



1776 K STREET NW
WASHINGTON, DC 20006
PHONE 202.719.7000
FAX 202.719.7049

7925 JONES BRANCH DRIVE
MCLEAN, VA 22102
PHONE 703.905.2800
FAX 703.905.2820

www.wileyrein.com

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R. Michael Senkowski
202.719.7249
msenkowski@wileyrein.com

VIA ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20228

Re: Written Ex Parte Presentation
RM-11685, RM-11697, IB Docket No. 13-213

Dear Ms. Dortch:

On November 5, 2014, Iridium Constellation LLC (“Iridium”) submitted a detailed engineering analysis showing that its revised spectrum proposal would promote important public interest goals without causing any harm to Globalstar, Inc. (“Globalstar”).¹ On January 14, 2015, Globalstar responded by filing an academic report that relies on unrealistic assumptions intended to show harmful interference and/or power limiting effects from Iridium’s proposal.² Ironically, however, the Roberson Report actually confirms that Iridium’s proposed spectrum sharing would not cause harmful interference to Globalstar, even if one postulates massive peak usage by both Iridium and Globalstar over huge geographic areas. In addition, the Roberson Report’s claims of power limiting, on the face of the report, exist independent from (and are not affected by) any expanded sharing by Iridium of spectrum with Globalstar. Indeed, if taken to their logical conclusion, these claims would indicate that Globalstar’s satellite system should be facing consistent power limitation from existing spectrum uses under the current band plan—something that Globalstar has not demonstrated or previously alleged. Simply stated, the Roberson Report does not provide documentation of harms resulting from Iridium’s sharing proposal.

As the record in this proceeding reflects, Globalstar and Iridium already share 0.95 MHz of spectrum. Globalstar and Iridium have both represented to the Commission that this spectrum is being heavily used by Globalstar and Iridium has stated that it

¹ Supplemental Comments of Iridium Constellation LLC, RM-11697, IB Docket No. 13-213, RM-11685 (filed Nov. 5, 2014) (“Iridium Nov. 5, 2014 Supplemental Comments”)

² Roberson and Associates, LLC, *Impact of Iridium Operations in 1616-1617.775 MHz on Globalstar Operations* (Jan. 14, 2015) (“Roberson Report”) attached to Letter from Regina M. Keeney, Counsel to Globalstar, to Marlene H. Dortch, Secretary, Federal Communications Commission, RM-11697 (filed Jan. 14, 2015) (“Globalstar Letter”).

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uses the shared spectrum to the same degree as its exclusive spectrum.³ Moreover, on numerous occasions spanning over more than a decade, Iridium has shared Globalstar's spectrum under special temporary authority ("STA") during emergency conditions (with both systems operating at heightened capacity) without Globalstar ever documenting a single instance of harm to its system. In fact, Globalstar acknowledged on the record that it has not detected, let alone identified harmful interference from, Iridium's operations on the same frequencies.⁴

In a series of meetings and filings in October and November of 2014, Iridium explained to the Commission that the heavy use and expected future growth of demand for Iridium's system justified its request for additional Lower Big LEO Band spectrum, and that its revised proposal would not cause harmful interference to Globalstar. In support of this request, Iridium filed specific data about its system operations and detailed interference analyses.

Globalstar in response—rather than providing evidence based on actual traffic loading or spectrum sharing experiences—has submitted an academic study prepared by Roberson and Associates, which attempts to show a possibility of harm to Globalstar's system based on unrealistic assumptions at odds with real-world experience. Specifically, the Roberson Report posits two potential forms of harmful interference: a degradation to the Globalstar signal quality due to co-channel interference and "power robbing" due to Globalstar's bent-pipe satellites repeating Iridium's co-channel and off-channel signals. However, neither case convincingly demonstrates that any material additional harmful interference to Globalstar's system would be caused by Iridium's spectrum sharing proposal.

As detailed in the attached engineering response prepared by Brandon Hinton, neither of the two primary claims in the Roberson Report has merit for the following basic reasons.

First, the Roberson Report claims that the potential for harmful interference caused by expanded Iridium operations is significantly greater than suggested in Iridium's analysis. However, even using the most extreme assumptions possible, the Roberson Report shows only an additional 0.36 dB increase in Globalstar's noise-

³ See Iridium Nov. 5, 2014 Supplemental Comments, at 2-4.

⁴ See Letter from L. Barbee Ponder IV, General Counsel & Vice President Regulatory Affairs, Globalstar, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission at 7 n. 18, RM-11697 (filed Oct. 24, 2014).

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plus-interference floor over the amount in Iridium’s analysis as a result of expanded sharing with Iridium—a level few would seriously contend should be considered detectable, let alone harmful interference. Furthermore, these interference events would rarely occur and would be of short duration. Iridium also notes that even under the scenario considered in the Roberson Report, the amount of interference generated by Iridium would be significantly less than the inter-system interference expected from the additional CDMA systems contemplated in the original Big LEO band plan—interference that the Globalstar system was designed to accommodate.⁵

Second, the Roberson paper asserts that Globalstar’s system would experience reduced capacity from Iridium transmissions in the proposed shared spectrum because of its “bent-pipe” satellite system. According to the Roberson Report, however, Globalstar rebroadcasts any transmission in the Lower Big LEO MSS Band, including the spectrum exclusively authorized to Iridium. The Roberson Report asserts that the bent-pipe architecture means that *any* use of the 1610-1626.5 MHz spectrum band would cause this problem. If correct, the Roberson Report’s analysis posits a harm that is spectrum agnostic—*the problem exists regardless of whether Iridium gets access to additional spectrum or not*. In making these claims, the Roberson Report effectively proves too much, as if true, Globalstar’s system would be incapable of managing Big LEO Band traffic increases, regardless of the Commission’s action on Iridium’s petition. Real-world experience with spectrum sharing between the operators shows that these claims are exaggerated and contrary to the facts.⁶

Here, there is no need to rely upon the theoretical analysis offered by Globalstar. Years of experience with Iridium and Globalstar systems operating over shared spectrum during times of heightened demand have demonstrated that Globalstar’s academic Roberson analysis cannot be factual. Instead, Iridium’s detailed technical analysis based on previously-accepted assumptions and the lack of any evidence of harmful interference to Globalstar show that Iridium’s proposal for shared spectrum

⁵ Iridium Nov. 5, 2014 Supplemental Comments, Ex. 2 at 3-5.

