Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Mobile Satellite Ventures Subsidiary LLC	)	
	)	
Application for Minor Modification of Space Station License (AMSC-1)	)	File No. SAT-MOD-20090429-00047
	)	
Application for Minor Modification of Space Station License (MSV-1)	)	File No. SAT-MOD-20090429-00046
	)	
Application for Minor Modification of Blanket License to Operate Mobile Earth Terminals (MSAT-1)	)	File No. SES-MOD-20090429-00536

PETITION TO DENY OF AMTECH SYSTEMS LLC

Amtech Systems LLC ("Amtech"), by its attorneys and pursuant to Section 309(d) of the Communications Acts of 1934, as amended, and Section 25.154 of the rules of the Federal Communications Commission ("FCC" or "Commission"),[1] hereby submits this petition to deny the above-captioned applications of SkyTerra Subsidiary LLC ("SkyTerra"), formerly Mobile Satellite Ventures Subsidiary LLC, to modify its Ancillary Terrestrial Component ("ATC") license by waiving technical rules.[2] As detailed below, waiver of certain of these technical rules as proposed by SkyTerra will result in harmful interference to Amtech's mobile earth terminals operating in the same spectrum and will consequently harm Amtech's provision of service to its customers.

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1 47 U.S.C. § 309; 47 C.F.R. § 25.154.

2 *See Mobile Satellite Ventures Subsidiary LLC, Application for Minor Modification of Space Station License (AMSC-1), Application for Minor Modification of Space Station License (MSV-1), Application for Minor Modification of Blanket License to Operate Mobile Earth Terminals (MSAT-1)*, File Nos. SAT-MOD-20090429-00047, SAT-MOD-20090429-00046, SES-MOD-20090429-00536 (Filed Apr. 29, 2009) ("SkyTerra Modification Application").

The Commission first granted SkyTerra authority to offer Mobile Satellite Service ("MSS") in 1989.[3] In 2004, the Commission granted SkyTerra authority to modify its MSS license in order to operate ATC facilities on a non-interference basis.[4] SkyTerra has not made public how or where it will deploy its ATC network. Amtech currently holds two non-common carrier blanket earth station licenses to operate mobile earth terminals ("METs") in the L-band.[5] Amtech uses these METs for remote and mobile asset tracking, monitoring and control solutions, primarily for the transportation industry. Amtech's METs are capable of receiving and are authorized to communicate using either the SkyTerra or Inmarsat satellites, which makes these METs subject to front end overload interference caused by high power signals from either satellite system. Because the proposed changes to SkyTerra's ATC operating parameters increase the risk of harmful interference to Amtech and its customers, Amtech unquestionably is a party in interest to SkyTerra's pending modification application.[6]

I. ATC OPERATORS MUST PROTECT PRIMARY MSS OPERATIONS FROM HARMFUL INTERFERENCE.

The L-band frequencies over which both Amtech and SkyTerra provide service are

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[3] *Amendment of Parts 2, 22 and 25 of the Commission's Rules to Allocate Spectrum for and to Establish Other Rules and Policies Pertaining to the Use of Radio Frequencies in a Land Mobile Satellite Service for the Provision of Various Common Carrier Services; the Applications of Hughes Communications Mobile Satellite, Inc., et. al.,* Memorandum Order and Authorization, 4 FCC Rcd 6041 (1989).

[4] *Mobile Satellite Ventures Subsidiary LLC, Application for Minor Modification of Space Station License for AMSC-1, Minor Amendment to Application for Authority to Launch and Operate a Next-Generation Replacement MSS Satellite Application for Minor Modification of Blanket License for Authority to Operate Mobile Earth Terminals with MSAT-1*, Order and Authorization, 19 FCC Rcd 22144 (2004) ("SkyTerra ATC Order").

[5] *See Satellite Communications Services Information Actions Taken*, Report No. SES-01081, File Nos. SES-MFS-20080303-01359 (Call Sign E990316), SES-MFS-20080303-01358 (Call Sign E030120) (Oct. 29, 2008) (Public Notice).

[6] *See* 47 U.S.C. § 309(d).

designated in the U.S. Table of Frequency Allocations for MSS.[7] In 2003, the Commission adopted rules to permit MSS licensees to operate ATC in conjunction with their MSS network,[8] and modified these rules in 2005.[9] The Commission determined that ATC networks could only operate if they caused no harmful interference to primary MSS operations.[10] Any determination regarding SkyTerra's waiver request must take into account this determination that ATC networks must be designed to protect other MSS operations operating in the same frequency bands from harmful interference. In fact, in adopting rules for ATC networks, the Commission explicitly rejected many alternative concepts because "the potential for interference between MSS and terrestrial mobile systems is, in fact, so great."[11] The final technical rules for ATC operations consequently were specifically designed to protect adjacent and in-band operations from harmful interference.[12] The Commission noted that it would not dictate specific system design features for ATC networks, but instead would "limit the total interference that an ATC may cause."[13] Moreover, the Commission made non-interference a continuing obligation for

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7 47 C.F.R. § 2.106.

8 47 C.F.R. § 2.106, footnote US380. *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands*, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962 (2003) ("2003 ATC Order").

9 *Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands*, Memorandum Opinion and Order and Second Order on Reconsideration, 20 FCC Rcd 4616 (2005) ("2005 ATC Order").

10 2003 ATC Order at 2017 (¶ 104) ("We adopt technical parameters for ATC operations. . . designed to protect adjacent and in-band operations from interference from ATC.").

11 2003 ATC Order at 1997 (¶ 60).

12 2003 ATC Order at 2016 (¶ 103) (adopting a "set of technical standards to avoid harmful interference to other users of the spectrum.").

