

Low Earth Orbit Satellites: Potential to Address the Broadband Digital Divide

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Low Earth Orbit Satellites: Potential to Address the Broadband Digital Divide

High-speed internet service, known as broadband, can be delivered through wired technologies, which use a physical cable (e.g., cable, fiber), and wireless technologies (e.g., mobile networks, satellite). The Federal Communications Commission (FCC) has defined a minimum speed for what it considers broadband service—100 megabits per second (Mbps) download and 20 Mbps upload—a standard that federal agencies have used in multiple federal broadband programs. Broadband services give users the ability to send and receive data at volumes and speeds that support a wide range of applications, including voice and video communications, entertainment, telemedicine, distance education, telework, and e-commerce.

Broadband technologies are currently being deployed, primarily by the private sector, throughout the United States. The term *digital divide* is used to characterize the gap between individuals who have access to broadband and those who do not. Federal funding has been provided for broadband infrastructure deployment, and while that funding has contributed to progress in closing the digital divide, some parts of the United States—particularly rural and remote areas—still lack access to broadband. These are typically areas where it is difficult to deploy terrestrial (e.g., ground-based) broadband technologies, such as fiber or cable, because of build-out challenges with terrain and cost. Some households in these areas use satellite services for communications, television, and internet. Historically, satellite broadband has been deployed using satellite systems in geostationary orbit (GEO). GEO satellites are susceptible to interference caused by weather and are reportedly not as reliable and resilient as wired broadband technologies, such as fiber.

Satellite broadband provided by satellites in low Earth orbit (LEO)—which became commercially available to consumers in recent years—may hold promise for further addressing the digital divide, especially in remote or rural areas. LEO satellites, which are positioned at a much lower altitude than GEO satellites, may be able to offer speeds closer to those that can be achieved with fiber, as well as lower latency (i.e., lag time). Some providers are in the process of developing, testing, and deploying LEO satellites for broadband delivery with the hope that they may provide higher speeds, lower latency, and expanded coverage. As this is an emerging technology, there are some unknowns—for example, whether LEO satellites can consistently provide the anticipated lower latency and higher speeds. Other uncertainties include the level of LEO satellite provider competition, cost, and challenges related to capacity and availability.

There is considerable debate around the eligibility of LEO satellites in federal broadband programs, particularly the Broadband Equity, Access, and Deployment (BEAD) program, which was discussed, for example, during a May 2025 hearing, “Fixing Biden’s Broadband Blunder,” held by the House Energy and Commerce Committee. Some observers see a potential for LEOs to provide broadband to remote and rural regions, while others have argued that federal broadband funding is better spent on investment in fiber because of fiber’s reliability and scalability (i.e., ability to handle future speed and bandwidth needs). As the development, testing, and deployment of LEO satellites progresses, the debate continues on how LEO satellites may address the digital divide. Some issues for Congress may include the role of LEO satellites in federal broadband programs, their costs and performance, and the associated demand for spectrum. These issues are central to congressional considerations related to the effective use of federal funds for broadband services and whether and how investments in wireless services can help close the digital divide.

Policy options related to this topic have been proposed in bills that are currently under consideration by the 119th Congress. These include, for example, providing vouchers to certain households to assist with broadband service and equipment costs (including satellite) under the BEAD program (H.R. 2750) and expanding the role of LEO satellites in certain federal broadband programs (H.R. 1870 and H.R. 2474).

Related issues may become ripe for congressional consideration, such as the potential to expand direct-to-cellular satellite services in areas where cell service and mobile broadband coverage is lacking, which could address the similarly situated cellular digital divide. While there is potential to address broadband and cellular coverage gaps with the expansion of LEO systems, there are also challenges, including availability of spectrum for satellite services and mitigating interference with other spectrum users.

Contents

Introduction	1
Broadband Technologies	1
The Digital Divide.....	3
Challenges to Deploying Broadband in Remote Areas.....	3
Satellite Broadband	4
Comparison of GEO and LEO Satellites.....	5
Considerations for LEO Satellites.....	7
Policy Issues for Congress.....	7
Role in Federal Broadband Programs	8
Rural Digital Opportunity Fund (RDOF).....	8
Broadband Equity, Access, and Deployment (BEAD) Program.....	9
Potential Challenges and Considerations	12
Affordability	12
Performance and Availability.....	14
Demand for Spectrum	16
What's Next: Increasing Mobile and Broadband Coverage Through Space-Based Cellular Networks	19

Figures

Figure 1. Broadband Infrastructure Components	2
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Tables

Table 1. Broadband Download and Upload Speed Ranges	2
Table 2. Selected Major GEO and LEO Satellite Providers in the United States.....	5
Table 3. Spectrum Bands Used for Satellite Broadband Services	17

Contacts

Author Information.....	22
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Introduction

Access to high-speed internet, known as broadband, has become increasingly essential as more aspects of daily life move online. The Federal Communications Commission (FCC) has set a minimum speed that it uses to define what it considers broadband service. In 2024, citing the standard now used in multiple federal broadband programs, the FCC raised this benchmark speed to 100/20 megabits per second (Mbps), meaning 100 Mbps for downloading data (i.e., retrieving data from the internet) and 20 Mbps for uploading data (i.e., sending data through the internet) from a prior 25/3 Mbps.¹

The comparatively lower population density of rural areas, along with difficult topography in some cases, contributes to lower broadband penetration rates relative to urban and suburban areas.² The *digital divide* describes the gap between individuals who have access to broadband and those who do not. For decades, Congress has directed financial resources through various federal programs to help reduce the digital divide—chiefly for infrastructure build-out (e.g., fiber).³ While this funding has helped to expand broadband infrastructure and increase availability of broadband services, traditional methods to close the digital divide are considered inadequate in some areas because of geographic limitations and cost considerations.

This report provides an overview of the challenges to deploying terrestrial (i.e., ground-based, such as fiber or cable) broadband technologies and compares terrestrial technologies and satellite broadband technologies. A discussion on the differences between satellite broadband providers in the United States, primarily those using geostationary orbit (GEO) satellites, which have provided space-based broadband for decades, and those using low Earth orbit (LEO) satellites, an emerging form of satellite broadband, follows. The report then focuses on the potential for LEO satellites to address the digital divide, as well as their potential limitations for achieving that goal, including policy issues and considerations for Congress.

Broadband Technologies

High-speed internet service, known as broadband, can be delivered through various means, including wired technologies, which use a physical cable (e.g., cable, fiber), and wireless technologies (e.g., mobile networks, satellite). The connection of a customer's home or business to the local network provider—including the technology used—is referred to as the “last mile” (Figure 1).⁴

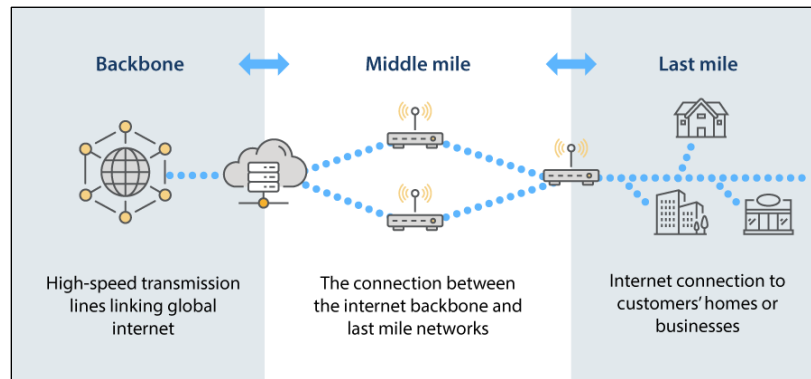
¹ Federal Communications Commission (FCC), “FCC Increases Broadband Speed Benchmark,” March 14, 2024, <https://docs.fcc.gov/public/attachments/DOC-401205A1.pdf>.

² FCC, *2024 Section 706 Report*, March 18, 2024, p. 21, <https://docs.fcc.gov/public/attachments/FCC-24-27A1.pdf>.

³ For example, see U.S. Department of Agriculture (USDA), “Broadband,” <https://www.usda.gov/sustainability/infrastructure/broadband>.

⁴ Government Accountability Office, *Middle Mile Grant Program Lacked Timely Performance Goals and Targeted Measures*, GAO-24-106131, October 2023, p. 7, <https://www.gao.gov/assets/gao-24-106131.pdf>.

Figure 1. Broadband Infrastructure Components



Source: CRS, adapted from Government Accountability Office (GAO), *Broadband: Middle-Mile Grant Program Lacked Timely Performance Goals and Targeted Measures*, GAO-24-106131, October 19, 2023, <https://www.gao.gov/products/gao-24-106131>.

Broadband gives users the ability to send and receive data at volumes and speeds that support a wide range of applications, including voice and video communications, entertainment, telemedicine, distance education, telework, and e-commerce. The speeds needed for adequate performance vary by online activity (e.g., general web browsing and email require less speed than streaming video). Additional bandwidth and speed may enhance the performance of some online activities.⁵ For example, faster speeds would allow multiple users in a household to simultaneously participate in high-definition video conferencing, browse the internet, stream videos, and play online games. Broadband speeds vary significantly depending on the technology. For example, fiber can provide faster download and upload speeds than digital subscriber line (DSL) or cable (see **Table 1**).

Table 1. Broadband Download and Upload Speed Ranges

Selected Technologies

Broadband Technology	Download Speed Range	Upload Speed Range
Digital subscriber line (DSL)	5-120 Mbps	1-20 Mbps
Cable	10 Mbps-1 Gbps	5-50 Mbps
Fiber	200 Mbps-20 Gbps	200 Mbps-20 Gbps
Geostationary orbit (GEO) satellite	25-150 Mbps	5 Mbps
Low Earth orbit (LEO) satellite	25-270 Mbps	5-25 Mbps

Source: CRS, adapted from Kate Fann, “DSL vs. Cable vs. Fiber: What’s the Best Wired Internet?,” *BroadbandNow*, July 30, 2024, <https://broadbandnow.com/guides/dsl-vs-cable-vs-fiber>; and Kate Fann, “What Is Satellite Internet? Pros, Cons, and Terminology,” *BroadbandNow*, August 1, 2025, <https://broadbandnow.com/guides/satellite-internet-pros-and-cons>.

