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

In the Matter of	)	
	)	
Amendment of Parts 2 and 25 to Implement	)	IB Docket No. 99-67
the Global Mobile Personal Communications	)	
by Satellite (GMPCS) Memorandum	)	
of Understanding and Arrangements	)	
	)	
Petition of the National Telecommunications and	)	RM No. 9165
Information Administration to Amend Part 25 of the	)	
Commission's Rules to Establish Emission Limits for	)	
Mobile and Portable Earth Stations Operating in the	)	
1610-1660.5 MHz Band	)	

REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULEMAKING

Adopted: May 2, 2002 **Released: May 14, 2002**

Comment Date: 60 days from publication in the Federal Register.
Comment Reply Date: 90 days after publication in the Federal Register.

By the Commission:

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I. INTRODUCTION

1. By this Report and Order, we amend the Commission's Rules to establish new out-of-band emission limits[1] for certain mobile earth-station terminals ("METs") used for Mobile Satellite Service ("MSS") communications. The emission restrictions apply to METs operating in the 1610-1660.5 MHz band (*i.e.*, "1.6 GHz METs") and METs operating in the 1990-2025 MHz band (*i.e.*, "2 GHz METs").[2] We are imposing these emission limits to prevent such METs from interfering with aeronautical reception of satellite radionavigation signals in the 1559-1610 MHz band. More specifically, the limits are designed to enhance flight safety by ensuring that emissions from such METs will not impair aircraft radionavigation during instrument approach and landing. We are also issuing a Further Notice of Proposed Rulemaking, included herein, in which we propose further requirements for the same purpose and invite public comment.

2. In addition to proposing to adopt emission limits for protection of aeronautical radionavigation, in the order instituting this proceeding,[3] the Commission also proposed to adopt rules to facilitate global operation of METs. The proposed rules pertaining to worldwide circulation of METs were designed to implement an international Memorandum of Understanding regarding Global Mobile Personal Communication by Satellite ("GMPCS-MoU") that was signed by representatives of the United States and more than 120 other governments and private-sector organizations.[4] We are not yet prepared to take final action with respect to GMPCS-MoU implementation but will do so in a future order in this proceeding.[5]

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[1] The term "out-of-band emission" is defined in Section 2.1 of the Commission's rules, 47 C.F.R. § 2.1, as an emission in frequencies immediately outside the transmitter's necessary (*i.e.*, authorized) bandwidth that results from modulation. We use the term in a broader sense here, as referring to any emission produced by a transmitter in frequencies outside its authorized bandwidth, whether or not the emission occurs in frequencies immediately outside that bandwidth or results from modulation.

[2] There are two basic types of 1.6 GHz METs: those used with "Big LEO" MSS systems and those used with geostationary-orbit MSS ("GSO MSS") systems. Big LEO systems provide two-way voice and data communication via non-geostationary-orbit satellites to mobile users in most areas of the world and afford seamless interconnection with the public switched telephone network. *See Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands* (Report and Order), 9 FCC Rcd 5936 (1994). Big LEO METs have assigned uplink frequencies between 1610 and 1626.5 MHz. Two Big LEO systems, the Globalstar System and the Iridium System, currently provide service in the United States. Three GSO MSS systems currently provide service to customers in the United States using assigned mobile-uplink frequencies between 1626.5 MHz and 1660.5 MHz. The Commission has issued licenses for eight additional MSS systems that are to provide two-way voice and data communications to users equipped with 2 GHz METs.

[3] Notice of Proposed Rulemaking, 14 FCC Rcd 5871 (1999) ("*Notice*").

[4] *See* n.29, *infra*.

[5] We also intend to address, in a future order, the comments filed in this proceeding concerning implementation of 911 emergency-call service via satellite. *See Public Notice: International Bureau Invites Further Comment Regarding Adoption of 911 Requirements for Satellite Services*, DA 00-2826, 66 FR 393960 (Jan. 17, 2001).

II. BACKGROUND

3. The International Civil Aviation Organization ("ICAO") has designated two satellite radionavigation systems for use as components of an integrated Global Navigation Satellite System ("GNSS") for aeronautical applications: the NAVSTAR Global Positioning System ("GPS") and GLONASS.[6] The space segment of the GPS system consists of 24 satellites in non-geostationary orbit maintained by the U.S. government. GPS satellites transmit ranging signals on a 1575.42 MHz carrier: a Standard Positioning Service ("SPS") signal and a Precise Positioning Service ("PPS") signal. The PPS signal is modulated by a code that can only be processed by users equipped with cryptographic keys, distribution of which has been limited mainly to military personnel. The SPS signal, which is available for general civilian use, extends through the band 1563.42 to 1587.42 MHz and is modulated with a pseudo-random-noise "C/A" code sequence, the null-to-null bandwidth of which occupies approximately two megahertz centered on the 1575.42 MHz carrier frequency.[7]

4. The Federal Aviation Administration ("FAA") is planning to shift from reliance on ground-based systems for aircraft radionavigation during instrument approach and landing in the United States to reliance on satellite guidance, to be obtained chiefly from GPS-SPS. Because GPS-SPS is not accurate enough, in itself, to serve as the primary means of guidance for instrument approach and landing, the FAA is promoting development of two auxiliary systems: a Wide Area Augmentation System ("WAAS") and a Local Area Augmentation System ("LAAS"). WAAS signals providing correction data will be downlinked to aircraft receivers via satellites in geostationary orbit transmitting in the GPS-SPS frequency band. The FAA expects to certify GPS/WAAS, which will afford horizontal and vertical positioning accuracy to a tolerance of approximately 8 meters, as a primary means of instrument navigation for Category I precision approach flight and all less-critical phases of flight.[8] According to the most recent Federal Radionavigation Plan, GPS/WAAS was to commence limited operations in 2000 and is to be fully implemented over the next six years.[9] LAAS, which is in an earlier stage of development than WAAS, would involve transmission of additional corrective signals from ground stations sited near runways. GPS/LAAS is expected to achieve guidance accuracy and reliability sufficient for all phases of instrument approach flight.

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6 GLONASS is an acronym extracted from the phrase "global navigation satellite system."

7 Next-generation GPS satellites, to be launched over a six-year period beginning in 2003, will transmit a second civilian ranging signal, designated "L2C," on the 1227.6 MHz carrier., The 1227.6 MHz carrier is not in a band allocated for Aeronautical Radionavigation, however, and the FAA has no current plan to use the L2C signal for that purpose. Plans have been announced for third-generation GPS satellites to transmit an additional "L5" ranging signal in the 1164-1215 MHz band for civilian aviation use, and the FAA has commissioned an advisory group to investigate protection requirements for potential aeronautical use of the L5 signal. The third-generation GPS constellation will not be numerous enough to provide continuous radiolocation with the L5 signal until a considerable number of years after the planned launch of the first L5-capable satellite in 2005, however.

8 *Federal Radionavigation Plan 1999*, § 3.2.4.3. The Federal Radionavigation Plan is published biennially by the U.S. Departments of Defense and Transportation to provide information on the management of Federally-provided radionavigation systems. An approach is Category I if the runway is visible at a distance of not less than half a mile and from an altitude of not less than 200 feet.

9 *Id.*

5. GLONASS is a non-geostationary radionavigation satellite system maintained by the Russian Ministry of Defense. According to a schedule published by the International Telecommunication Union ("ITU"),[10] GLONASS satellites will transmit navigation signals for civilian use approximately one megahertz wide on carrier frequencies between 1598 MHz and 1609.3125 MHz until January 1, 2005. After that date, the satellites will transmit on carrier frequencies between 1598 and 1605.375 MHz.[11] ICAO has accepted an offer from the Russian Federation to provide GLONASS positioning to civilian aircraft as a component of the proposed GNSS and is developing standards for hybrid receivers that would process both GPS and GLONASS signals. According to the Federal Radionavigation Plan, hybrid GPS/GLONASS receivers would have significant advantages over single-system receivers, including improved resistance to interference.[12] The FAA has not yet approved GLONASS for aeronautical radionavigation in the United States but is studying implementation of a next-generation U.S. system based on the ICAO concept of an integrated GPS/GLONASS GNSS. In any event, because ICAO has accepted GLONASS, the United States must, under the Convention on International Civil Aviation, comply with ICAO requirements for interference protection for GLONASS or file an exception. The United States has not filed such an exception to date.[13]

6. The Commission adopted limits to protect GPS from emissions from one type of MET in 1994, when it established rules for the "Big LEO" MSS service.[14] It required the e.i.r.p. density of out-of-band emissions from Big LEO METs in the 1574.397-1576.443 MHz GPS-SPS C/A band to be suppressed to levels no greater than -70 dBW/MHz, averaged over any 20 millisecond interval.[15] Further, the Commission ruled that the e.i.r.p. of any discrete emission of less than 600 hertz bandwidth from a Big LEO MET must not exceed -80 dBW in that band.[16] The Commission did not establish limits at that time to protect GLONASS, however. While acknowledging in the *Big LEO Report and Order* that out-of-band emissions from Big LEO METs could interfere with GLONASS reception, it left the issue to

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10 *See ITU-R REC M.1317* (1997) §1.1.

