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

COMMENTS OF SKYWAVE MOBILE COMMUNICATIONS, CORP. AND SKYWAVE MOBILE COMMUNICATIONS, INC.

SkyWave Mobile Communications, Inc.
SkyWave Mobile Communications, Corp.
1145 Innovation Drive, Suite 288
Ottawa, Ontario
Canada K2K 3G8

July 10, 2009

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SUMMARY

SkyWave Mobile Communications, Corp. and SkyWave Mobile Communications, Inc. (collectively, "SkyWave") file comments on the above-captioned Sky Terra applications ("Applications") to emphasize the substantial increased interference the requested SkyTerra waivers could cause SkyWave's land mobile satellite services throughout the United States. SkyWave provides critical tracking, monitoring and control functions vital to the military, law enforcement, security, first-responders, critical infrastructure, transportation and commercial sectors.

SkyWave serves approximately 55,000 land mobile terminals in the United States using SkyTerra and Inmarsat satellites. SkyWave's U.S. end-users include the Department of Defense Counter-Narcoterrorism Technology Program Office, the Naval Surface Warfare Center, Department of Homeland Security, Drug Enforcement Agency, Tennessee Valley Authority, Washington State Department of Transportation, American Red Cross, Southern California Edison, Union Pacific and more than 500 trucking companies. These end-users rely on SkyWave's ubiquitous coverage throughout the entire United States (and beyond). Federal government agencies and transportation companies select SkyWave for their mission-critical tracking, monitoring and control requirements because the service is reliably available in both urban and rural environments. SkyWave's service has been growing rapidly, adding more than 10,000 new terminals per year.

As discussed in the comments and technical annex, the SkyTerra's waivers to (1) increase ATC base station EIRP; (2) adopt any air interface standard without demonstrating that it would not increase interference; and (3) eliminate the out-of-

channel emissions limit for land mobile terminals could substantially increase interference to SkyWave's land mobile service in the U.S.

Some of SkyTerra's waivers implicitly assume that it can narrow the range of interference cases to cover only aeronautical terminals on planes near airports and maritime terminals on ships near ports. While there is no question that these aeronautical and maritime terminals need protection from ATC interference, so do the 55,000 SkyWave terminals, primarily on trucks and other vehicles that move throughout the urban and suburban environments across the United States.

SkyTerra's principal justification for granting the waivers is to implement the confidential agreement between SkyTerra and Inmarsat. While SkyWave has the utmost respect for these two satellite operators who supply its space segment, their agreement was not made with SkyWave, is not available to SkyWave, and apparently did not cover all of SkyWave's interference concerns.

SkyWave is committed to working constructively with the Commission, SkyTerra and other interested parties to resolve the interference issues. SkyWave is willing to assign sufficient engineering resources to work with SkyTerra's engineers and others to develop acceptable solutions. Until such solutions have been developed that assure that SkyWave's mission-critical services will remain reliably available throughout the U.S. to military, law enforcement, security, first-responders, critical infrastructure, transportation and commercial users, the waivers should not be granted.

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COMMENTS OF SKYWAVE MOBILE COMMUNICATIONS, CORP. AND SKYWAVE MOBILE COMMUNICATIONS, INC.

I. INTRODUCTION

SkyWave Mobile Communications, Corp. and SkyWave Mobile Communications, Inc. (collectively, "SkyWave") hereby file their comments on the above-captioned applications (collectively, "Applications").[1]

[1] On July 6, 2009, SkyWave filed a letter, explaining that it would respond to the identical above-captioned applications in a single filing on July 10, 2009 in response to the two public notices issued. *Policy Branch Information; Space Station Applications Accepted for Filing*, Report No. SAT-00609, File Nos. SAT-MOD-20090429-00047, SAT-MOD-20090429-00046 (June 5, 2009); *Satellite Commc'ns Servs.; Satellite Radio Applications Accepted for Filing*, Report No. SES-01145, File No. SES-MOD-20090429-00536 (June 10, 2009).

