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

In the Matter of	)	
	)	
Flexibility for Delivery of Communications By Mobile-Satellite Service Providers in the 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

COMMENTS OF THE BOEING COMPANY

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SUMMARY

After waiting more than four years, Boeing and seven other MSS applicants received licenses for 2 GHz MSS networks just three months ago. Rather than providing truly unencumbered authorizations, however, the Commission is entertaining challenges to its 2 GHz MSS spectrum allocation.

On its face, Boeing can support changes in the Commission's rules that offer some flexibility to MSS operators. Any change in the licensing and service rules, however, should be limited to measures that will help to ensure the commercial success of 2 GHz MSS networks, so that they can bring new services to consumers. Permitting MSS operators to offer terrestrial services that are truly "ancillary" to their primary MSS operations would appear to meet this standard. MSS operators, however, should be required to maintain MSS service as their first priority. Moreover, the Commission should require compliance with existing construction and coverage obligations as prior conditions to offering ancillary terrestrial service. Finally, providing flexibility to some 2 GHz MSS operators should not be provided as a trade-off in which a portion of the 2 GHz MSS band is reallocated for terrestrial 3G services.

The Commission should also place appropriate technical restrictions on ancillary terrestrial uses in the 2 GHz MSS band. For example, Boeing is opposed to any sharing of the MSS downlink band with an ancillary terrestrial component, because it would result in unacceptable interference to MSS user terminals operating in adjacent bands. Instead, Boeing supports the use of only one of the spectrum sharing scenarios suggested by ICO – the uplink duplex sharing mode.

Boeing would oppose any proposal that would open the 2 GHz MSS band to "independent" terrestrial services unrelated to licensed MSS service. Independent terrestrial

services would pose significant and unresolvable interference problems. Furthermore, the licensing of independent terrestrial operators may prevent Boeing from obtaining sufficient spectrum in the 2 GHz MSS band to provide the aeronautical services that the aviation industry requires.

The FCC's licensing and service rules expressly contemplate that "expansion" spectrum is to be made available to qualifying MSS licensees. Indeed, the licensees received significantly less spectrum than specified in their original applications. Before reallocating MSS spectrum to other services, the Commission should grant all of Boeing's initial spectrum request. Boeing requested access to less 2 GHz MSS spectrum than any other applicant. During the past four years, Boeing has thoroughly demonstrated its spectrum needs, which have gone unchallenged by any party in this proceeding.

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To: The Commission

COMMENTS OF THE BOEING COMPANY

The Boeing Company ("Boeing"), by its attorneys and pursuant to section 1.415 of the Commission's rules, 47 C.F.R. § 1.415, hereby presents its comments to the Notice of Proposed Rulemaking (*"NPRM"*) in the above-captioned proceedings.[1] For the reasons set forth herein, Boeing expresses both support and reservations regarding proposals to alter the existing licensing and spectrum allocation rules for the Mobile-Satellite Services ("MSS") in the 1990-2025 MHz and 2165-2200 MHz bands ("2 GHz Band") to permit ancillary terrestrial services ("ATS").

If not implemented carefully, the reallocation proposals in the *NPRM* could seriously undermine Boeing's efforts to deploy its unique satellite-based air traffic safety and management services by potentially denying access to the minimum necessary spectrum resources and creating a risk of harmful interference to its system. Boeing can support efforts that attempt to improve the chances for success of MSS licensees in the 2 GHz band, but any such steps must be

[1] *In the Matter of Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band*, IB Docket No. 01-185, Notice of Proposed Rulemaking, FCC 01-225 (rel. August 17, 2001) (*"NPRM"*).

limited in scope and effect in order to protect the spectrum rights and obligations granted to 2 GHz MSS licensees. Accordingly, the Commission should ensure that implementation of the ATS proposal in the *NPRM* does not impair the ability of MSS licensees to deploy and operate their proposed systems in accordance with the terms of their authorizations and the Commission's existing licensing and service rules for the band.

I. INTRODUCTION

After spending four years demonstrating the viability and clear public interest benefits of its system, Boeing – along with the seven other 2 GHz MSS licensees – finally received its license to construct and operate its 2 GHz MSS system a little more than three months ago.[2] Unique among the 2 GHz MSS licensees, Boeing proposes to provide Aeronautical Mobile-Satellite (Route) Service ("AMS(R)S") to the domestic and international aviation community.[3] Boeing's system is designed to improve the efficiency and safety of global air transportation through a satellite-based air traffic management ("ATM") and communications, navigation, and surveillance ("CNS") system. Throughout the proceedings surrounding the 2 GHz MSS service rules and authorizations, the clear public interest benefits resulting from implementation of Boeing's system remain uncontested and are as relevant as ever.

