proponents' technical arguments. Same-band satellite and terrestrial operations have created technical problem in other bands.[141] While these technical problems have not always proved insurmountable, particularly where only stationary deployments are involved,[142] the problems grow more complex where, as here, both the proposed satellite service and the proposed terrestrial service are planned as *mobile* services with widespread deployments.[143] In certain MSS bands at issue in this proceeding, moreover, international agreements[144] and permissive domestic licensing policies[145] make establishing long-term

[141] *See, e.g., Allocation and Designation of Spectrum for Fixed-Sorellire Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band: Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocorion of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government* Operorioris. Further Notice of Proposed Rulemaking. IB Docket No. 97-95. 16 FCC Rcd 12244 (2001) (V-Band Further Notice) (describing the difficulties of sharing between ubiquitous fixed terrestrial wireless systems and satellite systems. discussing agreements to dedicate separate spectrum to the two services and seeking comment on possible solutions where separation was not possible); *Advanced Services First Report and* Order, 16 FCC Rcd at 17223, ¶ 3 (noting that the possibility of the shared use of the band by **MSS** is "sharply diminished" by the introduction of terrestrial mobile services in the 2.5 GHz band and rejecting a proposal that would allow MSS to share frequencies in the *2.5* GHz band with terrestrial mobile and fixed services principally because "sharing between terrestrial and satellite systems would present substantial technical challenges").

[142] *Amendment of Pam 2 and 25 of the Commission's Rules* ro *Permit Operation of NGSO FSS Systems Co-Frequency with* GSO *and Terrestrial Systems in the Ku-Band Frequency Range,* Memorandum Opinion and Order and Second Report and Order. ET Docket No. 98-206, 17 FCC Rcd 9614 (2002) ***(MVDDS Order)*** (concluding. aher several years of study, that sharing is possible between geostationary DBS satellites and MVDDS systems. which use fixed. highly directional antennas stationary co-frequency terrestrial and satellite operations). ***modified by,*** Erratum. 17 FCC Rcd 5849 (PSPWD. rel. Aug. 14, 2002); ***see also*** ICO Supplemental Comments al **13-14** & nn.13-14 (describing MVDDS proceeding).

[143] ***See,*** *e.g.*, Globalstar Supplemental Comments at 5 & Attach. 1 at 1-43

[144] In the L-band. for example. the amount, specific frequencies and geographic location of the spectrum in which the five MSS operators in the region of the United States must operate can vary annually. In 1996, the five MSS operators and their respective administrations agreed to a framework by which they could negoliate future sharing arrangements for L-band spectrum in Region 2. This agreement. the 1996 Mexico City Memorandum of Understanding (Mexico City MoU), provides for annual coordination to divide the spectrum on the basis of. among other things, each satellite system's actual usage and realistic projections of future usage. Although annual meetings were to have taken place under the terms of the Mexico City MoU, these meetings have not occurred since the parties last agreed to a complex spectrum-sharing arrangement in London in 1999; therefore, the parties continue to operate under the 1999 assignments pending further negotiations. The following operators currently share L-band spectrum: MSV (United States); TMI (Canada); Inmarsat (United Kingdom); Solidaridad (Mexico): and Volna-More (Russia). In addition, the Multi-functional Transport Satellite (MTSAT-1R) from Japan is expected to commence L-band MSS operations sometime in 2003. To permit full operations. however, the Japanese system will nerd to obtain L-band MSS spectrum from the spectrum currently assigned to the five MSS operators that were parties to the 1996 Mexico City MoU. Although the parties to the Mexico City MoU have not yet established a meeting date to negotiate a new operating agreement that accounts for the needs of the new MTSAT system. the Japanese administration is expected to participate in the next available negotiation session under the principles of the Mexico City MoU. *See. e.g.*, MSV Supplement Comments at 8; Inmarsat May 21, 2002 *Ex Parte* Letrer. Attach. 1 at 3; Inmarsat Supplemental Comments at 13-14; *see also* National Space Development Agency of Japan. Future Launch Schedule. *available at* <http://www.nasda.go.jp/projects/mission-in-progress_e.html> (last visited Nov. 12, *2002)*

[145] Coordination between co-frequency communications systems, lor example. requires knowing fairly precise technical information about the configuration and operation of any systems operating in the relevant band. In the *2* GHz MSS band. however. only one of eight MSS licensees currently knows its precise operating frequencies. In the (continued....)

coordination plans extremely difficult and – together with the need to prevent and resolve recurrent concerns about mutual interference – would require the Commission's active and continued oversight over many years and still may not prove successful.'"

55. Based on the record and our analysis. we find that establishing shared usage between MSS and terrestrial services would likely compromise effectiveness to such a degree that neither service would prove cost-effective, and therefore would probably not be deployed. Therefore, we decline to adopt same-band. separate-operator sharing as an alternative to permitting MSS licensees in each of the three MSS bands at issue in this proceeding the option of adding ATCs in determining how they conduct their MSS operations.

### 2. Separate-Band, Separate-Operator Sharing

56. In our *Flexibility Norice* and again in our ***Severobilip** Public Norice,* we sought comment on whether "it is technically feasible for one operator to provide terrestrial services and another operator to provide satellite services ***in the same MSS band.***"[147] Though we did not propose a separate-band, separate-operator configuration, several commenters construed the *Flexibility Norice* and the ***Severobilip** Public Notice* to propose reallocating spectrum from MSS to terrestrial mobile use. In general, these commenters view the principal MSS ATC proposal as not truly same-band sharing but rather as band segmentation (*i.e.*, separate band, separate operator). For example, Verizon Wireless argues that MSS operations can be "severed" from terrestrial operations by reallocating the terrestrial and satellite spectrum into separate frequency bands.[148] Similarly, AT&T Wireless states that MSS licensees propose to segment the band themselves in the same way that it would be segmented for nonaffiliated providers because ATC and satellite components cannot operate co-frequency in the same cell regardless of whether MSS and terrestrial wireless service are provided by a single or by different providers.[149] According to these commenters, therefore, if "severability" is actually accomplished by segmentation, then there is no reason why the technical requirements for a non-affiliated terrestrial service should be any more complex

(Continued from previous page)
***2 GHz MSS Rules Order,*** the Commission divided the 2 GHz MSS uplink (1990-2025 MHz) and downlink (2165-2200 MHz) bands into distinct segments of equal bandwidth (Selected Assignments) to be based on the number of authorized systems. ***See** 2 GHz MSS Rules **Order.*** 15 FCC Rcd at 16138,¶ 16. An additional segment was reserved for MSS system expansion. ***Id.*** Under the Selected Assignment approach, each 2 GHz MSS operator must voluntarily identify its selected spectrum after the first satellite in its system reaches its intended orbit. ***Id.*** On October 15.2002. ICO notified the Commission that it had selected the first 3.88 MHz segment from the band edge at 1990 MHz (*i.e.*, 1990-1993.88 MHz) and the third 3.88 MHz segment from the downlink band edge at 2165 MHz (*i.e.*, 2172.76-2176.64 MHz). ***See*** Letter from Cheryl A. Tritt, Counsel to ICO Satellite Services G.P.. to Marlene H. Dortch. Secretary, Federal Communications Commission, File No. 188-SAT-LOI-97. IBFS File No. SAT-LOI-19970926-00163 *et al.* (Oct. 15, 2002). Four more 2 GHz MSS licensees must choose their Selected Assignments under our 2 GHz MSS service rules and licensing orders.

146 ***See.*** *e.g.*, Celsat Supplemental Comments at 3 (concluding that the prospect of separately owned and operated MSS and terrestrial mobile operations is "highly unrealistic" because "any Cornmission program of independent terrestrial operations would force MSS operators to somehow determine the location of all terrestrial users in real time and then to attempt to control millions of terrestrial calls on an on-going, real-time basis ***in perpetuity*** for their terrestrial competitors") (emphasis in original).

147 *Severability Notice* at 2.

148 Verizon Wireless Supplemental Comments at 1

149 *See* ***cy*** . AT&T Wireless April 1, 2002 *Er Parte* Letter at 3

than for a single operator.[150]

57. Most of the **MSS** licensees addressing this issue disagree at great technical length with the terrestrial operators' statements.[151] The MSS licensees state that they will implement their MSS ATC systems through shifts of frequency that would vary over time.[152] They contend that they do not intend to separate the two types of systems into different channels in the type of permanent way that the terrestrial carriers and their representatives claim that they will.[153]

58. We need not resolve the debate over whether MSS ATC will use **a** "dynamic" or "static" frequency-assignment mechanism to achieve greater frequency reuse. The Commission has identified MSS as an important component of our overall mix of spectrum allocations. The "separate-band, separate-operator" approach. however, would. in essence. reallocate spectrum from MSS to other uses. We believe that reconsideration of the spectrum-management decision to allocate resources to **MSS** is unreasonable and unwarranted. Nevertheless. to the extent parties believe that this basic spectrum-management decision should be altered. the Commission has initiated other proceedings to comprehensively address the proper amount of spectrum to allocate to **MSS.** some of which are resolved today. In this Order. we simply conclude that. within the spectrum currently allocated for **MSS.** some **MSS** licensees may find that they can achieve greater spectrum efficiency, greater capacity and more robust service by using MSS in combination with MSS ATC than through MSS alone.

### 3. Secondary Terrestrial Service

59. In response to the *Flexibility Notice*. Iridium proposed a secondary terrestrial service (STS) in the MSS bands at issue in this proceeding."‘ Under Iridium's STS proposal. the Commission would maintain the primary allocation for **MSS** in the *2* GHz MSS, L- and Big LEO bands, but establish a new, secondary allocation for terrestrial mobile services. The Commission would not limit eligibility for these new STS licenses to the MSS incumbents and. after opening a filing window, would use competitive bidding to resolve any mutually exclusive applications.[155] Iridium claims that its STS proposal would expand the number of potential parties that might implement terrestrial mobile services in the primary MSS bands beyond the number of **MSS** systems able to implement ATC under our primary proposal.[156]

60. We believe that Iridium's proposal for a primary MSS allocation and an STS allocation suffers from several problems. Most important, MSS and terrestrial mobile services cannot as a practical matter share the same band unless all of the components that might potentially cause interference,

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[150] ***See.*** *e.g.*, ***id.*** at 8.

[151] ***See.*** *e.g.*, ICO Supplemental Comments at 6-19: Globalstar Supplemental Comments **at** 4-7. Technical Appendix at 1-42; MSV Supplemental Comments at 6-9.

[152] Constellation Supplemental Comments at 3.

[153] *See, e.g.*, ICO Reply at 9-11; Globalstar Reply at 8-10; MSV Reply **at** 7. 10, 23-24.

[154] **Iridium** Comments at 5-8; Iridium Supplemental Comments at 2-4

[155] *See* Iridium Supplemental Comments at 4-6 (explaining various adjustments needed in the 2 GHz MSS service rules to limit uncertainties and other problems necessary to successfully implement a competitive bidding process in thr hand)

[156] *Id.* at 2.

including the terrestrial base stations. the mobile earth terminals and the MSS satellites, are capable of responding dynamically to interference."' As discussed below, the potential for interference between MSS and terrestrial mobile systems is, in fact. so great that we believe only a single type of operator – in this case, the incumbent MSS licensees – would possess both the ability and incentive to coordinate operations in a manner that avoids interference.[158]

61. Iridium also suggests that imposition of secondary status on in-band terrestrial systems would ensure that the satellite systems are adequately protected againsr harmful interference.[159] Establishing a secondary allocation. however. does not itself adequately protect primary licensees against interference. Iridium recognizes as much when it states that MSS licensees must first achieve a "high degree of comfort" that STS will not interfere with their operations before any new STS licenses could be issued.[160] But it does not identify an interference threshold by which the Commission might measure whether the MSS licensees have achieved comfort.[161] Lacking the necessary technical information in the record. we are concerned how coordination among primary and secondary licensees, alone, could ever result in the operational parameters necessary to make STS workable – the same parameters that Iridium acknowledges would be necessary for STS operations to be successful.[162] Significantly, moreover, primary service users are not required to coordinate with secondary operations.

62. Iridium recognizes that the precise technical paramerers of each secondary allocation would be difficult to establish and would vary widely depending on the exact system architectures, operational configurations. coding techniques, power levels and other parameters that each MSS licensee and each in-band secondary terrestrial system chose to use.[163] Complicating matters further, Iridium envisions each

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Is7 *See* discussion *supra* at Section III(B).

158 *See* discussion *infra* at Appendix C1-3

159 *See. e.g.*, Iridium Supplemental Comments at 6 ("By imposing secondary status on the terrestrial systems, the Commission ensures that the satellite systems are protected.").

160 Iridium Comments at 6; *see also* Iridium Supplemental Comments at 3 (claiming, twice, that it is "essential" that MSS systems not experience interference from secondary terrestrial operations); Iridium Supplemental Comments at 4 (demanding "*absolute* primary status" for incumbent MSS systems if its STS proposal were to be implemented) (emphasis added); Iridium Comments at 6 (noting that "great care must be exercised in fashioning the technical rules that would govern this new STS").

161 Iridium Supplemental Comments at 6 (specifics to be worked out in the inter-party coordination process or possibly Commission-established technical parameters), *see also* ICO Supplemenlal Comments at 14 n.15 (noting that Iridium has "neither provided any specific plan to operate any independent terrestrial system in MSS spectrum nor offered any technical analysis demonstrating the feasibility of such as system") (citation omitted).

161 *See. e.g.*, ICO Supplemental Comments at 14; Globalstar Comments at 14-15; Globalstar Bondholders Comments at 33-34; Globalstar Bondholders Supplemental Comments at 2; Celsat Comments at 8; Constellation Comments at 16; ICO Reply at 1. 7-8; Celsat Reply at 16-17 n.44; MSV Reply at 13-15; CTIA Reply at 14: Globalstar Reply at 11

163 Iridium Supplementnl Comments at 5. *see also* Iridium Supplemental Comments at 5 (conceding that STS would involve "potentially complex issues"); Iridium Supplemental Comments at 3 (noting that "[o]bviously . . . [STS] may theoretically complicate . coordination").

potential STS licensee as occupying more bandwidth than would be assigned to any one **MSS** licensee." **As** a result. each new STS licensee would need to coordinate its proposed secondary operations with at least two primary MSS systems.[165] Because each primary MSS system would use different satellites, different antennas and, in all likelihood. different coding and other operational parameters. each prospective STS licensee would need to design its terrestrial system to meet an insurmountable number of potential interference scenarios.'" Finally, even if the secondary terrestrial mobile applicant and the primary MSS licensees agreed on co-channel interference limits,[167] the secondary terrestrial mobile applicant would still need to consider the operational parameters of forthcoming next-generation satellite systems and, as with any licensee. protect adjacent channel MSS systems from potential interference.[168] Under these circumstances, a secondary terrestrial mobile system. if ever able to coordinate its operations with the primary MSS licensees, would likely be too constrained in its operations to implement STS.[169]

63. Finally. Iridium appears to believe that permitting all MSS licensees to integrate ATCs into their systems is tantamount to a "policy that, ***de facto***, would advance the interests of only one, uniquely situated, MSS system," namely those of ICO in the *2* GHz MSS band."' The majority of MSS licensees, however, affirm their ability to improve their spectrum efficiency by integrating a terrestrial component into their licensed MSS systems.[171] Although lridium itself may not be able to integrate a terrestrial component into its particular MSS system because of its historic choice of system technology."' many

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[164] ***See, e.g.***, Iridium Comments at 6 ("to provide adequate spectrum for STS operations -- including enabling the terrestrial licensee to be able to "work around" a given MSS system -- STS licenses should cover more than the bandwidth of one individual MSS system").

[165] *See also* Constellation Reply at 5 n.15 (asserting that iridium's proposal to have terrestrial use assignments larger than a single MSS system assignment renders the STS scheme too burdensome to consider as a reasonable alternative). In addition, in the **2** GHz MSS band where MSS licensees have not yet identified their Selected Assignments, Iridium concedes that prospective STS licensees would not even know the licensees with which they would be required to coordinate their operations. See Iridium Supplemental Comments at 3-4. To remedy this failing, iridium urges the Commission to reverse its recently issued ***2 GHz MSS Rules Order*** in part and immediately assign specific Frequencies to the 2 GHz **MSS** systems. Only by requiring MSS licensees to immediately choose their Selected Assignments could STS applicants know from the outset the identity of the corresponding primary satellite systems with which they would need to coordinate. ***See*** Iridium Supplemental Comments **at 4.**

[166] Constellation Reply at 13 (questioning how an STS applicant would ever adapt to both CDMA and TDMA technologies in the Big LEO band).

[167] Iridium Supplemental Comments at 6

[168] *Sec. e.g.*, CTIA Supplemental Comments at 8 ("Segmenting and separately authorizing terrestrial service in the MSS bands would not change this basic requirement to protect the operations of licensees in adjacent channels, whether satellite or terrestrial.")

[169] According to MSV. the cnordinotion requirement thai Iridium envisions imposing may very well prove so burdensome that MSS spectrum might lay fallow indefinitely. **MSV** Reply at 14-15.

[170] *See* Iridium Supplemental Commenta at ***2;*** Iridium Comments at 3 (claiming that MSS ATC is "an opportunity lor ICO and nu one else").

[171] ***See*** Globalstar Sept. 26, 2002 ***Ex Parte*** Letter. Attach. I at E. 11; TMI Sept. 26, 2002 *Ex Parte* Letter **at** 7; MSV Aug 29. 2002 *Ex Parte* Letter at 2.

[172] Iridium is unlikely to prove able tn integrate terrestrial operations into its licensed MSS frequencies as a result of Its historical choice to deploy time division multiplex analysis (TDMA) coding in its MSS system.

other MSS licensees besides ICO have demonstrated that they can do so. Accordingly, any concern that only one MSS licensee will be able to implement ATC is unfounded. In fact. Iridium appears far less concerned with monopolization of the MSS bands than with advancing its position that. unless the Commission can find a way of allowing ***Iridium*** to exploit the operational efficiencies. enhancements and other advantages that MSS ATC may offer, the Commission must prevent all other MSS licensees from trying to improve the efficiency of their respective MSS systems through deploying **ATC.** We. however, refuse to impose the same operational limitations on Commission licensees through regulation that Iridium has imposed on itself through its system design choices.

64. In summary, we conclude that Iridium's STS proposal would involve technical and operational complications, and problems to successfully implement. In light of those problems and notwithstanding the potential that STS may expand the number of parties eligible to implement flexible operations, we conclude that the likely burden on secondary operators. MSS licensees, and the Commission would outweigh the benefits anticipated from the proposal.[173] We, therefore, decline to adopt Iridium's STS proposal.

**4.** Conclusion

65. The record demonstrates that sharing between MSS and terrestrial mobile services is neither advisable, nor practical. Revocation of the authority of operational **MSS** systems and those MSS licenses that have met their implementation milestones in good faith is unreasonable and unwarranted. And our detailed technical analyses demonstrate that a third party cannot operate in the licensed MSS spectrum without compromising the operations of existing and future MSS licensees. We, therefore, face a choice between quickly achieving the public-interest benefits of improved spectrum efficiency. reduced costs and increased competition at the price of giving MSS licensees more than they had originally sought, or giving MSS licensees only what they originally received at the price of the public-interest benefits that **MSS** ATC promises. Under these circumstances, we decide that granting the **MSS** licensees additional spectrum flexibility represents the better course.

C. **MSS ATC** Service **Rules**

66. We adopt service-rule requirements for the provision of MSS ATC that, among other things, effectively condition MSS ATC on the provision of substantial satellite service. As explained below, an MSS licensee that wishes to include ATC must meet certain requirements concerning: (1) geographic coverage; *(2)* coverage continuity; **(3)** commercial availabiliry; (4) an integrated offering; and *(5)* in-band operation.[174] We view full and complete compliance with each of the requirements as essential to the integrity of our "ancillary" licensing regime. Without the integrity afforded by these MSS ATC service-rule requirements, an alternative licensing or distribution mechanism should be used. Thus. failure of an MSS operator to meet any of the ATC service requirements set forth in our Rules and this Order may result in enforcement action, including the imposition of a monetary forfeiture in addition to the loss of

[173] Iridium Supplemental Comments at 8

[174] As described in detail in section III(G), *infra*. we will require MSS licensees seeking ATC authorization to modify their space-station licenses using FCC Form 312 and provide specific information and certifications describing their **ATC** operations **as** meeting these requirements As is Commission practice for any application to modify **a** space-station license, these applications will he available for review in the licensee's public file. Any applications meeting these requirements will be treated as minor modifications. **As** with any minor modification.it upon Commission review the Commission deems it in the public interest to seek comment on an MSS ATC applicntion. the Commission at its discretion may provide public notice and opportunity for comment.

ATC and MSS operating authority. We remind licensees that, under section 503(b) of the Communications Act and the Commission's rules, the Commission may assess a monetary forfeiture against common carriers in amounts up to $120,000 for a single violation or per day of a continuing violation with a maximum forfeiture amount of $1,200,000 and against non-common carriers in amounts up to $11,000 for a single violation or per day of a continuing violation with a maximum forfeiture amount of $87,500.[175] We have no reason to believe that licensees will not comply in good faith with the service rules we adopt today: however, we will not hesitate to use our statutory enforcement authority against those licensees that do not.

### 1. "Ancillary" Service

67. Our decision to permit MSS ATC is based upon the premise that ATC remains "ancillary" to a fully operational space-based MSS system. We find that an ATC system is "ancillary" when an MSS operator meets all of our requirements for the provision of ATC.

68. In the *Flexibility **Norice,*** we stated that we intended the term "ancillary" to refer to those terrestrial services that MSS operators provide that: (1) "are integrated with the satellite network": *(2)* "use assigned MSS frequencies"; and (3) "are provided for the purpose of augmenting signals in areas where the principal service signal, the satellite signal. is attenuated."[176] We added that. by using the term "ancillary." we intended to exclude "services that differ materially in nature or character from the principal services offered by MSS providers."[177] Our intention in defining the term "ancillary" in the *Flexibility **Notice*** was to distinguish our use of "ancillary" in the context of the *Flexibility **Notice*** from other instances in which the Commission has employed the term, not to suggest any additional requirements. In other words. we intended the term ancillary to refer *to* a proposed set of conditions under which an MSS licensee might offer integrated mobile services in the hands allocated for the MSS licensee's use, consistent with its existing MSS authorization.[178]

69. Some commenters dispute our definition of "ancillary" in the *Flexibility Notice*.[179] For example. in the *Flexibility Norice.* we said that we did not intend ATC services to differ materially "in nature or character" from MSS services. By this language, we sought to illustrate our expectation that MSS and MSS ATC ***services*** should remain similar in material respects; in other words, we envisioned both MSS and MSS ATC as generally offering the same types of applications to the end user. While our intent in defining the term ancillary was to clarify. we believe that our definition in the *Flexibility* Notice may. in fact, have led to confusion of our use of the term "ancillary" in this context. CTIA, for example,

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[175] 47 U.S.C. § 503(b); **47** C.F.R. § 1.80

[176] *Flexibility* Norice, 16 FCC Rcd at 15546-47, ¶ 30

[177] *Id.* at 15546-47, ¶ 30.

