November 6, 2017

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Notice of *Ex Parte* Presentation by ViaSat, Inc. and Inmarsat, IB Docket No. 17-95

Dear Ms. Dortch:

On November 2, 2017, Ethan Lucarelli and Giselle Creeser of Inmarsat, Inc. ("Inmarsat"), Chris Murphy and Daryl Hunter of ViaSat, Inc. ("ViaSat"), and John Janka and Elizabeth Park of Latham & Watkins LLP representing ViaSat, met with Jose Albuquerque, Chip Fleming, Cindy Spiers and Sankar Persaud of the International Bureau. Kathyrn Medley of the International Bureau and Jonas Eneberg of Inmarsat participated via teleconference.

During the meeting, ViaSat and Inmarsat noted the widespread support in the record for the goals of the Notice of Proposed Rulemaking ("NPRM") in this proceeding, including facilitating deployment of Earth Stations in Motion ("ESIMs") and reducing the regulatory burdens on ESIMs, as well as proposing new rules to allow the operation of ESIMs in the Ka-band.[1] As the Commission noted in the NPRM, the rule changes would promote flexible use of spectrum.[2]

The parties also noted that adopting the new ESIM rules would reinforce the Commission's leadership in spectrum use. The parties noted further that, contrary to objections raised by Iridium—the sole NGSO MSS operator using the band—coexistence between GSO FSS ESIMs and NGSO MSS feeder links at 29.25-29.3 GHz is feasible, and that there is no justification for exclusion of ESIMs from this band segment. The two attached presentations from ViaSat and Inmarsat formed the basis for the technical discussion.

ViaSat and Inmarsat noted that, as a threshold matter, Iridium's authorization to operate NGSO MSS feeder links at 29.25-29.3 GHz is subject to the requirement in Section 25.258 of

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[1] *Amendment of Part 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, 32 FCC Rcd 4239 (2017).

[2] *Id.*, ¶ 2.

the Commission's rules to facilitate co-existence with GSO FSS operations that are co-primary in that band segment.[3] When the Commission adopted this rule in 1996, Iridium (through its predecessor, Motorola) asserted that it would be unable to share with GSO FSS systems. Accordingly, the Commission limited Iridium to operate its feeder links in the 29.1-29.25 GHz band segment,[4] while other proposed NGSO MSS system operators who indicated that sharing was possible were allowed to use the 29.25-29.5 GHz on a shared basis with GSO FSS.[5]

Subsequently, Iridium reversed course and took the position that "techniques might be developed in the future that would enable Iridium to share the 29.25-29.5 GHz uplink band with GSO/FSS systems."[6] On that basis, Iridium has since sought and received Commission authorization to operate its feeder links in the 29.25-29.3 GHz portion of the shared band. Since then, Section 25.258 has provided the framework for inter-operator sharing and GSO FSS deployment in that band segment.[7] As part of implementing the Commission's longstanding band plan for the Ka band, the Commission has blanket-licensed at least six million GSO FSS earth stations on a shared basis with Iridium in the 29.25-29.3 GHz band segment, demonstrating that coexistence is feasible.[8]

The co-existence of ESIMs with Iridium in the 29.25-29.3 GHz band segment is just as feasible. The same conditions that made use of the band for blanket-licensed fixed earth stations possible are the same in the case of ESIMs. Rather than restricting ESIM operations from the band, based on the attached analysis, the Commission should find that sharing is possible between ESIMs and NGSO MSS feeder links in the 29.25-29.3 GHz band. The attached technical analyses demonstrate two distinct sets of circumstances under which such sharing is feasible. As Inmarsat explained in its Reply Comments, Iridium's own analyses have relied upon various mitigation techniques—including off-axis separation between the Iridium earth

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[3] 47 C.F.R. § 25.258.

[4] *See Motorola Satellite Communications, Inc*., Order and Authorization, DA 97-229 (rel. Jan. 31, 1997).

[5] *See Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Systems*, First Report and Order, 11 FCC Rcd 19005 ¶ 63 (1996).