Notes: Mbps = megabits per second; Gbps = gigabits per second. One gigabit is equal to 1,000 megabits.

Consumers typically prefer fiber, if available, because of its potential for faster speeds and lower latency (i.e., a delay between when an action is taken, such as clicking on a link to visit a website, and when the result is shown).⁶ Installation costs for fiber may be a challenge in rural areas. For

⁵ FCC, “Broadband Speed Guide,” <https://www.fcc.gov/consumers/guides/broadband-speed-guide>.

⁶ Fiber Broadband Association, “Underserved Rural Americans View Fiber as Best Option for Broadband (continued...)”, <https://fiberbroadband.org/underserved-rural-americans-view-fiber-as-best-option-for-broadband>.

example, information compiled for the State of Washington reported ranges of \$20,000 to \$45,000 per mile for aerial deployment (i.e., above ground, typically on poles) and \$50,000 to \$120,000 per mile for underground deployment.⁷ Rural areas may also offer a lower return on investment for broadband providers, as sparsely populated areas have fewer potential customers. Individuals, households, businesses, and institutions in rural areas that do not have access to fiber broadband may rely on other options, such as satellite (GEO and LEO), wireless (e.g., cellular hotspot), or dial-up internet service, but in some cases, speeds are slower than the speeds achieved by fiber.⁸

The Digital Divide

During the COVID-19 pandemic, many organizations implemented remote working or distance learning policies to help mitigate the spread of the disease. The pandemic thus highlighted the importance of internet access. For millions of children, it means access to education.⁹ For many workers, it means being able to perform their jobs remotely. For patients, it means being able to speak with a doctor. Additionally, the internet is increasingly how citizens access government services, seek employment, find homes, order goods and services, and stay connected with friends, family, and hobbies.¹⁰

Challenges to Deploying Broadband in Remote Areas

The digital divide exists in both urban and rural areas, but substantial segments of rural areas lack the infrastructure needed to access high-speed internet service.¹¹ Deploying broadband is more difficult in rural and remote areas, which may have low numbers of geographically dispersed potential users relative to more densely populated urban and suburban areas, and may have challenging terrain, such as mountain ranges or ground that is frozen for long periods of time.

In the United States, broadband technologies are mainly deployed by private sector providers; thus, another challenge is the return on investment. For wired broadband technologies—such as cable and fiber—in particular, greater geographical distance between customers reduces a provider’s ability to spread costs over a large subscriber base. Broadband providers are often driven by the economics that factor into deployment, operation, and maintenance, which may disincentivize investment in broadband in high-cost and low-density rural areas relative to urban and suburban areas.¹²

Infrastructure,” June 12, 2025, <https://fiberbroadband.org/2025/06/12/underserved-rural-americans-view-fiber-as-best-option-for-broadband-infrastructure/>.

⁷ Introba, *Broadband Connectivity Analysis*, November 7, 2024, https://app.leg.wa.gov/ReportsToTheLegislature/home/GetPDF?fileName=Attachment%203%20-%20Broadband%20Connectivity%20Analysis_17245543-dc9a-4625-94d1-9241b8eb95eb.pdf.

⁸ Fiber Broadband Association, “Why Fiber?,” <https://fiberbroadband.org/why-fiber/>.

⁹ Lauren Camera, “Disconnected and Disadvantaged: Schools Race to Give Students Access,” *U.S. News & World Report*, April 1, 2020, <https://www.usnews.com/news/education-news/articles/2020-04-01/schools-rush-to-get-students-internet-access-during-coronavirus-pandemic#:~:text=According%20to%20the%20most%20recent,higher%2C%20at%2012%20million%20children.>

¹⁰ Emily Stewart, “Give Everybody the Internet,” *Vox*, September 10, 2020, <https://www.vox.com/recode/2020/9/10/21426810/internet-access-covid-19-chattanooga-municipal-broadband-fcc>.

¹¹ Andrew Perrin, “Digital Gap Between Rural and Nonrural America Persists,” Pew Research Center, May 31, 2019, <https://www.pewresearch.org/fact-tank/2019/05/31/digital-gap-between-rural-and-nonrural-america-persists/>.

¹² National Telecommunications and Information Administration (NTIA), “Economics of Broadband Networks,” March 2022, <https://broadbandusa.ntia.gov/sites/default/files/2022-03/Economics%20of%20Broadband%20Networks%20PDF.pdf>.

For decades, the focal point in policy debates has been how to deploy terrestrial broadband technologies—particularly fiber—nationwide. Although funding provided from federal programs to build broadband infrastructure in underserved and unserved areas has helped to increase deployment and coverage, in 2024, the FCC reported that approximately 28% of people living in rural areas lack access to fixed broadband¹³ at speeds of at least 100/20 Mbps.¹⁴ Addressing the digital divide may depend on alternative technologies. To overcome some of the geographic and economic limitations with broadband deployment, several companies are developing constellations of satellites in LEO to provide broadband service from space. Some assert that satellite is “vastly cheaper” to deploy than fiber in rural areas and is “readily available because it does not require any infrastructure buildout.”¹⁵

Satellite Broadband

Satellite broadband is the provision of broadband service from satellites. To deploy a satellite constellation—a network of satellites working together to simultaneously cover various regions of the Earth¹⁶—a provider must deploy both satellites and ground stations and must provide access to spectrum to transmit and receive data.¹⁷ To use satellite broadband, a consumer must have

- an antenna, known as a satellite dish or base station, typically two to three feet in diameter;
- a satellite internet modem; and
- a clear line of sight to the provider’s satellite(s).¹⁸

There are two types of satellites used for broadband—GEO and LEO. GEO satellites have historically been used for telecommunications and have provided commercial internet access since the 1990s.¹⁹ For information on selected major GEO satellite providers in the United States, see **Table 2**. Attempts to provide global connectivity through LEO satellites were made in the 1990s, but most efforts were stymied because the technology did not yet meet the demand.²⁰ However, decreasing launch costs and miniaturization of electronic design have made providing

¹³ Although satellite is typically categorized under fixed broadband, in this instance, fixed broadband includes digital subscriber line (DSL), fiber, cable, and fixed wireless. The FCC notes that this analysis of fixed broadband is based on all fixed terrestrial services (fixed broadband services excluding fixed satellite service). For more information, see FCC, *2024 Section 706 Report*, p. 25.

¹⁴ FCC, *2024 Section 706 Report*, p. 3.

¹⁵ Masha Abarinova, “Is Satellite Broadband Good Enough to Deliver Internet For All?,” *Fierce Network*, November 15, 2024, <https://www.fierce-network.com/broadband/satellite-broadband-good-enough-deliver-internet-all>. Although satellite does not require build-out to every home, the provider does need to build out the satellite infrastructure in order to provide service, and the consumer does need to purchase dishes or terminals in the home to receive service.

¹⁶ OnGeo, “Satellite Constellations: A Guide to Global Coverage,” November 29, 2024, <https://ongeo-intelligence.com/blog/understanding-satellite-constellations-global-coverage>.

¹⁷ For more information on satellite use of spectrum, see National Aeronautics and Space Administration (NASA), “Space Communications and Navigation Fun Facts,” October 16, 2023, <https://www.nasa.gov/directorates/space-operations/space-communications-and-navigation-scan-program/scan-outreach/fun-facts/>.

¹⁸ FCC, “Getting Broadband Q&A,” <https://www.fcc.gov/consumers/guides/getting-broadband-qa>.

¹⁹ Hughesnet, “The Evolution of High-Speed Satellite Internet,” <https://www.hughesnet.com/blog/evolution-high-speed-satellite-internet>.

²⁰ BlackSky, “Low Earth Orbit (LEO) Satellites,” August 13, 2021, <https://www.blacksky.com/low-earth-orbit-leo-satellites/>.

broadband via LEO satellites more feasible in recent years.²¹ LEO satellites (i.e., Starlink) began providing broadband service in 2020.²² For information on selected major LEO satellite providers in the United States, see **Table 2**.

Table 2. Selected Major GEO and LEO Satellite Providers in the United States

Provider	Download Speeds	Upload Speeds	Latency	Lifespan
Amazon (LEO)	400 Mbps-1 Gbps	Unknown	Unknown	5 years
SpaceX (LEO)	25-220 Mbps	5-20 Mbps	25-100+ ms	5 years
Hughes Network Systems (GEO)	Up to 100 Mbps	5 Mbps	Low	15 years
Viasat (GEO)	Up to 150 Mbps	3 Mbps	638 ms	15 years

Sources: Thomas Kohnstamm, “Everything You Need to Know About Project Kuiper, Amazon’s Satellite Broadband Network,” *Amazon*, November 11, 2024, <https://www.aboutamazon.com/news/innovation-at-amazon/what-is-amazon-project-kuiper>; Starlink, “Starlink Specifications,” https://www.starlink.com/legal/documents/DOC-1470-99699-90?srsId=AfmBOoq2NlrTM4vn8SmruXdQJe8DUNjilDFXntFzP_7woGB0LOAy4HCQ; Hughesnet, “Hughesnet Fusion Plan,” <https://www.hughesnet.com/fusion>; Hughesnet, “What Can You Do With a Hughesnet Plan?,” <https://www.hughesnetinternet.net/>; Viasat, “Home,” <https://www.viasat.com/isg/>; Viasat, “What Is the Upload Speed for Viasat?,” <https://www.rsinc.com/what-is-the-upload-speed-for-viasat.php>; Viasat, “What Is Viasat’s Latency?,” <https://www.rsinc.com/what-is-viasat-latency.php>; Adrienne Harebottle, “GEO 2.0: The Future of Geostationary Orbit,” *Via Satellite*, July 24, 2023, <https://interactive.satellitetoday.com/via/articles/geo-2-0-the-future-of-geostationary-orbit>; and Congressional Budget Office, *Large Constellations of Low-Altitude Satellites: A Primer*, May 2023, <https://www.cbo.gov/publication/59175>.

Notes: Amazon’s download speeds, upload speeds, and latency are projected. SpaceX’s download speeds, upload speeds, and latency are based on typical customer experiences. Hughes Network Systems does not provide a corresponding number for “low latency.” All lifespans are approximate.