In contrast to the other applicants, Boeing did not seek access to the entire MSS spectrum that was available. Boeing instead sought only that amount of spectrum reasonably related to its

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[2] *See In the Matter of Application of The Boeing Company Concerning Use of the 1990-2025/2165-2200 MHz and Associated Frequency Bands for a Mobile-Satellite System*, Order and Authorization, DA 01-1631 (rel. July 17, 2001) (*"Boeing Order and Authorization"*).

[3] AMS(R)S is a type of MSS that uses mobile earth stations aboard aircraft to provide communications for domestic and international air traffic and air traffic control, as well as to transmit aeronautical communications necessary to ensure safe and regular flights primarily along national and international civil air routes. *See id.* at ¶ 36.

proposed services. In order to bring these benefits to the public, Boeing demonstrated that its system requires at least eight megahertz of spectrum in each direction (8.25 MHz for uplink and 8.85 MHz for downlink) in order to operate in a technically and commercially effective manner.[4]

Ultimately, the Commission granted Boeing – as well as the other 2 GHz MSS licensees – only 3.5 MHz in each direction, despite the fact that the Commission's own formula for determining the amount of spectrum available to 2 GHz MSS licensees dictated that each applicant had a reasonable expectation of at least 3.88 MHz in each direction, which amounts to less than half of Boeing's original request.[5] Boeing accepted this result because the Commission left open a clear regulatory path to additional 2 GHz spectrum resources.[6]

This reduced amount of spectrum is a serious constraint and has forced Boeing to redesign its proposed AMS(R)S system, thus making it more complex and costly. Unlike the other 2 GHz MSS licensees, who have proposed consumer services, Boeing's service must still retain the capacity to provide service to all aircraft. The required service capacity does not

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[4] *See* Minor Amendment to Application of The Boeing Company, File No. 90-SAT-AMEND-98 (20); IBFS File No. SAT-AMD-19980318-00021 (February 11, 1998); Public Notice, Report No. SPB-119 (rel. March 19, 1998); Letter from Bruce A. Olcott, Counsel to The Boeing Company to Magalie Roman Salas, Secretary, Federal Communications Commission (January 8, 1999).

[5] *See Boeing Order and Authorization* at ¶¶ 8-9; *see also In the Matter of The Establishment of Policies and Service Rules for the Mobile Satellite Service in the 2 GHz Band*, IB Docket No. 99-81, Report and Order, 15 FCC Rcd 16127, 16138 ¶ 16-17 (2000) (*"2 GHz MSS Order"*) ("[A]lthough we are hopeful that all proposed systems proceed towards authorization, it is possible that not all will do so before we first authorize a 2 GHz MSS system. In such case, the remaining system proponents would receive more than 3.5 megahertz of spectrum upon authorization.").

[6] *See 2 GHz MSS Order*, 15 FCC Rcd at 16138 ¶ 16 (setting aside expansion spectrum for qualifying MSS operators equal to the entire share of one of the applicants and leaving open the possibility that spectrum recovered from failed licensees would also be available for 2 GHz MSS system expansion).

decrease just because the spectrum allocation is reduced. It is fundamentally unacceptable to provide air traffic control services only to some aircraft while leaving others without service.

The Commission put forth two general proposals in the *NPRM* for public consideration and comment:

> (1) whether to permit 2 GHz and L-band MSS operators to provide service in areas where the MSS signals are attenuated by integrating terrestrial operations with their networks using assigned MSS frequencies; or
>
> (2) whether to open up portions of the 2 GHz and L-bands for any operator to provide a terrestrial service that could either be offered in conjunction with MSS or as an alternative mobile service.[7]

Three rationales are offered for these proposed changes. First, ATS is needed in order to assure the commercial viability of MSS systems that are employing business plans that have had difficulty in the past achieving commercial success. Second, ATS will enable MSS operators to achieve improved signal penetration in urban areas and inside buildings. Third, MSS operators will be better able to serve rural and other underserved areas if they are permitted to utilize ATS.[8]

In principle, Boeing supports granting MSS licensees some additional flexibility in order to achieve these articulated goals. While Boeing's AMS(R)S network does not include an ATS component, Boeing expects to be involved with the construction and launch of other 2 GHz MSS

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[7] *NPRM* ¶ 3. Two MSS licensees, ICO Global Communications (Holdings) Ltd.("ICO") and Motient Services Inc. and its Mobile Satellite Ventures Subsidiary LLC (collectively "Motient"), put forward the first proposal regarding integrated terrestrial services within MSS networks in the 2 GHz MSS band and L-band, respectively. The second proposal, which would permit non-MSS operators to utilize these bands for terrestrial service, is raised by the Commission *sua sponte*. A third proposal, again suggested by the Commission *sua sponte*, would permit licensees in the "Big LEO" bands at 1610-1626.5/2483.5-2500 MHz also to utilize terrestrial operations. Boeing's comments herein are limited to the first two proposals and their possible effect on the 2 GHz MSS licensees.

