Before the
Federal Communications Commission
Washington, DC 20554

In the Matter of	)	
	)	
Wireless Operations in the 3650-3700 MHz Band	)	ET Docket No. 04-151
	)	
	)	
Rules for Wireless Broadband Services in the 3650-3700 MHz Band	)	WT Docket No. 05-96
	)	
	)	
Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3GHz Band	)	ET Docket No. 02-380
	)	
	)	
Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band	)	ET Docket No. 98-237
	)	
	)	

PETITION FOR PARTIAL RECONSIDERATION OF THE SATELLITE INDUSTRY ASSOCIATION

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June 10, 2005

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SUMMARY

SIA respectfully requests that the Commission reconsider two elements of its Report and Order and Memorandum Opinion and Order ("*Order*") in this proceeding. Specifically, to prevent harmful interference into C-band earth station receivers, the Commission should (i) reduce the out-of-band ("OOB") emissions limit applicable to wireless Internet service provider ("WISP") and other newly authorized operations in the 3650-3700 MHz band, and (ii) address the serious interference issues raised by SIA concerning the saturation of C-band earth station low-noise block-downconverters ("LNB") caused by such transmissions.

The OOB emissions limit adopted in the *Order* for WISP transmissions in the 3650-3700 MHz band is based on outdated assumptions and a misplaced reliance upon an ephemeral distinction between "licensed" and "unlicensed" operations, and as a result fails to adequately protect conventional C-band earth stations in the adjacent 3700-4200 MHz band. The Commission's reservation of discretion to require greater OOB attenuation at some point in the future only after harmful interference has occurred does not provide a realistic remedy for such interference. To avoid the potential for harmful interference to ubiquitous FSS earth stations operating in the adjacent band, the Commission should adopt an OOB emission limit no greater than that it proposed for unlicensed devices in the Notice of Proposed Rulemaking in this proceeding.

Moreover, devices operating in the 3650-3700 MHz band, under the rules adopted in the *Order*, have the potential to saturate the LNBs of earth stations operating in the 3700-4200 MHz band. Although SIA submitted a detailed analysis of the problem in its initial Comments, the Commission failed to address LNB saturation in the *Order*. It is essential that the problem be addressed and resolved on reconsideration.

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PETITION FOR PARTIAL RECONSIDERATION OF THE SATELLITE INDUSTRY ASSOCIATION

The Satellite Industry Association ("SIA"), pursuant to Section 1.429 of the Commission's rules, 47 C.F.R. § 1.429, respectfully requests that the Commission reconsider two elements of its Report and Order and Memorandum Opinion and Order ("*Order*") in the above-captioned proceeding.[1]

First, the out-of-band ("OOB") emissions limit adopted in the *Order* for wireless internet service provider ("WISP") and other transmissions in the 3650-3700 MHz band is based on outdated assumptions and fails to adequately protect conventional C-band

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[1] *In the Matter of Wireless Operations in the 3650-3700 MHz Band, Rules for Wireless Broadband Services in the 3650-3700 MHz Band, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3GHz Band, Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, Report and Order and Memorandum Opinion and Order*, 20 FCC Rcd 6502 (2005) ("*Order*").

Fixed-Satellite Service ("FSS") receive operations in the adjacent 3700-4200 MHz band. To avoid the potential for harmful interference to ubiquitous FSS earth stations operating in the adjacent band, the Commission should adopt an OOB emission limit no greater than that it proposed for unlicensed devices in the Notice of Proposed Rulemaking ("*NPRM*") in this proceeding.[2]

Second, devices operating in the 3650-3700 MHz band under the rules adopted in the *Order* have the potential to saturate the LNBs of earth stations operating in the 3700-4200 MHz band. Although SIA submitted a detailed analysis of the problem in its initial Comments,[3] the Commission failed to address LNB saturation in the *Order* and it is essential that the problem be addressed and resolved on reconsideration.

I. INTRODUCTION

SIA is a U.S.-based trade association providing worldwide representation of the leading satellite operators, service providers, manufacturers, launch services providers, remote sensing operators and ground equipment suppliers.[4] SIA and its member companies are extremely concerned about WISP and other newly authorized operations

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[2] *In the Matter of Wireless Operations in the 3650-3700 MHz Band, Rules for Wireless Broadband Services in the 3650-3700 MHz Band, Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3GHz Band, Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, Notice of Proposed Rulemaking*, 19 FCC Rcd 7545 (2004) ("*NPRM*").