Comparison of GEO and LEO Satellites

GEO satellites orbit the Earth above the equator at an altitude of 22,236 miles, so that their orbital motion exactly matches Earth’s rotation.²³ As a result, they stay in the same position relative to points on the Earth’s surface—a useful feature for applications such as weather monitoring, communications, and surveillance.²⁴ GEO satellites require three satellites for the equivalent coverage of the entire Earth, as compared to LEO satellites, which may have anywhere from hundreds to thousands of satellites in their Earth coverage constellation.²⁵ GEO satellites are

²¹ Kevin Walker, “Miniaturization—Driving the Next Generation of Space Technology,” *Benchmark*, June 11, 2024, <https://www.bench.com/setting-the-benchmark/miniaturization-is-accelerating-modern-aerospace-technology>.

²² Michael Sheetz, “Here’s How to Find Out When Elon Musk’s SpaceX May Provide You with Satellite Internet,” *CNBC*, June 12, 2020, <https://www.cnn.com/2020/06/12/spacex-starlink-satellite-internet-service-application-beta-test.html>.

²³ Viasat, “Unique Qualities of High-Capacity GEO Satellites,” November 17, 2023, <https://www.viasat.com/perspectives/corporate/2023/unique-qualities-of-high-capacity-geo-satellites/>.

²⁴ Robert Lea, “What Is a Geosynchronous Orbit?,” *Space.com*, December 26, 2022, <https://www.space.com/29222-geosynchronous-orbit.html>.

²⁵ Rex Fox O’Loughlin, “Orbital Ambitions: LEO Satellite Constellations and Strategic Competition,” *International Institute for Strategic Studies*, May 27, 2025, <https://www.iiss.org/online-analysis/six-analytic-blog/2025/05/orbital-ambitions-leo-satellite-constellations-and-strategic-competition/>.

large, making them comparatively more expensive to launch. GEO satellites have a roughly 15-year service life in orbit.²⁶

The orbital altitude of GEO satellites may increase latency and allow for greater interference from weather conditions or terrain. For instance, due to the distance the data must travel to a satellite in orbit and back, consumers using GEO satellite service can experience greater latency than from other forms of internet service.²⁷ Additionally, weather conditions (such as snow) and mountainous or heavily forested terrain may also cause interruptions in service due to the requirement that the satellite be in view of both the customer's and the provider's ground stations.²⁸

Objects are considered to be in low Earth orbit if they have an altitude of 1,200 miles or less above the Earth's surface during at least some part of their orbit.²⁹ Unlike GEO satellites, LEO satellites are constantly moving across the sky as seen from the ground, and each individual satellite is only within line of sight of a fixed point on Earth for a period of time. This requires the use of thousands of satellites to maintain coverage,³⁰ but it may mitigate loss of coverage due to weather or obstructions. LEO satellites are also not restricted to orbits over the equator, so they may be able to provide better service at high latitudes.³¹ Because transmitted data do not have to travel as far to reach the satellite and return to Earth, LEO operators expect to offer faster broadband speeds and less latency than GEO satellite services.³² Reported speeds for GEO satellites do not meet the FCC's benchmark speed of 100/20 Mbps (see **Table 2**).

Individual LEO satellites cost less to make and launch than GEO satellites.³³ The total cost of a constellation of LEO satellites can be substantial, as hundreds or thousands of satellites may be required to provide global coverage because of their smaller beams.³⁴ LEO satellites are designed to last approximately five years.³⁵

²⁶ Adrienne Harebottle, "GEO 2.0: The Future of Geostationary Orbit," *Via Satellite*, July 24, 2023, <https://interactive.satellitetoday.com/via/articles/geo-2-0-the-future-of-geostationary-orbit>.

²⁷ Fiber has the best performance in terms of latency, with an average range of 7-14 milliseconds (ms). Cable averages 12 ms and ranges as high as 24 ms, while DSL averages 23 ms and ranges as high as approximately 34 ms. A lower latency number is better than a higher latency number. For more information, see FCC, *Measuring Fixed Broadband - Thirteenth Report*, August 13, 2024, <https://www.fcc.gov/reports-research/reports/measuring-broadband-america/measuring-fixed-broadband-thirteenth-report>.

²⁸ BroadbandNow, "Satellite Internet in the United States," <https://broadbandnow.com/Satellite>.

²⁹ NASA, "Commercial Space Frequently Asked Questions," <https://www.nasa.gov/humans-in-space/leo-economy-frequently-asked-questions/>.

³⁰ Rob Rutkowski, "5 FAQs About Low Earth Orbit (LEO) Satellite Constellations," Bliley Technologies, June 29, 2017, <https://blog.bliley.com/5-faq-answers-new-space-leo-satellite-constellations>.

³¹ European Space Agency, "Low Earth Orbit," February 3, 2020, https://www.esa.int/ESA_Multimedia/Images/2020/03/Low_Earth_orbit.

³² SatelliteInternet, "The Best Satellite Internet Providers of 2021," <https://www.satelliteinternet.com/>.

³³ LEO satellites cost approximately \$500,000 to \$45 million per satellite. GEO satellites cost approximately \$100 million to \$400 million per satellite. For more information, see International Telecommunication Union, *The Last-Mile Internet Connectivity Solutions Guide*, 2020, p. 70, <https://www.itu.int/en/ITU-D/Technology/Documents/LMC/The%20Last-Mile%20Internet%20Connectivity%20Solutions%20Guide.pdf>.

³⁴ International Telecommunication Union, *The Last-Mile Internet Connectivity Solutions Guide*, 2020, <https://www.itu.int/en/ITU-D/Technology/Pages/LMC/LMC-Home.aspx>.

³⁵ Congressional Budget Office, *Large Constellations of Low-Altitude Satellites: A Primer*, May 2023, <https://www.cbo.gov/publication/59175>.

Considerations for LEO Satellites

LEO satellite constellations are still under development or being deployed. As these capabilities mature, a few considerations may affect their perceived success, including the following:

- Will LEO satellite providers be able to consistently meet the broadband minimum speed benchmark set by the FCC and attract users?³⁶
- How will user equipment and service plan costs compare to those of other broadband technologies?
- Will LEO broadband companies maintain profitability?

Table 2 provides information about projected speeds and latency for two major U.S. companies that are providing or seeking to provide broadband service through LEO satellites in the United States. These companies are at various stages in development, testing, and deployment:

- SpaceX is delivering commercial service in the United States and other countries under the name Starlink and has over 6,750 satellites in orbit.³⁷ SpaceX has plans to launch as many as 42,000 satellites in total.³⁸
- Amazon's LEO satellite broadband network, under the name Amazon Leo (formerly Project Kuiper), proposes to deliver high-speed, low-latency broadband services by operating 3,236 LEO satellites.³⁹ Amazon launched the first 27 satellites in April 2025.⁴⁰ Amazon intends to launch half of its planned 3,236 satellites by the end of July 2026, with plans to expand globally.⁴¹

Policy Issues for Congress

Providers are in various stages of developing, testing, and deploying LEO satellites with the hopes of providing speeds and latency that approach those currently associated with fiber, as well as expanded broadband coverage. As this progress continues, considerations for Congress may include

- the role of LEO satellites in federal broadband programs,
- related affordability and performance considerations,
- spectrum demands, and
- the emergence of space-based cellular broadband networks.

³⁶ David Jarvis, "Five Key Uncertainties Around High-Speed Internet from Low Earth Orbit," International Telecommunication Union, August 18, 2020, <https://www.itu.int/en/myitu/News/2020/08/18/07/51/Uncertainties-high-speed-Internet-low-earth-orbit-LEO-satellite-broadband>.

³⁷ Starlink, "Starlink Updates," <https://www.starlink.com/updates>.

³⁸ Joe Supan, "Starlink Plans to Send 42K Satellites into Space. That Could Be Bad News for the Ozone," *CNET*, July 2, 2025, <https://www.cnet.com/home/internet/starlink-plans-to-send-42k-satellites-into-space-that-could-be-bad-news-for-the-ozone/>.

³⁹ FCC, *In the Matter of Kuiper Systems, LLC, et al.*, order and authorization, July 29, 2020, p. 2, <https://docs.fcc.gov/public/attachments/FCC-20-102A1.pdf>.

⁴⁰ Joey Roulette, "Amazon Launches First Kuiper Internet Satellites, Taking On Starlink," *Reuters*, April 29, 2025, <https://www.reuters.com/business/media-telecom/amazon-launches-first-kuiper-internet-satellites-taking-starlink-2025-04-28/>.

⁴¹ Katherine Anne Long, "Amazon Internet Program, Project Kuiper, to Launch Satellite," *Government Technology*, April 20, 2021, <https://www.govtech.com/news/amazon-internet-program-project-kuiper-to-launch-satellite.html>.

Role in Federal Broadband Programs

As the infrastructure cost per connection for wired technologies (e.g., fiber) in rural areas is often high, broadband deployment may not be economically attractive without incentives—which have traditionally been in the form of federal or state subsidies (e.g., grants to state and local governments or internet service providers) or direct assistance to customers.⁴² Subsidies, with requirements to build out and provide broadband service in unserved or underserved areas for broadband deployment, have been the main way the federal and state governments have addressed the digital divide. However, until recently, broadband via LEO satellites had never been funded through federal grants or subsidies that provide support for broadband deployment. In the past, federal broadband programs addressing the digital divide have tended to encourage the deployment of technologies such as fiber, cable, or fixed wireless. Further—historically, broadband infrastructure awards have been tied to capital projects involving the construction of new networks, such as fiber.

In 2025, key issues of debate have been whether LEO satellites might be an alternative in places where fiber is not cost effective to deploy and whether LEO satellites might be able to connect rural and tribal communities more quickly than fiber, which can take years to deploy. In the 119th Congress, some Members have expressed interest in expanding the role of LEO satellites in certain federal broadband programs.⁴³

Guidance among federal programs that provide funding for broadband vary with respect to the use of certain broadband technologies. Some may require or favor investment in fiber, while others may be technology agnostic. In particular, LEO satellite providers have encountered perceived challenges in the ability to consistently meet eligibility and performance requirements (e.g., speed, coverage).

