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

In the Matter of	)	
	)	
ViaSat, Inc.	)	File No. SES-LIC-20051028-01494
	)	SES-AMD-20060314-00440
Application for Blanket Authority for Operation of	)	SES-AMD-20070309-00325
1,000 Technically Identical Ku-Band Aircraft	)	Call Sign : E050318
Earth Stations in the United States and Over	)	
Territorial Waters	)	

ORDER AND AUTHORIZATION

Adopted: November 19, 2007 **Released: November 20, 2007**

By the Chief, International Bureau and the Chief, Office of Engineering and Technology:

I. INTRODUCTION

1. With this order, we grant ViaSat, Inc. blanket authority for domestic operation of up to 1,000 technically identical transmit/receive earth stations aboard commercial aircraft. These earth stations will provide Aeronautical Mobile Satellite Service ("AMSS"), using the standard Ku-band frequency ranges 14.0-14.5 GHz (Earth-to-space) and 11.7-12.2 GHz (space-to-Earth), to link with leased transponders aboard the AMC-6 satellite operating at the 72º West Longitude orbital location. The ViaSat aircraft earth stations will provide two-way broadband communications for passengers and aircrew members aboard commercial airliners and private business jets, with access to email, the Internet, and corporate virtual networks. Implementation of the ViaSat AMSS system pursuant to this authorization will enhance competition in an important sector of the mobile telecommunications market in the United States.

II. BACKGROUND

A. Preceding Developments Pertaining to AMSS Operation with Ku-Band FSS Satellites

2. In license orders issued in 2001, the International Bureau ("Bureau") and the Office of Engineering and Technology ("OET") granted applications by The Boeing Company for authority to provide AMSS in the 11.7-12.2 GHz and 14.0-14.5 GHz bands. At that time there was no allocation for mobile-satellite service in those bands.[1]

3. The 2003 World Radiocommunication Conference (WRC-03) added a worldwide secondary Earth-to-space AMSS allocation in the 14.0-14.5 GHz band. At the same time, the International Telecommunication Union's Radiocommunication Sector adopted ITU-R M.1643, which sets forth

[1] *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 5864 (Int'l Bur. and OET, 2001) ("*Boeing 12 GHz License Order*"); *Order and Authorization*, 16 FCC Rcd 22645 (Int'l Bur. and OET, 2001) ("*Boeing 14 GHz License Order*").

detailed recommendations pertaining to operation of AMSS aircraft terminals in the 14 GHz band,[2] including recommended interference-avoidance requirements that are essentially identical to conditions previously imposed in the *Boeing 14 GHz License Order*.

4. In November 2003 the Commission accordingly amended the U.S. Table of Frequency Allocations to add a secondary Earth-to-space AMSS allocation in the 14.0-14.5 GHz band.[3] Further, in a Notice of Proposed Rulemaking released in February 2005 ("*Ku-Band AMSS NPRM*"), the Commission proposed to amend the Table of Allocations to recognize AMSS operations in the 11.7-12.2 GHz band and to establish rules prescribing licensing procedures and operational requirements for Ku-Band AMSS operation.[4] At present, however, there are no Commission service rules for licensing or operation of AMSS in the 14.0-14.5 GHz band, and there is no domestic allocation for AMSS in the 11.7-12.2 GHz band.

5. In April 2005, the Bureau granted another operator, ARINC, a blanket license for operation of AMSS terminals in the standard Ku Band for communication via leased transponders on an existing satellite.[5]

B. ViaSat's Application

6. ViaSat filed its application on October 28, 2005. The application was found acceptable for filing in a public notice issued in February 2006.[6] No petitions or comments were filed in opposition to the application.

7. ViaSat's planned AMSS system, which the applicant refers to by the tradename "Arclight," is designed to provide two-way broadband data communications via satellite radio links between aircraft earth stations ("AES's" or "AES terminals") and a Ground Earth Station ("GES") and Network Operations Center ("NOC"). ViaSat proposes to use a previously-licensed GES located in Carlsbad, California for this purpose, which ViaSat currently operates to support ARINC's "SkyLink" AMSS system. The Arclight AMSS NOC would be co-located with the GES.

