5. Technical Requirements for Protecting Fixed-Satellite Operations

a. Off-Axis E.I.R.P.-Density Limits and Associated Rules

55. In order to protect C-band fixed-satellite operations from harmful interference, we adopt off-axis e.i.r.p.-density limitations on co-polarized transmissions along the geostationary arc that are in accordance with the two-degree spacing rules.[151] The ITU placed off-axis e.i.r.p.-density limits on ESVs operating in the 5925-6425 MHz band.[152] However, the ITU limits are not consistent with the Commission's two-degree spacing rules, which are designed to protect FSS satellites spaced about two degrees apart in orbit along the geostationary arc. The limitations we set forth today are a direct result of combining Section 25.209, which sets forth antenna envelope limitations, and Section 25.212(d), which sets forth the constraints on power density delivered to the antenna.[153] The result of this combination is a constraint on off-axis e.i.r.p.-density needed to protect other FSS systems in the geostationary satellite orbit from co-polarized signals. The off-axis e.i.r.p. limits for ESV transmitters operating in the C-band are:[154]

Maximum e.i.r.p. Density			Off-Axis Angle
$26.3 - 25\log(\theta)$	dBW/4kHz	for	$1.0° \le \theta \le 7°$
5.3	dBW/4kHz		$7° < \theta \le 9.2°$
$29.3 - 25\log(\theta)$	dBW/4kHz		$9.2° < \theta \le 48°$
-12.7	dBW/4kHz		$48° < \theta \le 180°$

Where:
θ: is any angle in degrees from the axis of the main lobe along the geostationary arc.

56. Because we have adopted off-axis e.i.r.p.-density limits to protect FSS satellites, we decline to adopt the Commission's proposal in the *ESV NPRM* to require C-band ESV networks to utilize an antenna that is 4.5 meters or greater in diameter.[155] The off-axis e.i.r.p.-density limits may be met either

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[151] *See supra* Section III.A.

[152] ITU-R Resolution 902 (WRC-03) Annex 2.

[153] *See* 47 C.F.R. §§ 25.209, 25.212(d).

[154] The limitations developed are only applicable for digital traffic. Because commenters have only discussed digital traffic, we do not find it necessary to develop rules for analog ESV traffic and will not be implementing analog service rules. The off-axis e.i.r.p.-density limits listed here pertain to emissions from a single transmitter if the selected modulations permit one carrier per channel at the satellite receiver. If an ESV operator chooses to implement a modulation technique, such as CDMA, that can operate with multiple co-frequency transmissions from different vessels being simultaneously received at the same satellite, the limiting off-axis power-density would then be determined by the aggregate power received at the neighboring satellites. That is, if "N" ESV transmitters were each operating on the same frequency channel, to the same satellite, at the same time, the e.i.r.p.-density limit on each individual transmitter would be reduced by a factor of 10*log(N), in dB. For example, if five vessels were equipped with CDMA ESV transmitters all communicating to the same satellite, in the same uplink bandwidth, the e.i.r.p.-density of the individual transmitters would be reduced by a factor of 10*log(5) or 7.0 dB.

[155] *See ESV NPRM*, 18 FCC Rcd at 25283, ¶ 86. Specifically, the Commission proposed that ESV network applications or applications for hub earth stations utilizing the 6 GHz band would be routinely processed for license approval if they met the following criteria: (1) 4.5 meter antennas or larger that are consistent with Section 25.209; (2) power levels consistent with Sections 25.211(d) and 25.212(d); (3) antenna pointing accuracies of +/- 0.2 degrees or better; and (4) completed frequency coordination, where appropriate. *ESV NPRM*, 18 FCC Rcd at 25284-85, ¶ 91. The Commission noted that if ESV-operators used smaller antennas or different power levels, they would be (continued....)

through the use of a sufficiently large antenna, with an appropriate input power density, or by the use of a smaller antenna by reducing the input power density to the antenna. Because it is possible to meet the off-axis e.i.r.p.-density limits by using an antenna smaller than 4.5 meters for certain ESV-supplied services and, because we will permit as much flexibility as possible to the ESV operator, we refrain from adopting a minimum antenna size limit for ESVs.

57. As stated, the limit discussed immediately above addresses a limit on off-axis e.i.r.p.-density for co-polarized signals transmitted towards the geostationary orbit. Additional rules are required to fully protect all C-band FSS operations. These additional rules include: off-axis e.i.r.p.-density limits for co-polarized signals in directions other than along the geostationary orbit; off-axis e.i.r.p.-density limits for cross-polarized signals; and limits on the sidelobe structure of the ESV antennas. All of these limits have existing counterparts in Part 25 that are expressed as antenna envelope limitations and constraints on power-density delivered to the antenna. The corresponding rules we adopt for ESVs in the C-band are contained in new Section 25.221.[156] To assist in identifying potential interference from ESV operations, FSS operators can request vessel tracking data from the ESV operator's point of contact.[157]

b. Pointing Accuracy

58. Consistent with the ITU pointing accuracy limitation, and for the protection of neighboring FSS satellites, we require C-band ESV operators to maintain a peak tracking error of 0.2 degrees for all antennas within their licensed networks. Additionally, if the ESV antenna drifts more than 0.5 degrees from the intended satellite, the ESV terminal on the vessel must cease transmitting automatically until the ESV antenna is, once again, pointing to within 0.2 degrees of the intended satellite.

6. Vessel Size and Geographic Limitations

59. In the *ESV NPRM*, the Commission stated that vessels following the Coordination Approach would need to be 300 gross tons or larger, consistent with ITU-R JWP-4-9S Recommendations.[158] Vessel size may restrict the vessel's ability to access certain waterways as well as mitigate the impact of ESV operations on FS operations.[159] The Commission also sought comment on whether C-band ESV operations should be allowed in bodies of water, such as in the Great Lakes or large rivers in the United States, in addition to oceans.[160]

60. Some commenters support our proposal to adopt a minimum vessel size of 300 gross tons.[161] Other commenters urge the Commission to adopt a minimum vessel size of 5,000 gross tons because it would ensure that ESV operations remain on deep draft vessels that are restricted to coastal waters or

(Continued from previous page)
required to file an initial lead application that included technical analysis demonstrating that adjacent satellite operators that could be impacted would not experience harmful interference in accordance with the off-axis e.i.r.p.-density requirement. *Id.*

[156] *See* Appendix B (new Section 25.221(a)(1)-(4)).

[157] *See supra* ¶ 50.

[158] *ESV NPRM*, 18 FCC Rcd at 25275, ¶ 70.

[159] *Id.*

[160] *Id.* at 25283-84, ¶ 87.

[161] *See, e.g.*, Inmarsat Comments at 20; MTN Comments at 21.

major waterways.[162] These commenters are concerned that, without a larger vessel size requirement, the ESV operators could access the C-band while traveling on inland waterways.[163] For example, King County, which is located in the Puget Sound region of the State of Washington, explains that its public safety and service agencies rely on voice and data radio systems that are linked together by FS systems located in the 6 GHz band.[164]

61. *Vessel Size.* We adopt 300 gross tons as the minimum vessel size for ESVs utilizing the C-band, based on the ITU's recommendation to place C-band ESVs on vessels that are greater than 300 gross tons. A minimum vessel size will protect FS operations from interference by reducing the number of ESVs that could operate in the C-band. We decline, however, to adopt a larger vessel size, such as FWCC's proposal for a 5,000 gross ton minimum. Although a 300 gross ton minimum allows more ESV operators to access the C-band than a 5,000 gross ton minimum, we agree with commenters that a 5,000 gross ton requirement is not needed to protect FS operations.[165] Moreover, FWCC acknowledges that this restriction would be less critical if the Commission restricted ESV access to spectrum,[166] and we have done so by limiting ESV operators to 180 megahertz of coordinated spectrum at any given coordination area.[167]

62. The other C-band restrictions set forth in this *Report and Order* should limit the number of ESVs in the C-band, in addition to protecting FS from harmful interference by ESVs operating in that band. For example, some ESVs may not be willing to incur the costs of compliance with the other C-band requirements. Those operators may, instead, opt to use Ku-band. The remaining ESV operators will coordinate and comply with the other C-band requirements, thereby helping to ensure that FS operators are protected from harmful interference.

63. *Geographic Limitations.* We acknowledge that vessels that are 300 gross tons or larger could access inland waterways and harbors. We decline, however, to impose any geographic limitations on ESV operators utilizing the C-band, as long as they are able to satisfy the limitations we place on them in this *Order*. We believe that limiting access to certain waterways could be unnecessarily restrictive for ESV operators. For example, certain ESV operators that utilize the C-band may already be operating or plan to operate on inland waterways. If we were to prohibit ESV C-band users from traveling on inland

[162] FWCC Comments at 13-14. *See also* APCO Comments at 1-2; API Reply at 3-4. In particular, FWCC claims that the proposed limit of 300 gross tons would result in the dramatic expansion of ESV use by smaller ships capable of traveling through inland waterways. FWCC Comments at 13 (claiming that, as a result, the potential for interference to FS operations would increase to unacceptable levels).

[163] *See, e.g.*, FWCC Comments at 13-14; King County Comments at 1-2.

[164] King County Comments at 1. King County contends that identifying and resolving interference in the C-band could be difficult because state and local government agencies do not have the time or the equipment needed to perform these tasks. King County Comments at 2. Broadband Maritime disagrees with King County, claiming that even though ESV operators have been operating in the Puget Sound for several years, King County fails to cite a single reported case of harmful interference to FS operations. Broadband Maritime Reply at 3. Although Broadband Maritime contends that there have been no claims of interference from FS operations in the Puget Sound, we decline to draw a conclusion as to whether ESVs have previously caused interference to the FS operations.