11 *Id.* ICAO does not sanction aircraft use of GLONASS carrier frequencies above 1604.25 MHz, however. GLONASS transmits coded signals in a wider band for military use, but the U.S. government has not agreed to protect reception of military-code GLONASS in U.S. territory.

12 *Federal Radionavigation Plan, supra,* at § 3.4.2. *See also* Chin, Kraemer, Nim, and Van Dyke, John A. Volpe National Transportation Systems Center, U.S. Dept. of Transportation, "GPS/GLONASS RAIM Augmentation to WAAS for CAT I Precision Approach," published in *The Proceedings of the 53rd Annual Meeting of the Institute of Navigation* (1997).

13 According to aviation-industry participants in a study group commissioned by the FAA, the filing of a U.S. exception with regard to GLONASS protection might provoke other countries to drop support for aeronautical use of GPS, with consequent impairment of the navigational capability of aircraft flying international routes. *RTCA/DO-235, infra,* at F3.

14 *See* n.2, *supra.*

15 E.i.r.p., *i.e.*, effective isotropic radiated power, is a function of the power supplied to a transmitting antenna and the antenna gain in a given direction relative to that of an isotropic radiator. E.i.r.p. density is the e.i.r.p. over a specified bandwidth.

16 *See* 47 C.F.R. § 25.213(b).

be resolved after further study.[17]

7. Later in 1994, representatives of the Commission, the FAA, and the National Telecommunication and Information Administration ("NTIA") signed a Memorandum of Understanding concerning domestic implementation of the GNSS.[18] The signatory agencies agreed to consult with industry representatives concerning development of regulatory standards to prevent METs from interfering with GNSS aeronautical radionavigation. The study was to be conducted under the auspices of the RTCA, a non-profit corporation that routinely functions as a Federal Advisory Committee and develops consensus-based recommendations for the FAA. The Commission said that it would initiate a rulemaking to consider any ensuing RTCA recommendation and would include a condition in each MET license authorizing operation in frequencies near the GPS and GLONASS operating bands stipulating that operation is subject to any limits subsequently incorporated in the Commission's rules for protection of those GNSS services. All current FCC licenses for 1.6 GHz METs include an explicit condition to that effect.[19]

8. RTCA Special Committee 159 ("SC-159") convened to develop recommendations for additional out-of-band emission limits for METs to protect aircraft reception of satellite radiovavigation signals. The committee was comprised of representatives from the Commission, the FAA, the aviation industry, and the MSS industry. In January 1997, SC-159 published separate reports from the aviation and MSS contingents.[20] The members representing aviation interests, including the FAA representatives, maintained that METs should meet a wideband limit of -70 dBW/MHz or less and a narrowband limit of -80 dBW or less on emissions in the 1559-1610 MHz Aeronautical Radionavigation/Radionavigation Satellite ("ARNS") band in the interim prior to the downshifting of the GLONASS operating band and

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17 Aside from Section 25.213(b), there are currently two other relevant rule provisions pertaining to out-of-band emissions. There is a comprehensive set of restrictions on out-of-band emissions by satellite-service transmitters in Section 25.202(f), which are more lenient regarding suppression of emissions in the 1559-1610 MHz aeronautical radionavigation band from 1.6 GHz MSS terminals than the additional limits we are adopting here. There is also a general requirement in Subsection 2.102(f) that transmission frequencies shall be separated from the limits of the spectrum band allocated for service of the type in question insofar as necessary to avoid causing harmful interference with reception of "allocated" services in adjoining frequency bands.

18 *Memorandum of Understanding Between the Federal Communications Commission (FCC) National Telecommunications and Information Administration (NTIA) and The Federal Aviation Administration (FAA)*, Announcement 50736 (Nov. 18, 1994).

19 *See Botcorp America*, 17 FCC Rcd 1605 (Sat. Div. 2002) at ¶12; *Infosat Communications, Inc.*, 17 FCC Rcd 1610 (Sat. Div. 2002) at ¶18; *Comsat Corporation d/b/a Comsat Mobile Communications et al.*, 16 FCC Rcd 21661 (2001), at ¶¶ 92 and 115 and n.206; *TMI Communications and Company, L.P.*, 15 FCC Rcd 18117 (Sat. Div. 2000), at ¶13 and 15 FCC Rcd 24467 (Sat. Div. 2000) at ¶19; *SatCom Systems, Inc.*, 14 FCC Rcd 20798 (1999), at ¶¶ 53 and 69; *AirTouch Satellite Services US, Inc.*, 14 FCC Rcd 17328 (Int'l Bur. 1999), at ¶26; *U.S. Leo Services, Inc.*, 11 FCC Rcd 20474 (Int'l Bur. 1996), at ¶21; *AMSC Subsidiary Corporation*, 1995 WL 109123 (Int'l Bur. 1995), at ¶19. No license has been issued to date for 2 GHz METs.

20 *Assessment of Radio Frequency Interference Relevant to the GNSS*, Document No. RTCA/DO-235 (January 27, 1997).

should thereafter meet those limits in frequencies from 1559 MHz to 1605 MHz.[21] The committee's MSS members maintained that less-restrictive limits would suffice but conceded that it was at least feasible for 1.6 GHz METs to meet the -70 dBW/MHz limit urged by the aviation members in spectrum below 1580.42 MHz and to meet a -80 dBW narrowband limit in spectrum below 1585.42 MHz.[22] The MSS members contended, however, that it was economically infeasible to suppress emissions from handheld 1.6 GHz METs to those levels in the higher frequencies of the ARNS band.[23] Due to the lack of consensus, SC-159 did not issue a recommendation for out-of-band emission limits to protect GLONASS.

9. In September 1997, the NTIA filed a petition for rulemaking with the Commission in which it proposed a solution to the out-of-band emission problem.[24] The NTIA explained that its proposal reflected a compromise worked out by NTIA and FAA officials in consultation with MSS licensees. The essential elements of the proposed compromise were that the limits previously advocated by the aviation members of RTCA SC-159 would ultimately be imposed, but there would be an initial grace period before currently-operated 1.6 GHz METs would be subject to those limits on emissions in higher segments of the 1559-1610 MHz ARNS band.

10. More specifically, the NTIA asked the Commission to adopt the following requirements: (1) all 1.6 GHz METs would immediately be subject to a wideband limit of -70 dBW/MHz, averaged over 20 milliseconds, on the e.i.r.p. density of out-of-band emissions in the 1559-1580.42 MHz frequency range and a narrowband limit of -80 dBW/700 Hz, also averaged over 20 milliseconds, on emissions in the 1559-1585.42 MHz range; (2) Big LEO METs commissioned prior to January 1, 2002 would, in addition, be immediately subject to interim e.i.r.p. density limits of -64 dBW/MHz in frequencies from 1580.42 MHz to 1605 MHz and -74 dBW/700 Hz in frequencies from 1585.42 to 1605 MHz; (3) all 1.6 GHz METs, including Big LEO METs, commissioned after January 1, 2002 would have to meet limits of -70 dBW/MHz and -80 dBW/700 Hz in frequencies from 1559 MHz to 1605 MHz without relying on channel-blocking by network software; (4) all 1.6 GHz METs commissioned before January 1, 2002 must be deactivated as of January 1, 2005 unless altered by then, as necessary, to conform to the stricter limits applicable to terminals commissioned after January 1, 2002. Finally, the NTIA recommended that the Commission address any issue of potential interference with reception of GLONASS signals in U.S. territory on frequencies above 1605 MHz, before 2005, on a case-by-case basis.

11. Similar requirements have since been endorsed by international standards-setting bodies. In November 1997, the ITU adopted recommendations for regulatory limits on out-of-band emissions from METs licensed for transmission in frequencies between one and three GHz and used with non-

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21 *Id.* at F-15 and F-25.