⁶ Globalstar’s attempt to draw extreme conclusions from an academic study based on unrealistic hypotheticals is exactly the same type of misleading and senseless activity that Globalstar recently accused Kerrisdale Capital of employing. Globalstar, in that context, accused Kerrisdale of offering “grossly manipulated” technical analyses relying on assumptions that were “entirely unrealistic and would never exist in practice.” Letter from L. Barbee Ponder IV, General Counsel & Vice President Regulatory Affairs, Globalstar, to Marlene H. Dortch, Secretary, Federal Communications Commission at 4, IB Docket No. 13-213, RM-11685 (filed Oct. 30, 2014) (“Globalstar Oct. 30 Letter”).

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use is feasible. Therefore, as Iridium has demonstrated the merits and achievability of its revised spectrum proposal, and Globalstar has failed to provide any real-world data for opposing it, the Commission can and should grant Iridium's request for expanded sharing of Big LEO MSS spectrum.

I. IRIDIUM HAS DEMONSTRATED THE NEED FOR AND FEASIBILITY OF ITS PROPOSAL

In May 2014, Iridium requested that the Commission designate the 1616-1617.5 MHz spectrum for shared use between Iridium and Globalstar and assign the 1617.5-1618.725 MHz spectrum (which includes 0.95 MHz of currently shared spectrum) exclusively to Iridium.⁷ In response to Iridium's request for a full discussion of its pending proposal, the International Bureau convened a series of meetings with Iridium and Globalstar in October 2014. The participants discussed whether circumstances have changed since adoption of the current Big LEO MSS band plan in 2007 and whether such developments supported changes in the existing allocations between Iridium and Globalstar.

Iridium presented a detailed showing under Joint Protective Order documenting that its voice and data usage has grown significantly since 2007.⁸ Iridium subsequently confirmed integration and heavy use of the maximum amount of the 0.95 MHz shared spectrum consistent with its channelization.⁹ And the Engineering Analysis Iridium later submitted corroborated these assertions and demonstrated that any risk of potential interference from the rare instances of peak usage by both systems in the same geographic location in the United States would be borne by Iridium, not Globalstar.¹⁰

Both parties claim to be heavily using the 0.95 MHz of currently shared spectrum, and neither has detected the other's use. Unlike Iridium, Globalstar provided only

⁷ Supplemental Comments of Iridium Constellation LLC, RM-11697, IB Docket No. 13-213, RM-11685 (filed May 5, 2014) ("Iridium May 5, 2014 Supplemental Comments"). Iridium reiterates that it will address Globalstar's opposition to Iridium's proposed exclusive use of the 1617.5-1618.725 MHz spectrum following Globalstar's submission of information documenting its traffic on Channel 7. See Iridium Nov. 5, 2014 Supplemental Comments, at 1-2.

⁸ See Letter from Nancy J. Victory to Marlene H. Dortch, RM-11697, IB Docket No. 13-213, RM-11685 (Oct. 20, 2014); see also *Iridium Constellation LLC*, Joint Protective Order, RM-11697, IB Docket No. 13-213, RM-11685, DA 14-1500 (rel. Oct. 16, 2014).

⁹ Iridium Nov. 5 Supplemental Comments, Ex. 1.

¹⁰ *Id.*, Ex. 2.

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generalized or prospective statements about its use of the spectrum.¹¹ Despite Globalstar's commitment to do so, it has yet to provide traffic information confirming its use of the currently shared spectrum.¹²

At bottom, the evidence in the record demonstrates the following: (1) Globalstar and Iridium currently are sharing heavily used spectrum without Globalstar detecting any signal let alone experiencing harmful interference; (2) Iridium can immediately make use of expanded sharing to fulfill existing and future demand for its services; and (3) the risks of interference are borne by Iridium and not Globalstar. Consequently, the public interest compels a prompt grant of Iridium's petition for expanded sharing.

A. Experience Demonstrates That the Systems can Share at Times of Heavy Loading.

The actual, documented functionality of Globalstar's system during times of heavy loading of both systems in shared spectrum tells a much different story than the Roberson Report. Iridium's use of Globalstar spectrum pursuant to STA during peak periods did not result in evidence of harmful interference to Globalstar even in the wake of Hurricane Katrina and other disaster or emergency conditions.

The Commission has repeatedly granted STA for Iridium to provide critical emergency and disaster communications using spectrum authorized to Globalstar. In April 2003, the Commission granted Iridium STA for additional spectrum to support U.S. Department of Defense efforts in the Middle East.¹³ Following Hurricanes Katrina and Rita in 2005, Iridium received STA to provide service using

¹¹ See, e.g., Letter from L. Barbee Ponder IV, General Counsel & Vice President Regulatory Affairs, Globalstar, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission at 3, RM-11697 (filed Oct. 24, 2014) ("Globalstar Oct. 24 Letter") (Globalstar uses the spectrum "extensively in the United States and throughout the world"); Letter from L. Barbee Ponder IV, General Counsel & Vice President Regulatory Affairs, Globalstar, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission at 4, Presentation at 15, IB Docket No. 13-213, RM-11685, RM-11697 (filed Oct. 6, 2014) ("Globalstar Oct. 6 Letter") (Globalstar "intensively utilizes . . . every MHz" of its spectrum); *Id.*, Attachment pp. 15-16 (channel 7, which includes the shared spectrum, is its "second-most used set of frequencies").

¹² As the Commission has explained, providing "piecemeal and selective" information "waste[s] precious Commission resources." See *Maritime Communications/Land Mobile, LLC*, Order to Show Cause, 26 FCC Rcd 6520, ¶ 43 (2011).

¹³ See SAT-STA-20030425-00074.

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1616.0 – 1618.25 MHz spectrum.¹⁴ When an earthquake struck Haiti in 2010, the Commission granted Iridium STA to operate using 1616.0 – 1617.775 MHz.¹⁵ Likewise, when an earthquake struck Japan in 2011, Iridium received STA to operate in the same spectrum.¹⁶ In these instances, Iridium operated on Globalstar's spectrum without reports of harmful interference to Globalstar's MSS operations.

