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

In the Matter of the	)	
	)	
Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band	)	IB Docket No. 01-185
	)	
Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile Satellite Service	)	ET Docket No. 95-18

REPLY COMMENTS OF MOTIENT SERVICES INC., TMI COMMUNICATIONS AND COMPANY, LIMITED PARTNERSHIP, and MOBILE SATELLITE VENTURES SUBSIDIARY LLC

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Summary

The record provided by this second round of comments on proposals for spectrum flexibility for MSS systems further confirms that the Commission's proposal for flexibility will provide new and improved service, particularly for rural America; increase wireless competition; and lead to more efficient use of spectrum more efficiently. It also demonstrates that these benefits can be realized without causing harmful interference to existing or planned systems and in a manner that is consistent with international and domestic law and Commission policy.

Without the flexibility for MSS operators to provide ancillary terrestrial services, customers in rural areas will continue to have few if any choices for advanced wireless services. The few customers of satellite service that can afford the high-priced equipment and airtime charges will continue to be unable to use that equipment to get service in urban areas. No one will benefit, except Inmarsat and a few large terrestrial service providers, that will face less competition.

A careful engineering analysis, supported by independent expertise, shows that MSV's proposed ancillary terrestrial operations will not cause harmful interference to the existing L-band services of Inmarsat or others. Only a very small portion of the spectrum which Inmarsat now uses (approximately 3 MHz) is even potentially subject to co-channel interference from MSV, and Inmarsat has vastly overstated the interference environment by making unreasonable assumptions about such key parameters as shielding, power control, antenna discrimination, and polarization isolation.

In any case, to guard against any unacceptable interference, MSV will monitor the aggregate signal level reaching its own satellites and if necessary moderate the level of ancillary traffic. Inmarsat acknowledges that the look angle and design of MSV's satellites makes MSV's

system more susceptible than that of Inmarsat to any potential co-channel interference from ancillary U.S. terrestrial operations. Consequently, the safeguards which MSV has devised to ensure the viability of its own satellite and terrestrial networks also provide a mechanism for protecting Inmarsat.

No one makes a serious proposal for separate, unintegrated terrestrial and satellite systems to share MSS frequencies. The record provides no evidence that such independent operations could co-exist. This means that, if the Commission wants satellite service to remain viable and provide the improved quality and coverage that comes with ancillary terrestrial service, the only way to proceed is to allow existing licensees the flexibility to modify their licenses to add terrestrial facilities. Those facilities would be permitted to use only those frequencies licensed to and coordinated by the MSS system licensee for its satellite service.

Now that the Commission has had a round of comments on MSV's application and another round of comments on its Spectrum Flexibility proposal, all that remains is for the Commission to weigh the evidence and either act on the pending application or issue final rules. Mobile Satellite Ventures, for its part, stands ready to proceed with the construction and launch of a next-generation system that will offer affordable, handheld terminals and affordable advanced wireless communications on a truly nationwide mobile communications network.

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MOTIENT SERVICES INC.,
TMI COMMUNICATIONS AND COMPANY, LIMITED PARTNERSHIP, and
MOBILE SATELLITE VENTURES SUBSIDIARY LLC

Motient Services Inc. ("Motient"), TMI Communications and Company, Limited Partnership ("TMI"), and Mobile Satellite Ventures Subsidiary LLC ("MSV") hereby respond to the comments filed in the above-captioned proceeding regarding the Commission's proposal to provide Mobile Satellite Service ("MSS") licensees the flexibility to operate ancillary terrestrial base stations.[1] The comments demonstrate that the Commission's proposal offers several key public interest benefits: improving the viability and performance of satellite systems that are uniquely able to provide rural and remote service, making more scarce spectrum available for new services, and increasing competition in wireless services. The record demonstrates, at least

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1 MSV will provide MSS throughout North America using the satellites launched by Motient Services Inc. ("Motient") and TMI Communications and Company, Limited Partnership ("TMI"). Motient and TMI have applications pending before the Commission to assign their L-band MSS licenses to MSV.

in the bands in which MSV operates, these benefits can be obtained without reducing satellite capacity or causing harmful interference to other systems.

Background

In this proceeding, the Commission seeks comment on its Notice of Proposed Rulemaking ("NPRM") regarding proposals made by MSV and New ICO Global Communications (Holdings) Ltd. ("ICO") to augment their satellite service in urban areas with ancillary terrestrial facilities.[2] The Commission proposes to permit such flexibility and asks for comment on the need for ancillary terrestrial operations, ways to ensure that terrestrial operations remain ancillary to satellite service, the technical rules that should be adopted to protect co-channel and adjacent band licensees from interference, and licensing procedures. The Commission also seeks comment on an alternative approach that would authorize terrestrial operators to provide service either in conjunction with MSS operators or as an alternative service.

Commenters on the NPRM fall into three main groups: (i) MSS licensees and customers that support the Commission's primary proposal; (ii) those in the terrestrial wireless industry that primarily advocate the reallocation of MSS spectrum for terrestrial use only; and (iii) Inmarsat and its allies which argue that MSS is a viable service without terrestrial augmentation and that terrestrial operations will cause harmful interference to Inmarsat's L-band satellite service.

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[2] Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Band, *Notice of Proposed Rulemaking*, IB Docket 01-185 (August 17, 2001) ("NPRM").

Most MSS licensees support the Commission's MSS spectrum flexibility proposal.[3] MSS licensees agree that MSS signals cannot penetrate urban and indoor environments due to signal blockage and that the inability to provide service in these areas impedes the commercial viability of MSS.[4] In response to the terrestrial wireless industry's claim that MSS spectrum should be reallocated to terrestrial use, MSS providers cite the many public interest benefits of MSS, such as the provision of critical emergency services and the ability to serve maritime, aeronautical, and rural consumers that the terrestrial wireless industry cannot or does not want to serve.[5] MSS licensees agree that terrestrial operations will increase spectrum efficiency by using MSS spectrum in urban environments where it is currently unused and that terrestrial operations can do so without causing interference to other spectrum users.[6] They also note that allowing MSS providers to augment their signals with terrestrial facilities is consistent with the

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3 Comments of the Boeing Company, IB Docket No. 01-185 (Oct. 19, 2001); Consolidated Comments of Celsat America, Inc., IB Docket No. 01-185 (Oct. 19, 2001) ("Celsat"); Comments of Constellation Communications Holdings, Inc., IB Docket No. 01-185 (Oct. 22, 2001) ("Constellation"); Comments of Globalstar, L.P. and L/Q Licensee, Inc., IB Docket No. 01-185 (Oct. 22, 2001) ("Globalstar"); Comments of Loral Space & Communications Ltd., IB Docket 01-185 (Oct. 22, 2001) ("Loral"); Comments of Mobile Communications Holdings, Inc., IB Docket No. 01-185 (Oct. 21, 2001) ("MCHI"); Comments of Motient Services Inc., TMI Communications and Company, Limited Partnership, and Mobile Satellite Ventures Subsidiary LLC, IB Docket No. 01-185 (Oct. 22, 2001) ("MSV"); Comments of New ICO Global Communications (Holdings) Ltd., IB Docket No. 01-185 (Oct. 19, 2001) ("ICO"); Comments of TMI Communications and Company, Limited Partnership, IB Docket No. 01-185 (Oct. 22, 2001) ("TMI"); Comments of the Unofficial Bondholders Committee of Globalstar, L.P., IB Docket No. 01-185 (Oct. 21, 2001) ("Globalstar Bondholders"); *see also* Comments of Skytower, Inc., IB Docket No. 01-185 (Oct. 22, 2001) ("Skytower").

4 MSV at 11-16; Celsat at 8-9; Constellation at 2-3; Globalstar Bondholders at 18-20; ICO at 15-21; MCHI at 8-11; TMI at 1.

5 MSV at 5-11; Celsat at 17; Globalstar at 2-4; Globalstar Bondholders at 3-5; ICO at 5-15; Loral 2-5; MCHI at 5-8.

6 MSV at 16-18; Constellation at 5; Globalstar Bondholders at 27-28; ICO at 23-25; MCHI at 10.

Commission's spectrum flexibility policies as well as the recent decision to allow wireless cable licensees to provide mobile services.[7] The Progress and Freedom Foundation supports ancillary terrestrial operations by MSS providers, noting that such flexibility would be consistent with the "pro-market, pro-flexibility approach to spectrum allocation" the Commission has adopted.[8]

The Mobile Satellite Users Association ("MSUA") notes the valuable services MSS operators provide to rural and remote users such as truckers and farmers, government users including law enforcement agencies, and maritime and aeronautical users.[9] MSUA supports the improved service quality that would be provided by ancillary terrestrial service as well as the potential for it to bring more affordable service and greater commercial viability for the service providers. MSUA at 4.

The comments of the terrestrial wireless industry primarily focus on the 2 GHz band, although two comments by industry members mention in footnotes that their arguments could extend to the L-band. Cingular/Verizon at 7 n.19; CTIA at 3 n.3. The terrestrial wireless industry does not dispute that satellite service is problematic in urban areas, but it generally opposes the licensing of MSS providers to offer ancillary terrestrial services.[10] It argues that MSS is not a viable business model and that the Commission should not use this proceeding to

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7 MSV at 18-21; Celsat at 9; Constellation at 8; Globalstar at 6-8; Globalstar Bondholders at 23-27; ICO at 26-29; Loral 6-8, 13; MCHI at 9.

8 Comments of the Progress & Freedom Foundation, IB Docket No. 01-185 (Oct. 22, 2001) ("PFF").

9 Comments of the Mobile Satellite Users Association, IB Docket No. 01-185, at 3-4 (Oct. 22, 2001) ("MSUA").

10 Comments of AT&T Wireless Services, Inc., IB Docket No. 01-185 (Oct. 22, 2001) ("AWS"); Comments of the Cellular Telecommunications & Internet Association, IB Docket No. 01-185 (Oct. 22, 2001) ("CTIA"); Joint Comments of Cingular Wireless and Verizon Wireless, IB Docket No. 01-185 (Oct. 22, 2001) ("Cingular/Verizon");

Footnote continued on next page

preserve MSS.[11] It also contends that MSS providers are seeking to operate in urban areas in order to cross-subsidize service in rural areas. Cingular/Verizon at 15 n.48; CTIA at 12-13. Rather than allowing MSS providers to operate terrestrially, terrestrial wireless interests urge the Commission to reallocate MSS spectrum to exclusively terrestrial use and issue licenses via an auction. AWS at 13-14; Cingular/Verizon at 21-23; TDS at 12-13. In the alternative, if the Commission does allow for terrestrial use of MSS spectrum, the terrestrial wireless carriers argue that the opportunity to operate on the same spectrum as MSS operators should be made available to all interested parties and issued pursuant to an auction.[12] The terrestrial wireless carriers contend that otherwise, MSS providers will receive a "free" license that could give them a competitive advantage over terrestrial licensees that were awarded licenses via an auction.[13] The Progress and Freedom Foundation advocates a system of fees to be imposed on MSS providers for terrestrial use of MSS spectrum. PFF at 2, 13-15.

Inmarsat and its allies compose the third group of commenters.[14] They do not dispute the technical limitations of satellite service alone, but they argue that MSS is viable without the

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Comments of the Rural Cellular Association; Docket No. 01-185 (Oct. 22, 2001); Comments of Telephone and Data Systems, Inc., Docket No. 01-185 (Oct. 22, 2001).

11 AWS at 8-10; Cingular/Verizon at 17-18; CTIA at 6; TDS at 11-12.

12 Cingular/Verizon at 7; CTIA at 2, 7-8. Iridium proposes an auction for secondary terrestrial rights. Comments of Iridium Satellite LLC, IB Docket No. 01-185 (Oct. 22, 2001).

13 AWS at 11-13; Cingular/Verizon at 7, 10-11; CTIA at 11; TDS at 6-7.

14 Comments of Inmarsat Ventures plc, IB Docket No. 01-185 (Oct. 22, 2001); Comments of the Aviation Industry Parties (Air Transport Association of America, International Air Transport Association, and Aeronautical Radio, Inc., IB Docket 01-185 (Oct. 19, 2001) ("Aviation Parties"); Comments of Stratos Mobile Networks (USA) LLC and Marinesat Communications Network, Inc., IB Docket No. 01-185 (Oct. 22, 2001) ("Stratos"); Comments of Telenor Broadband Services AS, IB Docket No. 01-185 (Oct. 19, 2001).

ability to provide service in urban and indoor environments. Inmarsat at 2-11; MSUA 2-3; Telenor at 4. Inmarsat contends that there is sufficient demand for MSS from its current subscriber base of rural, maritime, and aeronautical customers. Inmarsat at 11. Regarding terrestrial operations in the L-band, Inmarsat and its allies claim that such operations will cause harmful interference to Inmarsat's service in the L-band as well as reduce available L-band spectrum.[15]

Other comments include those of the Aerospace and Flight Test Radio Coordinating Council ("AFTRCC"), which urges the Commission to ensure that terrestrial operations in the 1525-1559 MHz band do not cause harmful interference to aeronautical telemetry operations in the 1435-1525 MHz band.[16]

Discussion

I. ANCILLARY TERRESTRIAL OPERATIONS ARE ESSENTIAL TO MAINTAIN THE VIABILITY OF MOBILE SATELLITE SERVICE

A. MSS Is Uniquely Capable of Providing Certain Critical Services

The supporters of spectrum flexibility provide abundant and compelling evidence that rural areas are severely lacking in digital coverage and that only satellite service will be able to

15 Inmarsat at 12-18; Aviation Parties at 4-5; Stratos at 3-4, 8-9; Telenor at 6-7; Comments of Comtech Mobile Datacom Corporation, IB Docket No. 01-185 (Oct. 19, 2001), at 4; Comments of KITComm Satellite Communications Ltd., IB Docket No. 01-185 (Oct. 22, 2001), at 3-4.

