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BEFORE THE
Federal Communications Commission
WASHINGTON, DC 20554

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

JOINT REPLY COMMENTS OF L/Q LICENSEE, INC., GLOBALSTAR, L.P. AND AIRTOUCH SATELLITE SERVICES U.S., INC.

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L/Q Licensee, Inc., Globalstar, L.P. and AirTouch Satellite Services U.S., Inc. (collectively "Globalstar") hereby file these joint reply comments in the above-captioned proceeding.

I. SUMMARY

The comments filed in this proceeding confirm Globalstar's recommendation that the Commission must craft carefully its licensing and certification procedures to ensure that they facilitate the Commission's stated goals of global roaming of Global Mobile Personal Communications by Satellite[1] ("GMPCS") terminals and ubiquitous availability of mobile satellite

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[1] GMPCS is "any satellite system, (i.e., fixed or mobile, broadband or narrow-band, global or regional, geostationary or non-geostationary, existing or planned) providing telecommunication services directly to end users from a constellation of satellites." *See Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite ("GMPCS") Memorandum of Understanding and Arrangements; Petition of the National Telecommunications and Information Administration to Amend Part 25 of the Commission's Rules to Establish Emissions Limits for Mobile and Portable Earth Stations Operating in the 1610-1660.5 MHz Band*, IB Docket No. 99-67, RM No. 9165, *Notice of Proposed Rulemaking*, FCC 99-37, at n.1 (rel. March 5, 1999) ("*Notice*").

service ("MSS"). The comments support Globalstar's position that all GMPCS terminals sold or leased in the United States for personal use should be required to be certified under Commission equipment authorization procedures. In addition, the technical review of GMPCS terminals should occur in the certification process, not during licensing, and licensing should not be a prerequisite for obtaining terminal certification. The only requirement for temporary use is that terminals bear the International Telecommunications Union ("ITU") mark associated with the GMPCS Memorandum of Understanding. Terminals so marked be permitted to enter the U.S. without being categorized as either "for domestic use" or "for transit only."

The comments make clear that the Commission should adopt the phased out-of-band emission limits proposed by the National Telecommunications and Information Administration ("NTIA") for GMPCS terminals. The time-phased approach should be adopted because it: meshes with the scheduled implementation of Global Navigational Satellite Systems ("GNSS"); protects GNSS at the limits sought by aviation interests; and promotes the establishment of commercial MSS. More stringent standards would not serve the public interest in development of GMPCS systems and are not needed. Similarly, proposals that the Commission delay the implementation dates of the time-phased limitations are unnecessary and contrary to the public interest.

The principal critics of the Commission's proposed out-of-band emissions limits for the United States Global Positioning System ("GPS") present inaccurate and misleading analyses which do not detract from the carefully developed proposals advanced by the Commission. Both LSC, Inc. and the U.S. GPS Industry Council attempt to present reasons why the EIRP density levels should be more stringent for GMPCS and/or other services. Yet, their analyses fail

because they do not take into account the operational requirements for GPS for a specific application, as do the limits developed by the aviation and MSS communities in the RCTA Report. LSC, Inc. and the Council also erroneously attempt to apply the standard for "continuous availability" of a GPS signal from the satellite with an impossible standard for continuous availability of the GPS signal at a specific receiver. Furthermore, there is strong evidence in the record that the performances of GPS receivers can be improved. In fact, the Commission's out-of-band emissions proposals are more than sufficiently stringent to protect GPS receivers, and contrary arguments should be rejected.

Finally, the Commission should not mandate at this time emergency service obligations for GMPCS service providers. Unlike CMRS operators, MSS operators are deploying technically and operationally diverse systems, poorly suited to mandates for uniform emergency service requirements. Significant technical and operational challenges are faced by this nascent industry. AirTouch Satellite Services U.S., Inc. ("AirTouch") is committed to developing and providing emergency services with GMPCS terminals and has spent considerable effort and resources on developing such capabilities. To that end, AirTouch is actively investigating the possibility of developing basic emergency service capabilities by contracting with a third party to provide a call response center which would receive and route emergency calls to the appropriate public safety answering point ("PSAP"). Significant issues are presented, however. Enhanced 9-1-1 services present additional challenges and will require network and other changes. Again, there should be no Commission mandates at this time.

II. CERTIFICATION AND LICENSING PROCESSES SHOULD BE SIMPLE AND STREAMLINED

A. All GMPCS Terminals Sold in the United States Should Be Certified Under Commission Equipment Authorization Procedures

Several commenters argue that GMPCS terminals permanently installed on ships, boats or planes, and terminals used to provide basic telephone service to remote areas should all be exempt from GMPCS certification requirements.[2] Indeed, Constellation Communications, Inc. ("Constellation") argues that any new equipment certification procedures adopted in this proceeding should be applicable only to GMPCS terminals for which the ITU mark is being sought.[3] Parties also argue that to accommodate exempt GMPCS terminals the Commission should retain its existing blanket licensing procedures together with the proposed dual certification/licensing process.[4]

Globalstar, as well as Motorola Inc. and Comsat Corporation, opposes adopting exemptions to the GMPCS certification requirement.[5] Creating multiple exceptions from a general requirement applicable to GMPCS terminals sold or leased in the U.S. creates unnecessary regulatory complexity and burdens. Additional complexity will add uncertainty to the U.S. equipment certification process, thereby undermining the purpose of the GMPCS-MOU which seeks to facilitate worldwide roaming through a clear, streamlined certification process.

Equipment exempt from GMPCS certification would still be required to be reviewed for technical compliance under the Commission's existing blanket authorization process. In other

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2 *See* Boeing Comments at 4; Constellation Comments at 2-5; NTIA Comments at 27-28.

3 Constellation Comments at 3-4.

4 *See* Inmarsat Comments at 4; Constellation Comments at 6; LEO One USA Comments at 2.

5 Globalstar Comments at 6-9; Motorola Comments at 3-6; Comsat Comments at 3-4.

words, exempt terminals would be subject to the same scrutiny under the existing blanket licensing procedures as they would receive under the streamlined certification/licensing procedures proposed in Globalstar's comments. Thus, there is no regulatory benefit to be derived from exempting certain GMPCS terminals from certification. Under Globalstar's proposal, technical review for all GMPCS terminals would occur in the certification process, rather than licensing, and licensing would not be a prerequisite for obtaining terminal certification. Thus, by establishing exemptions to the certification requirement, the Commission would be required to undertake two separate processes serving the same purpose. Such a result makes no sense.

Globalstar, therefore, urges the Commission to require *all* GMPCS terminals sold or leased in the United States to be certified without exception. Such a rule would be much simpler both from an administration and compliance perspective, and there is no justification for the proposed disparate treatment.

