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# Spectrum Interference Issues: Ligado, the L-Band, and GPS

On April 20, 2020, the Federal Communications Commission (FCC) unanimously approved a controversial application by Ligado Networks, a U.S. satellite communications company, to deploy a terrestrial nationwide network using L-Band radio spectrum. Ligado's stated intent is to offer a combined satellite and terrestrial communications network that will enable other telecommunications carriers to deploy 5G services and provide wireless internet to support industrial networks.

The Ligado case has triggered debate within the federal government about priorities for use of the radio spectrum and the framework in which spectrum decisions are made. Federal agencies including the Departments of Defense (DOD), Homeland Security, and Transportation and many members of the Armed Services committees in both Houses of Congress object to the FCC's decision. They argue that "loud" signals from Ligado's high-power terrestrial transmitters will overpower "soft" signals from Global Positioning System (GPS) satellites operated by DOD, potentially disrupting military operations. GPS device manufacturers, the aviation industry, public safety agencies, and others that rely on GPS oppose the FCC's decision, citing potential interference with billions of GPS-reliant devices and systems. Several Members of Congress, the Secretary of State, and the Attorney General have supported the FCC decision, asserting that it could accelerate domestic 5G deployments and increase the competitiveness of U.S.-based manufacturers of 5G equipment.

## The L-Band

Ligado's proposed network would use the L-Band, the segment of the radio spectrum in the 1-2 gigahertz (GHz) frequency range, a portion of which (1525 MHz-1660.5 MHz) is allocated for satellite use. L-Band radio waves travel long distances and penetrate clouds, fog, and vegetation, making them useful for satellite communications and position, navigation, and timing services, such as GPS, that provide precise geolocation and timing information to enabled devices. L-Band users include private satellite communications operators, space agencies in various countries, DOD, the Federal Aviation Administration (FAA), the National Oceanic and Atmospheric Administration, and private telecommunication service providers, among others.

Use of the L-Band is coordinated globally by the International Telecommunications Union (ITU), as specified in its Radio Regulations. North American use of the L-Band is coordinated by satellite operators, pursuant to a 1996 international agreement—the Mexico City Memorandum of Understanding (MOU). Domestically, the FCC manages commercial use of the L-Band through licensing, and the National Telecommunications and Information Administration (NTIA) manages federal agency use, assigning frequencies and setting terms and

conditions, with advisement from the Interdepartment Radio Advisory Committee.

Guided by these international and domestic agreements and requirements, the FCC has designated segments of the L-Band for specific uses to avoid interference (see Figure 1). The lower portion (1525-1559 MHz) is used for space-to-Earth satellite downlink communications and the upper portion (1610-1660.5 MHz) for Earth-to-space satellite uplink communications. The segment in between (1559-1610 MHz) is designated for civilian GPS signals.

**Figure 1. L-Band**

Space to Earth Downlink	GPS	Earth to Space Uplink
1525	1559	1610
		1660.5

**Source:** Adapted by CRS from Richard N. Clarke, *Are Popular Wireless Services Like Wi-Fi and GPS Becoming the Pirate Radio of the 21<sup>st</sup> Century?*, June 28, 2016, [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2847792](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2847792).

**Notes:** Numbers show frequency ranges of each segment in MHz.

Interference may occur when high-power signals transmitted in one band disrupt signals in a nearby band due to out-of-band emissions (OOBE). Interference may also occur when receivers tuned to one band inadvertently receive signals from a nearby band, known as out-of-band reception (OOBR). To prevent interference, satellite operators can create guard bands (narrow bands of unused frequency), reduce the power levels from terrestrial transmitters to limit OOBE, or adjust or upgrade GPS equipment to limit OOBR.

## Background on the Ligado Proposal

In 2003, the FCC adopted rules allowing satellite companies operating in the L-Band to deploy Ancillary Terrestrial Component (ATC) stations—terrestrial infrastructure to fill satellite coverage gaps. Providers were required to offer integrated (satellite/terrestrial) services using dual-mode devices. The rules were intended to increase the efficiency of spectrum use, reduce service costs, increase operational capacity, enhance public safety communications, and strengthen domestic competition.

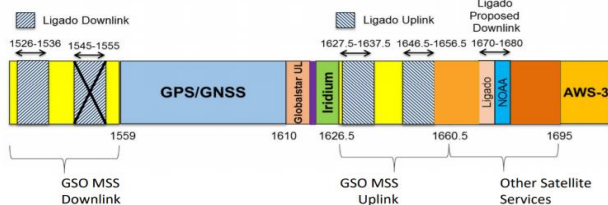
In 2004, the FCC authorized a company called Mobile Satellite Ventures to operate ATC stations to supplement its satellite services. Other L-Band users objected, citing interference concerns, and the company did not build a terrestrial network. In 2009, after making an agreement with another satellite company to gain access to a larger, contiguous segment of spectrum and negotiating more flexible interference standards related to ATC stations, Mobile Satellite's parent company, SkyTerra, requested that the FCC waive its ATC rules and grant it authority to substitute the more flexible technical requirements. GPS service providers and users, including government agencies,

objected, citing the potential for interference between ATC stations and GPS receivers. The objectors argued that U.S. law and FCC regulations placed the burden on SkyTerra to mitigate interference. Both sides submitted test results to the FCC to support their claims. In March 2010 the FCC granted the waiver, citing public interest.

