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May 14, 2015

*Via Electronic Filing*

Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street SW
Washington, DC 20554

Re: *Iridium Constellation LLC Petition for Rulemaking,* RM-11697
Written *Ex Parte*

Dear Ms. Dortch:

The Commission should reject Iridium Constellation LLC's ("Iridium's") latest revised request to access and use the spectrum of its chief competitor, Globalstar, Inc. ("Globalstar"). Iridium has no legitimate need for this spectrum, and its use of these frequencies would cause harm to Globalstar and its customers.

In its April 17, 2015 filing, Iridium purportedly "withdraw[s] without prejudice . . . at this time" its request to appropriate Globalstar's licensed spectrum above 1617.5 MHz.[1] Even under its latest revised proposal, however, Iridium would still encroach upon Globalstar's exclusively licensed mobile satellite service ("MSS") spectrum, gaining access to Globalstar's frequencies at 1616-1617.775 MHz on a shared basis.[2] As described in the January 14, 2015 technical report from Roberson and Associates, LLC ("Roberson and Associates") and confirmed in Roberson and Associates' further analysis attached to this letter, Iridium's use of Globalstar's licensed MSS spectrum at 1616-1617.775 MHz would have a substantial detrimental impact on Globalstar and its MSS customers within the United States and throughout North America.[3] The Commission should reject this latest anti-competitive regulatory maneuver and quickly deny this proposal and Iridium's underlying Petition for Rulemaking.

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1 Letter from R. Michael Senkowski, Counsel to Iridium Constellation LLC, to Marlene Dortch, Secretary, FCC, RM-11697, at 3 (Apr. 17, 2015) ("April Iridium Ex Parte").

2 *Id*. at 1.

3 *See* Letter from Regina M. Keeney, Counsel to Globalstar, to Marlene Dortch, Secretary, FCC, RM-11697 (Jan. 14, 2015) (attaching *Impact of Iridium Operations in 1616-1617.775 MHz on Globalstar Operations*, Roberson and Associates, LLC (Jan. 14, 2015) ("January Roberson Report").

In contrast to what Iridium has told the Commission in this proceeding about its purported spectrum shortfall, Globalstar is unaware of any similar claims made by Iridium to its investment community. Iridium has not mentioned these alleged spectrum needs in any of its Securities and Exchange Commission ("SEC") filings, including its 2014 10-K filing.[4] Given the fact that Iridium has received approximately $1.8 billion in financing for its Iridium NEXT project from some of the same institutions that financed Globalstar's second-generation constellation, it is unlikely that these institutions have been notified or believe that Iridium is short of spectrum.

Iridium's publicly available technical filings to the Commission fail to substantiate its claimed spectrum needs. Iridium has previously indicated that only one "timeslot" in each 90 millisecond TDMA frame will be utilized on its system, with a resulting duty cycle of only 9.2%.[5] More recently, Iridium stated that, while greater use of its network does occur occasionally at certain locations and times, it is not typical that such use would be sustained across large geographic areas.[6] Given this operational reality, Iridium clearly does not require more Lower Big LEO spectrum to support its operations. Rather, it appears Iridium is seeking access to Globalstar's licensed spectrum in an attempt to thwart a competitor and gain a competitive advantage in the MSS marketplace. The Commission should not tolerate this tactic. Just as the Commission would deny any request from Verizon for the reassignment or sharing of its competitor AT&T's licensed spectrum, the Commission should reject Iridium's demand that the Commission solve its alleged spectrum issues by giving it access to its closest competitor's frequencies.

As described in previous technical submissions in this proceeding, Globalstar would suffer serious harm if Iridium were granted access to additional Globalstar-licensed spectrum. The January 2015 Roberson and Associates Report indicated that the extension of Iridium transmissions from 1617.775 MHz down to 1616 MHz would significantly reduce Globalstar's capacity and have a severe detrimental impact on its MSS operations and customers.[7] Further

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4 Iridium Communications Inc. 2014 Annual Report (Form 10-K) (filed Feb. 26, 2015).

5 *See* Supplemental Comments of Iridium Constellation LLC, RM-11697, at 8 (Nov. 5, 2014) ("November Iridium Supplement").

6 Letter from R. Michael Senkowski, Counsel to Iridium Constellation LLC, to Marlene Dortch, Secretary, FCC, RM-11697, at 10 (Feb. 5, 2015) ("February Iridium Ex Parte").

7 *See* January Roberson Report. As Roberson has previously described, Globalstar's satellite capacity is inherently limited by the transmitter power available to each of its "bent-pipe" satellites as it re-broadcasts any received signals, including those from Iridium handsets operating below 1618.725 MHz. *Id*. at ii, 5. Given that Globalstar's satellites are already in orbit and their filter hardware cannot be modified, Iridium transmissions at 1616-1617.775 MHz would be received and repeated by Globalstar's satellites. These Iridium signals would consume Globalstar satellite power, make that power unavailable to Globalstar's own subscribers, and reduce Globalstar's capacity.

analysis by Roberson – attached in the Appendix to this letter – now confirms that Globalstar and its customers would suffer serious harm. Even using different assumptions about service area, duty cycle, and traffic mix, Roberson and Associates concludes that Iridium's operations at 1616-1617.775 MHz would likely reduce Globalstar user capacity by 21% to 31%, depending on the level of loading on Iridium's network.[8] Globalstar's loss of capacity would be most severe (potentially exceeding 31%) during disasters and other periods of maximum MSS usage, just when its customers would have the greatest need for Globalstar's service.