II. SKYWAVE AND ITS END-USERS HAVE A PARAMOUNT INTEREST IN AVOIDING INTERFERENCE FROM SKYTERRA'S ATC SYSTEM

SkyWave serves approximately 55,000 land mobile terminals in the United States using SkyTerra and Inmarsat satellites. SkyWave is one of the leading U.S. service providers on both satellite systems, based on the number of mobile earth terminals ("METs"). SkyWave designed, owns and operates the terrestrial network used to serve its end-users.

Inmarsat estimates that the satellite low data rate market served by SkyWave is $600 million today, with "significant growth potential."[2] Indeed, SkyWave's service has been growing rapidly, adding more than 10,000 new terminals per year. This rapid growth has been driven in significant part by governmental mandates and increased public and private concerns for freight security.

SkyWave provides critical tracking, monitoring and control functions vital to the military, law enforcement, security, first-responders, critical infrastructure, transportation and commercial sectors. SkyWave's U.S. end-users include the Department of Defense Counter-Narcoterrorism Technology Program Office, the Naval Surface Warfare Center, Department of Homeland Security, Drug Enforcement Agency, Tennessee Valley Authority, Washington State Department of Transportation, American Red Cross, Southern California Edison, Union Pacific and more than 500 trucking companies. These end-users rely on SkyWave's ubiquitous coverage throughout the entire United States (and beyond). Federal government agencies and transportation companies select SkyWave for their mission-critical tracking, monitoring and control requirements because the service is reliably available in both urban and rural environments.

[2] Inmarsat Press Release, July 2, 2009.

Indeed, SkyWave's customers typically have increased message traffic in urban areas where trucks and other vehicles obtain and dispose of their cargoes. Today, SkyWave is able to provide reliable service in urban areas.

SkyWave has the utmost respect for its MSS space segment suppliers, SkyTerra and Inmarsat.[3] SkyWave files separate comments in this proceeding to highlight the paramount interest of its end-users in ensuring that SkyWave's rapidly growing service continues to operate throughout the United States reliably without interference from SkyTerra's ATC system. SkyTerra has a strong commercial interest in providing a robust and profitable ATC service, even at the cost of diminishing or potentially harming its mobile satellite service. While Inmarsat has entered into a coordination agreement with SkyTerra, that agreement necessarily involves numerous trade-offs. SkyWave recognizes that Inmarsat is satisfied with the trade-offs in the SkyTerra-Inmarsat agreement,[4] but SkyWave does not have sufficient information about the agreement to confirm that the agreement will protect its 55,000 U.S. terminals from interference caused by SkyTerra's ATC operations. Indeed, based on SkyTerra's limited description of the SkyTerra-Inmarsat agreement in its Applications, it is clear that the agreement does not protect the SkyWave terminals from interference from ATC.

The Commission must look beyond the SkyTerra-Inmarsat agreement itself to resolve SkyWave's interference concerns. While the agreement might be sufficient to resolve the interference issues between the two satellite operators, the SkyTerra-Inmarsat agreement cannot be dispositive of interference from the ATC service to the SkyWave terminals. Indeed, while the Commission's ATC rules explicitly provide that a coordination agreement can supersede the Commission's specific rules on interference

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[3] In addition to supplying space segment, Inmarsat plc owns approximately 20% of SkyWave Mobile Communications, Inc.

[4] *See* Comments of Inmarsat Global Ltd. (July 6, 2009).

from the ATC system to another MSS operator, 47 C.F.R. § 25.253(a)(1)-(2), there is no similar provision with respect to ATC interference to METs.

The Commission spent four years developing and refining its ATC rules, achieving a technically complex balance between providing for a robust ATC service while still ensuring that the existing and prospective primary satellite users of the MSS bands would be able to continue to receive their critical mobile satellite service without significant interference. The Commission noted that "the potential interference between MSS and terrestrial mobile systems is, in fact, so great."[5] For this reason, the Commission "adopt[ed] technical parameters for ATC operations. . . designed to protect adjacent and in-band operations from interference from ATC."[6] Several of SkyTerra's proposed waivers of the Commission's Rules could upset the Commission's carefully crafted balance and permit substantial interference to tens of thousands of primary MSS users.

III. SKYTERRA'S WAIVERS WOULD INCREASE INTERFERENCE TO LAND MOBILE METS

The Applications request seven waivers of the Commission's ATC Rules. SkyWave comments on three waivers which could lead to significantly increased interference to land mobile METs: (1) increased ATC base station EIRP; (2) adoption of any air interface standard; and (3) a new out-of-channel emissions limit.

