Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Flexibility for Delivery of Communications	)	
by Mobile Satellite Service Providers in the	)	IB Docket No. 01-185
2 GHz Band, the L-Band, and the 1.6/2.4 GHz	)	
Bands	)	

PETITION FOR PARTIAL RECONSIDERATION AND CLARIFICATION OF MOBILE SATELLITE VENTURES SUBSIDIARY LLC

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Summary

Mobile Satellite Ventures Subsidiary LLC ("MSV") applauds the Commission's decision to allow Mobile Satellite Service ("MSS") providers to deploy an Ancillary Terrestrial Component ("ATC") to supplement their service. The Commission's decision to permit incumbent licensees to deploy ATC is a watershed in spectrum management that will serve as a model for flexible spectrum use. As the Commission recognizes, the deployment of ATC will increase efficient use of MSS spectrum, allow MSS providers to offer ubiquitous service by overcoming coverage gaps in urban areas, allow MSS operators to achieve economies of scale which will in turn dramatically reduce the cost of MSS equipment and service, promote public safety and national security, and increase competition among MSS providers.

Unfortunately, insofar as the L-band is concerned, the Commission's rules impose certain unnecessary technical restrictions on ATC. In the uplink direction, the Commission has chosen to limit the impact from co-channel L-band ATC user terminals to next-generation satellites of Inmarsat Ventures plc ("Inmarsat") to a level of at most 1.4% $\Delta T/T$. This degree of interference protection is unwarranted and arbitrary because it (i) is based on the erroneous assumption that MSV's satellites must be protected from its own ATC to a level of 6% $\Delta T/T$; (ii) is not necessary to protect Inmarsat from harmful interference; and (iii) conflicts with international norms and accepted practices. The Commission should instead protect Inmarsat satellites from co-channel L-band ATC user terminals to a level of 6% $\Delta T/T$, a level that will still ensure that Inmarsat satellites do not suffer harmful interference while at the same time allowing L-band spectrum to be reused in a more efficient and robust manner. The Commission's uplink interference analysis should also be revised because it incorrectly assumes an interference reduction factor of 3.5 dB for the use of a quarter-rate vocoder in ATC user terminals when a factor of 3.5 dB correctly applies to a half-rate vocoder. With these parameters corrected, the Commission can authorize a

terrestrial reuse factor of 14,785 for co-channel ATC operations in the L-band using a half-rate vocoder (instead of the reuse factor of 3450 authorized in the *ATC Order*) while still protecting Inmarsat-4 satellites to a level of 6% $\Delta T/T$.

Regarding the Commission's downlink interference analysis, there are three instances in which the Commission has used unreasonably conservative parameters or has adopted rules that are unnecessary to protect Inmarsat user terminals from any potential interference from L-band base stations. First, by assuming that Inmarsat's land-based and maritime user terminals will suffer overload interference at an interfering signal level of -60 dBm, despite uncontroverted record evidence that Inmarsat's user terminals are more resilient to interference, the Commission has underestimated the margin these user terminals will have against overload from L-band base stations. Modifying the Commission's analysis to specify an appropriate overload threshold of -45 dBm increases the overload margin by 15 dB, thereby allowing the Commission to authorize at least some L-band base stations to operate with a higher EIRP without increasing the potential for overload interference to Inmarsat user terminals. Second, to protect Inmarsat airborne user terminals, the Commission has required L-band base stations to operate with an unnecessary level of overhead gain suppression. L-band base stations can operate with 10 dB more gain over elevation angles from 55° to 145° and with 8 dB more gain over elevation angles from 30° to 55° from that authorized by the Commission without causing an increase of more than .03 dB in potential interference. Third, to protect Inmarsat user terminals in airports, the Commission has required L-band base stations to meet both a separation distance and a power flux density ("PFD") condition, when in fact the Commission can protect Inmarsat user terminals sufficiently by requiring base stations to meet either of these conditions. MSV also asks that the

Commission clarify its rule regarding coordination of L-band base stations with Search-and-Rescue Satellite-Aided Tracking ("SARSAT") earth stations, which is ambiguously worded.

Finally, MSV requests that the Commission clarify that non-forward-band ATC in the L-band is permitted provided an ATC applicant demonstrates that such an architecture satisfies the technical parameters adopted in this proceeding to protect other L-band MSS systems and operators in adjacent frequency bands.

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PETITION FOR PARTIAL RECONSIDERATION AND CLARIFICATION

Mobile Satellite Ventures Subsidiary LLC ("MSV"), pursuant to Section 1.429 of the Commission's rules, 47 C.F.R. § 1.429, hereby files this Petition for Partial Reconsideration and Clarification of the *Order* in the above-captioned proceeding in which the Commission has unreasonably restricted the ability of L-band Mobile Satellite Service ("MSS") operators to deploy an Ancillary Terrestrial Component ("ATC").[1]

Background

MSV. MSV is the successor to Motient Services Inc. ("Motient," formerly known as AMSC Subsidiary Corporation), the entity authorized by the Commission in 1989 to construct, launch, and operate a U.S. MSS system in the L-band.[2] MSV's licensed satellite (AMSC-1) located at 101°W was launched in 1995, and MSV began offering service in 1996. In November 2001, the Commission approved the application of Motient and TMI Communications and

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[1] *See 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, Report and Order*, 18 FCC Rcd 1962, FCC 03-15, IB Docket No. 01-185 (February 10, 2003) ("*ATC Order*"), *amended by Errata* (March 7, 2003). A summary of the *ATC Order* was published in the *Federal Register* on June 5, 2003. *See* 68 FR 33640 (June 5, 2003). Thus, this Petition for Partial Reconsideration and Clarification is timely filed on July 7, 2003, thirty (30) days after publication in the *Federal Register*. 47 C.F.R. § 1.429(d).

[2] *Memorandum Opinion, Order and Authorization*, 4 FCC Rcd 6041 (1989); *Final Decision on Remand,* 7 FCC Rcd 266 (1992); *aff'd sub nom*. *Aeronautical Radio, Inc. v. FCC*, 983 F.2d 275 (D.C. Cir. 1993) ("*Licensing Order*").

Company, Limited Partnership ("TMI") to consolidate their U.S. L-band MSS operations into a new company called Mobile Satellite Ventures LP ("MSV LP").[3] TMI at the time was the licensee of the Canadian-authorized L-band MSS satellite (MSAT-1) located at 106.5°W, and held Commission mobile earth terminal ("MET") licenses to provide MSS in the United States using MSAT-1.[4] As a result of this consolidation of U.S. MSS operations, MSV, a wholly owned subsidiary of MSV LP, is now the Commission licensee of AMSC-1 and holds the MET licenses formerly held by TMI to access MSAT-1 for L-band MSS in the United States. *See Motient/TMI Assignment Order* ¶ 14. MSV now provides a full range of land, maritime, and aeronautical MSS, including voice and data, throughout the contiguous United States, Alaska, Hawaii, the Virgin Islands, and coastal areas up to 200 miles offshore using both AMSC-1 and MSAT-1.[5]

MSV's Next-Generation System Application. In January 2001, MSV filed an application to launch and operate a next-generation MSS system at 101°W to replace AMSC-1.[6] In this

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[3]Motient Services Inc., TMI Communications and Company LP, and Mobile Satellite Ventures LLC, *Order and Authorization*, File No. SAT-ASG-20010302-00017 *et al.,* DA 01-2732 (November 21, 2001) ("*Motient/TMI Assignment Order*").

[4]*See Satcom Systems, Inc./TMI Communications and Company, L.P.*, 14 FCC Rcd 20798 (1999), *aff'd sub nom., AMSC Subsidiary Corp. v. FCC*, 216 F.3d 1154 (D.C. Cir. 2000), *modified*, 15 FCC Rcd 24467 (2000); *see also TMI Communications and Company, L.P.*, 15 FCC Rcd 18117 (2000).

[5]Mobile Satellite Ventures (Canada) Inc. ("MSV Canada") is now the owner and Canadian licensee of MSAT-1, under the legislative authority and jurisdiction of Industry Canada. MSV and MSV Canada are owned, controlled and operated by two separate corporate entities each of which has its own controlling shareholders. MSV's shareholders are composed of several parties, none of whom have a controlling interest. In the case of MSV Canada, TMI remains the controlling shareholder.

[6]*See* Application of Motient Services Inc. and Mobile Satellite Ventures Subsidiary LLC, File No. SAT-ASG-20010116-00010 (Jan. 16, 2001). At the request of Commission staff, MSV withdrew this application and refiled an identical application on March 2, 2001. *See* Application of Motient Services Inc. and Mobile Satellite Ventures Subsidiary LLC, File No. SAT-ASG-20010302-00017 *et al.* (March 2, 2001). The March 2001 application was filed as an

application, MSV proposed to integrate ancillary terrestrial base stations into its MSS network to overcome the fundamental limitation of all MSS systems – the inability to overcome signal blockage in urban and indoor environments. The Commission requested Comments on MSV's proposal, which were submitted in April 2001.[7] MSV, Motient, and TMI responded to these Comments in May 2001, emphasizing the importance of preserving viable MSS systems and demonstrating how terrestrial operations in the L-band would not cause harmful interference to other spectrum users.[8]

ATC NPRM. In response to MSV's application and a similar proposal filed for the 2 GHz MSS band,[9] the Commission issued a *Notice of Proposed Rulemaking* in July 2001 proposing to allow MSS licensees in the L-band, 2 GHz, and Big LEO MSS bands to integrate ATC into their MSS systems.[10] MSV, Motient, and TMI submitted Joint Comments and Joint Reply Comments as well as numerous *ex parte* presentations in support of the Commission's proposal, demonstrating that ATC would increase spectrum efficiency and make MSS a vital and viable nationwide mobile service.[11] MSV also submitted extensive technical evidence that ATC in the

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amendment to a July 1998 application to launch and operate a next-generation satellite at 101°W to replace AMSC-1. *See* Application of AMSC Subsidiary Corporation, File No. SAT-LOA-19980702-00066 (July 2, 1998); Application of Motient Services Inc., SAT-AMD-20001214-00171 (Dec. 14, 2000) (amending 1998 application to request additional feeder link spectrum).

[7]*See Public Notice*, Report No. SAT-00066 (March 19, 2001).

[8]*See* Motient, MSV, and TMI, Consolidated Opposition to Petitions to Deny and Reply to Comments, File No. SAT-ASG-20010302-00017 et al. (May 7, 2001).

[9]*Ex parte* letter from New ICO Global Communications (Holdings) Ltd. to Chairman Michael K. Powell, FCC, IB Docket No. 99-81 (March 8, 2001) ("ICO Letter").

[10]*See 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 Band, Notice of Proposed Rulemaking*, IB Docket No. 01-185, 16 FCC Rcd 15532 (2001) ("*ATC NPRM*").

[11]*See* Joint Comments of Motient, TMI, and MSV, IB Docket No. 01-185 (October 22, 2001) ("*MSV ATC Comments*"); Joint Reply Comments of Motient, TMI, and MSV, IB Docket No. 01-185 (November 13, 2001) ("*MSV ATC Reply Comments*").

L-band would not cause harmful interference to other L-band MSS systems, such as that of Inmarsat Ventures plc ("Inmarsat"), or to services operating in frequencies adjacent to the L-band, such as the Global Positioning System ("GPS").[12]

ATC Order. In February 2003, the Commission released an *Order* adopting its proposal to allow MSS licensees in the L-band, 2 GHz, and Big LEO MSS bands to integrate ATC into their MSS systems. *See ATC Order.* In doing so, the Commission acknowledged the many public interest benefits of allowing MSS licensees to reuse their spectrum for terrestrial service. For example, the Commission noted that ATC would promote the efficient use of MSS spectrum (*ATC Order* ¶¶ 1, 21, 23), allow MSS providers to offer ubiquitous service by overcoming coverage gaps in urban areas (*id*. ¶ 24), allow MSS operators to achieve economies of scale which will in turn dramatically reduce the cost of MSS equipment and service (*id*. ¶¶ 24, 32), promote public safety and national security (*id*. ¶ 29), and increase competition in the niche markets MSS providers serve (*id.* ¶ 23). The Commission adopted gating factors to ensure that

[12] *See, e.g. MSV ATC Comments*; *MSV ATC Reply Comments*; MSV *ex parte* presentation, IB Docket No. 01-185 (January 11, 2002) (general interference analysis); MSV *ex parte* presentation, IB Docket No. 01-185 (January 29, 2002) (further showing lack of harmful interference to AMSS receivers from ATC base stations); MSV *ex parte* presentation, IB Docket No. 01-185 (January 29, 2002) (describing impact of use of variable rate vocoders); MSV *ex parte* presentation, IB Docket No. 01-185 (May 1, 2002) (discussing MSV's extensive measurements and analysis of cross-polarization isolation); MSV and U.S. GPS Industry Council *ex parte* presentation, IB Docket No. 01-185 (July 17, 2002) (discussing protection of GPS); MSV *ex parte* presentation, IB Docket No. 01-185 (July 29, 2002) (discussing MSV's ability to achieve an average level of at least 10 dB of antenna discrimination); MSV *ex parte* presentation, IB Docket No. 01-185 (October 28, 2002) (discussing protection of SARSAT earth stations); MSV *ex parte* presentation, IB Docket No. 01-185 (November 4, 2002) (interference analysis using example spot beam patterns for Inmarsat-4 submitted by Inmarsat); MSV *ex parte* presentation, IB Docket No. 01-185 (November 18, 2002) (discussing in-building penetration margins); MSV *ex parte* presentation, IB Docket No. 01-185 (January 13, 2003) (discussing ATC with current-generation MSS system); MSV *ex parte* presentation, IB Docket No. 01-185 (January 16, 2003) (urging Commission to impose minimal restrictions on ATC); MSV *ex parte* presentation, IB Docket No. 01-185 (January 28, 2003) (discussing appropriate interference thresholds).

ATC remains ancillary to satellite service and required an MSS licensee seeking to operate ATC to file an application for ATC authority. 47 C.F.R. §§ 25.117, 25.149; *ATC Order* ¶¶ 66-102, 237-241.

