

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

In the Matter of )  
 )  
Amendment of the Commission's Rules with ) GN Docket No. 12-354  
Regard to Commercial Operations in the )  
3550-3650 MHz Band )

To: The Commission

**PETITION FOR RECONSIDERATION  
OF THE SATELLITE INDUSTRY ASSOCIATION**

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## SUMMARY

SIA seeks reconsideration of a number of the rules and policies set forth in the Commission's Report and Order regarding terrestrial wireless services in the 3.5 GHz band. These changes are needed to fulfill the Commission's commitment to ensuring that the introduction of new services does not disrupt incumbent satellite operations.

First, the Commission should revise its technical rules for CBRS to avoid a significant increase in the separation distances needed to protect FSS earth stations. The Order departs from prior proposals regarding out-of-band emissions and power levels and permits unlimited antenna height for Category B CBSDs, and these changes necessarily will require greater distances between CBRS facilities and earth stations. In particular, the upward shift of the strictest OOB limit to permit significant roll-off energy in the lower 20 MHz of the conventional C-band was adopted without adequate notice under the APA and places at risk both the commercial FSS services and the critical satellite telemetry conducted in that band segment. To prevent interference to these essential operations, separation distances between CBRS devices and the thousands of conventional C-band earth stations will need to be almost quadrupled, to more than 15 km. SIA recommends that the Commission instead reconsider these CBRS rules and revert to its prior proposals, allowing more modest separation distances.

The Commission must take steps to fill the significant holes in the framework for preventing and addressing interference. Perhaps the most glaring omissions are the Order's silence on the procedure for earth stations to report interference and the absence of timelines for expeditious resolution of such issues. The rules permit excessive delay for a CBRS device to respond to a command from the SAS to cease or alter the device's transmission characteristics as needed to correct or prevent interference: a sixty second time gap is too long to allow interference to go unchecked. The Order also lacks an automatic shut-off rule applicable if a

CBSD loses contact with the SAS or malfunctions. The Commission must correct these deficiencies.

The Order's provisions with respect to ensuring the accuracy of CBSD location information are significantly flawed as well. In particular, many of the shortcomings described by the National Association of Broadcasters regarding the TV white spaces rules have been replicated in the CBRS framework. To prevent the abuses NAB has highlighted, the Commission should require all CBSDs to incorporate geo-location technology and mandate that each SAS database administrator verify location data and expeditiously resolve any inconsistencies. Moreover, the Commission must revise Section 96.39(a)(3) to decrease the time interval for a CBSD to report a location change and to make clear that either a horizontal or vertical change in position must be reported if it exceeds the rule's parameters.

Substantial revision is also needed to the Order's provisions regarding protection of FSS earth stations. In particular, the record does not support imposing an annual registration obligation on thousands of earth station licensees in order for those stations to receive interference protection. Instead, SAS Administrators should derive the necessary technical information regarding earth station operations from the Commission's IBFS database. Moreover, the Commission must clarify Section 96.21 to ensure that earth stations in the 3.65 GHz band are adequately protected from interference and to better explain the two-phase process in the rule for shifting from application of the Part 90 protection criteria to those in Part 96. The Commission must also take steps to ensure that receive-only earth stations in the conventional C-band are not subject to harmful interference, which may justify a one-time registration requirement for such stations. If the Commission decides to retain annual registration for earth station licensees, it must at least revise Section 96.17(d) to allow a range of azimuth and elevation angles to be reported, consistent with the flexibility granted in earth station licenses. A mechanism for

registering new conventional C-band earth stations will also be needed, and the timing of the registration requirement should be clarified.

The Commission must take steps to accommodate future FSS operations as well. In particular, the Commission should grant co-primary status to any new 3.5 GHz earth stations in order to permit satellite operators to respond to customer demand. At a minimum, the Commission must make clear that earth station licensees are permitted to replace equipment as needed and retain their interference protection rights.

Finally, the Commission should strengthen protection of foreign FSS operations. SIA has emphasized the need to respect foreign administrations' ability to make their own spectrum decisions with respect to the 3.5 GHz band. Consistent with that objective, the Commission should require prior coordination of terrestrial 3.5 GHz operations close to U.S. borders.

TABLE OF CONTENTS

SUMMARY .....i

I. THE ORDER’S TECHNICAL RULES FOR CBSD OPERATION WILL SIGNIFICANTLY INCREASE THE SEPARATION DISTANCES NECESSARY TO PROTECT SATELLITE NETWORKS.....2

A. The Order’s Out-of-Band Emission Rule Is Substantively and Procedurally Defective .....3

1. The Placement of the OOBE Band Edges Will Put Critical Satellite Services at Risk.....3

2. The OOBE Rule Was Adopted Without Appropriate Notice.....5

B. The Maximum EIRP Permitted for Non-Rural Category B CBSDs Is Excessive .....6

C. The Order Permits Unlimited Antenna Height for Category B CBSDs .....7

D. Unless these Provisions are Reconsidered, Large FSS Protection Zones Will Be Needed .....7

II. THE ORDER DOES NOT ESTABLISH NECESSARY PROVISIONS FOR IMMEDIATELY ADDRESSING POTENTIAL OR ACTUAL INTERFERENCE.....10

A. The Order Does Not Include a Mechanism for Requiring Termination of CBSD Operations when an Interference Event Occurs.....10

B. The Rules Permit Excessive Delay in Responding to SAS Instructions .....11

C. The Commission Should Add an Automatic Shut-Off Rule .....12

III. THE ORDER’S REQUIREMENTS REGARDING CBSD LOCATION INFORMATION ARE INADEQUATE .....13

A. Experience in the TVWS Context Highlights the Difficulty of Ensuring the Reliability and Accuracy of CBSD Location Data .....13

B. Section 96.39(a)(3) Must Be Corrected and Revised .....15

IV.	THE ORDER’S EARTH STATION REGISTRATION PROVISIONS MUST BE REVISED TO REFLECT THE FSS LICENSING FRAMEWORK AND ELIMINATE UNREASONABLE BURDENS ON FSS LICENSEES.....	16
A.	The Record Does Not Justify Requiring Annual Registration of Licensed Earth Stations.....	17
B.	The Commission Must Clarify the Protection Regime for 3.65 GHz Earth Stations .....	18
C.	One-Time Registration Is Appropriate for Receive-Only Earth Stations.....	20
D.	If Section 96.17(d) Is Retained, It Must Be Revised and Clarified.....	21
V.	THE COMMISSION MUST REVISE THE RULES AS NEEDED TO ACCOMMODATE FUTURE CHANGES IN FSS OPERATIONS .....	22
A.	Future FSS Earth Stations Should Be Co-Primary in the 3.5 GHz Band .....	22
B.	At a Minimum, the Commission Must Clarify the Rules to Permit FSS Earth Station Licensees to Replace Equipment as Needed.....	23
VI.	THE RULES DO NOT PROVIDE SUFFICIENT PROTECTION OF FOREIGN FSS OPERATIONS .....	24
VII.	CONCLUSION.....	25
	TECHNICAL ANNEX	

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**PETITION FOR RECONSIDERATION  
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The Satellite Industry Association (“SIA”),<sup>1</sup> pursuant to Section 1.429 of the Commission’s rules, 47 C.F.R. § 1.429, hereby submits this Petition for Reconsideration of the Commission’s Report and Order in the above-captioned proceeding.<sup>2</sup> In order to fulfill its commitment to ensuring that newly authorized terrestrial wireless services in the 3550-3700 MHz band (“3.5 GHz band”) do not disrupt primary Fixed-Satellite Service (“FSS”)