22 The MSS contingent also conceded that it might be technically feasible to suppress broadband emissions from vehicle-mounted and transportable, non-handheld MSS terminals with assigned frequencies above 1621.35 MHz to -70 dBW/MHz in ARNS frequencies up to 1605 MHz.

23 *Id.* at E-24.

24 The petition was placed on public notice in Report No. 2227 (Sept. 23, 1997).

geostationary-orbit ("NGSO") MSS systems.[25] Those ITU recommendations do not include a narrowband limit or a grace period for suppression in higher frequencies but are otherwise consistent with the NTIA's proposal. For NGSO METs transmitting in the TDMA mode,[26] the ITU recommended a -70 dBW/MHz limit on emissions in the 1559-1605 MHz range and a scaled limit linearly interpolated to -10dBW/MHz at 1610 MHz for emissions in the 1605-1610 MHz band segment. It also recommended a -70 dBW/MHz limit on out-of-band emissions from NGSO CDMA METs[27] in frequencies between 1559 and 1580.42 MHz. Although it refrained, pending further study, from recommending a limit on NGSO CDMA MET emissions above 1580.42 MHz, the ITU said that the recommended limit would be no more strict than -70 dBW/MHz. The ITU subsequently issued similar recommendations for METs used with GSO MSS systems.[28] Although the ITU recommendations do not have the force of law, the U.S. signatories of the GMPCS MoU pledged support for them.[29]

12. The European Telecommunications Standards Institute and the European Commission on Post and Telecommunications have also adopted limits on emissions in the 1559-1610 MHz band from METs transmitting on frequencies between 1610 and 1626.5 MHz.[30] The European limits are the same as those recommended by the ITU for TDMA METs and apply to CDMA METs, as well.

13. In 1998, the Commission adopted a provisional standard for suppression of MET emissions in the 1559-1610 MHz band for licensees requesting equipment certification prior to adoption of mandatory emission limits in this proceeding.[31] The Commission ruled that METs meeting the ultimate -70 dBW/MHz and -80 dBW/700 Hz limits recommended by the NTIA would qualify for optional interim certification. The Commission cautioned, however, that METs voluntarily certified pursuant to

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25 ITU-R REC M.1343, *Essential Technical Requirements of Mobile Earth Stations for Global Non-Geostationary Mobile-Satellite Service Systems in the Bands 1-3 GHz.*

26 TDMA, *i.e.*, time-division multiple access, is a transmission technique involving use of the same frequency band for uplinks and downlinks in alternating time slots.

27 CDMA, *i.e.*, code-division multiple access, is a digital transmission technique in which the signal occupies a bandwidth much larger than needed to contain the information carried. Interference potential is reduced because, among other things, the signal is spread over a wide bandwidth and the power is dispersed.

28 ITU-R REC M.1480, *Essential Technical Requirements of Mobile Earth Stations of Geostationary Mobile-Satellite Systems that are Implementing the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding Arrangements in Parts of the Frequency Band 1-3 GHz.*

29 *Memorandum of Understanding to Facilitate Arrangements for Global Mobile Personal Communications by Satellite, Including Regional Systems (GMPCS-MoU)* (Geneva, 14 February 1997), Article 1.

30 European Testing and Standards Institute TBR-041 and TBR-042.

31 *1998 Biennial Regulatory Review – Amendment of Parts 2, 25, and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements, and Begin Implementation of the Global Mobile Personal Communications by Satellite (GMPCS) Arrangements* (Report and Order), 13 FCC Rcd 24687 (1998). The Commission instituted the voluntary certification program as an accommodation for MSS licensees that wanted to have the GMPCS-MoU ITU Registry mark placed on their METs. To qualify for the mark, METs must be type-approved by an administration that signed the GMPCS MoU.

the interim standard would be subject to whatever mandatory permanent limits are eventually adopted, and it gave no guarantee that the permanent limits would not be more restrictive.

14. In March 1999, the Commission issued the *Notice* in this proceeding, proposing to adopt most of the NTIA's recommendations for limits on emissions from 1.6 GHz METs and inviting further public comment. Shortly afterward, in the context of the rulemaking pertaining to establishment of licensing and service rules for 2 GHz MSS, the Commission proposed to adopt similar restrictions on out-of-band emissions from 2 GHz METs.[32]

III. DISCUSSION

A. New 1.6 GHz METs: Limits on Emissions Between 1559 MHz and 1605 MHz

15. As proposed, we are amending the Commission's rules to incorporate the NTIA's principal recommendations for limits on out-of-band emissions from METs licensed to transmit in frequencies between 1610 and 1660.5 MHz. As the Commission stressed in the *Notice*,[33] the NTIA's recommendations are consistent with ITU recommendations and represent a compromise that offers protection deemed necessary by the Federal agencies responsible for domestic implementation of the GNSS while affording MSS licensees lead time in which to achieve full compliance. We continue to believe that the compromise strikes a reasonable balance between fostering improvement in aeronautical radionavigation and promoting MSS development. In the following paragraphs, we discuss particular aspects of the new emissions regulations in light of issues raised in public comments.

1. Wideband Limit

16. The NTIA recommended, and the Commission proposed to adopt, a requirement that 1.6 GHz METs placed in service on or after January 1, 2002 suppress the e.i.r.p. density of wideband emissions in the 1559-1605 MHz frequency range to -70 dBW/MHz or less.[34] Most of the comments on this issue support this proposal. In joint comments, L/Q Licensee, Inc., Globalstar L.P., and AirTouch Satellite Services U.S., Inc. ("Globalstar companies") contend that the Commission's proposals should be adopted because they satisfy the requirements of the aviation industry without seriously compromising the MSS industry's economic potential and are consistent with international standards.[35] The Globalstar companies stress that "Big LEO" MSS licensees have been grappling for years with the problem of designing handsets without knowing what emission limits would be adopted for protection of the GNSS. Continued uncertainty in this regard, they assert, threatens to delay system development and discourage investment. Aeronautical Radio, Inc. ("ARINC"), RTCA, Inc., the U.S. GPS Industry Council, Orbital

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32 *Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band* (Notice of Proposed Rulemaking), 15 FCC Rcd 16127 (2000).

33 *Notice, supra*, at ¶¶ 52 and 61.

34 *Id.* at Appendix A.

35 "Joint Comments of L/Q Licensee, Inc., Globalstar, L.P. and Airtouch Satellite Services U.S., Inc." filed June 21, 1999 ("Globalstar Comments"), at 14.

Communications Corporation, Motorola, Inc., Constellation Communications, Inc., and Iridium LLC also support the proposed -70 dBW/MHz limit.[36]

17. On the other hand, Norcom Networks Corporation (a GSO-MSS reseller) contends that there is no evidence in the record to support adoption of the proposed -70 dBW/MHz limit.[37] Norcom asserts that, to the contrary, the MSS members of RTCA Special Committee 159 determined through probability analysis that a wideband limit of -54 dBW/MHz would protect GNSS receivers in all phases of flight.[38]

18. There is ample support for NTIA's recommendation, however, in the analysis by the aviation members of SC-159.[39] While it is true, as Norcom emphasizes, that the Committee's MSS representatives advocated a more lenient wideband limit, they based the recommendation on an assumption that 1.6 GHz METs could not feasibly be manufactured to meet a wideband limit stricter than -54 dBW/MHz in the GLONASS operating band. Yet Big LEO METs have since been deployed that meet the recommended -70 dBW/MHz limit at that band.[40] Furthermore, all of the commenting Big LEO licensees advocate adoption of the proposed -70 dBW/MHz limit on emissions in the 1559-1605 MHz band from METs placed in service after January 1, 2002. Although some GSO MSS licensees advocate grandfather exemptions for METs previously placed in service (a subject addressed later in this order), no one maintains that it is infeasible for newly-manufactured METs to meet a -70 dBW/MHz limit in the 1559-1605 MHz band.

19. In any event, the MSS members of SC-159 did not demonstrate that the findings of the Committee's aviation members were erroneous. The divergence between the two groups' conclusions about the level of protection needed was due primarily to disagreement over probability estimates and

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36 "Comments of Aeronautical Radio, Inc." filed June 21, 1999 ("ARINC Comments"), at 1-2 and 7; "Comments of RTCA" filed June 18, 1999, at 2; "Comments of the U.S. GPS Industry Council" ("USGPS Comments") filed June 21, 1999, at 2-3, 7, and 23; "Comments of Orbital Communications Corporation" filed May 3, 1999, at 10; "Comments of Motorola, Inc." filed June 21, 1999 ("Motorola Comments"), at 11; "Comments" filed by Constellation Communications, Inc. on June 21, 1999 ("Constellation Comments"), at 16 and Appendix A at 4; "Comments of Iridium LLC" filed June 21, 1999, at 12; "Comments of Iridium North America" filed June 21, 1999, at 2. Concerning emission limits, Iridium LLC and Iridium North America say that they agree with all of Motorola's comments on the subject. Further references to Motorola's comments herein should be understood to refer to these concurring comments as well.

