

Testimony of

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**U.S. Senate
Committee on the Armed Services**

**Department of Defense spectrum policy and the impact of the Federal
Communications Commission's Ligado decision on national security**

**Wednesday May 6, 2020
Dirksen Senate Office Building**

Mr. Chairman, Ranking member Reed, and members of the Committee, thank you for the opportunity to provide testimony today with my distinguished colleagues from the Department of Defense.

I am testifying today in my capacity as a private citizen and the views expressed by me are not intended to represent any government agency or private firm. My testimony is based on publicly available information. My views represent my concerns and those of the GPS civil user community.

While my CV has been provided to the committee, I would like to note that I have been involved in radio navigation operations and policy for more than 50 years. Forty-five years ago, I was the Commanding Officer of a LORAN C Transmitting Station in Lampang, Thailand as the war in Vietnam ended. Ten years ago, as the Commandant of the Coast Guard I personally turned the switch that decommissioned the final LORAN C chain operating in the United States.

My fellow panelists have presented unified testimony regarding the Federal Communications Commission's (FCC) Order and Authorization (OA) to allow Ligado Networks LLC "to deploy a low-power terrestrial nationwide network ..." and the associated impacts on the Department of Defense and national security. I endorse their testimony and recommendations.

My purpose here today is to speak on behalf of the hundreds of millions of civil users of GPS and Global Navigation Satellite Systems (GNSS) in the context of the committee's concerns regarding national security. It is premised on a broader concept of national security that extends to all elements of national power. The ubiquity of GNSS and GPS specifically, make the provision of positioning, navigation, and timing (PNT) services critical to the economic wellbeing and homeland security of the Nation. From the timing of financial transactions to power generation, synchronization of telecommunication, high precision agriculture, intelligent transportation systems, and air navigation and airspace management, GPS has become vital to the Nation's "general welfare" and "common defense." As stated in a 6 December 2019 letter from NTIA to the FCC, "The accuracy and ubiquitous availability of the Global Positioning System (GPS) is fundamental to the Nation's economy, national security, and continued technological leadership." The letter further states, "A recent study sponsored by the National Institute of Standards and Technology (NIST) estimated the economic benefits of GPS for private sector use at a range between \$903 billion and \$1.8 trillion as of 2017."

The risk to military systems, so clearly stated by this panel, is also shared by civil GPS users. However, unlike our military forces who have the ability to reduce risk through encryption and other tools, civil users are a separate user segment with greater receiver diversity and fewer risk reduction options. The single point in government where the

interests of civil GPS users are integrated with Department of Defense and brought into a consensus process through the PNT Executive Committee (EXCOM) and its supporting PNT Advisory Board (PNT AB). The general approach for reducing the risk to civil users has been a three-pronged strategy: **P**rotect the signal, **T**oughen the receiver, and **A**ugment GPS with backup or complimentary PNT services (**PTA**).

The impact of disruption or loss of a GPS signal varies with the type of receiver. This could manifest itself in anything from an ATM malfunction, to the loss of navigation in an intelligent transportation system, interference to an unmanned aerial system, or disruption of electrical power distribution. The of uses GPS range from simple FITBIT watches to the provision of coarse timing for highly refined, parsed timing services for financial transactions.

While there are a host of issues raised by the FCC OA, I would like to address five specific issues:

1. The administrative process by which this decision was made
2. The lack of a transparent process to resolve competing criteria as to how to measure disruptions to GPS by adjacent band interference
3. The density of terrestrial antennas required to provide the anticipated service and associated impact.
4. GPS Spectrum Protection
5. The assertion that the Ligado plan will significantly accelerate or enhance the deployment of 5G technology.

Overview

The concept contained in the OA that impacts of adjacent band interference can be measured and identified by Ligado as they occur and then mitigated in a timely and effective manner without prior testing strains credibility. Tests that were utilized by the FCC in the OA were funded by Ligado, were not conducted in a transparent fashion, and not widely supported. Further, the failure of the FCC to accept a standard floor for the tolerance of noise that was used by the Department of Transportation in the Adjacent Band Compatibility study is equally quizzical and its summary dismissal in the OA is troubling. This approach rejects the concept of “first do no harm” and replaces it with consequence management following the event.