ATC Order – Interference Analysis. While the Commission recognized that authorizing ATC in the L-band would serve the public interest, it also imposed many unique technical restrictions on L-band ATC mobile terminals ("MTs")[13] and base stations to protect Inmarsat's L-band satellite system from potential interference. For example, to protect Inmarsat's satellites from interference generated by emissions of co-channel ATC MTs, the Commission restricted each L-band ATC operator to a U.S.-wide terrestrial reuse factor of 1725, meaning that each L-band ATC operator can deploy only 1725 base station carriers on any 200 kHz channel in the United States. 47 C.F.R. § 25.253(c); *ATC Order* ¶¶ 132-147, Appendix C2 § 2.1.[14] The Commission concluded that this level of U.S.-wide terrestrial reuse would limit interference to MSV's proposed next-generation satellite to no more than a 0.25 dB rise in its noise floor (*i.e.*, 6% ΔT/T). *ATC Order* ¶ 138. The Commission further concluded that this U.S.-wide reuse allowance would limit interference to the current-generation Inmarsat-3 satellites to a level of 0.05% ΔT/T and to next-generation Inmarsat-4 satellites to a level of 0.7% ΔT/T. *ATC Order,* Appendix C2, Table 2.1.1.C.

Moreover, the Commission explained that its analysis only addressed implementation of ATC within the United States and assumed that MSV would implement one-half of its ATC

[13]Consistent with the terminology used by the Commission, throughout this Petition, the term "mobile terminal" ("MT") will refer to a user terminal that communicates with an MSS ATC system. *See ATC Order,* Appendix C1 n.14. The term "mobile earth terminal" ("MET") will refer to a user terminal that communicates only with an MSS system.

[14]The Commission further restricted L-band ATC operators to 863 base station carriers on any 200 kHz channel during the first eighteen months after testing of the first L-band base station. 47 C.F.R. § 25.253(c).

network in the United States. *ATC Order*, Appendix C2 § 2.1.1. Thus, assuming an L-band ATC operator chooses to deploy its entire ATC network in the United States without any ATC operations in other countries, the Commission effectively authorized a system-wide reuse factor of 3450 (*i.e.*, 1725 × 2) and protected current-generation Inmarsat-3 satellites to a level of 0.1% ΔT/T and next-generation Inmarsat-4 satellites to a level of 1.4% ΔT/T. Although the Commission has limited L-band ATC operators to a U.S.-wide reuse factor of 1725,[15] it has also provided L-band ATC operators with the flexibility to deviate from the rules provided no greater interference is caused than that permitted under the rules. 47 C.F.R. § 25.253, Note; *ATC Order* n.273. Assuming an L-band ATC applicant certifies that its system-wide reuse will not exceed 3450 and complies with all other parameters established in the *ATC Order*, its proposed system will cause no more interference to the co-channel operations of Inmarsat than that permitted in the *ATC Order*. For example, in its application for ATC authority, MSV plans to apply to operate 80% of its ATC network within the United States and 20% outside of the United States. Based on the system-wide terrestrial reuse factor of 3450 authorized in the *ATC Order*, this deployment proposal would permit a reuse factor of 2760 (*i.e.,* 3450 × 80%) in the United States, resulting in a total impact from ATC in the United States on Inmarsat-3 satellites of 0.08% ΔT/T and on Inmarsat-4 satellites of 1.12% ΔT/T. (MSV believes this disproportionate deployment of ATC in the United States, while still ensuring that the system-wide impact to Inmarsat-4 does not exceed 1.4% ΔT/T, is consistent with the *ATC Order*. To the extent the Commission deems it necessary, MSV asks that the Commission clarify that this interpretation is accurate or, if necessary, modify its rules to expressly permit such flexibility.)

[15] 47 C.F.R. § 25.253(c).

In addition, the Commission also based its uplink interference analysis on the assumption that L-band ATC MTs will use quarter-rate vocoders and channels that will reduce the EIRP of the MT by a factor of 3.5 dB. *ATC Order*, Appendix C2 § 1.10.

To protect Inmarsat's land-based and maritime METs from interference from L-band base stations, the Commission adopted limits on, among other things, the EIRP and carriers per sector of these base stations.[16] These limits were based on the Commission's interference analysis that assumed, among other things, that Inmarsat's land-based and maritime METs would suffer overload interference at an interfering signal level of -60 dBm. *ATC Order* ¶ 151, Appendix C1 § 1.2.4, Appendix C2 §§ 2.2.1.1 and 2.2.2.1. The Commission arrived at this overload threshold after noting that Inmarsat proposed a value of -90 dBm whereas MSV proposed a value of -45 dBm based on real world measurements and that the Radio Technical Committee on Aeronautics ("RTCA") standard for the overload threshold of an Inmarsat airborne MET was -50 dBm. *Id*. ¶ 151, Appendix C1 § 1.2.4. The Commission chose a value of -60 dBm because it was "considerably more conservative (by 15 dB) than the threshold value of -45 dBm measured by MSV" and because this value "should be sufficient to take account of Inmarsat's MET receiver susceptibility to overload interference principally because a -50 dBm value is the standard for airborne terminals." *Id*. ¶ 151.

To protect Inmarsat airborne METs from potential out-of-band and overload interference from L-band base stations, the Commission required L-band ATC operators to deploy base stations with certain degrees of overhead gain suppression at varying elevation angles. 47 C.F.R. § 25.253(e); *ATC Order* ¶ 160, Appendix C2 §§ 1.8, 2.2.3.1. Moreover, to protect Inmarsat METs located in airports from potential interference from L-band base stations, the Commission

[16] 47 C.F.R. § 25.253(d)(1) (providing that L-band base stations shall not exceed a peak EIRP of 19.1 dBW, in 200 kHz, per carrier with no more than three carriers per sector).

required L-band base stations to be located more than 470 meters from airport runways and aircraft stand areas and to meet an aggregate PFD level of -73.0 $dBW/m^2/200$ kHz at the edge of airport runways and aircraft stand areas. 47 C.F.R. § 25.253(d)(3), (4); *see ATC Order* ¶ 154, Appendix C2 § 2.2.1.3.

Finally, the Commission adopted additional technical limits on L-band ATC MTs and base stations to protect services operating in frequency bands adjacent to the L-band. For example, the Commission required L-band ATC MTs and base stations to meet certain out-of-band emission ("OOBE") limits to protect GPS receivers. 47 C.F.R. §§ 25.253(d)(7); 25.253(g)(3). In addition, the Commission adopted a vague and apparently extraneous requirement that an L-band ATC applicant "demonstrate how its ATC network base stations and mobile terminals will comply with the Global Mobile Personal Communications by Satellite (GMPCS) system requirements to protect the radionavigation satellite services (RNSS) operations in the allocation above 1559 MHz." 47 C.F.R. § 25.253(a)(6). The Commission also required L-band ATC operators to coordinate the placement of base stations with certain Search-and-Rescue Satellite-Aided Tracking ("SARSAT") earth stations. 47 C.F.R. § 25.253(f)(1).

Discussion

The Commission has adopted certain unnecessary technical restrictions on ATC in the L-band in both the uplink and downlink directions. MSV requests that the Commission revise its interference analyses and amend its rules as described herein to afford L-band ATC operators greater terrestrial reuse of L-band spectrum and greater flexibility in the deployment of base stations.[17]

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[17] In addition to the rule changes discussed below, MSV asks that the Commission either eliminate Section 25.253(a)(6) of its rules or clarify that it is redundant to Sections 25.253(d)(7) and 25.253(g)(3). Section 25.253(a)(6) requires an applicant for ATC in the L-band to "demonstrate how its ATC network base stations and mobile terminals will comply with the

I. THE COMMISSION SHOULD REVISE ITS UPLINK INTERFERENCE ANALYSIS, THEREBY ALLOWING GREATER TERRESTRIAL REUSE OF L-BAND SPECTRUM

The Commission's analysis of potential interference from co-channel L-band ATC MTs to Inmarsat satellites is based on two either unreasonably conservative or incorrect parameters, resulting in the Commission needlessly restricting terrestrial reuse of L-band spectrum to a factor of at most 3450. MSV requests that the Commission revise its uplink interference analysis by protecting Inmarsat satellites from potential interference from co-channel ATC MTs to a level of 6% ΔT/T and by clarifying that an interference reduction factor of 3.5 dB applies to half-rate, not quarter-rate, vocoders and channels. With these parameters modified, the Commission can authorize a terrestrial reuse factor of 14,785 for co-channel ATC in the L-band while still protecting Inmarsat-3 satellites to a level of 0.4% ΔT/T and Inmarsat-4 satellites to a level of 6% ΔT/T.

A. The Commission Should Protect Inmarsat Satellites from Co-Channel L-band ATC MTs to a Level of No More than 6% ΔT/T

The Commission has limited the system-wide impact from co-channel operation of L-band ATC MTs to current-generation Inmarsat-3 satellites to a level of 0.1% ΔT/T and to next-

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Global Mobile Personal Communications by Satellite (GMPCS) system requirements to protect the radionavigation satellite services (RNSS) operations in the allocation above 1559 MHz." 47 C.F.R. § 25.253(a)(6). These "GMPCS system requirements" refer to certain OOBE limits that are identical to what the Commission has required an ATC applicant to demonstrate pursuant to Sections 25.253(d)(7) and 25.253(g)(3). *See Report and Order,* IB Docket No. 99-67, FCC 02-134, 17 FCC Rcd 8903 (May 14, 2002) (adopting 47 C.F.R. § 25.216(c), (f)). It is unclear what demonstration is required under Section 25.253(a)(6) that is different than what the Commission has already required pursuant to Sections 25.253(d)(7) and 25.253(g)(3). Moreover, MSV notes that while Big LEO and 2 GHz MSS ATC operators are also required to meet certain OOBE limits to protect RNSS in the 1559-1610 MHz band, the Commission did not impose any requirement similar to Section 25.253(a)(6) on Big LEO or 2 GHz MSS ATC applicants. MSV's preference is that the Commission eliminate Section 25.253(a)(6). At the very least, MSV asks that the Commission clarify that Section 25.253(a)(6) does not impose any additional requirement beyond that of Sections 25.253(d)(7) and 25.253(g)(3).

generation Inmarsat-4 satellites to a level of 1.4% ΔT/T. MSV requests that the Commission reconsider this degree of interference protection afforded Inmarsat because it (i) is based on the erroneous assumption that MSV's satellites must be protected from its own ATC to a level of 6% ΔT/T; (ii) is not necessary to protect Inmarsat from harmful interference; and (iii) conflicts with international norms and accepted practices. MSV requests that the Commission instead protect Inmarsat satellites from potential interference from co-channel L-band ATC MTs to a level of 6% ΔT/T.

1. The Commission Has Erroneously Concluded that MSV's Satellite Operations Must Be Protected from Its Own ATC to a Level of 6% ΔT/T

The Commission's uplink interference analysis is based on the erroneous premise that MSV's next-generation satellite must be protected to a level of 6% ΔT/T (*i.e.*, 0.25 dB rise in the noise floor) from the operation of its own L-band ATC MTs. *ATC Order* ¶¶ 134-136, Appendix C2 § 1.14. MSV does not need, and has never advocated, this level of protection from its own ATC. During the course of the ATC rulemaking, MSV presented illustrative analyses of the potential for ATC to interfere with its own operations and those of other satellite systems. *See, e.g.*, MSV *ex parte* presentation, IB Docket No. 01-185 (January 11, 2002). These analyses were descriptive of the levels of interference that could be expected given certain parameters for the ATC. For example, given certain parameters, MSV calculated that operation of ATC would cause no more than a 0.25 dB rise in the noise floor of MSV's proposed next-generation satellite (*i.e.,* 6% ΔT/T) and would have a lesser impact on Inmarsat's co-channel operations (approximately 1% ΔT/T). *Id.* These analyses, however, were never intended to be prescriptive of the limits for ATC operation. MSV does not need to be protected from its own ATC to a level of 6% ΔT/T. If the Commission were to allow co-channel L-band ATC MTs to impact Inmarsat-4 satellites at a level of 6% ΔT/T, the impact on MSV's currently proposed next-generation satellite would scale proportionally to 51% ΔT/T. Even without any signal processing measures to mitigate the effect of this higher ΔT/T, it would translate to a 1.8 dB loss in available link margin, which is perfectly acceptable for a system that will be developed with at least 10 dB of margin against Additive White Gaussian Noise (AWGN). MSV is also considering options for ground-based signal processing that will mitigate intra-system interference. For instance, MSV may use return link space diversity reception and combine the outputs of at least two in-orbit satellites. Optimum space diversity combining of return link signals (in the Least Mean-Squared Error (LMSE) sense) would be performed, on a user-by-user basis, at a satellite gateway in order to further minimize the effects of signal fading and blockage. The same signal processing algorithms may be applied to minimize the co-channel interference effect of ATC. (MSV has applied for a patent for this technology.)

MSV may deploy next-generation replacement satellites that have even higher power than those proposed to date, with an antenna aperture significantly larger than 12 meters, in order to be able to further increase the system's available link margin, thus improving link reliability and reducing further the size and EIRP requirements of its satellite METs. ATC operations would cause much more than a .25 dB rise in the noise floor of such a higher power satellite, but would have no adverse consequences for the reasons stated above (MSV will design its next-generation satellite system with ATC interference mitigation signal processing and more than sufficient link margin (at least 10 dB) to accommodate any residual ATC interference). Thus, the intra-system impact from MSV's own ATC operating at a level that will affect Inmarsat's satellite system to a level of 6% ΔT/T will be relatively minor and will have no adverse effect on MSV's satellite operations.

The arbitrariness of the Commission's decision to restrict L-band ATC operations in order to protect L-band MSS operators from self-interference is highlighted by the fact that the Commission did not impose a similar intra-system interference limitation on the ATC operations of either 2 GHz or Big LEO MSS licensees. In authorizing 2 GHz and Big LEO MSS licensees to deploy ATC, the Commission appropriately refrained from assessing and limiting the potential for ATC to cause self-interference and instead focused solely on the potential for a licensee's ATC operations to cause interference to other MSS licensees or other services. There is no basis for the Commission to apply a different analysis to the L-band. For these reasons, the Commission's decision to limit MSV's own operation of ATC MTs to protect its own satellite is unwarranted.