[8] *NPRM* ¶¶ 23-25.

systems that plan to utilize ancillary terrestrial services. Boeing's support for ATS, however, is qualified in that it should be implemented only in accordance with the restrictions articulated below. For example, Boeing is opposed to any sharing of the MSS downlink band with an ancillary terrestrial component, because it would result in unacceptable interference to MSS user terminals operating in adjacent bands. Instead, Boeing supports the use of only one of the spectrum sharing scenarios suggested by ICO – the uplink duplex sharing mode.

II. THE COMMISSION SHOULD GRANT ADDITIONAL FLEXIBILITY TO PROVIDE ADVANCED WIRELESS TERRESTRIAL SERVICES IN MSS SPECTRUM ONLY UNDER LIMITED CIRCUMSTANCES.

The proposals for comment set forth in the *NPRM* are designed to better ensure that 2 GHz MSS licensees will successfully deploy systems that can provide new services to consumers in both urban and rural areas. Care must be taken, however, to ensure that these goals are accomplished successfully. Specifically, ancillary terrestrial services must truly be ancillary to MSS, not a substitute or a replacement. Furthermore, steps must be taken to ensure that ancillary terrestrial operations do not interfere with licensed MSS operations in the band.

A. Any Proposed Ancillary Terrestrial Service in the 2 GHz MSS Band Must Truly Be "Ancillary"

Flexibility provided to 2 GHz MSS licenses to utilize ATS must be restricted to instances where terrestrial operations are truly "ancillary" to the primary MSS service. ICO's and Motient's requests appear to satisfy this requirement. As noted by the Commission, both ICO and Motient seek authorizations only to deploy their networks with both satellite and terrestrial operations on the same frequencies and to transmit traffic on either portion – satellite or terrestrial – as needed to provide the requested service.[9] This description, according to the

[9] *NPRM* ¶ 29.

Commission, constitutes "ancillary" terrestrial services as it would be integrated with their satellite networks, would use their assigned MSS frequencies, and would be made available only in order to augment signals in areas where the satellite signal, which is to remain the primary service signal, is attenuated.[10] Boeing agrees with this definition of "ancillary" and, therefore, can support granting the 2 GHz MSS licensees this added flexibility, but only in accordance with the stated definition.

In contrast, Boeing cannot support the second proposal. As more fully described in Section III below, allowing non-MSS operators access to the 2 GHz band for any "independent" terrestrial service would result in harmful interference and would also threaten the current MSS spectrum allocation by compromising the availability of expansion spectrum for operators such as Boeing.[11] Allowing independent terrestrial use of the MSS spectrum by non-MSS service providers is untenable, regardless of whether such use is required to be coordinated with licensed MSS operators.[12]

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[10] *Id.* at ¶ 30.

[11] MSS operators may find it more economical to seek a business partner to provide the "ancillary" terrestrial service. While this, too, may create unforeseen burdens and problems, Boeing will not now oppose this type of operational structure as long as the MSS operator remains the sole licensee and retains ultimate control of the complete network, both satellite and terrestrial.

[12] If the Commission ultimately decides to permit "independent" terrestrial operators, any reallocation of the MSS spectrum for this purpose should not occur until the FCC has granted Boeing access to the full amount of spectrum it originally requested. *See* Application of The Boeing Company, File No. 179-SAT-P/LA-97(16); IBFS File No. SAT-LOA-19970926-00149 (filed September 26, 1997).

B. The First Priority Of MSS Licensees That Utilize Spectrum For Ancillary Terrestrial Services Must Be To Provide MSS Service

It is axiomatic that the first priority of MSS operators must be to provide, and continue to provide, MSS service within their selected spectrum assignment. Permitting MSS operators to offer ancillary terrestrial services opens the door to potential abuse, either by abandoning an MSS component or claiming more spectrum then reasonably entitled.

For example, ancillary terrestrial services operating in the MSS uplink band will effectively increase the noise environment that will be seen by the satellite receiver, thus reducing the capacity available for the satellite uplink.[13] As the terrestrial component grows, an effect could be that the MSS component of the service would provide less and less of the overall system capacity, essentially vacating the spectrum to the terrestrial component. This should not be permitted.

In addition, if allowed to offer ATS, an MSS operator should not be permitted to provide MSS service in its selected spectrum assignment, while providing ancillary terrestrial service in a 2 GHz MSS sub-band outside its selected assignment, or vice versa, thus claiming more spectrum than reasonably entitled. Any 2 GHz MSS spectrum that is used to provide ancillary terrestrial services must <u>first</u> be used to provide MSS, regardless of whether it is inside or outside the licensee's selected assignment.

Boeing proposes instead that the Commission adopt a rule that would ensure that the primary offering in the 2 GHz MSS spectrum is, and remains, MSS. Such a rule would specify, for example, that any MSS operator that utilizes spectrum for ATS must ensure that the MSS

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[13] As discussed in Section IV of these comments, Boeing opposes any sharing scenario that would permit ancillary terrestrial use of the MSS downlink band because of the interference that would result to adjacent MSS networks.

component remains the predominant use of the spectrum. In other words, no MSS operator could offer less than a minimum threshold of MSS service if they also want to offer ancillary terrestrial services.