Spectrum sharing during peak usage by both Iridium and Globalstar in the wake of Hurricane Katrina is particularly instructive. Iridium's system operated at full-bore pursuant to STA to support disaster relief communications.¹⁷ Likewise, Globalstar claimed its call volume increased 566 percent in the aftermath of Katrina.¹⁸ According to Globalstar, its network "functioned properly" and "operat[ed] without interruption throughout the Gulf Coast during Hurricane Katrina and in its aftermath."¹⁹ Thus, at the peak of sharing with Iridium, Globalstar was "able to maintain [its] quality of service."²⁰ Globalstar blamed any documented communications failures on the lack of "adequate training" of first responders using their devices.²¹ Rather than claiming harmful interference, Globalstar pointed out that "those who have relied on Globalstar's services during recent disasters and emergencies uniformly have praised them."²² Accordingly, despite the massive use of the shared spectrum, there was never any credible evidence of harmful interference to any of Globalstar's services from Iridium.²³

¹⁴ See SAT-STA-20050901-00171 (granting Iridium STA for additional spectrum following Hurricane Katrina); SAT-STA-20050923-00180 (granting Iridium STA for additional spectrum following Hurricane Rita).

¹⁵ See SAT-STA-20100115-00011.

¹⁶ See SAT-STA-20110311-00052.

¹⁷ See IBFS File Nos. SAT-STA-20050901-00171; SAT-STA-20050923-00181; *see also* Letter from Donna Bethea-Murphy, Iridium Satellite LLC to Marlene H. Dortch, Federal Communications Commission, at 2-4, IB Docket No. 02-364 (Mar. 24, 2006).

¹⁸ See Reply Comments of Globalstar LLC, EB Docket No. 06-119, Exhibit 1, at 1 (Aug. 21, 2006).

¹⁹ *Id.*, at 2-3, Ex. 1 at 3.

²⁰ *Id.*, Ex. 1, at 2.

²¹ *Id.*, at 6.

²² *Id.*, at 4.

²³ See, e.g., Letter from Jennifer D. Hindin, Wiley Rein & Fielding LLP to Marlene H. Dortch, Federal Communications Commission, at 2, IB Docket No. 02-364 (Aug. 3, 2006); Letter from R.

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Iridium's more recent use of the shared spectrum at 1617.775-1618.725 confirms the absence of interference to Globalstar from Iridium, including heavy deployment following the Texas Wildfires in 2011 and Superstorm Sandy in 2012.²⁴ During these same Iridium spikes, Globalstar lodged no interference complaints and trumpeted the effectiveness of its operations.²⁵ And Globalstar continues to state on the record that it has never detected Iridium's use of the 0.95 MHz of currently shared spectrum.²⁶

The Commission consistently has found that "conjecture and unsupported conclusions" do not warrant its consideration.²⁷ Experience over a course of years speaks louder than hypothetical scenarios and tortured assumptions.

(Continued . . .)

Michael Senkowski, Wiley Rein & Fielding LLP to Marlene H. Dortch, Federal Communications Commission, at 1-3, IBFS File Nos. SAT-STA-20050923-00180/00181, IB Docket No. 02-364 (Dec. 21, 2005).

²⁴ Reply of Iridium Constellation LLC, RM-11697, IB Docket No. 13-213, RM-11685, at 5 (Dec. 17, 2013); *see also* Letter from R. Michael Senkowski, Counsel to Iridium, to Marlene H. Dortch, Secretary, Federal Communications Commission at Attachment A, IB Docket No. 12-213, RM-11685, RM-11697 (filed Oct. 16, 2014) (illustrating increase in demand for Iridium's satellite services following Superstorm Sandy).

²⁵ *See, e.g.*, Press Release, Globalstar, Inc., Globalstar Satellite Phones Prepare Residents for the 2014 Hurricane Season, <http://www.globalstar.com/en/index.php?cid=7010&pressId=821> (May 22, 2014); Comments of Globalstar, Inc. at 5, IB Docket No. 13-213, RM-11685 (filed May 5, 2014).

²⁶ Iridium also finds perplexing Globalstar's repeated conjecture that Iridium's revised spectrum proposal somehow is ignited by anticompetitive motives toward Globalstar's long-promised ADS-B Link Augmentation System ("ALAS"). Globalstar again claims that it must have access to unencumbered spectrum above 1616 MHz to meet FAA/RTCA standards, and again it fails to cite a specific FAA/RTCA restriction to support this claim. Iridium repeats here that nothing in its current or proposed offerings "would prevent the operation of Globalstar's ALAS, . . . and there is no basis for concluding that Iridium's Petition is intended to, or would actually harm the competitive viability of these services." *See* Reply of Iridium Constellation LLC, RM-11697, RM-11685, IB Docket No. 13-213, at 12-13 (Dec. 17, 2013).

²⁷ *Staton Holdings Inc. d/b/a Staton Wholesale, Complainant v. MCI WorldCom Communications, Inc. and Sprint Communications Company, L.P., Defendants*, Order on Reconsideration, 25 FCC Rcd 5094, ¶ 30 n.68 (2010)

B. Iridium's Technical Analysis, Based on Reasonable Assumptions, Demonstrated the Feasibility of its Shared Spectrum Proposal.

The Engineering Analysis included with Iridium's Supplemental Comments further corroborates the evidence that Iridium's TDMA operations will not cause harmful interference to Globalstar's CDMA operations.²⁸ Indeed, the analysis shows that Iridium, not Globalstar, bears the risk of potential interference from the rare instances of peak usage by both systems in the same geographic location in the United States.

