been promulgated by key public and private information sources. In reality, broadband service levels do not achieve what providers profess. Speeds fall short of advertised rates. Reliability is expensive and retail broadband is at its "best effort." Availability is inconsistent. All of this is inferred because objective measures of availability and performance simply aren't available. The FCC data is clearly biased and there is evidence that providers intentionally misrepresent coverage to quash competition and suck in consumers.[21]

Our general conclusions are that (a) service level standards are increasing rapidly but are informal, (b) providers generally don't meet those standards even as they promote high-speed services, and (c) policymakers need to be better informed and more proactive, which includes getting better data. The general implication is, as noted above, to use the information in this memo as service-level targets. While they may be considered "standards," it is unlikely the standards will be achieved. Consumers and policymakers need better information about what is available relative to the targets and what is required to achieve the targets.

RESIDENTIAL SERVICE LEVEL STANDARDS

Last year, the FCC chairperson proposed updating the standard for broadband to 100/20.[22] They factored in the current cable TV infrastructure. Their legacy architecture can support gigabits downstream, but the upstream is currently limited to around 20 Mbps or less per subscriber. The 100/20 minimum can also be achieved with the newer generations of fixed wireless solutions. These are 2023

[21] See, "ISP admits lying to FCC about size of network to block funding to rivals," Jon Brodkin, Ars Technica, February 2, 2023, https://arstechnica.com/tech-policy/2023/02/cable-company-tries-to-block-grants-to-rivals-by-lying-about-coverage-area/

[22] See "FCC Chair Proposes Increasing Minimum Broadband Speeds," Marguerite Reardon, CNET, July 15, 2022, https://www.cnet.com/home/internet/fcc-chair-proposes-increasing-minimum-broadband-speeds/

minimums but are nothing new. For example, in 2019 Forbes published an article[23] recommending:

- "For social media, email, or light video streaming: 10-25 Mbps download bandwidth.
- "For gaming or heavy use of video, especially 4K: 50-100 Mbps download bandwidth.
- "For most households: At least 3 Mbps upload bandwidth, or at least 10% of your download bandwidth.
- "For heavy use of cloud backup or gaming: 5-10 Mbps, or at least 20% of your download bandwidth.
- "For households that share a lot of pictures or actively upload or stream video: 5-10 Mbps upload speeds would be more useful."

This article says, "In practice, it is difficult to use more than 100 Mbps," but fails to note that (a) services rarely meet their nominal speeds, (b) Wi-Fi, local over-subscription, and other factors may reduce performance, and (c) several applications or uses may occur simultaneously. Clearly, these should be considered bare minimums that are quickly outdated.

Each major upgrade in broadband bandwidth has unleashed a wave of innovative services. Even the upgrade from 1 Mbps to 5 Mbps had a major impact and enabled many of the video-based services we use today. The wide-scale deployment of fiber and the creation of millions of gigabit connections is, in itself, an innovation engine that will enable new applications we haven't even thought of. The bandwidth required per home is dependent on the applications consumed and the number of consumers. The bandwidth required at a given moment will be the sum of all the services being consumed plus network and protocol overhead. This applies to both the downstream and upstream directions.

[23] "How Much Bandwidth Do I Really Need Anyway?" Ben Wiechman, Forbes Technology Council, December 30, 2019, https://www.forbes.com/sites/forbestechcouncil/2019/12/30/how-much-bandwidth-do-i-really-need-anyway/?sh=108fc9cd7fdf

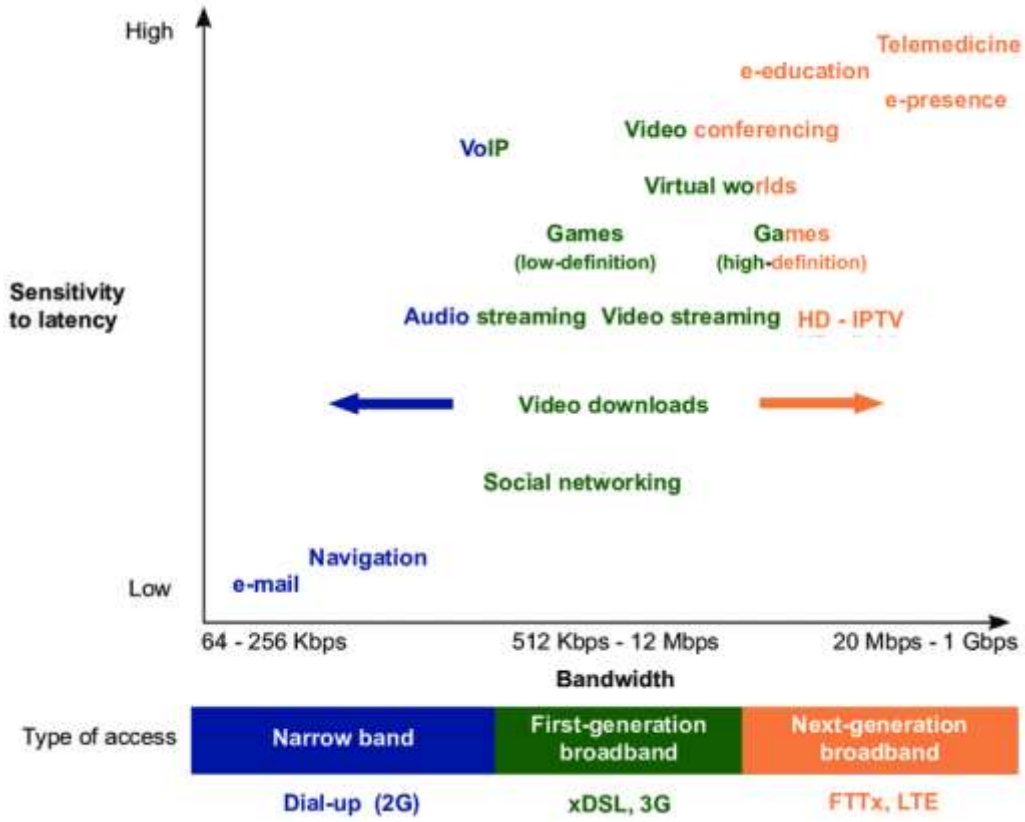

Figure 14. Bandwidth requirements for various applications[24]

Applications such as email are "bursty" and send small data packets at periodic times. There are not any issues if the packets take a few seconds, or even minutes, to arrive or if they arrive out of order. Netflix and streaming video providers, on the other hand, send a steady flow of video packets. Congestion and dropped packets will cause a noticeable degradation in these services as seen by video buffering and visual impairments. Some applications are asymmetrical, such as streaming video, where the downstream bandwidth can be megabits per second and the upstream (Pause, start, stop) is in thousands of bits per second. Video conferencing, however, is symmetrical with megabits per second in both directions.

Figure 14 illustrates the bit rate requirements of a range of existing and emerging high-data-rate applications. These are the bandwidth requirements for a single application. As we experienced during COVID lockdowns, it's the sum of all the

[24] Source: "Fast-tracking the digital revolution: Broadband for Latin America and the Caribbean," Jordán, Valeria & Galperin, Hernán & Peres, Wilson & Hilbert, Martin. United Nations Economic Commission for Latin America and the Caribbean (ECLAC), 2023, https://www.researchgate.net/publication/268048090_Fast-tracking_the_digital_revolution_Broadband_for_Latin_America_and_the_Caribbean

applications that will impact overall performance. Many home connections were overwhelmed with multiple video streams and multiple Zoom/TEAMS calls competing for limited bandwidth. The effects of congestion and lack of bandwidth could be experienced with buffering during streaming videos and poor video calls. The former is a result of network congestion somewhere between your TV and the video server and the latter is often a limitation in the upstream direction.

True 100/20 broadband would be sufficient bandwidth for all but the most demanding and futuristic applications. Of course, expert predictions for the growth of the internet and demand for bandwidth have commonly turned out to be rather inaccurate. Given the trends in application requirements and limited consumer disposable income, reasonable targets for "best effort," retail broadband services to all households in the next three to five years are:

- 100 Mbps x 100 Mbps for $30/month
- 500 Mbps x 500 Mbps for $50/month
- 1 Gbps x 1 Gbps for $70/month
- 5 G x 5 Gbps for $250/month

These targets are based on 2023 economics. These rates do not include fees and taxes, which could add 10%. The Federal ACP (Affordable Connectivity Program) provides qualified households with a $30/month subsidy. Within the time frame of the infrastructure, ISPs should plan to offer 10 Gbps services, possibly more as the electronic equipment advances. The long-term solution is fiber to most locations.

Gigabit connections will be the norm in 30 years, but fiber may never reach some locations. Given the economic and geographic realities of Central Oregon, fixed wireless and satellite may be the best, or only, services. The target for WISPs should be 100/20. However, there needs to be a usable "bargain" service of at least 50/10 for less than $30/month. Even at that level, it may take some time to achieve this target, leaving rural subscribers behind their peers in suburban and urban markets in the meantime. An important implication of this is that public online applications must function at these speeds.

ENTERPRISE SERVICE LEVEL STANDARDS

Business connectivity needs are changing too. Historically, businesses, and governments, would create a private network to connect each major location. This migrated to virtual connections using Ethernet virtual local area networks (VLANs) and IP Virtual Private Networks (VPNs). With this architecture, remote sites' data traffic would first be sent to the corporate data center and then be sent to the

internet. This would occur even if the remote sites were hundreds and thousands of miles away. This worked fine with email and web surfing.

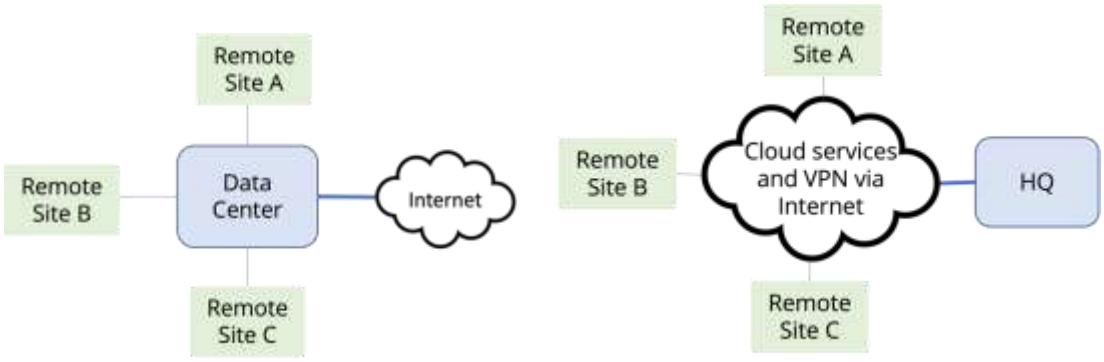

Figure 15. Enterprise networks have fundamentally transformed their underlying architecture around broadband.