13 2005 ATC Order at 4634 (¶ 50).

ATC operations.[14] Furthermore, although the Commission intended these rules fully to protect against interference from ATC operations, as an extra measure of protection for other operators, the Commission promulgated a specific provision so that in the case of any interference, ATC operators are required to take action to resolve this interference.[15]

II. THE COMMISSION SHOULD REJECT SKYTERRA'S REQUEST FOR WAIVER OF TECHNICAL RULES BECAUSE THE PROPOSED OPERATIONS WILL CAUSE HARMFUL INTERFERENCE TO AMTECH'S PROVISION OF SERVICE TO CUSTOMERS.

Waiver of certain of the Commission's technical rules as requested by SkyTerra will permit SkyTerra to operate at a higher power, and this increased power will generate added front end overload interference to Amtech's authorized operations. Moreover, SkyTerra's proposed operations will cause an increase in intermodulation interference that will harm Amtech's operations. Although the Commission's orders and rules make clear SkyTerra's obligations to protect MSS operators such as Amtech, SkyTerra has not provided sufficient evidence that Amtech will be protected if SkyTerra's requested waivers are granted.

A. SkyTerra's Proposed Operations Will Increase Power and Cause Harmful Interference to Amtech's Operations.

As shown in the attached Technical Annex, SkyTerra seeks to change the measurement criteria in Section 25.253(d) of the Commission's rules, which will allow SkyTerra to increase power by approximately 13.1 dB. This increase in power will cause front end overload interference to Amtech's METs operating in both urban and suburban environments and

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(Continued . . .)

[14] 2003 ATC Order at 2017, n. 273 (¶ 104) ("we do not intend to limit the ability of existing or future licensees to deploy new, different or innovative technologies, *provided that the applicant can demonstrate that the new system configuration produces no greater interference than permitted under our existing rules*." (emphasis added)).

[15] 2003 ATC Order at 2017 (¶ 104); 47 C.F.R. § 25.255.

SkyTerra must be required to protect Amtech's operations in all environments. Moreover, any evaluation of the effects of increased power cannot assume polarization isolation at the edge of coverage. As shown below and in the attached Technical Annex, the changes proposed by SkyTerra will expand the exclusion zone around all ATC base stations within which Amtech's customers will be blocked from receiving service.

1. SkyTerra's proposed change to the EIRP limit metric permitted by Section 25.253(d)(1) will increase the power level.

Section 25.253(d)(1) of the Commission's rules currently restricts ATC base stations so that they do not exceed a peak EIRP of 31.9-10*log(number of carriers) dBW/200kHz.[16] SkyTerra seeks waiver of this rule in order to "permit a maximum average EIRP of 32 dBW/MHz."[17] This proposed change removes the per carrier metric from the Section 25.253(d)(1) measurement. Under the current metric, the power level of 31.9 dBW must be shared by the number of carriers used by the ATC network within a sector. The Commission adopted this measurement because it provided flexibility in designing an ATC network,[18] but also provided other MSS operators, such as Amtech, with a known power limit; no matter how many carriers are used in any ATC network, Amtech is certain that the maximum EIRP will be 31.9 dBW across the sector. SkyTerra's proposal to drop this per carrier metric could increase the power across the frequency band and will leave Amtech without certainty regarding the exact power levels that will be used in each sector. Section 2 of the Technical Annex describes how this change will permit SkyTerra to increase power by as much as 13.1 dB.

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16 47 C.F.R. § 25.253(d)(1).

17 SkyTerra Modification Application at 10.

18 2005 ATC Order at 4638 (¶ 60).

2. **SkyTerra's ATC operations must protect Amtech's operations in both urban and suburban environments.**

As described above, Amtech uses METs for remote and mobile asset tracking, monitoring and control solutions, primarily for the transportation industry. The METs are used for tracking travel through both urban and suburban environments, and as such, must be protected in both environments. As shown in Section 3 of the Technical Annex, SkyTerra's proposed changes will increase interference in both urban and suburban environments. In suburban environments, where there is less blockage and clutter to mitigate interference, interference will cause greater harm to Amtech's METs. To ensure Amtech's provision of service to its customers without harmful interference, SkyTerra's operations must be required to protect Amtech's operations in all environments.

3. **Any evaluation of the effects of increased power cannot assume polarization isolation at the edge of coverage.**

In measuring how SkyTerra's proposed changes will impact Amtech's operations, it is important not to assume polarization isolation at the edge of coverage. As described in Section 3 of the Technical Annex, the polarization discrimination virtually disappears at low elevation angles, and, as such, will not provide additional interference protection to Amtech's operations.

4. **SkyTerra's proposed power level increase will greatly expand the size of the exclusion zone around ATC base stations.**

The practical result of SkyTerra's proposed power increase is to expand the area around each ATC base station in which Amtech's METs will be unable to receive a satellite signal because of interference. As described in Section 3.3 of the Technical Annex, the proposed increase in power will expand the size of the exclusion zone around ATC base stations to 0.04 km^2 and 0.11 km^2 respectively for terminals separated by more than and less than 2 MHz from the ATC downlink signal.

In suburban environments, the increased interference will be even more problematic. As

shown in Section 3.4 of the Technical Annex, for terminals more than 2 MHz from ATC base stations, the size of exclusion zone around each base station will expand from 0.03 km^2 to 2.4 km^2 or 22.6 km^2, depending on the propagation model. For terminals less than 2 MHz from ATC base stations, the size of exclusion zone around each base station will expand from 0.03 km^2 to 9.5 km^2 or 122.3 km^2, depending on the propagation model.