[165] MTN Reply at 11 (stating that this requirement is "patently unnecessary given the routine manner in which 'in motion' ESVs can be identified"); Stratos Reply at 10 (stating that this size is unwarranted). *See also* Intelsat Comments at 6-7 (stating that coordination is the most effective means for protecting FS).

[166] *See* FWCC Dec. 8, 2004 *Ex Parte* Letter at 2.

[167] *See supra* ¶¶ 40-41.

waterways, we could inadvertently prohibit access to certain ports that are accessible only through an inland waterway. Moreover, inland waterways will more likely be congested from a communications perspective, so there should be a natural incentive for ESV operators to use the Ku-band. If there is spectrum available in the C-band, however, it would be inefficient from a spectrum management perspective not to let ESV operators coordinate use of that spectrum, consistent with the conditions outlined herein.

64. In addition, we are not persuaded by King County's contention that ESV operators should not be allowed on inland waterways because, even if ESV operators were required to comply with C-band requirements such as coordination, harmful interference may still occur to its critical public safety operations.[168] Although interference-free operations may not be guaranteed, we are satisfied that the measures we adopt today will substantially reduce the risk of harmful interference to FS on inland waterways. Thus, if ESV operators can comply with the C-band requirements designed to protect FS operations, they may utilize the spectrum in the C-band, regardless of geographic location.

65. We also disagree with FWCC's contention that the availability of terrestrial-based broadband for smaller vessels traveling through inland or "close-in coastal waters" merits prohibited ESV use in these areas.[169] Commission policy is to promote competition wherever possible. FWCC's line of reasoning contradicts this policy by limiting consumer choice. In addition, FWCC fails to consider that this option may be less convenient for certain vessel operators. For example, a vessel may routinely access both inland waterways and the ocean, and terrestrial services would not provide coverage for the vessel as it traveled the open sea.

66. We acknowledge NSMA's concern that coordinating on inland waterways and certain coastal waters may pose a challenge in terms of identifying the boundaries in which vessels travel. According to NSMA, NOAA maps set forth the "deep draft" channels or sea lanes that assist in identifying the potential areas that in-motion vessels could occupy for the purposes of interference analysis.[170] To the extent that these paths are not identifiable in inland waterways, ESV operators will need to create "maps" of their planned routes and boundaries in which their vessels will travel, and use those maps as a standard during the coordination process.

7. The Non-Coordinated Approach

67. We decline to adopt the Non-Coordinated Approach that the Commission proposed in the *ESV NPRM*. Under the Non-Coordinated Approach, ESV operators would not be required to coordinate, but would be subject to additional requirements and have fewer benefits than coordinated ESV operators, such as a two-year license term.[171] We find that this approach would not adequately protect FS operations because, unlike coordination, it does not effectively prevent interference from happening.[172]

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[168] *See* King County Comments at 2.

[169] FWCC Reply at 23; *see also* King County Comments at 1-2.

[170] *See* NSMA Comments at 6.

[171] *See ESV NPRM*, 18 FCC Rcd at 25273-25275, ¶¶ 63-68. In comparison, the Commission proposed a fifteen-year license term for coordinated ESV operators. *See id.* at 25275, ¶ 70.

[172] *See, e.g.*, FWCC Reply at 14 (stating that "[t]he measures proposed for the non-coordinated operation merely facilitate identification of the offending vessel and *only after the interference occurs*."); NSMA Comments at 16 (stating that unacceptable interference may be "only potentially correctable on a post facto basis via an interference complaint"); Pinnacle Comments at 2 (stating that the Non-Coordinated Approach "represents an unnecessary risk to microwave operations").

The NSMA contends that the Non-Coordination Approach, even with the additional conditions proposed, would not be sufficient to protect FS operations.[173] In this Order we have adopted an approach that emphasizes prevention of interference for ESV use of the C-band, and that prevention is achieved only through coordination.

68. In support of the Non-Coordinated Approach, Broadband Maritime suggests that the FS would not suffer from interference if a number of stringent limits were placed on non-coordinated ESV operations, such as a minimum antenna elevation angle of 20 degrees, a more constraining limit on power emitted towards the horizon than the ITU limit provided in Resolution 902, and a 300 kHz limit on the bandwidth of the ESV transmit signal.[174] We decline to create a separate licensing regime involving non-coordination based on factors essentially tailored for a single operator. First, while these limits may reduce the probability of interference to the FS as compared to not imposing such limits, they do not effectively prevent interference. Second, Broadband Maritime's suggested limits do not analyze the worst case for FS and uses atypical FS system parameters.[175] For example, if a Broadband Maritime ESV were transmitting using the limitations it has put forth, interference to FS would be possible during a FS system fade.[176] Frequency coordination, on the other hand, takes the fading phenomenon into account in determining the amount of interference power a fixed system will receive from an FSS earth station, and, therefore, is a safer approach to eliminating the possibility of interference. Moreover, we find Broadband Maritime's suggested limitations are too constraining to form the basis for a licensing approach to address the entire ESV industry.[177]

69. Finally, we are not persuaded by commenters' arguments that coordination would be impractical and too costly for ESV operators that infrequently visit the same U.S. ports.[178] For example, Telenor argues that both a Coordination and a Non-Coordination Approach are necessary for those ESV operators finding the Coordination Approach "difficult if not impossible."[179] We find that the benefits of the Coordination Approach to ESV operators (*i.e.*, giving them a right to operate in the coordinated spectrum on a primary basis) outweigh the burdens cited (*i.e.*, additional costs or work). Indeed, ESV operators using ports infrequently may be able to find methods for reducing coordination costs, such as making arrangements with other operators to share facilities that fall within existing coordination agreements.[180] Given the risk of interference to FS and lack of benefits for ESV operators under the Non-Coordinated Approach, we conclude that ESV operators should coordinate or, alternatively, consider operating in the Ku-band for which we adopt less stringent restrictions.

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[173] NSMA Comments at 16.

[174] *See* Letter from Eliot J. Greenwald, Counsel, Broadband Maritime, to Marlene H. Dortch, Secretary, FCC, IB Docket 02-10, at 1-2 (dated Nov. 11, 2004).

[175] *Accord* Letter from Mitchell Lazarus, Counsel, FWCC, to Marlene H. Dortch, Secretary, FCC, IB Docket 02-10 at 1, Attachment (dated Nov. 19, 2004).

[176] *See supra* footnote 81 (defining "fade").

[177] For example, a 20-degree minimum elevation limit would exclude vessels from operating in most of Alaska, and would significantly limit the satellites available from New England ports. Similarly, the 300 kHz bandwidth limit would allow an ESV system to provide only voice and relatively slow internet services, rather than the broadband technologies envisioned by our action today.

[178] *See* Broadband Maritime Comments at 3; Broadband Maritime Reply at 5; Telenor Reply at 8-9.

[179] Telenor Reply at 8-9.

[180] *See supra* ¶ 31 (discussing cooperation among ESV operators to accomplish coordination).

8. Regulatory Status for ESVs in the C-Band Uplink (6 GHz Band)

70. *Background.* In the *ESV NPRM*, the Commission sought comment on the regulatory status (*i.e.*, primary, secondary) that should be assigned to ESVs utilizing the C-band.[181] Specifically, the Commission proposed to adopt domestic rules authorizing ESVs to operate in the C-band on a non-harmful interference basis (NIB) so that FS operations in that band would be protected.[182] The Commission also sought comment on whether to assign a different regulatory status for ESV operations, such as when ESVs were not in motion.[183] Some commenters propose that if ESVs coordinate their operations with terrestrial service systems, the Commission should assign primary status to ESVs.[184] Once coordination is achieved with an ESV, these commenters see no need to assign NIB status.[185] FWCC and Stratos support the licensing of ESVs on a NIB basis, whether or not they coordinate. FWCC claims that FS, as the incumbent, is entitled to full protection.[186] FWCC also contends that assigning primary status for coordinated ESVs would prevent FS expansion in highly populated areas where demand is high for FS.[187] Stratos contends that licensing ESVs on an NIB basis is consistent with the approach adopted in other Commission proceedings in which the Commission allowed a service on an NIB basis with a co-primary service.[188]

71. *Discussion.* Given our decisions that ESVs in the 6 GHz band are required to coordinate operations, limited to two satellite/36 megahertz per satellite per operator per location, and 180 megahertz of aggregate coordinated spectrum industry-wide per location, we assign primary status to ESVs operating in the 6 GHz band. As a result, once ESV operators have coordinated a frequency in a particular area, the first-come, first-served principle applies, meaning that new entrants into that geographic area will be required to coordinate those frequencies with the ESV operators. Accordingly, we place a footnote in the U.S. Table of Allocations as follows:

> NG181 In the band 5925-6425 MHz (Earth-to-space), earth stations on vessels (ESVs) are an application of the fixed-satellite service (FSS) and may be authorized to communicate with space stations of the FSS on a primary basis.

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[181] *See ESV NPRM*, 18 FCC Rcd at 25259-61, ¶¶ 27-30.

[182] *Id.* at 25260-61, ¶ 30.

[183] *Id.*

[184] *See, e.g.*, Inmarsat Comments at 3; Intelsat Comments at 5-6; MTN Comments at 15; PanAmSat Comments at 2-3 (arguing that primary status should be given to coordinated ESVs, but that the license term should be shorter than 15 years). In fact, MTN opposes the Coordination Approach as proposed by the *ESV NPRM* because it imposes regulatory burdens on ESVs, but only affords ESVs NIB status. *See* MTN Comments at 13. Intelsat explains that ESV operators should be treated like FSS operators because, from a technical perspective, coordinated fixed earth stations and coordinated ESV operations along specific routes have similar characteristics. *See* Intelsat Comments at 5-6. *See also* Inmarsat Comments at 3 (arguing that "ESVs [should] be considered as part of the primary FSS"). Inmarsat, however, only supports primary status for ESVs that are in fixed location.

