

March 27, 2017

Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, DC 20554

Re: *IB Docket Nos. 11-109, 12-340; IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091*

Dear Ms. Dortch:

The weight of the evidence presented by Iridium Communications Inc. (“Iridium”) in the above-referenced dockets leads to the inescapable conclusion that Ligado Networks LLC (“Ligado”) has failed to address Iridium’s legitimate concerns about interference to its well-established mobile satellite service (“MSS”). Ligado has no fundamental right to convert its satellite spectrum into a terrestrial wireless business. In sharp contrast, Iridium does have a fundamental right to protection from interference by Ligado’s proposed ATC business. The FCC’s history addressing an “ancillary terrestrial component” to operational satellite networks makes this abundantly clear. Ligado’s efforts to arbitrage its satellite business into a terrestrial wireless business would go further than FCC policy ever intended or FCC rules should ever allow. That Ligado wants to accomplish this at the expense of Iridium’s fully operational and vibrant MSS business (and sundry other collateral public interest damage to GPS and NOAA operations) should not be sanctioned by the FCC.

Ligado’s most recent submission attempts in vain to attack the methodology Iridium used to demonstrate the potential for interference into its MSS business.<sup>1</sup> Unlike Ligado, Iridium utilizes methodologies that are widely endorsed by industry and the FCC. More importantly, however, Ligado gravely misconstrues the FCC’s ATC rules in an attempt to skirt its fundamental responsibility to protect Iridium or any third party MSS provider from its proposed terrestrial wireless business. And like the Greeks entering Troy in the Trojan Horse, Ligado tries

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<sup>1</sup> See Letter from Gerard J. Waldron, Michael Beder and Hannah Lepow, Counsel to Ligado, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109, 12-340; IBFS File Nos. SES- MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091 (filed Jan. 16, 2017) (“January Ligado Letter”); Ligado’s Technical Response to Iridium’s December 14 Letter, IB Docket Nos. 11-109, 12-340; IBFS File Nos. SES- MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091 (filed Jan. 16, 2017) (“Ligado Technical Response”). The filings were in response to a December 16, 2016 Iridium letter (“December Iridium Letter”) that responded to arguments raised in a November 2, 2016 Ligado Notice of *Ex Parte* Presentation and a new technical analysis demonstrating the specific interference harms to Iridium aviation customers also filed on December 16, 2016 (“Iridium Aviation Analysis”).

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to persuade Iridium (and the Commission) that it will be better off under Ligado's newest terrestrial proposal than the status quo. Iridium has no interest in playing a role in that story – we all know how it ends. Unfortunately, Ligado's "spectrum reality" is merely a construct of its own making and not the spectrum reality the rest of the world and Iridium must live with every day. Iridium responds to each of these arguments in further detail below.

In its January Letter:

1. Ligado raises virtually no new arguments and nothing in the letter or technical response alleviates Iridium's conviction that out-of-band emissions ("OOBE") generated by Ligado's proposed terrestrial operations will significantly interfere with Iridium's operations in the adjacent 1617.775-1626.5 MHz spectrum band.
2. Ligado continues to assert that Iridium lacks any right to protection against such harmful interference due to the secondary status of Iridium's downlinks. This is flatly wrong. Ligado's ATC does not possess primary status, and even if it did have primary status in its band, basic spectrum management principles and FCC rules make clear that Ligado must mitigate any interference its ATC operations cause to Iridium's MSS operations (regardless of Iridium's status *vis a vis* other operators in its band). Importantly, Iridium has sunk billions of dollars of investment into its second-generation Iridium NEXT constellation in reliance upon this legal framework and the conclusion that it would be protected against the type of ATC interference Ligado proposes.
3. Ligado claims that Iridium's analysis is "divorced from the spectrum reality it exists in today."<sup>2</sup> On the contrary, Ligado's analysis is divorced from the legal reality that Ligado exists in today. Iridium is quite familiar with the existing spectrum environment within which it operates, and has successfully navigated that reality to the tune of 850,000 government and commercial subscribers that rely on its services every day across the globe. It is more aware than anyone that it must coexist with other providers in its band and other MSS operators, including the acceptance of some interference from such providers. It has successfully designed its systems to do so. What Ligado is proposing, terrestrial 4G LTE and 5G operations with vastly different uses and devices, and the potential for millions of such devices, many of which are virtually guaranteed to come into contact with Iridium terminals, is fundamentally different than Iridium's current operating environment.<sup>3</sup> Ligado's claim that its revised proposal makes Iridium better off than the status quo is therefore not accurate

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<sup>2</sup> January Ligado Letter at 1.

<sup>3</sup> See *infra* Section I.C.

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because it fails to take into consideration the future reality it wishes to force Iridium to operate in.