[6] *Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Systems*, Memorandum Opinion and Order, 16 FCC Rcd 11436 ¶ 5 (2001).

[7] *See, e.g.*, Hughes Network Systems, LLC, File No. SAT-LOI-20110809-00148 (filed Aug. 9, 2011); Petition to Dismiss of Iridium Constellation LLC, File No. SAT-LOI-20110809-00148 (filed Jan. 17, 2012); Hughes Network Systems, LLC, File No. SAT-LOA-20111223-00248 (filed Dec. 23, 2011); Comments of Iridium Satellite LLC, File No. SAT-LOA-20111223-00248 (filed Mar. 26, 2012).

[8] *See, e.g.*, HNS License Sub, LLC, File No. SES-MOD-20170726-00811, Call Sign E060445 (granted May 23, 2016).

station and GSO FSS operations, and the narrowness of the Iridium uplink beam, among others, to demonstrate the feasibility of sharing between GSO FSS operations and Iridium earth stations in the 29.215-29.3 GHz band.[9] Indeed, in many cases the operation of ESIMs could occur on a co-frequency/co-polarization/co-coverage basis with Iridium's feeder links.

Iridium's efforts to preclude GSO FSS ESIM operations in the 29.25-29.3 GHz band segment are technically baseless and inconsistent with Commission policy. As demonstrated by the attached analyses, sharing between ESIMs and NGSO MSS feeder links is feasible under a variety of situations that would permit both services to flourish. Rather than restricting innovative and efficient uses of spectrum through overly broad regulations, the Commission should instead promote flexibility in this band. ViaSat and Inmarsat urge the Commission to reject Iridium's attempt to stifle competition and instead allow ESIMs in the 29.25-29.3 GHz band segment subject to Section 25.258.

Please contact one of the undersigned if you have any questions regarding this submission.

Respectfully submitted,

/s/

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Attachments (2)

cc: Jose Albuquerque
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Cindy Spiers
Sankar Persaud

[9] Reply Comments of Inmarsat Inc. at 7, IB Docket No 17-95 (Aug. 30, 2017).

ESIM Operations in 29.25-29.3 GHz

Background

- Iridium's NGSO MSS feeder links are at 29.25-29.3 GHz under the condition that they share on a co-primary basis with GSO systems under 25.258
- Iridium claims it is not possible to determine how to co-exist with ESIMs in this band segment
  - "impractically complex sharing environment"
- Our analysis shows that
  - ESIMs/Iridium uplink coexistence is possible without the need for frequency/polarization isolation
    - Consistent with the requirement of 25.258, ESIMS can operate co-channel/co-polarization with Iridium without interfering with reception of Iridium's uplink transmissions

ESIMs and Iridium FL can Coexist

- Iridium feeder-link operations take place at well known gateway locations
  - Iridium operations in the 29.25-29.3 GHz band U.S. occur at three Earth station sites located in AZ, HI and AK
- The Iridium satellite orbit and FL beam characteristics are well known
- Interference is time varying - Iridium satellites move quickly ~16 seconds per degree
- ESIM antennas have narrow beamwidths ~0.9 degrees
  - Main beam transit in < 15 seconds
- Main beam alignments are very rare and very brief in duration

Characteristics used in analysis

Iridium system

- Satellite
- Height: 780 km
- Inclination angle: 86.4 degrees
- No. of satellites per plane: 11
- No. of planes: 6
- Satellite separation within plane: 32.7°
- Satellite phasing between planes: 31.6°
- Minimum elevation: 8°
- Satellite rx antenna gain: 30.1 dBi
- System noise temperature: 1295 K
- Antenna gain pattern: ITU-R Rec. 465-5

- Earth station
- Example location at 33°N, -111°E

- Carrier
- Bandwidth: 5.761 MHz
- No. of carrier: 1

- Interference Criteria: I/N and C/I Examined

GSO system

- Satellite
- Orbital location: 89° W

- ESIM
- Altitude: 10.7 km (Aero ESIM)
- Tx gain: 40.5 dBi (78 cm x 15.6 cm Rectangular Array)
- Antenna pattern: ITU-R Rec. 580-6
- Maximum power output: 25 W