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<sup>1</sup> SIA is a U.S.-based trade association providing worldwide representation of the leading satellite operators, service providers, manufacturers, launch services providers, and ground equipment suppliers. Since its creation twenty years ago, SIA has advocated for the unified voice of the U.S. satellite industry on policy, regulatory, and legislative issues affecting the satellite business. For more information, visit [www.sia.org](http://www.sia.org). SIA Executive Members include: The Boeing Company; The DIRECTV Group; EchoStar Corporation; Intelsat S.A.; Iridium Communications Inc.; Kratos Defense & Security Solutions; LightSquared; Lockheed Martin Corporation; Northrop Grumman Corporation; SES Americom, Inc.; SSL; and ViaSat, Inc. SIA Associate Members include: ABS US Corp.; Airbus DS SatCom Government, Inc.; Artel, LLC; Cisco; Comtech EF Data Corp.; DRS Technologies, Inc.; Eutelsat America Corp.; Glowlink Communications Technology, Inc.; Harris CapRock Communications; Hughes; iDirect Government Technologies; Inmarsat, Inc.; Kymeta Corporation; Marshall Communications Corporation.; MTN Government; O3b Limited; Orbital ATK; Panasonic Avionics Corporation; Row 44, Inc.; TeleCommunication Systems, Inc.; Telesat Canada; TrustComm, Inc.; Ultisat, Inc.; Vencore Inc.; WorldVu Development LLC (OneWeb) and XTAR, LLC.

<sup>2</sup> *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Report and Order and Second Further Notice of Proposed Rulemaking, GN Docket No. 12-354, FCC 15-47 (rel. Apr. 21, 2015) (“Order” and “Second Further Notice”).

operations in this spectrum and in adjacent bands, the Commission must make critical revisions to the framework for the Citizens Broadband Radio Service (“CBRS”).

Throughout this proceeding, the Commission has properly recognized that any action to introduce new terrestrial services in the 3.5 GHz band must be tailored to ensure that primary satellite services in the band and in adjacent spectrum are not put at risk.<sup>3</sup> As adopted, however, the regulatory framework for the 3.5 GHz band falls well short of that objective. The Commission has omitted significant protections needed to lower the risk of harmful interference to satellite operations and has completely failed to put into place procedures for addressing interference if and when it occurs. Moreover, the rules unduly burden satellite services and do not provide appropriate accommodation for satellite network growth and evolution.

SIA urges the Commission to reconsider and/or clarify its rules to correct these deficiencies. Without material changes, the 3.5 GHz regulatory regime could have significant adverse effects on satellite service offerings that are critical to the national and global communications infrastructure.

**I. THE ORDER’S TECHNICAL RULES FOR CBSD OPERATION WILL SIGNIFICANTLY INCREASE THE SEPARATION DISTANCES NECESSARY TO PROTECT SATELLITE NETWORKS**

The Order does not establish a complete framework to prevent interference to FSS operations, seeking additional comment in the Second Further Notice on issues relating to appropriate protection criteria and other matters.<sup>4</sup> However, the Order does decide a number of issues regarding CBRS technical characteristics that will significantly affect the interference impact of new 3.5 GHz terrestrial operations on FSS earth stations. Unless the Commission

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<sup>3</sup> See, e.g., Order at ¶ 4.

<sup>4</sup> Second Further Notice at ¶¶ 436-445.



reconsiders these decisions, the necessary result will be larger separation distances to prevent disruption of essential satellite services.

**A. The Order’s Out-of-Band Emission Rule Is Substantively and Procedurally Defective**

The Order contains out-of-band emission (“OOBE”) limit provisions that differ materially from the Commission’s prior proposals. As adopted, the OOBE rule is a threat to important satellite operations in the conventional C-band (3700-4200 MHz), including the telemetry necessary for safe launch and operation of spacecraft. Because the Commission did not invite comment on alternatives to its originally proposed OOBE band edges, the rule as adopted was premised on an inadequate record and fails to comply with the Administrative Procedures Act (“APA”).

**1. The Placement of the OOBE Band Edges Will Put Critical Satellite Services at Risk**

The Further Notice proposed OOBE limits of increasing strictness at specific frequencies, with the most stringent constraints applicable beginning above 3680 MHz and below 3520 MHz.<sup>5</sup> The Commission made clear that these OOBE limits were intended to provide a higher level of protection to vulnerable FSS operations in the 3.5 GHz band and the adjacent conventional C-band.<sup>6</sup> As proposed, the OOBE framework would have ensured that emissions from new 3.5 GHz terrestrial operations would be strictly limited starting 20 MHz below the lower edge of the conventional C-band at 3700 MHz.

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<sup>5</sup> *Amendment of the Commission’s Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Further Notice of Proposed Rulemaking, GN Docket No. 12-354, FCC 14-49, 29 FCC Rcd 4273 (2014) (“Further Notice”) at 4298-99, ¶¶ 81-84 and proposed § 96.38(d).

<sup>6</sup> *See id.* at 4298, ¶ 82 (recognizing the need for CBRS “operations to protect incumbent and dissimilar radio services with sensitive weak signal receivers such as in-band and out-of-band FSS earth stations”).

Instead, however, the Commission chose to shift the OOB limits significantly and place the cut-off for the strictest constraints well within the conventional C-band at 3720 MHz.<sup>7</sup> This decision was completely unjustified by the record and directly contradicts the Commission's stated goal of using the OOB limits to protect sensitive C-band FSS operations.

This unwarranted shift of the OOB limit band edges poses a threat to signals relied on for safe satellite operations. As adopted, the OOB rule permits much higher emissions within the 3700-3720 MHz edge of the conventional C-band than were suggested in the Further Notice.<sup>8</sup> Because satellite telemetry, tracking and command ("TT&C") operations are required to be performed in band-edge spectrum,<sup>9</sup> C-band satellites typically rely on a telemetry carrier close to 3700 MHz. These carriers convey information about the health and operation of the satellite, including data regarding the satellite's position that is essential to maintain a satellite within its prescribed operational volume and prevent collisions with other space objects. Interference to telemetry resulting from 3.5 GHz CBRS operations at the power levels permitted under the new OOB rule could therefore significantly disrupt a satellite operator's ability to safely launch and fly its spacecraft in conformance with Commission requirements.

The higher emission levels permitted in the 3700-3720 MHz band also could compromise the use of a material portion of a C-band satellite's commercial capacity. In particular, satellite transponders using the lower 20-MHz portion of the conventional C-band would be at risk of interference due to the higher energy roll-off permitted in this band segment and may therefore be unusable or usable only if leased at a substantial discount. Given the significant investment

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<sup>7</sup> Order at ¶ 184 and § 96.41(e).

<sup>8</sup> Specifically, the Order allows emissions in this band segment of -25 dBm/MHz, while the Further Notice proposed that emissions be limited to -40 dBm/MHz in any spectrum above 3680 MHz. *See id.* at ¶¶ 176 & 184.

<sup>9</sup> 47 C.F.R. § 25.202(g).

the satellite industry has made in C-band capacity and the importance of these services, a material decrease in reliability of satellite networks in this portion of the band would have far-reaching adverse effects. As adopted, the OOB rule will undercut, not advance, the stated objective of protecting sensitive FSS receivers.