4. Notwithstanding Ligado's claims that Iridium will be better off under Ligado's proposal compared to the status quo, in reality Iridium's technical analysis demonstrates that it is not is not technically or practically viable to have terrestrial and satellite services in the same spectrum neighborhood, for Iridium or Ligado. In order to provide a viable terrestrial service, Ligado will be forced to limit the frequencies available to satellite customers, and the potential growth of any terrestrial service will be necessarily at the expense of the satellite service and vice-versa. Satellite customers including private, commercial and federal, state and local government users will have to become second tier users in order to make room for Ligado's terrestrial operations. While this conclusion is obviously a significant concern for Iridium, given Ligado's limited MSS business today and its desire to convert its spectrum for terrestrial use, it is not surprising that Ligado is not equally concerned about this reality for its own satellite customers.

Iridium's technical analysis makes clear that a Ligado terrestrial network is virtually certain to cause substantial interference to Iridium users, and the Commission's rules dictate that Iridium has the right to operate its services without accepting such harmful interference from adjacent ATC operations. Therefore, absent an agreement in which Ligado sufficiently modifies its proposed ATC operations to avoid interference with the long-established Iridium services in the adjacent band, the Commission should deny Ligado's effort to convert its operations in the 1627.5-1637.5 MHz band to a terrestrial wireless broadband service.

## **I. LIGADO'S TECHNICAL ARGUMENTS STILL LACK MERIT**

In December 2016, Iridium filed a response to Ligado's November ex parte filing on Iridium's September 2016 technical assessment of Ligado interference to Iridium over a range of terrestrial interference scenarios and a new aviation-specific technical interference assessment. Ligado's January response to these filings makes many of the same technical arguments it previously filed. These new comments have little technical merit and do nothing to refute the basis for Iridium's assumptions or the conclusions demonstrating how Ligado interference will harm Iridium's wide array of existing and future services.

### **A. Ligado's Overall Technical Analysis Remains Flawed Due to Incorrect Assumptions**

#### **1. Ligado Continues to Advocate for Propagation Path Loss Models That do not Reflect Similar FCC and FAA Studies**

Ligado continues to support the highest-loss propagation model (Walfisch-Ikegami LOS, or WI-LOS) that is only appropriate for dense urban environments. As Iridium has made clear in

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its previous assessments, Iridium has a varied user application base that extends to usage in urban, suburban and rural areas. Iridium usage does exist in dense urban areas (including in-building usage for its high-power broadcast data messaging services), but it is certainly not the only, or even primary, usage environment. Therefore, to only assume dense urban propagation models to assess interference between Ligado and Iridium user terminals is inappropriate. Instead, Iridium uses propagation models that are appropriate to the actual environments in which interference scenarios are expected and which have been recognized by the FCC for such environments.

There are multiple interference scenarios in which Iridium and Ligado terminals would be near and in line of sight of each other: in same vehicle, in suburban areas, in disaster relief regions, at airports and others. As the FCC articulated in the *2003 ATC Order*, these situations are best modeled using free space path loss (“FSPL”) or terrain models, as used by Iridium.<sup>4</sup> RTCA SC-159 also agreed when studying Ligado interference to aviation services.<sup>5</sup>

Ligado also states that Iridium is using propagation models that are different than those used during the Iridium-Globalstar band sharing proceedings. Iridium did assume a different propagation path loss model when assessing potential Iridium interference to Globalstar, which was appropriate given that the Iridium-Globalstar (*i.e.*, MSS user terminal to MSS user terminal) interference scenario is different than the Ligado LTE terrestrial user terminal to Iridium MSS user terminal scenario. Ligado deployment of LTE terrestrial terminals would not be similar to Globalstar satellite terminal deployments. For example, terrestrial deployment would result in a much higher density of users, resulting in a higher likelihood of having an interfering user within close proximity to an Iridium user, and with a clear line-of-sight between the two terminals. This increased chance of interference warrants Iridium’s use of the propagation models described above.

## **2. Ligado Incorrectly Claims Iridium’s Analysis Omits Other Factors That Would Limit Ligado Interference**

Ligado continues to assert that a total of 20 dB of antenna gain, antenna polarization mismatch and head/body absorption losses should be considered in any Iridium-Ligado interference scenario. However, the *600 MHz Report and Order* assumes a -6 dBi LTE antenna gain, a 2 dB polarization mismatch loss, a 3 dB body loss for the interfering device, a 3 dB body loss for the victim device and 3.5 dB loss due to multipath and other propagation losses, for a

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<sup>4</sup> *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 2155, App. C2 § 1.6 (2003) (“*2003 ATC Order*”).

<sup>5</sup> Iridium December Letter at 2; See RTC Special Committee 159, Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations 17 (2011) (“*SC-159 Assessment*”).

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total of 17.5 dB additional losses to be assumed in the interference analysis.<sup>6</sup> We again note that no additional antenna gain pattern loss should be assumed for the interfering Ligado user terminal given that antenna gain is already assumed as part of Ligado's proposed e.i.r.p. mask. The victim Iridium user terminal already assumes a -3 dBi antenna gain, which is consistent for Iridium terminal antennas at low elevation angles. Assuming 3 dB body loss for both the Ligado and Iridium terminals is not appropriate either, given that Ligado intends to support, and Iridium currently supports, enterprise markets in which user terminals will not be handheld devices. We agree that the 2 dB polarization mismatch loss may be appropriate in some cases given the expectation that Ligado terminals will likely employ linear polarization relative to Iridium terminals employing circular polarization.