[178] ***Id.*** **at** 15546, ¶ 30: *see also* discussion *supra* n.5

[179] *See, e.g.*, Cingular/Verizon Comments at 15 & n.47. Cingular and Verizon, for example, cite Wehster's Dictionary for the proposition that "ancillary service is by definition subordinate or auxiliary to the primary service." ***Id*** *Cf., e.g.*, Globalstar Bondholdera Supplemental Comments at 2 ("[b]y definition. terrestrial authority cannot be 'ancillary' to MSS licenses unless terrestrial authority is available exclusively to existing MSS licensees"): **MSV** Comments at *23* (asserting that "no matter how much traffic is originated or terminated over the terrestrial base stations. the vast majority of the United Stares land mass will be served by the satellite and service in rural and remote areas will not be degraded" and therefore any In-hand terrestrial use will remain "ancillary" to the satellite emissions).

states that MSS and MSS ATC must, by necessity, differ in "nature and character" due to their different physical configurations."[180] Moreover, we recognize that our use of the term "ancillary" in the *Flexibility Notice* departs from dictionary definitions of the term.[181] To avoid confusion, therefore, we decline to adopt in our rules a definition of the term "ancillary." and instead clarify that the term "ancillary." with respect to MSS ATC. is defined as terrestrially-based. in-band MSS operations meeting the technical and policy requirements set forth in this Order.

70. Concerning the merits of requiring ancillary operation. commenters generally agree that, if ATC is permitted. **MSS** operators should: (1) integrate ATC offerings with the principal **MSS** offering. (2) use the same frequencies for ATC and the principal MSS operations, and **(3)** use ATC simply to augment signals, consistent with MSS operations, rather than create a materially different service.[182] Both commenters that support and those that oppose ATC caution against allowing a terrestrial component designed to augment MSS to become a freestanding terrestrial mobile service in spectrum allocated domestically and internationally for MSS use.[183] To the extent ATC is authorized, commenters generally support adopting the limiting principles on ATC operation.[184]

71. While commenters generally agree on the need to ensure that **MSS** terrestrial operations remain "ancillary," commenters disagree over precisely which operational requirements will best allow us to exercise effective oversight of MSS operations. In the *Flexibility* ***Notice.*** we sought comment on whether to ensure ancillary operation by requiring **MSS** licensees to observe five requirements concerning: (1) geographic coverage; **(2)** coverage continuity; (3) commercial availability; (4) in-band operation; and (5) central data switching.[185] Commenters also proposed that we adopt (6) mandatory bundling requirements for **MSS** ATC service offerings. We address each of these proposals and other proposed limitations on MSS ATC below.

**2.** Substantial Satellite Service

72. We require MSS licensees that seek authority to offer ATC service to provide substantial satellite service to the public. As described below, substantial satellite service requires certain band- and network-specific demonstrations concerning the MSS space-segment's geographic coverage area, coverage continuity and commercial availability. Applicants for MSS ATC authority must demonstrate

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**180** CTIA Comments at 3

181 1 *The New* Sliorrer *Oxford English Dictionary* 75 (1993) (defining ancillary **as** "subservient, subordinate, auxiliary, providing support; now esp. providing essential support or services to a central function or industry, especially to hospital or medical staff'); *Merriam-Webster's Collegiate Dictionary* (2002) (defining ancillary **as** "subordinate, subsidiary" or "auxiliary, supplementary"), *available at* <http://www.m-w.com/cgi-bin/dictionary?ancillary> (last visited. Dec. 30. 2002)

182 *See, e.g.*, API Comments at 5 (stating that "to the extent that MSS providers are permitted to offer terrestrial services in the 2.1 GHz band, such services should be authorized only on an ancillary basis ").

**183** *See* Boeing Comments **at** 6; Celsat Reply at 9 ("Celsat fully endorses the Commission's carefully drawn definition of ancillary because it ensures that terrestrial operations remain truly ancillary to the satellite service.").

184 ***See,*** *e.g.*, Boeing Comments at 5-8; ICO Comments **at** 43-51; MSV Comments **at 27-28:** CTIA Comments **at** 3-5; Voicestream Reply at 20-24; Constellation Reply **at** 9-16; TRW Reply at 4-6; Boeing Reply at 5-10; MSV Reply at 25-27; Globalstar Reply at 8-9.

185 *See Flexibility Notice*, 16 FCC Rcd **at** 15551-52, ¶¶ 42-46

compliance with these requirements and, of course. will remain responsible for the continuing accuracy and completeness of any information furnished in pending applications.[186] Upon licensing. failure of an MSS ATC licensee to meet any of these requirements will result in enforcement action with penalties **up** to and including loss of ATC and MSS operating authority as well as the imposition of a monetary forfeiture.

### a. Geographic Coverage

73. We find that for an **MSS** licensee to secure and to maintain authority to implement ATC, it must provide space-segment service across the entire geographic area stipulated in our rules and policies for that operator's particular space-station system geometry and frequency band as proposed in the *Flexibility Notice*. In the *Flexibility Notice*, we sought comment on whether to authorize MSS ATC only after the **MSS** operator demonstrates that it can provide space segment service covering **all** 50 states. Puerto Rico, and the **U.S.** Virgin Islands one-hundred percent of the time, consistent with the coverage requirements for 2 GHz MSS GSO operators.[187] For the L-band, we proposed an analogous restriction. We sought comment on adopting the same requirement for L-band operators "except that if a GSO **MSS** operator in the L-band can demonstrate that 100 percent coverage is not possible from the orbit location of the satellite" we proposed to "permit commercial operation of terrestrial facilities so long as the **MSS** service is continually available in all geographic areas the satellite is capable of covering."[188] We also sought comment on minimum coverage requirements for Big LEO operators prior to their being permitted to provide ATCs.[189]

74. Parties that support authorizing ATC suppon adopting geographic coverage requirements similar to the ones we proposed.[190] According to these parties, geographic coverage requirements will help ensure that MSS providers use ATC only where space-station signals are attenuated and will not migrate their service toward terrestrial-only operation at some point in the future.[191] **MSS** operators are unlikely to spend resources on ATC facilities in areas where space-station signals already reach because deployments in those areas would only duplicate existing infrastructure investment. Geographic coverage requirements. therefore, can help ensure that ATC remains an integrated operation that augments rather than replaces satellite-based MSS services.[192] Indeed, by imposing geographic coverage requirements we

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[186] See *infra* App. B; 47 C.F.R.§ 1.65

[187] *See Flexibility Notice*, 16 FCC Rcd ar **15547.1** 32: *id.* **at** 15551, ¶ 42.

[188] *See id.* at 15551,143

[189] *See id.* at 15564. ¶ 80.

[190] *See, e.g.*, Celsat Reply **at** 10 (addressing the *coverage* requirements *for* 2 GHz MSS band licensees and stating that "Celsat supports this coverage requirement because it effectively ensures rhat ancillary terrestrial use **will always** be part **and** parcel of a fully functioning satellite system."): Boeing Comments at 8; API Comments **at** 5 ("API agrees with the Commission's proposal that a certain level **of** MSS coverage be established before MSS licensees are authorized **to** provide terrestrial service."); MSV Comments at 23 (supporting Commission's proposals to ensure MSS licensees comply with satellite implementation and service requirements).

[191] *See, e.g.*, Celsat Reply **at** 11

[192] ***See. e.g.***. MSV Comments at 23: ICO Comments at 23-24: Globalstar Bondholders Reply **at** 21; Letter from Laurence H. Williams, ICO Global Communications Ltd., to Marlene H Dortch. Secretary. Federal Communications Commission. IB Docket No. 01-185. at 1-2 (filed. Dec. 16. 2002) (ICO Dec. 16. 2002 *Ex Parte* Letter).

intend to prohibit an MSS licensee from deploying an ATC base station that uses all of the **MSS** system's available frequencies to the exclusion of the satellite signals. If an **MSS** licensee were to deploy a base station that uses all available satellite channels, we are concerned that a user at some distance from the terrestrial base station may not receive a signal from either the terrestrial component. or the satellite system because the base station signal would be too weak and the satellite signal would be experiencing too much interference from the base station to close **a** link to the end user.[193] We believe that an MSS licensee would not intentionally create "dead zones" for its customers, especially since the primary selling point of MSS ATC service would be ubiquitous coverage to end users.[194] Nevertheless. imposing geographic coverage requirements on MSS ATC operators will not permit these types of "dead zones" because an **MSS** licensee that leh no satellite channels available for customer use would necessarily violate the band-specific requirements for ubiquitous or nearly ubiquitous geographic coverage.[195] For these reasons, an **MSS** licensee that wishes to provide ATC must ensure that it remains capable of providing the necessary throughput to maintain space-segment service across the entire geographic area stipulated in our rules and policies for that operator's particular space-station system geometry and frequency band. We intend to deny any initial or modification applications for MSS ATC systems that propose space-segment throughput that would be insufficient to meet the applicable geographic-coverage requirement.

75. In implementing geographic coverage requirements, we take into account the variable system configurations and band segments of the MSS systems at issue in this proceeding. For example, Globalstar Bondholders notes that our current geographic coverage requirements for space-stations differ depending on whether the system is GSO or NGSO and depending on the frequency band in which the satellite operates.[196] Under our satellite service rules, for example, Big **LEO** and 2 GHz MSS **NGSO** licensees must be capable of providing service: "(i) to **all** locations as far north as 70° North latitude **and** as far south as 55° South latitude for at least *75%* of every 24-hour period, *i.e.*, that at least one satellite will be visible above the horizon at an elevation angle of at least 5" for at least **18** hours each day, and (ii) on a continuous basis throughout the fifty states, Pueno Rico and the U.S. Virgin Islands, i.e., that at least one satellite will be visible above the horizon at an elevation angle of at least 5" **at** all times." [197] Similarly, L-band **MSS** licensees must be capable of providing service to "all of the U.S. domestic market, including all fifty states, Pueno Rico. the Virgin Islands and **U.S.** coastal areas up to 200 miles."[198] According to the Globalstar Bondholders, therefore. the Commission should "use existing coverage requirements as an ATC authority threshold to prevent **MSS** providers from neglecting required coverage outside of the 50 states, Pueno Rico. and the U.S. Virgin Islands."[199] We agree with Globalstar Bondholders that we should hold MSS space-station licensees that implement ATC to a standard **no** less

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193 *See infra* App. *C.*

194 *See* Globalstar Bondholders Comments at 2; Globalstar Bondholders Reply at 3: Celsat Comments at 17 n.42; MCHI Comments at 5-8; Celsat Reply at 11; MSV Comments at *23:* MSV Reply at 11; ICO Comments **at** 2; ICO Reply, App. at A-6.

195 New rule section 25.147(a)(6), moreover. expressly prohibits ATC base stations from using all available MSS frequencies. ***See infra*** App. B (adopting new rule 47 C.F.R.§ 25.147(a)(6)).

196 Globalstar Bondholders Reply at 21-22 n.50.

197 *See* 47 C.F.R. § 25.143(b)(2).

198 *MSV License*, 4 FCC Rcd **at** 6055, ¶ 97

199 Globalstar Bondholders Reply at 2 1-27 n.50

rigorous than that required for MSS operations generally. Thus, **an** eligible MSS licensee that wishes to implement ATC must provide space-segment service across the entire geographic area stipulated in our rules and policies for that operator's particular space-station system geometry and frequency band. We incorporate into Pan 25 of our rules the specific geographic coverage requirements applicable to each type MSS system under consideration in this Order as a prerequisite for the provision of ATC.[200]

76. We do not find persuasive the various concerns of parties opposed to geographic coverage requirements. These parties describe the geographic coverage requirements as "cumbersome" and "difficult to enforce."[201] These parties speculate that partial or temporary lapses in geographic coverage may create unanticipated complexities for enforcement.[202] We have, however, administered geographic coverage requirements on space station systems for many years.[203] These requirements are verifiable and represent an unusually straightforward standard for such a technically complex service.[204] As ICO observes, moreover, we apply similar types of coverage requirements for terrestrial wireless services.[205] We have, in practice, found geographic coverage requirements neither cumbersome. nor difficult to enforce. and we find that the addition of an ATC will not materially complicate our administration of these longstanding requirements.

77. We also find it unlikely that geographic coverage requirements would encourage the demise of MSS space station operations. Assertions to the contrary appear to rest on speculation that geographic coverage requirements do nothing to diminish the presumed financial incentives for an MSS ATC operator to reduce its capacity for satellite services to maximize the capacity of its available spectrum for terrestrial services, which would constrain other satellite operations in the band.[206] We have rejected this

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[200] *See infra* App. B

[201] Stratos Reply at 14; **see *also, e.g.*,** Aviation Industry Parties Comments at 11 ("Even with these coverage requirements. the temptation will be great for the MSS operator to abandon or minimize its effons to provide MSS and to concentrate on cellular service. **At** the end of the day. the hundreds **of** millions of dollars invested by aviation in the development of this service and the equipage of its aircraft would he for naught.").

[202] AT&T Wireless Comments at ***6*** ("Even if the Commission could rationally determine the appropriate level of MSS coverage that should he required prior to the commencement **of** terrestrial service, it is not clear what consequences should attach to partial or permanent lapses in satellite coverage caused by technical failure or obsolescence **of** a satellite (or any other reason).").

[203] ***See.*** *e.g.*, 47 C.F.R. § 25.143(b)(2)(iii).

[204] ***See*** 2 *GHz* ***Order.*** 15 FCC Rcd at 16153-54, ¶59.

[205] *See* ICO Reply at 10 n.41 (*citing* **47** C.F.R. § 24.103: *id.* § 24.203). Section 24.103(a) of our rules. for example. requires nationwide narrowband PCS licensees to "construct base stations that provide coverage to a composite area of 750,000 square kilometers or serve 37.5 percent of the U.S. population within five years of initial license grant date; and. **shall** construct base stations that provide coverage to a composite area of 1,500,000 square kilometers or serve 75 percent **of** the U.S. population within ten years of initial license grant date." 47 C.F.R. § 24.103(a). Alternatively. a narrowband nationwide PCS licenser may "provide substantial service to the licensed area." 17 C.F.R. § 24.103(a). Our rules define "substantial service" as "service that is sound, favorable, and substantially shove **a** level of mediocre service that would barely warrant renewal." 17 C.F.R. § 24.103(d).

[206] Stratos Reply at 17

same type of argument in considering grants of flexibility for other Commission licensees,"[207] and have considered and rejected these arguments as applied to MSS ATC elsewhere in this Order.[208]

### b. Coverage Continuity

78. We further adopt a requirement that MSS operators maintain space station coverage over the relevant geographic area to maintain authority to provide ATC. We also adopt standards for reasonable replacement of satellites in the event coverage should degrade as a result of satellite failure tailored to the particular configuration of a given MSS satellite system. For operational NGSO MSS ATC systems, we require the licensee to maintain an in-orbit spare. For operational *GSO* MSS **ATC** systems, we require the licensee to maintain a spare satellite on the ground within one year of commencing operations and launch it into orbit during the next commercially reasonable launch window following a satellite failure. We require licensees to report any outages that meet this standard within ten days of their occurrence.

79. In the ***Flexibility Notice,*** we also sought comment on whether and how to require the **MSS** operator to maintain space-station signal coverage if. for example, a satellite fails.[209] As discussed above, MSS licensees have strong economic and legal incentives to recoup the investment costs of their MSS systems by continuing to offer satellite-based services.[210] For global MSS operators, revenues from satellite service offerings to customers in the United States represent only a portion of the total revenue from the global satellite-services market. Under these circumstances, an MSS operator would have an economic incentive to replace the failed satellite.

80. Commenters that support ATC also tend to support requiring MSS licensees to maintain continuous coverage of the geographic region relevant for that particular licensee as a condition for ATC authority.[211] According to the Globalstar Bondholders, for example, "[e]nforcing MSS coverage requirements can ensure the provision of 'ancillary' service by preventing the operation of an ATC platform from degrading in any way the satellite service received by MSS subscribers that are not served by the ATC platform."[212] Several ATC proponents add that, if a licensee's failure to replace a satellite causes the MSS portion of the system to degrade, the Commission should revoke ATC authority.[213]

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[207] ***See, e.g., CMRS Flexibility Order.*** 11 FCC Rcd at 8975, ¶ *22* ("[N]othing in the record suggests that giving licensees who provide CMRS services the flexibility **to** offer fixed service would make them less responsive to market demand for mobile service. In fact, the record indicates that most carriers intend to offer consumers integrated packages and combinations of mobile and fixed services.").

[208] *See supra* § III(A)(4) (discussing competition and MSS ATC)

[209] **See** ***Flexibility Notice,*** 16 FCC Rcd **at** 15551, ¶ 44

[210] **See** *supra* § III(A)(4) (addressing enhanced competition)

[211] ***See, e.g.,*** Celsat Comments at 14 ("full-time coverage of the service area **is** the best way to ensure that terrestrial reuse of the 2 GHz MSS band is truly ancillary **to** the satellite service"); Boeing Comments at 8-9 ("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.").

[212] Globalstar Bondholders Reply at viii

[213] *See* Constellation Comments at 27; *see also, e.g.,* MSV Comments at 23-25: MSV Reply at 23-27. MSV supports a requirement that MSS licensees maintain their satellite service in order to provide terrestrial service. but (continued. . .)

81. Notwithstanding the preexisting economic and legal incentives that an MSS licensee may have to return the MSS space component to full operation as quickly as possible in the event of a satellite failure, we find that imposing a continuous coverage requirement would address concerns raised by certain commenters that MSS operators might not exercise sufficient diligence in returning an MSS system to full operation if the operator can continue to generate operating revenues from its ancillary terrestrial system.[214] AT&T Wireless. for example, claims that an infusion of new investment capital to ATC-enabled MSS systems "would make compliance with any satellite coverage thresholds adopted by the Commission virtually impossible because no new investment dollars would be devoted to launching and maintaining capital-intensive satellite systems."[215] We question whether an MSS operator would direct investment to ATC at the expense of the MSS system on which the authority to operate ATC depends. Although we view investment in ATC at the expense of MSS coverage requirements as unlikely, expressly conditioning ATC authority on maintenance of the MSS licensee's satellite-coverage obligation may provide some benefit in helping to ensure continued investment and innovation in an MSS licensee's space-station assets. because it would require the MSS operator to act as if the space-segment assets were still the company's sole source of income.[216] Given widespread support for a continuous coverage requirement,[217] the lack of any significant cost to MSS licensees and the possibility of some long-term benefit to the public. we adopt our proposal to require **MSS** licensees to maintain continuous coverage of the geographic region that we require them to serve.

82. As a part of our proposal to require continuous coverage, we sought comment on the circumstances under which we should revoke an MSS operator's ATC authority if coverage were interrupted. Although most commenters support a reasonable time for replacement of failed or disabled satellites. commenters propose widely variant time periods in which to replace failed MSS space stations.[218] MSV, for example. proposes that the Commission allow an operator two years to replace a failed satellite.[219] ICO proposes a three-month replacement period.[220] Meanwhile. Boeing proposes that the Commission establish specific milestones for satellite replacements. which, if not met. would require the MSS licensee to forfeit ATC authority; Boeing does not specify a time period in which replacement

(Continued from previous page)
asserts that an MSS operator whose satellite has failed should receive "a reasonable period of time," which MSV asserts is two years, to launch a replacement satellite. MSV Comments at 24-25.

[214] *See. e.g.*, AT&T Wireless Comments at 2-3; AT&T Wireless Reply at 2. 5-7; Boeing Comments at 7; CTIA Comments at 5-9.

[215] AT&T Wireless Reply at 11. Similarly, Boeing notes that, without some type of coverage requirement in place, over time "there is a strong possibility that the 2 GHz spectrum could eventually 'default' to terrestrial use without any satellite component." Boeing Comments at 8.

[216] *See, e.g.*, Boeing Comments at 9 ("[o]nce 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.").

[217] *See. e.g.*, *id.* at 8; MSV Comments at 24-25: ICO Comments at 44-46; Constellation Reply at 9; Boeing Reply at 5-6; MSV Reply at 25; Globalstar Reply at 8.

[218] Celsat Reply at 10-11 & n.16.

[219] *See* MSV Comments at **24-25** (suggesting a maximum two-year limit during which the MSS operators should be permitted to operate terrestrial facilities without satellite coverage. taking into consideration the time to procure "Ions-lead" parts to assemble a spare satellite).

[220] ICO Comments at 44 (suggesting three months as a reasonable replacement deadline lor "all but the most unexpected outages")

should occur. but suggests that the milestones should be shorter than those required for the construction and operation of initial **MSS** satellites."[221]

83. The construction, launch and operation of space stations **are** subject to launch failures. satellite malfunctions and other unique hazards. We agree that **MSS** licensees should repair or replace space stations within a reasonable time frame. For 2 GHz MSS systems, for example, we required licensees to meet a series of implementation milestones designed to ensure the construction, launch and operation of systems within three-and-a-half years of grant of the NGSO **MSS** licensees and within five years of the ***GSO*** MSS license grant."[222] Repairing or even replacing a malfunctioning satellite. for all its complexity, requires less time than designing and constructing a new system. Even in the worst case where a satellite is destroyed, a licensee can ordinarily replace a lost satellite with a ground spare at the next available launch window. or procure a technically identical satellite in an expedient manner since it would have already completed the complex design process. **As** suggested by Boeing's comments, however, different types of failures on different types of systems require different periods of time to correct.[223] To recognize these differences, we adopt a standard for reasonable replacement tailored to the particular configuration of a given **MSS** satellite system and the relative cost of NGSO and GSO space stations. For operational NGSO MSS ATC systems, we will require the licensee to maintain at least one in-orbit spare. For operational GSO MSS ATC systems, we will require the licensee to maintain a ground spare within one year of commencing operations and launch the ground spare into orbit during the next commercially reasonable launch window following a satellite failure. We require licensees to report any outages that meet this standard within ten days of their occurrence.[224]

84. While no replacement standard can anticipate every potential failure with precision, adopting standards tailored specifically for NGSO and GSO **MSS** configurations strikes an appropriate balance between reinforcing the licensee's commercial and legal incentives to provide continuous service and allowing sufficient time for the licensee to repair or replace satellites that have failed. In addition. we note that nothing in this Order constrains our authority to impose forfeitures on licensees that fail to meet their obligations as MSS licensees in addition to any other remedies available under our rules. We adopt these requirements as a condition of authorizing **ATC** and incorporate them into Part 25 of our rules.