16 Comments of Aerospace and Flight Test Radio Coordinating Council, IB Docket No. 01-185 (Oct. 22, 2001). Other comments focus on the 2 GHz and Big LEO MSS bands and, as such, are not the focus of this reply. *See* Joint Comments of the Association for Maximum Service Television, Inc. and the National Association of Broadcasters, IB Docket No. 01-185 (Oct. 22, 2001); Comments of the Society of Broadcast Engineers, Inc., IB Docket No. 01-185 (Oct. 19, 2001); Comments of the Wireless Communications Association, IB Docket No. 01-185 (Oct. 22, 2001); Comments of the Wireless Communications Division of the Telecommunications Industry Association, IB Docket No. 01-185 (Oct. 22, 2001).

overcome this problem.[17] Rural areas deserve the benefits of competition as much as urban areas, yet terrestrial wireless providers simply do not now and never will serve rural areas, oceans and waterways, and aeronautical users.

Terrestrial wireless carriers that advocate reallocating MSS spectrum to terrestrial use ignore the critical public interest benefits of MSS.[18] It is telling that while the Commission specifically asked that commenters provide data regarding the ability of current and future terrestrial systems to serve rural and unserved areas compared to satellite systems,[19] the terrestrial wireless industry was silent. CTIA provides the only evidence of coverage by terrestrial carriers in rural areas; its map confirms that coverage is far less extensive in rural areas than in urban areas. CTIA at 9 n.36.

The lack of evidence provided by terrestrial carriers of future or planned rural digital or broadband coverage is not surprising. Terrestrial wireless carriers know that they do not currently serve or have plans to serve areas that do not have a sufficient population density. Thus, when the terrestrial wireless interests tell the Commission that MSS is a failed allocation, that it is not the Commission's duty to preserve MSS, and that MSS spectrum should be reallocated to terrestrial use, they are effectively telling the Commission to abandon rural, maritime, and aeronautical users so that terrestrial wireless carriers can gain access to even more spectrum to serve their current subscriberships in population-rich areas. AWS at 8-11; Cingular/Verizon at 17; CTIA at 6; TDS at 12.

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17 MSV at 7-8; Constellation at 10-11; Globalstar Bondholders at 7-8; ICO at 8-11; Loral at 2-4; MCHI at 5-7; MSUA at 3.

18 MSV at 5-11; Celsat at 17; Globalstar at 2-4; Globalstar Bondholders at 3-5; ICO at 5-15; Loral 2-5; MCHI at 5-8.

19 NPRM at ¶ 26.

Rural, maritime, and aeronautical users are not the only beneficiaries of MSS. As the commenters note, in times of emergency, satellite service is often the only means of communications.[20] The many accounts of how MSS was used by rescue workers in New York City after the recent terrorist attacks as well as during floods, earthquakes, hurricanes, and other natural disasters demonstrate the critical role of MSS in America today.[21]

B. Ancillary Terrestrial Operations Are Needed to Sustain the Viability of the Mobile Satellite Service

Comments of the MSS industry demonstrate the signal problems MSS providers and customers face in urban environments, and the potential of spectrum flexibility to overcome that problem, leading to a broader customer base and lower handset and airtime price, and thereby providing the solution to maintaining the commercial viability of MSS.[22] In addition, MSS providers note that ancillary terrestrial operations will enhance the quality and reliability of MSS,[23] represent efficient use of spectrum,[24] and will result in additional funding for the MSS industry.[25]

Inmarsat and its users argue that ancillary terrestrial operations are not needed because a satellite-only service can succeed with a customer base of only aeronautical, maritime, and rural users. Inmarsat at 2-11; Stratos at 3; Telenor at 4; MSUA 2-3. But Inmarsat's success among

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20 MSV at 9-10, Exhibits B &C; Globalstar Bondholders at 9-12; ICO at 13-15; MCHI at 6 n.13; MSUA at 4.

21 MSV at 9-10, Exhibits B & C; Globalstar Bondholders at 10-12; ICO at 13-15; MCHI at 6 n.13; MSUA at 2-3; Stratos at 6-7.

22 MSV at 11-16; Constellation at 3-6, 9-10; Globalstar Bondholders at 19-20; Globalstar at 3-4, 13.

23 Celsat at 14; MCHI at 2, 10-11; Global. Bonds. at 17-19; Globalstar at 3, 13; Constellation at 2-5, 7.

24 Constellation at 5; Globalstar Bondholders at 27-28; MCHI at 10; ICO at 25-29.

MSS providers is an anomaly. No other MSS provider has had the decades of government ownership, worldwide monopoly, and privileges and immunities Inmarsat has enjoyed. Even now, Inmarsat is still owned in large part by foreign governments.[26]

Despite the contentions of the terrestrial wireless industry, MSS providers are not seeking a subsidy either from the government or from urban customers. Cingular/Verizon at 15 n.48; CTIA at 12-13. As CTIA correctly notes, a cross-subsidy is not possible in a competitive environment. CTIA at 12. MSS terrestrial operations will have to compete with terrestrial-only services in urban areas, thereby eliminating the potential to raise prices above their competitive level. The viability that accompanies spectrum flexibility is the result of additional revenue and added efficiency from the critical mass of subscribers that are possible with terrestrial operations. This critical mass is reached by increasing the utility and value of the service. There is a market for this kind of truly nationwide service. Subscribers in rural and remote areas want access to wireless high-speed data and good coverage using an inexpensive, lightweight mobile phone—just like what is available to their urban counterparts. Many urban subscribers want a single, lightweight mobile phone that will provide reliable service (including high-speed data service) when they travel in rural and remote areas that are not and likely never will be served by terrestrial-only carriers. Urban, suburban, and rural customers of MSV will choose MSV because they want and need its unique capabilities. There will be no subsidy.

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25 Globalstar Bondholders at 6, 15, 20; Globalstar at 3.

26 *See* Comsat Corporation et al., *Memorandum Opinion, Order and Authorization*, FCC 01-272 (Oct. 9, 2001), at ¶¶ 40, 43 (noting that the Signatories to INMARSAT (the intergovernmental organization) received shares in Inmarsat Ltd. (the private company) in proportion to their shares in INMARSAT and that Inmarsat Ltd. has not yet conducted an initial public offering to dilute its ownership by former Signatories).

C. Ancillary Terrestrial Operations Will Increase Competition in the MSS and Terrestrial Marketplace

Ancillary terrestrial operations will increase competition in both the MSS and terrestrial wireless market. The Aviation Parties note that service to rural America does not depend on maintaining the viability of MSV because Inmarsat will continue to provide service if MSV fails. Aviation Parties at 10. Indeed, if Inmarsat had its way, MSS providers would be denied the flexibility to operate terrestrially, thereby impeding their ability to maintain viable businesses, leaving only Inmarsat to provide MSS in the United States. Inmarsat services have historically been attractive only for niche applications, due to their high prices and limited form factors. But rural, aeronautical, and maritime consumers are as deserving as urban consumers of competition, lower prices, and improved telecommunications services and equipment. Indeed, while Inmarsat claims that it will continue to serve rural, aeronautical, and maritime consumers if other MSS providers fail, Inmarsat will never be able with a satellite-only network to offer the low-cost service and small, inexpensive and lightweight phones that MSV will be able to offer if it is permitted to integrate terrestrial operations into its satellite service. If left to Inmarsat alone, these consumers will be left with the same Inmarsat mobile terminals costing thousands of dollars each and dollars per minute for service. The Commission cannot allow these non-urban consumers to have at most only Inmarsat as an option for their telecommunications needs.

MSS terrestrial operations will also provide added competition to the terrestrial wireless industry. While Inmarsat argues that the nation does not need a seventh nationwide mobile phone provider,[27] most areas of the country have far fewer than six providers of terrestrial wireless service. As MSV discussed in its comments, and as the map CTIA references shows,

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27 Inmarsat at 27.

most areas of the country with lower population densities do not enjoy significant competition in the wireless market, if they enjoy any wireless service at all.[28] In addition, the inevitable consolidation that will result from the Commission's recent decision to eliminate the CMRS spectrum cap effective January 1, 2003 will lead to even less competition among terrestrial providers. *See Report and Order*, FCC 01-328 (adopted Nov. 8, 2001). Another source of competition can do nothing but benefit the nation's wireless telecommunications consumers.[29] Terrestrial operations by MSS providers will also provide consumers with an option they do not have today – truly ubiquitous service (nationwide, on the oceans and waterways, and in the air) with a small, handheld phone.

D. Dual-band Arrangements Are Not a Solution to MSS Coverage Problems

Inmarsat and the terrestrial wireless industry claim that MSS operators can provide service in urban areas by relying on commercial arrangements with terrestrial carriers operating in other bands.[30] MSV noted in its Comments the fundamental problems with reliance on dual-band arrangements with terrestrial wireless carriers, such as the minimal revenue generated for MSS providers, the unwillingness of equipment manufacturers to develop handsets operating with multiple protocols, the size and weight of the phones, and the difficulty with negotiating arrangements with numerous terrestrial carriers in order to achieve a nationwide footprint. MSV

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28 MSV at 22; CTIA at 9 n.36 (citing In the Matter of Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993, Annual Report and Analysis of Competitive Market Conditions With Respect to Commercial Mobile Services, *Sixth Report*, FCC 01-192, at Appendix E, Map 1 (released July 17, 2001) ("*Sixth CMRS Report*")).

29 For reasons already made clear, MSV disagrees with Globalstar that MSS will not compete with traditional terrestrial wireless providers. Globalstar at 14-15.

30 AWS at 6-7; Aviation Parties at 10; CTIA at 13; Inmarsat at 27-28; Telenor at 6-7; Stratos at 10.

at 14-16. These same concerns are echoed by other MSS providers. Celsat at 8; Global. Bondholders. at 8; Globalstar at 15, 34. Globalstar, another MSS provider with first-hand experience with the problems of dual-band arrangements, notes that such arrangements require consumers to have two phone numbers and that the MSS provider has no control over service quality, pricing, or billing practices of the terrestrial provider. Globalstar Bondholders at 34; Globalstar at 14. ICO adds that to the extent that roaming arrangements may be feasible for voice service, they would not allow for data, push-to-talk, text messaging, and other advanced features. ICO at 22. In fact, MSV alone among MSS or terrestrial wireless operators currently provides a wide-area or nationwide push-to-talk dispatch service, which would find enhanced usage as part of a next-generation MSS system.

Perhaps most importantly, relying on such arrangements would be a grossly inefficient use of valuable spectrum. The spectrum flexibility proposed by the Commission provides a dramatic increase in spectrum efficiency, with terrestrial and satellite facilities sharing the same spectrum. That efficiency would be lost if MSS operators had to rely on arrangements with terrestrial wireless operators in other bands.

E. Terrestrial "Repeaters" Are Not a Solution to MSS Coverage Problems

CTIA argues that terrestrial repeaters may be a solution to coverage difficulties of MSS providers, similar to the terrestrial operations of Digital Audio Radio Service ("DARS") licensees. CTIA at 6-7. Such an approach, however, would be an inefficient use of spectrum and would degrade satellite service. As ICO notes, such an approach would require all traffic to travel over the satellite, thereby taking satellite capacity that is needed to serve rural areas. ICO at 25 n. 41. While the use of terrestrial repeaters for DARS licensees has proven the consumer benefits and commercial attractiveness of the combined satellite/terrestrial approach, repeaters are spectrum efficient only for broadcast operations and not for two-way, point-to-point communications.

II. MSV'S TERRESTRIAL OPERATIONS WILL BE ON A NON-INTERFERENCE BASIS AND WILL NOT REDUCE SATELLITE USE OF L-BAND SPECTRUM

MSV fully appreciates the need for all existing operations to be protected from harmful interference by its proposed terrestrial service and has designed its system to demonstrably provide such protection. As discussed in the attached Technical Appendix, using conservative assumptions, MSV can operate its proposed terrestrial facilities, including thousands of terminals operating simultaneously on each of MSV's carrier frequencies, without risk of causing harmful interference to MSV's own satellite operations or to any of the co-channel, adjacent channel, or adjacent band operations of Inmarsat, aeronautical telemetry users, or others. Regarding co-channel interference to Inmarsat, as noted in the Technical Appendix, Motient and TMI have accessed very little L-band spectrum that is co-channel with Inmarsat satellites that are visible to North America. Technical Appendix at 2. As a further safeguard, MSV will monitor emissions from terrestrial mobiles at its satellites to insure that they do not approach a level that could interfere with its own or other systems.