Using the same assumptions as the 2007 Electronic Communications Committee (ECC) Report 95 *Sharing Between MSS Systems Using TDMA and MSS Systems Using CDMA in the Band 1610-1626.5 MHz* ("ECC Report 95"), Iridium's Engineering Analysis demonstrated that aggregate Iridium uplink interference to Globalstar is less than 3 percent of Globalstar's intra-system interference plus noise density.²⁹ This is because Globalstar's CDMA system is not only highly resistant to interference generally, but extremely resistant to interference from Iridium's narrow-channel TDMA operations.³⁰

The analysis showed that even a heavily-loaded Iridium system produces interference into the Globalstar satellite receiver at levels: (a) significantly lower than Globalstar's own intra-system interference plus noise density; (b) much lower than anticipated from any of the other expected original CDMA systems; and (c) significantly lower than the expected aggregate interference from all four hypothetical CDMA systems.³¹ Moreover, a typical Iridium user transmission of 37 kHz is 33 times narrower than a Globalstar user transmission, which Globalstar's spread spectrum system is designed to reject.³² And because Iridium's system design ensures that large blocks of contiguous frequency channels are not assigned into a specific region, Globalstar's satellite receiver would not experience

²⁸ Iridium Nov. 5 Supplemental Comments, Ex. 2.

²⁹ *Id.*

³⁰ *Id.*

³¹ *Id.*

³² *Id.*

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continuous interference from Iridium narrowband channels filling an entire Globalstar channel.³³

Accordingly, the Engineering Analysis, based on prior-accepted and public assumptions, confirms that Iridium and Globalstar can share the 1616-1617.5 MHz band segment without causing harmful interference to Globalstar.

II. GLOBALSTAR'S ACADEMIC ANALYSIS FAILS TO DEMONSTRATE ANY REAL POTENTIAL FOR HARMFUL INTERFERENCE POSED BY IRIDIUM'S REVISED SPECTRUM PROPOSAL.

Once again, Globalstar has neglected to put into the record any data about its actual operations, spectrum usage, or interference received. Instead, Globalstar has submitted an academic paper relying on unrealistic assumptions to arrive at faulty conclusions regarding the potential impact of Iridium operations on a shared basis with Globalstar in the 1616-1617.775 MHz segment of the Big LEO MSS Band. Moreover, even if one accepts Globalstar's analysis on its face, the Roberson Report still fails to demonstrate that Iridium's proposal would have any new harmful impact on Globalstar's operations. Though the Roberson Report attempts to show that Iridium "interference" severely impacts Globalstar satellite capacity, this impact is, in fact, purely a function of Globalstar's own system design limitations, as opposed to Iridium "interference."

A. Globalstar's Technical Analysis Is Based on Unrealistic Assumptions at Odds with Real-World Experience.

To reach its conclusions about the impact of Iridium's proposal, the Roberson Report relied upon unrealistic assumptions far different from any previously agreed to and divergent from accepted industry standards. Additionally, the operational scenarios examined in the report are highly improbable and inconsistent with real-world observations. Ironically, Globalstar's analysis suffers from similar defects to those it ascribed recently to the "grossly manipulated" technical analyses of Kerrisdale Capital, which Globalstar said relied on assumptions that were "entirely unrealistic and would never exist in practice."³⁴ Just as Globalstar accuses Kerrisdale of dismissing Globalstar's own "conservative" tests of TLPS

³³ *Id.*

³⁴ Globalstar Oct. 30 Letter, at 4.

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performance in favor of a “severely flawed” study that ignores the realities of current and proposed operations,³⁵ the Roberson Report’s “corrections” of Iridium’s technical analysis replace previously recognized technical and operational parameters with unrealistic assumptions that, ultimately, still fail to demonstrate any new harmful interference posed by Iridium’s proposal.

Iridium’s technical analysis was based primarily on the technical assumptions developed in the course of producing ECC Report 95³⁶ and the system parameters provided by Globalstar to the FCC in its 2004 *Petition for Reconsideration*.³⁷ For its part, the Roberson Report accepts these assumptions where it suits the purpose of showing a worst case scenario, and otherwise manufactures new parameters without support where necessary.

Three flawed assumptions account for the divergence in results between Globalstar and Iridium:

First, Globalstar assumes that all four time slots in each of Iridium’s TDMA frames would be filled on every frequency channel throughout the relevant time and area of interference, reflecting an uplink duty cycle of 36.8%.³⁸ While this level of use certainly does occur occasionally in the locations and times of heaviest use, it is not typical that this level of use would be sustained simultaneously across a large (*e.g.*, national or continental) geographic area.

Second, for the first time, Globalstar offers new parameters related to its satellites’ footprints that differ substantially from what it previously submitted to the FCC,³⁹

³⁵ *Id.* 2.

³⁶ Iridium notes that while it participated in the development of ECC Report 95, and used that Report’s assumptions as a basis for the technical analysis in its November 5, 2014 Supplemental Comments, Iridium maintains that even these assumptions overstate the potential for harmful interference. Iridium has never fully endorsed the conclusion of that report that sharing between the systems is not feasible, which is premised on assumptions about Globalstar’s MSS loading, among other factors, which have never been shown to be based in reality. Indeed, by 2007, Iridium was calling for more study within CEPT of the possibility of spectrum sharing. *See* CEPT, Electronic Communications Committee, Submission of Iridium to the Working Group FM44, 12 March 2007, Doc. No. FM44(07)09.

³⁷ *Petition for Reconsideration of Globalstar LLC*, IB Docket No. 02-364, ET Docket No. 00-258 (filed Sep. 8, 2004) (“2004 Globalstar Petition”).

³⁸ Roberson Report at 9.

³⁹ *See* 2004 Globalstar Petition, Tech. Appx., Tbl. 3.

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and agreed to in the development of the ECC Report.⁴⁰ With the new assumptions, Globalstar considers interference in a scenario in which Iridium's system is fully loaded throughout the entire 26.4 million square kilometer footprint of a Globalstar satellite.

Finally, as explained in the technical appendix below, Globalstar's analysis fails to account for the heterogeneous nature of traffic on Iridium's system, which includes a large number of short burst data M2M and messaging devices that are limited to transmit power levels 6 dB lower than Iridium's circuit-switched voice and data products.⁴¹

The scenario posited by the Roberson Report is beyond credulity. Essentially, the Roberson Report analysis hypothesizes circumstances in which both Iridium's and Globalstar's systems are (1) fully loaded with devices using the highest-power applications offered, (2) for a prolonged period of time, (3) evenly across an area larger than three times the entire land-mass of the continental United States. However, even under these unrealistic conditions, the Roberson Report actually shows that Iridium's access to additional shared spectrum would not cause any harmful interference to Globalstar's system, as explained below.