8. Arclight AES terminals, which have been certified by the Federal Aviation Administration,[7] are comprised of three major sub-assemblies: an Airborne Integrated Transceiver Router (AITR), an Antenna Control Unit (ACU) and a Tail-Mount Antenna Subsystem (TMASS). The AITR performs

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[2] Rec. ITU-R M.1643, Technical and operational requirements for aircraft Earth stations of aeronautical mobile-satellite service including those using fixed-satellite service network transponders in the band 14-14.5 GHz (Earth-to-space) (2003).

[3] *Amendment of Parts 2, 25, and 87 of the Commission's Rules to Implement Decisions from the World Radiocommunication Conferences Concerning Frequency Bands Between 28 MHz and 36 GHz and to Otherwise Update the Rules in this Frequency Range*, *Report and Order*, ET Docket No. 02-305, 18 FCC Rcd 23426 at ¶76 (2003). The amendment deleted a proviso that had limited the scope of the Mobile Satellite Services allocation in the band in question by specifically excluding AMSS.

[4] *Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Service Earth Stations in Frequency Bands Allocated to the Fixed Satellite Service, Notice of Proposed Rulemaking*, IB Docket No. 05-20, 20 FCC Rcd 2906 (2005).

[5] *Application for Blanket Authority for Operation of up to One Thousand Technically Identical Ku-Band Transmit/Receive Airborne Mobile Stations Aboard Aircraft Operating in the United States and Adjacent Waters*, *Order and Authorization*, 20 FCC Rcd 7553 (2005) ("*ARINC AMSS License Order* ").

[6] Report No. SES-00790, Satellite Radio Applications Accepted for Filing (Feb. 1, 2006).

[7] ViaSat Arclight AMSS Application, SES-LIC-20051028-01494, as amended by SES-AMD-20060314-00440 ("Arclight AMSS Application"), Exhibit 2 at § 2.2.1.

multiple functions, which include packet routing at the local area network interface, IP data encapsulation and recovery, downlink demodulation and decoding, uplink encoding and burst modulation, implementation of power and frequency control algorithms, network communications with the NOC, and control of the TMASS via the ACU. The main component of the TMASS is a steerable 0.2921 meter (11.5 inch) parabolic reflector antenna, which can rotate in 3 axes and can receive in the 11.7-12.2 GHz band while simultaneously transmitting in the 14.0-14.5 GHz band. The ACU uses data received from the aircraft inertial navigation system to continuously control the AES antenna so that it points at the target satellite as the aircraft executes flight maneuvers, with total root mean square pointing error of less than 0.1° in normal operation. Any aircraft maneuver or navigational failure that prevents the antenna from properly pointing to the target satellite will disrupt the received signal, with resultant shut down of the AES transmitter within one second by on-board fault management controls designed to stop transmission in the event of AES hardware failure or out-of-tolerance operation.[8]

9. To establish a connection, an Arclight AES must initiate a login sequence after processing a periodically-transmitted configuration message from the NOC via the assigned satellite transponder. After processing the configuration message, the AES transmits a login burst lasting approximately 16 milliseconds at a low power level. If no response is received from the NOC, the AES transmits successive login bursts at 10-second intervals, incrementally increasing power in 1-decibel steps up to a preconfigured maximum. If no response is received after attempting login at the maximum power level, the AES continues login attempts in a different frequency channel, starting at the lowest power level again.[9] Arclight AES terminals that are logged in transmit data in bursts at random time intervals, using a Code Division Multiple Access "Aloha" contention access protocol and Direct Sequence Spread Spectrum modulation with forward error control.[10] The power of the data transmissions from a logged-in AES terminal is dynamically controlled by the NOC, using a closed-loop algorithm that takes into account the E_b/N_o ratio (energy per bit divided by noise density) of data transmissions received by the GES and the aircraft's location in relation to the gain/noise-temperature contour of the satellite antenna.[11] The NOC also controls AES transmitter duty cycles and data-transmission rates, which can vary from 32 kbps to 512 kbps, and corrects frequency errors in AES transmissions.[12]