[3] Comments of Satellite Industry Association, ET Docket No. 04-151, at 20 and Exhibit 3 (filed July 28, 2004) ("SIA Comments").

[4] SIA's Executive Members include The Boeing Company; Globalstar LLC.; Hughes Network Systems, Inc.; ICO Global Communications; Intelsat; Iridium Satellite, LLC; Lockheed Martin Corp.; Loral Space & Communications Ltd.; Mobile Satellite Ventures; Northrop Grumman Corporation; PanAmSat Corporation; and SES Americom, Inc. SIA's Associate Members include Eutelsat Inc.; Inmarsat Ltd.; New Skies Satellites, Inc.; Stratos Global Corporation; and The DirecTV Group.

in the 3650-3700 MHz band that are not adequately designed to protect FSS earth station receive operations in the adjacent 3700-4200 MHz band.[5]

The 3700-4200 MHz band is the principal downlink allocation for C-band satellites. This spectrum is intensively used by satellite networks for a number of important satellite-delivered communications services throughout the United States, and FSS earth stations operating in this band are sensitive to interference from both in-band and OOB sources because they must receive transmissions from satellites located in geostationary orbit at an altitude of approximately 22,300 miles. As discussed herein, harmful interference in the 3700-4200 MHz band would be devastating to the satellite industry, the broadcast industry, and the general public, and the public interest requires the Commission to ensure unfettered continuity of C-band satellite transmissions.

The OOB emissions limit adopted in the *Order* ignores the current operational environment in the conventional C-band downlink spectrum and the potential impact on FSS earth station receive operations. The emissions limit is based on erroneous assumptions regarding the terrestrial services to be deployed in the 3650-3700 MHz band and a distinction between licensed and unlicensed operations that does not apply in this case. The Commission's reservation of discretion to require greater attenuation at some later date on a case-by-case basis only after harmful interference has occurred does nothing to solve the problem. Accordingly, the Commission should reconsider the OOB interference issues raised in the *Order* and adopt an OOB emissions limit no greater than -71.25 dBW/MHz (*i.e.*, 71.25+10 log(p) dB minimum attenuation below transmit power).

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[5] SIA recognizes that the *Order* authorizes operations other than WISP services in the 3650-3700 MHz band. However, for ease of reference, the discussion of WISP operations herein applies to WISP and all other operations authorized by the *Order*.

The *Order* also failed to address the problem of LNB saturation caused by WISP operations in the 3650-3700 MHz band. At the power levels established for WISP operations in the *Order*, normal WISP device emissions have the capacity to saturate the LNB of a conventional C-band earth station. Despite ample evidence of the problem in the record, the *Order* ignores the issue entirely. Accordingly, reconsideration is necessary to impose reasonable power restrictions on WISP devices operating in the frequencies immediately adjacent to the conventional C-band.

II. OUT-OF-BAND EMISSIONS FROM WISP OPERATIONS WILL CAUSE HARMFUL INTERFERENCE TO UBIQUITOUS CONVENTIONAL C-BAND EARTH STATIONS

The *NPRM* in this proceeding requested comment on rules governing both unlicensed and licensed WISP operations in the 3650-3700 MHz band. With respect to adjacent band interference control, the *NPRM* proposed to limit the OOB emissions of unlicensed WISP operations to spurious emissions with field strength equal to 500 uV/m measured at 3 meters and in 1 MHz bandwidth, or -71.25 dBW/MHz, as specified in Section 15.209(a) of the Commission's Rules.[6] The *NPRM* separately inquired whether the 3650-3700 MHz band should be designated for licensed WISP use only,[7] and solicited input as to what interference criteria should be selected to protect adjacent FSS operations under that scenario.[8]

The Commission ultimately adopted a "non-exclusive nationwide licensing scheme, coupled with a fixed and base station registration requirement" for WISP

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[6] *NPRM at* ¶ 59.

[7] *Id.* at ¶ 76.

[8] *Id.* at ¶ 84.

operations.[9] To address OOB interference, the Commission simply copied the OOB emission limit from Part 24 of its rules, which address personal communications services ("PCS").[10] The Commission apparently took comfort in the fact that the attenuation requirement adopted in the *Order* is consistent with those OOB emission limits specified in other Commission rule parts for wireless devices, and that a post-interference "saving clause" was included in the rules. The *Order* fails to recognize, however, the unique characteristics of FSS receive operations in the conventional C-band, that other rule parts govern devices that are quite different in nature, do not have the same characteristics as WISP devices, and are regulated under a true licensing scheme that establishes rigorous limits on power and aggregate EIRP. The *Order* also fails to recognize that any post-hoc, discretionary "remedy" would be ineffective in this case.

