

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

In the Matter of )  
 )  
Procedures to Govern the Use of Satellite ) IB Docket No. 02-10  
Earth Stations on Board Vessels in the 5925- )  
6425 MHz/3700-4200 MHz Bands and 14.0- )  
14.5 GHz/11.7-12.2 GHz Bands )

To: The Commission

**REPLY COMMENTS OF THE BOEING COMPANY**

The Boeing Company (“Boeing”), by its attorneys, hereby files these reply comments in the above-captioned proceeding.<sup>1</sup> As discussed in its initial comments, Boeing supports the Commission’s efforts to adopt rules to permit the operation of earth stations onboard vessels (“ESVs”) in Ku-band Fixed-Satellite Service (“FSS”) spectrum.<sup>2</sup> In these reply comments, Boeing underscores certain matters raised in its initial comments, addresses additional issues raised by other commenters in this proceeding, and proposes alternative licensing rules for Ku-band ESV operations.

**I. INTRODUCTION**

Boeing is the leading proponent of real-time, two-way advanced broadband mobile communications services for commercial, government and private aircraft customers through its

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<sup>1</sup> See Procedures to Govern the Use of Satellite Earth Stations on Board Vessels in the 5925-6425 MHz/3700-4200 MHz Bands and 14.0-14.5 GHz/11.7-12.2 GHz Bands, *Notice of Proposed Rulemaking*, IB Docket No. 02-10, FCC 03-286 (rel. Nov. 24, 2003) (“*NPRM*”).

<sup>2</sup> See Comments of The Boeing Company, IB Docket No. 02-10 (filed Feb. 23, 2004) (“Boeing Comments”). As noted in its initial comments, Boeing has not taken any positions with respect to specific C-band ESV rules and procedures.

Connexion by Boeing<sup>SM</sup> (“Connexion”) Ku-band Aeronautical Mobile-Satellite Service (“AMSS”) offering. Boeing seeks to utilize the satellite and ground-based network of the Connexion system to extend its broadband communications capabilities to the maritime industry. Using Connexion terminals specifically developed for the maritime market, vessel operators and their passengers will be able to use Connexion service to access a full range of broadband capabilities, including Internet and corporate intranet communications, remote monitoring of ship systems and cargo, high-speed data services, videoconferencing, access to satellite television programming and other services.

The numerous comments filed in this proceeding by ESV proponents, satellite operators and others confirm that there is universal support for new, advanced broadband maritime communications services in the Ku-band. In one important respect, however, the *NPRM* falls short by attempting to shoehorn the Ku-band ESV licensing rules into a VSAT regulatory regime developed two decades ago for a service with fundamentally different technical and operational characteristics. As a result of these differences, as well as proposed changes to the Part 25 earth station licensing rules under consideration in a separate rulemaking proceeding,<sup>3</sup> the Commission’s proposed ESV licensing approach threatens the viability of these new services. To facilitate the introduction of advanced broadband maritime communications services in the Ku-band, the Commission should instead adopt service-specific licensing rules. In this way, the Commission will help facilitate the prompt introduction and long-term viability of these important new services, while at the same time protecting other co-frequency operations.

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<sup>3</sup> 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 00-435 (rel. Dec. 14, 2000) (“*Part 25 NPRM*”).

## **II. THERE IS UNIVERSAL SUPPORT FOR PERMITTING BROADBAND MARITIME COMMUNICATIONS SERVICES IN KU-BAND FSS SPECTRUM**

In the *NPRM*, the Commission proposed to allow ESVs to operate on a primary basis in the Ku-band.<sup>4</sup> The Commission's stated goal was "to promote more efficient use of the spectrum while protecting and providing regulatory certainty to the existing primary allocations, including [] fixed satellite service (FSS) operators, and protection to stations of the secondary Government space research (SRS) and radio astronomy (RAS) operations in these frequency bands."<sup>5</sup> In addition, the Commission's proposals sought to "enable important new communications services to be provided to consumers on board vessels."<sup>6</sup>

Boeing agrees that Ku-band ESV operations should be authorized on a primary basis and fully supports the Commission's objectives of bringing advanced broadband maritime service to consumers consistent with the protection of other services in the band. Indeed, all other commenters that addressed Ku-band ESV licensing -- including ESV proponents, terrestrial fixed service interests and satellite operators -- agree that ESV operations should be permitted in primary Ku-band FSS frequencies.<sup>7</sup> The discussion below, as well as Boeing's proposed Ku-

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<sup>4</sup> *NPRM* at ¶ 30. Primary regulatory status is consistent with decisions reached at the 2003 World Radiocommunication Conference ("WRC-03") and ensures that ESVs are considered a co-primary application within FSS networks during inter-system coordination.

<sup>5</sup> *Id.*, ¶ 1.

<sup>6</sup> *Id.*

<sup>7</sup> *See generally* Comments of Maritime Telecommunications Network, Inc., IB Docket No. 02-10 (filed February 23, 2003); Comments of Stratos Offshore Services Company, IB Docket No. 02-10 (filed February 23, 2003); Comments of Inmarsat Ventures Ltd, IB Docket No. 02-10 (filed February 23, 2003); Comments of Telenor Satellite Services, Inc., IB Docket No. 02-10 (filed February 23, 2003); Comments of Schlumberger Omnes, IB Docket No. 02-10 (filed February 23, 2003); Comments of Tachyon Networks Incorporated, IB Docket No. 02-10 (filed February 23, 2003); Comments of the Fixed Wireless Communications Coalition, IB Docket No. 02-10 (filed February 23, 2003); Comments of Intelsat Global Service Company, IB

band ESV licensing rules as described in Section IV, *infra*, reflect the commenters' universal support for these important new services and seek to advance to the maximum extent possible the Commission's objectives in this proceeding.

