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

In the Matter of	)	
	)	
Wireless Operations in the 3650-3700 MHz Band	)	ET Docket No. 04-151
	)	
Rules for Wireless Broadband Services in the 3650-3700 MHz Band	)	WT Docket No. 05-96
	)	
Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band	)	ET Docket No. 02-380
	)	
Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band	)	ET Docket No. 98-237

REPORT AND ORDER

AND

MEMORANDUM OPINION AND ORDER

Adopted: March 10, 2005 **Released: March 16, 2005**

By the Commission: Chairman Powell, Commissioners Copps and Adelstein issuing separate statements.

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I. INTRODUCTION

1. By this Report and Order (Order), we adopt rules that provide for nationwide, non-exclusive, licensing of terrestrial operations, utilizing technology with a contention-based protocol, in the 3650-3700 MHz band (3650 MHz) band. We also adopt a streamlined licensing mechanism with minimal regulatory entry requirements that will encourage multiple entrants and stimulate the rapid expansion of wireless broadband services -- especially in rural America -- and will also serve as a safeguard to protect incumbent satellite earth stations from harmful interference. We establish licensing, service and technical rules that allow fixed and base-station-enabled mobile terrestrial operations. Finally, we maintain the existing Fixed Satellite Service (FSS) and Fixed Service (FS) allocations and modify the Mobile Service (MS) allocation to delete the restriction against mobile operations in the 3650 MHz band.[1] We also maintain the international/intercontinental operation requirements for FSS earth stations.

2. We affirm our belief that the 3650 MHz band is well-suited to respond to the needs expressed by the growing number of entrepreneurial wireless internet service providers (WISPs), that currently bring broadband services to consumers particularly those living in rural areas of the United States. Today, rural consumers often have fewer choices for broadband services than consumers in more populated areas. The licensing scheme that we adopt for this band will provide an opportunity for the introduction of a variety of new wireless broadband services and technologies, such as WiMax.[2] Furthermore, the actions we take herein for the 3650 MHz band will allow further deployment of

[1] The existing prohibition against aeronautical mobile operation is retained. *See* Table of Frequency Allocations, 47 C.F.R. § 2.106.

[2] The Wireless Microwave Access (WiMAX) Forum promotes the introduction or of new products and services using the IEEE 802.16 standard.

advanced telecommunications services and technologies to all Americans, especially in the rural heartland, thus promoting the objectives of Section 706 of the Telecommunications Act of 1996.[3]

3. In the Memorandum Opinion and Order (MO&O), we address several petitions for reconsideration and a motion for stay that were filed in response to the First Report and Order (*3650 MHz Allocation Order*) in ET Docket No. 98-237. We deny the petitions for reconsideration. We also deny the emergency motion for stay.

II. BACKGROUND

4. Historically, the 3650 MHz band was exclusive Federal Government spectrum allocated on a primary basis for radiolocation services and, later, was also allocated to the non-government radiolocation service on a secondary basis.[4] Subsequently, this band has been subject to a number of regulatory and statutory proceedings that we briefly recount here, and which are more fully described in the most recent Notice of Proposed Rulemaking on the 3650 MHz band preceding this order.[5]

5. In 1984, the Commission added a primary allocation in the 3650 MHz band for non-government FSS (space-to-Earth) operations, but adopted footnote US245 to restrict use of this FSS allocation "to international inter-continental systems . . . subject to case-by-case electromagnetic compatibility analysis."[6] In February 1995, the NTIA identified, pursuant to 1993 budget legislation, the 3650-3700 MHz band for transfer, effective January 1999, to mixed-use status, thus permitting Non-Government operations much more extensive than FSS earth stations.

6. In December 1998, in ET Docket No. 98-237, the Commission released a Notice of Proposed Rulemaking (*3650 MHz Allocation Notice*) proposing to allocate the 3650 MHz band to the non-government fixed service on a primary basis and tentatively concluding not to allocate the band to land mobile service.[7] In a companion Order (*FSS Application Freeze Order*), the Commission stated that it would no longer accept applications in the band for new FSS earth stations, major amendments to

[3] *See* Pub.L. 104-104, Title VII, § 706, Feb. 8, 1996, 110 Stat. 153, reproduced in the notes under 47 U.S.C. § 157 (*Section 706*). Section 706(c)(1) defines "advanced telecommunications capability . . . without regard to any transmission media or technology, as high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data graphics, and video telecommunications using any technology." *See, generally,* Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, CC Docket 98-146, *Second Report*, FCC 00-290, (rel. Aug. 21, 2000) (*Section 706 Second Report*).

[4] Table of Frequency Allocations, 47 C.F.R. § 2.106, footnote US110.

[5] *See*, Unlicensed Operation in the Band 3650-3700 MHz; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band; Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band, ET Docket Nos. 04-151, 02-380 and 98-237, *Notice of Proposed Rulemaking* (*Unlicensed Operation NPRM,* or *NPRM*), 19 FCC Rcd 7545 (2004), at ¶¶ 4 – 17.

[6] Table of Frequency Allocation, 47 C.F.R. § 2.106, footnote US245. *See also* Amendment of Part 2 of the Commission's Rules Regarding Implementation of the Final Acts of the World Administrative Radio Conference, Geneva, 1979, General Docket 80-739, *Second Report and Order*, FCC 83-511, 49 Fed. Reg. 2,357 (Jan. 19, 1984). In this Report and Order, the Commission also allocated the 5850-5925 MHz band to the FSS (Earth-to-space). The 3625-3700 MHz downlink segment and the 5850-5925 MHz uplink band are traditionally known as "extended C-band" (the 3700-4200 MHz downlink band and the 5925-6425 MHz uplink band are known as C- band).

[7] Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band, ET Docket No. 98-237, *Notice of Proposed Rule Making and Order*, 14 FCC Rcd 1295 (1998) (*3560 MHz Allocation Notice* and *FSS Allocation Freeze Order*, respectively).

pending FSS earth stations applications, or applications for major changes in existing FSS earth stations.[8] Subsequently, in May 2000, the Commission modified the freeze by allowing applications for new FSS earth stations and major modifications of existing FSS earth stations in the band if the proposed facilities were located within 10 miles or less of an existing grandfathered FSS site operating in the band.[9]

7. In October 2000, the Commission released a First Report and Order (*3650 MHz Allocation Order*) that allocated the 3650 MHz band to fixed and mobile (base station only) terrestrial services (FS and MS respectively) on a co-primary basis.[10] The *3650 MHz Allocation Order* grandfathered existing FSS earth stations on a primary basis, and established that any additional applications for primary earth stations had to be located within 10 miles of existing grandfathered sites and must be submitted prior to December 1, 2000. Pursuant to this grandfathering provision, additional FSS earth station operations could continue to be established in the future - but only on a secondary basis.[11] In addition, in the *3650 MHz Allocation Order*, the Commission deleted the government radiolocation allocation, but grandfathered the three existing government radiolocation sites that were a condition of the transfer.[12] All of the grandfathered primary sites are listed in Appendix E. Finally, the Commission deleted the unused government aeronautical radionavigation service (ground-based) allocation.[13]

8. Concurrently with adoption of the *3650 MHz Allocation Order*, the Commission adopted the *3650 MHz Service Rules Notice* seeking comment on licensing and service rules for fixed and mobile services.[14] In addition, the Commission sought comment on the feasibility of pairing the 3650 MHz band with the 4940-4990 MHz (4.9 GHz) band for mobile services and whether such a pairing would encourage synergies in the use of both portions of the spectrum.

9. In response to the *3650 MHz Allocation Order*, the Commission received four petitions for

[8] *Id.* at 1306 ¶ 14.

[9] *Memorandum Opinion and Order*, 15 FCC Rcd 9340 (2000) (*FSS Freeze MO&O*).

[10] *See* Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band; The 4.9 GHz Band Transferred from Federal Government Use, *First Report and Order and Second Notice of Proposed Rule Making*, ET Docket No. 98-237, WT Docket No. 00-32, 15 FCC Rcd 20488 (2000) (*3650 MHz Allocation Report & Order* and *3650 MHz Service Rules Notice*, respectively). The Commission's decision not to permit aeronautical mobile operations in the band is also consistent with the international allocation for the band.

[11] In the interim, the Commission has authorized four additional earth stations in the band on a primary basis by waiving the current secondary FSS allocation for new earth stations. New Skies Network, Inc. Request for Permanent Authority to Operate a Fixed Satellite Service Downlink Earth Station in the Extend C Band in the 3625-3700 MHz Band at Bristow, Virginia, Application File No. SES-LIC-20001130-02220 (E000696); Astrolink Request for Modification to its Existing Authority to Conduct Tracking, Telemetry, and Control Operations (TT&C) in the Extend C Band in Brewster, Washington, Application File No. SES-MOD-20011101-02077 (E000727); Lockheed Martin Request for Permanent Authority to Operate a Fixed Satellite Service Downlink Earth Station in the Extend C Band in the 3650-3700 MHz Band at Carpentersville, New Jersey), Application File No. SES-MOD-20001130-02268 (E7541); MCI WorldCom Network Services, Inc. requests for Permanent Authority to Operate a Fixed Satellite Service Downlink Earth Station in the Extend C Band in the 3625-3700 MHz at Yacolt, Washington, application File Nos. SES-MOD-19990820-01536 (KA323) and SES-MOD-19990820-01537 (KA221).

[12] *3650 MHz Allocation Order*, 15 FCC Rcd at 20503 ¶ 34-38. The three sites are St. Inigoes, MD, Pascagoula, MS and Pensacola, FL. *See* 47 C.F.R. § 2.106, US348.

[13] *3650 MHz Allocation Report & Order*, 15 FCC Rcd at 20506 ¶ 39.

[14] *See* n. 10, *supra*.

reconsideration and an emergency motion for stay.[15] These petitions, filed by parties representing FSS interests, challenge the decision to create a primary FS/MS allocation in the band, and to make non-grandfathered FSS earth stations secondary.[16] We address these petitions and the stay motion in the companion MO&O below.

10. In 2002, in the *4.9 GHz Order*, the Commission designated the 4.9 GHz band for exclusive public safety use and, thus, it is no longer available for commercial use.[17] Prior to this Order, the Commission had not taken any further action with respect to adopting licensing and service rules for the fixed and mobile service allocations in the 3650 MHz band.

11. In April 2004, the Commission released the Notice of Proposed Rulemaking (*Unlicensed Operation NPRM,* or *NPRM*) in the instant proceeding and proposed to allow the operation of unlicensed devices in the 3650 MHz band.[18] In the *NPRM*, we tentatively concluded that permitting unlicensed operation in the 3650 MHz band would foster the introduction of new and advanced services to the American public, especially in rural areas, and would result in a more efficient use of spectrum. We proposed to allow unlicensed devices to operate in this band with higher powers (up to 24 Watts EIRP) than typically allowed for Part 15 devices, and proposed requiring the use of smart/cognitive safeguards designed to avoid causing interference to licensed satellite services. We also sought comment on whether to restore a uniform primary allocation for all FSS earth stations in the band, and whether to delete the existing co-primary FS and MS allocations in this band - - - both as means to foster the development of new broadband services by unlicensed use in this spectrum.

12. Finally, the *NPRM* also sought comment on alternative options for providing licensed or a combination of unlicensed and licensed terrestrial services in this band. We asked whether it would be feasible for both FSS and FS licensed operations to share the band while still allowing for the operation of unlicensed devices. For example, one approach described in the *NPRM* would have split the band to allow separate spectrum for unlicensed devices and terrestrial licensed use in different segments, all in conjunction with FSS operations.

III. REPORT AND ORDER

13. In the *NPRM*, we found, among other things, that a growing number of WISPs are providing wireless broadband service in many areas where few alternatives are available. We observed that WISPs have expressed a clear need for additional spectrum for broadband use - - - including backhaul and subscriber connectivity - - - especially in rural areas. In light of the demonstrated need for additional spectrum for wireless broadband delivery, we concluded that the 3650 MHz band (with its grandfathered earth stations located mostly along the coasts[19]) appears to provide a unique opportunity to satisfy this demand. We tentatively concluded that permitting unlicensed devices to operate in the band would be the

[15] Petitions for Reconsideration were filed by: The Extended C-Band Ad Hoc Coalition, Echostar, Inmarsat Ltd., and Lockheed Martin Corp, all on December 18, 2000. The Extended C-Band Ad Hoc Coalition filed its Emergency Motion for Stay Pending Reconsideration on November 28, 2000.

[16] In the *Unlicensed Operation NPRM*, we deferred action on these petitions pending adoption of final rules regarding unlicensed operations in the 3650 MHz band and any resulting changes that might be made to the FSS/FS/MS allocations in this proceeding.

[17] *See* The 4.9 GHz Band Transferred from Federal Government Use, WT Docket No. 00-32, Second Report and Order and Further Notice of Proposed Rule Making (*4.9 GHz Order*), 17 FCC Rcd 3955 (2002).

[18] *See Unlicensed Operation NPRM*.

[19] The FSS earth station operations in the 3650-3700 MHz band are conducted in a receive-only mode. Many of these earth stations, however, also conduct transmit operations with paired frequencies in the 6 GHz FSS bands.

most beneficial approach, but also sought comment on alternative licensed approaches as well.

14. Over 100 parties reflecting a diverse range of opinion submitted responses to the *NPRM*. Broadly speaking, we received substantial confirmation that WISPs require additional spectrum for backhaul, especially in rural areas; and that it needs to be available with low upfront costs, and minimal burdens in order to be viable. However, a number of parties, including WISPs, express concern about the risk that intense use of spectrum by a variety of devices under a traditional unlicensed approach could result in mutual interference, thereby reducing the utility of this band. To address this concern, many WISPs suggest, for example, that we limit unlicensed use of the band to outdoor-only use. Commenters who support the development of community networks argue for low power unlicensed use of the band, with various techniques to encourage cooperative use of the spectrum such as the registration of high power fixed stations and the use of a "listen-before-talk" protocol built into equipment.[20] Many advocates of unlicensed access argue that a "first-in-time, first-in-rights" licensing or registration scheme would deny community networks the flexibility they need to deploy low power networks or high power backhaul stations, depending on the community's needs.[21] On the other hand, various corporate entities and industry trade groups prefer a licensed approach, in large part due to the enhanced quality of service that they argue would result from interference avoidance predictability and certainty under such an approach.[22] Some parties[23] also argue that the band should be made available for the introduction of new services and technologies, such as WiMax.[24] These parties support a range of options, including site-by-site licensing,[25] block licensing in small geographic areas,[26] and assignment by auction.[27] Finally, satellite interests express reservations about the *NPRM's* proposal to allow unlicensed operations due to their concern over interference protection issues.[28]

[20] *See, e.g., ex parte* comments of Media Access Project, filed Jan. 31, 2005, and Champaign-Urbana Community Wireless Network/Southern California Tribal Digital Village (joint comments), filed Feb. 1, 2005.

[21] *Id.*

[22] API recommends that the Commission adopt an exclusive (rather than shared) use approach, pursuant to which applications for use of the spectrum would be subject to prior frequency coordination, and licensees would be protected against interference from other later-in-time licensees.

[23] *See, e.g.,* Intel comments.

[24] WiMAX technology, which is based on the IEEE 802.16 standard, would enable the wireless transmission of large amounts of information over long distances, including non-line of sight operations using a variety of bandwidths, that could enable a complete wireless solution for delivering high speed Internet access for businesses and residences. WiMAX could be used, for example, to backhaul information from WiFi "hot spots," which rely on the IEEE 802.11 standard, or enable the development of metropolitan area networks that provide last mile broadband access in competition with cable, DSL and T1 services. The standards process is ongoing with additional protocols under consideration that could provide the opportunity for WiMAX products to operate in this band.

[25] API and Comsearch favor this approach.

[26] For example, Motorola argues that the potential exists to utilize the band for wide-area mobile broadband services using some form of TDD technology and that consideration of unlicensed operations should be deferred until all licensed options are explored. Motorola recommends a licensing approach that includes block licensing in small geographic areas, and providing for secondary markets leasing, with exclusive use preferred over a 'commons model.'

[27] Some parties indicate that the approach to licensing should allow for aggregation via combinatorial auction and permit block sizing (e.g., two blocks of 20 megahertz and 30 megahertz per area). API believes that a Band Manager approach could be utilized to the extent that the Commission considers it appropriate or advisable to assign some or all of any licensed allocation in the 3650 MHz band on a geographic area basis by competitive bidding.

[28] SIA, in particular, raises concerns that a traditional Part 15 unlicensed regime under the technical criteria proposed in the *NPRM* would not provide sufficient protection from interference to its grandfathered earth stations.

15. The record clearly supports use of the 3650 MHz band for a variety of FS and MS operations. We conclude that it would serve the public interest to maintain primary FS and MS allocations and a secondary FSS allocation in the band and to devise a regulatory scheme that provides flexibility for a variety of new terrestrial uses. Further, the public interest is best served by establishing minimal regulatory barriers to encourage multiple entrants in the 3650 MHz band and to stimulate the rapid expansion of broadband services - - - especially in America's rural heartland. At the same time, we must ensure that incumbent grandfathered satellite earth stations and Federal Government radiolocation stations in this band are protected from harmful interference.

16. To accomplish these objectives, we conclude that new terrestrial operations in the band should be licensed on a nationwide, non-exclusive basis, with all licensees registering their fixed and base stations in a common data base. This streamlined licensing and registration process will provide additional spectrum to WISPs and other potential users suitable for backhaul and other broadband purposes such as community networks - - - at low entry costs and with minimal regulatory delay. While terrestrial licensees in this band will not have interference protection rights of primary, exclusive use licensees, the licensing scheme imposes on all licensees the mutual obligation to cooperate and avoid harmful interference to one another. To ensure efficient and cooperative shared use of the spectrum, we further require all terrestrial operations in the 3650 MHz band to use technology that includes a contention-based protocol. Such systems allow multiple users to share the same spectrum by defining the events that must occur when two or more devices attempt to simultaneously access the same channel and establishing rules by which each device is provided a reasonable opportunity to operate. Under this approach, terrestrial operations can operate in geographic areas of their own choosing and, because a contention-based protocol will control access to spectrum, terrestrial operations will avoid interference that could result from co-frequency operations. Interference caused by radiofrequency (RF) energy from a fixed or base station transmitter into a nearby fixed or base station received will be addressed by the process we adopt to register fixed and base stations so that they can operate at locations and with technical parameters that will minimize the potential for interference between stations. By requiring use of contention-based technologies, we conclude that we do not have to limit terrestrial operations to outdoor-only or adopt other limiting measures to address possible contention among these new operations. As discussed more fully below, we also conclude that a contention-based protocol will allow the band to be used for a variety of base-station-enabled mobile terrestrial operations, thus providing additional flexibility in the use of the band as many commenters requested.

17. Licensing and registration of terrestrial fixed and base stations will also enable them to be easily identified and located to ensure the protection of incumbent FSS earth stations and Federal Government radiolocation stations. Under the approach we adopt here, new terrestrial operations will have to protect satellite earth station receive-mode operations and Federal Government radiolocation stations in the 3650 MHz band in substantial areas of the country. To simplify this process, we are establishing protection zones around the grandfathered FSS earth stations, similar to the protection areas already designated around the grandfathered radiolocation stations. New terrestrial operations are to avoid operating within these zones, but we will allow new terrestrial operations to negotiate agreements with earth station operators for operations within these protection zones.[29] The technical requirements we place on fixed and mobile operations, along with our licensing/registration regime, should allow as much flexibility as technically possible at this point, and both prevent interference to the protected earth stations and facilitate the quick resolution of any interference issues that may arise.

[29] Our rules already allow operations within the 80 km zone around grandfathered radiolocation stations provided the stations are coordinated through the Commission-NTIA process. *See* 47 C.F.R. § 2.106, US348.

18. In short, the actions we take in this Order for the 3650 MHz band should facilitate the rapid deployment of advanced telecommunications services and technologies to all Americans, thus promoting the objectives of Section 706 of the Telecommunications Act of 1996.[30] We also believe that the 3650 MHz band provides an ideal setting to build on the current successes of WISPs in providing broadband service to users not otherwise served, and to respond to calls by the Federal Advisory Committee on Diversity for Communications in the Digital Age to increase the opportunity for new entrants, including minorities, in emerging technology sectors of the communications industry.[31]

A. Allocation Issues

19. *Background.* In the *NPRM*, we proposed, in conjunction with our proposal to allow unlicensed operations in the 3650 MHz band, to delete the FS and MS (base station only) allocations. We also sought comment on whether we should retain the FS and MS allocations for licensed operations, and whether we should remove the "base station only" limitation for the MS allocation. Further, we sought comment on whether we should segment the band between licensed and unlicensed use and whether we should pair band segments. Regarding the FSS allocation, we sought comment on whether we should modify the FSS allocation to allow new facilities on a co-primary basis, regardless of whether we decided to allow unlicensed or licensed use of the band. Nonetheless, we also proposed to retain the application of footnote US245 to the Table of Frequency Allocations, which restricts FSS use of the band to international intercontinental operations. We further sought comment on whether we should recast footnote US 245 as a new footnote for the 3650 MHz band (*e.g.*, as footnote NGxxx), without the requirement for case-by-case electromagnetic compatibility analysis.[32]

20. As we noted above, a significant number of WISPs favor use of the 3650 MHz band on an unlicensed basis. IEEE 802 believes that unlicensed use of the band would benefit by deleting the FS and MS allocations, limiting operations to fixed point-to-point, and retaining footnote US 245. The Coalition of C-Band Constituents asserts that only operations from fixed or stationary locations should be allowed to facilitate sharing with FSS earth stations. On the other hand, Intel and Motorola favor use of this band by wide area mobile or portable devices such as low cost, client devices (*e.g.,* mobile computers). API favors a site-by-site licensing approach for fixed and mobile services would have the advantage of

[30] *See* Pub.L. 104-104, Title VII, § 706, Feb. 8, 1996, 110 Stat. 153, reproduced in the notes under 47 U.S.C. § 157 (*Section 706*). Section 706(c)(1) defines "advanced telecommunications capability . . . without regard to any transmission media or technology, as high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data graphics, and video telecommunications using any technology." *See, generally,* Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, CC Docket 98-146, *Second Report*, FCC 00-290, (rel. Aug. 21, 2000) (*Section 706 Second Report*).

[31] *See New Technologies Subcommittee Recommendations to the Federal Advisory Committee on Diversity for Communications in the Digital Age* (June 10, 2004). The Advisory Committee has recommended that the Commission increase the amount of spectrum that is set aside for unlicensed use (*e.g.*, adopt the proposals for unlicensed use in the 3650-3700 MHz band) and increase the power levels for unlicensed operations as a means to increase the opportunity for new entrants, including minorities, to develop communications services and products without having to secure a spectrum license. Although we are not increasing the amount of unlicensed spectrum in this Order as recommended by the Advisory Committee, we believe that our actions herein are consistent with the spirit of those recommendations. For example, the streamlined, non-exclusive licensing approach we adopt makes this spectrum available at low entry costs and with minimal regulatory delay. Furthermore, the approach adopted herein provides for higher operating powers and interference protection for such operations.