B. Increased Intermodulation Interference Will Cause Harm to Amtech's Operations.

Intermodulation interference will also increase as a result of SkyTerra's proposed operations, which will employ broadband rather than narrowband modulation. Broadband modulation undermines the rules provided by the Commission to protect against intermodulation interference. Specifically, Section 25.253(h) of the Commission's rules, which was intended to protect operators such as Amtech from intermodulation products,[19] requires ATC operators to limit the combined power of two unwanted signals to less than -70 dBm at the receiver.[20] Additionally, Section 25.253(h) contemplates a coordination process between ATC and MSS operators to resolve intermodulation interference problems. This rule was developed, however, based on an assumption of narrowband modulation. Narrowband modulation causes less problematic intermodulation interference because carriers can avoid or minimize this interference by changing frequencies. The coordination process envisioned by Section 25.253(h) permits ATC and MSS operators to coordinate which frequencies will be used to minimize intermodulation interference. However, if ATC operators deploy broadband carriers over much, if not all of the allocation, protection against intermodulation interference cannot be accomplished by changing frequencies. As described in Section 4 of the Technical Annex, the

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[19] 2005 ATC Order at 4637 (¶ 58).

[20] 47 C.F.R. § 25.253(h).

exclusion zone within which Amtech receivers will not be able to receive signals around each ATC base station will increase to 0.18 km^2 in urban environments and to 18.6 km^2 or 326.9 km^2 (depending on the propagation model) in suburban environments.

C. SkyTerra Does Not Provide Sufficient Evidence That Primary MSS Operations Will Be Protected.

SkyTerra claims that its proposed operations will not cause harmful interference, but provides little evidence to support this claim. Instead, SkyTerra argues that its proposed operations are consistent with the parameters of the mostly confidential Coordination Agreement between SkyTerra and Inmarsat Global Limited ("Inmarsat").[21] Much of the coordination information that purportedly protects MSS operations is information that is not available to Amtech or other MSS operators other than Inmarsat. SkyTerra has not finalized or made public any details regarding where and how it will deploy its ATC operations. Amtech cannot fully respond to SkyTerra's proposal without full knowledge of SkyTerra's proposed operations. Moreover, unfortunately for Amtech and other operators in the L-band, the Coordination Agreement is a private agreement between SkyTerra and Inmarsat, and is, as such, intended to protect only SkyTerra and Inmarsat. Although SkyTerra may have coordinated its proposed changes with Inmarsat, this coordination does not protect Amtech's operations.

SkyTerra also claims that its proposed power levels are consistent with what is permitted for PCS and AWS.[22] ATC, however, is an entirely different service than PCS or AWS. Both PCS and AWS are primary, terrestrial services. ATC, as evidenced by its very name, is an ancillary service, that can only be provided by satellite operators in conjunction with satellite

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21 SkyTerra Modification Application at 10.

22 *Id*.

service.[23] As such, ATC technical characteristics should not be benchmarked against PCS or AWS, but rather, limited by the obligation to avoid interference to primary mobile satellite operations such as Amtech's.

Finally, although SkyTerra documents how aeronautical and maritime operations will be protected, it generally ignores the protection of land-mobile operations. In fact, SkyTerra fails to even mention METs in its waiver request, and accordingly spends no time describing how incumbent METs operators will be protected from SkyTerra's proposed changes.[24] Although SkyTerra has not made public how or where it will deploy its ATC network, it is unlikely that this network will be limited to airports and waterways. As such, it is incumbent upon SkyTerra to provide adequate protection to land mobile operators, such as Amtech, who are currently providing service. Without evidence that land mobile operators such as Amtech will be protected from SkyTerra's proposed operations, the requested waiver of technical rules must be rejected.

D. All Operations By SkyTerra Must Be Conditioned Upon Compliance With Section 25.255 of the Commission's Rules.

As noted above, in addition to adopting specific technical rules to protect MSS operations from harmful interference caused by ATC networks, the Commission also adopted a rule,

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[23] 2003 ATC Order at 2000 (¶ 68). In fact, the Commission highlighted the difference between ATC and other terrestrial wireless services, finding that "[o]nly a limited portion of customers desiring terrestrial service are likely to be interested in supplementary MSS services." 2003 ATC Order at 1986 (¶ 40) (noting that "[w]ith different anticipated prices, coverage, product acceptance and distribution, the two services appear to be imperfect substitutes as far as customers are concerned").

[24] Moreover, the technical rules designed to protect aeronautical and maritime operations also provide interference protection for land mobile operations; changes to these rules to allow SkyTerra to operate at higher powers will therefore create greater interference to land mobile operations such as those provided by Amtech.

Section 25.255, which requires ATC operators to resolve any harmful interference.[25] Amtech urges the Commission to reject SkyTerra's request for waiver of the technical rules; however, in the event that any of these waivers is granted, the Commission must condition such grant upon compliance with Section 25.255. Pursuant to this rule, if SkyTerra's operations cause interference to Amtech's systems, SkyTerra must resolve this interference, including, if necessary, funding the replacement of Amtech's currently operating METs with METs that will not receive harmful interference from SkyTerra's ATC operations.

IV. CONCLUSION

As shown above and in the Technical Annex, SkyTerra's proposed technical waivers would cause harmful interference to Amtech's METs by increasing the area around ATC base-stations where Amtech METs cannot operate. Enlarging the geographic gaps in service does not serve the public interest and would be contrary to the obligation of ATC services to protect MSS operations. Thus, because there is not "good cause" for waiver, SkyTerra's Modification Application should be denied.

Respectfully submitted,

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Dated: July 10, 2009

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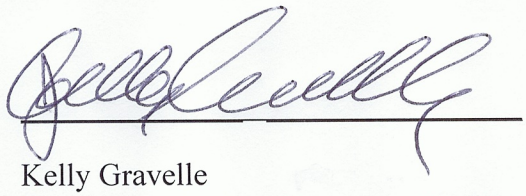
25 47 C.F.R. § 25.255.