**A. Ku-Band ESV Spectrum Issues**

To facilitate the introduction of broadband maritime communications services in the Ku-band, the Commission requested comment on whether to remove the underutilized Local Television Transmission Service ("LTTS") allocations in the 11.7-12.2 GHz and the 14.2-14.4 GHz bands in an effort to eliminate the potential for interference into LTTS operations.<sup>8</sup> All commenters that addressed this issue welcomed the Commission's proposal to remove these allocations;<sup>9</sup> and no LTTS licensee objected to their removal. Accordingly, Boeing urges the Commission to make these allocation changes.

In its initial comments, Intelsat proposed that the Commission also permit U.S.-licensed Ku-band ESVs to conduct receive operations in the 10.95-11.2 GHz and 11.45-11.7 GHz bands.<sup>10</sup> Intelsat argues that adding these frequencies for Ku-band ESV receive operations would be consistent with the Commission's public interest objectives in this proceeding.<sup>11</sup> Boeing supports Intelsat's proposal. Because these bands would be used for receive operations only, there is no possibility of potential interference into other services. Additionally, although footnote NG104 to the U.S. Table of Frequency Allocations limits use of the 10.95-11.2 GHz

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Docket No. 02-10 (filed February 23, 2003); Comments of SES AMERICOM, Inc., IB Docket No. 02-10 (filed February 23, 2003).

<sup>8</sup> See *NPRM* at ¶¶ 31, 37.

<sup>9</sup> See, e.g., Boeing Comments at 11-12, 14; Inmarsat Comments at 5, 8-9.

<sup>10</sup> See Intelsat Comments at 2.

<sup>11</sup> See *id.*

and 11.45-11.7 GHz bands to international systems,<sup>12</sup> Boeing believes that the Commission may still authorize ESV receive operations in the bands. Communications with U.S.-licensed ESVs at sea are international services for purposes of the footnote, at least with respect to operations in international waters, and communications in U.S. territorial waters and in port can be viewed as incidental to such international services. Moreover, the intent of footnote NG104 is to prevent a wide proliferation of FSS earth stations that, once coordinated, would make further use of the band by the fixed service very difficult. Because Resolution 902 provides that ESVs in motion may not claim protection from transmissions of primary terrestrial services,<sup>13</sup> however, Ku-band ESV receive operations would not constrain primary terrestrial operations in the 10.95-11.2 GHz and 11.45-11.7 GHz bands, and the policies underlying footnote NG104 would not be undermined if ESV operations were permitted in this spectrum.

In 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. Accordingly, the Commission should permit the use of additional Ku-band downlink frequencies by U.S.-licensed ESVs in accordance with the allocations in ITU Regions 1 and 3.

#### **B. Ku-Band ESV Operational Issues**

Although there was limited comment on Ku-band operational issues in light of the limited spectrum sharing concerns in the band, there are certain issues on which a consensus exists among Ku-band ESV commenters in this proceeding. For example, all commenters

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<sup>12</sup> See 47 C.F.R. § 2.106.

<sup>13</sup> See Resolution 902 (Geneva 2003) at Annex 1.

opposed imposition of a minimum vessel size requirement<sup>14</sup> and automatic shut-off capabilities<sup>15</sup> for Ku-band ESVs. Commenters also agreed that Ku-band ESVs qualifying for routine licensing should be permitted to obtain “ALSAT” authority to communicate with all U.S.-licensed satellites and foreign-licensed satellites on the Permitted Space Station List.<sup>16</sup>

In addition, Ku-band ESV proponents generally agreed that Radio Astronomy Service (“RAS”) and Space Research Service (“SRS”) operations in the Ku-band should be protected from harmful interference, although there were some differences of opinion regarding how such protection should be afforded.<sup>17</sup> Radio astronomy interests also commented on their protection requirements, suggesting that the Commission should establish exclusion zones around radio astronomy facilities within which Ku-band ESVs would not be permitted to operate.<sup>18</sup> Boeing believes that rather than adopting strict exclusion zones, the Commission should impose a

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<sup>14</sup> See, e.g., Boeing Comments at 27-28; Inmarsat Comments at 15; Stratos Comments at 16-17; MTN Comments at 26; Schlumberger Comments at 10; Intelsat Comments at 6-7.

<sup>15</sup> See, e.g., MTN Comments at 22-23; Schlumberger Comments at 10; Inmarsat Comments at 15-16. Pinnacle Telecom Group believes that complex automated controls are unwarranted and only add unnecessary costs to ESV operations. See Comments of Pinnacle Telecom Group, IB Docket No. 02-10 (filed February 23, 2003) at 5. Boeing agrees with this position -- particularly at Ku-band where there are no co-primary terrestrial services in the United States -- and supports requiring only those types of control mechanisms that are necessary to ensure that U.S. licensees are able to control remotely the operations of associated Ku-band ESVs. See Boeing Comments at 27.

<sup>16</sup> See Boeing Comments at 28-29; MTN Comments at 26; Inmarsat Comments at 15; Schlumberger Comments at 10-11; PanAmSat Comments at 3-4.