2. There Is No Technically Defensible Reason to Protect Inmarsat-4 Satellites to a Level of 1.4% ΔT/T

By protecting MSV to a level of 6% ΔT/T from its own ATC MTs, the Commission has protected Inmarsat-4 satellites to a level of 1.4% ΔT/T from co-channel operation of ATC MTs. This level of protection afforded Inmarsat is arbitrary because there is no record evidence to support that Inmarsat needs this level of interference protection. As discussed in Appendix A, there is no technically defensible reason for the Commission to protect Inmarsat-4 satellites to a level of 1.4% ΔT/T. *See* Appendix A. MSV's ATC operations will have much less potential impact to Inmarsat than MSV's satellite operations. The aggregate effect from all inter- and intra-system interference sources, excluding co-channel ATC MTs, to an Inmarsat-4 satellite receiver will be a link margin loss of approximately 1.761 dB (*i.e.*, 10log(1.5)). If co-channel ATC MTs are permitted to impact an Inmarsat-4 satellite at a level of 6% ΔT/T, the total link margin loss to Inmarsat-4 from all interference sources increases only slightly to approximately 1.931 dB (*i.e.*, 10log(1.56)) as compared to 1.761 dB without ATC. Co-channel ATC MTs impacting Inmarsat-4 satellite receivers at a level of 6% $\Delta T/T$ will thus contribute a negligible 0.17 dB of link margin loss. It is expected that Inmarsat-4 satellites are being developed with at least 4 dB of available link margin even after accounting for all non-ATC intra- and inter-system interference sources. Thus, adopting an L-band terrestrial reuse factor that allows co-channel ATC MTs to impact Inmarsat-4 at a level of 6% $\Delta T/T$ is appropriate because it will have an insignificant impact on the operations of Inmarsat-4 satellites and, to the extent there is any impact, it will only be on those frequencies that are shared co-channel. MSV notes that intra-hemisphere co-channel operations between Inmarsat-4 satellites and MSV's next generation system may not be technically possible if METs operating with Inmarsat-4 satellites have output EIRP levels in excess of 10 dBW.[18]

3. The Commission's Decision to Protect Inmarsat to a Level of 1.4% $\Delta T/T$ Conflicts with International Norms and Accepted Practices

As the Commission plainly states in the *ATC Order*, the accepted standard for any coordination obligation with respect to satellites is 6% $\Delta T/T$.[19] In addition, it is normal for satellite systems to accept greater levels of interference than 6% $\Delta T/T$. Indeed, as the

[18] Based on MSV's next-generation satellite system parameters that are already on record with the Commission, a 10 dBW EIRP Inmarsat-4 MET with a carrier bandwidth of 200 kHz, reused 20 times over the Inmarsat-4 satellite footprint, will impact MSV's next-generation satellite operations by 87% $\Delta T/T$. MSV also expects that some Inmarsat-4 METs will output more than 10 dBW EIRP and may operate over carrier bandwidths of less than 200 kHz. Thus, MSV's estimate of 87% $\Delta T/T$ to MSV's next-generation satellite system from intra-hemisphere co-channel operations of Inmarsat-4 may be conservative.

[19] *ATC Order* ¶ 164 ("We are not aware [of] any national or international requirement to limit the interference to or from any system to an increase in system noise of 1%. Historically, a 6% increase in a system's noise temperature has been used as a coordination trigger for space systems."); *see also* MSV *ex parte* presentation, IB Docket No. 01-185 (Jan. 21, 2003); MSV *ex parte* presentation, IB Docket No. 01-185 (Jan. 21, 2003). Moreover, the Canadian COMTEK study concluded that a significantly greater than 6% increase in the noise floor should be acceptable. *See* COMTEK Associates Inc., "Final Report Prepared for Industry Canada: Use of Mobile Satellite Spectrum to Provide Complementary Terrestrial Mobile Service to Improve Satellite Coverage," (November 5, 2002), Section 2.9.1 (pp. 20-21).

Commission recognizes in the *ATC Order*, Inmarsat can and does tolerate more than a 6% rise in its noise floor, apparently without adverse affect.[20] Given the ample record evidence that 6% ΔT/T is internationally accepted and a greater amount of interference is presently accepted by Inmarsat, the Commission's decision to protect Inmarsat-4 satellite receivers to a level of 1.4% ΔT/T is unjustifiably restrictive.

B. The Commission Should Clarify that an Interference Reduction Factor of 3.5 dB Applies to Half-Rate, Not Quarter-Rate, Vocoders

MSV requests that the Commission clarify that the interference reduction factor of 3.5 dB it has assigned to the use of a quarter-rate vocoder and a quarter-rate channel in fact applies to the operation of a half-rate vocoder and a half-rate channel. *ATC Order*, Appendix C2 § 1.10. In its analysis, the Commission assumed that MSV would use a quarter-rate vocoder and channel and concluded that the use of such a vocoder would reduce the EIRP of ATC MTs by a factor of 3.5 dB, thus decreasing the potential for interference to Inmarsat satellites. *Id*. As demonstrated in Appendix B, the use of a half-rate vocoder and channel, not a quarter-rate vocoder and channel, will reduce the potential for interference to Inmarsat by a factor of 3.5 dB. *See* Appendix B. MSV requests that the Commission amend Section 23.253(a)(2) of its rules as specified in Appendix E to require the use of half-rate, not quarter-rate, vocoders and channels. *See* Appendix E (Revision #2).

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[20] *ATC Order* ¶ 164 ("as Inmarsat has shown the typical increase in noise level of the Inmarsat 3 satellite, resulting from the L-Band MSS coordination process, is on the order of 29%, which is much higher than the typical coordination trigger of 6%"); *see also* Letter from Peter D. Karabinis and Lon C. Levin, MSV, to Marlene H. Dortch, FCC, IB Docket No. 01-185 (Jan. 21, 2003).

C. Based on the Revised Co-Channel Uplink Interference Analysis, the Commission Should Authorize a Terrestrial Reuse Factor of 14,785 for Co-Channel L-band Spectrum

By revising its uplink interference analysis to protect Inmarsat-4 satellites to a level of 6% $\Delta T/T$, the Commission can authorize a reuse factor of 14,785 for ATC in the L-band using a half-rate vocoder. This figure is derived from the following equation: $1725 \times (6\%/0.7\%) = 14{,}785$. Accordingly, MSV requests that the Commission revise Section 25.253(c) of its rules as indicated in Appendix E to specify a reuse factor of 14,785. *See* Appendix E (Revision #3).[21]

II. THE COMMISSION SHOULD REVISE ITS DOWNLINK INTERFERENCE ANALYSIS, THEREBY AFFORDING L-BAND ATC OPERATORS GREATER FLEXIBILITY IN THE DEPLOYMENT OF BASE STATIONS

While MSV generally agrees with the Commission's downlink interference analysis, the Commission in a few cases has used unreasonably conservative parameters or has adopted rules that are unnecessary to protect Inmarsat METs from any potential interference from L-band base stations. As discussed herein, MSV requests that the Commission (i) revise its overload analysis by assigning an appropriate value for the overload threshold of Inmarsat land-based and maritime METs, thereby allowing at least some L-band base stations to operate with a greater aggregate EIRP per sector; (ii) relax its requirement for the overhead gain suppression of L-band base stations; and (iii) afford L-band ATC operators the flexibility to deploy base stations near airports by requiring that L-band base stations meet either a separation distance or a PFD level,

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[21] In the *ATC Order*, to provide Inmarsat with yet additional interference protection, the Commission permitted L-band ATC operators to deploy only 50% of their permitted base station carriers per 200 kHz channel (*i.e.*, 50% of 1725, or 863 carriers) during the 18-month period following testing of the first ATC base station. 47 C.F.R. § 25.253(c). MSV is not seeking reconsideration of this requirement, but is asking that it be amended to reflect 50% of the maximum number of base station carriers the Commission decides to permit.

but not both. MSV also requests that the Commission clarify its rule regarding coordination of L-band base stations with SARSAT earth stations.

A. By Using an Appropriate Overload Threshold for Inmarsat METs, the Commission Can Allow at Least Some L-band Base Stations to Operate with a Greater EIRP per Sector and More Carriers

In the *ATC Order*, the Commission analyzed the potential for L-band base stations to overload Inmarsat land-based and maritime METs. *ATC Order* ¶¶ 149-151, Appendix C2 § 2.2.1. In its analysis, the Commission assumed an overload threshold of -60 dBm for Inmarsat land-based and maritime METs. *Id.* ¶ 151, Appendix C1 § 1.2.4, Appendix C2 §§ 2.2.1.1 and 2.2.2.1. By assuming this overload threshold, the Commission has underestimated the margin Inmarsat land-based and maritime METs will have against overload from L-band base stations and, as a result, has unreasonably restricted the EIRP and the number of carriers per sector of L-band base stations.

The Commission's decision to use an overload threshold of -60 dBm for Inmarsat land-based and maritime METs runs counter to the uncontroverted record evidence submitted by MSV that the appropriate overload threshold is -45 dBm. As the Commission recognizes, the information MSV supplied included laboratory and field measurements demonstrating that an Inmarsat land-based MET will overload when the front-end electronics (*i.e.,* the low noise amplifier (LNA)) is subjected to an in-band power level of -45 dBm or greater. *ATC Order* ¶ 150, Appendix C2 § 2.2.1.1; *MSV ATC Reply Comments*, Technical Appendix at 12-15. No party, including Inmarsat, has submitted any evidence refuting this data. Moreover, the Commission failed to analyze this evidence or conduct any independent testing.

To further supplement the record evidence, MSV attaches as Appendix C further measurements it has conducted of the 1 dB compression point of Inmarsat land-based and maritime METs produced by different manufacturers. *See* Appendix C.[22] The additional data presented herein corroborates the previously presented data and demonstrates that even an in-band signal level of -45 dBm does not overload an Inmarsat land-based or maritime MET. Thus, MSV's proposed value of -45 dBm for an overload threshold is appropriate and conservative.[23]

As a result of the Commission's decision to use an unreasonably conservative overload threshold of -60 dBm for Inmarsat non-airborne METs, the Commission has underestimated the margin Inmarsat land-based and maritime METs will have against overload by L-band base stations. Based on the -60 dBm overload threshold, the Commission calculated a margin of 1.8 dB for Inmarsat land-based METs and a margin of -1.9 dB for Inmarsat maritime METs against overload from L-band base stations. *ATC Order*, Appendix C2, Table 2.2.1.1.A (land-based METs) and Table 2.2.2.1 (maritime METs). When this analysis is modified and appropriately specifies an overload threshold of -45 dBm, the overload margin increases by 15 dB to 16.8 dB for Inmarsat land-based METs and to 13.1 dB for Inmarsat maritime METs.

[22]The tests results included herein in Appendix C represent objective measurements of the front-end linearity of a number of commercially available land-based and maritime Inmarsat METs to determine their 1 dB compression point. A large number of commercially available land-mobile METs and METs used by the United States Coast Guard, including Inmarsat B and Inmarsat C, were procured and tested. MSV will make its laboratories available to Commission staff to witness MSV's test procedure and measurements.

[23]MSV notes that the Commission recently issued a *Notice of Inquiry* exploring whether to incorporate receiver standards into its spectrum policies on a broader basis. *See Interference Immunity Performance Specifications for Radio Receivers, Notice of Inquiry*, ET Docket No. 03-65, MM Docket No. 00-39, FCC 03-54 (March 24, 2003) ("*NOI*"). In the *NOI*, perhaps with Inmarsat's overload claims in mind, the Commission states that "the preemptive effect of minimally performing receivers has been demonstrated, as licensees seek protection for service predicated on the performance of receivers with little tolerance for other signals." *Id*. ¶ 1. The Commission also notes that receiver performance standards will promote spectrum sharing. *Id*. ¶ 10. To the extent the Commission upholds its decision to assign an overload threshold of -60 dBm for Inmarsat land-based METs, MSV implores the Commission to consider imposing receiver performance standards on Inmarsat METs given their unreasonable susceptibility to interference and their preemptive effect on efficient sharing of L-band spectrum.

The rules adopted in the *ATC Order* specify an aggregate EIRP per base station sector of 23.9 dBW for L-band base stations.[24] With the additional 15 dB of margin added to the Commission's downlink interference analysis, the Commission can authorize the aggregate EIRP per base station sector to increase by 15 dB to 38.9 dBW without increasing the potential for overload interference to Inmarsat land-based or maritime METs. The rules adopted in the *ATC Order* also specify an aggregate EIRP per base station sector toward the physical horizon of 18.9 dBW.[25] With the additional 15 dB of margin added to the Commission's downlink interference analysis, the Commission can authorize the EIRP toward the physical horizon to increase to 33.9 dBW per sector without increasing the potential for overload interference to Inmarsat land-based or maritime METs. Moreover, provided the Commission's rules specify an aggregate EIRP limit per base station sector, there is no technical reason for the Commission to limit the number of carriers per base station sector.

To maintain compliance with the Commission's conclusions regarding the potential for overload interference from L-band ATC base stations to airborne Inmarsat METs, the aggregate EIRP in any direction from all L-band base stations within a 50 mile (80 kilometer) radius will be limited to 53.9 dBW (*i.e.*, 10log(1000) + 10log(3) + 19.1). *See ATC Order*, Appendix C2 §§ 2.2.3.1, 2.2.3.2.[26] For these reasons, MSV requests that the Commission amend Sections 25.253(d)(1) and (2) of its Rules as specified in Appendix E. *See* Appendix E (Revision #4).

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[24]Section 25.253(d)(1) provides that L-band base stations shall not exceed a peak EIRP of 19.1 dBW, in 200 kHz, per carrier with no more than three carriers per sector. This equates to an aggregate EIRP per sector of 23.9 dBW (*i.e.*, 19.1 + 10log(3)).

[25]Section 25.253(d)(2) provides that L-band base stations shall not exceed an EIRP toward the physical horizon of 14.1 dBW, in 200 kHz, per carrier. This equates to an aggregate EIRP toward the physical horizon per sector of 18.9 dBW (*i.e.*, 14.1 + 10log(3)).

[26]In Section 2.2.3.1 of Appendix C2 of the *ATC Order*, the Commission states that "From 302m a circular area approximately 100 miles from edge-to-edge would be visible to the aircraft." *ATC Order*, Appendix C2 § 2.2.3.1.

The Commission has also required L-band base stations to meet specific PFD levels at the edge of airport runways and the edge of waterways to protect Inmarsat land-based METs in airports and Inmarsat maritime METs on ships in waterways from overload interference. 47 C.F.R. § 25.253(d)(4), (5). Specifically, an L-band base station cannot exceed a PFD level of -73.0 dBW/m^2/200 kHz at the edge of airport runways and a PFD level of -64.6 dBW/m^2/200 kHz at the edge of waterways. *Id*. The Commission based these PFD levels on the erroneous assumption that Inmarsat land-based and maritime METs suffer overload interference at a level of -60 dBm. *ATC Order*, Appendix C2 § 2.2.1.3 (discussing protection of Inmarsat METs located in airports); § 2.2.2.1 (discussing protection of Inmarsat METs located on ships in waterways). As discussed above, given that the appropriate overload threshold for an Inmarsat land-based and maritime MET is -45 dBm, the Commission can increase the permitted PFD levels by 15 dB without increasing the potential for interference to Inmarsat land-based METs in airports or maritime METs on waterways. Thus, MSV requests that the Commission amend Sections 25.253(d)(4) and (d)(5) of its rules as indicated in Appendix E to specify appropriate PFD levels. *See* Appendix E (Revision #5).