[32] We note that the electromagnetic compatibility analysis was required in this band for the purpose of sharing with the Federal Government radiolocation service, which, for the 3650 MHz band, is now covered by footnotes US348 and US349.

"allow[ing] access to the spectrum and entry into the market at a relatively low upfront cost." Finally, SIA supports allowing new FSS earth stations in the band on a co-primary basis and deleting footnote US245.

21. *Decision*. We maintain the existing FSS and FS allocations in the 3650 MHz band and modify the MS allocation to remove the "base station only" restriction. These allocations will ensure that the potential widespread use of the band by new terrestrial operations will not be impeded by the introduction of new co-primary FSS earth stations.[33] We also conclude that our decision to use nationwide, non-exclusive licensing for new terrestrial facilities will be easier to administer if we maintain the FSS allocation whereby new earth stations will have secondary status.[34] Further, the record supports deleting the "base station only" restriction for the MS allocation, and we discuss in detail below the types of mobile applications that will be permitted in this band.

22. As proposed in the *NPRM*, we retain the international/intercontinental operating requirement on FSS earth stations by deleting the reference in the Table of Allocations to footnote US 245 in the 3650 MHz band, and recasting it as a new 'NG' footnote specifically for the 3650 MHz band. As we noted in the *NPRM*, we conclude that deletion of this restriction could result in more extensive FSS use and further curtail the use of this band by terrestrial operations. Finally, by providing for streamlined licensing of terrestrial operations under the existing allocations in the 3650 MHz band, we resolve the questions posed in the *NPRM* regarding segmentation of the band. Among other benefits, the licensing approach we are adopting avoids splitting the band between licensed and unlicensed terrestrial operations, thus making the full 50-megahertz of spectrum in the 3650-3700 MHz band more attractive to potential service providers.

B. Licensing Provisions

23. *Background*. In the *Unlicensed NPRM*, the Commission sought comment on whether the spectrum should be licensed using geographical area licensing or site-by-site licensing.[35] With regard to geographic area licensing, the Commission sought comment on what size licensing areas should be employed and whether the spectrum should be divided into spectrum blocks.[36] The Commission specifically sought comment on whether the entire band, or the part to be licensed, should be licensed as one block of spectrum on a nationwide basis.[37] The Commission also sought to develop a record on the advantages of licensing this spectrum using site-by-site licensing.[38] The Commission noted that one advantage to this approach might be that it allows access to spectrum with relatively low upfront costs.[39]

[33] In the *NPRM*, we also proposed to revise Section 15.250(a) by removing the restriction against unlicensed operations in the 3650-3700 MHz band. *See NPRM* at ¶ 58. In view of the streamlined licensing approach adopted herein for terrestrial operations, we maintain the restriction. Consequently, unlicensed devices will continue to be limited to spurious emissions only in this band.

[34] Prior coordination between co-primary services would be difficult to administer when all of the terrestrial stations would be of equal status regardless of when they begin operation.

[35] *See Unlicensed NPRM*, 19 FCC Rcd at 7569-7574 (¶¶ 76-96).

[36] *Id*. at 7571 (¶ 86).

[37] *Id.* at 7571-7572 (¶ 87).

[38] *Id*. at 7571-7572, 7574 (¶¶ 87, 94-95).

[39] *Id*. at 7574 (¶ 94).

24. In response, we received a number of comments proposing that access to the 3650 MHz band for wireless broadband services should be on a licensed basis.[40] Some commenters suggest that we should use small geographic licensing areas while others request nationwide licensing.[41] In addition, some commenters favor site-by-site licensing.[42] For instance, API states that site-by-site licensing allows "entities to license precisely the amount of spectrum that they need to cover their specific geographic areas of operations."[43] Some commenters who support an unlicensed approach object to a "first-in-time, first-in-rights" licensing approach, particularly for high power stations,[44] and some commenters suggest that the location and technical parameters of operation for unlicensed devices should be entered into a database readily accessible to all other users of the band as a way to identify potential sources of interference.[45]

25. *Discussion*. We conclude that allowing wireless providers access to the entire 3650 MHz band through a non-exclusive, nationwide licensing scheme that includes the registration of fixed and base stations, serves the public interest best. We base this conclusion on comments in the record which supported non-exclusive access to the band by multiple parties as well as on certain characteristics of this spectrum, including the need to protect grandfathered FSS earth station operations against harmful interference (which precludes ubiquitous use of this spectrum for other purposes throughout the United States, particularly in major population centers along much of the east and west coasts), the fact that this band offers no obvious pairing opportunities with other spectrum bands for duplex operations, and the comments in the record showing that this band is well suited for high power broadband operations using contention-based technologies, which allow multiple users to share spectrum in the same geographic area without interference.[46] We believe that this licensing approach will enable us to best provide for the introduction of a variety of new broadband services and technologies in the band.

26. The non-exclusive licensing approach we adopt here incorporates many of the characteristics of the shared use licensing method that we outlined in the *NPRM*. As we noted in the *Unlicensed NPRM*, one way to allow access to the 3650 MHz band for wireless services and operations is to use an approach similar to the licensing scheme used for the shared private land mobile radio (PLMR) frequencies.[47] Under this approach, multiple licensees operate on the same frequencies in the same geographic areas without having exclusive spectrum usage rights and interference protections. Our experience in the shared PLMR frequencies shows that non-exclusive use of frequencies can work well in some circumstances from an interference management perspective. Shared use in PLMR frequencies also allows for effective and efficient use of the spectrum and enables providers with limited resources access to spectrum for nominal application and licensing fees. We believe that adoption of a similar licensing scheme would be most appropriate for the 3650 MHz band.

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[40] *See, e.g.*, API Comments at 4; ITA Comments at 1; Intel Comments at 1; Motorola Comments at 3; Navini Comments at 3; SIA Reply Comments at 4.

[41] *See, e.g.*, Intel Comments at 2; Motorola Comments at 6.

[42] *See, e.g.*, API Comments at 7; Comsearch Comments at 13; SIA Reply Comments at 4.

[43] API Comments at 6.

[44] *See, e.g., ex parte* comments of Media Access Project, filed March 1, 2005; M.R. Rantanen, Tribal Digital Village/SCTCA, filed March 2, 2005; D.K. Irmiger, Trinity Health, filed March 2, 2005.

[45] *See, e.g., ex parte* comments of Media Access Project, filed Jan. 31, 2005; Coalition of C-Band Constituents Comments at 3; Comsearch Comments at 7.

[46] *See* ¶¶ 16-20, *supra*.

[47] *Unlicensed NPRM*, 19 FCC Rcd at 7574 (¶ 95).

27. We believe that a non-exclusive nationwide licensing scheme, coupled with a fixed and base station registration requirement, will ensure open access to this spectrum for nominal application fees and allow effective and efficient use of this spectrum in response to market forces. This will allow opportunities for rapid deployment of broadband technologies and will advance our goal of bringing broadband services to all Americans including consumers living in less densely populated rural and suburban areas. As the record indicates, we believe that the use of contention-based technologies will allow efficient use of this spectrum by multiple users without significant degradation of service. Thus, it is appropriate and in the public interest to have a licensing scheme that facilitates the sharing of this spectrum among multiple users. Such an approach will also allow licensees in this spectrum maximum flexibility to evolve their systems to meet uncertain future needs and requirements.

28. We wish to emphasize that the licensing requirements that we are adopting here for wireless operations in the 3650 MHz band are minimal in nature. The record in this proceeding indicates that service providers who typically operate on an unlicensed basis under our Part 15 rules are interested in using this spectrum for the development of wireless broadband services particularly in underserved and rural communities. We applaud these efforts and wish to encourage them. With this end in mind, and as discussed in further detail below, we are not imposing any eligibility restrictions other than the foreign ownership restriction imposed by statute. We also are not imposing any in-band or out-of-band spectrum aggregation limits. In short, this band will be open to all potential wireless service providers, including those with limited resources.

29. While the licensing and registration requirements we are adopting for wireless broadband operations in the 3650 MHz band are minimal in nature, it does provide benefits to licensees and the public. These requirements will ensure that all terrestrial wireless systems operating in the 3650 MHz band are identified, which will facilitate cooperation among users and ensure that the Commission can monitor the development and usage of this spectrum. While terrestrial licensees in this band will not have interference protection rights of primary, exclusive use licensees, the licensing scheme imposes on all licensees the mutual obligation to cooperate and avoid harmful interference to one another. [48] Should a licensee become aware of harmful interference, even if not intentionally caused, it must act in good faith to help eliminate the interference.[49] In addition, our licensing approach will protect grandfathered FSS earth station and Federal Government operations that will continue to operate in the band on a primary basis. In addition, under the licensing scheme we adopt today, two principal concerns identified by commenters -- the need for high power operations and the need to identify users operating in this band -- will be met.[50] Further, the licensing scheme we adopt will allow the Commission the opportunity to obtain contact information, should the need arise. We believe that site registration will facilitate voluntary interference avoidance and mitigation efforts among users and enable both the Commission and the public to monitor the intensity of spectrum usage in the band.

30. We recognize that some commenters have advocated exclusive licensing for the 3650 MHz band.[51] These commenters contend that exclusive licensing and interference protection are necessary to provide spectrum users with sufficient incentive to invest in the development of the band. However, we believe that on balance, the non-exclusive licensing approach adopted in this order, combined with

[48] The statute also prohibits willful or malicious interference, *see* 47 U.C.S. § 333, thus subjecting any party intentionally causing harmful interference to enforcement action.

[49] Interference avoidance also will be facilitated by the requirement that fixed and mobile stations employ a contention based protocol, as we discuss below.

[50] *See e.g.,* NYC Wireless Comments at 14; Tribal Digital Village Comments at 1; Coalition Comments at 1.

[51] *See, e.g.,* Intel comments at 1-2; Motorola comments at 2-3.

technical safeguards, is more suitable to the unique characteristics of this band.[52] Although a non-exclusive approach may require voluntary coordination efforts to avoid in-band terrestrial interference, the licensing regime we adopt herein obligates licensees to cooperate to avoid harmful interference, and makes the information necessary to conduct such coordination available via a site registration database. While commenters have also raised contention as an issue, the record indicates that this band is well-suited for high power broadband operations using contention-based technologies that facilitate sharing, and that provided entry barriers are low, parties are prepared to use these technologies to operate in the band on a non-exclusive basis. We believe that our licensing scheme and technical rules adopted herein will result in investments in this band. In addition, because of the limitations on the use of this band in coastal areas near FSS earth stations, and because of the lack of obvious pairing opportunities with other spectrum bands for duplex operations, much of the interest in development of the band is focused on smaller markets and less densely populated areas of the US where there is less likelihood of congestion and interference. Even in those larger markets that will be open for terrestrial use, we believe that licensees in the band will have the incentive to develop spectrum sharing practices based on the use of contention-based technologies that will promote efficient use of the band. In short, we believe that our decision strikes the best balance for all the competing interests in a manner that best serves the public interest.[53]

1. Nationwide Non-Exclusive Licensing

31. Each terrestrial licensee in the 3650 MHz band will have a non-exclusive nationwide license and be required to register its fixed and base stations.[54] The licensee will be allowed to register all of its fixed and base stations under one license. A non-exclusive nationwide wireless license does not authorize operation of a fixed or base station in this band until that station is registered. Each wireless licensee will be authorized to operate on all 50 megahertz of the 3650 MHz band on a co-primary basis with other wireless licensees, and there will be no spectrum aggregation limits. As a result, wireless licensee in the 3650 MHz band will be able to use as much of this spectrum as needed for their operations as long as they comply with all applicable licensing, service, and operating rules.[55] All wireless licensees in the 3650 MHz band will have equal rights to the use of this spectrum (*i.e.*, no priority for first-in users), but all these licensees will have a mutual obligation to cooperate and avoid harmful interference to each another.

32. Applicant qualification for non-exclusive nationwide wireless licenses in the 3650 MHz band will be assessed in accordance with FCC Form 601 and Commission rules.[56] There will be no limit to the

[52] We note that other bands, such as the 2500-2690 MHz band, are available for the development of new broadband services under an exclusive rights licensing regime. *See* Amendment of Parts 1, 21, 73, 74 and 101 of the Commission's Rules to Facilitate the Provision of Fixed and Mobile Broadband Access, Educational and Other Advanced Services in the 2150-2162 and 2500-2690 MHz Bands, WT Docket No. 03-66, *Report and Order and Further Notice of Proposed Rulemaking*, 19 FCC Rcd 14165 (2004).

[53] *See also* discussion in para. 45, *infra.*

[54] As we discuss below, mobile and portable stations that operate with a peak EIRP of 1 Watt/25 megahertz and receive and decode an enabling signal from a base station are not required to be registered. Consistent with that approach, mobile stations used in a fixed mode need not be registered as fixed stations so long as they meet the same requirements as mobile stations because the power limitation and operation within close proximity of a registered station will be adequate to protect grandfathered stations from interference.

[55] This is similar to the approach we took in the 4.9 GHz proceeding, where licensees are authorized to operate on any spectrum within the fifty megahertz band, but must follow a spectrum utilization plan. *See* In the Matter of the 4.9 GHz Band Transferred from Federal Government Use, *Memorandum Opinion and Order and Third Report and Order*, WT Docket No. 00-32, 18 FCC Rcd 9152, 9167-69 (2003) (*4.9 GHz Third R&O)*.

[56] 47 C.F.R. §§ 1.913-1.917. FCC Form 601 - *Application for Authorization in the Wireless Radio Service*.

number of non-exclusive nationwide wireless licenses that may be granted for this spectrum, and these licenses will serve as a prerequisite for registering individual fixed or base stations. We note that registration process is simple and streamlined.[57] It will be done electronically.[58] The initial filing date for these wireless licenses, along with directions on how to use the Universal Licensing System (ULS), will be announced in a future Wireless Telecommunications Bureau (WTB) Public Notice. We note that in order to keep the ULS licensing and registration data base accurate and up-to-date, we delegate to the WTB the authority to adopt rules regarding the reporting of data base information including reporting of any license or station transfers. The WTB will issue a Public Notice seeking comment on these issues, if needed.

2. Other Licensing Provisions

33. The *3650 MHz Service Rules NPRM* sought comment on licensing, operating and service rules related to wireless operations in the 3650 MHz band.[59] In our subsequent *Unlicensed NPRM*, we sought to refresh the record on these issues.[60] Below we address these issues in terms of how they relate to the non-exclusive nationwide licensing scheme with fixed and base station registration provisions that we have adopted for this spectrum.

34. *Rule Part and Regulatory Status*. The *3650 MHz Service Rules NPRM* sought comment on the rule part that should be utilized to govern wireless operations and services in the 3650 MHz band and noted that wireless broadband service licensees in the 3650 MHz band could be subject to other rule parts depending on the types of operations and services that they offered.[61] The Commission stated that it would be necessary to modify whatever rule part was chosen to reflect the particular characteristics and circumstances of this spectrum and the services that could be offered in this spectrum. This observation was supported by commenters.[62] The *3650 MHz Service Rules NPRM* also sought comment on how the Commission should fulfill its enforcement obligations and ensure compliance with the requirements of the Communications Act.[63]

35. Upon consideration of the record and given the non-exclusive nationwide nature of the licenses we are creating in the 3650 MHz band, we will place the licensing, service, and operation provisions for this spectrum in Part 90 of our rules.[64] This rule part contains licensing, service and operating provisions for the PLMR services, including services that operate on certain frequencies on a

[57] Applicants will be required to provide information necessary for identification and location of fixed and base stations (*e.g.*, latitude and longitude) and technical information on the station's operation to facilitate interference analysis (*e.g.*, bandwidth, frequency and antenna characteristics).

[58] Pursuant to Section 1.913(d) of the Commissions Rules certain categories of applicants are permitted to file their license applications manually. We urge, however, all applicants to file electronically using ULS because "[l]icensees who continue to file applications manually risk dismissal of their applications for routine errors." *See* Wireless Telecommunications Bureau Revises and Begins Phased Implementation of its Unified Policy for Reviewing License Applications and Pleadings, *Public Notice*, 14 FCC Rcd 11182, 11186 (WTB 1999).

[59] *See 3650 MHz Service Rules NPRM*, 15 FCC Rcd at 20505-20539 (¶¶ 40-133).

[60] *See Unlicensed NPRM*, 19 FCC Rcd at 7571,7574 (¶¶ 86, 96).

[61] *See 3650 MHz Service Rules NPRM*, 15 FCC Rcd at 20508-20509 (¶¶ 45-47).

[62] *See, e.g.*, Global Comments in ET Docket No. 98-237 in response to the *3650 MHz Service Rules NPRM* at 2 (housekeeping revisions will be needed in order to accommodate new devices in this band).

[63] *3650 MHz Service Rules NPRM*, 15 FCC Rcd at 20509-20511 (¶¶ 50-53).

[64] 47 C.F.R. Part 90.

shared use basis.[65] As with wireless services in the 3650 MHz band, this means that multiple licensees in these shared use bands operate on the same frequencies in the same geographic areas without exclusive spectrum usage rights and interference protections.[66] We are creating a new subpart under Part 90 that will be entitled 3650 MHz Wireless Broadband Services.

36. Licensees in the 3650 MHz band may provide services on a common carrier or non-common carrier basis[67] and will have flexibility to designate their regulatory status based on any services they choose to provide.[68] Such an approach will provide them with the greatest flexibility to use the spectrum for service applications that are best suited for their needs.[69] In other words, wireless licensees in the 3650 MHz band will be able to provide all allowable services anywhere within their service area at any time, consistent with whatever regulatory status they choose. We believe that this approach is likely to achieve efficiencies in administrative process and provide flexibility to the marketplace.

37. While wireless licensees in the 3650 MHz band will be subject to specific licensing and operating provisions adopted in this order, other rules may also apply to these licensees depending on the type of the service they provide. For instance, if a wireless licensee provides Commercial Mobile Radio Services (CMRS), which makes the licensee a common carrier, other obligations attach as a result of that decision under Title II of the Communications Act or the Commission's rules (*e.g.*, universal service, CALEA).[70]

38. *Spectrum Aggregation Limits, Eligibility, and Foreign Ownership Restrictions*. The *3650 MHz Service Rules NPRM* did not propose any in-band or out-of-band spectrum aggregation limits nor did it propose any eligibility restrictions on who can acquire a wireless license for this spectrum, other then the statutory foreign ownership restrictions.[71] These proposals are consistent with the non-exclusive nature of the wireless licensing scheme we are adopting for the 3650 MHz band. As a result, we will not impose any spectrum aggregation limits, either in-band or out-of-band, or eligibility restrictions other

[65] 47 C.F.R. § 90.173(a).

[66] *Id*.

[67] Regulatory status as a common carrier or non-common carrier depends on the services provided pursuant to the Communications Act, not the issuance of a license or authorization by the Commission. Generally, common carriers are telecommunications providers (*i.e.*, an entity that holds itself out for hire indiscriminately for the purposes of carrying transmissions provided by the customer) in so far as it provides telecommunications services (*i.e.*, the transmission of information of the user's choosing without change in the form or content of the information). *See* 47 U.S.C. § 153. This means that a non-common carrier does not hold itself out for hire indiscriminately for the purposes of carrying transmissions provided by the customer.

[68] We note that applicants may request common carrier status as well as non-common carrier status for authorization in a single license. *See* Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, CC Docket No. 92-297, *Second Report and Order, Order on Reconsideration, and Fifth Notice of Proposed Rulemaking*, 12 FCC Rcd 12545, 12636-38 (¶¶ 205-208), 12644-45 (¶¶ 225-226), 12652-53 (¶¶ 245-251) (1997) (*LMDS Second Report and Order*); *aff'd*, *Melcher v. FCC*, 134 F.3d 1143 (D.C. Cir. 1998).

[69] *See* Rural Carriers Comments in ET Docket No. 98-237 in response to the *3650 MHz Service Rules NPRM* at 4-5.

[70] 47 C.F.R. Part 20. In addition, certain rules may be applicable generally to all wireless services. *See, e.g.,* 47 C.F.R. Part 1, 17 (provisions implementing NEPA, antenna structure registration requirements).

[71] *3650 MHz Service Rules NPRM*, 15 FCC Rcd at 20512-20516 (¶¶ 57-63).

than the statutory foreign ownership restrictions.[72] All potential wireless service providers will have equal access to this band. We believe that opening this spectrum to as wide a range of applicants as possible will encourage new entry and investment as well as entrepreneurial efforts to develop new technologies and services, while helping to ensure efficient spectrum use. We further believe that this approach will promote economic opportunity and competition in the subject bands.

39. *License Term and Renewal Expectancy*. The *3650 MHz Service Rules NPRM* sought comment on a 10-year license term for wireless licenses in the 3650 MHz band and the standard that should be used for granting a renewal of that license.[73] Certain commenters supported a 10-year license term.[74] We agree with these commenters and conclude that it is in the public interest to adopt a 10-year license term. Our action is consistent with license terms adopted for other services including certain services in Part 90.[75] A ten year license term will provide regulatory certainty and encourage investments in the band. At the end of 10 years, licensees will be required through ULS to renew their non-exclusive nationwide license for wireless operations in the 3650 MHz band. Since there is no limit on the number of wireless licenses that will be granted for the 3650 MHz band, existing licensees can expect to receive license renewals as long as they are in compliance with the Commission's rules. In addition, renewal of a non-exclusive nationwide license will automatically renew registration of all fixed and base stations associated with that license.

40. *Performance Requirements*. The *3650 MHz Service Rules NPRM* sought comment on whether wireless licensees in the 3650 MHz band should be subject to any performance or build-out requirements.[76] Build-out in this band will be driven by market demand and the ability to meet this demand will not be restricted by a limited number of wireless licenses or an exclusive licensing structure. As a result, there is no need to impose a performance or build-out requirement. Any interested party is free to meet this demand at any time, as long as it has a valid wireless license, registers its fixed and base stations, and complies with other applicable rules. Although we do not impose a performance requirement, we will require that licensees delete registrations for unused fixed and base stations in order to maintain database integrity and facilitate efficient coordination between licensees.