C. MSS Operators Should First Comply With Existing Construction And Coverage Requirements As Conditions To Offering Ancillary Terrestrial Services

The operating licenses granted to the eight MSS operators detail specific construction and coverage requirements for which a failure to comply could result in a loss of the license as well as the selected spectrum assignment. A prior condition for offering ATS should be full compliance with these existing requirements. Boeing agrees with the Commission's proposal that an MSS operator should be permitted to provide services using terrestrial stations only after the MSS operator demonstrates it can provide space segment service covering all 50 states, Puerto Rico, and the U.S. Virgin Islands 100% of the time, and consistent with the coverage requirements for 2 GHz MSS operators.[14]

Boeing is concerned about the possible erosion of MSS spectrum in the bands below 3 GHz. Without some reasonable restrictions on the use of MSS spectrum for ancillary terrestrial service, such as prior compliance with construction and coverage requirements, there is a strong possibility that the 2 GHz spectrum could eventually "default" to terrestrial use without any satellite component. Boeing requested more MSS spectrum than it ultimately received in its license, and expects that it will require additional spectrum in order to offer its planned AMS(R)S service in the future. Boeing, therefore, supports these construction and coverage restrictions.

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[14] *NPRM* ¶ 32 (emphasis added).

Once ATS is initiated, MSS operators that employ ATS should also maintain, on an ongoing basis, sufficient satellite coverage and service availability of their MSS services. Boeing, therefore, would support the revocation of an MSS operator's terrestrial authorization if the operator does not, for example, replace a sufficient number of failed satellites within a reasonable time period to maintain the Commission's coverage requirements. Rather than specify an arbitrary deadline by which a replacement satellite must be in orbit, Boeing would instead support the establishment of milestones, similar to the construction and implementation milestones but with shorter time periods, for satellite replacement. A failure to meet these milestones would result in revocation of the MSS operator's terrestrial service authority. In addition, Boeing would accept build-out and testing of terrestrial components in advance of meeting the satellite coverage requirements, but MSS operators should not be allowed to begin use of terrestrial components to provide ancillary services until the satellite component coverage conditions have been met.[15]

III. THE COMMISSION MUST NOT PERMIT "INDEPENDENT" TERRESTRIAL OPERATIONS IN THE 2 GHz MSS BAND

As noted above, in the guise of helping 2 GHz MSS licensees, the Commission raises several proposals in the *NPRM*, including one that would have devastating consequences to 2 GHz MSS operators. Specifically, the Commission suggests the possibility of authorizing terrestrial operations in the 2 GHz band that are "independent" of the satellite operators that are licensed to use the same spectrum. As the Commission seems to acknowledge in the *NPRM*, this

[15] On a related issue, Boeing also supports the Commission's proposal (*NPRM* ¶ 48) that if an MSS operator fails to meet its implementation milestones, it would also lose any opportunity to implement an ancillary terrestrial service.

suggestion appears to be a backdoor approach toward the wholesale reallocation of spectrum that is discussed in the companion NPRM that was released in ET Docket Number 00-258.[16]

The Commission should not authorize independent terrestrial licensees in the 2 GHz MSS band for a number of reasons. First, independent terrestrial operations would cause unacceptable interference to MSS networks attempting to provide services to consumers. As demonstrated in the Commission's spectrum allocation proceeding for 2 GHz MSS – in which it was concluded that most 2 GHz MSS systems could not share spectrum with terrestrial operators in the band and, as a result, the existing operators would have to be relocated – most ubiquitously-deployed MSS networks cannot co-exist with terrestrial services operating in the same spectrum.

The potential for interference would be particularly severe for 2 GHz MSS networks such as the one proposed by Boeing. Boeing intends to provide safety-related AMS(R)S services that must have a high level of availability and reliability. Boeing's AMS(R)S service does not involve any ancillary terrestrial component. Any proposal by the Commission that would permit such use by independent terrestrial operators would have devastating impacts on Boeing's proposed services.

Second, permitting independent terrestrial operators in portions of the 2 GHz band could compromise the ability of Boeing and other 2 GHz MSS operators to secure the expansion spectrum that will be necessary for Boeing to provide adequate services to the aviation industry. As the Commission has acknowledged, a major source of expansion spectrum for 2 GHz MSS licensees is likely to be the unused spectrum that is recovered from other 2 GHz MSS licensees that fail to meet their construction milestones. Reassigning this spectrum to Boeing may be

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[16] *See NPRM* ¶ 37 (noting that the possibility of permitting independent terrestrial operators in the 2 GHz MSS band "is subject to findings we make from our companion *Further Notice of Proposed Rulemaking* on advanced wireless services").

difficult, however, if the Commission is forced to evict independent terrestrial users that have begun operations in the same spectrum that was recovered from a failed MSS operator. Independent terrestrial operators may be especially reluctant to vacate a recovered sub-band if they obtained access to the spectrum through an auction process. Eviction would be necessary, however, in order for the spectrum to be suitable for use for Boeing's AMS(R)S services. Alternatively, the Commission could alleviate this concern by assigning to Boeing the full amount of its original spectrum request prior to authorizing independent terrestrial operators in other segments of the 2 GHz MSS band.