B. The Commission Should Relax Its Requirement for the Overhead Gain Suppression of L-band Base Stations

To protect Inmarsat airborne METs from potential out-of-band and overload interference from L-band base stations, the Commission has required L-band ATC operators to deploy base stations with certain degrees of overhead gain suppression at varying elevation angles. 47 C.F.R. § 25.253(e); *ATC Order* ¶ 160, Appendix C2 §§ 1.8, 2.2.3.1. The required level of overhead gain suppression over elevation angles from 30° to 145° is unreasonably restrictive and will require L-band ATC operators to incur significant and unnecessary costs as well as production difficulties in deploying base stations. As demonstrated in Appendix D, L-band base stations can operate with 10 dB more gain over elevation angles from 55° to 145° and with 8 dB more gain over elevation angles from 30° to 55° without causing an increase of more than .03 dB in potential interference. *See* Appendix D. Thus, given the significant margins that already exist for out-of-band and overload interference to airborne METs the costs of implementing the level of overhead gain suppression adopted in the *ATC Order* far outweigh any purported benefits. Accordingly, MSV requests that the Commission amend Section 25.253(e) of its rules as specified in Appendix E to relax the required overhead gain suppression of L-band base stations. *See* Appendix E (Revision #6).

C. To Protect Inmarsat METs in Airports, L-band Base Stations Should Be Required to Meet Either the Separation Distance or the Aggregate PFD Level, But Not Both

To protect Inmarsat METs located in airports from potential interference from L-band base stations, the Commission has required L-band ATC operators to both locate base stations greater than 470 meters from airport runways and aircraft stand areas and to meet an aggregate PFD level of -73.0 dBW/m^2/200 kHz[27] at the edge of airport runways and aircraft stand areas. 47 C.F.R. § 25.253(d)(3), (4); *see ATC Order* ¶ 154, Appendix C2 § 2.2.1.3. MSV requests that the Commission amend its rules to require L-band base stations to meet either the separation distance or the PFD level, but not both. MSV notes that the Commission used an "either/or" approach in adopting a similar rule requiring L-band base stations to protect Inmarsat METs located on ships in waterways.[28] Moreover, Appendix C2 of the *ATC Order* clearly states that L-band base stations will be required to meet either the separation distance or the PFD level, but

[27] As discussed above, MSV requests that the Commission amend its rules to specify a PFD level of -58 dBW/m^2/200 kHz at the edge of runways.

[28] *Compare* 47 C.F.R. § 25.253(d)(5) (requiring L-band base stations near waterways to meet separation distance *or* PFD level) *with* 47 C.F.R. § 25.253(d)(3), (4) (requiring L-band base stations near airports to meet separation distance *and* PFD level).

not both, to protect Inmarsat METs in airports.[29] The rule adopted, however, is not consistent with Appendix C2.

Allowing L-band base stations to meet either a separation distance or a PFD level will not increase the potential for interference to Inmarsat METs located in airports. In the *ATC Order*, the Commission has calculated that a separation distance of 470 meters will be required between an L-band base station and an Inmarsat MET located in an airport to avoid exceeding the -60 dBm overload threshold of the MET. *ATC Order*, Appendix C2 § 2.2.1.3. This analysis assumes that the L-band base station is operating with three carriers per sector and an EIRP of 19.1 dBW per carrier, the maximum permitted under the rules.[30] Thus, L-band ATC operators should be allowed to place base stations operating in compliance with the Commission's rules greater than 470 meters from airport runways and airport stand areas without having to calculate the required PFD level.

Similarly, L-band ATC operators should be afforded the flexibility to deploy base stations within 470 meters of an airport, provided that the operator has engineered the base station to satisfy the required PFD level. For example, ATC operators may want to deploy smaller base stations closer to or even within airports. These base stations will operate at lower EIRP levels than the maximum permitted by the rules and will meet the Commission's required

[29] *ATC Order*, Appendix C2 § 2.2.2.2 ("[I]f the base station is no closer to an airport than 470 meters *or* has a PFD below -73.0 dBW/m^2 in 200 kHz at the edge of the airport runways and stand areas and the base station is installed at least 1.5 km from a harbor or navigable waterway *or* has a PFD below -64.6 dBW/m^2 in 200 kHz at the edge of the navigable waterway or harbor, then the potential interference to these types of Inmarsat terminals would be significantly reduced if not eliminated.") (emphasis added).

[30] As discussed above, given that the appropriate overload threshold for Inmarsat land-based METs is -45 dBm, MSV has requested that the Commission amend its rules to specify an aggregate EIRP limit per sector of 38.9 dBW for L-band base stations and a PFD level of -58 dBW/m^2/200 kHz at the edge of airport runways. The required separation distance to meet a PFD level of -58 dBW/m^2/200 kHz given an aggregate base station EIRP per sector of 38.9 dBW will remain 470 meters.

PFD level. Under the rules as adopted, however, L-band ATC operators will not be able to deploy these smaller base stations, even though they satisfy the required PFD level and accordingly will not cause interference to Inmarsat METs, because they will be located within 470 meters of an airport runway or aircraft stand area. For these reasons, MSV requests that the Commission amend Sections 25.253(d)(3) and (d)(4) of its rules as specified in Appendix E to require L-band base stations to meet either the separation distance or the PFD level, but not both. *See* Appendix E (Revision #7).

D. The Commission Should Clarify Its Rule Regarding Coordination of L-band Base Stations with SARSAT Earth Stations

MSV requests that the Commission amend the ambiguous language in Section 25.253(f)(1) pertaining to coordination of L-band base stations with SARSAT earth stations. MSV does not take issue with the substance of the rule, but asks that the language be clarified to avoid any ambiguity. Section 25.253(f)(1) states that an L-band ATC licensee must provide the Commission with sufficient information to complete coordination of base stations with SARSAT earth stations "for any ATC base station located either within 27 km of a SARSAT earth station, or within radio horizon of the SARSAT, whichever is less." 47 C.F.R. § 25.253(f)(1). This language is unnecessarily confusing. In the text of the *ATC Order*, the Commission clearly expresses the intent of this rule when it explains that an L-band ATC licensee will have to provide the Commission with information "to complete coordination of any ATC base station placed within 27 km from one of the locations listed in Table 3.3.A (listing location of SARSAT earth stations) and within the radio horizon of the SARSAT earth station." *ATC Order* ¶ 177. Thus, if an L-band base station is located within 27 km of a SARSAT earth station but not within radio horizon, coordination is not required. In order to avoid unnecessary confusion, MSV requests that the Commission amend the language in Section 25.253(f)(1) as specified in

Appendix E to make it consistent with the text of the *ATC Order*. *See* Appendix E (Revision #8).

III. THE COMMISSION SHOULD CLARIFY THAT NON-FORWARD-BAND ATC IS PERMITTED IN THE L-BAND

MSV requests that the Commission clarify that non-forward-band ATC is permitted in the L-band. In the *ATC Order*, the Commission adopted a rule that restricts ATC in all MSS bands to the forward-band mode of operation. 47 C.F.R. § 25.149(a)(1). The Commission has also adopted a rule allowing applicants for ATC authority in the L-band to propose a different system architecture than that contemplated by the rules provided no greater interference is caused than that permitted under the rules. 47 C.F.R. § 25.253, Note; *ATC Order* n.273. MSV urges the Commission to clarify that Section 25.149(a)(1) is qualified by the Note to Section 25.253 and thus Section 25.149(a)(1) does not prohibit non-forward-band ATC in the L-band. MSV asks the Commission to clarify that an L-band ATC operator is permitted to implement a non-forward-band architecture provided the operator demonstrates in its application for ATC authority that this system architecture produces no greater potential interference than that allowed by implementing the ATC system contemplated by the Commission's rules. By clarifying this point, the Commission will ensure that L-band ATC operators are not needlessly precluded from implementing non-forward-band ATC systems, such as Time Division Duplex (TDD).

Conclusion

For the reasons stated above, MSV requests that the Commission reconsider the *ATC Order* consistent with the views expressed herein.

Very truly yours,

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Appendix A

Inmarsat Satellites Should Be Protected from L-band ATC Mobile Terminals to a Level of At Most 6% ΔT/T

The Commission has unreasonably restricted the ability of L-band ATC operators to reuse their spectrum for ancillary terrestrial operations by protecting Inmarsat-4 satellites from potential interference from ATC mobile terminals ("MTs") to a level of 1.4% ΔT/T. As discussed herein, there is no technically defensible reason for the Commission to protect Inmarsat-4 satellite receivers to this level. Rather, a reasonable interference protection level for Inmarsat from operation of ATC MTs is 6% ΔT/T.

The Commission's own analysis confirms that the noise impact to Inmarsat-4 satellites decreases dramatically as MSV transitions from its current-generation to its next-generation system. *ATC Order*, Appendix C2 Table 2.1.1.C. While the satellite terminals used with MSV's current system will impact Inmarsat-4 co-channel operations to a level of 794.1% ΔT/T, satellite transmissions from MTs used with MSV's next-generation system will impact Inmarsat-4 co-channel operations to a level of only 23.9% ΔT/T. *Id*.

The noise increase from transmissions of satellite terminals used with MSV's next-generation system will result in a link margin loss for Inmarsat-4 co-channel receivers of approximately 0.9307 dB (*i.e.*, 10log(1.239)). If the Commission were to allow MSV's ATC MTs to impact Inmarsat-4 co-channel operations to a level of 6% ΔT/T, the total impact to an Inmarsat-4 co-channel receiver from MSV's aggregate transmissions (satellite <u>and</u> ATC) would be bounded by 29.9% ΔT/T (*i.e.*, 23.9% ΔT/T + 6% ΔT/T) and the link margin loss to Inmarsat-4 co-channel operations would be bounded by 1.1361 dB (*i.e.*, 10log(1.299)). Thus, MSV's MTs operating in ATC mode, impacting an Inmarsat-4 satellite at a level of 6% ΔT/T, will not cause more than 0.2 dB of link margin loss for that Inmarsat-4 satellite. In reality, however, the link margin loss due to the effect of the ATC will be even less, as discussed below.

The aggregate noise floor increase to Inmarsat-4 satellite receivers from all sources including satellite transmissions from METs used with MSV's next-generation system, those of Inmarsat's own system, and those of other MSS systems, but <u>excluding</u> MSV's ATC transmissions, will produce an aggregate noise floor increase to an Inmarsat-4 satellite receiver of at least 50% ΔT/T. Given that the aggregate effect of all non-ATC co-channel transmissions to an Inmarsat-4 satellite receiver is 50% ΔT/T, the link margin loss will be 1.761 dB (*i.e.*, 10log(1.5)). When the 6% ΔT/T impact of ATC MTs is added, the link margin loss becomes 1.931 dB (*i.e.*, 10log(1.56)). ATC MTs thus contribute a loss of only 0.17 dB in available link margin.

It is reasonable to assume that Inmarsat-4 satellites are being developed with at least 4 dB of link margin allocated to signal blockage and attenuation after accounting for all other non-ATC related interference and degradations.[31] Inmarsat-4 co-channel operations with MSV's ATC

[31] This is based on MSV's engineering judgment and on some Inmarsat parameter values that are in the public record. MSV does not have knowledge of all parameters needed to develop a precise link budget for the Inmarsat-4 system and for the many different terminals it may use.

may thus continue to operate reliably while still maintaining a margin of at least 3.83 dB (even after the effect of all intra- and inter-system interferers and the effect of a 6% $\Delta T/T$ ATC have been accommodated). An allocation of 6% $\Delta T/T$ to the ATC is therefore reasonable because the impact to Inmarsat, as demonstrated above, is negligible.

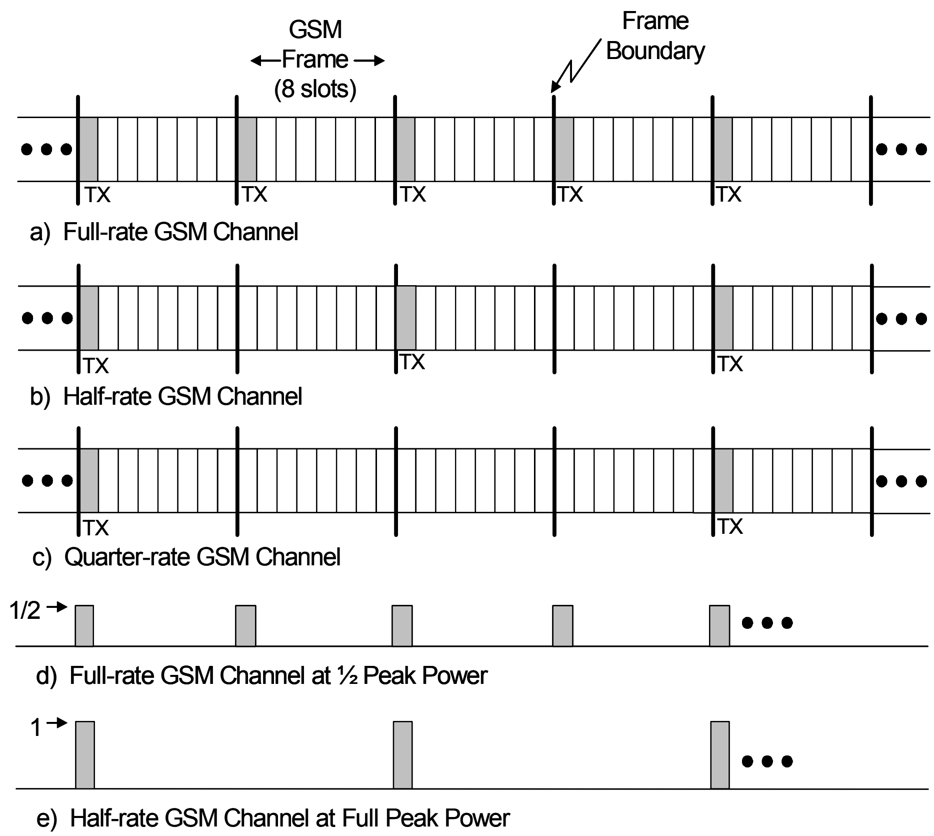
Only Inmarsat can provide such details. MSV encourages the Commission to request such details from Inmarsat.