41. *Disaggregation, Partitioning, and Secondary Markets*. The *3650 MHz Service Rules NPRM* sought comment on whether wireless licensees in the 3650 MHz band should be able to partition their own service areas and disaggregate their respective spectrum.[77] Typically, wireless licensees with exclusive licensing areas are permitted to partition and disaggregate[78] and commenters supported

[72] Sections 310(a) and 310(b) of the Communications Act, as modified by the Telecommunications Act of 1996, impose foreign ownership and citizenship requirements that restrict the issuance of licenses to certain applicants. 47 U.S.C. § 310(a), (b). We note that under the Act, an applicant requesting authorization for services other than broadcast, common carrier, aeronautical en route, or aeronautical fixed services would be subject to only section 310(a), which states "[t]he station license required under this Act shall not be granted to or held by any foreign government or the representative thereof." 47 U.S.C. § 310(a).

[73] *Id*. at 20518-20520 (¶¶ 72-74).

[74] *See, e.g*., Rural Carriers Reply Comments in ET Docket No. 98-237 in response to the *3650 MHz Service Rules NPRM* at 4.

[75] *See, e.g.,* 47 C.F.R § 90.149.

[76] *3650 MHz Service Rules NPRM*, 15 FCC Rcd at 20522-20525 (¶¶ 82-88).

[77] *Id*. at 20519-20523 (¶¶ 75-81).

[78] *See, e.g*, 47 C.F.R. § 27.15.

allowing wireless licensees in the 3650 MHz band to be able to take advantage of these provisions.[79]

42. We note that the use of partitioning and disaggregation is pertinent in geographic licensing settings where the licensee has *exclusive* use of a particular area. In the exclusive licensing context, partitioning and disaggregation encourage spectrum efficiency by enabling licensees to transfer or assign portions of their spectrum holdings to other users that the licensee does not intend to use.[80] Such mechanisms are unnecessary in this case because no licensee will hold exclusive rights to the spectrum, and any interested party may apply at any time for a license in the band regardless of the presence of other licensees in the geographic area were it intends to use the spectrum. Our decision, therefore, to license the 3650 MHz band for wireless services on a non-exclusive nationwide basis obviates the need to adopt partitioning and disaggregation provisions. Wireless licensees in the 3650 MHz band, however, may assign or transfer their non-exclusive nationwide licenses with all the fixed and base stations registered under those licenses.[81] We note that a licensee can transfer affixed or base station registered under its non-exclusive nationwide license to another non-exclusive nationwide licensee so long as the first licensee deletes the registered fixed or base station from its license and the second licensee registers the station under its license.

43. For similar reasons, we need not make our spectrum leasing rules applicable to wireless licensees in the 3650 MHz band. The non-exclusive licensing scheme we employ here, coupled with the required use by all licensees of contention-based technology, permits a high degree of access and spectrum re-use in these bands by multiple users, while minimizing the likelihood of harmful interference. Accordingly, the spectrum leasing arrangements described in the *Secondary Markets Report and Order* are not applicable,[82] and we do not see a need to apply those spectrum leasing rules and policies to this spectrum at this time.

3. Statutory Compliance for Licensing Approach

44. Our decision herein to adopt a licensing scheme that avoids mutual exclusivity comports with the competitive bidding approach set forth in the Commission's Balanced Budget Act proceeding. In the *BBA Report and Order*, the Commission established a framework for exercise of the Commission's auction authority, as expanded by the Balanced Budget Act.[83] The *BBA Report and Order* affirmed that, in identifying which classes of licenses should be subject to competitive bidding, the Commission must pursue the public interest objectives set forth in Section 309(j)(3).[84] Although Balanced Budget Act did not amend Section 309(j)(3)'s directive to consider certain public interest objectives in identifying classes

[79] *See, e.g.*, Comments in ET Docket No. 98-237 in response to the *3650 MHz Service Rules NPRM*, including ATG Comments at 6; Global Comments at 5-6; Rural Carriers Reply Comments at 4.

[80] *See* In the Matter of Geographic Partitioning and Spectrum Disaggregation by Commercial Mobile Radio Services Licenses, *Report and Order and Further Notice of Proposed Rulemaking*, WT Docket No. 96-148, 11 FCC Rcd 21831, 21843 (1996) (*Partitioning and Disaggregation Report and Order)*.

[81] *See* FCC Form 603.

[82] *See* In the Matter of Promoting Efficient Use of Spectrum through Elimination of Barriers to the Development of Secondary Markets, *Report and Order and Further Notice of Proposed Rulemaking*, WT Docket No. 00-230, 18 FCC Rcd 20604, 20643-44 (2003) (*Secondary Markets Report and Order)* (spectrum leasing policies apply to services in which licensees hold exclusive use rights with respect to the spectrum).

[83] *See* Implementation of Section 309(j) and 337 of the Communications Act of 1934 as Amended, *Report and Order and Further Notice of Proposed Rulemaking*, WT Dcoket No. 99-87, 15 FCC Rcd 22709, 22718-22723 (2000) (*BBA Report and Order)*.

[84] *Id.*

of licenses and permits to be issued by competitive bidding,[85] pursuant to that statute, Section 309(j)(1) did include a reference to the Commission's obligation to avoid mutual exclusivity under Section 309(j)(6)(E), which directs the Commission to use engineering solutions, negotiation, threshold qualifications, service regulations, or other means to avoid mutual exclusivity where it is in the public interest to do so.[86] Accordingly, the *BBA Report and Order* affirmed that the Commission has a continuing obligation to attempt to avoid mutual exclusivity by the methods prescribed in Section 309(j)(6) only when doing so furthers the public interest goals set forth in Section 309(j)(3).[87]

45. As a general matter, in determining whether to assign licenses through the use of competitive bidding, the Commission consistently has concluded that its obligation to avoid mutual exclusivity does not preclude it from adopting licensing processes in the non-exempt services that result in the filing of mutually exclusive applications where it determines that such an approach would serve the public interest.[88] In adopting the appropriate licensing scheme for any particular spectrum band, the Commission has interpreted its statutory obligation in a manner consistent with the opinion of the U.S. Court of Appeals for the D.C. Circuit which stated, "Section 309(j)(6)(E) imposes an obligation only to minimize mutual exclusivity 'in the public interest' and 'within the framework of existing policies.'"[89] Our decision regarding the appropriate licensing scheme for this particular spectrum centers around the unique characteristics of the 3650-3700 MHz band, including the need to protect grandfathered FSS earth station operations against harmful interference, the lack of pairing opportunities with other spectrum bands limiting the possibility of duplex operations, and the goal of enabling multiple users to share spectrum in the same geographic area without interference through the use of contention based technologies. As the record reflects, this band is well suited for high power broadband operations through such technology, and this approach is therefore likely to lead to the introduction of new and innovative broadband services in this band.[90] With respect to the 3650 MHz band, as discussed fully above, we have determined that it serves the public interest and the Commission's policy objectives to promote the rapid deployment of broadband services to assign non-exclusive nationwide licenses for the use of this spectrum. Insofar as this licensing scheme will not result in mutual exclusivity, the use of competitive bidding is not required.[91]

C. Technical Requirements

46. *Background*. In the *Unlicensed Operation NPRM*, we proposed to permit fixed unlicensed devices to operate with a maximum EIRP of 25 Watts.[92] In order to protect incumbent FSS earth stations, we proposed to prohibit the operation of fixed unlicensed devices within a keyhole-shaped protection zone derived using standard propagation models.[93] Furthermore, in order to ensure that fixed unlicensed

[85] *See* 47 U.S.C. §§ 309(j)(3).

[86] *See* 47 U.S.C. §§ 309(j)(1), 309(j)(6)(E).

[87] *See BBA Report and Order*, 15 FCC Rcd at 22718-22723.

[88] *Id.*

[89] *See Benkleman Telephone Co. et al v. FCC,* 220 F.3d 601,606 (D.C. Cir. 2000), *petition for rehearing on other grounds pending* (citing *DIRECTV, Inc. v. FCC*, 110 F.3d 816, 828 (D.C. Cir. 1997)).

[90] *See* paras 24-25, *supra*.

[91] Because we are not utilizing competitive bidding to assign licenses in this band, we have no need to address the various competitive bidding related issues that were raised in the Service Rules NPRM. *See also* discussion in para. 30, *supra*.

[92] *See Unlicensed Operation NPRM* at ¶ 43.

[93] *Id*. at ¶ 46.

devices were established outside these protection zones and operated in a manner that would avoid causing interference to FSS earth stations, we proposed to require that a professional install such devices.[94] We also tentatively concluded that fixed unlicensed devices should not be prohibited from using any particular type of antenna, provided that devices using sectorized, scanning spot-beam, or other antenna types with multiple beam capability would be required to limit the EIRP in any direction to no more than 25 Watts.[95] With regard to non-fixed unlicensed devices, we noted that the challenge of protecting satellite earth stations is more complex because a non-fixed device would not be limited to a single location, but may move around from one site to another.[96] Consequently, in order to protect the FSS and Federal Government operations in the 3650 MHz band, we proposed that non-fixed unlicensed devices be limited to a peak EIRP of 1 Watt.[97] Furthermore, we proposed that non-fixed devices be required to employ a DFS-like, listen-before-talk mechanism that would prohibit transmission when in proximity to a satellite earth station.[98] We also sought comment on whether a mobile station should listen for a dedicated beacon signal emanating from the earth station, have the cognitive capability to detect the absence or presence of the beacon signal, and make decisions on whether to transmit.[99] We tentatively concluded that these proposals should allow for most types of unlicensed use and, along with the other limitations discussed in the *NPRM*, afford adequate protection for FSS and Federal Government operations.

47. *Discussion*. In arriving at the technical criteria that we adopt here, we strike a balance among a number of competing factors in a manner that we conclude will best serve the public interest and foster the expeditious introduction of new terrestrial services in the 3650 MHz band. Of primary significance, we are mindful of the necessity to provide adequate interference protection to grandfathered FSS earth stations and Federal Government radiolocation stations operating in the band. In addition, we recognize the desirability of dealing with one of the predominant concerns expressed by a number of commenters - - - namely that unbridled terrestrial operations could result in levels of mutual interference that would impede efficient use of the spectrum. These two key factors, among others, lead us to consider the interplay between both *inter*-service (FS/MS with respect to FSS) as well as *intra*-service (mutual FS or MS) interference avoidance scenarios. Thus, our goal is to adopt criteria that will adequately protect grandfathered FSS and Federal Government stations, but at the same time, will also provide sufficient operating power and flexibility to make terrestrial operations an attractive proposition for potential service providers.

48. In broad terms, therefore, and as discussed more fully below, we adopt the same magnitude of power limits for terrestrial operations proposed in the *NPRM*, but qualify the limit in terms of power

[94] *Id.*at ¶ 41

[95] *Id.*at ¶ 44

[96] *Id.*at ¶ 48.

[97] *Id.*at ¶ 49. We noted that handheld unlicensed devices in the 2.4 GHz and 5.8 GHz bands normally operate well below the maximum of 1 Watt due to battery power limitations and human exposure to RF radiation limitations.

[98] DFS refers to dynamic frequency selection. As the literal meaning implies, a DFS signal threshold is often used to trigger a change in operating frequency by a transmitter to avoid causing interference. In this case, however, a signal threshold would be detected in a similar manner to DFS circuitry but used, instead, to adjust the EIRP of the unlicensed device. This approach is similar to that used to protect government radar systems in the 5 GHz band from unlicensed devices. *See Report and Order* in ET Docket No. 03-122, 69 Fed. Reg. 2677 (2004). We note that National Telecommunications and Information Administration (NTIA), FCC, National Aeronautical and Space Administration (NASA) and Department of Defense (DoD), along with input from the industry, worked to develop acceptable sharing conditions between unlicensed devices in the 5 GHz band and the sensitive government installations. *See Unlicensed Operation NPRM* at ¶ 50, n. 70.

[99] *See Unlicensed Operations NPRM* at ¶ 71.

density over a bandwidth. We conclude that FSS protection zones that are somewhat modified from those proposed in the *NPRM* remain a viable tool for avoiding interference scenarios that might arise from FS/MS operations. We also conclude that mobile terrestrial operations can be accommodated while protecting grandfathered FSS and Federal Government stations so long as such operation is enabled by transmissions from a nearby fixed or base station. We also conclude that technologies using a contention-based protocol are available that control access to spectrum and thereby mitigate the possibility of interference that could result from co-frequency operation of fixed and mobile stations, particularly in congested operating environments. In that connection, we adopt equipment certification provisions to ensure that both fixed and mobile stations incorporate the requisite contention-based technologies. Interference caused by radiofrequency (RF) energy from a fixed or base station transmitter into a nearby fixed or base station received will be addressed by the process we adopt to register fixed and base stations so that they can operate at locations and with technical parameters that will minimize the potential for interference between stations. We adopt out-of-band emission limits for terrestrial operations and specify criteria for operations in proximity to Canadian and Mexican borders. Finally, we retain the same 80 km coordination zone already established in the rules for the protection of the three grandfathered Federal Government stations operating in the band.

49. We will leave it up to the industry to determine flexible and efficient methods for meeting the technical requirements we adopt herein. In particular, the industry will need to address issues such as contention-based protocols and base-station enabled mobile operations.

50. *Fixed Station Operating Power*. In the *NPRM*, we proposed an EIRP limit of 25 Watts for fixed stations operating in the 3650 MHz band. We adopt a *peak* power limit, expressed as a power density, of 25 Watts per 25 megahertz bandwidth.[100] We adopt this limit for the following reasons. First, we note that the majority of commenters generally support the use of 25 watts for fixed operations. Additionally, we note that the potential for a system to cause interference is related to bandwidth in addition to power. In this respect, we recognize that different systems operating in the 3650-3700 MHz band may utilize various operating bandwidths.[101] Consequently, we believe that EIRP limits should be specified not simply as a maximum power, but rather in terms of power density (*i.e.*, power per unit of occupied bandwidth). By specifying our power limit in this way, protection of FSS earth stations is simplified because a single separation distance can be specified regardless of the bandwidth used. For example, a system using a bandwidth of 25 megahertz may use the full 25 Watts peak EIRP, but a system using only 1 megahertz bandwidth may only use 1 watt peak EIRP; in either case, the power density is equivalent. If we did not specify the EIRP limit in this manner, the 1 megahertz system could use the full 25 watts and consequently because all the power would be concentrated in a relatively small bandwidth, the separation distance necessary to protect FSS earth stations would be much larger than for a system with 25 megahertz bandwidth.[102] Therefore, we adopt a fixed station peak power density of 25 Watts EIRP in any 25 megahertz band. Furthermore, to promote additional flexibility in system design, any combination of transmitter output power and antenna gain will be permitted, so long as the peak 25

[100] We note that, at frequency ranges above one-gigahertz, a power density measurement bandwidth of one-megahertz would typically be specified. Consistent with that practice, and the intent of the rules adopted here, the maximum peak power density in any one-megahertz slice of spectrum in this band shall not exceed 1 Watt.

[101] For example, the Wi-Max standard specifies various bandwidths.

[102] For free space propagation, distance is proportional to the square of the distance or in terms of decibels distance doubles for each additional 6 dB of power. Because 25 watts is 14 dB more than 1 watt (*i.e.*, $10\log_{10}25=14$), a system operating with 25 watts over 1 megahertz of bandwidth would have the ability to successfully operate over distances approximately five times larger than a system that spreads 25 watts of power over 25 megahertz of bandwidth.

Watt/25 megahertz EIRP limit is not exceeded.[103] We believe that the power density requirement we adopt here facilitates our goal of ensuring efficient use of the band. As detailed below, this limit results in reasonably sized protection zones around FSS earth stations[104] to maximize the area in which terrestrial licensees can operate while also providing enough power for these terrestrial operations to operate over sufficient ranges to provide service to a large number of users.

51. *Mobile station operations.* Mobile operations, including mobile-to-mobile, will be permitted under the rules we adopt in this Order. We are mindful, however, that mobile operations pose a greater risk of causing interference to FSS earth stations than fixed stations. In the NPRM we sought comment on a variety of ways that a mobile device could operate in the band without causing harmful interference to grandfather incumbent stations. Many commenters found the suggestions in the NPRM, such as the beacon signal, complex and impracticable.[105] Others suggested having mobile devices rely on a signal from a fixed or base station as a simpler method to implement.[106] Based on the record, we conclude that, before it can transmit, a mobile station (including those operating in mobile-to-mobile mode) will be required to positively receive and decode an enabling signal transmitted by a base station.[107] Thus, mere spurious emissions from other RF sources, such as another mobile transmitter, cannot enable a mobile to transmit. We believe that this approach will ensure that spurious emissions from nearby devices will not inadvertently trigger the transmit ability of a mobile station. Furthermore, this approach will ensure that any mobile station will be within a reasonable distance of a base station[108] and, thus, far from an FSS earth station (or federal government station) before it can transmit. As noted above the rules we adopt will also allow for mobile-to-mobile operations. For example, a subscriber can place several devices upon its premises and use the 3650 MHz band to network them together as long as each device is within range of a fixed or base station. Beyond the basic requirement for the use of base station trigger, we conclude that we should not adopt additional rigid requirements regarding the characteristics of the signal needed to trigger mobile transmissions (*e.g.*, signal level and content). Instead, we will leave it up to the industry to determine flexible and efficient methods for meeting this requirement.[109] We note, however, that meeting this requirement should not pose any undue burden upon manufactures as much equipment deployed today already incorporates a similar mechanism. For example, the receiver in a Wi-Fi device or a cellular telephone scans for an available network and, upon locating a network, the device "handshakes" and authenticates on that network in order to have the proper permission to transmit.

[103] Because interference potential is directly related to a device's EIRP density, specifying this parameter rather than separate output power and antenna gain limits more directly reflects the potential for interference in the band.

[104] *See* para. 60, *infra*.

[105] *See, e.g.,* Comsearch Comments at 6-7; IEEE 802 Comments at 30.

[106] Navini Comments at 7.

[107] Under the rules we adopt, mobile-to-mobile communications may occur even if each mobile receives the required enabling signal from different base stations. The enabling signal requirement is designed to ensure that mobile stations are sufficiently far from a FSS earth station to avoid causing interference, not to limit the other mobile units with which a given mobile unit may communicate.

[108] We expect service areas around base stations to be no more than approximately 8-9 miles.

[109] The industry will need to address several issues as part of this process, including the characteristics of the enabling signal and an appropriate time limit within which a mobile may transmit before it must again receive and decode the enabling signal.

52. *Mobile operating power*. In the *NPRM*, we proposed to limit mobile devices to a peak EIRP of 1 Watt.[110] This power limit was supported by commenters.[111] Accordingly, we conclude that a maximum peak EIRP of 1 Watt over a 25 megahertz bandwidth will provide a reasonable balance between interference protection goals and fostering the most flexible use of mobile stations in the 3650 MHz band.[112] In the same manner as the power limits for fixed stations, we specify the mobile power limit in terms of bandwidth density in order to accommodate systems with various bandwidths while assuring predictable protection of incumbent stations. We also note that this power/bandwidth level is consistent with existing wireless mobile equipment operating in other bands, and with proposed wireless mobile systems under consideration by IEEE 802.16.[113]

53. *Antennas.* In the *NPRM*, we observed that sectorized and phased array antennas could be used to create highly spectrum efficient networks and could enable an application like a broadband local area network to serve a number of spatially separated clients from a single fixed antenna site.[114] Such antennas allow systems to use spectrum more efficiently by making it possible to re-use a given frequency to communicate with different devices along non-overlapping paths. We believe that allowing such flexibility encourages both new and novel antenna technologies that will foster more intensive spectrum use.

54. In that light, we conclude that transmitters installed at fixed locations should not be prohibited from using any particular type of antenna design. As a general requirement, the EIRP in any antenna beam must be limited to 25 Watts per 25 megahertz. However, transmitters using sectorized, scanning spot-beam, or other antenna types with multiple beam capability shall be required to limit their EIRP in any direction to no more than the limit we are adopting for fixed systems (*i.e*., 25 Watts per 25 megahertz). Thus, the aggregate power transmitted simultaneously on overlapping beams will have to be reduced such that the EIRP in the area of overlap does not exceed the limit for a single beam. In addition, to allow flexibility in deployment of advanced antenna systems, including sectorized and adaptive array systems, we will allow systems using these antennas to operate with an aggregate transmit output power transmitted simultaneously on all beams of up to 8 dB above the limit for an individual beam.[115] We believe that these rules will provide flexibility for licensees to employ a wide variety of advanced antennas to meet their needs while still ensuring protection to FSS earth stations. Applications for equipment authorization must include the algorithm that confirms that this requirement is met.

55. *Protection of terrestrial stations*. Under the licensing scheme being adopted for terrestrial transmitters in the 3650-3700 MHz band, it will be possible for both base and mobile stations to operate virtually anywhere - - - except near FSS earth stations and Federal stations as described below. Mechanisms must therefore be in place to ensure operation on an interference-free basis. We are concerned about two different kinds of interference in the 3650-3700 MHz band. The first could occur if

[110] *Unlicensed Operation NPRM* at para. 49.

[111] *See*, *e.g.*, Motorola Reply Comments at 5; Tropos Comments at 8 (which specifies that a 1 Watt limit is reasonable due to limitations of battery power).

[112] As with the power limit for fixed stations we limit the peak EIRP of the mobile device in any one megahertz of spectrum. Thus, the peak EIRP of a mobile device shall not exceed 40 milliwatts in any one-megahertz slice of spectrum.

[113] The Institute for Electrical and Electronic Engineers (IEEE) has designated the Wi-Max family of standards as 802.16.

[114] *See Unlicensed Operation NPRM* at ¶ 44, citing ET Docket No. 03-201 at paragraphs 5-15.

[115] This is consistent with the rules adopted in ET Docket No. 03-201 for unlicensed systems under Part 15. *See* 47 C.F.R. § 15.247(c)(2).

the radiofrequency (RF) energy from a fixed or base station transmitter interferes with the performance of a nearby fixed or base station receiver. The second type of interference could take place if two or more stations are competing with each other for access to the spectrum. With regard to the former, we will provide, at <http://wireless.fcc.gov/uls>, information regarding the location of all registered stations in the band. Parties seeking to register a new station should examine this database, and then make every effort to ensure that their station operates at a location, and with technical parameters, that would minimize the potential for mutual interference between both the new and existing stations.

56. We believe the best way of preventing the second form of interference from occurring is to require systems operating in the 3650-3700 MHz band to incorporate a contention-based protocol. Such protocols can be characterized by having the following properties: procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel.

57. Systems using a contention-based protocol have been common for quite some time for both licensed and unlicensed systems. For example, licensees operating in the private land mobile radio bands under Part 90 of our rules have employed contention based systems in its simplest form. That is, prior to transmitting, an operator would listen to the traffic on the radio and wait until the channel was free before transmitting (*i.e*, listen before talk).[116] More complex schemes also exist, such as that used by unlicensed Wi-Fi devices (also know as IEEE 802.11). Wi-Fi uses a contention-based protocol known as Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). This protocol, like the simple Part 90 model, also uses a listen before talk scheme. This means that a station wishing to transmit must first sense the radio channel to determine if another station is transmitting. If the channel is not busy, the transmission may proceed. The CSMA/CA protocol avoids collisions among stations sharing the medium by utilizing a random backoff time if the station senses a busy channel. This process is repeated until the station is allowed to transmit. Such a scheme ensures channel sharing while avoiding collisions. Because such a scheme inherently incorporates unpredictable delay as the transmitter waits until the channel is idle, it is often not the best choice for time sensitive applications such as voice communications.