B. Terminals Bearing the ITU Mark Associated with the GMPCS-MOU Should Be Permitted to Enter the U.S.

Several parties also oppose the Commission's proposal to require all terminals entering the U.S. to carry the ITU mark. For example, Constellation argues that the ITU mark should not be required for terminals brought into the U.S. for operation under a blanket license issued to a U.S. service provider.[6] Inmarsat, on the other hand, argues that GMPCS terminals should be

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[6] Constellation Comments at 7-9.

permitted into the U.S. without regard to whether they bear an ITU or FCC mark, provided that they are not to be used in the U.S.[7]

Globalstar continues to believe that all GMPCS terminals bearing the ITU mark and not for sale or lease in the U.S. should be permitted to enter the U.S. Further, such terminals should be permitted to enter the U.S. without regard to whether they are intended for "domestic use" or "for transit only."[8] The ITU mark on a terminal would signify that the terminal was certified by at least one administration or competent authority and that the specifications of that terminal were registered in the international ITU database.[9] As the Commission recognizes, both attributes of the ITU mark would help assure that the marked terminals would not cause harmful interference; and thus permitting entry of such terminals would not pose a significant threat to other spectrum users.[10]

Additional safeguards are provided in the GMPCS-MOU Arrangements which should ensure that GMPCS terminals roaming into the U.S. do not pose a threat of harmful interference. The U.S. should submit for the ITU mark only those GMPCS terminals that meet the applicable

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7 Inmarsat Comments at 3-4.

8 Further, the Commission should not categorize GMPCS terminals entering the U.S. as either "for domestic use" or "for transit only." Such categories are not necessary for the protection of consumers or domestic wireless networks. The Commission has already stated its intention to hold U.S.-licensed GMPCS service providers responsible for all transmissions in the U.S. that emanate from their networks. Holding satellite service operators responsible for blocking service to GMPCS terminals that are not approved by an operator for use in the U.S. is sufficient, without creating multiple lists of approved and not approved terminals. In addition, the Commission retains enforcement authority over MSS licensees, should harmful interference actually emanate from their networks. Thus, distinct regulatory requirements depending on the purpose for which the terminals are being brought into the U.S. are an unnecessary complexity which could impede the free movement of GMPCS terminals across international borders.

9 *Notice* at ¶ 25.

10 *Id.*

rules and policies for the service, and so, all terminals bearing the ITU mark that are type accepted in the U.S. will meet Commission-mandated standards.

Moreover, GMPCS system operators will specify in the ITU database which terminals are permitted to be used with their system. Therefore, the Commission can generally be assured that terminals bearing the ITU mark brought into the U.S. have been certified to standards acceptable to the GMPCS system operator authorized in the U.S., and that the operator has only designated terminals to be used with its system that fulfill its obligation to meet the rules and policies applicable to terminals. Since the GMPCS-MOU Arrangements permit GMPCS systems to be self-regulating for compliance with national standards, the Commission does not need to create various categories of entry/operational status for terminals that bear the ITU mark.

III. THE PROPOSED FRAMEWORK FOR REGULATING OUT-OF-BAND EMISSIONS IN THE 1559-1605 MHZ BAND IS IN THE PUBLIC INTEREST AND SHOULD BE ADOPTED

In the *Notice*, the Commission proposed to adopt a time-phased approach to regulating out-of-band emissions within the 1559-1605 MHz band from MSS METs operating in the 1610-1626.5 MHz and 1626.5-1660.5 MHz bands. These limits would protect the GPS and the Russian GLONASS system as part of the planned GNSS aeronautical radionavigation system. After January 1, 2002, all METs placed into service would be required to limit the EIRP density of emissions within 1559-1605 MHz to –70 dBW/MHz for broadband signals and –80 dBW for discrete narrowband signals of less than 700 Hz, and after January 1, 2005, all METs in service would be required to meet those limits. As explained in Globalstar's initial comments, the Commission's proposal is the best approach to achieving the sometimes competing objectives articulated in the *Notice*.

A. For MSS, There Is No Reason to Modify the Proposed Limits and the Time-Phased Implementation Plan

Several parties recommend modifications either to the proposed EIRP density limits or the dates on which those limits would be introduced. For example, Constellation, and AMSC Subsidiary Corporation recommend that the Commission postpone the January 1, 2005, compliance date for the limits in the 1597-1605 MHz band in the event that GLONASS is not yet operational.[11] On the other hand, Motorola and the U.S. GPS Industry Council (the "Council" or "USGPSIC") recommend that the Commission eliminate the time-phasing on the theory that there is no "technical justification" or "rational basis" for postponing the date for compliance with the most stringent limits.[12] Moreover, LSC, Inc., claims that the proposed out-of-band limits are not sufficiently stringent, and should be made 13 dB more stringent.[13]

The Commission should reject any suggestion that the proposed out-of-band emissions limits are either too stringent or not stringent enough, or are being placed into effect too soon, or not soon enough. The protection requirements for aviation uses of GPS and GLONASS have been debated and analyzed for over five years.[14] In the most thorough and complete study conducted on the issue -- by RTCA, Inc. -- the participating GNSS and aviation interests recommended adoption of limits at –70 dBW/MHz for broadband and –80 dBW for narrowband emissions as proposed in the *Notice*.[15] Although the analyses and studies of the MSS industry

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11 Constellation Comments at 11-12; AMSC Comments at 14-15.

12 Motorola Comments at 11-12; USGPSIC Comments at 21-23.

13 LSC, Inc. Comments at 4.

14 *See* Globalstar Comments at 17-20.

15 RTCA, Inc., "Assessment of Radio Frequency Interference Relevant to the GNSS," DO-235, at App. F (1997) ("*RTCA Report*").

found the protection requirements overly conservative and difficult to meet in the GLONASS band segment at 1597-1605 MHz, the MSS industry accepted the proposed protection levels for GPS.[16]

The time phase-in for the standards proposed in the *Notice* constitutes a reasonable compromise between the aviation interests and MSS interests, in recognition of the fact that GLONASS will not become part of the GNSS until, if at all, after January 1, 2005.[17] Therefore, the proposed EIRP density levels and the timing for implementation of these limits are consistent with the protection requirements desired by the aviation community and the protection levels now technically achievable by MSS systems. There is no reason for the Commission to reevaluate the extensive analysis and debate which has preceded the *Notice* and the rules derived therefrom based on the anecdotal comments submitted in this proceeding.[18]

B. The Interference Concerns Expressed by LSC and the GPS Industry Council Are Unfounded and Inaccurate

Both LSC, Inc. and the Council submitted comments which criticize the proposed out-of-band emissions standards. However, the arguments made in these pleadings are irrelevant to the issues before the Commission in this proceeding — and generally factually inaccurate. Moreover, the time for debate on the issues raised by these comments is long passed. Accordingly, the Commission should dismiss these comments out-of-hand and adopt the proposals in the *Notice*.

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16 *Id.* at 45 n.1.

17 The potential for GLONASS to become a part of GNSS remains unclear. As noted in the *RTCA Report*, App. E, E36-E38, there are technical and management issues which may delay development of the system. Despite these difficulties, there are benefits from adopting the proposed out-of-band emissions standards so that MSS and GNSS interests alike can realistically evaluate the interference environment for GNSS receivers. *See* Globalstar Comments at 23-24.

18 *See Notice*, ¶ 77.