### c. Commercial Availability

85. In the *MSS Flexibility Notice*, the Commission asked whether an "MSS operator could initiate operation of terrestrial services as soon as its operational satellites cover 100 percent of the United States

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[221] *See* Boeing Comments at 9

[222] *2 GHz MSS Rules Order,* **15** FCC Rcd at 16177-78, ¶ 106. Specifically. for 2 GHz **MSS** NGSO system licensees must enter **into a** non-contingent satellite manufacturing contract for the system within one year of aurhorization, complete critical design review within two years **of** authorization. begin physical construction **of** all satellites in the system within two and **a** half years of authorization, and complete construction and launch of the first two satellites within three and **a** half years of grant. ***See id*** For 2 GHz **MSS** GSO systems. licensees **must** enter into a non-contingent satellite manufacturing contract within one year, complete critical design review within two years. begin physical construction of all satellites in the system within three years, and complete construction of. and launch, one satellite of its constellation into its assigned orbital location within five years of authorization. *Id.*

[223] See. *e.g.*, Boeing Comments at 9

[224] ***See*** *infra* App. B

100 percent of the time, even if the operator has not yet launched its entire constellation of satellites."[225] We require MSS to be commercially available in accordance with the coverage requirements that pertain to each band as a perquisite to an MSS licensee's offering ATC service.[226]

86. Whether an operator can commence ATC operations prior to making its satellite system commercially available to the public represents an extension of the arguments for and against the geographic or continuous coverage requirements discussed above. Several commenters note, and we agree, that the financial incentives to operate an MSS system are neither as strong. nor as pressing, if an MSS licensee can operate the terrestrial component of its system prior to constructing, launching and operating MSS space stations and offering commercial MSS services."[227] According to these commenters. an MSS operator that can operate the terrestrial component of its system prior to operating the satellite portion may choose not to launch space stations, or may delay implementation through petitions for waiver of the implementation milestones.[228] We remain committed to the vigorous enforcement of our satellite implementation milestones. If the Commission were to permit full-scale commercial operation of MSS ATC prior to the commercial availability of service from the MSS space stations, however. the denial of a milestone extension request and the accompanying revocation of the applicant's MSS license would adversely affect not only the MSS licensee, but also the MSS licensee's terrestrial customers. Unlike satellite space station failures, in which the licensee may have one year or more to repair or replace the satellite prior to loss of ATC authority, a licensee's failure to meet an implementation milestone, such as a licensee's failure to enter a binding contract for the construction of the satellites. could occur without any advance notice to the public or the Commission. As a result. the Commission would be forced to choose between maintaining the integrity of its satellite licensing process. or requiring the operator to immediately cease service to customers with little advance notice. Given the potential for disruption either to an MSS licensee's customers or to the integrity of the Commission's licensing processes that might occur, we find that permitting commercial operation of ATC prior to commencement of MSS operations would disserve the public interest. Therefore, authorizations to provide MSS ATC shall be conditioned upon the commercial availability of MSS in accordance with the requirements of this Order prior to or at the same time ATC operations are initiated.

### 3. Integrated Service Offering

87. To remain consistent with our allocation and service rules. we believe that MSS licensees should offer an integrated service, MSS licensees must make an affirmative showing to the Commission that demonstrates that their ATC service offering is truly integrated with their MSS offering. We recognize that it is important for industry to have a clear understanding of what would meet this showing. Accordingly. the Commission is creating a minimum showing that would constitute a safe harbor for MSS ATC applicants to demonstrate that they are providing an offering that is integrated with their MSS

[225] *See Flexibility Notice*, 16 FCC Rcd at 15551, ¶ 44

[226] *See* App. B.

[227] *See, e.g.*, Boeing Comments at 8 ("[a] prior condition for offering ATS should be full compliance with" existing satellite implementation milestones).

[228] *See, e.g., id.* at 8-9; AT&T Wireless Comments at 2-3; *see also* Globalstar Reply at 25 ("Allowing MSS providers to offer commercial ATC services prior to compliance with applicable satellite coverage requiremenis could undermine the ancillary nature of ATC.")

offering.[229] The safe harbor is that **MSS** licensees that wish to provide ATC services could demonstrate that they use a dual-mode handset to provide rhe proposed ATC service.

88. **MSS** licensees that choose nor to rely on this safe harbor will have to submit for Commission review evidence demonstrating that the service they propose to offer will be integrated. This can be accomplished through technical, economic or any other substantive showing that the primary purpose of the MSS licensee's system remains the provision of MSS.[230] We encourage **MSS** operators to submit integrated service showings as early **as** possible to allow full evaluation without compromising the timing of ATC deployment. This integrated service requirement and the other rules adopted today will help ensure that **MSS** remains first and foremosr a satellite service and that the terrestrial component remains ancillary to the primary purpose of the **MSS** system. In this manner, the public will be able to obtain the many benefits associated with the deployment of MSS systems.

**4.** In-Band **Operation**

89. In the *Flexibility **Norice,*** we sought comment on which MSS frequencies we should permit **MSS** licensees to operate MSS ATC.[231] The Commission generally allocates spectrum **on** either a primary basis or a secondary basis.[232] Within the *2* GHz MSS band. however, MSS licensees may operate outside of the specific MSS sub-band that they have selected on a secondary basis to other **MSS** licensees, subject to certain conditions.[233] Within the Big LEO band, operators are authorized to use different amounts of spectrum within the band, depending on the type of frequency coding they have chosen to deploy.[234] And within the L-band, MSS operators' specific frequency assignments in the region of North America are assigned by international agreement and consensus, and operations outside of these assigned frequencies is generally not permitted.[235] In our *Flexibility **Norice.*** we asked whether and under what conditions we should authorize **MSS** ATC inside of the MSS allocations, but outside of the narrow "Selected Assignment" that any given **MSS** operator has elected to use.[236] Commenters also addressed whether granting ATC authority in less than all of an operator's licensed MSS frequencies in the Big LEO

[229] We do not believe that this same requirement should be imposed on Personal Data Assistants (PDAs), laptops, or other computers.

[230] An economic showing could include. for example. information on the pricing structure **of** an integrated service offering.

[231] **See** *Flexibility **Norice,*** 16 FCC Rcd at *15552.* ¶ 46-47

[232] **A** spectrum allocation permits the use of radio frequency spectrum for one or more of the various defined radio services listed in section 2.1 **of** the Commission's rules 47 C.F.R. § 2.105(b) & n.7.

[233] **See** *Flexibility **Norice,*** 16 FCC Rcd at 15552.¶ 46-47; **see** *also Amendment of the Commission's Rules* to *Establish* Rules *and* ***Policies*** *Pertaining to **a** Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands*, Report and Order, 9 FCC Rcd 5936. 5956. 5958 ¶¶ 48. **57** (1994) *(Big LEO Service Rules Order)* (granting all CDMA Big LEO licensees the right to operate across the entire 2483.5-2500 MHz band and the 1610-1621.35 MHz band).

[234] *Big LEO Service Rules **Order,*** 9 FCC Rcd 5954-63, ¶¶ 43-63

[235] **See** *Comsat Corporation d/b/a Comsat Mobile Communications*, Memorandum Opinion, Order and Authorization, 16 FCC Rcd 21661, 21696-99, ¶¶ 65-72 (2001) *(Comsat Authorization)*.

[236] *See Flexibility Notice*, 16 FCC Rcd at 15552, ¶¶ 46-47

bands was appropriate.

90. In the 2 GHz MSS band, several ATC proponents support authorizing ATC across the entire MSS hand, subject to the same or similar requirements as the principal MSS operations.[237] These commenters support granting ATC authority that is entirely coterminous with MSS authority in the eligible MSS bands.[238] Other commenters, however, urge us to adopt spectrum-usage restrictions on MSS ATC. CTIA, for example. urges the Commission to limit 2 GHz MSS ATC only to the licensee's Selected Assignment. According to CTIA. authorizing greater flexibility in MSS spectrum uses will impair the Commission's ability to reallocate spectrum "[b]ecause terrestrial systems would have to be physically retuned if their frequency bands were changed" due to missed implementation milestones or Commission action.[239] Voicestream similarly proposes a 7 megahertz spectrum cap on MSS ATC operation in the 2 GHz MSS band to prevent an MSS licensee from aggregating too much MSS spectrum for MSS ATC.[240]

91. In the Big LEO band, the Commission has divided the band between CDMA compatible systems and TDMA compatible systems. As explained in the Notice of Proposed Rulemaking initiated below,[241] the Commission in 1994 found that up to four CDMA Big LEO MSS systems could share 11.35 megahertz of service uplink spectrum in the 1610-1621.35 MHz band and 16.5 megahertz of service downlink spectrum in the 2483.5-2500 MHz band. The Commission then found that one TDMA system could operate satellite uplinks and downlinks in single 5.15 megahertz block of spectrum in the 1621.35-1626.5 MHz band. At present. two Big LEO systems – Iridium and Globalstar – are currently operational. As a CDMA system, Globalstar is authorized to operate uplinks in 11.35 megahertz of spectrum and downlinks in 16.5 megahertz of spectrum. As a TDMA system, Iridium operates bi-directionally in 5.15 megahertz of spectrum. After the close of the comment cycle in this rulemaking, however, Iridium petitioned the Commission to re-designate portions Big LEO band downlink spectrum from CDMA systems (Globalstar) to TDMA systems (Iridium) and implement other changes in the Big LEO band plan.

92. In the L-band, specific MSS frequencies are agreed upon through the Mexico City MoU,

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[237] **See,** *e.g.*, TMI Comments **at** 2 ("operation outside a 'selected assignment' or 'selected segment' should be both feasible and desirable due to the enhanced spectral efficiency"); Constellation Comments **at** 33 ("Constellation believes that the Commission should allow terrestrial use of any portion of the MSS operator's "selected assignment.").

[238] For example. TMI suggests that, **as** with satellite-based MSS operations. the Commission should limit MSS ATC operations that involve more than one Selected Assignment to situations in which MSS operators have devised a sharing scheme for the operation of terrestrial and satellite facilities. TMI Comments **at** 2-3. Similarly, just as MSS licensees must coordinate any satellite-based MSS operations outside of their Selected Assignment with other **MSS** licensees. Globalstar states that the Commission should require "some degree of coordination" among MSS licensees for any MSS ATC operations outside **of** the operator's Selected Assignment. Globalstar Reply at 7. Boeing. however. proposes to bar MSS operators from offering MSS in **its** Selected Assignment if the MSS operator provides ATC "in a 2 GHz **MSS** suh-hand outside its selected assignment, or vice versa." Boeing Comments **at** 7.

[239] CTIA Comments at 14. CTIA also claims that limiting MSS ATC to an operator's Selected Assignment would limit interference to other services. such as GPS. *Id.* For our analysis of possible interference concerns, *see* discussion *infra* at § III(D).

[240] Voicestream Reply at 24

[241] *See infra* § IV.

which is an agreement between the five MSS satellite operators and their respective national administrations that provide service in the L-band in the North American coverage area regarding spectrum assignments between the operators. The operators signed a one-year agreement. which was originally was to be revisited annually, that provided each system with an amount of spectrum based on its current and projected near-term traffic requirements.[242] The precise frequency assignments for these operators within the L-band MSS spectrum are subject to confidentiality provisions under the Mexico City MoU. The parties to the MoU last revised spectrum assignments in 1999 and, pending further negotiations, continue to operate under those assignments today.

**93.** To ensure maximum gains in spectrum efficiency. minimal potential for interference and limited regulatory intrusion, we believe a licensee's authority to operate MSS ATC should remain linked to its **MSS** authority, and limited to the precise frequency assignment authorized for MSS. Therefore, we limit each **MSS** licensee to its "core" MSS spectrum in each of the three bands at issue in this proceeding:

- In the 2 GHz band, an MSS operator may seek authority to provide ATC only in its Selected Assignment, which, under the 2 *GHz MSS Rules* ***Order*** is comprised of 3.5 megahertz in each direction for a total of 7 megahertz for each MSS licensee.[243] Because coordination among the MSS licensees to conduct MSS ATC outside of the MSS licensee's Selected Assignment is likely to prove difficult, time-consuming and unlikely to produce an acceptable interference environment, operations beyond the MSS licensee's Selected Assignment are not permitted.

- In the Big LEO band. both of the two MSS operators in band – Iridium and Globalstar – may seek authority to provide ATC in no more than 5.5 megahertz of spectrum in each direction consistent with the MSS ATC service rules.[244] Accordingly. systems that operate uplinks and downlinks in separate bands. such as Globalstar. could deploy MSS ATC in a total of up to 11 megahertz of spectrum while systems that operate uplinks and downlinks in the same band, such as Iridium, could deploy **MSS** ATC in a total of up to 5.5 megahertz. To avoid any possible prejudice to the outcome of allocation and assignment decisions under consideration in the Notice of Proposed Rulemaking adopted below, we adopt an upper limit of 5.5 MHz in each direction for possible MSS ATC operations. Furthermore. to avoid harmful interference, Big LEO MSS licensees will be permitted to implement ATC only on those channels that MSS is authorized. consistent with the Big LEO band-sharing arrangement set forth in this Order.[245]

- In the L-band, an **MSS** operator may seek authority to provide ATC only in those frequency assignments that are available to that MSS operator for **MSS** use in accordance with the

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[242] ***See*** *International Action: FCC Hails Historic Agreement on International Satellite Coordination*, "News Release." Report No. IN 96-16 (June 25, 1996); *see also Flexibility Notice*, 16 FCC Rcd at 15539-40, ¶ 13.

[243] The seven megahertz spectrum assignment originally granted to each 2 GHz **MSS** licensee is subject to increase, pending resolution of the 2 GHz MSS milestone implementation review process.

[244] We do not intend to prohibit Iridium from using technically innovative techniques to deploy in-band terrestrial operations in its MSS frequencies, provided Iridium can meet the technical and service rules established in this Order

[245] ***See*** *infra* § III(D)(3) (discussing where Iridium and Globalstar can operate ATCs); ***see also infra*** Section IV (Notice of Proposed Rulemaking, seeking comment on proposals for reassigning or reallocating a portion of spectrum in the Big LEO MSS frequency bands).

Mexico City MoU.[246] If future agreements reached pursuant to the Mexico City MoU were to alter precise frequency assignments of MSS ATC providers in the United States. the MSS **ATC** provider would be required to operate on its assigned MSS frequencies.

Generally speaking, therefore, MSS licensees may generally seek authorization for **MSS** ATC only in the bands in which they are authorized to operate an MSS system, subject to the same regulatory status **and** restrictions, if any, that the MSS licensee would have to observe in that MSS assignment.

### 5. Central Data Switching

**94.** In the *Flexibility Norice,* we sought comment on whether requiring that MSS operators integrate the terrestrial and satellite operations of their network through one central data switch would ensure that the terrestrial component is ancillary to the satellite component."' We asked commenters to address the types of functions that a central data switch performs and to discuss whether and how requiring a central data switch might encourage the integration of terrestrial component into the MSS network.[248] We also sought comment on how we might monitor compliance with a central data switch requirement.[249]

95. The comments indicate a certain amount of confusion over what we meant by proposing a "central data switch." Only three commenters addressed the issue at any length. **MSV.** which construed the "central data switch" as central monitoring and control point, supported this requirement.[250] ICO and Constellation, which construed a "central data switch" to mean routing **all** traffic over a single switch, opposed the proposal **as** failing to promote the integration of ATC into MSS and as creating a significantly more vulnerable, more expensive and more inefficient MSS system.[251] By proposing a central data switch, we did not intend that MSS operators would need to route their communications through a single mechanical or optical device that opens or closes circuits in the MSS licensee's systems.

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[246] ***See infra*** § III(D)(2)

[247] *Flexibility Notice*. 16 FCC Rcd at 15551-52, ¶ 45

[248] *Id*

[249] *Id*

[250] MSV Comments at 25.

[251] ICO Comments at *15* n.41 (claiming that the central data switch requirement "would make urban MSS traffic more vulnerable to outage (because it would create **a** single point of failure) and more expensive (because it would prevent network operators from using least-cost routing)."); **accord id.** at 45-46 (claiming no need exists **for a** central data switch requirement since it would **not** limit use of ATC. would not integrate ATC and MSS. would not ensure the terrestrial component remains ancillary to an MSS network. would make the service "more vulnerable to outage by creating a single point of failure for all traffic in the network'' and would contravene the Commission's general policy of operational and service flexibility");Constellation Comments at **31** n.65 ("Requiring a "central data switch'' is inefficient and may undercut the ability **to** establish a robust. distributed network and entail intrusive Commission involvement in network design and operation. The situation becomes complicated since Integrated networks are likely to have different paths for signaling and traffic, and for voice and packet-switched data."). In its reply comments, MSV indicated its opposition to **a** central switch requirement **as** envisioned by Constellation and ICO *See* MSV Reply at 25-26 (asserting that if the Commission sought to require central routing as Constellation and ICO assert. then "MSV shares ICO's cnncern **that** such a requiremen! will not allow for **least** cost routing and will result in a 'single point of failure "').

We agree with the commenters that adopting such a requirement would impose costs far in excess of any possible benefit in integrating ATC-enable MSS systems. We expressly decline to adopt a single-switch requirement for MSS ATC systems.

96. MSV's vision of our "central data switch" requirement comes closest to what we actually intended. We sought comment on the need for centralized control necessary to achieve dynamic frequency management of both MSS and ATC operations. and, in fact, the proponents of MSS ATC view centralized control as crucial to successful implementation of MSS ATC.[252] Constellation, for example, states that central control of both satellite and earth-station components of MSS permits the operator "to manage the assignment of powers and frequencies for satellite and terrestrial links within a satellite beam coverage area to maximize the total amount of service offered to subscribers ...."[253] ICO adds that it has developed and installed a single. integrated Satellite Resource Management System (SRMS) that will "produce frequency allocation plans that vary minute-by-minute, tracking [the system's] satellite movements through their six-hour orbits."[254] Although the MSS ATC proponents propose various methods of coordinating intra-system satellite and terrestrial operations, each method of achieving greater frequency reuse through MSS ATC requires the operator's "full knowledge of all satellite and terrestrial activity on its network in order to make real-time adjustments to accommodate continuously changing operating conditions."[255]

**97.** While we find that the ability to dynamically control the basic components of an integrated MSS **ATC** system is necessary for MSS ATC to achieve the maximum frequency reuse possible through the combination of satellite and terrestrial infrastructure, we agree with those commenters that note that requiring system management through a single central point of presence may have undesirable consequences. We also find the record does not demonstrate any significant benefit to such a requirement. Accordingly, we decline to adopt our proposal that **MSS** ATC operators control their respective MSS ATC operations through a central data switch.

### 6. Other Proposed Requirements

98. While certain technical standards are necessary to protect the public and to establish a baseline for commercial negotiation, we must resist the temptation to proscribe detailed. uniform technical specifications for Commission licensees absent legitimate public interest justifications for doing so.[256] Some commenters claim that ATC will quickly escape the basic limiting principles we seek to maintain unless we impose specific regulatory measures on MSS ATC operations beyond those we

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[252] MSV Comments at 25-26; ICO Supplemenial Comments at 6-7.

[253] Constellation Supplemenial Comments at 4

[254] ICO Supplemental Comments at 8

[255] *Id.* at 11.

[256] Globalstar Reply at 15 ("A grant of ATC authority should not require MSS providers to integrate ATC and MSS platforms in any one particular manner. Commission dictated integration is not flexibility at all. Rather. ATC authority is intended to provide MSS providers with the operational flexibility to individually develop. guided by efficiency enhancing market forces and public interest needs. innovative solutions to the coordination challenges raised by ATC-MSS integration.").

proposed in the *Flexibility Notice*.[257] Although commenters opposed to ATC ask us to consider adopting any number of additional regulatory restrictions on MSS ATC. the principal limitations they propose would require MSS operators: (1) to offer satellite service as the predominant use in any given geographic area;[258] (2) to use dual-mode handsefs or to route terrestrial calls through the MSS satellite network to ensure MSS ATC system integration;[259] **(3)** to demonstrate a technical inability to serve proposed ATC locations with MSS satellites as a condition to site-by-site ATC **authorization**;[260] ***(4)*** to pay **annual** fees to the Commission in exchange for MSS ATC **rights**;[261] and (5) to regulate the **carriage**.[262] pricing,[263] or terms and conditions[264] of an operator's MSS ATC offering. These proposed conditions. with slight variations from commenter to commenter. represent the most fully developed conditions that appear in the **record**.[265] In general, we find that the complexity, cost and inefficiency of these proposed conditions would outweigh any limited utility that they might have.

99. First, requiring MSS licensees to ensure that satellite services constitute the "predominant" or "primary" use of their systems – whether measured in minutes of use or by number of customers – would limit spectrum efficiency. **As** we have found, to achieve the spectrum efficiency gains. ATC relies on flexible switching between the terrestrial and satellite components: the operator can dynamically allocate spectrum to either satellite use or terrestrial use. The proposal to require "predominant" satellite use would limit the **MSS** provider's flexibility and its concomitant spectrum efficiencies, e.g., by requiring predominant satellite coverage in geographic areas that can be more efficiently served by ATC. such as large cities. Also, establishing precisely how much of a limitation on **MSS** operators such a requirement would entail determining how lo measure the "predominance" of satellite services between highly flexible. dynamically coordinated spectrum uses – whether by minutes of use. number of channels

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[257] **See,** *e.g.*, Comtech Mobile Comments at *5* ("simply defining the term 'ancillary' may be insufficient to ensure that satellite service remains the primary use of the spectrum").

[258] Voicestream Reply at *22* (proposing that the Commission adopt a rule barring an **MSS** operator from acquiring more terrestrial customers than satellite customers); Comtech Mobile Comments at 2-5 (recommending a limit on the proportion of a system's customers that use the terrestrial network rather than the satellite network **as** their primary source of service (*i.e.*, more than 50% **of** the customer's monthly minutes are over the terrestrial path rather than the satellite path)).

[259] Voicestream Comments at 20-24. CTIA suggests that the Commission only permit MSS providers to provide ATC services using dual-band handsets that automatically select a satellite transmission path **if it** is available. CTIA Commenrs at 6.

[260] API Comments at 5 (proposing a requirement that MSS licensees provide technical evidence **that** they are unable to serve via satellite each location that they intend to serve via ATC).

[261] **See** P&FF Comments at 2, 13-15

[262] Stratos Comments at 16-20.

[263] Voicestream Reply at 22

[264] *Stratos* Comments **at** 16-20.

[265] While other regulatory initiatives have been suggested. these other proposals duplicate existing regulations or lack sufficient record evidence for ***us*** to adopt. API. for example. proposes that MSS licensees "periodically" report their geographic coverage. API Comments at 5. Section 25.143 of our rules. however. already imposes such a reporting requirement on MSS licensees. **See,** *e.g.*. 47 C.F.K.§ 25.143(e) (requiring Big LEO and *2* GHz MSS licensees to report the operational status of their satellite constellations on October 15 of each year).

occupied, number of consumers served, revenue from calls. or coverage area of each component. In shon, even if we had not found that imposing a predominant use requirement for MSS ATC would limit spectrum efficiency, we currently lack sufficient record evidence to determine any basis by which to select one measure of "predominant use" over another.

100. Second, requiring satellite-routing would defeat most of the benefits of authorizing ATC in the first instance. The disadvantages would increase markedly if we were to further restrict MSS operators to offering only dual-mode phones that defaulted to the satellite transmission path. Requiring MSS licensees to route all traffic through the MSS satellite system would greatly limit the spectrum efficiency gains that will occur under ATC. Under the satellite-routing proposal, an MSS operator would be required to route communications from ATC base stations to MSS eanh stations to the MSS satellite and back again, ***even if more efficient system transmissions paths existed.*** An MSS ATC user. for example, might place a call to another MSS ATC user within the broadcast radius of the same ATC base station. Lnstead of permitting the licensee to use the least-cost routing method through the ATC base station, a satellite-routing requirement would force the licensee to send the signal from the ATC base station to an MSS earth station, which would send the signal to the **MSS** space-station, which would retransmit the signal back to the MSS eanh station, which would return the signal to the ATC base station from which it originated.[266] This circuitous, unnecessary transmission path would materially increase the cost and complexity of ATC and greatly limit the spectrum efficiencies possible under the dynamic spectrum-sharing model of an MSS ATC. We are not persuaded that the public interest considerations ostensibly served by requiring satellite-routing justify the significant costs of limiting consumer choice. stifling innovation, and requiring additional operational expenses and inefficiencies.