Rural Digital Opportunity Fund (RDOF)

In 2020, the FCC opened up eligibility for satellite providers in the RDOF. The RDOF is a broadband deployment program within the Universal Service Fund, which uses a competitive reverse auction to award funds to the broadband service providers that committed to deploying service to areas deemed by the FCC as unserved with broadband at the lowest cost.⁴⁴ In its 2020 report and order, the FCC recognized “the importance of allowing all technologies the ability to participate in the [RDOF] auction and offer service to unserved areas.”⁴⁵ In the auction, SpaceX (i.e., Starlink) bid and won funding support to provide broadband service to certain areas.⁴⁶ Before authorizing the funding, the FCC required all winning bidders to submit long-form

⁴² Rich Contreras, “Making Rural Fiber Deployments Cost Effective,” *PPC Broadband*, <https://www.ppc-online.com/blog/making-rural-fiber-deployments-cost-effective>.

⁴³ For example, in the Broadband Equity, Access, and Deployment (BEAD) program (see the Speed for BEAD Act, H.R. 1870) and potentially for broadband projects funded by the Appalachian Regional Commission (ARC) (see the Expanding Appalachia’s Broadband Access Act, H.R. 2474). For more information on broadband projects and ARC, see ARC, “Broadband Projects,” <https://www.arc.gov/broadband-projects/>.

⁴⁴ For more information on the Rural Digital Opportunity Fund (RDOF), see CRS Report R47621, *The Universal Service Fund and Related FCC Broadband Programs: Overview and Considerations for Congress*, by Patricia Moloney Figliola.

⁴⁵ FCC, *In the Matter of Rural Digital Opportunity Fund and Connect America Fund*, report and order, February 7, 2020, p. 22, <https://docs.fcc.gov/public/attachments/FCC-20-5A1.pdf>.

⁴⁶ Rachel Jewett, “SpaceX Wins \$885M in First Phase of FCC’s Rural Digital Opportunity Fund,” *Via Satellite*, December 7, 2020, <https://www.satellitetoday.com/government-military/2020/12/07/spacex-wins-885m-in-first-phase-of-fccs-rural-digital-opportunity-fund/>.

applications, which asked applicants to provide detailed technology and system designs.⁴⁷ After consideration of SpaceX's long-form application, in 2022, the FCC's Wireline Competition Bureau ultimately decided not to approve Starlink's application, citing concerns about subsidizing a "still developing technology for consumer broadband."⁴⁸ Following the decision, SpaceX sought FCC review and urged the agency to reverse the bureau's determination. In December 2023, the FCC affirmed (in a 3-2 vote) the bureau's decision to deny Starlink's long-form application.⁴⁹ Some Members of Congress have sought further information from the FCC on the denial.⁵⁰ In November 2024, FCC Chairman Brendan Carr noted that the FCC would likely not revisit the decision, as Starlink has not filed further appeals.⁵¹

Broadband Equity, Access, and Deployment (BEAD) Program

The BEAD program, administered by the National Telecommunications and Information Administration (NTIA), is a broadband program focusing on infrastructure, in which states are directed to develop their own competitive processes to award subgrants to broadband service providers.⁵² In its notice of funding opportunity (NOFO) issued in May 2022, the NTIA determined that states should prioritize projects that propose to use fiber before projects that propose to use non-fiber technologies.⁵³ The use of other technologies, such as LEO satellites, were to be considered only under limited circumstances, such as if the use of that technology to connect locations with broadband service would be less expensive.⁵⁴ In March 2025, Secretary of Commerce Howard Lutnick announced that the agency was reviewing and "revamping the BEAD program to take a tech-neutral approach."⁵⁵ In June 2025, the Department of Commerce released the BEAD Restructuring Policy Notice, which removed the fiber preference and allowed for all technology types that meet the BEAD technical performance standards—including the use of LEO satellites.⁵⁶

Between the publication of the NOFO and the release of the BEAD Restructuring Policy Notice, there were differing opinions on the potential removal of the fiber preference and expansion of LEO satellite eligibility. Some technology policy analysts asserted that with finite federal

⁴⁷ For background on the RDOF auction, see CRS Report R46501, *Rural Digital Opportunity Fund: Requirements and Selected Policy Issues*, by Colby Leigh Pechtoll.

⁴⁸ FCC, *FCC Rejects Applications of LTD Broadband and Starlink for Rural Digital Opportunity Fund Subsidies*, August 10, 2022, <https://docs.fcc.gov/public/attachments/DOC-386140A1.pdf>.

⁴⁹ FCC, *In the Matter of Application for Review of Starlink Services, LLC et al.*, order on review, December 12, 2023, p. 6, <https://docs.fcc.gov/public/attachments/FCC-23-105A1.pdf>.

⁵⁰ Rachel Jewett, "House Oversight Chair Investigates FCC's Starlink RDOF Denial," *Via Satellite*, October 9, 2024, <https://www.satellitetoday.com/government-military/2024/10/09/house-oversight-chair-investigates-fccs-starlink-rdof-denial/>.

⁵¹ Ari Bertenthal, "Carr: FCC Unlikely to Restore Starlink RDOF Subsidy," *Broadband Breakfast*, November 22, 2024, <https://broadbandbreakfast.com/carr-fcc-unlikely-to-restore-starlink-rdof-subsidy/>.

⁵² NTIA, "Broadband Equity Access and Deployment Program Overview," <https://broadbandusa.ntia.gov/funding-programs/broadband-equity-access-and-deployment-bead-program>.

⁵³ NTIA, *Notice of Funding Opportunity: Broadband Equity, Access, and Deployment Program*, May 13, 2022, p. 42, <https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf>.

⁵⁴ NTIA, *Notice of Funding Opportunity*, p. 13.

⁵⁵ U.S. Department of Commerce, "Statement from U.S. Secretary of Commerce Howard Lutnick on the BEAD Program," March 5, 2025, <https://www.commerce.gov/news/press-releases/2025/03/statement-us-secretary-commerce-howard-lutnick-bead-program>.

⁵⁶ NTIA, *Broadband Equity, Access, and Deployment (BEAD) Program: BEAD Restructuring Policy Notice*, June 6 2025, p. 8, <https://www.ntia.gov/sites/default/files/2025-06/bead-restructuring-policy-notice.pdf>.

funding, LEO satellites may be the most economical way to deploy broadband to rural areas.⁵⁷ However, LEO satellite constellations may be more expensive to maintain in the long run, as each LEO satellite must be replaced at certain time intervals (approximately five years; see **Table 2**). This is compared with fiber optic cables, which are typically expected to last at least 20-25 years.⁵⁸ According to the Benton Institute for Broadband & Society, “when viewed over a 30-year period ... , the total cost of LEO infrastructure can be much higher than the total cost of fiber infrastructure. This is largely due to the fact that a fiber network is built once whereas a LEO network must be rebuilt continuously.”⁵⁹ Further, some stakeholders believe that saving some money in the short term using LEO satellites may occur at the expense of underinvesting in fiber technologies and could result in rural areas experiencing another digital divide in the future if LEO satellites are unable to keep up with evolving speed and bandwidth needs.⁶⁰ On the other hand, installing fiber networks is expensive, and though the provided BEAD funding is anticipated to help further build out fiber broadband infrastructure in some areas, it is not feasible to connect all unserved locations—especially in areas that have difficult terrain or geographic restrictions.

Some states may view the usage of LEO satellites as a short-term solution that can provide an immediate connection while waiting for more permanent solutions (e.g., fiber) to be deployed. For example, in November 2024, New Mexico’s broadband office requested \$70 million from the state’s legislative finance committee to increase broadband service connections through satellite, which “ensures New Mexicans are not on the wrong side of the digital divide for the next few years while longer term projects are built.”⁶¹ Other states may view LEO satellites as a longer-term solution and have started to incorporate the use of LEO satellites into their state-run programs to connect areas where “traditional broadband infrastructure is often prohibitively expensive to deploy or could take years to build out.”⁶² Texas, for example, published its intention to conduct a pilot program directed toward the deployment of LEO satellites in rural and remote areas that were not addressed by fiber.⁶³ An update by the Texas Broadband Office noted that

⁵⁷ For instance, using Starlink as an example, one technology consultant estimated a cost of \$3.5 billion (\$548 per location) to connect 6.4 million locations unserved by broadband under the BEAD program, as opposed to a cost of \$41.6 billion (\$6,500 per location) through fiber connections. See Chris Scharrer, “Chris Scharrer: Why Would SpaceX Need \$20B from BEAD?,” *Broadband Breakfast*, April 23, 2025, <https://broadbandbreakfast.com/chris-scharrer-why-would-spacex-need-20b-from-bead/>.

⁵⁸ Harry Guinness, “The Long-Lasting Benefits of Fiber Internet for Your Home,” *Frontier*, October 9, 2024, <https://blog.frontier.com/2024/10/the-long-lasting-benefits-of-fiber-internet-for-your-home/>.

⁵⁹ Drew Garner, “Is LEO the ‘Benefit of the Bargain’ for BEAD?,” Benton Institute for Broadband & Society, March 26, 2025, <https://www.benton.org/blog/benefit-bargain-bead>.

⁶⁰ Tim Stelzig, “Tim Stelzig: Creating a Lasting Solution for BEAD,” *Broadband Breakfast*, May 20, 2025, <https://broadbandbreakfast.com/tim-stelzig-creating-a-lasting-solution-for-bead>.

⁶¹ Connect New Mexico, “Roundhouse Revenue Request: State Broadband Office Calls on Legislative Committee for \$70 Million to Expand Satellite Service,” press release, November 19, 2024, https://connect.nm.gov/uploads/1/4/1/9/141989814/press_release_obae_satellite_funding_request.pdf; see also Masha Abarinova, “New Mexico Doesn’t Want to Just Sit Around and Wait For BEAD,” *Fierce Network*, November 26, 2024, <https://www.fierce-network.com/broadband/new-mexico-doesnt-want-just-sit-around-and-wait-bead>.