[185] Intelsat Comments at 6. *See also* MTN Comments at 15 (claiming that imposing NIB status on coordinated ESVs overprotects FS stations).

[186] FWCC Reply at 6-9.

[187] *Id.* at 8.

[188] Stratos Reply at 4 n.7.

72. We agree with commenters who argue that ESV operators should have an incentive to spend the time and expense to coordinate with FS operators.[189] In addition, because the ESV operators would be receiving full licenses, as opposed to temporary authorization, we believe that it is appropriate to provide those ESV operations with primary status. We also agree with FWCC that the Communications Act requires the Commission to protect incumbents from harmful interference.[190] We satisfy this requirement by placing operating conditions on ESVs in the C-band.

9. Regulatory Status for ESVs in the C-Band Downlink (4 GHz Band)

73. In the C-band downlink, or 4 GHz band, ESVs are receive-only, and thus, do not pose a risk of harmful interference to FS operations in that band. Therefore, we do not require ESV operators to coordinate their operations in the C-band downlink. It is possible however, that ESVs may receive interference from FS transmitters in this band. For this reason, the ITU has stated that in-motion ESVs cannot claim protection from C-band FS transmitters.[191] To implement the decision of the ITU, we adopt the Commission's proposal in the *ESV NPRM* to allow in-motion ESVs to communicate with FSS satellites as long as ESV operators do not claim protection from interference or constrain the operation or expansion of other allocated radio services in the C-band downlink.[192] Moreover, we believe that protection from harmful interference is not warranted because a moving ESV will likely experience such interference intermittently. Most commenters support this approach for similar reasons.[193] We note that there are no secondary services allocated in the United States for the 3700-4200 MHz band. Therefore, to provide ESVs protection from possible non-conforming uses of the band, while requiring ESVs to accept interference from the primary FS transmissions, we grant in-motion ESVs receiving in the 4 GHz band secondary status by adding footnote NG180 below.

74. We decline to adopt in full the Commission's tentative conclusion in the *ESV NPRM* that stationary ESVs, like in-motion ESVs, must accept all interference in the C-band downlink.[194] Interference received by an ESV on a docked vessel would not be transitory, but would be of longer duration and therefore, of a more serious nature than interference received by an ESV on a moving vessel. Because of the more serious nature of interference to ESVs while docked, we allow ESV operators to obtain protection for their dockside ESVs by coordinating the relevant downlink frequencies for 180 days, and renewable thereafter for terms of 180 days. A 180-day coordination requirement is consistent with the temporary-fixed earth station rules in Part 25 of the Commission's rules[195] and addresses FWCC's concern that a given coordinated location at a port is occupied by an ESV only

[189] *See, e.g.*, MTN Comments at 15 (arguing that assigning NIB status provides no incentives for ESVs to invest the time and expense required to coordinate with FS stations).

[190] FWCC Reply at 7 (arguing that failing to provide full protection to the incumbent violates the Communications Act as well as principles of fairness). In particular, FWCC claims that, under the Communications Act, the Commission must "[m]ake such regulations not inconsistent with law as it may deem necessary to prevent interference between stations . . . ." *Id.*

[191] *See* ITU-R Resolution 902 (WRC-03) Annex 1.

[192] *ESV NPRM*, 18 FCC Rcd at 25266, ¶ 44.

[193] *See, e.g.*, Inmarsat Comments at 11; MTN Comments at 11-12.

[194] *See ESV NPRM*, 18 FCC Rcd at 25266, ¶ 44.

[195] *See* 47 C.F.R. § 25.277(a) (allowing earth stations to operate on a temporary-fixed earth station basis when it remains in one location for less than six months). This is also consistent with the Bureau's statement in the *MTN Order* that the ESV operator's "proposed dockside service is a temporary-fixed earth station service rather than a permanent fixed earth station service." *MTN Order*, 15 FCC Rcd at 23210, ¶ 24.

intermittently.[196] We clarify, however, that dockside ESVs are not classified formally as temporary-fixed earth station services under Section 25.277 of our rules, because certain requirements for temporary-fixed earth stations would not be appropriate for ESVs. For example, the authorization and coordination period for temporary-fixed stations lasts only as long as the temporary-fixed station remains in a particular location.[197] Unlike temporary-fixed earth stations, the coordination period for docked ESVs will be 180 days regardless of how long the ESV remains docked. In other words, dockside ESVs would coordinate frequencies at a particular dockside location for 180 days, and will be entitled to protection from interference during the entire coordination period, instead of being required to coordinate frequencies every time the ESV enters and leaves port – a requirement that would be overly burdensome. We make this differentiation based on output from WRC-03 indicating that fixed ESVs should be treated as ordinary FSS system Earth stations in the international context.[198] Accordingly, we place a footnote in the U.S. Table of Allocations stating the following:

> NG180 In the band 3700-4200 MHz (space-to-Earth), earth stations on vessels (ESVs) may be authorized to communicate with space stations of the fixed-satellite service and, while docked, may be coordinated for up to 180 days, renewable. ESVs in motion must operate on a secondary basis.

C. Ku-Band Operations

75. In this section, we set forth the requirements ESV operators must comply with in the Ku-band uplink at 14.0-14.5 GHz, the Ku-band downlink at 11.7-12.2 GHz, and the "extended" Ku-band downlink at 10.95-11.2 GHz and 11.45-11.7 GHz. To promote ESV use of the Ku-band, we adopt new rules and amend the Table of Frequency Allocations in a manner that provides a regulatory environment that is less restrictive than the C-band. In addition, we impose specific restrictions on Ku-band ESV operations to ensure that FSS systems and certain government services are adequately protected from the potential interference ESV operators may cause.

1. Regulatory Status for ESVs in the Ku-Band

76. We adopt our proposal in the *ESV NPRM* to authorize ESV operations on a primary basis in the Ku-band uplink at 14.0-14.5 GHz and the Ku-band downlink at 11.7-12.2 GHz, by adding a footnote to the Table of Frequency allocations to reflect ESV's primary status in these bands.[199] There are currently no primary terrestrial applications licensed in the uplink (14.0-14.5 GHz) portion of the band. As a result, unlike the C-band, we do not require Ku-band operators to coordinate with fixed terrestrial systems.[200]

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[196] *See* FWCC Reply at 27.

[197] *See* 47 C.F.R. § 25.277.

[198] *See, e.g.*, Inmarsat Comments at 11-12 (citing ITU-R Resolution 902 (WRC-03)); MTN Comments at 12 (same).

[199] In the *ESV NPRM*, the Commission sought comment on its proposal to authorize Ku-band ESV operations on a primary basis and the ramifications that would result from such an authorization. *ESV NPRM*, 18 FCC Rcd at 25260, ¶ 30.

[200] The Commission's Table of Frequency Allocations lists Radionavigation as a primary allocation in the 14.0-14.2 GHz band. However, we note that footnote US292 makes Radionavigation secondary for FSS. *See* 47 C.F.R. § 2.106 US292.

77. The Commission received broad support in the record for authorizing ESV operations on a primary basis in the Ku-band.[201] Assigning primary status to Ku-band ESVs permits these operations to be considered a recognized application within FSS networks that will ensure ESVs' ability to access multiple satellites following FSS inter-system coordination.[202] Affording Ku-band primary status, in the manner in which we adopt today, is also consistent with the decisions reached at WRC-03.[203]

78. We find that the alternative proposal we set forth in the *ESV NPRM* to allocate ESVs as a secondary mobile-satellite service (MSS) application would not be in the public interest.[204] We agree with those commenters who argue that inter-system coordination among FSS operations can be more readily accomplished if each service within the allocation is afforded primary status.[205] Furthermore, allocating ESV operations on a secondary basis conflicts with the fundamental goal of this *Order* to encourage ESV use of the Ku-band by offering a less restrictive operating environment with greater, *i.e.*, primary, regulatory rights. We find that the technical limitations we adopt below for Ku-band ESVs will ensure compatibility with other primary FSS applications in these bands.

2. Changes to the U.S. Table of Frequency Allocations for the Ku-Band

79. We adopt our proposal to modify the U.S. Table of Frequency Allocations to reflect the primary status of ESV operations in the Ku-band.[206] Based on our decision to permit ESVs in the Ku-band to communicate with satellites of the FSS, we add the following non-Federal Government footnote NG183 to the U.S. Table of Frequency Allocations for these bands:

> NG183 In the bands 11.7-12.2 GHz (space-to-Earth) and 14.0-14.5 GHz (Earth-to-space), earth stations on vessels (ESVs) are an application of the fixed-satellite service (FSS) and may be authorized to communicate with space stations of the FSS on a primary basis.

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[201] *See, e.g.*, Boeing Comments at 6-7; MTN Comments at 25 n.60; Stratos Comments at 3; Inmarsat Comments at 4; Intelsat Comments at 2; Tachyon Comments at 2; Schlumberger Comments at 9; Stratos Reply at 12; SES Americom Reply at 2.

[202] Boeing Comments at 6; Inmarsat Comments at 3; Stratos Comments at 7-8.

[203] Boeing Comments at i, 7 (noting that "[t]he decisions taken at WRC-03 establish that ESV operations in the Ku-band should be treated as a primary service under the Commission rules [because] Footnote 5.457A, which permits ESV operations in Ku-band FSS spectrum in accordance with Resolution 902, is associated with the FSS primary allocation in the International Table of Frequency Allocations."); Inmarsat Comments at 4 (arguing that "[t]hrough footnote 5.457A, WRC-03 clearly authorized ESVs to operate as part of FSS networks which are allocated on a primary basis."); *see also* ITU-R Resolution 902 (WRC-03), noting b (referencing the regulatory procedures of Article 9 apply for ESVs operating a specified fixed points). We note that Article 9 of the ITU Radio Regulations is used internationally for the coordination of primary FSS earth stations. As described below, we do not adopt a coordination requirement or different operational conditions for "in-motion" Ku-band ESVs. We therefore find that allocating Ku-band ESVs as an application of our primary FSS allocation, while not identical to, is nonetheless consistent with the conclusions reached at WRC-03.