Iridium's expanded use of Globalstar's licensed spectrum would threaten to degrade the quality of Globalstar's service to its subscribers throughout the United States and elsewhere in North America, to Iridium's competitive benefit. Today, Globalstar provides industry-leading, highly reliable, crystal-clear CDMA-quality voice and data services. With Iridium sharing its spectrum down to 1616 MHz, Globalstar customers would sometimes be unable to establish connections in low-signal locations where they are currently able to receive service. As Iridium is no doubt aware, such effects would give Iridium an unjustified competitive boost in the MSS marketplace.

Iridium's operations at 1616-1617.775 MHz would have a particularly detrimental impact on Globalstar's aviation services, including its planned ADS-B Link Augmentation System ("ALAS"), a space-based, next-generation air traffic management system. Automatic Dependent Surveillance-Broadcast ("ADS-B") is a key component of air traffic control modernization that allows air traffic controllers to continuously monitor aircraft flight parameters on a real-time basis.[9] Globalstar's ALAS relies on Globalstar's satellite constellation to extend ADS-B capability into areas where line-of-site communication between aircraft and a terrestrial ADS-B ground station is not possible. To meet applicable Federal Aviation Administration and RTCA, Inc. standards, Globalstar's aviation terminals, including ALAS equipment, can *only* operate in Globalstar's licensed spectrum above 1616 MHz. As Roberson and Associates indicates, increased interference due to Iridium operations at 1616-1617.775 MHz would degrade the quality of service of Globalstar's aviation services, including ALAS, by decreasing the success rate of those aeronautical transmissions and reducing the service area of those operations. While Globalstar, the commercial airline industry, and airline passengers would suffer this harm,

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[8] Iridium is wrong that Globalstar's satellites "hear" everything in the Lower Big LEO band up to 1626.5 MHz. February Iridium Letter at 13. Globalstar's satellites have passband filters that limit the energy entering Globalstar's satellite receive antennas to the 1610-1618.725 MHz band, where Globalstar is authorized to operate in the United States. Thus, there is no merit to Iridium's claim that Globalstar's capacity concerns are "moot" or otherwise without basis; the additional energy that Iridium users would generate within Globalstar satellites' passband at 1610-1618.725 MHz would have a significant impact on Globalstar's satellite capacity.

[9] *See, e.g.*, Letter from L. Barbee Ponder IV, Globalstar, Inc., to Marlene Dortch, Secretary, FCC, RM-11697, at 6-7 (Oct. 24, 2014).

Iridium alone would benefit as it attempts to deploy an alternative ADS-B satellite delivery system that will compete directly with ALAS.[10]

Iridium suggests that, if its proposal is adopted, Globalstar and Iridium could coordinate their operations above 1616 MHz during natural and man-made disasters and other periods of peak MSS usage. Such coordination, however, would most likely require these MSS operators to turn off or limit service to subscribers, including public safety personnel, at the very time those services are needed most. In any event, Iridium has access to sufficient Big LEO MSS spectrum to meet the needs of its customers and, in the highly unlikely emergency scenario where it needs additional spectrum, Iridium can seek special temporary authority for such operations. The Commission should not give Iridium permanent access to Globalstar's exclusively licensed spectrum down to 1616 MHz in order to account for a hypothetical and extremely rare circumstance.

In addition to the harmful impact on Globalstar and its customers, the Commission should weigh the harmful effects Iridium's operations at 1616-1617.775 MHz would have on the Radio Astronomy Service ("RAS"). In an *ex parte* filing in October 2014, the National Radio Astronomy Observatory ("NRAO") indicated that expanding Iridium operations down to 1616.0 MHz would greatly increase the potential for interference into RAS below 1613.8 MHz.[11] More recently, NRAO has pointed out that "unwanted emissions into the radio astronomy band at 1610.6-1613.8 MHz are known to increase as Iridium's operating bandwidth grows downward," and that "[s]ince the inception of its operation, harmful levels of unwanted emissions from the Iridium constellation operating in the MSS (space-earth) allocation above 1616 MHz have fallen into the band 1610.6-1613.8 MHz that is allocated to the [RAS]."[12]

Iridium claims that any issues relating to the impact of its MSS operations on RAS "can be resolved in the appropriate coordination contexts,"[13] but NRAO makes clear in its April 29, 2015 *ex parte* response that it is greatly concerned with the direction and pace of those coordination efforts. In particular, NRAO explains that "[t]he protection mechanism proposed by Iridium is unfavorable to radio astronomy and generally unworkable given the way radio

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[10] In April 2013, Aieron LLC, a joint venture between Iridium and NAV CANADA, announced an agreement to launch and integrate its ADS-B payloads on Iridium's next-generation satellites. Press Release, *Iridium Joint Venture, Aireon, Signs Long-Term Data Services Contract with NAV CANADA*, Iridium (Apr. 29, 2013), http://investor.iridium.com/releasedetail.cfm?ReleaseID=760199.