## **2. The OOB Rule Was Adopted Without Appropriate Notice**

Neither SIA nor satellite service customers addressed these risks in their prior comments because the Further Notice contained no indication that the Commission would be considering an OOB rule that permitted roll-off energy within the conventional C-band. The only OOB option discussed in either the text or the proposed rule at the Further Notice stage was one in which all emissions from Citizens Broadband Radio Service Devices (“CBSDs”) and End User Devices outside of a channel assigned by the Spectrum Access System (“SAS”) were required to be attenuated by a factor of  $43 + 10 \log (P)$  dB, equivalent to -13 dBm/MHz, with a stricter limit of -40 dBm/MHz for emissions above 3680 MHz and below 3520 MHz.<sup>10</sup>

The Further Notice sought general comment on the appropriateness of these limits, including the OOB levels and the size of the “transition gap” appropriate for implementing the strictest OOB limits, but did not articulate specific alternative options to be considered. In particular, even though the Further Notice again raised the possibility of extending the proposed 3.5 GHz framework to the 3650-3700 MHz band,<sup>11</sup> nowhere did it suggest that such an extension would lead to an upward shift in the frequency designations at which the strictest OOB limits would apply. The Further Notice’s silence on this critical issue deprived SIA and other prospective commenters of the reasonable opportunity to raise concerns about such a shift.

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<sup>10</sup> Further Notice, 29 FCC Rcd at 4298-99, ¶¶ 81-84 and proposed § 96.38(d).

<sup>11</sup> *Id.*, 29 FCC Rcd at 4322-24, ¶¶ 163-69.

Instead, the Commission observes for the first time in the Order that it “must consider the OOB limits in context of our decision to include the 3650-3700 MHz band as part of the 3.5 GHz band.”<sup>12</sup> The APA clearly requires that an agency must provide interested parties with notice that includes “either the terms or substance of the proposed rule or a description of the subjects and issues involved.”<sup>13</sup> The courts have held that an agency must “describe the range of alternatives being considered with reasonable specificity.”<sup>14</sup> While “a final rule need not be an exact replica of the rule proposed in the Notice, the final rule must be a ‘logical outgrowth’ of the rule proposed.”<sup>15</sup> If “the final rule deviates too sharply from the proposal, affected parties will be deprived of notice and an opportunity to respond to the proposal.”<sup>16</sup>

In this case, the Further Notice did not even contemplate the possibility of a 40 MHz upward shift in the demarcation point for the strictest OOB levels. The rule as adopted was neither expressly set forth in the Further Notice nor a “logical outgrowth” of the proposed rule. This lack of meaningful notice is fatal to the rule’s validity.

**B. The Maximum EIRP Permitted for Non-Rural Category B CBSDs Is Excessive**

Other rule provisions also depart from the proposals in the Further Notice and will raise the risk of FSS service disruption. Section 96.41(b) specifies a maximum EIRP of 40 dBm/10 MHz for Category B CBSDs operating in a non-rural area.<sup>17</sup> In contrast, the Further Notice proposed a maximum EIRP of 30 dBm/10 MHz for non-rural CBSD devices that are not

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<sup>12</sup> Order at ¶ 186.

<sup>13</sup> 5 U.S.C. § 553(b)(3).

<sup>14</sup> *Time Warner Cable Inc. v. FCC*, 729 F.3d 137, 170 (2d Cir. 2013), quoting *Prometheus Radio Project v. FCC*, 652 F.3d 431, 450 (3d Cir. 2011).

<sup>15</sup> *National Black Media Coal. v. FCC*, 791 F.2d 1016, 1022 (D.C. Cir. 1986) (citations omitted).

<sup>16</sup> *Id.* (citations omitted).

<sup>17</sup> Order at ¶ 209 & § 96.41(b).

designated as fixed point-to-point systems.<sup>18</sup> Thus, the EIRP limit adopted in the Order for non-rural Category B devices is substantially higher than was previously discussed in the Further Notice. This higher EIRP for Category B CBSDs will increase the potential for interference to incumbent FSS operations.

**C. The Order Permits Unlimited Antenna Height for Category B CBSDs**

The Order does not specify a maximum allowed antenna height above average terrain (“HAAT”) for either rural Category B CBSDs, which are authorized to operate at 47 dBm EIRP, or for non-rural Category B CBSDs, which can have an EIRP up to 40 dBm.<sup>19</sup> As SIA and other commenters have observed, the maximum allowed antenna height is an important component of the interference assessment.<sup>20</sup> Like the other rule sections discussed above, the absence of a limit on HAAT for Category B CBSDs will increase the potential for interference to incumbent FSS operations.

**D. Unless these Provisions are Reconsidered, Large FSS Protection Zones Will Be Needed**

In each case discussed above, the Commission’s decisions to grant increased operational flexibility to 3.5 GHz devices come at a clear cost. Unless the Commission modifies the rules on reconsideration, these provisions substantially increase the separation distances that will be required to ensure that FSS operations are not disrupted.

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<sup>18</sup> Further Notice, 29 FCC Rcd at 4345, proposed § 96.38(b).

<sup>19</sup> Order at ¶ 213; *see also* § 96.43(a) (imposing a 6 meter height limit for Category A CBSDs) and § 96.45 (no height limit specified for Category B CBSDs).

<sup>20</sup> *See, e.g.,* SIA *Ex Parte* Presentation in GN Docket No. 12-354 filed Oct. 15, 2014 at 2 (noting that “the vertical positioning of a CBRS device is particularly important to assessing interference potential”); *see also* Reply Comments of Federated Wireless, Inc. in GN Docket No. 12-354 filed Aug. 15, 2014 at 12 (observing that the interference risk from an emitter on the 32<sup>nd</sup> floor is much greater than for a device in the basement).

Specifically, because the Order shifted the OOB limit demarcations from what was proposed in the Further Notice, allowing a higher level of out-of-band emissions from new 3.5 GHz devices to fall within the heavily-used conventional C-band spectrum, the Commission will need to implement larger separation distances between 3.5 GHz operations and thousands of vulnerable FSS receivers. The Order specifically recognizes this risk, rejecting its originally proposed 30 megahertz transition gap because “there would be a significant impact on the required separation distance between CBSDs operating just below 3700 MHz, and C-band earth station receivers operating between 3700-3730 MHz.”<sup>21</sup> But the decision to adopt a 20 MHz instead of a 30 MHz transition gap did not eliminate or even reduce this impact – greater distances will still be needed to protect conventional C-band earth stations. Increased separation distances will be especially important to avoid disruption of the C-band infrastructure and of the TT&C functionality that is critical for safe spacecraft operation.

SIA previously submitted an evaluation by RKF Engineering of the interference effects of out-of-band emissions above 3700 MHz using the stricter limit of -40 dBm/MHz for emissions above 3680 MHz proposed in the Further Notice. This analysis resulted in separation distances on the order of 4 km for FSS operations above 3700 MHz and at earth station elevation angles of 5 degrees.<sup>22</sup>

SIA asked RKF Engineering to perform an updated study to assess the effects of the new OOB limit structure adopted by the Commission that shifted the OOB limits significantly and placed the OOB constraint breakpoints well within the conventional C-band at 3720 MHz. RKF Engineering reviewed a sample of existing operating channels within 3700-3720 MHz and

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<sup>21</sup> Order at ¶ 188.

<sup>22</sup> SIA Comments in GN Docket No. 12-354 filed July 14, 2014 at 18 & attached Technical Annex, Section 2.2, Figure 12.

the OOB levels as adopted by the Commission, which would permit a CBSD to have out-of-band emissions of -13 dBm/MHz at 3700 MHz; -25 dBm/MHz at 3710 MHz; and -40 dBm/MHz at or above 3720 MHz.<sup>23</sup>

Using these parameters, the interference power level affecting the lowest frequency FSS earth station channel within 3700-3720 MHz was calculated. That channel was chosen because the OOB interference power is greatest there. The separation distance was then recalculated based on this highest level of interference. Assuming all parameters were constant other than the new OOB limit, the analysis found that using the new OOB limits resulted in a separation distance of over 15 km for an FSS Earth station operating above 3700 MHz at an elevation angle of 5 degrees.<sup>24</sup> This represents an increase of over 11 km in the separation distance needed to protect the thousands of FSS earth stations above 3700 MHz.