DECLARATION UNDER PENALTY OF PERJURY OF KELLY GRAVELLE

I, Kelly Gravelle, am the Executive Vice President and Chief Technical Officer of Transcore, L.P. ("Transcore"). Transcore sells remote tracking and monitoring services pursuant to the non-common carrier blanket earth station authorizations held by Amtech Systems LLC ("Amtech"). Both Amtech and Transcore are subsidiaries of Roper Industries. I hold a Bachelor of Engineering Degree (Electrical) from McGill University and have over 25 years of experience in developing and deploying RF communications products in the transportation industry.

I hereby declare under penalty of perjury that I am qualified to speak on behalf of Amtech. I have reviewed the preceding Petition to Deny submitted on behalf of Amtech, and the factual statements therein are complete and accurate to the best of my knowledge, information, and belief.

I certify that I am a technically qualified person with overall responsibility for the information contained in the foregoing Petition to Deny. I am familiar with the requirements of Part 25 of the Commission's rules, and the information contained in the Petition to Deny and Technical Annex is complete and accurate to the best of my knowledge, information, and belief.



Kelly Gravelle
Executive Vice President and Chief Technical Officer
Transcore, L.P.

Dated: July 10, 2009

CERTIFICATE OF SERVICE

I hereby certify that on July 10, 2009, I caused a true and correct copy of the foregoing to be served by first-class mail, unless noted otherwise, on the following:

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Technical Annex

1 Introduction

1.1 Overview

In this annex, the interference impacts of SkyTerra's proposed waivers and modifications of the ATC rules of 47 C.F.R § 25.253 are examined. In particular, the focus is on impacts of ATC base station (BTS) downlink modifications to Amtech's land mobile MSS terminals operating in the MSS L-band.

The analysis shows that SkyTerra's requested changes will increase the downlink EIRP, with direct impact on overload interference to Amtech terminals. SkyTerra's requested changes will increase intermodulation interference, with direct impact to Amtech terminals, as discussed in detail. The ranges at which overload and intermodulation interfere with MSS downlinks to Amtech METs increases substantially, especially in suburban propagation environments. The increases in overload and intermodulation interference effects that would arise from the SkyTerra proposals would have a significant impact to the quality of Amtech's service, especially in suburban areas, and would increase costs due to the need to detect interference issues in the Amtech MSS forward link.

Amtech would also note that SkyTerra's proposed modification lacks clarity which is needed to determine the impact to Amtech's land mobile terminals, which has greatly inhibited a complete analysis of the interference effects associated with the proposal. This is due to: (1) replacement of widely applicable specifications in the current version of Section 25.253 with aviation-terminal-specific changes without detail on land mobile specifications and (2) reliance on

unspecified provisions in the Coordination Agreement of December 20, 2007 between SkyTerra, SkyTerra Canada and Inmarsat, which is not a public document in its entirety. Amtech believes that SkyTerra should be required to provide missing technical data to enable the full interference effects from the proposed modifications to be analyzed. Finally, the requirement to clarify EIRP averaging is discussed.

1.2 Mobile Satcom System Description

Amtech provides two-way data communications over leased channels on geostationary L-Band satellites. Amtech is authorized by the FCC to operate METs (Mobile Earth Terminals) on MSAT 1, MSAT-2 and the list of Inmarsat satellites approved to serve the United States in the L-band (the "ISAT List"). Amtech's FCC licenses currently authorize the operation of up to 100,000 MT-1000 series, MT-2000 series and MT-3000 series METs in the United States. Amtech's METs use SkyWave's GlobalWave system, including SkyWave ESE (Earth Station Equipment) collocated at the satellite provider LES (Land Earth Station) and providing the transmit and receive functions for the satellite channel; and a PPC (Packet Processing Center) which is the GlobalWave hub providing the scheduling, routing, and operations management of the system.

Amtech offers services to customers in the North American transportation sector using METs which are attached to the truck, trailer, rail-car and other mobile and stationary assets. The services offered include transportation, asset tracking and monitoring, truck dispatch messaging and truck performance monitoring as well as a mix of other tracking and monitoring services. The services include several safety related systems which provide notification of emergency situations from truck drivers and boaters. Amtech terminals operate in a range of environments in the rural, suburban and urban areas. The truck and trailer yards and delivery locations and the

routes those assets travel on will include suburban and urban areas and they will often operate in close proximity to the sites of SkyTerra's ATC base stations. By design the low loss receive front-end of Amtech's METS is open to all frequencies in the L-band (1525-1559 MHz) making them susceptible to interference from the relatively higher power that will be presented from close proximity ATC base stations regardless of the specific frequencies of the L-band transmissions from the ATC base stations.

1.3 References

In this Annex, FCC 03-15 refers to the FCC's *Report and Order and Notice of Proposed Rulemaking*, released February 10, 2003, while FCC 05-30 refers to the FCC's *Memorandum Opinion and Order and Second Order on Reconsideration*, released February 25, 2005. The SkyTerra modification request that is referred to is titled *Modification and Request for Expedited Consideration*, dated April 29, 2009. This document is referred to here as the Modification.

2 ATC Base Station Downlink EIRP

2.1 EIRP Averaging

In section I(B)(1) of the Modification, SkyTerra requests an EIRP waiver "to permit a maximum average EIRP of 32 dBW/MHz per BTS sector…" The nature of the averaging must be specified to determine the interference impact of this change. Averaging could conceivably be performed over some combination of solid angle, frequency, different ATC base stations and time. If averaging is to be performed over time, the precise timeframe of that averaging must be specified, as different results will pertain if the average is performed (for example) over seconds during the busy hour, or over the course of 24 hours.