[11] Letter from Harvey S. Liszt, National Radio Astronomy Observatory, RM-11697, at 1 (Oct. 21, 2014).

[12] Letter from Harvey S. Liszt, National Radio Astronomy Observatory, RM-11697, at 1 (Apr. 29, 2015) ("NRAO April Letter").

[13] April Iridium Ex Parte at 2.

astronomy telescopes are currently operated," and "[t]he coordination proposed by Iridium with regard to its next generation satellites is predicated on the forbearance of astronomers and spectrum regulators in continuing to tolerate the harmful interference that Iridium causes."[14] NRAO adds that "the current coordination process has occurred at much too slow a pace to reach any productive end before launch of the next generation of Iridium satellites."[15] The lack of progress in this coordination and the likely harm to RAS provides the Commission with additional grounds to deny Iridium's request to access Globalstar's licensed frequencies at 1616-1617.775 MHz.

* * *

In 2007, after a four-year proceeding, the Commission "re-balanced" the Lower Big LEO band by re-assigning more than three megahertz of Globalstar's spectrum to Iridium.[16] In that order, the Commission declared that its band plan would improve spectrum efficiency, provide an equitable distribution of the spectrum between the two MSS licensees in the band,[17] and "provide long-term certainty and stability in the Big LEO market."[18] In full reliance on the certainty and stability of the Big LEO band plan, Globalstar has invested in, and launched, a $1 billion second generation of satellites and developed new products and business opportunities. Globalstar's lenders similarly relied on the *Big LEO Spectrum Order* when they extended a loan of almost $600 million to Globalstar to finance the construction and launch of its second-generation constellation, and these parties continue to depend on a stable regulatory environment in this frequency band.[19] The Commission should not undercut Globalstar's long-term

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14 April NRAO Letter at 2.

15 *Id*.

16 *See Spectrum and Service Rules for Ancillary Terrestrial Components in the 1.6/2.4 GHz Big LEO Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands*, Second Order on Reconsideration, Second Report and Order, and Notice of Proposed Rulemaking, 22 FCC Rcd 19733 (2007) ("*Big LEO Spectrum Order*"), *aff'd sub nom.*, *Globalstar, Inc. v. FCC*, 564 F.3d 476 (D.C. Cir. 2009).

17 *Big LEO Spectrum Order* ¶ 1.

18 *Id*. ¶ 17.

19 BNP Paribas – which is also helping to finance Iridium's next-generation constellation – has stated that "[Globalstar's] Lenders relied upon the prior decisions of the Federal Communications Commission that allocated certain frequencies for Globalstar's exclusive use." Letter from Jean-Philippe Poirier, BNP Paribas, to Marlene Dortch, Secretary, FCC, IB Docket No. 13-213, at 1 (Nov. 21, 2014). BNP Paribas further states that it "continue[s] to have concerns about any effort to reallocate any portion of Globalstar's spectrum with or to others, because such changes could have a material negative impact on Globalstar's operational and financial health." *Id*.

commitment to its MSS customers and undermine the regulatory certainty needed for such investments by giving Iridium, its closest competitor, access to its most critical, unencumbered frequencies. Rather, the Commission should deny Iridium's Petition for Rulemaking and its newest revised proposal.

Pursuant to section 1.1206(b)(2) of the Commission's rules, 47 C.F.R. § 1.1206(b)(2), this *ex parte* letter and the attached Roberson and Associates Report are being filed electronically for inclusion in the public record of the above-referenced proceeding.

Respectfully submitted,

/s/ *Regina M. Keeney*
Regina M. Keeney

Attachment

cc: Mindel De La Torre
Jose Albuquerque
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**Roberson and Associates, LLC**
Technology and Management Consultants

# Response to Iridium Ex Parte

Prepared for Globalstar Inc., by:

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Date: May 14, 2015

# Reply to Iridium Ex Parte Filing

## Summary

Iridium's ex parte response to Roberson and Associates' January 14, 2015 report in this proceeding does not alter Roberson and Associates' conclusion that Iridium's operations at 1616-1617.775 MHz would cause significant harm to Globalstar and its customers throughout the United States. Assuming revised but reasonable values for the Globalstar service area, Iridium traffic loading, and Iridium handset power levels, Iridium users operating at 1616-1617.775 MHz would cause a 21% to 31% degradation of Globalstar's capacity, depending on the intensity of the Iridium usage and the mix of Iridium voice and short data message traffic. Globalstar's loss of capacity would be most severe (potentially exceeding 31%) during disaster scenarios and other periods of maximum MSS usage when its customers would have the greatest need for Globalstar's service.

