#FIBERDelivers

Frequently Asked Questions

Q: How does the internet work?

A: The basics[1] of how the internet works: The internet consists of data transmitted across the world using mostly fiber-optic cables. This "backbone" network connects data points around the globe, crisscrossing countries, continents and oceans. Various technologies such as DSL, cable and fiber from Internet Service Providers (ISPs) connect consumers to this network. For this reason, internet services sold from ISPs to consumers are called "last mile" technologies. And while most of the data is transmitted via fiber, these "last mile" providers can make or break service speed.

Q: What are the different internet technologies that are available?[2]

A: There are several different internet technologies available to deliver broadband.

- **Fiber** internet is the fastest available internet technology. It uses fiber-optic cables, which are capable of transmitting large amounts of information quickly. While fiber is fast, it isn't currently available in as many areas as other types of internet technologies. Much of the limitation in its availability stems from the higher cost of constructing the fiber network compared to copper cables already in place.

- **Fixed Wireless (4G/5G)** connects end-users and devices via radio waves transmitted from a base station. Fixed wireless is susceptible to interference from rain, fog and other weather conditions, which can affect the wireless signal. Obstructions such as trees and hills can affect the quality of the service and even rule it out as an option. Fixed wireless internet is usually more expensive than other forms of broadband for companies and consumers.[3]

- **Cable** uses the same types of coaxial (Coax) copper cables that transmit cable TV services. It has broadband capability and thus can reach high speeds. It is usually available through current or former cable TV providers in their respective areas. Cable internet speeds are usually higher than DSL speeds, but much lower than fiber optic cables.

- **DSL** uses a connection that looks similar to a phone line, with technology that enables broadband transmission. The speed of data over these "twisted pair" copper lines is also dependent on or limited by your proximity to the DSL main distribution point – often referred to as the central office (CO).

---

[1] https://broadbandnow.com/guides/dsl-vs-cable-vs-fiber

[2] https://www.highspeedinternet.com/resources/the-consumers-guide-to-internet-speed

[3] https://www.androidauthority.com/what-is-fixed-wireless-internet-831394/

- **Satellite** internet is delivered wirelessly to a receiver. While satellite internet can have bandwidth comparable to DSL and cable, it has latency issues that can affect performance.

Q: What are the benefits and drawbacks to each internet technology?

A: See the chart below. (Source: Vantage Point[4])

	Benefits	Drawbacks
Wireless		
mmW 5G	Tremendous speed and capacity over very short distances.	Very limited wireless reach makes it not suitable for sparsely populated rural areas.
Midband 4G/5G	Lower upfront costs; speeds comparable to good copper networks.	Slower speeds due to limited spectrum; frequent upgrades are costly; requires deep fiber.
Wireline		
DSL (twisted-pair copper)	Can leverage existing outside plant.	Limited speeds; not suitable for long distances; requires deep fiber; expensive upgrades.
Coax	Can leverage existing outside plant.	Not suitable for long distances; requires deep fiber; expensive upgrades.
Fiber	Future-proof; easier upgrades; lowest total cost over the life of the network; suitable for distances up to 20 miles between electronics.	Higher upfront costs; may be slower to deploy.

Q: Can you tell me about what activities work with which internet speeds?

A: See chart below for a sample. (Source: Highspeedinternet.com[5])

0–5 Mbps	5–40 Mbps	40–100 Mbps	100–500 Mbps	500–1,000+ Mbps
Works for:	Works for:	Works for:	Works for:	Works for:
• Checking email • Streaming music on one device • Searching on Google	• Streaming video on one device • Video calling with Skype or FaceTime • Online gaming for one player	• Streaming HD video on a few devices • Multiplayer online gaming • Downloading large files	• Streaming video in UHD on multiple screens • Downloading files quickly • Gaming online for multiple players	• Doing a lot of almost anything

Q: Can't we just have a mix of cable, fixed wireless and fiber? Then people can choose what they need?