⁶² Texas Comptroller of Public Accounts, “Texas Prepares to Launch LEO Satellite Grant Program to Expand Broadband Access in Rural Areas,” January 17, 2025, <https://comptroller.texas.gov/about/media-center/news/20250117-texas-prepares-to-launch-leo-satellite-grant-program-to-expand-broadband-access-in-rural-areas-1736976863012?>

⁶³ Texas Comptroller of Public Accounts, “Texas Prepares to Launch LEO Satellite Grant Program to Expand Broadband Access in Rural Areas.”

although a notice of funding availability was issued, no qualified applications were received, the solicitation was cancelled, and there are no plans to reissue the solicitation.⁶⁴

It is uncertain whether the inclusion of LEO satellite broadband providers will help to address the digital divide through their participation in federal broadband programs. For example, some stakeholders argue that with Starlink’s nearly ubiquitous coverage, consumers in BEAD-supported locations (i.e., the specific locations identified by states as eligible for providers to build network infrastructure using BEAD funding) have likely already had broadband service available to them through Starlink for several years—and that funding Starlink service through the BEAD program is not offering a new option to those consumers.⁶⁵ Others have questioned providing federal funding to LEO providers, as historically broadband infrastructure awards have been tied to capital projects (i.e., projects involving new construction), and LEO satellites infrastructure is already in existence.⁶⁶ Congress may consider whether funds intended for infrastructure build-out (e.g., the BEAD program) would be subsidizing (1) in-home terminals (i.e., dishes) to enable connection to a network that already exists and is reportedly providing service to nearly 100% of the United States,⁶⁷ (2) deployment of new LEO satellites to enhance network coverage and capacity, or (3) other possibilities.

One industry expert has raised the issue of whether federal agency adoption of LEO satellites as a reliable broadband service in the June 2025 BEAD Restructuring Policy Notice coupled with the widespread availability of LEO satellites⁶⁸ “might eliminate any perceived federal need for future broadband grants.”⁶⁹

Reactions to the June 2025 BEAD Restructuring Policy Notice were mixed—some policymakers and stakeholders applauded the changes to the qualified technologies, and others supported restricting funding to the deployment of fiber networks. Congress could debate whether it should address restricting or expanding the technologies funded by the BEAD program through legislation or whether it should defer to the NTIA.⁷⁰

Congress could contemplate whether to allow LEO satellite providers to compete in other federal broadband programs (e.g., the ReConnect Loan and Grant Program administered by the U.S. Department of Agriculture [USDA]).⁷¹ If Congress wishes to pursue this possibility, it could

⁶⁴ Texas Broadband Development Office, “Programs,” <https://comptroller.texas.gov/programs/broadband/funding/index.php#satellite>.

⁶⁵ Doug Dawson, “BEAD and the Rural Public,” CCG Consulting, June 12, 2025, <https://potsandpansbyccg.com/2025/06/12/bead-and-the-rural-public>.

⁶⁶ Jericho Casper, “Advocates: Fine Print in New BEAD Notice Favors Satellite Providers,” *Broadband Breakfast*, June 24, 2025, <https://broadbandbreakfast.com/advocates-fine-print-in-new-bead-notice-favors-satellite-providers/>.

⁶⁷ See Starlink, “Availability Map,” <https://www.starlink.com/us/map?srsId=AfmBOorf3FFKMV0eIz2GmL2q7B4Gj-iL1iXJwr8n-BX391toK1FPE0Bx>; and Starlink, “My Region is at Capacity or Shows as ‘Sold Out’ on the Availability Map. What Does That Mean?,” https://www.starlink.com/support/article/240ac933-68ce-00dd-d8ec-0d5bf5816f3d?srsId=AfmBOoqMuIP0AQlOBRIZoa_ECRMG5eSf_AHufOxdKd1Jy_iMNYHhfdGE.

⁶⁸ See Starlink, “Availability Map,” <https://www.starlink.com/us/map>.

⁶⁹ Doug Dawson, “Implications of Satellite Being Broadband,” *POTs and PANs*, July 1, 2025, <https://potsandpansbyccg.com/2025/07/01/implications-of-satellite-being-broadband/>.

⁷⁰ Leslie Stimson, “Reactions to BEAD Changes Are Strong,” *Inside Towers*, June 10, 2025, <https://insidetowers.com/reactions-to-bead-changes-are-strong/>.

⁷¹ For the ReConnect Loan and Grant Program, award funds may be used “to fund the construction or improvement of facilities required to provide fixed terrestrial broadband service.” See USDA, “Program Overview,” <https://www.usda.gov/sustainability/infrastructure/broadband/reconnect-loan-and-grant-program/program-overview>.

examine the successes and challenges of LEO satellite participation in the BEAD program to inform whether or not to include this technology in other federal broadband programs.⁷²

Surrounding the continued debate around which technology or technologies are best suited to close the digital divide, there may be several questions for Congress to contemplate. These could include, for example, whether the cost of fiber outweighs the potential benefits or whether the lowest cost approach should become the new policy directive moving forward. Congress may also consider whether a mixture of technologies (i.e., satellite and terrestrial) could be a viable solution, how to achieve this mixture across the United States, and whether there are any policies that hinder a mixture of technology solutions being used to close the digital divide. Congress could also examine how satellite and terrestrial broadband can complement each other in order to increase coverage or provide supplemental coverage.⁷³

Potential Challenges and Considerations

As LEO satellite broadband becomes eligible for federal broadband funding, there are some factors for consideration related to affordability and performance (i.e., capacity, speeds, and availability).

Affordability

Affordability for consumers of LEO satellite broadband service may be a challenge because of the equipment required to receive service and the cost of a monthly service plan. For instance, a standard Starlink kit (which includes a terminal, Wi-Fi router, power supply, and mount) is \$349, and the monthly service cost is \$120.⁷⁴ Starlink does offer a service plan called “Residential Lite,” which is available in select areas at a reduced cost of \$80 per month.⁷⁵ However, the Residential Lite plan is deprioritized during peak hours, which, according to Starlink, “means speeds may be slower for Residential Lite service relative to Residential service when our network has the most users online.”⁷⁶ Amazon has not announced details on price points for equipment or monthly service plans, or projected speeds for its broadband service, but noted that “affordability is a key principle” of Amazon Leo.⁷⁷

Some states have pilot-tested programs in an attempt to make LEO satellites more affordable for consumers. For instance, Maine’s Working Internet ASAP Program provides a LEO satellite option to homes and businesses that are difficult to reach and have no other options for broadband service. Maine allows eligible homes and businesses to apply for subsidized in-home LEO satellite hardware (e.g., for Starlink, this would include a power supply, cables, base, and Wi-Fi

⁷² For information on USDA broadband programs, including eligibility and requirements, see USDA “Telecom Programs,” <https://www.rd.usda.gov/programs-services/telecommunications-programs>.

⁷³ As an example of supplemental coverage, following a natural disaster, satellite broadband services can be used when terrestrial networks have been damaged or destroyed. Satellite Industry Association, *Broadband Connectivity*, <https://sia.org/satellites-services/broadband-connectivity/>.

⁷⁴ Starlink, “Starlink for Homes,” <https://www.starlink.com/residential>.

⁷⁵ Starlink, “What Is the Starlink ‘Residential Lite’ Service Plan?,” <https://www.starlink.com/support/article/6e0a6781-d9e6-8cc1-153e-763daa011f9a>.

⁷⁶ Starlink, “What Is the Starlink ‘Residential Lite’ Service Plan?”

⁷⁷ Thomas Kohnstamm, “Everything You Need to Know About Project Kuiper, Amazon’s Satellite Broadband Network,” *Amazon*, November 11, 2024, <https://www.aboutamazon.com/news/innovation-at-amazon/what-is-amazon-project-kuiper>.

router)⁷⁸ and installation support, though users are still responsible for paying the monthly costs associated with the service.⁷⁹ Similarly, a proposal by the New Mexico broadband office to use state funds would assist residents with the cost of equipment needed for satellite service and provide a monthly subsidy for low-income households to help make the service more affordable.⁸⁰

Some Members of Congress see the possibility that monthly service plans or equipment may raise affordability challenges to consumers. For example, the Bridging the Broadband Gap Act of 2025 (H.R. 2750) would authorize states to use BEAD funding to provide vouchers to certain households to pay for 50% of the initial cost of a satellite or fixed wireless receiver, as well as \$30 toward each monthly bill for the first year of service. However, this policy option may still not make satellite service more affordable for all households. Additionally, if a household decides to continue service after the first year, the household would no longer receive the \$30 subsidy for its monthly bill and would then be paying full price for service. The NTIA addressed some aspects of affordability concerns in its June 2025 BEAD Restructuring Policy Notice, as LEO providers must offer BEAD-supported locations equipment at no cost to new subscribers during the program's 10-year performance period.⁸¹

New LEO satellite broadband market entrants, such as Amazon, could serve as competitors to Starlink or other service offerings and potentially provide competitively priced broadband services, increasing consumer choice and competition. When a new competitor, such as a LEO provider, enters an area, existing terrestrial providers with large capital costs already invested may lower prices, provide other incentives, and invest in additional infrastructure and marketing in an attempt to retain customers.⁸² In areas where there may be only one existing broadband service provider, new LEO satellite market entrants can allow consumers a choice among service plans.⁸³ On the other hand, in areas served by a single LEO satellite broadband provider, the absence of other broadband providers may lead to broadband options that are not affordable for some consumers, leaving them unable to connect despite availability because of cost concerns.

Subsidizing LEO satellite broadband service for consumers may help to narrow the digital divide in some communities that are currently unserved or underserved by terrestrial broadband. Thus, Congress could consider whether an affordability program targeted specifically for consumers subscribing to LEO satellite services may meet this need. If Congress were to consider this, some factors may include how much of a subsidy to provide; whether a subsidy would include equipment or the cost of a monthly service plan, or both; the duration of the subsidy (e.g., one

⁷⁸ Starlink, "What Comes in My Starlink Kit?," <https://www.starlink.com/support/article/67db861f-7c98-cc54-30ad-a55eb6625b93?srltid=AfmBOopPaKnEf9BCpgAjKHvsTV0N1LTNngiKQqJQgHwfvYFDj3Q6A3RV>.

⁷⁹ Maine Connectivity Authority, "Working Internet ASAP," <https://www.maineconnectivity.org/wia>.

⁸⁰ Connect New Mexico, "Roundhouse Revenue Request: State Broadband Office Calls on Legislative Committee for \$70 Million to Expand Satellite Service," November 19, 2024, https://connect.nm.gov/uploads/1/4/1/9/141989814/press_release_obae_satellite_funding_request.pdf.