A. The *Order* Failed To Adequately Consider the Unique Sensitivity of FSS Earth Station Receivers

The SIA's Comments and Reply Comments in this proceeding demonstrated that C-band FSS earth station receivers are particularly susceptible to OOB interference from devices operating in the 3650-3700 MHz band.[11] Significantly, the conventional C-band is *the primary* distribution vehicle for all major television programming in the United States. Thus, harmful interference in the 3700-4200 MHz band would be devastating to the satellite industry and the general public, impairing the distribution of almost all of the major news, weather, and entertainment television networks that inform and entertain the public and upon which homeland security can sometimes depend. Hence, the public

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[9] *Order* at ¶ 27.

[10] *Order* at ¶ 74.

[11] *See* SIA Comments at 11-12; Reply Comments of Satellite Industry Association, ET Docket No. 04-151, at 5-6 (filed August 27, 2004) ("SIA Reply Comments").

interest compels that every effort be made to guarantee the unfettered continuity of C-band satellite transmissions.

It is especially important to preserve the integrity of C-band transmissions as the demand for satellite bandwidth for video distribution increases, driven in part by the introduction of High Definition Television ("HDTV") and other bandwidth-intensive applications. FSS space station and earth station operators are compelled to maximize their limited bandwidth resources by resorting to more aggressive modulation schemes (*e.g.*, 8PSK and QAM), which allow for more efficient bandwidth utilization but require more power for accurate decoding at the receive earth station and are more sensitive to noise and interference.[12]

Highly spectrum-efficient modulation techniques operate on much tighter margins than traditional FSS signals using older compression and modulation standards. As a result, the effects of interference from OOB emitters are likely to be more severe than has been the case in the past. It is for these reasons, as SIA discussed in its comments, that the ITU has urged Administrations to take "all necessary precautions" to limit interference and to limit all non-FSS and non-co-primary interference to *no more than 1%* of total aggregate interference for earth stations.[13]

The sensitivity of FSS earth stations makes conservative management of their operating environment of critical importance. The OOB interference limit established in the *Order* fails to fully consider this sensitivity and does not adequately protect adjacent C-band earth stations against OOB interference from WISP operations.

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[12] Earth stations that operate with these modulation schemes typically operate with a 1 to 2 dB margin in the current noise environment.

[13] *See* SIA Comments at 11-13.

B. The OOB Limit Adopted in the *Order* Will Allow Harmful Interference Into FSS Earth Station Receivers

The *Order* established a limit of 43+10 log(p) dB below transmit power minimum attenuation for WISP fixed and mobile operations in the 3650-3700 MHz band.[14] Although the Commission characterized this limit as "very conservative" and typical of OOB emissions standards for other licensed terrestrial services,[15] the *Order* fails to assess the interference impact of the limit. Indeed, it relies upon outdated assumptions and a distinction between licensed and unlicensed operations that does not apply in this case. As a result, the relaxed OOB emissions limit adopted in the *Order* will allow WISP devices to cause harmful interference to FSS downlink operations in the conventional C-band and must be reconsidered.

1. The *Order* Failed To Assess the Interference Impact of the OOB Emissions Limit for WISP Devices

To support its decision to apply the Part 24 OOB limit to WISP operations in the 3650-3700 MHz band, the Commission cited divergent comments filed by interested parties in response to a December 1998 notice of proposed rulemaking,[16] when use of the band was being considered only for more traditional terrestrial fixed operations.[17] The *Order* further suggests without citation that subsequent comments on OOB emissions

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[14] *Order* at ¶¶ 74-75.

[15] *Id.*

[16] *See Order* at ¶ 74, n. 150; *see also Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band, Notice of Proposed Rule Making and Order,* 14 FCC Rcd 1295 (1998) ("*1998 NPRM*").

[17] *See, e.g., 1998 NPRM* at ¶ 6 (finding that the 3650-3700 MHz band is "well suited for fixed service use" and suggesting the provision of basic telephone service as a possible use).

filed in response to an October 2000 second notice of proposed rulemaking[18] were also split as to what criteria to apply, but even then the use of the band was considered limited to more traditional fixed services. Thus, rather than assess the actual interference impact of the OOB emissions limit chosen in the *Order*, the Commission simply noted contradictory comments filed half a decade ago (or more) under very different circumstances to apply an OOB emissions limit to new WISP services that was initially proposed for more traditional fixed services.