58. Because we are not according terrestrial licensees exclusive use of the spectrum in any area and because we wish to provide for widespread deployment of equipment, we believe that a contention-based protocol is a reasonable, cost effective method for ensuring the ability of any user to access the spectrum. A contention based protocol also will have to ensure that all users will have a reasonable opportunity to operate, so that no operator can block others' access to the spectrum.[117] Accordingly, we will require fixed, base and mobile equipment designed for use in the 3650 MHz band to incorporate

[116] Because we expect data communications in this band, a simple listen before talk approach relying on aural sensing would not be appropriate here.

[117] We also note that each licensee has an obligation to act in good faith to help eliminate interference, as discussed above.

some type of contention based protocol.[118] As has been our practice, we will not specify a specific protocol, but leave it to the industry and standards bodies to determine appropriate protocols. The incorporation of such a protocol will be a requirement of the equipment certification process, and equipment that appears to be designed to preclude others from using this spectrum will not be approved. In monitoring the use of this spectrum, the Commission remains free to modify the rules if there appears to be significant problems in this regard. We also will add the following definition of contention-based protocol into the rules:

> Contention based protocol: A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate. Such a protocol may consist of procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel.

59. *FSS Earth Station Protection.* In the *NPRM*, we proposed to define protection zones around each FSS earth station within which, operation of fixed transmitters would be prohibited.[119] Specifically, we proposed that installation of a fixed transmitter be prohibited within a plus-or-minus 15-degree arc of any earth station's main antenna beam if the separation distance between the fixed device and the earth station was within 180 km.[120] At azimuths outside this main beam protection arc, a fixed transmitter

[118] The requirement for the use of contention protocol for the terrestrial services is unrelated to the potential use of contention protocols by the earth stations in the FSS. Very small aperture (VSAT) network operators in the FSS may use contention protocols to manage the traffic within their VSAT networks. In that context, there is an increase in power levels and an increased potential for harmful interference during collisions. Petition of Spacenet, Inc. for a Declaratory Ruling that Section 25.134 of the Commission's Rules Permits VSAT Remote Stations in the Fixed Satellite Service to Use Network Access Schemes that Allow Statistically Infrequent Overlapping Transmissions of Short Duration, or, in the Alternative, For Rulemaking to Amend that Section, *Order*, 15 FCC Rcd 23712 (Int'l Bur., 2000) (*Spacenet Order*). Accordingly, the Commission has proposed rules to limit VSAT network power levels during collisions, most recently in an NPRM adopted concurrently with this Order. *See* 2000 Biennial Regulatory Review -- Streamlining and Other Revisions of Part 25 of the Commission's Rules Governing the Licensing of, and Spectrum Usage by, Satellite Network Earth Stations and Space Stations, *Notice of Proposed Rulemaking*, IB Docket No. 00-248, FCC 05-**xxx** (adopted Mar. 10, 2005) (*Part 25 Streamlining Third Further Notice*). We conclude that, in the context of terrestrial operations in the 3650-3700 MHz band, the requirements we adopt in Section 90.1321(b) as set forth in Appendix A are adequate to prevent harmful interference.

[119] We observed that FSS earth stations in the 3650 MHz band use high gain antennas that are very susceptible to interference from undesired signals directed toward the main beam. As a result, operation of a fixed unlicensed device located close to the earth station's main beam azimuth, even with relatively low EIRP, could cause interference at large distances. Conversely, an unlicensed device located outside the earth station's main beam azimuth could operate with relatively higher power and at closer separation distances without causing interference. *See NPRM* at ¶ 45.

[120] The 180 kilometer distance proposed in the *NPRM* was derived from the 200 kilometer coordination zone that the Commission previously proposed as appropriate for much higher powered licensed fixed operations to protect FSS earth stations in the 3650 MHz band. In the *3650 MHz Service Rules Second Notice*, the Commission tentatively concluded that within 200 kilometers of a FSS site it would be necessary for a licensed fixed operation to coordinate with the FSS operation. Outside of this coordination zone, the licensed operation would not need to coordinate and could operate with up to 1640 Watts EIRP. The 200 kilometer licensed coordination zone was based on line of sight protection to FSS earth stations and took into account elevation angle, and terrain shielding and over the horizon distances from the FSS earth station sites. **[cite]** Outside of the main beam, the required separation distance (or exclusion zone) of 25 kilometers assumes that a noise-to-interference ratio of 10 dB is acceptable to the FSS operators and that the ITU-R large FSS antenna roll-off gain pattern is appropriate.

would be prohibited if the separation distance from the earth station was within 25 km. At all other locations outside these zones, we proposed that fixed transmitters could be installed and be permitted to transmit with a total maximum EIRP of 25 Watts unless the specifics of such operation would cause harmful interference to FSS earth stations. Finally, we proposed that such terrestrial operations be permitted on an unlicensed basis.

60. Under the streamlined licensing approach adopted here, terrestrial FS/MS operations must continue to protect satellite earth stations that retain their primary status under our FSS grandfathering provisions for the 3650 MHz band. Consequently, as we discuss further below, we adopt herein circular protection zones of 150 km around the grandfathered earth stations.[121] We recognize that the simplified circular protection zone that we are imposing here employs a high degree of worst-case conservatism that, in many instances, could result in prohibiting the use of transmitters in less-than-worst-case circumstances where, in reality, there would be no likelihood of interference to FSS earth stations. To provide additional flexibility in the face of our conservative protection zones, we will allow terrestrial operations within these protection zones, so long as they negotiate agreements with the earth stations operators.

61. SIA argues in its comments that permitting unlicensed operations will, as a general premise, cause harmful interference to co-channel and adjacent channel FSS receivers because the location of such users are unknown and cannot be tracked.[122] As an initial matter, in this Order, we have elected to adopt a streamlined licensing scheme with a site registration requirement. In adopting this approach coupled with the technical requirements that establish earth station protection zones and restricts the areas in which mobiles can operate, we are taking steps to ensure that the locations of all terrestrial users are known. Thus, the aspects of SIA's criticisms that go to our proposals for an unlicensed approach are rendered moot and need not be further considered. However, SIA makes additional arguments regarding the protection necessary for FSS earth stations that are applicable regardless of whether operations occur on a licensed or unlicensed basis. We address those comments below.

62. SIA opines that the proposals made in the *NPRM* will not adequately protect FSS earth stations in the 3650 MHz band.[123] For example, SIA claims that we the Commission has underestimated: 1) the protection that a device must afford FSS earth stations in the 3650 MHz band, 2) the aggregate interference from users of the 3650 MHz band, 3) the areas in which devices must be excluded, and 4) the potential for interference to FSS earth stations in the adjacent 3700-4200 MHz band.[124] SIA does accede however, that revised separation distances for fixed devices might offer a viable alternative.[125] Finally, SIA notes that the Commission must adopt adequate enforcement mechanisms.

[121] A list of grandfathered FSS earth stations is attached in Appendix E. This list is based upon information available in our official licensing data bases. It may be updated by future Public Notice to correct omissions. The technical parameters for each of the listed stations can be found in the International Bureau Filing System at *http://www.fcc.gov/ib*.

[122] SIA Comments at 29

[123] SIA Comments at 10.

[124] SIA Comments at 18.

[125] SIA Comments at 26.

63. Based on their analysis, SIA calculated that fixed stations operating with 25 watts EIRP must be located at least 313 km away from an FSS earth station to ensure adequate protection.[126] We disagree with SIA's conclusions and instead believe that a separation distance of 150 km will provide the necessary protection for the worst case earth station configuration (*i.e.*, earth station pointing to the eastern and western limits of the geostationary arc at an elevation angle of 5^o).[127] In addition, we believe that in many cases separation distances of less than 150 km can readily be achieved and still protect the FSS earth station. In reaching this conclusion, we observe that SIA, based on recommendation ITU-R S.1432,[128] assumed a criterion of $\Delta T/T$ equal to 0.5% to protect the earth stations.[129] To derive this conservative protection criterion, SIA observed that the ITU-R Recommendation specifies that of the total signal level present at an earth station, 1% of that be allocated as emanating from unlicensed devices. Then to account for transmissions from multiple devices, SIA proposed that this be further reduced by half to 0.5%. We find the protection criterion proposed by SIA to be overly conservative and unsupported by either measurement or operational experience. Further, the Commission has been consistent in its position that the specifications found in ITU-R S.1432 are design criteria for FSS earth stations, not interference protection criteria. Thus, as in the past, we categorically reject the use of these design guidelines as suitable interference criteria. In addition, we note that had SIA considered a licensed scheme for this band (and consequently, treated the interference as coming from a co-primary allocated services), the design guidelines of ITU-R S.1432 would allocate 6% as the appropriate potential signal level at the earth station antenna. Such a change to the "interference criterion" used by SIA would greatly reduce the required protection distances computed in their analysis. Therefore, we are not persuaded by SIA's arguments.

64. Using similar techniques to SIA,[130] we conclude that a protection distance of 150 km is more than adequate to protect FSS earth stations. First, it is important to observe that protection of an earth station, which has the ability under its license and the rules to operate across the full geostationary satellite arc, must be based on worst case operating conditions of a 5^o elevation angle. In addition, we assumed use of the antenna radiation pattern specified in our rules.[131] However, rather than specifying a specific protection level ($\Delta T/T$) and multipath propagation model, our analysis considered a range of parameter values. Thus we avoided selecting a specific value for the protection criterion for the earth

[126] This calculation is based on a multipath propagation model of 0.1%; meaning SIA assumed that the 0.1% was the percentage of time that the noise interference allowance (*i.e.*, $\Delta T/T$; *see* note 101, *infra*.) could be exceeded. This model is based on standard calculations for coordinating fixed stations and earth stations specified in ITU Radio Regulations, Appendix 7. SIA also calculated separation distances of 370 km for a multipath propagation model of 0.01% and of 220 km for a model of 1%.

[127] Each FSS earth station is licensed to operate with specific satellite space stations. However, the rules allow, as a minor license modification, licensees to add additional space station locations. *See* 47 C.F.R. § 25.118. Thus, regardless of the space stations with which a licensee is authorized to communicate, we must assume that it can communicate with any space station across the visible geostationary arc, such that the antenna elevation angle is 5^o or greater. *See* 47 C.F.R. § 25.205 which specifies that earth station antennas will not normally be authorized for transmission at angles less than 5^o. Thus, the full viewable geostationary arc is composed of all the geostationary satellites visible to an earth station operating at 5^o elevation angle and above

[128] Recommendation ITU-R S.1432 -- Apportionment of the allowable error performance degradations to Fixed-Satellite Service (FSS) hypothetical reference digital paths arising from time invariant interference for systems operating below 15 GHz.

[129] $\Delta T/T$ is an interference threshold, which is a measure of the amount of interference that can be tolerated by an earth station. Specifically, $\Delta T/T$ is a measure of the increase in system noise temperature of the earth station and is related to the interference-to-noise-ratio, I/N by the following formula: I/N in dB = 10*log ($\Delta T/T$)

[130] *See* SIA Comments at Exhibit 1, 6-7.

[131] *See* 47 C.F.R. § 25.209.

stations in our analyses by assuring that the protection distance of 150 km is consistent with conservative assumptions and tradeoffs for the elements of our link budget. Additionally, in keeping with our conservative approach, we point out that the power limit we adopt herein is on the order of 18 dB *lower* than that proposed for licensed fixed point-to-point facilities.[132] Further, we note that by adopting out of band emission limits for the licensed fixed devices we further safeguard the protected earth stations, because these earth stations operate not only in the 3650-3700 MHz band, but also in the adjacent bands to which the out of band emission limits apply. Thus, the earth stations will directly benefit from any reduction in emissions necessary to satisfy the out of band emission limits. And finally, it is important to consider that we are adopting rules that require operators to obtain a license and register their location so that earth station operators will readily have the necessary contact information to locate potential sources should they experience interference. To underscore the conservative nature of this approach, we note that we are adopting a protection zone that far exceeds what is required, especially in the back and an area in the center of the viewable geostationary arc of the FSS antenna.[133] We are confident that the values adopted here will provide more than adequate and conservative protection to the grandfathered earth stations.

65. To further assure that FSS earth stations are adequately protected, we will impose the protection distance as a circular zone around the earth station. This differs from our proposal of using a keyhole-like pattern based on the earth station pointing towards a specific satellite. We make this decision because, in practice, each earth station can look at multiple satellites across the geostationary arc. Thus, a circular protection zone is more appropriate for ensuring interference protection in all cases. In addition, we point out that using a circular zone has the benefit of simplicity for all parties as it is easy to determine exactly which areas are excluded from terrestrial station operation.

66. Finally, we note that a more accurate determination of the requisite separation distances can be derived if the particular operating parameters of both the fixed terrestrial transmitter and protected FSS earth stations are taken into account. However, requiring operators to independently make detailed transmission path and link budget calculations could be unduly burdensome. We do, however, recognize that such operation within the conservative portion of the protection zone is possible. We thus will allow such operation so long as the FS station and the FSS station licensees mutually agree on appropriate operating parameters. An FS entity that requests to operate within the protection zone will be required to negotiate with each protected earth station that is potentially affected by the proposed fixed or mobile operation. Further, the FSS station licensee must not refuse to negotiate with the fixed licensee, and both parties should negotiate in good faith. The results of these negotiations must be documented and kept with the station's records in the event that this information is needed by the Commission. To illustrate a possible technique for coordinating a fixed station at distances closer than 150 km, we observe that in most cases the earth station operates at elevation angles well above 5^{o}.[134] This antenna discrimination property can be used to calculate separation distances less than 150 km in many cases while still protecting the earth station from harmful interference. Methodology to make such calculations is provided as an example in Appendix D.

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[132] *See* NPRM at para. 47. We proposed that fixed systems would be limited to a maximum EIRP of 1640 Watts (32.15 dBW), which, if measured over the same bandwidth, is 18 dB greater than the 25 watts (14 dB) being adopted here.

[133] An FSS earth station antenna pointed towards the center of its viewable geostationary arc operates at elevation angles well above 5^{o} which provides protection by isolating it from terrestrial stations. Similarly, an antenna will have very little gain, if any, directly behind it, thus isolating it from energy emitted from a terrestrial station.

[134] As an earth station points at various satellites on the geostationary arc, its elevation angle increases as it approaches a pointing azimuth of 180^{o} which corresponds to pointing at the center of the arc.

67. *Equipment Authorization Requirements.* As discussed above in the licensing sections, we adopt rules to license terrestrial operations in the 3650 MHz band under Part 90 of our rules. We observe that there is a general requirement for all equipment to obtain certification under that rule part.[135] This requirement recognizes that there is a certain "core group" of equipment that requires a higher level of oversight than manufacturer's self-approval (Declaration of Conformance or Verification), due to a high risk of non-compliance, the potential to create significant interference to safety and other communication services, and the need to ensure compliance with the requirements to protect against radio frequency exposure.[136] We find that because of the risk of interference to FSS earth stations, equipment designed for operation in the 3650 MHz band falls into this "core group" of equipment. Thus, as with other Part 90 equipment, we will require manufacturers to obtain certification for their equipment. We note that applications for equipment authorization must contain specific information regarding the methods employed to meet our rules. Specifically, we've already noted that the certification application for systems using advanced antenna technology must provide the algorithm used to reduce the EIRP to the maximum allowed in the event of overlapping beams. In addition, the application must contain information discussing how the equipment meets the requirement to employ a contention based protocol for gaining access to the spectrum and for mobile transmitters, including a description of how the requirement to positively receive and decode an enabling signal is incorporated.

68. One final point to consider is that the rules currently require certification to be approved by the Commission or a designated Telecommunication Certification Body (TCB) before they may be marketed. In General Docket 98-68, we established the requirements for TCBs that are allowed to approve equipment in the same manner as the Commission.[137] In that proceeding, we stated that while we intended to use TCBs to certify a broad range of equipment, we found that certain functions should continue to be performed by the Commission. The functions included certifying new or unique equipment for which the rules or requirements do not exist or for which the application of the rules is not clear.[138] Because we have not previously specified that certification would be based on specification of a contention based protocol, nor on the ability of a mobile station to transmit only after receiving an enabling signal from a base station, we believe that many questions about the application of the rules may arise. Thus, we believe that TCBs should not be permitted to certify or approve permissive changes for equipment operating under the rules adopted herein until we gain sufficient experience with this band.[139] Once the Commission gains sufficient experience with equipment in this band, it will determine whether TCBs should be permitted to certify them. Accordingly, until the Chief of the Office of Engineering and Technology acting under the existing delegated authority issues an announcement by public notice, TCBs will not be permitted to certify equipment in the 3650-3700 MHz band.[140]

69. *RF Safety*. As noted above, we will require manufacturers to obtain certification for their equipment, among other reasons, to address the need for compliance with the requirements to protect

[135] *See* 47 C.F.R. § 90.203.

[136] *See Report and Order* in ET Docket No. 97-94, 13 FCC Rcd 11415 (1998).

[137] *See In the Matter of 1998 Biennial Regulatory Review – Amendment of Parts 2, 25 and 68 of the Commission's Rules to Further Streamline the Equipment Authorization Process for Radio Frequency Equipment, Modify the Equipment Authorization Process for Telephone Terminal Equipment, Implement Mutual Recognition Agreements and Begin Implementation of the Global Mobile Personal Communications by Satellite (GMPCS) Arrangements*, Report and Order, FCC 98-338, 13 FCC Rcd 24687 (1999).

[138] *Id.* at ¶ 33.

[139] We currently do not allow TCBs to certify equipment requiring measurements of the specific absorption rate (SAR) of RF radiation by the body. No change in that policy is proposed.

[140] *See* 47 C.F.R. § 0.241(g).

against radio frequency (RF) exposure. In addition, licensees are responsible for ensuring that transmitting equipment, as actually installed, continues to meet RF exposure guidelines. For example, fixed transmitters operating at the peak EIRP output power of 25 Watts/25 MHz authorized in this Order would not generally be required to undergo routine RF safety evaluation as a part of the equipment certification process because installation constraints typically result in sufficient separation distances such that human exposure limits would not be exceeded.[141] Nevertheless, we recognize that such transmitters, particularly those that might be licensed by individuals or other small entities, could have a greater chance of being installed in a diverse range of atypical environments; possibly, for example, even inside a residential home. In such instances, an improper installation could result in circumstances where RF safety standards might be exceeded due to a reduced separation distance. Consequently, we will require, as part of the certification process, that equipment manufacturers include sufficiently detailed installation instructions and guidelines to ensure that licensees locate such transmitters in a manner that will maintain appropriate human exposure separations at all times.

70. By comparison, non-fixed transmitters generally require additional evaluation as a part of the manufacturer's equipment certification process.[142] Based upon the peak EIRP operating limit of 1 Watt specified here, we will require routine evaluation for these devices to demonstrate RF exposure compliance. In any event, manufacturers are responsible for ensuring that any equipment they design, manufacture, and sell meets the corresponding RF safety limits.[143] Licensees of non-fixed transmitters may generally rely upon the manufacturers' equipment certification that RF exposure guidelines for that equipment have been met.

71. *Federal Government Facilities.* In the *NPRM*, we sought comment on whether the methods described in the *NPRM* would provide an effective means of protecting the three Federal Government radiolocation stations that operate in the 3650-3700 MHz band on a primary basis. These stations, located at St. Inigoes, MD, Pascagoula, MS, and Pensacola, FL, were grandfathered as a condition of the transfer of the 3650 MHz band to a mixed-use status.[144] The current rules require that FS and FSS stations located within 80 kilometers of each site coordinate with the Federal Government.[145] As noted, this protection criterion for Federal stations has been in existence for fixed stations since 1999 and we did not propose to alter it. Thus, we will continue to require coordination with NTIA through the Frequency Assignment Subcommittee of the Interdepartmental Radio Advisory Committee for any station that requests registration of a site closer than 80 km from the three specified radiolocation sites. We further note that our ULS system has the capability of screening for any terrestrial applications that might propose site coordinates located within the 80 kilometer coordination zone and, within approximately 24 hours, flag that application for any necessary coordination.

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[141] Fixed transmitters are exempted from routine evaluation to demonstrate RF exposure compliance, except that the requirements of §1.1307(b)(3) are applicable when a fixed transmitter is co-located with other transmitters on a site.

[142] In particular, for RF safety purposes, non-fixed transmitters (such as those discussed under the general umbrella term 'mobile' elsewhere in this Order) fall into two categories - - - 1) 'portable', and 2) 'mobile.' Portable transmitters are classified as those that operate within 20 cm of human contact, while mobile transmitters are those that operate at distances greater than, or equal to, 20 cm from human contact. Furthermore, portable devices are typically required to comply with Specific Absorption Rate (SAR) limits, while mobile devices are required to comply with power density limits, as defined in §§2.1093 and 2.1091, respectively, of the rules.

[143] *See* 47 C.F.R. § 1.1310 for details concerning the commission's rules related to human exposure.

[144] *See* letter dated November 2, 1999 from William T. Hatch, Acting Associate Administrator, NTIA to Dale Hatfield, Chief, OET ("*November NTIA letter*"). The coordinates of each site are: St. Inigoes, MD (38° 10' N., 76°, 23' W.); Pascagoula, MS (30° 22' N., 88°, 29' W.); and Pensacola, FL (30° 21' 28" N., 87°, 16' 26" W.).

[145] *See* 47 C.F.R. § 2.106, note US348.

72. Furthermore, we reiterate to potential users of the 3650-3700 MHz band that the adjacent 3600-3650 MHz band is used by high power federal government radar systems and they are not limited to the three protected sites. Consequently, terrestrial transmitter/receiver manufacturers will likely find the need to incorporate design measures to protect their equipment from possible overload by these adjacent band radar signals. The Commission strongly recommends that parties installing equipment in this band should determine if there are any nearby Federal Government radar systems that could affect their operations. Information regarding the locations and operational characteristics of the radar systems operating adjacent to this band are provided in NTIA TR-99-361.