Like the change in the OOB rule, the higher-than-proposed EIRP for non-rural Category B CBSDs and the choice not to impose a limit on antenna height for any Category B CBSDs will also increase necessary protection zones to prevent in-band and out-of-band interference. SIA urges the Commission instead to reconsider these rule provisions and revert to the original proposals in the Further Notice in order to reduce the threat to FSS operations and the size of the required protection zones.

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<sup>23</sup> Order at ¶ 184.

<sup>24</sup> See attached Technical Annex, Report of RKF Engineering Solutions, LLC, at 2-4.

## **II. THE ORDER DOES NOT ESTABLISH NECESSARY PROVISIONS FOR IMMEDIATELY ADDRESSING POTENTIAL OR ACTUAL INTERFERENCE**

The Order recognizes the enforcement challenges presented by the complicated, multi-tier framework for CBRS networks.<sup>25</sup> As adopted, however, the new rules are devoid of meaningful measures to address the threat of interference to FSS and other incumbent operations.

### **A. The Order Does Not Include a Mechanism for Requiring Termination of CBSD Operations when an Interference Event Occurs**

The Order is completely silent as to what steps an FSS earth station operator should take if it experiences interference from CBRS devices. The Order expressly contemplates that the SAS may be unable to resolve disputes regarding claims of interference or to identify the source of interference, and states that in such an event, the Commission will step in.<sup>26</sup> The Commission fails, however, to provide any procedural mechanism for resolving such disputes, or to specify any timetable for doing so. For example, is the incumbent operator expected to call the Commission to report an interference event? Will the Commission then contact all the SAS Administrators? How long will the responsible SAS have before it must order a CBSD to shut down? How will the database know which CBSD to shut down, particularly in the event of aggregate interference?

An incumbent satellite network and its customers should not be subject to harmful interference for an indefinite length of time before it is resolved. Broadcast customers, for example, cannot accept the risk of outages of undetermined length. A satellite operator cannot lose telemetry information being received, especially during launch and early orbit phase (“LEOP”) or drift operations, for an indeterminate length of time, as that puts satellite health and orbital safety at risk.

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<sup>25</sup> Order at ¶ 349.

<sup>26</sup> *Id.* at ¶ 352.



As observed in a recent petition for rulemaking, the Commission’s record of handling interference disputes does not instill confidence that such matters will be addressed promptly and with the necessary transparency.<sup>27</sup> The Commission cannot simply leave these critical matters to be fleshed out at a later time – particularly a time when an incumbent operator is experiencing ongoing interference. Instead, a specific set of procedures must be in place to ensure that interference events will be addressed expeditiously. Among other things, the Commission must determine to whom interference complaints should be addressed, and should put in place procedures that require immediate suspension of CBSD operations pending investigation. In addition, the Commission should set strict time deadlines for ultimate resolution of an interference complaint.

**B. The Rules Permit Excessive Delay in Responding to SAS Instructions**

Even assuming a framework were in place for ensuring that the SAS would quickly require a CBRS device to stop transmitting or make other changes to prevent or rectify interference to an FSS earth station, the Order permits a significant delay before the device must comply with such an instruction. Specifically, Section 96.39(c)(2) states that a CBSD “must cease transmission, move to another frequency range, or change its power level within 60 seconds as instructed by an SAS.”<sup>28</sup>

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<sup>27</sup> Samuelson-Glushko Technology Law & Policy Clinic and J. Pierre de Vries, Petition for Rulemaking: Spectrum Interference Dispute Resolution, RM-11750 (May 8, 2015) at 7-9 (describing past cases in which the Commission failed to address interference issues in a fact-based, transparent, and timely manner). Although SIA does not support the petition’s proposed solution of using an Administrative Law Judge procedure for satellite and earth station matters (*see* SIA Comments in RM-11750 filed July 13, 2015), the petition does highlight significant flaws in the Commission’s current approach to interference matters.

<sup>28</sup> Order, § 96.39(c)(2).

The Commission does not explain why such a lengthy interval is needed for a CBRS device to respond to an SAS command, especially given the adverse consequences of such delay. Sixty seconds is simply too long to wait before acting to prevent an interference event and too long to permit interference that is already occurring to go unaddressed. An outage of even one minute suffered by an incumbent satellite operator is unacceptable and could have serious implications. For example, interruption of satellite telemetry information during LEOP or drift operations could undermine safe satellite operation.

The risk of damage to satellite operations is heightened further because this provision is not the only source of delay built into the CBRS framework. Instead, the sixty-second period for responding to commands would be added to the time required by the SAS to make the necessary interference calculations that would lead to its issuing the termination or modification command. If the command is being issued in response to relocation of a CBRS device, Section 96.39(a)(3) permits an additional 60 seconds for the device to determine and communicate its position change. One must also add in the time necessary for communications among SAS Administrators if the CBRS operations in an area are controlled by different SAS providers. The cumulative effect of these delays in addressing interference could be extremely serious.

The Commission must not sanction such unacceptable time lags in dealing with prospective or actual interference. Instead, the Commission should revise Section 96.39(c)(2) to significantly reduce the period for a CBRS device to respond to an SAS command.

### **C. The Commission Should Add an Automatic Shut-Off Rule**

The current regulatory framework does not address a situation in which a CBRS device loses contact with the SAS or suffers an operational failure. In such a circumstance, the rules should require the CBRS device to cease transmissions immediately. For example, Section 15.407(c) requires that unlicensed national information infrastructure devices “shall

automatically discontinue transmission in case of either absence of information to transmit or operational failure.”<sup>29</sup> A similar mandate should apply to all CBRS devices.

### **III. THE ORDER’S REQUIREMENTS REGARDING CBSD LOCATION INFORMATION ARE INADEQUATE**

As the Order recognizes, “[a]ccurate CBSD location is essential for coordinating interactions between and among users in the band and for protecting Incumbent Users from harmful interference.”<sup>30</sup> However, the Order’s provisions regarding location data are fundamentally flawed.

#### **A. Experience in the TVWS Context Highlights the Difficulty of Ensuring the Reliability and Accuracy of CBSD Location Data**

The Order adopts a definition of CBSDs that allows only fixed devices, not portable devices as proposed in the prior Further Notice.<sup>31</sup> The Order goes on to define a fixed station as a device operating at a fixed location that may be moved from time to time but must turn off and re-register with the SAS prior to transmitting from a new location.<sup>32</sup> The Commission seems to assume that limiting CBSDs to fixed stations will facilitate the management of interference because SAS Administrators will always know where all the CBSDs are. However, there is no evidence of the feasibility of ensuring that a CBSD’s reported initial location is accurate or that the device cannot be moved a significant distance without re-registering its new location. To the contrary, the problems that that National Association of Broadcasters (“NAB”) has identified

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<sup>29</sup> 47 C.F.R. § 15.407(c).

<sup>30</sup> Order at ¶ 220.

<sup>31</sup> Order, § 96.3 (defining CBSDs as fixed stations or networks of fixed stations); *cf.* Further Notice, proposed § 96.3 (defining CBSDs as fixed or portable base stations).

<sup>32</sup> Order, § 96.3 (a fixed station “may be moved from time to time but Fixed CBSDs must turn off and re-register with the SAS prior to transmitting from a new location”).

with the television white spaces (“TVWS”) databases<sup>33</sup> suggest that the Commission’s confidence in the efficacy of the Order’s location information requirements is misplaced.