Appendix B

Analysis of Vocoders

The purpose of this analysis is to demonstrate that MSV's use of a half-rate vocoder in conjunction with a half-rate channel will result in at least 3.5 dB average EIRP reduction, relative to operations using a full-rate GSM vocoder and channel. The first three illustrations below (Figures 1A(a) through 1A(c)) define the full-rate, half-rate, and quarter-rate GSM channel structures. As can be observed from the illustrations, when a terminal is allocated a full-rate channel, the terminal transmits one burst per frame. When a terminal is allocated a half-rate channel, that terminal transmits only one burst once every two frames. Analogously for the quarter-rate GSM case, the terminal transmits one burst once every four frames. Figures 1A(a) through 1A(c) illustrate the three distinct GSM channels (full-, half-, and quarter-rate) that can be allocated to a terminal.

Figure 1A – GSM Channel Structures
(Full-rate, Half-rate, and Quarter-rate)



Now consider Figures 1A(d) and 1A(e). Figure 1A(d) illustrates the bursts of a terminal that is operating on a full-rate GSM channel and is radiating at a power level of ½ of maximum. Figure 1A(e) depicts the bursts of a terminal that is operating on a half-rate channel and is radiating at maximum power. It is clear that, from an average radiated power point of view, the two terminal scenarios of Figures 1A(d) and 1A(e) are indistinguishable. The terminal that is operating on a full-rate channel at ½ of maximum power radiates **on the average** the same EIRP as the terminal operating on a half-rate channel at maximum power.

Having established the above, and given that the relevant measure of uplink interference is the aggregate average EIRP that is launched by the ATC, we can conclude that: **Limiting the ensemble of terminals to half-rate channels over the range of output power from ½ of maximum to maximum is, from an average EIRP standpoint, equivalent to limiting the ensemble of terminals to transmitting no more than ½ of maximum power while operating on full-rate channels.** The constraint of a half-rate vocoder **and** a half-rate channel on an ATC terminal, every time the terminal's power amplifier is commanded to deliver ½ or more of maximum power, offers at least 3 dB average EIRP reduction.[32] With the above half-rate vocoder **and** half-rate channel constraint imposed on the ensemble of ATC terminals, the ensemble of terminals can, equivalently, be thought of as always operating in full-rate GSM mode but with a maximum EIRP that is limited to, at most, half of the specification limit.

Contrary to the Commission's approach of analyzing the effect of a low-rate vocoder, the distribution of users (whether users are outdoors, in-buildings, in-vehicles, near the BTS, at the edge of the BTS service area, etc.) is irrelevant. The Commission did, however, correctly conclude that the distribution of users is irrelevant in its uplink interference analysis (see *ATC Order* Appendix C2, Tables 1.14.A, 2.1.1.A, and 2.1.1.C). Nowhere in the Commission's uplink interference analysis is the distribution of users a relevant consideration. The key relevant parameter (among others) is the peak EIRP of the terminal. The half-rate vocoder in effect guarantees that no terminal can ever radiate more than -3.5 dBW (in equivalent full-rate peak EIRP) even though terminals are (per the Commission's analysis) capable of outputting 0 dBW peak EIRP.

Figure 2A further illustrates the principle. As can be seen from Figure 2A (solid line) a terminal is increasing its power output while transmitting on a full-rate channel. When the terminal's power amplifier (PA) output reaches -3.5 dBW, the terminal's vocoder is switched to half-rate <u>and</u> at the same time the terminal is allocated a half-rate channel (the terminal is now transmitting one burst every other frame). At this point, even though the terminal's PA continues to output -3.5 dBW, the power bursts are occurring every other frame thus establishing the equivalence, from an average power point of view, that the terminal is operating in full-rate and bursting (on every frame) at -7.0 dBW.

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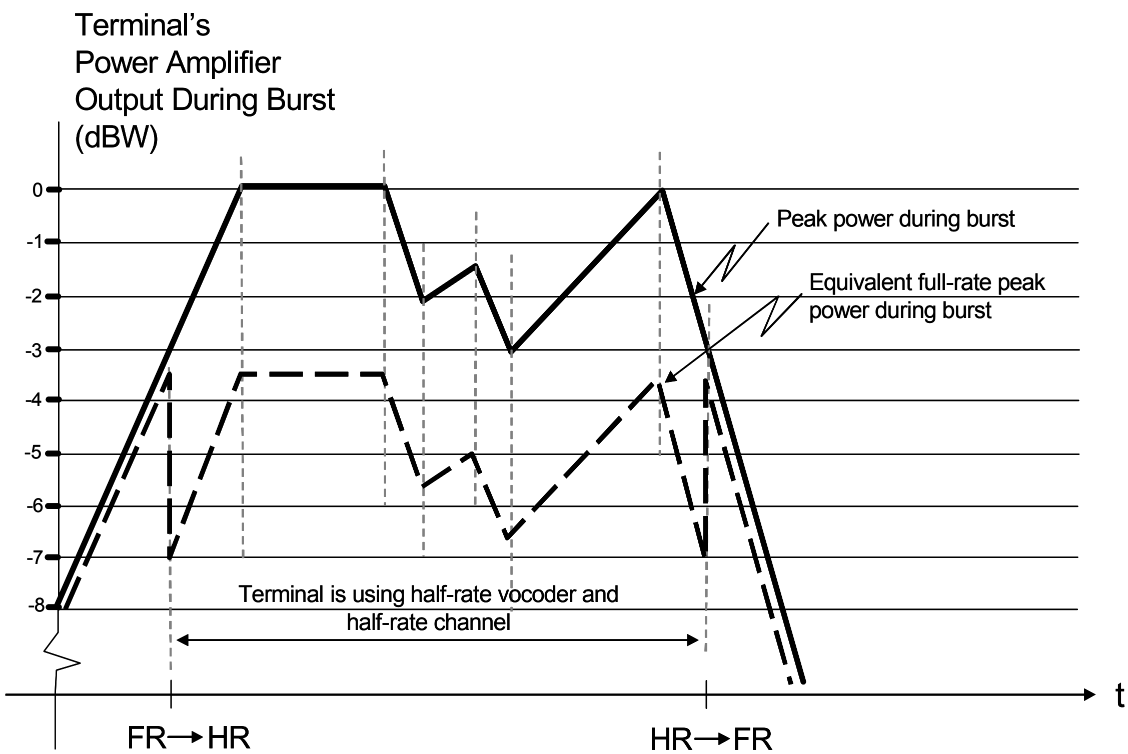
[32]The actual average EIRP reduction will be greater than 3 dB because the half-rate vocoder will output 4.75 kbps. This rate is lower than ½ of full-rate GSM (the full-rate GSM vocoder outputs approximately 13 kbps) thus affording more forward error correction (FEC) protection. The added FEC protection will improve E_b/N_0 performance by at least 0.5 dB thus requiring less transmitted power by the same amount.

As is further illustrated in Figure 2A, although the output power level of the terminal's PA continues to increase, up to the specification limit of 0 dBW, the equivalent peak power of the terminal never exceeds -3.5 dBW. The half-rate vocoder and half-rate channel constraints operate to ensure that even though during the burst the terminal may be outputting 0 dBW it is doing so once every other frame. Finally, Figure 2A illustrates a point in time when the terminal's PA output level becomes -7 dBW (or lower) at which point the terminal may once again return to using a full-rate vocoder and a full-rate channel. It is interesting to note that <u>on the average</u> more than 3.5 dB of interference suppression will be attained. As can be observed from Figure 2A, there will be intervals of time when the terminal is transmitting on a half-rate channel while the equivalent full-rate peak power is well below -3.5 dBW. Thus, associating only 3.5 dB of interference suppression with a half-rate vocoder is conservative.

Figure 2A – Effect of Imposing a Half-Rate Vocoder and a Half-Rate Channel Constraint on the Upper-Most 3.5 dB of Terminal Power Range



Appendix C

Laboratory Measurements of Inmarsat Satellite Receiver Front-End Overload vs. Input Drive Level

The purpose of this analysis is to demonstrate that the appropriate overload threshold for Inmarsat land-based and maritime mobile terminals is -45 dBm. In the *ATC Order*, the Commission used a value of -50 dBm as the front-end RF input level corresponding to the 1 dB compression point of airborne Inmarsat receivers. The Commission used this value as a basis for estimating potential overload interference from MSV's ATC base stations. The value of -50 dBm is based on performance requirements for AMS(R)S receivers specified in ARINC Characteristics 741. For terrestrial receivers not specifically covered under the ARINC requirement, the Commission reduced the ARINC requirement by 10 dB and assumed a 1 dB compression point of -60 dBm for terrestrial Inmarsat receivers (both land-based and maritime).

Laboratory tests performed by MSV to characterize land-based and maritime (*i.e.*, non-airborne) Inmarsat receiver front-end linearity consistently show that the value of -60 dBm assumed by the Commission is unduly conservative. MSV has procured and measured the front-end linearity of a number of commercially available terrestrial Inmarsat terminals including Inmarsat B and Inmarsat Standard C terminals used by the United States Coast Guard. The measured results consistently show that the 1 dB compression point occurs at front-end input levels significantly higher than even the -50 dBm value applied to airborne receivers. A description of the test process and results are given below:

Test Terminals:

Table 1 identifies the satellite terminals that were commercially procured and tested by MSV in its laboratory facilities.

Table 1: Terminal Models Tested

Manufacturer	Model	Service
Nera	Worldphone Office	Mini-M
Thrane & Thrane	CapSat Mobile Telephone TT3060A	Mini-M
Mitsubishi	TS111	MSV system (Mini-M like)
Thrane & Thrane	TT – 3060 B	Mini-M
Nera	Saturn Bm Marine Terminal	Inmarsat-B
Thrane & Thrane	TT-3022-D Capsat	Inmarsat Standard-C

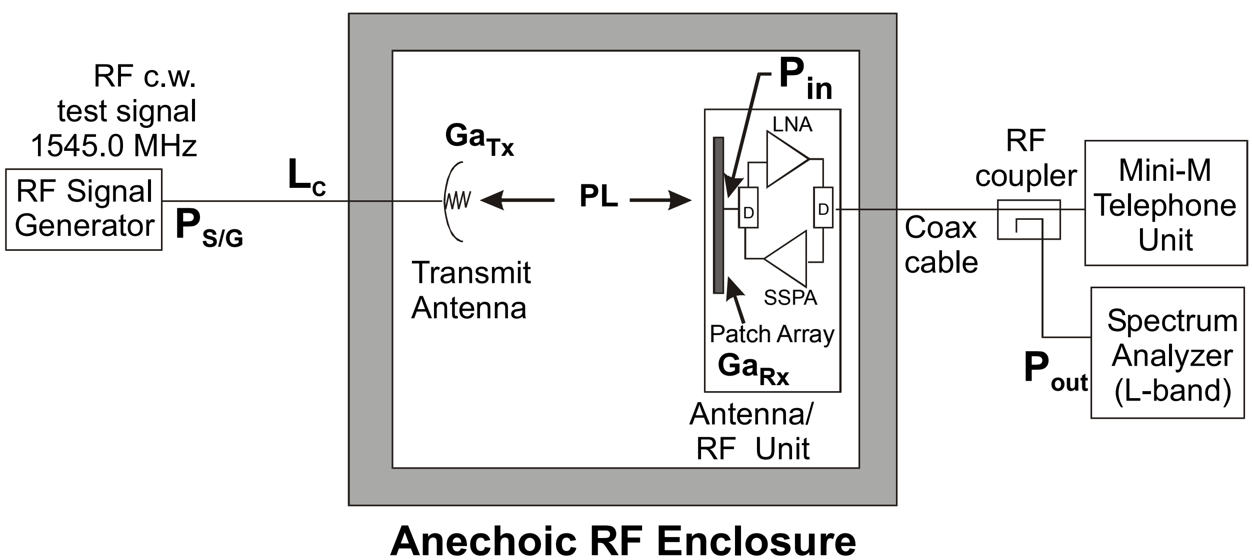
These terminals (with the exception of Inmarsat B) comprise an integrated antenna/RF unit connected by coax cable to a "below-decks" telephone unit that provides modem and user interface functions and supplies DC power to the antenna/RF unit. The antenna/RF unit contains the antenna element(s), LNA, SSPA, duplexers, and associated electronics. A picture of the Nera Worldphone showing the two major components is shown below in Figure 1.

Fig. 1: Photo of Nera Worldphone

Laboratory Test Set-up and Procedure:

The objective of the testing conducted was to measure the RF input level referenced to the receiver front-end that causes the output level to be compressed by 1 dB relative to linear. However, because for most METs the antenna and RF front-end electronics were integrated into a common unit as shown in Figure 1 (with the exception of the Inmarsat B MET) it was not possible to access the antenna output/front-end input interface directly. Therefore it was decided to inject the input test signal (the overload signal) by radiating it from a test antenna, inside an anechoic RF chamber, through the satellite terminal's integrated antenna assembly. Figure 2 shows a block diagram of the test setup. In the case of the Inmarsat B MET, the antenna output port of the terminal was accessible and we were able to inject the test (overload) signal directly into the terminal's front-end electronics input interface.

Fig. 2: Laboratory Test Configuration



The METs having an integrated antenna/RF unit were placed inside the RF enclosure facing the test transmit antenna at a known separation distance, as shown above. An RF coupler was inserted in the coax cable feed between the terminal's antenna/RF unit and telephone unit so that the output level of the LNA could be measured, using a spectrum analyzer, without interfering with the operation of the terminal. The transmit test antenna was connected by coax cable to a signal generator that produced a continuous wave (CW) carrier at 1545 MHz.