37 "Comments of Norcom Networks Corporation" filed June 21, 1999, at 5-7.

38 *Id.* at 6.

39 *RTCA/DO-235*, Appendix F.

40 The Iridium MET licensee represented when applying for a blanket MET authorization that the Iridium METs would meet a wideband limit of –70 dBW/MHz and a narrowband limit of –80 dBW across the 1559-1610 MHz band-segment. *See U.S. Leo Services, Inc.* (Order and Authorization), 11 FCC Rcd 20474 (Int'l Bur. 1996). The Globalstar MET licensee likewise represented that Globalstar METs would meet the pertinent interim and final limits proposed in the *Notice* in this proceeding. *See AirTouch Satellite Services US, Inc.*(Order and Authorization), 14 FCC Rcd 17328 (Int'l Bur. 1999). We presume that the Iridium and Globalstar METs since placed into service have performed consistently with those representations.

judgments about acceptable risk, which are not susceptible to resolution with mathematical certainty.[41] As a member of the aviation contingent of SC-159, the FAA, which supervises U.S. implementation of the GNSS and is responsible for ensuring and promoting aviation safety in the United States, agreed that a -70 dBW/MHz limit is needed for protection of GNSS operations in frequencies up to 1605 MHz. Norcom has not demonstrated that this FAA/NTIA recommendation – which is consistent with ITU recommendations, European requirements, and the Commission's current requirement for suppression of Big LEO MET emissions in the GPS band[42] – is founded on erroneous premises.

20. *Potential Improvement of GNSS Receivers.* The extent to which MET emissions must be suppressed to protect GNSS approach guidance depends on the extent to which GNSS systems are vulnerable to interference. We invited comment as to whether the interference susceptibility of GNSS aircraft receivers could be improved significantly over the parameters assumed by the aviation members of SC-159 without substantially increasing the receivers' cost or impairing their performance.[43] In response, the Globalstar companies assert that a recent study by the Applied Physics Laboratory at Johns Hopkins University[44] indicates that GPS receiver susceptibility could be substantially improved at low cost through various novel techniques. The study does not include an analysis regarding potential interference from METs, however, and does not consider costs of retrofitting existing equipment or expenses attributable to nonrecurring engineering services and component integration. The authors of the study note, moreover, that most of the low-cost suppression techniques they discuss are in early stages of development and that those proven in actual use are either ineffective against broadband interference or ineffective against interference from multiple sources.[45] The authors accordingly concluded that no single suppression technique would achieve fully-satisfactory results with current technology.[46] In sum, we cannot conclude from the Johns Hopkins study or any information in the record before us that GNSS interference tolerance can be improved at a supportable cost to an extent that would warrant relaxation of the wideband limit to a level higher than –70 dBW/MHz.

2. Narrowband Limit

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41 Although it disputed assumptions, the MSS contingent conceded that the aviation contingent's *calculations* were correct. *RTCA/DO-235* at E-10. On the other hand, the aviation contingent identified several relevant factors that the MSS analysis did not take into account: wind shear and aircraft control deviation, *id.* at F.3.2; the possibility of aircraft position below the glidepath, *id.* at F-27; reduced separation from radio-frequency interference (RFI) sources in Category II and III precision approach situations, *id.* at F.4.3; uncertainty as to receiver antenna gain in the downward direction, *id.*; noise-floor increase due to presence of multiple RFI sources, *id.* at F.4.4; and lack of opportunity for corrective action during Category III approach, *id.* at F.3.1.

42 *See* ¶6, *supra.*

43 *Notice* at ¶76.

44 *GPS Risk Assessment Study, Final Report*, VS-99-007 (January 1999). The Applied Physics Laboratory conducted the study at the joint request of the FAA and the Air Transport and Aircraft Owners and Pilots Associations. The study is published on the internet at http://airlinepilots.com/Safety/Safety009.htm.

45 *Id.* at Table 5-2.

46 *Id.* at Tables 5-11 and 5-12.

21. In accordance with the NTIA's recommendations, we also proposed limits on narrowband emissions. For 1.6 GHz METs placed in service after January 1, 2002, we proposed to adopt a requirement to suppress the e.i.r.p. of discrete emissions of less than 700 hertz bandwidth to -80 dBW in frequencies between 1559 MHz and 1605 MHz. Two commenters argue against this proposal. Motorola stresses that neither the ITU's recommended limits on MET emissions in that frequency band nor the pertinent European requirements include a narrowband restriction. Motorola maintains that adopting U.S.-only narrowband limits could create barriers to international roaming and complicate equipment approval overseas.[47] Hughes Network Systems likewise asserts that we should avoid adopting national criteria at variance from predominant international standards and therefore recommends that we refrain from adopting narrowband limits pending further study.[48] The Globalstar licensees do not object to the proposed narrowband limit for METs type-accepted for sale or lease in the United States but advise against prohibiting domestic use of "roaming" foreign-licensed METs that have not been certified to meet the narrowband requirement. They point out that applying such a requirement to foreign-licensed METs could affect use of foreign-certified METs bearing the GMPCS-MoU ITU Registry mark, since METs certified elsewhere might receive the mark without demonstrating compliance with a narrowband limit. To preclude domestic use of ITU-marked METs for noncompliance with an "idiosyncratic" U.S. narrowband restriction, according to the Globalstar licensees, would defeat the purposes of the GMPCS MoU by making it necessary for international travelers to buy duplicative equipment.[49]

22. The NTIA replies that the proposed narrowband limit is necessary to protect aeronautical radionavigation. GPS-SPS, WAAS, and GLONASS are known to be particularly susceptible to disruption from continuous-wave or very narrowband interfering signals, according to the NTIA, primarily because of the relatively short period of theC/A code signals. The NTIA maintains that METs produce narrowband out-of-band emissions with continuous-wave characteristics that can mix with "strong lines" in a GPS, WAAS, or GLONASS code sequence and leak through receiver correlators directly into the tracking loops and consequently that the power of interfering narrowband emissions from a MET must be kept 10 dB lower than wideband emissions to protect GPS/WAAS and GLONASS reception.[50] The NTIA points out that the ITU was currently (*i.e.*, at the time when the NTIA filed its comments) considering a draft recommendation acknowledging that aeronautical GNSS radionavigation requires 10 dB greater protection from narrowband emissions by the ITU. The ITU has since adopted the recommendation.[51]

23. The NTIA's advice that increased suppression of narrowband emissions is needed

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47 Motorola Comments, *supra*, at 17.

48 Comments of Hughes Network Systems filed June 21, 1999, at 2.

49 Globalstar Comments, *supra*, at 25-26.

50 "Reply Comments of the National Telecommunications and Information Administration" filed July 21, 1999 ("NTIA Reply Comments"), at 3-4. A correlator is a component of a spread spectum system that compares received signals for agreement with a local reference.

51 *See* ITU-R REC M.1477, *Technical and Performance Characteristics of Current and Planned Radionavigation-Satellite Services (space-to-earth) and Aeronautical Radionavigation Service Receivers to Be Considered in Interference Studies in the Band 1559-1610 MHz*, Annex 5 Section 4 (2000) ("It is noted that GNSS receivers require an additional protection of 10 dB when the interfering signal is 700 Hz or less in bandwidth.")

consistent with analysis endorsed by *all* members of RTCA SC-159, including the MSS representatives.[52] No commenter has attempted to demonstrate with technical analysis that a narrowband limit is unnecessary.[53] The NTIA's advice is consistent, moreover, with a recent ITU recommendation[54] and with the Commission's current rule for protection of GPS from MET emissions, which specifies a -80 dBW narrowband limit.[55] We are therefore adopting a -80 dBW narrowband limit for new 1.6 GHz METs. Whether there should be an exception for foreign-certified METs bearing the GMPCS-MoU Registry mark will be addressed in a further order in this proceeding concerning implementation of the GMPCS MoU.[56]

24. *Specification issue.* The NTIA originally recommended that we adopt narrowband limits on spectral power density. We observed in the *Notice* that the RTCA SC-159 report discussed limits on narrowband power, rather than narrowband power density, and that the current rule restricting narrowband emissions in the core GPS band likewise sets an absolute limit on power. We therefore proposed to continue to specify narrowband limits in terms of power.[57] In their comments, the NTIA, Motorola, and Rockwell Collins agree that the narrowband limits should pertain simply to power level,[58] and no other commenter advocates use of a narrowband power-density specification instead. Accordingly, as proposed, we are adopting limits on the power, rather than the power density, of narrowband emissions.