III. INDEPENDENT TERRESTRIAL OPERATIONS IN THE L-BAND ARE NOT FEASIBLE

Terrestrial wireless interests and Iridium argue that if the FCC allows terrestrial use of MSS spectrum, then the Commission should auction these terrestrial rights to any interested parties. Cingular at 7; CTIA at 10-11; Iridium at 5-7. Advocates of such an approach, however, provide absolutely no technical evidence of how independent terrestrial operators can exist without causing debilitating interference to satellite operations. As MSV and other MSS operators make very clear, satellite and terrestrial operations in the L-band must be integrated under the control of one entity.[31] Regarding the L-band, MSV demonstrated that time-sharing and dynamic spatial coordination are the only means by which ancillary terrestrial operators in the L-band can reuse frequencies assigned to the U.S. MSS system and that such coordination requires that ancillary terrestrial operations be an integral part of the MSS network. MSV at 33-36; Tech. App. Section II. In contrast, independent terrestrial operations would cause debilitating interference to L-band MSS operators or severely reduce satellite capacity, potentially breach international coordination agreements, jeopardize safety services, and slow the deployment of service. *Id.* In addition, if the satellite and terrestrial operations are independent, the satellite operations also will cause interference to terrestrial operations. Other MSS providers add that the interests of the independent terrestrial carrier and the MSS operator will never be aligned to achieve the type of coordination required for integrated satellite and terrestrial operations in MSS spectrum.[32] Despite the Commission's request for comment on these issues,[33] not one advocate of independent terrestrial operations discusses how it could overcome these problems.

Iridium proposes a scheme for licensing terrestrial operations to operate on a "secondary" basis, but it too fails to show that independent operations are practical or desirable. Iridium at 5-8. The careful coordination required to operate terrestrially in MSS spectrum without causing debilitating interference to satellite operators means either an MSS provider can operate

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31 MSV at 33-36; Boeing at 6, 9-12; Constellation at 19; Globalstar Bondholders at 28 n.55, 33-34;MCHI at 10 n.23.

32 Constellation at 19; Globalstar Bondholders at 28 n.55, 33-34; MCHI at 10 n.23.

33 NPRM at ¶ 49; *see* MSV at 33-34. In addition to these basic coordination issues applicable to all MSS bands, terrestrial providers never discuss how the L-band international coordination process and requirements for priority and preemptive access would be affected by independent terrestrial operations in the L-band.

terrestrial facilities to supplement its satellite service, or no one can, leaving the spectrum to lie fallow.

IV. GRANTING MSS PROVIDERS FLEXIBILITY TO OPERATE TERRESTRIALLY ON AN ANCILLARY BASIS IS LAWFUL AND CONSISTENT WITH COMMISSION POLICY

A. Ancillary Terrestrial Operations in the L-band Are Consistent with International Treaties and Agreements

Authorizing terrestrial operations in the L-band is consistent with the ITU Radio Regulations as well as the Mexico City Memorandum of Understanding ("MOU"), because such operations will be on non-interference basis to other systems, will not be a factor in L-band coordination negotiations, and will not cause MSV self-interference resulting in increased spectrum demands. In addition, as commenters note, terrestrial use of MSS spectrum is consistent with the vision of International Mobile Telecommunications-2000 ("IMT 2000") set forth by the ITU. Celsat at 2-7, 9; MCHI at 4.

MSV recognizes that the L band is not allocated internationally for terrestrial use. MSV at 23. But the ITU Radio Regulations allow the Commission to license operations that go beyond the international table of frequency allocations as long as the assignment is expressly conditioned on not causing harmful interference to other operations. ITU Radio Reg. Article S4.4. Inmarsat argues that MSV's proposed terrestrial operations will cause harmful interference to the operations of the Inmarsat, Russian, Japanese, and Mexican L-band systems. Inmarsat at 18. As discussed above and in the attached Technical Appendix, however, MSV has shown using very conservative assumptions that such interference will not occur. MSV's proposed terrestrial operations in the L-band will not cause harmful interference to Inmarsat's operations or those of any other systems, either inside or outside of the United States.

In connection with its application to launch and operate a next-generation satellite system, MSV demonstrated that its terrestrial operations will not exceed 6% □T/T, which is the ITU standard for determining when GSO satellites must coordinate with one another.[34] Inmarsat argues that even if MSV meets this standard, it has no relevance for terrestrial operations because it only applies to satellite coordination and Inmarsat and the United Kingdom have no obligation to coordinate an L-band MSS system with terrestrial facilities. Inmarsat at 19. Inmarsat, in effect, argues that any interference from L-band terrestrial base stations, no matter how small and imperceptible, is too much. The Commission should not entertain such an unreasonable interpretation on what constitutes operation on a "no harmful interference" basis.

MSV's proposed terrestrial operations are consistent with the Mexico City MOU. Inmarsat cites a number of provisions of the MOU that the United States will purportedly violate if its allows MSV to operate terrestrially. First, Inmarsat cites a provision that requires the United States to avoid situations that could give rise to unacceptable interference within North America to MSS systems covered by the MOU and to resolve any harmful interference. Inmarsat at 22. Again, however, as discussed above and in the Technical Appendix, MSV's proposed terrestrial operations in the L-band will not cause harmful interference to any MSS systems. Inmarsat also argues that it is relevant to this proceeding that, as Inmarsat alleges, Motient has refused to negotiate a new agreement because its need for L-band spectrum is presently low and it is hoping to receive authority to operate terrestrially to increase its demands. Inmarsat at 23. This is nonsense. The reason there is no new agreement is that Inmarsat refuses

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34 *Ex Parte* Letter from Bruce D. Jacobs, Counsel for Motient and MSV, to Ms. Magalie Roman Salas, Secretary, FCC, File No. SAT-ASG-20010302-00017 et al. (July 6, 2001); *Ex Parte* Letter from Bruce D. Jacobs, Counsel for Motient and MSV, to Ms. Magalie

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to permit the new regional systems to gain access to the spectrum they need and are entitled to under the MOU for their satellite operations. The North American regional operators (Motient and TMI) have never sought to coordinate spectrum for terrestrial use and MSV is not changing that position now. MSV is committed to continuing to limit its coordination efforts to gaining access to spectrum for its satellite operations. MSV at 26. As discussed in the attached Technical Appendix, MSV's terrestrial operations will not cause harmful interference to MSV's own satellite operations and will not cause MSV to demand more L-band spectrum.[35]

B. Ancillary Terrestrial Operations Are Consistent with the Communications Act and Commission Decisions and Policies

Authorizing MSS providers to operate terrestrial facilities in the L-band without requiring an auction is consistent with Sections 303(y) and 309(j) of the Communications Act, the decisions and policies of the Commission regarding flexible use of spectrum, and the decision authorizing TMI and Inmarsat to provide service in the United States.

1. Permitting Ancillary Terrestrial Operations Is Consistent with Section 303(y)

Because the Commission is not being asked to allocate or reallocate a frequency band for flexible use, it is unclear that Section 303(y) even applies to the requests to operate ancillary terrestrial facilities in MSS spectrum. MSV at 21. Rather, merely adding a footnote to the Table

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Roman Salas, Secretary, FCC, File No. SAT-ASG-20010302-00017 et al. (July 25, 2001).

35 Inmarsat also takes issue with MSV's request to operate its next-generation system in the entire L-band, arguing that MSV cannot prevent others from operating in the L-band under the pretext that its use of the entire L-band is "subject to international coordination." Inmarsat at 25. This shows a misunderstanding of MSV's application, which seeks the same right that Inmarsat has to access for satellite operations as much of the L-band as it can coordinate.

of Allocations will suffice to allow for ancillary terrestrial operations. In any event, as MSV and other MSS licensees demonstrate, ancillary terrestrial operations are consistent with Section 303(y) of the Communications Act.[36] 47 C.F.R. § 303(y). Ancillary terrestrial operations meet all the requirements of the Act: they are consistent with international agreements;[37] will promote continued satellite service to all Americans;[38] will increase spectrum efficiency;[39] will not create harmful interference;[40] and will spur, not deter, investment in MSS communications services by improving coverage in urban areas.[41]

2. Permitting Ancillary Terrestrial Operations Without an Auction Is Consistent with Section 309(j)

From both a legal and a policy perspective, the Commission can allow MSS providers to operate ancillary terrestrial facilities without requiring an auction. As an initial matter, as discussed above, independent terrestrial operations in the L-band are not feasible. Thus, any argument that L-band spectrum could somehow be auctioned to be used for terrestrial services by an independent entity in conjunction with an L-band MSS operator is implausible. The fact is that if the Commission decides to continue to permit satellite operations in the band, the satellite system operator is the only entity that can provide terrestrial service. Any separately licensed

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36 MSV at 21; Celsat at 9-13; Constellation at 8; Globalstar Bondholders at 23 n.38; Globalstar at 6-9; ICO at 29; Loral at 2, 8-9.

37 *See supra* pages 14 to 16; MSV at 21; Celsat at 9-10; Globalstar Bondholders at 23-24, n.38; Globalstar at 7-8; ICO at 29; Loral at 8-9.

38 MSV at 21.

39 MSV at 21; Celsat at 11-12; ICO at 29; Loral at 9.

40 *See supra* page 12; Technical Appendix; MSV at 21; Celsat at 13; Globalstar Bondholders at 23-24, n.38; Globalstar at 8-9; ICO at 29; Loral at 9.

41 MSV at 21; Celsat at 12-13; Globalstar Bondholders at 23-24, n.38; Globalstar at 8; ICO at 29; Loral at 9.

entity attempting to provide terrestrial service would cause unacceptable interference to satellite operations. Thus, commenters' discussion of auctions and the ORBIT Act are largely academic.

From a legal perspective, auctioning MSS spectrum for ancillary terrestrial use is not required and appears to be prohibited. Several commenters argue that Section 309(j) requires that the Commission auction MSS spectrum for any terrestrial use. *See, e.g.*, Cingular/Verizon at 7-9; CTIA at 3, 7-9. These same commenters argue that the ORBIT Act, which prohibits the auctioning of "spectrum used for the provision of international or global satellite communications services," does not prohibit such auctions because the spectrum will be used terrestrially. *See* 106 P.L. 180, 114 Stat. 48, codified at 47 U.S.C. §765f.

Section 309(j) does not require auctions when the Commission grants an existing licensee flexibility to augment its service to provide enhanced service to the public.[42] The Commission authorized Motient to provide MSS in 1989,[43] and now MSV, the successor to Motient, is seeking to launch a replacement system.[44] Its proposed use of its licensed frequencies requests only an ancillary terrestrial component to an already authorized international satellite service. Nothing in Section 309(j) or the Commission's policies require the Commission to issue a new authorization or revoke an existing license to allow a licensee a flexible use of its existing

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42 Section 309(j) of the Communications act provides that:

"If, consistent with [the Commission's obligation to avoid mutual exclusivity], mutually exclusive applications are accepted for any initial license or construction permit, then ... the Commission shall grant the license or permit to a qualified applicant through a system of competitive bidding." 47 U.S.C. § 309(j).

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

44 *See* Application of Motient Services Inc. and Mobile Satellite Ventures Subsidiary LLC, File No. SAT-ASG-20010302-00017 et al. (March 2, 2001).

spectrum. *See* Loral at 11. Thus, there should be no mutual exclusive applications for initial licenses and Section 309(j) of the Communications Act is therefore not implicated.[45]

The ORBIT Act precludes the Commission from auctioning the spectrum at least to the extent that it is to be used for international satellite services. As ICO notes, pursuant to *National Public Radio v. FCC*,[46] to the extent that Congress has created specific exemptions from competitive bidding procedures, the Commission must take those exemptions seriously. ICO at 39.

A decision by the Commission to grant flexible use of the MSS spectrum and not to conduct auctions does not accord different treatment to similarly situated parties in violation of *Melody Music*.[47] Such a charge would be more appropriate if the Commission was to authorize some but not all similarly situated MSS licensees to operate ancillary terrestrial facilities.

From a policy perspective, authorizing ancillary terrestrial use by MSS providers is not unfair to terrestrial providers and will not produce a windfall for the MSS industry. AWS and CTIA argue that allowing MSS providers to operate terrestrially will amount to the award of a "free" license without compensation to the public when terrestrial providers had to pay for their licenses at auction. AWS at 11-12; CTIA at 11. As a result, they argue, MSS providers will enjoy a cost advantage over terrestrial providers. AWS at 11-12; CTIA at 11. Ironically, this argument comes from companies that themselves were awarded licenses worth billions of dollars without paying a penny at auction. As Loral points out, almost all the cellular licenses were

45 *See* Constellation at 21; Loral at 10-11; *see also* ICO at 38 (Commission's obligation under Section 309(j)((6)(E) to avoid mutual exclusivity whenever possible is appropriate here where one proposal is preferable on every relevant policy ground except the amount of money generated for the U.S. Treasury).

46 254 F.3d 226 (D.C. Cir. 2001).

47 TDS at 8 (citing Melody Music, Inc. v. FCC, 345 F.2d 730 (D.C. Cir. 1965)).

awarded using selection procedures other than auctions. Loral at 12. If AWS truly desires a level playing field among terrestrial wireless providers, then the Commission would have to take back and auction these cellular licenses. Moreover, MSS operators such as MSV have already incurred enormous costs (over $1.5 billion) in connection with the development of their existing satellite systems.

The purpose of auctions is not to raise money for the federal government, and in fact the public will not go uncompensated if the Commission allows MSS operators the flexibility to operate terrestrial facilities without conducting an auction.[48] MSS providers are committing to spend billions of dollars to launch satellites to provide broadband service to the rural, aeronautical, and maritime consumers that are unserved by terrestrial wireless or wireline carriers. Service to this segment of the America population is not only a benefit to those users, but to the nation as a whole.[49] The MSS industry is committing to spending billions of dollars to ensure that rural and underserved America are afforded access to the same broadband capabilities as urban dwellers. Both industries, therefore, are sacrificing to benefit the public good. For the same reasons, MSV does not support the Progress and Freedom Foundation's suggestion that MSS providers be required to pay a fee in order to operate terrestrially to ensure a level playing field. PFF at 13-15.