As a result, the *Order* adopted an OOB emission limit nearly 30 dB higher than the limit that was suggested in the *NPRM* for ubiquitous WISP operations (initially contemplated on an unlicensed basis).[19] The analysis that SIA provided in its prior Comments showed the potentially detrimental effects of these devices even with the more conservative emission limit (-71.25 dBW/MHz) proposed in the *NPRM*.[20] The results are even more troubling with the new limit.

As a starting point, analysis has shown that the minimum carrier/interference ("C/I") ratio for typical satellite carriers should be at least 22 dB under all circumstances.[21] Because the link margin for FSS earth station signals using high order modulation schemes is quite limited, the introduction of yet another source of interference could be quite detrimental to the proliferation of HDTV.

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[18] *See Order* at ¶ 74.

[19] *Order* at ¶¶ 74-75; *NPRM* at ¶¶ 59, 85.

[20] SIA Comments at 19-20 and Exhibit 2.

[21] This analysis is not based on a theoretical conservative approach, but rather a practical approach derived from hard-line data gathered from actual operation.

Attachments A and B show, separately for the "licensed" limit adopted in the *Order* (-43 dBW/MHz)[22] and the "unlicensed" limit proposed in the *NPRM* (-71.25 dBW/MHz),[23] the effects of OOB emissions *from a single device* on earth stations operating in the conventional C-band where the offending signal arrives at the earth station from various off-axis angles (5, 15, 30, and 45 degrees) and from various distances. Together, these tables demonstrate that (1) if the OOB emission limit adopted in the *Order* is not tightened to at least the level anticipated in the *NPRM* for unlicensed operations, FSS earth stations will frequently be unable to achieve the C/I levels necessary for reliable operations;[24] and (2) limiting OOB emissions to the degree anticipated for unlicensed devices in the *NPRM* will resolve the problem of WISP OOB interference in most instances.[25] Note that these analyses do not take into account the possibility of multiple interfering devices, which would obviously exacerbate the situation. Given these facts and the lack of contradictory evidence in the record, the Commission should reconsider the OOB interference limit set forth in the *Order*.

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[22] Attachment A examines interference using the OOB level specified in the *Order*, *i.e.*, "the power of any emission outside the authorized frequency ranges . . . attenuated below the transmitting (P) by a factor of at least 43 + 10log (P)." Because the *Order* also specifies a "uniform" power and bandwidth distribution (*e.g.*, 25 watts in 25 MHz, 10 watts in 10 MHz, 1 watt in 1 MHz), the suppression formula will always yield an OOB EIRP density of -43 dBW/MHz.

[23] Attachment B has the same set of calculations as Attachment A, but uses the lower OOB emission limits described in the *NPRM* for unlicensed devices. Paragraph 59 of the *NPRM* suggested limiting the emissions into the adjacent band to spurious emission with field strength of 500 uV/m measured at 3 meters. Converting this to an EIRP density yields -71.25 dBW/MHz.

[24] *See* Attachment A.

[25] *See* Attachment B.

2. The Order Relies on a Distinction Between Licensed and Unlicensed Uses That Does Not Apply in This Case

Although the *Order* does not permit full unlicensed operations in the 3650-3700 MHz band, it adopted a "quasi-licensed" approach that affords WISPs primary regulatory status along with virtually all of the benefits associated with unlicensed services.[26] For example, the Commission's licensing approach requires registration of fixed WISP transmitters and base stations and limits the use of mobile equipment to areas within range of a base station, but otherwise imposes only minimal restrictions on WISP deployment.[27] A perfunctory registration requirement for some devices does not alter the fact that "quasi-licensed" WISP operations, including wholly unregistered mobile transmitters, have more in common with unlicensed devices described in Part 15 than they do with formally licensed services such as Part 24 PCS devices.[28] In fact, the *Order* specifically emphasizes that the licensing requirements adopted are "minimal in nature."[29]

When licensing rules are rigorous and the contemplated service has well-defined operational parameters, it may be reasonable to set higher limits for OOB emissions because of the controlled nature of service deployment, more stringent equipment manufacturing standards, and licensee accountability. However, when a licensing program is reduced to mere registration of fixed transmitter locations with no registration of mobile units and the contemplated service involves the deployment of ubiquitous low-

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[26] *Order* at ¶¶ 25-29.