1. Administrative Process

An example of the normal process to convert satellite service spectrum to terrestrial mobile broadband spectrum was the 2 GHz MSS spectrum licensed to Dish Networks. In that instance, FCC proposed an allocation for Fixed and Mobile Services (Notice of Proposed Rulemaking (NPRM) 7/15/2010, Report and Order 4/4/2011); developed service rules to use the allocations (NPRM 3/21/2012, Order 1/30/2013); then modified the Dish Network license after a public comment period to comply with the service rules (4/3/2013)). Consistent with the 2000 Orbit Act, which prohibits FCC from auctioning satellite service spectrum, Dish Network’s spectrum was not auctioned, but conversion of

Dish's MSS spectrum was conditioned on Dish bidding at least 1.564 billion dollars in the H-block spectrum auction (which it did).

In contrast, conversion of Ligado's spectrum to provide terrestrial wireless services is essentially free and, as wireless expert Tim Farrar noted in 2011, could result in a multi-billion-dollar windfall for the company with no recompense to the American taxpayer. In the case of Ligado Networks, FCC did not follow the normal regulatory process for reasons that remain unclear. Rather than following the example of the Dish Network's process, and making an allocation to the Mobile Service, FCC instead seems to have made a de facto allocation to the Mobile Service without the normal public process being followed. Specifically, Condition 2 of the attached conditions to the March 26, 2010 Memorandum Opinion and Order and Declaratory Ruling (DA 10-535) required: "Without regard to satellite service, SkyTerra shall construct a terrestrial network to provide coverage to at least 100 million people in the United States by December 31, 2012; to at least 145 million people in the United States by December 31, 2013; and to at least 260 million people in the United States by December 31, 2015." As evidenced by the past nine-plus years of the Ligado waiver request and subsequent license modification proceeding, it is apparent to me the use of the MSS L-band satellite service spectrum for terrestrial wireless broadband service should have been the subject of a NPRM as normally would be required under the Administrative Procedure Act (APA). The only terrestrial service allowed in Ligado's spectrum is satellite augmentation service (MSS Ancillary Terrestrial Component (ATC), which is terrestrial fill-in for areas of poor satellite reception such as urban areas subject to building blockage and other impairments). FCC made it clear in 2003, when it adopted the original MSS ATC rules, that stand-alone terrestrial service was not intended for the MSS band. In that 2003 MSS ATC Order, FCC stated: "We do not intend, nor will we permit, the terrestrial component to become a stand-alone service." Rather than go through the normal process of making an allocation to the Mobile Service, which is the broad radio service category under which terrestrial mobile broadband would normally be provided, and then developing service rules to use that allocation so that harmful interference isn't caused to other spectrum users in the same or adjacent bands, the FCC avoided the public process of making an allocation to the Mobile Service and the separate public process of developing service rules to use that allocation.

2. Measuring Disruptions:

Of note, harmful interference is defined in the International Telecommunication Union (ITU) Radio Regulations as interference which "...endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with [the] Radio Regulations." This definition is consistent with the definitions appearing in the FCC rules and the federal agency rules set forth by the NTIA. However, what is not well understood is that the requirement that one radiocommunications service not cause harmful interference to another radio service is a last resort or capstone requirement when rules that are designed to ensure compatible operations between different radio services, and prevent harmful interference, fail. The rules that ensure compatible operations are normally developed in an FCC rulemaking process as noted earlier.

Because of the irregular process the FCC used, the public debate over whether the FCC should make a terrestrial Mobile Service allocation in the MSS L-band never occurred and, as a result, the service rules proceeding (e.g., rules for use of the allocation), where mechanisms and criteria to ensure compatibility between Ligado and GPS would have been debated in a public comment process, never occurred. Instead of a NPRM for service rules to use an allocation to the mobile service that the FCC never made, FCC conditioned a 2011 Waiver for LightSquared (now Ligado) so that it could not commence commercial terrestrial operations until “harmful interference concerns have been resolved”. FCC likewise issued an April 2016 Public Notice and limited the discussion only to showing harmful interference. Interference protection criteria, such as a 1 dB drop in carrier-to-noise density ratio (C/No), or equivalently an interference-to-noise ratio (I/N) of -6 dB, on which the government test and analysis was based and which are designed to prevent harmful interference, were completely ignored by the FCC. The National Advanced Spectrum and Communications Test Network (NASCTN) testing on which the FCC relies tested only 14 receivers in a total of 20 configurations, testing none in the important classes of certified-aviation, non-certified aviation, space-based, cellular, and military grade. The NASCTN tests did not consider the multiple simultaneous stresses to receiver operation (e.g. motion, multipath, limited view of the sky, other sources of interference), did not test for reception of all GNSS signals even though most modern receivers can receive all of them, and did not test all modes of receiver operation. NASCTN admitted the limitations of its testing, indicating that its objective was only “to establish a test methodology,” and “testing a set of devices that represents the comprehensive market in a statistically complete manner is not practical in the timeframe of this testing.”