<sup>17</sup> See Boeing Comments at 12-14; Stratos Comments at 18; MTN Comments at 25; Schlumberger Comments at 10; Inmarsat Comments 6-7, 10-11.

<sup>18</sup> See Comments of the National Radio Astronomy Observatory, IB Docket No. 02-10 (filed February 23, 2003); Comments of Cornell University, IB Docket No. 02-10 (filed February 23, 2003).

coordination requirement to ensure protection of radio astronomy operations.<sup>19</sup> Thus, Boeing reiterates its support for the proposed NTIA coordination requirement to protect the SRS and RAS operations as a condition of any Ku-band ESV authorization that must be satisfied prior to commencing operations.<sup>20</sup>

Boeing would note that the comments of the National Radio Astronomy Observatory (“NRAO”) could potentially be read to suggest that Ku-band ESVs should be authorized on something other than a primary basis. Although the NRAO did not oppose ESV operations in the Ku-band, it did repeat the *NPRM*’s inquiry as to whether the Commission “should require ESVs in the Ku-band to operate on a non-harmful interference basis to the secondary Ku-band services, as would be typical for operations that are non-conforming to the allocations table,”<sup>21</sup> and without explanation strongly urged the Commission adopt this requirement.<sup>22</sup> Of course, because Ku-band ESVs are recognized networks in the FSS as a result of decisions made at WRC-03, ESV operations are considered conforming, primary services that need not operate on a non-interference basis to secondary Ku-band services; and the Commission has undertaken to implement this regulatory status domestically in the context of this proceeding. In any event,

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<sup>19</sup> Boeing believes that any such coordination requirement (which may ultimately lead to establishment of an exclusion zone based on the technical characteristics of the proposed ESV operations and the radio astronomy facility) should be measured from the location of the relevant facility. This would simplify application of the coordination requirement and make it easier to implement. *See* Comments of Cornell University at 5 (requesting an exclusion zone around the Arecibo facility as a distance from the Puerto Rican coast rather than the facility itself).

<sup>20</sup> *See* Boeing Comments at 12-14.

<sup>21</sup> *NPRM* at ¶ 30.

<sup>22</sup> *See* Comments of the National Radio Astronomy Observatory, IB Docket No. 02-10 (filed February 23, 2003) at 3.

Boeing fully supports requiring Ku-band ESVs to adequately protect existing and future RAS operations.

Finally, with respect to protection of SRS operations, Boeing notes that the potential new Tracking and Data Relay Satellite System (“TDRSS”) earth station to be constructed in either Langley, Virginia or Wallops Island, Virginia would be close to navigable waters in which Ku-band ESVs may operate. Although coordination with NTIA ultimately will ensure protection for all SRS operations, Boeing would expect that the new TDRSS facility would be designed and implemented in a manner that best protects those frequencies actually used by the facility from potential interference from Ku-band ESV transmissions and other co-frequency operations.

### **III. THE COMMISSION SHOULD REVISE ITS PROPOSED BLANKET LICENSING PROCEDURES FOR KU-BAND ESV OPERATIONS**

The commenters in this proceeding agree that blanket licensing of Ku-band ESVs is essential to the success of broadband maritime services.<sup>23</sup> To promote the successful deployment of ESV operations in the Ku-band, the Commission should adopt comprehensive licensing and service rules that reflect the unique operational characteristics of this service. In the *NPRM*, however, the Commission proposes to shoehorn new ESV licensing rules into the regulatory regime developed for Ku-band VSATs nearly 20 years ago. While the current VSAT licensing rules can provide guidance on applicable interference criteria for routine licensing of Ku-band

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<sup>23</sup> See Boeing Comments at 14-25; Tachyon Comments; Inmarsat Comments at 13-17; MTN Comments 26-30; Stratos Comments at 19-21; Intelsat Comments at 2-3; SES AMERICOM Comments at 6-7; PanAmSat Comments at 3-4.

ESVs,<sup>24</sup> it is not appropriate or necessary to impose antiquated VSAT licensing requirements on a new service with fundamentally different operational characteristics.<sup>25</sup>

Concurrent with this proceeding, the Commission is engaged in a separate biennial review of its Part 25 earth stations licensing rules.<sup>26</sup> In that proceeding, the Commission has proposed substantial revisions to the rules, as has the Satellite Industry Association (“SIA”).<sup>27</sup> Because the Commission has proposed to insert the Ku-band ESV licensing rules into the current Part 25 VSAT licensing regime, care must be taken to avoid unintended adverse consequences on the ESV licensing rules being developed in the instant proceeding. Thus, the Commission must ensure that ESV licensing rules adopted in this proceeding remain unaffected by changes to other portions of the Part 25 earth station licensing rules.

**A. The Commission’s ESV and Part 25 Proposals and Resolution 902**

In the *NPRM*, the Commission proposed to authorize Ku-band ESV operations pursuant to the same standards applicable to Ku-band VSAT terminals. Specifically, the Commission proposed to blanket license Ku-band ESVs with a minimum antenna diameter of 1.2 meters based on compliance with the power levels set forth in Section 25.134(a)(1) and antenna performance standards set forth in Section 25.209.<sup>28</sup> The Commission further proposed to permit the operation of Ku-band ESVs not conforming to these parameters based on a demonstration

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<sup>24</sup> See Boeing Comments at 14-25; Stratos Comments at 19-21; Inmarsat Comments at 13-17; see also MTN Comments 26-30; Inmarsat Comments at 13-17; Intelsat Comments at 2-3; SES AMERICOM Comments at 6-7; PanAmSat Comments at 3-4.