B. The Roberson Report Ironically Shows That Even Under Its Extreme Assumptions, Iridium's Proposal Would Not Cause Harmful Interference to Globalstar.

Even if it is taken at face value, the Roberson Report's analysis still fails to show that Iridium's proposed operations would result in any new harmful interference. Globalstar posits two types of interference scenarios. The "interference-limited" case relies on the Roberson Report's "corrected" link budget analysis, but still evidences a level of additional interference so small as to be negligible. And the "power-limited case," is not caused by or increased by Iridium's spectrum proposal. Indeed, Roberson states that Globalstar's system is susceptible to capacity loss due to traffic growth anywhere in the Lower Big LEO Band, whether from Iridium or Globalstar. In each scenario, the additional shared spectrum requested by Iridium would have no perceivable effect on Globalstar's operations.

⁴⁰ ECC Report 95 at 29.

⁴¹ See *infra* Tech. Appx. at 3.

1. Even under Globalstar's unrealistic assumptions, Iridium's use of additional Big LEO spectrum would have a negligible effect on Globalstar's operations.

The Roberson Report leverages the unrealistic assumptions discussed above to conduct a "corrected" link budget analysis designed to illustrate the link degradation that would be experienced by Globalstar due to Iridium's expanded use of the 1616-1617.775 MHz band.⁴² Globalstar asserts that its analysis shows that, in a loaded traffic scenario, the aggregate Iridium interference would increase the noise plus intra-system interference floor of the Globalstar satellite receiver by over 12 percent, "significantly higher than the limit of 3% for satellite systems referenced by Iridium."⁴³ While 12 percent objectively is higher than 3 percent, whether this amounts to "significant" interference is questionable. Globalstar has offered no evidence for the assertion that this increase would degrade "Globalstar users' quality of service."⁴⁴

When conceived of in terms of actual effect on Globalstar's operation, it is important to recognize that this 12 percent figure corresponds to an increase in Globalstar's noise-plus-interference floor of only 0.36 dB more than previously calculated by Iridium. While there is not a universally accepted benchmark for when intersystem impact on noise floor should be considered harmful interference, an increase this small compared to the base level of noise in the operating environment would not be noticeable. Because Globalstar terminals have at least 6 dB power control (i.e., link margin) available to them, in addition to satellite diversity gain, worst-case link degradations less than 0.5 dB should not impact Globalstar services.⁴⁵

Moreover, Iridium's expanded use would have no harmful impact on Globalstar's simplex SPOT service.⁴⁶ Globalstar's simplex services operate with significantly

⁴² Roberson Report at 10-11, 15-17.

⁴³ *Id.* at 14.

⁴⁴ *Id.*

⁴⁵ Roberson Report at 17; Description of the Globalstar System, at 4-1, *available at* <http://gsproductsupport.files.wordpress.com> ("Diversity combining is used to provide continuous communications even under conditions where a path to one satellite is totally blocked. The Globalstar system can operate with relatively low link margins and still provide a high link availability.").

⁴⁶ *See* Tech. Appx. at 6.

higher link margin than Globalstar duplex services. With that in mind, Globalstar tellingly provides no explanation how even a 0.5 dB decrease in link margin would produce a “disastrous result” on its SPOT service.⁴⁷

2. Globalstar’s bent pipe architecture does not preclude additional use of the Big LEO spectrum by Iridium.

The “power-limited case” is similarly unpersuasive. While “power-robbing” is not an unheard-of phenomenon in bent-pipe systems, it’s more accurately regarded as a design limitation than an interference issue. Despite years of interaction and regulatory proceedings at various venues, this is the first time Globalstar has put this design characteristic of its system onto the record as a relevant consideration.

Even so, the Roberson Report fails to demonstrate that the incremental addition of shared spectrum sought by Iridium would have any perceivable detrimental effect on Globalstar. This is because Globalstar’s satellite transponders apparently have been designed to receive and retransmit signal energy throughout the entire 1610-1626.5 MHz Lower Big LEO Band, “even if it falls outside of the CDMA channels.”⁴⁸ The study, therefore, suggests that any growth in Lower Big LEO Band traffic—whether on Iridium’s or Globalstar’s own system—will be retransmitted, consume power, and reduce capacity due to a design limitation in Globalstar’s system. The Roberson Report, in this respect, posits a challenge that is spectrum agnostic—the alleged problem would occur within the existing band plan, and permitting Iridium shared access to additional spectrum will not aggravate the detrimental effects.

On this point, the Roberson Report essentially proves too much, raising questions about the accuracy of its analysis. If taken at face value, the Roberson Report shows that Globalstar’s system would be rendered useless its own bent-pipe design that repeats the entire band.⁴⁹ Taken to its logical conclusion, the Roberson Report assumptions about the functioning of the Globalstar satellite system due to its bent

⁴⁷ Roberson Report, at iii.

⁴⁸ *Id.* at 5.

⁴⁹ Even if the Roberson Report’s analysis is read to say that Globalstar’s system only repeats its licensed passband, the argument still fails. Iridium and Globalstar have been operating under a shared spectrum regime for years, including in times of emergency and significant loading. Yet, by its own admission, Globalstar has never been able to detect Iridium’s use of the spectrum, let alone document any harmful interference. *See* Iridium Nov. 5, 2014 Supplemental Comments, at 3. As such, the conclusions of the Roberson Report are flatly contradicted by the observed facts.

pipe architecture would mean that: (1) current use of the spectrum by Iridium and Globalstar would have created extensive, reportable capacity reduction (and it has not); (2) increased numbers of subscribers of *all* Lower Big LEO Band spectrum by Globalstar and Iridium, regardless of the band plan, would overwhelm the Globalstar system with harmful capacity reduction (which it will not); and (3) there is nothing that Globalstar or the Commission could do to resolve this design issue. In reality, Globalstar's bent-pipe architecture is capable of handling additional Big LEO traffic but, as is true for any radio communications system, there are trade-offs associated with the system that must be managed. Real-world experience undoubtedly shows the claims of the Roberson Report to be exaggerated and contrary to the facts.

3. Use of the Big LEO spectrum demonstrates that provision of additional spectrum to Iridium is workable and achievable without harmful interference to Globalstar.