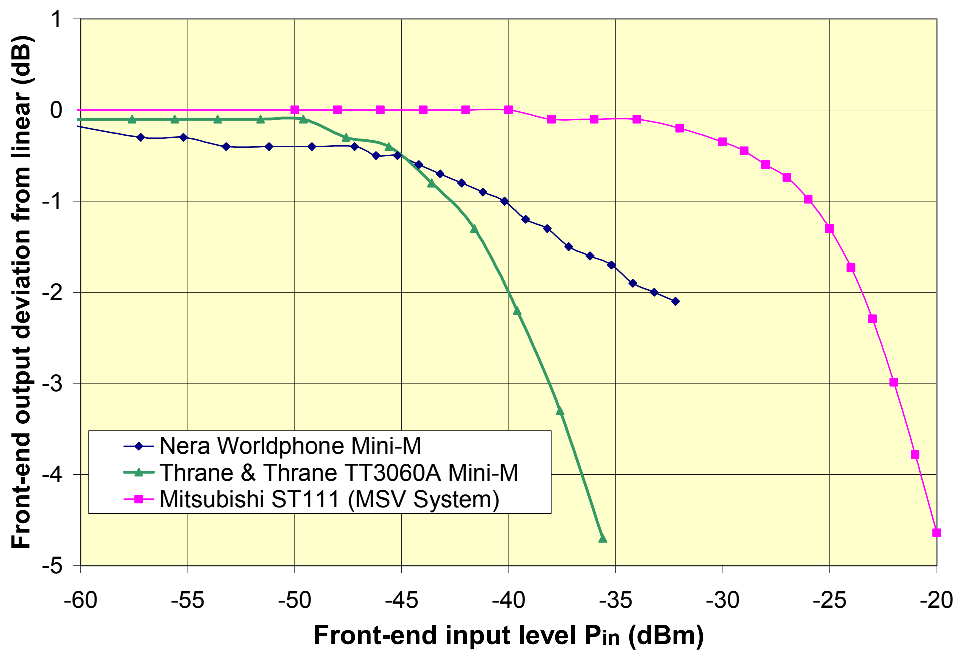
During the test, the signal generator output level $\mathbf{P_{S/G}}$ was increased in steps, starting at a very low level, while the carrier level $\mathbf{P_{out}}$, which is proportional to the front-end output power, was measured at the spectrum analyzer. The power level $\mathbf{P_{S/G}}$, transmit feed loss $\mathbf{L_C}$, transmit antenna gain $\mathbf{Ga_{Tx}}$, and path loss **PL** inside the RF enclosure were known and calibrated prior to the test. The receive antenna gain $\mathbf{Ga_{Rx}}$ of each MET was also known.

By knowing the various gains and losses described above, the test signal input power referenced to the receiver front-end input, denoted $\mathbf{P_{in}}$ in Figure 2, can be calculated as follows:

$$\mathbf{P_{in}}\ (\text{dBm}) = \mathbf{P_{S/G}}\ (\text{dBm}) - \mathbf{L_C}\ (\text{dB}) + \mathbf{Ga_{Tx}}\ (\text{dBi}) - \mathbf{PL}(\text{dB}) + \mathbf{Ga_{Rx}}\ (\text{dBi}) \qquad (1)$$

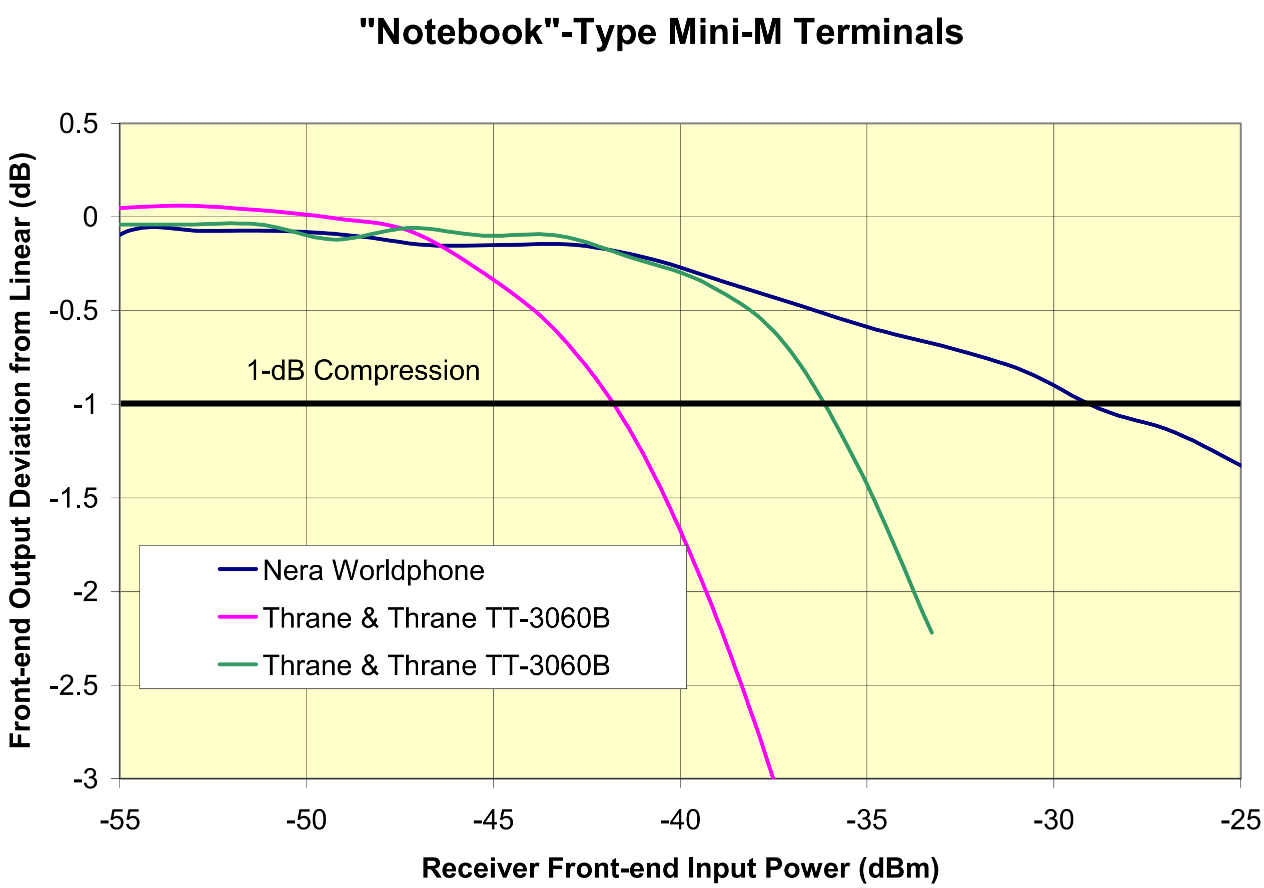
Figure 3 depicts the deviation from linear of the front-end output power $\mathbf{P_{out}}$ as a function of front-end input level $\mathbf{P_{in}}$, for two Inmarsat Mini-M terminals, one manufactured by Nera, and the second by Thrane & Thrane, and also depicts the performance of an MSV MET. It can be seen that the 1 dB compression points occur at input levels of about -40 dBm and -43 dBm for the Nera and Thrane & Thrane receivers, respectively. Also shown in Figure 3 is the linearity measurement of a Mitsubishi ST111 L-band satellite mobile terminal used on MSV's current satellite network. The Mitsubishi ST111 is not Inmarsat-compatible, but has similar RF performance characteristics to the Mini-M terminals. The measured 1 dB compression point for the ST111 is impressive at -26 dBm.

Figure 3: Measurements Conducted on Two Mini-M METs and on one MSV MET



Following the initial set of measurements depicted in Figure 3, additional METs were procured in order to increase the sample size. Figure 4 documents the results of measurements performed on three additional Mini-M METs (one by Nera, and two by Thrane & Thrane). The Nera Mini-M could impressively withstand higher than -30 dBm input levels before reaching the 1 dB compression point. The Thrane & Thrane units were not as resilient but could withstand -43 dBm or higher input levels before reaching the 1 dB compression point.

Figure 4: Additional Measurements Conducted on Mini-M METs



Each of the curves above represents the dB average of a multitude of runs. That is, each one of the METs was subjected to the same measurement procedure at different times in order to ascertain the repeatability of results. The results of different runs for each MET proved sufficiently repeatable. The following three Figures illustrate the spread in the repeatability measurements.