⁸¹ NTIA, *BEAD Restructuring Policy Notice*, June 6, 2025, p. 21, <https://www.ntia.gov/sites/default/files/2025-06/bead-restructuring-policy-notice.pdf>.

⁸² Chris Daehnick et al., "Large LEO Satellite Constellations: Will It Be Different This Time?," McKinsey & Company, May 4, 2020, <https://www.mckinsey.com/industries/aerospace-and-defense/our-insights/large-leo-satellite-constellations-will-it-be-different-this-time>.

⁸³ Sarah Thacker, "Bridging the Digital Divide with LEO Satellites," *Broadband Breakfast*, June 10, 2024, <https://broadbandbreakfast.com/bridging-the-digital-divide-with-leo-satellites/>.

year, in perpetuity); and criteria for subsidy eligibility. Congress could look to the Affordable Connectivity Program as an example, including lessons learned and best practices.⁸⁴

Congress could also opt not to explore the provision of subsidies to consumers for LEO broadband service, as Amazon has noted its intent to provide affordable broadband service through Amazon Leo,⁸⁵ and the entrance of Amazon into the market may drive down current service and equipment costs.

Performance and Availability

Though promising, LEO satellites have some potential issues related to performance. In some instances, a satellite signal may not be able to penetrate into certain locations. For example, according to Starlink data shared with the New Mexico broadband office in November 2024, there are approximately 200 locations in the state (i.e., deep ravines or valleys) where satellite coverage is inaccessible.⁸⁶ Congress could direct federal agencies providing support for broadband deployment to adopt technology neutrality for the use of federal funds to be used for multiple technologies (e.g., fixed wireless, Wi-Fi), which could help to provide services in such areas.

Another uncertainty around LEO satellites is capacity and how this capacity will affect availability, speeds, prices, and data caps. Even if providers deploy many more satellites, the capacity of each satellite is limited, and a finite number of satellites are expected to be overhead at any given time. For instance, according to Angela Siefer, executive director of National Digital Inclusion Alliance—a nonprofit organization that advocates for broadband access and closing the digital divide—“Starlink was ‘amazing’ and ‘a lifesaver’ last year in North Carolina in the aftermath of Hurricane Helene, but that capacity quickly dried up as more people connected.”⁸⁷

In low-density areas, this capacity limitation may not be a significant issue, since the total number of users on satellites will be low. For denser areas, the capacity of satellites could be saturated and may result in LEO satellite providers (1) increasing the number of satellites deployed; (2) adjusting availability (e.g., slowing speeds, instituting data caps); or (3) increasing prices, which could affect access and service to some subscribers.⁸⁸ For example, in certain parts of Washington state, Starlink is imposing a \$750 demand surcharge when consumers purchase or activate a new service plan.⁸⁹ Further, if LEO satellite companies are not able to generate sufficient revenue, or if

⁸⁴ For more information, see CRS In Focus IF12637, *The End of the Affordable Connectivity Program: Options for Consumers and Congress*, by Patricia Moloney Figliola.

⁸⁵ Amazon, “Amazon Leo,” <https://www.aboutamazon.com/what-we-do/devices-services/amazon-leo>.

⁸⁶ Masha Abarinova, “New Mexico Doesn’t Want to Just Sit Around and Wait for BEAD,” *Fierce Network*, November 26, 2024, <https://www.fierce-network.com/broadband/new-mexico-doesnt-want-just-sit-around-and-wait-bead>.

⁸⁷ Colin Wood, “‘SPEED for BEAD’ Broadband Reform Bill Earning Mixed Reviews,” *StateScoop*, March 18, 2025, <https://statescoop.com/speed-bead-broadband-bill-starlink-2025/>.

⁸⁸ Ben Fineman, “Starlink Summary: February 2021,” Michigan Broadband Alliance, p. 1, <https://content.civicplus.com/api/assets/1341b1bd-c075-4acb-9f29-ba5313486cdc?cache=1800>.

⁸⁹ Michael Kan, “Starlink Imposes Eye-Popping ‘Demand Surcharge’ for New Sign-Ups in This State,” *PC Mag*, June 20, 2025, <https://www.pcmag.com/news/starlink-imposes-eye-popping-demand-surcharge-for-new-sign-ups-in-this>.

LEO satellites lifespans are shorter than anticipated,⁹⁰ the result might be a descaling of investments, leading to connectivity and capacity issues.⁹¹

A counterpoint is that capacity issues could be mitigated, for example, by the launch of more satellites. For example, in May 2025, it was reported that Starlink fully removed its waitlist for Starlink in the United States, which “suggests SpaceX has added more capacity to the network.”⁹² In April 2025, it was reported that a design change is allowing SpaceX to launch more satellites in each batch to address network capacity issues.⁹³

The launch of more satellites to solve capacity issues may exacerbate other issues. For instance, the growing number of satellites in space has raised the FCC’s concerns about orbital congestion and the threat of collisions with orbital debris, also known as “space junk.”⁹⁴ LEO satellites travel at thousands of miles per hour, and in-orbit collisions can cause damage to hardware and service.⁹⁵ The FCC has sought to address some issues related to orbital debris. As an example, as part of satellite licensing, the FCC requires satellite providers to provide an orbital debris mitigation plan addressing how they will conform to FCC rules.⁹⁶ Additionally, in 2022, the FCC adopted a rule requiring “non-geostationary satellite operators to deorbit their satellites after the end of their operations to minimize the risk of collisions that would create debris.”⁹⁷ Although this effort may help to mitigate the orbital debris issue, it could discourage providers from entering the market, as some may see the challenges of compliance and potentially costly consequences for failing to comply as a deterrent.⁹⁸

Whether capacity will be a challenge for LEO providers potentially participating in the BEAD program is unknown. However, under the June 2025 BEAD Restructuring Policy Notice, LEO providers must reserve network capacity to meet the demand for service in BEAD-supported locations. Thus, LEO broadband providers also must hold this capacity for 10 years in order to ensure service can be provided to BEAD-supported locations.⁹⁹ One option for Congress could be

⁹⁰ For example, see Muskaan Sharma, “Sun’s Eruptions Are Killing Off SpaceX’s Starlink Satellites, Claims NASA Scientist,” *MSN*, May 28, 2025, <https://www.msn.com/en-in/news/techandscience/sun-s-eruptions-are-killing-off-spacex-s-starlink-satellites-claims-nasa-scientist/ar-AA1FDaOx?cvid=971F61AE4D5645558F0E0FE3DD9580D0&ocid=hpmnsn&apiversion=v2&noservercache=1&domshim=1&renderwebcomponents=1&wcseo=1&batchservertelemetry=1&noservertelemetry=1>.

⁹¹ Jeffrey Hill, “The FCC’s Path to a U.S. Nationwide 5G Rollout Gets Lost in the Thick of Rural America,” *Via Satellite*, January 19, 2021, <http://interactive.satellitetoday.com/via/february-2021/the-fccs-path-to-a-u-s-nationwide-5g-rollout-gets-lost-in-the-thick-of-rural-america/>.

⁹² Michael Kan, “The Starlink Waitlist Is Gone in the US, But You Should Check If Your Area Has a ‘Demand Surcharge,’” *PC Mag*, May 1, 2025, <https://www.pcmag.com/news/spacex-removes-starlink-waitlist-in-the-us-but-demand-surcharge>.

⁹³ Michael Kan, “New Design Means SpaceX Can Launch More Starlink Satellites at a Time,” *PC Mag*, April 7, 2025, <https://www.pcmag.com/news/new-design-means-spacex-can-launch-more-starlink-satellites-at-a-time>.

⁹⁴ See FCC, “Mitigation of Orbital Debris in the New Space Age,” 85 *Federal Register* 52422, August 25, 2020, <https://www.federalregister.gov/documents/2020/08/25/2020-13185/mitigation-of-orbital-debris-in-the-new-space-age>.

⁹⁵ FlyPixAI, “Time to Clean Up Low Earth Orbit: Addressing the Growing Space Debris Threat,” December 18, 2024, <https://flypix.ai/blog/low-earth-orbit-debris/>.

⁹⁶ FCC, “Orbital Debris,” February 21, 2024, <https://www.fcc.gov/space/orbital-debris>.

⁹⁷ FCC, *In the Matter of Space Innovation and Mitigation of Orbital Debris in the New Space Age*, second report and order, September 29, 2022, p. 1, <https://docs.fcc.gov/public/attachments/FCC-22-74A1.pdf>.

⁹⁸ Matthew French, “How to Avoid FCC Fees for Space Debris and Help Save Low Earth Orbit,” Lee Company, <https://www.theleeco.com/insights/how-to-avoid-fcc-fees-for-space-debris-and-help-save-low-earth-orbit/>.

⁹⁹ NTIA, *BEAD Restructuring Policy Notice*, June 6, 2025, p. 19, <https://www.ntia.gov/sites/default/files/2025-06/bead-restructuring-policy-notice.pdf>.

to require LEO satellite providers participating in the BEAD program to report on capacity issues and mitigation strategies.

A challenge related to capacity is speeds. Ookla—a company that provides data on broadband speeds—notes that although

Starlink’s network performance over the past three years shows a dramatic increase in median download and upload speeds as well as a decline in latency ... only 17.4% of U.S. Starlink Speedtest users nationwide were able to get broadband speeds consistent with the FCC’s minimum requirement for broadband of 100 Mbps download speeds and 20 Mbps upload speeds. However, this small percentage of Starlink users is primarily due to its low upload speeds.¹⁰⁰

Issues with speed could diminish as additional satellites are launched. Whether Starlink or other LEO providers (e.g., Amazon) will be able to consistently provide speeds to meet BEAD standards is also unknown, with some stakeholders—such as local broadband officials, rural advocates, and internet service providers—voicing doubts.¹⁰¹ Other LEO satellite advocates assert that just as fiber providers will build network infrastructure meeting the speed standards for BEAD, LEO providers will do the same.¹⁰² One option for Congress would be to consider directing the NTIA to create an online portal for consumers in BEAD-supported locations to report on the speeds they are receiving to ensure compliance with BEAD program requirements.