B. Interim Requirements for 1.6 GHz METs

1. Proposed Interim Requirements

25. In accordance with NTIA recommendations, the Commission proposed in the *Notice* to temporarily excuse 1.6 GHz METs placed in service before January 1, 2002 from meeting the -70 dBW/MHz and -80 dBW wideband/narrowband ("-70/-80") limits in upper segments of the ARNS band. While METs placed in service on or after that date would be immediately subject to those limits throughout the 1559-1605 MHz band, 1.6 GHz METs placed in service before then would be initially subject to the -70 dbW/MHz limit from 1559 MHz only up to 1580.42 MHz and to the -80 dBW narrowband limit from 1559 MHz only up to 1585.42 MHz. The Commission further proposed that

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52 *RTCA/DO-235*, Appendix C.

53 The commenters' silence in this regard is especially telling in light of the fact that the *Notice* expressly rejected essentially the same argument for lack of technical support and invited the party that had raised it to cure the omission in subsequent comments. *Notice* at ¶82.

54 *See* n.51, *supra.*

55 47 C.F.R. § 25.213(f).

56 *See* ¶2, *supra.*

57 *Notice* at ¶78.

58 "Comments of the National Telecommunications and Information Administration" filed June 21, 1999 ("NTIA Comments"), at 14; Motorola Comments at 14; "Comments of Rockwell Collins, Inc." filed June 21, 1999 ("Rockwell Comments"), at 6.

during an interim period extending until January 1, 2005 such "grandfathered" Big LEO METs would be subject to less restrictive limits of -64 dBW/MHz on wideband emissions and -74 dBW on narrowband emissions in the adjacent frequencies up to 1605 MHz. Pre-2002 METs with assigned frequencies between 1626.5 and 1660.5 MHz, on the other hand, would be free of new limits on wideband emissions above 1580.42 MHz and narrowband emissions above 1585.42 MHz during the interim period. The partial grandfathering would cease on January 1, 2005, after which date any grandfathered 1.6 GHz METs still in use would be required to meet the "-70/-80" suppression requirements in all frequencies from 1559 MHz to 1605 MHz.

2. Objections to Temporary Grandfathering

26. The NTIA, ARINC, and the Globalstar licensees maintain that the proposed time-phasing of restrictions on emissions in the upper portion of the ARNS band for METs placed in service before 2002 strikes a satisfactory balance between the interests of MSS operators and users and the need for protection for aeronautical radionavigation.[59] Several commenters advise against any such temporary grandfathering, however. Motorola asserts that allowing pre-2002 METs to produce temporarily higher emission levels in upper segments of the 1559-1605 MHz band will make it more likely that substandard METs will remain in use after January 1, 2005.[60] Rockwell Collins, Inc. maintains that U.S. protection for GLONASS or another European satellite navigation system operating in the upper portion of the ARNS band is crucial to the viability of an international GNSS and that delayed application of the "-70/-80" limits to emissions in that segment could therefore thwart global implementation of GNSS precision-approach guidance.[61]

27. We remain convinced that it will serve the public interest to forbear temporarily from requiring 1.6 GHz METs already in service to meet the "-70/-80" suppression standard in the upper portion of the ARNS band, which will prolong the service life of previously-manufactured equipment, conserving the value of prior investment by users, manufacturers, and equipment sellers.[62] Rockwell Collins' contention that "-70/-80" limits covering emissions in the upper ARNS band should be immediately imposed on all 1.6 GHz and 2 GHz METs, regardless when placed in service, is directly contrary to the NTIA's recommendation. The NTIA has consistently advocated adopting a rule that would allow METs previously brought into service to continue in operation until January 1, 2005 before becoming subject to the "-70/-80" limits with respect to emissions in the upper part of the ARNS band.[63]

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59 NTIA Comments at iv and 25; ARINC Comments at 2-3; Globalstar Comments at 14-17.

60 Motorola Comments at 11-12;

61 Rockwell Comments at 3. Rockwell Collins asserted in this regard that foreign efforts to maintain the GLONASS system and develop new satellite radiodetermination systems have been motivated by reluctance to rely solely on the U.S.-controlled GPS system for GNSS satellite infrastructure. *Id.*

62 According to uncontradicted statements in comments from Motient, Norcom, and Comsat, many terminals with authorized uplink frequencies between 1626.5 MHz and 1660.5 MHz that were not designed to meet "-70/-80" limits in the upper ARNS band are currently in use in the United States for MSS provided via geostationary satellites licensed to Inmarsat and Motient. *See* ¶¶ 33 and 42, *infra.*

63 *See, e.g.*, NTIA Comments at iv ("Geostationary MSS terminals that are currently in service ... should be permitted to operate at their current out-of-band emission levels until January 1, 2005").

The NTIA has participated in this proceeding on behalf of the Executive Branch of the Federal government, particularly the FAA, which plans and supervises development and operation of aeronautical radionavigation systems in the United States. The NTIA asked us to institute this proceeding and devised its proposal in close consultation with the FAA. Indeed, the NTIA reported that the FAA had approved its proposal for temporary grandfathering.[64] Because no one has presented convincing evidence that grandfathering of previously-operational METs until January 1, 2005 would compromise public safety, we defer to the FAA's expert judgment in this regard (as conveyed by the NTIA). Therefore, as proposed, we are adopting time-phased requirements for suppression in the upper ARNS frequencies.

3. Cut-off Frequency for Immediate "-70/-80" Protection

28. The NTIA points out that the Executive Branch has amended the Performance Standard for GPS-SPS, which previously equated SPS bandwidth with the null-to-null bandwidth of the C/A-code ranging signal, *i.e.*, 1574.397-1576.443 MHz, to redefine SPS as extending from 1563.42 MHz to 1587.42 MHz.[65] According to the NTIA, the change was made to acknowledge that receivers can process the wider bandwidth (which the NTIA describes as "the full transmitted bandwidth of the C/A code signal") to minimize tracking errors due to noise, interference, and multipath distortion. The NTIA asserts that many civilian GPS applications, including safety-of-life applications, will make use of the wider bandwidth. Therefore, the NTIA urges the Commission to require 1.6 GHz METs in current use to meet initial "-70/-80" limits in ARNS frequencies up to 1587.42 MHz, instead of merely requiring them to meet an initial -70 dBW/MHz limit in frequencies up to 1580.42 MHz and an initial -80 dBW narrowband limit in frequencies up to 1585.42 MHz, as proposed in the *Notice*.

29. In reply comments, the Globalstar licensees express skepticism about the utility of wide-bandwidth GPS receivers but raise no objection to the NTIA's recommendation to extend immediate "-70/-80" protection up to 1587.42 MHz.[66] No one else filed comments in opposition to the NTIA's recommendation in this regard.

30. As no one has objected to the Exective Branch's recommendation for upward adjustment of the cut-off, we incorporate the adjustment in the rules we adopt today. That is, we are requiring currently-operational METs to initially suppress wideband and narrowband emissions to "-70/-80" in frequencies from 1559 MHz up to 1587.42 MHz.

4. Deadline for Conformance to the Final Standard

31. In light of preliminary criticism of the proposal to establish a January 1, 2005 deadline for

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64 *See* Letter from Richard D. Parlow, Associate Administrator, Spectrum Management, to Regina M. Keeney, Chief, International Bureau, published in Public Notice Report No. 2227 (Sept. 23, 1997).

65 NTIA Comments at 7. *See Global Positioning System Standard Positioning Service Performance Standard* (October 2001), published on the internet at http://www.navcen.uscg.gov/.

66 "Joint Reply Comments of L/Q Licensee, Inc., Globalstar, L.P. and Airtouch Satellite Services U.S., Inc." filed July 21, 1999 ("Globalstar Reply"), at 16.

grandfathered METs to meet "-70/-80" limits in frequencies up to 1605 MHz, the Commission invited comment on the advisability of waiving or postponing the deadline with respect to suppression of emissions in the 1597-1605 MHz segment reserved for GLONASS operation in the event of unanticipated delay in domestic implementation of GLONASS.[67] A number of interested parties address this issue.