# 1. Introduction: Iridium Proposal for Spectrum Sharing

In its February 2013 Petition for Rulemaking and subsequent ex parte filings,[1] Iridium LLC ("Iridium") has proposed rule changes that would reduce Globalstar's mobile satellite service ("MSS") capacity and degrade its service. Under Iridium's most recent proposal, Iridium would gain shared access to Globalstar's exclusively licensed MSS spectrum at 1616-1617.775 MHz. In January 2015, Roberson and Associates provided a technical analysis that described the significant harm to Globalstar's MSS system that would result from allowing Iridium operations in this band segment.[2] In response, Iridium filed an ex parte letter[3] criticizing the Roberson and Associates analysis. Now, in this report, Roberson and Associates responds to the assertions and conclusions contained in Iridium's ex parte submission.

# 2. Response to Iridium Ex Parte Filing

## 2.1 Globalstar Satellite Receiver Bandwidth

In its filing, Iridium asserts that Globalstar's satellites receive and re-transmit RF energy throughout the entire Lower Big LEO band at 1610-1626.5 MHz. On this basis, Iridium contends that its use of additional spectrum below 1617.775 MHz would have no consequence for Globalstar, since any potential capacity impact on Globalstar from Iridium's operations would already be occurring. This claim is erroneous. Globalstar satellite receivers contain filters which limit their transponder receiver bandwidth to the Globalstar uplink passband at 1610-1618.725 MHz. Device transmissions above 1618.725 MHz are not received and re-transmitted by Globalstar's satellites.

For this reason, Iridium is wrong to state that "regardless of whether Iridium transmissions are overlapping Globalstar channels in a band sharing scenario, or are operating completely above Globalstar's authorized band in a segmented band plan, the resulting impact is the same." Under Iridium's proposed rule change, the Globalstar system would receive substantial amounts of additional signal energy from Iridium operations at 1616-1617.775 MHz. As Roberson and Associates' January 2015 analysis previously demonstrated, and as explained in further detail below, it is the re-broadcast of this additional signal energy that would cause significant harm to the Globalstar system, stealing capacity from its subscribers.

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1 *See* Petition for Rulemaking of Iridium Constellation LLC, RM-11697 (Feb. 11, 2013); Supplemental Comments of Iridium Constellation LLC, RM-11697 (May 5, 2014); Iridium Constellation LLC, Ex-Parte Filing, RM-11697 (Apr. 17, 2015).

2 Roberson and Associates, LLC, *Impact of Iridium Operations in 1616-1617.775 MHz on Globalstar Operations*, attached to Globalstar Inc. Ex-Parte Filing, RM-11697 (Jan. 14, 2015).

3 Iridium Constellation LLC, Ex-Parte Filing, RM-11685 (Feb. 5, 2015).

## 2.2 Response to Iridium Claims

Iridium criticizes the assumptions made by Globalstar and Roberson and Associates about Globalstar's satellite footprint size and service areas, Iridium's traffic loading, and the nature of Iridium's traffic. Roberson and Associates addresses each of these issues below.

1. Satellite Footprint Size and Satellite Service Areas

   Regarding the satellite footprint parameters, Roberson and Associates has confirmed that the Globalstar satellite footprint and beam sizes contained in its January analysis are accurate for Globalstar's first-generation and second-generation satellites.[4] In response to Iridium's claims on this issue, Roberson and Associates believes that, for the purposes of this capacity impact analysis, it reasonable to assume that the service area of the Globalstar and Iridium satellites at a minimum includes the land areas of the contiguous U.S. (CONUS) and Mexico and a portion of the land area of Canada.

   The table below shows the respective land areas of the North American countries within the receive footprint of Globalstar's satellites. The effective service area for Canada is conservatively estimated at 25% of the total Canadian land area, in consideration of the expected low user density and high latitude of a significant portion of that country. The total area over which Iridium users generate interference into a Globalstar satellite is therefore assumed to be 11.9 million square kilometers. This value is used below to calculate the capacity impact of Iridium operations at 1616-1617.775 MHz on Globalstar's system.

Table 1. Approximate Globalstar North America Service Area

| Country Served | Land Area ($10^6$ sq-km) | Globalstar Service Area ($10^6$ sq-km) |
|---|---|---|
| CONUS | 7.7 | 7.7 |
| Mexico | 1.9 | 1.9 |
| Canada | 9.1 | 2.28 |
| Total | | 11.9 |

2. Iridium Traffic Loading

   Regarding the level of Iridium traffic loading that can be expected at 1616-1617.775 MHz, a conservative assumption for the traffic load is a level that corresponds to 2% blocking (user grade-of-service) for voice call attempts on the Iridium network.[5] 10% blocking would

[4] 1.65 million sq-km per Globalstar beam.

[5] ITU-T Recommendation E.774, *Quality of service, network management and traffic engineering – Traffic engineering – Mobile network traffic engineering*, Oct. 1996, at 5 – Table 2 (Probability of Link blocking for terrestrial/satellite Subsystem - Satellite mobile network: Normal Load = 2%, High Load = 10%).

constitute a very high level of loading, such as during disaster scenarios and other periods of peak usage,[6] while 5% blocking corresponds to an intermediate level of loading.