[204] The Commission sought comment on whether ESV operations would be better accommodated by a secondary MSS allocation. *ESV NPRM*, 18 FCC Rcd at 25260, ¶ 30. The Commission noted that allocating Ku-band ESVs as MSS would place U.S. ESVs at a lower priority than might be the case for foreign licensed ESV operators. *Id.*

[205] Inmarsat Comments at 4.

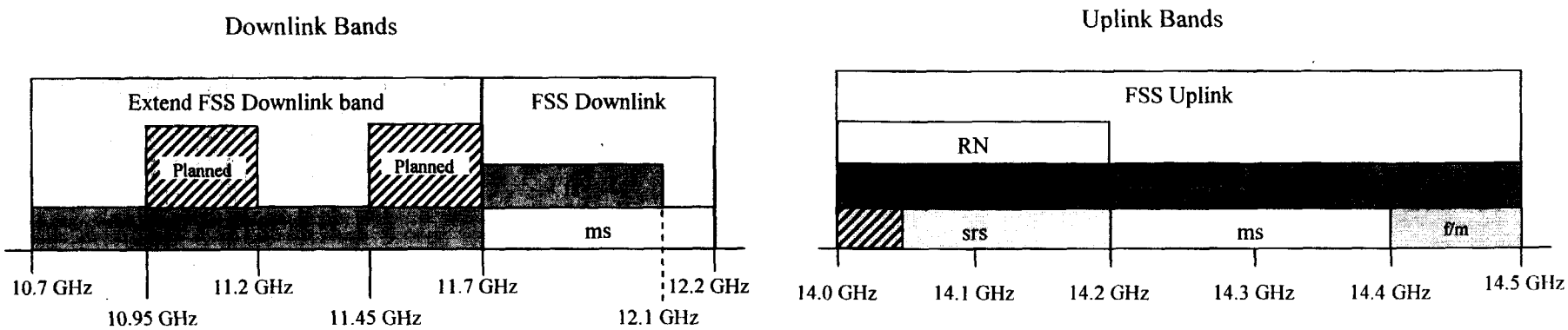
[206] *ESV NPRM*, 18 FCC Rcd at 25260 & 25265, ¶¶ 30, 41-42.

Modifying the table in this manner will put parties on notice that mobile receivers may be operating in the band.[207]

80. As Figure 1 illustrates, there are a significant number of service allocations in the downlink (10.95-11.2 GHz and 11.45-12.2 GHz) and uplink (14.0-14.5 GHz) portions of the Ku-band that we authorize for ESV operations. The effect that ESV operations may have on these allocations is discussed in greater detail below.

[207] The Commission's Table of Frequency Allocations, 47 C.F.R. § 2.106, is subdivided into the International Table of Frequency Allocations (columns 1-3), the U.S. Table of Frequency Allocations (columns 4 and 5), and a cross-reference to FCC Rule Parts (column 6). The International Table mirrors the ITU Radio Regulations and is included in the Commission's Rules for informational purposes only. 47 C.F.R. § 2.104(a). We are making several editorial amendments to the International Table in order to conform it to the 2004 edition of the ITU Radio Regulations. First, in the band 5925-6425 MHz, reference to footnotes 5.457A and 5.457B is added to the right of the direct Table entry "FIXED-SATELLITE (Earth-to-space)." Second, in the list of international footnotes, the text of four international footnotes is revised as follows: in footnote 5.457B, "the Libyan Arab Jamahiriya" is placed in correct order and the word "the" is added to "Syrian Arab Republic"; in footnote 5.487, the words "the provisions of" are removed; in footnote 5.487A, the misspelling of the word "geostationary" is corrected; and in footnote 5.488, the end of the first sentence is revised to read "subject to the provisions of No. 9.14 for coordination with stations of terrestrial services in Regions 1, 2, and 3." Third, WRC-03 suppressed footnote 5.491. Therefore, we take this opportunity to remove footnote 5.491 from the Region 3 Table and from the list of international footnotes.

Figure 1: FSS Ku-Bands Allocations



Key:

	ms	: Secondary Mobile Except Aeronautical
	RN	: Gov. and Non-Gov Radionavigation Services (secondary to FSS – see US292)
	srs	: Secondary Gov. and Non-Gov Space Research Service
		: NASA TDRSS Operational band
	f/m	: Secondary Gov. Fixed and Mobile Services
	lmss	: Secondary Land Mobile Satellite Service
	FSS	: Fixed Satellite Service
		: ITU Planned Portion of FSS Extended Band
	fs	: Secondary Gov. Fixed Service (see FN 5.486)
	FS	: Primary Fixed Service

Additionally, the radio astronomy service may use 14.47-15.0 GHz

a. Ku-Band Downlink: 10.95-11.2 GHz & 11.45-12.2 GHz

81. The allocations and operating conditions for portions of the Ku-band downlink spectrum we impose today differ based on several factors, including the fact that commercial and government operations are located in portions of the Ku-downlink band. We discuss each band separately below.

(i) Changes to the U.S. Table of Allocations in the 11.7-12.2 GHz Band

82. *Background.* The U.S. Table of Frequency Allocations for the 11.7-12.2 GHz band includes a primary allocation for FSS downlink operations. Additionally, there is a footnote allocation for the Government fixed service in the 11.7-12.1 GHz portion of the band.[208] There are also secondary allocations for mobile (except aeronautical) service and a secondary footnote allocation for non-government fixed systems in this band.[209] The Local Television Transmission Service (LTTS) is the principal service licensed in the secondary allocations in this band.[210] In the *ESV NPRM*, the Commission sought comment on whether LTTS operators make significant use of the 11.7-12.2 GHz band.[211] The Commission proposed removing the secondary allocations for fixed and mobile except aeronautical mobile services if little LTTS use were shown.[212]

83. *Discussion.* We remove the secondary mobile allocation from this band to afford primary Ku-band ESV operations better protection from in-band interference from secondary transmitters. We received no comment from LTTS licensees in this proceeding.[213] A recent review of our licensing databases indicates that there are about 50 LTTS licenses in service in the 11.7-12.2 GHz bands. We

[208] *See* 47 C.F.R. § 2.106 (footnote 5.486 appears in the Federal Government portion of the Table). The U.S. Table of Frequency Allocations (47 C.F.R. § 2.106 columns 4 and 5) is subdivided into the Federal Government Table of Frequency Allocations (Federal Government Table) and the non-Federal Government Table of Frequency Allocations. The Federal Government Table is administered by the National Telecommunications and Information Administration (NTIA) and is included in the Commission's Rules for informational purposes only. 47 C.F.R. § 2.105(a) and (d)(3). With the concurrence of NTIA, we are making several editorial amendments to the Federal Government Table. First, footnote 5.486 (secondary fixed service allocation in the band 11.7-12.1 GHz) is removed from the Federal Government Table because our research finds that this footnote had been inadvertently added to Federal Government Table. Second, footnote 5.490 (existing and future terrestrial services shall not cause interference to the BSS) is removed from the band 12.2-12.7 GHz in the Federal Government Table because this spectrum is allocated for exclusive non-Federal Government use. Third, because of these actions, there are no entries in the Federal Government Table for the blocks that represent the bands 11.7-12.1 GHz, 12.1-12.2 GHz, and 12.2-12.7 GHz. It is NTIA's standard practice not to split frequency bands unless there is a reason to do. Therefore, these bands are being merged to form the band 11.7-12.7 GHz.

[209] *See* 47 C.F.R. § 2.106 (footnote 5.486 appears in the non-Federal Government portion of the Table).

[210] Additionally, there are three Common Carrier Fixed point-to-point licensees shown in the Commission's ULS data base. These operations are listed as either temporary fixed (WPJB305) or temporary mobile (KK7264 and KL4973). As secondary services, these licensees cannot cause harmful interference to, and must accept any interference from, the primary FSS service including ESVs.

[211] *ESV NPRM*, 18 FCC Rcd at 25261, ¶ 31.

[212] The Commission also proposed removing, if necessary, the associated Part 101 rules relating to LTTS operations in this band. *ESV NPRM*, 18 FCC Rcd at 25261, ¶ 31.

[213] Several commenters supported the Commission's proposal to remove the LTTS allocation from this portion of the Ku-band. MTN Comments at 25 n.60; Boeing Comments at 11-12; Inmarsat Comments at 5, 8-9; Stratos Comments at 17.

understand that LTTS licenses specify that they may use alternate operational frequencies that are not located in the Ku-band. Given that LTTS is licensed in other bands, we find it unlikely that removing the secondary mobile allocation from this band will have a deleterious effect on current or future LTTS operations.[214]

84. As we are removing this allocation completely from the band, we will no longer consider future LTTS license applications for the 11.7-12.2 GHz band as of March 1, 2005, and "grandfather" current LTTS licensees to operate as a secondary mobile service 11.7-12.2 GHz band with the understanding that the Commission will not renew these licenses.[215] Accordingly, we modify the appropriate portions of Part 101 of our rules to reflect the revised status of LTTS operations in the 11.7-12.2 GHz band, and add footnote NG184 to the U.S. Table of Allocations.[216]

(ii) ESV Operations in the 10.95-11.2 GHz and 11.45-11.7 GHz Bands

85. *Background.* The frequency band 10.7-11.7 GHz is allocated internationally for FSS on a primary basis. Within the United States, this band is referred to as the "extended" Ku-band,[217] and FSS use of this band is reserved for international systems by footnote NG104.[218] In the United States, these bands are used by the fixed service for LTTS, Microwave Business, Microwave Public Safety, and Common Carrier Fixed Point-to-Point operations.[219]

86. *Discussion.* We agree with Intelsat and Boeing's proposals to extend our authorization of Ku-band ESV downlink operations to include the 10.95-11.2 GHz and 11.45-11.7 GHz portion of the "extended" Ku-bands.[220] We do, however, require ESV operations in these bands to operate on a non-protected basis. That is, ESV operators must accept interference from all current and future FS operations in these bands. These portions of the Ku-band are used by ESVs for reception only and it is

[214] Boeing notes that if we were to decide to maintain this secondary allocation in the 11.7-12.1 GHz band it would be possible for current or future LTTS operations to disrupt Ku-band ESV operations that are now allocated on a primary basis. Boeing Comments at 11.