The Applications are curiously silent on the legal standard for granting the requested waivers. The Commission may grant a waiver under Section 1.3 "for good

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[5] *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*, 18 FCC Rcd 1962 (2003) ("*2003 ATC Order*") ¶ 60.

[6] *2003 ATC Order* ¶ 104.

cause shown" if the waiver does not "undermine the purposes of the rule, and there [is] a stronger public interest benefit in granting the waiver than in applying the rule."[7]

A. SkyTerra Should Not Be Able to Increase the Base Station EIRP

SkyTerra proposes that the Commission's Rules (47 C.F.R. §25.253(d)(1)-(4)), limiting peak ATC base station ("BTS") EIRP, be relaxed substantially by using an average EIRP, and by removing the per carrier metric. SkyTerra does not explain how this average EIRP would be determined. In addition, elimination of the per carrier metric would allow SkyTerra to increase the BTS power significantly.

Effectively, SkyTerra seeks a further reconsideration of the Commission's Rule governing BTS power levels. In the Commission's 2003 rulemaking establishing the ATC rules,[8] the Commission established a peak EIRP limit of 23.9 dBW. In response to a SkyTerra/MSV Petition for Reconsideration, and following a careful technical analysis and balancing of competing claims and interests, the Commission approved a SkyTerra/MSV request to increase the peak EIRP by 8 dBW to 31.9 dBW.[9] Not satisfied with the rule change it requested, SkyTerra/MSV now asks that its requested

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[7] *Rainbow DBS Company LLC; Consent to Withdraw and Unconditionally Release Bonds and Request for Waiver of the Bond Requirement*, Memorandum Opinion and Order, 22 FCC Rcd 4272, ¶¶7-8 (2007) (*citing WAIT Radio, WAIT Radio v. FCC*, 418 F.2d 1153, 1157 (D.C. Cir. 1969) and *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990)).

[8] *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*, 18 FCC Rcd 1962 (2003) ("*2003 ATC Order*").

[9] 47 C.F.R. §25.253(d)(1). *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 Second Order on Reconsideration*, 20 FCC Rcd 4616 (2005) ¶¶ 53-55 ("*ATC Reconsideration Order*").

rule be waived to permit an additional substantial increase in BTS power of 13.1 dBW, as shown in SkyWave's analysis in the Technical Annex at 3.[10]

This technical analysis further demonstrates that, in urban environments, the predicted interference range would approximately double for METs operating at both less and greater than 2 MHz spacing from the ATC BTS downlink if SkyTerra's waiver were granted. Technical Annex at 7.

The predicted expansion of the interference range can be substantially greater in suburban environments. As shown in the Technical Annex, the interference range can readily extend to as much as 20 square kilometers in the suburban environment for terminals separated by more than 2 MHz, and more than 100 square kilometers for terminals separated by less than 2 MHz. Technical Annex at 9-10. While the Commission has previously considered ATC interference scenarios primarily in urban environments, the Commission does not limit deployment of ATC base stations to urban environments. Since SkyTerra's requested waiver would have a substantial interference impact in suburban environments, the Commission should evaluate the impact of the requested waiver in suburban environments, or should condition the waiver only to urban ATC BTS.

SkyTerra first attempts to justify the waiver by claiming it is "consistent with the parameters and models agreed to in the Coordination Agreement," Applications at 10. Even if the requested waiver is consistent with the SkyTerra-Inmarsat Agreement,

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[10] SkyWave recently completed an acquisition of assets, including technology, customers and employees, from Transcore (an affiliate of Amtech Systems LLC). The engineers who performed the technical analysis included people who began the analysis while Transcore employees and are now SkyWave employees. Transcore now resells the communications services of SkyWave. Accordingly, both companies face the same interference risks from SkyTerra ATC, and both companies have relied on a similar technical analysis for their filings.