For example, the Council and LSC, Inc. premise their arguments on two misconceptions. First, protection limits for GNSS receivers cannot be calculated or recommended in a vacuum. Rather, limits must be evaluated in the context of specific operational requirements of the applications associated with a service. That is precisely why RTCA examined the impact of METs at 100 feet on a GNSS receiver aboard a landing aircraft with respect to the availability, continuity, accuracy and integrity of the intended navigation application. Neither the Council nor LSC, Inc. evaluates the proposals in light of the operational requirements and real-world environments for aviation, terrestrial or other GNSS applications.[19] If they did so, for example, with respect to terrestrial applications, they would have to account for the fact that foliage and buildings are much more likely impediments to receipt of GPS signals than interference from MSS METs and for the impact of such impediments on the availability of GPS signals.[20]

Second, LSC, Inc. and the Council confuse the "continuous availability" of a GPS signal from the satellite with the continuous availability of a GPS signal *at a specific receiver*. While the United States has committed to protect the former, the latter is an unattainable goal. No matter what protection requirement is imposed on MSS METs, GPS receivers will not achieve continuous availability inside buildings, under trees with thick foliage, in urban canyons, in

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[19] The 1559-1610 MHz band is allocated to the Aeronautical Radio-Navigation Satellite ("ARNS") service, which is defined as a "radionavigation-satellite service in which earth stations are located on board aircraft." 47 C.F.R. § 2.106. The protection requirements which have been imposed upon MSS systems operating at 1610-1660.5 MHz arise from the use of GPS as an ARNS system. GPS receivers used in the various terrestrial scenarios cited by LSC, Inc., and the Council do not fall within this definition, and should not receive the same accommodation as have ARNS-related receivers.

[20] *See* Tech. App., § 1.2.

railroad tunnels, etc. Analyses of protection requirements based on this unattainable goal are absurd and, of course, predestined to require impossibly stringent and unrealistic standards.[21]

Both LSC, Inc. and the Council list various "safety" applications for GPS receivers on terrestrial vehicles that are allegedly at risk.[22] Even if the assertion that emergency vehicles rely on GPS signals were true, the fact is that these vehicles already operate in an environment with a large body of existing emitters whose emission limits are *less stringent* than those proposed in the *Notice*. Contrary to the claim that *any* outage for these services would be disastrous, none of the vehicles could, consistent with the alleged safety function, achieve or need the claimed "continuous availability."[23]

Although it accepts the proposed out-of-band emissions standard for MSS METs, the Council devotes pages of argument to what the standard should be for services not at issue in this proceeding. Its analysis, however, is flawed. It proposes a "collocation" standard of one meter for emissions limits from a noise source into a GPS receiver.[24] However, there are no known operational requirements for GPS applications that would justify such a standard and the Council offers no scenario where use of such a standard would improve the quality of service.[25] The Council also makes much ado in the study attached to its comments of the distance at which a

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21 *See id.*, § 1.1.

22 *See* USGPSIC Comments at 17-20; LSC, Inc. Comments at 6-7. The Commission should note that the parties do not provide even one single example, much less a quantification, of the number of emergency vehicles or their locations that are dependent on GPS signals.

23 *See* Tech. App., §§ 1.1, 2.4. 3.

24 USGPSIC Comments at 28-29.

25 *See* Tech. App., § 3.

GPS terminal loses "the first satellite" as a result of alleged interference from an MSS terminal.[26] But, generally, the loss of one satellite is not important to the user, because the receiver may see as many as six to eight satellites, and only four are needed for navigation.[27]

LSC, Inc. also complains about the potential aggregation of GMPCS METs.[28] But, the likelihood of such an aggregation is infinitesimally small, and its probability pales in comparison to the likelihood that a GPS receiver would lose lock on the GPS signal as a result of foliage, buildings, tunnels, etc.[29] LSC, Inc. also vastly overstates the threat to the FAA's Wide Area Augmentation System ("WAAS").[30] In fact, there is no such threat. WAAS reference receivers are the most robust dual-frequency survey-quality GPS receivers available, far exceeding the performance of low-cost civilian receivers. Moreover, there are significant physical barriers to a GMPCS terminal approaching WAAS receivers.[31] LSC, Inc. has provided no information that indicates that there would be an impact on WAAS receivers from GMPCS handsets.

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26 *See* USGPSIC Comments, Att. 1; Tech. App., § 3.

27 *See* Tech. App. § 2.1. The Council complains about loss of a GPS signal on general aviation aircraft where an MSS MET is within 20 feet. But, unless the MET and GPS receiver are on the same plane, and the MET is not directly connected to the cabin communications system as required (47 C.F.R. § 25.136(a)), this scenario is extra-ordinarily unlikely to occur. Indeed, if anything, the Council's test demonstrates that the GPS receivers *can* co-exist in close proximity to MSS METs, and will recover a GPS signal after a passing event of interference.

28 LSC, Inc. Comments at 14.

29 *See* Tech. App., § 2.2.

30 LSC, Inc. Comments at 15.

31 *See* Tech. App., § 2.3.

C. The Record Indicates that More Robust GPS Receivers Can Be Deployed

Several comments suggested that more stringent out-of-band emissions limits are needed for either GMPCS terminals or emitters from other services because the rejection capabilities of GPS receivers cannot be improved.[32] This claim has been refuted in the comments themselves and other documentary evidence cited in the record. In its Attachment 1, the Council provided test data for five different GPS receivers. There is 3:1 ratio of interference distances between the best and worst of these commercially available receivers, which equates to a 9.5 dB difference in receiver robustness.[33]

A recent study conducted by the Applied Physics Laboratory at Johns Hopkins University indicated that several techniques can yield substantial improvement in receiver susceptibility at very low cost.[34] Also, the RTCA Report lists several interference mitigation methods.[35] The suggestion that all GPS receivers are alike and at the maximum capability with respect to their interference suppression characteristics is simply wrong. Further, adopting specific standards for emitters which will be deployed in the market place is an excellent method to encourage manufacturers to develop more robust receivers.

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32 *See* RTCA Comments, at 3; NTIA Comments, at 11-13; USGPSIC Comments, at 20.

33 Tech. App., § 4. Note that the lower-cost consumer receivers were more robust, suggesting that products with a short life-cycle are taking advantage of more recent technology.

34 Johns Hopkins University, Applied Physics Laboratory, "GPS Risk Assessment Study: Final Report," at § 5 (Jan. 1999); *see also* Tech. App., § 4.

35 *RTCA Report*, at § 10.2

D. The Public Interest in Achieving Free Roaming of GMPCS METs Mandates That Compliance with the Narrowband Limit Not Be a Condition of Entry

The Commission has proposed to adopt a EIRP density limit of –80 dBW for discrete out-of-band emissions of less than 700 Hz in the 1559-1605 MHz band. Although the United States has previously imposed such a "narrowband limit" on METs operating in the 1610-1626.5 MHz band,[36] there is no comparable narrowband limit in either ITU-R Recommendation M.1343 or ETSI TBR-41. Therefore, GMPCS METs certified by other administrations can receive the ITU mark without having demonstrated compliance with the narrowband limit.