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48 47 U.S.C. § 309(j)(7)(A) (the Commission may not base a finding of public interest, convenience, and necessity on expectation of Federal revenues resulting from use of competitive bidding); *see also* Loral at 12.

49 *See* Federal-State Joint Board On Universal Service, *Report and Order*, 12 FCC Rcd 8776, ¶ 8 (May 8, 1997) ("At the simplest level, increasing the number of people

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3. Permitting Ancillary Terrestrial Operations Is Consistent with Commission Policies and Decisions

As MSV and other commenters note, ancillary terrestrial operations are consistent with the Commission's flexibility policies and decisions, such as allowing DARS licensees to supplement their satellite signals with terrestrial repeaters,[50] allowing terrestrial wireless carriers to provide fixed services,[51] allowing paging licensees to operate from high altitude balloons,[52] permitting flexible use of broadcast spectrum,[53] and adopting flexible service rules for the Wireless Communications Service[54] and Interactive Video and Data Service ("IVDS").[55] Many commenters note that the Commission's recent decision to allow MDS/ITFS licensees to provide mobile services presents an analogous situation to what the Commission faces in this proceeding.[56] In the MDS/ITFS proceeding, rather than acceding to the demands of the terrestrial wireless industry that MDS/ITFS spectrum be reallocated for 3G wireless use, the Commission instead allowed the incumbent MDS/ITFS licensees themselves to provide 3G services. The Commission should do the same here.

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connected to the telecommunications network makes the network more valuable to all of its users by increasing its usefulness to them.").

50 MSV at 20; Celsat at 13; Globalstar Bondholders at 25; ICO at 26-28; MCHI at 9-10, n. 22; SkyTower at 4.

51 MSV at 19; Celsat at 12; Globalstar Bondholders at 26; ICO at 26; Loral at 6-8; MCHI at 9-10, n. 22.

52 MSV at 18; SkyTower at 4.

53 MSV at 19; Celsat at 12; Globalstar Bondholders at 26-27; ICO at 26; MCHI at 9-10, n. 22; Progress and Freedom Foundation at 6.

54 MSV at 19; Celsat at 11-12; Globalstar Bondholders at 27; Progress and Freedom Foundation at 6.

55 Loral at 7.

4. Ancillary Terrestrial Operations Are Consistent with the Decisions Allowing L-band MSS in the United States

Finally, terrestrial operations in the L-band will not violate the "non-interference" condition of the *Inmarsat* and *TMI Orders*.[57] In granting applications to provide MSS in the United States using the satellites of Inmarsat and TMI, the Commission conditioned operations in the L band on a non-interference basis because of the lack of a long term coordination agreement. *Inmarsat Order* at ¶ 72; *TMI Order* at ¶ 34. Because L-band terrestrial operations will be a non-interference basis, this condition will continued to be satisfied.

C. MSS Terrestrial Operations Will Remain Ancillary to and Integrated with Satellite Operations

Some commenters doubt whether "ancillary" terrestrial operations will be truly ancillary. They argue that terrestrial operations will inevitably dominate satellite use and that more revenue will be generated from terrestrial than satellite usage, thereby giving MSS providers incentive to abandon satellite service in favor of terrestrial.[58] They also suggest certain conditions that should apply to ensure that terrestrial operations remain ancillary. Comtech at 5; CTIA at 6-7. Finally, they argue that the satellite and terrestrial components of an MSS provider's network will not be integrated because a call could originate and terminate over the terrestrial portion of the network without ever being carried over the satellite. AWS at 5-6; CTIA at 5-6; RCA at 2-3.

Footnote continued from previous page

56 MSV at 19; Celsat at 11-12; Globalstar Bondholders at 24-25; ICO at 26-28; Loral at 6-8, 13; MCHI at 9-10, n. 22.

57 *See* Comsat Corporation et al., *Memorandum Opinion, Order and Authorization*, FCC 01-272 (Oct. 9, 2001) ("*Inmarsat Order*"); SatCom Systems, Inc. and TMI Communications and Company, L.P., *Order and Authorization*, 14 FCC Rcd 20798 (Nov. 30, 1999) ("*TMI Order*").

58 Aviation at 10; Inmarsat at 26-27; Telenor at 7; Stratos at 10; CTIA at 3-4; RCA at 2.

The Commission has already addressed these concerns by specifically proposing that MSS operations launch a satellite that provides full coverage of the United States prior to operating terrestrial facilities for commercial service. NPRM at ¶¶ 32, 42. This proposal enjoyed unanimous support among MSS providers.[59] Any argument that an MSS provider will suddenly abandon its satellites once terrestrial operations commence fails to appreciate the economics underlying the satellite industry. Constructing and launching a satellite is the largest expenditure a satellite firm faces. Thus, once launched and operating, an MSS operator will have every incentive to receive a return on that investment. *See* Constellation at 6. Far from abandoning its satellite, the MSS provider will seek to maximize its use of the satellite to avoid having to construct otherwise unnecessary terrestrial facilities.

Satellite and terrestrial operations will be integrated even though it is possible for calls over MSV's system to originate and terminate over the terrestrial component without accessing the satellite. How traffic is routed over the network has no bearing on whether the terrestrial portion is integrated with the satellite portion. At all times in the system MSV proposes, the satellite and terrestrial components will share the same spectrum, will be under the central control of a dynamic radio resource manager that allocates and distributes frequencies between the terrestrial and satellite portions in real time,[60] and will have a system of switches that are networked together and monitored at a central point.[61]

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59 MSV at 23-24; Boeing at 8; Celsat at 14; Constellation at 26-27; Globalstar Bondholders at 29-30; ICO at 44.

60 MSV, Technical Appendix, at 2-5.

61 MSV, Technical Appendix, at 7.

V. THE COMMISSION SHOULD ADOPT MSV'S PROPOSED SERVICE AND LICENSING RULES FOR L-BAND GSO OPERATORS

A. MSV Supports Fifty-State Coverage for L-band MSS Operators and a Two-Year Replacement Period

MSV initially recommended that the coverage requirement for L-band satellites only extend to CONUS, but it is now prepared to agree with those licensees that proposed to require MSS operators to provide satellite coverage to at least the 50 states prior to operating terrestrial facilities.[62]

ICO also suggests that MSS operators be allowed three months to replace a failed satellite, which would effectively require an in-orbit spare, in order to continue terrestrial operations. ICO at 44. In ICO's case, this reflects its intention to operate a constellation of several satellites as is appropriate for a non-geostationary system. MSV, in contrast, plans to launch and operate two GSO satellites, which will enable MSV to meet its proposed fifty-state coverage requirement even if one satellite should fail. The only way in which MSV will not provide fifty-state satellite coverage is in the very unlikely event that both satellites fail. For replacing a satellite, MSV therefore proposed a two-year timeframe, which reflects its system design. MSV at 24-25. MSV continues to urge the Commission to consider these differences in system design when adopting final rules governing replacement of failed satellites.

B. MSV Supports the Commission's "Central Data Switch" Concept to the Extent It Means Common Control of Satellite and Terrestrial Facilities

In its comments, MSV supported the Commission's "central data switch" concept to the extent it means that the satellite and terrestrial components of an MSS system will be monitored and controlled centrally. MSV at 25-26. ICO reads the "central switch data" concept to mean

[62] *Compare* MSV at 23-24 *and* Boeing at 8; Celsat at 14; Constellation at 27-28; ICO at 44.

that all traffic on a integrated satellite and terrestrial network must be routed through one switch. ICO at 25 n.41. If this is what the Commission means by a "central data switch," then MSV shares ICO's concern that such a requirement will not allow for least cost routing and will result in a "single point of failure." *Id.*

C. Broadband PCS Rules Should Be Applied to MSS Terrestrial Facilities

In the NPRM, the Commission proposes applying the existing broadband PCS rules regarding tower height, power limits, coordination procedures, and emission limits as a model for MSS terrestrial base stations. NPRM at ¶¶ 55-57. Constellation argues the broadband PCS rules may not be appropriate for all MSS spectrum bands and that the rules should be based on those applicable to facilities operating in spectrum bands adjacent to where the particular MSS provider operates. Constellation at 37. MSV supports the Commission's proposal to apply the broadband PCS rules, as well as the out-of-band emission limit in Section 25.213(b) to protect GPS/RNSS, to L-band terrestrial facilities. MSV at 27. Such rules are sufficient to protect other licenses, provide a standard with which equipment manufacturers are familiar, and ensure regulatory parity between MSS and terrestrial providers.

D. Many of the Commission's Proposals Enjoy Unanimous Support

Finally, MSV notes that many of the Commission's proposed service and licensing rules enjoyed unanimous support among MSS providers. For example, all MSS providers commenting on the issue supported permitting the construction and testing of terrestrial facilities prior to launch of a satellite in order to ensure that terrestrial operations are in place upon launch of service. MSV at 30; Boeing at 9; Constellation at 26; ICO at 44. MSS providers also agree on the following proposals: that individual coordination of base stations is not needed;[63] that terrestrial operations be authorized by modifying an MSS space station license;[64] and that adding a footnote to the Table of Allocations is sufficient to authorize ancillary terrestrial operations.[65]

63 MSV at 29; ICO at 47.

64 ICO at 47.

65 MSV at 32; Constellation at 24; ICO at 48-49.

Conclusion

For the aforementioned reasons, Motient, TMI, and MSV urge the Commission to grant L-band MSS providers the flexibility to operate terrestrial base stations to augment their satellite service in urban environments.

Respectfully submitted,

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Technical Appendix

Inmarsat raises a number of technical objections to the Commission's proposal, alleging that (i) ancillary terrestrial operations in the L-band will cause harmful interference to its co-channel and adjacent channel mobile uplinks and downlinks and (ii) MSV's terrestrial operations will cause harmful interference to MSV's own satellite operations and thus reduce MSV's satellite capacity. The Aerospace and Flight Test Radio Coordinating Council ("AFTRCC") expresses concern about the potential for harmful interference to its facilities and operations from ancillary terrestrial base stations.

MSV has already responded to many of Inmarsat's concerns.[1] As discussed further below, the hard evidence shows that MSV's terrestrial operations will not cause harmful interference to Inmarsat's system or its users and will not reduce the capacity of MSV's satellite system. As to AFTRCC's concerns, MSV similarly provides evidence below that its terrestrial operations will not cause harmful interference to aeronautical telemetry operations in the L-band.

I. INTERFERENCE TO CO-CHANNEL OPERATIONS IN THE EARTH-SPACE DIRECTION

Inmarsat's comments to the NPRM present a table addressing uplink co-channel interference to Inmarsat 4 satellites from MSV's ancillary terrestrial operations. However, Inmarsat has understated the value of several key parameters in this table. It is reproduced below with columns added to highlight the differences between Inmarsat's and MSV's analysis.

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1 *See* Motient, MSV, and TMI, Consolidated Opposition to Petitions to Deny and Reply to Comments, File No. SAT-ASG-20010302-00017 et al. (May 7, 2001); *Ex Parte* Letter from Bruce D. Jacobs, Counsel for Motient and MSV, to Ms. Magalie Roman Salas, Secretary, FCC, File No. SAT-ASG-20010302-00017 et al. (July 6, 2001); *Ex Parte* Letter from Bruce D. Jacobs, Counsel for Motient and MSV, to Ms. Magalie Roman Salas, Secretary, FCC, File No. SAT-ASG-20010302-00017 et al. (July 25, 2001).

Whereas Inmarsat concludes that each MSV co-channel carrier used in ancillary mode will cause 0.2% ΔT/T noise increase on Inmarsat 4 co-frequencies, MSV's analysis, using realistic parameters, shows that the effect is three orders of magnitude smaller than what Inmarsat estimates. The last column of the table addresses the case for the in-orbit Inmarsat 3 satellite at 54°W; in that case, the effect of MSV's ancillary operations is even more benign, by an additional order of magnitude.

As discussed below, Inmarsat has understated the value of several key parameters: the average level of environmental shielding, the (victim) satellite's antenna discrimination, the average power reduction to be provided by closed-loop power control, and the level of polarization isolation. Particularly on the average level of shielding, Inmarsat grossly underestimates its value by almost 15 dB (see the attached affidavit from Dr. Wolfhard J. Vogel, an authority in the field of propagation).

Inmarsat's Table 3.1-1 reproduced with additional columns – Calculation of Uplink Interference from MSV Terrestrial Mobile Terminals to Co-Frequency Inmarsat-4 and Inmarsat-3 Satellite Beams Serving Geographic Areas Outside of the USA (A single MSV terrestrial carrier is assumed)

Parameter	Units	Inmarsat Values- (Inmarsat 4)	MSV Values- (Inmarsat 4)	MSV Values- (Inmarsat 3)
Inmarsat Satellite G/T	dB/K	13	**13**	**-1.45**
Inmarsat Satellite Antenna Gain	dBi	41	**41**	**27**
Inmarsat Satellite Receive Noise Temperature	K	650	**650**	**700**
Inmarsat Satellite Receive Noise Spectral Density	dBW/Hz	-200.5	**-200.5**	**-200.1**
MSV Terminal EIRP	dBW	0	**0**	**0**
MSV Terminal Bandwidth	kHz	200	**200**	**200**
MSV Terminal EIRP Spectral Density	dBW/Hz	-53.0	**-53.0**	**-53.0**
Free Space Loss	dB	188.8	**188.8**	**188.8**
Shielding (average for many terminals)	dB	3	**15**	**15**
Inmarsat Satellite Receive Antenna Discrimination (average for many terminals)	dB	20	**30**	**22**
Power Control Reduction (average for many terminals)	dB	2	**6**	**6**
Polarization Isolation (Linear to Circular) (average for many terminals)	dB	1.4	**3**	**3**
Received Interfering Signal Spectral Density	dBW/Hz	-227.2	**-254.8**	**-260.8**
$\Delta T/T$ increase per MSV carrier	%	0.213%	**0.0004%**	**0.000086%**

It also bears noting that relatively little of the L-band spectrum that MSV has accessed pursuant to the Mexico City MOU is co-channel with Inmarsat satellites that are even potentially visible to North America. This includes the Inmarsat 3 satellites at 54°W, 15.5°W, and 178°E. Other co-channel frequencies may be used by Inmarsat's Indian Ocean region satellites, but these cannot possibly receive any interference from MSV's terrestrial operations over CONUS.

