

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)
)
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)

IB Docket No. 02-10

To: The Commission

**PETITION FOR RECONSIDERATION OF
THE BOEING COMPANY**

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SUMMARY

The Commission should revise its earth stations on vessels (“ESV”) rules to allow the most efficient use of Ku-band satellite spectrum to provide mobile broadband service to underserved markets, such as ships at sea, aircraft and mass transportation vehicles. The ESV Order, and the Commission’s recently released Public Notice on Spectrum for Broadband, seek to promote the use of spectrum to provide wireless broadband service to unserved and underserved markets.

The Commission’s ESV rules, however, inhibit the use of one of the most effective and efficient technologies to provide mobile broadband services, specifically variable power code division multiple access (“CDMA”) signaling techniques, such as Boeing’s “bandwidth-on-demand” system.

The Commission’s Order on Reconsideration unexpectedly changed its ESV rules to remove mention of variable power CDMA networks and the method that should be used to apply the Commission’s aggregate power limits to ESV networks employing such spectrally efficient signaling techniques. In correcting this omission, the Commission should revisit its position on the licensing requirements for CDMA-based variable power ESV networks. Specifically, the Commission should authorize them on an ALSAT basis to operate at power levels up to the aggregate off-axis EIRP mask without the imposition of the $10 \cdot \log(N)$ rule or an arbitrary 1 dB reduction in power, and without requiring coordination. Such a change would promote technical neutrality and serve the public interest by allowing operators of such networks to provide broadband services to the maritime market in the most spectrally efficient manner.

Alternatively, the Commission should revise its ESV rules to harmonize them with its newly adopted vehicle-mounted earth stations (“VMES”) rules. Pursuant to such an approach, the ESV rules should be supplemented to specifically address variable power ESV systems. The Commission’s ESV rules should also be supplemented to permit dynamic power CDMA ESV networks to operate without an arbitrary 1 dB reduction in power if the operator of the target satellite network certifies that the use of such power levels are consistent with its operator-to-operator coordination agreements.

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The Boeing Company (“Boeing”), by its attorneys and pursuant to Section 1.429(i) of the Commission’s Rules, 47 C.F.R. § 1.429(i), hereby submits the following petition for reconsideration of the Commission’s Order on Reconsideration released in the above-referenced docket.¹ The Order on Reconsideration revises Section 25.222 of the Commission’s rules to omit reference to earth stations on vessels (“ESV”) that use certain code division multiple access (“CDMA”) techniques, such as Boeing’s variable power level “bandwidth-on-demand” system. This change is inapposite with the goal of technical neutrality and impairs the ability of satellite service providers to use Ku-band satellite spectrum most efficiently to provide mobile broadband service to the underserved market of ships at sea.

¹ 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*, IB Docket No. 02-10, Order on Reconsideration, 24 FCC Rcd 10369, FCC 09-63 (rel. July 31, 2009) (“Order on Reconsideration”). Pursuant to Section 1.429(i), any order disposing of a petition for reconsideration which modifies rules adopted by the original order is subject to reconsideration. As discussed in detail herein, the Order on Reconsideration modifies Section 25.222 of the Commission’s rules.

I. THE COMMISSION SHOULD MODIFY ITS RULES TO PERMIT MORE EFFICIENT USE OF SATELLITE SPECTRUM TO PROVIDE WIRELESS BROADBAND SERVICE TO UNDERSERVED MOBILE MARKETS

The Commission recently released a Public Notice on Spectrum for Broadband requesting comment regarding, among other things, ways to use spectrum more efficiently to provide mobile wireless broadband service to unserved and underserved markets.² The Spectrum for Broadband Public Notice requests comment on the spectrum bands that are best positioned to support mobile wireless broadband, and specifically seeks comment on spectrum assigned to satellite services.³ The Commission further seeks comment regarding whether spectrum bands are being used in the most efficient and productive way to serve the public interest.⁴

One of the spectrum bands that has long been used to provide wireless broadband services to underserved areas is the Fixed-Satellite Service (“FSS”) spectrum allocation in the 11.7-12.2 GHz and 14.0-14.5 GHz bands (“Ku-band”). The Ku-band FSS allocation is currently used to provide broadband services to fixed receivers, including two-way broadband Internet access services to homes, businesses, and public institutions in remote locations. The broadband services provided by Ku-band FSS networks serve important public interest goals in part because they are available to consumers anywhere in the country, including inaccessible locations that are unserved by terrestrial wireline and wireless networks.

² See Comment Sought on Spectrum for Broadband, Public Notice, DA 09-2100 (Sept. 23, 2009) (“Spectrum for Broadband Public Notice”).