As several comments pointed out,[37] a Commission mandate that GMPCS METs be certified to meet the narrowband limit for either entry or operation in the United States could have the effect of precluding entry or operation of METs certified outside the United States that bear the ITU mark. If other administrations, in turn, impose idiosyncratic conditions for entry and operation of METs certified in the United States, then the goal and purpose of the GMPCS MOU and Arrangements could be defeated.

Globalstar does not object to a Commission-imposed narrowband limit for GMPCS terminals type-accepted for sale or lease in the United States, or for terminals type-accepted within other administrations to meet the United States standards. However, the Commission or United States should not take action which would have the effect of isolating the United States market for incoming roamers and/or impairing the acceptance of outgoing roamers. Moreover, it is not a viable solution for the Commission to place upon GMPCS service providers in the

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36 *See* 47 C.F.R. § 25.213(b).

37 *See* Globalstar Comments at 25-26; Hughes Comments at 1-3; Motorola Comments at 17.

United States the responsibility to ensure that incoming METs be certified to all idiosyncratic national requirements.[38] U.S. service providers generally would not have the power to require that all METs be type-accepted to standards not applicable in the administration of certification.

Besides defeating the purpose of the GMPCS MOU and isolating the United States from global roaming, a requirement that each GMPCS MET be certified to all U.S. standards sends the entirely wrong message to the world community. The United States cannot expect that the standards it adopts in the public interest will be respected by other administrations if the United States does not respect the standards other administrations adopt in the public interest. Ultimately, competing standards harm consumers by precluding roaming or forcing them to buy duplicative equipment, and harm satellite service providers by increasing the costs and complexity of attempting to market equipment in both domestic and foreign markets. Accordingly, the Commission should generally allow GMPCS METs bearing the ITU mark to enter the United States and operate with an authorized GMPCS service based on the reasons articulated in Section II above.

E. The Technical Rules Governing GMPCS METs Should Facilitate Deployment of These Services to the Public

Several parties raised issues that have an impact on the technical rules governing GMPCS METs. In response, and as discussed herein, the Commission should adopt the rules which best facilitate deployment of GMPCS services.

GPS Signal Bandwidth. NTIA asked that the Commission modify Section 25.213(b) of its rules to reflect the new frequency range of 1563.42-1587.42 MHz based on the theory that

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38 *See* 47 C.F.R. § 25.136(c).

civil GPS receivers utilize the entire transmitted bandwidth of the Coarse/Acquisition code signal to minimize tracking errors due to noise, interference and multipath.[39]

Although this proposal is not objectionable, there are technical factors which suggest that the optimum design point is not the full bandwidth of the C/A code signal.[40] Moreover, the optimum design point for GPS is not necessarily the same for GLONASS. Therefore, even if Section 25.213(b) is modified, no conclusion should be drawn regarding the necessary protection bandwidth for GLONASS.

Future GNSS Systems. NTIA claims that a proposed GNSS system operating in the 1587.69-1609.17 MHz band will have the same protection requirements as GPS and GLONASS.[41] However, at this point in time, it is premature to suggest protection requirements for a hypothetical system, and it is not clear that any system could operate reliably in this band given the authorized MSS emissions above 1610 GHz.[42]

1605-1610 MHz. Aeronautical Radio, Inc. suggests that the Commission should adopt a standard for out-of-band emissions in the 1605-1610 MHz band other than that in the ITU-R Recommendation M.1343. Its only rationale is that no one has allegedly offered a reason to depart from these limits.[43] To the contrary, there are good reasons why the Commission should not modify its proposal. First, in order to facilitate deployment and development of global systems, the Commission should use standards for GMPCS that are consistent with those used

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39 NTIA Comments at 7-8.

40 *See* Tech. App., § 5.1.

41 NTIA Comments at 10.

42 *See* Tech. App., § 5.2.

43 Aeronautical Radio Comments at 6.

internationally, whenever possible. This is one such case where there is simply no reason to override the ITU recommendation, much less a compelling public interest case. Second, it is illogical to adopt an idiosyncratic, more stringent limit in the 1605-1610 MHz band, where it is the position of the United States not to protect GLONASS operations above 1605 MHz.

IV. SATELLITE SERVICE PROVIDERS SHOULD BE PERMITTED TO DEVELOP EMERGENCY SERVICES IN THE MANNER MOST APPROPRIATE TO THEIR PARTICULAR NETWORK REQUIREMENTS

Several parties argue that the Commission should immediately impose emergency service obligations upon satellite service providers.[44] These demands for emergency service capabilities are based in large measure on the assumption that MSS service is comparable to Commercial Mobile Radio Services ("CMRS") and should bear comparable emergency service obligations. As demonstrated in Globalstar's comments, however, this premise is false and the Commission should not impose emergency service requirements at this time.[45]

Deploying emergency services on satellite-based networks is much more complex than on terrestrial cellular or PCS networks. Further, unlike CMRS operators, MSS operators are deploying technically and operationally diverse systems intending to serve diverse market segments. Such diverse systems are poorly suited to uniform mandates for emergency service requirements. Additionally, in light of the extraordinary market, technical and financial challenges facing MSS systems in these early stages of deployment, application of emergency service obligations at this time would not serve the public interest.

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[44] National Search and Rescue Committee Comments at 2; Association of Public-Safety Communications Officials-International Comments at 2-3; Coast Guard Comments at 6; NTIA Comments at 26.

[45] Globalstar Comments at 26-29.

In addition to network difficulties, as Globalstar discussed in its comments, there are numerous other significant complexities to providing emergency services. The majority of these complexities arise because of MSS' status as a global service, rather than a geographically restricted service such as cellular and PCS. As a global service, MSS providers will have difficulty locating users with sufficient accuracy and determining the appropriate PSAP for call routing and information delivery purposes. In addition, because MSS will be ubiquitous throughout the U.S., service providers must determine the appropriate transport mechanism for connecting to *all* of the approximately 6,200 PSAPs in the United States from only a limited number of gateways. Moreover, while gateways must be interconnected to PSAPs, there is no established standard for interconnection for voice and data signaling. Further, MSS will provide coverage in areas where 9-1-1 service may not exist — insofar as 9-1-1 services are not ubiquitous throughout the Nation. Service providers will also have to resolve how best to accommodate the different emergency number sequences used in each nation, and to accommodate subscribers roaming between nations. Compounding these significant technical problems, there are also unresolved questions regarding liability associated with providing emergency services, and the cost recovery methodology for furnishing emergency services. Again, MSS systems pose unique challenges in this area.

Nonetheless, Globalstar believes that strong consumer demand for emergency services will drive the MSS market. Toward that end, AirTouch (the U.S. service provider) is actively exploring options such as a service bureau solution for basic 9-1-1 service at commercial launch. AirTouch is hopeful that the service bureau would have the capability to route emergency calls,

offer 7day/24 hour availability, and establish a strategic relationship with PSAP database management companies. Again, key issues remain to be addressed, including liability and cost.