<sup>25</sup> See Boeing Comments at 14-25; Stratos Comments at 19-21.

<sup>26</sup> See *Part 25 NPRM*.

<sup>27</sup> See *id.*; see also SIA Comments, IB Docket No. 00-248 (filed March 10, 2003).

<sup>28</sup> See *NPRM* at App. A (new Sections 25.115(c)(3)(ii)(I) and 25.134(a)(3)).

that “unacceptable interference will not be caused to any affected adjacent satellite operators by the operations of the non-conforming earth station as described in 25.134(b) for VSATs,”<sup>29</sup> similar to the routine licensing of non-conforming VSAT terminals pursuant to a technical demonstration under Section 25.209(f).<sup>30</sup>

In the pending Part 25 rulemaking proceeding, the Commission proposed to revise its earth station licensing rules by revising Section 25.209(f) and adding new Section 25.220 to, among other things, codify the routine licensing of earth stations that reduce off-axis e.i.r.p. to the levels produced by an earth station compliant with Sections 25.134 and 25.209.<sup>31</sup> Similarly, Resolution 902, championed by the United States and adopted at WRC-03 after years of detailed technical study by the international community, sets forth off-axis e.i.r.p. limits (as well as a pointing accuracy requirement) to ensure compatibility of Ku-band ESV operations with FSS satellite networks.<sup>32</sup> Thus, there is an international consensus that off-axis e.i.r.p. is the relevant measure of adjacent satellite interference and that such an approach is appropriate for licensing new Ku-band ESV systems.

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<sup>29</sup> *See id.* at App. A (new 25.134(a)(3)).

<sup>30</sup> *See* 47 C.F.R. § 25.209(f); *see also In the Matter of Routine Licensing of Large Networks of Small Antenna Earth Stations Operating in the 12/14 GHz Frequency Bands*, Declaratory Order, 1986 WL 291567 (rel. Apr. 9, 1986).

<sup>31</sup> *See Part 25 NPRM* at App. B (new Sections 25.209(f) and 25.220(c)(1)). Operations in excess of compliant off-axis e.i.r.p. levels would require adjacent satellite operator coordination. *See id.* at App. B (new Section 25.220(d)-(e)). As discussed below, the SIA has opposed this proposal for traditional C-band and Ku-band FSS earth stations.

<sup>32</sup> Resolution 902 (Geneva 2003) at Annex 2.

**B. An Off-Axis E.I.R.P. Mask Is the Appropriate Mechanism for Routinely Licensing Ku-Band ESV Terminals**

As discussed at length in Boeing's initial comments, the Commission should adopt service-specific blanket licensing rules for Ku-band ESVs based on an off-axis e.i.r.p. mask and other requirements that account for the unique operational characteristics of the service, rather than shoehorning ESV licensing rules into an antiquated VSAT regulatory regime.<sup>33</sup> An off-axis e.i.r.p. approach to Ku-band ESV licensing is consistent with the applicable ITU regulatory regime; the Commission's proposals for revising its earth station licensing rules; and Commission precedent authorizing ESV, Land Mobile-Satellite Service ("LMSS") and AMSS earth station operations in the Ku-band.<sup>34</sup> Furthermore, because VSATs and ESVs provide fundamentally different services with unique operational characteristics, it is entirely appropriate that they be licensed pursuant to separate technical requirements.

The VSAT industry is characterized by tens of thousands of ubiquitous low-cost, fixed antenna earth stations with pointing errors of 0.5° or more communicating with satellites in a 2° spacing environment. Therefore, it is understandable that mandating antenna performance and input power can provide an effective means to control off-axis interference.<sup>35</sup> In contrast, next-

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<sup>33</sup> See Boeing Comments at 14-25. For the sake of brevity, Boeing will not repeat all of the compelling public interest reasons supporting adoption of an off-axis e.i.r.p. approach to ESV licensing, and respectfully refers the Commission to the detailed discussion of these issues included in its initial comments.

<sup>34</sup> See 47 C.F.R. §§ 25.134(a)(1) and (b), 25.209; see also *Crescomm Order*, 11 FCC Rcd. 10944, (Int'l Bur./OET, 1996); Qualcomm, Inc., *Memorandum Opinion, Order and Authorization*, 4 FCC Rcd 1543 (1989); Qualcomm, Inc., *Order and Authorization*, 6 FCC Rcd 735 (1991); *The Boeing Company*, Order and Authorization, 16 FCC Rcd. 5864 (2001); *The Boeing Company*, Order and Authorization, 16 FCC Rcd. 22645 (Int'l Bur./OET 2001). This approach is also consistent with the licensing rules adopted by the Commission for next-generation Ka-band earth stations. See 47 C.F.R. §§ 25.138.

<sup>35</sup> See 47 C.F.R. §§ 25.209(b). Specifying VSAT antenna input power and performance requirements serves two fundamental purposes. First, the combination of these factors defines

generation Ku-band ESV networks employ mechanically steered antennas with a pointing accuracy of 0.2° and sophisticated network control mechanisms, and thus can accurately control the aggregate off-axis e.i.r.p. levels produced by ESV uplink transmissions. As a result, the Commission need only authorize Ku-band ESV operations subject to compliance with an off-axis e.i.r.p. mask rather than applying rules developed 20 years ago for an entirely different service.