For example, NAB demonstrated that reliance on “professional” installation in the absence of any definition of or qualifications for such installation provides no assurance that location information will be reliable.<sup>34</sup> NAB showed that TVWS device manufacturers were selling equipment directly to consumers online, with no requirement that a professional installer be involved.<sup>35</sup> In one instance, a manufacturer posted its “professional installation manual” online, apparently so that any purchaser of a device could be considered qualified to complete a “professional installation.”<sup>36</sup>

Moreover, NAB showed that there were no checks on data provided in the registration process. NAB recounted examples of reported locations that were blatantly false, including devices registered near Quito, Ecuador, in the Atlantic Ocean off the coast of Cameroon, and in the middle of empty fields.<sup>37</sup> Even after a “clean-up” of the TVWS database was performed in response to NAB’s petition, NAB reported individual devices located well beyond the reasonable communications range of any other device, including one in Lake Michigan.<sup>38</sup> NAB also noted disagreements between database administrators regarding the total number of active TVWS devices, notwithstanding the requirement that the databases harmonize their respective information on a daily basis.<sup>39</sup>

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<sup>33</sup> National Association of Broadcasters Emergency Motion for Suspension of Operations and Petition for Rulemaking, RM-11745, filed Mar. 19, 2015 (“NAB Petition”).

<sup>34</sup> *Id.* at 11.

<sup>35</sup> *Id.* at 12.

<sup>36</sup> *Id.* at 11-12.

<sup>37</sup> *Id.* at 10-11.

<sup>38</sup> NAB *Ex Parte* Presentation in ET Docket No. 14-165 and RM-11745 filed July 2, 2015 at 2.

<sup>39</sup> NAB Petition at 12 & n.26.

The framework in the Order makes no attempt to correct the deficiencies NAB pointed out in the TVWS proceeding. The Commission must rectify that error. Even if the Commission were to adopt a set of requirements for certification as a “professional installer” as some have suggested,<sup>40</sup> it cannot do away with the risk of human error or purposeful manipulation in location reporting. Instead, the Commission should eliminate the option for reporting locations by installers and require all CBRS devices to have a geo-location capability.<sup>41</sup> Moreover, unless the Commission extends the geo-location requirement to End User Devices as well, SAS calculations to protect FSS earth stations from interference will need to be based on worst-case assumptions regarding End User Device locations.<sup>42</sup>

The Commission must also ensure during the SAS review process that the prospective administrator has incorporated verification procedures to check the validity of location data. Finally, each administrator must be required to take steps to investigate and expeditiously resolve any discrepancies discovered during harmonization with other SAS Administrators.

**B. Section 96.39(a)(3) Must Be Corrected and Revised**

Specific changes are also needed to Section 96.39(a)(3), which currently states that a “non-professionally installed CBSD must check its location and report to the SAS any location

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<sup>40</sup> The Wireless Internet Service Providers Association (“WISPA”) has proposed a framework for a certification program for TVWS and CBRS devices. *See* WISPA *Ex Parte* Presentation in ET Docket No. 14-165, GN Docket No. 12-354, and RM-11745 dated July 9, 2015.

<sup>41</sup> Manufacturers of TVWS devices recently joined NAB in supporting a requirement that all TVWS equipment “incorporate automatic geolocation capability or be under the control of a device that includes that capability,” arguing that such a change will “vastly improve the accuracy of the TVWS database and eliminate many of the device and database problems identified in the NAB petition.” *See Ex Parte* Presentation of Adaptrum, Inc., Carlson Wireless Technologies, Inc., Koos Technical Services, Inc., MELD Technology, Inc., and the National Association of Broadcasters in ET Docket No. 14-165 and RM-11745 filed July 17, 2015 at 1.

<sup>42</sup> *See* SIA Comments in GN Docket No. 12-354 filed July 15, 2015 at 7-8.

changes exceeding 50 meters horizontal and  $\pm 3$  meters elevation from its last reported location within 60 seconds of such location change.”<sup>43</sup>

First, allowing a 60-second interval to elapse before a device reports a location change is too long. As discussed above, significant disruption of FSS operations could occur if an interfering signal is permitted to persist for even a minute. Furthermore, this delay will be added on to the time required for the SAS to recalculate the impact of the location change on the interference environment and the time for the CBSD to respond to any new SAS instructions. As a result, the total delay stemming from a location change could be well in excess of 60 seconds, which would clearly be unacceptable.

Second, the rule must reflect the fact that either a horizontal or vertical change will alter the interference analysis. Accordingly, the Commission should substitute the word “or” for the word “and” in this provision, so that it requires reporting of “location changes exceeding 50 meters horizontal or ~~and~~  $\pm 3$  meters elevation.”

#### **IV. THE ORDER’S EARTH STATION REGISTRATION PROVISIONS MUST BE REVISED TO REFLECT THE FSS LICENSING FRAMEWORK AND ELIMINATE UNREASONABLE BURDENS ON FSS LICENSEES**

Section 96.17 establishes a requirement that CBSDs protect authorized FSS earth stations in the 3600-3650 MHz and 3700-4200 MHz bands, but in order to seek protection, the earth station operator must annually register its earth stations and provide detailed technical information.<sup>44</sup> These requirements are unnecessary, unduly burdensome, and inconsistent with the FSS licensing regime.

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<sup>43</sup> Order, § 96.39(a)(3).

<sup>44</sup> Order, § 96.17.

**A. The Record Does Not Justify Requiring Annual Registration of Licensed Earth Stations**

As a threshold matter, the Commission fails to explain why primary satellite licensees should be required to submit an annual registration providing information that is already on file with the Commission in order to qualify for interference protection. Section 96.17(d) requires submission of basic operational parameters, most of which are elements of the earth station license itself – or have been submitted as part of the license application – and none of which changes from year to year.<sup>45</sup> Furthermore, changes in most of this information require license modification through an application filed with the Commission’s IBFS database.

Thus, while it is true that SAS Administrators will need access to earth station operational information, there is no reason they cannot simply obtain it from the Commission’s publicly available IBFS database. Requiring the data to be obtained from IBFS will also ensure consistency and eliminate the risk of data errors being introduced as a result of the annual registration process.

Requiring earth station licensees to submit this data annually in order to be protected from in- and out-of-band interference is a completely unwarranted administrative burden that

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<sup>45</sup> Specifically, an earth station license includes the station’s geographic location, antenna gain, and range of permissible antenna azimuths and elevation angles. The information specified in Section 96.17(d)(iii), “azimuth and elevation antenna gain pattern,” is not included in an earth station license. However, the license does indicate whether a licensed antenna complies with Section 25.209, which specifies the pattern characteristics required for routine licensing. Thus, for compliant antennas, a pattern can be determined based on the specifications in Section 25.209. If an applicant seeks a license for an antenna that does not comply with Section 25.209, it must submit antenna patterns in support of its application. *See* Frequently Asked Questions: Processing of Earth Station Applications, No. 14, available at <http://transition.fcc.gov/ib/sd/esa/faq.html#FAQ14> (“if the proposed antenna does not meet the requirements set forth in Section 25.209(a) and (b), the application must include antenna radiation patterns as specified in Section 25.132(b)(1)). Patterns submitted in support of such applications can be obtained from the Commission’s earth station application database, IBFS.

interposes an obstacle to qualifying for interference protection applicable to incumbent operations. Although there are relatively few earth stations licensed in the 3600-3650 MHz band, there are thousands of licensed conventional C-band earth stations that would be subject to this onerous obligation. The Commission should delete Section 96.17(d) and provide instead that information regarding earth station technical parameters will be made available to SAS Administrators from the Commission's IBFS database and updated routinely when new or modified licenses are granted.

**B. The Commission Must Clarify the Protection Regime for 3.65 GHz Earth Stations**

The scope of Section 96.17 is limited to the protection of earth stations in the 3600-3650 MHz band and the 3700-4200 MHz conventional C-band, and the rule does not address existing earth stations operating at 3650-3700 MHz (the "3.65 GHz band"). Instead, Section 96.21 applies to 3.65 GHz band earth stations. That rule, however, does not provide a clear framework for ensuring 3.65 GHz earth stations do not suffer harmful interference.