Enhanced 9-1-1 capabilities pose more challenges to MSS systems than can be addressed in the near term. For Globalstar, challenges include the fact that the current network design for location capability is incompatible with enhanced 9-1-1 requirements. The network is inherently unable to meet the Phase II standard of 125 meter position accuracy in 67 percent of all cases, required of terrestrial cellular and PCS carriers.[46] To confirm, these network challenges must be overcome before AirTouch will be in a position to deploy a technical solution for enhanced 9-1-1 services.

Developing emergency services for the Globalstar System is primarily a network — as opposed to a handset — issue. Indeed, Globalstar has designed its terminals with the intent that the capability of displaying location information would be provided through software, without hardware modifications. Consequently, a decision not to implement emergency service requirements at this time will not foreclose the possibility of establishing and readily implementing such requirements in the future.

Globalstar submits, therefore, that the Commission should not impose requirements for providing emergency services on MSS networks. Instead, the Commission should leave the service providers, gateway operators, and satellite operators with the flexibility to develop the most efficient mechanism for deploying emergency services to consumers. Finally, toward that end, Globalstar would support the suggestion made by the National Search and Rescue Commit-

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46 *See Revision to the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems*, 11 FCC Rcd 18676, at ¶ 71 (1996).

tee to address creation of a national database of PSAPs which would necessarily include telephone numbers for each PSAP in order to facilitate routing of 9-1-1 calls. As technical and other hurdles are overcome, emergency services will be provided.

CONCLUSION

For the foregoing reasons, Globalstar urges the Commission to streamline its proposed licensing and certification procedures by eliminating different regulation for various artificial categories of GMPCS terminals, deferring technical review of GMPCS terminals to the certification process, and permitting terminals to be certified without an associated blanket license. Additionally, the Commission should adopt the phased out-of-band emission limits proposed by NTIA for GMPCS terminals. Finally, the Commission should not impose emergency service requirements upon MSS service providers.

Respectfully submitted,

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APPENDIX

TECHNICAL STATEMENT

1. INTERFERENCE PROTECTION LIMITS FOR GNSS

1.1 USGPSIC and LSC improperly equate a commitment to GPS with a commitment to ensure continuous availability of navigation by all receivers under all conditions.

The U.S. GPS Industry Council ("USGPSIC") and LSC, Inc., confuse a commitment for the continuous availability of GPS ***signals in space***, with the continuous availability of navigation function at a particular ***receiver***. The continuous availability of GPS signals in space is a laudable goal and is technically achievable to a high degree of availability, at least for users near the Earth's surface that are not shielded by terrain, foliage, or manmade objects such as buildings, tunnels and metallic structures, or fixed or vehicular enclosures. The US is committed to the continuous availability of GPS signals in space subject to these qualifications, and the Commission's rule making proposals are consistent with it.

The continuous availability of navigation function at a particular ***receiver*** is a different matter entirely. Continuous availability at a given receiver is ***not*** guaranteed by any policy statement of the US, and indeed such continuous availability is impossible to achieve in practice. GPS receivers fail completely inside tunnels, parking garages, buildings, and even certain outdoor settings such as deep canyons or city streets with high buildings, or even a city street wherein the GPS user is surrounded by high trucks with metal sides.

1.2 Protection limits should be based on a rational assessment of operational need and realistic system designs.

Protection limits are clearly needed to protect safety-of-life services, and other services, from harmful interference. But to arrive at a rational protection limit which provides the necessary level of protection without undue burden on other services, it is necessary to examine the operational requirements of the key applications associated with a service. When the RTCA considered the impact of GMPCS MES on GPS and GLONASS receivers (RTCA/DO-235), four quality-of-service parameters were carefully assessed and documented as a prelude to the interference analysis. These four quality-of-service parameters were the availability, continuity, accuracy and integrity of the intended

navigation application.[1] The interference analysis was then based on an assessment of receiver performance versus C/Nt, ***in terms of these four key parameters,*** and a link budget that related an emissions level at an MES to a C/Nt level at the receiver input. This provided a rational and verifiable framework for the assessment of RFI impact on operational performance.

Understanding the users' required quality-of-service is a key step which cannot be overlooked. USGPSIC and LSC do not provide any such data for the land-based safety-of-life applications which are alleged to exist, since to do so would reveal the inconsistency of their argument. Most humans live the majority of their lives inside of buildings, and many of the safety-of-life applications identified by LSC involve operational scenarios with significant shadowing. GPS is not usable in these environments.

Even outdoor GPS users may be adversely affected by shadowing. For example, LSC's web site provides a reference for foliage attenuation which indicates that significant attenuation can exist at low elevation angle paths through a forest. LSC's web site also notes that shadow fading is typically log-normally distributed with one-sigma fades on the order of 6-12 dB, implying relatively high probability of fades in excess of 10 dB. LSC notes that the correlation distance for shadow fading is related to the size of the obstructions (typically 5-40 meters), and that slow-moving users may experience long fade times.[2] Hand-held GPS receivers do not even operate from inside automobiles on the open road, unless a remote antenna is provided outside the metal frame of the car or suction-cupped to the windshield. Service outages due to shadowing can persist for minutes or hours, e.g., if a user or host vehicle is located in a building or parking garage for an extended period.

Since the land-mobile user has poor GPS availability in a classical sense (i.e., probability of successful operation at an arbitrary instant of time), applications which rely on GPS navigation must be designed to "work around" the availability problem. Many solutions have been devised and implemented. Typically, the "last known position" may be sufficient for the task at hand. If real-time navigation is required, dead-reckoning techniques or alternative navigation sensors are provided. If a particular application requires high navigation availability, the designer of the application will find a means to achieve it considering the operational constraints of GPS. The outages due to shadowing are severe, frequent and long-lasting. In contrast, outages due to the simultaneous proximity of multiple active GMPCS handsets, if they occur at all, will be infrequent and of very short duration. Therefore, any user whose application has been designed to operate through shadowing will be completely unaffected by GMPCS MES emissions at the levels proposed by the Commission.

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[1] The most stressing application considered by RTCA was Category I precision approach.

[2] A police officer standing on a street corner would presumably satisfy the conditions of a "slow-moving user."

2. DISCUSSION OF LSC, INC. COMMENTS

2.1 LSC's analysis of GPS receiver performance is superficial.

LSC states[3] that full accuracy tracking is lost when the Phase Locked Loop ("PLL") loses lock. This is true, but it is not clear how this relates to required navigation performance for the land-mobile applications being assessed. Since these land-mobile applications must contend with frequent outages of GPS due to shadowing, etc., it is unclear why loss of lock in the PLL is identified as a threshold for interference analysis. Certainly, the accuracy provided by continuous PLL tracking is not required to dispatch emergency personnel to a caller in distress.

LSC's reliance on PLL lock performance appears inconsistent with his discussion of GPS receiver types (e.g., Table 1 on page 12), since the 4 space vehicle (SV) Multiplex receiver and 8 SV Multiplex receiver cannot retain PLL lock when transitioning from one SV to another. If continuous PLL lock is a requirement, these receivers should be deleted from consideration since they lose lock several times each second, on each satellite, as a consequence of their basic design. If, on the other hand, continuous PLL lock ***is not*** a requirement, then presumably the real requirement is less demanding (but never defined anywhere by LSC).

