



# Wireless Internet Speeds

Is it possible to achieve maximum speeds for wireless internet with existing technology?

## **Wireless internet is slower and less reliable than direct forms of internet connection.**

Internet speeds are measured by bandwidth, the amount of data transferred over time, usually measured in Megabits per second (Mbps), and latency, the time it takes for information to travel between the sender and receiver. For more information about internet speeds and wired internet delivery, please see our Science Note on [Internet Speeds](#). Direct, wired connections are faster than wireless, and each wireless connection negatively impacts bandwidth and latency, with cumulative effects ([Afflerbach, 2023](#)).

Current wireless internet delivery options include satellite internet and fixed wireless internet. Satellite internet connects wirelessly from providers through satellites to home receivers (**Fig 1**). Fixed wireless internet consists of a wireless tower connected directly to wired internet (fiber, cable, or DSL) that projects wireless internet via high frequency radio waves (4G or 5G) over a 5-6 mile area, like a large-scale router ([Low, 2021](#)).

Newer forms of satellite and fixed wireless inter-

## Research Highlights

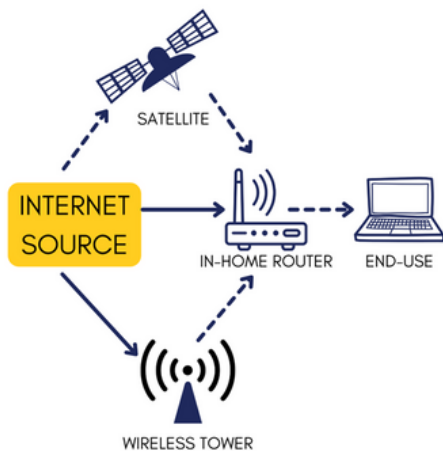
Weather, terrain, and distance to sources have major impacts on wireless speed and reliability.

The number of users and capability of end-user hardware (computers, routers, etc.) greatly impacts wireless speed.

Advertised speeds for both wired and wireless internet are measured under near-perfect performance conditions, and are not replicated in real-world applications.

net advertise bandwidth speeds equal to some wired forms of internet ([Earthlink, 2023](#); [Starlink, 2023](#); [Rise Broadband, 2023](#)). However, satellite and fixed wireless internet suffer from latency issues and jitter, where data is not transferred consistently, which can cause problems for end-use applications such as video calls or online gaming ([Internet Speeds](#)). Satellite internet can be interrupted by bad weather, including clouds and wind, and topography such as hilly or wooded terrain. New low earth orbit satellites reduce latency by reducing the distance a signal must travel but have the same issues with service interruption ([Afflerbach, 2023](#)).

Lower frequencies of fixed wireless (4G) have lower bandwidth but can travel longer distances, while higher frequencies (5G) have difficulty traveling long distances and penetrating buildings and other materials that may be in the way. To alleviate this, transmitters can be placed on high, vertical structures, which is discussed in the Science Note [Vertical Asset Management](#).



**Figure 1. Pathways of internet delivery.** Internet sources can be directly wired (solid lines) to wireless towers or in-home routers, which then deliver wireless internet (dashed lines). Each wireless connection negatively impacts the bandwidth and latency, and the effects are cumulative. That is, the greater number of wireless connections, the slower the information delivery. Similarly, more end-use device, and older devices are not capable of achieving the highest speeds, regardless of the amount of bandwidth delivered.

## End-user hardware and usage has significant impact on wireless performance

As wireless internet capabilities increase, end-users' ability to make use of higher speeds is generally sub-optimal, especially in poor and rural areas (Whitacre, 2022). End-use technology (computers, gaming consoles, smart devices, etc.) and home internet tools (routers, modems, etc.) that are >3 years old do not have the technological capabilities to handle increased information speeds (Low 2023, personal communication; Paul, 2022).

Similarly, the number of devices using the internet at any given time impacts bandwidth. Smart TVs, fridges, thermostats, and other devices can use up available data resulting in slow connections for devices such as cell phones or laptops (Afflerbach, 2023).

## Advertised internet speeds are tested in near-perfect performance conditions.

Internet service providers (ISPs), including fixed wireless internet providers, generally advertise a single, high speed for their products that is determined by speed tests in near perfect con-

ditions. Unlike in many homes, where there are multiple devices, older devices, and wireless connections (such as from the router to any device in the home), ISPs and the Federal Communications Commission (FCC) often test products using a single, wired, new device to determine advertised speeds and usage data (FCC, 2020; Feamster and Livingwood, 2020). Even users with direct home connections (fiber, cable, DSL) will experience slower speeds as soon as the signal transmits from the router, through the air, to a wireless device such as a cell phone or computer (Valentín-Sívico, 2023). Some companies are working to provide more accurate reports of speeds across an entire service area, that take into account physical barriers, line of sight, and distances to wireless towers (Beverage 2023, personal communication).

Achieving close to advertised speeds across an entire service area requires a greater number of fixed wireless connection points on vertical assets to overcome barriers associated with wireless internet delivery (Afflerbach, 2023). However, advertised speeds are almost never achieved, even by the majority of wired internet users. At present, fixed wireless provides the greatest stability and reliability in rural and underserved areas where direct wired internet access is not available (Low 2023, personal communication).

*MOST Policy Initiative is a 501(c)3 nonprofit organization that provides nonpartisan research information to members of the Missouri General Assembly upon request. This Science Note is intended for informational purposes and does not indicate support or opposition to a particular bill or policy approach. A full list of references used in this Science Note may be found at <https://mostpolicyinitiative.org/science-note/wireless-internet-speeds>. Please contact [info@mostpolicyinitiative.org](mailto:info@mostpolicyinitiative.org) with any questions.*