There is no need to rely on tortured analysis and unrealistic hypotheticals when the two systems have been operating in a shared spectrum environment successfully for years, including under heavily-loaded circumstances. For instance, Iridium's services were widely and rapidly deployed following the Texas Wildfires in 2011 and Superstorm Sandy in 2012.⁵⁰ Iridium made extensive use of the shared spectrum during these events and neither of these usage spikes prompted interference complaints from Globalstar. Indeed, Globalstar makes much in its marketing materials and advocacy before the Commission of the effectiveness of its operations in the wake of Superstorm Sandy.⁵¹ The fact that we have already seen successful sharing with heavy loading on both systems, including during major emergencies, suggests that there is a flaw in Globalstar's assumptions, its analysis, or both.

III. CONCLUSION

Simply put, once again, Globalstar has offered no evidence of actual or potential harmful interference. After repeated opportunities and countless pages of analysis, its failure to do so should lead to the conclusion that no such evidence exists. Like any responsible operator, Globalstar monitors its system performance. If it were experiencing interference-limiting or power-limiting events due to Iridium's

⁵⁰ See *supra* n.24.

⁵¹ See *supra* n.25.

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operations in the shared or exclusive spectrum assignments, it would have raised these issues by now. To the contrary, Globalstar has stated that it has never even detected Iridium's use of the shared spectrum, which entirely supports the technical analysis put into the record by Iridium. Under these circumstances, where Iridium repeatedly has justified its request and documented its feasibility, and Globalstar has failed to offer any real rebuttal, the Commission should act promptly to grant Iridium the relief requested.

Respectfully Submitted,

/s/ R. Michael Senkowski

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Counsel to Iridium Constellation LLC

Technical Appendix
Prepared by: Brandon Hinton, Consultant to Iridium and
Senior Principal Systems Architect Engineer, Exelis, Inc.

Reply to Report of Roberson and Associates, LLC, *Impact of Iridium Operations in 1616-1617.775 MHz on Globalstar Operations*

1 Background

Consistent with its proposal and presentations to the Commission on revising the Big LEO band (1610-1626.5 MHz), Iridium's revised band plan would not impact harmfully Globalstar's existing or future services. Globalstar recently filed an *ex parte* with the Commission, including a technical report by Roberson and Associates, LLC (the "Roberson Report"), that attempts to provide a theoretical basis for how the revised band plan would impact detrimentally Globalstar's users.¹ The analysis in the Roberson Report is flawed and insufficient in demonstrating any actual negative impact to Globalstar.

In November 2014, Iridium submitted "Supplemental Comments" to the Commission providing a Technical Appendix that provided detailed interference link budgets and supporting description that qualitatively and quantitatively characterized the level and impact of Iridium transceiver uplink L-band emissions into the Globalstar satellite receiver.² Iridium also noted that, due to the very different characteristics of the signal transmissions employed by each system, Iridium satellite receivers actually suffer a greater amount of interference from Globalstar transceivers in a band-sharing scenario. The Roberson Report provides an academic exercise that exaggerates the impact of any potential interference from Iridium and does nothing to change what Iridium showed in its Supplemental Comments. Furthermore, the Roberson Report also attempts to show that Iridium interference severely impacts Globalstar satellite capacity, when in fact this impact is purely a function of Globalstar's own system design limitations, as opposed to Iridium "interference."

2 Further Technical Analysis with Consideration of Globalstar Technology Limitations

2.1 Review of previous Iridium analysis

In its Supplemental Comments, Iridium detailed the minimal impact of Iridium transceiver emissions into a Globalstar satellite receiver when both services are operating co-frequency within the same coverage area. Iridium user transmissions occupy channels that are approximately 30 times smaller than a Globalstar spread spectrum channel and are therefore the

¹ Supplemental Comments of Iridium Constellation LLC, RM-11697, IB Docket No. 13-213, RM-11685 (filed Nov. 5, 2014) ("Iridium Nov. 5, 2014 Supplemental Comments").

² Roberson and Associates, LLC, *Impact of Iridium Operations in 1616-1617.775 MHz on Globalstar Operations* (Jan. 14, 2015) ("Roberson Report") attached to Letter from Regina M. Keeney, Counsel to Globalstar, to Marlene H. Dortch, Secretary, Federal Communications Commission, RM-11697 (filed Jan. 14, 2015) ("Globalstar Letter").

kind of narrowband interference that spread spectrum systems are capable of mitigating. It was also shown that, even in moderately heavy loading conditions, Iridium interference would be:

- lower than Globalstar's own intra-system interference plus noise density;
- lower than anticipated from any of the other original CDMA systems that were expected to share with Globalstar in the original Big LEO band plan; and
- lower than the expected aggregate interference from the other three planned CDMA systems in the original Big LEO band plan.

Specifically, the detailed interference budget analysis showed that under loaded traffic conditions, Iridium interference would contribute an increase of 2.8% to the Globalstar satellite receiver noise plus intra-system interference.

2.2 Review of Roberson Report

Globalstar's recent Filing attempts to demonstrate that any band sharing between Iridium and Globalstar would produce harmful interference to Globalstar, *yet the technical analysis provided in that filing actually provides strong evidence to the contrary*, i.e., that sharing with Iridium would not be harmful to Globalstar services. The Roberson Report conducts an academic exercise that attempts to make two main arguments about how Iridium emissions could potentially be harmful to Globalstar:

- 1) by producing co-channel interference that degrades the Globalstar received signals by adding to the desired channel's noise and interference floor, i.e., the "interference limited" case, and,
- 2) by producing "interference" that effectively "steals" power from the Globalstar satellite bent-pipe transponder amplifier, leaving less power available to Globalstar's desired signals, i.e., the "power limited" case.

Both arguments are separately refuted below.

2.2.1 Interference-Limited Case Analysis

The Roberson Report reviewed the detailed Iridium interference link budget provided in Iridium's Supplemental Comments (Table 2 in the Technical Appendix). That interference link budget used many assumptions that were studied and agreed upon in the ECC Report 95 on MSS sharing, as well as Globalstar system parameters provided by Globalstar in the 2004 *Petition for Reconsideration of Globalstar LLC*.³ The analysis shows that, in a loaded traffic scenario, the aggregate Iridium interference would increase the noise plus intra-system interference floor of the Globalstar satellite receiver by 2.8% (or, $I/N = -15.2$ dB). Additionally, this level of Iridium interference would be at least 11 dB *less* than the aggregate interference from the other three originally planned Big LEO band CDMA systems with which Globalstar was expected to share.