The position taken by the SIA in the Commission's Part 25 proceeding with respect to licensing of non-conforming earth stations does not alter this conclusion. Specifically, while the FCC proposed to permit routine licensing of non-conforming earth stations that reduce off-axis e.i.r.p. to levels compliant with Sections 25.134 and 25.209 of the rules without need for adjacent satellite operator coordination,<sup>36</sup> the SIA opposed this licensing approach for non-conforming C-band and Ku-band FSS earth stations.<sup>37</sup> Instead, the SIA proposed to require adjacent satellite operator coordination for all non-conforming C-band and Ku-band FSS earth stations, with the limited exception of certain small Ku-band FSS earth stations with non-conforming gain antenna patterns that can demonstrate enhanced pointing accuracy to establish compliant antenna gain at 2° off-axis.<sup>38</sup>

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the off-axis e.i.r.p. directed towards adjacent satellites for uplink transmissions. Second, the antenna performance requirement defines the minimum permissible susceptibility to interference from adjacent satellites on the downlink path. By limiting interference into adjacent satellites from VSAT transmissions, and protecting VSAT receivers from adjacent satellite downlink interference, large numbers of VSAT terminals can be deployed without operator-to-operator coordination in a 2-degree spacing environment.

<sup>36</sup> See *Part 25 NPRM* at ¶¶ 15-19.

<sup>37</sup> See *SIA Comments* at 23.

<sup>38</sup> *Id.* at 23-24 and App. A (revised Section 25.220(d)(2)).

The SIA has confirmed, however, that its proposal in the Commission's Part 25 proceeding only sought to address licensing of traditional C-band and Ku-band FSS earth stations.<sup>39</sup> According to the SIA, "[a]pplication of the licensing provisions included in the SIA proposal to other kinds of Ku-band and C-band systems, including earth stations on board vessels (ESVs) and Aeronautical Mobile-Satellite Service (AMSS) earth stations, was not contemplated by the SIA proposal."<sup>40</sup> Without addressing the merits of the SIA position, it is clear that the proposal was not intended to cover ESV licensing. The Commission can ensure that this and other proposed changes to the Part 25 earth station licensing rules do not affect the Ku-band ESV regulatory regime developed in this proceeding by adopting separate, stand-alone ESV licensing rules.

#### **IV. PROPOSED KU-BAND ESV BLANKET LICENSING RULES**

Boeing's initial comments in this proceeding contained a detailed discussion of the provisions that should be included in comprehensive licensing and service rules necessary to govern Ku-band ESV operations.<sup>41</sup> In these reply comments, Boeing proposes alternative Ku-band ESV licensing rules based on the rules initially proposed by the Commission in the *NPRM*.<sup>42</sup>

By adopting blanket licensing rules consistent with Boeing's initial comments and these reply comments, the Commission may routinely authorize Ku-band ESV operations, adequately protect co-frequency services from potential interference and ensure compliance with Resolution

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<sup>39</sup> See Letter from SIA to Marlene H. Dortch, IB Docket No. 00-248 (filed March 23, 2004) (written *ex parte* presentation clarifying certain aspects of the SIA proposal).

<sup>40</sup> *Id.* at 2.

<sup>41</sup> See Boeing Comments at 14-25.

<sup>42</sup> See Attachment 1 (Proposed ESV Blanket Licensing Rules).

902. In this way, the Commission will facilitate the prompt introduction and long-term viability of broadband maritime communications services in the Ku-band. The salient elements of Boeing's alternative Ku-band ESV licensing proposal are outlined below.

**A. Off-Axis E.I.R.P. Mask for Routine Licensing of Ku-Band ESVs**

Consistent with Commission precedent authorizing advanced Ku-band earth station operations subject to maintaining aggregate off-axis e.i.r.p. levels below those produced by routinely licensed VSAT terminals, and in accordance with the regulatory approach embodied in Resolution 902, Boeing believes that Ku-band ESVs should cause no more interference to adjacent FSS satellites than a VSAT terminal compliant with the Sections 25.134 and 25.209 of the Commission's rules. Accordingly, as discussed in its initial comments, Boeing proposes that Ku-band ESVs that meet the following aggregate off-axis e.i.r.p. mask be routinely licensed by the Commission:

<u>Angle off-axis</u>	<u>Maximum e.i.r.p. in any 4 kHz band</u>
$1.0^\circ \leq \theta \leq 7.0^\circ$	15 - 25 log $\theta$ dBW
$7.0^\circ < \theta \leq 9.2^\circ$	-6 dBW
$9.2^\circ < \theta \leq 48^\circ$	18 - 25 log $\theta$ dBW
$\theta > 48^\circ$	-24 dBW

These values are consistent with the off-axis e.i.r.p. levels of routinely licensed Ku-band VSAT terminals, and are 8 dB less than the values in Resolution 902 (adjusted for bandwidth differences).<sup>43</sup> By licensing Ku-band ESVs pursuant to this off-axis e.i.r.p. mask, the Commission will ensure that routinely licensed Ku-band ESVs have no greater interference potential than routinely licensed VSAT terminals in the Ku-band.

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<sup>43</sup> There is an 8 dB difference between Boeing's proposed off axis e.i.r.p. values and those set forth in Resolution 902 because the Resolution's values are designed for global application in the 3° spacing environment prevalent in other regions of the world, rather than the 2° spacing environment in the U.S. orbital arc.