Lastly, we note that the same *600 MHz Report and Order* that Ligado uses as a basis for its assumptions, explicitly states that free space path loss models are appropriate for these types of interference scenarios, stating: "We also note that there is unanimous support in the record to use free space propagation for the analysis of interference from personal/portable white space devices to wireless handsets."<sup>7</sup>

## **B. Ligado's Aviation Analysis Also Relies on Incorrect Assumptions**

Ligado questions the underlying assumptions of the Iridium Aviation Analysis, even though Iridium leverages substantial input from aviation GPS and satellite communications studies recognized by the FCC and the Federal Aviation Administration ("FAA").

### **1. Impact of Aircraft Fuselage on Interference Signal**

Ligado's first assertion is that a 6 dB fuselage signal blockage factor should be used in the analysis. Fuselage blocking can be a factor when the victim Iridium antenna is on top of the fuselage and the interfering Ligado terminals are directly under the aircraft. However, as Iridium described in its "Helicopter and Aircraft Take Off/Landing Interference Scenario" section, the sub-horizon elevation angles to interfering Ligado terminals from the Iridium antenna on low-flying aircraft are quite low, based on the aircraft height and distance to surrounding Ligado terminals.<sup>8</sup> Table 1 below provides the range of elevation angles for the interference scenarios described in Iridium's assessment. Negative elevation angles from the victim Iridium antenna

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<sup>6</sup> *Amendment of Part 15 of the Commission's Rules for Unlicensed Operations in the Television Bands, Repurposed 600 MHz Band, 600 MHz Guard Bands and Duplex Gap, and Channel 37*, Report and Order, 30 FCC Rcd 9551, 9600 ¶¶ 124-126 (2015).

<sup>7</sup> *Id.*, 30 FCC Rcd at 9599 ¶ 123. In addition, in its analysis of interference in the AWS-4 proceeding, the FCC used a 2 meter separation distance and free space path loss. *Service Rules for Advanced Wireless Services in the 2000-2020 MHz and 2180-2200 MHz Bands et al.*, Report and Order and Order of Proposed Modification, 27 FCC Rcd 16102, 16158-59 ¶ 142 (2012).

<sup>8</sup> Iridium Aviation Analysis at 10.

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reference plane corresponds to elevation angle below horizon, *i.e.*,  $-90^\circ$  elevation angle would be straight down through the fuselage. As shown in Table 1, for the interference scenarios described in the Iridium Aviation Analysis, most elevation angles to the interfering Ligado terminal are very low (*i.e.*, nearly horizontal), though for the 5,000 m altitude case, some Ligado terminal transmission would be attenuated by the fuselage. In this latter case, Iridium is willing to accept some attenuation due to fuselage blocking, but as seen in Iridium's assessment, the primary interference concern occurs when the Iridium-equipped aircraft is at lower altitudes less than 500 m, in which case signal blockage from the fuselage is unlikely to occur.

**Table 1: Elevation Angles From Iridium Antenna on Top of Aircraft Fuselage to Interfering Ligado Terminal**

Iridium-equipped aircraft altitude (m)	Range of horizontal distances to interfering Ligado terminal	Range of elevation angles from Iridium antenna to Ligado terminal
100	1 - 10 km	$-5.7^\circ$ to $-0.6^\circ$
500	1 - 10 km	$-26.6^\circ$ to $-2.9^\circ$
5,000	5 - 10 km	$-78.7^\circ$ to $-26.6^\circ$

## 2. Iridium Aviation Antenna Pattern Gain

For these aviation interference scenarios, Ligado also claims that the victim Iridium antenna gain used in the interference assessment should be much lower due to the negative elevation angle to interfering Ligado terminals on the ground. Ligado has mistakenly referenced the antenna gain used by Iridium in their assessment. Ligado claims that Iridium stated that a typical Iridium antenna has a gain of  $-6$  dBi at horizon (*i.e.*, elevation angle of  $0^\circ$ ). However, Iridium clearly stated that these antennas “have a typical gain of about  $-6$  dBi at small elevation angles below horizon.”<sup>9</sup> This is also why Iridium, in their terrestrial Ligado interference assessment, used an antenna gain of  $-3$  dBi for  $0^\circ$  elevation angle to an adjacent Ligado terminal, so Iridium has in fact assumed a lower antenna gain for the aviation case.

## 3. Ligado User Terminal Emission Parameters

Ligado also claims that its user terminal emissions will be lower than maximum power levels provided in its 2015 application, due to real world power control and duty cycle factors appropriate for LTE mobile user applications. Iridium reasserts that Ligado has not addressed the effect of reduced on-channel emissions from a Ligado user terminal to OOB power levels

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<sup>9</sup> *Id.* at 6.

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and continues to rely on the expertise of RTCA SC-159, which also did not assume power control effects for Ligado terminals.

