

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

In the Matter of	)	IB Docket No. 11-109
	)	IB Docket No. 12-340
Ligado Applications to Modify the Ancillary)	
Terrestrial Component (ATC) of Its L-Band	)	SAT-MOD-20151231-00090, SAT-MOD-
Mobile Satellite Service (MSS) Networks	)	20151231-00091, SES-MOD-20151231-
	)	00981

COMMENTS OF AIRCRAFT OWNERS AND PILOTS ASSOCIATION, AIRLINES FOR AMERICA, AVIATION SPECTRUM RESOURCES, INC., BRISTOW U.S., LLC, CARGO AIRLINE ASSOCIATION, DELTA AIRLINES, HELICOPTER ASSOCIATION INTERNATIONAL, INTERNATIONAL AIR TRANSPORT ASSOCIATION, NATIONAL AIR TRANSPORTATION ASSOCIATION, ROCKWELL COLLINS IMS, SOUTHWEST AIRLINES, AND UNITED PARCEL SERVICE

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

Jim Coon
Senior Vice President, Government Affairs and Advocacy
421 Aviation Way
Frederick, Maryland 21701

HELICOPTER ASSOCIATION INTERNATIONAL

Matthew S. Zuccaro
President & CEO
1920 Ballenger Avenue
Alexandria, VA 22314-2898

AIRLINES FOR AMERICA

Captain Billy Nolen
Senior Vice President, Safety, Security, and Operations
1301 Pennsylvania Avenue, NW Suite 1100
Washington DC 20004-1707

INTERNATIONAL AIR TRANSPORT ASSOCIATION

Douglas E. Lavin
Vice President, Member and External Relations, North America International
1201 F Street NW Suite 650
Washington DC 20004

AVIATION SPECTRUM RESOURCES, INC.

Kris Hutchison
President
180 Admiral Cochrane Drive Suite 300
Annapolis, MD, 21401

BRISTOW U.S. LLC

Robert Phillips
Regional Director, Americas Region
4605 Industrial Drive
New Iberia, Louisiana 70560

CARGO AIRLINE ASSOCIATION

Stephen A. Alterman
President
1620 L Street Northwest
Suite 610
Washington, D.C. 20036

DELTA AIR LINES, INC.

Kenneth Adams
Manager, Field Operations Radio
Engineering & Support
1775 M H Jackson Service Road
TOC 3 – 3rd Floor
Atlanta, GA 30354-3743

NATIONAL AIR TRANSPORTATION
ASSOCIATION

John McGraw
Director, Regulatory Affairs
818 Connecticut Avenue, NW, Suite 900
Washington, D.C. 20006

ROCKWELL COLLINS IMS

John E. Monto
Director
2551 Riva Rd.
Annapolis, MD. 21401

SOUTHWEST AIRLINES

Neal Young
Manager, Aircraft Communication
2432 Wyman Street
Dallas, TX 75235

UNITED PARCEL SERVICE

Dontai Smalls
Vice President, Public Affairs
316 Pennsylvania Ave. SE
Suite 300
Washington, DC 20003-1173

Dated: May 23, 2016

SUMMARY

The Commission should postpone action on Ligado's Applications to modify the ancillary terrestrial component (“ATC”) of their licenses until outstanding work is completed to ensure the protection of certified aviation GPS receivers. There remain too many unresolved issues to alleviate the aviation sector’s concerns that Ligado's proposed operations will present an unacceptable threat of harmful interference to the aviation GPS receivers. Such interference would result in serious risks to public safety, adverse impacts to GPS-enabled operational benefits, and the loss of billions of dollars in Federal Aviation Administration ("FAA") and commercial aviation sector GPS investments.

Despite Ligado’s proposed new conditions, the Joint Aviation Parties continue to submit that it would be inappropriate at this time to consider authorizing any terrestrial commercial mobile operations that may result in reduction in safety-critical GPS based functionality. The introduction of downlink commercial mobile broadband operations in the 1526-1536 MHz band should follow only after sufficient study of the effects of any proposed license condition modifications is completed by the FAA. Further, the whole of Ligado’s licensed emission profile in all bands should be considered under the same concept of FAA oversight to ensure safety of aviation and the flying public, including aggregate handset emissions and out-of-band emission (“OOBE”) limits that incorporate all unwanted and spurious emissions.

Ligado’s suggestion that the Commission impose a condition on Ligado's licenses that comprehensively subjects its emissions to specific power limits adopted by and in coordination with the continued oversight of the FAA may be worthy of further consideration. If adopted, such a condition should permit the FAA to conduct further evaluations and revise the limits over time, without further Commission intervention, as needed to maintain aviation safety.

In addition to certified aviation GPS receivers, Ligado's Applications still raise questions about the protection of other GPS receivers used by the aviation industry for location, tracking, and system timing signals, to name several examples. Ligado's method of testing the impact of interference to these non-certified receivers uses a non-standard approach based on key performance characteristics of a devices' stated position accuracy. But the Commission should consider only testing that applies the well-accepted, and objective 1 dB metric as the GPS inference criterion. Specifically, the Commission should wait until the Department of Transportation completes its widely supported testing under the accepted standard before any action is taken on Ligado's applications.

Finally, the Applications raise unresolved concerns regarding the potential harmful interference critical to AMS(R)S satellite communications ("SATCOM") provided by Inmarsat (downlink in 1525-1559 MHz and uplink in 1626.5-1660.5 MHz) and Iridium (uplink *and* downlink in 1616-1626.5 MHz) that should be fully evaluated before acting on the Applications. Aviation's use of AMS(R)S SATCOM systems for air traffic control and operational connectivity is critical to long range aviation requirements. Without any current studies on the compatibility of Ligado's proposed operations with the SATCOM systems, the Commission should ensure that the implications for such systems are tested and fully functional before proceeding with the Applications.

For the foregoing reasons, the Commission should not consider granting Ligado's Applications, whether in current or modified form, before these matters are fully studied and resolved. A premature decision, before all of the concerns raised above have been addressed, would be contrary to the public interest, could substantially compromise aviation safety, and

could lead to serious adverse economic consequences for the aviation sector and the flying public.