If we consider the multiplexing receivers despite their inability to retain PLL lock through SV transitions, we nonetheless conclude, from their relatively low margin (LSC Table 1 on page 12), that such receivers are inappropriate for safety-of-life applications. The GMPCS industry should not be penalized for a poor GPS receiver design.

On page 13, LSC cites a 1.5 dB sensitivity loss from the RTCA recommendation. This number was an "intermediate result" specifically related to an aviation application (Category I precision approach) and should not be viewed as a formal recommendation. Furthermore, this intermediate result is in the context of a receiver where all signals are tracked continuously, and where PLL cycle slip could lead to a loss of required navigation accuracy. The criterion for PLL cycle slip probability was set at 10^{-4} per second for the Category I precision approach application. This performance criterion, and the sensitivity loss of 1.5 dB, cannot be applied to other applications.

LSC assumes all SVs are at the minimum elevation angle and minimum signal strength. But due to their orbital constraints, it is physically impossible for all SVs to be at the minimum elevation angle at one time. As an SV moves higher in the sky, its received signal strength increases (4 dB enhancement at zenith) and the receiver's antenna gain also increases (typically 5-7 dB enhancement at zenith). Furthermore, GPS satellites typically operate at transmit signal levels which are several dB greater than the minimum specification. Typical signal levels at the GPS receiver processor may be 5-10 dB higher than LSC's minimum worst-case. Navigation depends on a minimum of four

[3] LSC Comments on Protection for GPS/GLONASS Radionavigation Systems, May 2, 1999, page 9.

spacecraft, and there are typically 8 SVs in view.[4,5] When there are more than four SVs under track, the weakest signals have very little impact on the user's navigation solution since the Kalman filter in the GPS receiver tends to emphasize the strongest and most stable signals and de-emphasize the weakest and least stable signals. Indeed, the weakest signals may have been substantially "ignored" even while under track.

2.2 *Interference scenarios postulated by LSC are unrealistic.*

LSC makes much of the potential for a local grouping of GMPCS users, perhaps 10 users within a small domain, which could potentially degrade the navigation performance of a nearby GPS receiver. However, the likelihood of this event is vanishingly small compared to the likelihood of GPS outage due to shadowing and other factors. Following the analysis in RTCA/DO-235 (page E-29), the likelihood of a single GMPCS emitter being present and operating in a satellite mode may be evaluated with the following assumptions:

- A total of 3 million MES throughout the US vehicle population of 150 million vehicles, yielding a ratio of one MES per 50 vehicles;
- 100 vehicles within a threat radius of 100 feet (this is bumper-to-bumper traffic during rush hour), yielding an average of N=2 MES within the 100 foot threat radius;
- Per-MES probability of being active during the busiest hour = 0.015 (same as cellular telephone average during peak busy hour);
- Probability of call being by satellite = 0.1;
- Probability of voice activity (given that MES is in use) = 0.6.

Therefore, the probability of an MES being present and transmitting is 0.0018. We will ignore power control considerations, which in practice further minimize impact,[6] and we will round this probability to 0.002 (0.2%). RTCA considered the impact of multiple emitters, carefully considering all factors in the most demanding and vulnerable GPS application for civil aviation (precision approach), and ultimately concluded that an emissions limit based on single-entry analysis was appropriate. LSC apparently disagrees, raising the prospect (on page 14 of LSC comments) of 10 GMPCS users within 100 feet of an airborne receiver. The probability of this event, using the scenario parameters listed above, is $(0.002)^{10} = 10^{-27}$. To put this very small number in perspective, assume the total human population of Earth comprises 8 billion people, each

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[4] Rob Conley, "Results of the GPS JPO's GPS Performance Baseline Analysis: The GOSPAR Project," *Navigation* (Journal of the ION), Spring 1998, p.7.

[5] Observed satellite visibility is found to closely match the GPS signal specification. For example, the GPS signal specification Annex B indicates worldwide satellite visibility is 97.15% (7 or more in view) and 99.96% (6 or more in view). Rob Conley, ibid., reports similar results. For example, on a typical representative day (27 April 1997), worldwide satellite visibility was 96% (7 or more in view) and 99.7% (6 or more in view).

[6] For a given GMPCS MES, out-of-band emissions are proportional to radiated on-channel power. As on-channel power is reduced through the application of power control algorithms, out-of-band emissions are reduced as well.

individual owns an aircraft, and each aircraft conducts one precision approach every second for 12 billion years (roughly equal to the age of the Universe). We would expect only one of these 10^{27} approaches to encounter the threat environment postulated by LSC. This aircraft might than be forced to perform a missed approach (i.e., if all GPS signals at that time were actually at their minimum specified levels, and if the pilot had not visually acquired the runway prior to the moment of closest approach to the clustered GMPCS emitters).

LSC goes on to apply the 10 MES scenario to a land-mobile environment, although here LSC considers threat radii of 100 feet, 400 feet and 1000 feet. LSC alleges a potential receiver sensitivity loss of 3 dB at a range of 1000 feet (page 2 of LSC comments, and Figure 6 on page 18); this threat radius encompasses 100 times the land area of the smaller threat radius assumed by RTCA. Scaling the probability calculation,[7] we find a single-entry probability of 0.2 (i.e., the probability that a single MES is operating in a satellite mode within a threat radius of 1000 feet). The likelihood of 10 emitters within 1000 feet is then $(0.2)^{10} = 10^{-7}$. This is still a very small number, completely dwarfed by the likelihood of shadowing in the environment.

LSC also applies some unrealistic link budget assumptions for ground-mobile applications, adjusting the GPS receiver's antenna gain in the direction of a GMPCS user to +3 dBiC to account for a 30 degree roll. It is not clear how a ground vehicle could experience a 30 degree roll – or what is more outlandish, a simultaneous 30 degree roll in all the directions associated with the 10 hypothesized GMPCS emitters.

LSC never discusses the operational requirements of the hypothesized applications, or the detailed hardware characteristics and operational procedures of the hypothesized users. There is a reason for this – no reasonable discussion of requirements and detailed usage scenarios would support any serious allegations of impairment. The most favorable interpretation of LSC's operational scenarios leads to a likelihood of 10 simultaneous close-range emitters on the order of 10^{-7}, whereas the likelihood of shadowing can easily be 10% or higher depending on typical user operations. The difference is roughly six orders of magnitude, so the performance of a land-mobile GPS user will be overwhelmingly dominated by shadowing.

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[7] It is hard to imagine how a simple scaling of emitter count could occur in practice, except possibly in the parking lot for Disneyland (where most vehicles would be empty anyway), but for the sake of argument we will simply increase the number of MES by the areal ratio = $(1000/100)^2 = 100$.

