Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service	IB Docket No. 17-95

REPLY COMMENTS OF IRIDIUM SATELLITE LLC

INTRODUCTION

For the better part of a decade, geostationary satellite orbit ("GSO") operators in the fixed-satellite service ("FSS") have explored using the 29.25-29.3 GHz band to host earth stations in motion ("ESIMs") as a small part of the overall spectrum evaluated for this purpose. But after kicking the tires for years, their interest in actually using this spectrum has never grown serious. Despite the ample time they have had to study the band for ESIM operations, GSO operators have yet to actually suggest a viable method to coordinate ESIMs with Iridium's non-geostationary satellite orbit ("NGSO") satellite constellation, which uses the 29.25-29.3 GHz band for feeder-link operations. This remains the case even though everyone agrees that the FCC's rules explicitly require such coordination,[1] and even though Iridium has explained the specific challenges that make coordinating with ESIMs infeasible.

[1] *See* 47 C.F.R. § 25.203(h); *id.* § 25.258; *Amendment of Parts 2 and 25 of the Commission's Rules to Facilitate the Use of Earth Stations in Motion Communicating with Geostationary Orbit Space Stations in Frequency Bands Allocated to the Fixed Satellite Service*, Notice of Proposed Rulemaking, IB Docket No. 17-95 ¶ 53 & n.56 (rel. May 19, 2017) ("*NPRM*") (noting that if the Commission authorized ESIMs, "ESIM applicants and licensees planning to conduct operations in the 29.25-29.3 GHz band would have to coordinate with Iridium under 47 CFR §§ 25.203(h) and 25.258 prior to operating in those frequencies").

None of this has changed over the course of this proceeding. Although the *NPRM* provided GSO operators with the opportunity to present their case for deploying ESIMs in the 29.25-29.3 GHz band,[2] SES, ViaSat, and Inmarsat pay lip service to the coordination issues present in the band.[3] They simply assert that ESIMs and Iridium can coordinate, but provide no meaningful analysis to back this claim up.

Perhaps unexamined assertions are all the spectrum is worth for ESIMs. At just 50 MHz wide, the 29.25-29.3 GHz band is tiny in comparison to other potential ESIM bands, and dwarfed by the 2,000 MHz of new ESIM spectrum identified by the Commission in the *NPRM*. Or perhaps these operators have tried, but failed, to develop a means of sharing the spectrum. Whatever the reason may be, the inattention of ESIM proponents to the sharing challenges unique to the 29.25-29.3 GHz band makes the Commission's decision easy. Without an available method to coordinate operations on the record, and with substantial record evidence that coordination would be infeasible, the Commission cannot authorize new services and rely on a coordination requirement to protect Iridium's feeder link operations. Accordingly, the Commission should proceed with its proposal to make new spectrum available for ESIMs, but it must decline to authorize ESIMs in the 50 MHz of spectrum between 29.25 and 29.3 GHz.

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2 *NPRM* ¶¶ 53-54.

3 *See* Comments of ViaSat, Inc. at 9, IB Docket No. 17-95 (filed July 31, 2017) ("ViaSat Comments"); Comments of Inmarsat, Inc. at 5, IB Docket No. 17-95 (filed July 31, 2017) ("Inmarsat Comments"); Comments of SES S.A. and O3b Limited at 9, IB Docket No. 17-95 (filed July 31, 2017) ("SES/O3b Comments").

I. COORDINATING WITH ESIMS IN THE 29.25-29.3 GHZ BAND IS INFEASIBLE.

As Iridium detailed in its comments, and as it has often explained in the past, the fact that ESIMs move unpredictably makes coordinating ESIMs with Iridium's feeder-link operations a practical impossibility.[4]