The case relating to the potential of MSV's ancillary operations causing harmful interference to MSV's own satellite operations is addressed in the following table. Once again, Inmarsat understates the parameter values already discussed thus reaching exaggerated quantitative conclusions. In this case, Inmarsat reaches the absurd conclusion that MSV's own system would suffer unacceptable levels of interference from its own ancillary component.

Inmarsat's qualitative conclusion, however, is correct. That is, MSV's own satellite will be more vulnerable to MSV's ancillary operations than any other system. This fact actually protects Inmarsat's and other L-band users because it will be in MSV's own interest to monitor the aggregate ancillary signal level reaching its own satellites and moderate ancillary traffic in response, thereby eliminating even the most remote possibility of generating harmful interference.

Inmarsat's Table 3.5-1 reproduced with additional column - Calculation of Uplink Interference from MSV Terrestrial Mobile Terminals to Co-Frequency MSV Satellite Beams Serving Geographic Areas in the USA
(A single MSV terrestrial carrier is assumed)

Parameter	Units	Inmarsat Value	MSV Value
MSV Satellite G/T	dB/K	16	16
MSV Satellite Antenna Gain	dBi	43	41
MSV Satellite Receive Noise Temperature	K	450	450
MSV Satellite Receive Noise Spectral Density	dBW/Hz	-202.1	-202.1
MSV Terminal EIRP	dBW	0	0
MSV Terminal Bandwidth	kHz	200	200
MSV Terminal EIRP Spectral Density	dBW/Hz	-53.0	-53.0
Free Space Loss	dB	188.8	188.8
Shielding (average for many terminals)	dB	3	15
MSV Satellite Receive Antenna Discrimination (average for many terminals)	dB	10	10
Power Control Reduction (average for many terminals)	dB	2	6
Polarization Isolation (Linear to Circular) (average for many terminals)	dB	1.4	3
Received Interfering Signal Spectral Density	dBW/Hz	-215.7	-234.8
$\Delta T/T$ increase per MSV carrier	%	4.3%	0.05%

The key parameters that account for the disparities between Inmarsat's and MSV's analysis are discussed further below.

A. Environmental Shielding

Inmarsat argues that shielding by buildings and other obstructions in dense urban areas will result in an average attenuation of only 3 dB. Inmarsat, Technical Annex, Section 4.1. (In the past, Inmarsat has agreed that such shielding would provide as much as 15 dB of attenuation. Inmarsat Ventures, Partial Petition to Deny, Attachment 1 (April 18, 2001), p. 1.). Dr. Wolfhard J. Vogel, an authority in the field of propagation phenomena, has performed a study for MSV. He has concluded that for satellite elevation angles ranging between 30 and 40 degrees, 15 dB of average urban shielding should be considered a lower bound (see attached technical summary provided by Dr. Wolfhard J. Vogel).

Data from a variety of sources and for a variety of outdoor urban environments[2] shows that, for a satellite elevation angle of 30°, the average signal attenuation will be 13.8 dB. This takes into account the average body shielding attenuation of 3 dB.[3] However, the average attenuation will be much greater for terminals operating inside buildings or vehicles. A hand-held terminal operating inside a vehicle incurs an additional 7.5 dB of signal attenuation.[4] Inside

[2] See Hess, "Land-Mobile Satellite Excess Path Loss Measurements," IEEE Transactions on Vehicular Tech., Vol. VT-29, No. 2, pp.290-297, May 1980, and Goldhirsh and Vogel, Handbook of Propagation Effects for Vehicular and Personal Mobile Satellite Systems, Johns Hopkins University, Applied Physics Laboratory publication A2A-98-U-0-021, Dec. 1998. Also, see Lutz et al., "The Land Mobile Satellite Communication Channel – Recording, Statistics, and Channel Model," IEEE Trans. Vehicular Tech., Vol. 40, No. 2, May 1991, pp. 375-386. Also, see Akturan, R. and W. J. Vogel, "Path Diversity for LEO Satellite-PCS in the Urban Environment," IEEE Trans. Ant. and Prop., Vol. 45, No. 7, pp. 1107-1116, July 1997. Also, see Karasawa et al., "A propagation channel model for personal mobile-satellite services," Proc. Progress Electromagn. Res. Symposium, European Space Agency (ESA), Noordwijk, the Netherlands, July 1994, pp. 11-15.

[3] See IEEE Transactions on Antennas and Propagation, "Effects on Portable Antennas of the Presence of a Person," Vol. 41, No. 6, June 1993.

[4] Results of 1.6 GHz fade measurements of satellite signals into vehicles were presented 1996 in Vogel et al. (Vogel, W.J., Torrence, G.W. and Kleiner, N., "Measurement of propagation loss into cars on satellite paths at L-band," in *Mobile and Personal Satellite Communications 2.*

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buildings, terminals experience an average signal attenuation of 15 dB due to the building's self-shielding properties alone. If a person is using a terminal inside of a building and that building is itself shadowed by surrounding structures (as is often the case in urban environments) signal shielding in excess of 15 dB is to be expected.

The average elevation angle, over the United States cities for which MSV contemplates deploying ancillary components, relative to Inmarsat's 54°W satellite, is 30°. MSV estimates that with respect to this orbital location, the aggregate ancillary signal that may be generated by MSV's US-wide operations will experience an average attenuation in excess of 17 dB, 2 dB more than is assumed in MSV's analysis throughout this document (and consistently in all previous MSV filings). This is based on a statistical distribution of users in an urban setting, where 30% of communications activity takes place outdoors (13.8 dB average shielding); 30% of activity is assumed to occur within vehicles (13.8 + 7.5 = 21.3 dB average shielding); and 40% of communications is assumed to take place inside buildings (average shielding in excess of 15 dB). The other two Inmarsat 3 satellites (at 15.5°W and 178°E) that use some carriers co-channel with MSV, have much lower elevation angles relative to the same US cities and will thus enjoy an even greater level of shielding.

B. Power Control

Inmarsat argues that closed-loop power control by MSV's terminals will provide only a 2 dB reduction in the average power emitted by each terminal. Inmarsat, Technical Annex, Section 4.3. In contrast, MSV estimates that closed-loop power control will reduce average emissions by at least 6 dB. One conservative example should help to clarify the reasonableness

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Proceedings of the Second European Workshop on Mobile/Personal Satcoms (EMPS'96),
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of MSV's estimate. Assume that a base station sector is designed to serve a cell radius of 1 km, and that, per standard PCS design practices, 18 dB of building penetration margin is allocated to the available link margin at edge-of-coverage.[5] Assume a worst-case scenario that puts all users at edge-of-coverage. Furthermore, assume that half the users are outdoors and half are indoors. Of those who are indoors, assume 80% are near windows or close to the external periphery of buildings, and that the rest are deep inside buildings, requiring maximum power to close the link. Those users who are outdoors will require about 15 dB less than maximum power to close the link. The users who are indoors but close to windows or a building's periphery will require about 8 dB below maximum power to close the link. Only the ten percent of users who are deep inside buildings will require close to or full power. In this scenario, the average power per user is 7.5 dB lower than maximum. In a more realistic scenario, the user population will be randomly distributed and some users will be much closer to the base station transmitter and the power reduction due to closed-loop power control will be even greater.

C. Satellite Antenna Isolation

Inmarsat argues that the receive antennas on its Inmarsat-4 satellites provide no more than 20 dB of isolation for its co-channel operations. Inmarsat, Technical Annex, Section 4.2. This is not a credible estimate. Even the Inmarsat 3 satellite that is positioned at 54°WL (serving

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Vatalaro, F.; Ananasso, F., Editors, Springer-Verlag, Berlin).

[5] E-mail from Mark Brattstrom, Product Manager, Ericsson, to Peter D. Karabinis, MSV (Sept. 7, 2001); see also E. Walker, "Penetration of Radio Signals into Buildings in the Cellular Radio Environment," B.S.T.J., Vol. 62, No. 9, 1983; A.M.D. Turkmani, "Radio Propagation into Buildings at 1.8 GHz," COST231 TD(90) 117 Rev 1, 1991, and "Building Penetration Losses,"COST231 TD(90) 116 Rev 1, 1991, and "Urban Transition Loss Models for Mobile Radio in the 900- and 1800-MHz Bands," COST231 TD(90) 119 Rev 2, 1991; I. Kostanic, C. Hall, J. McCarthy, "Measurements of the Vehicle Penetration Characteristics at 800 MHz," Conference Proceedings, VTC 1998.

South America) provides a minimum of 22 dB of antenna isolation relative to the United States. Inmarsat 4 satellites will use larger antennas than Inmarsat 3 satellites and will thus provide higher directivity and gain, resulting in higher antenna isolation. Based on the information provided by Inmarsat in its filings, regarding Inmarsat 3 and Inmarsat 4 parameters, the Inmarsat 3 antenna gain is 27 dBi while that of Inmarsat 4 is 41 dBi; a 14 dB difference. Inmarsat, Technical Annex, Table 3.1-1. Based on this and MSV's own design efforts for its next generation satellite system, co-channel Inmarsat 4 satellites serving other parts of the world (including South America) are expected to provide at least 30 dB of antenna isolation relative to co-channel operations over the United States.

D. Polarization Isolation

Inmarsat contends that, based on Appendix S8 of the ITU Radio Regulations, only 1.4 dB of polarization isolation can be assumed between MSV's linearly polarized terminal transmissions and Inmarsat's circularly polarized satellite receive antennas. Inmarsat, Technical Annex, Section 4.4. As shown below, the average polarization isolation on the satellite path return link is 3 dB.

Let us consider the case for which not only are the MSV mobiles transmitting linear polarization, but the satellites are also receiving linear polarization (a worst case scenario). Inmarsat, in its filings, without providing specific reasons, has pointed out that such systems may be deployed in the future. Response of Inmarsat Ventures PLC, SAT-ASG-20010302-00017, Attachment A, Supplemental Engineering Exhibit, at 2 (May 21, 2001). The scenario posed by linearly transmitting terminals and linearly receiving satellites also has relevance relative to the existing (Inmarsat 3) and planned (Inmarsat 4) systems. The reason for this is that, even though Inmarsat 3 and Inmarsat 4 satellites are based on circularly polarized antennas, the aggregate ancillary signal generated by MSV's US operations will be seen by the co-channel Inmarsat satellites (Inmarsat 3 and Inmarsat 4) via their antenna side-lobes. Circularly polarized antenna elements experience significant departures from the circular polarization characteristic as the incident energy departs from bore-sight and arrives over the side-lobes. Thus, relative to MSV's ancillary signal, the antenna of a co-frequency Inmarsat satellite will appear to be highly elliptical, with a large axial ratio, giving it an almost linearly polarized characteristic.

Given the random distribution and arbitrary orientation of the ensemble of MSV's terminals, the linearly polarized wave incident on the satellite antenna will be randomly oriented with respect to the antenna polarization axis and will have a projection on this axis that can be expressed as[6]:

$$\mathcal{E}(t, \zeta, \Psi) = (2)^{1/2}\mathrm{Cos}(\omega t - \beta\zeta)\mathrm{Cos}\Psi,$$

where Ψ defines the polarization orientation of the incident signal $\mathcal{E}$, relative to the antenna polarization axis, and is a random variable uniformly distributed from $-\pi$ to π, and zero otherwise. The quantity ζ denotes the direction of propagation of the ancillary signal wave front at frequency ω. The expected (average) power that the satellite antenna will intercept can now be found by performing the following operations:

$$P_{av} = E[\langle 2(\mathrm{Cos}(\omega t - \beta\zeta))^2 (\mathrm{Cos}\Psi)^2\rangle] = 1/2, \rightarrow 10\log(P_{av}) = -3 \text{ dB},$$

where the inner operator, $\langle\ \rangle$, performs time averaging, and the outer operator, E[ ], performs ensemble (statistical) averaging. We see that 3 dB of the aggregate energy is, on average, lost due to the randomness in orientation of the incident ancillary wave front relative to the receive antenna polarization axis.

[6] The constant $(2)^{1/2}$ normalizes the wave-front power to unity. That is, with $\Psi \equiv 0$, $E[\langle\mathcal{E}\mathcal{E}\rangle] = 1$

In citing Appendix S8 of the ITU Radio Regulations, Inmarsat overlooks that Appendix S8 is meant only as a coordination trigger for the worst-case situation in which there is a single transmitter having the worst-case polarization orientation with respect to the receiving satellite antenna. In contrast, in the case relevant to MSV, there will be numerous transmitters with randomly distributed polarization orientations. Thus, Appendix S8 is not applicable.