[215] In the *ESV NPRM*, the Commission sought comment on whether existing LTTS operations should be "grandfathered" and allowed to operate in the Ku-band if this allocation was removed. Noting the difficulty of protecting moving receivers from possible interference from terrestrial services, the Commission alternatively proposed precluding Ku-band ESVs from claiming protection from such operations. *ESV NPRM*, 18 FCC Rcd at 25261, ¶ 32 (noting Annex 1 to Resolution 902 at WRC-03 states that: "ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with Radio regulations").

[216] *See* Appendix B.

[217] The so-called "extended Ku-band" includes allocations at 12.75-13.25 GHz, 13.75-14.0 GHz, 10.7-10.95 GHz, 10.95-11.2 GHz, 11.2-11.45 GHz, and 11.45-11.7 GHz. Within the "extended" Ku-band downlink, the 10.7-10.95 GHz and 11.2-11.45 GHz bands are authorized for use in accordance with ITU-R Appendix 30 B, which provides for the planned use of the GSO FSS. The rules we adopt today only apply to Ku-band operations at 10.95-11.2 GHz and 11.45-11.7 GHz.

[218] *See* 47 C.F.R. § 2.106 NG104 (stating that "[t]he use of the bands 10.7-11.7 GHz (space to Earth)...by the fixed satellite service in the geostationary-satellite orbit shall be limited to international systems, *i.e.*, other than domestic systems").

[219] A search of the ULS database reveals that the majority of services using the band are Common Carrier Fixed Point-to-Point. There are a total of 2106 active Common Carrier Fixed Point to Point licensees, 164 active Microwave Business licensees, 410 active Microwave Public Safety licensees, and 73 active LTTS licensees.

[220] Intelsat Comments at 2; *see also* Boeing Reply at 4-5.

virtually certain that any additional ESV-related satellite transmissions will not interfere with other operations in the band.[221] Although NG104 of the Table of Frequency Allocations limits the use of these bands to international systems,[222] we agree with Boeing that the original intent of this footnote was to protect future FS growth by limiting the wide proliferation of FSS earth stations.[223] Because we find that Ku-band ESV downlink operations will not interfere with current or future FS operations, and because ESVs will not receive protection from interference in this band, we agree with Boeing that the intent of NG104 will not be undermined by allowing ESVs to operate domestically in the 10.95-11.2 GHz and 11.45-11.7 GHz bands.[224] Accordingly, we add the following non-Federal Government footnote NG182 to the U.S. Table of Frequency Allocations for these bands:

> NG182 In the bands 10.95-11.2 GHz and 11.45-11.7 GHz, earth stations on vessels (ESVs) may be authorized to communicate with U.S. earth stations through space stations of the fixed-satellite service but must accept interference from terrestrial systems operating in accordance with Commission Rules.

b. Ku-Band Uplink: 14.0-14.5 GHz

87. The U.S. Table of Frequency Allocations for the 14.0-14.5 GHz band includes a primary allocation for FSS uplink operations.[225] The Table also includes secondary allocations for mobile (except aeronautical mobile), MSS (including AMSS), Government and Non-Government Space Research and Radionavigation services.[226] There is also a footnote providing protection, to the extent practicable, of radio astronomy services (RAS) in a small portion of this band.[227] There are no primary FS allocations in any portion of the 14.0-14.5 GHz band.

88. The secondary allocation for MSS, including AMSS, spans the entire 14.0-14.5 GHz band.[228] We agree with those parties who argue that the presence of secondary MSS, including AMSS, will not

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[221] Intelsat Comments at 2; Boeing Reply at 4.

[222] *See* 47 C.F.R. § 2.106 NG104.

[223] Boeing Reply at 5.

[224] Boeing Reply at 5. Boeing also notes that "[i]n addition to the new extended Ku-band downlink bands proposed by Intelsat, U.S. licensed ESVs operating in international or foreign waters in ITU Regions 1 and 3 would need to use the Ku-band downlink frequencies allocated in those regions (*i.e.*, the 12.2-12.75 GHz band) in order to provide two-way services, rather than the downlink band allocated within Region 2." Boeing urges the Commission to permit this additional use by U.S.-licensed ESVs in accordance with the allocations in ITU Regions 1 and 3. Boeing Reply at 5. Though the Commission's rules do not have extraterritorial application, we acknowledge that the Ku-band is not harmonized on a world-wide basis and thus, U.S.-licensed ESV operators are free to operate in the Ku-band in ITU Regions 1 and 3 in accordance with the rules of the administrations whose waters they operate in, including portions of the Ku-band not used by the United States.

[225] 47 C.F.R. § 2.106.

[226] *Id. See also supra* Figure 1.

[227] 47 C.F.R. § 2.106 US203 (stating that "every practicable effort will be made to avoid the assignment of frequencies to stations in the fixed or mobile services in [the 14.47.14.5 GHz band]. Should such assignments result in harmful interference to [radio astronomy observations made at sites listed in the footnote] the situation will be remedied to the extent practicable.").

[228] *See Amendment of Parts 2, 25, and 87 of the Commission's Rules to Implement Decisions from World Radiocommunication Conferences Concerning Frequency Bands Between 28 MHz and 36 GHz and to Otherwise* (continued....)

pose a concern to ESV operators in the 14.0-14.5 GHz band.[229] As a primary operation in this band, ESVs are functionally equivalent to conventional FSS operations, while MSS, as a secondary operation, is required to protect ESV operations and not afforded additional protections.[230]

(i) Federal Government Stations in the 14.0-14.2 GHz Band

89. The 14.0-14.2 GHz band is allocated on a secondary basis to the space research service for Federal Government and non-Federal Government use.[231] The only currently-authorized non-FSS facilities in this portion of the Ku-band uplink are two National Aeronautics and Space Administration (NASA) space research Tracking and Data Relay Satellite System (TDRSS) receive facilities (located in Guam and White Sands, New Mexico) that operate with frequency assignments in the 14.0-14.05 GHz band.[232] We note that the interference rejection filtering associated with the existing TDRSS leaves them vulnerable to interference to varying degrees. The White Sands facility, for example, has only minimal interference rejection filtering across the entire 14.0-14.5 GHz band, while the Guam facility has somewhat better filtering above 14.2 GHz.[233] We also note that NASA plans to establish another TDRSS receive facility on the east coast of the United States within two-to-three years, with several mid-Atlantic region sites under consideration. We would expect that any future NASA facilities operating in this band would be equipped with state-of-the-art interference rejection filtering.

90. We recognize the importance of protecting these space research facilities from receiving harmful interference. As a condition of licensing, we therefore require ESV operators proposing operations in the 14.0-14.2 GHz band and planning to travel within 125 km of the NASA TDRSS sites at Guam or White Sands to coordinate through the National Telecommunications and Information Administration (NTIA) Interdepartment Radio Advisory Committee's (IRAC) to resolve any potential concerns.[234] NTIA/IRAC coordination will be necessary only when an ESV operates in the 14.0-14.2

(Continued from previous page)
Update the Rules in this Frequency Range, ET Docket No. 02-305, Report and Order, 18 FCC Rcd 23426, 23454-55 ¶¶ 76, 78 (2003).

[229] MTN Comments at 25; Stratos Comments at 16; Inmarsat Comments at 8.

[230] MTN Comments 25-26.

[231] We recently proposed removing the primary allocation for radionavigation in the 14.0-14.2 GHz band from the Table of Frequency Allocations. *See Review of Part 87 of the Commission's Rules Concerning the Aviation Radio Service*, WT Docket No. 01-289, Report and Order and Further Notice of Proposed Rulemaking, FCC 03-238, 18 FCC Rcd 21432, 21472 ¶ 85 (2003).

[232] *See Amendment of Parts 2, 25 and 73 of the Commission's Rules to Implement Decisions from the World Radiocommunication Conference (Geneva, 2003) (WRC-03) Concerning Frequency Bands Between 5900 KHz and 27.5 GHz and to Otherwise Update the Rules in this Frequency Range*, ET Docket No. 04-139, Notice of Proposed Rulemaking, FCC 04-74, 19 FCC Rcd 6592, 6609 n.74 (2004).

[233] The diplexer for the White Sands earth stations provides only 35 dB or less of interference attenuation from 14.35 to 14.5 GHz, while the diplexer at the Guam earth station provides little to no interference protection from 14.05 to 14.23 GHz, but provides 70 dB of attenuation at 14.48 GHz. *See* Letter from Robert E. Spearing, Deputy Associate Administrator for Space Communications, Office of Space Flight, NASA, to Craig Holman, Regulatory Counsel, The Boeing Company, at Figure 2 (Dec. 18, 2001), *cited in The Boeing Company*, Order and Authorization, DA 01-3008, 16 FCC Rcd 22645, 22648 n.21 (Int'l Bur./OET 2001).

[234] NTIA is responsible for managing the government portion of the Table of Frequency Allocations. In bands shared between Federal and non-Federal Government services, the Commission and NTIA operate under a long-standing coordination agreement. *See NTIA Manual, Basic Coordination Arrangement Between IRAC and the FCC*, (continued....)