TABLE OF CONTENTS

SUMMARY.....	i
I. DESCRIPTION OF THE JOINT AVIATION PARTIES.....	2
II. INTRODUCTION.....	5
III. THE COMMISSION SHOULD DEFER ACTION ON THE APPLICATIONS UNTIL THE OUTSTANDING WORK IS COMPLETED TO ENSURE PROTECTION OF CERTIFIED AVIATION GPS RECEIVERS.....	7
IV. QUESTIONS REMAIN REGARDING PROTECTION OF OTHER GPS RECEIVERS USED BY THE AVIATION INDUSTRY	15
V. UNRESOLVED CONCERNS REGARDING POTENTIAL HARMFUL INTERFERENCE TO CRITICAL SATELLITE COMMUNICATIONS ARE RAISED BY THE APPLICATIONS	19
VI. CONCLUSION.....	21

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
	)	IB Docket No. 11-109
Ligado Applications to Modify the Ancillary	)	IB Docket No. 12-340
Terrestrial Component (ATC) of Its L-Band)	
Mobile Satellite Service (MSS) Networks	)	SAT-MOD-20151231-00090, SAT-MOD-
	)	20151231-00091, SES-MOD-20151231-
	)	00981

COMMENTS OF AIRCRAFT OWNERS AND PILOTS ASSOCIATION, AIRLINES FOR AMERICA, AVIATION SPECTRUM RESOURCES, INC., BRISTOW U.S., LLC, CARGO AIRLINE ASSOCIATION, DELTA AIRLINES, HELICOPTER ASSOCIATION INTERNATIONAL, INTERNATIONAL AIR TRANSPORT ASSOCIATION, NATIONAL AIR TRANSPORTATION ASSOCIATION, ROCKWELL COLLINS IMS, SOUTHWEST AIRLINES, AND UNITED PARCEL SERVICE

Aircraft Owners and Pilots Association ("AOPA"), Airlines for America ("A4A"), Aviation Spectrum Resources, Inc. ("ASRI"), Bristow U.S., LLC ("Bristow"), Cargo Airline Association ("CAA"), Delta Airlines, Helicopter Association International ("HAI"), International Air Transport Association ("IATA"), National Air Transport Association ("NATA"), Rockwell Collins IMS, Southwest Airlines, and United Parcel Service ("UPS") ("Joint Aviation Parties"), hereby responds to the Commission's April 22, 2016, Public Notice in the above-referenced dockets seeking comment on the December 31, 2015, license modification applications of New LightSquared ("Ligado").¹ By the Applications, Ligado seeks to modify the ancillary terrestrial component ("ATC") of its L-band mobile satellite service ("MSS") networks. In the Applications, Ligado proposes that certain license conditions be placed on its modified ATC

¹ *Comment Sought on Ligado's Modification Applications*, Public Notice, IB Docket Nos. 11-109 and 12-340 (rel. Apr. 22, 2016) ("Public Notice"); *see also* Applications of LightSquared Subsidiary LLC, Narrative, IBFS File Nos. SAT-MOD-20151231-00090, SAT-MOD-20151231-00091, and SES-MOD-20151231-00981 (filed Dec. 31, 2015) ("Applications"). Contemporaneously with filing the Applications, Ligado withdrew its 2012 request to modify its MSS licenses.

authorization to address interference concerns tailored specifically to protect the use of the Global Positioning System (“GPS”) by the aviation sector, in addition to conditions intended to address interference concerns of the general GPS industry and the public as a whole.

As explained in more detail below, it would be premature to grant the Applications at this time, and risk repeating the spectrum management mistakes of the past. Substantial safety of flight concerns remain within the organizations comprising the Joint Aviation Parties regarding the adequacy of the conditions to protect the GPS receivers and other avionics used by the aviation sector, including but not limited to certified aviation receivers, other GPS devices, and satellite communications.² Until those concerns are addressed, whether by the completion of ongoing analysis by the Federal Aviation Administration (“FAA”) among others, or by the imposition of revised conditions, the Commission should refrain from acting on the Applications. Only once those concerns are fully resolved, assuming they can be, should the Commission continue its deliberation of this matter.

I. DESCRIPTION OF THE JOINT AVIATION PARTIES

AOPA advocates for the interests of General Aviation. Hundreds of thousands strong and spanning 75 countries, we represent the largest aviation community in the world.

A4A is the industry trade organization for the leading U.S. airlines. Annually, commercial aviation helps drive nearly \$1.5 trillion in U.S. economic activity and more than 11 million U.S. jobs. A4A vigorously advocates on behalf of the American airline industry as a

² Indeed, because Ligado seems to pin its hopes on access to the 1675-1680 MHz band as well the other spectrum it currently holds, the Commission should also not act on the Applications unless and until an appropriate solution is found for commercial mobile use of that band. That band is currently used for radiosondes and critical meteorological satellite downlinks used heavily by both the federal government and non-government organizations. The Commission has sought comment on Ligado’s proposal to use the 1675-1680 MHz under a separate public notice also issued on April 22, 2016. *See* Comment Sought to Update the Record on Ligado’s Request that the Commission Initiate a Rulemaking to Allocate the 1675-1680 MHz Band for Terrestrial Mobile Use Shared with Federal Use, Public Notice, RM-11681, DA 16-433 (rel. Apr. 22, 2016).

model of safety, customer service and environmental responsibility and as the indispensable network that drives our nation's economy and global competitiveness.

ASRI is the communications company of the U.S. air transport industry, and is owned by U.S. airlines and other U.S. airspace users. ASRI is also the licensee for U.S. Aeronautical Enroute Service ("AES") used for aeronautical operational communications and the sponsor of the Aeronautical Frequency Committee ("AFC").³ This enables ASRI to draw on the expertise and opinions from across the U.S. aviation sector, promoting the safe and efficient operation of civilian aviation radio communications systems operating within the U.S. By coordinating with the AFC, ASRI supports the safe operation of U.S. aviation in an international environment through participation with the International Civil Aviation Organization ("ICAO"), IATA, and International Telecommunication Union Radiocommunications Sector ("ITU-R").

Bristow is the leading provider of helicopter services to the worldwide offshore energy industry based on the number of aircraft operated and one of two helicopter service providers to the offshore energy industry with global operations. Bristow has major transportation operations in the North Sea, Nigeria, the U.S. Gulf of Mexico, and in most of the other major offshore oil and gas producing regions of the world, including Australia, Brazil, Canada, Russia, and Trinidad.

CAA is the nationwide trade organization representing the interests of the nation's all-cargo air carriers before Congress and federal and state regulatory bodies. Specializing in the transportation of cargo, CAA members are the primary drivers of a worldwide economy that demands the efficient time-definite transportation of a wide range of commodities.