³ See *id.* at 5.

⁴ See *id.* at 6.

Ku-band FSS networks are also increasingly being used to provide broadband wireless services to *mobile* receivers in order to serve additional underserved market segments such as ships at sea, aircraft and mass transportation vehicles. For example, Boeing provides in-flight broadband connectivity to critical U.S. Government aircraft transporting senior U.S. Government leadership.⁵ Boeing has also provided on an experimental basis mobile broadband service to ships at sea and military vehicles.

The Commission's ESV rules, however, currently inhibit the use of one of the most effective and efficient technologies to provide these mobile broadband services. Specifically, the Commission's ESV rules do not address the use of dynamic-power CDMA signaling techniques unless the operators of such networks apportion the signal power on such networks evenly between all co-frequency terminals. In contrast, the Commission's vehicle-mounted earth stations ("VMES") rules do address dynamic-power systems, but prohibit ALSAT licensing for such systems and require an arbitrary 1 dB reduction in power, unless the system is individually coordinated. This disparate treatment of dynamic-power CDMA techniques is contrary to the Commission's longstanding goal of technical neutrality.

The Commission's current limitations on dynamic power ESV networks (requiring that all co-frequency terminals employ identical power levels) and dynamic power VMES networks (prohibiting ALSAT licensing and requiring coordination or a 1

⁵ Boeing initially provided its aeronautical broadband service pursuant to a blanket earth station license issued by the Commission's International Bureau in December, 2001. *The Boeing Company Application for Blanket Authority to Operate Up to Eight Hundred Technically Identical Transmit and Receive Mobile Earth Stations Aboard Aircraft in the 14.0-14.5 GHz and 11.7-12.2 GHz Frequency Bands*, Order and Authorization, 16 FCC Rcd 22645 (2001). Boeing now provides its aeronautical broadband service under contract to the federal government pursuant to an experimental license issued by the Office of Engineering and Technology (Call Sign WC2XVE).

dB power reduction) unnecessarily limit the commercial flexibility and broadband throughput of such networks and inhibit their ability to provide broadband services to consumers on ships, trains, trucks and aircraft in the most efficient manner possible.

It is inappropriate and spectrally inefficient to impose divergent technical limitations on ESV and VMES networks, particularly since such networks generally operate using the same satellite transponders, network control systems, and transmit/receive equipment. Further, the rules that are imposed should not arbitrarily limit the broadband throughput of such networks when such restrictions have never been demonstrated to be necessary to prevent harmful interference.

The Commission should therefore modify its rules to permit CDMA-based networks to operate broadband mobile networks on an ALSAT basis using adaptive power control and the full power levels permitted for other FSS services, without the imposition of an arbitrary 1 dB power reduction and without requiring coordination. Such CDMA-based networks have operated in the United States on an experimental basis for many years without resulting in any complaints of harmful interference. The Commission should therefore ensure that Ku-band FSS spectrum can be used in the most efficient manner possible by revising its rules to provide the same flexibility to dynamic-power CDMA-based networks as is already available to broadband mobile networks in the Ku-band using other signaling technologies.

II. THE COMMISSION SHOULD MODIFY ITS RULES GOVERNING THE AGGREGATE OPERATIONS OF CDMA-BASED ESV NETWORKS TO ENABLE THE MORE EFFICIENT USE OF SPECTRUM TO PROVIDE BROADBAND SERVICES

In 2005, the Commission released its ESV Report and Order licensing ESV operations to “advance the Commission’s goals and objectives for market-driven

deployment of broadband technologies,” which include “integrated access to voice, high-speed data, video-on-demand, and interactive delivery services, which are becoming a fundamental component of modern communications.”⁶ The goal of the ESV rules was to “assure that, through ESVs, broadband services are available to businesses and consumers on the high seas, coastlines, and inland waterways.”⁷

In apparent conflict with the stated public interest goals of the Commission’s 2005 ESV order and its longstanding policy of technical neutrality, the Commission recently released an Order on Reconsideration in the ESV proceeding that omits from Section 25.222(a)(1) any reference to CDMA-based ESV networks that use variable power control.⁸ Prior to the Order on Reconsideration, Section 25.222(a)(1), as modified by the Part 25 Sixth Report and Order, provided that,

“[f]or an ESV network using code division multiple access (CDMA) technique, N is the maximum number of co-frequency simultaneously transmitting earth stations in the same satellite receiving beam.”⁹

Pursuant to the old rule, variable power level CDMA-based ESV networks, such as Boeing’s, could not be licensed unless each transmitting earth station artificially limited its power to not exceed the $10 \cdot \log(N)$ value.¹⁰

⁶ *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*, IB Docket No. 02-10, Report and Order, 20 FCC Rcd 674, 676, ¶ 4 (2005) (“ESV Order”).