[27] *Order* at ¶¶ 59-66.

[28] For example, Part 24 imposes rigorous power and emissions limits. *See, e.g.*, 47 C.F.R. §§ 24.132, 24.133, 24.237, 24.238.

[29] *Order* at ¶ 28

cost, consumer-oriented equipment, a more conservative OOB emission limit is required. Given the disparate operational characteristics of traditional licensed services and WISP operations, as well as the unique characteristics of FSS receive operations in the adjacent band, it not reasonable to apply the same OOB emission levels to mass-market WISP consumer devices that are different in nature and use from that anticipated under other licensing regimes such as Part 24.

C. The Commission's Reservation of Discretion to Require Greater OOB Attenuation at Some Point in the Future Does Not Reduce the Risk of Harmful OOB Interference

Although not discussed in the body of the *Order*, the Final Rules promulgated therewith include new section 90.1323(b), which states that "[w]hen an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section." This reservation of discretion by the Commission to consider greater attenuation when particular instances of interference arise, however, does not salvage the inappropriately low OOB emissions limit adopted in the *Order* and does not provide the prospective ability to remedy interference that the rule text would suggest. While SIA generally supports the Commission's retention of discretion to deal with new OOB interference issues as they arise, such discretion should not be confused with or be considered a replacement for adopting an appropriate OOB emissions limit.

As an initial matter, whatever effect that Section 90.1323(b) will have on the attenuation of OOB interference will be had only after substantial disruption of C-band satellite services caused by OOB emissions from WISP operations, and only with the accompanying costs and burdens associated with any request for administrative action by

the Commission. Given its workload and the demands on staff time, the Commission is not in a position to quickly and efficiently hear and decide OOB interference complaints in a way that could insure timely remediation of serious OOB interference incidents occurring at individual C-band FSS earth stations. To say that individual emissions may be subjected to greater attenuation after some later review of the situation by the Commission is to say that only the most destructive incidents of identifiable and continuous harmful interference from WISP fixed and base station operations will be subject to review, and even then the process of addressing the problem will take significant time, effort, and expenditure of resources.

In addition to registered WISP base stations and fixed devices, the *Order* allows the manufacture of inexpensive mobile WISP devices and permits their use by the general public on an unregistered basis. OOB interference from such devices cannot practically be remedied by later Commission action because the interference from a mobile WISP device in the hands of a consumer will be unpredictable, the operator of the interfering device will be anonymous, and the location of the device will be unknown and changing. As the Commission found to be the case with similarly ubiquitous consumer devices,

> [I]dentifying each individual source of interference from radar detectors is not practical for a satellite operator because these devices are mobile and therefore interfere intermittently. Further, these interference sources are not under the control of the satellite operator, so in most cases it is not possible for the satellite operator to remedy the interference even if the source could be identified.[30]

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[30] *Review of Part 15 and Other Parts of the Commission's Rules*, *First Report and Order*, 17 FCC Rcdd 14063, 14068 ¶ 15 (2002).

Because after-the-fact remediation of OOB interference caused by ubiquitous mobile WISP devices is practically impossible, the Commission's reservation of discretion to impose greater attenuation requirements on individual emitters provides no protection whatsoever for C-band FSS earth stations, and therefore makes adopting a more stringent OOB emissions limit all the more critical.

III. THE *ORDER* ALTOGETHER IGNORES THE SERIOUS CONCERNS RAISED BY SIA ABOUT POTENTIAL SATURATION OF FSS EARTH STATION LNBS

The Comments submitted by SIA in this proceeding raised serious concerns about how *a single WISP device* of the type approved in the *Order* could cause the LNB of a C-band earth station to saturate.[31] The *Order*, however, does not address SIA's LNB saturation evidence – or the issue of LNB saturation – at all.

LNBs are basically amplification devices used in FSS earth stations, and are designed to operate within a specific power range much like any other amplifier. If these devices are forced to operate near the level of saturation, the result could be distortion of the received signal in the form of phase noise, which is quite detrimental to high order modulation schemes such as those used for HDTV distribution. Saturation also triggers amplifier suppression effects in which the emissions from WISP devices could actually overcome weaker satellite transmissions. SIA's Comments in this proceeding examined the case of a 4.5 meter earth station, which is the standard in the cable television industry, experiencing interference from a device transmitting at an EIRP of 25 watts at various distances and arrival angles relative to the main beam of the earth station.[32] This analysis shows that space-to-earth transmissions in the conventional C-band would suffer severely

[31] SIA Comments at 20 and Exhibit 3.