Today, business and enterprise connectivity is going through a major architectural change, illustrated in Figure 15. Businesses of all sizes are migrating their IT workloads to the cloud and most, if not all, new software applications are sold in a "Software-as-a-Service" model. Thus, today's on-site corporate data centers are being augmented, and replaced, by remote data centers and by the public cloud. Business services, such as voice and video, have already migrated to the cloud and future applications will be hosted in the cloud too. In addition to the major trend toward cloud migration, there is an increase in the number of devices and locations connected to the network and an increase in the average bandwidth per device and location. This adds costs and complexities to their IT operations.

This has given rise to SASE (Secure Access Service Edge). The key value of SASE is that it enables secure, remote access to cloud and on-premises resources from any device, anywhere, while also optimizing network performance and reducing costs. SASE combines network security functions, such as zero trust networking, firewalls, and intrusion prevention systems (IPS), with cloud-based networking services like SD-WAN (software-defined wide area networking) and internet connectivity. It will enable corporations to take advantage of the proliferation of fiber-based gigabit services to support remote corporate locations and work-at-home employees.

With the trend toward the cloud and SASE, more and more mission-critical applications will be latency sensitive. To address this, edge computing has arisen. The concept is to augment centralized cloud servers with servers deployed in the nearest internet exchange such as PITIC in Portland. Over the next 30 to 50 years,

as fiber is widely deployed, and new bandwidth and latency-intensive applications become mainstream, the edge will migrate outward to cities such as Bend.

The future architecture will be based on redundant high-speed secure broadband connections to the edges of the internet and the cloud. Businesses that need connections to function continuously, will demand redundant connections from two separate ISPs with physically different middle-mile paths to a major internet exchange.

A primary difference between residential- and business-grade services are their Service Level Agreements (SLAs). These are commitments made by the ISP to the customer. In many cases, there are monetary penalties incurred should the ISP fail to meet their SLA obligations. SLAs can encompass bandwidth commitments such as sustainable bitrates and burst rates, latency thresholds, as well as network uptime commitments.

As all businesses are becoming data-driven, high-speed connectivity will be mandatory for any facility location if it's not already. Multiple providers with diverse, non-overlapping infrastructures are practically required for maximum resilience. The smart farms of the future in Deschutes County, for example, will collect massive amounts of data and will need fiber connections to process the data in the cloud to make real-time operating decisions. The amount of bandwidth required per location will depend on the type of site, the types of applications used at the site, and the number of users using the applications. Thus, we believe that each location should have access to the following data services:

- 500/500 best effort
- 1000/1000 best effort
- 500/500 w/SLA
- 1000/1000 w/SLA
- 10G/10G w/SLA
- 100G/100G w/SLA

The costs for "best effort" services should be no more than $0.30 per Mbps per month, based on Magellan's knowledge of local broadband markets. The target should be below $0.05 per Mbps per month. A service-level agreement (SLA) typically involves commitment for full bandwidth (dedicated capacity) to specific points, which could be a building or an internet port, up 99.999% of the time, so it will be substantially more expensive. The vendor usually commits to addressing major and minor issues within a short timeframe—hours for major outages—and to provide financial remedies for outages. Monitoring and reporting requirements are common elements to the point that services with SLAs are often referred to as

"managed services." Service Level Agreements (SLAs) are of utmost importance for ensuring the smooth operation of vital connections. They also say a lot about a provider's network, operations, and staff. Therefore, the costs of services with SLAs are highly variable depending on customer requirements.

MIDDLE MILE CAPACITY AND SERVICE LEVEL STANDARDS

The data rates recommended above are for the "last mile" or the connection from the household or business to the local fiber aggregation point (e.g., central office). The middle mile connects each fiber aggregation point to the internet exchange points such as PITIC in Portland. The amount of middle mile bandwidth required by an ISP is determined by the number of subscribers and the average actual data used per subscriber. Even with a 1 Gbps local connection, the actual sustained data rates are much lower. For example, if four people were streaming HD video the total downstream sustained rate would be approximately 20 Mbps downstream and less than 1 Mbps upstream.

Today, ISPs start at a 10 Gbps connection per 800-1000 subscribers. With the recommended redundant connection that would be 20 Gbps in total bandwidth. However, most ISPs do not want the middle mile to be a bottleneck in performance and aim for a maximum of 40-50% utilization. At 50% utilization that would be 10 Mbps per subscriber at peak times with all users active.

Looking ahead over the life cycle of fiber assets, we expect the average bandwidth consumption per location to increase substantially. ISPs will set a threshold of utilization and once it's surpassed, they will add additional middle-mile circuits. This could be increments of 10 Gbps or 100 Gbps. For example, when the middle mile network reaches 40% of capacity, purchase an additional 10 Gbps connection. This will eventually put pressure on the middle mile in terms of the capacity needed and the costs of providing it. For now, middle mile bandwidth continues to decrease year after year.

SATELLITE INTERNET ACCESS

For many remote areas, satellite internet may be the best or only option. Historically, there are two satellite internet companies servicing the entire continental USA; HughesNet and ViaSat. These are based on geosynchronous satellites (GEO) that orbit ~23,000 miles above the Earth. Even though the signals travel at the speed of light, the 23,000 miles up and 23,000 miles down add substantial latencies (600-700 milliseconds).

There are at least two Low Earth Orbit Satellites (LEOS) constellations being deployed today. One is Starlink from Elon Musk's SpaceX Corporation, and the other is a UK-based consortium called OneWeb. These satellites orbit the earth at altitudes of about 350-500 miles. Thus, latencies have been reduced to 30-50 milliseconds from 600-700 milliseconds latencies of the GEO offerings. Data rates of 50-100 Mbps downstream are expected once the full constellation of satellites is launched over the next few years. Starlink is currently in beta testing and has limited availability in most locations. It costs $99/month and has a $500 upfront charge for hardware.

We do not consider GEO or LEO satellite broadband as a viable primary option for urban and suburban users. However, they could be considered as a redundant backup link for the city government, businesses, and residences. In the near term, a LEO satellite option may be the best alternative for the most remote areas.

WIRELESS BROADBAND

Terrestrial radio-based broadband technologies are evolving rapidly. Inexpensive, last-generation technologies can provide minimal broadband speeds quite flexibly. Current products meet and exceed emerging standards with near-line-of-sight over a few miles. 5G fixed wireless is becoming a cost-effective, more flexible alternative to wired broadband. Next-generation technologies will increase speeds and overcome coverage issues, although fundamental physics means there will always be a distance-speed trade-off: The farther the device is from an antenna, the weaker the signal and the slower the speed will be.

A fundamental human reality dictates that most "last 100 feet" physical connections will be wireless via radio. No one wants to be wired to a wall. Most devices are mobile. The exceptions are powerful workstations and servers, but even those are often controlled via remote sessions on laptops. The ever-increasing number of appliances and other items that need connectivity, particularly the universe of industrial internet-of-things (IIoT) for agriculture, manufacturing, transportation, utilities, etc., can't practically be physically wired to a network. While these generate small amounts of data individually, the small streams add up to mighty rivers, which requires fiber.

PLANNING AND POLICY IMPLICATIONS

There is not a particular "killer app" or a new service that will drive consumers to demand gigabit broadband. Rather, it is the sum of multiple, concurrent applications on numerous devices that will drive demand and impact broadband

performance. Most of the last 100 feet and much of the last mile of our network infrastructure will be via radio-based, wireless connections. These connections will be aggregated onto fiber infrastructure. Much of the users' experience will be determined by where their apps and content reside and how close they are to it. Some systems require data to be very close to the point of use and network economics dictate that content generally be kept as close as possible to where it is created and used. Even highly distributed systems such as blockchain depend on local connectivity.

A basic goal for planning should be to get fiber as close to premises as possible, recognizing that wireless access points and cell sites will be required for most access. Fiber and radio are complementary, not mutually exclusive. It is important to distinguish the infrastructure from the services. Although some providers are highly integrated, the simple reality is that infrastructure is always shared by multiple services. The fundamental issue is who controls access. Access services make it possible to use other services. So logically, to ensure the greatest possible benefits, access services should be as flexible and inexpensive as possible. Competition between providers is the only factor that will enable more options while keeping costs down.

Therefore, another goal should be to get as much investment from as many providers as possible. The first company to build the infrastructure can exclude competitors. Large providers have an advantage due to the cost of deploying fiber, customer switching costs, and the ability to subsidize areas with competitors. Technological change can impact this, particularly since most devices connect wirelessly, but fiber infrastructure provides an inherent competitive advantage. It is economically dubious to have more than one fiber infrastructure in rural areas. Even in dense urban core areas, multiple network infrastructures can be problematic.

Shared infrastructure is the general solution to the conundrum of how to get better and more options at lower costs. It is more economically efficient and doesn't enable one provider to generate excessive profits. But there is no market impetus for shared infrastructure. Public agencies develop and manage infrastructure assets, and they need connectivity. Therefore, public agencies have an inherent interest in shared network infrastructure, especially if it addresses other public priorities such as safety, economic opportunities, and, of course, internet access. Short of building infrastructure, public agencies can foster investment and improved service levels in a number of ways, addressed in the next section.

5. Gaps and Priority Areas

Broadband gaps generally come in two forms. The first is the most obvious: Service is not available at a reasonable performance level and/or price. This typically results from limited competition and/or demand in an area. Demand comes down to the density of prospective customers able and willing to pay for broadband. Providers basically have a formula for offering services. If the numbers don't add up, they don't deploy.