Demand for Spectrum

Wireless technologies (including LEO satellites) use radio spectrum to transmit data. Spectrum demands have increased in recent years with the emergence of, and consumer demand for, new wireless technologies and services. Many of these new services are data intensive, such as streaming video and access to cloud storage, further increasing demand for bandwidth. Since wireless technologies are typically limited to specific frequency bands, there is intense demand for spectrum to support them.¹⁰³

In the United States, two agencies—the NTIA and the FCC—regulate use of radio frequencies¹⁰⁴ to avoid interference among users. The two agencies work together to allocate spectrum for a broad range of uses (e.g., satellite, mobile, broadcasting). The NTIA manages spectrum use by federal agencies (e.g., the Department of Defense, the Federal Aviation Administration, the Federal Bureau of Investigation)¹⁰⁵ and assigns specific frequencies to each agency. The FCC allocates and assigns spectrum for nonfederal use (i.e., commercial, state and local government, tribal use). The FCC assigns specific frequencies to commercial users, including satellite users.¹⁰⁶

¹⁰⁰ Sue Marek, “Starlink’s U.S. Performance Is on the Rise, Making It a Viable Broadband Option in Some States,” *Ookla*, June 10, 2025, <https://www.ookla.com/articles/starlink-us-performance-2025>.

¹⁰¹ Jericho Casper, “Advocates: Fine Print in New BEAD Notice Favors Satellite Providers,” *Broadband Breakfast*, June 24, 2025, <https://broadbandbreakfast.com/advocates-fine-print-in-new-bead-notice-favors-satellite-providers/>.

¹⁰² Joe Kane, “Broadband Myths: LEOs Don’t Belong in BEAD,” Information Technology & Innovation Foundation, July 14, 2025, <https://itif.org/publications/2025/07/14/broadband-myths-leos-dont-belong-in-bead/>.

¹⁰³ NTIA Office of Spectrum Management, “National Spectrum Strategy,” <https://www.ntia.gov/programs-and-initiatives/national-spectrum-strategy>.

¹⁰⁴ *Radio spectrum* is the range of radio frequencies that are used for communicating.

¹⁰⁵ FCC, “Radio Spectrum Allocation,” <https://www.fcc.gov/engineering-technology/policy-and-rules-division/general/radio-spectrum-allocation>.

¹⁰⁶ While the FCC uses competitive bidding (i.e., auctions) to grant licenses for rights to use specific frequencies for commercial wireless communications, the Open-Market Reorganization for the Betterment of International Telecommunications Act, or ORBIT Act (P.L. 106-180), prohibits the FCC from using competitive bidding to assign spectrum to satellites used for the provision of international or global satellite telecommunications services.

In March 2018, the FCC approved SpaceX’s application to use certain frequencies to deploy and operate 4,425 LEO communications satellites.¹⁰⁷ In July 2020, the FCC granted approval for Amazon to deploy and operate 3,236 satellites.¹⁰⁸

Satellites use specific segments or “bands” of spectrum to provide broadband services (see **Table 3**). While spectrum rights are not exclusive to any one company, first entrants (i.e., those who deploy first) have priority, and new users must design their systems to avoid interference with existing operators.¹⁰⁹ Early in the planning process, companies apply for and obtain licenses from their national regulators (e.g., the FCC in the United States), and a general description of the satellite constellation is filed with the International Telecommunications Union (ITU) by the FCC on behalf of the company, including the frequencies it will use. “A company is required to coordinate with any satellite system that might be affected by its planned []constellation, provided the other system was filed before its filing, but there is no requirement to coordinate with those whose filings are made after its own.”¹¹⁰ This could lead LEO broadband satellite providers entering the market to encounter increasingly crowded airwaves, as dedicated bands and interference avoidance requirements affect spectrum availability. For example, according to some industry stakeholders,

the satellite industry is accustomed to sharing spectrum among operators and some fixed terrestrial services [e.g., through coordination and business-to-business agreements], but the explosive demand for connectivity has led to greater and more frequent tensions. Fights over licensing, allocation and use are becoming the norm and are putting satellite and terrestrial service providers in competition for limited bandwidth.¹¹¹

Table 3. Spectrum Bands Used for Satellite Broadband Services

Frequency Band	Frequency Range (GHz)	Service Type	Applications to Broadband-Related Services
L-band	1.518-1.675 GHz	Mobile Satellite Service (MSS)	Civilian mobile communication services
S-band	1.97-2.69 GHz	MSS	Mobile broadband services, in-flight connectivity
Ku-band	10.7-14.5 GHz	Fixed Satellite Service (FSS), Broadband Satellite Service (BSS)	Fixed data services
Ka-band	17.3-30 GHz	FSS, BSS	Two-way broadband services for both mobile and fixed applications

¹⁰⁷ FCC, *FCC Authorizes SpaceX to Provide Broadband Satellite Services*, March 29, 2018, p. 1, <https://www.fcc.gov/document/fcc-authorizes-spacex-provide-broadband-satellite-services>.

¹⁰⁸ Amazon, “Amazon Receives FCC Approval for Project Kuiper Satellite Constellation,” July 30, 2020, <https://www.aboutamazon.com/news/company-news/amazon-receives-fcc-approval-for-project-kuiper-satellite-constellation>.

¹⁰⁹ Sissi Cao, “SpaceX Expands Starlink Project to 42,000 Satellites, ‘Drowns’ ITU in Filing Paper,” *Observer*, October 21, 2019, <https://observer.com/2019/10/spacex-elon-musk-starlink-satellite-internet-itu-fcc-filing/>.

¹¹⁰ Aaron C. Boley and Michael Byers, “Satellite Mega-Constellations Create Risks in Low Earth Orbit, the Atmosphere and on Earth,” *Scientific Reports*, vol. 11 (May 20, 2021), <https://www.nature.com/articles/s41598-021-89909-7>.

¹¹¹ Leandra Bernstein, “Crowded Spectrum Pushing Satcom Operators into Q/V Band,” *Kratos*, August 19, 2022, <https://www.kratosdefense.com/constellations/articles/crowded-spectrum-pushing-satcom-operators-into-q-v-band>.

Q/V Band	37.5-51.4 GHz	MSS, BSS	High-speed broadband services (fixed and mobile) and in-flight connectivity
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Sources: *SatNow*, “What Are Satellite Frequency Bands?,” February 12, 2025, <https://www.satnow.com/community/what-are-satellite-frequency-bands>; and Federal Communications Commission (FCC), “Definitions,” p. 1, <https://docs.fcc.gov/public/attachments/DOC-402905A1.pdf>.

Notes: GHz = gigahertz. This table includes spectrum band used for both fixed and mobile broadband services. According to the FCC, “fixed broadband service refers to any type of broadband service that terminates at a specific end-user premises,” and “mobile broadband service refers to a service that allows end users to receive information from and/or send information to the internet from a mobile device and using a mobile network.”

As the deployment of LEO satellites for broadband accelerates, regulations around frequency allocation may continue to evolve. For instance, in May 2025, the FCC launched a proceeding to potentially “unlock more than 20,000 megahertz of spectrum for high-speed internet delivered from space . . . , more than the sum total of all spectrum available for satellite broadband today.”¹¹² Through this proceeding, the FCC sought comment on expanding satellite connectivity in four spectrum bands.¹¹³ Some of these bands are already used for satellite broadband services but may be underused (i.e., Ku-band, V band), while other bands are not currently used for satellite broadband services (i.e., 52 GHz band, W-band).¹¹⁴ The FCC’s actions may lead to enhanced capacity, more deployments (e.g., more satellites, more systems), and a more competitive satellite broadband market. Some stakeholders have argued that the government should ensure that satellite providers follow the same conditions as mobile telecommunications network operators, who are required to compete for access to spectrum through bidding (i.e., auctions). They argue that satellite spectrum should be auctioned rather than merely assigned.¹¹⁵ Congress could determine whether or not to address this issue through legislation that could, for example, require auctions of satellite bands or increase application fees. Another option would be legislation to repeal the prohibition of competitive bidding for spectrum for international or global satellite telecommunications services stipulated in the Open-Market Reorganization for the Betterment of International Telecommunications Act (ORBIT Act; P.L. 106-180). Congress may also decide to continue to defer to the FCC.

Satellite operators may disagree regarding spectrum use. For instance, according to an academic journal, “with the sheer number of telecommunications providers [including satellite providers] but the limited number of technically and legally available bands for communication, rising competition and ballooning bandwidth desires have forced the FCC to hear and adjudicate on conflicting filings that often overlap on their requested band allocations.”¹¹⁶ There may also be challenges with regulatory bodies in different countries regarding standards setting and spectrum

¹¹² FCC, “FCC Looks to Unleash More than 20,000 Megahertz for Satellite Spectrum Abundance,” press release, May 22, 2025, <https://docs.fcc.gov/public/attachments/DOC-411583A1.pdf>.

¹¹³ FCC, *In the Matter of Satellite Spectrum Abundance*, further notice of proposed rulemaking and notice of proposed rulemaking, May 27, 2025, <https://docs.fcc.gov/public/attachments/FCC-25-29A1.pdf>.

¹¹⁴ W-band is 75-110 GHz.

¹¹⁵ Policy Circle, “Satellite Spectrum Showdown: Telecom Giants Face Off in Auction Debate,” October 19, 2024, <https://www.policycircle.org/industry/jio-starlink-satellite-spectrum-duel/>.

¹¹⁶ Hriday Unadkat, “Starlink Spectrum Wars: Examining the FCC’s Role in Regulating the New Space Age,” *Princeton Legal Journal*, vol. 4, no. 1 (Spring 2025), <https://legaljournal.princeton.edu/starlink-spectrum-wars-examining-the-fccs-role-in-regulating-the-new-space-age/>.

coordination, affecting the competitive landscape.¹¹⁷ Congress may consider ways to encourage coordination among agencies that have jurisdiction over space and spectrum.