⁷ *Id.* at 677.

⁸ *See* Order on Reconsideration, 24 FCC Rcd at 10408, Appendix B. revised Section 25.222(a)(1).

⁹ 47 C.F.R. § 25.222(a)(1).

¹⁰ For example, the off-axis EIRP density of each of five transmitting ESVs would be limited by the same amount, in this case $10 \cdot \log(5)$, or 7.0 dB. A single earth station could operate at any variable power up to 7.0 dB.

In the ESV Order on Reconsideration, however, the Commission revised Section 25.222(a)(1) to read as follows,

“[f]or ESV networks using multiple co-frequency transmitters that have the same EIRP, N is the maximum expected number of co-frequency simultaneously transmitting ESV earth stations in the same satellite receiving beam.”¹¹

By its terms, the revised rule applies only to ESV networks using multiple co-frequency transmitters (e.g., CDMA), that employ the same EIRP. This unexpected change to the rules apparently means that, although the $10 \cdot \log(N)$ rule apparently is still applicable to dynamic power CDMA-based ESV networks, no definition exists for the value of N when applied to such networks.

The text of the Order on Reconsideration provides no justification or insight regarding why the Commission deleted reference to dynamic power CDMA-based ESV networks in Section 25.222(a)(1) of its rules. The omission, however, apparently was not inadvertent. The Commission acknowledged the omission in the VMES order that was concurrently released by the Commission, noting “there currently are no aggregate power-density rules for co-frequency dynamic-power ESV transmissions similar to what we adopt today for VMES.”¹²

This unexplained change in the Commission’s ESV rules provides an opportunity for the Commission to reconsider whether its disparate treatment of dynamic power

¹¹ Order on Reconsideration, 24 FCC Rcd at 10408, Appendix B. revised Section 25.222(a)(1)(i)(A).

¹² *Amendment of Parts 2 and 25 of the Commission’s Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service*, IB Docket No. 07-101, Report and Order, 24 FCC Rcd 10369, 10447, ¶ 102, FCC 09-64 (rel. July 31, 2009) (“VMES Order”).

CDMA-based ESV networks continues to serve the public interest. Unlike frequency division multiple access (“FDMA”) or time division multiple access (“TDMA”) systems, CDMA technology allows more than one transmitter to use the same frequency channel at the same time, thereby more efficiently using spectrum. Proven technologies are in use today in mobile Ku-band FSS networks that ensure that dynamic power CDMA-based mobile networks do not exceed the off-axis EIRP density limits specified in the Commission’s rules.

For example, Boeing’s mobile Ku-band network employs a bandwidth-on-demand spectrum sharing approach that enables the efficient and effective allocation of network capacity among large numbers of mobile terminals without resulting in harmful interference to adjacent networks. Boeing’s bandwidth-on-demand system uses dynamic power control to ensure that aggregate off-axis EIRP density limits are maintained, while varying the transmit power levels of individual antennas based on capacity needs. Boeing has successfully operated its bandwidth-on-demand system without causing harmful interference to other systems.

Continued imposition of the $10 \cdot \log(N)$ rule on dynamic power CDMA ESV networks is not only unnecessary, but it potentially prevents operators of ESV networks from providing a variety of broadband data-rate options and pricing plans to large and small maritime customers. By requiring that each customer be apportioned an equal percentage of the overall network transmit power, the $10 \cdot \log(N)$ rule arguably precludes the marketing of multiple terminal classes that include some high-power/high data-rate “premium” terminals and some low-power/low data-rate “economy” terminals. The

10*log(N) requirement imposes this impediment without providing any demonstrated reduction in harmful interference or otherwise serving the public interest.

In order to promote technical neutrality and the most efficient use of Ku-band spectrum for mobile broadband services, the Commission should therefore reconsider and revise its ESV rules to specifically authorize variable power CDMA systems to operate on an ALSAT basis up to the aggregate off-axis EIRP spectral density mask without the 10*log(N) rule or a 1 dB reduction in power. No public interest justification exists for continuing to require CDMA-based mobile networks to arbitrarily apportion an equal percentage of the interference to each mobile terminal operating in a network or reducing the power level by 1 dB. Such prophylactic measures provide no additional interference protection to other users of Ku-band FSS spectrum, and instead inhibit the ability of dynamic power CDMA-based ESV networks to use spectrum in its most efficient manner to provide mobile broadband services to maritime consumers.