The other type of gap that can exist in broadband and other network services relates to how local broadband traffic is routed, including the network infrastructure required to carry that traffic to internet exchange points (IXPs) so it can be routed from the subscriber's provider's network to other networks that connect services—Amazon, Facebook, Google, Netflix, etc.—and other users. While this type of gap isn't apparent to internet users, it affects the performance and reliability of broadband, cell phone, and other network services.

Data gathered for this assessment, including input from local stakeholders, revealed evidence of both gaps for Deschutes County. Specifically, as shown in Figure 16, data from the FCC—both the National Broadband Map and the Rural Digital Opportunities Fund (RDOF)—and Faster Internet Oregon (FIO) indicated areas under-served with broadband. The information derived from the National broadband map is very approximate because we were unable to pull the data indirectly. The density of prospective broadband subscriber premises indicates where the demand is.

The pink areas in Figure 16 indicate where the FCC National Broadband Map shows locations that do not have broadband service that meets the State of Oregon's standard for 100 Mbps downstream and 20 Mbps upstream (aggregate 120 Mbps throughput) available. The light blue areas are those eligible for RDOF subsidies. While the FIO speed tests were not geographically consistent—and could be from locations that have faster internet available but chose not to subscribe to it—it is notable that the three data sets align. What is not so evident in Figure 16 is exactly how the gaps align with subscriber premises, particularly in Bend. Figure 17 provides a zoomed-in view of the FCC National Broadband Map for southern Bend, which shows that the actual under-served area is east of the Bend Golf and Country Club, particularly south of Knott Road, outside the city's boundaries, which is a relatively affluent, small, and sparsely populated area. Therefore, we removed that as a prospective priority area.

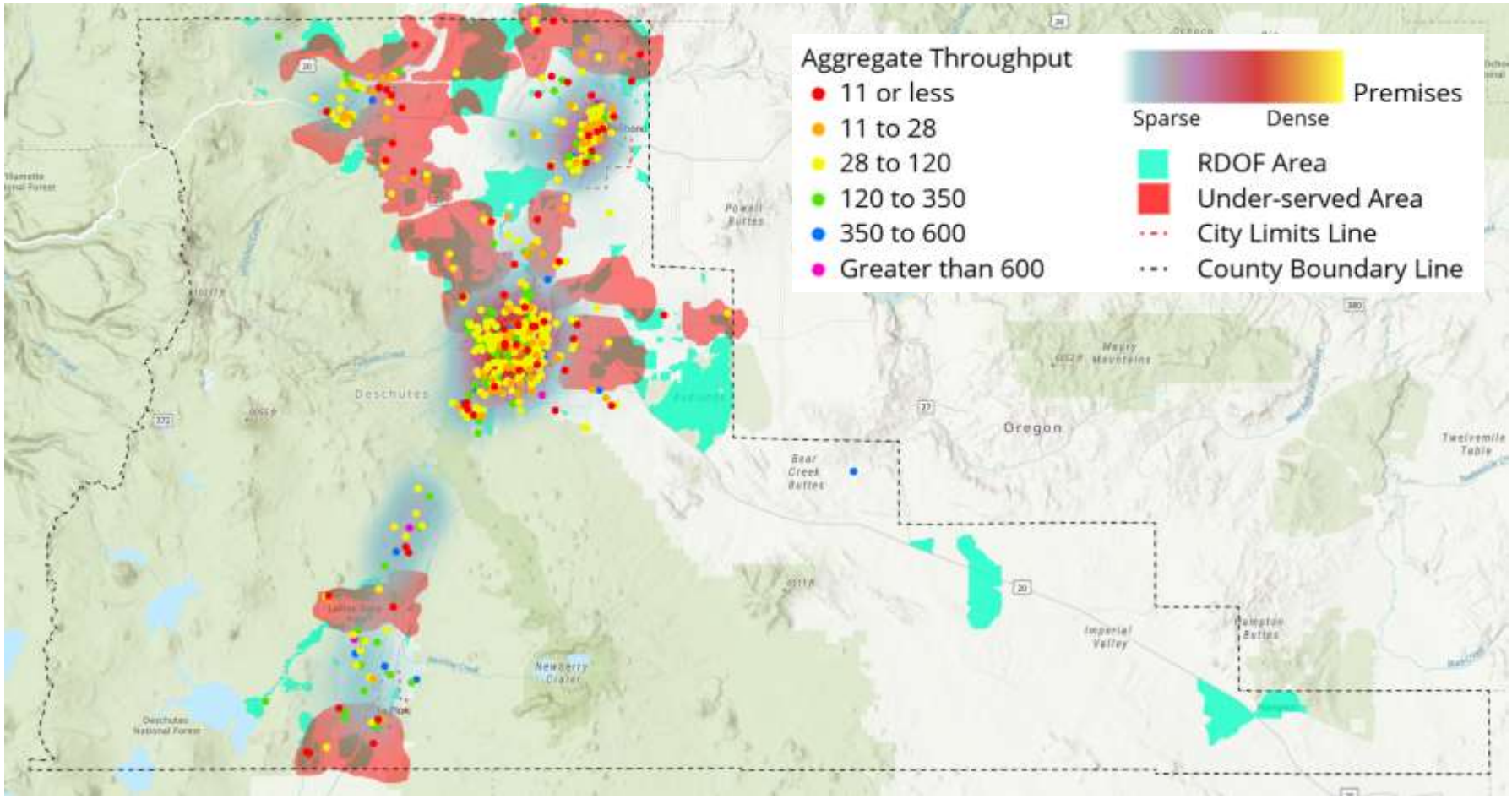

Figure 16. Broadband availability and performance in Deschutes County, OR[25]

[25] Sources: Deschutes County, Faster Internet Oregon/OptiMap, and Federal Communications Commission

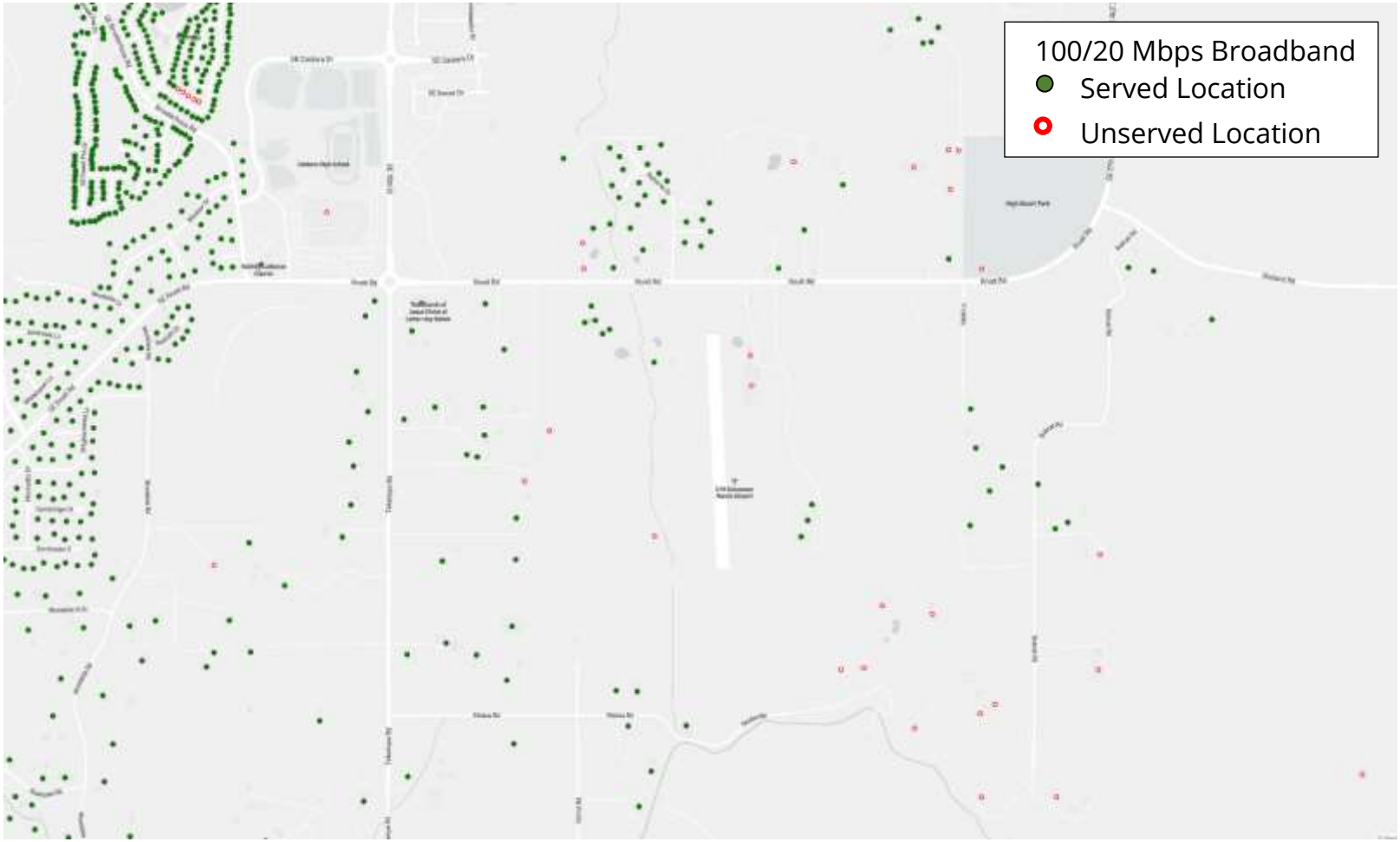

Figure 17. Availability of 100 Mbps download and 20 Mbps upload broadband southeast of Bend[26]

[26] Source: FCC National Broadband Map, https://broadbandmap.fcc.gov/area-summary/fixed?version=dec2022&geoid=13460&type=cbsa&zoom=13.62&vlon=-121.546582&vlat=43.645994&br=r&speed=100_20&tech=2_3