GHz band within 125 km of the Guam or White Sands TDRSS sites, and ESVs may not operate in the 14.0-14.2 GHz band within 125 km of the TDRSS sites until such coordination has taken place.[235] We require NTIA/IRAC coordination as a condition to licensing as opposed to a prerequisite to licensing. Thus, we do not require a Ku-band ESV operator to complete this coordination prior to receiving a Commission ESV license.[236]

91. In deference to the U.S. assets operated by NASA, we expect the coordination to be conducted on an equal basis between NASA and the ESV operator, even though the space research service is a secondary allocation in the 14.0-14.2 GHz portion of the 14.0-14.5 GHz FSS uplink band, while ESVs are primary. Ku-band ESV operators must notify the International Bureau once they have completed this coordination. Upon receipt of such notification, the Bureau will release a public notice stating that operations within the new coordination zone may commence in 30 days if no party has opposed such operations. Should NTIA seek to provide similar protection to future TDRSS sites that have been coordinated through the IRAC Frequency Assignment Subcommittee process, NTIA should notify the International Bureau that the TDRSS site is nearing operational status. The Bureau will then issue a notice requiring all Ku-band ESV operators to cease operations in the 14.0-14.2 GHz band within 125 km of the new TDRSS site until they coordinate with the new site. After NTIA/IRAC coordination has been completed at the new TDRSS receive site, ESV operations will again be permitted to operate in 14.0-14.2 GHz within 125 km of the new TDRSS site, subject to any operational constraints developed in the coordination process. Due to the wideband nature of the TDRSS downlink signal, coordination between ESV operations and future operational TDRSS earth stations will be required in the 14.0-14.2 GHz band. However, NASA will endeavor to design any future TDRSS earth stations to minimize the coordination impact on ESVs from TDRSS operations below 14.2 GHz.

92. Given that the operational range of ESVs is limited to oceans, large rivers and lakes, and because NASA will have a very limited number of space research earth stations that will be receiving from the Government data relay satellites, we conclude that coordination between ESVs and TDRSS operations is possible, should not unnecessarily delay Ku-band ESV operators from initiating their licensed service in areas that may interfere with TDRSS sites, and will not prove to be a burden for ESVs.[237]

(ii) Changes to the U.S. Table of Allocations in the 14.2-14.4 GHz Band

93. Based on the same justifications discussed above regarding LTTS operations in the 11.7-12.2 GHz band,[238] we remove the secondary mobile (except aeronautical) allocation from the 14.2-14.4 GHz band, thus precluding new LTTS operations and revising the status of existing LTTS operations in this

(Continued from previous page)

Chapter 8.3.1, (visited Dec. 13, 2004) <http://www.ntia.doc.gov/osmhome/redbook/8.pdf>. *See also ESV NPRM*, 18 FCC Rcd at 25262, ¶ 34 (discussing NTIA coordination).

[235] As we noted *supra* ¶ 8, WRC-03 established the minimum distance from the low-water mark as officially recognized by the coastal state beyond which ESVs can operate without the prior agreement of any administration as 125 km in the 14-14.5 GHz band.

[236] *See, e.g.*, Stratos Comments at 18; Inmarsat Comments at 6; *but see* SOI Comments at 10 (supporting a "pre-licensing" IRAC coordination requirement).

[237] MTN has acknowledged that it will coordinate its use of the 14.0-14.2 GHz band with NTIA/IRAC. MTN Comments at 25 (citing Letter from Raul R. Rodriguez, Counsel to MTN, to Marlene Dortch, Secretary, FCC, File No. SES-LIC-20011130-02259 (Nov. 22, 2002)).

[238] *See supra* Section III.C.2.a.(i).

band. Similar to the 11.7-12.2 GHz band, the 14.2-14.4 GHz band contains a secondary mobile allocation available for LTTS operations. An initial review of the Commission's licensing database found 25 LTTS licenses for this band but did not yield information regarding how many licensees were using this spectrum for LTTS operations.[239] No parties provided evidence of any active LTTS operations in this band. Given the apparently limited use by LTTS licensees of the mobile allocation and their ability, under the terms of their license, to operate in alternative spectrum, we alter the Table of Frequency allocations to remove the secondary mobile (except aeronautical) allocation and thus preclude future LTTS operations from the 14.2-14.4 GHz band.[240]

94. Because we remove the secondary mobile (except aeronautical) allocation completely from the band, we will no longer consider future LTTS license applications for the 14.2-14.4 GHz band as of March 1, 2005. However we "grandfather" current LTTS licensees to operate as a secondary mobile service in the 14.2-14.4 GHz band with the understanding that the Commission will not renew these licenses.[241] As a secondary service these operations must accept interference from primary Ku-band ESV operations. Accordingly, we modify the appropriate portions of Part 101 of our rules to reflect the revised status of LTTS operations in the 14.2-14.4 GHz band and add footnote NG184 to the U.S. Table of Allocations.[242]

(iii) Federal Government Stations in the 14.4-14.5 GHz Band

95. We note that there are several secondary Federal Government mobile, fixed and transportable telemetry operations in the 14.4-14.5 GHz band. In the *ESV NPRM*, the Commission sought comment on the extent to which this band is used to provide these services, and whether these services could be adequately protected if ESV operations were permitted in this band.[243] The record in this proceeding indicates that there is a need to ensure ESVs have access, on a primary basis, to the full 14.0-14.5 GHz band to provide its services and to allow for consistent operations given its access to these frequencies in foreign locations.[244] We did not receive any comment on secondary Federal Government mobile, fixed and transportable use of this band, and therefore the standard primary/secondary sharing environment applies. However, we did receive comment with regard to protecting RAS operations in the

[239] *ESV NPRM*, 18 FCC Rcd at 25263-64, ¶ 37. The Commission sought comment on whether this secondary allocation should be removed, whether existing operations in this band should be grandfathered or required to cease operations, and if such operations were allowed to continue what their status should be relative to ESV operations. The Commission noted that a 2001 study by the Boeing Corporations in a separate proceeding indicated that most LTTS operators licensed in this band were no longer in business and those that were operating indicated they did not utilize the 14 GHz band. *ESV NPRM*, 18 FCC Rcd at 25263-64, ¶ 37.

[240] *See* Stratos Comments at 19; Inmarsat Comments at 8-9.

[241] In the *ESV NPRM*, the Commission sought comment on whether existing LTTS operations should be "grandfathered" and allowed to operate in the Ku-band if this allocation was removed. Noting the difficulty of protecting moving receivers from possible interference from terrestrial services, the Commission alternatively proposed precluding Ku-band ESVs from claiming protection from such operations. *ESV NPRM*, 18 FCC Rcd at 25261, ¶ 32 (noting Annex 1 to Resolution 902 states that: "ESVs in motion shall not claim protection from transmissions of terrestrial services operating in accordance with Radio regulations.").

[242] *See* Appendix B.

[243] *ESV NPRM*, 18 FCC Rcd at 25265, ¶ 38.

[244] MTN Comments at 26; Inmarsat Comments at 9-10.

14.47-14.5 GHz band.[245] Three radio observatory sites were specifically mentioned in conjunction with ESVs.[246] Cornell, the operator of the Arecibo Observatory on Puerto Rico, suggests protection in the 14.47-14.5 band from ESVs within approximately 90 km of the observatory.[247] CORF requests protection of the radio observatories when ESVs are within 125 km of Mauna Kea, Hawaii or within 45 km of the radio observatory on St. Croix, Virgin Islands.[248]

96. While RAS operations in the 14.47-14.5 GHz band are important, they are limited to specific geographical locations and do not require broad exclusion zones to protect them from interference. Consistent with the Commission's proposal in the *ESV NPRM*,[249] as a condition of licensing, we require ESV operators proposing operations in the 14.47-14.5 GHz band and planning to travel within the above-described distances from these three radio observatory sites to coordinate through NTIA/IRAC to resolve any potential concerns. NTIA/IRAC coordination is a condition to licensing as opposed to a prerequisite to licensing, and we do not require a Ku-band ESV operator to complete this coordination prior to receiving a Commission ESV license. Ku-band ESV operators must notify the International Bureau once they have completed coordination. Upon receipt of such notification, the Bureau will release a public notice stating that operations within the new coordination zone may commence in 30 days if no party has opposed such operations.

97. We note that radio observations in the 14.47-14.5 GHz band are not performed on a continuous basis and are usually scheduled in advance.[250] Thus, coordination between ESVs and RAS operations is possible, should not unnecessarily delay Ku-band ESV operators from initiating their licensed service in areas that may interfere with RAS sites, and should not prove to be a burden for ESVs. Indeed, one Ku-band ESV operator has committed to coordinating with IRAC in this band.[251] To assist in this effort, we agree with Boeing's suggestion that RAS observatories should provide advance notice to ESV operators regarding their observations.[252]

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[245] MTN Comments at 26; Cornell Comments at 2-5; NRAO Comments at 1-3; CORF Comments at 1-7. Radio astronomy has permissive use of the 14.47-14.5 GHz band for the observatories listed in footnote US203 to the U.S. Table of Frequency Allocations, 47 C.F.R. § 2.106 US203.

[246] These three observatories are not listed for the 14.47-14.5 GHz band in 47 C.F.R. § 2.106 US203.

[247] Cornell Comments at 5 (the Arecibo Observatory is located at latitude 18° 20' 46" W, longitude 66° 45' 11" N).

[248] CORF Comments at 6-7 n.5 (the radio observatory at Mauna Kea, Hawaii is located at latitude 19° 48' N, longitude 155° 28' W; the observatory on St. Croix, Virgin Islands is located at latitude 17° 46' N, longitude 64° 35' W). *See also* NRAO Comments at 3.