III. DISCUSSION

A. Prevention of Interference in the 14.0-14.5 GHz Band

1. Off-Axis equivalent isotropically radiated power (e.i.r.p.) Density

10. An earth station antenna's off-axis radiation, radiation in directions other than along the antenna's boresight, can interfere with a satellite adjacent to the earth station's target satellite. In the interest of minimizing such interference, Recommendation ITU-R M.1643 states that an AMSS system that uses the 14.0-14.5 GHz band for AES uplink transmission should be operated in such a manner that the aggregate off-axis e.i.r.p. density produced by simultaneously transmitting AES terminals in the network do not exceed "the levels that have been published and coordinated for the specific and/or typical earth station(s) pertaining to FSS networks …."[13]

[8] Arclight AMSS Application, Exhibit 2 at §§ 2.2.1, 2.2.1.1, 2.2.1.2, and 2.2.1.3

[9] Arclight AMSS Application, Exhibit 2 at § 2.4.2.1

[10] Arclight AMSS Application, Exhibit 2 at §§ 3.1.2.2 and 3.2.1.

[11] Arclight AMSS Application, Exhibit 2 at § 2.4.4. ViaSat adds that these parameters will be used to estimate the on-axis equivalent isotropically radiated power (e.i.r.p.) of AES data transmissions. *Id*.

[12] Arclight AMSS Application, Exhibit 2 at §§ 2.4.4, 2.4.5, and 2.4.6.

[13] Rec. ITU-R M.1643, Annex 1, Part A, ¶1.

11. Although not directly applicable to AESs, the Commission's rules for Fixed-Satellite Service (FSS) earth stations provide guidance as to the technical criteria for evaluating AESs' off-axis e.i.r.p. density. Under the Commission's rules, authority for operation of a single FSS earth station to provide digital services in the 14.0-14.5 GHz uplink band can be routinely granted without coordination if the station's antenna equivalent diameter is 1.2 meters or more and the spectral density of the input power to the antenna will not exceed -14 dBW/4kHz.[14] The minimum antenna-diameter criterion effectively limits eligibility for routine licensing to applications specifying antennas with gain patterns consistent with the off-axis gain limits set forth in Section 25.209 of the Commission's rules.[15] A fixed earth station with an antenna too small to meet the off-axis gain limits in Section 25.209 can be licensed pursuant to criteria prescribed in Section 25.220(c).[16] Paragraph (1) of Section 25.220(c) provides that authority for such a non-conforming earth station may be granted if the applicant proposes to limit the maximum power density of the signal input into the earth station's antenna to a level determined by reducing the maximum permissible input power density for a routinely-licensed station by the number of decibels that the non-compliant antenna exceeds the applicable gain limits in Section 25.209.[17] Alternatively, Section 25.220(c), Paragraph (2), provides that authority for operation of a non-conforming Ku-band earth station that does not meet the input-power limit prescribed in Paragraph (1) may be granted if, *inter alia*, the applicant files a statement from the operator of the target satellite certifying that it has coordinated the proposed operation of the non-conforming earth station with the operators of all adjacent GSO satellites within six degrees of separation.[18]

12. In combination, the off-axis gain limits in Section 25.209 and the input power-density limit of -14 dBW/4kHz specified in Section 25.212(c) effectively define the following maximum levels of permissible off-axis e.i.r.p. density toward the geostationary-satellite-orbit arc from a single routinely-licensed FSS earth station transmitting digitally modulated signals in the 14.0-14.5 GHz band:[19]

Angle off-axis	Maximum e.i.r.p. density in any 4 kHz band
$1.0^\circ \leq$ Theta $\leq 7.0^\circ$[20]	15 -25$\log_{10}$Theta dBW
$7.0^\circ <$ Theta $\leq 9.2^\circ$	-6 dBW
$9.2^\circ <$ Theta $\leq 48^\circ$	18 -25$\log_{10}$Theta dBW
Theta $> 48^\circ$	-24 dBW

[14] 47 CFR § 25.212(c). To be eligible for routine processing, an application for a digital Ku-band earth station must also specify a maximum downlink e.i.r.p. density no greater than 10 dBW/4kHz. *See* 47 CFR § 25.134(g)(2) and *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, Sixth Report and Order, Fifth Report and Order*, IB Docket No. 00-248, 20 FCC Rcd 5666 (2005) at ¶99.