101. Third, requiring MSS licensees to demonstrate a technical inability to serve proposed ATC locations with MSS satellites as a condition of every ATC base station authorization would create spectrum and administrative inefficiencies. Achieving optimal spectrum usage may require **an MSS** operator to use ATC even though a particular call might be served via satellite. Moreover, requiring an MSS licensee to demonstrate a technical inability to serve the area surrounding the ATC base station would require the Commission to adopt a site-by-site licensing process to scrutinize the technical merits of every proposed ATC base station location. The MSS licensee would need to update its engineering analysis for each proposed ATC base station location whenever buildings are built, modified, or razed in or near the proposed ATC base station location. Tower locations are scarce in any urban environment. Subjecting MSS licensees to the additional technical constraint of guaranteeing that no satellite signal could penetrate the proposed tower location. panicularly given the steady variation of our nation's urban landscape due to development and demolition, has the potential to preclude the selection and construction of any MSS ATC base stations. We find that the expensive. time-consuming testing and monitoring of every proposed base station locations would prevent the rapid deployment and development of MSS ATC without any corresponding public benefit or regulatory rationale.

102. Fourth. we reject a proposal to impose additional fees on MSS licensees that implement ATC to supplement their MSS network. In the case of MSS ATC. several commenters observe[267] and

[266] *See, e.g.*, Globalstar Reply at 26 ("Artificially limiting terrestrial spectrum reuse as proposed by these commenters would increase the amount of traffic required to be carried by an **MSS provider's** satellite system. Some of this traffic could be more efficiently and economically carried via an ATC platform. By requiring this traffic nevertheless to be carried via satellite. the Commission effectively would reduce the amount of spectrum bandwidth available to rural subscribers that only can be economically served by satellites.").

[267] ***See*** MSV Comments at 31-33 (asserting that no rational basis exists by which to determine the magnitude of any such fees).

even the principal proponent of an MSS ATC fee acknowledges, that insufficient economic data exists on which we could develop a rational user-fee regime.[268] Even if we were to conclude that a user fee on MSS ATC were warranted and could be rationally geared to the prospects of the MSS ATC segmeni, the Communications Act of 1934, as amended. does not clearly authorize us to impose such fees on MSS licensees that implement ATC. When Congress allowed flexible use of the broadcast spectrum and permitted licensees to offer ancillary or supplemental services, for example, Congress granted the Commission express authority to require the licensee to pay fees designed to avoid unjust enrichment and to recover for the public an amount that, to the extent feasible, equals the amount that would have been recovered had the service been licensed pursuant to the provisions of section 309(j).[269] Outside of the broadcast spectrum. however. no similar grant of authority directs us to impose fees on other flexible uses that we permit. As we observed in our *Flexibility Norice.* "absent legislation. we likely do not have the authority to assess . . . fees" on MSS ATC.[270] No commenter disputes this observation. At this time. therefore, we do not find that imposing additional fees on **MSS** licensees that implement ATC would serve the public interest.

## D. Technical Requirements and Rules for Terrestrial Operations

103. In the *Flexibility Norice,* we proposed to adopt flexible technical requirements and service rules that would encourage ATC development in the most rapid, economically efficient and diverse manner.[271] We proposed to apply a minimum set of technical standards to avoid harmful interference to other users of the spectrum and sought comment on whether our specific proposals were necessary and sufficient.[272] After reviewing the record evidence. including comments from the National Telecommunications and Information Administration (NTIA), we address these issues in this section. First. we individually evaluate the *2* GHz MSS band. L-band. and Big LEO bands. Though the concepts and proposals for ATC operations are similar among the MSS systems, each frequency band has its distinct inter-service and intra-sewice sharing scenarios. In each of the bands, we address the intra-service sharing scenarios (i.e.. **MSS** systems sharing the same MSS allocation with ATC operations) and then we evaluate the inter-service sharing possibilities (i.e., when the MSS ATC operations are in a frequency band that **is** adjacent to another service allocation). For the intra-service analyses, we evaluate the amount of interference that would be caused to another operator's system that is sharing the same MSS allocation. This interference could be an increase in the noise received by the space station receivers of the other MSS system or it could be interference caused io the mobile earth terminals (METs)

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268 *See* P&FF Comments at 13 n.49, 14-15

269 *See* 41 U.S.C. § 336: see *also Fees for Ancillary or Supplementary Use of Digital Television Spectrum Pursuant to Section 336(e)(1) of the Telecommunications Act of* 1996. MM Docket No. 97-247, Memorandum. Opinion and Order. 14 FCC Rcd 19931, 19939, ¶ 20 (1999) (construing section 336 of the Communications Act to provide that "only *ancillary or supplementary* services are subject to fees under the Act") (emphasis in original).

270 *Flexibility Norice,* 16 FCC Rcd at 15549-50, ¶ 40.

271 *Id.* at 15555. ¶ 54

272 We sought comment on what limits should be placed on the terrestrial facilities' out-of-band emissions into adjacent bands. whether it is necessary to imposc intersystem limits, or instead allow applicants to coordinate among themselves. whether there are alternative approaches that would provide ample proteciion while better furthering our goals of encouraging rapid, efficient deployment of Integrated MSS terresfrial services. and whether ihere are differences between the *2* GHz MSS snd L-bands that would require an alternative approach for operations in onr *or* the other band. *Id.*

operating with the other MSS system. For the inter-service case. we evaluate the impact of our-of-band emissions from ATC operations on adjacent band systems.

104. We adopt technical parameters for ATC operations in each of the bands at issue designed to protect adjacent and in-band operations from interference from ATC.[273] We fully expect that these operational parameters will be sufficient. Nevertheless, in the unlikely event that an adjacent MSS or other operator does receive harmful interference from ATC operations. either from ATC base stations or mobile terminals. the ATC operator must resolve such interference. If the MSS ATC operator claims to have resolved the interference and other operators claim that interference has not been resolved. then the parties to the dispute may petition the Commission for a resolution of their claims.[274]

### 1. 2 GHz MSS Band

105. On August 25, 2000, the Commission released the *2 GHz MSS **Rules Order*** setting forth licensing and service rules for pending applicants to provide MSS in the 1990-2025 MHz and 2165-2200 MHz bands.[275] In the *2 GHz MSS **Rules Order,*** the Commission adopted a band arrangement that can accommodate initially the multiple and technically-diverse systems that have requested authorization. Each authorized system received an equal share of the available frequencies. Because there is not sufficient spectrum to award to each applicant the full amount of spectrum that it has indicated its proposed system requires, the Commission stated in the *2 GHz MSS **Rules Order*** that operational systems could aggregate spectrum assignments "by reaching agreement for sharing of those assignments among themselves."[276] Not all proposed systems can share the same spectrum due to the modulation schemes proposed. A licensee will select the specific frequencies in which its primary service operations will take place at the time it has launched one satellite into its intended orbit.[277] In addition, because there are a number of incumbent terrestrial services, such as Broadcast Auxiliary Services, in the 2 GHz MSS band, each authorized system will have flexibility to operate MSS at other frequencies in the band.[278]

106. The July 17, 2001 Orders authorizing Boeing, Celsat, Constellation, Globalstar, ICO, Iridium, MCHI, and TMI to provide 2 GHz MSS in the United States requires the satisfaction of certain implementation milestones:[279] Our milestone rules are intended to ensure the speedy delivery of service

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[273] Many of the rules adopted today impose operating limits to protect against harmful interference based on current technology, current coding methods or current network configurations. ***See** infra* App. B (adopting new rules **41 C F.R** §§ 25.147. 25.252, 25.253, 25.254). Although our rules are designed with today's sysrems in mind. we do not intend to limit the ability of existing or future licensees to deploy new. different or innovative technologies. provided that the applicant can demonsrrare that the new system configuration produces no greater inrerference than permitted under our existing rules. We adopt notes to this effect in each of our band-specific **MSS ATC** rules. See *infra* App. B (47 C.F.R. §§ 25.252. 25.253. 25.254).

[274] *See. e.g.*, 47 C.F.R. §§ *25.272,* 25.274

[275] *2 GHz MSS Rules Order.* 15 FCC Rcd 16127

[276] *Id.* at 16140-41, ¶ 22

[277] *Id.* at 16138, ¶ 16.

[278] *Id.* at 16139-40, ¶¶ 19-21. Operations at frequencies outside of an MSS operator's selected frequency assignment cannot cause harmful interference to other assigned satellite network or incumbent terrestrial services

[279] *See supra* n.10. As foreign applicants seeking authorizations for their foreign licensed systems. ICO and TMI were authorized as non-U.S. licensed satellite systems for which the Commission reserved specrrum to serve the (continued. .)

to the public and to prevent warehousing of spectrum.[280] To date, all licensees have certified that they have met their first construction milestone of July 17. 2002 to enter into a non-contingent satellite manufacturing contract. Boeing plans lo use its 2 GHz MSS license specifically to provide aeronautical services.[281] Boeing has filed an application to modify its 2 GHz MSS authorization to substitute a geostationary orbir satellite network for the non-geostationary orbit MSS network in its license.[282] Celsat plans to implement a geostationary satellite orbit MSS system while Iridium plans to implement a non-geostationary satellite orbit MSS system.[283] Globalstar has filed an application to modify its 2 GHz MSS authorization to reduce the number of operational non-geostationary orbit satellites in its network, with proposed technical modifications.[284] TMI operates a geostationary orbit satellite system licensed in Canada and. through a subsidiary, holds a letter of intent authorization from the Commission.[285] ICO operates an NGSO satellite network and is authorized under the laws of the United Kingdom and, through a subsidiary. holds a letter of intent authorization from the Commission which requires that a second satellite be launched prior to January 2005.[286] On July 18, 2002. ICO. Constellation, and MCHI filed

(Continued from previous page)
United States Pursuant to the 2 *GHz MSS Rides Order,* these authorizations provided each system access to "Selected Assignments" of 3.5 megahenz of spectrum in each of the 1990-2025 MHz and 2 165-2200 MHz bands and the transceivers must be capable of tuning across at least 70% of the MSS allocation. The International Bureau delayed full implemeniation of the 2 *GH: MSS Rules Order* with regard to an incremental 0.38 megahertz of spectrum per licensee in each band. pending Commission consideration of various pending proposals related to the 2 GHz frequencies.

280 These milestone deadlines began to run on the authorization date. July 17,2001. Specifically. non-geostationary satellite orbit (NGSO) MSS operators must enler into a non-contingent satellite manufacturing contract within one year of authorization, complete critical design review (CDR) within **two** years of authorization, begin physical construction **of** all satellites in the system within two-and-a-half years of authorization, and complete construction and launch of the first two satellites within three-and-a-half years of authorization. *See* 2 *GHz MSS Rules Order,* 15 FCC Rcd at 16177,¶ 106. The entire system must be launched and operational within six years of authorization. *Id.* at 16178.7 106. Geostationary satellite orbit (GSO) operators must enter **a** non-contingent satellite manufacturing contract within one year, complete CDR within two years, begin physical construction of all the GSO satellites in the system within three years, and complete construction of one satellite in the constellation and launch it into its assigned orbital location within five years of authorization. *Id.* at 16177.7 106. Hybrid GSO-NGSO satellite systems must follow GSO milestones for the GSO portion of their systems as well as NGSO milestones for the NGSO portion of their systems. *Id.*

281 *Boeing 2 GHz MSS License.* I6 FCC Rcd at 13704, ¶ 36.

282 *See Application of The Boeing Company to Modify its Satellite Authorization.* SAT-MOD-20020726-00133. Public Notice Report No. SAT-0115(rel. Aug. I, 2002).

283 *Celsat 2 GH: MSS License.* 16 FCC Rcd at 13712, ¶ 2; *Iridium* 2 *GHz MSS License.* 16 FCC Rcd at 13778,¶ 2.

284 *See Applications of Globalstar L.P. to Modify its Satellite Authorization.* SAT-MOD-20020722-00107, SAT-MOD-20020722-00108, SAT-MOD-20020722-00 109, SAT-MOD- 20020722-00110, SAT-MOD- 20020722-00112. Public Notice Report No. SAT-0115 (rel. Aug 1, 2002).

285 *See TMI 2 GHz MSS Order,* 16 FCC Rcd 13808. MSV, one of the original applicants in this proceeding, is a joint venture between TMI and Motient Corporation. *See supra* n.13 and accompanying text.

286 *See ICO 2 GH: MSS Order.* I6 FCC Rcd at 13775¶ 31. ICO has informed the Commission thai it has completed construction of additional satellites. *See. e.g.,* Letter of Cheryl A. Tritt, Counsel io ICO Services Limited to Magalie Roman Salas. Secretary, Federal Communication Commission, File **Nos.** 188-SAT-LOI-97; SAT-LOI-19970926-00163; SAT-AMD-20000612-00107; SAT-AMD-20001103-00155 (filed Oct. 15. 2001) (responding to its obligations under section 25.143(e) Annual Report and Certification of Construction Milestones).

applications with the Commission proposing to: (1) transfer control of Constellation's and MCHI's MSS licenses to ICO; and *(2)* modify the technical specifications of Constellation's and MCHI's 2 GHz MSS system to conform with the iechnical specifications of ICO's *2* GHz MSS system."' The proposed modifications include a request for Constellation and MCHI to implement their *2* GHz MSS systems by sharing satellite infrastructure with ICO pursuant to a Spectrum Sharing Agreement. pending approval of the transfer of control applications.[288] On January **29.** 2003, the International Bureau declared Constellation's, Globalstar's and MCHI's *2* GHz **MSS** licenses null and void, after finding that these entities failed to satisfy their first *2* GHz MSS implementation milestone.[289]

107. In its application, ICO proposed four different frequency plans and architectures to integrate ATC into its MSS system.[290] Briefly, the four architectures are: (1) Forward Band Mode, *(2)* Reverse Band Mode, **(3)** Downlink Duplex Mode, and (4) Uplink Duplex Mode. In the Forward Band Mode. ATC Mobile Terminals (MTs) would transmit in the **MSS** uplink frequency band and Base Stations (BSs) would transmit in the downlink band; in the Reverse Band Mode, the MTs would transmit in the MSS downlink frequency band and the BSs would transmit in the uplink band; in the Uplink Duplex Mode, the MTs and BSs would transmit in the uplink MSS frequency band; and in the Downlink Duplex Mode, the MTs and BSs would transmit in the downlink MSS frequency band. We evaluate in Appendix C1 all four Modes of ATC operation in greater detail to determine the potential for each Mode to cause interference to other in-band *2* GHz MSS systems and to systems operating in adjacent frequency allocations. ICO was the only *2* GHz MSS band licensee to submit a proposal for **ATC**.[291] Other than Boeing, which was the only *2* GHz MSS band licensee to express concern about **ATC** operations potentially interfering with its MSS system, the *2* GHz MSS band licensees either generally supported the concept of ATC or explicitly indicated that ATC could be implemented without causing interference to MSS systems."'

108. We conclude that the Forward Band Mode of operation for ATC is the least interfering to in-band MSS systems and systems operating in adjacent frequency bands. Moreover, since the Forward Band Mode would require the fewest technical and operating constraints, overall it would have the greatest amount of technical flexibility for implementation and it appears to be the more desirable Mode

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[287] ***Application of Constellation Communications Holdings Inc. to Modify its Sarellire Authorization***, SAT-MOD-20020719-0103, Public Notice Repori No. SAT-O116 (rel. Aug. 5. 2002); ***Application of Constellation Communications Holdings Inc. to Transfer Control of Satellite Authorizations to ICO Global Communications Holdings,*** SAT-T/C-20020718-0014, Public Notice Report No. SAT-OI16, (rel. Aup. 5, 2002); ***Application of Mobile Communications Holdings Inc. to Modify its Satellite Authorization***. SAT-MOD-20020719-0105. Public Notice Report No. SAT-OI 16. (rel. Aug. 5. 2002); ***Application of Mobile Communications Holdings Inc. to Transfer Control of Satellite Authorizations to ICO Global Communications Holdirigs.*** SAT-T/C-20020719-00104, Public Norice Report No. SAT-OI16, (rel. Aug. 5, 2002) (collectively ***ICO/MCHI/Constellation Applications Norice).***

[288] **See *ICO/MCHI/Constellation Applications Notice*,** at 1-3

[289] *See* ***supra*** n.11

[290] *See* ICO Mar. 8. 2001 ***Ex Parte*** Letter at 8-10 & App. B

[291] Globalstar, however. provided substantial technical information on how it would integrate **a** forward band mode ATC network in its 2 GHz MSS system. ***See*** Globalstar Supplemental Comments, Technical Comments at 15-18.

[292] ***See. e.g.,*** ICO Comments at 15-30: Constellation Comments at 22-38: TMI Comments at 2-4; MCHI Comments **at** 11; Globalstar Bondholders Comments at 31; ***see also, e.g.***, Boeing Comments at 12-13; Boeing Reply **at** 7-8, 23. Boeing's specific concerns are addressed below.

to implement ATC.[293] As described in detail in Appendix C1, our analyses indicate that the Reverse Band Mode, and both Duplex Modes of operation for ATC, have significantly greater potential to interfere with other systems than the Forward Band Mode. Specifically, an ATC MT operating in Reverse Band Mode or the Downlink Duplex Mode, has the potential to interfere with other MSS MET receivers when the terminals are within approximately 300 feet of each other.[294] Additionally, ATC BSs operating in Reverse Band Mode and in the Uplink Duplex Mode have the potential to interfere with Broadcast Auxiliary Service (BAS) equipment in the allocation above 2025 MHz when, for example, ATC BSs and Electronic News Gathering (ENG) receivers are within 2.6 km of each other.[295] The technical and operational constraints that would have to be placed on these Modes of ATC operation to protect in-band and adjacent allocation systems (e.g., coordination prior to operation, more stringent EIRP or out-of-band emission levels) would lessen the technical flexibility to effectively deploy ATC. **We** decline to authorize these Modes of operation for ATC and we adopt technical rules to implement the Forward Band Mode.

109. To implement the decision in this Order, we adopt rules permitting ATC in the Selected Assignments of the 2 GHz MSS band licensees.[296] The ATC technical rules shall apply to all *2* GHz MSS licensees choosing to implement ATC in their selected MSS frequency assignments.[297] The technical rules for ATC, discussed below, provide for operation of ATC in the *2* GHz MSS allocations, protect currently licensed in-band MSS systems from interference, and protect systems operating in adjacent service allocations from interference. In brief, to protect other in-band MSS systems and systems operating in adjacent frequency bands, ATC operators will be required to meet specific MT out-of-band emission limits based upon our analyses that include reserving a minimum amount of link margin for power control in their ATC networks to accommodate for structural attenuation.[298] ATC operators will also be required to meet specific BS out-of-band emission limits, meet an **EIRP** limit toward the horizon and maintain a separation distance from airports. We discuss each of the rules below.

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[293] ICO, for example, indicates that "the Forward Band Mode is the most straightforward" and it seems to place more emphasis on this Mode of operation. **See** ICO Mar. 8, 2001 *Ex Parte* Letter at 8. Globalstar and MSV also support the Forward Band Mode approach for ATC operations in the Big LEO and L-band, respectively. ***See*** Globalstar Comments at 1a & n.28; Motient/TMI Assignment and Modification Application, File No. ISP PDR-20010302-00007 at 8-9 (filed, Mar. 1, 2001).

[294] ***See*** *infra* App. C1 § 2.2.4.1

[295] ***See infra*** App. C1 § 3.1. Added constraints would he required on the Base Stations (e.g. site-by-site coordination of the base stations prior to operation) to ensure protection of ENG operations in the adjacent frequency allocation.

[296] ICO has informed the Commission **of** its Selected Assignment within the 2 GHz MSS Band. ***See*** Letter of Cheryl **A.** Tritt, Counsel to ICO Satellite Services G.P. to Marlene H. Dortch, Secretary, Federal Communications Commission, File No, 188-SAT-LOI-97; IBFS Nos. SAT-LOI-19970926-00163;SAT-AMD-20000612-00107; SAT-AMD-20001103-00155 (Ocroher 15, 2002) (2 GHz MSS Selected Assignment Notification, Annual Section 25.143(e) Report, and Section 25.121(d)(2) Certification).

[297] *See supra* § III(C); ***see also infra*** App B

[298] We use the term "structural attenuation" to mean the signal attenuation caused by transmitting to and from mobile terminals that are located in buildings or other man-made structures that limit the transmission of radiofrequency radiation

### a. Intra-Service Sharing

110. ICO's ATC proposal suggests that ATC could be provided on a licensee's selected MSS assignment and, on a secondary basis. on other MSS licensees' selected frequency assignments in the MSS allocation.[299] Since we are limiting 2 GHz licensees ATC operations to the licensee's selected assignments,[300] we only address the interference potential of ATC operations in one licensee's selected frequencies to the MSS operations in another licensee's selected frequency assignments (i.e., we address the interference potential from an adjacent channel perspective). Boeing has conducted substantial technical studies on adjacent channel interference in response to ICO's proposed integrated ATC network."' Boeing is concerned about the potential for interference that ICO's ATC operations could cause to Boeing's licensed MSS satellite network. We address Boeing's analysis, which is based upon its original proposal for a non-geostationary satellite network, in Appendix C1

111. Boring submitted initial comments indicating that, based upon a number of assumptions, it is concerned about possible interference from the ATC BSs to its satellite uplink receivers."' Since we are only authorizing the Forward Band Mode of ATC operation, BSs will not be transmitting in the satellite uplink band and this potential for interference no longer exists. Additionally, Boeing indicated that. based on ICO's proposal. it did not expect interference to occur to its satellite **uplink** receivers from ATC MTs.[303] However, ICO modified its proposal to include more liberal ATC MT out-of-band emission levels[304] and we evaluate the Boeing link analysis in Appendix C1 using the modified assumptions provided by ICO. The results of our analysis concur with Boeing's initial results that ATC MTs operating in Forward Band Mode will not interfere with Boeing MSS receivers in the uplink. Specifically, taking into account the *-67* dBW/4kHz out-of-channel emission level we adopt and the mitigating effects of ATC network power control which is standard engineering practice to include in terrestrial mobile networks,[305] the Boeing satellite receiver noise would be increased by less than 1%.[306] This increase in satellite receiver noise temperature would not cause unacceptable interference to Boeing's satellite operations or other MSS systems operating in adjacent channels in the MSS

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[299] This proposal is consistent with the MSS service rules relating to MSS frequency assignments. *See 2 GHz MSS Rules Order* 15 FCC Rcd at 16172-89, ¶¶ 92-140

[300] *See supra* § III(C)(3).

[301] *See* Boeing Comments App. A at 1-7

[302] Boeing Comments at 12

[303] *Id.*, App. A, Table 4

[304] ICO modified its MET out-of-channel emission level ot -93.5 dBW/4kHz to -67 dBW/4kHz. *See* ICO Apr. 11, 2002 *Ex Parte* Letter at 2.

[305] *See* MSV Reply, Technical Annex at 7; *see also* Jean-Paul M.G. Linnartz, ed.. *Wireless Communication: The Interactive Multimedia CD-ROM, Link Budget*, *available at* <http //150.250 105.16/~krchnave/spring2002/wireless/Kluwer CD/chaptr04/outage/linkbudg.htm> (last visited, Jan. 9. 2003).

