U.S. Department of Transportation

Office of the Secretary of Transportation

1200 New Jersey Avenue, S E
Washington, DC 20590

November 22, 2019

Peter A. Tenhula
Deputy Associate Administrator
Office of Spectrum Management
National Telecommunications and Information Administration
Chair, Interdepartment Radio Advisory Committee
Herbert C. Hoover Building, Room 4099A
1401 Constitution Avenue, N.W.
Washington, D.C. 20230

Re: Draft FCC Order and Authorization on Ligado Networks LLC's Mobile Satellite Services (MSS) License Modification Application

Dear Mr. Tenhula:

Thank you for providing the draft of a potential Federal Communications Commission (FCC) Order and Authorization on Ligado Networks LLC's Mobile Satellite Services (MSS) License Modification Application to the Interdepartment Radio Advisory Committee (IRAC) for review and comment.

The Department of Transportation (Department or DOT) offers the following comments on the draft order. DOT appreciates FCC's continued consideration of the important issues raised in this proceeding and we recognize that the Draft Order and Authorization represents [redacted]

However, as stated in the 2018 DOT GPS Adjacent Band Compatibility Assessment Report:

"*[B]ased on the results of the OST-R testing and analysis of the other categories of receivers, the transmitter power level that can be tolerated by certified aviation may cause interference with, or degradation to most other categories of GPS/GNSS receivers including those used for General Aviation and drones, as detailed in the results set forth in this report.*" DOT Report Executive Summary p. VIII.

This interference or degradation can include increased GPS and Global Navigation Satellite System (GNSS) satellite acquisition times, reduced position accuracy, or loss of signal lock

resulting in no position solution. On December 3, 2018, the National Space-Based PNT Executive Committee, aware of Ligado's most recent license modification request, wrote a letter to NTIA stating : *"[I]t is clear that the proposed service would exceed the tolerable power limits necessary to prevent disruption of GPS receivers*."

However, DOT notes that the majority of GPS receivers in use in the United States are not U.S. Government devices. Indeed, most of the GPS/GNSS devices used for critical infrastructure and commercial applications are not owned by the U.S. Government. The types of GPS uses that would experience interference include emergency response, commercial trucking, general navigation, general aviation, high-precision instruments for surveying, precision agriculture, machine control, scientific applications, and timing signals, as detailed below.

Unfortunately, this brief statement does not begin to acknowledge and account for the serious and widespread impacts this action would have on many important categories of existing GPS users. In considering such a proposal, the FCC should thoroughly assess and account for the economic costs and burdens that would result. Many GPS/GNSS receivers have integrated antennas into their receivers so that it is not possible to retrofit them with new antennas. Furthermore, many receivers are integrated into end-user applications making adversely affected GPS users unable to retrofit or replace their GPS receivers, even if they could afford to do so.

[1] The GPS receiver manufacturers who signed these agreements strongly endorse use of the 1 dB Interference Protection Criteria that DOT applied in its adjacent band compatibility assessment.

In this document, we put in perspective the applications that may be impacted by GPS/GNSS signals that would be interfered with and/or degraded by deployment of Ligado's network. DOT strongly recommends that any consideration of Ligado's proposed terrestrial nationwide network in the MSS band must include a rigorous effort to quantify the economic costs of these effects and balance them against any economic benefits of authorizing the proposed services.

1) Police, Fire, and Other Emergency Vehicles

GPS has become an integral part of all modern emergency response systems, from assisting stranded motorists to guiding emergency vehicles (police, fire, ambulance).

The ability to pinpoint the location of police, fire, rescue, and other vehicles or boats, and effectively to relate their locations to an entire network of transportation systems in a geographic area, has become critical to the operations of first responders. Location information provided by GPS, coupled with automation, reduces delay in the dispatch of emergency services and is essential to their operations.

2) Commercial Trucks and Buses

The trucking industry's use of GPS is extensive and widespread for applications such as fleet management, driver routing, and total asset visibility. The Federal Motor Carrier Safety Administration (FMCSA) does not have data on overall use of GPS by the Commercial Motor Vehicle (CMV) industry, but, according to FMCSA, there are over 580,000 interstate motor carriers and 12 million registered large trucks.

The GPS Innovation Alliance estimates that between 50 percent and 86 percent of all 'fleet owning firms' adopted GPS for fleet management. In addition, they estimate a total adoption rate of 67.9 percent of trucks (https://www.gpsalliance.org/). They do not separate adoption rate by truck class. Using these estimates provides a range of 7 million to 10.5 million medium and heavy trucks with GPS.

FMCSA regulation, 49 CFR 395.20, Appendix A to Subpart B, requires that an Electronic Logging Device (ELD) measure a commercial motor vehicle's position every five miles and record the position each hour to the log, as well as during events, such as a driver's changing of duty status from "driving" to "sleeper berth" or "on-duty not driving" with the precision of +/- 1 mile. FMCSA estimates 2.8 million to 3 million drivers are required to use ELDs in interstate CMV operations. Based on input from FMCSA, they are concerned that ELDs may be affected.