[15] The Commission has determined that gain at off-axis angles of 1.25 degrees or more in the geostationary-satellite orbital plane from a Ku-band earth station with a 1.2-meter transmitting antenna will not exceed the levels specified in Section 25.209(a), 47 CFR § 25.209(a). *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, Sixth Report and Order and Third Further Notice of Proposed Rulemaking*, IB Docket No. 00-248, 20 FCC Rcd 5593 (2005) ("*Sixth Report and Order and Third FNPRM*") at ¶11 and n.27. Also see 47 CFR § 25.209(g) (gain limits for routinely-licensed Ku-band antennas with diameters of 1.2 meters or more apply at off-axis angles of 1.25 degrees or more).

[16] *See* 47 CFR §§ 25.209, 25.220(c).

[17] *Id*.

[18] 47 CFR § 25.220(c).

[19] *See* 47 CFR §§ 25.209, 25.212(c).

[20] For Ku-band earth stations with antennas between 1.2 meters and 5 meters in diameter, the 15 - 25$\log_{10}\theta$ dBW limit applies at angles above 1.25 degrees rather than at angles above 1.0 degree. *See* 47 CFR § 25.209(g).

where Theta is the angle in degrees from the axis of the main lobe.[21] The Commission has proposed to adopt a rule that would require each AES terminal in a Ku-band AMSS system to comply with these off-axis e.i.r.p. limits (which we will refer to hereafter as "the routine-licensing off-axis radiation envelope").[22]

13. ViaSat acknowledges that the antenna it proposes to incorporate in the Arclight AES terminals is incapable, due to its small diameter, of meeting the off-axis gain limits for routinely-licensed FSS earth stations in Section 25.209.[23] Taking into account the measured gain pattern of the Arclight AES antenna,[24] it can be determined by calculation that the off-axis e.i.r.p. density radiated from a single Arclight AES terminal toward the geostationary orbital arc will not exceed the routine-licensing off-axis radiation envelope, provided that the maximum power density of the antenna input is limited to -24.25 dBW/4kHz. This power-density level is 10.25 dB below the limit for routinely-licensed Ku-band FSS earth stations transmitting digitally modulated signals. ViaSat indicates in the Arclight AMSS application that the power density of the input into an Arclight AES antenna will not exceed -29.08 dBW/4kHz.[25] Thus, it appears that the off-axis e.i.r.p. density toward the geostationary orbital arc generated by a single Arclight AES terminal will always be well below the routine-licensing off-axis radiation envelope.

14. As we have noted, however, ViaSat proposes to use access protocols that could allow multiple AES terminals to transmit in the same frequency channel at the same time.[26] When an applicant requests blanket authority for Ku-band earth stations to operate in a network with an access protocol that could allow such simultaneous co-frequency AES transmissions, it is necessary to take into account the combined off-axis radiation from simultaneously operating terminals as well as the levels of off-axis radiation that a single terminal can generate to determine the aggregate e.i.r.p. density of the AES transmissions.[27] ViaSat initially proposed to allow aggregate off-axis e.i.r.p. density toward the geostationary arc from simultaneously-transmitting Arclight AES terminals to exceed the routine-licensing envelope for brief time periods.[28] By amendment filed on March 9, 2007, however, ViaSat withdrew this proposal.[29] Rather, ViaSat now proposes to keep aggregate off-axis e.i.r.p. density from AES operation within the routine-licensing envelope all of the time. ViaSat asserts that the Arclight NOC would keep aggregate off-axis radiation within the envelope by dynamically controlling the input power of individual AES terminals, monitoring and controlling the number of AES terminals accessing the network, and limiting the number of data bursts AES terminals may send when the average number of simultaneous transmissions exceeds a threshold determined by statistical algorithms.[30]

15. ViaSat has filed a copy of a coordination letter signed by SES Americom, the licensed

[21] Moreover, the Commission has adopted these limits in its rules pertaining to operation of Ku-band earth stations on vessels. *See* 47 CFR § 25.222(a)(1).

[22] *Ku-Band AMSS NPRM* at ¶36.