³ AFC membership includes all major U.S. airlines, cargo carriers, and helicopter operators; U.S. Communication Service Providers, Airlines for America, Aircraft Owners and Pilots Association, Helicopter Safety and Advisory Conference (HSAC), National Air Transport Association, Helicopter Association International, the Federal Aviation Administration and the International Air Transport Association.

Delta Airlines has grown into one of the world's largest global airlines, helping more than 160 million travelers get to the places they want to go to each year. The airline and its subsidiaries operate over 5,400 flights daily and serve an extensive domestic and international network that includes 333 destinations in 64 countries on six continents.

HAI is a not-for-profit, professional trade association that represents the interests of the helicopter community. HAI has over 4,000 members, including 1,727 companies in 74 nations. Since 1948, HAI has provided its members with services that directly benefit their operations by offering programs to enhance safety, encourage professionalism, and promote the unique benefits of vertical flight. HAI's first priority is – and always will be – safety.

IATA represents the interests of some 260 airlines in over 117 countries, over 90 of which fly into and out of the United States. The safety and security of our member airlines is IATA's highest priority. As such, IATA has a significant interest in the protection of aviation GPS receivers

NATA is the leading organization representing aviation service businesses such as fixed based operators, charter providers, maintenance and repair organizations, flight training, airline service companies and aircraft management companies, including those supporting fractional shareholders. NATA's mission is to empower its members to be safe and successful aviation businesses.

Rockwell Collins IMS is a provider of Air to Ground Datalink and Voice services for the aviation community.

Southwest Airlines operates more than 3,600 flights a day, serving 94 destinations across the United States and six additional countries. With more than 47,000 Employees serving more than 100 million Customers, Southwest Airlines continues to differentiate itself from other air carriers with exemplary Customer Service.

UPS operates one of the world's largest, safest, and most on-time airlines. UPS Airlines integrates small packages and heavy freight in its daily network of more than 500 aircraft and nearly 1,800 flight legs that reach more than 700 destinations in over 220 countries and territories worldwide. At any given time, the economic value of the goods and services moving in the UPS supply chain equates to 6% of the U.S. gross domestic product and 2% of global GDP. UPS Airlines plays an integral role in that supply chain and it is essential that the national aviation network operates efficiently and effectively to ensure American competitiveness.

II. INTRODUCTION

Interference-free GPS operation is critical to maintaining the commercial U.S. aviation industry's unparalleled safety record and achieving future efficiency gains. GPS will become even more important as the Federal Aviation Administration ("FAA") and the industry implement satellite-based NextGen Air Traffic Control technologies and programs.⁴ Ligado, in urging the Commission to put its Applications on public notice, has argued that releasing this spectrum, 1526-1536 MHz in particular, for mobile broadband is in the public interest. As a general matter, the Joint Aviation Parties are aware of the eventual need for additional commercial mobile broadband capacity and that adding spectrum is one of the many elements of a strategy to meet those needs. However, only making an additional 40 MHz of spectrum available for commercial mobile broadband, on balance, is of secondary significance to ensuring

⁴ See <http://www.faa.gov/nextgen>. The FAA's NextGen Program is a new satellite-based National Airspace System due for implementation across the United States in stages between 2012 and 2025. NextGen will be used to shorten routes, save time and fuel, reduce traffic delays and emissions, increase capacity, and permit controllers to monitor and manage aircraft with greater safety. Radio communications will be increasingly replaced by data exchange and automation will reduce the amount of information the air crew must process at one time.

safe and accurate GPS operations across the country, which is of paramount public interest, not just for the flying public's safety, but almost every single American who uses GPS either directly or indirectly in their daily lives. For the aviation community, interference events may present dangers and catastrophic consequences that cannot be resolved after the fact. Therefore, due diligence is required before any decision is made that may impact aviation safety. In addition to the improved safety that GPS permits, the U.S. aviation industry has invested heavily in GPS-enabled devices to receive the benefits of accurate location and timing, among other features, for safe and more efficient operation of its infrastructure. Changes that adversely affect these improvements would result in significant costs and delays for U.S. airlines, and ultimately the flying public. Given a clear public safety issue versus a rush to add modest amounts of spectrum for mobile broadband, the Joint Aviation Parties believe it is a small price to pay for the Commission to delay action on the Applications until all major questions are resolved, as detailed below.

As described herein, too many unknowns remain at present regarding the compatibility of Ligado's proposed operations with aviation GPS receivers (and other GPS receivers) to warrant progressing of the Applications in the near term. While Ligado has reached a negotiated agreement with several manufacturers (Garmin, Trimble, and Deere and Company) that include commitments to use only certain frequencies subject to certain operating conditions, those arrangements cannot be assumed to be satisfactory to all GPS manufacturers, and do not provide assurances of compatibility with GPS receivers as a whole. Those arrangements specifically excluded certified aviation GPS receivers.⁵ Additional work is needed by the FAA and the aviation community to permit proper evaluation of the compatibility issues and to

⁵ See Applications at Attachment Description, Response to Question 43, p. 10 ("The Garmin agreement specifically excludes certified aviation receivers, thus leaving that issue open.").

determine what conditions are needed for operation of a terrestrial commercial mobile wireless system in the adjacent frequency bands to GPS. Such work should be consonant with domestic and internationally established aviation standards relied upon by GPS equipment designers, developers, and manufacturers, and ultimately by aviation companies and the flying public. Those standards are designed to ensure safety of flight as well as maximum operational efficiency of aviation-related activity. The Joint Aviation Parties urge the Commission to ensure that all doubts have been addressed fully, especially those relating to aviation safety, before making any decision. Thus, until the foregoing work is satisfactorily completed, the Commission should not act on the Applications.

III. THE COMMISSION SHOULD DEFER ACTION ON THE APPLICATIONS UNTIL THE OUTSTANDING WORK IS COMPLETED TO ENSURE PROTECTION OF CERTIFIED AVIATION GPS RECEIVERS

Use of certified aviation GPS receivers is critical to aviation safety and navigational efficiency. Certified aviation GPS receivers support three main functions: navigation, surveillance (automatic dependent surveillance-broadcast (“ADS-B”)), and terrain awareness and warning systems (“TAWS”). In some aircraft, GPS receivers also provide critical information to air traffic control and flight stability systems. Unlike most other GPS devices, certified aviation GPS receivers have interference rejection requirements specified by the FAA and harmonized internationally, to ensure a high level of reliability in *all* aircraft conditions and phases of flight and to satisfy well-established international safety-of-life requirements.