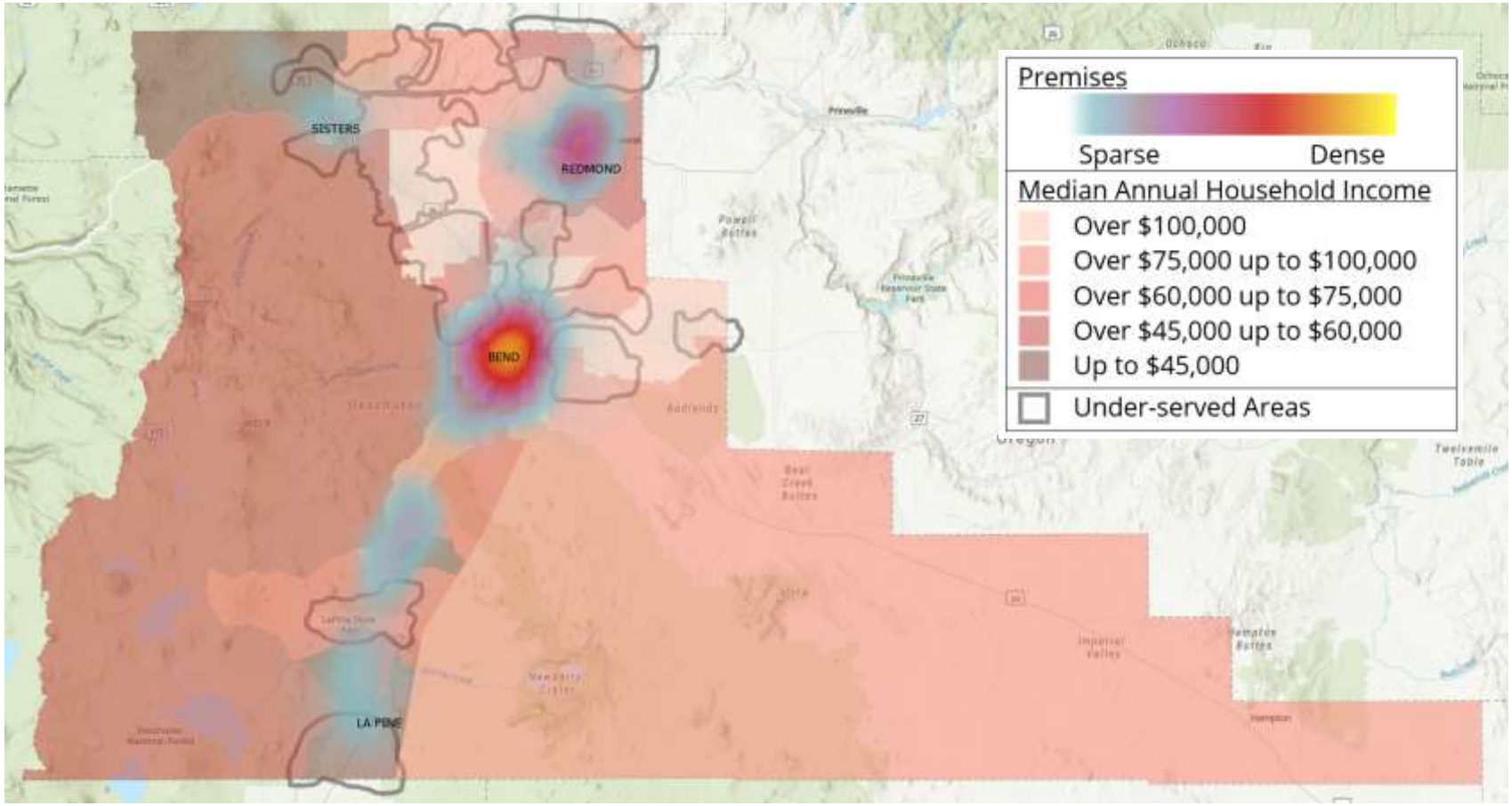

Figure 18. Under-served areas, premises density, and median household income by Census tract

The general conclusion is that the availability gaps in Deschutes County are generally on the edges, outside incorporated areas, in exurban or rural residential areas. The largest gap related to household income appears to be south of La Pine. Beyond that, stakeholders were concerned that, because most internet traffic in, from, and to central Oregon is routed through Portland, any seismic event in western Oregon would cause Deschutes County to lose access to the internet. There was also a more general concern among stakeholders that overall network capacity into and out of the region was inadequate. Improved network resilience would also help reduce availability gaps by (a) ensuring operational integrity and reliability but also (b) creating more options for local providers, reducing their costs, and thereby fostering additional investment.

Regional linkage is one consideration for priority projects. Several exurban and rural residential areas with limited availability of broadband span county lines, creating regional linkages. This situation is evident in northern Deschutes County/southern Jefferson County, eastern Deschutes County/western Crook County, and southern Deschutes County/northern Klamath County. In each case, the impacted areas face limitations due to their distance from nearby cities or population centers in adjacent counties. This situation is most evident around Sisters and Terrebonne, with northwest Crook and southern Jefferson County, as well as Camp Sherman and Crooked River Ranch. Additionally, the southern portion of La Pine exhibits a strong regional linkage to Klamath County. Enhancing network resilience and keeping more local traffic local would benefit the entire region.

Given all the above information and considering stakeholder inputs and standards for internet services, Magellan recommends COIC, its members, and stakeholders, focus on the following as priorities for broadband development in Central Oregon:

- Fiber-to-the-Premise
    - Crooked River Ranch-Terrebonne
    - North of Sisters
    - South of La Pine
- Local routing of local network traffic
- Middle-mile fiber route from Bend to Salem
- Wireless broadband solutions for remote rural locations

6. Feasibility Assessment

FIBER-TO-THE-PREMISES FOR UNDER-SERVED AREAS

The “gold standard” for broadband is fiber-to-the-premise (FTTP) because it can deliver multi-gigabit connections (1,000 Mbps and faster). While providers with legacy coaxial cable plants—the infrastructure that connects subscribers—continue to build with copper wires, optical fiber is more economical overall. This is especially true in areas without service that meets the 100/20 Mbps standard. Several areas in Deschutes County have this situation. Three of those—areas around Terrebonne, north of Sisters, and south of La Pine, illustrated in figures 19, 20, and 21—have relatively low household incomes. Therefore, these may be seen as priority areas for public investment.