In the analysis of this annex, the term "maximum average EIRP" is assumed to substantially mean peak EIRP over solid angle (per sector) and time. This peak is assumed to be a limit applied to each ATC BTS individually. Amtech respectfully notes that this important figure has not been clarified by SkyTerra and reserves the right to analyze interference effects based upon any clarification provided by SkyTerra for its meaning of the term "maximum average EIRP."

2.2 Peak Downlink EIRP

SkyTerra's proposed Modification is expected to increase the ATC BTS EIRP per sector. The current regulation of 47 C.F.R. 25.253(d)(1) states that ATC base stations shall not "exceed a peak EIRP of 31.9-10*log(number of carriers) dBW/200 kHz, per sector, for each carrier in the 1525-1541.5 and 1547.5-1559 MHz frequency bands." With reference to FCC 03-15, Appendix C2, section 2.2.1.1, table 2.2.1.1.A and FCC 05-30 paragraph 55, we believe this limits the peak EIRP per sector to no more than 31.9 dBW in the band of 1525-1559 MHz. SkyTerra's requested change would remove the limit on EIRP and replace it with maximum average EIRP per MHz (an EIRP spectral density measure rather than EIRP measure), with no well-defined limitations on the number of carriers, total bandwidth or peak power.

Although SkyTerra states in their Modification that they intend to have "up to two 10 MHz or four 5 MHz bandwidth carriers/sector in a BTS sector," they have not requested that the waiver include a BTS downlink bandwidth limitation. Although the worst case bandwidth might be greater in the future, for this analysis we will assume that a limit of 20 MHz downlink bandwidth per sector is observed. With this assumption the maximum average EIRP is

$$32\,^{dBW}/_{MHz} + 10\log_{10} 20MHz = 45dBW$$

Thus, the waiver would yield an increase in peak EIRP of 13.1 dB.

In addition to the increase in power due to the signal bandwidth, the waiver if allowed will most likely result in an even greater increase peak EIRP. This is due to its proposal to remove limitations on modulation. While standard GSM uses constant envelope modulation in the downlink, this is not likely to be true if other modulations are adopted. For example OFDM modulation, if used, would lead to a peak-to-average power ratio in excess of 10 dB. Notwithstanding this, the analysis in this annex uses the average power, even though the non-zero peak-to-average power ratio is expected to increase the impact of both overload and intermodulation interference.

3 Overload Interference Range Expansion

3.1 Overload Signal Levels

In FCC 05-30, the FCC concluded "that Inmarsat receivers can tolerate another 8 dB increase in power when the interfering signal is more than approximately two megahertz removed from the desired signal." The FCC also noted that "in cases where the interfering signal is less than approximately two megahertz removed from the desired signal, our assumption of Inmarsat MET receiver tolerance of -60 dBm was correct." Amtech's forward links could be at any frequency in the MSS L-band, either within 2 MHz of an ATC signal or with greater frequency separation. Because of this, link budgets and interference ranges are computed here using assumed overload interference signal limits of both -52 dBm and -60 dBm, to demonstrate the impact of increased overload interference due to SkyTerra's requested waivers both within and outside 2 MHz of ATC signals.

3.2 Path loss versus Range Computation

The propagation models used to compute range-path loss relationships (other than free space propagation) were downloaded from the NIST website at http://w3.antd.nist.gov/wctg/manet/prd_propcalc.html. The significant model parameters used were: ATC BTS signal frequency of 1545 MHz, base station height of 30 meters, MET height of 2.5 meters.

The propagation model used for urban environments was the Hata large city model. In the overload interference analysis of FCC 03-15, Appendix C2, the FCC adopted a path loss of 86 dB at 100 meters.[1] The precise model that was used to derive this path loss was not made explicit. Rather than attempt to guess the exact model (along with its parameters) that was used by the FCC, we have used the Hata large city model which computes a path loss at 100 meters range of 95.4 dB, significantly higher than the FCC value of 86 dB and therefore more favorable to SkyTerra's proposal. Use of the more favorable Hata model makes the impact of SkyTerra's proposed changes to ATC downlink induced MET overload interference understated in this analysis for urban propagation environments, when compared to what would be expected if the FCC's model was applied.

Two propagation models are used for suburban environments: (1) the WI-LOS model and (2) free space propagation.

3.3 Urban Environment

Four link budget versions are included here. The variations on the link budget are:

[1] See FCC 03-15, Appendix C2, sections 1.6 and 2.2.1.1

Link Budget	Total Peak EIRP per sector	Interference limit
A	31.9 dBW	-52 dBm
B	45.0 dBW	-52 dBm
C	31.9 dBW	-60 dBm
D	45.0 dBW	-60 dBm

Table 3.3-1 Urban Environment Link Budget Variations – Overload Interference

For urban propagation, the FCC's assumptions from FCC 03-15 on power control, voice activation, polarization, MET gain, and BTS gain have been adopted without changes.[2] This is because the elevation angle of the BTS with respect to the MET is expected to be similar to the 25° assumed by the FCC.

The link budgets are shown below:

[2] See FCC 03-15, Appendix C2, section 2.2.1.1.