The FCC is taking steps toward potentially making more spectrum available for satellite broadband, which may prove useful for LEO satellite deployments in the long term by encouraging new entrants into this space.¹¹⁸ More potential entrants may lead to increased disagreements between satellite broadband providers or others in the industry (e.g., broadcasters) over spectrum.¹¹⁹ These disagreements often result in appealing to and adjudication by the FCC; more disagreements could lead to increased requests for FCC adjudication.¹²⁰ While providers await FCC decisions, it could keep them from moving forward with deployments. Such matters, including expeditious dispute resolution by the FCC, could be oversight issues for Congress. Other options could include directing agencies involved in international forums to form and advance positions favorable to U.S. satellite companies to ensure U.S. leadership in broadband satellite services; an opportunity could exist for the United States at the 2027 World Radiocommunication Conference.¹²¹

What's Next: Increasing Mobile and Broadband Coverage Through Space-Based Cellular Networks

Although efforts to close the digital divide have primarily focused on access to fixed broadband technologies, some individuals have access only to cellular service (i.e., voice and text messaging services) and, relatedly, mobile broadband.¹²² According to the FCC,

Mobile advanced telecommunications capability¹²³ services allow consumers to access advanced telecommunications capability on the go. Although speeds, service quality, and

¹¹⁷ For instance, according to a paper from the International Journal of Science and Technology, “inconsistent spectrum policies across countries can result in difficulties for operators looking to deploy global networks. The allocation of spectrum for 5G, for example, differs across regions. While the 3.5 GHz band is widely used for 5G in Europe and parts of Asia, other regions like the U.S. have allocated C-band (3.7-4.2 GHz) for 5G, leading to challenges for operators in achieving spectrum harmonization. This lack of coordination can also hinder international roaming, resulting in inconsistent service quality for users traveling across borders.” See Aqsa Sayed, “Evolution of Spectrum Management in Telecommunications: Challenges and Future Directions,” *International Journal on Science and Technology*, vol. 13, no. 2 (April-June 2022), p. 5, <https://www.ijst.org/papers/2022/2/1163.pdf>.

¹¹⁸ See FCC, *In the Matter of Satellite Spectrum Abundance*, further notice of proposed rulemaking and notice of proposed rulemaking, May 27, 2025, <https://docs.fcc.gov/public/attachments/FCC-25-29A1.pdf>.

¹¹⁹ See, for example, Dak Dillion, “Broadcasters Push Back on Satellite Spectrum Sharing Changes as FCC Weighs Modernization,” NCS, August 27, 2025, <https://www.newscaststudio.com/2025/08/27/broadcasters-push-back-on-satellite-spectrum-sharing-changes-as-fcc-weighs-modernization/>.

¹²⁰ Hriday Unadkat, “Starlink Spectrum Wars: Examining the FCC’s Role in Regulating the New Space Age,” *Princeton Legal Journal*, vol. 4, no. 1 (Spring 2025), <https://legaljournal.princeton.edu/starlink-spectrum-wars-examining-the-fccs-role-in-regulating-the-new-space-age/>.

¹²¹ For more information, see ITU, “World Radiocommunication Conferences (WRC),” <https://www.itu.int/en/ITU-R/conferences/wrc/Pages/default.aspx>; and NTIA, “International,” <https://www.ntia.gov/category/international>. According to the FCC, “the World Radiocommunication Conference (WRC) is a treaty-level forum held by the International Telecommunication Union (ITU) (a United Nations agency) every three to four years where countries decide on the allocation of frequency spectrum to allow the deployment or growth of all types of radiocommunication services such as wireless, broadcasting, and aeronautical service.” See FCC, “The World Radiocommunication Conference (WRC),” <https://www.fcc.gov/about-fcc/advisory-committees/world-radiocommunication-conference-wrc>.

¹²² The FCC has not adopted a speed benchmark for mobile broadband but assesses service availability for mobile broadband through its Section 706 reports. See FCC, *2024 Section 706 Report*, p. 2.

¹²³ *Advanced telecommunications capability* is a statutory term defined as “high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology.” See 47 U.S.C. §1302(d)(1), and FCC, *2024 Section 706 Report*, p. 2.

usage allowances tend to be lower for mobile than for fixed services, mobile broadband services offer consumers the ability to stay connected outside of their homes, including in emergency situations—such as sending video or other documentation of crimes and weather events—ubiquitous access to health information, engagement in commerce, and as a stopgap when fixed advanced telecommunications capability services are not available. Capable mobile devices can also run over mobile networks, such as health monitors, Internet-connected outdoor cameras, and smart wearables. Having access to both mobile and fixed advanced telecommunications capability services in an area is important for communities not to fall behind.¹²⁴

Connecting to service in areas where cellular networks are not available has previously required the use of a satellite phone, which connects to satellites in orbit, and Earth stations on the ground, but not to cell towers.¹²⁵ In recent years, some providers of cellular services have explored partnering with LEO satellite providers to provide features of cellular services directly to smartphones. To facilitate these types of connections, in March 2024, the FCC adopted rules to “enable collaborations between wireless carriers and satellite operators to make sure smartphone users stay connected even in areas where there is no terrestrial mobile service.”¹²⁶ A partnership between T-Mobile and Starlink was the first of this type of arrangement to be authorized by the FCC, in November 2024.¹²⁷

Some media reports have asserted that 2025 “saw the launch of the first satellite constellations designed to provide commercial services straight to unmodified smartphones, which looks set to become the biggest satellite use case, with the [U.S.] leading the way on adoption.”¹²⁸ Direct-to-device (D2D) services enabling connection from smartphones to satellites where cellular networks are not available can provide benefits, particularly when—for instance—emergency services need to be contacted but there is no signal, or connectivity when cellular networks are down because of a disaster or other factors. As these D2D services are still emerging, there are currently some limitations. For example, short message service (SMS) messages are typically the only supported feature (i.e., no voice, data, or multimedia features).¹²⁹ More advanced capabilities are anticipated, including mobile broadband service. For instance, LEO satellite provider AST SpaceMobile, in collaboration with U.S. cellular providers, is reportedly building the first and only space-based cellular broadband network.¹³⁰

D2D advocates argue that when fully realized, “satellite-to-cellular service would all but eliminate any ‘dead zones.’”¹³¹ This in turn could negate the need for some federal programs that

¹²⁴ FCC, *2024 Section 706 Report*, p. 11 (internal footnote numbers deleted).

¹²⁵ Matthew Anderson, “Understanding Satellite Phones: What They Are and How They Work,” *Acer Brands*, April 2023, <https://blog.acer.com/en/discussion/620/understanding-satellite-phones-what-they-are-and-how-they-work>.

¹²⁶ FCC, “FCC Advances Supplemental Coverage from Space Framework,” March 14, 2024, <https://docs.fcc.gov/public/attachments/DOC-401208A1.pdf>.

¹²⁷ FCC, *In the Matter of Space Exploration Holdings, LLC et al.*, order and authorization, November 26, 2024, <https://docs.fcc.gov/public/attachments/DA-24-1193A1.pdf>.

¹²⁸ Dan Robinson, “Will 2025 Be the Year Satellite-to-Smartphone Services Truly Take Off?,” *Register*, January 2, 2025, https://www.theregister.com/2025/01/02/satellite_phone_services_starlink/.

¹²⁹ Nicole Lee, “What You Need to Know About Satellite Connectivity in Phones,” *CNET*, May 7, 2025, <https://www.cnet.com/tech/mobile/what-you-need-to-know-about-satellite-connectivity-in-phones/>. Starlink’s website indicates that its direct-to-cell service capabilities will include browsing and data services beginning sometime in 2025. See Starlink, “Starlink Direct to Cell,” https://www.starlink.com/us/business/direct-to-cell?srltid=AfmBOopbWhjnJwUK4njaz0H_57KjXj2Fbm-lInBSZqzs2b06qSWq_jLR.

¹³⁰ See AST SpaceMobile, “SpaceMobile Network,” <https://ast-science.com/spacemobile-network/>; and AST SpaceMobile, “Our Technology,” <https://ast-science.com/spacemobile-network/our-technology/>.

¹³¹ Scott Hutchinson, “Practical Satellite-to-Cellular Communication Is Coming Closer to Reality,” *SageNet LLC*, July 2024, <https://www.sagenet.com/insights/practical-satellite-to-cellular-communication-is-coming-closer-to-reality/>.

provide support for the build-out of terrestrial cellular networks, such as the 5G Fund for Rural America.¹³² Some telecom experts say that service provided from satellite has specific use cases and will not make terrestrial cellular service obsolete.¹³³ As these services continue to emerge, Congress may assess how this technological innovation may further address the digital divide.

Service provided to cellular devices (e.g., smartphones) by LEO satellites also require the use of spectrum. Wireless providers can choose between two options: (1) they can allow a satellite provider to use some of their spectrum, or (2) they can use spectrum intended for satellite use that is controlled by the satellite provider.¹³⁴ Analysis provided by a global technology, media, and telecoms consulting firm noted that while the use of satellite spectrum may result in less potential interference with cellular network operations, the service is not backward compatible with existing cellphones, meaning that it cannot be used without modification.¹³⁵ As more partnerships are formed in this space, options for Congress could include addressing the use of spectrum for D2D, allocating or directing the NTIA and the FCC to allocate more dedicated or shared bands for satellite and mobile, and acting to mitigate spectrum interference and handset compatibility issues.¹³⁶

¹³² For more information, see CRS In Focus IF12465, *5G Fund for Rural America: Current Status and Issues*, by Jill C. Gallagher.

¹³³ Doug Dawson, “Why Satellite Cellular Won’t Replace Traditional Cell Networks Anytime Soon,” *CircleID*, October 21, 2024, <https://circleid.com/posts/why-satellite-cellular-wont-replace-traditional-cell-networks>.

¹³⁴ Joan Engebretson, “The Pros and Cons of Two Different D2D Satellite-to-Cellphone Paths,” *Telecompetitor*, June 18, 2025, <https://www.telecompetitor.com/the-pros-and-cons-of-two-different-d2d-satellite-to-cellphone-paths/>.

¹³⁵ Shagun Sachdeva et al., “MNOs and OEMs Need to Adopt Satellite D2D Now,” *Analysys Mason*, June 2025, p. 7, https://www.analysysmason.com/contentassets/0073eb3b7b00483e95dfbf2331707371/analysys_mason_mnos_oems_satellite_d2d_jun2025_nsi139.pdf.

¹³⁶ For an example of potential spectrum interference issues, see Jericho Casper, “FCC Backs SpaceX’s Direct-to-Cell Service at Higher Power Levels,” *Broadband Breakfast*, March 13, 2025, <https://broadbandbreakfast.com/fcc-backs-spacex-direct-to-cell-service-at-higher-power-levels/>.

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