A: You could, but it seems most prudent to choose the best and most future-proof technology. When building new networks, the goal should be to aim higher and do better. We need to connect all Americans with the best possible broadband, no matter whether they live in urban or rural areas or upper or lower-income neighborhoods. Speeds or latency that may appear okay today will fall short tomorrow.

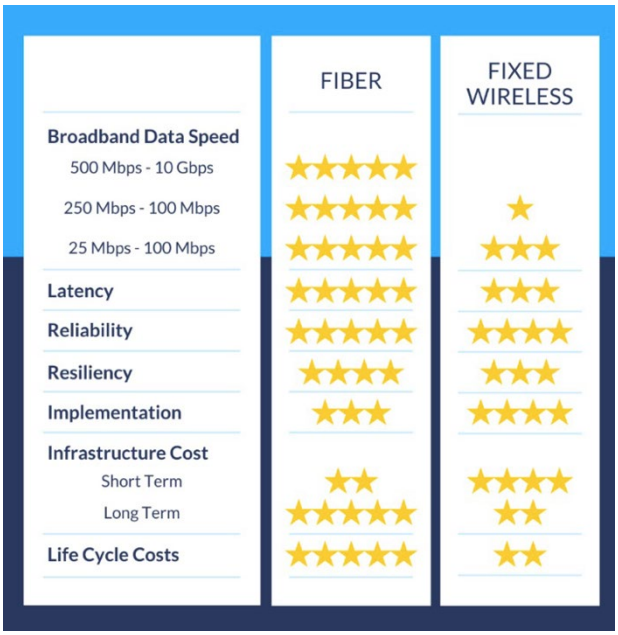
We're building infrastructure, not paving potholes.

[4] https://www.ntca.org/sites/default/files/documents/2021-02/Rural%20America%27s%20Critical%20Connection%20--%20FRS%20White%20Paper.pdf
[5] https://www.highspeedinternet.com/resources/the-consumers-guide-to-internet-speed

Q: Can you compare Fiber to Fixed Wireless?

A: See the chart.

- Fiber Costs (including formulation and engineering, attachment fees and completion) runs between $8 to $25 per foot for aerial fiber and $12 to $50 per foot for buried fiber.
- Fixed Wireless Access Cost (to construct and fully install a single antenna site with multi-sectored equipment on an existing structure): $100k-300k, excluding the cost of constructing the towers/antenna structures.



Source: Fiber Broadband Association Technology Committee

Q: What are the advantages to fiber internet?

A: There are many advantages to fiber internet.

- **It's the fastest.** It uses fiber-optic cables to send data to and from your connected devices. "Light is ridiculously faster than electricity at doing this which means fiber internet is lightyears… faster than cable or DSL."[6] Even the most cutting-edge wireless networks depend upon the presence of fiber to enable higher speed services. "[U]ltimately, the quality and reliability of the *wireless* network will depend on the *wireline* (fiber) network carrying traffic to and from the 5G small cells."[7]

- **It's symmetrical.** Fiber enables symmetrical upload and download speeds. Upload speeds enable better experiences when it comes to video conferencing, streaming and gaming. File uploads and VPNs also perform far better on symmetrical networks. Other technologies have significantly slower upload speeds.

- **It's future-proof and sustainable.** Fiber is the best choice for ensuring that a network being built now will be capable of satisfying user demand over its useful life. Fiber has at least 500 times higher capacity than any other technology. Fiber anticipates future demands and allows for services that will remain affordable and efficient for years to come. It is durable, scalable, easier to update and less costly to maintain. "Once fiber is laid down, network upgrades cost less than those for other broadband technologies."[8]

- **It's a better investment.** "Not only do Fiber to the Premises (FTTP) networks have a lower 30-year cost of ownership, but they also have a greater revenue potential when compared to the other technologies because of their greater broadband capacity." – *Vantage Point Solutions*[9]

- **It's reliable.** Fiber is the most reliable internet technology, delivering a signal less susceptible than cable, copper, or spectrum-based services to interference or deterioration of performance due to distance or

[6] https://dailywireless.org/internet/how-does-fiber-internet-work/
[7] https://www.rcrwireless.com/20190220/opinion/readerforum/fiber-optic-5g-reader-forum
[8] https://www.politico.com/news/2021/04/21/biden-infrastructure-broadband-lobbying-484002
[9] https://www.ntca.org/sites/default/files/documents/2021-05/Future%20Proof%20--%20Economics%20of%20Rural%20Broadband%20FINAL.pdf

climate conditions.