[32] SIA Comments at Exhibit 3.

degraded link performance due to an adjacent-channel 25 Watt emitter within 400 meters at an arrival angle of 15 degrees.

With the large difference in power level between a typical 36 MHz satellite signal as received by an earth station and the power level of the type of signals described in the *Order*, the risk of saturating FSS earth station LNBs will be significant, and addressing this concern by retrofitting earth stations with band pass filters would be very challenging technically. The level of attenuation required to suppress OOB emissions from the adjacent 3650-3700 MHz band might result in a severe degradation in the reception of the desired signals in the 3700-4200 MHz band. For example, a device located 100 meters away and at 15 degrees off the main axis of an earth station would require a suppression of at least 20 to 30 dB in order not saturate the LNB.[33] With the interferer being immediately adjacent to the 3700 MHz band edge, it is practically impossible to design a filter that could sufficiently attenuate the undesired signal without compromising the desired signal that is immediately above 3700 MHz.

Because of the high risk of LNB saturation presented by full-power WISP operations in the immediately adjacent 3650-3700 MHz band, SIA requests that the Commission consider imposing reasonable but adequate safeguards such as decreasing the 25 Watt power limit for WISP devices, or limiting full-power transmissions to only the lower half of the 3650-3700 MHz band while allowing lower EIRP emissions in the top 25 MHz of the band. LNB saturation is a serious problem, and the lack of discussion of LNB saturation in the *Order* is a significant omission; however, reasonable and adequate minimization of this risk would be neither difficult nor costly.

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[33] *See* Attachment C.

III. CONCLUSION

Because the OOB emissions limit established in the *Order* does not adequately protect FSS receive operations in the conventional C-band, SIA respectfully requests that the Commission adopt an OOB emissions limit no greater than -71.25 dBW/MHz (71.25+10 log(p) dB minimum attenuation below transmit power). Furthermore, SIA requests that the Commission fully address the issue of LNB saturation due to high EIRP emissions from WISP operations in the 3650-3700 MHz band and adopt reasonable measures to protect against such harm.

Respectively submitted,

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June 10, 2005

Attachment A: Effects of Out-of-Band Emissions on Satellite Earth Stations (by devices operating in the 3650-3700 MHz band)

Max Power of Spurious Emission (dBW/MHz)	Distance to Victim Antenna (meters)	Free Space Loss (dB)	Signal Level @ Victim Antenna (dBm/36 MHz)	Arrival Angle of Interferer (°)	Gain of Victim Antenna in direction of Interferer (dBi)	Effective Signal Level of Interferer @ Victim Antenna (dBm/36 MHz)	Typ. Satellite Signal Level @ LNB Flange (dBm/36 MHz)*	Achieved C/I level	Required C/I level	C/I Margin
-43	50	77.7	-75.1	5	11.5	-63.6	-83	-19.4	22	**-41.4**
-43	100	83.7	-81.1	5	11.5	-69.6	-83	-13.4	22	**-35.4**
-43	200	89.7	-87.1	5	11.5	-75.6	-83	-7.4	22	**-29.4**
-43	400	95.7	-93.1	5	11.5	-81.6	-83	-1.4	22	**-23.4**
-43	600	99.3	-96.7	5	11.5	-85.1	-83	2.1	22	**-19.9**
-43	800	101.8	-99.2	5	11.5	-87.6	-83	4.6	22	**-17.4**
-43	1000	103.7	-101.1	5	11.5	-89.6	-83	6.6	22	**-15.4**
-43	50	77.7	-75.1	15	2.6	-72.5	-83	-10.5	22	**-32.5**
-43	100	83.7	-81.1	15	2.6	-78.5	-83	-4.5	22	**-26.5**
-43	200	89.7	-87.1	15	2.6	-84.5	-83	1.5	22	**-20.5**
-43	400	95.7	-93.1	15	2.6	-90.6	-83	7.6	22	**-14.4**
-43	600	99.3	-96.7	15	2.6	-94.1	-83	11.1	22	**-10.9**
-43	800	101.8	-99.2	15	2.6	-96.6	-83	13.6	22	**-8.4**
-43	1000	103.7	-101.1	15	2.6	-98.5	-83	15.5	22	**-6.5**
-43	50	77.7	-75.1	30	-4.9	-80.0	-83	-3.0	22	**-25.0**
-43	100	83.7	-81.1	30	-4.9	-86.0	-83	3.0	22	**-19.0**
-43	200	89.7	-87.1	30	-4.9	-92.1	-83	9.1	22	**-12.9**
-43	400	95.7	-93.1	30	-4.9	-98.1	-83	15.1	22	**-6.9**
-43	600	99.3	-96.7	30	-4.9	-101.6	-83	18.6	22	**-3.4**
-43	800	101.8	-99.2	30	-4.9	-104.1	-83	21.1	22	**-0.9**
-43	1000	103.7	-101.1	30	-4.9	-106.0	-83	23.0	22	**1.0**
-43	50	77.7	-75.1	45	-9.3	-84.4	-83	1.4	22	**-20.6**
-43	100	83.7	-81.1	45	-9.3	-90.4	-83	7.4	22	**-14.6**
-43	200	89.7	-87.1	45	-9.3	-96.5	-83	13.5	22	**-8.5**
-43	400	95.7	-93.1	45	-9.3	-102.5	-83	19.5	22	**-2.5**
-43	600	99.3	-96.7	45	-9.3	-106.0	-83	23.0	22	**1.0**
-43	800	101.8	-99.2	45	-9.3	-108.5	-83	25.5	22	**3.5**
-43	1000	103.7	-101.1	45	-9.3	-110.4	-83	27.4	22	**5.4**