As noted earlier, in limiting the considerations for Ligado’s proposed network to not cause harmful interference to GPS, the FCC negated all test and analysis performed at significant expense and effort by the U.S. government and relied exclusively on testing funded by Ligado.

3. Antenna density and mobile receivers

The OA also focuses on the impact of receivers in relation to fixed towers and testing has been based on the distance of the receiver from the tower. The density of antennas to provide the proposed service is not clear. As a result, there is no clear path to assess the impact on mobile receivers, those embedded in handsets or mobile platforms such as aircraft, vehicles, unmanned systems, and emergency services that may randomly come in close proximity to Ligado base stations. This would also apply to Department of Defense resources deployed for homeland defense (HD) or defense support to civilian agency (DSCA) missions. As the former Principal Federal Official for the response to Hurricanes Katrina and Rita and the National Incident Commander for the Deepwater Horizon Oil Spill, I can personally attest to the need for fully capable military forces when the situation dictates. The current Defense support to the coronavirus pandemic response underscores the domestic need for an effective and reliable military force.

4. GPS Spectrum Protection

The FCC's action in permitting the proposed Ligado network to proceed apparently fails to recognize that permitting incompatible uses of spectrum adjacent to that in which GPS operates destabilizes and degrades the overall spectrum *environment* for GPS. This is contrary to National Space Policy (June 28, 2010) and the October 25, 2018 Presidential Memorandum on Developing a Sustainable Spectrum Strategy for America's Future, both of which provide direction to "sustain the radiofrequency environment" in which critical U.S. space systems operate. FCC engineers undoubtedly know that all receivers take in some power from adjacent band signals and if the adjacent band interfering power is sufficiently strong, as is the case with Ligado's terrestrial system, it can overload the receiver (in this case GPS) and result in disruption of the received GPS signal. This is called receiver overload or receiver blocking. It seems to me, given the importance of GPS to the overall national interest, consideration should have been given to protecting and sustaining the overall spectral environment in which GPS operates.

5. 5G

Finally, much has been said about the potential to use Ligado's spectrum to advance U.S. 5G objectives and enable a competitive advantage against China in the "race to 5G". However, Ligado's spectrum is not allocated to 5G or terrestrial services anywhere in the world and, given the incumbent global satellite operations (e.g., Inmarsat, Thuraya), will not be allocated for 5G. There are no Third-Generation Partnership Project (3GPP) standards for 5G in the band nor any equipment available to use the band. Despite Ligado's stated intention to start development of these 5G standards, the reality is the use of Ligado's spectrum for 5G will create an isolated market in the U.S. with almost no possibility of expansion for global use. So, it is far from clear to me how our competitive position relative to China would be enhanced by the FCC approval of the Ligado license modification. In fact, since many telecommunications networks rely on GPS for network timing, degradation of GPS could result in greater reliance on foreign GNSS systems, such as the Russian Federation's GLONASS or China's Beidou system, to the detriment of the U.S. global competitive posture overall.

Concluding Thought

In March of 2016, General John E. Hyten testified before the House Armed Services Committee, Subcommittee of Strategic Forces, and described the importance of GPS to the military and to the nation. In his testimony, General Hyten stated: "I don't think that we should infringe on the GPS spectrum. That is a critical capability, not just for the military security of the Nation but for the entire economic well-being of this Nation. We can't allow that to happen."

GPS has become more important and more ubiquitous since General Hyten testified. Today, General Hyten's testimony is as relevant and important as the day he testified. The overall national interest is best served by ensuring that the national and global utility that is GPS is not disrupted or degraded.

That is my personal commitment as well.