Parameter	Units	Link A	Link B	Link C	Link D
Total EIRP per sector	dBW	31.9	45.0	31.9	45.0
BS to MET Propagation Loss	**dB**	**84.2**	**97.3**	**92.2**	**105.3**
Power Control	dB	5.2	5.2	5.2	5.2
Voice Activation	dB	4.0	4.0	4.0	4.0
Polarization Isolation	dB	8.0	8.0	8.0	8.0
MET Gain to BS	dB	0	0	0	0
BS Gain to MET	dB	-12.5	-12.5	-12.5	-12.5
Received Interference	dBW	-82	-82	-90	-90
Saturation Level	dBW	-82	-82	-90	-90
Saturation Level	dBm	-52	-52	-60	-60
Margin	dB	0	0	0	0
Required Separation Distance	**m**	**51**	**113**	**81**	**191**

Table 3.3-2 Urban Environment Link Budgets – Overload Interference

Link budgets A and C show the interference ranges at the current peak EIRP, for saturation levels of -52 and -60 dBm respectively. Link budgets B and D show the interference ranges at an EIRP of 45 dBW, for saturation levels of -52 and -60 dBm respectively. As can be seen, for METs operating at both less than and greater than 2 MHz spacing from the ATC BTS downlink, the predicted interference range approximately doubles when compared to the interference range with the current peak EIRP.

With this analysis, we have shown that even with a much more conservative propagation model than that used by the FCC in its overload interference analysis, the area around each urban ATC BTS affected by overload interference is expected to increase to 0.04 km^2 and 0.11 km^2

respectively for terminals separated by more than and less than 2 MHz from ATC BTS downlink signals.

3.4 Suburban Environment

Link budget assumptions for suburban environments are somewhat different than those for urban environments. The elevation of the BTS with respect to the MET is low, between 0-5°. At this elevation angle, the BS antenna discrimination is no longer -12.5 dB. Comparing the regulations of 25.253(d) (1) and (2), and also 25.253(d) (3) and (4), a figure of -5 dB is used as the base station antenna discrimination for low elevation. In addition, the terminal gain and polarization isolation will change with the lower elevation angle. Amtech METs are used in applications requiring low cost and low profile, because of which single micro-strip patch antennas are used. These antennas have high axial ratios at low elevation angles and approach linear polarization. Because of this, a figure of 1 dB is used for polarization discrimination. The gain of the patches at low elevation is also low, -7 dBic for elevations of 0°.

Four link budget versions are included here, as in the previous section. The variations on the link budget are identical to the urban propagation section:

Link Budget	Total Peak EIRP per sector	Interference limit
A	31.9 dBW	-52 dBm
B	45.0 dBW	-52 dBm
C	31.9 dBW	-60 dBm
D	45.0 dBW	-60 dBm

Table 3.4-1 Suburban Environment Link Budget Variations – Overload Interference

As previously noted, the WI-LOS and free space models are used to compute propagation ranges from the required link budget path losses below. The ranges for the two models are included in separate rows in the link budget; however the path losses in both cases are identical as required to close the budgets. Free space ranges are computed as follows:

$$D = 10^{\frac{L - 20\log_{10} f - 32.45}{20}}$$

in which D is the distance in km, L the path loss in dB and f the frequency in MHz.

The link budgets are shown below:

Parameter	Units	Link A	Link B	Link C	Link D
Total EIRP per sector	dBW	31.9	45.0	31.9	45.0
BS to MET Propagation Loss	**dB**	**91.7**	**104.8**	**99.7**	**112.8**
Power Control	dB	5.2	5.2	5.2	5.2
Voice Activation	dB	4.0	4.0	4.0	4.0
Polarization Isolation	dB	1.0	1.0	1.0	1.0
MET Gain to BS	dB	-7.0	-7.0	-7.0	-7.0
BS Gain to MET	dB	-5.0	-5.0	-5.0	-5.0
Received Interference	dBW	-82	-82	-90	-90
Saturation Level	dBW	-82	-82	-90	-90
Saturation Level	dBm	-52	-52	-60	-60
Margin	dB	0	0	0	0
Required Separation Distance (WI-LOS model)	**m**	**270**	**870**	**550**	**1740**
Required Separation Distance (free space model)	**m**	**590**	**2680**	**1490**	**6240**

Table 3.4-2 Suburban Environment Link Budgets – Overload Interference

As can be seen from the propagation ranges, with the increased EIRP requested in the SkyTerra Modification, the ranges from each ATC base station in which service to Amtech METs is interrupted by downlink overload interference will increase substantially.

With this analysis, we have shown that the area around each suburban ATC BTS affected by overload interference is expected to increase from the 0.03 km^2 assumed by the FCC in their

analysis (i.e. 100 m interference range) to 2.4 km^2 and 22.6 km^2 respectively with WI-LOS and free space propagation, for terminals separated by more than 2 MHz from ATC BTS downlink signals. For terminals separated by less than 2 MHz from ATC BTS downlink signals, the area around each suburban ATC BTS affected by overload interference is expected to increase to 9.5 km^2 and 122.3 km^2, depending on whether propagation follows the WI-LOS model or free space propagation.

4 Intermodulation

4.1 Introduction

With the use of narrowband modulation and a limited number of carriers with cellular frequency reuse, ATC BTS intermodulation interference to another service operating in the MSS L-band would only be expected to occur in some fraction of the ATC BTS cells. This is because the frequencies of the ATC downlink signals and interfered MSS service would have to line up so that the intermodulation interference falls within the band of the interfered MSS L-band forward link signal. While this might be true in one ATC cell, another (adjacent, for example) ATC cell would in general be expected to have a different set of downlink frequencies and intermodulation interference to the other MSS service might not occur. With broadband modulations on the ATC downlinks, the intermodulation bandwidth will be widened as well, covering as much or even more than the entire MSS L-band. Intermodulation interference would be more ubiquitous, potentially interfering with a given MSS service in every ATC cell rather than a subset. Because of this, intermodulation deserves close attention in the context of broadband ATC downlink modulation.