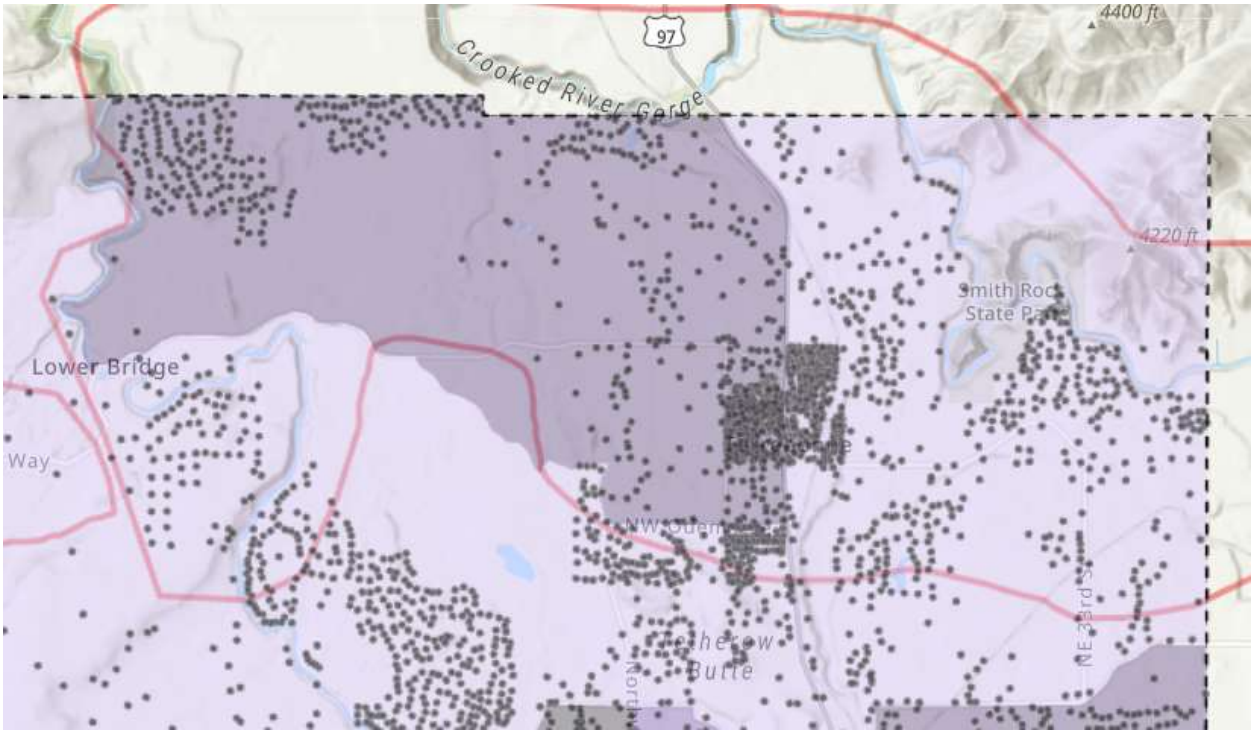

Figure 19. Prospective priority area around Terrebonne

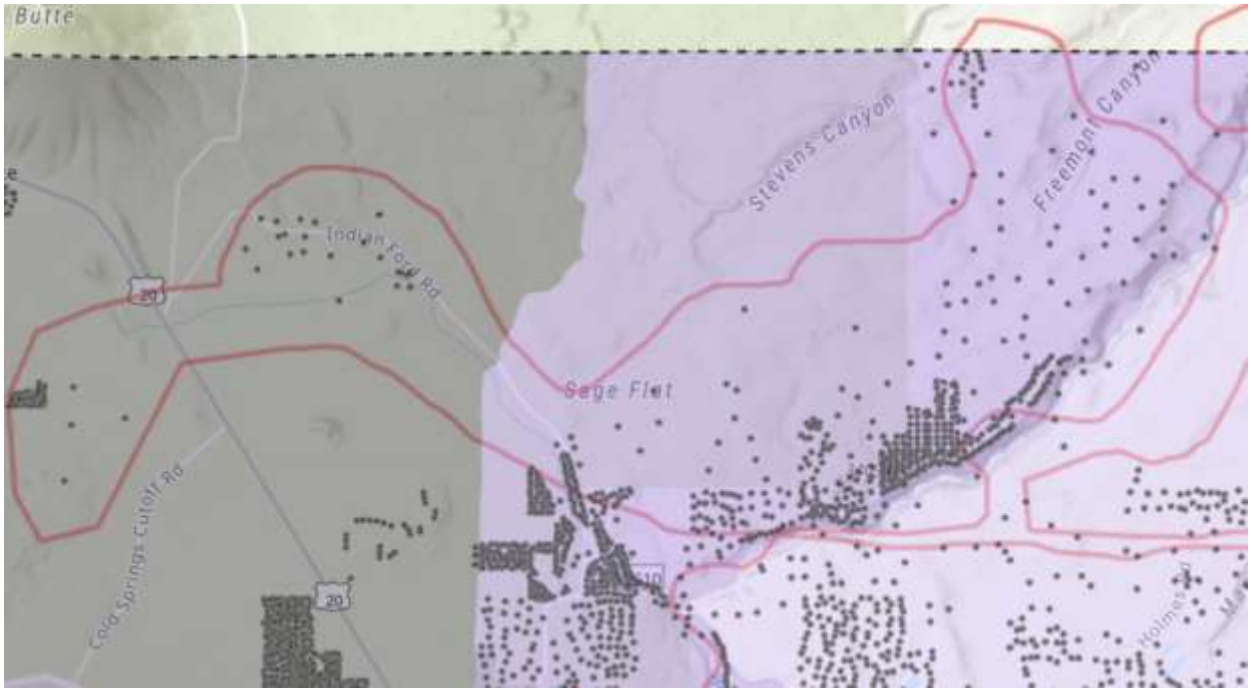

Figure 20. Prospective priority area north of Sisters

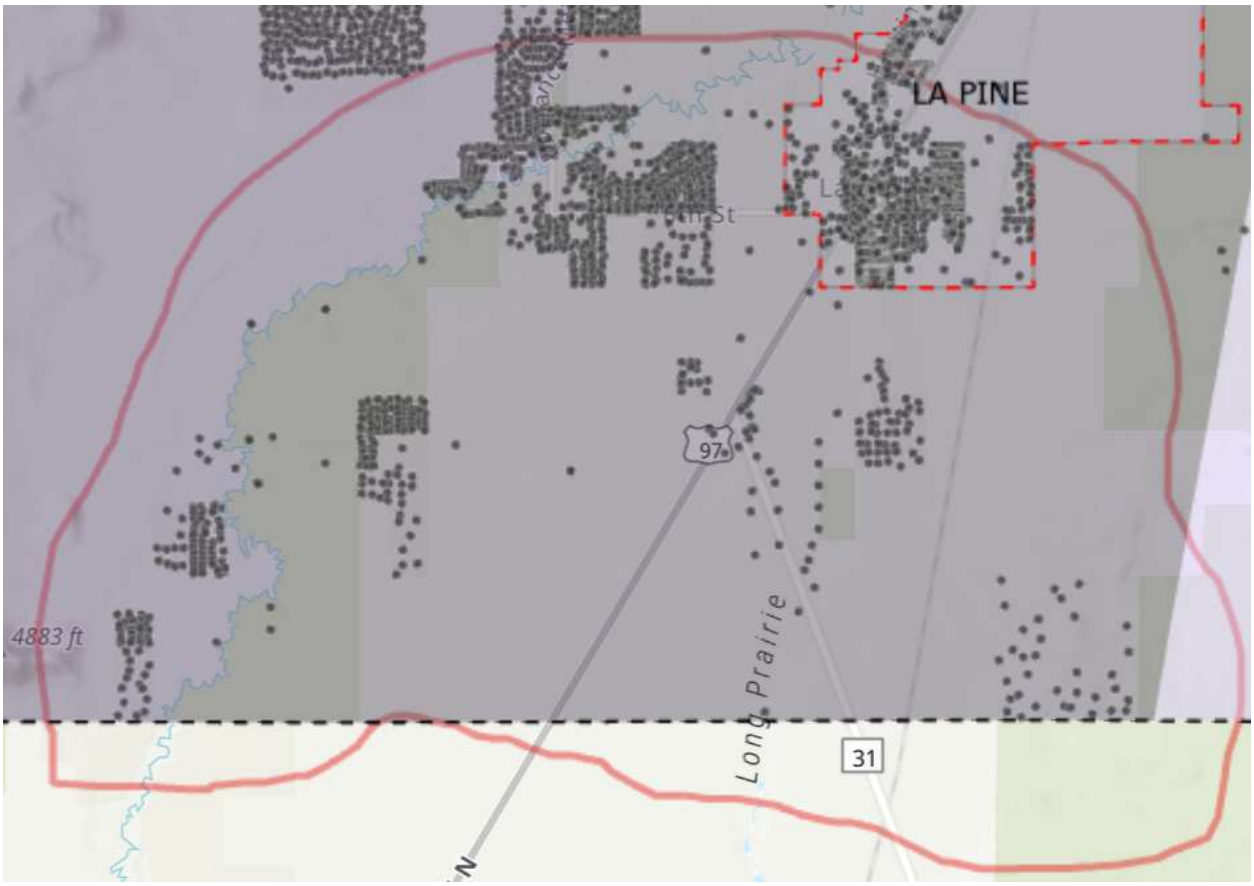

Figure 21. Prospective priority area south of La Pine

Technical Requirements and Costs

The most common technology for FTTP is Gigabit Passive Optical Network (GPON). GPON consists of a high-capacity gateway router at a central location, which connects the local network to the internet backbone via backhaul connections, one or more optical line terminators (OLT), aggregate traffic from subscribers, hubs with optical splitters serving multiple subscribers (typically, 32 per splitter), and optical network units (ONU) at subscribers' sites. The fiber optic cables that make up the GPON plant are deployed in the public right-of-way along roads and other easements. Table 13 provides a summary of cost and coverage estimates for the three priority areas.

Table 13. Cost and coverage estimates[27] for priority projects

Project	North of Sisters	South of La Pine	Terrebonne
Road Miles	28.56	84.48	145.28
Square Miles	13.34	50.51	44.14
Population	762	3,294	4,917
Households	438	1,784	2,151
Average Download	56.38	54.72	64.86
Median Download	16.17	4.98	19.47
Projected fiber	28.86	90.76	150.07
Fiber plant	$2,077,957	$6,534,768	$10,805,365
Electronics	$319,819	$1,302,641	$1,570,618
Backhaul/Feeder	$479,555	$1,567,483	$2,475,196
Total Cost with Backhaul	**$2,877,331**	**$9,404,892**	**$14,851,179**
Per household	$6,569	$5,272	$6,904

Linked projects

Because the three priority areas are located at the edges of the county, there is not a clear opportunity to link them to each other. This could be done on a business level by seeking a provider to build out and provide services to all three areas. For the same reason, the priority areas could be directly linked to projects in the adjacent counties. Specifically, the under-served area south of La Pine overlaps with Klamath County, and the one around Terrebonne overlaps with Crook and Jefferson

[27] Estimates generated by Breaking Point Solutions, LLC, ExpressOptimizer under license to State of Oregon.

Counties. There are clear potential linkages to projects planned by the irrigation districts and ODOT. Exactly which projects and the extent to which they may be linked requires additional information and analysis.

Governance, Ownership, and Partnerships

The FTTH infrastructure will almost necessarily be owned by the provider. While there are several examples of "open access" networks,[28] such models require a third party, wholesale provider, typically a local government or utility. The irrigation districts could potentially fill this role. If public funds are used to deploy FTTH, it would be ideal to have a formal oversight board or similar that could track deployment, monitor service levels, and, if necessary, claw back funding if the provider fails to hit milestones or targets. If the provider is required to donate or reinvest revenue from subsidized locations, as discussed below, this would require governance as well.

The key partnerships for FTTH would be with providers, assuming local governments or other public entities are not funding, managing, or operating services. These are more likely to be "vendor" rather than "partner" relationships, as the public sector would pay one or more providers to deploy FTTH or otherwise subsidize the services. A partnership opportunity, assuming the deployment is fully or largely funded by the public, would be to have the provider use revenue from subsidized locations for digital inclusion, training, or similar programs. The other partnerships, depending on how the deployments are funded, would be among local government, possibly irrigation districts, and with the state, particularly ODOT as well as the State Broadband Office.

Equitable access and affordability

All the areas identified as FTTH priorities have limited availability of 100/20 Mbps broadband and relatively low-income householders. Therefore, this project would directly improve access and affordability. There are other areas of the county that could qualify as under-served, particularly the areas around Alfalfa, east of Bend, and around Tumalo, north of Bend. These areas appear to be more affluent and densely populated so are less likely to require public investment for broadband development.

[28] The most widely noted example of an open access network is probably Ammon, Idaho (https://www.ammonfiber.com/). There are several in Oregon, specifically EUGNet, as well as public utility districts across the state of Washington.

Financial, Legal, and Regulatory Considerations

Table 14 provides a high-level analysis of the premises that could be served in each area and, assuming a 60% take rate (given no comparable services), revenue potential. The number of years to breakeven is for private investment, i.e., if the provider had to fund the deployment, not including overhead, marketing, customer service, etc. Given the nominal breakeven is more than 10 years, these projects would likely never be privately funded.

Table 14. Revenue potential and breakeven estimates

Project	North of Sisters	South of La Pine	Terrebonne
Fiber Prospects	438	1,784	2,151
Total Cost with Backhaul	$2,877,331	$9,404,892	$14,851,179
Take rate	60%	60%	60%
Monthly Recurring Cost	$80	$80	$80
Monthly Revenue	$21,024	$85,632	$103,248
Years to breakeven at 3.5%	14.5	11	15.5

Beyond private capital, the major source of funding is the $65B allocated for last-mile infrastructure by the federal government, $400M to $1B of which will flow through the State of Oregon. Additionally, there is available funding for broadband projects through the National Telecommunications and Information Agency (NTIA) and the USDA Rural Utility Service (RUS). It's important to mention that the Federal Communications Commission (FCC) had previously awarded subsidies from the Rural Digital Opportunity Fund (RDOF) to Starlink for areas considered high priority. However, these subsidies were later rescinded.

The RDOF program aimed to support the expansion of broadband infrastructure in rural and underserved regions.[29] Problems with eligibility criteria and funding allocation decisions led to the temporary award and subsequent withdrawal of subsidies for certain projects, including those involving Starlink in priority areas. Exactly how and if those funds will be re-awarded is yet to be determined. It is also possible to fund this infrastructure through general obligation, private activity, and revenue bonds, if there are local governments able and willing to take on that debt and private companies ready to capitalize on it.