SkyWave and its end-users are not parties to that agreement.[11] While operator-to-operator interference rules can be superseded by a coordination agreement, 47 C.F.R. § 25.253(a)(2)-(3), interference to METs cannot. This critical distinction makes sense. A satellite operator can agree to accept greater interference into its satellite system than permitted by FCC Rule if it receives sufficient financial consideration or technical tradeoffs in a different portion of its agreement. However, the satellite operator cannot bind other parties, such as the end-users or service providers, with respect to interference to METs.

SkyTerra's second justification is that the requested waiver would bring ATC base stations in line with the permitted power limits for PCS and AWS base stations.[12] This justification also fails because (1) ATC is only an ancillary service in the L-band that must be provided without significant interference to the co-frequency primary mobile satellite service; (2) the PCS and AWS services do not present a similar interference threat to MSS METs because there is substantial separation between these bands; and (3) the PCS and AWS regulations cited by SkyTerra do not have the same power limits requested by SkyTerra's waivers.

The attached technical analysis establishes that granting the waiver would lead to interference in substantially greater areas around ATC base stations in urban and

[11] Given SkyTerra's heavy reliance on the SkyTerra-Inmarsat agreement, the Commission should require the at Sky Terra make it available to the engineers for the parties participating in this proceeding through a suitable nondisclosure agreement. Unless SkyWave is given access to the SkyTerra-Inmarsat agreement, it would violate the Administrative Procedures Act and SkyWave's Due Process rights for the Commission to rely on the confidential SkyTerra-Inmarsat agreement to grant the Applications. Any request for a waiver of the Commission's Rules is "subject to the provisions of the Administrative Procedures Act. . . ." 47 C.F.R. §1.3. SkyTerra's vague and unsupported claim that its very specific change from peak EIRP to average EIRP is consistent with the parameters and models agreed to in the agreement cannot be tested by other interested parties.

[12] Applications at 10, *citing* 47 C.F.R. §§ 24.232(a), 27.50(d)(1)(2).

suburban environments than permitted by the Commission's Rule. As noted, in 2005, the Commission granted one SkyTerra request to increase the BTS power levels. This requested waiver should not be granted because (1) SkyTerra has not demonstrated good cause for the waiver; (2) the waiver would undermine the purpose of the Commission's Rule, which is to protect the MSS METs from overload and intermodal interference caused by the peak EIRP from the ATC BTS; and (3) SkyTerra has not established that there is "a stronger public interest benefit in granting the waiver than in applying the rule" to protect MSS METs from interference.[13]

B. SkyTerra Should Not Be Able To Increase Overload or Intermodulation Interference by Using Alternative Air Interface Protocols

SkyTerra asks the FCC to waive its Rules so it could use "*any* air interface protocol" without "first demonstrat[ing] that such operations would produce no more interference than a standard GSM network." Application at 8 (emphasis in original). Since the Commission has already determined that another protocol could increase the interference, and since SkyTerra has not shown good cause for waiving this important rule, the waiver request should not be granted.

In the *ATC Reconsideration Order*, the Commission's technical analysis concluded that protocols other than GSM could lead to greater interference. See *ATC Reconsideration Order*, Annex A, §§ 3.3, 3.6-3.7. Evaluating the interference risk in advance is critical because once an ATC operator has deployed a system with a different air interface it could be problematic to order that the system be converted to GSM.

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[13] *Rainbow DBS Company LLC; Consent to Withdraw and Unconditionally Release Bonds and Request for Waiver of the Bond Requirement*, Memorandum Opinion and Order, 22 FCC Rcd 4272, ¶¶7-8 (2007) (*citing WAIT Radio, WAIT Radio v. FCC*, 418 F.2d 1153, 1157 (D.C. Cir. 1969) and *Northeast Cellular Telephone Co. v. FCC*, 897 F.2d 1164, 1166 (D.C. Cir. 1990)).

SkyTerra has not offered a good cause justification for overcoming the Commission's prior findings of increased interference from non-GSM protocols. SkyTerra merely suggests that conformity with parameters in the SkyTerra-Inmarsat agreement is sufficient. Applications at 8. If the SkyTerra-Inmarsat agreement parameters are sufficient to avoid increased interference, then SkyTerra should make the appropriate demonstration of this fact in an application, open to scrutiny from all interested parties, as required by the Commission's Rules. However, SkyTerra has not demonstrated good cause for skipping this required showing, or for increasing interference to MSS METs.