An FAA assessment of the impact to aviation from interference to certified aviation GPS receivers, including potential loss of life, was conducted in 2011.⁶ The FAA noted that it could take approximately ten years to design, develop, certify and install modified

⁶ "LightSquared Aviation Impacts," Federal Aviation Administration Navigation Services (Jul. 12, 2011) available at: <http://www.govexec.com/pdfs/072711bb1.pdf>

equipment in the civil aviation fleet. The FAA found that the original planned operations of Ligado's pre-bankruptcy predecessor, LightSquared, would have resulted in the loss of many GPS-enabled operational benefits such as Performance-based Navigation ("PBN") and ADS-B and would have increased the safety risk associated with the malfunctioning of TAWS, risking public safety across the National Airspace System. Additionally, billions of dollars in existing FAA and GPS user investments would have been lost, with a requirement to re-plan the FAA's NextGen investments at considerable cost and delay. Retrofit costs for U.S. aircraft operators were estimated at \$6 billion over a ten-year period, with estimates for NextGen changes, loss of aviation efficiencies and public safety costs totaling over \$72 billion.

Furthermore, a detailed technical assessment of the radiofrequency interference ("RFI") impact to certified aviation GPS receivers was conducted by the FAA in 2012.⁷ Proposed Ligado emissions in the 1526-1536 MHz band of 32 dBW were deemed to be not compatible with FAA requirements for operations dependent on GPS receivers at low altitudes in the vicinity of the ATC transmitters, and therefore a serious concern for aviation safety. Specific impacts predicted by the 2012 report from interference caused by the proposed commercial mobile operation in the 1526-1536 MHz band were unreliable aircraft GPS operation below 300 feet generally and up to 1800 feet in worse conditions. In one scenario tested, the Ligado 1526-1536 MHz downlink signal at 32 dBW exceeded a helicopter GPS receiver's maximum allowed interference power by 24.1 dB for acquisition mode, and by 18.1 dB for tracking mode.⁸

⁷ "Status Report: Assessment of Compatibility of Planned LightSquared Ancillary Terrestrial Component Transmissions in the 1526-1 536 MHz Band with Certified Aviation GPS Receivers," Federal Aviation Administration, p. iii. (Jan. 25, 2012) (redacted version available at https://www.ntia.doc.gov/files/ntia/publications/faa_report_public_release_25_jan_2012_final.pdf)

⁸ A maximum interference power of -16 dBm received at a GPS receiver was modeled at the United Medical Center, Washington, D.C.

Additionally, the analysis did not include the modelling of normal levels of helicopter pitch, or additional interference power at the aircraft due to transmissions from other Ligado towers. Both of these factors could add significantly to the required attenuation needed from the Ligado base station downlink. As shown above, concerns of interference would apply to both fixed wing aircraft flying in known operational airspace, as well as helicopters, and even Unmanned Air Systems (“UAS”), which use GPS for navigation while operating much closer to the ground.⁹ In addition, emergency helicopters operations for unplanned flights such as emergency MediVac services, support of law enforcement, and searches for missing persons require GPS for critical safety related applications.

Therefore, based on the findings of the FAA, the Joint Aviation Parties have previously advocated, and continue to believe, that it would be inappropriate to consider any commercial mobile operations that may result in reduction in safety-critical GPS based functionality, including fixed-wing navigation TAWS, flight stability systems, aids to visual navigation, and decreased helicopter TAWS functionality.¹⁰ Accordingly, the introduction of commercial mobile broadband in the 1526-1536 MHz band should follow only after sufficient study of the ameliorating effects of any proposed license condition modifications is completed by the FAA. That has not yet been completed, and therefore the Ligado Applications should not presently be granted or denied, but rather held in abeyance until the FAA carries on its work to a suitable conclusion.

⁹ It should be noted that some UAS systems use GPS receivers as the sole source of navigational data during flight.

¹⁰ See Letter of Kris Hutchison, President, Aviation Spectrum Resources, Inc., *et al.*, to Marlene H. Dortch, Secretary, FCC, filed in IB Docket No. 12-340; IBFS File Nos. SAT-MOD-20101118-00239; SAT-MOD-20120928-00160; SAT-MOD-2010928-00161; SES-MOD-20121001-00872 (Dec. 12, 2015).

Nonetheless, one aspect of Ligado’s proposed license conditions bears further comment at this time. As part of any solution to any interference concerns, the Joint Aviation Parties read the Applications to suggest that the FAA issue a Technical Standard Order (“TSO”) to ensure protection of certified aviation GPS receivers from commercial mobile radios that would dictate, in effect, the technical parameters of the commercial mobile radios.¹¹ Specifically, “New LightSquared proposes that its license be conditioned on power limitation requirements for the 1526-1536 MHz band necessary to achieve compatibility with current and future MOPS that are incorporated into an active Technical Standard Order from the FAA.”¹² An FAA TSO is a minimum performance standard, defined by the FAA, used to evaluate specified materials, parts, and appliances to be used *on civil aircraft*.¹³ As an initial matter, the Joint Aviation Parties would note that the FAA continues to study and has yet to formally respond to the Ligado proposal for an “active TSO.” While the Joint Aviation Parties generally support the FAA’s determinations on what is required to protect aviation, the limited information available on the use of a TSO as a means to protect against interference from Ligado stations in the 1526-1536 MHz raises several questions that must be fully considered by the Commission in conjunction with the FAA.

¹¹ See Applications at Attachment Description, Response to Question 43, pp. 4, 7, 11 (“Applications Description”).

¹² *Id.* at 11. “MOPS” are Minimum Operational Performance Standards (“MOPS”) developed by the Radio Technical Commission for Aeronautics (“RTCA”), a nonprofit association that supports and coordinates volunteers developing consensus-based standards for aircraft navigation receivers, typically at the request of the FAA. “*Chartered by the FAA to operate Federal advisory committees, RTCA employs a consensus-driven process to generate minimum performance standards for CNS/ATM systems and equipment; to forge recommendations on key aviation policies, and identifying and developing mitigation on issues affecting air traffic management operations. Our performance standards form the basis for FAA regulatory requirements; our policy advice informs the FAA’s prioritization and investment decisions; and our tactical advice helps resolve real-world impediments to air transportation today.*” Available at: www.RTCA.org

¹³ See 14 C.F.R. § 21.1(b)(2).