73. *Operation in Proximity to U.S. Borders.* To provide sufficient protection to Canadian and Mexican stations operating in the 3650-3700 MHz band that are located near the U.S. borders, we proposed in the *NPRM* to require that fixed devices be located at least 8 kilometers from the U.S./Canada or U.S./Mexico border if the antenna of the device looks within the 160^{o} sector away from the border and be located at least 56 kilometers from each border if the device looks within the 200^{o} sector towards the border. This proposal is consistent with the treatment of licensed fixed stations in bands above 470 MHz along the U.S./Canada border.[146] We conclude that these same considerations apply to the type of licensed operation that we permit in this Order. Accordingly, we adopt the requirements for operation near the borders as proposed. We point out, however, that even under these guidelines, operators might need to further reduce their power to protect FSS earth stations in Canada or Mexico. We further note that, under our current agreement with Canada, operations within the distances specified above may be permitted if we are able to coordinate such use with Canada. We have no agreement with Mexico to permit such coordinated use at this time. In the future, we may negotiate more specific agreements with Mexico and Canada to govern operations near our borders in the 3650-3700 MHz band. Licensees in this band would be required to comply with the provisions of such agreements.

74. *Adjacent Band Emissions.* In the *NPRM*, we sought updated comment on what interference criteria might be used to protect adjacent band services from licensed systems operating in the 3650 MHz band. For example, we asked if we should require that licensed non-fixed devices comply with the field strength limit described in the *NPRM* for unlicensed devices; or whether we should require that licensed fixed stations comply with a particular field strength limit or satisfy the adjacent band protection criteria proposed in the *3650 MHz Service Rules Second Notice.*[147] In the *3650 MHz Service Rules Second Notice*, we proposed that, in order to protect FSS operations in the 3700-4200 MHz band from interference, terrestrial stations operating in the 3650-3700 MHz band would have to comply with the Part 101 emission limits already in place to protect such FSS systems from licensed fixed stations operating in the 3700-4200 MHz band.[148] Therein, we discussed a proposal made earlier in the ET. Docket 98-237 proceeding concerning whether the out of band emission limit defined by 43 + 10 log(P) dB minimum attenuation that applies to broadband PCS should be applied to FS operations in the 3650-3700 MHz

[146] *See* U.S. - Canada treaty, "Revised Technical Annex Telecommunication: Coordination and Use of Radio Frequencies Above 30 Megacycles per Second," Signed at Ottawa June 16 and 24, 1965; entered into force June 24, 1965.

[147] *See Unlicensed Operation NPRM* at ¶ 84.

[148] *See 3650 MHz Service Rules Second Notice*, 15 FCC Rcd at 20533 ¶ 115. *See also* 47 C.F.R. §101.111.

band.[149] Comments to that earlier proposal were divided.[150] In that context, the Commission proposed in the *3650 MHz Service Rules Notice* to require that terrestrial service equipment operating in the 3650-3700 MHz band comply with the emission limits already in place for FS operation in the adjacent 3700-4200 MHz band.[151] Commenters to that proposal were similarly split on what criterion to apply.

75. We adopt rules here to require that new terrestrial operations in the 3650 MHz band limit emissions into the adjacent 3600-3650 MHz and 3700–4400 MHz bands by a minimum attenuation of 43 + 10 log(P) below the transmit power. That is, the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P). We note that this requirement is consistent with the out of band emission limit specified in several of the Commission rule parts (reference) for wireless devices including higher power devices. Furthermore, the limit specified in this section is a generic limit that has been applied successfully for many of our wireless services. Finally, we note that this limit is very conservative, especially for coded digital signals which generally decay more rapidly and produce lower levels of out of band emission than analog signals. On balance, therefore, we believe that this criterion should provide appropriate protection from out of band emission.

76. *Space station power flux density*. In the *3650 MHz Service Rules Notice* we sought comment on whether we should adopt a rule for the power flux density (pfd) that a space station operating in the 3650-3700 MHz band may produce consistent with the limit for space stations in the adjacent 3700-4200 MHz band. The limit for the 3700-4200 MHz band, which is contained in Section 25.208(a) of the Commission's rules,[152] is identical to the limit in the ITU Radio Regulations, which applies throughout the 3400-4200 MHz band. One commenter supports applying the same pfd limit in the 3650-3700 MHz band as we do to the upper adjacent band.[153] In order to conform our rules in this regard to the ITU Radio Regulations, we will apply the same pfd limit in the 3650-3700 MHz band as we do in the 3700-4200 MHz band.

IV. MEMORANDUM OPINION AND ORDER

77. In this MO&O we address several petitions for reconsideration and an emergency motion for stay that were filed in response to the *3650 MHz Allocation Order* in ET Docket No. 98-237.

A. Statutory Considerations

78. The Coalition, Lockheed Martin and Immarsat argue, among other things, that the Commission improperly based its allocation decisions in the *3650 MHz Allocation Order* on expectation

[149] *See 3650 MHz Service Rules Notice* at ¶ 110, citing *Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band*, ET Docket No. 98-237, Notice of Proposed Rule Making and Order, 14 FCC Rcd at 1295, at 1303-04 (¶ 11) (1998).

[150] For example, FSS operators requested that a stricter limit of 60 + 10log(p) dB be placed on FS operations in the 3650-3700 MHz band. In addition, Nortel recommended that we require that at the edge of the 50 megahertz block in any 30 kHz bandwidth, unwanted emission spectral power density be attenuated by at least (i) 10 dB at the band edge; (ii) 25 dB at 200-400 kHz from the band edge; (iii) 25 dB at 400 kHz to 50 dB at 3.0 MHz offset, linearly interpolated; (iv) 50 dB beyond 3 MHz from the band edge or in any one MHz band which is removed more than 250% of the necessary bandwidth at least 43 + 10 log (Pmean) dB or 80 dB whichever is less stringent, where Pmean is the mean output power of the transmitter in watts. *See 3650 MHz Service Rules Notice* at ¶ 110.

[151] *Id*. at ¶111.

[152] *See* 47 C.F.R.§ 25.208(a).

[153] Astrolink comments at 10.

of revenue. It is further argued that the decision to substitute the 50 megahertz of spectrum in the 3650-3700 MHz band for the 15 megahertz to fulfill the Commission's statutory obligations (identified by certain statutory provisions for other frequency bands) was flawed.

79. Consistent with our conclusion in the *Unlicensed Operation NPRM*, we find no statutory obstacle to our decision to affirm our previous allocation decision.[154] In the *Unlicensed Operation NPRM*, we concluded that we do not have any remaining statutory obligations under Section 3002 of the BBA.[155] Moreover, in consideration of our decision discussed more fully above to adopt a licensing approach that does not result in the acceptance of mutually-exclusive applications, the arguments presented by satellite interests to the effect that the Commission inappropriately determined that the 3650 MHz band could satisfy the requirements of Section 3002 of the BBA are moot.[156]

B. Allocation issues

80. Petitioners generally challenge the rules adopted in the *3650 MHz Allocation Order* that created a new, primary FS/MS allocation and made future, non-grandfathered FSS earth stations secondary. Among others, the Extended C-Band Ad Hoc Coalition (C-Band Coalition) argues that the record demonstrates a demand for satellite services but little support for proposed FS in the band. Lockheed Martin, Inmarsat and the C-Band Coalition further generally argue that the Commission did not consider the significant potential for sharing between FS/FSS even though certain commenters provided evidence to support sharing, and that the Commission must address technical sharing issues before deciding whether to eliminate future primary FSS operations. For example, Inmarsat argues that FSS earth stations don't need exclusion zones defined by coordination contours; and that mitigation factors can be used for sharing. The C-Band Coalition further argues that most potential FS providers did not support the FS allocation and that, consequently, the decision in 3650 MHz Allocation Order is not supported by substantial evidence and is not rational.

81. In the *NPRM*, we asked for comments to refresh the record on the full range of allocation, technical, service and licensing issues raised in this proceeding - including the possibility of revisiting the FSS allocation status in the 3650 MHz band. Thus, we have considered anew the potential benefit of different sharing mechanisms in light of this renewed and expanded record. With more specific relation to these petitions for reconsideration, our decision here affirms the FSS allocation changes made in the *3650 MHz Allocation Order*. In essence, we have decided that it is desirable to foster new terrestrial services under the FS/MS allocations while protecting a relatively small and static number of grandfathered FSS earth stations in the band. We accomplish this goal by providing a mechanism (under a streamlined licensing approach) for preventing and addressing any interference concerns of FSS earth

[154] *Unlicensed Operation NPRM*, 19 FCC Rcd 7545 (¶¶ 19-21).

[155] We also found that, to the extent that it might be argued that our obligations under Section 3002 remain unfulfilled, several alternative options exist with which to fulfill them. *Id.*

[156] *See, e.g.,* Extended C-Band Coalition Petition at 15-16 (suggesting that Commission inappropriately based allocation decision on expectation of auction revenues); Lockheed Martin Petition at 3, 7 (substitution of 3650 MHz band spectrum to fulfill statutory obligations was arbitrary and unwarranted); Inmarsat Petition at 5-6 (Commission erred in concluding that 3650 MHz band was an "equivalent and viable substitute" for 15 megahertz of spectrum in the 1990-2110 MHz range). We note that in accordance with Section 3002(c)(4) of the BBA, it was NTIA that identified alternative frequencies that included, among others, the 3650 MHz band as possible substitutes for the required assignment of 15 MHz. *See* Identification of Alternate Bands in Response to the Balanced Budget Act of 1997, NTIA 98-39 (Nov. 1998),at 25-29. Moreover, a statutory condition of the recommendation for such substitution required that the alternative spectrum "better serve the public interest, convenience, and necessity" and that "the alternative could reasonably be expected to produce comparable receipts." *See* The Balanced Budget Act of 1997, Section 3002(c)(4), Pub. L. 105-33, 111 Stat. 251-258 (1997) ("BBA").

stations that might arise from sharing the band with terrestrial operations. We thus find that our decision strikes a balance among a number of competing factors in a manner that we believe will best serve the public interest and foster the expeditious introduction of new terrestrial services in the 3650 MHz band.

82. In light of our full review of the refreshed record in this proceeding, and in light of the decisions made in the companion Order, we thus deny the aspects of the petitions that challenge and seek to reverse the allocation decisions made in the *3650 MHz Allocation Order*.

C. TT&C Issues

83. In the *3650 MHz Allocation Order*, we denied a petition for rulemaking insofar as it requested the designation of ten megahertz of spectrum within the 3650-3700 MHz band exclusively for Tracking, Telemetry and Command (TT&C).[157] We noted that Part 2 of our rules allow the 3650-3700 MHz band to be used for TT&C under the FSS allocation provided they support an FSS system.[158] Although we dismissed without prejudice the petition insofar as it requested that FSS licensees with systems operating outside the 3650-3700 MHz band (e.g., Ka and V band satellite systems) be allowed to use the band for TT&C, we raised this issue in the 3650 MHz Service Rules Notice. Furthermore, the *3650 MHz Allocation Order* determined that existing TT&C earth stations in the 3650-3700 MHz band would be treated the same as other earth stations in the band (i.e., existing earth stations and applications submitted prior to Dec. 1, 2000 would have primary status) but would only be protected for the frequencies already authorized for TT&C use. We also stated that any other TT&C site that received grandfathering protection would also be protected only for the specific frequencies for which the site was authorized to operate on pursuant to its license.

84. The Extended C-Band Ad Hoc Coalition (Coalition) argues that the November 30, 2000 deadline for filing co-primary earth stations applications is arbitrary and unsupported by the record. The Coalition argues that new satellites, particularly in the Ka and V bands, need access to the 3650 MHz band for TT&C purposes because propagation anomalies (such as rain fade) in higher frequency bands makes them unsuitable for such use. Among other concerns, the Coalition further argues that equipment for TT&C does not exist for higher bands, and that allowing the TT&C operations in the 3650 MHz band would increase system reliability and reduce operational costs. They further argue that the FCC filed advance publication and coordination information with the ITU to cover use of the 3650 MHz band for TT&C links by future satellites in the Ka and V bands. The Coalition also argues that TT&C downlinks require only a small number of earth stations using a limited amount of spectrum. In light of these assertions, the Coalition seeks reconsideration to allow the operation of new TT&C earth stations on a primary basis in the 3650 MHz band, including out-of-band Ka and V band systems, within the protected 10 mile zone around incumbent grandfathered earth stations that was established by the *FSS Freeze MO&O*. Other parties, such as GE Americom and Inmarsat, generally support the Coalition's arguments for modifying the filing deadline for co-primary TT&C earth stations, including use of the 3650 MHz band for TT&C by out-of-band Ka and V band satellite systems.

85. Echostar requests that the FCC clarify its intent to exempt from the FSS application "freeze" all future requests by earth stations for TT&C operations that serve satellites already authorized in the 3650 MHz band, including new uplink sites such as EchoStar's Gilbert, AZ site. In that regard, Echostar states that it desires to have the flexibility of using various earth stations for TT&C if, for example, one of its satellites were to be moved to a different orbit location. If this was not the Commission's intent, Echostar requests that we reconsider the decision and provide for this flexibility of TT&C operations that serve already authorized satellite systems.

[157] *See 3650 MHz Allocation Order* at ¶ 33.

[158] *Id*.

86. Along similar lines, Lockheed Martin requests that we remove the restriction on grandfathered TT&C sites to frequencies for which the ES is already licensed, and allow new frequencies for TT&C subject to coordination. In support, Lockheed argues that these restrictions curtail the range of choices for TT&C sites, and that new satellite design or services could require change in TT&C frequency or power levels. Lockheed further argues that secondary status for TT&C is problematic and, since satellite operators would not invest in a secondary TT&C operation at 3650 MHz, the Commission's decision does not help alleviate congestion in the adjacent 3700-4200 MHz band.

87. We deny the petitions the reconsideration insofar as they request that we allow in the 3650 MHz band new TT&C earth stations on a primary basis for out-of-band FSS systems. We conclude, as we stated in the *3650 MHz Service Rules Notice*, that the basic purpose of our Part 25 in-band rules for TT&C is valid. Rule section 25.202(g) effectively limits FSS operators to operating TT&C links in the same frequency bands as their FSS operations. Thus, a GSO/FSS operator will generally coordinate its TT&C operations with the same set of satellites, at adjacent orbital locations, with which it coordinates its FSS operations. This simplifies the coordination process for FSS systems and also provides an incentive for an operator to maximize the efficiency of a system's TT&C operations while minimizing the constraints placed on other satellite operations. Our decision also is based on a recognition that certain events have occurred since these petitions were filed that mitigate the need to provide the requested relief. We note, in particular, that we have since authorized satellite systems in the Ka band with TT&C links to be located within band. As a result, TT&C facilities are now available for Ka band systems. As for pending V band system applications, we believe that it is best to address the TT&C needs of particular systems in the context of acting on specific applications for waiver rather than modify our rule based on generalized arguments that some assigned frequency bands of satellite systems are so congested, unreliable, or lacking in manufactured equipment as to render in-band TT&C operations unfeasible.

88. With regard to the filing deadline for co-primary TT&C earth station applications, the secondary status of non-grandfathered TT&C sites, and the restriction on grandfathered TT&C sites to frequencies for which the earth station is already licensed, we believe that those aspects of the Commission's decision in the *3650 MHz Allocation Order* are necessary measures that help ensure the terrestrial operations under the primary FS/MS allocations are not unduly hampered. We thus decline to modify these decisions. Furthermore, we clarify that the decision in the *3650 MHz Allocation Order* was not intended to exempt from the FSS application "freeze," as EchoStar requests, any future requests for earth stations for TT&C operations that serve satellites already authorized in the 3650 MHz band, including new uplink sites. Nonetheless, we recognize that individual cases of particular need, particularly for systems already authorized for the 3650 MHz band, can be better addressed through a waiver process that would evaluate each request on its merit.

D. Emergency Motion for Stay

89. In October, 2000, the Commission determined that it was necessary to establish a limit on the acceptance of applications and on the construction of FSS facilities that would be considered primary under the established grandfathering provisions.[159] Accordingly, in the *3650 MHz Allocation Order,* the Commission decided that applications for FSS earth stations in the 3650-3700 MHz band located within 10 miles of the authorized coordinates of an existing grandfathered earth station must be filed prior to December 1, 2000, in order to still be considered co-primary.[160]

90. In response, the Coalition filed an "Emergency Motion for Stay Pending Reconsideration"

[159] *See 3650 MHz Allocation Order*, at ¶ 29.

[160] *Id.*. The Commission also stated that it would continue to accept applications subsequent to the end of the filing window for additional FSS earth stations, but that such additional earth stations would be considered secondary.

moving that the Commission issue a stay of the November 30, 2000, deadline by which satellite users were required to file new or modified applications for earth stations to operate space-to-Earth links on a co-primary basis in the 3650 MHz band.[161]

91. We deny the motion for stay. When the Commission established the November 30, 2000, filing deadline, it did so because it found that additional new FSS facilities permitted by the *Freeze MO&O* could affect the use of the 3650-3700 MHz band by the terrestrial services.[162] By deciding in this Order to maintain the FSS allocation changes made in the *3650 MHz Allocation Order*, we reaffirm our conclusion that allowing additional primary FSS earth stations in the 3650 MHz band could negatively affect the prospects for viable FS/MS terrestrial operations. In light of the foregoing, we conclude that granting the stay (with the possible consequence of establishing new FSS filing window, and thereby increasing the number of primary FSS earth stations in the band) would be directly counter to our fundamental judgments concerning future use of the 3650 MHz band and would not serve the public interest.

V. CONCLUSION

92. In this Order, we adopt a streamlined licensing approach to authorizing terrestrial operations in the 3650 MHz band that combines beneficial aspects of both an unlicensed and licensed regimes. We continue to believe that the 3650 MHz band is well suited to respond to the needs expressed by the growing number of entrepreneurial wireless Internet service providers (WISPs) for additional spectrum to provide broadband backhaul and connectivity, particularly to those customers located in rural areas of America's heartland that are often beyond the reach of traditional providers. Permitting terrestrial operation in the 3650 MHz band under the streamlined licensing approach adopted herein should facilitate the rapid deployment of advanced telecommunications services and technologies to all Americans, thus promoting the objectives of Section 706 of the Telecommunications Act of 1996.

VI. PROCEDURAL MATTERS

A. Final Regulatory Flexibility Analysis

93. A Final Regulatory Flexibility Analysis has been prepared for this Report and Order and is included in Appendix B.

B. Paperwork Reduction Analysis

94. This Report and Order contains new information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under Section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new information collection requirements contained in this proceeding. In addition, we note that the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), requires the Commission to consider ways to "further reduce the information collection burden for small business concerns with fewer than 25 employees."

95. In this Report and Order, we require entities, including business concerns with fewer than 25 employees, who are interested in using the 3650 MHz band for wireless services to acquire a wireless license and register their fixed and base stations before beginning to offer services in the band. The

[161] *See* Emergency Motion for Stay Pending Reconsideration, filed by Extended C-Band Coalition, November 29, 2000.

[162] *See 3650 MHz Allocation Order*, at ¶ 29

impact of this requirement on small businesses and those with few than 25 employees should be minimal. The licensing and registration process is simple and streamlined and will be done electronically utilizing the Commission's Universal Licensing System. As a result, businesses with fewer than 25 employees should be able to acquire a wireless license for this band without difficulty and with a minimum of burden. We believe that the licensing scheme we have adopted for this spectrum is ideally tailed to the needs of businesses with fewer than 25 employees and other entities with limited resources.

C. Congressional Review Act

96. The Commission will send a copy of this Report and Order in a report to be sent to Congress and the Government Accountability Office (GAO) pursuant to the Congressional Review Act, see 5 U.S.C. 801(a)(1)(A).

D. Contact Persons

97. For further information concerning this rule making proceeding contact: Gary Thayer at (202) 418-2290, Gary.Thayer@fcc.gov; Office of Engineering and Technology; Eli Johnson at (202) 418-1395, Eli.Johnson@fcc.gov; Wireless Telecommunications Bureau.

VII. ORDERING CLAUSES

98. Accordingly, IT IS ORDERED that, pursuant to the authority contained in Sections 4(i), 302, 303(e), 303(f), and 307 of the Communications Act of 1934, as amended, 47 USC Sections 154(i), 302, 303(c), 303(f), and 307 this Report and Order IS HEREBY ADOPTED.

99. IT IS FURTHER ORDERED that Parts 1, 2, 15, and 90 of the Commission's rules ARE AMENDED as specified in Appendix A, and such rule amendments shall be effective 30 days after publication of the text thereof in the Federal Register. This Report and Order contains information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13, that are not effective until approved by the Office of Management and Budget. The Federal Communications Commission will publish a document in the Federal Register following approval of the information collection by the Office of Management and Budget ("OMB") announcing the effective date of those rules.

100. IT IS FURTHER ORDERED that, pursuant to Sections 4(i), 302, 303(e), 303(f), 303(r) and 307 of the Communications Act of 1934, as amended, 47 USC Sections 154(i), 302, 303(e), 303(f), 303(r) and 307, the 3650 MHz Proceeding in ET Docket No. 98-237 IS TERMINATED.

101. IT IS FURTHER ORDERED that, pursuant to Sections 4(i), 302, 303(e) 303(f), 303(g), 303(r) and 405 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302, 303(e), 303(f), 303(g) and 405, that the petitions for reconsideration of the *3650 MHz Allocation Order* ARE DENIED.

102. IT IS FURTHER ORDERED that, pursuant to Sections 4(i), 302, 303(e) 303(f), 303(g), 303(r) and 405 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 302, 303(e), 303(f), 303(g) and 405, that the *Emergency Motion for Stay* of the *3650 MHz Allocation Order* IS DENIED.

103. IT IS FURTHER ORDERED that, pursuant to 47 U.S.C. § 155(c) and 47 C.F.R. §§ 0.131(c) and 0.331, the Wireless Telecommunications Bureau IS GRANTED DELEGATED AUTHORITY to adopt requirements regarding the reporting of registration and licensing information, pertaining to the 3650 MHz Wireless Broadband Services, in the Universal Licensing System database.

104. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this Report and Order and Memorandum Opinion and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A: Final Rules

For the reasons discussed in the preamble, the Federal Communications Commission amends 47 C.F.R. parts 2, 25, and 90 as follows:

PART 1 – PRACTICE AND PROCEDURE

1. The authority citation for Part 1 continues to read as follows:

AUTHORITY: 47 U.S.C. 151, 154(i), 154(j), 155, 225, 303(r), 309, and 325(e)

3. Section 1.1307 is amended by revising paragraph (b) (2) to read as follows:

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.