[29] For a detailed explanation of RDOF, visit Rural Digital Opportunity Fund - Universal Service Administrative Company (usac.org).

There are no legal or policy barriers to deploying FTTH other than construction permitting, contracting, and regulations governing the use of public funds. Providers have recently—after the information gathering phase of this study—raised concerns about the growing number of requirements imposed by local governments for construction in the public rights of way. The providers indicate that increasing demands may cause delays, additional costs, and administrative burdens for expanding their network infrastructure.

Collaboration and regular communication between local governments and broadband providers, streamlining the permitting process, establishing clear guidelines, and prioritizing the deployment of broadband infrastructure in priority areas would benefit both providers and local jurisdictions as well as the community as a whole. To be most effective, these activities should involve the irrigation districts, ODOT, and, other entities that manage and use easements.

LOCAL ROUTING OF LOCAL NETWORK TRAFFIC

Much of the data originating from and destined for users in Central Oregon is routed through Portland, via the Northwest Access Exchange. Routing local traffic through distant exchanges creates vulnerabilities, reduces performance, and shifts investment priorities away from access and distribution infrastructure to backhaul/long-haul routes. The vulnerabilities result from adding points of failure, including long stretches of fiber cable running through areas prone to earthquakes and fire.

Even when moving at the speed of light, data gets delayed during its routing to a distant exchange, as does translating the data from optical to electrical and running it through routers and switches. Any network equipment also adds points of failure. As the amount of data increases, providers need more backbone capacity to transport the data out of and back into the region. Consequently, they have to spend more on backhaul, which doesn't directly generate revenue, so they have less capital to spend closer to actual customers. It makes a lot of sense to keep local traffic local but it requires a local exchange, interconnecting major facilities, and competitors to cooperate.

Technical Requirements and Costs

The technical requirements for localized data routing are relatively low and simple. The most basic requirement is for all providers to be physically connected at one or more sites in the area. They also have to be logically connected so traffic can be routed directly among their networks. In Internet terms, the latter is provided via an autonomous system, which is just a configuration (an autonomous system number

or ASN) shared by equipment owned by different parties. An autonomous system consists of defined IP address[30] spaces for connected networks to send data back and forth as peers. There must also be neutral route servers, which tell the providers' routers how to handle data for peering.

Central Oregon has most of this in place in the form of the Central Oregon Internet Exchange (COIX). The COIX has its own ASN, IP address space, and two route-servers in different locations for redundancy. Network service providers and large organizations can connect directly to the COIX at the BendTel data center (130 NW Greenwood), Cascade Divide datacenter (207 SW Columbia St), and Lumen's Bend central office (100 Kearney Ave). These three locations are physically interconnected via dark fiber donated to the COIX by BendTel.

The Vault (20845 Sockeye Pl, Bend, OR 97701) data center, operated by Oneneck IT Solutions,[31] a TDS subsidiary, is not interconnected via COIX. TDS and LS Networks, a regional enterprise/middle-mile network, do not participate in COIX, nor does Lumen (CenturyLink), which routes all traffic through Portland. Lumen has a restrictive peering policy but TDS is nominally open to peering with anyone. LS Networks prides itself on being a regional network with direct peering. The costs for these companies to participate in COIX would be minimal. The largest cost component would be the direct connection between the Vault and other co-location facilities.

Linked Projects

While localized routing is not conceptually linked to other projects, it actually links various networks. Therefore, any broadband development in Deschutes County would benefit from it.

Governance, Ownership, and Partnerships

The COIX is a membership-based nonprofit organization with bylaws, a board of directors, and officers—a President, Vice President, and Secretary/Treasurer—elected by the directors. The COIX is essentially a partnership between its peering members, which includes organizations using the members' networks. This includes

[30] IP stands for "Internet Protocol," the means by which devices identify themselves for sending and receiving data, including an IP address. The set of IP addresses in a network is referred to as its "address space." Data to addresses outside the space are routed off the network, which requires a gateway interconnected to other gateways. An autonomous system groups different address spaces and gateways together.

[31] https://www.oneneck.com/

BendTel, Cascade Divide Partners, Fatbeam, H4Y Technologies LLC, Link Oregon, Tier.Net Technologies LLC, and Yellowknife Wireless Company. A key activity for partners may be stress-testing network performance via disaster drills.

Equitable Access and Affordability

Localized routing would not directly impact access and affordability for consumers. It would improve overall network performance and reduce risks due to network vulnerabilities. It could marginally reduce providers' requirements for backhaul capacity.

Financial, Legal, and Regulatory Considerations

COIX is financed by its members, which pass those costs on to their customers. No additional financing is required for localized routing. There are no legal or policy barriers to localized routing.

REDUNDANT MIDDLE-MILE FIBER ROUTE FROM BEND TO SALEM

Currently, Central Oregon and eastern Oregon—Portland, Salem, etc.—are connected via a limited number of fiber routes. Most of these routes run north from Bend through Madras, either north of Mount Hood, along the Columbia River, or south of the mountain, which is an active volcano. Another fiber route, which anecdotally has limited capacity, runs along State Route 58 to Eugene. Fiber also runs south from Bend to Klamath Falls and east to Boise. While it would be beneficial to have more capacity along these routes, they would be much longer routes, not provide a redundant route to Salem, nor be as useful for broadband, cellular, and other access services.

Technical Requirements and Cost Estimate

A fiber route to Salem, through the North Santiam Canyon, would be a redundant route directly to the state capital. It would also serve as a middle-mile route to interconnect numerous public facilities along the way and provide backhaul for local broadband services. At a base rate of $95 a foot—assuming underground deployment of two conduits with inner duct, vaults every 1,000 feet, and 288-strand fiber cable—this 132-mile route would cost $66.2M to construct. Costs could be reduced by interconnecting with existing fiber in the Sisters and/or Stayton areas and incorporating portions of the build into capital projects planned for the North Santiam Canyon. This route would link Bend to Salem and multiple communities

along the way, including Black Butte Ranch, Camp Sherman, and recreational areas along US Hwy 20.

Linked Projects

Middle-mile fiber between Bend and Salem would link the regions and provide connectivity to areas between. Most of the impact would be outside Deschutes County, particularly in southwest Jefferson County, northeastern Linn County, and eastern Marion County. There may be linkages to projects being planned by irrigation districts and ODOT, although those are in other parts of the county.

There are substantial amounts of long-haul fiber running along US Hwy 97. Most of this connects to large, private data centers in the Hood River area to locations in California. Facebook was reportedly developing additional fiber at the time of this report. Deschutes stakeholders could possibly tap some of this capacity by having some of this fiber terminate in a co-location facility. This would require (a) the owner of the fiber to allow access, which long-haul operators are generally loathed to do, and (b) some entity to lease fiber strands between Bend and a distant co-location facility.

Governance, Ownership, and Partnerships

The default option would be for this infrastructure to be privately owned. Multiple private companies have an interest in this route, including Blue Mountain Networks, LS Networks, Peak, Vizer, and Ziply. It would be challenging for any of these companies to make a strong business case for the route. Ziply, which is the incumbent local exchange carrier (ILEC), i.e., “telephone company” in the area, would have the strongest business case. As the local incumbent, they would have a business interest in excluding other providers who might compete with them from the route. Lumen and TDS may have similar interests, especially due to their reliance on backhaul to Portland and other major metros.

There are multiple public agencies with an interest in this route, including Link Oregon and ODOT. The University of Oregon Hazards Lab needs this infrastructure for seismic and wildfire monitoring, and it has funding from FEMA for these purposes. Marion and Linn counties and their cities would benefit from the route, as would Deschutes and, to a lesser extent Jefferson counties. Several of these cities are rebuilding after the 2020 wildfires and have funding for recovery. The Army Corps of Engineers, Bureau of Land Management, and Forest Service all have a substantial presence in the area. These public entities could get very economical

connectivity at a very low long-term cost by purchasing IRUs[32] for fiber along this route.

Private ownership with non-discriminatory IRU opportunities for private and public entities would likely be the best overall approach for building and managing this route. This approach would generate substantial up-front capital to build the route along with some recurring revenue for maintenance. It would allow multiple private companies to share the route, several of which may use it to offer services in the area. Indeed, currently, available broadband funds may be available to cover the costs of access infrastructure in the areas for providers with a stake in the route. In this way, the route would also improve broadband availability, affordability, and access.

Equitable Access and Affordability

A fiber route between Bend and Salem could increase access and affordability for consumers along the route by providing additional, economical capacity to retail broadband providers. Most of this impact, as with linked projects, would be outside Deschutes County.

Financial, Legal, and Regulatory Considerations

There are public funds available for this project via public partners. As noted above, various private companies could benefit from a redundant middle-mile fiber route between Bend and Salem. Therefore, they should be willing to help finance it. The project may also be attractive to private investors.

There are no legal or policy barriers to this approach, beyond common requirements for construction in environmentally sensitive areas. Most of the construction would be in established public rights of way or in conjunction with other infrastructure construction so this should not be an undue issue. This project could also be carried out by a purpose-built public benefit corporation, which might have marginal benefits over a private for-profit, such as limiting threats from corporate mergers and acquisitions. The State of Oregon has no provisions for public authorities or special districts to construct network infrastructure.

[32] Indefeasible rights of use, a form of long-term capital lease.

WIRELESS BROADBAND SOLUTIONS FOR REMOTE RURAL LOCATIONS

Deschutes County has many areas that simply are not economical for fiber deployment. Prospective subscribers are too remote and/or geographic characteristics make deployment too costly. While the capacity and reliability are not comparable to fiber, radio-based wireless connections can be much more economical. That said, wireless facilities require fiber to interconnect them.

Technical Requirements and Costs

Wireless connections require an antenna and base station, which convert data streams to radio frequency signals, on each end. The "local" equipment must be connected via a router to backhaul that carries data to the providers' core network. Increasingly, base stations are located away from and serve multiple antennas, requiring "fronthaul" from the antenna to the base station. Antennas must be mounted at some distance above the ground, typically on a tower, for the radio signal to reach the remote site. "Remote" equipment at the customers' premises must be connected via a router to local devices or network.