- **It amplifies economic development.** Fiber benefits community economic development and vitality through elevated housing prices and creating more desirable conditions for relocation.

- **It's addressing reality.** "If you have a family of four working and learning at home, a total of 25 Mbps is just not adequate. You can only jam so much information down a single wire unless that wire is fiber." - *Christopher Ali, a University of Virginia associate professor who studies the digital divide*[10]

Q: What are symmetrical speeds? Why do they matter?

A: With symmetrical speeds, you have fast upload speeds that match your download speeds. Fast upload speeds provide many advantages including removing internet bottlenecks, uploading larger files faster and readily available cloud services. "Fiber internet download speeds can be anywhere from 250–1,000 Mbps. Unlike cable and DSL, fiber providers usually offer 'symmetrical' service, meaning the upload speeds are the same high speed. The high speeds make streaming high-definition video to multiple devices easy on a fiber connection."[11]

Q: What about Starlink? Is that faster than fiber?

A: Satellite technology simply cannot compete with fiber. A recent study conducted by NTCA and the Fiber Broadband Association found that Starlink's proposed satellite internet plan would face a capacity shortfall by 2028.[12]

Q: Isn't fiber prohibitively expensive, especially where houses are far apart?

A: As broadband demand increases over time; it is important to evaluate broadband technologies both from short- and long-term cost perspectives to ensure that a network being built now will be capable of satisfying user demand over the useful life of the facilities rather than having to rebuild them repeatedly to keep pace with such demand. "Not only do FTTP networks have a lower 30-year cost of ownership, they also have a greater revenue potential when compared to the other technologies because of their greater broadband capacity." - *"Future Proof: Economics of Rural Broadband," A Greenfield Rural Broadband Case Study, prepared by Vantage Point Solutions, Inc. for the Foundation for Rural Service.*

FIBER IS CRITICAL ACROSS MANY INDUSTRIES

Q: How does broadband internet and specifically fiber, impact our country's farming and agriculture industry?

A: Fiber enables precision agriculture. Fiber-based networks and technologies allow farmers to increase crop yield while preserving precious natural resources. Below are just a couple of examples:

- "The Chicago Board of Trade lists a grain price instantly, and, if you're not up to speed, you lose out… The price can change in 30 seconds, and you can be selling grain for less than margin if your internet can't keep up. Slow internet can cost farmers hundreds of dollars when trying to sell their grain…. [but our] speed became much better when we got fiber optics a year ago…" - *Gary Smith, Okaw Farmers Co-op, Lovington, Ill*

[10] https://www.aarp.org/home-family/personal-technology/info-2020/high-speed-internet-access.html
[11] https://broadbandnow.com/guides/dsl-vs-cable-vs-fiber
[12] https://www.ntca.org/sites/default/files/documents/2021-02/FBA_LEO_RDOF_Assessment_Final_Report_20210208.pdf

- "For my farm I depend on broadband for selling our meat through our website and digital marketing. It can be incredibly challenging to accomplish basic work, such as updating our website or even sending emails. Most businesses expect and want us to receive our billing electronically, use online bill pay and access other account information online. For many this may seem like a simple task, but it is a regular headache for managing the business side of the farm and our household." — *St. Croix County Farm Bureau member Leslie Svacina*

Q: Why does fiber matter in real estate and how does it impact home values?

A: A fiber-to-the-home connection can raise a home's value by 3%.[13]

- "Properties with broadband access, and particularly fiber to the home, are much more marketable and much more highly desired." - *Scott McKinney, McKinney Realty, Cable, Wis.*

Q: Why does fiber matter in education?

A: Increased bandwidth is needed to create educational opportunities for kids at home and in school, including video conferencing and educational applications.