First, Ligado acknowledges the potential adverse impact on certified receivers as noted in the 2012 FAA study, which examined the effects of a single terrestrial radio. Ligado proposes, in response, recognizing the “core competencies [of the FAA and RTCA] in this field and a long and well-established multi-stakeholder consultation process,” that its operations in the 1526-1536 MHz band be subject to FAA-imposed conditions, which may be modified over time to “ensure that [Ligado’s] operations are compatible with existing and future [aviation] standards,” to ameliorate those concerns.¹⁴

However, the Joint Aviation Parties note that the 2012 FAA study also makes clear that potential impact of aggregate handset emissions operating above 1627 MHz being received by certified aviation GPS receivers remains open. Therefore, the impact of aggregate handsets must be considered and implemented in any FAA control measures to protect certified GPS receivers, especially as these are not fixed and could be in much closer proximity to flying aircraft. This is especially the case because even a single handset can create interference if in close proximity to a GPS receiver. Given the mobility of handsets, the interfering power levels received by aircraft from them can actually exceed that of higher-powered base stations dependent on the situation. The effects of mobile broadband systems on other aircraft systems have been previously studied in ICAO.¹⁵ Although individual high-power base stations can affect aviation systems to a greater range than a given handset, an aircraft can actually receive higher interference signal levels from a single handset (up to 18 dB higher received power using the example provided). This merits further examination of the aggregate effects given handsets’

¹⁴ Applications Description, *supra*, at 11.

¹⁵ "ASRI Preliminary Study into Radio Altimeter Adjacent Band Compatibility," International Civil Aviation Organization, Working Paper, ACP-WG-F30/WP-14 (Mar. 13-19, 2014).

possible proximity to aircraft and aircraft operating areas, and near omni-directional antenna patterns that cannot be shielded from susceptible receivers.

Indeed, given the potential safety impacts, the whole of Ligado's licensed emission profile should be considered under the same concept of FAA oversight to ensure safety of aviation and the flying public, including out-of-band emission ("OOBE") limits that incorporate all unwanted *and* spurious emissions. It would seem unreasonable that the Commission would ensure protection for aviation safety from only a single aspect of a commercial mobile system's emissions, while not waiting for all other emissions from the same mobile system to also be conclusively studied.

Second, the Joint Aviation Parties submit that any changes to the Ligado license conditions that would present a different Ligado emission profile due to a modified deployment model or system architecture necessitates additional studies by the FAA to confirm compatibility with certified aviation GPS receivers. For example, a reduction in the Ligado power levels that make a small cell deployment more suitable would require assessment of aggregate base station interference levels to aircraft at low and mid-level altitudes resulting from a high density small cell system architecture. Furthermore, any future studies should incorporate the 6 dB safety margin as required in the relevant ITU-R Recommendation¹⁶ and by ICAO.¹⁷

Third, the Ligado proposal to use an FAA TSO as the basis for regulating the emissions of the Ligado radios operating in 1526-1526 MHz poses some practical problems. In the case of the existing GPS TSOs C145/C146, C/161, and C/196, the performance requirements

¹⁶ Characteristics and Protection Criteria for Receiving Earth Stations in the Radionavigation-Satellite Service (Space-To-Earth) and Receivers in the Aeronautical Radionavigation Service Operating in the Band 1559-1610 MHz, ITU-R Recommendation 1903 at § 3 (Jan. 2012) ("ITU-R Recommendation 1903").

¹⁷ Handbook on Radio Frequency Spectrum Requirements for Civil Aviation including Statement of Approved ICAO Policies, International Civil Aviation Organization, DOC 9718 –AN/957 at § 9.2.22 (2009).

specified have been derived directly from the RTCA Minimum Operational Performance Standards (“MOPS”) (DO-229, DO-253, & DO-316 respectively).¹⁸ However, TSOs are only intended to cover aviation systems, and not external systems that are unrelated to aviation. In contrast, while there is some ambiguity, Ligado is proposing that an FAA TSO be used effectively to impose regulatory limits on a *non-aviation system* that does not communicate or intend to interact with the GPS receiver or other aviation systems. By definition, a TSO is a minimum performance standard issued by the FAA for specified materials, parts, processes, and appliances used on civil aircraft, not the systems operation or systems of a non-aviation entity such as Ligado. While the Joint Aviation Parties appreciate what appears to be the general intent behind this proposal, the Joint Aviation Parties believe that the TSO framework by itself would not accommodate what Ligado seems to have in mind, i.e. using RTCA MOPS requirements, as the basis for regulatory technical and operational limits imposed by the Commission on commercial mobile radios. The Joint Aviation Parties are concerned that, without clarification, Ligado’s current proposal could leave the propagation environment, operational considerations (both aircraft and Ligado), and the Ligado transmitter functions open to external interpretation and competing technical arguments. This could result in a similar standoff to the current situation between the respective opponents and proponents to Ligado’s proposal. Uncertainty regarding the limits applicable to Ligado’s commercial operations, or their proper interpretation, could undermine assurances of GPS operational safety or frustrate efforts of the Commission to move forward.

¹⁸ Minimum Operational Performance Standards, RTCA, Document Nos. 229, 253, and 316, available at <http://www.rtca.org/Files/ListofAvailableDocsMarch2013.pdf>

To achieve a more comprehensive protection of aviation GPS and ensure safety of flight, provided preliminary FAA analysis proves favorable,¹⁹ a condition should be imposed on Ligado's licenses that subjects all of Ligado's emissions -- including base stations and handsets, both in channel and out-of-band -- to specific power restrictions implemented in concurrence and through coordination with the FAA. This perpetual condition on any current or future license in these bands would be based on existing *and subject to future* RTCA MOPS, and use an FAA-led assessment to identify suitable Ligado emission limits to protect all users of all aviation GPS receivers. Such an approach would eliminate any need for continued action from the Commission, as originally suggested by Ligado with regards to aviation safety, while also giving the FAA direct supervision over emissions from a system that has important implications for aviation safety. Additionally, such a condition would not preclude the FAA from objecting to *any* Ligado emissions in the bands adjacent to GPS bands, should further evaluation deem changes necessary to maintain aviation safety. As Ligado notes in its general proposal, the FAA condition should be "self-executing and 'evergreen.'" It is self-executing in that the Commission can impose this license condition at any time, and whenever the FAA/RTCA adopts or amends such a requirement, that obligation immediately falls upon the company. It is 'evergreen' in that if ever the FAA/RTCA should alter its requirement, then that new obligation becomes binding on the company as an FCC licensee, without need for a Commission action."²⁰ These features