Both fixed terminals and ESIMs create in-line interference at the Iridium satellite receiver whenever an Iridium satellite passes through the terminal's main beam.[5] Each in-line event that exceeds the Iridium satellite's maximum tolerated interference level contributes to the unavailability of Iridium's feeder links, and the potential disruption of service to many users.[6] To coordinate with Iridium, GSO operators must be able to verify that these in-line events, in the aggregate, will not breach the protection criteria of the Iridium network, which are defined in terms of whether the satellite receiver's tolerated interference level would be exceeded for an unacceptable percentage of time.[7] These criteria include a long-term protection criterion, which tolerates lower levels of interference at the satellite receiver, but for a larger percentage of time, and a short-term protection criterion, which tolerates a greater level of interference, but for a much smaller percentage of time.[8]

The short-term criterion ensures that Iridium's operations are protected from the dominant form of interference created by GSO networks: the bursts of short-term interference generated by each in-line event. The short-term criterion, however, can be difficult to meet, because it requires GSO earth stations not to produce excessive interference for more than a very

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4 *See* Comments of Iridium Satellite, LLC, IB Docket No. 17-95 (filed July 31, 2017) ("Iridium Comments").

5 *Id.* at 10-11.

6 *Id.* at 11.

7 *Id.* at 11, 13-14.

8 *Id.*

small percentage of time. Multiple in-line events, even if they occur over a relatively long period, can result in the sufficient unavailability of Iridium's feeder links to breach the short-term criterion.

In the case of *fixed* terminals, even when there are many of them, GSO operators can verify protection of the Iridium network by defining a geographic exclusion region within which their fixed terminals will not be placed.[9] GSO operators and Iridium can determine with certainty that fixed-terminal emissions outside the exclusion region will comply with the Iridium network's protection criteria, including the short-term protection criterion, because the region defines the outermost boundary of all interference reception zones, calculated for all Iridium azimuth and elevation angles, within which the GSO earth station's emissions might exceed the Iridium satellite receiver's maximum tolerated interference level for an unacceptable percentage of time.[10] The interference reception zones, in turn, can be modeled for each azimuth-elevation geometry based on known characteristics about the Iridium satellite receiver antenna, known emission characteristics of each interfering GSO earth station, known impacts of other GSO networks with satellites in view of the Iridium feeder link earth station (i.e., gateway), and, critically, *the number of GSO earth stations* in view of the Iridium gateway and *the relative location of each interfering GSO earth station* and corresponding GSO satellite to the Iridium gateway and corresponding Iridium satellite.[11]

This approach is not available with ESIMs. Because ESIMs transmit from different locations, the exact point in time when an ESIM creates interference will differ from terminal to

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9 *Id.* at 10-12.

10 *Id.*

11 *Id.* at 11 & n.31.

terminal.[12] Thus, to determine whether in-line events, in the aggregate, breach the Iridium network's protection criteria, Iridium and GSO operators must know the number of ESIMs in region of the Iridium gateway, and the location and emission characteristics of each individual ESIM terminal *over time*.[13] ESIMs, however, are in constant and unpredictable motion *so their numbers and locations over time cannot be known*. It is impossible to determine how many ESIMs are operating in a given region, the current, historical, and projected location of each ESIM over time (i.e., the path of each ESIM), and whether, at each location in time along the path of the ESIM, the ESIM breached, is breaching, or can be expected to breach the Iridium satellite's maximum tolerated interference level.[14]

Without this information, GSO operators and Iridium cannot determine whether all ESIMs on a given GSO network produce, in the aggregate, unacceptable levels of interference with the Iridium network, and therefore they cannot coordinate. Put simply, Iridium is not aware of any method to verify whether ESIMs operating in constant and unpredictable motion within a hypothetical exclusion region would comply with a large NGSO network's protection criteria, especially Iridium's short-term protection criterion, which will be breached if enough in-line interference events occur over even a relatively long period of time.[15]

II. GSO OPERATORS FAIL TO ADDRESS THE UNIQUE COORDINATION CHALLENGES IN THE 29.25-29.3 GHZ BAND.

The only GSO operators to support authorizing ESIMs in the 29.25-29.3 GHz band ignore this problem completely. They merely assert that "the potential for [ESIM] interference

[12] *Id.* at 15-16 & Figure 2.

[13] *Id.* at 14-16.