[23] Arclight AMSS Application, Exhibit 2 at § 5.2.1.1.

[24] *See* Arclight AMSS Application, Exhibit 2 at § 3.1.2.2, and letter with attachments dated Jan. 23, 2006 to the FCC Secretary from Elizabeth R. Park, Counsel to ViaSat.

[25] *See* Arclight AMSS Application, Exhibit 2 at § 3.2.2, specifying that the spectral density of the aggregate (two-frequency) return links will be approximately 15 dB-PSD below the level required at the authorized bandwidth.

[26] *See* ¶ 9, *supra*.

[27] *See*, *e.g.*, 47 CFR § 25.222(a)(1).

[28] Arclight AMSS Application, Exhibit 2 at § 1.1.2.

[29] SES-AMD-20070309-00325.

[30] *Id.* at § 5.2.1.2.

operator of the AMC-6 satellite. In the letter, SES states its understanding that ViaSat will operate the Arclight AMSS system in such a way that aggregate off-axis e.i.r.p. from Arclight AES terminals will "always [be] equal to or less than that of routinely authorized VSAT [Very Small Aperture Terminal]" remote stations. In other words, the aggregate off-axis e.i.r.p. will always be within the routine-licensing off-axis radiation envelope. Further, AES operations would be consistent with coordination agreements between SES and operators of adjacent satellites.[31] The off-axis radiation limits that ViaSat proposes are acceptable to PanAmSat, the operator of the only co-frequency satellite within six degrees of the AMC-6 satellite. We conclude that it would serve the public interest to authorize Arclight operation within those limits, subject to the conditions imposed in this order and any additional requirements imposed in the pending *Ku-Band AMSS* rulemaking. In the event another co-frequency FSS satellite commences operation at a location within six degrees of the target satellite, ViaSat shall confine aggregate off-axis radiation to a level one dB below the routine-processing limits, pending coordination with the operator of the new satellite.[32] Both previous recipients of license authority for Ku-band AMSS operation voluntarily proposed to keep off-axis radiation from single terminals within a one-dB margin below the routine-processing limits and to keep aggregate off-axis radiation within that margin for all but a small fraction of the time.[33] In view of the fact that ViaSat is proposing to operate with random-access protocols that would allow simultaneous operation by multiple terminals, we think it is reasonable to require ViaSat to meet a similar restriction during any period of time when its AMSS operation has not been coordinated with respect to an operational co-frequency satellite within six degrees of the target satellite. We believe this requirement will minimize the possibility of unacceptable interference to other licensed operations.

2. Related Requirements Based on ITU-R M.1643

16. In addition to proposing off-axis e.i.r.p. limits for Ku-band AMSS systems, the Commission proposed several other technical requirements in the *Ku-Band AMSS NPRM* based on recommendations in ITU-R M.1643 to minimize risk of harmful interference with co-channel FSS systems. Specifically, the Commission proposed to adopt the following requirements pertaining to operation of Ku-band AES terminals: maintaining pointing accuracy within 0.2 degrees; use of tracking algorithms that are resistant to capturing signals from adjacent satellites; immediate cessation of transmission upon detection of unintended satellite tracking; operational control by an NOC located in the United States that can detect AES malfunctions and send "enable transmission" and "disable transmission" commands to the AES terminals; automatic cessation of AES transmission upon receipt of a parameter-change command pending receipt of an enable-transmission signal from the NOC; and on-board fault detection with automatic shutdown upon detection of a fault that could result in harmful interference.[34] Based on review of the subject application, we conclude that operation of the Arclight AMSS system would satisfy these proposed requirements.

3. Protection of Space Research Service and Radio Astronomy

17. The 14.0-14.2 GHz band is domestically allocated for secondary-status Federal-government operation in the Space Research Service ("SRS").[35] The National Aeronautics and Space Administration

[31] Letter dated April 19, 2006 "To Whom It May Concern" from Krish Jonnalagadda, Manager of Satellite Marketing Development for SES Americom, Inc., and Daryl T. Hunter. P.E., Senior Systems Engineer for ViaSat, Inc., endorsed by Mohammad Marashi, Vice President of Customer Support Engineering for PanAmSat Corporation.