The American Public Transportation Association (APTA) has an extensive database of Transit/Commuter Bus with Automated Vehicle Location (AVL) units installed which are based on GPS technology. In 2019, there are over 57,000 buses with AVL units installed among 330+ transit agencies.

3) Automotive Navigation Systems

On October 23, 2018, the Auto Alliance sent a letter to the FCC stating: "GPS is a critical technology for many current and future vehicle safety systems, including both Advanced Driver Assist Systems ("ADAS") and Automated Driving Systems ("ADS"). The

availability and accuracy of GPS offers increased safety for vehicles and other road users traveling on our nation's roadways. Many of today's vehicles are equipped with ADAS safety features or other systems that rely on precise GPS signals for position, navigation, in-vehicle security, remote diagnostics, emergency services and other applications. Ligado's proposal could jeopardize the ability of GPS receivers to obtain an accurate signal, thereby putting such vehicle safety systems at risk."

According to the National Highway Traffic Safety Administration (NHTSA), it is difficult to estimate with accuracy the precise total number of on-highway vehicles equipped with GPS-enabled devices. However, the figure is between 80 million and 140 million. Uses of GPS receiver chipsets includes onboard navigation units, telematics/ concierge systems (i.e., OnStar, Sync, Enform, Mbrace, BMWAssist, etc), and SiriusXM radio receivers (while the large majority of satellite radios includes GPS-enabled location services, a portion of the earliest satellite radios sold into the vehicle market do not).

For light duty cars, satellite radio comprises the largest portion of GPS devices, especially for older vehicles. Newer vehicles generally combine radio/navigation/other functions into a single unit, so it is difficult to make any distinction.

A few key data points:

- As of Jan. 2019, SiriusXM reports 117 million vehicles equipped with satellite radio, with 34M active subscribers.
- Since 2010, all GM cars have been equipped with OnStar, for a total production of 27.3 million cars and light trucks. Other OEs have followed the trend of equipping all cars with a telematics systems to varying degrees and at different times.
- As of 2016, 8 million cars were reported to have a fleet management systems (with GPS-enabled location included) and expected to double by the end of 2019.
- Automotive Business reported in 2009 that 7% of all light duty vehicles (7% of 220M=15.4M) had a GPS navigation unit.
- From 2015, 75 percent of new cars have SiriusXM radio installed as standard (75 percent of 82.9M = 62.2M).

Understanding that there is some double counting for the numbers above, it is reasonable to assume that there may be as few as 80 million, and as high as 140 million light duty vehicles equipped with some type of GPS receiver in the US.

These figures do not include the medium to heavy vehicles (trucks, buses, etc.) discussed above and excludes farming, mining, construction, or any other off-highway vehicles equipped with GPS/GNSS receivers.

4) General Aviation

According to the Federal Aviation Administration (FAA), the proposed power level of 9.8 dBW protects Instrument Flight Rules (IFR)-certified aviation receivers beyond 250 feet laterally and 30 feet above each base station antenna. However, the 9.8 dBW power level

does not protect non-IFR certified aviation receivers. Non-IFR certified aviation receivers that would be affected include Visual Flight Rules (VFR) panel mount, hand held, and Electronic Flight Bag (EFB) devices used for VFR navigation, display of electronic charts, and flight information. Virtually every general aviation aircraft carries at least one non-IFR certified GPS receiver, and air carrier aircraft typically carry two.

If Ligado were to deploy the system as described in the proposal, there are estimated to be 350,000 installed and portable VFR aviation GPS and EFB devices in both general aviation and commercial aircraft that would be affected.

5) Positive Train Control and Other Railroad Operations

GPS is an integral part of nationwide railroad operations. GPS is used in most aspects of railroad operations and maintenance and is relied upon for critical safety systems. Below is a high-level list of railroad systems that rely on GPS, according to the Federal Railroad Administration (FRA).

GPS interference would have a significant safety effect on railroad operations, as well as an effect on the efficiently of railroad operations, especially in highly congested areas such as the North East, Chicago, Kansas City, New Orleans, Los Angeles, etc. Users are estimated here:

<u>Rail Operations:</u>

a) Positive Train Control (I-ETMS)–7 Class I Railroads and 16 Commuter or Class II/II Railroads, encompassing 54,000 route miles of track.
b) Energy Management Systems (e.g. cruise control for locomotives)–7 Class I Railroads, all locomotives
c) Remote Control Locomotive Systems (for operation in yards)–7 Class I Railroads, plus some shortline yards.

<u>Maintenance Systems:</u>

a) Rail Integrity Testing (testing for broken rail with laser systems)–7 Class I Railroads and 4 Commuter Railroads, but this testing will be allowed under FRA regulations and could impact 28 Commuter Railroads and many shortlines.
b) Automated Rail Testing (automating testing of track for geometry failures)–4 Class I Railroads (current), but this testing is planned to be allowed under FRA regulations and could impact all Class I railroads.

c) Drones used for inspection, including bridge inspections–Class I railroads
d) Asset Management and Asset Tracking systems, also supporting Emergency Response systems–Class I railroads.
e) Infrastructure inspection (by FRA and railroads)–FRA and Class I railroads.