Third, if the Commission were to reallocate the 2 GHz MSS band for terrestrial services, it would undermine the Commission's long-standing policy of seeking domestic harmonization with worldwide radio frequency allocations. The frequencies 1980-2010 MHz and 2170-2200 MHz are allocated to MSS on a primary basis worldwide, while the frequencies 2010-2025 MHz and 2160-2170 MHz are also allocated to MSS on a primary basis in the Americas (ITU Region 2).[17] United States delegates to the 1992 World Administrative Radio Conference and the 1995 World Radiocommunication Conference participated in the deliberations that resulted in these international allocations. Moreover, the Commission has recently affirmed its conclusion that "wireless services, and, especially, satellite systems operate most efficiently in a globally consistent allocation of contiguous spectrum."[18] Unilaterally re-allocating the 2 GHz MSS band now for independent terrestrial services would belie these international agreements,

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[17] *Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 2 GHz*, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, FCC 01-224 ¶ 22 n.31 (rel. August 20, 2001) ("*New Advanced Wireless NPRM*").

[18] *See Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands*, Further Notice of Proposed Rulemaking, FCC 01-82 ¶ 8 (rel. May 31, 2001).

ultimately harming U.S. consumers, manufacturers, and service providers by isolating the United States market from the rest of the world.[19]

IV. REGARDLESS OF ANY POTENTIAL CHANGES IN THE LICENSING AND ALLOCATION RULES, 2 GHz MSS OPERATORS MUST REMAIN PROTECTED FROM HARMFUL INTERFERENCE

Boeing has performed an interference analysis, attached hereto as Appendix A, regarding the four sharing techniques proposed by ICO: (1) forward band sharing; (2) reverse band sharing; (3) downlink duplex sharing; and (4) uplink duplex sharing.[20] In short, sharing between MSS service and an ancillary terrestrial service in the downlink band cannot be accommodated because of harmful, unresolvable interference to any MSS licensee in an adjacent band.

Unacceptable levels of interference would result due to a propagation characteristic commonly referred to as the "near-far" problem. MSS satellites operate at a relatively significant range from their intended receive terminals on Earth. As a result, the desired signal emanating from the satellite reaches the user terminals at a relatively low power level. In contrast, an ancillary terrestrial transmitter would be very close to MSS user terminals and would be received by the user terminals at much higher power levels. In such situations, even if an ancillary terrestrial transmitter is operating in an adjacent band, the disproportionate power levels would overpower the space-to-Earth satellite signal, resulting in harmful interference.

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[19] The CMRS industry has previously acknowledged the importance – and resulting benefits to all three stakeholders – in US participation in and compliance with international allocations. *See Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, including Third Generation Wireless Systems*, Notice of Proposed Rulemaking, FCC 00-455 ¶ 9 (rel. January 5, 2001) (citing Petition for Rulemaking of the Cellular Telecommunications & Internet Association (filed July 12, 2000)).

[20] *NPRM* ¶ 60.

Due to the severity of the near-far problem, Boeing is opposed to any sharing of the MSS downlink band with an ancillary terrestrial component. Instead, Boeing supports the use of only one of the spectrum sharing scenarios suggested by ICO – the uplink duplex sharing mode.

Boeing also is concerned regarding the power density of ancillary terrestrial transmitters and user terminals operating in the 2 GHz MSS uplink band. Some restrictions on the radiated maximum density (Watts/Hz/km2) of ancillary user terminals and base stations would therefore be warranted.[21]

Finally, Boeing opposes any suggestion that the United States Table of Allocations be altered to permit co-primary operation of fixed and mobile services in the 2 GHz MSS band.[22] This change would result, again, in significant and unresolvable interference problems and would be inconsistent with international spectrum allocations. A fixed or mobile terminal co-frequency in the region of a satellite receive terminal would greatly exceed any reasonable interference threshold, thus resulting in a total loss of service for the MSS operator. Instead, the Commission should permit the use of ancillary terrestrial services in MSS spectrum solely according to its existing policies, which permit the provision of ancillary spectrum uses in limited instances.[23]

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[21] Boeing also agrees with the Commission's proposal (*NPRM* ¶ 58) to place the same use restrictions on cell phones and certain types of VHF/UHF MSS terminals on commercial aircraft on handheld terminals used with MSS terrestrial facilities.