* * * * *

(2) (2) Mobile and portable transmitting devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services (PCS), the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services (ship earth stations only), the Specialized Mobile Radio Service, and the 3650MHz Wireless Broadband Service authorized under Subpart H of parts 22, 24, 25, 26, 27, 80, and 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in Sec. Sec. 2.1091 and 2.1093 of this chapter. Unlicensed PCS, unlicensed NII and millimeter wave devices are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use, as specified in Sec. Sec. 15.253(f), 15.255(g), 15.319(i), and 15.407(f) of this chapter. Portable transmitting equipment for use in the Wireless Medical Telemetry Service (WMTS) is subject to routine environment evaluation as specified in Sec. Sec. 2.1093 and 5.1125 of this chapter. Equipment authorized for use in the Medical Implant Communications Service (MICS) as a medical implant transmitter (as defined in Appendix 1 to Subpart E of part 95 of this chapter) is subject to routine environmental evaluation for RF exposure prior to equipment authorization, as specified in Sec.2.1093 of this chapter by finite difference time domain computational modeling or laboratory measurement techniques. Where a showing is based on computational modeling, the Commission retains the discretion to request that specific absorption rate measurement data be submitted. All other mobile, portable, and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure under Sec. Sec. 2.1091, 2.1093 of this chapter except as specified in paragraphs (c) and (d) of this section.

* * * * *

PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS

1. The authority citation for Part 2 continues to read as follows:

AUTHORITY: 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

2. Section 2.106, the Table of Frequency Allocations, is amended as follows:

a. Revise page 54.

b. In the list of United States footnotes, revise footnote US245.

c. In the list of non-Federal Government footnotes, remove footnote NG170 and add footnote NG185.

§ 2.106 Table of Frequency Allocations.

The revisions and additions read as follows:

* * * * *

2900-3100 RADIONAVIGATION 5.426 Radiolocation 5.425 5.427			2900-3100 MARITIME RADIONAVIGATION Radiolocation G56 5.427 US44 US316	2900-3100 MARITIME RADIONAVIGATION Radiolocation US44 5.427 US316	Maritime (80) Private Land Mobile (90)
3100-3300 RADIOLOCATION Earth exploration-satellite (active) Space research (active) 5.149 5.428			3100-3300 RADIOLOCATION G59 Earth exploration-satellite (active) Space research (active) US342	3100-3300 Radiolocation Earth exploration-satellite (active) Space research (active) US342	Private Land Mobile (90)
3300-3400 RADIOLOCATION 5.149 5.429 5.430	3300-3400 RADIOLOCATION Amateur Fixed Mobile 5.149 5.430	3300-3400 RADIOLOCATION Amateur 5.149 5.429	3300-3500 RADIOLOCATION US108 G31 US342	3300-3500 Amateur Radiolocation US108 US342 5.282	Private Land Mobile (90) Amateur (97)
3400-3600 FIXED FIXED-SATELLITE (space-to-Earth) Mobile Radiolocation 5.431	3400-3500 FIXED FIXED-SATELLITE (space-to-Earth) Amateur Mobile Radiolocation 5.433 5.282 5.432				
	3500-3700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 5.433		3500-3650 RADIOLOCATION G59 AERONAUTICAL RADIONAVIGATION (ground-based) G110 US245	3500-3600 Radiolocation 3600-3650 FIXED-SATELLITE (space-to-Earth) US245 Radiolocation	Private Land Mobile (90)
3600-4200 FIXED FIXED-SATELLITE (space-to-Earth) Mobile			3650-3700 US348 US349	3650-3700 FIXED FIXED-SATELLITE (space-to-Earth) NG169 NG185 MOBILE except aeronautical mobile US348 US349	Satellite Communications (25) Private Land Mobile (90)
	5.435				
	See next page for 3700-4200 MHz		See next page for 3700-4200 MHz	See next page for 3700-4200 MHz	See next page for 3700-4200 MHz

* * * * *

UNITED STATES (US) FOOTNOTES

* * * * *

US245 In the bands 3600-3650 MHz (space-to-Earth), 4500-4800 MHz (space-to-Earth), and 5850-5925 MHz (Earth-to-space), the use of the non-Federal fixed-satellite service is limited to international inter-continental systems and is subject to case-by-case electromagnetic compatibility analysis. The FCC's policy for these bands is codified at 47 C.F.R. § 2.108.

* * * * *

NON-FEDERAL (NG) FOOTNOTES

* * * * *

NG185 In the band 3650-3700 MHz, the use of the non-Federal fixed-satellite service (space-to-Earth) is limited to international inter-continental systems.

* * * * *

3. Section 2.1091 is amended by revising paragraph (c) to read as follows:

§ 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

* * * * *

(c) Mobile devices that operate in the Cellular Radiotelephone Service, the Personal Communications Services, the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services and the Specialized Mobile Radio Service, and the 3650MHz Wireless Broadband Service authorized under subpart H of part 22 of this chapter, parts 24, 25, 26 and 27 of this chapter, part 80 of this chapter (ship earth stations devices only) and part 90 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more. Unlicensed personal communications service devices, unlicensed millimeter wave devices and unlicensed NII devices authorized under §§ 15.253, 15.255, and 15.257, and subparts D and E of part 15 of this chapter are also subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if their ERP is 3 watts or more or if they meet the definition of a portable device as specified in § 2.1093(b) requiring evaluation under the provisions of that section. All other mobile and unlicensed transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§ 1.1307(c) and 1.1307(d) of this chapter. Applications for equipment authorization of mobile and unlicensed transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

4. Section 2.1093 is amended by revising paragraph (c) to read as follows:

§ 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

* * * * *

(c) Portable devices that operate in the Cellular Radiotelephone Service, the Personal Communications Service (PCS), the Satellite Communications Services, the General Wireless Communications Service, the Wireless Communications Service, the Maritime Services, the Specialized Mobile Radio Service, the 3650 MHz Wireless Broadband Service, the 4.9 GHz Band Service, the Wireless Medical Telemetry Service (WMTS) and the Medical Implant Communications Service (MICS), authorized under subpart H of part 22 of this chapter, parts 24, 25, 26,27, 80 and 90 of this chapter, subparts H and I of part 95 of this chapter, and unlicensed personal communication service, unlicensed NII devices and millimeter wave devices authorized under subparts D and E, §§ 15.253, 15.255 and 15.257 of this chapter are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use. All other portable transmitting devices are categorically excluded from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in §§ 1.1307(c) and 1.1307(d) of this chapter. Applications for equipment authorization of portable transmitting devices subject to routine environmental evaluation must contain a statement confirming compliance with the limits specified in paragraph (d) of this section as part of their application. Technical information showing the basis for this statement must be submitted to the Commission upon request.

* * * * *

PART 25 – SATELLITE COMMUNICATIONS

5. The authority citation for Part 25 continues to read as follows:

AUTHORITY: 47 U.S.C. 701-744. Interprets or applies Sections 4, 301, 302, 307, 309 and 332 of the Communications Act, as amended, 47 U.S.C. Sections 154, 301, 302, 307, 309 and 332, unless otherwise noted.

6. Section 25.202 is amended by adding an entry for 3.65-3.7 GHz and a new footnote 17 to the table in paragraph (a)(1) to read as follows:

§ 25.202 Frequencies, frequency tolerance and emission limitations.

(a)(1) * * *

Space-to-Earth (GHz)	Earth-to-space (GHz)
3.65-3.7 [17] * * * * *	* * * * *

* * * * *

[17] FSS earth stations in this band must operate on a secondary basis to terrestrial radiocommunication services, except that the band is shared co-equally between certain grandfathered earth stations and the terrestrial radiocommunication services.

* * * * *

7. Section 25.208 is amended by revising the heading and by revising the first sentence of paragraph (a) to read as follows:

§ 25.208 Power flux-density limits.

* * * * *

(a) In the band 3650-4200 MHz, the power flux density at the Earth's surface produced by emissions from a space station for all conditions and for all methods of modulation shall not exceed the following values:

* * * * *

8. Part 25 is amended by adding a new section 25.256 to read as follows:

§ 25.256 Special Requirements for operations in the 3.65-3.7 GHz band.

Upon request from a terrestrial licensee authorized under Subpart Z, Part 90 that seeks to place base and fixed stations in operation within 150 km of a primary earth station, licensees of earth stations operating on a primary basis in the fixed satellite service in the 3.65-3.7 GHz band must negotiate in good faith with that terrestrial licensee to arrive at mutually agreeable operating parameters to prevent unacceptable interference.

PART 90 – PRIVATE LAND MOBILE RADIO SERVICES

1. The authority citation for Part 90 continues to read as follows:

AUTHORITY: Sections 4(i), 11, 303(g), 303(r), and 332(c)(7) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 161, 303(g), 303(r), 332(c)(7).

2. The table of contents for Part 90 is amended by adding subpart Z as follows:

* * * * *

Subpart Z – 3650 MHz Wireless Broadband Services

3. Section 90.7 is amended by adding a new definition, in the alphabetically-appropriate location, as follows:

§ 90.7 Definitions.

* * * * *

Contention-based protocol. A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate. Such a protocol may consist of procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel.

* * * * *

4. Section 90.203 is amended by adding a new paragraph (o), to read as follows:

§ 90.203 Certification required.

* * * * *

(o) Equipment certification for transmitters in the 3650-3700 MHz band.

(1) Applications for all transmitters must describe the methodology used to meet the requirement that each transmitter employ a contention based protocol (see §§ 90.7, 90.1305 and 90.1321 of this part);
(2) Applications for mobile transmitters must identify the base stations with which they are designed to communicate and describe how the requirement to positively receive and decode an enabling signal is incorporated (see § 90.1333 of this part); and
(3) Applications for systems using advanced antenna technology must provide the algorithm used to reduce the equivalent isotropically radiated power (EIRP) to the maximum allowed in the event of overlapping beams (see § 90.1321 of this part).
(4) Applications for fixed transmitters must include a description of the installation instructions and guidelines for RF safety exposure requirements that will be included with the transmitter. (See § 90.1335).

5. A new subpart Z is added to read as follows;

Subpart Z - Wireless Broadband Services in the 3650-3700 MHz Band

§ 90.1301 Scope.

This subpart sets out the regulations governing wireless operations in the 3650-3700 MHz band. It includes licensing requirements, and specific operational and technical standards for wireless operations in this band. The rules in this subpart are to be read in conjunction with the applicable requirements contained elsewhere in the Commission's rules; however, in case of conflict, the provisions of this subpart shall govern with respect to licensing and operation in this band.

§ 90.1303 Eligibility.

Any entity, other than those precluded by section 310 of the Communications Act of 1934, as amended, 47 U.S.C. 310, is eligible to hold a license under this part.

§ 90.1305 Permissible operations.

Use of the 3650-3700 MHz band must be consistent with the allocations for this band as set forth in Part 2 of the Commission's Rules. All stations operating in this band must employ a contention-based protocol (as defined in Section 90.7).

§ 90.1307 Licensing.

The 3650-3700 MHz band is licensed on the basis of non-exclusive nationwide licenses. Non-exclusive nationwide licenses will serve as a prerequisite for registering individual fixed and base stations. A licensee cannot operate a fixed or base station before registering it under its license and licensees must delete registrations for unused fixed and base stations.

§ 90.1309 Regulatory status.

Licensees are permitted to provide services on a non-common carrier and/or on a common carrier basis. A licensee may render any kind of communications service consistent with the regulatory status in its license and with the Commission's rules applicable to that service.

§ 90.1311 License Term.

Because the licensee will obtain a single license for all of its facilities, the license renewal period will be ten years from the registration of the first fixed or base station. Adding fixed and base stations will not change the overall renewal period of the license.

§ 90.1312 Assignment and Transfer.

Licensees may assign or transfer their non-exclusive nationwide licenses, and any fixed or base stations registered under those licenses will remain associated with those licenses.

§ 90.1319 Policies governing the use of the 3650-3700 MHz band.

(a) Channels in this band are available on a shared basis only and will not be assigned for the exclusive use of any licensee

(b) Any base, fixed, or mobile station operating in the band must employ a contention-based protocol.

(c) All applicants and licensees shall cooperate in the selection and use of frequencies in the 3650-3700 MHz band in order to minimize the potential for interference and make the most effective use of the authorized facilities. A database identifying the locations of registered stations will be available at <http://wireless.fcc.gov/uls>. Licensees should examine this database before seeking station authorization, and make every effort to ensure that their fixed and base stations operate at a location, and with technical parameters, that will minimize the potential to cause and receive interference. Licensees of stations suffering or causing harmful interference are expected to cooperate and resolve this problem by mutually satisfactory arrangements.

§ 90.1321 Power and antenna limits.

(a) Base and fixed stations are limited to 25 watts/25 MHz equivalent isotropically radiated power (EIRP). In any event, the peak EIRP power density shall not exceed 1 Watt in any one-megahertz slice of spectrum.

(b) In addition to the provisions in paragraph (a) of this section, transmitters operating in the 3650-3700 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(1) Different information must be transmitted to each receiver.

(2) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (a) of this section, as applicable. The directional antenna gain shall be computed as follows:

(i) The directional gain, in dBi, shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain, in dBi, of the individual element or stave having the highest gain.

(ii) A lower value for the directional gain than that calculated in paragraph (b)(2)(i) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beam-forming.

(3) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels and if transmitted beams overlap, the power shall be reduced to ensure that the aggregate power from the overlapping beams does not exceed the limit specified in paragraph (b)(2) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (b)(2) of this section by more than 8 dB.

(4) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (b)(2) of this section.

(c) Mobile and portable stations are limited to 1 watt/25 MHz EIRP. In any event, the peak EIRP density shall not exceed 40 milliwatts in any one-megahertz slice of spectrum.

§ 90.1323 Emission limits.

(a) The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or less, but at least one percent of the emission bandwidth of the fundamental emission of the transmitter, provided the measured energy is integrated over a 1 MHz bandwidth.

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

§ 90.1331 Restrictions on the operation of base and fixed stations.

(a) (1) Except as provided in paragraph (a)(2) of this section, base and fixed stations may not be located within 150 km of any grandfathered satellite earth station operating in the 3650-3700 MHz band. The coordinates of these stations are available at [website].

(2) Base and fixed stations may be located within 150 km of a grandfathered satellite earth station provided that the licensee of the satellite earth station and the 3650-3700 MHz licensee mutually agree on such operation.

(3) Any negotiations to enable base or fixed station operations closer than 150 km to grandfathered satellite earth stations must be conducted in good faith by all parties.

(b) (1) Except as specified in paragraph (b)(2) of this section, base and fixed stations may not be located within 80 km of the following Federal Government radiolocation facilities:

St. Inigoes, MD - 38° 10' N., 76°, 23' W.
Pascagoula, MS - 30° 22' N., 88°, 29' W.
Pensacola, FL 30° 21' 28" N., 87°, 16' 26" W.

Note: Licensees installing equipment in the 3650-3700 MHz band should determine if there are any nearby Federal Government radar systems that could affect their operations. Information regarding the location and operational characteristics of the radar systems operating adjacent to this band are provided in NTIA TR-99-361.

(2) Requests for base or fixed station locations closer than 80 km to the Federal Government radiolocation facilities listed in paragraph (b)(1) of this section will only be approved upon successful coordination by the Commission with NTIA through the Frequency Assignment Subcommittee of the Interdepartmental Radio Advisory Committee.

§ 90.1333 Restrictions on the operation of mobile and portable stations.

(a) Mobile and portable stations may operate only if they can positively receive and decode an enabling signal transmitted by a base station.

(b) Any mobile/portable stations may communicate with any other mobile/portable stations so long as each mobile/portable can positively receive and decode an enabling signal transmitted by a base station.

(c) Airborne operations by mobile/portable stations is prohibited.

§90.1335 RF safety.

Licensees in the 3650-3700 MHz band are subject to the exposure requirements found in Sections 1.1307(b), 2.1091 and 2.1093 of our Rules.

§90.1337 Operation near Canadian and Mexican borders.

(a) Fixed devices generally must be located at least 8 kilometers from the U.S./Canada or U.S./Mexico border if the antenna of that device looks within the 160° sector away from the border. Fixed devices must be located at least 56 kilometers from each border if the antenna looks within the 200° sector towards the border.

(b) Fixed devices may be located nearer to the U.S./Canada or U.S./Mexico border than specified in paragraph (a) of this section only if the Commission is able to coordinate such use with Canada or Mexico, as appropriate.

(c) Licensees must comply with the requirements of current and future agreements with Canada and Mexico regarding operation in U.S./Canada and U.S./Mexico border areas.

APPENDIX B: Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),[163] an Initial Regulatory Flexibility Analysis ((IFRA) was incorporated in the Notice of Proposed Rule Making (NPRM), "*Unlicensed Operation in the Band 3650-3700 MHz."* [164] The Commission sought written public comments on the proposals in the NPRM, including comment on the IRFA. This Final Regulatory Flexibility Analysis conforms to the RFA.[165]

A. Need for, and Objectives of, the Report and Order

The Report and Order ("Order") adopts rules that provide for nationwide, non-exclusive, licensing of terrestrial operations, utilizing contention-based technologies, in the 3650-3700 MHz band (3650 MHz band).

The Order would take the following actions:

- Maintain the existing Fixed Satellite Service (FSS) and Fixed Service (FS) allocations and modify the Mobile Service (MS) allocation to delete the restriction against mobile-to-mobile operations in the 3650 MHz band. The Order would also maintain the international / intercontinental operation requirements for FSS earth stations.

- Adopt a streamlined licensing mechanism that will serve as a safeguard to protect incumbent satellite earth stations and Federal Government radiolocation stations from harmful interference

- Establish minimal regulatory entry requirements that should encourage multiple entrants and stimulate the rapid expansion of broadband services - especially in rural America

- Establish licensing, service and technical rules that allow fixed, and base-station-enabled mobile terrestrial operations

B. Summary of Significant Issues Raised by Public Comments in Response to the IRFA

None.

C. Description and Estimate of the Number of Small Entities to Which Rules Will Apply

The RFA directs agencies to provide a description of, and, where feasible, an estimate of, the number of small entities that may be affected by the rules adopted herein.[166] The RFA generally defines the term "small entity" as having the same meaning as the terms, "small business," "small organizations," and "small governmental jurisdiction."[167] In addition, the term "small business" has the same meaning as the

[163] *See* 5 U.S.C. § 603. The RFA, *see* 5 U.S.C. §§ 601-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Public Law 104-121, Title II, 110 Stat. 857 (1996).

[164] *See Notice of Proposed Rule Making* in ET Docket No. 04-151, 19 FCC Rcd 7545 (7580) (2004).

[165] *See* 5 U.S.C. § 604.

[166] *See* 5 U.S.C. § 604(a)(3).

[167] 5 U.S.C. § 601(6).

term "small business concern" under the Small Business Act.[168] A "small business concern" is one which: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[169] Nationwide, there are a total of 22.4 million small businesses, according to SBA data.[170]

A "small organization" is generally "any not-for-profit enterprise which is independently owned and operated and is not dominant in its field."[171] Nationwide, there are approximately 1.6 million small organizations.[172] The term "small governmental jurisdiction" is defined as "governments of cities, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand."[173] As of 1997, there were approximately 87,453 governmental jurisdictions in the United States.[174] This number includes 39,044 county governments, municipalities, and townships, of which 37,546 (approximately 96.2%) have populations of fewer than 50,000, and of which 1,498 have populations of 50,000 or more. Thus, we estimate the number of small governmental jurisdictions overall to be 84,098 or fewer.

The Commission has not developed a definition of small entities applicable to manufacturers of communications devices that are licensed on a nationwide, non-exclusive basis. Therefore, we will utilize the SBA definition applicable to Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing. Examples of products in this category include "transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment"[175] and may include other devices that transmit and receive IP-enabled services, such as personal digital assistants (PDAs). Under the SBA size standard, firms are considered small if they have 750 or fewer employees.[176] According to Census Bureau data for 1997, there were 1,215 establishments[177] in this category that operated for the entire

[168] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small-business concern" in the Small Business Act, 15 U.S.C. § 632). Pursuant to 5 U.S.C. § 601(3), the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register."

[169] 15 U.S.C. § 632.

[170] *See* SBA, Programs and Services, SBA Pamphlet No. CO-0028, at page 40 (July 2002).

[171] *See* 5 U.S.C. § 601(4).

[172] Independent Sector, The New Nonprofit Almanac & Desk Reference (2002).

[173] 5 U.S.C. § 601(5).

[174] U.S. Census Bureau, Statistical Abstract of the United States: 2000, Section 9, pages 299-300, Tables 490 and 492.

[175] Office of Management and Budget, North American Industry Classification System, pages 308-09 (1997) (NAICS code 334220).

[176] 13 C.F.R. § 121.201, NAICS code 334220.

[177] The number of "establishments" is a less helpful indicator of small business prevalence in this context than would be the number of "firms" or "companies," because the latter take into account the concept of common ownership or control. Any single physical location for an entity is an establishment, even though that location may be owned by a different establishment. Thus, the numbers given may reflect inflated numbers of businesses in this category, including the numbers of small businesses. In this category, the Census breaks-out data for firms or companies only to give the total number of such entities for 1997, which was 1,089.

year.[178] Of those, there were 1,150 that had employment of under 500, and an additional 37 that had employment of 500 to 999. The percentage of wireless equipment manufacturers in this category was approximately 61.35%,[179] so we estimate that the number of wireless equipment manufacturers with employment of under 500 was actually closer to 706, with and additional 23 establishments having employment of between 500 and 999. Consequently, we estimate that the majority of wireless communications equipment manufacturers that may be affected by our action are small entities.

D. Description of Projected Reporting, Recordkeeping, and Other Compliance Requirements for Small Entities

The terrestrial service operations authorized by this Order will be governed by new regulations that will be housed in Part 90 of our rules. There presently exists a general requirement for all equipment to obtain certification under Part 90.[180] Thus, as with other Part 90 equipment, we will require manufacturers to obtain similar certification for their equipment.[181] Consequently, the new equipment certification rules adopted for Part 90 in this proceeding for transmitters operating the 3650-3700 MHz band would apply similar reporting or recordkeeping requirements. Further, the regulations add permissible operating frequencies for broadband and other technologically advanced uses. The adopted regulations would not require the modification of any existing products. Additionally, rules adopted for use of the 3650 MHz band require that all applicants and licensees shall cooperate in the selection and use of frequencies in the 3650-3700 MHz band in order to minimize the potential for interference and make the most effective use of the authorized facilities.[182] A database identifying the locations of registered stations will be available at the FCC's website to facilitate such cooperation.

E. Steps Taken to Minimize the Significant Economic Impact on Small Entities, and Significant Alternatives Considered

The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than design standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities. 5 U.S.C § 603.

In the NPRM, the Commission proposed a regulatory scheme for the 3650 MHz band that would have permitted unlicensed use of the band. The NPRM also sought comment on alternative approaches, including those that would provide for licensing of terrestrial operations. Based upon comments to the NPRM and further analysis, this Order adopts an approach that provides for nationwide, non-exclusive licensed operations. Consistent with the underlying goals expressed in the NPRM, we believe that this approach will best provide for the introduction of a new variety of broadband services and technologies in

[178] U.S. Census Bureau, 1997 Economic Census, Industry Series: Manufacturing, "Industry Statistics by Employment Size," Table 4, NAICS code 334220 (issued Aug. 1999).

[179] *Id*. Table 5.