In the additional 1.775 MHz bandwidth that Iridium proposes to share with Globalstar, there would be 8.52 TDM Iridium channels in each Iridium spot beam. With four available timeslots on the uplink channel, there are a total of 34 timeslots per beam. The following table shows the average number of simultaneous timeslots that can be utilized, based on the Erlang-B traffic model, to maintain 2%, 5%, and 10% blocking levels to Iridium users.[7] The level of TDM slot occupancy corresponding to these blocking levels represents the range of traffic that can be expected on the Iridium network. These values will be used below to assess the impact of Iridium operations at 1616-1617.775 MHz on Globalstar's MSS system.

Table 2. Iridium Slot Occupancy as a Function of Call Blocking (User Grade-of- Service)

| Blocking | Avg TDM Slot Occupancy per Iridium Beam (maximum 34) |
|---|---|
| 2% | 25.5 |
| 5% | 28.6 |
| 10% | 32.4 |

3. Heterogeneous Nature of Iridium Traffic

Iridium has not publicly disclosed the fraction of short data traffic loading on its system. The effect of the heterogeneity of its traffic on Globalstar capacity can be readily assessed, however. Below, Roberson and Associates assumes that a certain proportion of Iridium's traffic is short message traffic, and calculates the overall impact of Iridium's combined voice and data traffic, using the 6 dB lower transmit power for short message traffic. This analysis recognizes that a given amount of data traffic generates one-fourth the interference (6 dB less) of an equivalent amount of duplex voice traffic.

### 2.3 Degradation to Globalstar RF Power-Limited Capacity Using Revised Assumptions

The following table summarizes the degradation to Globalstar's overall satellite capacity resulting from Iridium's proposed operations at 1616-1617.775 MHz, using the revised assumptions described above and corresponding to different user grades of Iridium service (call blocking levels in column 1).

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6 *Id*.

7 *See* Erlang B Calculator, Westbay Engineers Limited, http://www.erlang.com/calculator/erlb/ (last modified Jan. 4, 2014).

The Globalstar capacity degradation is a function of the inherent, finite amount of Globalstar satellite RF power, equivalent to 2500 simultaneous users, available at the Globalstar satellite. In the projected impacts on Globalstar shown in Table 3, there is approximately equal traffic loading across the Globalstar and Iridium spot-beams in the North America service area.

Table 3: Globalstar Capacity Degradation Due to Satellite RF Power Limit

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Iridium Blocking (User Grade of Service) | Avg Iridium Users Over NA Service Area ($11.9 \times 10^6$ sq-km) | Equivalent Globalstar Users (Iridium all voice) @ 1.54 Iridium Users per Globalstar User (4.5 dbW Iridium handset power) | Globalstar Capacity Degradation (Iridium is 100% voice) | Equivalent Globalstar Users 80%/20% voice/data (data traffic @ -6dB) | Capacity Degradation to Globalstar (80%/20% voice/data) |
| 2% | 949 | 616 | 24.6% | 524 | 20.9% |
| 5% | 1064 | 691 | 27.6% | 587 | 23.5% |
| 10% | 1205 | 783 | 31.3% | 665 | 26.6% |

The average number of Iridium users in the North America (NA) service area (column 2) is calculated by (i) dividing the NA service area by the Iridium spot beam size of 0.319 million sq-km and (ii) multiplying by the average number of simultaneously active TDM time slots per spot beam. The number of equivalent Globalstar users for each Iridium voice user (column 3) is calculated using the Iridium provided value of 4.5 dBW for the Iridium handset power.[8] The Globalstar capacity degradation in column 4 is computed by dividing the equivalent Globalstar user power generated by Iridium users by 2500, the RF power limited capacity of a Globalstar satellite.

Applying these revised assumptions, Iridium's operations at 1616-1617.775 MHz would cause significant capacity degradation to Globalstar, with capacity reductions ranging from 24.6% to 31%, depending on the intensity of the Iridium usage and the particular blocking level under the Erlang-B traffic model. In certain disaster situations, where peak loading could be even greater than the 10% blocking level, the capacity impact on the Globalstar MSS network could be even higher.

In addition, applying a reasonable assumption regarding the composition of Iridium's MSS traffic, column 6 in table 3 shows the degradation to Globalstar if 80% of the Iridium traffic is voice and 20% is short data messaging. The number of Globalstar users for a mix of 80% voice and 20% short data Iridium traffic is shown in column 5, again based on the fact that data traffic generates one-fourth the interference impact of Iridium voice traffic.

[8] In its January 2015 filing, Roberson and Associates used a value of 2.7 dBW for the Iridium voice handset power, based on assumptions drawn from non-Iridium sources. In the analysis presented here, the value supplied by Iridium in its June 2014 filing, 4.5 dBW, is used. With this value, 1.5 Iridium voice users generate interference power, and consume Globalstar satellite RF power, equivalent to 1 Globalstar user. The detailed calculation is contained in Appendix B.