[32] ViaSat may be subject to a different set of operating requirements due to adoption of applicable rules or policies in the *Ku-band AMSS* rulemaking.

[33] *See ARINC AMSS License Order* at ¶¶ 18, 24 and 32.

[34] *Ku-Band AMSS NPRM* at ¶¶ 41-44.

[35] *See* 47 C.F.R. § 2.106.

("NASA") currently operates SRS Tracking and Data Relay Satellite System ("TDRSS") stations in White Sands, New Mexico, and Guam that receive signals from geostationary satellites in the 14.0-14.05 GHz segment of the SRS band. NASA plans to establish an additional 14 GHz TDRSS station near Blossom Point, Maryland. ITU-R M.1643 recommends that Ku-band AMSS systems be coordinated with SRS operation by limiting AES emission levels, or terminating AES operation, in the vicinity of SRS earth stations.[36] The Commission has proposed to require Ku-band AMSS applicants to resolve concerns regarding interference with SRS operation through coordination.[37]

18. When it filed the Arclight AMSS blanket license application, ViaSat included a copy of a coordination agreement signed in October 2005 by representatives of ViaSat and NASA.[38] Under the terms of the agreement, ViaSat must terminate transmissions from any Arclight AES that would exceed defined interference thresholds when the AES is within line of sight of a TDRSS earth station, including any such TDRSS station that commences operation in the future.

19. The National Science Foundation ("NSF"), an independent Federal agency created by Congress, supports radio-astronomy observation in the 14.47-14.5 GHz band at National Radio Astronomy Observatories in New Mexico and West Virginia. The use of the band for radio-astronomy observation at those sites is recognized in Footnote US203 to the U.S. Table of Allocations, which requires steps to be taken to minimize interference with such operation from terrestrial radio transmitters. The NSF also supports radio-astronomy observation in the same band at various other sites in the continental United States, Hawaii, Puerto Rico, and the U.S. Virgin Islands.[39] ITU-R M.1643 recommends that AES terminals cease transmission in the 14.47-14.5 GHz band and meet power flux density ("PFD") limits in the 14.0-14.47 GHz band when within line of sight of radio astronomy stations observing in the 14.47-14.5 GHz band.[40] The Commission has proposed to require Ku-band AMSS applicants to resolve concerns regarding interference with such radio-astronomy observation stations through coordination.[41]

20. ViaSat states in its blanket license application that Arclight AES terminals will cease transmission on frequencies above 14.44 GHz when within line of sight of a radio astronomy station during periods of scheduled radio astronomy observation in the 14.47-14.5 GHz band. ViaSat also states in the application that radiation in the 14.0-14.47 GHz band from Arclight AES terminals within line of sight of radio astronomy stations during such periods of observation will not exceed the power flux density limits specified in ITU-R M.1643: $-190 + 0.5 \cdot \theta$ dB(W/(m^2 · 150 kHz)) for $\theta \leq 10°$ and –185 dB(W/(m^2 · 150 kHz)) for $10° < \theta \leq 90°$, where θ is the angle of arrival of the radio frequency wave above the horizontal.[42] Further, ViaSat filed a copy of a coordination agreement with the NSF, executed in April 2006, in which ViaSat agreed to meet specified limits on aggregate PFD in the 14.47-14.5 GHz

[36] Rec. ITU-R M.1643, Annex 1, Part D.

[37] *Ku-Band AMSS NPRM* at ¶¶ 23 and 28.

[38] Coordination Agreement Between the National Aeronautics and Space Administration and VIASAT, Incorporated for Operation of the VIASAT Arclight AMSS Operation in the 14.0-14.5 GHz Band, executed on Oct. 26, 2005.

[39] 47 C.F.R. § 2.106, Footnote US203.

[40] Rec. ITU-R M.1643, Annex 1, Part B.

[41] *Ku-Band AMSS NPRM* at ¶¶ 23 and 28.

[42] Arclight AMSS Application, Exhibit 2 at § 5.2.4, as amended. The proposed PFD limits are identical to a pertinent recommendation in ITU-R M.1643.

band at various listed radio astronomy sites during periods of observation in that band.[43]

21. The authorization granted in this order is subject to conditions requiring compliance with the coordination agreements with NASA and the NSF as well as any additional requirements that the Commission adopts in the Ku-Band AMSS rulemaking proceeding with respect to protection of Federal-government operations in the 14.0-14.5 GHz band.