[22] *NPRM* ¶ 69. The U.S. Table of Allocations is found in Section 2.16 of the Commission's rules, 47 C.F.R. § 2.106.

[23] *See, e.g., Motorola Satellite Communications, Inc.*, DA 96-1789, ¶¶ 10, 11 (1996) (permitting the provision of FSS in MSS spectrum that is incidental or ancillary to conforming services); *Communications Satellite Corporation and American Mobile Satellite Corporation*, 5 FCC Rcd 4117, 4118 (1990) ("*AMSC*") (permitting the provision of AMS(R)S and LMSS in L-band MMSS spectrum on an interim basis on an incidental or auxiliary basis).

V. MSS OPERATORS MUST NOT BE DEPRIVED OF ACCESS TO EXPANSION SPECTRUM AS A CONSEQUENCE OF THIS PROCEEDING

The Commission's 2 GHz MSS allocation and licensing orders clearly provide that MSS licensees will have access to additional spectrum, either through designated expansion spectrum, or through spectrum "abandoned" by MSS licensees that fail to construct their systems. 2 GHz MSS licensees such as Boeing have fully demonstrated their need for expansion spectrum. Therefore, any decision by the Commission to permit ancillary terrestrial services in the 2 GHz MSS band should not be misused as a "bargaining chip" or as a "trade off" to permit the introduction of terrestrial 3G services in the band and limit MSS licensees from acquiring the expansion spectrum that they require.

In the *2 GHz MSS Order*, the Commission expressly set aside additional spectrum, equal to the entire share of one of the 2 GHz MSS applicants, for expansion for qualifying MSS operators.[24] Yet, even before the 2 GHz MSS applicants were granted their licenses, the CMRS industry attempted a "land grab" for the full 70 MHz of spectrum for its speculative "3G" advanced wireless services.[25] Wisely, the Commission rejected proposals for wholesale reallocation of the band. The Commission is still considering an FNPRM, however, that raises the possibility of converting some portion of the 2 GHz MSS band for terrestrial 3G services.[26]

While Boeing is filing on this date separate comments opposing these proposals, suffice it to say here that, as noted above, a cap of only 3.5 MHz of spectrum in each direction would

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[24] *2 GHz MSS Order*, 15 FCC Rcd at 16138 ¶ 16.

[25] *See* Petition for Rulemaking of the Cellular Telecommunications & Internet Association, ET Docket No. 00-258 (filed May 18, 2001).

[26] *New Advanced Wireless NPRM* ¶¶ 23-26. Boeing offers more specific comments regarding the use of any of the 2 GHz MSS band for 3G in its response to this FNPRM, filed separately.

prevent Boeing, from a technical standpoint, from bringing its satellite-based air transport safety and management system to the public. The Commission set forth a clear regulatory path to additional 2 GHz MSS spectrum resources.[27] Proposals to reallocate 2 GHz MSS spectrum for terrestrial 3G would undermine this process, thus denying Boeing – and perhaps other 2 GHz MSS operators – access to the spectrum resources necessary to implement a technically and commercially viable MSS system.

The Commission should also refrain from linking the proposals of the 3G industry with the ancillary terrestrial proposals of ICO and Motient. For example, the Commission asks in its *NPRM* whether "we should view the ICO and Motient proposals as indicating that too much spectrum has been allocated for MSS?"[28] The more reasonable conclusion is that insufficient spectrum has been allocated for MSS. As a result, MSS licensees are being forced to design networks that can operate initially in relatively small spectrum segments, even though it would be much more efficient to operate in larger assignments. Furthermore, the current situation creates uncertainty for the MSS industry regarding the availability of needed expansion spectrum.

The Commission should not attempt to use the ICO and Motient proposals as a way to strike a compromise by granting ICO's and Motient's proposals as some sort of "trade off" for splitting off the promised 2 GHz MSS expansion spectrum to the CMRS industry. In any event, any reallocation of MSS spectrum to terrestrial users should not occur until the FCC has granted Boeing access to the entirety of its original spectrum request.

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[27] *2 GHz MSS Order* ¶¶ 35-38.

[28] *NPRM* ¶ 28.

VI. CONCLUSION

Boeing can support limited flexibility for the 2 GHz MSS licensees allowing them to deploy true "ancillary" terrestrial services for the purposes of improving their chances of commercial success. If ancillary terrestrial services are permitted, they should be limited only to the uplink duplex sharing mode, and should not be permitted in the MSS downlink band.

Boeing also urges the Commission to refrain from authorizing any independent terrestrial operators that are separate and apart from licensed MSS operations in the 2 GHz MSS band. Independent terrestrial operations would cause significant and unresolvable interference problems for MSS networks. Therefore, before the Commission authorizes any independent terrestrial services, or reallocates any portion of the 2 GHz MSS band to other services, the FCC should first grant Boeing's entire original spectrum request in order to ensure that Boeing will be able to provide AMS(R)S with adequate availability and reliability for the global aviation industry.