Figure 5: Nera Mini-M Repeatability Measurements

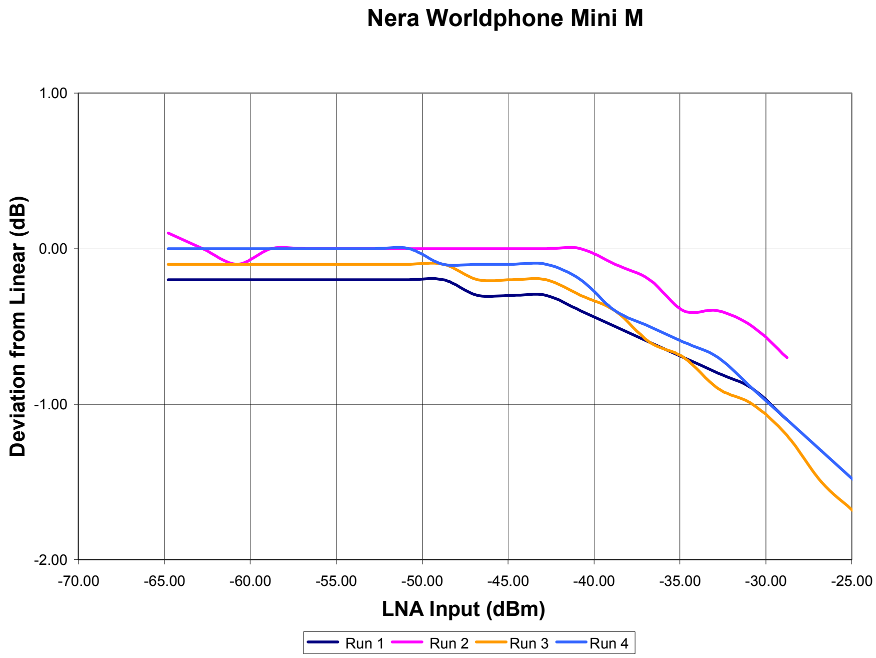


Figure 6: Thrane & Thrane Mini-M Repeatability Measurements

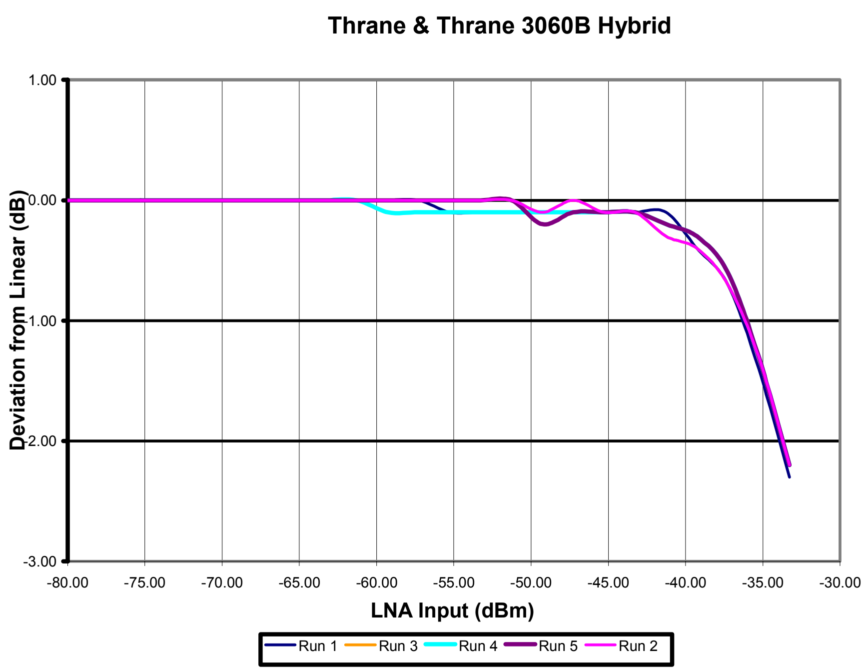


Figure 7: Thrane & Thrane Mini-M Repeatability Measurements

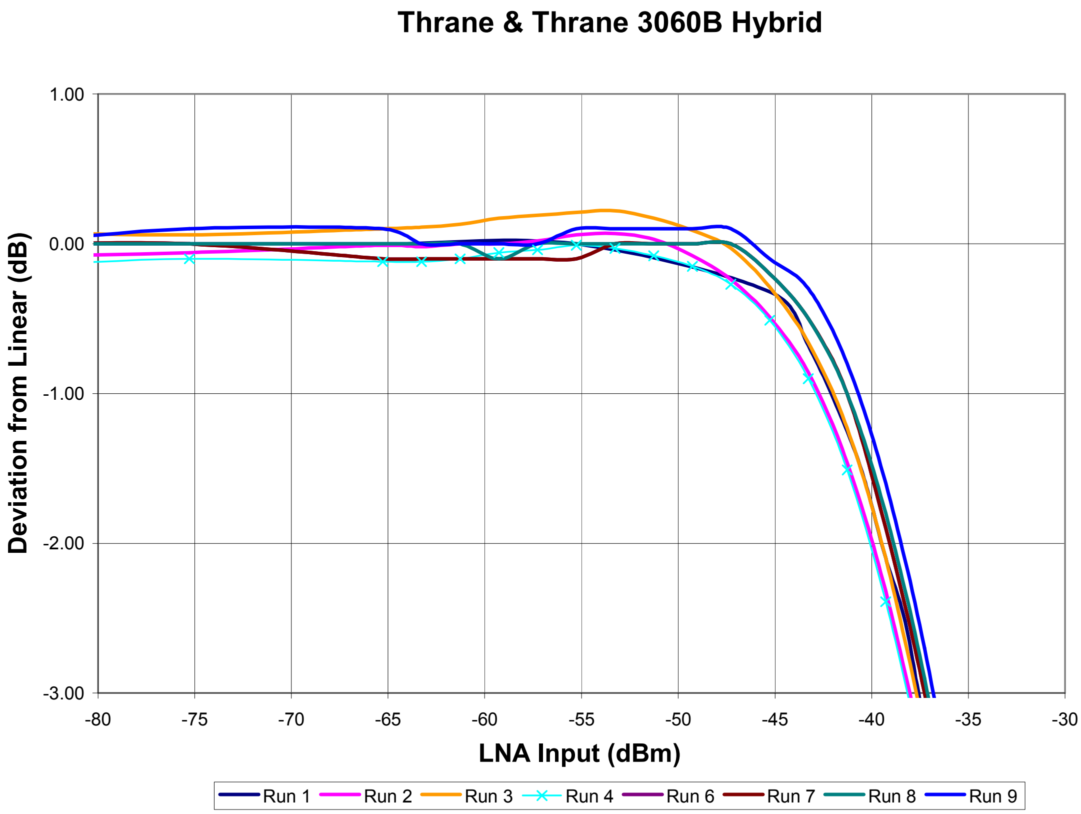


Figure 8: Measurements Conducted on Inmarsat B Maritime Terminal

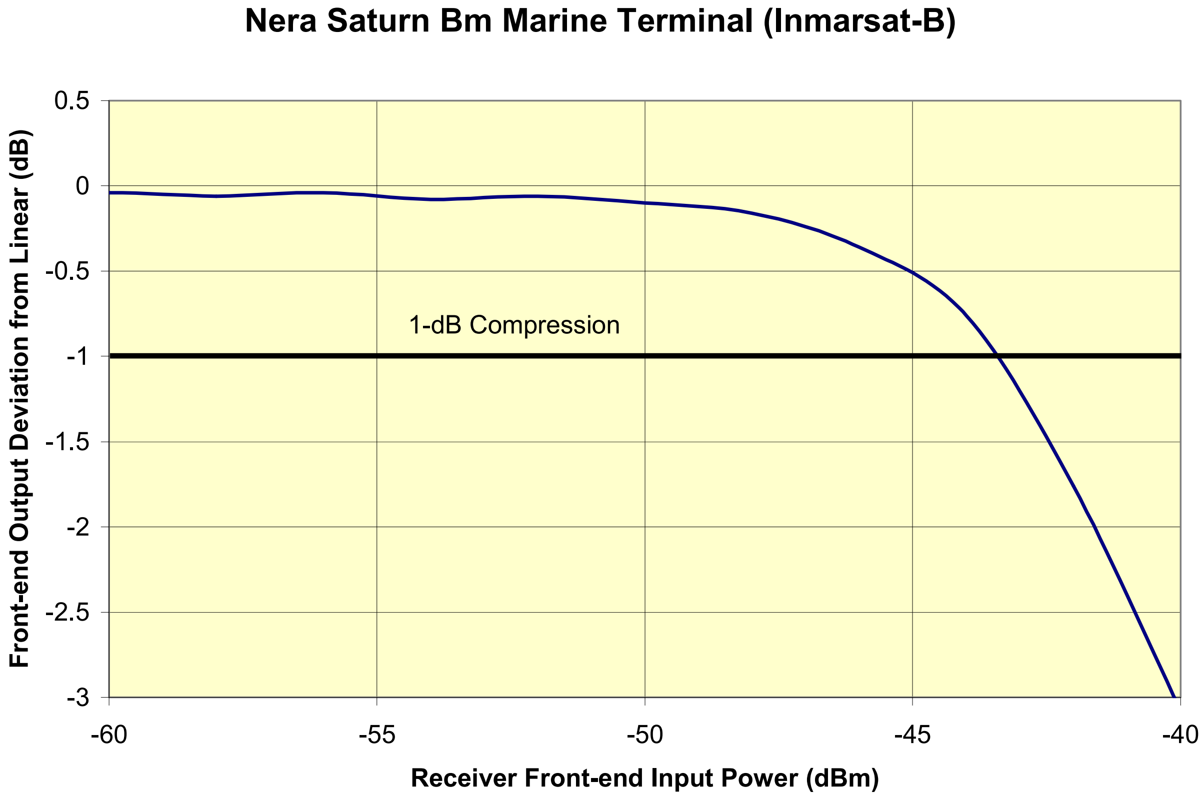


Figure 9: Repeatability Measurements Conducted on Inmarsat B Maritime Terminal

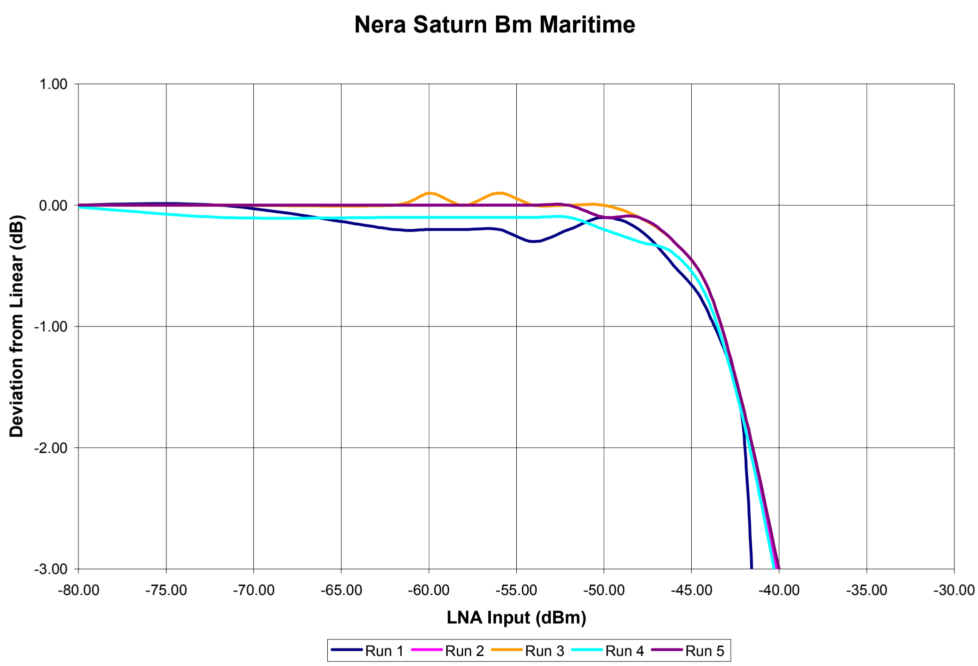
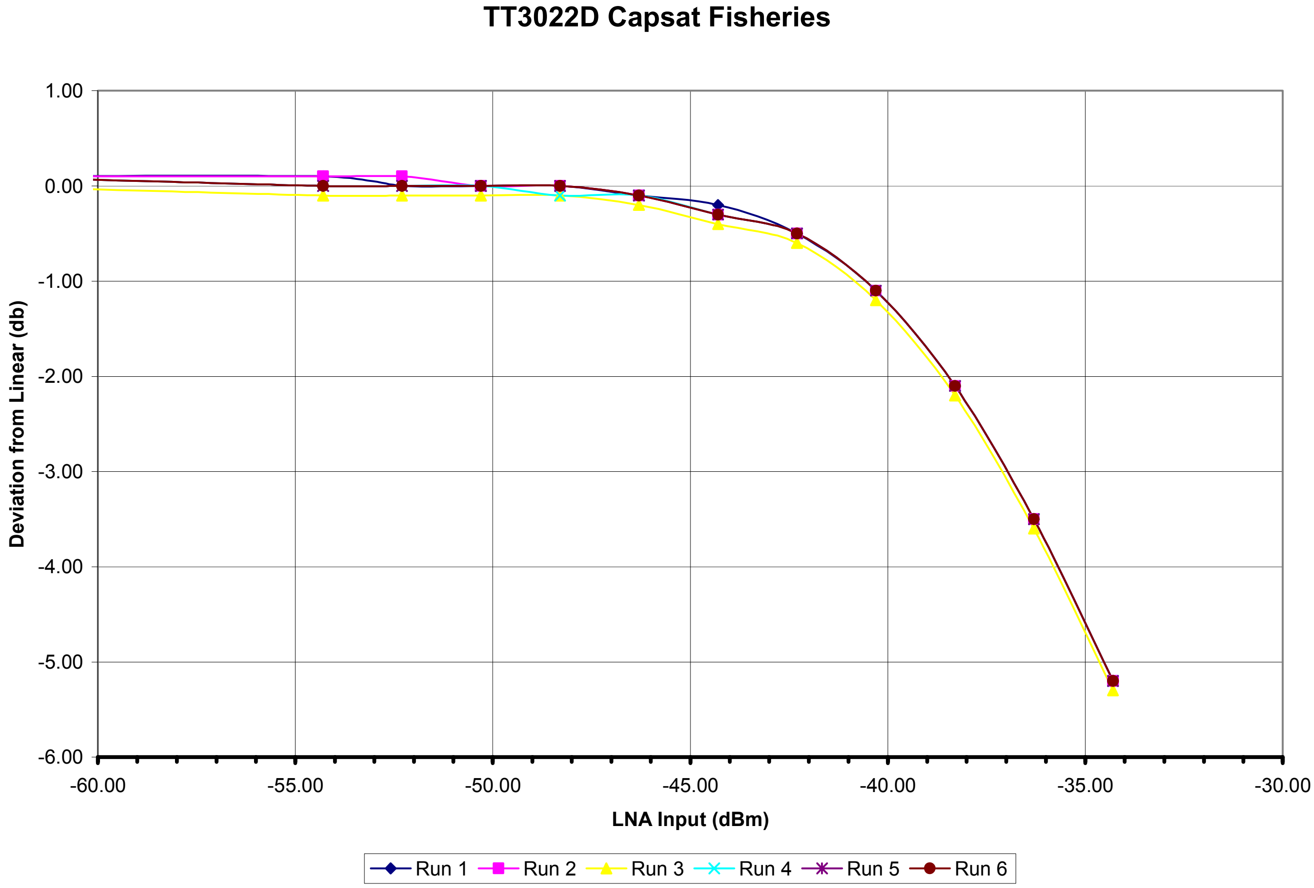


Figure 10: Measurements Conducted on Inmarsat Standard C Maritime Terminal



Conclusion:

MSV's testing of commercially procured Inmarsat METs, both land-mobile and maritime, show that the 1 dB compression point of such METs occurs at an input signal level that is at least 17 dB higher than the Commission's assumed threshold of -60 dBm. Hence, the Commission's assumption that an input signal level of -60 dBm produces 1 dB compression to a land-mobile or maritime MET is unnecessarily conservative, serves no practical purpose, and needlessly constrains the EIRP flexibility of L-band ATC base stations.

Appendix D

Analysis of Base Station Overhead Gain Suppression

The purpose of this analysis is to demonstrate that MSV's base stations can operate with 10 dB higher emissions over elevation angles from 55° to 145° and with 8 dB higher emissions over elevation angles from 30° to 55° without causing an increase of more than .03 dB of potential interference to airborne satellite terminals. In the *ATC Order,* the Commission specified the following antenna pattern overhead discrimination mask for ancillary terrestrial component (ATC) base station antennas operating in the 1525-1559 MHz bands:

Table 1: ATC Base Station Antenna Discrimination Limits as Set Forth in the *ATC Order*

Angle from Direction of Maximum Gain, in Vertical Plane, Above Antenna (Degrees)	Antenna Discrimination Pattern (dB)
0 …………………………………	Gmax
5………………..……………….	Not to Exceed Gmax -5
10………………………………	Not to Exceed Gmax -19
15 to 30………………………….	Not to Exceed Gmax -27
30 to 55…………………………..	Not to Exceed Gmax -35
55 to 145 ………………………	Not to Exceed Gmax -40
145 to 180……………………….	Not to Exceed Gmax -26

In Appendix C-2 of the *ATC Order*, the Commission presented results of an analysis, based on a Monte Carlo simulation, of potential interference to AMS(R)S receivers from ATC base station emissions. The Commission's analysis confirmed the sufficiency of the above base station antenna limits to protect AMS(R)S operations. However, the Commission did not present a sensitivity analysis to assess the impact to AMS(R)S terminals of relaxing the stated antenna mask pattern. MSV has performed such an analysis with the focus on the high elevation region of the antenna pattern. Based on this analysis, MSV herein demonstrates that the mask of the base station antenna pattern is over-specified and can thus be relaxed significantly over the region of high elevation angles with almost no impact to AMS(R)S receivers. This conclusion is a direct consequence of the very limited number of base stations that affect an AMS(R)S receiver over the region of high elevation angles, and is independent of the level of AMS(R)S antenna discrimination toward the base station(s).

The impact of relaxing the base station antenna pattern over the region of high elevation angles is so small because, for high elevation angles, there are relatively few base stations (of the ensemble of 1000 that the analysis takes into account) that contribute interference to the AMS(R)S platform. Thus, the stated relaxation in the base station antenna pattern will have negligible impact on the thermal noise increase and overload margin of an AMS(R)S platform but will have significant beneficial impact on the cost and manufacturability of L-band ATC base stations.[33] When one considers the discrimination of the AMS(R)S terminal antenna toward a base station, over the region of high elevation angles, even this negligible impact disappears.[34]

The simplified base station antenna pattern will yield significant benefit to MSV in terms of manufacturing cost reductions of its base stations. Table 2 below specifies the envelope of the base station antenna pattern that MSV believes is appropriate to protect AMS(R)S without imposing unnecessary discrimination requirements over the region of high elevation angles that do not offer any further protection to AMS(R)S operations and are very costly for MSV to implement.

Table 2: Proposed ATC Base Station Antenna Discrimination Limits

Angle from Direction of Maximum Gain, in Vertical Plane, Above Antenna (Degrees)	Antenna Discrimination Pattern (dB)
0 …………………………………	Gmax
5………………..……………….	Not to Exceed Gmax -5
10………………………………	Not to Exceed Gmax -19
15 to 55………………………….	Not to Exceed Gmax -27
55 to 145 ………………………	Not to Exceed Gmax -30
145 to 180……………………….	Not to Exceed Gmax -26

MSV has demonstrated by analysis that the above proposed limits produce no change in the isolation factor for the total ATC base station distribution. MSV's analysis modeled the same base station distribution scenario that the Commission used for its Monte Carlo simulation - a random distribution of 1000 base stations within a circle of 50 mile (80 km) radius. However, rather than performing a Monte Carlo simulation, MSV used numerical integration to calculate the expected value of isolation for a single randomly distributed base station. Then, assuming that the placement of each base station is an independent random variable (consistent with the Commission's Monte Carlo simulation), the isolation factor for the total distribution of 1000 base stations is 30 dB plus the expected value of isolation (in dB) from a single base station. In the limit as the number of simulation trials becomes large, the Commission's Monte Carlo simulation results should converge to the analytical expected value. As described below, this was indeed found to be the case.

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[33] MSV has had in-depth technical discussions with CSS Antenna, Inc., a cellular/PCS antenna manufacturer. Based on these discussions and inputs that MSV has received from other manufacturers, the base station antenna mask as presently specified by the Commission is very difficult to meet and commercially reproduce in large quantities.

[34]In its simulation model, the Commission noted that "no antenna discrimination was used for the Inmarsat antenna even though an airborne satellite antenna would be expected to have some and, perhaps, a significant amount of shielding from terrestrial transmissions." *ATC Order*, Appendix C2, at p. 221. MSV agrees with the Commission's observation, particularly over the region of high elevation angles.