[306] *See infra* App. C1. The analysis contained in Section 2.1.3. does not include the use of power control and therefore the results are conservative. A typical value to use for power control in cellular and PCS systems is 18 dB. Incorporating power control in the ATC network would add at least 10 dB to Boeing's link margin to protect it from receiving interference from ATC MT transmissions.

allocation.[307] To protect in-band MSS systems from interference, we adopt section 25.252(c)(2) to require that 2 GHz ATC MTs meet an out-of-channel emission level of -67 dBW/4kHz with the expectation that a MSS licensee will reserve a minimum of 10 dB in its link budget for power control within its ATC network. as is within the 10-20 dB range of standard engineering practice. to overcome the effects of structural attenuation. MSS licensees may not extend the coverage area of any ATC cell beyond the point where an ATC MT could operate at the edge of coverage of **the ATC cell** with a maximum EIRP of -10 dBW.

112. Boeing also submitted substantial technical analyses on the potential for interference that ATC operations could have on its downlink operations. Specifically. Boeing addressed the impact it would expect ATC BS and MT operations to have on its aircraft earth station receivers."' Since we are only authorizing the Forward Band Mode of ATC operation. MTs will not be transmitting in the satellite downlink band and this potential for interference no longer exists. However, the potential for the BSs to interfere with **MSS** MET receivers still exits in the Forward Band Mode and we analyze the impact on Boeing's MT receivers in Appendix C1.[309] The Boeing analysis assumed an out-of-channel[310] emission level of -56 dBW/4kHz.[311] However. ICO modified this level to -100.6 dBW/4kHz to be more restrictive than originally proposed.[312] Using the more restrictive out-ofchannel level. brings the separation distance between the ATC BSs and the Boeing aircraft earth stations down from almost 22 km lo 190 meters (630 feet) to avoid interference to the aircraft earth stations on **or** near the ground.[313] **An** airport is a controlled area, and maintaining a separation distance between a BS and a runway or tarmac of approximately 190 meters should be achievable. Though the separation distance is relatively small. it may be possible for in-flight earth stations to be located within 190 meters **from** an ATC BS (one that separated from an airport by more than 190 meters) when the aircraft is taking off or landing. To mitigate the potential interference caused to aircraft receivers either in-flight or on the ground, **we** first adopt section 25.252(b)(1) to limit 2 GHz **BS** out-of-channel emissions to -100.6 dBw/4kHz and also section 25.252(b)(4) to require MSS licensees to locate all BSs more than 190 meters from the runways and aircraft stand areas of any airport and at least 190 meters away from airport landing and take-off flight paths to mitigate potential out-of-band interference.[314]

113. There also exists the potential for the BSs to saturate or overload aircraft receivers while

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[307] The 1% increase in satellite receiver noise temperature **is** compared to the 6% delta T/T used to denote an unacceptable level of inrerference and trigger coordination among satellite systems prior to operation of **a** new satellite network.

[308] Boeing Comments at 10

[309] *See infra* App. C1 § 2.2.2

[310] By "out our-of-channel,"we mean at the edge of the 2 GHz MSS licensee's Selected Assignment

[311] Boeing Comments. App. A. Table I

[312] *See* ICO April 11. 2002 *Ex Parte* Letter at *2*

[313] *See infra* App. C1 § 2.2.2. The Forward Band Mode ATC BSs would produce an increase in the satellite earth station receiver noise hv 6% or less

[314] *See infra* App. B (adopting new rules 47 C.F.R.§§ 25.252(b)(1). (b)(4))

they are on or near the ground.[315] Boeing provides an analysis in its comments that suggests that its receivers will be overloaded by ATC transmissions when its receivers are within approximately *2* km of a BS.[316] Our analysis confirmed Boeing's calculations that, in areas where free-space propagation is the dominant mode of propagation, the ATC BSs may saturate a Boeing MET that is located within approximately *2* km of an ATC BS.[317] We analyzed this situation further. however, to take into account the effects of propagation in an urban environment (where BSs will be located) and while the aircraft receiver is on or near the ground. In urban areas where free-space propagation will nor be the dominant mode of propagation, higher attenuation of the BS signals will result in less interfering power being received by a MSS MET.[318] Using the **BS** in-band **EIRP** of 27 dBW, and taking into account the down-tilt of the antenna of *2.5* degrees, a maximum EIRP of *25.5* dBW *(27* dBW – antenna gain G with downtilt = ***2.5*** degrees) will result toward the horizon. Limiting the ATC BS to *25.5* dBW toward the horizon, and taking into account the effects of signal attenuation in an urban setting. we conclude that Boeing's MSS receivers, and the receivers of other MSS systems in the **2** GHz band that may be less robust to overload interference, **will** not undergo saturation from BSs located in urban areas when the METs are also located in the urban area. We therefore adopt this EIRP limit in our **rules**.[319] To take into account Boeing's concern of overload interference to MSS METs located outside of urban areas, we require that 2 GHz ATC BS be limited to an aggregate power level of **-51.8** dBW/m$^2$ (in addition to the 190 meters restriction to protect MSS METs from out-of-band interference) at the runways and aircraft stand areas of any airport and airport landing and take-off flight paths to avoid the possibility of overload interference to an aircraft **MSS** receiver.'"

114. We also address the potential situation where BS transmissions could overload an **MSS** earth station on board an aircraft that is airborne. Boeing assumes, among other things. that mainbeam coupling of the BS antenna and the airborne **MSS** MET exists. We developed a mathematical model IO simulate the interference scenario posed by Boeing where the total interfering power from 1000 randomly distributed BSs visible to an aircraft at various altitudes is calculated at the input of an airborne **MSS** eanh station receiver.[321] Our analyses further assumes that each randomly distributed BS has an EIRP of 27

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315 Receiver overload. or saturation. occurs when sufficient interference power is present at the receiver to cause it to act in a non-linear manner. This potential for interference is increased by the requirement that MSS earth stations are capable of tuning across 70% of the **MSS** allocation. ***See*** *2 GHz* ***MSS Rules Order.*** 15 FCC Rcd at 16152, ¶ 52.

316 ***See*** Boeing Additional Technical Analysis. April 5, 2002. Table 7.

317 ***See*** *infra* App. C1 § 2.2.4.2. We note that **if** the antenna is tilted toward the ground at **a 5** degree angle vs. **a** 2.5 degree angle (used by Boeing) the separation distance reduces to less than 1 **km** in **a** free-space propagation environment.

318 *See infra* App. C1 § 2.2.4.2. Specifically, we use a program developed by the National Institute of Standards and Technology that compares the results of several propagation models and the results show that significantly higher attenuation than free space loss should be expected in an urban setting. We note. too. that the additional attenuation in the urban environment would also be sufficient to protect MSS receivers that are less robust to overload interference (i.e., -60 dBm).

319 *See infra* App. B (adopting new rule § 25.252(a)(3). which requires MSS ATC licensees to limit BS EIRP toward the horizon to 25.5 dBW).

320 ***See*** *supra* App. C1 § 2.2.4.2.

321 *See infra* App. C1 § 2.2 4.3 (describing the assumptions used to simulate the interference scenario) & Attach. I (MathCad Model).

dBW, that the antenna follows the ITU-R model contained in Recommendation ITU-R M.1336,[322] and the antenna height is at 30m and tilted toward the ground hy 2.5 degrees. Based on the results of our analysis, a relatively large deployment of ATC BSs would not cause Boeing's airborne MSS receivers to saturate while airborne and the porential for interference is low if the BS maximum EIRP toward the horizon is limited to *25.5* dBW (27 dBW – antenna gain G with downtilt = *2.5* degrees). We adopt section 25.252(a)(3) to limit BS EIRP toward the physical horizon to *25.5* dBW and an over-head gain suppression greater than 25 dB outside of the main lobe of the antenna to ensure protection of airborne MSS terminals.[323]

### b. Inter-Service Sharing

115. We have also evaluated the potential interference that may be caused to systems operating in adjacent frequency allocations to the *2* GHz MSS band. Our findings are described in detail in Appendix CI, Section 3. We summarize our findings, below and conclude that ATC operations in the *2* GHz **MSS** allocations will not cause unacceptable interference to systems operating in adjacent frequency allocations.

116. Broadcast Auxiliary (BAS) and Electronic News Gathering (ENG) equipment operate above the 1990-2025 MHz MSS uplink allocation. The Society of Broadcast Engineers (SBE) is concerned about the potential for Interference that ATC operations could cause to ENG and BAS operations in the adjacent allocation.[324] SBE is particularly concerned about the interference that could be caused if proposed BS operations are permitted in the uplink **MSS allocation.**[325] According to SBE, placing high-powered BSs in spectrum immediately adjacent to spectrum used for BAS receivers will require a separation distance of 2.6 km between a BS and BAS receiver. We indicated earlier that maintaining this type of separation distance is one example of a technical and operational constraint thar would limit the implementation of ATC networks. Because we are adopting rules to implement Forward Band Mode ATC operations, however, the potential for BS interference to ENG and BAS equipment no longer exists. SBE indicates in its same comments that low power mobile telephone use of the **MSS** allocation will pose little or no risk of interfering with BAS receivers.'" The rules we adopt in section 25.752 to protect in-band MSS systems from out-of-channel interference will also protect ENG and BAS equipment operating in frequency bands above the MSS uplink allocation.'"

117. In the *Flexibility Notice*. we proposed adopting out-of-band emissions limitations for ATC operations consistent with our current rules for PCS.[328] CTIA. and certain incumbent PCS licensees

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[322] ***See*** ITU-R Recommendation F.1336-1, *Reference Radiation Patterns of Omnidirectional. Sectoral arid Other Antennas in Point-to-Multipoint Systems for Use in Sharing Studies in the Frequency Range From 1 to About 70 GH:, available nr* <http://www.itu.int/rec/recommendation.asp?type=items&lang=e&parent=R-REC-F.1336-I-200005-1> (last visited, **Jan.** 8, 2003).

[323] ***See infra*** App. B (adopting new rules 47 C.F.R. §§ 25.252(a)(3). (a)(5))

[324] SBE Comments at 6-11; SBE Reply Commenta at 1

[325] SHE Commenta at 8. We address SBE's additional comments on ICO's proposed duplex operations and use of a single antenna for ATC and MSS operalions in Appendix CI. Section 3.1

[326] SBE Comments **at** 8.

[327] *See infra* App. B (adopiing new rule 47 C.F.R. § 25.252)

[328] *Flexibility Notice*, 16 FCC Rcd at 15547. 15555-56, ¶¶ 34. 55

and PCS equipment manufactures. however. have raised the issue of possible out-of-band emissions interference from 2 GHz ATC METs transmitting in the 1990 to 2025 MHz band to PCS mobile receivers operating in the 1930-1990 MHz band, which they claim would not be adequately protected by our current attenuation requirement of **43 +** 10 log P dB for PCS mobile transmitters.[329] CTIA also has indicated that PCS mobile handsets would not be able to adequately filter out transmissions from nearby MSS ATC handsets; which could result in either a desensitization or overload of PCS receivers. Verizon has also expressed its concern on this same point.[330] **CTIA** suggests that this potential for interference could be mitigated by providing 15-20 MHz of frequency separation between the PCS bands and ATC operations and by imposing much tighter out-of-band emissions limits on ATC equipment.

118. We agree with the commenting parties that under certain circumstances, there is a potential for interference from MSS ATC handsets to existing PCS handsets. However, we believe that the amount of frequency separation and the extremely stringent out-of-band emissions limits requested by CTIA and Verizon to address this form of interference are unnecessarily restrictive. The 1980-2010 MHz band has been allocated for MSS use since the 1992 World Administrative Radio Conference. Since at least 1994, we have been aware of the potential for some level of interference between MSS and PCS systems.'" PCS carriers similarly were aware of potential interference from MSS systems in adjacent spectrum. and could have taken this into account in the design of their equipment. But the likelihood of potential interference from future MSS operations was generally considered minimal due to the fact that MSS systems were expected to operate primarily in rural and/or remote environments, and in such areas the probability of an MSS handset operating close enough to a PCS handset to cause interference was low. However, ATC may pose a greater interference problem for adjacent PCS operations because of the likelihood that **ATC** handsets will operate in the identical environments in which PCS handset operate (e.g.. in urban areas, indoors, etc.), and that in such environments ATC handsets could be close enough to PCS handsets to cause interference. We therefore find that some additional requirements on ATC handsets are necessary and appropriate.

119. *Out-of-Band Interference*. To address out-of-band emission interference, we shall require that MSS ATC handsets comply with a more stringent out-of-band emissions limitation than we originally proposed in the *Flexibility Notice*. Specifically. we will require that any ATC mobile terminal meet the following out of band requirements: emissions below the frequency 1995 MHz and above the frequency 2025 MHz shall be attenuated by at least 70 + 10 log P dB, measured in a one megahertz or greater bandwidth; emissions in the band 1995-2000 MHz and 2020-2025 MHz shall be attenuated by at least a value **as** determined by linear interpolation from 70 + 10 log P dB to **43 +** 10 log P dB at the nearest MSS band edge at 2000 MHz or 2020 MHz, respectively; and. all other emissions shall be

[329] *See, e.g.*, Letter from Diane Cornell. Counsel. Cellular Telecommunications and Internet Associarion to Marlene H. Dortch, Secretary. Federal Communications Commission. IB Docket No. 01-185 at 4-10 (filed, Jan. 14, 2003) (CTIA Jan. 14. 2003 ***Ex Pane*** Letter).

[330] Letter trom Donald C. Brirtingham, Director. Wireless Spectrum Policy. Verizon Corp. to Marlene H. Dortch. Secretary, Federal Communications Commission. IB Docket No. 01-185 at 1-6 (tiled. Jan. 6. 2003). Nextel. however. disagrees wirh **CTIA** and Verizon's view. contending that while ATC could theoretically cause interference to PCS operations in limited circumstances. the probability of such interference actually occurring is low. See Letter trom Regina M. Keeney, Counsel. Nextel Communications Inc. to Marlene H. Dortch, Secretary. Federal Communications Commission. IB Docket No. 01-185 at 3-7 (filed Jan. 22, 2003).

[331] *See Amendment of the Commission's Rules to Establish New Personal Communications Services*, Third Memorandum Opinion and Order. 9 FCC Rcd 6908. 6922-23, ¶¶ 83-87 (1994).

attenuated by at least **43** + 10 log P dB.[332] In addition, in the event that a PCS operator receives harmful interference from ancillary ATC base stations or mobile terminals. we will also require that the ATC operator must resolve any such interference. If the MSS ATC operator claims to have resolved the interference and other operators claim that interference has not been resolved. then the parties to the dispute may petition the Commission for a resolution of their claims. We find that compliance with these requirements will adequately protect incumbent PCS operations in the 1930 to 1990 MHz hand from interference from MSS ATC and still maintain the usefulness of spectrum in the 2000-2020 MHz band for ATC operations.'" We also find that compliance with more stringent out-of-band limitations will further the public interest in helping the Commission to establish more effective and efficient spectrum management."'

120. *PCS* ***Receiver*** *Desensitization or* ***Overloud.*** Certain incumbent wireless carriers assert that there exists the potential for ATC mobile terminals to cause desensitization or receiver overload to PCS mobile receivers operating below 1990 MHz.[335] We do not believe that the problem of desensitization and overload *is* as severe as these parties contend. First. we believe that the parties may have assumed that the only interference rejection capability *of* an existing PCS mobile receiver *is* from the front-end band pass filter of the receiver. This does not take into account other factors such as additional filtering from the intermediate frequency (IF)circuitry Additionally. the panies' assertions that receiver desensitization or overload interference will occur appear to be based on what would be considered worst-case circumstances (e.g.. that ATC and **PCS** handsets are operating in close proximity under line-of-sight conditions. that ATC handsets are operating at **full** power. and that the antennas of the handsets are aligned for perfect coupling). The probability of these various circumstances occurring simultaneously is relatively small. We thus believe that, while the potential for PCS receiver desensitization or overload from ATC operations exists, it is less than suggested by the commenting panies. We also believe that interference problems that may develop over time as ATC is deployed can be mitigated by future PCS handset design modifications and through a cooperative effort by PCS and MSS ATC licensees to resolve these issues.[336]

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[332] In addition to adopting this -70 dBW/MHz emission to protect PCS receivers. the Commission's decision to reallocate the 1990-2000 MHz band to services other than MSS will result in **a** 10 MHz separation between **ATC** and current PCS operations. See *AWS Report and Order*, FCC 03-16.

[333] In setting out requirements ***for*** attenuating out-oi-hand emissions by 43 + 10 log P dB at 2000 MHz and at 70 + 10 log P dB at 1995 MHz, we would expect that the actual out-of-hand emissions in the PCS hand at 1930-1990 MHz would he attenuated even more.

[334] **As** noted in **a** recent staff report by the Spectrum Policy Task Force. the staff recommended that the Commission consider tightening out-of-band emission limits over rime so that disparate uses of the spectrum can **have** less interference impact **on** each other. ***See*** Federal Communications Commission, Spectrum Policy Task Force Report. ET Docket No. 02-135, 22 (**Nov.** 2002). *available at* <http://www.fcc.gov/Daily_Releases/Daily_Business/2002/db1115/DOC-228542A1.doc> (last visited, Jan. 29, 2003). Furthermore, as suggested in the Spectrum Policy **Task** Force report, we will review these out-of-hand limits in about five years to determine whether they are adequate or necessary. ***See id.*** at 32.

[335] See CTIA Jan. 14, 2003 ***Ex Pone*** Letter at 5-6

[336] We note that. as a practical matter. there will he some period of time before ATC is deployed and **a** longer period before it has the potential to reach market penetration levels that could materially affect the likelihood of interference. We also note that the Spectrum Policy Task Force report encourages the use of voluntary receiver performance requirements to address these types of problems *See* Spectrum Policy **Task** Force Report **at** 31

121. We also analyzed the impact of ATC operations on the Space Operations Service allocation above the 1990-2025 MHz MSS uplink allocation. Again, since we are adopting rules to implement the Forward Band Mode of ATC operation, the MET transmissions are the only potentially interfering element of ATC with respect to Space Operations systems in this frequency range. Our analysis indicates that. using conservative assumptions developed by the ITU-R,[337] ATC MET out-of-band emissions above 2025 MHz will be significantly below the interference criteria established for the Space Operations Service.[338] Space Operations Service (and Space Research Service) systems operate above the 2165-2200 MSS downlink frequency allocation as well. In the Forward Band Mode of ATC operation, BSs would transmit in the 2165-2200 MHz MSS downlink frequency allocation. Of the two services, the Space Operations Service has the more stringent interference criteria. This is used in our evaluation of the interference potential from ATC to these adjacent band systems.

122. Our analysis concludes that Space Operations and Space Research systems receiving on the ground in the 2200-2290 MHz band would be protected from ATC out-of-band emissions.[339] A separation distance of 0.82 kilometers is required to protect a space operations downlink facility from the out-of-band emissions of an ATC base station. These receive facilities are typically located on government facilities where BSs would not be co-located and interference to space operations receivers would be in a controlled environment. The interference margin for space research receivers, by our calculations. is actually more than 5 dB and interference from BSs to space research receivers is not expected. Space research antennas generally are large antennas that track the space research satellites and they, too, are typically located on government facilities where BSs operations would be in a controlled environment. For space research receivers that are used by universities and private companies, and are located in urban areas, there are operational characteristics (i.e., the elevation angle from the earth station to the satellite would be greater than 0 degrees) that have not been taken into account in our analysis that would increase the interference margin. Given these factors, in addition to the extra attenuation that BS signals would experience in an urban setting, the interference margin for these types of space research receivers would increase, making the sharing situation more compatible.

123. We then evaluated the potential interference from BS out-of-band emission levels caused to terrestrial fixed and mobile systems operating below the 2165-2200 MHz **MSS** downlink allocation. ATC BSs will operate in the Forward Band Mode under far more constrained out-of-band emission levels than those required of PCS base stations licensed to operate below 2165 MHz.[340] Interference from BSs to mobile systems operating in the adjacent frequency allocations therefore is not an issue. Analog and digital terrestrial fixed service systems continue to operate in and below the MSS allocation?' however,

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[337] *See* Recommendation ITU-R SA.1154, ***Provisions to Prorecr the Spare Research (SR), Spare Operations (SO) and Earth-Exploration Satellite Service (EES) and to Facilaare Sharing with the Mobile Service in the 2025-2110 MHz arid 2200-2290 MHz Bands*. available at** <http:iiwuu.itu.int/rec/recommendation.asp?type=items&lang=e&parent=R-REC-SA.1154-0-199510-I> (last visited, Jan. 10. 2003).

[338] *See infra* App. C1 § *3.1*

[339] *See infra* App. C1 § *3.1*

[340] For reference, the BS out-of-band emission level of -100.6dBW/4kHz we adopt here compares favorably to the – 75 dBW/MHz for a PCS base station operating at maximum power and with a 43+10 log P out-of-hand rrquiremenr.

[341] We note that because MSS licensees are required to relocate terrestrial licensees in the event that an incumbent terrestrial facility causes interference to the MSS earth station receivers within the MSS band, we address the potential for out-of-band interference to terrestrial facilities. not the potential for in-hand interference. *See 2 CHZ* (continued ....)

and we analyze the impact of **ATC** operations on these adjacent band systems. Our analysis indicates that the proposed ICO BSs would meet the long-term and short-term interference criteria to protect analog terrestrial fixed systems in the adjacent frequency band.[342] It further indicates thai because the interference margins calculated for analog systems are so large. more robust digital terrestrial fixed systems will not experience interference from out-of-band **ATC** base-station emissions.[343]

124. Last, we address the potential interference to the Global Positioning System (GPS) from **ATC** BSs and **MTs** operating in the 2 GHz band. GPS operates in a portion of the **1559-1610 MHz** Radionavigation Satellite Service (RNSS) allocation. In the *Flexibility* ***Notice,*** the Commission recognized that the unwanted emissions from terrestrial stations in the MSS will have to be carefully controlled in order to avoid interfering with GPS receivers.[344] The Commission specifically requesied comment on whether limits for base stations similar to those specified in section 25.213(b) for mobile earth terminals (METs) are adequate to protect GPS receivers.[345] NTIA responded to our request for comment along with several other parties.[346] NTIA asserts that there are two issues that must be considered in the request for comment on the protection of GPS: (i) the frequency range(s) over which the emission level would be applicable; and (ii) whether the emission level established for a mobile earth station in an MSS system should be applied to **ATC** BSs and **MTs**.[347] Other parties suppon the application of the **GMPCS** limits to **ATC** BSs and **MTs**.[348]

125. Since the release of the ***Flexibility Norice,*** the Cornmission has adopted the *GMPCS* ***Order*** that requires MSS METs transmitting on frequencies between **1990** MHz and **2025** MHz conform to two restrictions: a wideband limit of -70 dBW/MHz, averaged over 20 milliseconds. on the EIRP density of ihe out-of-band emissions in the **1559-1610 MHz** frequency range and a narrowband limit **of** -80 dBW/700 Hz. also averaged over 20 milliseconds. on emissions in the **1559-1610** MHz frequency range.[349] On NTIA's first point, then, the *GMPCS* ***Order*** expanded the frequency range from that

(Continued from previous page)
*Rules* ***Order,*** 15 FCC Rcd ai 16132, ¶ 78. Our analysis presumes that ATC BSs are **used** only to provide service in areas where direct MSS signal reception otherwise would be available absent attenuation or blockage from natural or man-made structures in that area and that any relocation of incumbent terrestrial facilities necessary to protect direct MSS reception has been completed prior to ATC operations.