E. Monitoring

The above analysis, using realistic and conservative parameter values, has demonstrated that it will be possible for MSV to operate large numbers of mobile terminals in a terrestrial ancillary mode without producing harmful interference in the direction of Inmarsat's co-channel satellites. The Commission, however, need not base a ruling purely on this analysis, as conservative as it may be, because MSV will do even more and provide additional assurance in the form of continual, real-time monitoring.

In order to be assured that its own network components will continue, over the life of the system, to interoperate with maximum efficiency, the MSV system will be deployed with built-in monitoring, in real time, of the aggregate ancillary signal that is generated by MSV's ancillary terrestrial operations. Based on inputs from monitoring, closed loop feedback control will be imposed on the ancillary network components such that the aggregate ancillary signal being measured by MSV's satellites does not approach potentially harmful limits. Inmarsat and MSV both agree that MSV's satellites will be more susceptible to the effects of the aggregate ancillary signal because the elevation angles to MSV's satellites will be greater[7] and MSV's satellite antenna discrimination will be less than that of Inmarsat's. Inmarsat, therefore, will always be

[7] The average elevation angle (over MSV's US operations) to MSV's 101°W satellite is 43°. The same average, taken for the Inmarsat 3 satellite at 54°W is 30°.

protected simply because any potentially harmful ancillary signal level will always be seen first by MSV's own satellites and will thus be maintained under control. MSV is prepared to monitor and report the aggregate signal power being received at its satellites from its mobile terminals operating in the ancillary terrestrial mode, and limit those operations accordingly to the extent necessary to protect its own satellite operations and those of Inmarsat.

II. INTERFERENCE TO ADJACENT CHANNEL OPERATIONS IN THE EARTH-SPACE DIRECTION

Inmarsat makes essentially the same arguments concerning the potential for adjacent-frequency interference to its satellites as it makes for co-channel interference, and in general, the same responses apply. That is, Inmarsat greatly understates the extent to which shielding, power control, and polarization isolation will reduce the energy that reaches Inmarsat's satellites.

In addition, Inmarsat understates the extent to which MSV will limit its out-of-band emissions. MSV has committed to comply (as a minimum) with Section 24.238 of the Commission's rules. Section 24.238 clearly states that the measurement bandwidth in determining out-of-band emissions is 1.0 MHz. Inmarsat, in contrast, interprets the rule to require an attenuation of 43+10log(P) within the ancillary carrier bandwidth, 200 kHz in this case. As a result, Inmarsat overstates, by a factor of 7 dB (10log(1.0 MHz/200 kHz)), the effect of MSV's signal. The table below contrasts Inmarsat's and MSV's analysis on this matter.

Inmarsat's Table 3.2-1 reproduced with MSV column - Calculation of Uplink Interference from MSV Terrestrial Mobile Terminals to Adjacent-Frequency Inmarsat 4 Satellite Beams Serving the USA (A single MSV terrestrial carrier is assumed)

Parameter	Units	Inmarsat 4 Value	MSV Value
Inmarsat 4 Satellite G/T	dB/K	13	**13**
Inmarsat 4 Satellite Antenna Gain	dBi	41	**41**
Inmarsat 4 Satellite Receive Noise Temperature	K	650	**650**
Inmarsat 4 Satellite Receive Noise Spectral Density	dBW/Hz	-200.5	**-200.5**
MSV Terminal Transmit Power to Antenna per 200 kHz Carrier	dBW	0	**0**
MSV Terminal Antenna Gain	dBi	0.0	**0.0**
MSV Terminal EIRP per 200 kHz Carrier (in MSV Channel)	dBW	0	**0**
Out-of-band Attenuation (43+10log(P))	dB	43	**-**
MSV Terminal EIRP per 200 kHz Carrier (in Inmarsat 4 Channel)	dBW	-43.0	**-50.0**
MSV Terminal EIRP Spectral Density (in Inmarsat 4 Channel)	dBW/Hz	-96.0	**-103.0**
Free Space Loss	dB	188.8	**188.8**
Shielding (average for many terminals)	dB	3	**15**
Power Control Reduction (average for many terminals)	dB	2	**6**
Polarization Isolation (Linear to Circular) (average for many terminals)	dB	1.4	**3**
Received Interfering Signal Spectral Density	dBW/Hz	-250.2	**-274.8**
$\Delta T/T$ increase per MSV carrier	%	0.001067%	**0.000004%**

It is evident from the above table, that Inmarsat, once again, has overstated the effect on adjacent satellite channels, by MSV's ancillary operations, by three orders of magnitude.

III. OVERLOAD ANALYSIS OF INMARSAT TERMINALS AND THE EFFECT OF OUT-OF-BAND EMISSIONS BY MSV'S ANCILLARY BASE STATIONS

Inmarsat argues that MSV's base stations will overload or desensitize Inmarsat receivers in their vicinity and that out-of-band emissions from MSV's base stations will cause harmful interference to its receivers. Inmarsat, Technical Annex, Section 3.3. These arguments are not supported by the facts, as is demonstrated below.

Number of carriers. Inmarsat's assumption of 25 simultaneous 200 kHz carriers being deployed per base station sector is completely unrealistic not only for MSV's system but for any other known cellular or PCS system. For the MSV system, 3 carriers per base station sector is a reasonable upper bound. This reduces the aggregate base station transmit power per sector by 9 dB over Inmarsat's assumption.

Propagation loss. Inmarsat assumes Free Space Loss (FSL) propagation and the existence of a line-of-sight path between the base station and the satellite terminal. Since base stations will only be located in populous environments, the FSL model is not appropriate. Assuming the Walfisch-Ikegami non-line-of-sight propagation model parameters, which are more realistic for this environment, MSV calculates a propagation loss at 100 meters of 95.5 dB, or 19.5 dB more than Inmarsat's FSL model.

Receiver characteristics. Inmarsat's overload power threshold of -120 dBW is unrealistically low. MSV has performed measurements on a representative ensemble of satellite terminals to determine actual as-built desensitization/overload thresholds. Both in the laboratory and in the field, tests have been conducted to measure input signal levels that cause receiver LNA compression and, hence, overload and desensitization.

Each terminal that was subjected to measurements in the laboratory was connected to either a satellite simulator or a rooftop dish antenna (providing access to the live satellite network). For the outdoor tests, the terminal antenna was present to provide direct access to the satellite. For the laboratory tests, and for some of the outdoor tests, an interfering GSM/GMSK carrier was injected directly into the terminal's RF input through an RF coupler. The frequency separation between the interfering carrier and the terminal's receive channel was varied from 260 kHz to more than 8 MHz. At each frequency separation, the performance of the test terminal was monitored while gradually increasing the interference level to determine thresholds for 1) just-noticeable degradation, and 2) heavy distortion or lost data frames, rendering the terminal unusable.

For some of the outdoor measurements, a calibrated dish antenna mounted on a camera tripod was used to transmit the interfering GSM/GMSK carrier at a known EIRP. The interfering source antenna was pointed directly toward the test satellite terminal antenna with clear line-of-sight between the two. Both terminal and interference source antennas were identically polarized (RHCP). Beginning at a suitably long separation distance, the terminal under test was moved slowly toward the interfering source until the first signs of performance degradations were observed.[8] At this point, the distance to the interfering antenna was measured. By knowing the interfering carrier EIRP, the terminal antenna gain toward the interference source antenna, and the free-space-loss corresponding to the measured separation distance, the received interference signal power at the satellite terminal antenna output could be calculated.

MSV has found that for the worst satellite terminal performer identified, the overload threshold is -88 dBW (32 dB better than what Inmarsat stipulates for Mini-M), while the other units performed better than this. MSV's test sample included a Mini-M terminal (for which Inmarsat quotes a -120 dBW limit). This Mini-M terminal was found to be one of the most overload-resistant of all the units tested, with an impressive desensitization threshold of -75 dBW, 45 dB better than what Inmarsat stipulates.

MSV's experimental results are corroborated by ARINC specifications on desensitization thresholds for AMS(R)S platforms. ARINC Characteristic 741, Part 1-9 (November 1997) ¶

[8] Loss-of-lock events (intermittently occurring) in tracking mode, or the onset of vocoder artifacts in voice mode.

2.2.4.2 specifies the gain of the front end (comprising the LNA and diplexer) as $53\ dB \leq G \leq 60$ dB. In the same document, ¶ 2.2.4.5 specifies the 1 dB compression point at a minimum front-end output level of 10 dBm. Thus, the worst-case front-end input level leading to desensitization is – 50 dBm (or –80 dBW) -- a level of 40 dB higher than the –120 dBW value used by Inmarsat.

Inmarsat claims that worldwide frequency allocations from 1535-1559 MHz are reserved for MSS. This argument is made by Inmarsat in support of its claim that existing satellite terminal designs are not expected to provide front-end overload protection from higher-power terrestrial signals. Inmarsat cites frequency allocations given in ITU Radio Regulations Article S5 to support its claim. However, Inmarsat fails to include in its argument the fact that the ITU Radio Regulations also provide several allocations for terrestrial-based services in the 1525-1559 MHz band.[9] Since Inmarsat's terminals are designed to receive signals across the full 1525-1559 MHz band and are used everywhere, it is reasonable to expect that, as verified by MSV's testing, manufacturers will build them with front-end designs that accommodate the possibility of stronger signal levels produced by terrestrial-based services. MSV's experimental program has confirmed this.

Base station antenna pattern. At a separation distance of only 100 meters, MSV's base station antenna pattern will provide significant attenuation toward a satellite terminal. Inmarsat completely fails to account for this effect. At a distance of 100 meters from a base station, attenuation relative to antenna bore-sight is about 12.5 dB. This is based on actual prototype antenna measurements, taking into account a 30-meter base station antenna height, and a 5°

[9] Footnote S5.355 of the Radio Regulations provides for a secondary allocation for Fixed Services in this band in African and Middle-Eastern countries. Footnote S5.359 provides for a primary allocation in this band in European, African, and Middle-Eastern countries.

antenna element down-tilt. MSV's results are substantiated further by the attached affidavit from CSS, the company that designed, built and measured several base station antennas for MSV.

The following table illustrates the extent to which Inmarsat has overstated the potential for desensitization of Inmarsat Mini-M terminals due to MSV's base station transmissions. Whereas Inmarsat concludes that at 100 meters from an MSV base station a Mini-M terminal would be desensitized, MSV shows that, subject to realistic parameter values, the same terminal at this distance maintains more than 25 dB of margin against desensitization and receiver overload.

Inmarsat's Table 3.3-2 reproduced with MSV column – Downlink Interference Analysis – Overload of Inmarsat Receiver Front-End

Parameter	Units	Inmarsat	MSV
MSV Base Station EIRP per 200 kHz carrier	dBW	19.1	19.1
Total Bandwidth of Base Station Transmissions	MHz	5	0.6
Max. Number of Base Station Carriers Per Sector	#	25 (14 dB)	3 (5 dB)
Distance of Inmarsat Terminal from Base Station	m	**100**	**100**
Propagation Path Loss†	dB	76	95.5
Power Control Reduction	dB	6	6
Voice Activity Reduction	dB	4	4
Polarization Isolation	dB	3	8
Gain of Inmarsat Terminal toward Base Station	dBi	0	0
Base station antenna discrimination toward Inmarsat terminal	**dB**	--	**-12.5**
Received Interfering Signal Power	dBW	-55.9	-101.9
Threshold for Overload of Inmarsat Mini-M*	dBW	-120	-75
Desensitization Margin	**dB**	**-64.1**	**+26.9**

* This number is based on measurements performed by MSV.
† Inmarsat assumes line-of-sight propagation; MSV assumes Walfisch-Ikegami non-line-of-sight propagation as more realistic at a distance of 100 meters from the base station.

In addition to the above analysis which holds for a specific distance (100 meters away from the ancillary base station), MSV has considered the general case where a satellite terminal can be anywhere within the ancillary base station's service region (1 km service radius). The following figure establishes that at any arbitrary location over the entire base station's service area, substantial margin exists against desensitization. The figure takes into account the effect of urban propagation and uses the Walfisch-Ikegami model to predict signal strength as a function of distance.[10] The two curves shown on the figure have different validity intervals. The curve

[10] The COST Walfisch-Ikegami propagation model is described in "Propagation Prediction Models", Dieter J. Cichon and Thomas Kurner, Section 4.4. The model uses physical parameters to characterize the signal propagation environment. Physical parameter values were selected to
Footnote continued on next page

derived from the line-of sight Walfisch-Ikegami model only holds in the vicinity of the tower, before the first line of obstructions is encountered, and therefore is not valid for distances beyond about 30 meters. Thus, at about 30 meters from the base station tower, a transition from the Walfisch-Ikegami line-of-sight curve to the Walfisch-Ikegami non-line-of-sight curve occurs. As such, it is seen that a minimum of 25 dB in margin against desensitization is maintained throughout the entire ancillary base station service area, with margins in excess of 30 dB over substantial portions thereof.