In 2010, SkyTerra was incorporated into a new firm, LightSquared, which proposed to deploy a nationwide satellite/terrestrial 4G network to carry mobile phone and broadband traffic. NTIA, on behalf of several federal agencies and GPS users and equipment manufacturers, objected, claiming the terrestrial base stations would “overload” GPS receivers and interfere with GPS services. In January 2011, the FCC approved LightSquared’s request on the condition that it address GPS interference concerns. LightSquared modified its proposal and submitted technical reports to the FCC purporting to show that interference could be mitigated. GPS trade groups, interagency technical bodies, and federal agencies submitted technical reports purporting to show continued potential for interference. The FCC withdrew approval in February 2012. Three months later, LightSquared declared bankruptcy.

The company emerged from bankruptcy in 2015 and was subsequently renamed Ligado Networks. After reconfiguring its use of its L-Band frequencies, in May 2018 Ligado modified its proposal and sought FCC approval to deploy a terrestrial network using bands farther away from GPS (see **Figure 2**). It stated that it had resolved differences with GPS operators and users and the FAA.

**Figure 2. 2018 Ligado Proposal**



**Source:** “Impact of Ligado’s Proposal on SATCOM, Aviation and Weather Data Users (Coalition Deck),” September 2019, <https://ecfsapi.fcc.gov/file/10906015584180/Coalition%20Deck%20for%20Sept.%204%202019%20FCC%20meetings.pdf>.

**Notes:** The proposal includes multiple guard bands (yellow). It eliminates the previously proposed use of the 1545-1555 MHz band to create a wider guard band between its downlink operations and GPS. GSO = Geostationary Orbit; MSS = Mobile Satellite Service; AWS-3 = Advanced Wireless Services (mobile communications).

### Viewpoints on the 2018 Ligado Proposal

Commenters were divided on the Ligado proposal. Some telecommunication carriers, infrastructure equipment providers, advanced technology firms, and consumer advocacy organizations supported the proposal, saying it would make more spectrum available for innovative technologies and advanced 5G services.

GPS service providers, equipment makers, and GPS users objected, citing OOB concerns. Several federal agencies objected to Ligado’s proposal. In December 2019, NTIA wrote to the FCC on behalf of the Executive Branch recommending it reject the proposal. In March 2020, the U.S. Air Force sent NTIA a memorandum signed by 12 federal agencies, describing potential impacts to military operations if GPS systems are disrupted. A DOD letter to

NTIA dated March 23, 2020, strongly opposed the application, citing 10 U.S.C. §2281, which states that the Secretary of Defense “may not agree to any restriction on the GPS proposed by the head of a department or agency of the United States outside DOD that would adversely affect the military potential of GPS.”

Some carriers say the proposed network would provide access to spectrum to expand 5G services, while others note that the band has not been designated for 5G use globally and no current equipment or device can operate in the band.

### FCC Draft Order and Reaction to Draft Order

On April 16, 2020, the FCC released a draft order to approve Ligado’s application. Secretary of State Mike Pompeo urged approval, saying quick action by the FCC is “vital to our national security and will help ensure that the United States is the global leader in advanced technologies.” Attorney General William Barr stated that FCC approval “is essential if we are to keep our economic and technological leadership and avoid forfeiting it to Communist China.”

### FCC Decision on Ligado and Reactions

On April 20, 2020, the FCC unanimously approved Ligado’s application, with conditions. Ligado agreed to (1) deploy a low-power terrestrial nationwide network in bands farther away from the GPS band; (2) mitigate interference by reducing power levels at its base stations to 99.3% less than proposed in its 2015 application; (3) create a guard band greater than 20 MHz between its terrestrial service and the GPS band, and guard bands between its terrestrial service and other users; and (4) report base stations’ locations and mitigate any reports of interference.

Several Members of Congress praised the FCC decision, asserting that Ligado’s project will lead to more efficient use of spectrum, expand broadband use, and enable 5G innovation. Conversely, many members of the House and Senate Armed Services Committees expressed their opposition, citing national security concerns. The Senate committee held a hearing on May 6, 2020, and sent a letter to the FCC opposing the project, signed by 32 Senators. On May 22, 2020, the NTIA filed a petition with the FCC to stay the order, and a separate petition to reconsider.

### Considerations for Congress

As demand for mobile data increases, and new data-intensive uses emerge, such as autonomous vehicles, the potential for disputes over the allocation, management, and use of spectrum is likely to increase. This includes disputes between federal agencies such as the FCC and the NTIA. Congress can potentially examine current federal processes for setting spectrum priorities, balancing competing user needs, and resolving spectrum disputes. Options for Congress could include a 2004 recommendation by the Government Accountability Office that a neutral arbiter, such as an office within the White House or the National Academies of Sciences, Engineering, and Medicine, should provide objective review of technical reports and resolve disputes between competing users and uses.

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