[14] *Id.*

[15] *Id.* at 15-16 & Figure 2.

to NGSO MSS feeder links" can be "controlled by the same coordination conditions as those for fixed earth stations," because GSO operators can use network monitoring capabilities to ensure that their ESIM terminals do not communicate in the 29.25-29.3 GHz band when located in "agreed-upon exclusion zones around Iridium feeder links."[16] But as noted, the problem that has been pending before GSO operators for years is how to define those exclusion zones in the first place, given the unpredictable interference environment generated by ESIMs. And so far they have no answers.

None of the operators purportedly interested in the 29.25-29.3 GHz band explain how these exclusion zones can be defined. Instead, they ask the Commission to take it on faith that defining an exclusion zone will be possible because the Commission's rules permit blanket licensing of *fixed* terminals, subject to successful coordination with Iridium.[17] But, unlike ESIMs, fixed terminals are not in constant and unpredictable motion and therefore do not present the same challenge of verifying compliance with Iridium's protection criteria. Again, to verify that a particular exclusion region ensures compliance with Iridium's protection criteria, Iridium and GSO operators would have to know not only the number of ESIMs operating within the vicinity of an Iridium gateway and their emissions characteristics, but also the locations of each ESIM over time and whether, at each location in time, the ESIM is contributing to interference with an Iridium satellite.

To put it differently, even if the GSO operator managed to obtain a snapshot of information about the location of all ESIMs communicating with its network, it still would not be able to verify protection of Iridium's system, because past and future in-line events generated by

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[16] Inmarsat Comments at 6; *see also* ViaSat Comments at 9-10 ("Coordination with Iridium's feeder link operations will rely on . . . network control and monitoring capabilities").

[17] Inmarsat Comments at 5; *see also* ViaSat Comments at 9-10; SES/O3b Comments at 9-10.

each ESIM will also contribute to the percentage-of-time threshold above which interference becomes unacceptable. Nor can the GSO operator simply assume that a particular number of ESIMs in a particular region are producing interference simultaneously. As Iridium previously explained, while the number of simultaneously operating ESIMs can be useful in determining whether a GSO network exceeds the long-term protection criterion, it is of no value in verifying compliance with the short-term protection criterion.[18] This is because the short-term protection criterion is driven by the aggregate number of individual interference events that a network's ESIMs generate over time, and not the aggregate interference levels created when a network's ESIMs interfere at the same time.[19]

The best evidence that GSO operators are truly lost at sea, and have no idea how to coordinate with Iridium, is their suggestion that the Commission should derail this proceeding to coordinate on their behalf. SES acknowledges that "[c]oordination with Iridium" is "appropriate" and claims that it is possible, only to ask *the Commission* to "define a perimeter around Iridium earth stations within which coordination is necessary."[20] If GSO operators have not managed to develop a means of defining that perimeter by now—even after arguing for more ESIM spectrum before the ITU and the Commission for years, and even after the Commission issued an *NPRM* seeking comment on this very issue[21]—then there is no reason to believe that they will offer any solutions capable of supporting a reasoned decision in the side proceeding contemplated by SES. Indeed, the mere suggestion that Commission intervention is necessary

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18 Iridium Comments at 14-16 & Figure 2.

19 *Id.*

20 SES/O3b Comments at 10.

21 *NPRM* ¶¶ 53-54.

demonstrates the enormous practical difficulties of sharing the band with ESIMs, and what little progress the industry has made to overcome these challenges.

CONCLUSION

The Commission should not authorize new services that must coordinate with existing services when the record indicates that such coordination would be infeasible—and no one has demonstrated a methodology that could work. Yet that is precisely what it is being asked to do in the 29.25-29.3 GHz band. As Iridium has explained in detail, the uniquely unpredictable interference environment created by ESIMs makes it infeasible to coordinate in the 29.25-29.3 GHz band, and ESIM proponents have offered nothing to dispute Iridium's analysis. Accordingly, the Commission should proceed with its proposal, but should authorize ESIMs in the 29.**3**-30.0 GHz band, and not in the 29.**25**-30.0 GHz band as proposed in the *NPRM*.

Respectfully submitted,

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