There are two approaches to providing wireless broadband, either of which can use licensed or unlicensed spectrum. Generally, licensed spectrum provides more reliable connections. The emerging standard is "fixed wireless access" (FWA), which is very similar to how cellular service is provided, except it does not allow for mobile connectivity. Both are types of radio access networks (RAN), in which each antenna—cells consisting of multiple antennas, each covering a particular area—can connect multiple subscribers. For that reason, this is approach also called "point-to-multipoint" (PtMP). A fundamental issue with PtMP connections is that they can generally only reach about a mile or so from the cell site.

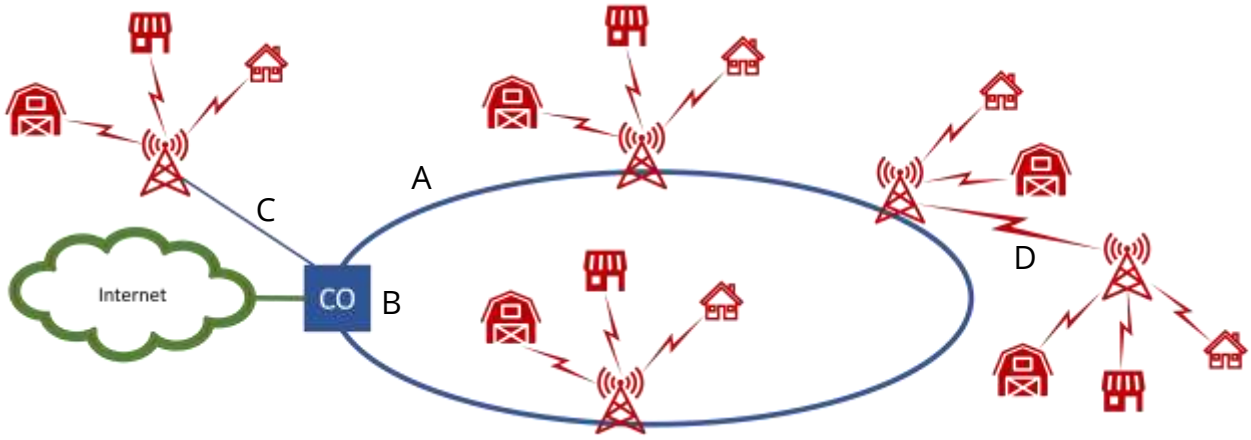

Figure 22. Point-to-point wireless connections require a dedicated antenna on a tower—which can be connected to the rest of the network via fiber or wireless—for each subscriber location

Figure 22 illustrates the overall framework and technical prerequisites for the alternative approach of point-to-point wireless connectivity. In this approach, each subscriber location has a dedicated antenna on a tower that points directly to an antenna at the subscriber site. These are often called "bridges" because they basically extend connections to remote sites. The key benefit of this approach is that the PtP links reach up to 10 miles over unlicensed spectrum with reasonably little interference, especially in rural areas. The blue lines in Figure 22 represent fiber runs. A ring layout for fiber ("A") improves reliability because if there is a cut the radio sites are still connected to the central office (CO) ("B"). That said, where a fiber ring isn't practical, radio sites can be connected by point-to-point fiber ("C"). Radio sites where fiber isn't practical can be interconnected via wireless ("D").

PtMP is generally more economical than PtP, especially in relatively more densely populated areas. That said, PtP can be quite economical. The cost to construct a tower, including shared equipment, is approximately $200K. The per-subscriber cost, including antenna at both central and remote subscriber locations, can be as low as $100, although more robust solutions will cost approximately $2,000 per remote site. Some vendors provide PtP solutions in which the central antenna can support multiple subscribers, effectively making them PtMP, for between $1,800 and $250 per subscriber depending on the number of subscribers. The key factor is the cost of fiber backhaul, which could easily run into hundreds of thousands of dollars to acquire and multi-millions of dollars to construct. It is reasonable to expect connections radio site/tower would cost at least $2,000 per month each to purchase as a service.

Linked Projects

Given the flexibility and range of wireless broadband solutions for remote, rural areas, a project of this type could easily reach adjacent counties. More importantly, as noted above, wireless broadband requires fiber backhaul. Therefore, wireless and fiber projects are highly complementary. Fiber middle-mile projects are particularly beneficial to wireless and wireless can add a great deal of value to such projects. Routing middle-mile fiber past and to towers makes it practical to economically deploy wireless broadband—and "traditional" cellular service—to generate revenue to pay for the cost of the fiber. Several irrigation districts and ODOT are planning projects that would address this issue. Additional information is required to identify relevant projects and their viability for broadband development.

Governance, Ownership, and Partnerships

There are numerous ways to structure ownership of wireless broadband. On one extreme, the wireless and related equipment can be owned by the end user. This is a common approach for enterprise and institutional customers. The most common approach for consumer and small business purposes is the provider owns the equipment and charges a monthly service fee. In either case, the fiber backhaul will typically be owned by a third party and leased or provided as a service to the owner of the wireless equipment.

Governance and partnerships are generally not relevant to these models; they involve simple customer-vendor relationships. These issues do come into play if the tower sites or backhaul fiber are jointly owned and/or built with public funds. These facilities, towers in particular, must be financed and maintained. If that is done with public funds, there must be some form of governance to ensure maintenance and use are equitable and achieve public priorities. More commonly, construction, financing, and maintenance are handled by a formal partnership.

The irrigation districts and ODOT could be ideal partners for rural wireless broadband. Beyond that, numerous prospective vendors and partners might provide wireless broadband, particularly the companies that currently offer such services in the region—PrineTIME Internet Solutions, Webformix, and Yellowknife. See "Other Network Service Providers" on page 27 for additional information. Companies that develop and operate towers—American Tower, Crown Castle, and SBA Communications are the three largest—may also be partners or resources for such projects.

Equitable Access and Affordability

Wireless broadband may be the only practical means to provide affordable, equitable access to remote, rural locations. The only alternative is satellite broadband, specifically Starlink.

Financial, Legal, and Regulatory Considerations

As noted above, the cost per subscriber ranges from $200 to $2,000, in addition to approximately $200K per tower, including shared equipment. If the towers are privately owned, there will be a lease cost rather than an upfront capital expense. A reasonable monthly fee for wireless broadband is $50. As noted above, the cost fiber backhaul is the key dependency for financing, along with the cost of money. Because the number of prospective subscribers, cost of backhaul, and availability and location of towers are unknown at this point, it is not possible to estimate the costs of return on investment.

While it remains to be seen for Oregon, other states and federal funding programs have either disallowed or placed stringent performance requirements on wireless for grant funding eligibility. Therefore, the fiber, tower(s), and equipment would likely need to be financed separately with little public funding.

The key regulatory considerations are federal rules governing the use of radio spectrum and the permitting and registration of towers. Local permitting and zoning regulations may also apply. Generally, these are minor considerations that are very familiar to firms working in this space, including equipment vendors, facility owners, and service providers.

7. Action Plan

The general challenge going forward is to determine which project(s) should be given priority for public investment. There will be limited public funds available and those funds will likely be targeted to unserved rural areas. It is possible that none of the projects discussed above will meet the criteria for eligibility. Private entities might invest in one or more of these projects, but it is not immediately apparent who those entities might be. This report provides the basic information needed to prioritize projects but priority decisions will ultimately be made by those who control the funds. Deschutes County stakeholders may be able to influence these decisions and/or directly fund some projects. The general next step is to make these determinations and pursue funding.

A related challenge is to develop capacity for planning network infrastructure. The availability of broadband today is largely the result of its planning being handled by large, for-profit organizations without any consideration of public priorities or input from community members. A few targeted broadband development projects will not change that. It will require a sustained, focused effort to develop the infrastructure in much the same way as recreation, transportation, and utility infrastructures are planned. Even this action plan will require administrative support and information. This study should be seen as a starting point. To effectively execute the action plan, Magellan recommends Deschutes County stakeholders work together to:

- Identify and fund the appropriate entity to lead and support network infrastructure planning in the region.
- Approach network development in much the same way as economic development, as a public effort to attract private investment.
- Establish a geographic information system for managing information about network assets and related items.
- Analyze public assets and properties for siting radio infrastructure.
- Assess demand with Census data, FIO speed test results, and information from other sources, including primary data (e.g., community survey).
- Develop capacity to manage public asset leases and share assets among public agencies. This is necessary, for example, for the irrigation districts' fiber assets to be developed as an integrated resource base and used to achieve public priorities.
- Identify and track network infrastructure, particularly via permitting and planning. Revise permitting processes as necessary for this purpose.

- Include consideration of network infrastructure in all relevant capital projects.
- Keep track of industry trends, especially emerging applications, and leading-edge services, in terms of required flexibility and reliability as well as coverage and speed.
- Conduct a thorough analysis to identify routes into priority underserved areas.
- Review public spending on connectivity and aggregate demand of various public agencies to create a "carrot" for attracting private investment.
- Adopt smart policies for broadband development, including consistent design and construction standards, development conditioning, "Dig Once" and joint build policies, and expedited permitting.

1. ORGANIZATION A TASK FORCE FOR EACH PRIORITY PROJECT

Community and regional stakeholders should evaluate prospective projects based on the information provided in this report. Additional information about funding sources and other resources will need to be gathered and maintained. COIC or the appropriate lead/coordinating agency could handle much of this if stakeholders implement our recommendations but they will need input and support from stakeholders. Each task force would be charged with making the case for its particular project and for presenting those cases to other stakeholders. The rest of this action plan lays out the actions each task force should take.

2. IDENTIFY AND FULLY ENGAGE STAKEHOLDERS FOR PRIORITY AREAS

Most stakeholders have been identified and nominally engaged during the course of this study. Several, particularly the irrigation districts, were not substantially involved until near the end. Others, most notably the major, incumbent network service providers, were engaged primarily to track the study but not necessarily address the issues. Specifically, none of these stakeholders provided information about the location or disposition of their assets or stated intentions to invest in expanding access.