Even if 20% of Iridium traffic is comprised of short data messaging, the capacity degradation to Globalstar is substantial, ranging from 20.9% to 26.6% and potentially higher levels during disaster scenarios and other periods of maximum MSS usage.

### 2.4 Globalstar Degradation Based on Iridium Interference-Caused Noise Rise

In its February 5 filing, Iridium contends that the calculated level of interference from Iridium handsets to a Globalstar satellite is insignificant, whether that level is 3% of the total noise-plus-interference budget as calculated by Iridium or 12% as described in the January 2015 Roberson and Associates analysis. Iridium states that this interference represents a rise in the noise-plus-interference level of either 0.13 dB (for a 3% interference increase) or 0.49 dB (for a 12% interference increase). Iridium asserts that CDMA is inherently tolerant of narrowband interference such as that caused by Iridium's TDM system.

In response, Roberson and Associates submits that Iridium's characterization of interference levels in CDMA systems represents a profound misunderstanding of the nature of CDMA systems and operations. In TDMA systems, signal levels from individual handsets are received at levels far above the noise floor, and an increase of 0.49 dB in the noise-plus-interference level is cause for little concern. However, in CDMA systems, where signal levels from handsets are received at levels far below the noise floor, a 0.49 dB rise in the noise level can have a substantial impact. As a matter of design, there is a limited budget for how much interference a satellite CDMA channel can tolerate, and every fraction of a dB of additional interference cuts directly into that budget, reducing CDMA capacity or link margin. The tolerance of a CDMA system to narrowband interference is a matter of degree and dependent on the CDMA spreading gain, as described in the January 2015 Roberson and Associates analysis.

Roberson and Associates has calculated the noise rise for the Globalstar MSS system from Iridium handset operations at 1616-1617.775 MHz, given a reasonable revision of relevant assumptions for this analysis (see Sections 2.2 and 2.3 above). For this revised interference analysis, Iridium time-slot loading is assumed to be 75% (=25.5/34 from Table 2), corresponding to a 2% blocking level for Iridium users in the Globalstar spot beam. Iridium handset power is assumed to be 4.5 dBW. The relative sizes of the Iridium and Globalstar spot beams are the same as described in Sections 2.2 and 2.3 above. (Given that the impact of Iridium interference on CDMA capacity occurs within a *single* Globalstar spot-beam, the overall service area for the Globalstar satellites is not relevant to this CDMA interference analysis.) Using these revised assumptions, the increase in the noise-plus-interference to Globalstar in a single spot-beam is calculated to be 14%, slightly larger than the previously calculated value of 12%. If 80% voice traffic and 20% short message traffic is assumed, the increase in noise-plus-interference to Globalstar is 11.9%[9].

[9] *See* Appendix A.

### 2.5 Degradation to Globalstar Aviation Services, Including ADS-B Link Augmentation System (ALAS)

The increase in interference within a Globalstar spot beam due to Iridium operations at 1616-1617.775 MHz would have a particularly detrimental impact on Globalstar's aviation services, including its planned ADS-B Link Augmentation System (ALAS), a space-based, next-generation air traffic management system. Automatic Dependent Surveillance-Broadcast (ADS-B) is a key component of air traffic control modernization that allows air traffic controllers to continuously monitor aircraft flight parameters on a real-time basis.[10] Globalstar's ALAS relies on Globalstar's satellite constellation to extend ADS-B capability into areas where line-of-site communication between aircraft and a terrestrial ADS-B ground station is not possible.[11] To meet applicable Federal Aviation Administration ("FAA") and RTCA, Inc. standards, Globalstar's aviation terminals, including ALAS equipment, can only operate in Globalstar's licensed spectrum above 1616 MHz. Increased interference due to Iridium operations at 1616-1617.775 MHz would degrade the quality of service of Globalstar's aviation services, including ALAS, by decreasing the success rate of those aeronautical transmissions and reducing the service area of those operations.

### 3.0 Conclusion

Roberson and Associates has analyzed the Iridium ex parte filing criticizing the analysis and conclusions in the January 2015 Roberson and Associates report. Roberson and Associates finds nothing in this Iridium filing that alters the conclusion that significant harm to Globalstar and its customers would occur if Iridium were allowed to operate on Globalstar's exclusively licensed spectrum at 1616-1617.775 MHz. Applying certain revised assumptions, Iridium's operations at 1616-1617.775 MHz would likely reduce Globalstar user capacity by 21% to 31%, depending on Iridium traffic loading and the mix of Iridium voice and short data message traffic. Globalstar's loss of capacity would be most severe (potentially exceeding 31%) during disaster scenarios and other periods of maximum MSS usage when its customers would have the greatest need for Globalstar's service.