Section 25.253(h) provides intermodulation interference protection to MSS operators, in that the MSS operator "may request coordination to modify the base station carrier frequencies or to reduce the maximum base station EIRP on the frequencies contributing to the third-order intermodulation products." However, this rule was developed with an understanding that, at least in the L-band, the MSS operator would be using narrowband technologies. As SkyTerra has proposed this modification to the existing rules to allow for broadband technology, the reality is that "coordination" of frequencies would no longer be readily achievable. Broadband technology (bandwidths of 5 or 10 MHz or greater) will simply be incapable of inhibiting the production of intermodulation interference even with coordination efforts. As has been noted, with broadband carriers the intermodulation products may cover the entire MSS band, in which case frequency coordination could not provide any relief. In general, the only solution to mitigating intermodulation interference from a broadband interferer would be to require a reduction in EIRP.

4.2 Interfering Intermodulation Signal Levels

In this section, an interfering intermodulation signal level is estimated for broader band signals than GSM, based on the FCC's measurements of FCC 05-30 Appendix A. In particular, two 10 MHz downlink signals are assumed. In line with the FCC's overload interference approach, the interfering signal level is based on the worst case of the 4 terminals tested by the FCC: the one labeled Inmarsat Terminal A.

The FCC's measurements of intermodulation interference showed very little impact of signal bandwidth on interfering signal level. From figure 5 in FCC 05-30 Appendix A for Inmarsat Terminal A, across most of the spectrum the cdma2000 signal has a measured interfering level of -66.5 dBm while the GSM measured interfering signal varies with an average over 1540-1558 of

-69 dBm. With signal bandwidths of 1250 and 200 kHz respectively, the relationship of interfering signal level to signal bandwidth can then be estimated as

$$SL = -76.2 + 3.14 \log_{10} BW$$

(with SL being interfering intermodulation signal level in dBm, inclusive of both signals, and BW being the bandwidth of each interfering signal in kHz). Only the GSM and cdma2000 interfering levels were used to compute this linear relationship because CW interference is a special case, being narrower than the Inmarsat signal bandwidth of 40 kHz, while intermodulation from the GSM and cdma2000 signals are expected to be 600 kHz and 3750 kHz wide respectively.

This equation predicts an interfering signal level of -63.6 dBm for intermodulation interference from two 10 MHz signals. Note that this is the aggregated signal level from both intermodulating signals; with 2 intermodulating signals it is the total signal level received from the BTS downlink.

4.3 Urban Intermodulation Interference Range

In this section the urban intermodulation interference range is computed based on two 10 MHz interfering signals with a total BTS EIRP of 45 dBW, and an interfering intermodulation signal level of -63.6 dBm. As in section 3.3, the Hata large city propagation model is used.

Parameter	Units	Value
Total EIRP per sector	dBW	45.0
BS to MET Propagation Loss	**dB**	**108.9**
Power Control	dB	5.2
Voice Activation	dB	4.0
Polarization Isolation	dB	8.0
MET Gain to BS	dB	0
BS Gain to MET	dB	-12.5
Received Interference	dBW	-93.6
Interference Level	dBW	-93.6
Interference Level	dBm	-63.6
Margin	dB	0
Required Separation Distance	**m**	**242**

Table 4.3-1 Urban Environment Link Budget – Intermodulation Interference

As can be seen, the interference range from broadband intermodulation is predicted to be significantly larger than that from downlink overload interference. It is substantially larger than the 100 meter range used by the FCC for overload interference computation, even though the propagation model generates higher path loss versus distance.

With this analysis, we have shown that even with a much more conservative propagation model than that used by the FCC in its overload interference analysis, the area around each urban ATC BTS affected by intermodulation interference is expected to be approximately 0.18 km^2.

4.4 Suburban Intermodulation Interference Range

In this section, the suburban intermodulation interference range is computed based on two 10 MHz interfering signals with a total BTS EIRP of 45 dBW, and an interfering intermodulation signal level of -63.6 dBm. As in section 3.4, WI-LOS and free space propagation models are used.

Parameter	Units	Value
Total EIRP per sector	dBW	45.0
BS to MET Propagation Loss	**dB**	**116.4**
Power Control	dB	5.2
Voice Activation	dB	4.0
Polarization Isolation	dB	1.0
MET Gain to BS	dB	-7.0
BS Gain to MET	dB	-5.0
Received Interference	dBW	-93.6
Saturation Level	dBW	-93.6
Saturation Level	dBm	-63.6
Margin	dB	0
Required Separation Distance (WI-LOS model)	**m**	**2430**
Required Separation Distance (free space model)	**m**	**10200**

Table 4.4-1 Suburban Environment Link Budget – Intermodulation Interference

With this analysis, we have shown that the area around each suburban ATC BTS affected by intermodulation interference is expected to be 18.6 km^2 and 326.9 km^2, depending on whether

propagation follows the WI-LOS model or free space propagation. This is significantly larger than the 0.03 km^2 assumed by the FCC in their overload interference analysis.

5 Interference Monitoring Cost

Title 47 CFR § 25.255 states that the MSS ATC operator must resolve any harmful interference to other services caused by ATC operations. If this is very infrequent, then no regular monitoring by Amtech of ATC induced interference is likely to be necessary. With both downlink overload and intermodulation interference ranges increasing significantly especially, in suburban areas, and with intermodulation potentially occurring into Amtech's MSS downlink in every ATC cell, the likelihood of interference to Amtech's METs is increased immensely. In this case, surveillance of ATC-induced interference to Amtech's MSS will become necessary.

Interference into Amtech's MSS forward link will be difficult to detect remotely. In many cases, communications are machine-to-machine; there is no human operator at the terminal to take note of the terminal location and environment as well as communications robustness. Terminals operate intermittently rather than continuously, with widely variable duty cycles, sending messages as infrequently as once per day or as frequently as once every few minutes. If a terminal lost reception of its forward link due to interference, the back-office would not be able to determine this; the terminal would merely be muted. The terminal itself would not have the capability to determine whether it was being blocked by interference or by physical blockage such as a mountain or parking garage deck.