³ 2007 Electronic Communications Committee (ECC) Report 95 *Sharing Between MSS Systems Using TDMA and MSS Systems Using CDMA in the Band 1610 – 1626.5 MHz*.

The Roberson Report “corrected” this analysis by using a different set of extreme traffic loading assumptions. Iridium’s analysis was already biased toward a near-worst case scenario in terms of traffic loading and Iridium transceiver interference levels. Extreme traffic loading scenarios, in which all four Iridium traffic time slots in each channel are in continuous, long-duration use on every used frequency channel throughout a Globalstar footprint are rare in practice and have minimal impact on Globalstar services as a percentage of time. Furthermore, both the Iridium and Roberson analyses used worst-case assumptions for Iridium transceiver usage. Much Iridium traffic on the system today is generated by Short Burst Data (SBD) transceivers which are limited to transmit power levels 6 dB below that of the Iridium circuit switched voice and data handsets. Therefore, even in extreme emergency scenarios, actual Iridium-produced interference levels would be significantly less than described in the Roberson Report.

Aside from the above shortcomings in the interference analysis, the Roberson Report concludes that the actual aggregate Iridium interference level seen by Globalstar “will increase to over 12% of the Globalstar interference-plus-noise budgeted amount, significantly higher than the limit of 3% ... referenced by Iridium.” “Significantly higher” is clearly an exaggeration of the impact on Globalstar services, both in terms of actual interference level and in percentage of time that such interference would occur. The following table characterizes the interference amount in actual dB degradation of the Globalstar satellite receiver interference-plus-noise floor.

Table 1: Comparison of Interference Values

	$\Delta T/T$	I/N	Corresponding dB increase in Globalstar noise floor (e.g., (I+N)/N))
Iridium analysis	3%	-15.2 dB	0.13 dB
Roberson analysis	12%	-9.2 dB	0.49 dB
Impact on receiver noise floor of 12% vs. 3% $\Delta T/T$			0.36 dB

In other words, even if we use the extreme worst-case traffic loading and Iridium emissions assumptions in the Roberson Report, we see that the “significantly higher” interference of 12% is actually an impact of only 0.36 dB more at the Globalstar satellite receiver. This level of interference would never be approached during normal or even highly loaded traffic scenarios. This hardly seems like a “harmful” amount of interference to be accepted in a two-system sharing scenario, considering the available link margins employed by Globalstar in conjunction with satellite diversity enhancements.

2.2.2 Power-Limited Case Analysis

The main “interference” problem that the Roberson Report focuses on is the impact of Iridium emissions on the Globalstar satellite bent-pipe transponder amplifier and is actually a function of total number of Iridium and Globalstar users, rather than unwanted interference. This is typically referred to as “power robbing” in the satellite communications industry and, in the context of Globalstar, is described in the Roberson Report as:

“The second type applies to the case where the satellite’s total transmit power on the downlink channel is limited to a certain set value (again, the Globalstar system operates as a “bent pipe” system, in which the satellite’s transponder re-broadcasts uplink signals to Globalstar’s earth gateway stations using a different downlink channel). In this case, any undesired interference energy received within the satellite’s uplink passband (even if it falls outside of the CDMA channels) is re-broadcast by the transponder, and so subtracts from the total power available to transmit desired signals.”⁴

The Roberson Report then provides a detailed analysis of the potential impact of a large number of Iridium users on a Globalstar satellite in the proposed shared band of 1616-1617.775 MHz. This analysis assumes that, under a maximally loaded scenario, Iridium could have nearly 2,800 users in this amount of shared spectrum in the entire Globalstar satellite footprint that would produce emissions that “steal” power from the Globalstar transponder amplifier.⁵ This assumes a maximum number of users operating throughout the entire Globalstar satellite footprint, which is an area of over 26 million square kilometers, or over three times the area of the continental United States.⁶ Most emergency disaster relief areas are typically concentrated in areas much smaller than this. In any case, based on the analysis of Iridium user transmission levels relative to Globalstar user transmission levels, every 2.34 Iridium users steal capacity from one potential Globalstar user.⁷ Using this number, it is concluded that,

“... assuming a Globalstar fully loaded capacity of 2500 users per satellite, a fully-loaded Iridium system in the same band segment incrementally decreases Globalstar capacity by 47% per affected satellite.”⁸

The above analysis reveals the limitations of the Globalstar satellite transponder design. Each Globalstar satellite receives the entire 1610-1626.5 MHz user uplink band and retransmits (e.g., transponds) this entire band to a serving gateway at C-band where the desired Globalstar signals are received and processed. This means that *all* Globalstar and Iridium transmissions that occur within the 1610-1626.5 MHz band combine to steal power from the transponder amplifier. This fact is actually corroborated in the Roberson Report on page 5 in the section quoted above and repeated here (emphasis added):

“In this case, any undesired interference energy received within the satellite’s uplink passband (**even if it falls outside of the CDMA channels**) is re-broadcast by the transponder, and so subtracts from the total power available to transmit desired signals.”⁹

Therefore, *all* Iridium transmissions, whether operating under the current band plan on a non-interference basis, or in the new proposed band plan, impact the Globalstar satellite in the same way.

⁴ Roberson Report, at 5

⁵ *Id.*, at 8

⁶ *Id.*, Table 1.

⁷ *Id.*, at 9, Table 1.

⁸ *Id.*, at 7.

⁹ *Id.*, at 5.

The first thing to note about this is that the power-robbing that results from Iridium transmissions is *completely independent* of whether any portion of the 1610-1626.5 MHz band is being shared between Globalstar and Iridium. In other words, 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. Sharing spectrum with overlapping Iridium and Globalstar channels has no impact one way or the other.