4. Protection of Terrestrial Radio Services

22. ITU-R M.1643 recommends adoption of PFD limits on emissions from AES terminals in the 14.0-14.5 GHz band when they are within line of sight of any territory where fixed terrestrial networks are in operation.[44] The 14.2-14.4 GHz band is domestically allocated on a secondary basis for grandfathered operation of land mobile stations licensed prior to March 2, 2005.[45] The 14.4-14.5 GHz band is allocated on a secondary basis for governmental fixed and mobile services.[46]

23. ViaSat asserts in its blanket-license application that there are no terrestrial radio services licensed for operation in North America in the 14.0-14.5 GHz band that would receive interference from operation of Arclight AES terminals. According to ViaSat, it is highly unlikely that AES terminals that transmit only when locked onto a geostationary target satellite would ever transmit in the direction of a ground-based radio station within the latitudes of the continental United States. Nevertheless, ViaSat states that Arclight AES terminals in aircraft at altitudes of 5,000 feet or higher will operate in compliance with the recommended PFD limits specified in ITU-R M.1643 when their antennas are pointed at an angle of 15 degrees above horizontal. According to ViaSat, this scenario is the worst case possible for Arclight AES operations in continental-US airspace.[47] Based on ViaSat's representation, it appears that the PFD from Arclight AES terminals will always be within the limits specified in M.1643. We do not authorize Arclight AES operation with PFD in excess of those limits.

B. Downlink Transmission in the 11.7-12.2 GHz Band

24. The 11.7-12.2 GHz band is domestically allocated on a primary basis for FSS downlink transmission, including downlink transmission to earth stations on vessels,[48] and is allocated on a secondary basis for operation of grandfathered terrestrial radio stations.[49] The Commission has proposed to add an allocation for AMSS downlinks in the 11.7-12.2 GHz band,[50] but there is no AMSS allocation in the band at the present time. Hence, ViaSat requests a waiver to permit operations in the 11.7-12.2

[43] Coordination Agreement Between the National Science Foundation and ViaSat, Inc. for Operation of the ViaSat Arclight AMSS and Radio Astronomy Sites Jointly Sharing the 14.0-14.5 GHz Band, filed as attachment to letter dated Apr. 12, 2006 to the FCC Secretary from Elizabeth R. Park, Counsel to ViaSat.

[44] Specifically, ITU-R M.1643 recommends adoption of PFD limits of $-132 + 0.5 \cdot \theta$ dBW(W/(m^2·MHz)) for $\theta \leq 40°$ and -112 dBW(W/(m^2·MHz)) for $40° < \theta \leq 90º$, where theta is the angle of arrival of the AES emissions in degrees above the horizontal. *See* Rec. ITU-R M.1643, Annex 1, Part B.

[45] 47 CFR § 2.106, Footnote NG184.

[46] 47 CFR § 2.106.

[47] Arclight AMSS Application, Technical Description § 5.2.2.

[48] 47 CFR § 2.106, Footnotes NG145 and NG183, and *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 (Report and Order)*, IB Docket No. 02-10, FCC 04-286, 20 FCC Rcd 674 (2005) at ¶79.

[49] 47 CFR § 2.106, Footnote NG184.

[50] *Ku-Band AMSS NPRM* at ¶15

GHz band on a non-interference, non-protected basis.[51]

25. Section 25.134(g)(2) of the Commission's rules specifies a limit of 10 dBW/4kHz on the e.i.r.p. density of digital satellite transmissions in the 11.7-12.2 GHz band for routinely-licensed VSAT systems.[52] An applicant proposing to operate with satellite carrier e.i.r.p. density above 10 dBW/4kHz must file, in its application, a statement from the target satellite operator attesting that it has coordinated such proposed operation with the operators of other geostationary satellites within 6 degrees of orbital separation.[53] ViaSat indicates in its application that the e.i.r.p. density of Arclight AMSS downlink transmissions in the 11.7-12.2 GHz band will not exceed 9.82 dBW/4kHz.[54] Moreover, SES, the target satellite operator, and PanAmSat, which operates the only co-frequency satellite within six longitudinal degrees, have certified that the proposed downlink operation would be consistent with the terms of the coordination agreements reached by the affected operators.[55]