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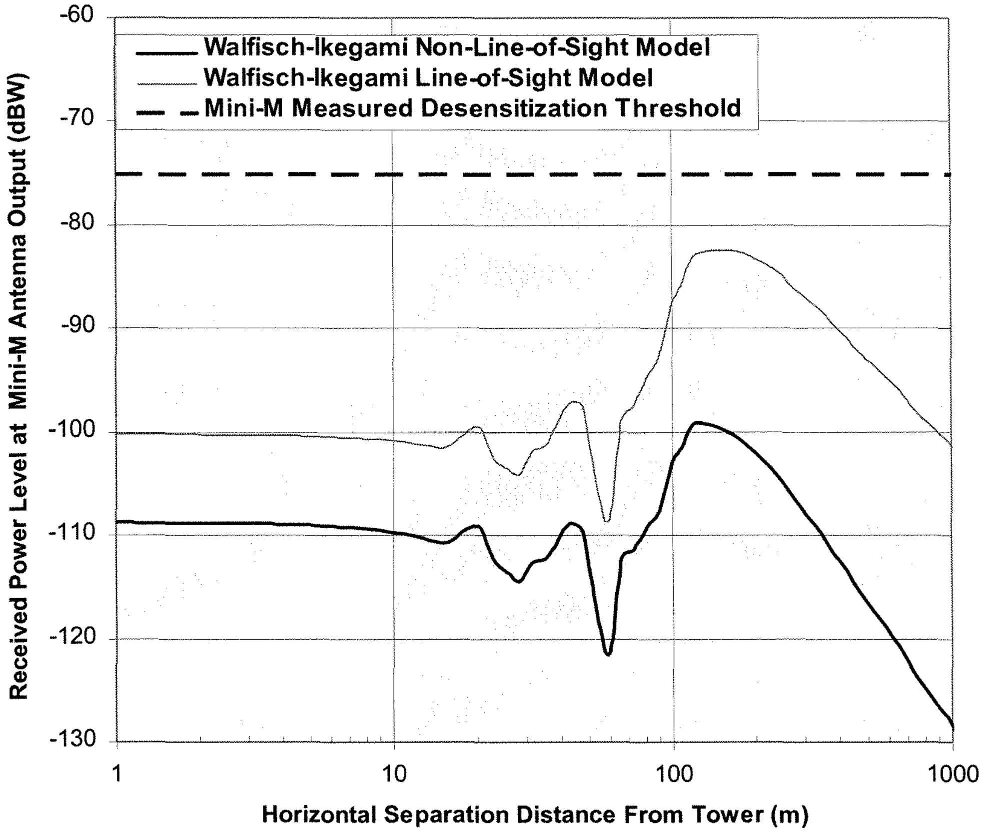
model the propagation losses expected in the urban environments where ancillary base stations will be deployed. The angle of incidence between the ray to the base station and the street were the satellite terminal is located was set to an average value of 45°. Building separation and street width were taken to be 35 meters and 18 meters, respectively. Rooftop heights are assumed no higher than 15 meters (five floors) and the base station antenna is at 30 meters of height. The Walfisch-Ikegami model for urban propagation, as used in this analysis, predicts the available signal strength, as a function of distance from the base station, with 90% probability.

Interference Power received by a Mini-M as a function of distance from an MSV Ancillary Base Station



Out-of-band emissions. In the unlikely event that an Inmarsat terminal establishes communications from within an urban environment, the analysis below establishes a worst-case scenario for what the effect of the base station's out-of-band emissions might be on increasing the effective noise temperature ($\Delta T/T$) of the terminal. As is illustrated by the previous figure (using the non-line-of-sight Walfisch-Ikegami curve) the ancillary base station signal strength in the vicinity of 100 meters away from the base station transmitter, is at a maximum level. This is due to the main-lobe characteristic of the base station antenna and the down-tilt angle thereof. We observe from the referenced figure, that at other locations over the ancillary base station's service area, the interference signal would be lower, by as much as 10 dB or more. The following table presents the analysis for the worst-case distance of 100 meters. It is seen that, once again, Inmarsat has overstated the effect of MSV's out-of-band emissions by many (six) orders of magnitude. As MSV's analysis shows, this is attributable in part to a misinterpretation of the FCC part 24 requirements on out of band emissions. Inmarsat has assumed that the specified attenuation level on the out-of-band signal, of 43+10log(P) dB, is to be measured over 200 kHz instead of the FCC-specified 1.0 MHz measurement bandwidth. This alone, leads Inmarsat to overstate its case by 7 dB. In addition, Inmarsat neglects the fact that in urban settings line-of-sight propagation does not exist (especially at a distance of 100 meters away from the base station transmitter). This oversight leads Inmarsat to overstate its case by an additional 19.5 dB. An additional 12.5 dB of interference attenuation is neglected by Inmarsat in not taking into consideration MSV's base station antenna discrimination characteristic. There is an additional 5 dB of interference suppression due to polarization discrimination (MSV's base stations transmitting LHCP while Inmarsat terminals receive RHCP) that Inmarsat neglects. All this, and an unrealistically low noise temperature for the terminal that, by assumption, is operating in a noisy urban environment, leads Inmarsat to grossly overstate the impact of MSV's base stations on nearby satellite terminals.

Inmarsat's Table 3.4-1 with MSV column added - Downlink Interference Analysis - Out of Band Emissions into the Inmarsat Receiver

Parameter	Units	Inmarsat Value	MSV Value
MSV Base Station Power to Antenna per 200 kHz Carrier	dBW	3.1	3.1
MSV Base Station Antenna Gain - Peak	dBi	16.0	16.0
Out-of-band Attenuation (43+10log(P))	dB	46.1	--
MSV Base Station Out-of-Band Emissions to Antenna‡	dBW/MHz	--	-57.9
MSV Base Station EIRP per 200 kHz Carrier (in MSV Channel)	dBW	19.1	19.1
MSV Base Station Antenna Discrimination Toward Inmarsat Terminal	dB	--	-12.5
MSV Base Station EIRP per 200 kHz Carrier (in Inmarsat Channel)	**dBW**	**-27.0**	**-61.4**
Distance of Inmarsat Terminal from MSV Base Station Transmitter	m	100	**100**
Propagation Loss: Line-of-Sight is used by Inmarsat; Walfisch-Ikegami non-line-of-sight is assumed by MSV	dB	76.0	95.5
Power Control Reduction	dB	6	6
Voice Activity Reduction	dB	4	4
Polarization Isolation (LHCP to RHCP)	dB	3.0	**8.0**
Gain of Inmarsat Terminal towards MSV Base Station Transmitter	dBi	0.0	0.0
Sum of Propagation Losses	**dB**	**89.0**	**113.5**
Received Interfering Signal Power in 200 kHz	**dBW**	**-116.0**	**-174.9**
Received Interfering Signal Power Spectral Density	dBW/Hz	-169.0	-227.9
Inmarsat Terminal Receive Noise Temperature	K	**150**	**290**
Inmarsat Terminal Receive Noise Spectral Density	dBW/Hz	-206.8	-204.0
ΔT/T increase per MSV 200 kHz Carrier	%	611,842.9%	0.4%

‡ The out-of-band emissions mask of MSV's base stations will meet or exceed FCC part 24 minimum performance specifications.

Airborne terminals. This analysis considers an aircraft in the vicinity of an urban area served by MSV's ancillary base stations. As an initial matter, there are many different geometries to be considered. Some are worse than others. Other things being equal, an aircraft at high altitude sees a larger area. If the whole earth were covered with base stations, it would see proportionally more sources of interference. This will not be the case, however, since base stations will only be in urban areas, and urban areas cover a tiny fraction of all possible areas. In practice, then, the worst case tends to occur at lower altitudes rather than higher.

Moreover, it has already been pointed out that base station antenna patterns are not uniform. Most of the RF energy is directed within the cell, and so consideration of the side-lobes is as important as the main lobe.

The analysis conducted by MSV assumed an aircraft altitude of 304 meters for the reasons given in the footnote[11] and an ancillary base station height of 30 meters, as typical of MSV's design. For these parameters, the distance over which the aircraft will see base stations is about 81.8 km, or roughly fifty miles. Up to 1000 base stations were assumed visible to the aircraft. To create the table that follows, the line-of-sight distance from the aircraft to each visible base station was evaluated. Received power, per base station, was calculated by taking into account antenna directivity of both the base station antenna and that of the airborne satellite terminal, and the radiated base station EIRP. The interference contribution to the airborne terminal from each visible base station was calculated using line-of-sight propagation, and the sum over all such interference components was evaluated, yielding the aggregate ancillary signal power level at the airborne satellite terminal antenna output.

The table below summarizes the results of the calculation. The allowable ΔT/T due to MSV's aggregate out-of-band emissions is set at 6%, and the desensitization threshold of the airborne terminal is assumed to conform to the ARINC specification of –50 dBm (-80 dBW). The table shows a desensitization margin of more than 9 dB for the airborne terminal and conformance with ΔT/T = 6%. The airborne terminal's antenna gain toward each base station was assumed to be 0 dBi.

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[11] Aircraft flying over urban areas must be at an altitude exceeding 304 meters (see RTCA/DO-235 Document, Appendix A).

Calculation of the Aggregate Interference Received by an Airborne MSS Terminal at an Altitude of 1000 feet (304 m) From a Region Covered by MSV's Base Stations

INPUT PARAMETER VALUES		
Radius of the Earth =	6378	km
Aircraft Altitude =	304	m
Base Station Height =	30	m
Base Station Frequency =	1545	MHz
Base Station Antenna Down-tilt =	5.0°	--
Horizon Distance (H) from the Aircraft =	62.3	km
Horizon Distance from a Base Station =	19.6	km
Total Distance =	81.8	km

SPURIOUS EMISSIONS INTO AN AIRCRAFT RECEIVER		
Base Station Spurious EIRP Density/Carrier =	-101.9	dBW/Hz
Carriers per Base Station Sector =	3	--
Voice Activity Reduction =	4	dB
Power Control Reduction =	6	dB
Polarization Discrimination =	8	dB
Total Effective Spurious EIRP Density per Base Station =	-115.1	dBW/Hz
Aggregate Spurious Power Density at Aircraft Receiver (1000 Base Stations) =	**-216.7**	**dBW/Hz**
Aircraft Receiver Noise Temperature =	25.0	dBk
Aircraft Receiver Thermal Noise =	-203.6	dBW/Hz
Allowable DT/T =	6%	--
Max Allowable Spurious **Power Density at Aircraft Receiver =**	**-215.8**	**dBW/Hz**

AIRCRAFT RECEIVER DESENSITIZATION CALCULATION		
Base Station EIRP per Carrier =	19.1	dBW
Carriers per Base Station Sector =	3	--
Voice Activity Reduction =	4	dB
Power Control Reduction =	6	dB
Polarization Discrimination =	8	dB
Effective Base Station EIRP =	10.9	dBW
Aggregate Power at Aircraft Receiver (1000 Base Stations) =	**-60.7**	**dBm**
Max Allowable Power at Aircraft Receiver =	**-50.0**	**dBm**

In its comments, ARINC observes that for an aircraft flying at 70,000 feet, ground-based transmitters are within line-of-sight up to approximately 304 nautical miles away. ARINC, Section II.B. ARINC then incorrectly concludes that, "Terrestrial operations in upper L-band will preclude the use of frequencies of aviation for more than 300 miles offshore." MSV has extended the analysis of interference to airborne terminals described above to include aircraft at high altitudes. The number of base stations was allowed to grow to fill the entire area visible from the aircraft. The result is that for a Concorde flying at 70,000 feet, the number of base stations used in the analysis is more than 350,000, a very unrealistic high number. Even with 350,000 base stations visible, a Concorde flying at 70,000 feet will have over 15 dB of margin against reaching 6% $\Delta T/T$ due to out-of-band emissions from ancillary base stations. The margin against desensitization also exceeds 15 dB.

IV. INTERFERENCE TO AERONAUTICAL TELEMETRY OPERATIONS

In its comments, AFTRCC expressed concern about the potential of MSV's ancillary base stations interfering with AFTRCC telemetry receivers. AFTRCC at 5-7. The concern is based on the proximity of the respective frequency bands: AFTRCC operates in the band 1435-1525 MHz and MSV's ancillary base stations would transmit in the band 1525-1559 MHz. The following table provides a calculation of the separation distance required between an MSV base station and an AFTRCC telemetry receiver to meet the interference level specified by Recommendation ITU-R M.1459. The calculation shows that a separation distance of less than 1 km is sufficient to meet the specified interference level.

Calculation of Potential Interference from BTS to AFTRCC Receiver.

Parameter	Units	Value
Frequency	GHz	1.525

Max Allowed Level @ <4 degrees (per Recommendation ITU-R M.1459)	dBW/m^2/ 4 kHz	-181.0
Area of Isotropic Ant.	dB-m^2	-25.1
Max Allowed Level into Isotropic Antenna	dBW/4 kHz	-206.1

Ancillary Base Station Frequency	GHz	1.525
Base Station EIRP	dBW	19.1
Voice Activity Factor	dB	-4
Power Control	dB	-6
Carriers per Base Station Sector		3
Effective EIRP	dBW	13.9
Out of band Attenuation	dBc/MHz	-61.0
Effective Out-of-Band Emissions	dBW/4 kHz	-71.1
Base Station Filter Attenuation	dB@1525 MHz	-40.0
Base Station Radiated Spurious Power Density	dBW/4 kHz	-111.1

Path Loss Required to Satisfy Allowed Level	dB	95.0
Walfisch-Ikegami Non-Line of Sight Distance Required to Yield above Path Loss	km	0.1

Statement of Dr. Wolfhard J. Vogel, PhD

On the Subject of Shielding

Inmarsat argues that shielding by buildings and other obstructions in dense urban areas will result in an average attenuation (or shielding) of only 3 dB. Inmarsat grossly underestimates this parameter. For satellite elevation angles ranging between 30 to 40 degrees, 15 dB of average shielding is a realistic low bound for dense urban environments, given that users will be distributed randomly between outdoor, in-vehicle, and in-building environments.