- Carrier
- Bandwidth: 80 MHz
- Duty cycle: 6%
- No. of ESIM: 6 (i.e. six earth stations in order to address the multiple short-term interference issue)

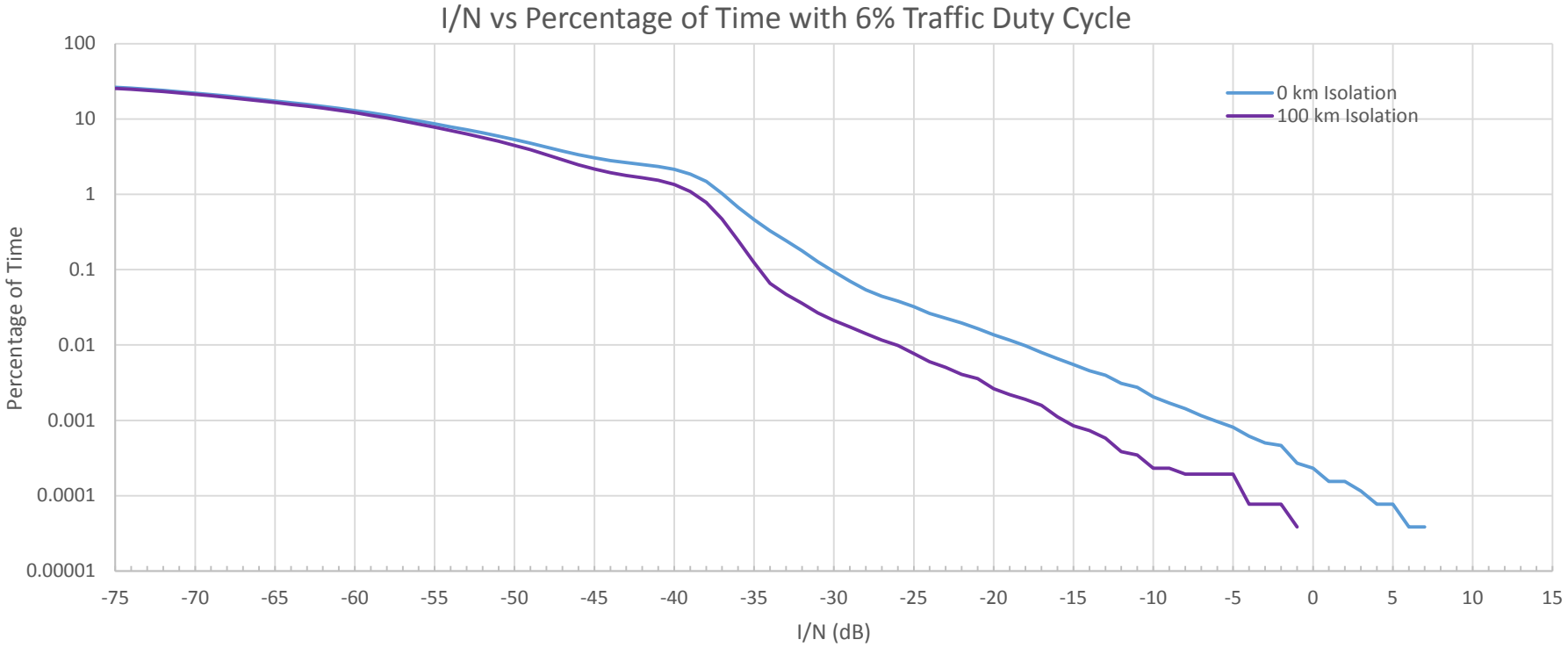
Analysis

- A statistical analysis was performed in Visualyse using the characteristics above, as well as:
  - Typical ESIM motion, i.e., flights between city pairs at nominal altitude and speed
  - ESIM TDMA traffic duty cycle, evaluated at 6% to simulate heavy terminal usage
  - Iridium gateway FL beam pointing as satellites orbit over time using a longest hold time to 5° above horizon method
- Several simulations were run to examine results with ESIMs operating in flight with no additional frequency/polarization isolation (beyond existing GSO frequency reuse plan), and with additional frequency/polarization isolation at various distances