[Because of fiber,] "99% of schools nationwide are on scalable connections. Those schools have a clear path to delivering enough bandwidth for digital learning in every classroom, every day." - *Education Superhighway*[14]

Q: What about 5G? Isn't that fast and doesn't that connection go through the airwaves?

A: Without fiber, 5G does not work. The small cells, antennas and towers that send 5G signals to mobile devices are supported by fiber infrastructure.

"Fiber deployed both aerially and underground is expected to be essential for 5G networks and the high-speed broadband services they will provide. Indeed, fiber is likely to serve as the backbone upon which next-generation wireless networks and services are built."[15] - *Wireless Infrastructure Association*

Q: How does fiber impact gamers and streamers?

A: As streaming in HD and 4K becomes the norm and our homes increasingly filled with Wi-Fi enabled devices for gaming and working/learning remotely on multiple devices, higher speeds are a requirement. "Streaming video and videoconferencing require higher speeds. Fiber internet service consistently offers low rates of data loss (less than 0.4 milliseconds) and the lowest latency to ensure minimal disruptions." - *U.S. News & World Report*[16]

"When it comes to online gaming, latency is pretty important ... and that can unfortunately mean the difference between winning or losing - whether you get a kill or get killed. The GigaZone has been absolutely fantastic. The speeds are tremendous." - *Gigazone gaming tournament participant*[17]

---

[13] https://magazine.realtor/technology/feature/article/2020/09/broadbands-inequities

[14] https://stateofthestates.educationsuperhighway.org/#national

[15] https://wia.org/blog/fiber-inextricably-linked-with-5g-connectivity

[16] https://www.usnews.com/360-reviews/internet-providers/what-is-a-good-internet-speed

[17] https://www.youtube.com/watch?v=PndOCZMdkLU

Q: Does fiber internet benefit older populations? Many people I know who are retired don't stream much and don't game.

A: "As the U.S. population continues to age, high-speed networks can be a valuable platform to make the world more accessible, providing convenient pathways to the resources, activities, and services that empower older adults to live healthy, independent, and meaningful lives." - *Christopher Baker, AARP Public Policy Institute, Liz Seegert, MA, Center for Health, Media and Policy, Hunter College*[18]

Q: What other aspects of our lives does fiber impact and how?

A: Fiber broadband impacts so many aspects of our lives. A few other examples are:

- **Teleworking**. Video conferencing is the new norm. Virtual private networks (VPNs) provide the security and fiber provides the capacity needed to transact business; teleworking is made possible with fiber.

  > "We believe there is a clear connection between the pandemic and accelerated demand for FTTH. Our consumer studies and others have shown a dramatic increase in working at home and the use of two-directional video, as well as virtual private networks." - *Michael Render, founder and CEO RVA Market Research and Consulting*[19]

- **Telehealth**. Especially in rural areas, where people must travel long distances to get to their doctors, specialists or a hospital, or for older people or anyone with limited mobility, telemedicine is critical.

- **Productivity**. People in households with what is considered the minimum definition of high speed internet (25 Mbps / 3 Mbps) may suffer 90 hours of lost productivity annually compared to those in the highest speed quintile (261 Mbps / 47 Mbps).[20]

- **Economic development/smart communities**. Fiber-based networks improve communities and make them attractive destinations for people and businesses to relocate, which prevents brain drain. As a critical infrastructure, fiber-based communities see immediate benefits:

