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**PHYSICS TODAY**

# New 5G exemption may jam GPS devices

Opposition in the public and private sectors is growing against a US telecommunications plan that would allow one company to use its satellite communications radio spectrum for terrestrial applications.

**A** unanimous decision on 19 April by the Federal Communications Commission (FCC) allows Ligado Networks to use its radio spectrum in the 1500–1700 MHz frequency range to develop a ground-based 5G network for smartphones, driverless vehicles, and other internet-connected devices. The FCC approval is unusual and unprecedented: Ligado's portion of that spectrum range has usually been designated for satellite applications only, and various GPS receivers are likely to malfunction as a result of the decision.

Representatives from many communities—airline companies, federal departments, surveyor associations, weather forecasting, and the defense industry, among others—oppose the decision, and many have petitioned the FCC to reconsider. The 30-day period to submit a petition has passed, and FCC rules stipulate that petitions must be responded to within 90 days. But as *PHYSICS TODAY* went to press, the FCC had made no public response. On 22 April, the chairs and ranking members of the Senate and House Armed Services Committees warned that if the FCC approval stands, “it will be up to Congress to clean up this mess.”

Ligado had been trying for a decade to obtain FCC approval to use its satellite spectrum for terrestrial applications. In 2010 the telecommunications company, which was then known as LightSquared and was acquired by a private hedge fund, initially applied to the FCC to repurpose its satellite spectrum holdings. But the GPS community, which includes geophysicists and meteorologists, aired concerns about adjacent-band interference.

Radio-spectrum applications each operate in a certain frequency band, and



**AIRLINE COMPANIES MAY BE FORCED TO PAY** for costly upgrades to their GPS hardware because of a new telecommunications rule that would introduce more radio interference.

GPS users argued that the terrestrial signals would disrupt receivers tracking GPS satellites in the nearby band. After the FCC denied the request, LightSquared filed for bankruptcy in 2012. Then three private equity firms bought the company and renamed it Ligado Networks, tweaked the spectrum plan by lowering the power of transmitter emissions, and resubmitted a spectrum proposal in 2015.

Despite the recent green light for its proposal, Ligado faces financial challenges. The company's website says that it has been partnering with Nokia and Ericsson to develop a 5G telecommunications network, but whether those efforts would continue should the FCC reverse its decision is unclear. Ligado and the other telecommunications companies declined to comment on the matter.

## Out of bounds

The Ligado holdings—the 1526–1536 MHz, 1627.5–1637.5 MHz, and 1646.5–

1656.5 MHz bands—lie in the so-called L-band frequency range, 1–2 GHz. Radio regulations set by the United Nations International Telecommunication Union stipulate that activity in that range be reserved for mobile satellite services or communications between mobile Earth stations and space stations. Frequency bands allocated for terrestrial use typically don't overlap bands for satellite use. But the new FCC order grants Ligado permission to use its spectrum for a 5G network and other terrestrial applications in the US.

GPS satellites transmit signals in the L-band in three frequency bands; the one closest to Ligado's spectrum is centered at 1575 MHz with a bandwidth of about 30 MHz. The power of any radio signal weakens with the distance squared from the transmitter, and satellites are at least 20000 km from the GPS receivers on Earth. But Ligado's proposed transmitters would be only tens or hundreds of



meters away from those receivers, which weren't designed to filter such a powerful signal.

In April 2018 the Department of Transportation published an assessment that considered how GPS receivers would be affected by a cellular base station emitting at 1530 MHz, which lies in Ligado's spectrum. Ligado's proposed cellular base stations, per the FCC decision, may emit no more than 9.8 dBW, which is lower than the 32 dBW of typical cellular base stations. Although the report concludes that smartphones can still operate without loss of functionality, it determines that a GPS receiver used for high-precision work, general location and navigation, or timing would "become unpredictable in its ability to meet the accuracy, availability, and integrity requirements of its intended application."

Besides the potential for GPS interference, the FCC decision may have downwind ramifications for US weather forecasting. Dan DePodwin, the forecasting manager for AccuWeather in State College, Pennsylvania, says that if the FCC's decision holds, "the next [spectrum]

piece will be 1675 to 1680 megahertz." In 2019 the FCC announced its intention to reallocate that band for federal and private shared use. Ligado currently leases the adjacent 1670–1675 MHz band. If the spectrum is repurposed for terrestrial use, the change would likely interfere with the joint NOAA–NASA *Geostationary Operational Environmental Satellites*, which transmit meteorological and hydrological data relied on by weather forecasters, researchers, and emergency managers.