32. The Globalstar licensees and ARINC advise against adopting any such contingent policy for waiving or postponing the deadline. Stressing that other administrations have already prescribed the -70 dBW/MHz limit for immediate application to MET emissions in frequencies up to 1605 MHz, the Globalstar licensees argue that certainty, finality, and consistency are more important to MSS equipment manufacturers and service providers than an open-ended prospect of future relief.[68] ARINC argues that licensees should meet the proposed deadline regardless of the progress of domestic regulatory authorization for GLONASS because our government has a treaty obligation to permit foreign aircraft relying on GLONASS to operate in U.S. airspace.[69] ARINC contends that we should protect GLONASS for such foreign aircraft so that foreign governments will reciprocate by providing protection for GPS reception by U.S. aircraft.

33. On the other hand, Motient Corporation argues for setting the deadline at January 1, 2010, at the earliest. Motient asserts that Congress has yet to appropriate money for domestic implementation of GLONASS and that it would take more than a decade after it does so to integrate GLONASS into domestic aeronautical radionavigation systems.[70] In the alternative, Motient contends that if the Commission were to insist on specifying a January 2005 deadline, it should postpone the deadline or grant waivers should it later become clear that GLONASS will not be used for approach guidance in the United States by then. Motient estimates that it would incur an equipment-replacement expense of $60-80 million if forced to meet a January 1, 2005 full-compliance deadline for METs placed in service prior to 2002. Norcom Networks Corp., a reseller providing value-added MSS via Motient's satellite facilities, similarly alleges that it would cost several million dollars to retrofit its existing METs to meet the proposed "-70/-80" limits in the GLONASS operating band.[71] Norcom recommends that the Commission refrain from setting a deadline for pre-2002 METs to meet new limits on emissions in the GLONASS operating band until the FAA grants final approval for domestic use of GLONASS by commercial aircraft.

34. Other commenters, including the NTIA, support the proposal to establish a January 2005 full-compliance deadline for grandfathered METs but advocate retaining flexibility for subsequent

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67 *Notice* at ¶73.

68 Globalstar Comments at 24.

69 ARINCComments at 5. ARINC cited Chapter 2 of the Convention on International Civil Aviation (Chicago, 1944).

70 "Comments of AMSC Subsidiary Corporation" filed June 21, 1999 ("Motient Comments"), at 14-15. (Motient, a GSO MSS licensee, is identified by its former name, AMSC, in comments filed previously in this proceeding.)

71 Norcom Comments at 5.

waiver or postponement. The NTIA maintains that it would be unwise to waive or postpone requirements for new METs but recommends that the Commission assess the prospects for domestic GLONASS implementation later in the pre-2005 interim and consider adjustment of the full-compliance deadline for grandfathered METs in light of its findings.[72] Constellation Communications, Inc., Inmarsat Ltd., and TMI Communications likewise contend that the Commission should be willing to postpone the deadline if such relief seems warranted in light of intervening developments.[73]

35. We are specifying a January 1, 2005 full-compliance deadline for grandfathered METs, as previously proposed. The commenters who argue for a later deadline or against specifying any such deadline at present have not demonstrated that requiring full compliance by 2005 will be unduly onerous. They assert that it would be expensive for them to meet such a requirement but have provided no corroboration for their cost estimates. Nor have they rebutted the reasonable contention that further delay in domestic implementation of ITU recommendations for suppression in the GLONASS band would strain international comity. Anyone who might be adversely affected may, of course, request waiver or postponement of the deadline in light of subsequent developments, and any such request will be duly considered.

5. Applicability of Interim Limits on Emissions in Upper ARNS Frequencies

36. The Commission proposed to require grandfathered Big LEO METs to meet a -64 dBW/MHz limit and a -74 dBW narrowband limit ("-64/-74" limits) in the upper part of the 1559-1610 MHz band in the interim prior to the January 2005 deadline for full compliance with the "-70/-80" standard. We are adopting these interim requirements because the NTIA maintains that they are necessary for protection of aeronautical radionavigation and because no Big LEO licensee has objected that they are too strict. Big LEO METs eligible for temporary grandfathering must meet these interim limits if operated after the effective date of the rules we are adopt here.

37. There is some difference of opinion as to whether we should also impose these upper-band interim restrictions on currently-operational METs with assigned uplink frequencies between 1626.5 MHz and 1660.5 MHz. The NTIA recommends more lenient interim treatment for such METs.[74] It stresses that although no Big LEO METs were yet in operation when it filed its rulemaking petition proposing "-70/-80" limits, the Inmarsat and Motient GSO MSS systems, with assigned MET uplink frequencies between 1626.5 MHz and 1660.5 MHz, were already fully operational at that time. Further, the NTIA acknowledges that many METs used to obtain service via the Inmarsat and Motient satellite systems were not designed to suppress emissions in the upper ARNS band to the extent since proposed for the interim standard for Big LEO METs. In recognition of this difference of circumstance, the NTIA recommends that 1626.5-1660.5 MHz METs brought into service before 2002 be permitted to continue operation with current emission levels in ARNS frequencies above 1587.42 MHz until January 1, 2005.

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[72] NTIA Comments at 24.

[73] "Comments" of Constellation Communications, Inc. filed June 21, 1999, at 12; "Comments of Inmarsat Ltd." filed June 21, 1999, at 10 ("Inmarsat Comments"); "Reply Comments of TMI Communications and Company, L.P." filed July 21, 1999, at 6.

[74] NTIA Comments at 25.

The NTIA maintains that this differentiated approach would protect equipment investments and afford adequate time for redesigning Motient and Inmarsat METs to meet the final limits.

38. ARINC, Motorola, and Iridium LLC contend, on the other hand, that the interim limits should apply to currently-operational 1626.5-1660.5 MHz METs, as well as to Big LEO METs. ARINC argues that requiring the former to meet interim "-64/-74" limits in the upper part of the 1559-1610 MHz ARNS band would not be unduly onerous, since their assigned uplink frequencies are not immediately adjacent to the 1559-1610 MHz ARNS band.[75] Motorola and Iridium LLC argue that any interim standard for pre-2002 teminals should cover Motient and Inmarsat METs because they comprise a subtantial portion of the METs now in service in the United States.[76]

39. Because the NTIA advises against imposing interim limits on emissions in the upper ARNS band from temporarily-grandfathered 1626.5-1660.5 MHz METs, we conclude that it is unnecessary to do so in order to protect aeronautical radionavigation. Therefore, in the interest of minimizing the cost of compliance we are imposing no new restrictions on such METs with respect to emissions in ARNS frequencies above 1587.42 MHz duirng the interim prior to January 1, 2005.

6. Preapproval of Modifications for Grandfathered METs

40. In its petition for rulemaking, the NTIA recommended that the Commission require licensees to apply for advance approval of any plan to rely on network software to bring termporarily-grandfathered 1.6 GHz METs into conformance with the final limits by blocking transmission on channels in the lower part of their uplink bands. The Commission observed in the *Notice*, however, that the NTIA had offered no reason for exercising such preliminary regulatory supervision over technical design. The Commission proposed, instead, to rely on certification based on performance measurement to ensure that any temporarily-grandfathered METs kept in service after January 1, 2005 would operate in conformance with the final emission limits.[77] In subsequent comments, the NTIA concedes that requiring prior approval of software configurations for channel-blocking could be unduly intrusive.[78] The other commenters addressing this issue also agree that there is no need for such a procedure.[79] We remain unconvinced that there is any need for pre-approval of software configurations for channel-blocking. Rather, as proposed in the *Notice*, we intend to rely on the equipment type-certification process to ensure compliance with the final standards.

7. Limiting Date for Grandfathering Eligibility

41. As we have noted, the Commission proposed in the *Notice* to temporarily establish lesser

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75 ARINC Comments at 4.

76 "Reply of Motorola, Inc." filed July 21, 1999, at 9-10; "Reply Comments" of Iridium LLC filed August 9, 1999 ("Iridium Reply"), at 10.

77 *Notice* at ¶97.

78 NTIA Comments at 16.

79 Globalstar Comments at p.26.

interim requirements for METs placed in service before January 1, 2002 while immediately imposing the full, final "-70/-80" limits on METs placed in service on or after that date. The January 1, 2002 date is now past, however. In order to avoid causing any hardship that might result from immediately applying the final emission requirements to METs already in service, we are extending eligibility for interim grandfathering to cover all METs placed in service prior to the effective date of the rule changes we are adopting here. Thus, all METs brought into service before July 21, 2002 will be subject to the pertinent interim requirements until January 1, 2005.