Because of the inability to remotely diagnose interference issues, and with a large increase in the probability of interference to Amtech METs, a regular program of field testing would be required with substantial cost to Amtech.

6 Widely Applicable Specifications Replaced with Aeronautical Specifications

6.1 EIRP

In section I(B)(1) of the Modification, SkyTerra references "sections 25.253(d)(1)-(4) of the L-band ATC rules," and in a related waiver request "proposes that the total PFD from BTS emissions in the 1.5 GHz band, calculated to be receivable at an aeronautical receiver at an altitude of at least 100 meters from the Earth's surface, be limited to -26.8 dBW/m^2…" We believe that SkyTerra is requesting this waiver as a replacement for 25.253(d)(2) and (4) which control the peak EIRP towards the horizon in the bands 1525-1541.5 MHz/1547.5-1559 MHz and 1541.5-1547.5 MHz respectively. If this is true, then the proposed modification replaces widely applicable specifications which control the peak EIRP towards the horizon with ones specific to aviation terminals above the Earth only and not necessarily controlling EIRP towards the horizon.

This is of significance to Amtech because the low elevation (i.e. horizontal) EIRP will have a direct impact on interference in suburban environments, as previously outlined in sections 3.4 and 4.4, and also in open environments. Without a specific limit the long range line of sight impact to Amtech's land mobile terminals cannot be predicted, and would not be controlled by the regulations.

6.2 Out of Channel Emissions

In section I(B)(3) of the Modification, SkyTerra proposes that the FCC waive Section 25.253(b), modifying its widely applicable OOCE limit with proposed location-specific PFSD limits for airports and navigable waterways as well as a non-location-specific proposed modification:

(1) the total power flux spectral density (PFSD) from BTS emissions in the 1.5 GHz band that are calculated to be receivable at an aeronautical receiver at an altitude of 100 meters or greater from Earth's surface shall not exceed -187.27 dBW/m^2-Hz at a spectral offset of 2 MHz from the nominal edge of spectrum used for ATC;

The proposed change replaces the widely applicable OOCE limit of 23.253(b) with one that is specific to aviation terminals and does not necessarily control OOCE to land mobile terminals.

This is of significance to Amtech because its terminals will be susceptible to interference from out-of-channel emissions. Without a specific limit the out of channel emissions from ATC BTS to Amtech terminals cannot be predicted, and would not be bounded by the regulations.

7 Clarification of Coordination Agreement

The Modification refers to the Coordination Agreement of December 20, 2007 between SkyTerra, SkyTerra Canada and Inmarsat:

This agreement defines mutually-acceptable technical and operating rules for all three parties, including the terms necessary for SkyTerra to proceed with ATC deployment as proposed in this application. The agreement also provides certainty in other matters that are crucial to long-term planning by all parties. These matters include a highly-flexible approach to accommodating a variety of possible deployments while maintaining acceptable interference levels, a phased process for implementation, a mechanism for further optimization through additional coordination, and procedures to ensure compliance.

The Coordination Agreement is used as a general basis for SkyTerra's waiver requests, for example in section I:

> *As contemplated by the Commission's ATC rules and pursuant to the Coordination Agreement, in this application SkyTerra requests certain waivers to provide it with additional operational flexibility for its terrestrial component.*

The Coordination Agreement is used specifically as a basis for SkyTerra's request for authority to use additional air interface protocols in section I(A)(1) of the Modification:

> *In this filing, SkyTerra seeks a waiver of the rule for flexibility to operate with any air interface protocol without first making such a showing, as long as such operations conform to the parameters in the Coordination Agreement…*

The Coordination Agreement is used specifically in section I(B)(1) of the Modification as a basis for SkyTerra's request to waive the EIRP limits of 25.253(d)(1)-(4):

> *The Coordination Agreement, however, allows different emission bandwidths to be deployed, in which case, the number of carriers may vary. SkyTerra therefore requests that the Commission waive its rules to permit a maximum average EIRP of 32 dBW/MHz per BTS sector in the 1.5 GHz band, consistent with the parameters and models agreed to in the Coordination Agreement.*

The Coordination Agreement is used specifically in section I(B)(3) of the Modification as a basis for SkyTerra's request to waive the OOCE limits of 25.253(b):

> *SkyTerra requests that the Commission waive its rule to provide additional flexibility in this regard, consistent with the parameters and models agreed to in the Coordination Agreement.*

The Coordination Agreement is used in section I(B)(5) of the Modification as a basis for SkyTerra's request to waive the rules of 23.253(d)(8) and (e), regarding polarization, antenna gain and overhead gain suppression:

> *SkyTerra seeks a waiver of the rule to permit its operation of base stations with the more precise and flexible operating metrics for base station emissions specified in the Coordination Agreement.*

The Coordination Agreement is not a public document (specifically the technical annexes are not). Because of this, it is not possible for Amtech to determine the impact of operating with different air interface protocols. Nor is it possible to determine what limits might be set or implied for downlink interference to Amtech's land mobile terminals at very low elevation angles, or what limits might pertain for OOCE to Amtech's land mobile terminals. Finally, the antenna gain and polarization operating metrics are not published and so it is impossible to determine what the impact of downlink overload and intermodulation interference (in particular off the antenna peak) might be with any precision.

Amtech would welcome the opportunity to review the technical content of the Coordination Agreement, and to work with SkyTerra to attempt to resolve any issues of ATC interference into Amtech's MSS system brought to light by such a review.