Second, and most importantly, even if the band plan remains unchanged, i.e., Iridium continues to operate only in its current authorized frequency band, those non-interfering Iridium emissions "steal" capacity from the Globalstar satellite. The Roberson Report attempts to characterize the *incremental* impact on its capacity limitations due to increasing Iridium's spectrum (per Iridium's proposed band plan). However, that analysis completely ignores the impact of all other Iridium users operating in channels above Globalstar's authorized spectrum under the current band plan. Under an unrealistic, exaggerated set of assumptions, the Roberson Report estimates that 2,782 Iridium users would operate in the proposed 1616-1617.775 MHz band in a fully loaded scenario, or equivalently, 1,567 Iridium users per 1 MHz.¹⁰ Since Iridium distributes its traffic evenly across its entire duplex band, we can extrapolate that scenario to assume that there would be an additional 12,891 Iridium users operating in the 1617.775-1626.0 MHz band.¹¹ Again, according to the Roberson Report analysis showing that 2.34 Iridium users are equivalent to 1 Globalstar user, then 12,891 Iridium users is equivalent to the capacity of 5,509 Globalstar users. Since a Globalstar satellite can only support a maximum of 2,500 users at a time (due to transponder amplifier limitations), that means that a Globalstar satellite is completely incapable of supporting any Globalstar users when there are a large number of Iridium users operating completely outside of Globalstar's authorized channels. Incrementally increasing Iridium's spectrum will not alter this fact.

Thus, even in a traffic loading scenario significantly less than the improbable, fully loaded scenario described in the Roberson Report, it would appear that Globalstar doesn't have the resources to support any of its users when a significant number of Iridium users *are operating within the current band plan*. If this were actually the case, it would seem that Globalstar satellites would be experiencing severe power-limited capacity problems even when Iridium operates in a moderately loaded scenario and even when the band is completely segmented between the two systems. To reiterate the statement made above, Globalstar has never provided any evidence that Iridium emissions limit their operations, even during situations in which Iridium has extended its spectrum to the full 1616-1626.5 MHz band as a result of a grant of special temporary authority ("STA") to support emergency situations.

Any complaints that Globalstar makes regarding the future impact on its satellite capacity by additional Iridium users under Iridium's proposed band plan is rendered meaningless because it has been shown that the real limitation to Globalstar satellite capacity is its own number of users along with Iridium users operating outside of Globalstar channels. Globalstar's system design limitations should not have any bearing on granting Iridium the additional spectrum that Iridium

¹⁰ See *id.*, at 8, Table 1 (2782 divided by (1617.775-1616.000) = 2782/1.775 = 1567 users per MHz).

¹¹ 1567 users per MHz multiplied by (1626.0 - 1617.775) = 1567 x 8.225 = 12,891 users.

has demonstrated it needs to support its real (as opposed to academic or theoretical) capacity demands.

2.3 Other Concerns

Globalstar notes that increased interference from Iridium in the proposed revision to the Big LEO band plan would have a “significant” impact on Spot service. As noted above, “significant” has been defined as either 0.1 dB increase in Globalstar satellite receiver noise plus interference floor under heavy traffic loading conditions (Iridium Supplemental Comments), or 0.5 dB increase under worst-case conditions (Roberson Report). In any case, Globalstar should explain how even a 0.5 dB decrease in link margin affects performance of its simplex service. Globalstar simplex services operate with significantly higher link margin than Globalstar duplex services as a result of much higher processing gain. Globalstar’s simplex service operates at a data throughput of 100 bps,¹² which, when spread over 1.23 MHz, yields a processing gain of over 40 dB. This provides simplex services with approximately 20 dB more processing gain (and therefore link margin) than its standard duplex voice service operating at 9600 bps. Iridium interference at either of the above levels would have negligible impact on Globalstar simplex services.

Globalstar also makes reference to new higher data rate services to be rolled out over its network in the future and that those services will have less processing gain (and thus link margin) than its current legacy services. Again, Iridium interference levels on the order of a few tenths of a dB cannot be expected to affect these services unless they essentially have no link margin. Based on the capacity analysis in section 2.2.2 above, Globalstar would appear to have much greater concerns about how its satellites will be capable of handling higher bandwidth services instead of concerns over small amounts of interference.

3 Conclusions

For the reasons provided above, the Commission should reject any academic assertion by Globalstar that Iridium’s proposed band plan would have any harmful effects on Globalstar services. Globalstar’s recent filing again avoids providing any real system data showing the alleged impacts on its services under the current band plan, which already includes sharing 0.95 MHz of spectrum. Furthermore, any perceived theoretical degradation in Globalstar system performance has been demonstrated to mainly be due to Globalstar system design limitations related to its bent-pipe transponder architecture.

Even under Globalstar’s extreme worst-case traffic loading scenarios (which make assumptions with which Iridium disagrees), the maximum level of aggregate interference from Iridium emissions would result in less than 0.5 dB degradation in the Globalstar satellite receiver (or about 0.3 dB more than Iridium’s submitted estimation), for a very small percentage of time. This amount of degradation would have a minimal impact on Globalstar duplex and simplex services – certainly much less than is typically allowed in most band sharing scenarios.

¹² Globalstar, *Simplex Transmitter Unit*, available at <http://common.globalstar.com/docs/simplex.pdf>.

Globalstar also makes a frivolous claim, again under an extreme worst case traffic loading scenario in which maximum Iridium resources are used to support a disaster relief effort throughout an entire Globalstar satellite footprint having 5800 km diameter, that increasing Iridium spectrum access by 20% under the proposed band plan would “steal” power from the Globalstar satellite transponder power amplifier, to the point of taking “47%” of the satellite’s capacity. However, Globalstar’s argument doesn’t hold up given that their satellite transponder design architecture forces it to use power to transpond the entire 1610-1626.5 MHz band – including not only their desired user signals, but ALL existing authorized Iridium user signals operating outside of Globalstar’s channels. Under this condition and assuming Globalstar’s own analysis is true, Globalstar satellite capacity resources would already be completely overtaken by normal Globalstar and Iridium users in a disaster relief scenario and therefore be unaffected by any proposed incremental increase in Iridium access to spectrum.

Iridium has provided evidence to the Commission of a growing demand for spectrum on its system today, which will only increase as the Iridium subscriber base continues to expand every quarter and as its next generation system, Iridium NEXT, begins to launch new services later this year. Moreover, technical analysis submitted by the company shows that Iridium can use this spectrum without any harmful impact on Globalstar’s users and services. Globalstar’s latest filing does nothing to refute these showings.