C. Inmarsat METs

42. Inmarsat, Comsat, Sea-Land Service, Inc., and the Chamber of Shipping of America argue for extended grandfathering or permanent exemption of Inmarsat METs currently in service.[80] Although it asserts that the "vast majority" of the METs currently used with its system operate within the proposed final limits,[81] Inmarsat contends that the difficulty of retrofitting noncompliant Inmarsat METs to meet those limits by January 1, 2005 would be "insurmountable." Further, it argues that the proposed "-70/-80" limits are overly strict for application to Inmarsat METs because they were devised on the basis of calculations assuming use of omnidirectional transmitters, whereas Inmarsat METs are directional and therefore have significantly reduced emission at high elevation angles. In an attached analysis Inmarsat purports to show, among other things, that no current Inmarsat terminal would produce interference above the permissible level with aircraft reception of GNSS signals unless operated in the immediate vicinity of a runway.[82] For similar reasons, Comsat, which provides MSS via Inmarsat satellites, argues for permanent exemption of Inmarsat "Standard A" METs.[83]

43. The NTIA, Motorola, and Rockwell Collins, Inc. advise against adopting a permanent grandfather exemption for Inmarsat METs.[84] The NTIA contends that Inmarsat's interference analysis fails to consider the possibility of a GNSS-equipped aircraft passing through the mainbeam or close-in sidelobe of an Inmarsat Standard A terminal. Rockwell Collins contends that noncompliant Inmarsat ship METs could pose a serious risk for aircraft using GNSS approach guidance because many major U.S. airports are adjacent to navigable waterways.

44. We are not persuaded that existing Inmarsat METs can be permanently exempted without

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80 Inmarsat Comments at 7-10 and Annex 1; "Comments of Comsat Corporation" filed June 21, 1999 ("Comsat Comments"), at 16-18; "Comments of Sea-Land Service, Inc." filed July 21, 1999; "Reply Comments of the Chamber of Shipping of America" filed Aug. 2, 1999.

81 Inmarsat Comments at i.

82 Inmarsat Comments at Annex 1. Inmarsat refers to the analysis in *RTCA/DO-235*, Appendix F, on which the NTIA has predicated its recommendation for "-70/-80" limits on radiated power. The Appendix F analysis posits that the received strength of an interfering signal, *i.e.*, its strength at the input of an aircraft's GNSS receiver, should not exceed -146.1 dBW.

83 Standard A terminals are first-generation Inmarsat METs that use analog modulation. There are several other types of Inmarsat METs in current use, all of which are of more recent design and use digital modulation.

84 NTIA Reply Comments at 6-7 and Annex A; Motorola Reply Comments at 9; Rockwell Comments at 3-4.

consequent risk to aviation. The Commission has previously considered an argument for such an exemption and found it insufficient,[85] and Comsat and Inmarsat have not materially improved upon the argument in subsequent comments. Inmarsat's own analysis shows that some Inmarsat METs in current use could cause unacceptable levels of interference in GNSS receivers of aircraft in critical approach flight.[86] That they could cause such interference only if situated close to a runway – which is also true of the other types of METs covered by the regulations we are adopting here – does not obviate concern, since Inmarsat has not denied that either land-based or ship-based Inmarsat METs could operate close enough to landing aircraft to disturb GNSS approach guidance.

45. Comsat, Inmarsat, and the Chamber of Shipping suggest that instead of imposing new emissions limits on Inmarsat METs previously placed in service, we could decree "exclusion zones" around airports to prohibit operation of such METs in areas where that might present a threat to aviation safety. The NTIA and Motorola object that the advocates of the exclusion-zone approach failed to explain how compliance with such a requirement could be ensured. The objection is well-taken. Although the Commission has adopted exclusion zones for protection of radioastronomy sites in its rules for Big LEO MSS systems, those systems are inherently capable of determining the location of users' METs by technical means.[87] It has not been shown in this proceeding, however, that there is any feasible way for service providers to prevent Inmarsat METs of current design from transmitting in the immediate vicinity of airports.

46. We therefore conclude that the commenters have not shown justification for permanently exempting existing Inmarsat METs of any type from the requirement to suppress emissions in the upper ARNS band to "-70/-80" levels. Inmarsat and its U.S. reseller, Comsat, have been on notice at all relevant times, moreover, that ITU and FCC regulations require licensees to avoid harmfully interfering with reception of services in adjacent bands[88] and require special measures to be taken for protection of safety-related radionavigation.[89] In distributing or authorizing manufacture of METs producing potentially harmful out-of-band emissions in the 1559-1610 MHz ARNS band prior to final adoption of emission standards for protection of GNSS aeronautical radionavigation, they have accepted a risk of regulatory consequences.

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85 *Notice* at ¶¶ 86 and 89.

86 Inmarsat has not provided test-based performance data for Standard A terminals but acknowledges that some Standard B Inmarsat METs tested in 1999 produced emissions in frequencies just below 1605 MHz with an e.i.r.p. density level 3 dB higher than –70 dBW/MHz. Inmarsat Comments at 7. Inmarsat's calculated data indicate that an Inmarsat MET producing emissions at that higher level, *i.e.*, -67 dBW/MHz, could interfere with aircraft GNSS reception. *Id.*, Annex 1.

87 The determination capability is required by rule. In the interest of ensuring protection for radioastronomy, 47 C.F.R. § 25.213 decrees, in Paragraph (a), that "[a]ll [Big LEO] systems shall be capable of determining the position of the user transceiver ... through either internal radiodetermination calculations or external sources such as LORAN-C or the Global Positioning System."

88 *See* ITU Radio Regulation S4.5 and 47 C.F.R. §2.102(f).

89 *See* ITU RR § 4.10. More specifically, Inmarsat and Comsat were notified in 1994 that MET authorizations would be subject to emissions limits to be adopted for protection of GLONASS and a condition to that effect is included in the blanket licenses for Inmarsat METs. *See Notice* at ¶49 and ¶7, *supra.*

47. We understand, however, that many cargo and passenger ships docking in U.S. seaports, including foreign-flagged vessels,[90] carry Inmarsat Standard A terminals to comply with the Global Maritime Distress and Safety System ("GMDSS") requirements of the Safety of Life at Sea ("SOLAS") Convention. To avoid potential disruption of maritime safety services, we will not specify a final compliance deadline for these terminals until shipowners have been apprised of the new emission limits and have had an opportunity to replace or modify the terminals, as necessary. We invite comment on the appropriate compliance deadline for such Inmarsat A maritime terminals in the Further Notice in this proceeding.[91] In the meanwhile, the Commission will work with the NTIA, the Coast Guard, the ITU, the International Maritime Organization, and other international organizations to expedite replacement of GMDSS METs not meeting the final "-70/-80" limits.

D. Measurement Issues

1. Measurement Interval

48. The Commission proposed in the *Notice* to define the new emissions limits as averaged over an interval of 20 milliseconds.[92] The proposal to specify a 20 millisecond measurement interval was consistent with the NTIA's prior recommendations and with the Commission's existing restriction on wideband emissions from Big LEO METs in the GPS C/A-code band. In comments on the *Notice*, however, the NTIA recommends that the Commission specify a shorter measurement interval for METs using TDMA modulation.[93] The NTIA explains that it had previously recommended uniform use of a 20 millisecond interval because the symbol duration of GPS and GLONASS data is 20 milliseconds, but that, because the symbol duration of WAAS data is much shorter, WAAS is vulnerable to disruption by pulsed signals that endure for as little as 2 milliseconds. The NTIA asserts, moreover, that out-of-band emissions levels from METs using TDMA are a function of the duration of transmission time slots. Therefore, the NTIA recommends that, in order to protect WAAS reception, out-of-band emissions from TDMA METs should be measured over a time interval equal to the duration of the TDMA system's transmission time slots. The recommendation applies only to future TDMA systems, though. For existing MSS systems employing TDMA (and for CDMA and FDMA systems) the NTIA suggests, as before, that a 20 millisecond interval be used.[94]

49. Rockwell Collins recommends that the Commission specify a 2 millisecond measurement

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90 According to the U.S. Coast Guard, 7,657 foreign-flagged vessels entered U.S. ports in the year 2000 and only one percent of ships subject to the SOLAS Convention are U.S.-flagged.

91 *See* ¶87, *infra*.

92 *Notice* at Appendix A ¶5.