Respectfully submitted,

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APPENDIX A

Interference Analysis

As noted by the Commission, ICO does not set forth a specific architecture for its proposed ancillary terrestrial component ("ATC").[29] Rather, ICO presents four possible ways that its system could be structured. Boeing has undertaken an analysis, provided below, of each of the four structures to determine the potential interference, if any, to Boeing's proposed AMS(R)S system in the 2 GHz MSS band.

Summary. Sharing between MSS and an ancillary terrestrial services in the downlink band cannot be accommodated because of harmful, unresolvable interference to any MSS licensee in an adjacent band. This is a result of the familiar "near-far" problem. In other words, where the satellite is at a significant range from the intended receive terminal on earth, the desired signal at the earth terminal is at a low signal level. Therefore, an ancillary terrestrial transmitter operating in an adjacent band would significantly overpower a nearby satellite receiver, causing harmful interference. This result eliminates all but one of the sharing scenarios, the uplink duplex sharing mode. Consequently, Boeing is opposed to any sharing of the MSS downlink band with an ancillary terrestrial component.

Analysis. ICO identifies the following four modes for intra-system sharing: (1) forward band sharing; (2) reverse band sharing; (3) downlink duplex sharing; and (4) uplink duplex sharing.[30] These four sharing modes imply four different types of transmissions to be analyzed for potential interference to Boeing's AMS(R)S system:

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[29] *Id.* ¶ 59.

[30] *Id.* ¶ 60.

1. ATC base station transmitting in the satellite downlink spectrum and potentially interfering with the Boeing system user terminal (UT);

2. ATC user terminal transmitting in the satellite downlink spectrum and potentially interfering with a Boeing user terminal that is nearby;

3. ATC base station transmitting in the satellite uplink spectrum and potentially interfering with the Boeing satellite receiver; and

4. ATC user terminal transmitting in the satellite uplink spectrum and potentially causing interference into the Boeing satellite receiver.

In the first and second interference conditions, the potential interference is into a Boeing system user terminal. The amount of interference into the user terminal will depend on the distance from the Boeing user terminal to the ATC transmitter. The analysis determines the minimum separation distance that must be maintained in order to avoid an unacceptable level of interference. In the third and fourth cases the interference is into the Boeing satellite receiver. In these cases the range is fixed. Therefore, an interference margin is calculated. A positive margin means the interference is below the interference criterion.

The interference criterion that is commonly used with co-primary systems in the satellite service is a $\Delta T/T$ of 6 %. This equates to an Io/No of –12.2 dB. This will be used as the interference criteria in calculating the minimum separation distance, and will also be used in determining the interference margin. It should also be noted that the power levels and out-of-band emission levels are those used by ICO in its proposal.

<u>Sharing Mode #1: ATC Base Station Transmitting in the Satellite Downlink Spectrum</u>. In this mode, the potential interference is to a Boeing user terminal that is trying to receive a signal from a satellite. The satellite signal at the Boeing user terminal is low (near threshold), and the ATC base station signal at the Boeing user terminal has the potential to be very large depending on: (1) the distance between the ATC base station transmitter and the Boeing user terminal, and (2) the

OOB emissions mask from the ATC base station. Table 1 below shows the calculation of the minimum separation distance that is required.

This calculation shows the interference from only one base station. However, it should be clear that multiple ATC base stations, which would be needed to serve a large metropolitan area, would result in even greater levels of interference to the Boeing user terminal.

Table 1: ATC Base Station Interference to Boeing User Terminal

Frequency	GHz	2
Noise temp (Boeing UT)	K	200
Noise density, No (Boeing UT)	dBW/Hz	-205.59
Interference Criteria, Io/No	dB	-12.2
Allowed Io	dBW/Hz	-217.79
OOB emissions (ATC Base station)	dBW/4-kHz	-56.50
Reference Bandwidth	kHz	4
OOB emission density	dBW/Hz	-92.52
Antenna Gain (Boeing UT)	dB	0
Propagation Loss (LOS)	dB	125.27
Range	km	21.90

Note: This analysis uses an antenna gain for the Boeing user terminal of 0 dB. The actual gain would depend significantly on the geometry.

A separation range of greater than 20 km would be required between an ancillary terrestrial base station and a Boeing system user terminal to avoid harmful interference. This is an unacceptable condition, as it would effectively restrict Boeing from operating in or near any metropolitan areas.

Sharing Mode #2: ATC User Terminal Transmitting in the Satellite Downlink Spectrum. In this mode, the potential interference is to a Boeing user terminal from a nearby ATC user terminal. The signal at the Boeing user terminal is low (near threshold), and the ATC user terminal signal at the Boeing user terminal has the potential to be very large. Table 2 shows the calculation of the minimum separation distance that is required between an ATC user terminal and a Boeing user terminal.