[180] *See* 47 C.F.R. § 90.203.

[181] *See* Order at ¶ 69 – 70, *infra*.

[182] *See* adopted new rule § 90.1319 (c) in Appendix A.

the 3650 MHz band, while protecting grandfathered FSS earth station operations from harmful interference that may be caused by the new services and technologies.

We see no evidence that the rules set forth in the *Report and Order and Memorandum Opinion and Order* will have a significant economic impact on small entities. The costs involved in the selection and use of frequencies by affected entities, including small entities, should be minimal because of the available on-line database to assist with these efforts. Furthermore, these minimal costs will be shared by all entities that use the 3650 MHz band. In particular, as noted in the Report and Order, the streamlined licensing approach should also reduce the costs and regulatory barriers to obtaining a license.[183]

F. Report to Congress

The Commission will send a copy of the *Report and Order and Memorandum Opinion and Order*, including this FRFA, in a report to be sent to Congress and the Government Accountability Office, pursuant to the Congressional Review Act.[184] In addition, the Commission will send a copy of the *Report and Order and Memorandum Opinion and Order*, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the *Report and Order and Memorandum Opinion and Order* (or summaries thereof) will also be published in the Federal Register.[185]

[183] *See*, *e.g.*, *3650 MHz Order* at ¶¶ 27-29.

[184] *See* 5 U.S.C. § 801(a)(1)(A).

[185] *See* 5 U.S.C. § 604(b).

APPENDIX C: List Of Parties Filing Comments And Replies

Abe Rahey
Abe Voelker
Adam Brodel
Alan Cain
Alex Huppenthal
Altazip Inc
Alyrica Networks, Inc.
American Petroleum Institute
Attron Networks - Tony Weasler
Bart Preecs
BigTube Wireless, LLC
Bo Hamilton
Boyd Goodin
Branch Run Communications
Brett Glass
Brevard Wireless
Bruce Collins
Bryan Fields
Butch Evans, BPS Networks
Carol Acuff
Carol Shirley
Chad Teat
Charles Wu
Chase Phillips
Christapher James Hasher
Clyde Messinger
Coalition of C-Band Constituents
Comsearch
Dan Nyanko
Darrin Eden
David Lawrence
David R Hughes
Don Irmiger
Don L. Marshall
Doug Hair
Electronic Corportae Pages, Inc Tushar Patel
Endless Mountains
CyberSPACE
Eric Draven
Frank Muto
Geoffrey M. Silver
George Rogato
Gino Villarini
Greg Coffey
Hugh Hempel
IEEE 802
Industrial Telecommunications Association, Inc.
Intel Corporation
Intel Corporation
Jack Martin
Jack Unger
James M. McKinion
James P. Taylor
Jason Pottorf
Jason Straight
JC Randall
Jeffrey Sterling
Jerry Roy
Jim Martin
Joe Falaschi
John R. Worthington
John Stanton
John Thomas
John Vogel
Jon Langeler
Ken Walker
Kenneth DiPietro
Kevin Sullivan
Kewanee.com - Robert Bailleu
Kurt Fankhauser
Kurt Fankhauser
Laura Forlano
Lewey Taylor
MAP
Martin Moreno
Matthew R. Rantanen, Tribal Digital Village
Michael Boisse
Michael Falaschi
Michael J. Erskine
Michael Maranda
Michael Neuliep
Michiana Wireless - John Buwa
Mike Bushard Jr
Mike Dockstader
Mike Fennell
Motorola, Inc.
Motorola, Inc.
Mt. Vernon. Net, Inc. - John Scrivner
Nathan V Crook
Navini Networks, Inc.
Near You Networks - Rick Smith

Noah Miller
North Branch Consulting Group
North East Oregon Fastnet - Mark Koskenmaki
Northeast Texas Online, Inc.
NYCWireless, et al.
Odessa Office Equipment - Marlon K. Schafer
Old Colorado City Communications
OnlyInternet Broadband & Wireless, Inc. - Rick Harnish
PART-15.ORG
Paul Smith
Peter Palombella
Phil Kats
Philip Clever
Professor Christian Sandvig
Qorvus Systems, Inc. / Tom Sharples
R.J. Sussman
Richard Herrmann
Rick Mitchell
RNet Communications - William Edwards
Robert Trout
Rodney Lockhart
Ron Wallace
Sabryna Cornish
Sascha D. Meinrath
Satellite Industry Association
Satellite Industry Association
Satyanarayana Jasty
Sharon Schumacher
Skybeam - Matt Larsen
Southern Michigan Broadband, LLC - Eric Olmstead - President/CEO
Statewide Internet Services / Benjamin Winn
Stelios Valavanis
Sterling Jacobson
Stuart Pierce
Sue Sende Cole
Superior Wireless - Joe Laura
Thomas Harker
Tim Waite
Tropos Networks
Ty Carter
Vaxeo.com - Brad Armstrong
Very Fast Internet - Anthony Will
Virtual Network Services, Inc.
John Hokenson
Wireless Broadband Systems
Dan Metcalf
Michael Maranda
James L. Seibert Jr.
CUWIN, et al.
Tim Garthwaite
Stephen B. Ronan
Victor Pickard
J. Lynn
Donald K. Irmiger III
Sascha Meinrath
Robert Horvitz
Bruce Lai and Matthew Rubenstein
Matthew R. Rantanen/Southern California Tribal Digital Village
Laura Forlano
Haudy Kazemi
Peter Wainwright
Elaine Nelson
Chad Akins
Esmeralda Vos
Michael Keegan
Robert Keyes
Michael Keegan
Gary Sanders
John Cooper
Drew Celley
John Sundman
Valerie Scarlata
Andrew Ó Baoill
Darrin Eden
Steven White
Stelios Valavanis
Intel Corporation
Ursula Sindlinger
Bob Hrbek
CUWIN and Digital Tribal Village
NAF, et al.
TowerStream Corp. Bennet & Bennet, PLLC
Carol Shirley
Carol Acuff

APPENDIX D: A Methodology For Locating Fixed Stations Within The FSS Earth Station Protection Zone

The rules adopted herein require that fixed stations in the 3650-3700 MHz band be located at least 150 km from any grandfathered FSS earth station unless all affected licensees agree on closer spacing. Below, we present as an example, one methodology that can be used to determine a safe distance within the FSS earth station protection zone where a fixed station can be located without increasing the potential of that station to cause harmful interference to the earth station. We reiterate that this is being presented only as an example of one methodology. We recognize that there are many methods for providing the required protection, such as locating the fixed station behind an obstruction, and that licensees are free to propose any method they deem appropriate.

The 150 km protection zone is based on an analysis of the interference potential of a fixed station to a victim earth station under worst case operating conditions.[186] The methodology presented below recognizes that in most cases, the earth station does not operate in its worst case configuration. Using this fact, fixed stations can take advantage of the isolation provided by the higher elevation angles with which earth stations generally operate and transmit from locations within the protection zone without causing interference. This computed separation distance is based on the maximum level of interference noise power that may be caused to an FSS earth station.[187]

The Tables below show the assumptions and parameters used in our analysis:[188]

[186] As pointed out above, FSS earth stations must be protected for use of the full geostationary satellite arc. Thus, the worst case operating conditions are for a satellite operating at the extreme east or west edge of the arc with a 5^{o} elevation angle.

[187] The methodology presented herein does not assume any discrimination due to the pointing of the fixed station antenna (*e.g.*, the fixed station could be pointed directly away from the earth station). Thus, for fixed stations that use directional antennas better results than those calculated here can be achieved.

188 The maximum level of interference noise power caused to an FSS earth station is based on the earth station antenna gain at an off-axis angle θ (degrees) referred to the main beam axis. This is measured from the axis of the main beam of the earth station.

Table 1: Typical FSS Earth station parameters

Earth Stations	**3650-3700 MHz**					
Antenna reference pattern[189]	47 CFR §25.209 (a)(2)					
Off-axis gain towards the local horizon (dBi)[190,]	Elev. Angle	5°	15°	25°	35°	≥48°
	Off-axis gain	14.5	2.6	–2.9	–6.6	–10.0
Receive Bandwidth (range)	40 kHz-36 MHz					
Receive center frequency	3675 MHz					
Polarization	Linear or circular					
Earth station system noise temperature[191]	142.8^{o} K					
Deployment	All regions, in all locations (rural, suburban, urban)[192]					

Table 2: Fixed station parameters

Fixed stations	**Parameters**
Maximum transmit EIRP density	25 watts/25 MHz
Antenna type	Omni or directional

As mentioned, the methodology presented here takes advantage of the fact that earth stations are generally not operating in the worst case configuration. More specifically, we recognize that the elevation angle of an earth station varies in relationship to the position of the geostationary satellite with which it communicates.[193] Further, the range of pointing azimuths[194] and elevation angles that an earth station uses varies with its location – as earth stations are located at higher latitudes, the size of the visible

189 *See* recommendation ITU-R S.465. See also http://ntiacsd.ntia.doc.gov/ussg1/temp/TG1-8/052e+plen.doc.

The antenna radiation pattern in the plane of the horizon set forth in Section 25.209(a)(2) of our rules for earth stations pointing towards the geostationary arc is:

32-25*log10 (θ) dBi, for $1 \leq \theta < 48°$.

-10 dBi, for $48° \leq \theta \leq 180°$.

190 The values were derived by assuming a local horizon at 0° of elevation. Note that the off-axis antenna gain is independent of the earth station antenna diameter.

191 See SIA comments at 3 of Exhibit 1. The maximum interference permitted at the earth station receiver input is measured in terms of an increase to the earth station noise floor. An interference criterion typically used to quantify the amount of interference that can be tolerated by a satellite system or an earth station is known as the ΔT/T threshold. This criterion is related to the increase in system noise temperature and corresponds to the interference-to-noise ratio, I/N, (*i.e.,* 10 log (ΔT/T)).

192 FSS ES antennas in this band may be deployed in a variety of environments: smaller antennas (*e.g.,* 1.8m -3.8m) are commonly deployed on the roofs of buildings in urban or semi-urban locations , whereas larger antennas (4.5m and above) are typically mounted on the ground and deployed in semi-urban or rural locations.

193 All geostationary satellites are located approximately 36,000 km above the equator at 0^{o} latitude.

194 Azimuth is measured by using true north as the reference point. Thus an azimuth of north is 0^{o}, east is 90^{o}, south is 180^{o}, and west is 270^{o}.

geostationary arc decreases limiting the available azimuth angles and the elevation angles necessary to see these satellites gets lower.[195]

In the next sections, we will show how to calculate the minimum separation distance between a single fixed station and a single FSS earth station. Finally, we provide an example calculation of the minimum separation required separation distance of a fixed station from several FSS earth stations.

Section 1: Determine the MINIMUM separation distance between a single fixed station and a single FSS Earth station.

Several steps are necessary to determine the minimum separation distance between a fixed station and an FSS earth station. To make this calculation, the first step is to determine the location of the eastern and western limits of the visible geostationary arc for any given the fixed station location. Then, a calculation can be made to determine the discrimination angle (*i.e.,* off-axis angle) between the axis of the main beam of the earth station and the fixed station. Using this value, the earth station antenna gain in the direction of the fixed station can then be calculated. Finally, the minimum distance can be calculated.

Step 1: Determine the eastern and western limits of the visible geostationary arc for any FSS earth station. As previously stated, this corresponds to an earth station with a 5^o elevation angle

The elevation angle of an earth station can be calculated using the following formula: [196]

$$El = \arctan\left[\frac{\cos(\Delta) * \cos(Le) - 0.1512}{\sqrt{1 - \cos^2(\Delta) * \cos^2(Le)}}\right] \qquad \text{Equation 1}^{[197]}$$

Where:

El = Earth station elevation angle in degrees

Le= Earth station latitude in degrees

Δ =S-N

and

S = Satellite longitude in degrees

N= Earth station longitude in degrees

Rearranging Equation 1, yields:

$$\cos^2(\Delta)\cos^2(Le)(1+\tan^2(El)) - 2(0.1512)\cos(\Delta)\cos(Le) + (0.1512)^2 - \tan^2(El) = 0; \qquad \text{Equation 2}$$

[195] For example, a typical earth station located at 25^o north latitude has range of elevation angles between 5^o and 66^o. In contrast, an earth station located at 76.3^o north latitude can only see one satellite at a maximum elevation angle of 5 degrees, corresponding to 180 azimuth.

[196] The equations used in this analysis assume North latitude and West longitude.

[197] Douglas, Robert L. "Satellite Communications Technology". Prentice Hall Publishers. Englewood Cliffs, NJ, 1988, pg 89.

If we let X = cos(Δ)cos(Le), then

$$S = \arccos\left(\frac{X}{\cos(Le)}\right) + N$$

Where:

S = the westernmost satellite longitude visible to an earth station operating at 5^o elevation angle.

Then Equation 2 simplifies to a quadratic equation:

$a*X^2 + b*X + c = 0$[198] Equation 3

Where:

$a = (1+\tan^2(El))$;

$b = -2(0.1512)$;

$c = (0.1512)^2 - \tan^2(El)$

The practical root, X_1, of equation 3 can then be used to determine the deviation from the earth station longitude that defines the eastern and western limits of the visible geostationary arc.

If we let $W = \arccos\left(\frac{X_1}{\cos(Le)}\right)$

Where W = deviation from earth station longitude that defines visible geostationary arc

Then the visible geostationary arc is:

$(N - W) \leq$ visible Arc $\leq (N + W)$

Where: (N – W) and (N + W) are the easternmost and westernmost satellite longitudes visible to an earth station operating at 5^o elevation angle.

[198] This is solved using the quadratic formula to yield two roots X_1 and X_2

$X_1 = (-b + \text{sqrt}(b^2 - 4ac))/2a$;

$X_2 = (-b - \text{sqrt}(b^2 - 4ac))/2a$; this root is rejected because it provides a solution for a negative elevation angle.

This result can be converted from degrees longitude to a corresponding azimuth angle from true North. These azimuth angles are used in the steps that follow.[199]

$$Azimuth = 180 + \arctan\left[\frac{\tan(\Delta)}{\sin(Le)}\right]$$

Thus, the visible geostationary arc is:

$$180 + \arctan\left[\frac{\tan(-W)}{\sin(Le)}\right] \le \text{Visible Arc} \le 180 + \arctan\left[\frac{\tan(W)}{\sin(Le)}\right]$$

Step 2: Determine the angle between the axis of the main beam of the earth station and the fixed station (*i.e.,* off-axis angle, θx). This angle is calculated using the formula:[200]

$$\theta x = \arccos\left(\cos(El) * \cos(As - Af)\right) \qquad \text{Equation 4}^{201}$$

Where:

θx: off-axis angle[202];
El: Earth station elevation angle
As: Azimuth from earth station towards the satellite
Af: Azimuth from earth station towards the fixed station

Step 3: Determine the earth station antenna gain that corresponds to the value of θx.

$$Gd = 32 - 25 * \log(\theta x) \qquad \text{Equation 5}$$

Where:

Gd = earth station antenna gain in the direction of the fixed station

[199] Douglas, Robert L. "Satellite Communications Technology". Prentice Hall Publishers. Englewood Cliffs, NJ, 1988, pg. 91.

[200] The earth station antenna discrimination angle between the its pointing vector (*i.e.*, direction towards a satellite) and its local horizon in the direction of the fixed facility can be determined using vector dot products and spherical geometry. Dot product is defined by the equation: Dot(A, B) = ||A||*||B||*cos(θx). For the smooth earth case, the relationship reduces to cos(θx) = cos(EL)*cos(As – Af).

[201] The 150 km protection zone is based on a worst case scenario. This occurs when the axis of the main beam of the fixed station points directly towards the axis of the main beam of the earth station. In this scenario, As = Af and the off axis angle θx becomes equal to the earth station elevation angle, El. We note that in order for this worst case to occur, two independent stations would need to be perfectly aligned. Therefore, we believe the likelihood of this occurring to be very small.

[202] This is often referred to as the discrimination angle.

Step 4: Calculate the minimum separation distance required between the earth station and the fixed station based on the fixed station location and the earth station antenna gain in the direction of the fixed station.

$$Mfx = 18.17 * Exp^{(-0.055 * Gd)} \quad \text{Equation 6}$$

Where:

Mfx = variable accounting for all propagation losses other than free space (*e.g.*, multipath, etc.)[203]

Finally,

$$Dx \ (km) = \frac{150}{10^{\left[\frac{(-0.724 + Gd - Mfx)}{20}\right]}} \quad \text{Equation 7}$$

Where:

Dx = minimum separation distance in kilometers

Section 2: Example Calculation OF MINIMUM SEPARATION DISTANCE BETWEEN A FIXED STATION AND MULTIPLE EARTH STATIONS

This example assumes a fixed station located within 150 km of four earth stations.[204] The fixed station has an omnidirectional antenna and is located at 37° north latitude and 80° west longitude. It is assumed that the earth stations are located at the following coordinates.

Earth Station1: 38° North latitude; 80° west longitude - 111.20 km from fixed station

Earth Station2: 37° North latitude; 81° west longitude - 88.80 km from fixed station

Earth Station3: 36° North latitude; 80° west longitude - 111.20 km from fixed station

Earth Station4: 37.15° North latitude; 81° west longitude - 90.27 km from fixed station

[203] This term was created as a simplification of all the factors that account for propagation loss. It is a conservative estimation of loss based solely on the off axis discrimination angle (*i.e.*, the lower the elevation angle the greater the loss). This equation yields results consistent with the propagation model used by SIA in the analysis submitted in their comments.

[204] The great circle distance, D, between two points with coordinates {lat1, lon1} and {lat2, lon2} is given by:

D (km) = 6371* arccos(sin(lat1)*sin(lat2)+cos(lat1)*cos(lat2)*cos(lon1-lon2))

Using the approach described above, the full arc in azimuth for each earth station is:

Earth Station1: $100.95^o \leq$ Full Arc $\leq 259.05^o$

Earth Station2: $100.56^o \leq$ Full Arc $\leq 259.44^o$

Earth Station3: $100.17^o \leq$ Full Arc $\leq 259.83^o$

Earth Station4: $100.61^o \leq$ Full Arc $\leq 259.39^o$

The azimuth angle from each earth station to the fixed station can be computed:[205]

Earth Station1 Azimuth = 180 degrees;

Earth Station2 Azimuth = 90 degrees;

Earth Station3 Azimuth = 0 degrees.

Earth Station4 Azimuth = 100.35 degrees.

Now, the earth station off-axis angle can be calculated using equation 4:

Earth Station1 θx = arcos (cos(5)*cos(180-100.95)) = 79.09 degrees.

Earth Station2 θx = 11.67 degrees

Earth Station3 θx = 100.13 degrees

Earth Station4 θx = 5.0 degrees

Using the off axis angle, the antenna gain towards the fixed station is given by equation 5.

Earth Station1 Gd = -10 dBi

Earth Station2 Gd = 5.32 dBi

Earth Station3 Gd = -10 dBi

Earth Station4 Gd = 14.53 dBi

[205] Except for earth station4, the azimuth angles can be determined by inspection. In general, the following equations can be used to determine azimuth angle between two points:

phi = arcos((sin(lat2) - sin(lat1)*cos(D)) / (sin(D)*cos(lat1))); where D is the great circle distance between the two points under consideration

IF sin(lon2-lon1) < 0, Az = phi

IF sin(lon2-lon1) > 0, Az = 2*pi – phi

Note: these equations do not work if one point is located at the north or South Pole.

The corresponding separation distances can be determined by equations 6 and 7:

Required separation distance to Earth Station1, D1 = 37.45 km

Required separation distance to Earth Station2, D2 = 84.56 km

Required separation distance to Earth Station3, D3 = 37.45 km

Required separation distance to Earth Station4, D4 = 150 km

Finally, the required separation distance must be compared to the actual separation distance to ensure adequate protection of the earth station:

Earth Station1, D1 = 37.45 km < 111.20 km

Earth Station2, D2 = 84.56 km < 88.80 km

Earth Station3, D3 = 37.45 km < 111.20 km

Earth Station4, D4 = 150 km > 90.27 km

Therefore, the fixed station is sufficiently far from Earth Stations 1, 2, and 3 to provide interference protection. However, unless an agreement is negotiated, it cannot be located at its proposed location because it is not at a sufficient distance from Earth Station4 to provide the required interference protection.

Calculate the PROTECTION zone around an earth station

Using the methodology presented in this Appendix, a protection zone for an earth station smaller than the 150 km circle adopted in our rules can be calculated. To compute this protection zone, the equations of Section 1 can be solved iteratively for incremental values ranging from 0 to 360 degrees of the fixed station azimuth angle (Af). The figure shown below is an example of the calculated protection zone around an earth station located at 49° north latitude and 120° west longitude.[206] It is important to note that the earth station location used for this example is in the northern part of the U.S.[207] For more southern locations, the minimum separation distance at azimuths directly in front and back of the earth station would be smaller.

[206] The computed visible geostationary satellite arc ranges from -51.1° east longitude to 188.89° west longitude.

[207] This location was chosen for illustrative purposes only and does not imply that there is a grandfathered earth station at this location.