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10 *See Air Traffic Service Brief – Automatic Dependent Surveillance-Broadcast (ADS-B)*, AOPA Foundation, http://www.aopa.org/Advocacy/Air-Traffic-Services-,-a-,-Technology/Air-Traffic-Services-Brief-Automatic-Dependent-Surveillance-Broadcast-ADS-B (last visited May 14, 2015).

11 *See Globalstar's Space-Based ADS-B*, Globalstar, http://www.globalstar.com/en/index.php?cid=6300 (last visited May 14, 2015).

# Appendix A: Revised Calculation of the Increase in the Noise-Plus-Interference to Globalstar in a Single Spot-Beam

The revised calculations for the increase in Globalstar's noise-plus-interference level due to interference from Iridium operation in shared spectrum within a Globalstar spot beam, expressed as a percentage of Globalstar's noise-plus-interference budget, are presented here, for both the case of 100% voice traffic, and for an 80% voice / 20% data mix, the data traffic transmitted at a power 6 dB below that of voice.

| Row | Calculation of Iridium aggregate interference as a percentage of Globalstar's noise-plus-interference budget | Iriidium original values | Units | Revised and corrected values (100% voice) | Revised and corrected values (80% voice, 20% data) | Comments |
|---|---|---|---|---|---|---|
| 2 | Iridium handset nominal e.i.r.p. (burst) [one user] | 4.50 | dBW | 4.50 | 3.80 | Iridium provided value<br>For 20% data, weighted power such that 20% of units assumed to be data at 6 dB reduced power |
| 3 | Duty cycle of Iridium transmission burst relative to the total time frame | -10.36 | dB | -10.36 | -10.36 | 10*log(8.28/90)<br>One user UL transmits 8.28 ms out of a frame of 90 ms. There are between 1 and 4 UL transmissions in a 90 ms burst. |
| 4 | Average Tx EIRP | -5.86 | dBW | -5.86 | -6.57 | Row 2 + Row 3<br>**This is represents a single user slot.** |
| 5 | Globalstar satellite altitude | 1414.00 | km | 1414.00 | 1414.00 | Iridium provided value |
| 6 | Typical Globalstar satellite slant range [to Iridium] | 1952.00 | km | 1952.00 | 1952.00 | Iridium provided value |
| 7 | Frequency | 1.62 | GHz | 1.62 | 1.62 | Iridium provided value |
| 8 | Path loss | 162.43 | dB | 162.43 | 162.43 | Free space path loss f/ Row 6 and Row 7 |
| 9 | Globalstar sat. antenna gain | 14.60 | dB | 14.60 | 14.60 | Iridium provided value |
| 10 | Cross-polarization isolation | 6.00 | dB | 6.00 | 6.00 | Iridium provided value |
| 11 | Single received Iridium handset interference power | -159.69 | dBW | -159.69 | -160.40 | Row 4 - Row 8 + Row 9 - Row 10<br>**For a single Iridium user per frame.** |
| 12 | Number of Iridium channels per Globalstar channel | 29.50 | | 29.52 | 29.52 | Globalstar CDMA channels are 1.23 MHz. Iridium channel spacing is 41.67 KHz. Ratio is 29.52. |
| 13 | Iridium channel reuse | 5.00 | | 5.00 | 5.00 | Iridium provided value |
| 14 | Maximum realizable Iridium channels per Globalstarchannel | 5.90 | | 5.90 | 5.90 | Row 12 / Row 13 |
| 15 | Approximate number of Iridium spot beams per Globalstar spot beam | 3.00 | | 5.18 | 5.18 | Globalstar footprint area = 26,420,794 total or 1,651,299 sq km per beam (16 beams in footprint).<br>Iridium footprint area = 15,299,900 total or 318,747 sq km per beam (28 beams in footprint).<br>1.651/0.319 = 5.18 |
| 16 | Maximum realizable Iridium channels per Globalstar channel, per Globalstar spot beam | 17.70 | | 30.59 | 30.59 | Row 14 * Row 15 |
| 17 | Aggregate Iridium uplink interference power per Globalstar channel and spot beam | -147.21 | dBW | -144.84 | -145.54 | Row 11 + 10*log(Row 16) |
| 18 | Globalstar sat TX bandwidth | 60.90 | dB-Hz | 60.90 | 60.90 | 10*log(1230000) |
| 19 | Aggregate Iridium uplink interference power density (single slot) | -208.11 | dBW/Hz | -205.74 | -206.44 | Row 17 - Row 18<br>**For a single Iridium user per frame.** |
| 20 | Assumed TDMA slot occupation per frame | 1.00 | | 3.00 | 3.00 | Account for 3 Iridium users per frame (2% blocking) |
| 21 | Aggregate Iridium uplink interference power density (multi-slot) | -208.11 | dBW/Hz | -200.97 | -201.67 | Row 19 + 10*log(Row 20) |
| 22 | Globalstar sat. noise power density | -201.60 | dBW/Hz | -201.60 | -201.60 | Iridium provided value |
| 23 | Globalstar's self-proclaimed sat rx intrasystem interference density | -193.00 | dBW/Hz | -193.00 | -193.00 | Iridium provided value |
| 24 | Globalstar sat rx noise plus intra-system interference density | -192.44 | dBW/Hz | -192.44 | -192.44 | 10*log(10^(Row 22/10) + 10^(Row 23/10)) |
| 25 | Aggregate Iridium uplink interference density to Globalstar receiver noise density, Ii/No | -6.51 | dB | 0.63 | -0.07 | Row 21 - Row 22 |
| 26 | Ratio of aggregate Iridium uplink interference density to Globalstar receiver noise plus interference density | -15.67 | dB | -8.53 | -9.23 | Row 21 - Row 24 |
| 27 | Aggregate Iridium uplink interference density as a percentage of Globalstar receiver noise plus interference density | 2.71 | % | 14.04 | 11.93 | 10^(Row 26/10) * 100% |