Table 2: ATC User Terminal Interference into Boeing User Terminal

Frequency	GHz	2
Noise temp (Boeing UT)	K	200
Noise density, No (Boeing UT)	dBW/Hz	-205.59
Interference Criteria, Io/No	dB	-12.20
Allowed Io	dBW/Hz	-217.79
OOB emissions (ATC UT)	dBW/4-kHz	-93.50
Number of UT's in area		6
Reference Bandwidth	kHz	4
OOB emission density	dBW/Hz	-121.74
Antenna Gain (Boeing UT)	dB	0
Propagation Loss (LOS)	dB	96.05
Range	km	0.76

The amount of interference will be dependent on the number of ICO user terminals that would be transmitting within range of the Boeing user terminal. Since the Boeing user terminal is mounted on top of the fuselage of an aircraft, the most likely scenario for interference would be for ICO's ATC user terminals used at an airport terminal. It is not uncommon to find several individuals using their cell phones while waiting for an airplane at the terminal. Six ICO user terminals were considered to be transmitting for this analysis. This number could be significantly larger. Boeing therefore finds this to be an unacceptable interference condition.

Sharing Mode #3: ATC Base Station Transmitting in the Satellite Uplink Spectrum. In the case of the ATC base station transmitting in the uplink spectrum, the potential interference is into the Boeing satellite receiver. The footprint for a Boeing system spot-beam on the earth is very large (about 1800-km diameter) and it is likely that there could be a large number of ATC base stations within any spot beam from the satellite. This is particularly true if the ATC cells are small as ICO claims they would be. A larger number of ATC cells would be required to cover a large metropolitan area. The following analysis assumes there are 500 ATC base stations operating within a single spot beam footprint of the Boeing satellite. Table 3 below shows the calculation for the interference margin in this case.

Table 3: ATC Base Station Interference to Boeing Satellite Receiver

Frequency	GHZ	2
OOB emissions /ATC base station	dBW/4kHz	-56.50
Number of ATC base stations		500
OOB reference bandwidth	kHz	4
OOB emission density	dBW/Hz	-65.53
Satellite Altitude	km	20182
Elevation angle	degrees	10.00
Range to Satellite	km	24700
Path loss	dB	186.31
Satellite receive antenna gain	dB	33.00
Io	dBW/Hz	-218.85
Satellite receive noise temperature	K	450
Satellite receive noise density, No	dBW/Hz	-202.07
Io/No	dB	-16.78
Io/No required	dB	-12.20
Interference margin	dB	4.58

A reasonable ATC base station design would most likely use an antenna that provided most of the radiation in the horizontal direction and very little directly overhead. Therefore, the analysis above assumes an elevation angle to the satellite of 10 degrees. The details of the ICO

ATC base-station antenna radiation pattern are not known and would have to be considered in any future analysis. This current analysis shows that the interference in this condition is less than the threshold. However, it is of concern. Boeing would want some upper limit on the aggregate power density that is allowed for ancillary terrestrial service.

Sharing Mode #4: ATC User Terminal Transmitting in the Satellite Uplink Spectrum. In the case of the ATC user terminal transmitting in the uplink spectrum, the potential interference is into the Boeing satellite receiver. As previously, the footprint for the spot beam is very large and could see a large number of ATC user terminals. Table 4 below shows the calculation for the interference margin in this case.

Table 4: ATC User Terminal Interference to Boeing Satellite Receiver

Frequency	GHZ	2
OOB emissions /ATC base station	dBW/4kHz	-93.50
Number of ATC user terminals		10000
OOB reference bandwidth	kHz	4
OOB emission density	dBW/Hz	-89.52
Satellite Altitude	km	20182
Elevation angle	degrees	90.00
Range to Satellite	km	20182
Path loss	dB	184.56
Satellite receive antenna gain	dB	34.80
Io	dBW/Hz	-239.28
Satellite receive noise temperature	K	450
Satellite receive noise density, No	dBW/Hz	-202.07
Io/No	dB	-37.21
Io/No required	dB	-12.20
Interference margin	dB	25.01

In this case, the ATC user terminals probably have close to an omni-directional antenna gain, which would be justified considering the position of the satellite directly overhead. As

expected, even with a very large number of user terminals, there is a very larger interference margin. It is not expected that this interference condition would be a problem to Boeing's AMS(R)S system.

Conclusion. The conclusion of the analysis above is that ancillary terrestrial services operating in the MSS downlink band produce an unacceptable interference level. However, operation of ancillary terrestrial services in the MSS uplink band would be acceptable provided the terrestrial base stations are limited to a maximum radiated power density (Watts/Hz/km2).

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION SUBMITTED IN THESE COMMENTS

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in these Comments, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted in these Comments, and that it is complete and accurate to the best of my knowledge.

By: Robert Higgins
Technical Fellow

October 18, 2001