[342] ***See*** *infra* App. C1 § ***3.1***

[343] *See infra* App. C1 § 3.2

[344] *Flexibility* ***Norice,*** 16 FCC Rcd at 15559 & 15565. ¶¶ 68 & **63.**

[345] *Id.*

[346] *See. e.g.,* Letter from Fredrick R. Wentland, Acting Associate Administrator. Office of Spectrum Management. National Telecommunications and Information Admintsiration to Donald Abelson, Chief, International Bureau. Federal Communications Commission, IB Docket No. 01-185 at 1 (Nov. 12, 2002) (NTIA Nov. 12.2002 *Ex Parte* Letter).

[347] *Id.* at 2. NTIA also urges the Commission to adopt out-of-band emission levels for the newly allocated L2 (1215-1240 MHz) and L5 (1164-1188 MHz) frequency bands for future GPS operations. Id.

[348] ***See*** Globalstar July 1, 2002 *Ex fane* Letter at 24.

[349] *Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum* ***of*** *Understanding and Arrangements*. Report and Order and Further Notice of Proposed Rulemaking. 17 FCC Rcd 8903. 8936. ¶ 88 (2002) (*GMPCS* ***Order).*** Additionally. in a separate rulemaking proceeding for (continued.. .)

required of section 25.213(b) to protect GPS from MSS MET out-of-band emissions. On NTIA's second point about whether the emission levels established for a mobile earth station in an MSS system should be applied to ATC BSs and MTs, NTIA indicates that the GMPCS emission limits in the 1559-1610 MHz band for METs operating in the 1990-2025 MHz frequency range are based on protection of GPS receivers used on aircraft in a precision approach landing operational scenario and not to protect terrestrial (e.g., land-based) operational scenarios.[350] NTIA is correct that the GMPCS tules that apply to MSS equipment are based on aircraft usage of the GPS system. We recognize that NTIA believes that these rules do not provide adequate protection to terrestrial usage.[351] NTIA also expressed its concern and reluctance to limit the protection of GPS based on the aviation scenario only and believes strongly that protection of terrestrial uses of GPS such as E911-assisted GPS should be addressed.[352]

126. The record before us does not support the adoption out-of-band emission levels more stringent than those required of GMPCS equipment. Nor does it suppon expanding the limits to frequency allocations other than the 1559-1610 MHz band.[353] We require that *2* GHz ATC base stations and mobile terminals meet the already established GMPCS wideband and narrowband out-of-band emission levels to protect GPS operations in the 1559-1610 MHz band. Indeed. ICO provided ATC base station and mobile terminal equipment specifications that demonstrate that it is capable of meeting the GMPCS out-of-band emission attenuation requirements.[354] In light of NTIA's concerns, however, we plan to continue to assess the appropriate interference protection levels for GPS. Moreover. the Office of Engineering and Technology (OET) will issue a public notice shortly soliciting comment to assist in the examination of what changes in the level of protection for GPS, if any. should be established in the future. The public notice will address the out-of-band emission limits that are necessary to protect the three GPS civil signals for various operational scenarios (e.g., terrestrial, aviation, maritime).

### c. Conclusion

127. We adopt certain technical and operational rules to provide for *2* GHz MSS ATC MT and BS operations in the Forward Band Mode of operation to protect in-band, adjacent channel systems within the MSS allocation and systems operating in adjacent frequency allocations. ATC MTs are required to meet an out-of-band attenuation level of 43 + 10 log P dB at the *2* GHz MSS band edge and increasing to 70 + 10 log P at 1995 MHz and 2025 MHz, respectively. ATC BS are required by our rules to meet an out-of-assigned-band emission limit of -100.6 dBW/4kHz and are limited to producing an

(Continued from previous page) establishing rules for MSS in the 2 GHz hands. NTIA tiled comments supporting the -70 dBW/MHz and -80 dBW emission limits in the 1559-1610 MHz hand for MES operating in the 1990-2025 MHz band. *See* Comments of the National Telecommunications and Information Administration, IB Docket No. 99-81, at 9 (filed, June 24. 1999). ***available at*** <http://svartifoss2.fcc.gov/prod/ecfs/retrieve.cgi?native_or_pdf=pdf&id_document=6007946277> (last visited, Dec. 30, 2002).

350 *See* NTIA Nov. 12, 2002 *Ex Pane* Letter. Encl. 2 at 5

351 *GMPCS Order*, 17 FCC Rcd at 8923-25, ¶¶ 49-52. The limits adopted in the *GMPCS Order* are based on an assumed separation distance of approximately 100 feet between an airborne GPS receiver and a single terrestrial transmitter.

352 NTIA Jan. 24. *2003 Ex Pane* Letter at 2-3.

353 *See, e.g.*, NTIA Nov. 12, 2002 *Ex Pone* Letrrr. Encl. 1 at 1 & Encl. 2 at 2 (discussing expanded frequency bands for GPS).

354 *See* ICO Apr 11, 2002 Er *Porte* Letter at 2 (discussing out-of-hand emissions in *2* GHz MSS downlink bind)

EIRP of no more than 25.5 dBW toward the horizon with an overhead gain-suppression requirement. ATC operators must locate their BSs at least 190 meters from any airpon runway or aircraft stand area. including take-off and landing flight paths: a power flux of -51.8 dBW/m² must be maintained at the same airpon areas. ATC BSs and MTs must also meet the out-of-band emission levels required of GMPCS equipment to protect GPS operations in the 1559-1610 MHz RNSS allocation. These rules are sufficient to protect other systems operating in or near the 2 GHz MSS allocations, while providing **2** GHz MSS licensees the operational and technical flexibility, should they choose to implement ATC as pan of their MSS networks.

### 2. L-Band

128. In 1989, the Commission licensed AMSC, now MSV, to construct, launch, and operate a three-satellite **GSO** MSS system in the upper portion of the L-band.'" Recently, the Commission modified MSV's license to operate in the Lower L-Band as **well.**[356] MSV is authorized, consistent with international coordination arrangements. to operate on spectrum throughout the entire L-band not to exceed a total of 20 MHz ***of spectrum.***[357] MSV currently operares one satellite. which was launched in 1995 and is coordinated with the four other non-U.S.-licensed L-band satellite operators in the North America coverage area. Today, MSV offers land, maritime, and aeronautical **MSS,** including voice and data. to the United States and its coastal areas.

129. MSV seeks authority to operate an ATC as pan of its current and next-generation mobile satellite systems in both the upper and lower L-bands.[358] Generally, MSV proposes ATC operations that are integrated with its satellite network. This would, according to MSV, enable co-channel reuse of the satellite service link frequencies in adjacent satellite antenna beams to provide coverage to areas where the satellite signal is attenuated by foliage or terrain and to provide in-building coverage.[359] Customers using lightweight. handheld mobile terminals could communicate through both the satellite and the ATC base stations. The satellite path would be the preferred communications link, but if the user's satellite path is blocked, the communications link would be sustained via the fill-in base stations. When a user travels between the two coverage areas or between base stations, the network control facility would hand off the user among facilities as required to sustain a continuous communications link. For the public interest reasons set fonh above, we establish here the technical service rules for L-band ATC operations. MSV and other L-Band operators authorized to provide services in the **U.S.** may **now** seek to modify their authorizations. consistent with the technical rules adopted here, to operate ATC in conjunction with their space station networks on the frequency assignments authorized and coordinated for MSS.

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[355] ***See*** *MSV License* **4** FCC Rcd **ar** 6048-49, ¶¶ *53-59*. The term "upper 1-Band" denotes the 1545-1559 MHz and 1646.5-1660.5 MHz bands.

[356] *See L Band MSS Rules* ***Order,*** 17 FCC Rcd at 2704, ¶ 1. The term "lower L-Band" denotes the 1525-1530 MHz, 1530-1544 MHz and 1626.5-1645.5 MHz frequency bands.

[357] The Administrations that are parties to the North American MOU include the United States, Canada, Mexico. Russia and the United Kingdom. Unlike most international coordination agreements that create permanent assignments of specific spectrum, the operators' assignments change from year to year based on their marketplace needs. Each of the five operators received less spectrum than it had requested for its system, and in some cases. less specrrum than it had **hcen** authorized to use by its respective administration.

[358] *See. e.g.,* MSV Dec. 16.2002 *Ex Parte* Letter at 1

[359] MSV Mar. 1, 2001 *Ex Parte* Letrer at it.

### a. Intra-Service Sharing – Protection of Adjacent Channel and Adjacent Beam MSS Operations

130. Inmarsat has conducted substantial technical studies in response to MSV's ATC proposed use in the L-band. Inmarsat. in the first instance. is concerned about the potential interference MSV ATC operations could cause to its currently operating, Inmarsat-3 satellite network. Inmarsat is also concerned about the potential impact on its future generation network. Inmarsat-4.

131. Inmarsat argues that the Commission should not allow terrestrial use of the L-band because terrestrial uses would create unacceptable interference to Inmarsat's network and the services it provides, including vital safety services provided in the L-band.[360] Inmarsat claims that the terrestrial services proposed at L-band would create five main interference problems:[361]

(1) The in-band signals of MSV's ATC mobile terminals (MTs) will cause unacceptable interference to the signals king received by the Inmarsat satellites;[362]
(2) The out-of-band emissions from MSV's ATC MTs will cause unacceptable interference to the signals being received by the Inmarsat satellites;[363]
(3) ATC base station (BS) in-band signals will create unacceptable interference into the receivers of nearby Inmarsat mobile earth terminals;[364]
(4) ATC base station out-of-band emissions would create unacceptable interference into the receivers of nearby Inmarsat mobile eanh terminals;[365] and
(5) MSV's ATC operations will degrade the performance of its own space-based services and reduce the traffic-carrying capacity of the MSV space segment, thereby increasing MSV's need for additional L-band spectrum.[366]

We evaluate below MSV's reply[367] to each of Inmarsat's points and conclude that MSV's use of ATC consistent with the operational restrictions adopted herein will be capable of protecting the current and future generation Inmarsat satellite networks from unacceptable interference.

#### (i) Effect of ATC Operations on Inmarsat Satellites

132. Inmarsat and MSV currently share the L-band spectrum with three other GSO MSS systems in North America. The United Kingdom is the licensing administration for the Inmarsat space segment. The Commission has licensed fixed eanh stations (the Land Earth Station or Gateway) and

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[360] Inmarsat Comments at 2.

[361] *Id.* at 12-17.

[362] *Id.*, Technical Annex § 3.1.

[363] *Id.*, Technical Annex § 3.2.

[364] *Id.*, Technical Annex § 3.3.

[365] *Id.* Technical Annex § 3.4.

[366] *Id.*, Technical Annex § 3.5.

[367] *See* MSV Reply. Technical App. at 1-26

authorized METs in the United States to access the lnmarsat system.[368] Canada is the licensing administration for the TMI space stations. The Commission has also authorized MSS mobile earth terminals (METs) in the United States to access the Canadian space stations.[369] We do not wish to create a situation where either of these system would be incapable of serving the United States in accordance with their authorizations. We evaluate the potential for interference that MSV's ATC base stations and MTs would have on the lnmarsat system, in particular. TMI supports the ATC network as proposed by MSV.[370] **NTIA** analyzed the potential for interference to an lnmarsat satellite receiver based upon its use to support the Global Maritime Distress and Safety System (GMDSS) and the Aeronautical Mobile Satellite En-Route Service (AMS(R)S).[371]

133. MSV. TMI and Inmarsat are able to serve **METs** in the United States through the use of geographic and frequency separation. In the geographic regions served by both Inmarsat and MSV. for example, the satellites use different frequencies (*i.e.*, frequency separation). Where the two systems serve different geographic areas of the United States, each of the systems may use the same frequencies (*i.e.*, through geographic separation). In either scenario, the Earth station transmissions of each of the systems are received by the other's space station receiver. The more stations transmitting simultaneously on the Earth (or the greater the power level from a given station or group of stations). the greater the potential for interference to the other's space-station receiver. A space network receives interference from the other system in the form of "noise."[372] The analyses conducted by MSV and lnmarsat evaluate the amount of "noise" that the other system will receive from MSV's use of ATC. lnmarsat and NTIA are concerned that the MSV ATC system may cause interference to its **MSS** system. Based upon the analyses below and supplemented by the L-Band Technical Appendix (Appendix C2) we conclude that the interference potential is not significant and that ATC operations will not preclude Inmarsat from continuing to serve end users in the United States now or in the future. To this end we adopt several technical limitations on L-Band ATC, also discussed more thoroughly. below.

134. The parties to this proceeding have disagreed over the correct value to use for certain of the parameters required to analyze the potential interference from the proposed MSV ATC system to the lnmarsat satellites. By making the assumption that a number of these parameters take on the same value for both systems and analyzing the difference in effect **of** ATC interference between the two systems, it is possible IO qualitatively determine which system will receive the greatest amount of interference. MSV proposes to operate its ATC system in a way that limits interference to its own satellite and we have developed an analysis to determine the magnitude of the corresponding interference that would be received by the Inmarsat satellites.

135. As noted above, both the Inmarsat and MSV systems share the spectrum through either frequency separation (when they operate in the same geographic regions) or through geographic

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368 *See Comsat Authorization*. 16 FCC Rcd at 21702-07, ¶¶ 82-93

369 *See Application of SatCom Systems Inc. arid TMI Communications arid Company. LP*, Order and Authorization. 14 FCC Rcd 20798, 20826-28, ¶¶63-75 (1999).

370 **MSV** Comments ai i

371 *See* **NTIA** Nov. 12, 2002 *Ex Parte* Letter. Encl. 4.

371 By "noise." we refer io any iype of interference that destroys the integrity of signals on a line. *See* Webopedia Noise, *available at* <http://www webopedia com/TERM/n/noise html> (last visited, Jan. E. 2003). Radio waves, electrical wires. lightning and other frequency emitters can creaie noise. *Id.*

separation (when they operate co-frequency). When the MSV and Inmarsat-4 satellites operate on a co-frequency basis. the Inmarsat-4 satellite receives interference power from all of the areas on the ground in which MSV is operating both MSS and ATC on a co-frequency basis. We first identify the most sensitive potential interference situation. Our worst case analysis examines the difference in the ATC MT interference power received by both the MSV satellite and the Inmarsat-4 satellite while assuming that several of the disputed technical parameters are the same for both the MSV and Inmarsat system.[373] The methodology of our analysis is described below.

136. Both the MSV and Inmarsat satellites will have a large number of antenna beams and each beam will be assigned to provide coverage to a specific area on the ground. Both satellites can serve the same geographic area by having the overlapping beams operate on separate frequencies. More than one beam from each satellite can operate on the same frequency, as long as there is sufficient geographic separation (antenna beam discrimination) between co-frequency beams. To assess the interference to an Inmarsat beam operating on frequency F1 from all of the MSV beams operating on the same frequency. F1, we begin with the interference power that MSV's satellite is able to accept as self interference from its own ATC operations. This self interference is quantified as the power level that causes an increase in MSV's satellite receiver noise of 0.25 dB. We note this level of interference power as $P_{0.25}$. MSV has indicated that it will implement its ATC system so that it will have an average of 10 dB (i.e., a factor of 10) antenna discrimination between the MSV satellite receiver and the ATC transmitters operating on the ground near the F1 beam coverage area. The 10 dB power differential means that the actual interference power generated by ATC transmitters near the land area served by the F1 beams can actually be 10 times higher than the power that would increase the MSV receiver noise by 0.25 dB (i.e., $P_{0.25}$). The maximum interference power generated near the ground area served by the F1 beam is then proportional to $P_{0.25}*10$. This value ($P_{0.25}*10$) represents the interference power generated near MSV's beams operating on the same frequency as the relevant Inmarsat receiver.

137. We then determine how many F1 beams the MSV network will have. MSV states that its next generation satellite will have about 200 beams and will use a 7 fold frequency reuse plan. Therefore one can assume that, MSV will operate (200/7 = 28.6) 29 beams[374] each producing $P_{0.25}*10$ interference power and a total interference power on the ground proportional to $P_{0.25}*10*29$. This value is equal to *290* times $P_{0.25}$ or $P_{0.25}*290$. Because Inmarsat and MSV are sharing on a co-frequency, geographic-separation basis, this interference power is generated on the ground in areas not directly covered by the Inmarsat antenna beam in question. The power that enters the Inmarsat FI beam depends upon the antenna discrimination between the Inmarsat antenna beam and the land areas in which the ATC interference power is generated. Calculations. in Appendix C2. Section 1.11, show that Inmarsat has at least 25 dB (a factor of 11300) discrimination towards the land areas in which the interference from ATC is generated. So, the interference power potentially received by the Inmarsat F1 beam is capped at $P_{0.25}*290/300 = P_{0.25}*0.96$, or slightly less than the interference power received by MSV's satellite beams.

138. This qualitative analysis assumes two things: (1) MSV's noise power will increase no more than 0.25 dB and *(2)* certain system parameters will be the same for both the MSV and Inmarsat systems. Both assumptions are reasonable. First with respect to 0.25 dB noise-power cap, Inmarsat correctly notes that it is very difficult to accurately and repeatedly measure the noise increase in a satellite receiver *of* 0.25 dB. These types of measurements. however. are not required. **As** discussed in detail

[373] In a separate calculation, we do take into account the different values for the parameters associated for the different satellites.

[374] This parameter is discussed in more detail in App. C2. Secrion I.13. The value used here is a worst case value

below, limiting the total number of base stations operating on a specific frequency effectively limits the potential interference noise at the MSV satellite to 0.25 dB. Second, with respect to the similarity in system parameters, both the MSV and Inmarsat systems will, in fact. respond similarly in similar situations or Inmarsat would gain benefit with respect to MSV on the following:

- ***Average Power Reduction*** – any reduction in average transmit power of the ATC transmitters whether in power control, vocoder factor and voice activation factor would affect the interference power received at both satellites equally.

- ***Outdoor Blockage*** – we agree with Inmarsat that outdoor blockage will reduce the interference power towards the Inmarsat satellite by about **3** dB, or 50%; however, because the MSV satellite will be, on the average. seen at a higher elevation angle than the Inmarsat satellites, we conclude that outdoor blockage will reduce the interference power more towards the Inmarsat satellites when compared with the interference received at the MSV satellite.[375]

- ***Polarization Isolation*** – both MSV and Inmarsat satellite receivers use the same type of polarization, so any reduction in average transmit power of the ATC transmitters caused by this affect would reduce the interference power received at both satellites equally.

- ***Free Space Loss*** – the average distance between CONUS and the MSV satellites will be slightly less than the average distance between CONUS and the operational Inmarsat satellites, so the propagation loss from the ATC transmitters to the MSV satellite will be slightly less than the propagation loss from the ATC transmitters to the Inmarsat-4 satellite. This differential means that the interference at the MSV satellite would be slightly greater than at the Inmarsat-4 satellite due to this parameter.

- ***Satellite Mainbeam Gain*** – both Inmarsat-4 and the next generation MSV satellite will have the same main beam gain of 41 dBi.

- ***Satellite Receiver Noise Temperature*** – the Inmarsat satellite receiver noise temperature of 600K[376] is higher than that of the MSV satellite receiver of 450K.[377] Therefore, the effect of a given low-level of interference power will be somewhat less noticeable to the Inmarsat-4 receiver than it would be to the MSV receiver.

In summary. this qualitative evaluation of potential interference from MSV's ATC MT's to the Inmarsat-4 satellite. assuming that the parameter values listed above would be **equal** for both the MSV and Inmarsat satellites, removes the areas of dispute over the parameter values estimating the worst case potential interference situation. The results show that one should expect the interference power received by an Inmarsat-4 beam operating co-frequency with MSV's ATC network to be about the same, or less

[375] We use the term "outdoor blockage" to describe the radiofrequency attenuation that occurs when an obstacle interrupts the link-of-sight path between a transmitter and a satellite receiver. "Outdoor blockage" is distinct from "structural attenuation." We use the term "structural attenuation" to mean the signal attenuation caused by transmitting to and from mobile terminals that are located in buildings or other man-made structures that limit the transmission of radiofrequency radiation. *See supra* n.229. We use the two terms to distinguish between these two concepts and to avoid the confusion that might result from using the various terms that commenters employ.

[376] Inmarsat Comments. Technical Annex at Table 3.1-1

[377] MSV Reply. Technical App. at 4

than, the interference power received by **MSV**

139. We now conduct a quantitative assessment of the potential for interference between the two system. This analysis determines the potential for interference to Inmarsat by evaluating the ratio of noise that would be produced by MSV's **MSS** operations (if fully loaded) to noise that would be produced by MSV's future MSS and ATC operations.'" Our calculations first assume that MSV and Inmarsat provide service to the same geographic region but in different sub-frequency bands of the L-Band (i.e., they are sharing the L-band using frequency separation)[379] and. second, that **MSV** and Inmarsat use the same frequency assignments where their satellite footprints do not overlap (i.e., they are sharing through geographic separation).[380] The results of our analysis show that the impact of future **MSV** operations, both ATC and MSS, on current and future Inmarsat satellites will be significantly less than the current sharing situation in the L-band, assuming a fully loaded current system.[381]

140. Our evaluation of potential interference to Inmarsat's networks is based on **MSV's** comparison of the percentage of increased noise that the Inmarsat networks (current and future) would experience from the currently operating **MSV MSS** system to the future generation **MSV** system incorporating ATC operations."' Our analysis assumes that the ATC system is implemented as a **TDMA GSM** system. It also assumes that ATC MTs are limited to an out-of-band emission level of *-67* dBw/4kHz, that the link budget for ATC reserves a minimum of 18 dB for structural attenuation and that the vocoder is used to reduce potential interference.[383]

141. We conclude, based on the results of our analyses in Appendix C2, that the MSV satellite system will produce significantly less interference to other L-Band satellites than **MSV's** current **MSS** system. Furthermore. **MSV's** proposed ATC system will produce only a small portion of the increased noise that the **MSV** satellite will cause to other systems in the L-band. Specifically, for the adjacent band case (frequency separation). **MSV's** use of ATC would contribute to the Inmarsat-4 network (the worst case) less than one quarter of one percent of the noise that **MSV's** currently licensed **MSS** system would produce without ATC.[384] The noise received by Inmarsat-4 from **MSV's** future **MSS** and ATC operations, combined, would still produce less than one quarter of one percent of the noise that **MSV's** currently operating system would produce, assuming 90.000 simultaneously operating **ATC** METs in the future **MSV** system.[385] For the adjacent beam case (geographic separation), **MSV's** use of ATC would

[378] *See* App. C2, Evaluation of L-Band ATC Proposals. Tables 3.1.1.A – 1.1.I.D

[379] ***See** infra* App. C2 at Table 2.1.1.A.

[380] ***See** infra* App. C2 at Table 2.1.1.C. Sharing through geographic separation does not necessarily imply "true" adjacent sharing. The "adjacent beam" with which ATC sharing is feasible must have sufficient beam isolation for sharing with MSV's MSS operation to occur.

[381] *See* App. C2 at Tables 2.1.1.B and 2.1.1.D (summarizing the results of our calculations)

[382] ***See*** MSV Jan. 11, 2002 *Ex Parte* Letter at 22.