* Assuming:
1.) Saturated carrier at 39 dBW
2.) Rx antenna gain of 44 dBi (typical 4.5 m antenna)
3.) 196 dB free space loss
4.) No satellite output back off is assumed.

Attachment B: Effects of Out-of-Band Emissions on Satellite Earth Stations (by devices operating in the 3650-3700 MHz band)

Max Power of Spurious Emission (dBW/MHz)	Distance to Victim Antenna (meters)	Free Space Loss (dB)	Signal Level @ Victim Antenna (dBm/36 MHz)	Arrival Angle of Interferer (°)	Gain of Victim Antenna in direction of Interferer (dBi)	Effective Signal Level of Interferer @ Victim Antenna (dBm/36 MHz)	Typ. Satellite Signal Level @ LNB Flange (dBm/36 MHz)*	Achieved C/I level	Required C/I level	C/I Margin
-71.25	50	77.7	-103.3	5	11.5	-91.8	-83	8.8	22	**-13.2**
-71.25	100	83.7	-109.4	5	11.5	-97.8	-83	14.8	22	**-7.2**
-71.25	200	89.7	-115.4	5	11.5	-103.9	-83	20.9	22	**-1.1**
-71.25	400	95.7	-121.4	5	11.5	-109.9	-83	26.9	22	**4.9**
-71.25	600	99.3	-124.9	5	11.5	-113.4	-83	30.4	22	**8.4**
-71.25	800	101.8	-127.4	5	11.5	-115.9	-83	32.9	22	**10.9**
-71.25	1000	103.7	-129.4	5	11.5	-117.8	-83	34.8	22	**12.8**
-71.25	50	77.7	-103.3	15	2.6	-100.7	-83	17.7	22	**-4.3**
-71.25	100	83.7	-109.4	15	2.6	-106.8	-83	23.8	22	**1.8**
-71.25	200	89.7	-115.4	15	2.6	-112.8	-83	29.8	22	**7.8**
-71.25	400	95.7	-121.4	15	2.6	-118.8	-83	35.8	22	**13.8**
-71.25	600	99.3	-124.9	15	2.6	-122.3	-83	39.3	22	**17.3**
-71.25	800	101.8	-127.4	15	2.6	-124.8	-83	41.8	22	**19.8**
-71.25	1000	103.7	-129.4	15	2.6	-126.8	-83	43.8	22	**21.8**
-71.25	50	77.7	-103.3	30	-4.9	-108.3	-83	25.3	22	**3.3**
-71.25	100	83.7	-109.4	30	-4.9	-114.3	-83	31.3	22	**9.3**
-71.25	200	89.7	-115.4	30	-4.9	-120.3	-83	37.3	22	**15.3**
-71.25	400	95.7	-121.4	30	-4.9	-126.3	-83	43.3	22	**21.3**
-71.25	600	99.3	-124.9	30	-4.9	-129.8	-83	46.8	22	**24.8**
-71.25	800	101.8	-127.4	30	-4.9	-132.3	-83	49.3	22	**27.3**
-71.25	1000	103.7	-129.4	30	-4.9	-134.3	-83	51.3	22	**29.3**
-71.25	50	77.7	-103.3	45	-9.3	-112.7	-83	29.7	22	**7.7**
-71.25	100	83.7	-109.4	45	-9.3	-118.7	-83	35.7	22	**13.7**
-71.25	200	89.7	-115.4	45	-9.3	-124.7	-83	41.7	22	**19.7**
-71.25	400	95.7	-121.4	45	-9.3	-130.7	-83	47.7	22	**25.7**
-71.25	600	99.3	-124.9	45	-9.3	-134.3	-83	51.3	22	**29.3**
-71.25	800	101.8	-127.4	45	-9.3	-136.8	-83	53.8	22	**31.8**
-71.25	1000	103.7	-129.4	45	-9.3	-138.7	-83	55.7	22	**33.7**