III. THE COMMISSION SHOULD ALTERNATIVELY REVISE SECTION 25.222 TO HARMONIZE ITS ESV RULES WITH THE NEWLY ADOPTED VMES RULES

In its arguments above, Boeing urges the Commission to modify Section 25.222(a) of its rules in order facilitate the most efficient use of spectrum to provide broadband services to maritime users. If the Commission declines to take such action, the Commission should, at the very least, supplement Section 25.222 of its rules for ESV networks in order to harmonize them with the Commission's Section 25.226 rules for VMES.

In the VMES Order, the Commission adopted VMES rules that were modeled on its ESV rules.¹³ The VMES rules, however, also contain a new subsection 25.226(a)(3) that applies to a “VMES system that uses variable power-density control of individual simultaneously transmitting co-frequency VMES earth stations in the same satellite receiving beam.”¹⁴ For such variable power systems the Commission requires that the effective aggregate EIRP-density from all terminals be at least 1 dB below the applicable off-axis EIRP-density mask unless the target satellite operator certifies that operations at higher power levels are consistent with its operator-to-operator coordination agreements.¹⁵

The Commission, however, does not explain, either in the VMES Order or the ESV Order on Reconsideration, why the rules for VMES networks should address the operating requirements for VMES networks employing dynamic power control, but not ESV networks that employ identical technology. There is no relevant difference between mounting terminals on vehicles on land versus ships at sea that would explain the Commission’s apparent reluctance to address variable power ESV systems. In fact, Boeing has concurrently operated ESV, VMES and aeronautical-mobile satellite service systems using the same satellite transponders and the same Ku-band spectrum without resulting in either inter-system or intra-system interference.

The Commission should therefore add a corresponding subsection (a)(3) (including the (a)(3)(ii) coordination option) to the ESV rules to clarify the application of

¹³ See VMES Order, 24 FCC Rcd at 10420, 10438, 10442, ¶¶ 15, 79, 90.

¹⁴ *Id.* at 10493, Appendix B, Section 25.226(a)(3).

¹⁵ See *id.*, Appendix B, Section 25.226(a)(3)(i),(ii).

the $10 \cdot \log(N)$ rule for variable power ESV networks. Specifically, operators of dynamic power CDMA-based ESV networks should be required to comply with the $10 \cdot \log(N)$ rule unless they secure certification from their target satellite network that operations at higher power levels (up to the off-axis EIRP density limits) are consistent with the satellite network's operator-to-operator coordination agreements.

At the same time, the Commission should clarify the appropriate application of its new VMES rules to dynamic power CDMA networks. As Boeing will explain in a petition for reconsideration that it will file in the VMES proceeding, the VMES rules that were adopted by the Commission state that the effective aggregate EIRP density from all VMES terminals shall be at least 1 dB below the off-axis EIRP-density limits defined in 25.226(a)(1)(i)(A)-(C), unless the system is certified for higher power levels by the target satellite operator.¹⁶ Section 25.226(a)(1)(i)(A) defines N for FDMA and TDMA systems as one, and defines N for VMES networks using multiple co-frequency transmitters *that have the same EIRP*, as the maximum expected number of co-frequency simultaneously transmitting VMES earth stations in the same satellite receiving beam.¹⁷ The rule, however, does not define N for CDMA systems with variable power transmitters.

In order to correct this omission, Section 25.226(a)(3)(i), and any corresponding variable power system rule for ESVs, should be clarified to state that “the effective aggregate EIRP-density from all terminals shall be at least 1 dB below the off-axis EIRP-density limits defined in (a)(1)(i)(A)-(C), assuming N equals one.” This would provide

¹⁶See *id.* at 10493, Appendix B, Section 25.226(a)(3)(i),(ii).

¹⁷ See *id.* at 10491-2, Appendix B, Section 25.226(a)(1)(i)(A).

needed clarity to current and future providers of mobile broadband wireless services to the currently underserved maritime and vehicular mass transit market segments.

IV. CONCLUSION

In order to promote the Commission's mobile wireless broadband goals and most efficiently use allocated spectrum, the Commission should revise its rules to further facilitate the use of Ku-band FSS spectrum to provide mobile broadband service to underserved markets. Specifically, the Commission should revise its ESV rules to authorize CDMA-based variable power ESV networks to provide broadband service at power levels up to the aggregate off-axis EIRP limits without the $10 \cdot \log(N)$ rule or 1 dB reduction in power.

Alternatively, the Commission should conform its ESV rules to its newly adopted VMES rules in order to specifically address dynamic power CDMA-based ESV networks. In doing so, the Commission should clarify the application of the $10 \cdot \log(N)$ rule to such networks, and the option of operating such networks without an arbitrary 1 dB reduction in power if certification is secured from the target satellite operator.

Respectfully submitted,

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