[383] *See infra* App. C2 § 1.3.5

[384] *See infra* App. C2 at Table 2.1.1.B. It is emphasized that the percentages of increased noise do not take into account MSV's proposed use of variable rate vocoders. For the assumptions used in our **analyses.** *see infra* App. C2 § 1

[385] *See infra* App C2 at Table 2.1.1.**B.**

contribute to the Inmarsat-4 network (the worst case) about one tenth of one percent **of** the noise that MSV's currently licensed MSS system would produce without ATC.[386] The noise received by Inmarsat-4 from MSV's future MSS and ATC operations, combined. would produce only a little more than three percent of the noise that MSV's currently operating system would produce.[387]

142. In sum. both of our analyses for ATC operations over MSV's next generation satellite network include the effects of out-of-band and adjacent-beam sharing. In general, the Inmarsat satellites appear to have more discrimination to ATC MT operations, either via antenna beam discrimination or out-of-band roll-off,[388] than the MSV satellite. As a result. the noise-floor of Inmarsat's satellite receivers would be significantly less affected by MSV's MTs than MSV's own next-generation satellite receivers. To protect co-frequency and adjacent frequency MSS operations in the L-band from ATC operations. we adopt several rules that are based on the ATC system operating as a TDMA GSM system. Under these rules. the ATC handsets must use a I watt peak EIRP and must implement both a power control of 30 dB in *2* dB steps and a vocoder algorithm that is capable of reducing the time averaged power by 7.4 dB. Specific out-of-band emissions are adopted for the MTs. In addition. the number of base stations permitted to operate on a 200 kHz channel is limited to no more than 1725. An MSS licensee shall also reserve a minimum of 10dB in its link budget for power control within its ATC network, **as** is within the range of standard engineering practice to overcome the effects of structural attenuation. In addition. **MSS** licensees shall not extend the coverage area of any ATC cell beyond the point where an **ATC** MT could operate at the edge of coverage of the ATC cell with a maximum EIRP of -10dBW.

143. We believe we have accurately analyzed the potential for interference from MSV ATC transmitters to Inmarsat; however. we recognize that both Inmarsat and MSV reach somewhat different conclusions on the circumstances under which interference would occur. Recognizing the importance of providing adequate interference protection to Inmarsat, and in particular the safety-related services it provides to ships and aircraft, we will permit MSV to operate only 50% of its permitted base stations per channel (*viz.*, 50% of 1725, or 863 stations) during an initial 18-month, phase-in period.[389] This restriction will be equivalent to imposing an additional **3** dB of protection for Inmarsat during initial deployment. The 18-month phase in period will permit Inmarsat and MSV to study whether any interference has resulted, giving enough time to observe any seasonal variations and to analyze the results of the study. After the 18 month period, MSV may operate all 1725 base stations per channel. While we adopt rules to prevent harmful interference. we do not intend to prohibit L-band MSS operators from agreeing to less restrictive limitations on MSS ATC. We support and encourage private negotiations among interested parties in the band and will consider waiver requests of these rules based on negotiated agreements.

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[386] **See** *infra* App. C2 at Table 2.1.1.D. It is again emphasized that the percentages of increased noise do not **take** into account MSV's proposed use of variable rate vocoders.

[387] *See infra* App. C2 at Table 2.1.I.D.

[388] **We** note that Inmarsat-4 will have approximately 25 dB of antenna discrimination towards the ATC transmitters *compared with* MSV's planned 10 dB average discrimination in the adjacent beam situation. In the adjacent band situation. the ATC transmitter will have at least SO dB out-of-band roll-off to the Inmarsat satellite while the **MSV** system **receives** the transmissions in-band.

[389] We intend the initial IS-month. phase-in period to occur only once. For example. if the phase-in period were **met** durinp the life of MSV's current-generation satellite system. the deployment MSV's next-generalion satellite system uould not restart a new phase-in period.

144. MSV also requests the ability to provide ATC operations in conjunction with its currently operating first-generation MSS network.[390] According to the system characteristics for the first-generation MSV system[391] and the currently operating Inmarsat network.'" the next-generation satellites will be about 12 dB more sensitive to interference than the current satellite systems. Since the first generation satellites are *less* susceptible to interference from ATC operations as proposed than the second-generation satellite systems are, the limitation on the number of ATC base stations (1725) combined with the limitation on the number of ATC base stations (863) during the one-time, 18-month, phase-in period is more than sufficient to protect the current generation satellites that are in operation. Therefore. we will permit ATC operation in conjunction with first-generation satellites so long as the rules in place to protect next-generation satellite systems are met.

145. Furthermore, MSV urges the Commission to minimize the restrictions on its planned ATC network deployment to the extent possible where its operations are not co-channel with another **MSS** system's operations. They argue that such situations require no restrictions and that if the amount of isolation between the co-channel operations with other MSS satellites is greater than that used to develop any restrictions, then those restrictions on co-channel operations should be relaxed accordingly.'" Above, we discuss one such restriction. By limiting the number of base stations carriers permitted to operate on a 200 kHz channel. the noise increase to the MSV satellite is limited to 0.25 dB. We find this restriction is necessary because we are not convinced, based on the record, that MSV can accurately and repeatedly measure this low level of interference at their satellite and we believe that this limitation on MSV's satellite noise increase will provide for MSS ancillary terrestrial service and limit the potential for interference to other co-frequency **MSS** operators.

146. In addition, MSS operations in the L-band are to be conducted according to the frequency arrangement arrived at under the 1996 Mexico City MOU. The MOU is a confidential frequency sharing arrangement that was intended to be revisited annually by the operators until the long-term requirements of all parties are satisfied and a final agreement among the Administrations is reached. At this time. it is unclear which channels will be occupied by which **MSS** operator in the future because the MOU frequency arrangement is not static. Even in a static environment, parties do not always agree on the precise types of operations that constitute co-channel interference. In a dynamic environment, such **as** L-band MSS, we are concerned that determining the co-channel interference that arises from fluctuating and geographically discrete operations might require our continued oversight over many years with no foreseeable end

147. For these reasons. we decline to adopt rules that would relax interference protections to other MSS licensees based on MSV's assumption that the number of co- and adjacent-channel operations in the L-band is limited. To this end. we limit MSV to 1725 base stations carriers on any given 200 kHz channel. We will, however, entertain case-by-case requests by MSV to deploy more base stations than permitted by this rule upon a showing that there would be no increase in co-channel or adjacent channel interference to other MSS providers and that the MSS licensee's satellite service would not be affected

[390] MSV Dec 16.2002 ***Ex Pone*** Letter at I

[391] **MSV** Reply. Technical **App. at** 4

[392] Inmarsat Comments, Technical **Annex** at Table 3.1-1

[393] ***See.*** *e.g.*. Letter from Lon Levin. Vice President, Mobile Satellite Venrures, to Marlene H. Dortch, Secretary. Federal Communications Commission (Jan. 16. 2003) (MSV Jon. 16, 2003 *Ex Parte* Letter).

beyond that permitted in the rules.[394] Any request should also indicate whether or not all affected parties to the 1996 Mexico City MOU agree to the proposed additional terrestrial operations.

### (ii) Effect of ATC Base Stations on Inmarsat MES

148. Inmarsat raised concerns about the potential for interference that MSV's ATC base stations could cause to its MET receivers.[395] This potential for interference may exist in four ways: (1) overload[396] of the Inmarsat land-based MET receiver when it is near an ATC base station; (2) out-of-band interference to the Inmarsat land-based MET receiver from ATC base stations; (3) aggregate interference to an airborne Inmarsat MET receiver from a large number of MSV base stations visible from an aircraft: and (4) overload of an airborne Inmarsat MET receiver from an ATC base station. We evaluate each of these potential interference situations. Our evaluation assumes that the ATC base stations must operate with no more than 19.1 dBW per carrier and no more than 3 carriers per cell. The base station must use a left-hand-circular-polarization (LHCP) antenna with 16 dB of peak gain and an overhead gain suppression of 40 dB outside of the main lobe of the antenna. The EIRP towards the horizon must be limited to 14.1 dBW per carrier and the base station will implement a power control algorithm of 30 dB in 2 dB steps. We examine the potential for interference from MSV's base stations in these four cases and determine it to be minimal.

149. ***Inmarsat MET Receiver Overload.*** Inmarsat claims that if an MSV base station is operating within 100 meters of one of its METs, the MET will receive a signal that is significantly above that which would saturate or overload its MET receiver. Inmarsat assumes in its analysis that MSV will have 25 carriers per ATC cell, that its MET will overload or saturate when exposed to –120 dBW of interfering power (or –90 dBm), that the MSV base station antenna discrimination would be 0 dBi when the MSS terminal is 100 meters from a base-station antenna (i.e., there would be no antenna discrimination), and that the signal attenuation from the base station to the MET would be free-space loss (*i.e.*, no blockage from buildings or other sources is taken into account).[397]

150. In contrast, MSV states that the maximum number of carriers per ATC cell in its design is only 3, that it has tested a representative ensemble of satellite terminals to determine actual, as-built desensitization/overload thresholds that demonstrates the saturation level to be –45 dBm, that. in practice, its base station antennas will typically be on a tower or building and the angle from the base-station antenna main-beam to the MET receiver would lead to a discrimination value of –12.5 dB, and MSV uses the Walfisch-Ikegami (WI) propagation model which predicts 94 dB of loss versus the 76 dB of free space loss assumed by Inmarsat.[398]

151. In our analysis of ATC base stations overloading Inmarsat MET stations. we use three carriers per cell in accordance with MSV ATC design parameters. We also assume a receiver saturation

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[394] *See generally* App. B (adopting 47 C.F.R. § 25.253)

[395] Inmarsat Dec. 6. 2001 *Ex Parte* Letter at 7.

[396] Receiver "overload" or "saturation" occurs when the input total power is sufficient to drive the receiver from its normal, operational linear state, into a non-linear state. The resulting non-linear slate results in the distortion of the desired input signals and. fur severe overload. the inability of the receiver to operate.

[397] Inmarsat Comments. Technical Annex at Section 3.3.I

[398] MSV Reply. Technical App. at § III

value of –60 dBm.[399] The –60 dBm value is considerably more conservative (by 15 dB) than the threshold value of –45 dBm measured by MSV for an Inmarsat mini-M terminal.[400] Assuming a -60 dBm threshold value for receiver overload should be sufficient to take account of Inmarsat's MET receiver susceptibility to overload interference principally because a -50 dBm value is the standard for airborne terminals.[401] Furthermore, we use a value of –12.5 dB as the amount of antenna discrimination between the base station antenna and Inmarsat's MET at 100 meters. Recommendation ITU-R F.1336 indicates that it is possible to have as much as 24 dB of antenna discrimination between an ATC base station antenna and a MET located 100 meters from the base station.[402] We therefore believe that the 12.5 dB value proposed by MSV in its analysis is reasonable io use in ours. Last, we assume a value of 86 dB of attenuation due to path loss in our analysis of overload interference. The 76 dB value proposed by Inmarsat is close to the calculated free-space-loss if the antenna is located on a 50-meter tower 100 meters from the MET. We base our use of 86 dB on a program formulated by the National Institute of Standards and Technology, which compares various propagation models and produces a range of expected loss from 80 to 94 dB due to path loss for this situation.[403]

152. Taking the above factors into account, our analysis indicates that any signal loss between an MSV ATC base station and the Inmarsat MET greater than approximately 86 dB should be sufficient to protect an Inmarsat MET from overload interference in an urban environment.[404] Indeed. all of the propagation models. except free-space, predict an urban environment loss greater than 86 dB at virtually all locations. even most of those within 100 meters of the MSV base station. The actual loss is a strong function of the surrounding environment and the propagation model used. It is possible that in limited situations, panicularly in urban settings, the free-space loss between an Inmarsat terminal and a base station may be less than 86 dB. Nevertheless. all of the urban and city propagation models used predict a loss significantly higher than the free-space model and we do not expect overload interference from ATC base stations to Inmarsat METs in an urban environment to be problematic. We do not anticipate that many ATC base stations will be deployed outside of urban areas and the probability of unacceptable interference to METs outside of urban areas will be low. Although there may be a few instances where an Inmarsat MET receiver will be overloaded by a nearby ATC base station. we provide further proteclion by adopting section 25.253(c)(2), which limits ATC base stations to a maximum EIRP level of 14.1 dBW toward the horizon to protect other MSS system METs from overload interference.[405]

153. Though in these cases. occasional. limited periods of saturation of Inmarsat's terminals operating in these areas could occur, we expect this to occur rarely. This possibility must be considered in light of the already limited usage of L-Band terminals in urban settings due to line-of-sight interruption between the Inmarsat terminals and the satellite due to buildings, trees and other obstructions. As discussed above in this Order, we believe that the use of an ATC system in addition to a MSS system is a

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[399] *See infra* App. C1 § 1.2.4.

[400] *See* MSV Reply, Technical App. at 1?.

[401] *See* Boeing April 8, 2002 *Ex Pane* Lener. Technical Analysis ai 10.

[402] *See infra* App. C2 at Figure 1.8.A.

[403] *See infra* App C2 § 1.6.

[404] *See infra* App C2 § 2.2.1.A.

[405] *See infra* App. B (adopting new rule 47 C F.R § 25.253(e)(2)).

more efficient use of the spectrum than the use of **MSS** systems alone.

154. Certain open areas such as airports and harbors, even within an urban environment, offer large building-free areas where signal propagation from a base station is best characterized as free-space propagation. We have analyzed these areas and we adopt limits to protect airborne and maritime Inmarsat terminals in these locations.[406] Maritime lnmarsat terminals, such as the Inmarsat-B terminal. utilize larger antennas than the typical airborne lnmarsat terminal. The **use** of different antennas means the protection criteria for airports will differ from the protection criteria for harbors. Based upon calculations contained in Table 2.2.1.3.A of the L-Band Technical Appendix C2, the MSV base station should be placed 470 meters from a runway or aircraft stand area. This assumes that two base stations are visible to the aircraft. Additionally, the ATC base station shall produce a power flux density at the edge of the airpon of no more than -73.0 $dBW/m^2$ per 200 kHz. We adopt section 25.253(c)(3) to codify these limits on ATC base station emissions near airports to protect aircraft earth stations. In the case of lnmarsat terminals operating on boats and ships. we find that a separation distance of 1.5 km (0.9 miles) is required for the protection of the Inmarsat-B terminal from an ATC base station if there is a clear view of the water from the base station. We adopt this separation distance in our Rules. Additionally, a pfd of -64.6 $dBW/m^2$ per 200 kHz shall be maintained at the waters edge of any navigable waterway. We, therefore, adopt section 25.253(c)(5) to codify these limits on ATC base station emissions near harbors and navigable waterways to protect maritime lnmarsat terminals[407]

155. ***Our-of-Bund Interference to Inmarsat METs***. lnmarsat also expressed concern about the possibility of out-of-band interference from MSV's **ATC** base stations to its ***MET*** **receivers.**[408] In MSV's analysis, it assumes an out-of-band suppression level of -57.9 dBW/MHz (-118 dBW/Hz) for its base stations based on Ericsson's commitment IO designing MSV's equipment to meet that **value.**[409] MSV assumes, as in the overload case, that there will be 12.5 dB of antenna discrimination between the ATC base station and the Inmarsat MET. It also assumes 8 dB of polarization isolation between the base station antennas and the **MET** antennas used by **Inmarsat.**[410] Alternatively, lnmarsat assumes an out-of-band emission value of –27 dBW/200 kHz (-80 dBW/Hz), no antenna gain discrimination from the ATC base station to the lnmarsat terminal, and 3 dB of polarization isolation.[411]

156. The details of both MSV's and Inmarsat's analyses are compared in Appendix CZ. Table 2.2.1.2.A. The table also contains the assumptions we used in analyzing the impact of out-of-band interference. We use the our-of-band emission attenuation value that **MSV** proposed and which **its** equipment manufacturer is committed to meeting. For the reasons discussed in the receiver overload section, above, we use a –12.5 dB value for antenna discrimination between the ATC base station and the lnmarsat MET and assume a propagation loss between the transmitter and receiver in **an** urban environment of 86 dB of attenuation. Since the two systems will use orthogonal circular polarized antennas. and both antennas are viewed outside of their main beams. we do not assume a large value of

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[406] *See infra* App. C2 § 2.2.1.B

[407] **See** *infra* App. B (adopting **new** rule 47 C.F.R. § 25.253(e)(5)).

[408] Inmarsat *Comments. Technical* ***Annex,*** § 3.4

[409] *See* MSV Jan. 11. 2002 *Ex* ***Pone*** Letter at 26: MSV Comments at **Ex.** E

[410] *See* MSV Jan. 11. 2002 *Ex Parte* Lener ai ***26***

[411] Inmarsat Comments, Technical **Annex.** Table 3 4-1

polarization discrimination.

157. Based on our analysis of out-of-band interference from ATC base stations to Inmarsat MET receivers, and taking all of the above factors into account, we conclude that an Inmarsat MET could experience a noise increase of approximately **3%.** This is in contrast to 600,000% calculated by Inmarsat in its analysis.[412] The Noise to Interference ratio (N/I) that corresponds to **3%** is 15 dB (i.e., the noise produced by the ATC base station in the Inmarsat MET will be 15 dB below the noise floor of the receiver) and the Inmarsat MET receiver performance should not be adversely affected by the **MSV** base station. This situation should not be problematic. As discussed above in this Order, we believe that a more efficient use is made of the spectrum by having both ATC and MSS operations in the urban environment rather then the MSS operations alone. We adopt an ATC Base Station out-of-band emission limit of -57.9 dBW/MHz in section 25.253(b) to protect other MSS system METs from ATC out-of-band interference.[413]

### (iii) Effect of ATC on Airborne Inmarsat Terminals

158. ***Out-of-Band Interference to Airborne Inmarsat METs.*** Inmarsat performed an analysis to assess the possibility of an airborne Inmarsat terminal receiving interference from a large number of MSV ATC base stations at various elevation angles while the aircraft is flying at a worst-case altitude of 302 meters (1000 feet).[414] From an altitude of 302 **m.** a circular area approximately 164 kilometers (100 miles) from edge-to-edge[415] is visible from the aircrafi. Inmarsat's analysis conservatively assumes that there would be 1000 ATC base stations in this visible area and Inmarsat refers to ITU-R Recommendation F.1336[416] as evidence that, at best, an antenna isolation of only approximately 10 dB is available from any one of the ATC base station antennas within that visible area.[417] We compare Inmarsat's analysis with MSV's assessment of the potential for interference to Inmarsat airborne receivers.[418]

159. One important factor in analyzing the potential for interference, however, is the amount of isolation expected to occur between the aircraft terminal and the ATC base stations in the area visible to the aircraft. We developed such a model to determine the amount of isolation that should be expected based on Inmarsat's parameters. Specifically, our model randomly distributes 1000 potentially interfering ATC base station transmitters across the area visible to the aircraft flying at an altitude of 302 meters. It

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412 *Id*

413 *See infra* App. B (adopting new rule **47** C.F.R. § 25.253(c))

414 Inmarsat Comments, Technical Annex, § 3.3.2.

415 An MSV Base station antenna with a height of 30 meters is visible from an aircraft at an altitude of 302 meters at a distance of 81.9 kilometers.

416 ITU-R Recommendation F.1336, *Reference Radiation Patterns of Omnidirectional, Sectoral and Other Antennas in Point-To-Multipoint Systems for Use in Sharing Studies In Tire Frequency Range from 1 GHz to about 70 GHz*, *available at* <http://www.itu.int/itudoc/itu-r/archives/tsg/1998-00/rwp9d/43844.html> (last visited, Jan. 10, 2003).

417 Inmarsat Comments, Technical Annex, § 3.3.2. Inmarsat compares its assumption that **MSV's** ATC base station antennas will have only 10dB of overhead antenna discrimination to the aircraft versus MSV's assumption that a maximum isolation of 40 dB is achievable.

418 MSV Jan. 11, 2002 *Ex Parte* Letter at 22-25; MSV Reply, Technical App. at 22

then calculates the line-of-sight distance from each visible base station to the aircraft, sums the propagation loss between each base station and the aircraft antenna. yielding the aggregate ATC base station signal attenuation level (i.e., isolation factor). Our model calculates an expected isolation of 105.1 dB between an airborne Inmarsat MET and the population of ATC base stations visible to the aircraft.[419] Our interference analysis also uses MSV's out-of-band suppression value of 68 dB in the part of the frequency band used by Inmarsat and it assumes that an average gain of **0** dB from the Inmarsat antenna will be available because the antenna will be mounted on the upper surface of the aircraft.

160. Our results show that there is a potential increase in the Inmarsat receiver noise floor of approximately sixteen percent[420] as opposed to MSV's calculated value of five percent.[421] However, a better criterion to use is the interference-to-noise ratio (I/N) at the receiver. According to our calculations, the worst case I/N is approximately -8 dB, whereas MSV's I/N works out to be -13 dB. In other words. the interference is 8 dB less (or reduced by a factor of 9) than the self-inherent noise of the Inmarsat airborne receiver. This level of added noise would not hinder the operation of the airborne receiver. Moreover. the situation improves dramatically as the aircraft altitude is increased. For example. raising the altitude to 5000 fi increases the I/N ratio to approximately -17 dB. At this point the interference is negligible. To ensure the protection of airborne METs of other **MSS** systems, we adopt section 25.253(e), which requires a maximum overhead gain suppression of 40dB.

161. ***Inmarsat Airborne Receiver** Overload.* Inmarsat also contends that there exists the possibility of an airborne Inmarsat terminal being overloaded by ATC base **stations.**[422] Our analysis of potential saturation of airborne Inmarsat terminals again uses Inmarsat's parameters of 1000 base stations visible to a low-flying aircraft at 302 meters (1000 feet) and that the same isolation factor of 105.1 dB would result. We use the –50 dBm receiver overload threshold for the airborne terminals.[423] Based on these input parameters, we conclude that there exists 10 dB of margin against receiver overload from **ATC** base stations. **As** indicated for the out-of-band case, however. as the altitude of the aircraft is increased the margin against saturation increases significantly. Given the conservative nature of our model (e.g., antenna gain patterns, 1000 base stations in the visible area,[424] the lowest acceptable aircraft altitude, and no account of terrain shielding), overload from ATC base stations is not expected to be an issue for airborne Inmarsat terminals.

**(iv)** Other **Inmarsat** Arguments

162. *Constraint of Future Development **of MSS.*** Inmarsat claims that adopting ATC limits designed to protect only today's spacecraft would preclude more advanced spacecraft from **operating.**[425]

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[419] In comparison, MSV calculates an isolation factor of 101.6 dB. ***See*** MSV Reply, Technical App. at **24.**

[420] ***See*** *infra* App. C2 § 2.2.3.

[421] MSV Reply, Technical App. at 23.

[422] Inmarsat Comments, Technical Annex § 3.3.2

[423] *See infra* App. C2 **at** Table 2.2.3.2.A

[424] In developing this computer model. we assumed maximum of 1000 base stations was assumed. While we realize that the ares visible to an aircraft increases with altitude. we kepr constant the number of base stations ai 1000. This number of base stations uas felt to be conservative.