### Sparring over spectrum

Telecommunications interest groups and the Department of Justice support the FCC decision. For example, the CEO of the Wireless Infrastructure Association, Jonathan Adelstein, said in a 20 April press release that the FCC's approval of Ligado's L-band plan "is even more critical now during these unprecedented circumstances as mobile connectivity is increasingly relied upon." In a statement about maintaining US economic and technological advantages compared with China, Attorney General William Barr said, "I applaud FCC Chairman [Ajit] Pai's proposal to make available L-band spectrum."

Many organizations across government and industry oppose the FCC decision, however. The Department of Homeland Security said in a statement on 21 April that the FCC should have denied the Ligado license because it would hamper the collection and use of "precise and uninterrupted Positioning, Navigation and Timing (PNT) data from the Global Positioning System."

Sixty-eight organizations—including the airlines Southwest and United, professional scientific associations like the American Meteorological Society and the American Geophysical Union, defense and technology companies like Lockheed Martin, and delivery companies such as UPS and FedEx—filed a statement on 6 May in response to the Senate Armed Services Committee hearing on how the FCC authorization for Ligado's spectrum would affect national security, public safety, and the economy. To avoid powerful interference, GPS users would need to upgrade their hardware with stronger

RF filters, according to the statement. It also says that replacing current GPS and satellite equipment would cost taxpayers billions of dollars.

Several federal and private organizations, including the National Telecommunications and Information Administration and Trimble—a California-based company that develops GPS receivers and software for agriculture, construction, transportation, and other industries—filed petitions asking the FCC to revoke the approval. But, says Tim Farrar, a telecommunications analyst and president of TMF Associates in Menlo Park, California, "I don't believe any new compelling evidence was presented in the petitions for reconsideration that were filed. It appears unlikely that the FCC will reverse its decision unless forced to by Congress."

The House Armed Services Committee wrote a letter on 7 May to the FCC asking it to provide a more thorough rationale for the Ligado decision. On 15 May, a bipartisan group of 32 senators wrote a letter to Pai and the other four commissioners urging them "to immediately stay and reconsider their Order on this matter, more fully consider the technical concerns raised by numerous federal agencies and private sector stakeholders, and outline a path forward that adequately addresses these concerns."

On 11 June the Senate Armed Services Committee approved 25–2 its fiscal year 2021 National Defense Authorization Act. Among other things, the bill seeks to protect the public's access to GPS and satellite communications infrastructure. Under the terms of the FCC order, the Department of Defense would be required to identify vulnerable GPS receivers and work with Ligado to repair or replace them. The bill instructs DOD to ignore the FCC order until the secretary determines the total cost of GPS interference and an independent technical analysis is completed by the National Academies of Sciences, Engineering, and Medicine.

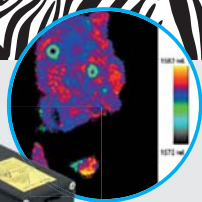
More opponents have joined the fight against the FCC's order. On 23 June, five professional associations, representing equipment manufacturers, farmers, pilots, boaters, and transportation builders,





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US SENATE PHOTOGRAPHIC STUDIO/RENEE BOUCHARD

**US SENATOR TAMMY DUCKWORTH (D-IL)**, a veteran and member of the Armed Services Committee, is part of a bipartisan group of 32 senators that urged the Federal Communications Commission in a 15 May letter to address the technical risks that may arise from its decision to grant an exemption to the telecommunications company Ligado.

established the Keep GPS Working Coalition, which supports the bipartisan legislation proposed by the Senate Armed Services Committee.

Farrar says Ligado faces financial pressure because of an agreement with Inmarsat, a satellite communications company based in London. Inmarsat has leased some of its L-band spectrum to Ligado and agreed to allow Ligado to defer its 2019 payments. Having obtained FCC approval, Ligado must now pay Inmarsat \$136 million per year, according to an Inmarsat press release.

If Ligado can't pay those debts, its spectrum may sit idle, according to Farrar, and the potential for GPS interference may disappear. But he and other telecommunications analysts say that if Ligado strikes an agreement with Verizon, it may be able to pay Inmarsat and even make a profit. Like the other large telecommunications companies, Verizon

is working to develop its own 5G network, though Farrar thinks it needs to buy additional spectrum. Ligado has suggested that for Verizon to improve its 5G network, it could use Ligado's L-band spectrum in conjunction with midrange spectrum in the 3700–4200 MHz band.

A new auction for that midrange spectrum is scheduled for 8 December. In a letter to the White House dated 8 April, one of the five FCC commissioners, Mike O'Rielly, urged President Trump to "free the necessary spectrum bands to provide our wireless providers the means to succeed." Farrar says that "to give Verizon time to prepare for the auction, they [Ligado] probably need to do a deal in September or October. If nothing happens, it's likely that Ligado will have to file for bankruptcy at the end of the year."

**Alex Lopatka** 