As a threshold matter, Section 96.21 does not explain how information regarding 3.65 GHz earth stations will be incorporated into the SAS databases. Unlike Section 96.17, Section 96.21 does not contain a registration requirement for 3.65 GHz earth stations. As SIA has discussed above, there is no reason to require annual registration for either 3.5 GHz or conventional C-band FSS earth stations, and the same is true for 3.65 GHz facilities. However, absent registration, the Commission must make clear that SAS Administrators will be required to collect and maintain information on 3.65 GHz earth stations from the Commission's IBFS licensing database.

Furthermore, the two-phase approach to protection of 3.65 GHz earth stations set forth in Section 96.21(c) requires further explanation. The provision states that initially both



grandfathered wireless broadband licensees authorized in this band and CBRS users must comply with the existing protection criteria in Part 90, subpart Z. SIA assumes that this means no CBRS devices will be permitted within 150 km of a grandfathered 3.65 GHz earth station absent coordination, as specified in Section 90.1331(a).<sup>46</sup> In addition, presumably the power and antenna limits set forth in Section 90.1321<sup>47</sup> would apply to CBRS operations in the 3.65 GHz band during this period. However, the Commission must make these requirements more explicit. The Commission should also provide a process for incorporating any coordination agreements between grandfathered 3.65 GHz earth stations and CBRS users into the SAS databases, as it has done in Section 96.17(e) for agreements between CBRS users and earth stations in other bands.<sup>48</sup>

Section 96.21(c) goes on to provide that protection of 3.65 GHz earth stations pursuant to Part 90 will terminate once “the last Grandfathered Wireless Broadband Licensee’s license expires within the protection area defined for a particular grandfathered FSS earth station.”<sup>49</sup> However, the Order does not explain what this means – is the earth station’s protection area defined by the 150-km radius currently specified in Part 90,<sup>50</sup> or does the term have some other implication? Moreover, it is unclear how the SAS or anyone else will know when the “last” license for a Part 90 wireless broadband provider within the protection area expires, triggering the shift to the Part 96 interference protection regime. On reconsideration, the Commission must clarify these matters.

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<sup>46</sup> 47 C.F.R. § 90.1331(a).

<sup>47</sup> 47 C.F.R. § 90.1321.

<sup>48</sup> Order, § 96.17(e).

<sup>49</sup> Order, § 96.21(c).

<sup>50</sup> 47 C.F.R. § 90.1331(a).

### **C. One-Time Registration Is Appropriate for Receive-Only Earth Stations**

As SIA has previously explained, receive-only earth stations in the conventional C-band communicating with U.S.-licensed satellites or foreign-licensed satellites on the Commission's Permitted Space Station List need not be licensed or registered today.<sup>51</sup> As a result, there is an unknown number of C-band earth stations for which there is currently no information in the IBFS database.

These receive-only stations are entitled to protection from harmful interference from the CBRS. However, the current text of Section 96.17(d) refers only to "earth station licensees" seeking protection from CBRS devices.<sup>52</sup> Thus, the rule could be interpreted as excluding unlicensed receive-only earth stations from its scope.

To address this issue, the Commission should revise Section 96.17 to make clear that interference protection rights extend to unlicensed receive-only C-band earth stations. In order to ensure that SAS Administrators have access to operating parameters for these earth stations, the Commission should establish a registration process, but there is no reason to require such registrations to be submitted annually. Instead, the Commission should adopt a procedure to enable registration of receive-only earth stations on a one-time basis, with the opportunity to update the registration if the technical data subsequently changes. The Commission will need to consider how best to publicize the new registration requirement to ensure that operators of receive-only earth stations have a reasonable opportunity to take action to protect their systems from interference.

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<sup>51</sup> See, e.g., SIA Reply Comments in GN Docket No. 12-354 filed Apr. 5, 2013 at 18.

<sup>52</sup> Order, § 96.17(d).

**D. If Section 96.17(d) Is Retained, It Must Be Revised and Clarified**

As discussed above, Section 96.17(d) should be deleted on reconsideration because it is unjustified and would unduly burden FSS earth station licensees. If the Commission nevertheless retains the rule, substantial revisions will be needed.

First, the Commission must make clear that, consistent with the authority conferred by their licenses, earth station operators can register a range of antenna azimuth and elevation angles. Earth station licensees require the flexibility quickly to repoint their antennas to different satellites in order to meet customer requirements and respond to new opportunities. The Commission has long supported this flexibility by making available an ALSAT designation for antennas operating in the conventional C-band spectrum, authorizing such antennas to communicate with any satellite on the Permitted Space Station List, which includes all U.S.-licensed satellites and all non-U.S.-licensed satellites authorized to serve the U.S.<sup>53</sup> Repointing flexibility is also essential to accommodate LEOP operations and other situations when a satellite is being relocated using the TT&C frequencies at the band edge just above 3700 MHz. Repointing of antennas within the licensed range should not require submission of updated registration information as this would constitute an unwarranted burden on earth station licensees.

In addition, the rule should be revised to address the registration of newly licensed earth stations. The rule provides for protection of conventional C-band earth stations, which will continue to have primary status in the band, but there is no mention of the need to update the list of authorized earth stations when a new conventional C-band antenna is licensed. That omission should be rectified on reconsideration.

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<sup>53</sup> See 47 C.F.R. § 25.103 (definition of the Permitted Space Station List).

Finally, the timing for annual registration of earth stations should be clarified. The rule's current language is confusing, stating that the registration must be submitted "no later than 30 days before the end of the preceding calendar year." If the Commission intends to require registration each year by no later than December 1, it should revise the rule to make that explicit.

**V. THE COMMISSION MUST REVISE THE RULES AS NEEDED TO ACCOMMODATE FUTURE CHANGES IN FSS OPERATIONS**

The Commission should also adjust the rules adopted in the Order to provide critical flexibility for ongoing and evolving FSS operations in the 3.5 GHz band.

**A. Future FSS Earth Stations Should Be Co-Primary in the 3.5 GHz Band**

First, the Commission should reconsider its decision to relegate new 3.5 GHz band earth stations to secondary status and instead allow future earth stations to be established on a co-primary basis with the CBRS. SIA appreciates the Commission's recognition that existing earth station facilities may occasionally need to be moved and its indication that it will consider waivers to facilitate such relocations within a limited distance.<sup>54</sup> However, there is no reason why an FSS operator should have to make a special waiver showing if it seeks to add a future 3.5 GHz earth station in an area where CBRS operations have not developed.

Contrary to the Commission's assumptions, according FSS continuing co-primary status for new earth stations would not undermine the stability of the "spectral ecosystem" for the CBRS.<sup>55</sup> As SIA has shown, the Commission's international-only restriction on 3.5 GHz earth stations has already served to limit the growth of FSS in this spectrum and would continue to do so.<sup>56</sup> In fact, the Commission's list of licensed earth stations in this band shows only a few new

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<sup>54</sup> Order at ¶¶ 37-38 & n.85.

<sup>55</sup> *Id.* at ¶ 38.

<sup>56</sup> *See, e.g.*, SIA Comments in GN Docket No. 12-354 filed Feb. 20, 2013 at 21-22.

earth stations granted within the last five years.<sup>57</sup> Thus, there is no reason to expect that allowing FSS earth stations to retain co-primary status would have a material effect on the ongoing availability of spectrum for CBRN operations.