¹⁹ The Ligado Applications suggests that shifting the burden through an "FAA-driven condition" would solve the problem of compatibility with certified aviation GPS receivers. Before the Commission moves to impose such a condition, the FAA should first complete its ongoing analysis to see if all basic concerns have been or can likely be addressed, after which a more rigorous coordination and implantation, subject to the FAA condition, can be pursued. The Joint Aviation Parties are concerned about a repeat, albeit in different clothes, of the conditional waiver granted in 2011 for the LightSquared's ATC operations, which was dependent on *future* interference protection analyses being favorably (to LightSquared) completed, which, of course, they never were.

²⁰ Applications Description, *supra*, at 12.

should be essential components in any license conditions designed to protect aviation safety from interference.

IV. QUESTIONS REMAIN REGARDING PROTECTION OF OTHER GPS RECEIVERS USED BY THE AVIATION INDUSTRY

In addition to the navigational requirements of certified aviation GPS receivers, the aviation industry relies heavily on non-certified GPS receivers (“standard GPS devices”) for location, tracking, and system timing signals. Ligado has attempted to assuage concerns regarding the potential for interference to standard GPS devices, and even other GNSS devices, through testing of selected devices using its own methodology.²¹ In contrast to the well accepted, objective standard of a 1 dB rise in the noise floor as an interference protection criterion, Ligado proposes using new standards based on key performance characteristics using a device’s stated position accuracy. The Joint Aviation Parties submit that attempting to use an accuracy test or other subjective performance metric to assess an interference criterion is impractical and virtually impossible given the multiple ways in which standard GPS devices are used and the many types of devices affected. In some applications, position is not the primary metric, but rather time, frequency, attitude, heading, or other parameters (e.g., atmospheric delay, reflected signal strength, geometry of GPS satellites), alone or in combination. Combined with the variation and number of different GPS receivers by different manufacturers, and in light of the many ways GPS receivers are used, an attempt to define a single accuracy

²¹ See Letter from Gerald J. Waldron, Counsel to Ligado Networks, LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 12-340 and 11-109, RM-11681 (filed Feb. 24, 2016) (attaching presentation entitled “GPS and Adjacent Band Co-existence Study: Illustration of Method and Selected Results,” summarizing its testing of general navigation and smartphones devices, as well as the test plan it used, entitled “GPS Sensitivity Measurement Plan”) (Ligado Feb. 24, 2016 Ex Parte); Letter from Gerald J. Waldron, Counsel to Ligado Networks, LLC, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 12-340 and 11-109 (filed Apr. 14, 2016) (Ligado April 14, 2016 Ex Parte).

performance/interference indicator is not feasible. Therefore, applying the existing 1 dB metric for the GPS interference criterion is the most appropriate metric,²² and the Commission should wait until testing by the Department of Transportation (“DOT”) using this established metric is completed before taking any action on the proposed license conditions in the Applications.

Use of an interference protection criterion in the form of a 1 dB decrease in the carrier-to-noise density ratio (C/N_0), or an equivalent I/N of -6 dB, is well established as the most appropriate metric for the protection criterion for standard GPS devices, as well as other Radionavigation Satellite Service (“RNSS”) receivers. The 1 dB metric has been recognized in the domestic regulatory arena as the only appropriate protection criterion for standard GPS devices. For example, in 2003, the FCC’s proceeding on the required emission limits for Ultra-Wideband (“UWB”) devices to be compatible with GPS receivers were based on a total rise in the noise floor (N_0) of the GPS receiver of 1 dB (which has the same effect as decreasing C/N_0

²² Ligado claims that its key performance characteristics approach is founded on the Commission’s definition of “harmful interference,” which is the same definition used in the NTIA Redbook and the ITU Radio Regulations. “Harmful Interference. 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 ITU] Radio Regulations.” *See* 47 CFR § 2.1. *See also* U.S. Department of Commerce, NTIA, Manual of Regulations and Procedures for Federal Radio Frequency Management, § 6.1.1 (2008) (“NTIA Redbook”); ITU Radio Regulations, § 1.169 at p. 23 (2012). While the Commission does not regularly ascribe the values to quantify “harmful interference” which operates as a guide for interference events to be resolved among e events to be resolved among spectrum users in the absence of applicable technical rules that have been contravened, the Joint Aviation Parties do not advocate that the Commission do so here. Rather, the Commission should adopt an interference protection criterion to ensure that a certain level of interfering signal is prevented in the first place, as the means to ensure that systems operating in the same or adjacent bands do not interfere with one another. Criteria of this sort in the form of emissions masks, out of band emissions limits, etc., are not uncommon in the Commission’s rules and are most appropriate here where an established 1 dB standard has been relied upon by designers and manufacturers for many years. In this light, the efforts of the FCC’s Technological Advisory Council (TAC) to develop “harm claim thresholds” that would attempt to quantify harmful interference levels for different radiocommunication services is inappropriate for GPS or RNSS receivers. Such an effort contravenes longstanding U.S. domestic and international policy, precedent, and practice applying the 1 dB interference protection criterion as an objective limit.

by 1 dB).²³ Then, in 2004, the same criterion of a 1 dB rise in the noise floor was used in developing the FCC's rules for limiting emissions of Low Power Television stations into the GPS band.²⁴

Additionally, the 1 dB decrease in C/N_0 interference protection criterion is also recognized and used extensively in the International Telecommunications Union-Radiocommunications Sector (ITU-R) for multiple safety systems, including GPS. The ITU-R recommendations for RNSS, of which GPS is one type, use this same interference protection criterion to establish the maximum acceptable third-party interference power level into the receivers.²⁵ Indeed, the ITU makes clear that 1 dB is an *aggregate* value, taking into account the total interference power at the antenna output of an RNSS receiver due to all interfering sources (in-band, adjacent band and out-of-band) other than those in the RNSS.²⁶

IATA would also note that other GNSS systems used by global aviation as a whole are very important to flight and air traffic management systems, and use the same 1 dB degradation standard to measure interference. Protection of these frequency spectrums used by

²³ Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, ET Docket No. 98-153, 18 FCC Rcd 3857 at 3863 (rel. Mar. 12, 2003) states "...the UWB emission limits were...based on a 1 dB increase in the noise floor of the GPS receiver..." It is noted that initially the FCC proposed an I/N of -3 dB as the appropriate criterion, but this was revised to -6 dB and the equivalent 1-dB increase in the GPS receiver noise floor.