# Appendix B: Calculation of Number of Iridium Interferers Expressed as Equivalent Globalstar Users

The revised calculations for the number of Iridium interferers in terms of equivalent Globalstar users are presented here, for both the case of 100% voice traffic, and for an 80% voice / 20% data mix, the data traffic transmitted at a power 6 dB below that of voice.

| Row | Calculation of no. Iridium interferers in terms of equivalent Globalstar' users | Units | Values (100% voice) | Values (80% voice, 20% data) | Comments |
|---|---|---|---|---|---|
| 2 | Globalstar handset nominal e.i.r.p. | dBW | -10.00 | -10.00 | Iridium provided value |
| 3 | Path loss | dB | 162.43 | 162.43 | From Row 8 App A |
| 4 | Globalstar sat. antenna gain | dB | 14.60 | 14.60 | From Row 9 App A |
| 5 | Globalstar sat. received power from single user | dBW | -157.83 | -157.83 | Row 2- Row 3 + Row 4 **This is for a single user.** |
| 6 | Single received Iridium handset interference power | dBW | -159.69 | -160.40 | From Row 11 App A |
| 7 | Power difference between Iridium and Globalstar single user received powers | dB | 1.86 | 2.57 | Row 5 - Row 6 |
| 8 | Ratio of received powers from single Iridium and Globalstar users | | 1.54 | 1.81 | 10^(Row 7/10) |

# Appendix C: Company Profile

**Profile: Roberson and Associates, LLC**

Roberson and Associates, LLC, is a technology and management consulting company with government and commercial customers that provides services in the areas of RF spectrum management, RF measurements and analysis, and technology management. The organization was founded in 2008 and is composed of a select group of individuals with corporate and academic backgrounds from Motorola, Bell Labs, IBM, IITRI (now Alion), independent consulting firms, and the Illinois Institute of Technology. Together the organization has over 400 years of the high technology management and technical leadership experience with a strong telecommunications focus.

**Profiles: Roberson and Associates, LLC, Staff**

**Kenneth J. Zdunek, Ph.D. –V.P. and Chief Technology Officer**

Dr. Zdunek is Vice President and the Chief Technology Officer of Roberson and Associates. He has 35 years of experience in wireless communications and public safety systems. Concurrently he is a research faculty member in Electrical Engineering at the Illinois Institute of Technology, in Chicago, Illinois, where he conducts research in the area of dynamic spectrum access and efficient spectrum utilization, and teaches a graduate course in wireless communication system design. He is a Fellow of the IEEE, recognized for his leadership in integrating voice and data in wireless networks. Prior to joining Roberson and Associates, he was VP of Networks Research at Motorola, a position he held for 9 years. Dr. Zdunek was awarded Motorola's patent of the year award in 2002 for a voice-data integration approach that is licensed and extensively used in GSM GPRS. He holds 17 other patents, included patents used in public safety trunked systems and cellular and trunked systems roaming. He directed the invention and validation of Nextel's iDENTM voice-data air interface and IP based roaming approach, and was the principal architect of Motorola's SmartNetTM public safety trunking protocol suite. In the 1990's, he directed a Spectrum Utilization and Public Safety Spectrum Needs Projection submitted to the FCC in support of the 700 MHz spectrum allocation for Public Safety. He was awarded the BSEE and MSEE degrees from Northwestern University, and the Ph.D. EE degree from the Illinois Institute of Technology. He is a registered Professional Engineer in the State of Illinois. He is past president, and on the board of directors of the Chicago Public Schools Student Science Fair, Inc.

**Michael L. Needham – Principal Engineer**

Mr. Needham joined Roberson and Associates in November of 2013 with more than 28 years of experience in corporate research and development. His most recent position was Distinguished Member of the Technical Staff in the Applied Research Center at ARRIS (formerly Motorola Mobility/Google). He has worked in a broad range of technologies in the areas of wireless communication and media delivery systems, including: network architecture design, specification, and analysis; data protocol design; radio system modeling; and media analytics. He has 25 issued U.S. patents, with several more pending, and many years of experience in intellectual property assessment and management. Mr. Needham also has numerous publications in technical journals and conferences. He holds B.S. and M.S. degrees in electrical engineering from the University of Illinois in Urbana-Champaign.