[249] *ESV NPRM*, 18 FCC Rcd at 25265, ¶ 39.

[250] *See, e.g.*, MTN Reply at 13 (emphasizing the intermittent nature of radio astronomy observations).

[251] *See* MTN Comments at 26.

[252] Boeing Comments at 14. We note that in the 1.6/2.4 GHz service rules, we require the radio astronomy community to provide similar information to 1.6/2.4 GHz Mobile-Satellite Service licensees. *See* 47 C.F.R. § 25.213(a)(1)(vi). We expect that the radio astronomy community would provide to ESV operators the same information to facilitate the ESV operators' coordination efforts.

3. Technical Requirements for Protecting Fixed-Satellite Operations

a. Off-Axis E.I.R.P.-Density Limits and Associated Rules

98. As an alternative to modifying our VSAT technical requirements to accommodate ESV operations, Boeing asserts that the Commission should adopt ESV-specific technical limitations to ensure these systems conform to acceptable performance criteria.[253] Specifically, Boeing proposes aggregate off-axis e.i.r.p.-density limits along the geostationary satellite arc for co-polarized signals of Ku-band ESVs.[254]

99. We adopt Boeing's proposal by combining the antenna performance requirements of Section 25.209(g) and the input power density to the antenna requirements of Section 25.212(c) of the Commission's rules,[255] to produce off-axis e.i.r.p.-density limits for ESV transmitters. The limits that Boeing proposed are consistent with the limits for routinely licensed VSAT transmitters for co-polarized signals transmitted towards the geostationary orbit. We therefore adopt the following off-axis e.i.r.p.-density limits for ESV transmitters operating in the Ku FSS bands:[256]

Maximum e.i.r.p. Density			Off-Axis Angle
$15 - 25\log(\theta)$	dBW/4kHz	for	$1.25 <= \theta <= 7°$
-6	dBW/4kHz		$7° < \theta <= 9.2°$
$18 - 25\log(\theta)$	dBW/4kHz		$9.2° < \theta <= 48°$
-24	dBW/4kHz		$48° < \theta <= 180°$

Where:
θ: is an angle in degrees from the axis of the main lobe along the geostationary orbit.

100. Additionally, Boeing argues that the Commission should allow minor variations in the ESV antenna performance where it would not adversely affect neighboring satellites.[257] For the Ku-band earth stations, the allowable variations are set forth in Section 25.209(a). We agree with Boeing that the antenna gain variations captured in Section 25.209(a), for Ku-band antennas, are part of the VSAT antenna envelope upon which we are basing the ESV off-axis power density limitations.[258] In this manner, the allowance for these variations is incorporated into the operational conditions we adopt for Ku-band ESVs. The off-axis e.i.r.p.-density limits discussed immediately above apply to co-polarized signals transmitting towards the geostationary orbit. To be consistent with the Commission's two-degree spacing rules, we also adopt e.i.r.p.-density limits for co-polarized transmissions in directions other than

[253] Boeing Comments at 14.

[254] *See supra* footnote 50 and accompanying text.

[255] This rule Section deals with antenna performance requirements for Ku-band narrow band transmissions.

[256] The off-axis e.i.r.p.-density limits listed here pertain to emissions from a single transmitter if the selected modulations permit one carrier per channel at the satellite receiver. *See supra* footnote 154 for an example of how an ESV operator might be able to limit off-axis power-density should it choose to implement a modulation technique, such as CDMA, that can operate with multiple co-frequency transmissions from different vessels being simultaneously received at the same satellite.

[257] Boeing Comments at 20; Boeing Reply at 15.

[258] Boeing Comments at 20; Boeing Reply at 14–15.

the geostationary orbit and cross-polarized e.i.r.p.-density limits. We add Section 25.222 to our rules to reflect this decision.

101. We disagree with Boeing's assertion that Ku-band ESV operators should be allowed to coordinate uplink transmissions with adjacent satellite operators in excess of the limits described above, up to the limits contained in ITU-R Resolution 902.[259] Boeing points out that other administrations implement their respective FSS systems under a three-degree spacing regime, as opposed to the Commission's two- degree spacing, and that ESV applicants should be able to demonstrate compliance with blanket licensing rules by demonstrating compliance with the off-axis e.i.r.p.-density limits contained in Resolution 902, rather than the Commission's two-degree spacing limits, and obtain a certificate of non-interference from the satellite providers.[260] While we recognize that other administrations operate under a three-degree FSS spacing regime and may, therefore, permit higher off-axis power limits, to operate with satellites licensed by the Commission, we expect U.S.-licensed FSS space station operations to meet the off-axis e.i.r.p.-density limits contained in Section 25.222 of the Commission's rules.

b. ESV Power Limits Toward the Horizon and Minimum Antenna Elevation Angle

102. In the *ESV NPRM*, the Commission sought comment on whether it should limit the antenna elevation angle for Ku-band ESV operations to "some minimum value" and, if so, what that value should be.[261] Commenters who addressed this issue proposed either a 10 or 15 degree minimum elevation angle for Ku-band ESVs.[262] Inmarsat, taking a different approach, notes that ITU-R Resolution 902 contains limits on e.i.r.p. and e.i.r.p.-density towards the horizon of 16.3 dBW and 12.5 dBW, respectively (collectively, "ESV horizontal limits"), and argues that if these limits are adopted, a minimum elevation angle limit is unnecessary.[263] Inmarsat further argues that the ESV operator would be permitted to operate with additional flexibility because the ESV horizontal limit approach allows the ESV operator to perform a trade-off between the two parameters of horizontal e.i.r.p. and elevation angle, while achieving the same level of interference protection with respect to any terrestrial receive stations.[264] We agree, and in the interest of providing operational flexibility to Ku-band ESV operators, and to provide NASA/TDRSS operations the technical certainty they require to share spectrum with ESV operators,[265] we adopt these ESV horizontal limits in that portion of the band shared with NASA/TDRSS operations. Specifically, we adopt the two limits contained in ITU Resolution 902, an e.i.r.p. towards the horizon of no greater than 16.3 dBW, and an e.i.r.p.-density towards the horizon of no greater than 12.5 dBW/MHz.[266] We note that under Section 25.205 of our rules, all FSS Earth stations, including ESV antennas, are required to operate with an elevation angle of 5 degrees or greater, unless the applicant

[259] The off-axis e.i.r.p.-density limits provided in Annex 2 to ITU-R Res. 902 (WRC-03) are approximately 23 dB higher than the limits for two-degree spacing being addressed here.

[260] Boeing Comments at 20-21.

[261] *ESV NPRM*, 18 FCC Rcd at 25267, ¶ 47.

[262] MTN Comments at 21; SOI Comments at 10.

[263] Inmarsat Comments at 13; *see* ITU-R Resolution 902 (WRC-03), Annex 2.

[264] Inmarsat Comments at 13.

[265] *See supra* Section III.C.2.b.(i).

[266] *See* 47 C.F.R. § 25.204(i).

demonstrates that a lower elevation angle is needed, or that the antenna will be pointed away from the land masses.[267]

c. Antenna Size and Pointing Accuracy

103. We decline to adopt our proposal, set forth in the *ESV NPRM*, to require a minimum antenna size for Ku-band ESVs.[268] We are satisfied that the off-axis e.i.r.p limits in this *Order* adequately protect adjacent satellite systems and ensure that ESVs do not cause harmful interference to adjacent FSS satellite operators. However, consistent with WRC-03, we require that Ku-band ESV operators maintain a pointing accuracy of no less than 0.2 degrees for all antennas within their licensed network.

104. Incorporating a smaller antenna size for Ku-band ESV operations into our rules is supported by current ESV operators[269] and complies with the conclusions of WRC-03.[270] We find, however, that we can provide the same protection to adjacent satellite operators by adopting off-axis e.i.r.p. limits for ESV operations. As a result, we eliminate the need to regulate the specific size of the antenna being used. We also agree with those commenters who argue the Commission should adopt an antenna pointing accuracy requirement of 0.2 degrees and note that this value is consistent with the technical parameters contained in Resolution 902.[271] In fact, one Ku-band ESV operator has already taken steps towards implementing this capability in its ESV network.[272] Furthermore, if the ESV antenna drifts more than 0.5 degrees from the intended satellite, the ESV terminal on the vessel must cease transmitting automatically until the ESV antenna is, once again, pointing to within 0.2 degrees of the intended satellite.[273] Limiting all Ku-band ESV antennas in this manner ensures adequate protection to adjacent FSS satellites.

d. Additional Requirements

105. We adopt our proposal in the *ESV NPRM* to allow Ku-band ESVs to receive authority to operate with any U.S. licensed satellite and non-U.S. satellite on the Permitted List (ALSAT

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[267] 47 C.F.R. § 25.205.

[268] *ESV NPRM*, 18 FCC Rcd at 25270, ¶ 55. The Commission proposed that ESV networks that sought routine processing to operate in the Ku-band would have to meet the requirements of Section 25.134(a)(1) of our rules and have a minimum antenna diameter of 1.2 meters.

[269] Intelsat Comments at 16.

[270] WRC-03 stated, in Resolution 902, that licensing organizations may authorize the deployment of smaller antennas (down to 0.6 meters) at 14 GHz so long as the interference to FS would be no greater than would be caused by 1.2 meter antennas. *See* ITU-R Resolution 902 (WRC-03). The Commission noted that smaller antenna sizes would decrease the cost of certain ESVs and therefore would be desirable to operators. *ESV NPRM*, 18 FCC Rcd at 25271, ¶ 56.

[271] Stratos Comments at 20; Boeing Comments at 21; MTN Comments at 29; Inmarsat Comments at 14; SES Americom Comments at 8. ITU Resolution 902 suggests a peak tracking accuracy of 0.2 degrees. *See* ITU-R Resolution 902 (WRC-03), Annex 2.