As noted above, we recommend approaching network development much like economic development—even as an extension of those efforts. Think of network

services as a targeted industry. Public funding can't replace that industry, but it can and should be leveraged to attract it. While Central Oregon has a relatively large stable of providers, it could be larger, more diverse, and more deeply invested. Ask yourselves, "Which providers are not in the area," "Which providers have limited investments in the area," and "How can we increase the number of companies and the amount they have invested?"

Major network service consumers, particularly government agencies, educational institutions, large private employers, non-profit and public healthcare providers, and utilities, are critical stakeholders because they yield a lot of power in the marketplace. They also have critical and evolving needs for connectivity that often reach beyond their organizations. Schools, for example, need students connected outside of school, and many employers need their employees to have fast flexible connections at home and in the field. If major consumers were to collaborate, agree on priorities, aggregate their demand, and spend accordingly, providers and private investors would respond in kind.

3. DEFINE PRIORITY PROJECT AREAS, OUTCOMES, TASKS, AND WORK PRODUCTS

The general goals and activities are defined in this report, but it is only a starting point. The next step is to get much more specific. Which premises are to be connected by fiber, for example? What types of infrastructure should be deployed and specifically where should it be placed? What role will local stakeholders play in guiding and tracking private service offerings? Who will establish and run partnerships to build a redundant fiber route and/or rural wireless broadband radio sites? Exactly where and how will those things be built? The outcomes, tasks, and work products for each task force or focus area will be different and distinct yet interrelated. If any of the prospective projects discussed above are truly priorities, it will be incumbent on the task forces and supporting organizations to define specifically what will be accomplished and how.

4. PURSUE PRIVATE INVESTMENT

The three keys to attracting private investment are to (1) make a clear, strong business case for the investment, (2) to identify prospective investors, including key decision-makers and influencers, and (3) "close the deal," including specific objectives and outcomes, public contributions, and consequences for not achieving the objectives and outcomes, along with mechanisms for tracking these things. A formal organizational structure may be necessary for these purposes, but most can

likely be achieved via existing organizations—e.g., COIC—with adequate support from stakeholders. Central Oregon is much less likely to receive private investment in network infrastructure that aligns with public priorities without some entity leading the charge and doing the work.

5. PURSUE PUBLIC FUNDING

As with private investment, public funding requires a clear case, specifically in the form of grant applications. Someone must identify funding opportunities and write grant applications, which includes ensuring all funding requirements are met. It may be possible to fund broadband development with other public funds, including local bonds. Grant applications and other funding sources require explicit buy-in from relevant stakeholders. When awarded, the funds must be managed. On-going, possibly long-term, monitoring may be necessary to ensure public funds are used in a manner that creates clear public benefit. Again, the specifics of these tasks depend on the project and funding source(s).

Federal and State Broadband Funding

The federal government allocated $1.9T via American Rescue Plan Act (ARPA), to aid public health and economic recovery from the COVID-19 pandemic in spring of 2021. About six percent, or $8.7B, was allocated specifically for broadband and another $10B went to general infrastructure.[33] The State of Oregon received approximately $6.4B and allocated $26.3M of this to broadband as part of the $120M Capital Projects fund.

Infrastructure Investment and Jobs Act provides for $1.2T in federal spending over the next five years, including $65B for broadband,[34] $48.2B of which will be administered by the National Telecommunications and Information Administration. $40B is for grants to states to fund deployment. The State of Oregon is establishing a framework for the IIJA state block grants totaling over $100M for broadband and digital equity. IIJA provides funding for complementary infrastructure, too: $111B for roads, bridges, and major projects, including $300M to local governments in Oregon, $79B for the power grid, $48B for water infrastructure, and $47B for resiliency. There are other federal funds available, too, particularly for grants and low-interest loans for rural broadband development through USDA.

[33] Source: https://www.ncsl.org/fiscal/arpa-state-fiscal-recovery-fund-allocations

[34] Source: https://www.ey.com/en_us/infrastructure-investment-and-jobs-act

NTIA Funding Opportunities

The NTIA programs include Broadband Equity, Access, and Deployment (BEAD), Digital Equity, and Middle Mile Infrastructure as well as amendments to the Tribal Broadband Connectivity Program. BEAD's objective is to close the availability gap, particularly in unserved locations (those without 25/3 Mbps service available), underserved locations (those without 100/20 Mbps), and community anchor institutions without gigabit connections. Other considerations include persistent high-poverty areas, the capacity of the proposed network, time to build, and prior compliance with federal laws. The $42.3B of BEAD funds will be distributed through the states, as discussed below. Awardees will be required to offer a low-cost plan to all their subscribers.

The Digital Equity Program provides a total of $2.75B to close the digital divide and promote digital equity and inclusion. Program priorities are low- to moderate-income households, rural areas, seniors, veterans, and individuals who are incarcerated, have disabilities or language barriers, and/or are members of a racial or ethnic minority. Eligible applicants the state or its political subdivisions, economic development authorities, electric utilities, native entities, nonprofit associations, corporations, foundations, or institutions, regional planning councils, tribal governments, tech companies, telecom companies or cooperatives, and utility cooperatives or public utility districts.

The $1B Middle Mile Infrastructure program is a direct competitive grant on a technology-neutral basis for similar eligible entities. Its focus is the expansion and extension of middle-mile infrastructure to promote broadband resiliency and reduce the cost of connecting unserved and underserved areas. Proposed projects must meet two of five conditions: (1) fiscally sustainable strategies, (2) non-discriminatory interconnection, (3) specific, documented, and sustainable demand for middle mile interconnection, (4) availability of conditions and resources to speed up deployment, and/or (5) demonstrable benefits to national security interests.

State of Oregon Funding Opportunities

Separate from the federal funds, the state's Oregon Broadband Fund had $1.5M for 2022. Some of the Oregon Universal Service Fund (OUSF) from a 5% surcharge on all retail telecommunication sales in the state were transferred to the Broadband Fund. The priority for the state is to get broadband to Oregonians who currently do not have high-speed internet access. The Oregon Broadband Office has two programs for disbursing federal funding: the American Rescue Plan Act (ARPA) Capital Projects Fund Broadband Deployment Program and the Broadband

Technical Assistance Program (BTAP).[35] See Figure 23 for the state's planned roll-out of these programs.

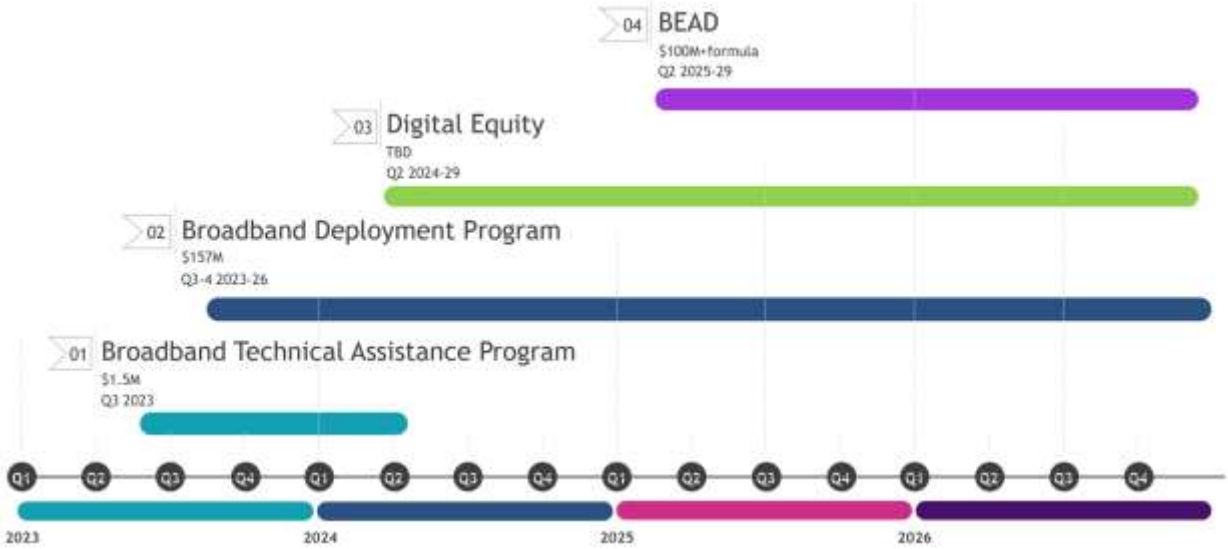

Figure 23. The State of Oregon's broadband program timeline[36]

Applicants for federal and state funds will be required to complete an extensive application, supported by geospatial data on infrastructure and services in the project area. Eligible applicants for the Universal Service Fund Broadband Program include councils of government, economic development corporations, electric utilities and co-operatives, municipalities, non-profit organizations, regional planning, and development councils, as well as network service providers.

Evaluation criteria for the state's Universal Service Fund Broadband Program include directly addressing the lack of broadband access, affordability, and adoption of broadband by end-users and having sufficient staff or consultant resources to deliver the proposed project. Locations lacking 10/1 Mbps service are top priority, followed by those that lack 25/3 Mbps service. Providers that serve nonresidential locations have the right of first refusal for all state-funded broadband projects in that area. Applications for developing broadband infrastructure will be open to formal challenges by incumbent providers, even if they do not want to undertake the project.

[35] For detailed, up-to-date information about the State of Oregon's broadband funding and planning efforts, visit https://www.oregon.gov/biz/programs/Oregon_Broadband_Office/Pages/default.aspx.

[36] Source: "Oregon Broadband Office: Bridging the Digital Divide in Oregon," Business Oregon, July 2023.

CLOSING

Deschutes County has uneven broadband availability, exacerbated by increasing population and other demographic changes. As in most areas, network infrastructure and services were developed independently, by private companies based on profit motives, with little coordination with or input from public entities and community stakeholders. As the geographic center of the state, the area provides a hub between areas west of the Cascades and the high desert areas to the east. Broadband literally provides access to key economic activities and is critical to essential public services.

The overall need is to establish a comprehensive, resilient system for equitably connecting all residents and establishments in the region. There are abundant opportunities to meet this need created by planned and prior investments by numerous entities. The challenge is to align and coordinate development across sectors, and to attract private and public investment in broadband infrastructure. The region is well-positioned for this, in part due to COIC's leadership. With COIC as a catalyst, we feel Deschutes County, its cities, communities, organizations, and residents can capitalize on the full range of resources to make a huge leap forward in broadband development.