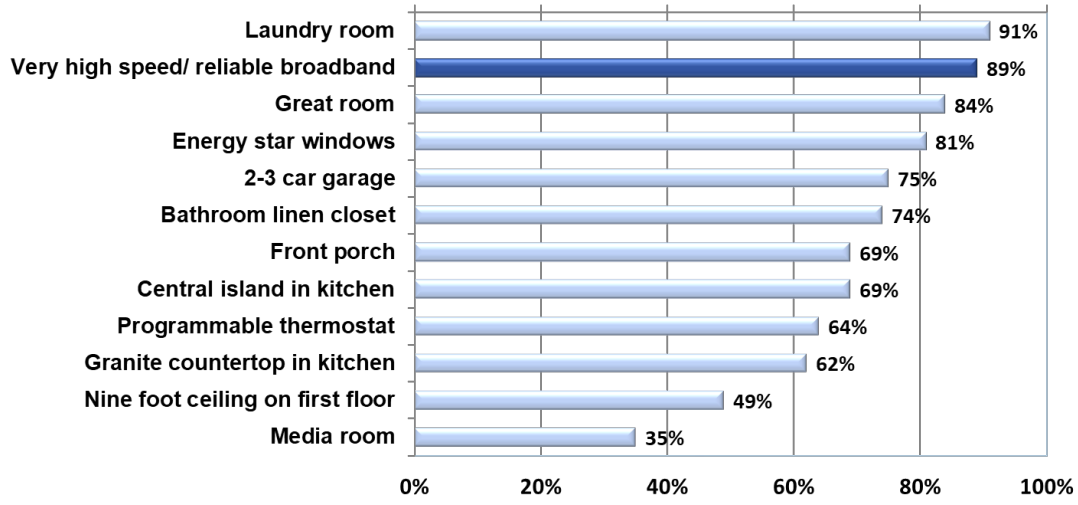
  - Gigabit broadband speeds and beyond
  - Significant economic impact
  - Jobs (in agriculture, health, energy), economic diversification
  - Smart grid modernization; 43% reduction in power outages[21]

Q: How do consumers' decisions about homes and communities depend on broadband?
RVA Consumer Studies 2018[22] found that having very high-speed broadband rates highly in these decisions:

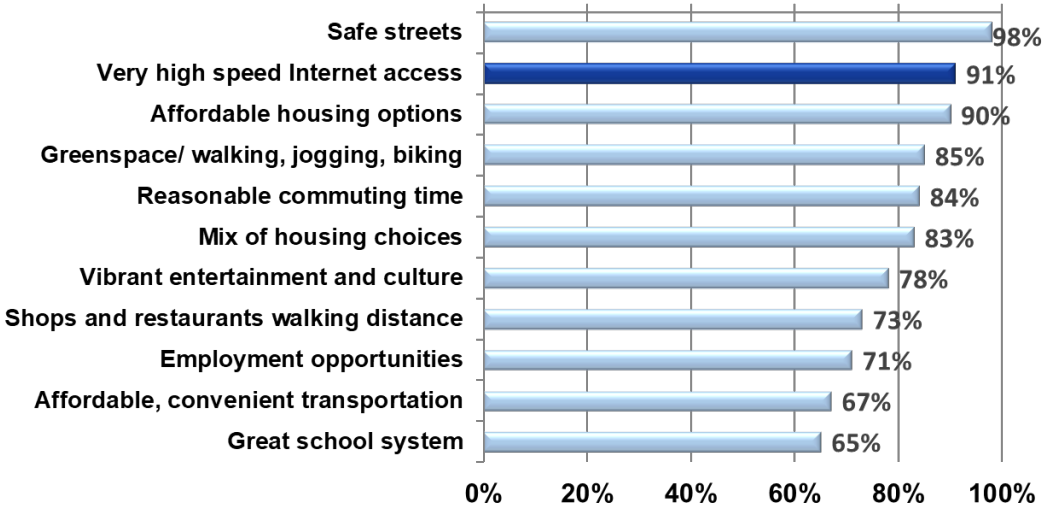
---

[18] https://www.giaging.org/documents/AARP_high-speed-internet-_aging_in_plan_PPI_report.pdf
[19] https://www.fiercetelecom.com/telecom/ftth-investment-to-surpass-60b-next-five-years-rva
[20] "Fiber Closes the Digital Divide" FBA research paper (forthcoming), https://www.fiberbroadband.org/p/cm/ld/fid=978
[21] Chattanooga Economic Impact Study – Professor Bento Lobo UT-Chattanooga
[22] RVA Consumer Studies 2018

Single Family Home Purchase



Community Relocation



Q: Are fiber investments cost effective?