²⁴ See Ex Parte Letter from Kathy Smith, Chief Counsel, National Telecommunications and Information Administration, to Marlene H. Dortch Secretary, FCC, MB Docket No. 03-185 at A-7 (Aug. 27, 2004). The FCC used the analysis and recommendations submitted by the NTIA. Page A-7 of the NTIA submission specifically refers to the I/N criterion of -6 dB used in the NTIA analysis to develop the LPTV filtering required, which the FCC adopted.

²⁵ ITU-R Recommendation 1903 at § 0. Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) and receivers in the aeronautical radionavigation service operating in the band 1 559-1 610 MHz.

²⁶ See id. "Therefore, the accepted approach is to define the aggregate interference power density threshold at a level that will not raise the total noise floor by more than 1 dB above the environmental noise floor."

all GNSS signals were emphasized by ICAO ANC/12 recommendations. These recommendations urge ICAO Member States, including the U.S., to provide effective spectrum management and protection of GNSS frequencies to reduce the likelihood of interference or degradation of GNSS performance. The Commission should be aware of the potential impacts of the proposed terrestrial commercial mobile operations on these other GNSS systems, which has not been fully developed, before acting on the Ligado Applications.

Given this ubiquitous existing use of the 1 dB metric for aggregate interference to GPS receivers, it would be highly unusual for the Commission to adopt an entirely new metric -- that is not recognized or used for GPS receivers as the basis -- for a decision on the Applications without further consideration. This is especially the case as the Ligado approach, which has received very little support relative to the testing approach being employed by DOT.

Finally, the Joint Aviation Parties note that GPS devices have continued to improve their capabilities over the many years of their employment by civilian users. This has been due in part to new technologies and signal processing methods to use the existing received signal levels and assuming the standard 1 dB level of margin. Reduction of this known and available margin, let alone the introduction of what are essentially subjective standards based on performance measures, would hamstring manufacturers pursuing future GPS improvements. Given how the previous improvements have facilitated dramatic growth in recent years in GPS applications throughout the nation's economy and civilian life, casting aside the established interference protection criterion to allow terrestrial commercial use of a small portion of spectrum in the scheme of things for a single terrestrial system would have a chilling effect on future application developments and be counterproductive to the Commission's mandate to manage the spectrum to serve the American public as a whole.

Therefore, with regard to standard GPS devices, the Joint Aviation Parties submit that the Commission should await the outcome of the highly supported DOT ABC study currently being undertaken before making any decision on whether to grant Ligado's Applications as proposed.

V. UNRESOLVED CONCERNS REGARDING POTENTIAL HARMFUL INTERFERENCE TO CRITICAL SATELLITE COMMUNICATIONS ARE RAISED BY THE APPLICATIONS

In addition to the concerns noted above, the Joint Aviation Parties also contend that additional consideration of the effects of Ligado's emissions on safety related AMS(R)S satellite communications ("SATCOM") systems must be addressed in this filing before proceeding further. Commercial aviation uses AMS(R)S SATCOM systems provided by Inmarsat (downlink allocation at 1525-1559 MHz and uplink allocations at 1626.5-1660.5 MHz) and Iridium (uplink and downlink allocation at 1616-1626.5 MHz) for both air traffic control purposes and additional operational connectivity. These systems have become a critical function to meet long-range aviation requirements, and are used regularly in flight, including oceanic air traffic control voice messages. In addition, the increased bandwidth available from new SATCOM constellations from these providers will allow for further flight-critical services in supporting of operations and safety, such as Electronic Flight Bags ("EFB"), Flight Management System ("FMS") updates, and datalink frequency table modifications, among others. Given the importance of these systems, the risk of a premature decision on Ligado's proposal may have multiple effects on aviation SATCOM systems and further studies of the compatibility with both Iridium and Inmarsat is required, which may result in further adjustments to Ligado's proposed license conditions.

No studies to the Joint Aviation Parties' knowledge have been conducted on the compatibility of the proposed Ligado ATC operations with the Iridium system, and the potential

effects of the Ligado emissions remain an unknown for a system separated by only 2 MHz from mobile handsets that have had no limits placed on their operation.

Furthermore, the Inmarsat service was studied in RTCA Special Committee-222, resulting in a report, RTCA DO-343, outlining the issues with then-LightSquared's proposed terrestrial operations.²⁷ It concluded that the interference from Ligado's emissions may make it impossible to verify either Inmarsat's SBB²⁸ or Classic Aero²⁹ SATCOM functionality prior to pushback. The report therefore stated that such interference may require a modification of aircraft operating procedures or SATCOM equipment to be modified to achieve greater resilience to interference."³⁰ This is a significant concern to aviation operators, confirmed by A4A, IATA, and their airline members, as ground operation of SATCOM is critical to ensure that SATCOM systems are operational as required by the FAA. These systems must be tested successfully before flight to ensure they are fully functional before entering oceanic airspace in addition to the other ground-based services mentioned above.

Furthermore, a submission by Inmarsat to the UK communications regulator OfCom in December 2015, has raised new questions about the potential effects of Ligado's emissions on aviation SATCOM receivers, which are standardized worldwide.³¹ The Inmarsat

²⁷ RTCA DO-343: Minimum Aviation System Performance Standard for AMS(R)S Data And Voice Communications Supporting Required Communications Performance (RCP) and Required Surveillance Performance (RSP) In Procedural Airspace, DO-343 (Aug. 21, 2013) available at http://www.rtca.org/store_product.asp?prodid=1119 ("DO-343 Study").

²⁸ SBB (Swift Broadband): a new Inmarsat SATCOM network that provides high capacity data and voice connectivity for aircraft globally except for the polar regions.

²⁹ Classic Aero: Inmarsat's existing AMS(R)S SATCOM system meeting ICAO standards for data and voice connectivity for aircraft globally except for the polar regions.

³⁰ The DO-343 Study found for a Classic Aero SATCOM receiver that the overload (saturation) margin was between -29.6 to -34.6 dB when a 42dBW Ligado signal was received at 1300m on 1550 MHz (variation dependent on SATCOM receiver cable loss).