6) Maritime

Vessels navigating U.S. ports, inland waterways and coastal areas near a proposed Ligado transmitter may find themselves with a compromised GPS signal. These maritime applications include a variety of government, military, law enforcement, public and commercial vessels including the Maritime Administration (MARAD) National Defense Reserve Fleet (NDRF) for Strategic Sealift. The ability of these critical vessels, including 46 ships of the Ready Reserve Force (RRF), and others to navigate safely in U.S. waters is an essential operation.

These and other vessels operated under or in agreements under various programs for MARAD and Military Sealift Command are so vital to the nation that interfering with their reception of GPS signals (which could affect their ability to accurately move people and materials in times of crisis) is absolutely unacceptable.

Also of concern in U.S. port environments are numerous passenger ferries carrying tens of thousands of people every day, some at high speeds in a dynamic environment subject to strong currents, high winds, rough wave conditions, dense traffic and more. During operations in darkness when visibility deteriorates and is poor or restricted, the GPS signal becomes even more important, since much of the equipment helping navigate the vessel is using GPS to not only provide positioning information, but is also providing inputs to speed, heading, steering, radar and target information, Electronic Chart Display Information System (ECDIS), Under Keel Clearance (UKC information), Automatic Identification (AIS) information, and VHF radio communications.

Other vessels in U.S. ports and urban waterway areas could also seriously suffer from interference to the GPS signal, including high-speed recreational boaters, law enforcement responders (i.e., Blue Force Tracking and more), commercial vessels of all types and other watercraft. High-precision operations such as survey vessels, buoy tenders, dredges, surveillance craft, pollution cleanup vessels and others need a very accurate position input to ensure the accuracy of their operations.

For the St. Lawrence Seaway Development Corporation (SLSDC) operations, applications dependent on GPS include:

- Vessel tracking (via AIS)
- Vessel speed monitoring (via AIS)
- Vessel information required for Draft Information Systems (via AIS)
- Hydrographic surveying (kinematic GPS surveying system)
- Buoy positioning (via Differential GPS)

- General safety of navigation (via GPS by transiting vessels and Seaway vessels)
- Seaway's computer network (via GPS time servers-time synchronization of computer systems)

7) Surveyors and Construction Applications

Unlike conventional techniques, GPS surveying is not bound by constraints such as line-of-sight visibility between survey stations. The stations can be deployed at greater distances from each other and can operate anywhere with a good view of the sky, rather than being confined to remote hilltops as previously required.

GPS is especially useful in surveying coasts and waterways, where there are few land-based reference points. Survey vessels combine GPS positions with sonar depth soundings to make the nautical charts that alert mariners to changing water depths and underwater hazards. Bridge builders and offshore oil rigs also depend on GPS for accurate hydrographic surveys.

Land surveyors and mappers can carry GPS systems in backpacks or mount them on vehicles to allow rapid, accurate data collection. Some of these systems communicate wirelessly with reference receivers to deliver continuous, real-time, centimeter-level accuracy and unprecedented productivity gains. In addition, these types of high accuracy GNSS receivers have been incorporated into construction equipment to enable precision machine control with centimeter-level positioning.

8) Commercial Drones and Other Precision Uses, Including Precision Agriculture

Unmanned aircraft systems (drones) would also be significantly affected, particularly commercial high precision drones used for delivery, agriculture, mapping/survey and other high accuracy missions. High precision drones are particularly susceptible to adjacent band interference since they can operate at very low altitudes and use very sensitive, high-accuracy GPS receivers. Just under a half million UAS are used in professional applications, as well as approximately one million recreational UAS would be impacted.

GNSS-based applications in precision farming are widely used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping. GPS allows farmers to work during low-visibility field conditions such as rain, dust, fog, and darkness.

Other high precision applications include a network of high-precision GPS/GNSS receivers the U.S. Geological Survey (USGS) has installed for early earthquake warning. In addition, NASA and NOAA are exploring radio occultation for measuring water vapor content by utilizing GNSS receivers on Low Earth Orbit satellites.

9) Timing Signals

Precise time is crucial to a variety of economic activities around the world. Communication systems, electrical power grids, and financial networks all rely on precision timing for synchronization and operational efficiency.

[redacted]

[redacted]

The FAA has identified over 3,000 GPS timing devices used in FAA mission systems and support applications would be impacted.

Consistent with the December 3, 2018 Space-Based PNT Executive Committee letter to NTIA, and the significant impact to a myriad of civil GPS applications, DOT recommends that the FCC reject Ligado's license modification application.

Sincerely,

Steven G. Bradbury
Acting Deputy Secretary and General Counsel