Furthermore, Ligado now states that it will not be providing consumer mobile voice terminals, but instead will be focusing on non-voice enterprise markets.<sup>10</sup> This could significantly change the Ligado terminal transmission power and duty cycle characteristics. Mobile voice users typically have over-the-air sessions which may accommodate power control reductions throughout the call since voice applications typically can withstand a lower grade of service relative to high-integrity data applications. Furthermore, voice applications certainly may result in lower duty cycles during silent periods when no voice is being transmitted (*i.e.*, voice activity factor), relative to data applications. Iridium expects that enterprise data communication applications would not be characterized by these reduced transmission power and duty cycle factors, which would only further support Iridium's original assumptions about Ligado user terminal emissions.

#### **4. Same-aircraft Interference Scenario**

For Iridium's same-aircraft interference scenario, Ligado apparently recognizes that its user terminals could produce interference to Iridium's aviation and safety services and therefore assumes this issue can be resolved through coordination. However, any such "coordination" would need to be based on the fact that Iridium is currently installed on over 30,000 aircraft to provide AMSS and AMS(R)S services and will not accept any new interference from as yet to be deployed Ligado terrestrial terminals.

#### **5. Airport Terminal Interference Scenario**

Iridium also originally provided another aviation interference scenario in which Ligado user terminals are near an airport terminal with Iridium-equipped aircraft. Ligado reemphasizes its same claims about antenna polarization mismatch, antenna gain, head/body isolation and power control adjustments it made for the terrestrial interference scenarios. Iridium has addressed all of these concerns above. Furthermore for this scenario, Iridium notes with interest that Ligado now states that the five Ligado users assumed by Iridium represent "a small portion of users served by the base station."<sup>11</sup> Curiously, Ligado had previously recommended assuming Ligado user densities consistent with WG-1 (which Iridium did), but now appears to be saying that Ligado will in fact be deploying much higher user densities than Iridium had assumed. These higher Ligado user densities would certainly worsen the aggregate interference experienced by Iridium terminals.

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<sup>10</sup> Letter from Gerard J. Waldron, Michael Beder and Hannah Lepow, Counsel to Ligado, to Marlene H. Dortch, Secretary, FCC, IB Docket Nos. 11-109, 12-340; IBFS File Nos. SES- MOD-20151231-00981, SAT-MOD-20151231-00090, SAT-MOD-20151231-00091 (filed Sept. 8, 2016).

<sup>11</sup> Ligado Technical Response at 17.

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**C. Ligado Conflates Its Potential for Interference with That of Other MSS Systems**

Ligado's claim that Iridium's interference analysis does not consider the operations of the existing geostationary ("GSO") MSS systems could not be further from the truth.<sup>12</sup> Iridium is quite familiar with the interference environment in which it currently operates.<sup>13</sup> What Ligado fails to address is the marked differences between the present mobile-earth station device deployments in the L-band and Ligado's ATC deployment. Ligado's argument that the mobile earth stations operating in the L-band would hamper Iridium's operations more than Ligado's ATC terminal operations does not hold given the differences between the two services. There is a potential for a significantly larger number and higher density of Ligado user terminals leading to an increased risk of interference given the likely proximity of Ligado ATC terminals to Iridium earth stations. Traditional GSO mobile earth station service terminals are more likely to be deployed in more remote areas where terrestrial coverage is inadequate. The rural deployment makes it less likely that the GSO mobile earth station service terminals will be in line-of-sight proximity to Iridium user terminals. Iridium has already demonstrated the close distances in which Iridium terminals and Ligado ATC terminals may be situated along with the increased likelihood of line-of-sight interference caused by Ligado terminals into Iridium operations.<sup>14</sup> Beyond the difference in terrain and geographical distance between mobile-earth station and Ligado terminals to Iridium terminals, the characteristics of the two services' antennas differ significantly. The GSO mobile earth station service terminals employ higher-gain, shaped beam antennas that point directly at the satellite arc, attenuating the risk of interference to Iridium. In contrast, Ligado's ATC service would deploy omni-directional antennas envisioned for its CMRS terminals which would pose a greater interference risk for Iridium's service. In short, Iridium is aware of its operating environment and the negative effects the deployment of Ligado's ATC service would have on that ecosystem.

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<sup>12</sup> Ligado January Letter at 7.

<sup>13</sup> Iridium has been on the record for the last fifteen years stating that it in fact does receive interference from other MSS systems. Iridium fought for many years to prevent relaxation of the OOB mask for GSO MSS terminals described in Recommendation ITU-R M.1480. Ultimately, the FCC rejected that relaxation due, in part, to the fact that the existing mask already resulted in interference to Iridium. Iridium susceptibility to interference from GSO MSS user terminals has been studied for many years within ICAO's Aeronautical Communications Panel (ACP), RTCA SC-159 & RTCA SC-222 on AMS(R)S, and ARINC AEEC Air Ground Communications Systems (AGCS) projects.

<sup>14</sup> Iridium December Letter at 2.