Ku-band ESV systems also should have the flexibility, like Ku-band VSAT operators, to coordinate transmissions in excess of these e.i.r.p. levels, up to the values included in Resolution 902, subject to an additional interference showing and the rights of future Ku-band licensees to require compliant operations in certain circumstances.<sup>44</sup> Furthermore, for Ku-band ESVs communicating with FSS satellites relying on operator-to-operator coordination to address adjacent satellite interference (*i.e.*, for international operations where 2-degree spacing may not be the norm), applicants should be authorized to operate in accordance with the interference levels that have been accepted by adjacent satellite systems through the operator-to-operator coordination process, up to the off-axis e.i.r.p. limits set forth in Resolution 902.

With respect to FSS satellite downlink transmissions associated with Ku-band ESV operations, Boeing proposes for ESV blanket licensing a satellite EIRP spectral density value of no greater than 9 dBW/4 kHz for digitally modulated emission of any transmission for all methods of modulation and accessing technologies. Although this value is greater than the Commission's existing level of 6 dBW/4 kHz for Ku-band VSATs, it is the same level proposed by the SIA as a revised value for routine licensing of Ku-band VSAT operations.<sup>45</sup> Because the interference environment is unaffected by whether a VSAT or ESV is receiving satellite downlink transmissions, the Commission should adopt the same satellite downlink e.i.r.p. value for both ESVs and VSATs.

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<sup>44</sup> See 47 C.F.R. § 25.134(c). The Commission's Ka-band earth station blanket licensing rules contain similar provisions regarding the coordination of higher off-axis e.i.r.p. values. See 47 C.F.R. § 25.138(b), (c).

<sup>45</sup> See SIA Comments at 25-26.

## **B. Other Ku-Band ESV Blanket Licensing Requirements**

As requested by numerous commenters in this proceeding, the Commission should permit a minimum antenna size of 0.6 meters for routinely licensed Ku-band ESVs.<sup>46</sup> Resolution 902 expressly provides that administrations may authorize the deployment of 0.6 meter Ku-band ESVs so long as the interference to *primary terrestrial services* is no greater than that of a 1.2 meter ESV.<sup>47</sup> Because there are no primary terrestrial services in the United States, and because 0.6 meter Ku-band ESVs are capable of meeting the off-axis e.i.r.p. requirements set forth above, the Commission need not artificially restrict Ku-band ESVs to antennas that are 1.2 meters or greater in diameter. Indeed, the absence of primary terrestrial services in the 14.0-14.5 GHz band makes Ku-band ESVs ideal for operation on inland and coastal waterways, and permitting antennas as small as 0.6 meters will promote the availability of broadband communications capabilities on the smaller vessels that ply these waters.

In addition, the Commission should require Ku-band ESVs to maintain a pointing accuracy of +/- 0.2 degrees, unless pointing accuracy is specifically taken into account in an ESV operator's calculation and control of off-axis e.i.r.p. produced by the network. The intent of the pointing accuracy requirement, limiting potential interference into adjacent FSS satellites, is essentially addressed through compliance with the off-axis e.i.r.p. limits set forth in Resolution 902 so long as pointing error is factored into the off-axis e.i.r.p. produced by the system. Thus, although consistent with the provisions of Resolution 902, a separate pointing accuracy requirement may be unnecessary. Boeing's proposed rules specifies a 0.2 degree pointing

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<sup>46</sup> See Boeing Comments at 21; Inmarsat Comments at 16-17, Stratos Comments at 20; Intelsat Comments at 7.

<sup>47</sup> Resolution 902 (Geneva 2003), Annex 2 at note \* to the table.

accuracy requirement for Ku-band ESVs to the extent that antenna mis-pointing is not otherwise taken into account.

Resolution 902 also imposes e.i.r.p. and e.i.r.p. spectral density limits towards the horizon to protect co-primary fixed and mobile services. Although there are no such services operating in the United States, Ku-band ESVs should be required to comply with this requirement.

In addition, U.S.-licensed Ku-band ESV network licensees should be permitted to communicate with ESVs on board foreign registered vessels subject to compliance with the Commission's ESV rules. The U.S. ESV licensee would be responsible for ensuring that all Ku-band ESVs operating on their networks (including those on foreign-registered vessels) comply with the Commission's rules, and must have the ability to inhibit operations and/or terminate service to ESVs that cause interference or otherwise fail to comply with the Commission's rules. Boeing proposes that a foreign-licensed ESV would be temporarily associated with a U.S. ESV licensee when communicating with a U.S.-licensed ESV hub. For this temporary period, the U.S.-licensed ESV operator would assume responsibility for the ESV as if it were regularly licensed to it. Such an approach is similar to the Commission's treatment of MSS transceivers designed to operate with U.S.-licensed systems,<sup>48</sup> and is appropriate in the context of Ku-band ESV operations given the international maritime nature of the service.

Finally, the Commission's proposed ESV rules contained burdensome and unnecessary application and reporting requirements regarding the operational areas of Ku-band ESVs.<sup>49</sup> Specifically, the Commission proposes to require Ku-band ESV applicants to provide a detailed

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<sup>48</sup> See 47 C.F.R. § 25.136(c); see also *Big LEO Report and Order*, 9 FCC Rcd. 5936, ¶ 208 (1995) ("[A] roaming user's transceiver operations would fall within the blanket license of the satellite operator or the service vendor."); see also 47 C.F.R. § 25.135(d).