* Assuming:
1.) Saturated carrier at 39 dBW
2.) Rx antenna gain of 44 dBi (typical 4.5 m antenna)
3.) 196 dB free space loss
4.) No satellite output back off is assumed.

Attachment C: LNB Saturation Analysis

Unlicensed Device Tx Power (Watt)	Distance to Victim Antenna (meters)	Free Space Loss (dB)	Signal Level @ Victim Antenna (dBm)	Arrival Angle of Interferer (°)	Gain of Victim E/S Antenna in direction of Interferer (dBi)	Effective Signal Level of Interferer @ Victim Antenna (dBm)	Typical Combined Power of 24 Transponders at LNB Flange (dBm)*	Total Power of Satellite Signal + Interferer (dBm)	Typ. LNB Saturation Level (dBm)	Exccedance above LNB Saturation Level (dB)
25	50	77.7	-33.7	5	11.5	-22.2	-69.0	-22.18	-55	**32.8**
25	100	83.7	-39.7	5	11.5	-28.2	-69.0	-28.20	-55	**26.8**
25	200	89.7	-45.7	5	11.5	-34.2	-69.0	-34.22	-55	**20.8**
25	400	95.7	-51.8	5	11.5	-40.2	-69.0	-40.24	-55	**14.8**
25	600	99.3	-55.3	5	11.5	-43.8	-69.0	-43.75	-55	**11.2**
25	800	101.8	-57.8	5	11.5	-46.3	-69.0	-46.24	-55	**8.8**
25	1000	103.7	-59.7	5	11.5	-48.2	-69.0	-48.17	-55	**6.8**
25	50	77.7	-33.7	15	2.6	-31.1	-69.0	-31.11	-55	**23.9**
25	100	83.7	-39.7	15	2.6	-37.1	-69.0	-37.13	-55	**17.9**
25	200	89.7	-45.7	15	2.6	-43.2	-69.0	-43.14	-55	**11.9**
25	400	95.7	-51.8	15	2.6	-49.2	-69.0	-49.13	-55	**5.9**
25	600	99.3	-55.3	15	2.6	-52.7	-69.0	-52.59	-55	**2.4**
25	800	101.8	-57.8	15	2.6	-55.2	-69.0	-55.02	-55	**0.0**
25	1000	103.7	-59.7	15	2.6	-57.1	-69.0	-56.86	-55	**-1.9**
25	50	77.7	-33.7	30	-4.9	-38.6	-69.0	-38.63	-55	**16.4**
25	100	83.7	-39.7	30	-4.9	-44.7	-69.0	-44.64	-55	**10.4**
25	200	89.7	-45.7	30	-4.9	-50.7	-69.0	-50.61	-55	**4.4**
25	400	95.7	-51.8	30	-4.9	-56.7	-69.0	-56.45	-55	**-1.4**
25	600	99.3	-55.3	30	-4.9	-60.2	-69.0	-59.68	-55	**-4.7**
25	800	101.8	-57.8	30	-4.9	-62.7	-69.0	-61.80	-55	**-6.8**
25	1000	103.7	-59.7	30	-4.9	-64.7	-69.0	-63.30	-55	**-8.3**

* Assuming:
1.) Saturatred carrier at 39 dBW
2.) Rx antenna gain of 44 dBi (typical 4.5 m antenna)
3.) 196 dB free space loss