[425] Inmarsat Nov. 6. 2002 *Ex **Porrc*** Letter. Attach. 1 at 14-15

By more advanced spacecraft. lnmarsat is specifically referring to those having higher antenna gains and higher gain-to-receiver noise temperatures (G/T) ratios. We disagree. The advance in spacecraft technology to which Inmarsat is referring is due to advances in technology that generate high-gain. multiple-beam antenna patterns. There are two situations to consider: (1) in-beadout-of-band and (2) out-of-beadin-band (or co-frequency). In the first situation, isolation between the two systems is provided by the transmitter out-of-band specifications. If two different MSS systems cover the same geographic area with two different generation satellites, the newer generation system with the higher gain antenna will not necessarily suffer a larger degradation in receiver noise floor. Table 2.1.1.A of Section 2.1 of Appendix C2 analyzes this co-beam, adjacent channel case and shows that the MSS terminals of the fully loaded current-generation MSV system will cause a 3.5% increase in noise temperature of each beam of the current generation Inmarsat MSS system that has four beams covering the United States. For the next-generation system with 100 beams covering the United States, the increase in receiver noise is 3.8% or approximately the same. In this case. the next-generation system has a larger number of smaller antenna beams (100 vs. 4) each with appreciably higher gain (41 dBi vs. 27 dBi). While the next generation system has higher gain. which makes each individual MSV MSS terminal result in a higher increase in interference, the area covered by each beam is smaller. Because the beam is smaller, it encompasses fewer MSS terminals and the two effects balance resulting in the approximately same total noise for the current and next generation systems.

163. Table 2.1.1.C of Appendix C2 addresses the second case where the intersystem isolation is created by the spacecraft antenna. The Table indicates that the interference level does, in fact, go up as the antenna gain increases. Two of the current MSV MSS terminals in the side-lobes of the Inmarsat 3 satellite antenna will increase the lnmarsat receiver noise level by 58.6%. Because of the higher satellite antenna gain on the Inmarsat 4 satellite, the same MSS terminals in the side lobes of the Inmarsat 4 satellite. antenna increase the receiver noise by 794%. However. using the next generation MSV MSS terminals, the increase in the receiver noise levels is reduced to 1.8% and 23.9% respectively for Inmarsat-3 and Inmarsat-4. This indicates that. considering only the MSS operations, there will be a limit to the differences in technology between the systems that can share on a co-frequency basis. If one system implements a very sensitive satellite system ahead of another MSS system the new system may be at a disadvantage. With respect to the ATC, we note that in the case of both Inmarsat-3 and Inmarsat-4, the calculated noise floor increase from **ATC** operations is significantly less than from the MSV MSS operations. The issue, therefore, is not that ATC could constrain the future development of the MSS. but that the imbalance between current and future MSS systems that are operating on a co-frequency basis could end up constraining antennas used on the most advanced **MSS** system.

164. ***Appropriate Technical Factors for Calculating ATC Limits in the Uplink Band.*** lnmarsat states that the **ATC** should be limited so that the increase in the lnmarsat receiver noise floor is no more than 1%, and a 20 dB margin 'to allow future spacecraft technology development' should be used in calculating this 1%.[426] We are not aware any national or international requirement to limit the interference to or from any system to an increase in system noise of 1%. Historically. a 6% increase in a system's noise temperature has been used as a coordination trigger for space systems. That is. if the interference power from one space system causes a noise temperature increase of less than 6% in another space system then coordination is not required. However. as lnmarsat has shown the typical increase in noise level of the lnmarsat 3 satellite, resulting from the L-Band MSS Coordination process, Is on the order of 29%. which is much higher[427] than the typical coordination trigger of 6%.[428] lnmarsat also

[426] *Id* at 17.

[427] In a coordination process system operators are not bound by any particular inter-system interference limit

contends that, without prejudicing the L-Band MSS coordination process, the same increase in Inmarsat 4 system's noise temperature can be expected from **MSV's** next generation **MSS** operations.[429] We conclude that as long as the increase in receiver noise from the ATC is significantly less than the increase in noise resulting from the MSS operations. that sharing is feasible. and we disagree with Inmarsat's suggested 1% limit. Inmarsat also suggests that a 20 dB margin be used in determining the increase in noise to an MSS satellite receiver from ATC to allow for future spacecraft technology development. **As** discussed above, we conclude that the MSS operations are the limiting factor in co-frequency sharing between MSS systems and not the ATC operations. Therefore, no specific margin is required.

165. MSV argues that it is possible to use a specific technique for measuring the **ATC** emissions being received at its spacecraft.[430] MSV asserts that it can use its satellites to monitor the level of aggregate interference caused by its terrestrial communications services to its sarellite system. To be assured that its own network will inter-operate with maximum efficiency. MSV indicates that its system will be deployed with built-in monitoring capabilities to assess on a real-time basis the terrestrial signal that is generated by MSV's terrestrial operations.''' Based on inputs from monitoring, closed loop feedback control will be imposed on the terrestrial network such that the aggregate terrestrial signal being measured by MSV's satellites **does** not approach potentially harmful limits. Moreover, MSV indicates that it is prepared to monitor and report the aggregate signal power being received at its satellites from its mobile terminals operating in the terrestrial mode, and limit those operations accordingly to the extent necessary IO protect its own satellite operations and those of **Inmarsat.**[432] This technique would permit measurement of the aggregate terrestrial uplink power at the MSV satellite. MSV slates that the techniques that it can use are proprietary because of possible patentable ideas. But a total increase in noise power at the satellite receiver of *0.25* dB. MSV states. can be measured.

166. Inmarsat opposes the use of "aggregate uplink **PFD** limits" as a way of constraining **L-**band emissions.''' It contends that **it** would be difficult to apportion the PFD among various countries in view of the MSS satellites and among the various systems operating in this band would. for a number of reasons, be difficult to measure.[434] Inmarsat maintains that because MSV's **MSS** satellite operates at a different orbital location than the lnmarsat spacecraft. the level of terrestrial interference that each spacecraft actually receives from MSV's terrestrial terminals will vary.'" Inmarsat also indicated that it would be difficult to monitor and control L-Band terrestrial emissions via aggregate emission limits.

167. We agree with Inmarsat that it would be difficult to monitor and control L-Band emissions on an aggregate basis. We are not convinced that it is possible to accurately and repeatedly

(Continued from previous page)

[428] Inmarsat May 10, *2002 Ex* ***Pone*** Letter **at** 3.

[429] This is also close IO the increase in lnmarsat 4 **noise** temperature, resulting form **MSV's** MSS operalions that we calculated **in** Table **2.1.1.C** (3.5% versus 29%)

[430] MSV Reply. Technical **App.** at 10-11

[431] ***Id.*** at 10

[432] *Id.* at 11

[433] Inmarsat Nov. 6.3002 *Ex Parte* Letter at 18

[434] *Id* at 12

[435] Inmarsat Reply at 17

measure such a **small** increase in the noise floor of a satellite receiver due solely to ATC transmissions. Factors such as equipment inaccuracies, changes in downlink atmospheric losses. the difficulty of separating the ATC emissions from multiple L-Band sources within the MSV system and the effect of having multiple L-Band MSS systems contribute to the impracticality of this technique. It is possible, however. to limit the maximum number of ATC transmitters that can operate at one time from the United States territory and we take this approach. We adopt a limit of **1725** Base Stations that can be deployed to operate on any 200 KHz channel in section 25.253(c) to achieve the same effect.

168. Inmarsat maintains that all co-frequency transmitters within the affected side lobes of its MSS satellites' uplink beams must be constrained, and that this includes any ATC transmitters in the US, Canada, Mexico and Central and South America.[436] ATC transmitters greater than approximately 3 or 3% satellite beam-width, away from an Inmarsat beam will be decoupled from the beam in question by at least 30 dB and will not contribute substantially to co-channel interference in that beam.[437] Additionally. as shown by Inmarsat, beams within approximately 2 to 2 ½ beam-widths of the coastline of the United States. Canada, Mexico, Central America and the Northern part of South America are constrained from lnmarsat co-channel operations because of the MSS operations of other L-Band MSS systems.[438] This potentially leaves a small set of lnmarsat teams that could potentially be affected by ATC co-frequency operations. However, as we have stated. if the interference power generated by the ATC is significantly less than that generated by the co-frequency MSS operations then there should not be an interference issue.

169. ***Appropriate Technical Factors** for Calculating ATC Limits in **the Downlink Band.*** Inmarsat enumerates a number of technical factors it believes should be taken into account in calculating limits for any ATC operation for protection of an Inmarsat receiver from saturation in the downlink band.[439] This subject is treated in detail in the Technical Appendix C2.[440] lnmarsat also addressed what it calls "appropriate"[441] technical factors to protect an lnmarsat MET from unwanted emissions. Again this subject is treated in the Technical Appendix C2. As discussed in detail in the Appendix C2. Section 1, we have considered Inmarsat's assumptions, as well as MSV's and we can not agree with all of Inmarsat's proposed technical factors.

**b.** Inter-service Sharing **– Protection of** Adjacent Service **Systems**

170. Several services are allocated spectrum that is between and adjacent to the 1525-1559 MHz and 1626.5-1660.5 MHz L-band MSS spectrum. Between the frequency bands, the AMS(R)S and aeronautical terrestrial services are allocated spectrum in the upper L-band, and the GMDSS and Search and Rescue Satellite (SARSAT) downlinks operate in ponions of the lower L-band. At the top edge of the uplink MSS band, above 1660 MHz, the Radio Astronomy Service is allocated spectrum within and adjacent to the L-Band spectrum. Below the 1626.5 MHz MSS band edge, Big LEO MSS systems

436 Inmarsat Nov. 6. 2002 *Ex Parte* Lerrer at 11

437 *Id.* at 7.

438 *See* Inmarsat Sepr. 12, 2002 *Ex Parte* Letter at 10

439 Inmarsat Nov. 6.2002 Er *Parte* Letter at I9

440 *See infra* App. C2 § 2.2.1.A

441 Inmarsat Nov 6. 2002 *Ex Parte* Letter at 20.

operate in the MSS allocation from 1610-1626.5 MHz. Several services are allocated spectrum adjacent to the 1525-1559 MHz band as well. Below the 1525 MHz band edge, Mobile Aeronautical Telemetry systems operate in the 1435-1525 MHz allocation. Above the 1559 MHz band edge, the Global Positioning System operates in the 1559-1610 MHz Radionavigation Satellite Service (RNSS) allocation. We assess the potential for L-Band ATC operations to interfere with these services.

### (i) Systems Operating Within the 1525-1559 MHz and 1626.5-1660.5 MHz Bands of the L-Band Spectrum

171. Footnote US308 to the U.S. Table of Allocations provides priority to AMS(R)S systems in the upper L-band.[442] In 1993, NTIA and the Federal Aviation Administration (FAA) proposed a minimum set of capabilities to ensure that METs operating in the band 1545-1559 MHz and 1646.5-1660.5 MHz comply with Footnote US308 and ITU Radio Regulation S5.357A.[443] MSS METs that are authorized to provide MSS in the upper L-band are subject to meeting these conditions. MSV's ATC operations (MT and base stations) must meet the same conditions to protect AMS(R)S to comply with footnote US308. Indeed, MSV demonstrates in its comments that its ATC system will possess inherent features for handling priority communications to comply with the same priority and preemption requirements that its MSS system must comply with according to US308.[444] Specifically. MSV's ATC system will be capable of prohibiting entire populations of mobile terminals from accessing its system to provide spectrum for AMS(R)S.[445] In addition to its priority capabilities, the MSV system will also be capable of preempting active channels automatically and immediately (i.e., in less than one second, the MSV gateway would be able to allocate the preempted resource(s) to the AMS(R)S).[446] Terminals would be preempted from providing MSS and ATC through MSV's ability to simultaneously preempt corresponding satellite and terrestrial resources by the use of a centralized and common control facility for space and ground assets.[447] Based on MSV's representations. we conclude that its ATC system will meet the priority and preemption requirements that it is obligated to meet to comply with Footnote US308. We adopt section 25.253(a)(5) to require that, at time of license application, ATC operators demonstrate how they will comply with the requirements of US308.

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[442] 47 C.F.R § 2.106, n.US308. Footnote US308 to the U.S Table of Frequency Allocations provides as follows: "In the frequency bands 1549.5-1558.5 MHz and 1651-1660 MHz, the Aeronautical-Mobile Satellite (R) requirements that cannot be accommodated in the 1545-1549.5 MHz. 1558-1559 MHz, 1646.5-1651 MHz and 1660-1660.5 MHz bands shall have priority access with real-rime capability for communications in the mobile satellite service. Systems not interoperable with the services shall operate on a secondary basis." The ITU Radio Regulation contains a similar prioriiy-and-preemptive-access requirement. *See* ITU Radio Regulations. S5.357A, *available at* <http://people.itu.int/~meens/Pt2/RR/s5note2.htm> (last visited. Dec. 24, 2002). In addition, we note that in the 1545-1549.5 MHz, 1558-1559 MHz, 1646.5-1651 MHz and 1660-1660.5 MHz bands. MSS is secondary to AMS(R)S and the 1660-1660.5 MHz band is reserved for AMS(R)S with the further condition that mobile earth stations operating in these bands shall not cause harmful interference io stations in the Radio Astronomy Service.

[443] *See* Letter to Cheryl Tritt. Chief. Common Carrier Bureau. Federal Communications Commission. from Richard D. Parlow, Associate Administmior. Office of Spectrum Management. NTIA. and Gerald Markey. Manager, Spectrum Engineering Division, FAA (Jan. 14, 1993).

[444] *See. e.g.*, MSV Comments. Technical App.. Section V.

[445] MSV Comments. Technical App. at 8-9

[446] *Id.*, Technical App at 10.

[447] *Id.*. Technical App. at 11

172. On a related matter. the Aviation Industry Parties jointly oppose the FCC's ATC proposal insofar as it would permit licensing terrestrial base stations to provide land mobile service in the upper L-band MSS/AMS(R)S allocation.[448] Current aviation requirements and new initiatives. the Parties assert, depend upon continued access to interference-free use of the upper L-band MSS allocation with real-time priority and preemptive access to the entire spectrum in the allocation when the need arises. According to the Panies, the proposal by MSV to add a terrestrial land mobile service to the L-band MSS allocation would increase the risk of interference to critical safety communications with aircraft in flight and diminish the unique spectrum available for aviation systems.[449] NTIA analyzes potential interference to the Inmarsat-4 satellite based upon its usage in the AMS(R)S and GMDSS services.[450] NTIA asserts that, based upon MSV's analysis, interference to Inmarsat-4 satellite receivers could be possible.[451] NTIA also expresses concern over possible interference from ATC BSs to Inmarsat METs operating as AMS(R)S receivers.[452] We address the potential for MSV's ATC system to interfere with the Inmarsat system. specifically, and conclude that it is possible to provide ATC in the L-Band without causing unacceptable interference to Inmarsat's current and planned satellite networks. Also, we require MSV's ATC system operators. as mentioned above, to demonstrate how the ATC system is capable of complying with the AMS(R)S priority and preemption requirements that it is obligated to meet under Footnote US308 and under the ITU Radio Regulations.

173. In the *Flexibility Notice*, we noted that. according to Footnote US309, terrestrial stations are permitted to operate in the frequencies allocated to the AMS(R)S.[453] The Aviation Industry Parties and MSV do not take issue with US309 with respect to potential interference that could be caused to stations operating under the footnote allocation. Rather. ICO and MSV contend that the existence of the footnote for aeronautical terrestrial stations in the AMS(R)S supports their claim that it is possible to have a footnote allocation for ATC operations.[454] The incorporation of ATC into the U.S. Table of Allocations

[448] Aviation Industry Comments at 6-10

[449] The Aviation Parties add that their industry will be making increased demands on the Inmarsat system and the upper L-band spectrum for safety communications. that MSV's system is not interoperable with the AMS(R)S system described in the Standards and Recommended Practice5 (SARPS) of the International Civil Aviation Organization (JCAO),and that MSV's system does not provide any significant coverage on over-ocean routes and in remote areas of the world where ground infrastructure is inadequate. *See* Aviation Industry Comments at 6-10; Boeing Reply at 8.

[450] *See* NTIA Nov. 12, 2002 *Ex Parte* Letter at Encl. 4.

[451] Specifically, NTIA calculates that interference would occur if more than 661 MTs transmitted simultaneously on the same frequency as an Inmarsat-4 beam. *See* NTIA Nov. 12, 2002 *Ex Pane* Letter. Encl. 4 at 6. MSV has asserted that 2000 MTs operating on the same basis would not cause harmful interference. *See* MSV Jan. 11,2002 *Ex Pane* Letter at 25.

[452] *See* NTIA Nov. 12, 2002 *Ex Parte* Letter at Encl. 3.

[453] *Fleribilin Notice*, 16 FCC Rcd at 7. ¶ 12 n.27. We note that footnote US309 expressly provides that "[t]ransmissions in the bands 1545.5-1559 MHz from terrestrial aeronautical stations directly to aircraft stations. or between aircraft stations . . . are also authorized when such transmissions are used to extend or supplement the satellite to aircraft links. Transmissions in the band 1646.5-1660.5 MHz from aircraft stations . . . directly to terrestrial aeronautical stations. or between aircraft stations, are also authorized when such transmissions are used to extend or supplement the aircraft-to-satellite links" *See* 47 C.F.R. § 2.106 n.US309.

[454] *See* ICO Comments at 48; MSV Comments at 32 Indeed, there are no terrestrial stations operating in conjunction with AMS(R)S system?currently in operation that could receive interference. *See* AIP Comments at 7

is addressed in Section III.F of this Order.[455]

174. Similar to the priority granted to AMS(R)S in the upper L-Band, footnote US315 to the U.S. Table of Allocations provides priority to the GMDSS in the lower L-band spectrum.[456] Recently, the Commission established rules listing the minimum set of capabilities to ensure that METs operating in the bands 1530-1544 MHz and 1626.5-1645.5 MHz frequency bands comply with Footnote US315 and ITU Radio Regulation S5.353A.[457] MSS METs that are authorized to provide service in the lower L-Band are subject to meeting these conditions.[458] ATC operations (MT and base stations) must meet the same conditions to protect GMDSS to comply with footnote US315. MSV demonstrates in its comments that its ATC system will be capable of prohibiting entire populations of mobile terminals from accessing its system thereby providing priority to GMDSS automatically and immediately (i.e., in less than one second. the MSV gateway would be able to allocate the preempted resource(s) to the GMDSS).[459] Terminals would be preempted from providing **MSS** and ATC through **MSV's** ability to simultaneously preempt corresponding satellite and terrestrial resources by the use of a centralized and common control facility for space and ground assets.[460] NTIA expressed concern that ATC operations could cause interference to GMDSS receivers.[461] Based on MSV's representations, we conclude that its ATC system will meet the priority and preemption requirements that it is obligated to meet to comply with Footnote US315. We adopt section 25.253(a)(5) to require at time of license application, ATC system operators to demonstrate how they will comply with the requirements of US315.[462]

#### (ii) Systems Operating Within the 1626.5-1660.5 MHz Portion of the L-Band Spectrum

175. A portion of the Radioastronomy Service (RAS) allocation in the L-band overlaps with the L-Band MSS allocations from 1660-1660.5 MHz. The ITU has conducted studies and developed a

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[455] *See infra* § III.F

[456] 47 C.F.R. § 2.106, n.US315. Footnote US315 to the U.S. Table of Frequency Allocations provides as follows: "In the frequency hands 1530-1544 MHz and 1626.5-1645.5 MHz. maritime mobile-satellite distress and safety communications, *e.g.*, GMDSS, shall have prioriry access with real-time capability in the mobile-satellite service. Communications of mobile-satellite system stations not participating in the GMDSS shall operate on a secondary basis to disrress and safety communications of stations operating in the GMDSS. Accounr shall be taken of the priority of safety-related communications in the mobile-satellite service." Similar language is contained in the ITU's Radio Regulation 5.353A.

[457] ***See L-Band MSS Rules Order.*** 17 FCC Rcd 2720-2722, ¶¶37-40.

[458] *See* 37 C.F.R. § 25.136(d)

[459] **MSV** Comments, Technical **App.** at 10.

[460] *Id.*, Technical App. § V

[461] *See* NTIA Nov. 12. 2002 *Ex Parte* Lerter. Encl. 3 (addressing potential inierlerence to both AMS(R)S and GMDSS receivers from MSV BS). **For** our analysis of this sharing situation, *see infra* App. C2 § 2.2.2.

[462] See *infra* App. B (adopting new rule 47 C.F.K. § 25.253(a)(5)).

Recommendation on protection requirements for Radioastronomy stations.[463] The RAS sites in the United States are identified in section 25.213(a)(1)(i) and (ii) of the Commission's Rules.[464] ATC operators should take all practicable steps to avoid causing interference to U.S. RAS observations in the 1660-1660.5 MHz band, consistent with Recommendation ITU-R RA.769-I of the International Radio Regulations. Since RAS observatories in the U.S. are located in remote area specifically to avoid receiving interference from radio frequency transmitters operating in and near the RAS spectrum. we anticipate that the potential for ATC METs to interfere with Radioastronomy observations in the 1660-1660.5 MHz band is significantly mitigated.

### (iii) Systems Operating Within the 1525-1559 MHz Band Portion of the L-Band Spectrum

176. Search and Rescue Satellite (SARSAT) downlink operations are conducted in the 1544-1545 MHz band in accordance with Footnote S5.356 of the International Radio Regulations.[465] SARSAT uplink transmissions are located around 406 MHz from Emergency Position Indicator Radio Beacon (EPIRB) transmitters, which are downlinked in the 1544-1545 MHz band to various earth station receivers in located in the United States. The locations of these Earth stations are listed in the Appendix C2, Table 3.3.A. MSV is not authorized to provide MSS service in the 1544-1545 MHz band so the potential for interference is strictly an out-of-band case.[466] We note. however, that some of the SARSAT earth stations listed in Table 3.3.A. are located in or near urban areas where ATC base stations would be located.[467] In its tiling, NTIA calculated the minimum coordination distance between a SARSAT station an ATC BS.[468] Our calculation, although based upon a different type of analysis, substantially agree with the analysis performed by NTIA.[469]

177. In Section 3.3 of Appendix C2, we analyze the potential for interference between transmitting ATC base stations operating in bands adjacent to the receiving SARSAT earth stations. We base our analysis on the MSV ATC base stations being capable of meeting an out-of-band emission level of -57.9 dBW/MHz as in our other interference analyses. We calculate that if an ATC base station is located more than 86 km from the SARSAT receivers, under free-space loss conditions. interference to the SARSAT earth station will not occur.[470] However, by using a rough terrain model, the distance is

[463] *See* ITU-R Recommendation, ITU-R RA.769-1, *Protection Criteria Used for Radioastronomical* Measiirenienrs. available at <http://www.itu.int/rec/recommendation.asp?type=items&lang=e&parent=R-REC-RA.769-1-199510-I> (last visited. Jan. 10.2003).

[464] See 47 C.F.R. §25.213(a)(1)(i)-(ii)

[465] *See* ITU-R, Radio Regulations. n.S5.356, *available* or <http://people.itu.int/~meens/Pt2/RR/s5note2.htm#S5.356> (lost visited Dec. 24, 2002); 47 C.F.R. § 2.106 n.S5.356 (incorporating international rule into domestic table of allocations). S5.356 states that the use of the band 1544-1545 MHz hy the mobile-satellite service (space-![,-Earth) is limited to distress and safety communications.

[466] See *L-Band MSS Rules* Order, 17 FCC Rcd ai 2712. ¶ 19

[467] *See* NTIA Nov. 12, 2002 *Ex* Pone Letter at Encl. 5

[468] *See* NTIA Nov. 12, 2002 *Ex* Pone Letter at Encl. 5

[469] *See infra* App C2 § 3.3

[470] See *infra* App. C2 at Table 3.3.B. This result is based on the worst case scenario of the main-beam coupling between the SARSAT receive antenna and the ATC base station transmitting antenna using free-space loss.