Table 3 below summarizes the results of MSV's analytical calculation of the isolation factor for 1000 base stations using the base station antenna discrimination values in Tables 1 and 2, and compares these results to the Commission's simulation result:

Table 3: Comparison of Simulation vs. Analytically Derived Isolation Values

Case	Solution Method	BTS Antenna Discrimination	AMS(R)S Antenna Gain from -30^o to -90^o	Isolation Factor for 1000 Base Stations
A	Monte-Carlo simulation (FCC)	Per Table 1	0 dBi	**-105.1 dB**
B	Analysis (MSV)	Per Table 1	0 dBi	**-105.75 dB**
C	Analysis (MSV)	Per Table 2	-10 dBi	**-105.74 dB**
D	Analysis (MSV)	Per Table 2	0 dBi	**-105.72 dB**

Case A above shows the Commission's Monte Carlo simulation results presented in the *ATC Order* which are based on the base station antenna discrimination values of Table 1 (specified by the Commission in the *ATC Order*). The simulation conservatively assumes an Inmarsat AMS(R)S receiver antenna gain of 0 dBi at elevation angles below the aircraft.

Case B shows the results of MSV's analysis using the same assumptions for both base station antenna discrimination and AMS(R)S receiver antenna gain that the Commission used in its simulations. This case was performed to verify that the two solution methods produced equivalent results. Comparing the isolation values from Case A and Case B reveals that the Commission's Monte Carlo simulation value and MSV's result are in agreement (only 0.65 dB difference).

In Case C, the analysis was repeated substituting the base station antenna discrimination changes proposed in Table 2, and assuming an additional AMS(R)S receiver antenna isolation factor of 10 dB for elevation angles from -30 to -90 degrees below the aircraft. The results show that the base station isolation (including the effect of the 10 dB AMS(R)S antenna discrimination over the range from -30º to -90º) is essentially unchanged from Case B, confirming that the proposed changes to the discrimination limits in Table 2 have no practical effect on the base station isolation factor.

In Case D, the analysis was repeated using the proposed discrimination mask in Table 2, but in this case the airborne AMS(R)S receiver antenna gain toward the ATC base stations was set to 0 dBi, consistent with the Commission's conservative assumption. The results show only 0.02 dB reduction in the base station isolation factor compared to Case C which assumed 10 dB of AMS(R)S antenna isolation below the aircraft. **Case D demonstrates that the specific aircraft antenna gain at elevation angles between -30^o and -90^o does not influence the base station isolation factor.** This is because the geographic area contained within the circle defined by a -30^o elevation arc from an aircraft altitude of 1000 feet is very small compared to the entire surface area viewed by the aircraft. Thus, a randomly-distributed group of ATC base stations that is within the viewing area of the aircraft will contribute a very small proportion of total interference power at elevation angles from the aircraft below -30^o.

Additional Discussion:

RTCA Document DO-235A (*Assessment of Radio Frequency Interference Relevant to the GNSS*) provides a detailed assessment of installed aircraft GNSS antenna pattern discrimination at angles below the aircraft (negative elevation angles). This assessment is based on results from modeling simulations, pattern measurements made with GPS antennas mounted on a full-scale fuselage section, and pattern measurements made on a scale-model aircraft. Based on these studies, the RTCA concluded that an average back lobe antenna gain below the aircraft of -10 dBic is representative of the elevation angle range of -30 to -90 degrees below the horizon. This gain value applies to en-route, non-precision approach, and Category I precision approach aircraft types. *See* RTCA/DO-235A, Appendix G.

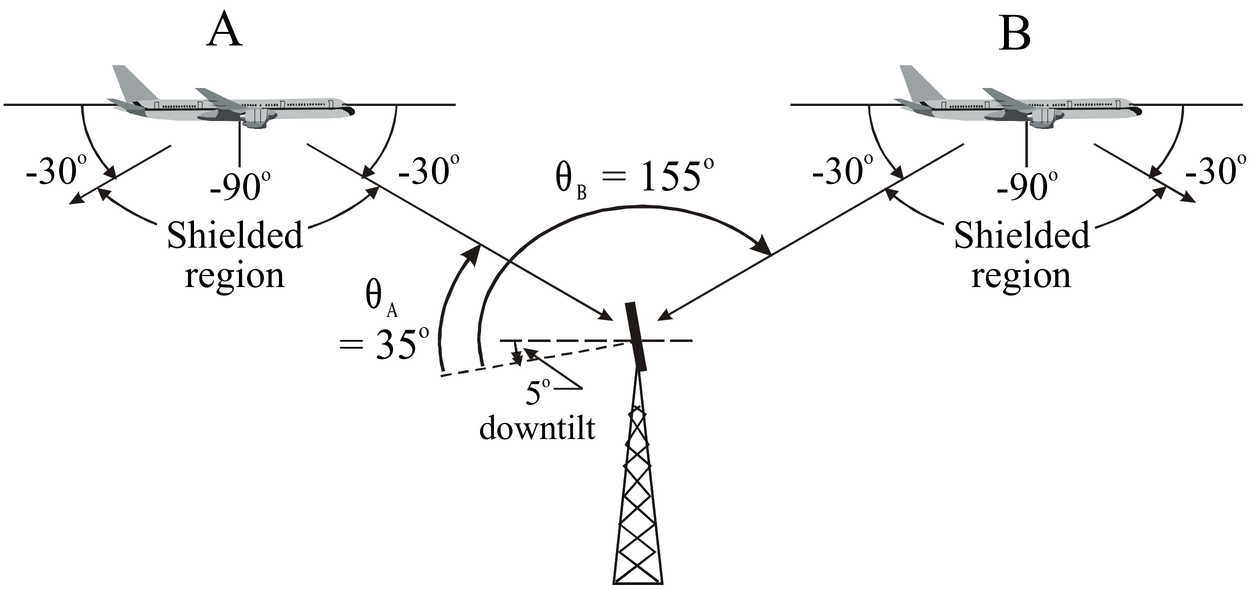
With regard to aeronautical antennas used for AMS(R)S service, RTCA document DO-210C (*Minimum Operational Performance Standards for Aeronautical Mobile Satellite Services (AMSS)*), defines two basic types, a high gain antenna and a low-gain omni-directional antenna. Performance and coverage specifications for the low-gain version are similar to those defined by the RTCA for GNSS antennas. The high gain AMSS antenna performance is specified to be much more directive than the low gain version in terms of discrimination against adjacent satellites, so we would expect its average back lobe discrimination below the aircraft to be at least as good as that of the broader-beam low-gain antenna. Both AMS(R)S and GNSS antennas are installed on top of the aircraft and use right-hand circular polarization.

While RTCA/DO-210C provides no specifications for AMS(R)S antenna gain below the aircraft, it is believed reasonable (based on the above discussion) that this gain may be modeled using the value given by RTCA/DO-235 for GNSS antennas, that is, -10 dBic for elevation angles from -30^{o} to -90^{o}. NTIA, in its *Ex Parte* interference analysis dated November 12, 2002, used a similar rationale to conclude that an AMS(R)S receive antenna gain of -10 dBic below the aircraft represents a conservative estimate of the received interference power level.

Since the Commission has assumed an antenna gain of 0 dBi for the AMS(R)S terminal toward ATC base stations (over all angles), the -10 dBic value from -30^{o} to -90^{o} corresponds to 10 dB of additional isolation, which has not been included in the Commission's model.

The orientation of the aircraft's -30^{o} to -90^{o} shielded region with respect to an ATC base station location is illustrated in Figure 1, which depicts an aircraft flying directly over a base station.

Figure 1: Aircraft Shielded Region



As the approaching aircraft reaches Point A representing -30° look-angle toward the base station, the base station enters the shielded region below the aircraft where the additional 10 dB of isolation is present. The base station remains in the shielded region until the aircraft reaches Point B. From the base station perspective, the aircraft shielded region is directed toward the base station at elevation angles from $\theta_A = 35^o$ to $\theta_B = 155^o$, measured from the base station antenna bore site (assuming 5° down-tilt angle).

Conclusion:

MSV has demonstrated that the ATC base station antenna pattern, as specified by the Commission in the *ATC Order*, can be relaxed significantly with no practical impact to AMS(R)S operations. MSV's sensitivity analysis has shown that 10 dB of pattern relaxation from 55º to 145º and 8 dB relaxation from 30º to 55º degrades the base station isolation factor by no more than 0.03 dB.

Appendix E

Proposed Rule Revisions
Deletions appear as Overstrike text surrounded by {}
Additions appear as Bold text surrounded by []

Revision #1:

Eliminate Section 25.253(a)(6) or clarify that it is redundant to Sections 25.253(d)(7) and 25.253(g)(3). (*See* above text at footnote 16)

Revision #2:

Revision to Section 23.253(a)(2) (*See* above text at pages 14 and Appendix B)

(a) An applicant for an ancillary terrestrial component in these bands shall:

(2) implement a variable rate vocoder in the ATC mobile terminal such that the duty cycle of the mobile terminal is reduced when the EIRP of the mobile terminals requested by the power control system is increased above a nominal ~~-{7.4}~~ **[-3.5]** dBW. The duty cycle will be reduced by refraining from transmitting on consecutive time slots. The duty cycle of the mobile terminal, as measured over a 0.25 second period, shall comply with the following schedule:

Nominal Mobile Terminal Peak EIRP	Mobile Terminal Transmit Duty Cycle
Equal to or less than ~~-{7.4}~~ **[-3.5]** dBW	100%
Greater than ~~-{7.4}~~ **[-3.5]** dBW	50%
~~{Greater than -4.4 dBW}~~	~~{25%}~~
~~{Greater than -1.4 dBW}~~	~~{20%}~~
~~{Greater than -0.4 dBW}~~	~~{18.2%}~~

Revision #3:

Revisions to Section 25.253(c) (*See* above text at pages 9-15 and Appendix A)

(c) The maximum number of base stations operating in the U.S. on any one 200 kHz channel shall not exceed ~~{1725}~~**14,785**. During the first 18 months following activation for testing of the first ATC base station, the L-band ATC operator shall not implement more than ~~{863}~~**7,393** base stations on the same 200 kHz channel. L-band ATC operators shall notify the Commission of the date of the activation for testing of the first ATC base station and shall maintain a record of the total number of ATC base stations operating in the U.S. on any given 200 kHz of spectrum. Upon request by the Commission, L-band ATC operators shall provide this information to resolve any claim it receives from an L-band MSS operator that ATC operations are causing interference to its MSS system.

Revision #4:

Revisions to Section 25.253(d)(1)-(2) (*See* above text at pages 15-19 and Appendix C)

(d) Applicants for an ancillary terrestrial component in these bands must demonstrate that ATC base stations shall not:

(1) exceed ~~{peak}~~ **[an]** EIRP of ~~{19.1}~~ **[38.9]** dBW~~{, in 200 kHz, per carrier with no more than three carriers~~ }per sector **[and the aggregate peak EIRP in any direction from all base station sectors facing in that direction within any 50 mile (80 km) radius shall not exceed 53.9 dBW]**.

(2) exceed an EIRP toward the physical horizon (not to include man-made structures) of ~~{14.1}~~ **[33.9]** dBW per **[sector]** ~~{carrier in 200 kHz}~~.

Revision #5:

Revisions to Section 25.253(d)(4)-(5) (*See* above text at pages 15-19 and Appendix C)

(d) Applicants for an ancillary terrestrial component in these bands must demonstrate that ATC base stations shall not:
*
(4) exceed an aggregate power flux density level of ~~-{73.0}~~ **[-58.0]** dBW/m^2/200 kHz at the edge of airport runways and aircraft stand areas, including takeoff and landing paths;
(5) locate any ATC base station less than 1.5 km from the boundaries of all navigable waterways or the ATC base stations shall not exceed a power flux density level of ~~-{64.6}~~ **[-49.6]** dBW/m^2/200 kHz at the water's edge of any navigable waterway.

Revision #6:

Revision to Section 25.253(e) (*See* above text at pages 19-20 and Appendix D)

(e) Applicants for an ancillary terrestrial component in these bands must demonstrate, at the time of the application, that ATC base stations shall use left-hand-circular polarization, maximum gain of 16 dBi and overhead gain suppression according to the following:

Angle from Direction of Maximum Gain, in Vertical Plane, Above Antenna (Degrees)	Antenna Discrimination Pattern (dB)
0 ……………………………………	Gmax
5………………………………………	Not to Exceed Gmax - 5
10……………………………………	Not to Exceed Gmax -19
15 to ~~30~~**55**……………………………	Not to Exceed Gmax - 27
~~30 to 55………………………………~~	~~Not to Exceed Gmax - 35~~
55 to 145 …………………………….	Not to Exceed Gmax - ~~40~~**30**
145 to 180……………………………	Not to Exceed Gmax - 26

Revision #7:

Revision to Section 25.253(d)(3) and (4) (*See* above text at pages 20-22)

(d) Applicants for an ancillary terrestrial component in these bands must demonstrate that ATC base stations shall not:

(3) **[either]** locate any ATC base station less than 470 meters from all airport runways and aircraft stand areas, including takeoff and landing paths **[or exceed an aggregate power flux density level of -58.0 dBW/m^2/200 kHz at the edge all airport runways and aircraft stand areas, including takeoff and landing paths]**;

(4) ~~{exceed an aggregate power flux density level of -73.0 dBW/m2/200 kHz at the edge all airport runways and aircraft stand areas, including takeoff and landing paths;}~~**[[reserved]]**

Revision #8:

Revision to Section 25.253(f)(1) (*See* above text at pages 22-23)

(f) Prior to operation, ancillary terrestrial component licensees shall:

(1) provide the Commission with sufficient information to complete coordination of ATC base stations with Search-and-Rescue Satellite-Aided Tracking (SARSAT) earth stations operating in the 1544-1545 MHz band for any ATC base station located ~~{either}~~ within 27 km of a SARSAT station ~~{, or}~~ **[and]** within radio horizon of the SARSAT station ~~{, whichever is less}.~~

TECHNICAL CERTIFICATION

I, Dr. Peter D. Karabinis, Vice President & Chief Technical Officer of Mobile Satellite Ventures Subsidiary LLC ("MSV"), certify under penalty of perjury that:

I am the technically qualified person with overall responsibility for preparation of the technical information contained in the foregoing "Petition for Partial Reconsideration and Clarification." The information contained in the "Petition for Partial Reconsideration and Clarification" is true and correct to the best of my belief.

/s/ Peter D. Karabinis
Dr. Peter D. Karabinis
Vice President & Chief Technical Officer

July 7, 2003