³¹ Inmarsat Response, OfCom Consultation Document: New Spectrum For Audio PMSE (Dec. 18, 2015). Available at <http://stakeholders.ofcom.org.uk/binaries/consultations/new-spectrum-audio-PMSE/responses/Inmarsat.pdf>

submission was in response to an OfCom public consultation on moving Personal Microphones for Special Events (“PMSE”) into the 1525-1559 MHz band. Inmarsat calculated that for a PMSE device operating within the 1525-1559 MHz band, with a power output of approximately 20 dBm EIRP over less than 1 MHz bandwidth, aircraft operation of SATCOM during flight would be affected: “the required path loss is not achieved when the operation of the body worn microphone with 20 dBm EIRP is considered, even when the terminal is operated indoors while considering body loss.” Given these calculations, Inmarsat noted that PMSE systems would be “a serious risk for interference to the MSS terminals operated on board aircraft, irrespective of the aircraft altitude.” The Joint Aviation Parties have yet to fully assess the Inmarsat study submitted in the UK process, but given the concerns raised by the MSS operator itself in the UK, and compared to a proposed 62 dBm license for Ligado in the United States, such SATCOM interference concerns should be fully considered by the Commission before moving ahead with the Ligado proposal. This is especially the case for the Iridium service given the lack of current information or consideration to the effects of Ligado’s emissions on aeronautical safety SATCOM systems.

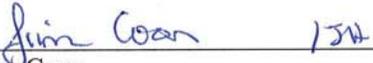
VI. CONCLUSION

As explained herein, there are a number of outstanding safety of flight issues that must be resolved before the Commission can consider the Ligado Applications, whether in their current or in a modified form. Those safety issues not only affect protection of certified aviation GPS receivers from interference, but also concern standard GPS devices, satellite communications, and the meteorological downlinks at or near 1675-1680 MHz. It would be contrary to the public interest, given the central and growing importance of GPS to aviation safety and efficiency, as well as to the national economy and public safety, for the Commission to act before appropriate studies and testing are completed, for example, by the FAA and/or DOT

using the accepted interference criterion. Any one of the unresolved issues discussed herein is, by itself, more than enough to suspend consideration of the Ligado Applications until the outstanding questions have been fully assessed and answered. To go forward before these matters are addressed as a whole could pose enormous risk to aviation safety and potentially drive substantial economic harm to U.S. airlines and the other Joint Aviation Parties.

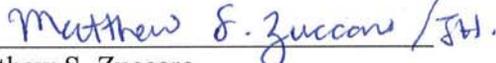
Respectfully submitted,

AIRCRAFT OWNERS AND PILOTS
ASSOCIATION



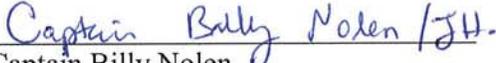
Jim Coon
Senior Vice President, Government Affairs and Advocacy
421 Aviation Way
Frederick, Maryland 21701

HELICOPTER ASSOCIATION INTERNATIONAL



Matthew S. Zuccaro
President & CEO
1920 Ballenger Avenue
Alexandria, VA 22314-2898

AIRLINES FOR AMERICA



Captain Billy Nolen
Senior Vice President, Safety, Security, and
Operations
1301 Pennsylvania Avenue, NW Suite 1100
Washington DC 20004-1707

INTERNATIONAL AIR TRANSPORT
ASSOCIATION



Douglas E. Lavin
Vice President, Member and External
Relations, North America International
1201 F Street NW Suite 650
Washington DC 20004

AVIATION SPECTRUM RESOURCES, INC.



Kris Hutchison
President
180 Admiral Cochrane Drive Suite 300
Annapolis, MD, 21401

NATIONAL AIR TRANSPORTATION
ASSOCIATION



John McGraw
Director, Regulatory Affairs
818 Connecticut Avenue, NW, Suite 900
Washington, D.C. 20006

BRISTOW U.S. LLC

Robert Phillips /JH.
Robert Phillips
Regional Director, Americas Region
4605 Industrial Drive
New Iberia, Louisiana 70560

ROCKWELL COLLINS IMS

John E. Monto /JH.
John E. Monto
Director
2551 Riva Rd.
Annapolis, MD. 21401

CARGO AIRLINE ASSOCIATION

Stephen A. Alterman /JH.
Stephen A. Alterman
President
1620 L Street Northwest
Suite 610
Washington, D.C. 20036

SOUTHWEST AIRLINES

Neal Young /JH.
Neal Young
Manager, Aircraft Communication
2432 Wyman Street
Dallas, TX 75235

DELTA AIR LINES, INC.

Kenneth Adams /JH.
Kenneth Adams
Manager, Field Operations Radio
Engineering & Support
1775 M H Jackson Service Road
TOC 3 – 3rd Floor
Atlanta, GA 30354-3743

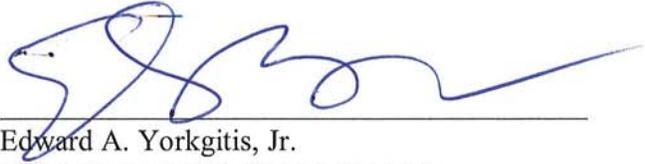
UNITED PARCEL SERVICE

Dontai Smalls /JH.
Dontai Smalls
Vice President, Public Affairs
316 Pennsylvania Ave. SE
Suite 300
Washington, DC 20003-1173

Dated: May 23, 2016

Certificate of Service

I hereby certify that a true and correct copy of these comments of the Joint Aviation Parties was served upon the parties listed below on this 23rd day of May 2016 by email delivery via arrangements made through counsel for Ligado to accept service of comments by email in lieu of service by hand.



Edward A. Yorkgitis, Jr.
KELLEY DRYE & WARREN LLP
3050 K Street NW
Suite 400
Washington, DC 20007
Phone: (202) 342-8540
Email: cyorkgitis@kelleydrye.com

Counsel for Aviation Spectrum Resources, Inc.

Jeffrey Carlisle
LIGHTSQUARED SUBSIDIARY LLC
10801 Parkridge Boulevard
Reston, VA 20191

Gerald Waldron
COVINGTON & BURLING LLP
One CityCenter
850 Tenth Street, NW
Washington, DC 20001
Counsel for LightSquared Subsidiary LLC