2.3 LSC description of the FAA's Wide Area Augmentation System is inaccurate and misleading.

LSC claims (p. 15) that the WAAS reference receiver at the Billings Flight Service Station is easily within 71 meters of locations where GMPCS handsets could be used. LSC alleges that this leads to a safety risk for landing aircraft. ***This could not be further from the truth.*** We have not verified the location of the WAAS reference receiver cited by LSC, but WAAS reference receivers are some of the most robust dual-frequency survey-quality GPS receivers available, far exceeding the performance of low-cost single-frequency civilian receivers, and they operate with atomic clocks for enhanced tracking stability and antennas which are specially designed to reject GPS multipath signals and other spurious signals arriving at low elevation angles. There are physical barriers (fences, etc.), to prevent close approach by unauthorized personnel and vehicles which could introduce multipath or extraneous signals. The emissions of one or several GMPCS handsets would have no impact whatsoever on these receivers. Furthermore, the output of the WAAS reference receiver is sent to the WAAS Master Station (WMS), where it is processed along with the outputs of numerous other reference receivers in order to generate the WAAS corrections. The WMS is designed to tolerate the loss of one or even several reference stations, and integrity of the output is never in doubt. LSC's innuendo regarding a potential safety risk is scurrilous and flies in the face of engineering reality.

2.4 LSC's example safety-of-life applications make no technical sense.

LSC appears to make the implicit assumption that a single short-term outage, of any duration, may be sufficient to disrupt a safety-critical operations. This assumption is invalid for land-mobile users regardless of their equipment complement (i.e., since land-mobile users must contend with frequent and long-term outages anyway). Many of LSC's specific examples make no technical sense, as discussed briefly below.

1. *Dispatch, rendezvous and monitoring for police, fire and medical rescue (p. 6). LSC also raises the specter of a police officer calling for backup, expecting GPS to yield a position fix, but being jammed by a GMPCS user across the street (p. 16).* It seems unlikely that police, fire and medical personnel will rely for safety purposes on equipment and systems which would fail to provide a position fix for personnel operating inside apartment buildings, parking garages, narrow alleyways, or other shadowed locations. Last we checked, many safety personnel actually operate in these environments (i.e., where GPS is unavailable). LSC's example raises the image of a police officer excusing himself/herself from a critical and tense indoor situation, in order to make a call for backup from out-of-doors (note: the time away from the scene could consume several minutes since the police officer would need to find a suitable unshadowed location, and GPS receivers typically take 30-120 seconds to provide a position fix even when not shadowed). This is clearly unacceptable. Sole reliance on a "point solution position fix" at the time of a phone call is a concept with numerous

operational shortcomings. Dispatch, rendezvous and monitoring systems are therefore designed in a more flexible way in order to tolerate outages.

2. *Train switching and control.* Trains are fairly long and move relatively fast. They do not change speed very quickly, so their position can be safely and reliably extrapolated over short periods of time from a single position and velocity report. This is good, since GPS will be unavailable in tunnels and train stations and may be lost momentarily as the GPS receiver becomes shadowed by buildings, bridge abutments, terrain, etc. These outages far exceed the impact of GMPCS MES in the environment. Furthermore, GMPCS users with dual-mode phones will typically operate in a terrestrial mode from inside the train.
3. *Tectonic plate stress monitoring.* While the survey-quality receivers used for this task are fixed and unmoving, and could therefore be subject to a short-term outage if a hiker happens to sit next to the survey antenna while making a satellite phone call, short-term outages are not significant for this application.
4. *Dam stress/fracture monitoring.* Same as above.
5. *Pipeline monitoring.* Same as above.
6. *ONSTAR (motorist services).* All vehicular navigation systems incorporate means for dead-reckoning, since the primary navigation sensor (e.g., GPS) is non-functional in many environments as noted above. Short-term outages, due to many factors, are accommodated in a manner which is transparent to the user/motorist.
7. *Downed line locating and dispatch.* Same as pipeline monitoring (for the fixed-plant equipment) and ONSTAR (for the maintenance/repair crew).
8. *Minefield clearing (creating a regular grid).* We could not give credence to the vision of GMPCS users unexpectedly overrunning a dangerous minefield in the process of its being cleared.
9. *Enhanced 911 (E-9-1-1) concept using cellular phones with GPS.* As noted above, there are many environments where a terrestrial cellular phone will operate but GPS (and satcom) will not. These environments include buildings, garages, tunnels, subways, the interiors of cars and other vehicles, and even many urban street environments. Since E-9-1-1 systems require high availability for safety reasons, they cannot rely exclusively on "single point solutions" from an embedded GPS receiver.
10. *Child abductions.* While this is a much more emotionally disturbing than the others, the same real-world constraints apply. Systems which rely on GPS must compensate and avoid reliance on "single point solutions".

2.5 Summary

LSC has not provided any information to support the claim that a more critical application than aeronautical approach and landing exists, or that human safety is in any way threatened by the Commission's proposed limits. On the contrary, the LSC comments fail to provide any documented requirements, or even a detailed engineering discussion of hypothesized applications and threat scenarios, sufficient to demonstrate a reasonable threat. LSC's postulated threat scenarios are unrealistic, and cannot form the basis for any deviation from the NTIA recommendations.

3. DISCUSSION OF USGPSIC COMMENTS

In its discussions of its test results, the USGPSIC proposes a target standard of "co-location" of the noise source and the GPS receiver, at a range of 1 meter.[8] However, the USGPSIC provides no justification for this standard. There are no known and agreed operational requirements which would justify such a standard, and the USGPSIC does not describe any scenario where such a standard would provide an operationally meaningful improvement in quality of service.

USGPSIC states (also on page iii) that, at an emissions limit of -70 dBW/MHz, "receivers started losing the ability to track GPS satellites at distances on the order of 90 feet from the noise source." This appears to conflict with their own test data (Attachment 1), which indicate that the worst-case receiver under test (i.e., the General Aviation receiver) started to suffer a loss of tracking at 14.6 meters = 48 feet. This is a 2:1 difference in range and a 6 dB difference in equivalent received signal strength.

USGPSIC cites a number of purported safety-related applications such as GPS receivers in ambulances, police cars, fire engines, harbor navigation, search and rescue, and harbor docking,[9] and proposes a stringent emissions limit of -100 dBW/MHz (wideband) in the 1559-1605 MHz band for non-GMPCS/future emitters. This proposed limit appears to ignore the large body of existing equipment (including literally millions of VHF and UHF mobile transceivers) which may exceed even the Commission's proposed limit of -70 dBW/MHz (wideband) for GMPCS. ***Current GPS equipment appears to work well in the current environment, which includes these existing sources.*** This applies to all of the applications cited by the USGPSIC, such as machine control and mining and in-vehicle navigation systems (page 15), which are forced to contend with current high levels of interference from many sources. The Commission's proposed limits appear to be more than adequate given current real-world experience. The USGPSIC demand for a more stringent limit to protect non-aeronautical applications is not supported by any quantitative statement of operational need, or any quantitative analysis that can be independently verified. The Commission should reject these demands out-of-hand.