Permitting new co-primary earth stations would serve the public interest by allowing satellite service providers to make efficient use of existing spacecraft with 3.5 GHz payloads to meet customer demand. The Commission observes that future FSS earth station growth can be accommodated in the conventional C-band,<sup>58</sup> but shifting services to the conventional C-band will not allow recovery of the sunk investment that has already been made in in-orbit 3.5 GHz capacity. Given the cost of installing a new earth station facility, an operator is unlikely to take the risk of constructing a site without co-primary protection from future interfering CBRN operations. Accordingly, the Commission should reconsider its decision regarding the allocation status of future 3.5 GHz earth stations.

**B. At a Minimum, the Commission Must Clarify the Rules to Permit FSS Earth Station Licensees to Replace Equipment as Needed**

At the very least, the Commission must make clear that operators will be allowed to replace currently authorized 3.5 GHz antennas in the ordinary course. The Order expressly contemplates a limited range of modifications that will be permitted to existing earth stations, even when those changes will affect the station's susceptibility to interference.<sup>59</sup> However, this list does not mention antenna replacement. Given antenna lifetimes, it is likely that an operator that needs to replace outdated equipment will not be in a position to replicate the technical parameters of the antenna reaching its end of life. Accordingly, the Commission should

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<sup>57</sup> See list found at <https://www.fcc.gov/cbrn-protected-fss-sites>.

<sup>58</sup> Order at ¶ 38.

<sup>59</sup> *Id.* at ¶ 37.

explicitly authorize modifications to existing 3.5 GHz earth stations that are necessary to accommodate equipment replacement at a grandfathered site.

## **VI. THE RULES DO NOT PROVIDE SUFFICIENT PROTECTION OF FOREIGN FSS OPERATIONS**

SIA has repeatedly emphasized that any approach developed to permit use of 3.5 GHz spectrum on a shared basis with the FSS must apply domestically only.<sup>60</sup> We have noted that U.S. FSS operations in the 3.5 GHz band are subject to unique restrictions under Commission policy.<sup>61</sup> In many other countries, the extended C-band spectrum is much more widely used, and the Commission must ensure that its actions do not harm operations in other jurisdictions or impinge on other Administrations' ability to tailor spectrum usage rules to country-specific requirements.

The Order's handling of CBRS operations near the Canadian and Mexican borders reinforces SIA's concerns on this front. Specifically, Section 96.19 provides that "Citizens Broadband Radio Service operation in the 3550-3700 MHz band is subject to current and future international agreements with Mexico and Canada," and states that the "terms of these agreements shall be implemented by the SAS."<sup>62</sup> The rule does not impose any limitations on CBRS operations pending negotiation of bilateral agreements or discuss how Canadian and Mexican earth stations can seek relief if they receive harmful cross-border interference.

This approach stands in contrast to the more robust protections for Canadian and Mexican FSS antennas that were implemented in Part 90. Specifically, Section 90.1337 of the rules places explicit limitations on terrestrial wireless broadband operations near the U.S. border

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<sup>60</sup> See, e.g., SIA Comments in GN Docket No. 12-354 filed Feb. 20, 2013 at 4-7.

<sup>61</sup> *Id.* at 4-5.

<sup>62</sup> Order, § 96.19.

unless and until the necessary coordination agreements have been reached.<sup>63</sup> The Commission should revise Section 96.19 to incorporate similar restrictions on CBSD locations to reduce the risk of interference to FSS operations in neighboring countries.

## **VII. CONCLUSION**

As discussed herein, substantial revision is needed to adjust the regulatory framework adopted in the Order to ensure that essential satellite services are protected. SIA urges the Commission to make the changes described herein, consistent with its commitment to introducing shared spectrum use without harming incumbent satellite operations.

Respectfully submitted,

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July 23, 2015

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<sup>63</sup> 47 C.F.R. § 90.1337 provides that:

(a) Fixed devices generally must be located at least 8 kilometers from the U.S./Canada or U.S./Mexico border if the antenna of that device looks within the 160° sector away from the border. Fixed devices must be located at least 56 kilometers from each border if the antenna looks within the 200° sector towards the border.

(b) Fixed devices may be located nearer to the U.S./Canada or U.S./Mexico border than specified in paragraph (a) of this section only if the Commission is able to coordinate such use with Canada or Mexico, as appropriate.

(c) Licensees must comply with the requirements of current and future agreements with Canada and Mexico regarding operation in U.S./Canada and U.S./Mexico border areas.



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## Technical Annex

### **PROTECTION OF ADJACENT BAND FSS EARTH STATIONS**

RKF performed an analysis for OOB interference using the new values in the FCC rules. The analysis assumed active FSS Earth Station operations in the 3700-3720 MHz spectrum and CBSDs operating at the maximum EIRP of 40 dBm/10 MHz permitted for non-rural devices and with the out-of-band mask specified in new Section § 96.41(e).

### **METHODOLOGY AND ASSUMPTIONS**

The CBSDs were assumed to have an OOB mask defined by linear interpolation between the following points:

- -13 dBm/MHz at 3700 MHz
- -25 dBm/MHz at 3710 MHz
- -40 dBm/MHz at  $\geq 3720$  MHz

Using sample channels for FSS Earth Stations (ES) within 3700-3720 MHz (with the first channel starting at 3702.1 MHz and the last channel ending at 3724.45 MHz), and the above OOB mask, the OOB level for each ES channel was calculated, and the highest OOB level was then used to calculate the separation distances required.

The **highest OOB** level was found to be **-15.76 dBm/MHz**, which corresponded to the first ES channel centered at 3702.3 MHz (with 0.4 MHz bandwidth).

Next, the separation distances were calculated assuming:

- 1) Out-of-band interference criterion of  $I/N = -23$  dB is not exceeded at the ES receiver (assuming interference from a single CBSD transmitter is dominant)
- 2) ES receiver antenna pattern per ITU-R S.465-6 for ES off-axis angles 5 to 48 degrees
- 3) ITU-R P.452-14 propagation path loss model for distances  $\geq 1$  km, assuming:
  - Frequency = 3702.1 MHz
  - The calculated loss could be exceeded 20% of the time



#### 4) Free Space Path Loss (FSPL) for distances < 1 km

Note that (1) and (2) above were the assumptions used in the previous analysis. Instead of characterizing the path loss with FSPL (as was done in the previous analysis), this analysis was enhanced by using the ITU-R P.452 model, as the distances were mostly above 10 km for the higher OOB level adopted by the FCC.

In addition, to provide fair comparison to the previous analysis, the separation distances were recalculated for the previous OOB level of -40 dBm/MHz assuming path loss modeling per (3) and (4) above.

The P.452-14 propagation was run assuming the same parameters used in the previous analysis (for in-band) except that Smooth-Earth was assumed in this analysis (rather than actual Terrain database). In the absence of actual transmitter and receiver locations, the following locations were chosen.

- Transmitter location: 32.5 deg latitude (southern US), 95 deg longitude (central US)
- Receiver location: 32.5 deg latitude, longitude varied to get 1km to 200 km separation distance from transmitter (moving to the West of Tx)

Note that P.452-14 was also run for 40 deg latitude (northern US) and for the concerned path losses, the difference between the path losses using the 32.5 vs. 40 deg latitude was found to be negligible and resulted in similar separation distance plots. Nevertheless, the higher distance curve (which corresponded to the 32.5 deg latitude) was chosen here.

## RESULTS

Figure 1 shows the resulting separation distances required to meet the I/N threshold mentioned earlier. The purple curve corresponds to the new OOB level of -15.76 dBm/MHz based on the ES channels and the new OOB mask. The curve at -40 dBm/MHz is for the previous OOB level but with the P.452 model applied.