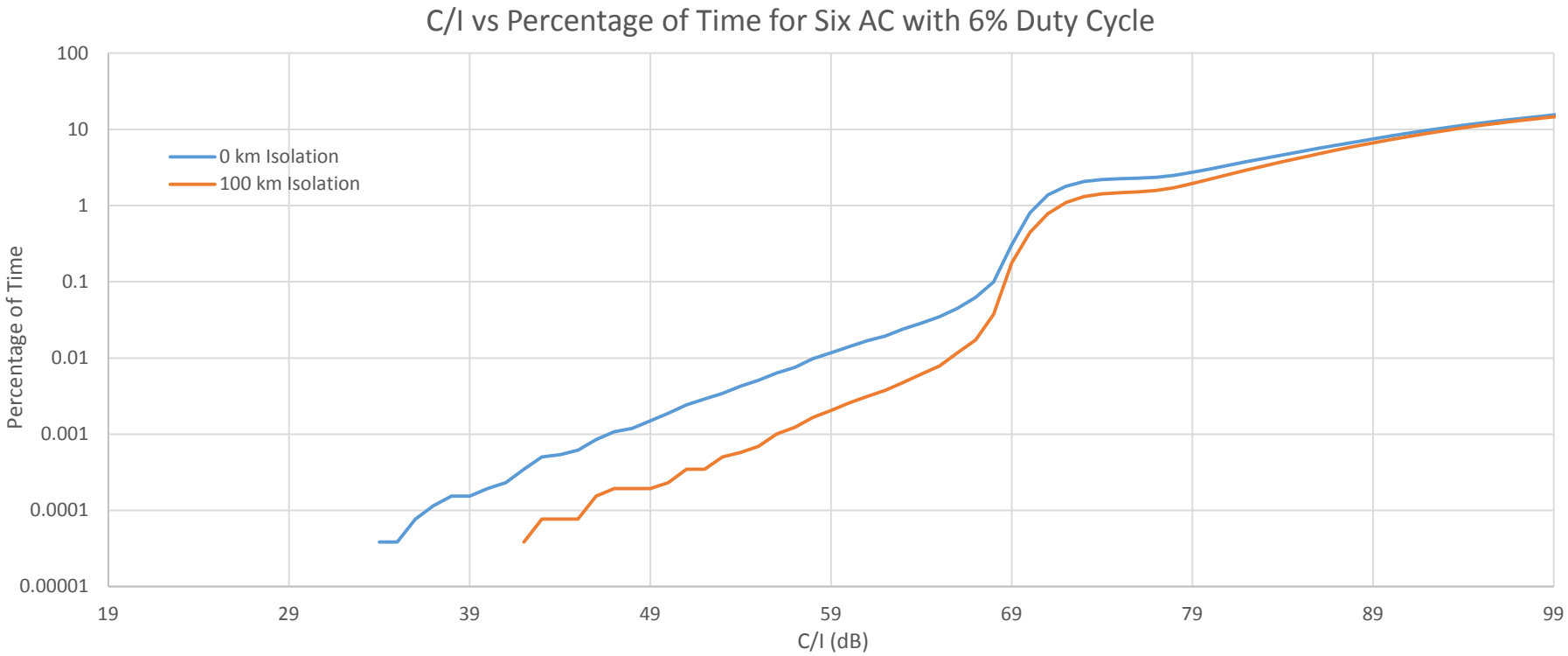
Results

- The following plots show the results of the simulations
- With heavy TDMA traffic duty cycle, and no additional frequency/polarization isolation, I/N is less than -56 dB more than 90% of the time, and less than -18 dB more than 99.99% of the time
- With heavy TDMA duty cycle, and no additional frequency/polarization isolation, C/I is greater than 58 dB for more than 99.99% of the time, again with no additional frequency/polarization isolation