Data from a variety of sources and for a variety of outdoor urban environments[1] shows that, for a satellite elevation angle of 30°, the average signal attenuation will be 13.8 dB. This includes the average body shielding effect of 3 dB[2]. For terminals operating inside buildings or vehicles, the average signal attenuation will be greater. A hand-held terminal operating inside a vehicle experiences an additional 7.5 dB of average signal attenuation[3]. Inside urban-core buildings, terminals experience an average signal

[1] See Hess, "Land-Mobile Satellite Excess Path Loss Measurements," IEEE Transactions on Vehicular Tech., Vol. VT-29, No. 2, pp. 290-297, May 1980, and Goldhirsh and Vogel, Handbook of Propagation Effects for Vehicular and Personal Mobile Satellite Systems, Johns Hopkins University, Applied Physics Laboratory publication A2A-98-U-0-021, Dec. 1998. Also, see Lutz et al., "The Land Mobile Satellite Communication Channel – Recording, Statistics, and Channel Model," IEEE Trans. Vehicular Tech., Vol. 40, No. 2, May 1991, pp. 375-386. Also, see Akturan, R. and W. J. Vogel, "Path Diversity for LEO Satellite-PCS in the Urban Environment," IEEE Trans. Ant. and Prop., Vol. 45, No. 7, pp. 1107-1116, July 1997. Also, see Karasawa et al., "A propagation channel model for personal mobile-satellite services," Proc. Progress Electromagn. Res. Symposium, European Space Agency (ESA), Noordwijk, the Netherlands, July 1994, pp. 11-15.

[2] See IEEE Transactions on Antennas and Propagation, "Effects on Portable Antennas of the Presence of a Person," Vol. 41, No. 6, June 1993.

[3] Results of 1.6 GHz fade measurements of satellite signals into vehicles were presented 1996 in Vogel et al. [Vogel, W.J., Torrence, G.W. and Kleiner, N., "Measurement of propagation loss into cars on satellite paths at L-band.", in *Mobile and Personal Satellite*

attenuation of 15 dB due to the building's self-shielding properties alone. If a person is using a terminal inside of a building and that building is itself shadowed by surrounding structures (as is often the case in dense urban environments) average signal attenuation in excess of 18 dB is to be expected.

The average elevation angle relative to the Inmarsat 54°W satellite, calculated for the ensemble of CONUS-wide cities for which MSV contemplates deploying ancillary components, is approximately 30°. With respect to this satellite, the aggregate ancillary signal that may be generated by MSV's CONUS-wide operations will experience an average attenuation, due to urban shielding, in excess of 17 dB; more than 2 dB than is assumed in MSV's analysis. This result, based on a statistical distribution of urban users, assumes 30% of communications activity occurring outdoors (13.8 dB average shielding); 30% of activity occurring inside of vehicles (13.8 + 7.5 = 21.3 dB average shielding); and 40% of communications occurring inside buildings (average shielding in excess of 18 dB).

Dated: November 5, 2001

Wolf Vogel

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Communications 2. Proceedings of the Second European Workshop on Mobile/Personal Satcoms (EMPS'96), Vatalaro, F.; Ananasso, F., Editors, Springer-Verlag, Berlin].

Statement of CSS Antenna, Inc.

CSS ANTENNA, INC.
10552 Philadelphia Road, Suite 150
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Telelephone 410-344-1010
Fax 410-344-1007

October 29, 2001

Dr. Peter Karabinis
Mobile Satellite Ventures LLC
10802 Parkridge Boulevard
Reston, VA 20191-5416

Dear Dr. Karabinis:

CSS Antenna, Inc. did in fact design and build the antenna shown in Inmarsat's Figure 3.3-1 of their response (lower trace labeled Motient proposed antenna performance). This was also one of eight antennas built, and not a prototype "one of a kind" antenna. This design uses a one-piece circuit board for the feed network and radiating elements combined. This is controlled by fabricating every board from the same artwork, making every antenna exactly like the last one. This design also eliminates any assembly variations, which are traditional in our industry.

We can produce this antenna in very high volume. This antenna is assembled in the same package as a current PCS antenna of ours, which we produce by the thousands today. This makes this antenna a very cost effective choice for large scale Base Station deployment.

We based the design of this antenna at a Frequency of 1.660 GHz and can produce the same results in an antenna tuned for 1.525-1.559 GHz. Attached is the actual tested data of the 1.660 GHz antenna, from the CSS test lab as well as an independent testing house, Seavey Engineering in Pembroke, MA.

CSS Antenna, Inc. is a leading manufacturer of Cellular and PCS Base Station Antennas in North America. CSS supplies Antennas to the majority of the Operators, including being the Antenna Company of choice for the largest Operator, in the United States.

Cordially,

David M. Sobczak
Executive VP
CSS Antenna, Inc.

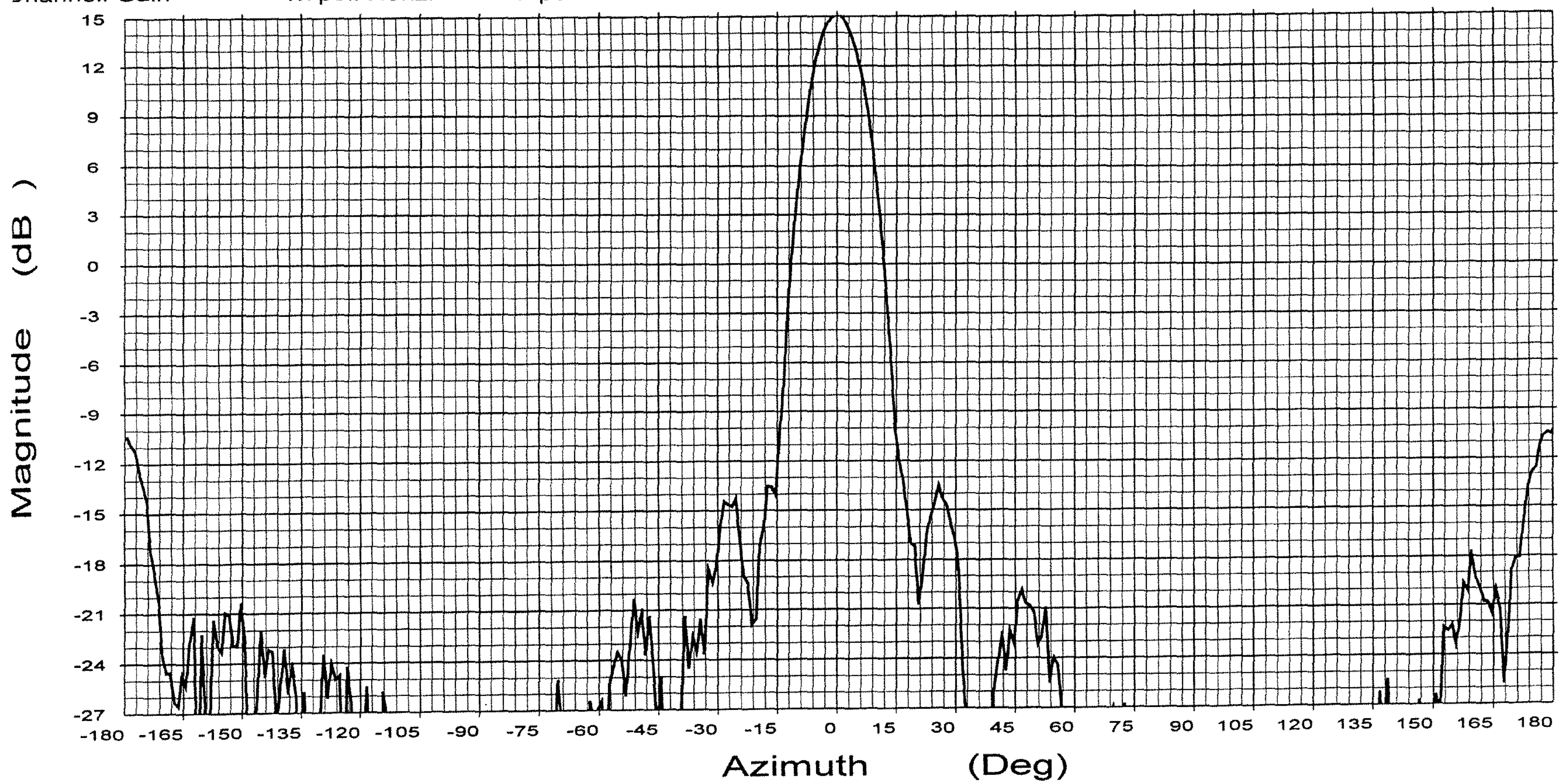
File: EM1003EG.DAT
Date: 02-Aug-00
Time: 17:00
Operator: Mark Gladden
Ser. no.: 1003
Channel: Gain

LCC Dipole (Eng. model 1003)
E-plane, gain

Tx pol: Horiz. Rx pol: Horiz.

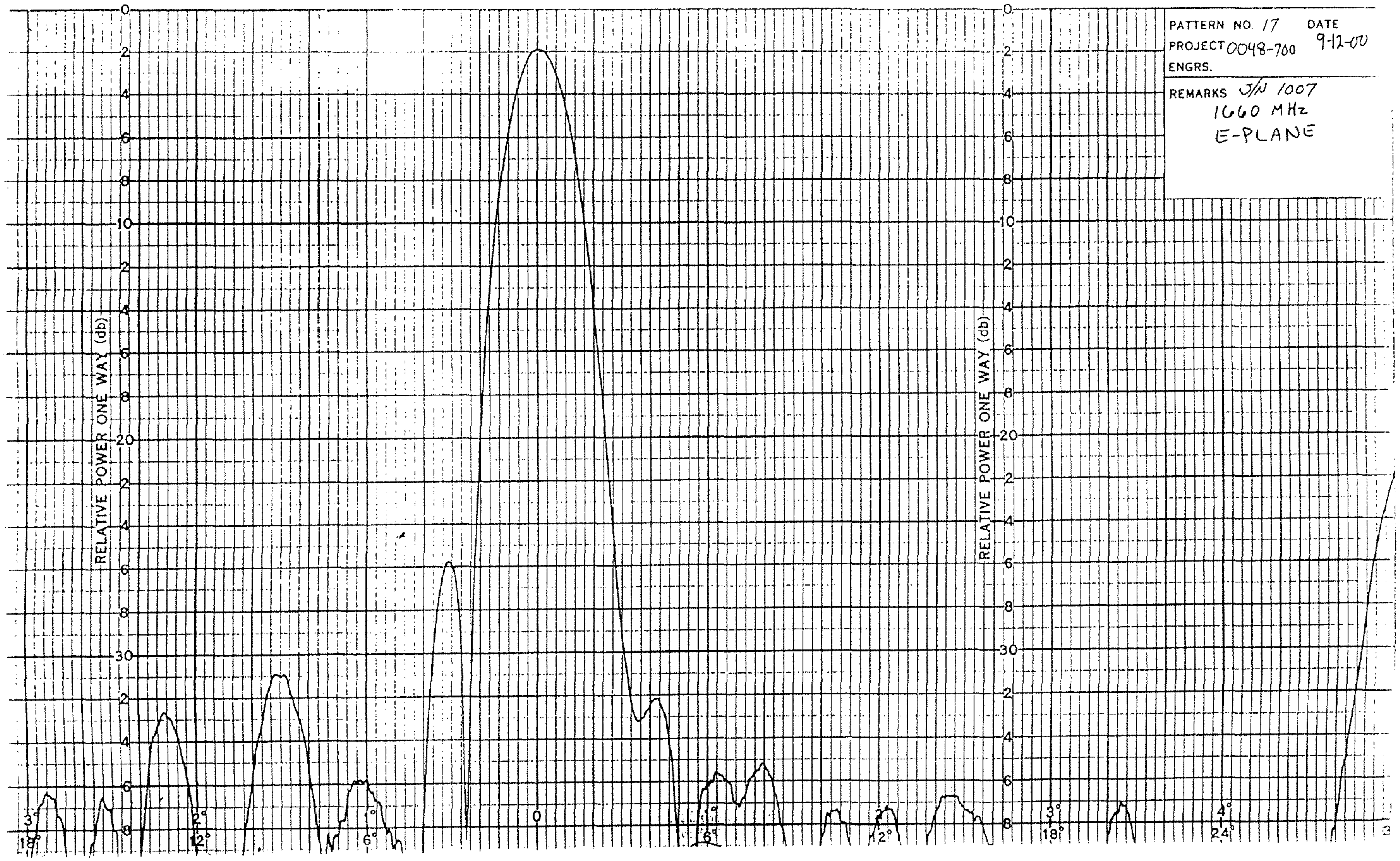
Calibration status:
File: EM1003EG.DAT
Chan.: Gain
Table: LCC band
Units: dBi

Frequency : 1.660 GHz



Beam Peak		Beam Width
Deg	dB	(Deg)
-0.01	15.09	11.10

Seavey Engineering Associates, Inc., 28 Riverside Drive. Pembroke. MA 02359



Technical Certification

I, Dr. Peter D. Karabinis, Chief Technical Officer of Mobile Satellite Ventures LLC, certify under penalty of perjury that:

I am the technically qualified person with overall responsibility for the preparation of the technical information contained in the above "Technical Appendix." The information contained in this document is true and correct to the best of my belief.

Dr. Peter D. Karabinis

Dated: November 13, 2001

Certificate of Service

I, Sylvia Davis, a secretary with the law firm of Shaw Pittman LLP, hereby certify that true and correct copies of the foregoing Reply Comments were sent by first-class mail this 13th day of November 2001 to the following:

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