USGPSIC also states (page 6): "Continuity is an operational requirement for a broad range of commercial and public safety users of GPS. Close proximity interference to GPS receivers at any of the levels proposed in the *NPRM* would end the continuous availability of GPS." However, continuity is clearly ***not*** an operational requirement, in the sense implied by USGPSIC, since the reality is that land-mobile GPS receivers typically experience frequent outages which may persist for many seconds or minutes at a time. This is expected, and land-mobile applications are designed accordingly. The outages due to shadowing and multipath are much more frequent, and longer-lasting, than

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[8] Comments of the US GPS Industry Council, June 21, 1999, page iii.
[9] Comments of the US GPS Industry Council, June 21, 1999, page 19.

the outages which may occur as a result of momentary close proximity to a GMPCS handset. USGPSIC has not provided any analysis which would indicate that interference events to land-mobile GPS users are operationally significant.

4. GPS RECEIVER PERFORMANCE CHARACTERISTICS

USGPSIC, LSC, and others, frequently argue that all GPS and GLONASS receivers behave identically, that a single receiver model is appropriate for all GNSS receiver interference calculations, and that no improvement in receiver technology is economically feasible (at least in the near term). USGPSIC makes this claim unequivocally asserting that "...the susceptibility is unrelated to the receiver design, and is strictly a function of the low level of the satellite power."[10]

These claims fly in the face of documentary evidence to the contrary, as well as the existence of several companies and Government research programs dedicated to increasing the robustness of GPS receivers. In fact, the USGPSIC provides contrary evidence in its own comments. In its Attachment 1, USGPSIC documents the results of a simple open-air test of 5 different receivers including: 1) wideband survey, 2) WAAS reference, 3) consumer, 4) general aviation and 5) in-car navigation. There is a 3:1 ratio of interference distances between the best and worst of these commercially-available receivers, both in terms of the distance that induced a loss of one satellite and the distance at which all satellites were reacquired.[11] The 3:1 ratio in distance equates to a 9.5 dB difference in receiver robustness, so even for this limited set of receivers, none of which contained any special circuits to guard against interference, essentially a 10 dB variation in robustness was observed.[12] So receiver design ***does*** make a difference.

It is interesting to note that the consumer and in-car navigation receivers were the most robust despite their extremely low cost, while the wideband receivers and general aviation receiver were the ***least*** robust. This may be due to the fact that the product life cycle for consumer electronics is relatively short, so the consumer and in-car navigation receivers can take advantage of the latest available technology.

We note that GPS users have an obligation to select a receiver appropriate to the intended application. Users engaged in safety-of-life applications have a particular responsibility to select equipment appropriate to the task, and should avoid low-performance receivers that could adversely affect operational capability. Since the lowest-cost receivers apparently exhibit the highest degrees of robustness, this should not be an issue.

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[10] Comments of the US GPS Industry Council, June 21, 1999, footnote 30 on page 20.

[11] Comments of the US GPS Industry Council, June 21, 1999, Attachment 1, Table VII.

[12] We note that the equipment, which could be used for the land-mobile applications identified by LSC, is likely well-modeled by the consumer and in-car navigation receivers.

The receivers tested by USGPSIC do not contain any special circuits to reject interference, but such circuits are being developed now and are already commercially available. RTCA/DO-235 listed several interference mitigation methods in Section 10.2. Johns Hopkins University has published a report, sponsored by the Air Transport Association, which goes into greater detail in terms of interference mitigation and anti-jamming for GPS and GNSS receivers.[13] JHU indicates (section 5) that several techniques can yield many 10's of dB improvement at very low cost. There are several small companies which currently market interference cancellation devices, which have demonstrated the levels of performance noted by JHU.[14]

5. DISCUSSION OF NTIA COMMENTS

5.1 Amended SPS Signal Specification

NTIA requests (pages 7-8) that the Commission conform Section 25.213(b) of its Rules to the amended SPS Signal Specification by replacing the current frequency range of 1574.397-1576.443 MHz with the new frequency range 1563.42 - 1587.42 MHz. NTIA bases its request on the alleged recognition that civil GPS receivers utilize the entire transmitted bandwidth of the C/A code signal to minimize tracking errors due to noise, interference and multipath. However, noise and interference are ***exacerbated*** by wide receiver bandwidth. There is actually a technical tradeoff since the presence of broadband noise and interference would lead a designer to adopt a narrow receiver bandwidth (e.g., on the order of the main lobe), while the presence of multipath might lead a designer to adopt a wider receiver bandwidth. The optimum design point is clearly not at the full bandwidth of the C/A code, since the extreme spectral edges contain little energy and a wideband front end only serves to make the receiver more vulnerable to interference.[15]

For GPS, the optimum front-end bandwidth for a standard correlator receiver is on the order of the C/A code main lobe. For a narrow-correlator receiver, the optimum front-end bandwidth is a function of the correlator spacing, but is typically in the range of 2-4 times the main lobe bandwidth. For GLONASS, consideration of a single channel would parallel that of GPS, but the situation is more complex since each GLONASS satellite uses the same PN code offset in frequency. The channel spacing is only 562.5 kHz – roughly equivalent to the half-width of the signal main lobe. So a wideband front-end potentially makes the receiver vulnerable to interference from adjacent GLONASS

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[13] GPS Risk Assessment Study, Johns Hopkins University Applied Physics Laboratory, January 1999. (available on the web).

[14] NTIA repeats the claim, on page 13 of its Comments, that "[t]here is also a prohibitive cost associated with the implementation of these interference suppression techniques." However, this claim is based on work that is several years old, and appears to be incorrect given the current pace of development.

[15] The existence of a GPS or GNSS receiver with wide front-end bandwidth does not *prima facie* indicate that such a design is a good thing – it may be more a reflection of incomplete understanding on the part of the manufacturer, or a conscious desire to minimize cost at the expense of performance.

frequencies. As a consequence of these technical issues, no conclusions should be drawn at this stage regarding the necessary protection bandwidth for GLONASS.

5.2 Advanced Published ESA RNSS System

NTIA claims (page 10) that the recently Advanced Published RNSS system by ESA, targeted for operation in the 1587.69-1609.17 MHz portion of the band, will have the same protection requirements as GPS and GLONASS since it will necessarily have a signal level on the surface of the Earth that is on the same order of magnitude as GPS and GLONASS. However, there is insufficient information to make this claim, and it is not even clear that a system can be made to operate reliably in the indicated portion of the band (i.e., since the terrestrial receivers would have to provide in excess of 70 dB filter isolation over less than 1 MHz, prior to any amplifier or mixing stages, in order to avoid front-end desensitization from the authorized MSS emissions above 1610 MHz).

Engineering Certification

I hereby certify that I am the technically qualified person responsible for preparation of the foregoing Technical Statement attached to the Joint Reply Comments of L/Q Licensee, Inc., Globalstar, L.P., and AirTouch Satellite Services U.S., Inc.; that I am familiar with Part 25 of the Commission's Rules and the rules and policies proposed for Global Mobile Personal Communications by Satellite in the Notice of Proposed Rulemaking, FCC 99-37 (released March 5, 1999); that I have prepared the information contained in the Technical Statement; and that it is complete and accurate to the best of my knowledge and belief.

Signed this 18th day of July ___, 1999.

Stephen B Hyype