I/N vs Percentage of Time with 6% Traffic Duty Cycle



C/I vs Percentage of Time for Six AC with 6% Traffic Duty Cycle



Conclusions

- Co-channel, co-polarization ESIMs sharing with Iridium in the 29.25-29.3 GHz band in the vicinity of FL gateways is possible
- This is possible because of the characteristics of each system
  - Iridium's FL receiving beam gain and G/T are quite low
  - As a result of the higher performance available from HTS satellites, ESIM terminal EIRPs are much lower than previous generation FSS earth stations and considerably lower than the several generations old Iridium FL gateway
    - For example ESIM EIRP of 43.5 dBW vs Iridium gateway EIRP of 78.2 dBW – a 34.7 dBW difference
  - Even after adjusting for carrier bandwidths this results in > 34 dB C/I in even the worst case alignment with no co-frequency, co-polarization isolation
  - While en route, ESIMs also will be operating on other frequencies/polarizations due to GSO satellite spectrum reuse patterns
- When considering I/N, ESIMs don't raise the Iridium satellite receiver's noise floor much because the satellite's receiver is not very sensitive

ESIM Operations in Conventional Ka-band

ESIMs and MSS Feeder Links are “co-primary” in the 29.25-29.3 GHz band and coordination is feasible

inmarsat
The mobile satellite company

ESIM Operations in the 29.25-29.3 GHz Band

- FCC rules allow operation of NGSO MSS Feeder Links (FL) and blanket licensed GSO FSS earth station in the 29.25-29.5 GHz band on a *co-primary basis* subject to coordination under 47 CFR §§25.258
- The Commission has proposed new rules to allow the operation of ESIMs communicating with GSO space stations in the conventional Ka band - 18.3-18.8 GHz and 19.7-20.2 GHz (space-to-Earth), and 28.35-28.6 GHz and 29.25-30.0 GHz (Earth-to-space) as an application of the FSS
- The Commission recognized that ESIM licensees planning to conduct operations in the 29.25-29.3 GHz band would be subject to coordination under 47 CFR §§25.258 prior to operating in those frequencies
- Iridium's objections to the use of the 29.25-29.3 GHz band by ESIMs are unfounded
- Inter-operator coordination is feasible using well-established practices that have facilitated successful sharing of this band for years without the need for further regulatory restrictions

Iridium's claims are exaggerated or false (1/2)

Claim	Fact
"impractically complex sharing environment"	Exclusion zones can be determined in a similar manner as in the case of fixed earth stations
"no method exists"	We are not aware of any publically documented methodology (e.g. ITU-R Recommendation) to develop exclusion zones for fixed earth stations either, but operators coordinate anyway
"the boundary of the exclusion zone depends on the number and location of GSO terminals, which, for ESIMs, will change over time and cannot be pre-determined"	The maximum number of potentially interfering ESIMs operating co-frequency with a NGSO MSS feeder link carrier can be easily determined based on the GSO network characteristics, such as beam coverage, channelization and frequency reuse. The very purpose of deriving an exclusion zone is to determine at what locations the earth stations can operate. Hence, the locations are by definition not known in advance. The same is true for the locations of blanket licensed earth stations. In both cases, parties conducting coordination need to carry out analysis to determine an exclusion zone that achieves compatibility.

Iridium's claims are exaggerated or false (2/2)

Claim	Fact
"the shape and orientation of interference zones vary by the altitude and flight path of each interfering GSO terminal, meaning that GSO operators would have to ensure that their constantly moving ESIMs comply with constantly changing exclusion zones"	Exclusion zones can be derived for different altitudes, e.g. ground and 10,000 meters. A composite exclusion zone can be determined based on the envelope of the two boundary cases.
"when individual ESIM terminals communicate at different times, they multiply the number of short-term interference events that erode each GSO network's allotment of Iridium's short-term protection criterion"	This issue is also applicable to fixed earth stations and it only occurs if two or more earth stations operate in the same NGSO MSS feeder link channel, either on different frequencies or at different times (if TDMA is used). This can easily be addressed by using appropriate assumptions.
"there is no means to determine whether individual ESIM terminals interfering at different times create, in the aggregate, excessive interference into the Iridium system, because the number and location of the ESIMs remain unknown"	If an exclusion zone is derived based on the methodology described below, the movement of ESIMs (away from the exclusion zone boundary) will reduce interference levels into the NGSO MSS feeder link.