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**D. Terrestrial and Satellite Services as Proposed by Ligado Cannot Technically or Practically Coexist**

In the Ligado Technical Response, Ligado provided a list of Mobile Earth Terminals (“METs”) authorized to communicate with Ligado’s satellite, including 1.36 million terminals that have been authorized in the United States.<sup>15</sup> The following Table provides the number of METs, licensed by Ligado or its partners, and maximum power for each authorization.

Call Sign	Licensee	# terminals	Max power (W)
E130033	ViaSat	500,000	18
E000725	Skybitz	450,000	4
E030120	Amtech	100,000	5
E930367	Ligado	100,000	17.5
E980179	Ligado	100,000	17.5
E990083	National Systems & Research Company	40,000	16
E090029	Comtech	25,000	13.3
E980159	Satcom Systems	25,000	17.5
E980203	Outerlink	20,000	14.76

In 2013, LightSquared reported that it “operates three (3) lines of business, including Mobile Satellite Communications (“MSAT”), Mobile Data Services (“MDS”) and Private Network Carriers (“PNC”) through a wholesale business model whereby its partners bill the end-users, and the Company bills its partners at a wholesale rate. Through these three lines of business, the Company has over fifteen (15) wholesale partners that collectively support approximately 300,000 subscribers across several markets throughout North America.”<sup>16</sup> Given the fact that its 300,000 subscribers in 2013 were distributed throughout North America, not just the United States, the 1.36 million terminals *authorized* in the United States is likely a substantial overstatement of the actual number in use.

<sup>15</sup> Ligado Technical Response at 19, 23 n.xxxviii.

<sup>16</sup> Notice of Filing by Ad Hoc LP Secured Group of Solicitation Versions of First Amended Plan and Disclosure Statement, LightSquared, Inc., et al., Debtors, Chapter 11, Case No. 12-12080 (SCC), U.S. Bankruptcy Court, SDNY (filed Oct. 28, 2013).

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Ligado has made it abundantly clear that the company views future use of its spectrum to be primarily for next generation terrestrial mobile services, not satellite. Just as Iridium is acutely aware that Ligado's proposed terrestrial services will cause harmful interference to Iridium satellite services, Ligado must also recognize that its proposed terrestrial operations will put in jeopardy its satellite operations offered in the same band. To simultaneously serve its terrestrial and satellite customers, Ligado must either take spectrum away from prospective use by its satellite customers, thus limiting the customer's growth potential, or must operate its terrestrial and satellite networks in a fashion that permits compatibility between the two services, which is not technically feasible.

There are four self-interference scenarios that would be encountered if Ligado were to attempt to use the same spectrum for both satellite and terrestrial services: (1) terrestrial handset into MSS satellite, (2) MSS handset into terrestrial base station, (3) MSS satellite into terrestrial handset, and (4) terrestrial base station into MSS handset. Scenario 1 likely is not a major concern (although there could be many thousands of terrestrial terminals within a satellite beam) and scenario 3 is also not likely to be a significant issue. Scenarios 2 and 4, however, will cause interference to the terrestrial base station or the MSS terminal respectively. Interference into the terrestrial base station is practically assured due to the significantly higher power transmitted by the MSS terminal. Interference into the MSS handset is just as likely because the MSS terminals need more stringent desired to undesired ("D/U") ratios since they have much less margin and conceivably no MSS terminal would be able to work within miles of a base station, *i.e.*, no MSS wherever there is contiguous terrestrial base station coverage.

Thus, in order to provide a viable terrestrial service, Ligado will be forced to limit the frequencies available to satellite customers, and the potential growth of any terrestrial service will be necessarily at the expense of the satellite service and vice-versa. Satellite customers including private, commercial and federal, state and local government users will have to become second tier users in order to make room for Ligado's terrestrial operations. Looking at these two scenarios, it becomes very clear that it is possible to have a terrestrial service, or to have a satellite service, but it is not practical or technically viable to have both. The success of one service necessarily means the demise of the other. However, given Ligado's focus on converting its spectrum for terrestrial use and its limited MSS business today, it is not surprising that Ligado does not appear to be concerned about the impact of its terrestrial proposal on existing MSS users. Ultimately, the deployment of Ligado's proposed terrestrial operations would not be ancillary to its satellite operations as required by the Commission.<sup>17</sup>

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<sup>17</sup> *ATC Report and Order*, 18 FCC Rcd at 1964-65 ¶¶ 1-2; LightSquared Subsidiary LLC Request for Modification of its Authority for an Ancillary Terrestrial Component, *Order and Authorization*, 26 FCC Rcd 566, 575, 584 ¶¶ 16, 37 (2011).