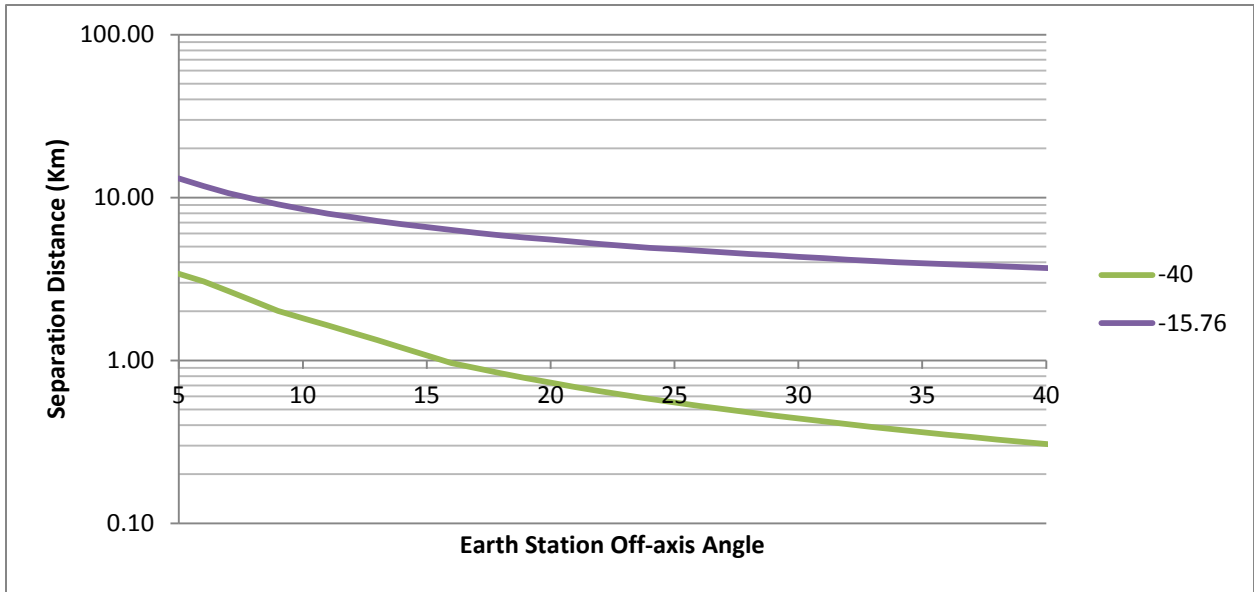


Figure 1 - Separation Distances Required (using P.452 model)

For reference, Figure 2 shows the OOBE curves and corresponding points for the FSPL model only (which is only valid up to about 10 km separation distance).

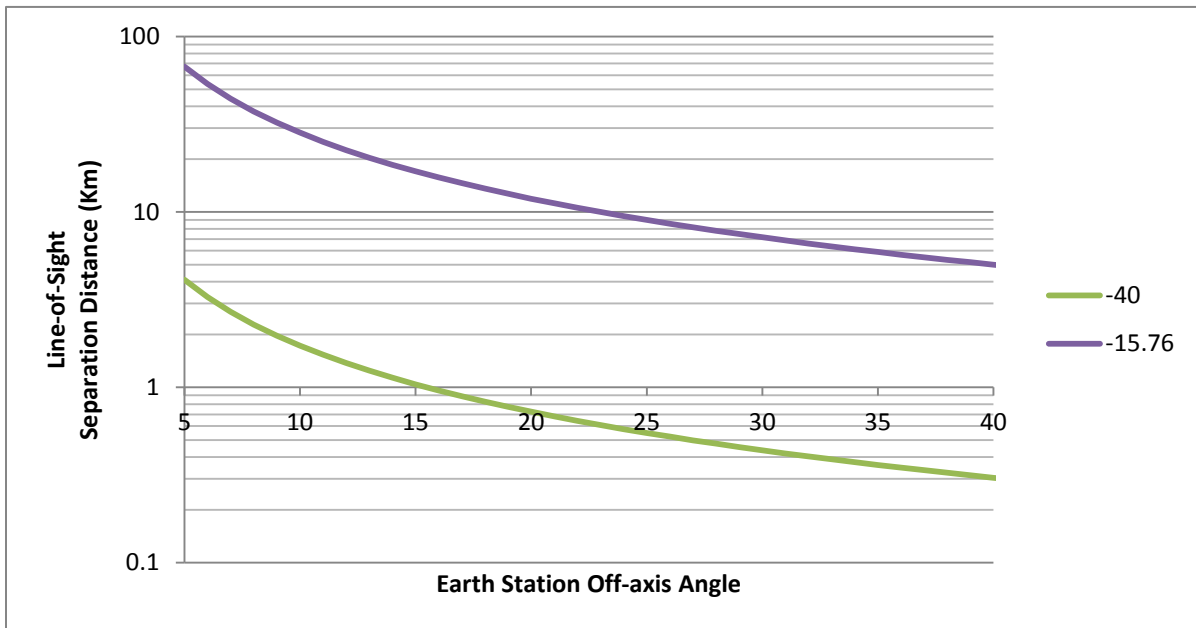


Figure 2- Separation Distance required (using FSPL)

Finally, Figure 3 shows the curves of Figure 1 and Figure 2 in one plot. As shown, FSPL gives less path loss and hence more separation distance required than the P.452 model for distances > 3 km.

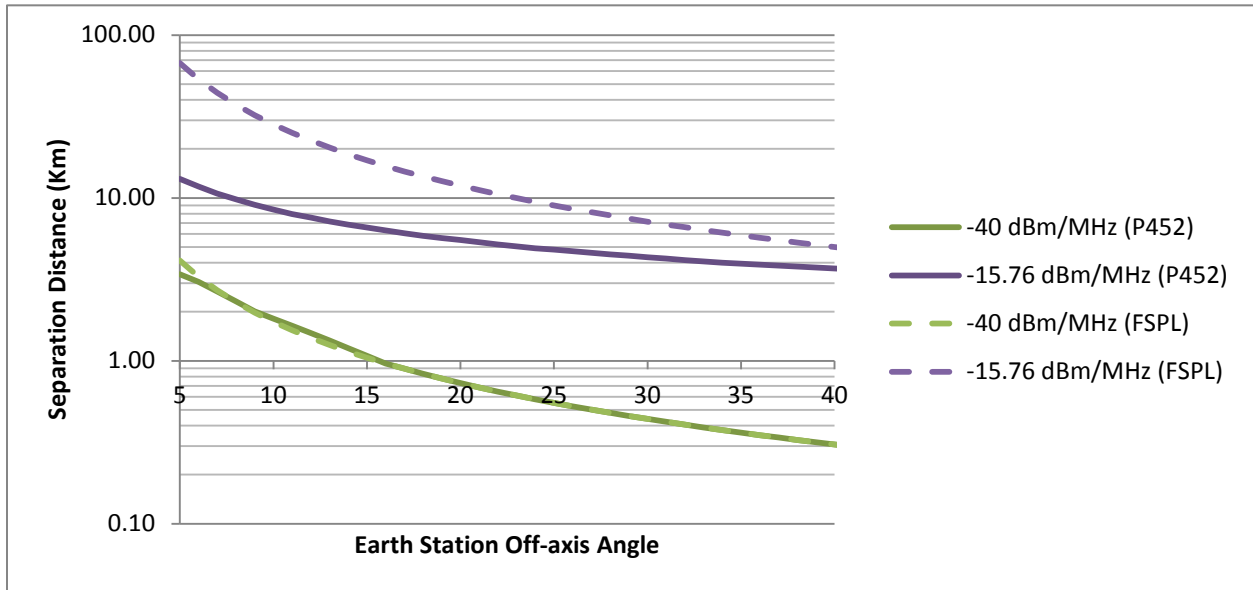


Figure 3 - Comparison of Separation Distances between P.452 and FSPL models