ESIM and Iridium FL stations can coexist

- Iridium FL operations are at defined locations and in the U.S. use of 29.25-29.3 GHz band is limited to three earth station sites in AZ, HI and AK
- All agree that coordination, based on the use of exclusion zones, is feasible between blanket licensed GSO FSS fixed earth stations whose locations are unknown and a NGSO MSS feeder link earth station
- Exclusion zones for ESIMs, including Aero-ESIM, around NGSO MSS FL earth stations can be determined in essentially the same way, and will resemble those for blanket licensed earth stations
- The following conservative analysis was done only for the purposes of demonstrating the feasibility of coordination under near worst-case assumptions. In practice, actual inter operator coordination will utilize more specific inputs, which may lead to even more favorable coordination results.

Exclusion Zones around Iridium FL sites

Simulation analysis performed to determine difference between exclusion zone for ESIMs at ground level and aeronautical ESIMs (“A-ESIM”) at an altitude of 10 km (cruising altitude)

- Simulations were run on Visualyse software to produce statistics of interference from ESIMs into Iridium feeder uplinks;
- In this example, simplified exclusion zones were generated using eight sample points in different azimuth directions relative to an Iridium gateway (during coordination more points may be generated to improve the granularity)
- Multiple ESIMs transmitting co-frequency with the Iridium earth station;
- ESIMs are assumed to be static and operating continuously – this is over simplified and will result in an over estimation of the exclusion zone since the interference is time varying but is provided as an outer case;
- In order to determine ESIM locations that fulfil the I/N criteria, simulations were run with the ESIMs located at different points along the chosen azimuth;
- Simulation parameters: 500 ms time step, 15 day duration;
- System parameters and I/N criteria assumptions as shown in the next slide;

Assumptions

Iridium system

Satellite
Height: 780 km
Inclination angle: 86.4 degrees
No. of satellites per plane: 11
No. of planes: 6
Satellite separation within plane: 32.7°
Satellite phasing between planes: 31.6°
Minimum elevation: 8°
Satellite rx antenna gain: 30.1 dBi
System noise temperature: 1295 K
Antenna gain pattern: ITU-R Rec. 465-5

Earth station
Example location at 33°N, -111°E

Carrier
Bandwidth: 7.5 MHz
No. of carrier: 1

Interference Criteria
Based on ITU-R Rec 1323

GSO system

Satellite
Orbital location: 150°W

Earth station
Altitude: 0 m (Land terminal), 10 km (Aero ESIM)
Tx gain: 43.4 dBi (60 cm diameter)
Antenna pattern: ITU-R Rec. 580-6
Maximum p.s.d: -56.5 dBW/Hz