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## II. LIGADO'S LEGAL ARGUMENTS LACK MERIT

Ligado's repetition of its flawed legal arguments in prior filings makes them no more persuasive this time. Still, Ligado's claim that Iridium is required to accept OOBE from Ligado's ATC operations because of the secondary status of Iridium's downlinks is incorrect. This contention leads Ligado to incorrectly rely upon interpretations of the U.S. Table of Allocations to defend its theory of Ligado's entitlement to interference protection. However, the U.S. Table of Allocations and Commission precedent are squarely in Iridium's favor. Within the Big LEO band, Iridium is required to confer interference protection rights upon other authorized Big LEO band operations. However, this requirement does not extend beyond the Big LEO band. The Commission rules and precedent clearly demonstrate that Iridium is under no obligation to protect Ligado's ATC operations in the adjacent 1627.5-1637.5 MHz band. On the contrary, however, Commission rules and precedent clearly demonstrate that Ligado is required to protect Iridium's MSS operations from the adjacent band ATC operations proposed by Ligado.

### A. The FCC's Spectrum Management Policies Entitle Iridium's Primary and Secondary Status in the Big LEO Band to Interference Protection from Adjacent-band Operations

Contrary to basic spectrum management principles and FCC practice, Ligado improperly claims that Iridium is not entitled to protection because Iridium's MSS downlink operations are secondary while Ligado claims that its ATC is primary in the adjacent 1627.5-1637.5 MHz band are primary. Nothing in Ligado's latest filing undermines Iridium's position that Ligado's ATC does not possess primary status and the FCC's spectrum management policies require Ligado to mitigate any interference its ATC operations may cause to Iridium's MSS operations.

Under the terms of the Big LEO band plan and Iridium's MSS license, Iridium provides MSS "on an exclusive basis in the 1618.725-1626.6 MHz band, and shares the 1617.775-1618.725 MHz band with the Globalstar MSS system."<sup>18</sup> Iridium's assigned spectrum at 1617.775-1626.5 MHz is allocated to both (i) MSS uplinks on a co-primary basis and (ii) MSS downlinks on a secondary basis.<sup>19</sup> The Commission adopted a secondary allocation for the MSS downlinks in the 1613.8-1626.5 MHz band with the intent of: (i) accommodating Iridium's bi-directional MSS operations in the band; and (ii) providing interference protection to services

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<sup>18</sup> *Iridium Constellation LLC*, Order and Authorization, 31 FCC Rcd 8675, 8676 ¶ 3 n.9 (IB/OET 2016). See also *2008 Globalstar Modification Order* at 15222 ¶¶ 46-47.

<sup>19</sup> *2008 Globalstar Modification Order* at 23 FCC Rcd 15207, 15222 ¶¶ 46-47; see also *Iridium Constellation LLC*, Order and Authorization, 31 FCC Rcd 8675, 8676 ¶ 3 n.9 (IB/OET 2016).

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allocated in the Big LEO band on a primary basis.<sup>20</sup> These respective rights are spelled out in the Table of Frequency Allocations in Section 2.106.<sup>21</sup> Iridium’s MSS license confers upon it protection rights with respect to other authorized operations in the Big LEO band, and does not require it to accept OOBE interference from adjacent-band services. Further, Iridium is not required to provide interference protection to Ligado’s ATC operations under the Commission’s allocation and service rules, regardless of the primary or secondary status of its operations.

The U.S. Table of Frequency Allocations defines interference rights specific to the operators’ frequency band. In the U.S. Table of Frequency Allocations, Ligado’s L-band spectrum in the 1626.5-1660 MHz band is allocated to MSS uplinks on a primary basis.<sup>22</sup> This spectrum is not assigned to ATC operations on a primary or a secondary basis and therefore does not confer any status to Ligado’s ATC service beyond its operation in conjunction with its authorized MSS network. Rather, footnote US380 to the U.S. Table of Allocations – the only footnote to discuss ATC operations – allows MSS providers to “operate an ancillary terrestrial component *in conjunction with* its MSS network, subject to the Commission’s [ATC] rules ... and subject to all applicable conditions and provisions of its MSS authorization.”<sup>23</sup> The Commission specified in its *2003 ATC Order* that ATC services may only be provided by incumbent MSS licenses.<sup>24</sup> The same order declined to allow terrestrial services to operate in the MSS bands without concurrent MSS operations.<sup>25</sup>

In the *2003 ATC Order*, the Commission created Section 25.255 to require that MSS ATC operators “resolve any ... interference” it causes to other services.<sup>26</sup> The Commission stated that an ATC operator must resolve any harmful interference experienced by an adjacent MSS operator or other operator.<sup>27</sup> Section 25.255 “reflects the Commission’s carefully crafted determination that an ATC operator bears a duty to resolve any harmful interference, notwithstanding the ATC operator’s compliance with other applicable ATC technical rules,

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<sup>20</sup> See *Amendment of Section 2.106 of the Commission’s Rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile-Satellite Service, Including Non-geostationary Satellites*, Report and Order, 9 FCC Rcd 536, 537 ¶ 8, 539-41 ¶¶ 19-26 (1994).

<sup>21</sup> 47 C.F.R. §2.106.

<sup>22</sup> *Id.*

<sup>23</sup> *Id.*, n.US380.