<sup>49</sup> See *NPRM* at App. A (new Section 25.115(c)(3)(ii)(B)-(C)).

description of operating areas within 125 km of the United States baseline “including ports and harbors where any ESV associated with the network may operate while in motion, halted for some unspecified time, moored or anchored, and all shipping channels and sea lanes where any ESV associated with the network may operate while in motion or halted for some unspecified time.”<sup>50</sup> In addition, the Commission proposes that “each licensee shall annually provide the Commission an updated list of all ports, harbors, shipping channels and sea lanes where any ESV associated with the network may operate.”<sup>51</sup> While such information may be useful in the context of C-band ESV licensing given sharing concerns with ubiquitous, co-primary terrestrial operations, there are no such concerns in the Ku-band. Indeed, given the potential use of Ku-band ESVs throughout the coastal and inland waterways of the United States by vessels of all sizes, it would be virtually impossible to provide the information sought by the Commission. Boeing would also note that no such application and reporting requirements exist for Ku-band VSATs, which similarly operate throughout the United States. Accordingly, Boeing urges the Commission not to require this operational information from Ku-band ESV operators.

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<sup>50</sup> *Id.* at App. A (new Section 25.115(c)(3)(ii)(B)).

<sup>51</sup> *Id.* at App. A (new Section 25.115(c)(3)(ii)(C)).

**V. CONCLUSION**

For the foregoing reasons, Boeing respectfully requests that the Commission promptly adopt Ku-band ESV licensing and service rules that are consistent with its initial comments and these reply comments.

Respectfully submitted,

**The Boeing Company**

s/ Philip L. Malet

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# ATTACHMENT 1

## PROPOSED ESV BLANKET LICENSING RULES

*The following proposed rules constitute revisions to the Ku-band ESV licensing rules set forth in the NPRM. See NPRM at App. A. Insertions are depicted as **bold, underlined text**, and deletions are depicted as ~~strikethroughs~~. Proposed Section 25.2XX does not contain revision marks because it is entirely new text.*

### **§25.115 Application for earth station authorizations.**

\* \* \* \* \*

(c)(3) Satellite earth station on board vessels (ESVs) or hub station applications for ESV networks operating in the 11.7-12.2 GHz/14.0-14.5 GHz (12/14 GHz or Ku-band).

(i) Applications to license networks of ESVs or hub earth stations for a network of ESVs operating in the 14.0-14.5 GHz frequency band under blanket operating authority shall be filed electronically on FCC Form 312, Main Form and Schedule B, for each large (5 meters or larger) hub station, and Schedule B for each representative type of small antenna (less than 5 meters) operating within the network.

(ii) The initial lead application shall provide a detailed overview of the complete network and fully identify the scope and nature of the service to be provided. The complete technical details of each representative type of small antenna shall also be provided. The lead application for a Ku-band ESV system must identify:

(A) the **maximum** number of ESVs associated with the network;

(B) the operational area(s) where the proposed ESVs will operate. ~~The description of the operational area should include a detailed description of any area within 125 km of the United States baseline, and in particular including ports and harbors where any ESV associated with the network may operate while in motion, halted for some unspecified time, moored or anchored, and all shipping channels and sea lanes where any ESV associated with the network may operate while in motion or halted for some unspecified time;~~

(C) each licensee shall annually provide the Commission an updated list of all ports, harbors, shipping channels and sea lanes where any ESV associated with the network may operate;

~~(D)~~ the ESV system's means of identification and location and method for maintaining a real-time secure database containing this information; ~~and automatic mechanisms to terminate transmissions whenever the station operates outside of its authorized geographic area or operational limits;~~ and a telephone number for the ESV operator point of contact to whom interference claims can be made 24-hours-a-day, seven-days-a-week;

~~(E)~~ the ESV system's means to verify ESV performance and to terminate ESV transmissions immediately;

~~(F)~~ the minimum antenna diameter (m);

~~(G)~~ the pointing accuracy of the ESV antenna in degrees;

~~(H)~~ the ESV transmitted power spectral density at the input to the antenna (dBw/40kHz);

~~(I)~~ demonstration of compliance with §25.2XX.09 and §25.132

**§25.134 Licensing provisions of Very Small Aperture Terminal (VSAT) and C-band Small Aperture Terminal (CSAT), and Satellite Earth Stations on Board Vessels (ESV) networks.**

\* \* \* \* \*

~~(a)(3) *ESV networks operating in the 12/14 GHz frequency band.*~~

*[Note: Eliminate rule provision entirely; replace with new Section 25.2XX]*

**New § 25.2XX**

**§25.2XX Operating and licensing conditions for Satellite Earth Stations on Board Vessels (ESV) networks in the 12/14 GHz frequency band.**

(a) Each application for a blanket earth station on board vessel (ESV) license in the 12/14 GHz frequency band that meet the requirements of this Section 25.2XX and that employ antennas that are 0.6 meters or larger in diameter will be routinely processed. ESVs in the 12/14 GHz frequency band shall have an antenna pointing accuracy of +/-0.2 degrees or better, or otherwise shall take antenna pointing accuracy into account in calculating the transmit off-axis EIRP values set forth in paragraphs (a)(1) and (a)(2).

(1) For communications with FSS space stations that have not coordinated higher values with adjacent space stations, ESV transmit off-axis EIRP spectral density along the GSO arc for co-polarized signals shall not exceed the following values:

<u>Angle off-axis</u>	<u>Maximum EIRP in any 4 kHz band</u>
$1.0^\circ \leq \theta \leq 7.0^\circ$	15 - 25 log $\theta$ dBW
$7.0^\circ < \theta \leq 9.2^\circ$	-6 dBW
$9.2^\circ < \theta \leq 48^\circ$	18 - 25 log $\theta$ dBW
$\theta > 48^\circ$	-24 dBW

(2) The values given in paragraph (a)(1) of this section may be exceeded by 3 dB for values of  $\theta > 10^\circ$ , provided that the total angular range over which this occurs does not exceed  $20^\circ$  when measured along both sides of the GSO arc.