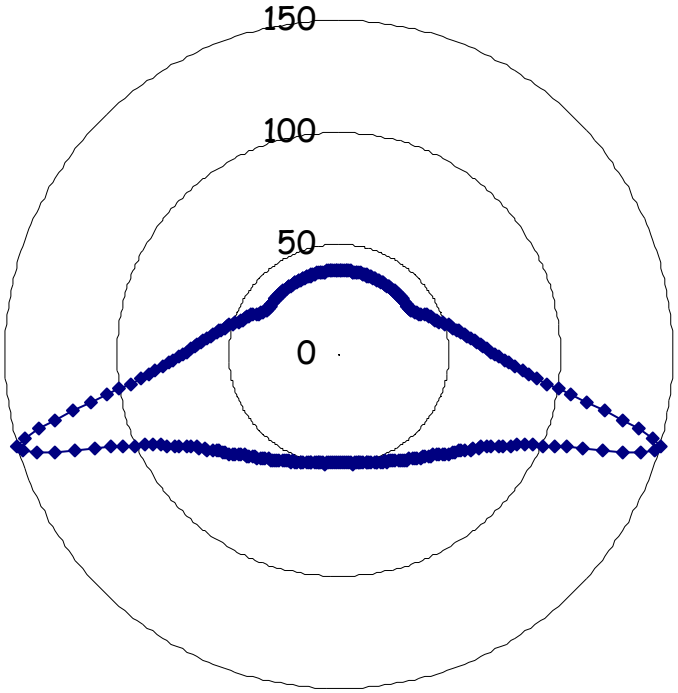


Figure: Earth Station Protection Zone

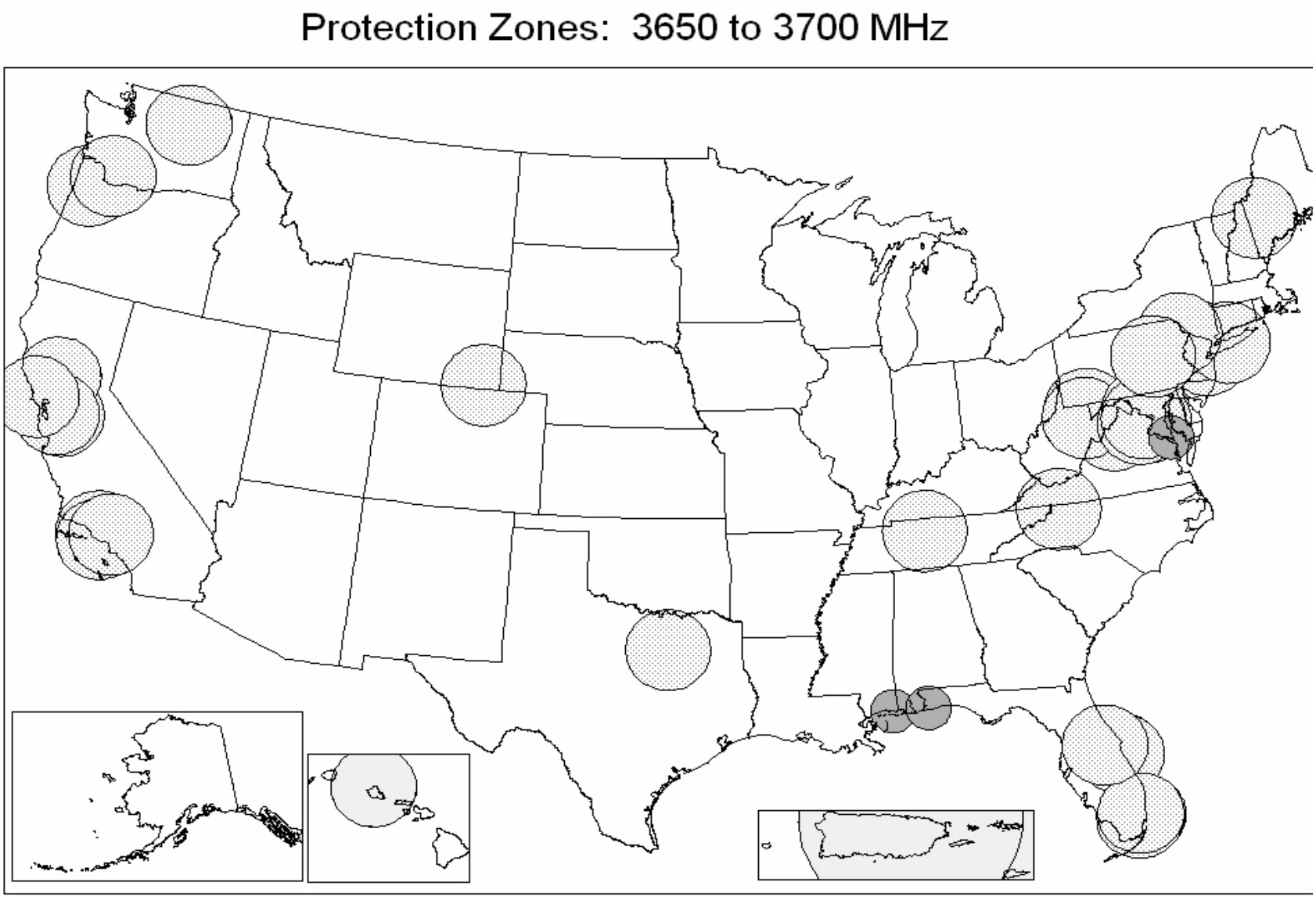
APPENDIX E: List Of Grandfathered FSS Earth Stations

State	City	Latitude	Longitude	NAD*	Call Sign	Filenumber	Licensee
CA	Chatsworth	34°14'20.70"N	118°34'11.50"W	83	E000326	SESMOD2000112902256	McKibben Communications
CA	Livermore	37°45'40.00"N	121°47'53.00"W	n/s	KA232	SESLIC1997103001576	Sprint Communications Company, L.P.
CA	Malibu	34°4'52.60"N	118°53'52.90"W	83	E980066	SESMOD2000112902218	AT&T Corp.
CA	Malibu	34°4'50.30"N	118°53'46.40"W	n/s	KA273	SESRWL2000072401194	AT&T Corp.
CA	Malibu	34°4'49.70"N	118°53'43.90"W	27	KA91	SESMOD1998081701067	AT&T Corp.
CA	Malibu	34°4'51.00"N	118°53'44.00"W	27	KB32	SESMOD1998081701066	AT&T Corp.
CA	Mountain House	37°45'0.70"N	121°35'37.80"W	83	KA206	SESMOD2000022200272	Pacific Satellite Connection, Inc.
CA	Mountain House	37°45'1.70"N	121°35'38.80"W	83	KA86	SESMOD2000022200265	Pacific Satellite Connection, Inc.
CA	Salt Creek	38°56'20.20"N	122°8'48.00"W	n/s	KA371	SESRWL1999101201864	AT&T Corp.
CA	Salt Creek	38°56'21.00"N	122°8'49.20"W	27	KA372	SESRWL2003103101527	AT&T Corp.
CA	Salt Creek	38°56'22.30"N	122°8'49.60"W	n/s	KA373	SESRWL2000121502350	AT&T Corp.
CA	San Ramon	37°45'39.70"N	121°47'56.80"W	83	E6241	SESMOD2000112902270	Sprint Communications Company L.P.
CA	Somis	34°19'31.00"N	118°59'41.00"W	27	KA318	SESRWL2002030500275	SES Americom, Inc.
CA	Sylmar	34°18'55.00"N	118°29'12.00"W	83	E6148	SESRWL2004102901607	FiberSat Global Services, LLC
CA	Sylmar	34°19'4.00"N	118°29'0.00"W	27	KA274	SESRWL1999022500279	Globecast North America Incorporated
CA	Three Peaks	38°8'51.90"N	122°47'38.00"W	83	E950208	SESMOD2001032600656	Loral Spacecom Corporation
FL	Medley	25°51'19.00"N	80°19'52.00"W	n/s	E960068	SESLIC1995120700087	Teleport Of The Americas, Inc.
FL	Medley	25°50'26.00"N	80°19'3.00"W	27	E960406	SESMOD1999042201041	Globecast North America Incorporated
FL	Melbourne	28°5'10.00"N	80°38'10.00"W	n/s	E950276	SESMOD2003051500668	Harris Corporation
FL	Melbourne	28°2'25.00"N	80°35'48.00"W	27	KA354	SESLIC1995032300008	Melbourne International Communications Limited
FL	Miami	25°55'33.30"N	80°13'16.20"W	83	E980299	SESMOD2000072101188	USA Teleport, Inc.
FL	Miami	25°48'35.00"N	80°21'10.00"W	83	KA407	SESRWL2004030500317	Americasky Corporation
FL	Miami	25°48'35.00"N	80°21'11.00"W	n/s	KA412	SESRWL2004042200574	Americasky Corporation
FL	Miramar	25°58'32.00"N	80°17'0.00"W	n/s	E960105	SESLIC1995122600010	GEMS International Television
FL	Orlando	28°25'29.00"N	81°7'21.00"W	27	KA280	SESRWL2000101902129	Sprint Communications Company L.P.
GU	Pulantat	13°25'0.00"N	144°44'57.00"E	n/s	KA28	SESLIC1997081401122	MCI WORLDCOM Network Services, Inc.
GU	Pulantat	13°25'5.20"N	144°45'5.70"E	83	KA326	SESMOD2000120102250	MCI WORLDCOM Network Services, Inc.
HI	Haleiwa	21°40'14.60"N	158°2'3.10"W	83	KA25	SESMOD2003051300642	Intelsat LLC
HI	Paumalu	21°40'27.00"N	158°2'16.00"W	27	KA265	SESMOD2002040500579	Intelsat LLC
HI	Paumalu	21°40'15.50"N	158°2'6.10"W	83	KA266	SESMOD2004081801190	Intelsat LLC

State	City	Latitude	Longitude	NAD*	Call Sign	Filenumber	Licensee
HI	Paumalu	21°40'14.10"N	158°2'6.10"W	83	KA267	SESMOD2004081801191	Intelsat LLC
HI	Paumalu	21°40'25.00"N	158°2'16.00"W	27	KA268	SESMOD2002040500583	Intelsat LLC
HI	Paumalu	21°40'24.00"N	158°2'16.00"W	27	KA269	SESMOD2004042900611	Intelsat LLC
HI	Paumalu	21°40'24.00"N	158°2'16.00"W	27	KA270	SESMOD2004011300031	Intelsat LLC
MD	Clarksburg	39°13'5.60"N	77°16'12.40"W	27	KA259	SESMOD2002040500569	Intelsat LLC
MD	Clarksburg	39°13'5.00"N	77°16'12.00"W	27	KA260	SESMOD2002040500571	Intelsat LLC
MD	Clarksburg	39°13'2.60"N	77°16'10.90"W	83	KA261	SESMOD2003040200453	Intelsat LLC
MD	Clarksburg	39°13'1.80"N	77°16'11.40"W	83	KA262	SESMOD2003040200454	Intelsat LLC
MD	Clarksburg	39°13'4.40"N	77°16'13.90"W	83	KA263	SESMOD2004040800539	Intelsat LLC
MD	Clarksburg	39°13'5.20"N	77°16'13.90"W	83	KA264	SESMOD2004040800538	Intelsat LLC
MD	Clarksburg	39°13'7.00"N	77°16'12.00"W	83	KA275	SESMOD2003051300641	Intelsat LLC
ME	Andover	44°38'1.20"N	70°41'51.30"W	83	E000306	SESLIC2000062201004	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°38'1.20"N	70°41'51.30"W	83	E000700	SESLIC2000113002229	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°37'58.00"N	70°41'54.00"W	n/s	KA349	SESMOD1997060300716	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°37'58.20"N	70°41'55.30"W	83	KA386	SESRWL2003102101443	MCI WORLDCOM Network Services, Inc.
ME	Andover	44°38'0.00"N	70°41'55.00"W	27	WA20	SESRWL2003091701297	MCI WORLDCOM Network Services, Inc.
ME	Andover #6	44°37'58.20"N	70°41'55.30"W	83	E930190	SESRWL2003062400894	MCI WORLDCOM Network Services, Inc.
NC	West Jefferson	36°25'50.00"N	81°23'45.00"W	n/s	E970334	SESLIC1997052700684	Infotel International Services, Inc.
NJ	Carpentersville	40°38'39.00"N	75°11'29.00"W	27	E7541	SESMOD2000113002268	Lockheed Martin Corporation
NJ	Carteret	40°34'44.70"N	74°13'0.50"W	83	E950361	SESMOD2000080801394	All Mobile Video, Inc.
NJ	Carteret	40°34'45.40"N	74°12'59.50"W	83	E950372	SESMOD2000080801390	All Mobile Video, Inc.
NJ	Franklin	41°7'4.00"N	74°34'33.00"W	n/s	E6777	SESLIC1999031200365	Sprint Communications Company, L.P.
NJ	Franklin	41°7'4.00"N	74°34'33.00"W	n/s	KA231	SESRWL1997062300835	US Sprint Communications Company L.P.
NY	Hauppauge	40°49'15.40"N	73°15'48.40"W	83	E950436	SESMOD2002030700321	Reuters America, Inc.
NY	Hauppauge	40°48'53.60"N	73°14'18.40"W	83	E970361	SESMOD2000112202201	Globecomm Systems, Inc.
OR	Moores Valley	45°20'32.40"N	123°17'19.40"W	83	KA365	SESLIC2003100201362	Neptune Pacific License Corporation
PA	Catawissa	40°53'39.00"N	76°26'21.00"W	27	E980493	SESMOD2000112902217	AT&T Corp
PA	Hawley	41°27'51.00"N	75°7'47.90"W	27	E950209	SESMOD1996073100731	Loral Spacecom Corporation
PA	Roaring Creek	40°53'35.90"N	76°26'22.60"W	n/s	KA444	SESRWL2002041800608	AT&T Corp.
PA	Roaring Creek	40°53'37.50"N	76°26'21.80"W	27	WA33	SESRWL2004032300452	AT&T Corp.
PR	Carolina	18°26'0.00"N	65°59'35.00"W	27	KA377	SESRWL2003071000942	Americom Government Services, Inc.
PR	Humacao	18°9'5.00"N	65°47'20.00"W	n/s	E872647	SESRWL2000091201765	Telecommunicaciones Ultramarinas de Puerto Rico
PR	San Juan	18°26'47.00"N	66°3'58.00"W	27	KA466	SESLIC1995030600004	Telecommunicaciones Ultramarinas de Puerto Rico
TN	Nashville	36°14'5.70"N	86°45'21.40"W	n/s	E960050	SESLIC1995101100315	Northstar Studios, Inc.

State	City	Latitude	Longitude	NAD*	Call Sign	Filenumber	Licensee
TN	Nashville	36°14'5.70"N	86°45'19.40"W	n/s	E960073	SESLIC1995101700295	Northstar Studios, Inc.
TN	Nashville	36°14'6.20"N	86°45'20.40"W	n/s	E970010	SESLIC1996100800361	Northstar Studios, Inc.
TX	Desoto	32°37'48.00"N	96°50'32.00"W	n/s	KA306	SESRWL2002030300266	Megastar Inc
VA	Alexandria	38°47'38.00"N	77°9'46.00"W	27	E970267	SESMOD2004070200978	SES Americom, Inc.
VA	Alexandria	38°47'36.00"N	77°9'59.00"W	27	KA81	SESMOD1998071701970	SES Americom, Inc.
VA	Bristow	38°47'1.60"N	77°34'24.30"W	83	E000152	SESMOD2004020900202	New Skies Networks, Inc.
VA	Bristow	38°47'2.40"N	77°34'21.90"W	83	E000696	SESMOD2003102801506	New Skies Networks, Inc.
VA	Quicksburg	38°43'45.40"N	78°39'25.10"W	83	E000589	SESLIC2000082401509	MCI WORLDCOM Network Services, Inc.
VA	Quicksburg	38°43'45.40"N	78°39'25.10"W	83	E010140	SESLIC2000113002478	MCI WORLDCOM Network Services, Inc.
VA	Quicksburg	38°43'45.40"N	78°39'24.20"W	83	E990175	SESMOD2000113002226	MCI WORLDCOM Network Services, Inc.
VA	Reston	38°57'0.00"N	77°22'40.00"W	n/s	E950406	SESLIC1995062900762	Sprint Communications Company, L.P.
WA	Brewster	48°8'51.00"N	119°41'29.00"W	n/s	E960222	SESLIC1996022101766	SES Americom, Inc.
WA	Brewster	48°8'49.00"N	119°41'28.00"W	27	KA20	SESRWL2002110601960	SES Americom, Inc.
WA	Brewster	48°8'51.00"N	119°41'29.00"W	n/s	KA294	SESRWL2003072201015	SES Americom, Inc.
WA	Yacolt	45°51'46.40"N	122°23'44.30"W	83	KA221	SESMOD1999082001537	MCI WORLDCOM Network Services, Inc.
WA	Yacolt	45°51'45.50"N	122°23'43.80"W	83	KA323	SESMOD1999082001536	MCI WORLDCOM Network Services, Inc.
WV	Albright	39°34'7.00"N	79°34'45.00"W	27	KA413	SESRWL2004060800805	AT&T Corp.
WV	Etam	39°16'50.00"N	79°44'13.00"W	n/s	KA378	SESRWL2001060801039	AT&T Corp.
WV	Etam	39°16'48.00"N	79°44'14.00"W	27	WA21	SESRWL2001060801038	AT&T Corp.
WV	Rowlesburg	39°16'52.10"N	79°44'10.70"W	n/s	KA351	SESRWL2002092301654	AT&T Corp
WY	Cheyenne	41°7'56.00"N	104°44'10.50"W	27	E950253	SESMOD2000050500706	Echostar North America Corporation
WY	Cheyenne	41°7'55.70"N	104°44'11.50"W	27	E980118	SESMOD2001111402151	Echostar North America Corporation

APPENDIX F: Protection Zones For Grandfathered FSS And Federal Government Stations



STATEMENT OF
CHAIRMAN MICHAEL K. POWELL

Re: In the Matter of Wireless Operations in the 3650-3700 MHz Band (ET Docket No. o4-151); Wireless Operations in the 3650-3700 MHz Band (WT Docket No. 05-96), Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band (ET Docket No. 02-380); Amendment of the Commission's Rules With Regard to the 3650-3700 MHz Government Transfer Band (ET Docket No. 98-237), Report and Order and Memorandum Opinion and Order

I am delighted that we are today opening this 50 MHz of spectrum for the provision of wireless broadband for consumers, especially in rural areas. This spectrum has been underutilized for far too long. The innovative rules we are adopting will make this spectrum available with minimal regulatory burdens. Thus, it should be attractive to entrepreneurial WISPs, community-based networks, and others interested in providing broadband in rural communities. With our flexible technical rules, this spectrum is also a potential home for new innovative technologies, such as WiMAX.

Identifying the best approach for this band has not been easy. The existing satellite earth stations and grandfathered Federal radar stations in this band must be protected. They severely curtail possible use of this spectrum to serve a substantial portion of the U.S. population. Coming up with an approach that provides the needed safeguards but still effectively allows new uses of the spectrum has been a difficult challenge – but a challenge that I am pleased that we have been able to meet.

Last April, we adopted a Notice of Proposed Rulemaking that took a hard look at 50 MHz of spectrum in the 3650-3700 MHz band. Since then, the Commission has received over a hundred comments about specific proposals that could potentially allow the use of unlicensed and or licensed terrestrial services in these bands. Today, we adopt a new approach that takes all of these views into account, and incorporates elements of both the Commission's licensed and unlicensed models in a hybrid approach that is best suited to the distinctive characteristics of this band.

I believe the Order carefully balances competing factors, minimizes the potential for harmful interference, and provides sufficient operating power and flexibility to help speed the introduction of new services to the marketplace. The streamlined licensing and registration process we adopt will provide additional spectrum for entrepreneurial WISPs for the expansion of wireless broadband services with minimal regulatory burdens. In addition, it will provide additional flexibility for a variety of base-station-enabled mobile terrestrial operations and protect incumbent grandfathered satellite earth stations and federal government radiolocation stations from harmful interference.

I commend the staffs of the Office of Engineering and Technology and the Wireless Telecommunications Bureau for their hard work on this complex item, working closely with their counterparts in the International Bureau. Only through these collaborative efforts have we been able to cut the Gordian Knot of the 3650 MHz band.

STATEMENT OF
COMMISSIONER MICHAEL J. COPPS

RE: Wireless Operations in the 3650-3700 MHz Band (ET Docket No. 04-151); Wireless Operations in the 3650-3700 MHz Band; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band (ET Docket No. 02-380); and Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band (ET Docket No. 98-237).

I'm hopeful that our actions in this item will lay the groundwork for much needed new broadband competition and additional broadband service to rural parts of the Country. To encourage this, we adopt a licensing system that draws much of its inspiration from the success of the unlicensed bands. While each operator will need an FCC license and will have to register fixed facilities, these licenses are not exclusive. Multiple licenses will be able to provide service in the same community, competing with one another or serving different types of customers. In this way, the system we create today is much like the system we use in the unlicensed bands. Entrepreneurial, municipal and mesh networks can begin operation without the heavy financial burden of an auction and competition will not be limited by the use of exclusive licenses. Auctions and exclusive licenses are powerful tools that have given us great success in other bands and we should not retreat in our use of these tools. But these devices do not always best serve every band, technology, and business plan, as the Commission finds today.

Unlike the unlicensed bands, however, we allow higher power use and establish tools by which licenses can avoid or correct interference. First, each licensee must include technology within its network that is designed to avoid interference. This, we hope, will avoid much of the interference possible when multiple high power systems operate along side one another. Second, each licensee will know the location of each other licensee because of the registration system, reducing the costs associated with identifying potential interference sources and allowing better initial system designs. Therefore, while there is no first-in-time interference protection, licensees can engineer their systems to avoid mutually destructive interference between new and existing systems. Additionally, every licensee has the responsibility, when contacted by another licensee asserting that they are suffering interference, to work with them in good faith to resolve the interference. If a licensee believes another licensee is intentionally interfering or breaching this good faith responsibility, they can come to the FCC.

Importantly, we also exclude licensees from operations in areas where government facilities and satellite operations are likely to receive harmful interference. Fixed facilities will not be allowed in these areas. Mobile devices will not be able to operate when brought into these areas because all mobile equipment must be able to receive a usable signal from a fixed transmitter before itself transmitting. This will ensure that they cannot wander into restricted areas. These restricted areas will significantly reduce the ability for the 3650 band to bring competition into parts of the Country, but avoiding harmful interference to government and satellite operators is critical. Additionally, satellite and new terrestrial operators have the responsibility to work in good faith to find ways of allowing new terrestrial use even in these restricted areas where possible. I hope that this will result in some technical agreements in these areas.

This is an innovative approach, and I congratulate OET and WTB for their hard work.

STATEMENT OF
COMMISSIONER JONATHAN S. ADELSTEIN

Re: Wireless Operations in the 3650-3700 MHz Band (ET Docket No. 04-151); Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band (ET Docket No. 02-380); and Amendment of the Commission's Rules with Regard to the 3650-3700 MHz Government Transfer Band (ET Docket No. 98-237); Report and Order and Memorandum Opinion and Order

In many respects, this is a bold decision. Based on some circumstances unique to the 3650-3700 MHz band, our decision bucks conventional wisdom, and puts in place rules and procedures that are intended to maximize multiple licensed users sharing spectrum in the same geographic area. While not a traditional "unlicensed" model, we have taken appropriate steps to significantly lower barriers to entry. The approach we are taking here should make it much easier for this spectrum to get in the hands of people who are ready and willing to use it.

This follows in the footsteps of our decision in the 70/80/90 GHz proceeding that also broke new ground in our approach to spectrum licensing. I think this reflects a positive trend at the Commission. We need to find the right balance between a licensing model for traditional, area-wide mobile systems, and a model for services such as those proposed for the 3650-3700 MHz band – a band that ultimately may serve a different user group, one that often is driven by more localized, community based needs.

We want to take advantage of the WiFi movement and take it to another level. I realize that we could not do everything the mesh network community had hoped for – we had to ensure that incumbents are properly protected – but we put in place a regime that doesn't rely on first in time and provides equal access to all.

I support our decision today. Of course, only time will tell if the novel decisions we make here result in increased use of this encumbered spectrum band. But I think that given the success of unlicensed wireless networks, we are on the right track, and our creative spectrum management approach is well justified.