<sup>24</sup> *2003 ATC Order*, 18 FCC Rcd at 1996-99 ¶¶ 60-64. See also December Iridium Letter at 9 (stating that in the *2003 ATC Order* the Commission opted to not allow terrestrial services in the MSS bands to operate separately from MSS licenses).

<sup>25</sup> *Id.*

<sup>26</sup> 47 C.F.R. § 25.255.

<sup>27</sup> *2003 ATC Order*, 18 FCC Rcd at 2017 at ¶ 104.

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because the allocation ‘remains first and foremost a satellite service.’”<sup>28</sup> The Commission has stated that the rule imposes an “absolute obligation on the MSS/ATC operator to resolve any harmful interference to other services.”<sup>29</sup> The text of Section 25.255 mandates resolution of harmful interference from ATC operators and does not draw a distinction between types of “harmful interference” or “other services.” Ligado’s interpretation of the rule would effectively rewrite the plain text of the rule and add restrictions on the non-interference principle that do not exist in the text. Section 25.255 protects the interests of other services, whether primary or secondary, and states that MSS ATC operators must resolve any such interference. Ligado’s ATC operations are authorized only on an unprotected, non-harmful interference basis and are subject to Section 25.255’s interference protection requirement. Iridium’s co-primary (for uplinks) or secondary (for downlinks) status does not require it to accept OOB interference from Ligado’s adjacent-band ATC operations. Ligado’s argument that Section 25.255 of the Commission’s rules is a dispute resolution rule has no bearing on that fact and no basis in the FCC record leading to adoption of the rule.<sup>30</sup> Iridium has built its business and second-generation Iridium NEXT constellation in reliance upon the plain language of the text of Section 25.255. To read the text in the manner that Ligado suggests turns the purpose of the rule on its head and would severely impact Iridium’s long-considered business model for, and substantial investment in, its second-generation satellite constellation.

Reading footnote US380 in conjunction with the *2003 ATC Order* demonstrates that Ligado’s ATC service has an unprotected interference status under all circumstances and accords protection to Iridium as an MSS provider to be free from harmful interference caused by the ATC operations of other MSS providers in adjacent bands. Thus, Ligado is required to correct OOB interference issues caused by its ATC operations to all other authorized services, including Iridium’s MSS.

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<sup>28</sup> December Iridium Letter at 10, *citing 2003 ATC Order*, 18 FCC Rcd at 1965-66 ¶ 3; *see also Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Memorandum Opinion and Order and Second Order on Reconsideration, 20 FCC Rcd 4616, 4620 ¶ 11 (2005) (“To protect other users ... from harmful interference from ATC, we adopted a number of technical rules for ATC .... The MSS/ATC operator is also required to resolve any harmful interference to other services caused by its ATC base stations or handsets.”); *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Order on Reconsideration, 18 FCC Rcd 13590, 13595-96 ¶ 13 (2003) (“We require pre-operational construction and testing operations be in compliance with all appropriate technical rules including section 25.255 relating to procedures for resolving possible harmful interference.”).

<sup>29</sup> *Spectrum & Service Rules for Ancillary Terrestrial Components in the 1.6/2.4 GHz Big LEO Bands; Globalstar Licensee LLC, Auth. To Implement an Ancillary Terrestrial Component, Report and Order Proposing Modification*, 23 FCC Rcd 7210, 7223 ¶ 35 (2008).

<sup>30</sup> 47 C.F.R. § 25.255.

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Ligado also misinterprets the language of Section 2.105 to suggest that a secondary user in a spectrum band must accept interference from a primary service in an adjacent frequency band.<sup>31</sup> Section 2.105 states that stations of a secondary service “[c]annot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date.”<sup>32</sup> Ligado’s reading of the rule does not adhere to longstanding Commission policy that defines an operator’s primary or secondary status with respect to other services authorized in the *same* frequency band, which in the case of Iridium is limited to the Big LEO band.<sup>33</sup> In addition, Section 2.105 is not relevant here because the primary and secondary allocations of Iridium’s operations are superior to the unprotected status of Ligado’s proposed ATC operations and do not confer a right to interference protection upon Ligado. Section 2.105 applies only to secondary versus primary uses within the same frequency band, not secondary versus unprotected uses in adjacent bands.<sup>34</sup>

Ligado refers to two services that enjoy co-primary status within the Big LEO band in its erroneous argument that Iridium’s secondary downlink frequencies should be required to protect Ligado’s ATC operations.<sup>35</sup> In the *1994 Big LEO Order*, the FCC decided not to (i) impose PFD limits on secondary MSS downlinks in the 1613.8-1626.5 MHz band to protect primary Radioastronomy Service (“RAS”) and Radionavigation-Satellite Service (“RNSS”) operations or (ii) impose specific OOB limits on secondary MSS downlinks in the 1613.8-1626.5 MHz band to protect primary RNSS operations.<sup>36</sup> The Commission’s stated reasoning was that “secondary services ... shall not cause harmful interference nor claim protection from primary services.”<sup>37</sup> Ligado’s argument fails for several reasons. First, the RAS and RNSS operations are contained

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<sup>31</sup> January Ligado Letter at 3.