[272] MTN Comments at 29 (noting its success with using stabilized antenna systems and controllers that can detect within 100 milliseconds if the pointing error should ever exceed 0.5 degrees and cease transmission immediately.)

[273] *See* Appendix B (new Section 25.222(a)(7)).

authority).[274] We find significant support in the record for granting Ku-band ESVs ALSAT authority.[275] Affording this flexibility to Ku-band ESV operators helps to ensure the viability of the service by providing them the flexibility to negotiate with multiple satellite service providers.[276] This flexibility also encourages all Ku-band ESV operators to design their systems in a manner that will protect satellite service providers with which they currently interface as well as those with which they may seek to interface in the future.

106. The ability to utilize numerous FSS satellite capacity providers also will enhance competition and reduce the costs of providing ESV services.[277] Specifically, giving ESV operators the flexibility to alternate among satellite providers as necessary affords these operators the opportunity to negotiate market-based pricing for transponder capacity.[278] Moreover, requiring Ku-band ESV operators to file an application every time they wish to change satellite providers is costly to both the applicant and the Commission.

107. In the *ESV NPRM*, the Commission proposed that Ku-band ESV network operators be required to prove, via an affidavit, that its operations have been successfully coordinated with adjacent satellite licensees that are two degrees removed from the satellite used by the ESV operator.[279] We find that requiring submission of an affidavit stating that this coordination has taken place is unnecessary given the operational conditions and off-axis e.i.r.p. limits we require of Ku-band ESV systems. These conditions and limits adequately protect adjacent systems that are two-degrees removed from the GSO orbit location used by the ESV system.

108. We also decline to adopt the proposal, set forth in the *ESV NPRM*, to require transmitter power control for Ku-band ESVs as a method of avoiding interference to satellites that are adjacent to the satellite receiving transmissions from the ESV.[280] Mandating a showing that a Ku-band ESV operator has the ability to control dynamically its transmitter power, via its hub station or other methods, is unnecessary given the off-axis e.i.r.p. limits we adopt today.[281] The record indicates that many commenters agree.[282] For example, Intelsat argues that there are no special provisions for mandating power control for VSAT systems and therefore ESVs, which have similar network characteristics, should operate under rules comparable to those of VSATs.[283] Boeing asserts that, so long as the off-axis e.i.r.p.

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[274] *ESV NPRM*, 18 FCC Rcd at 25270, ¶ 53. The Commission noted that the alternative would be to grant Ku-band ESVs the authority to access individual satellites only. *Id.*

[275] Broadband Maritime Comments at 6; Boeing Comments at 28; Inmarsat Comments at 15; SOI Comments at 11; Stratos Reply at 12.

[276] Broadband Maritime Comments at 6; Boeing Comments at 30.

[277] Boeing Comments at 30.

[278] Broadband Maritime Comments at 6.

[279] *ESV NPRM*, 18 FCC Rcd at 25269, ¶ 51. *See also* 47 C.F.R. § 25.134(a), (b).

[280] *ESV NPRM*, 18 FCC Rcd at 25269-70, ¶ 53.

[281] MTN Comments at 29.

[282] Inmarsat Comments at 14; Boeing Comments at 31; MTN Comments at 29.

[283] Intelsat compares § 25.204(e) of our rules, which limits the use of uplink power control for earth station operating above 10 GHz to only that forward power control necessary to overcome precipitation fading plus, at most, 1 dB, and § 25.204(g) which mandates adaptive uplink power control for FSS earth station operating in the 20-30 GHz (continued....)

is below the limits we adopt in our rules, the Commission should not mandate the methods by which these limits are maintained.[284] We agree with Boeing and Intelsat and see no reason to develop special rules for ESVs with regard to uplink power control so long as they operate within the off-axis e.i.r.p. limits adopted in this Order.[285]

4. "In-Motion" Ku-Band ESVs

109. We note that ITU-R Resolution 902 establishes regulatory provisions requiring in-motion Ku-band ESVs to accept interference from terrestrial services.[286] This would apply to interference from services of higher status and to services with co-equal status to ESVs. However, there are no co-primary terrestrial services in the 11.7-12.2 GHz band where ESVs are primary, and in the 10.95-11.2 GHz and 11.45-11.7 GHz bands, ESV operators are required to accept interference from terrestrial services whether the ESVs are in-motion or stationary. Therefore, unlike in the C-band, we find it unnecessary to differentiate between in-motion and stationary ESVs in the Ku-band.[287]

5. Size Limitations of Vessels Utilizing Ku-Band ESVs

110. We decline to adopt a size restriction for vessels operating with ESVs in the Ku-band.[288] As explained above, we impose a minimum vessel size requirement for ESV operations in the C-band, to limit interference with the terrestrial services that may share the band.[289] Unlike the C-band, there are very few terrestrial systems currently operating in the Ku-band, and those are allocated on a secondary basis.[290] Thus, in contrast to the C-band, concerns that ESVs in the Ku-band will interfere with terrestrial services are significantly reduced. Accordingly, it is not necessary to impose size restrictions on Ku-band ESV-equipped vessels to protect terrestrial operations.

111. Moreover, limiting ESV operations to vessels of a certain size would undermine our goal of promoting ESV use in the Ku-band. Specifically, an unnecessary size restriction on vessels utilizing ESVs in the Ku-band would unjustifiably preclude use of this service on smaller vessels, which are capable of navigating inland and coastal waterways.[291] By making Ku-band ESVs available to vessels

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band. *See* Intelsat Comments at 14. Intelsat is correct, ESV operation will be similar to that of VSATs under § 25.204(e) and should not require mandated uplink power control under § 25.204(g).

[284] Boeing Comments at 31.

[285] MTN notes that its hub already exercises uplink power control over all Ku-band ESVs within its network. MTN Comments at 29.

[286] ITU-R Resolution 902 (WRC-03).

[287] *See supra* Section III.B.9. Indeed, the Commission questioned whether there was a need to delineate between "in-motion" and stationary Ku-band ESVs. *ESV NPRM*, 18 FCC Rcd at 25261-62, ¶ 32.

[288] In the *ESV NPRM*, the Commission sought comment on whether Ku-band ESV operations should be limited to vessels that are 300 gross tons or larger, similar to the restriction for C-band ESVs. However, the Commission did acknowledge that such a restriction may not be appropriate given the current limited terrestrial use of the 14.0-14.5 GHz band *ESV NPRM*, 18 FCC Rcd at 25270, ¶ 54.

[289] *See supra* Section III.B.6.

[290] Stratos Comments at 17. We note that Ku-band ESV operators will have to coordinate with a limited number of Federal Government sites. *See supra* Sections III.C.2.b.(i) and III.C.2.b.(iii).

[291] Stratos Comments at 17; Boeing Comments at 28.

capable of carrying a standardized Ku-band ESV system that meets our technical rules, we allow for more ubiquitous use of this service.[292] The record in this proceeding supports this conclusion.[293]

6. Ku-Band ESV Data Tracking

112. In the unlikely event that we are presented with an interference concern regarding Ku-band ESV operations, we require Ku-band ESV hub operators to have the capability to track and maintain certain data regarding their ESV operations.[294] Specifically, ESV network operators must maintain information on the satellite(s) that each vessel uses, operating frequencies and bandwidth used, the time of day, the vessel location (*i.e.*, longitude and latitude), the country of registry of each vessel, and a point of contact for any foreign administration of vessel registration, if applicable.[295] We require Ku-band ESV operators to maintain their tracking data for one year.[296] Although we note that some ESV operators are capable of tracking certain data regarding their ESV operations on a real time basis,[297] we agree with those commenters who argue that the risk associated with ubiquitous distribution of such tracking information outweighs the benefit it may provide in preventing interference to other operators.[298]

113. As with the C-band,[299] Ku-band ESV operators must have a point of contact in the United States available 24 hours a day, 7 days a week that will be able to respond immediately to Ku-band ESV system interference concerns. This point of contact must have the ability to immediately terminate Ku-band ESV operations upon request by the Commission. Furthermore, to assist in resolving any unexpected interference concerns with incumbents, Ku-band ESVs operators must provide ESV tracking information within 24 hours upon request from frequency coordinators, fixed service operators, fixed-satellite service operators, NTIA, or the Commission.[300] Our point of contact requirement mitigates the need for requiring Ku-band ESV operators to provide third party access to this information. In the unlikely event that Ku-band ESVs interfere with another licensed operator, the Commission may require the Ku-band ESV operator to cease operations until the interference concern is resolved.

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[292] Indeed, smaller vessels are most suited for Ku-band operations because the Ku-band operates at a higher frequency and ESV operators can offer antennas which are smaller and require less deck space. In addition the antennas are lighter in weight and the stabilizing platforms operate with lower power demands, allowing for easier stabilization on smaller vessels.

[293] MTN Comments at 26; Inmarsat Comments at 15; SOI Comments at 10; Stratos Reply at 12; SES Americom at 5; Boeing Comments at 27-28.

[294] *See* Appendix B (new Section 25.222(c)(1) & (2)).

[295] *Id.*

[296] *See* Appendix B (new Section 25.222(c)(1)).

[297] MTN Comments at 30; Inmarsat Comments at 13.

[298] *See* MTN Comments at 30; Boeing Comments at 26; Inmarsat Comments at 13; Intelsat Comments at 6; *but see* NRAO Comments at 2 (supporting either an password protected internet database showing or a single point of contact to resolve ESV interference concerns).

[299] *See supra* Section III.B.4.

[300] In the *ESV NPRM*, the Commission sought comment on whether it would be necessary to require Ku-band ESV operators to maintain vessel tracking information on a real time basis and to make such information available on a secure basis. *ESV NPRM*, 18 FCC Rcd at 25267, ¶ 47.