(3) For communications with GSO FSS space stations that have not coordinated higher values with adjacent space stations, the maximum GSO FSS satellite EIRP spectral density of the digitally modulated emission of any transmission shall not exceed 9 dBW/4 kHz for all methods of modulation and accessing technologies.

(4) For communications with GSO FSS space stations that have coordinated higher values than those in paragraphs (a)(1) and (a)(3) with adjacent space stations, ESV transmit off-axis EIRP spectral density along the GSO arc for co-polarized signals and GSO FSS satellite EIRP spectral density shall not exceed the values coordinated for the space station.

(5) Each applicant for ESV license(s) that proposes transmit EIRP densities in excess of those specified in paragraphs (a)(1) and (a)(2) of this section, or GSO FSS satellite EIRP spectral density in excess of that specified in paragraph (a)(3) of this section, shall submit link budget analyses of the operations proposed along with a detailed written explanation of how each carrier EIRP density figure is derived. Applicants shall certify that all potentially affected parties (i.e., those GSO FSS satellite networks that are 2, 4 and 6 degrees apart) acknowledge and do not object to the use of the applicant's higher EIRP spectral density.

(5) Licensees authorized pursuant to subparagraphs (a)(4) and (a)(5) of this section shall bear the burden of coordinating with any future applicants or licensees whose proposed compliant co-frequency operations, as defined by paragraph (a) of Section 25.134 and subparagraphs (a)(1), (a)(2) and (a)(3) of this section, is potentially or actually adversely affected by the operation of the non-compliant licensee. If no good faith agreement can be reached, however, the non-compliant licensee shall reduce its power density levels to those compliant with subparagraphs (a)(1), (a)(2) and (a)(3) of this section.

(b) ESV operators in the 12/14 GHz shall maintain a maximum EIRP spectral density towards the horizon of 12.5 dBW/MHz and a maximum EIRP towards the horizon of 16.3 dBW while operating within 125 km of a potentially concerned administration as defined in Resolution 902 (Geneva 2003).

(c) Each ESV operator shall not commence operations in the 14.0-14.5 GHz band until such operations have been coordinated successfully with authorized U.S. Government stations through the National Telecommunications and Information Administration (NTIA) Frequency Assignment Committee of the Interdepartment Radio Advisory Committee (IRAC).

(1) ESV operators shall avoid causing harmful interference to authorized U.S. Government radio astronomy stations during observations in the 14.47-14.5 GHz band.

(2) ESV operators shall avoid causing harmful interference to authorized U.S. Government space research stations operating in the 13.4-14.2 GHz band.

(3) The details of individual coordination agreements, including specific protection levels, will vary based on the characteristics of U.S. Government station and the ESV network. The coordination agreements may require ESV operators to reduce ESV signal power levels, add sharp filtering, cease transmissions, improve ESV antenna performance, or implement other measures to protect U.S. Government operations.

(d) No ESV associated with an authorized 12/14 GHz ESV operator shall transmit to a space station unless first authorized by the ESV blanket licensee or by a service vendor authorized by that licensee, and the specific transmission is conducted in accordance with the operating protocol specified by the space station operator.

(e) Any non-U.S. licensed ESV associated with an authorized 12/14 GHz ESV operator will be deemed, when communicating with a U.S.-licensed ESV hub station, to be temporarily associated with and licensed to the ESV operator or service vendor holding a hub earth station

license awarded pursuant to this section. The U.S. ESV licensee shall, for this temporary period, assume the same licensee responsibility for the ESV as if the ESV were regularly licensed to it.

(f) An ESV applicant shall provide for each ESV antenna type, a series of radiation patterns measured on a calibrated antenna range and, as a minimum, shall be made at the bottom, middle, and top frequencies of the 14.0-14.5 GHz band or, if the ESV will operate only in a portion of the 14.0-14.5 GHz band, at the bottom, middle, and top frequencies of the sub-band in which the ESV will operate. The radiation patterns should include:

(1) Co-polarized patterns for each of the two orthogonal senses of polarizations in two orthogonal planes of the antenna.

(i) In the azimuth plane, plus and minus 7 degrees and plus and minus 180 degrees.

(ii) In the elevation plane, zero to 45 degrees.

(2) Main beam gain.

(g) Protection of Ku-band ESV receive antennas from adjacent satellite interference is based on the antenna performance specified in Section 25.209(a) and (b), and Ku-band ESV receive antennas shall be entitled to no more protection than an antenna compliant with Section 25.209(a) and (b). For purposes of monitoring receive antenna performance and susceptibility to interference, a 12/14 GHz ESV applicant shall provide, for each ESV type, the antenna performance plots specified in paragraph (f) for the 11.7-12.2 GHz band, as well as other bands in which the ESV receiver is designed to operate.

(h) A 12/14 GHz ESV licensee applying to renew its license must include on FCC Form 312-R the number of ESVs constructed at the time of renewal.

#### **New § 25.132(h)**

25.132 (h) This section shall not apply to 12/14 GHz ESV applicants seeking authority to operate pursuant to Section 25.2XX.