<sup>32</sup> 47 C.F.R. § 2.105.

<sup>33</sup> December Iridium Letter at 9.

<sup>34</sup> Ligado’s assertion that Iridium’s interpretation of the rule would allow an unlicensed party operating under Part 15 to block the implementation of Ligado’s ATC operations is not true. Section 2.105 sets allocation status in the Table of Frequency Allocations within the same frequency band, not between them, unless specifically stated in a footnote. Footnote US380 does not address adjacent band interference. Therefore, Ligado’s proposed ATC service is not entitled to protection as it relates to Iridium’s secondary downlinks. As stated above, Ligado is required to correct interference issues caused by its ATC into “all other authorized services.” However, Ligado would be able to claim protection from interference caused by unlicensed devices operating under Part 15 because these devices are prohibited from causing harmful interference and must cease transmissions when interference occurs. 47 C.F.R. § 15.5.

<sup>35</sup> January Ligado Letter at 3-4, citing Amendment of Section 2.106 of the Commission’s Rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile-Satellite Service, Including Non-geostationary Satellites, Report and Order, 9 FCC Rcd 5936, 5982, 5995 at ¶¶ 117, 140 (1994) (“1994 Big LEO Order”).

<sup>36</sup> January Ligado Letter at 3-4.

<sup>37</sup> 1994 MSS Order 9 FCC Rcd at 5982 ¶ 117.

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within the Big LEO band.<sup>38</sup> Second, while Iridium's MSS downlinks may be required to tolerate interference from co-primary radionavigation operations in the Big LEO band, the Commission never expressed intent to extend interference protection rights to services allocated in adjacent frequency bands. As an ancillary service to its MSS operations, Ligado's ATC service must operate on unprotected, non-interference basis. Simply put, nothing about Ligado's ATC status can require Iridium to accept interference from Ligado's ATC operations.<sup>39</sup>

**B. Ligado Mischaracterizes the FCC's 2008 Globalstar Modification Order to Argue That Iridium Is Not Protected from ATC Operations in Adjacent Bands.**

Ligado incorrectly argues that the language in the FCC's *2008 Globalstar Modification Order* only addresses the relative rights of primary and secondary uses of the 1617.775-1618.725 MHz band segment, not Iridium's band in its entirety.<sup>40</sup> Ligado uses this position as support for its argument that Iridium is required to provide interference protection to operators in adjacent bands. Ligado cites to the ordering clauses which authorize Iridium "to operate in the 1618.775-1626.5 MHz band on an exclusive basis, to operate in the Earth-to-space direction in the 1617.775-1618.725 MHz band, on a shared basis with the Globalstar Big LEO system, and to operate in the space-to-Earth direction in the 1617.775-1618.725 MHz band on a shared basis with the Globalstar Big LEO system."<sup>41</sup> Ligado argues that the *2008 Globalstar Modification Order* is silent with respect to other services authorized in the Big LEO band and the interference protections accorded thereto. While the *2008 Globalstar Modification Order* may discuss frequency allocation among Globalstar and Iridium, the Order is part of an ongoing Commission effort to allocate spectrum for operators in the Big LEO band.<sup>42</sup> The purpose of the *2008 Globalstar Order* and the other Big LEO spectrum allocation orders was to define interference protection within the Big LEO band, not to extend interference protection rights to other services allocated in adjacent bands. At no point during the creation of the Big LEO band plan did the Commission express intent to extend interference protection rights to other services allocated in adjacent frequency bands. While Iridium's secondary MSS downlinks may be required to withstand interference from co-primary radionavigation operations in the Big LEO band, this requirement does not extend to tolerating OOBE interference from adjacent-band operations.

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<sup>38</sup> December Iridium Letter at 4, citing *Amendment of Section 2.106 of the Commission's Rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile-Satellite Service, Including Non-geostationary Satellites*, Report and Order, 9 FCC Rcd 536, 537 ¶¶ 8, 539-41 ¶¶ 19-26 (1994).

<sup>39</sup> December Iridium Letter at 8.

<sup>40</sup> January Ligado Letter at 4-5 (citing *2008 Globalstar Modification Order* at 23 FCC Rcd 15207).

<sup>41</sup> *2008 Globalstar Modification Order* at 15222 ¶¶ 46-47.

<sup>42</sup> *Id.* at 15207-8 ¶¶ 1-2.

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Please contact the undersigned with any questions.

Sincerely,

/s/ \_\_\_\_\_

Bryan N. Tramont  
Patrick R. Halley



## ENGINEERING CERTIFICATION

The undersigned hereby certifies to the Federal Communications Commission as follows:

1. I am the technically qualified person responsible for the engineering information contained in the foregoing Application,
2. I am familiar with Part 25 of the Commission's Rules, and
3. I have either prepared or reviewed the engineering information contained in the foregoing Application, and it is complete and accurate to the best of my knowledge and belief.

Signed:

/s/  
Brandon Hinton  
Director, Systems Engineering & Test  
Harris Corporation

March 27, 2017  
Date