Even when upfront investment costs are higher, fiber represents the most cost-effective means of delivering sufficient bandwidth for users now and for decades to come. In the white paper, "Economics of the New Normal," Vantage Point Solutions examines the cost of delivering broadband and finds that:[23]

- Any copper or HFC (hybrid fiber-coaxial) technology installed today will likely reach the end of its useful life long before it reaches the end of its economic life.

[23] https://www.ntca.org/sites/default/files/documents/2021-05/Future%20Proof%20--%20Economics%20of%20Rural%20Broadband%20FINAL.pdf

- At the end of 30 years a conservative estimate is that a mid-band wireless network may cost 30% less than a FTTP network, but its broadband speed would be 10 times slower at the start and would likely be more than 3,000 times slower at the end of that 30-year period.

- FTTP can reach 20 miles from the central office, or an area of nearly 1,000 square miles. To deliver gigabit speeds, an area of 1,000 square miles would require 10 to 20 towers for a wireless broadband design.

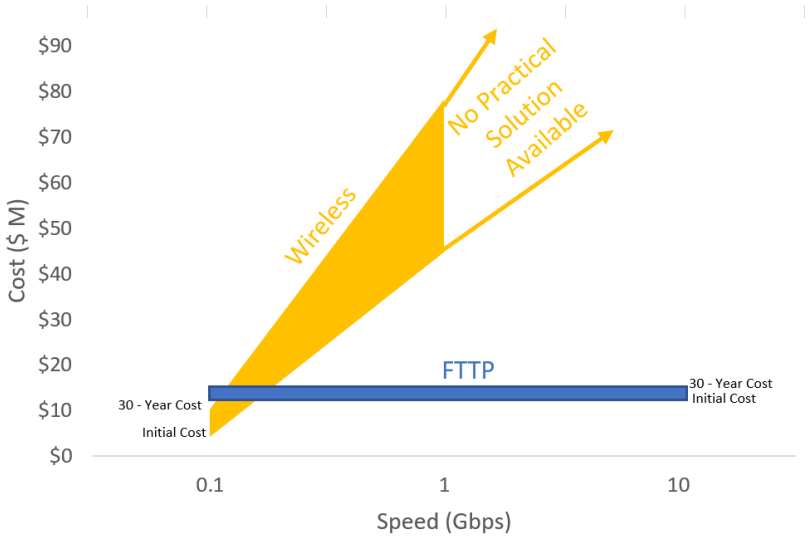
Ookla, the global speed test provider, reports average U.S. fixed broadband speeds of 179/65 Mbps in Jan 2021, ranking 12th Globally. Over the past 5 years U.S. fixed broadband speeds for download and upload have been increasing at a compound annual growth rate of 27% and 28% respectively, from 65/19 Mbps in 2016. If these growth rates continue over the next decade, the average U.S. fixed broadband speeds will be 1500/599 Mbps by 2030.[24]

The installation costs of a cable (either fiber optic or coaxial) can be 4 to 10 times the cost of cable itself. There is little difference in installed cost. Therefore, distance is the largest cost driver of deploying a rural broadband network. Cost summary is shown below:

	Initial Cost & Performance		30-Year Cost & Performance	
	Speed (Mbps)	**Capex**	**Speed (Gbps)**	**Capex**
Wireless (Mid Band)	100/20	$4.2M	0.6/0.012	$10.2M
Wireless (mmW)	1,000/500	$44.8M	6/3	$78.2M
FTTP	1,000/1,000	$12.6M	2,500/2,500	$14.4M

Q: Does fixed wireless or fiber give you a better investment over time?[25]

A: FTTP/FTTH provides the highest performance at a reasonable and incremental cost over the life of the network. Fixed wireless broadband costs increase rapidly over time. Please see the chart for more information.



[24] "Fiber Closes the Digital Divide" FBA research paper (forthcoming), https://www.fiberbroadband.org/p/cm/ld/fid=978
[25] https://www.ntca.org/sites/default/files/documents/2021-05/Future%20Proof%20--%20Economics%20of%20Rural%20Broadband%20FINAL.pdf