C. SkyTerra Should Not Be Able To Increase Out-of-Channel Interference to Land Mobile Terminals

SkyTerra has requested a waiver of the out-of-channel emissions ("OOCE") of BTS in Section 25.253(b). SkyTerra's waiver would replace the general requirement to limit OOCE to -57.9 dBW/MHz at the edge of the frequency assignment with a new set of limits that would apply only to protection for aeronautical and maritime terminals. Since there would be no OOCE limit for land mobile METs, SkyWave opposes the request.

SkyWave provides service to a large and growing number of terminals on the Inmarsat system. The Commission previously determined that the limit of -57.9 dBW/MHz at the edge of the frequency assignment struck the appropriate balance between ATC operations and MSS in adjacent channels. Apparently, this OOCE limit was requested by SkyTerra/MSV based on a representation from Ericsson that it could manufacture ATC base stations to that specification. *ATC Order*, Annex C.2, § 2.2.1.2. While the SkyTerra-Inmarsat agreement may provide a reasonable alternative standard for aeronautical and maritime terminals, SkyTerra has not provided good cause for varying from the established Commission Rule for land mobile METs.

IV. COMMISSION SHOULD CONFIRM THAT SKYTERRA'S ATC OPERATIONS WILL STILL BE SUBJECT TO 47 C.F.R. §25.255

Regardless of how the Commission resolves the pending waiver requests, the Commission should make clear that Section 25.255 applies to SkyTerra's ATC operations even where other Commission Rules have been waived. This rule provides in pertinent part that:

> If harmful interference is caused to other services by ancillary MSS ATC operations, either from ATC base station operations or mobile terminals, the MSS ATC operator must resolve any such interference.

In the *2003 ATC Order*, the Commission explained that the purpose of Section 25.255 is to serve as a safety valve, ensuring that, in addition to the detailed interference rules in Sections 25.252-254, there is a general prohibition on the ancillary ATC operations causing harmful interference to the primary mobile satellite services.[14] SkyTerra has not directly requested a waiver of the no harmful interference rule. However, given the centrality of this Rule, the Commission should make it clear that any waiver granted to SkyTerra is subject to the continuing duty to avoid harmful interference to mobile satellite services.

V. CONCLUSION

The Applications do not meet the heavy burden of justifying the requested waivers to (1) increase ATC BTS EIRP; (2) use any air interface protocol without establishing that it would not cause greater interference than GSM; and (3) increase OOCE with respect to land mobile METs. Granting these waivers would permit SkyTerra's ATC system to cause substantial interference to tens of thousands of land

[14] *2003 ATC Order* ¶ 104.

mobile METs used throughout the U.S. by the military, government, security, first responders, critical industry and transportation sectors.

SkyWave is prepared to work with SkyTerra to resolve the interference issues raised by the waivers. SkyWave is willing to assign sufficient engineering resources to work with SkyTerra's engineers and others to develop acceptable solutions. Until such solutions have been developed that assure that SkyWave's mission-critical services will remain reliably available throughout the U.S. to military, law enforcement, security, first-responders, critical infrastructure, transportation and commercial users, the waivers should not be granted.

Respectfully submitted,

SKYWAVE MOBILE COMMUNICATIONS, INC.
SKYWAVE MOBILE COMMUNICATIONS, CORP.

By: /s/
Tom Houtman
Director, Product Development
SkyWave Mobile Communications, Inc.
SkyWave Mobile Communications, Corp.
1145 Innovation Drive, Suite 288
Ottawa, Ontario
Canada K2K 3G8

July 10, 2009

Certification

I, Tom Houtman, Director, Product Development for SkyWave Mobile Communications, Inc., certify that I am the technically qualified person with overall responsibility for preparation of the information contained in the foregoing comments. I am familiar with the requirements of Part 25 of the Commission's rules, and the information contained in the comments is true and correct.

/s/
Tom Houtman
Director, Product Development
SkyWave Mobile Communications, Inc.