93 NTIA Comments at 16-18.

94 FDMA, *i.e.*, frequency division multiple access, is a technique for avoiding mutual interference by dividing available bandwidth among a set of transmitters so that each has an assigned transmission subchannel not shared with any other. See nn. 26 and 27, *supra*, for definitions of CDMA and TDMA.

interval for *all* METs subject to the new limits in order to protect WAAS.[95] Rockwell Collins has not shown that there is any need to require non-TDMA METs to meet limits predicated on a 2 millisecond measurement interval, however, and does not dispute the NTIA's advice to the contrary. We therefore reject the recommendation for an across-the-board 2 millisecond measurement specification applying to TDMA and non-TDMA METs alike.

50. The NTIA's proposal of a shorter measurement interval for TDMA METs is problematic because, as Motorola acknowledges, the proposal is at odds with a current ITU recommendation.[96] The proposal involves a novel regulatory distinction not discussed in *RTCA/DO-235*, moreover, and is somewhat vague, as the NTIA has not explained precisely what it means by "future TDMA systems." Nor has it explained why the proposed specification should not apply to METs used with any existing system. We therefore decline to adopt the recommendation at this time. Rather, we specify 20 millisecond measurement intervals for all covered METs in the rules we adopt today, inviting further comment, in the Further Notice, *infra*, on the recommendation for shorter measurement intervals for TDMA METs.

2. Measurement Bandwidth

51. Motorola asked us to rule that measurement bandwidths of less than 1 MHz may be used when testing compliance with limits on wideband emissions, pointing out that the ITU had expressly approved use of such a technique, provided that the measured power in the narrower bandwidth is integrated over 1 MHz.[97] The Commission invited comment on the recommendation in the *Notice*.[98] Motorola, the NTIA, and the Globalstar licensees support the recommendation in subsequent comments,[99] and no commenter has argued against it.

52. Motorola also requests a clarifying statement concerning measurement bandwidth for testing compliance with narrowband limits. In an earlier stage of this proceeding, Motorola objected that it would be difficult to test for compliance with the NTIA's proposed -80 dBW/700 Hz narrowband limit because measurement spectrum analyzers resolve at bandwidths of 300 hertz or 1 kHz rather than at 700 hertz. We replied in the *Notice* that because we were proposing to adopt a limit on the power, rather than the power density, of discrete narrowband emissions, compliance could be demonstrated with measurements across 1 kHz.[100] Motorola asserts in response that in the presence of noise, 1 kHz measurements would exaggerate the power of such emissions.[101] Motorola therefore asks us to rule that

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95 Rockwell Comments at 6.

96 The ITU specifies a 20 millisecond measurement interval in its recommendations for suppression of emissions from non-geostationary-system METs in the GPS-SPS band. ITU-R M.1343, Annex 1, Footnote 3 in Tables 1, 4, 7, and 12.

97 *See* ITU-R REC M.1343.

98 *Notice* at ¶80.

99 Motorola Comments at 14; NTIA Comments at 19; Globalstar Comments at 25.

100 *Id.* at ¶79.

101 Motorola Comments at 15.

compliance with the narrowband limits can be established by with measurements of less than 700 hertz as well as by using measurements of more than 700 hertz. (Motorola stresses, however, that it does not mean to suggest that the narrowband limit should be specified differently than the Notice proposed. *I.e.*, Motorola does not contend that the narrowband limit should be anything other than a limit of -80 dBW on the e.i.r.p. of discrete emissions of less than 700 Hz bandwidth.) Rockwell Collins likewise contends that 300 hertz measurements should be permitted for this purpose.[102] In reply comments, the NTIA agrees that 300 hertz measurements could be used to test for compliance with the narrowband limit and recommends that we sanction use of that technique.[103]

53. The comment in the *Notice* concerning use of 1 kHz measurements was not meant to imply that other measurement bandwidths could not be used. There is no basis in the record of this proceeding for precluding use of 300 Hz measurements for testing compliance with the narrowband limits. Applicants can use any measurement technique that suffices to demonstrate compliance.

3. Peak-Hold Versus Non-Peak-Hold Measurement

54. Motorola maintains that peak-detecting spectrum analyzers exaggerate the indicated power of wideband emissions from TDMA METs by the peak-to-root-mean-square factor of the measurement technique and exaggerate it further by failing to account for the transmitter's duty cycle.[104] Motorola therefore recommends that we allow use of non-peak detectors to test TDMA METs for compliance with the wideband limits. The Globalstar licensees support the recommendation and contend that use of non-peak detectors should also be allowed for measuring wideband emissions from CDMA and FDMA METs.[105] No one opposed these suggestions.

55. These recommendations are consistent with the Commission's rulemaking proposal. The *Notice* specified the proposed wideband emissions limits as restrictions on *average*, not peak, e.i.r.p. density within a 20 millisecond measurement interval.[106] The proposed limits were consistent in this respect with the Commission's existing rule concerning MET emissions in the GPS-SPS null-to-null band, Section 25.213(b), which has likewise specified a restriction on the average power density of wideband emissions. The proposed specification of averaged wideband limits was also consistent with the NTIA's prior recommendations. As no one has argued for adoption of limits on peak wideband emissions, we are adhering to our proposal to impose limits on average e.i.r.p. density. Compliance with those limits can, of course, be demonstrated (either for TDMA, CDMA, or FDMA METs) with instruments that measure average, rather than peak, power density.

E. 2 GHz METs: Limits on Emissions Between 1559 MHz and 1605 MHz

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102 Rockwell Comments at 6.

103 NTIA Reply Comments at 5.

104 Motorola Comments at 15.

105 Globalstar Comments at 25.

106 *Notice* at Appendix A.

56. When it established rules for "2 GHz" MSS systems with MET uplink assignments between 1990 MHz and 2025 MHz, the Commission said that it would address comments concerning limits on 2 GHz MET emissions for protection of ARNS in the context of this proceeding.[107] The Commission had stated previously that it saw no reason to adopt different requirements for 2 GHz METs than for 1.6 GHz METs in this regard.[108] It therefore proposed to require 2 GHz METs to suppress the e.i.r.p. density of emissions in the 1559-1605 MHz band to -70 dBW/MHz or less and suppress the e.i.r.p. of discrete emissions of less than 700 Hz bandwidth to -80 dBW or less in that band. As promised in the *2 GHz Report and Order*, we address the public comments on those proposals here.

57. Most of those who filed relevant comments in the *2 GHz* proceeding, including the NTIA, agreed that 2 GHz METs should be subject to the proposed "-70/-80" limits on emissions in the 1559-1605 MHz band.[109] Only one commenter, Celsat America, Inc., opposed adoption of the -70 dBW/MHz limit for 2 GHz METs. Celsat asserted, without supporting rationale, that imposing such a limit on 2 GHz METs would add unnecessarily to the cost of providing service.[110] That unsupported assertion is contradicted by the NTIA's advice that imposing the limit on 1.6 GHz and 2 GHz METs is necessary for protection of aeronautical radionavigation, which is consistent with ITU recommendations and backed by extensive analysis in *RTCA/DO-235*.

58. Globalstar and ICO approve of the proposal to impose a wideband limit of -70 dBW/MHz on 2 GHz MET emissions in the 1559-1605 MHz band but advise against adoption of a narrowband limit.[111] Neither of them offered any evidence or analysis, however, to refute the NTIA's empirically-based contention that -80 dBW narrowband suppression is needed for protection of GNSS aircraft approach guidance.[112] We therefore find these objections no more persuasive than the analogous objections against imposing a narrowband limit on 1.6 GHz METs, which we have already discussed.[113]

59. As proposed, we are adopting "-70/-80" limits on permissible wideband and narrowband emissions from 2 GHz METs in the 1559-1605 MHz band. As no operating authority for 2 GHz METs has yet been issued, there is no need to phase-in these requirements.

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107 *Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band* (Report and Order), 15 FCC Rcd 16,127 (2000) (*"2 GHz Report and Order"*), at ¶163.

108 *Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band (NRPM), 14 FCC Rcd 4843 (1999)*, at ¶116.

109 "Comments of the National Telecommunications and Information Administration" in Docket No. 99-81 ("NTIA 2GHz Comments") at iii; "Reply Comments of Inmarsat Ltd." in Docket 99-81 at 15; "Comments of the Boeing Company" in Docket 99-81 at 38; "Comments of Aeronautical Radio, Inc." in Docket 99-81 at 7; "Comments of Iridium LLC" in Docket 99-81 at 53.

110 "Reply Comments of Celsat America, Inc." in Docket No. 99-81 at 27.

111 "Comments of Globalstar, L.P." in Docket 99-81 at 49-50; "Comments of ICO Services Limited" in Docket 99-81 at 23.

112 *See* ¶23, *supra*, and *RTCA/DO-235*, Appendix C.

113 *See* ¶¶ 21-23, *supra*.