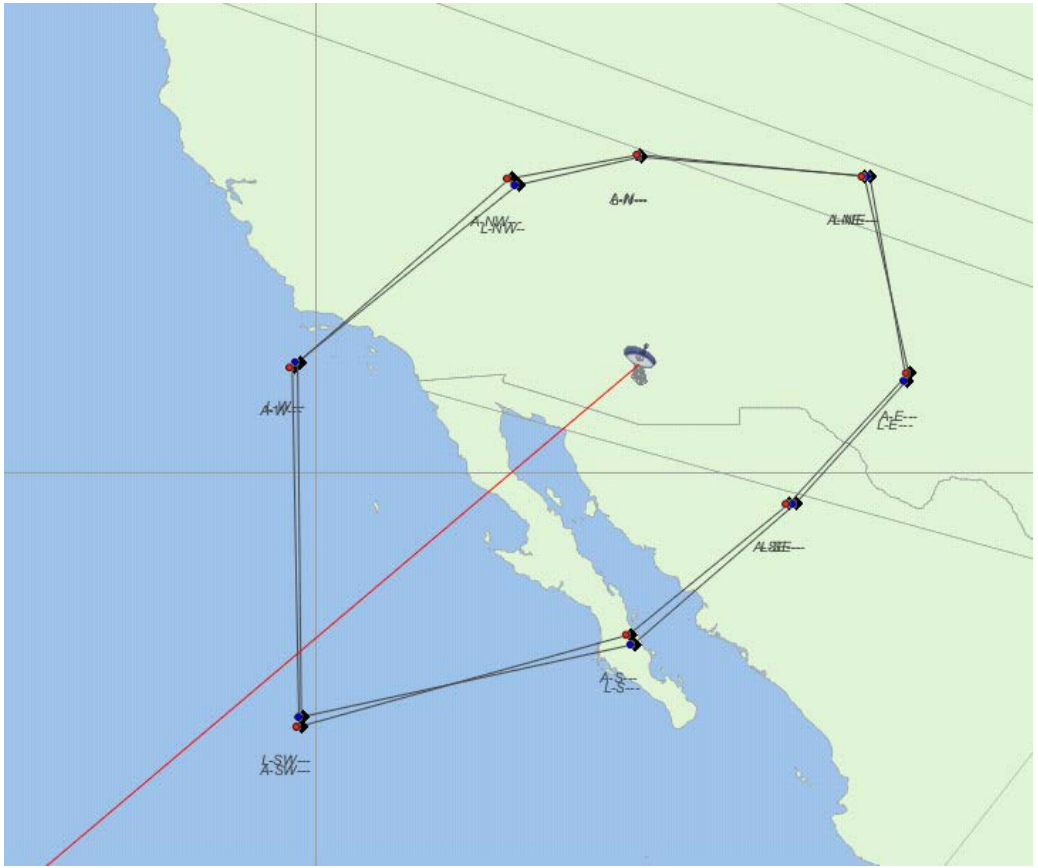
Carrier
Bandwidth: 2.5 MHz
No. of carrier: 3 (i.e. three adjacent earth stations in order to address the multiple short-term interference issue – see p. 6)

Exclusion zone (1/2) Diagram

- Land terminal test point
- A-ESIM test point

Direction towards the GSO satellite

Note: More test points can be included as required



Exclusion zone (2/2)

Distance (on the ground) from the exclusion zone test points to the Iridium earth station

Direction	Land UT(km)	Aeronautical ESIM (km)	Delta (L --> A)	Delta %
North	640.8	647.2	6.4	+1.0%
North east	818.6	810.3	-8.3	-1.0%
East	696.4	699.3	2.9	+0.4%
South east	597.5	585.8	-11.7	-2.0%
South	866.6	837.5	-29.1	-3.4%
South west	1425.4	1455.2	29.8	+2.1%
West	885.9	900.9	15.0	+1.7%
North west	633.1	659.7	26.6	+4.2%

Area

Land UT(km^2)	Aeronautical ESIM (km^2)	Delta (L --> A)	Delta %
1,953,334	1,958,971	-5.637	+0.3%

Discussion of Analysis

- The exclusion zone difference between the Land UT and A-ESIM in the example scenario is very small, i.e.
  - ✓ Less than 5% change of distance to the Iridium earth station;
  - ✓ Less than 0.5% change of area of the zone.

- The analysis provided was very conservative but demonstrates that coordination is feasible

- Actual coordinated exclusion zones will depend on specific GSO characteristics, protection criteria of NGSO MSS FL and other assumptions, including more modelling the movement of ESIMs, that would reduce required exclusion zones

Conclusions

- Sharing with Iridium in the 29.25-29.3 GHz band in the vicinity of FL gateways is possible
- Iridium's objections to the use of the 29.25-29.3 GHz band by ESIMs are unfounded
- Existing methods can be used to calculate exclusion zones for ESIMs similar to those for blanket licensed fixed VSAT
- The Commission should adopt its proposal in the NPRM and allow ESIM operations in the 29.25-29.3 GHz bands subject to coordination under 47 CFR §§25.258