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:

Gary M. Epstein
Executive Vice President, Law and Regulation
SkyTerra Subsidiary LLC
10802 Park Ridge Boulevard
Reston, VA 20191

Bruce D. Jacobs
Tony Lin
John K. Hane
Pillsbury Winthrop Shaw Pittman LLP
2300 N Street, N.W.
Washington, DC 20037

Counsel for SkyTerra Subsidiary LLC

Best Copy and Printing, Inc.**
fcc@bcpiweb.com

** By electronic mail only

/s/
Tom Houtman

Technical Annex

1 Introduction

1.1 Overview

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

The analysis shows that SkyTerra's requested waivers will increase the downlink EIRP, which will directly increase the overload interference to SkyWave terminals. The analysis shows that SkyTerra's requested waivers will increase intermodulation interference, with direct impact to SkyWave terminals. The ranges at which overload and intermodulation interfere with MSS downlinks to SkyWave METs increases substantially, especially in suburban propagation environments. This is expected to have significant impact to the quality of SkyWave's service, especially in suburban areas, and to increase costs due to the need to detect interference issues in the SkyWave MSS forward link.

In addition to this analysis the annex points out some areas in which SkyTerra's proposed modification lacks clarity which is needed to determine the impact to SkyWave's land mobile terminals. This is due to replacement of general specifications in the current version of 25.253 with aviation-terminal-specific changes without detail on land mobile specifications. In addition, the requirement to clarify EIRP averaging is discussed.

1.2 References

In this Annex, FCC 03-15 refers to *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*, 18 FCC Rcd 1962 (2003), while FCC 05-30 refers to *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 Second Order on Reconsideration*, 20 FCC Rcd 4616 (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 Basestation Downlink EIRP

2.1 EIRP Averaging

In section I(B)(1) of the Modification, SkyTerra requests a waiver of 47 C.F.R. §25.253(d)(1)), limiting **peak** ATC base station ("BTS") EIRP per sector to 31.9 dBW, "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 elevation, azimuth or solid angle, frequency, different ATC basestations 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.

2.2 Peak Downlink EIRP

SkyTerra's proposed Modification is expected to increase the ATC BTS EIRP per sector. The current regulation of 47 CFR 25.253 (d) (1) states that ATC basestations 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 31.9 dBW in the band of 1525-1559 MHz. SkyTerra's requested Rule waiver 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

$$32 \text{ dBW/MHz} + 10 \log_{10} 20 \text{ MHz} = 45 \text{ dBW}$$

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 probably increase peak EIRP even further. 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, and multi-carrier W-CDMA could be similar. Notwithstanding this, the analysis in this annex uses the average power, even though the nonzero 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." SkyWave'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, basestation 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. Because of this the impact of SkyTerra's proposed waiver of the FCC rule on the ATC downlink induced MET overload interference is understated (and therefore favorable to SkyTerra) 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: the WI-LOS model and free space propagation.

3.3 Urban Environment

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

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

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

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:

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
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

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

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 BS antenna discrimination for low elevation. In addition, the terminal gain and polarization isolation will change with the lower elevation angle. SkyWave METs are used in applications requiring low cost and low profile, because of which single microstrip 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
Distance (WI-LOS model)	**m**	**270**	**870**	**550**	**1740**
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 BTS in which service to SkyWave 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.

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. It should be noted that this level is higher than the notification and coordination threshold of -70 dBm set in section 25.253(h). Basing the analysis on -63.6 dBm rather than -70 dBm reduces the estimated impact of intermodulation and so is favorable to Skyterra.

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
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
Distance (WI-LOS model)	**m**	**2430**
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

The FCC Rules, 47 C.F.R.§25.255, require the MSS ATC operator to resolve any harmful interference to other services caused by ATC operations. If interference is very infrequent then no regular monitoring by SkyWave 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 SkyWave's MSS downlink in every ATC cell, the likelihood of interference to SkyWave's METs is increased immensely. In this case, surveillance of ATC induced interference to SkyWave's MSS will become necessary.

Interference into SkyWave's MSS forward link will be difficult to detect remotely. 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 SkyWave METs, a regular program of field testing would be required with substantial cost to SkyWave.

6 General 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 general 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 SkyWave 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 SkyWave'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 the rule of 25.253(b), modifying its generally 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 general 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 SkyWave 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 SkyWave terminals cannot be predicted, and would not be bounded by the regulations.