26. The Commission has previously granted authority to Boeing and ARINC for use of the 11.7-12.2 GHz band for AMSS downlink transmission from existing FSS satellites, based on a showing that the 10 dBW/4kHz limit would not be exceeded or proof of consent by adjacent satellite operators.[56] Consistent with these precedents, we conclude that a waiver is warranted to allow ViaSat to use the 11.7-12.2 GHz band for AMSS downlinks on a non-interference, non-protected basis.

IV. CONCLUSION

27. We find, pursuant to Section 309 of the Communications Act, 47 U.S.C. § 309, that grant of blanket authority for ViaSat to operate its proposed Arclight AMSS system, as conditioned herein, will serve the public interest, convenience, and necessity.

V. ORDERING CLAUSES

28. Accordingly, IT IS ORDERED that ViaSat, Inc.'s application, File Nos. SES-LIC-20051028-01494, as amended by File Nos.SES-AMD-20060314-00440 and SES-AMD-20070309-00325, IS GRANTED to the extent indicated herein, and ViaSat, Inc. IS AUTHORIZED to operate up to 1,000 technically-identical transmit/receive mobile earth stations aboard aircraft operating with the AMC-6 satellite at orbital location 72° W.L., in the 11.7-12.2 GHz and 14.0-14.5 GHz frequency bands in the

[51] *See* 47 CFR § 2.102(a).

[52] 47 CFR § 25.134(g)(2).

[53] 47 CFR § 25.220(e)(1)(ii). *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, Fifth Report and Order in Docket 00-248*, 20 FCC Rcd 5666 (2005) at ¶¶ 93-95 (concluding that authority should be routinely granted for digital downlink transmission in the 11.7-12.2 GHz band with e.i.r.p. density up to 10 dBW/4kHz without requiring coordination).

[54] Arclight AMSS Application, Technical Description § 3.3.2.

[55] Letter dated April 19, 2006 "To Whom It May Concern" from Krish Jonnalagadda, Manager of Satellite Marketing Development for SES Americom, Inc., and Daryl T. Huner. P.E., Senior Systems Engineer for ViaSat, Inc., endorsed by Mohammad Marashi, Vice President of Customer Support Engineering for PanAmSat Corporation.

[56] *Boeing 12 GHz License Order* at ¶10 (granting blanket license conditioned on submission of proof that operators of adjacent satellites had no objection to proposed operation with peak downlink e.i.r.p. density in excess of the 10 dBW/4KHz routine-licensing limit); *ARINC AMSS License Order* at ¶54 (noting that proposed maximum downlink e.i.r.p. density was well below 10 dBW/4kHz).

continental United States and over its territorial waters, consistent with the specifications in the application and in compliance with the Commission's rules, except insofar as waived herein, and subject to the following conditions.

a) The Arclight AMSS system must operate in compliance with any rule requirements subsequently adopted by the Commission.

b) The Arclight AMSS system must accept interference from lawful operation of any station in the 11.7-12.2 GHz band in accordance with the U.S. Table of Frequency Allocations (47 C.F.R. § 2.106) and shall immediately terminate operation upon notification that such operation is causing harmful interference, not permitted under the terms of a pertinent coordination agreement, with lawful operation of any radio system in the 11.7-12.2 GHz band in conformance with the U.S. Table of Frequency Allocations.

c) Arclight AMSS operation shall immediately terminate upon notification that such operation is causing harmful interference, not permitted under the terms of pertinent coordination agreements, with (1) lawful operation of any radio system in the 14.0-14.5 GHz band authorized on a primary basis in conformance with the U.S. Table of Frequency Allocations or authorized on a secondary basis prior to the effective date of this order, or (2) operation of any TDRSS earth station in the band 14-14.2 GHz, or (3) radio astronomy observations in the 14.47-14.5 GHz band.

d) The Arclight AMSS licensee shall maintain a point of contact for discussing interference concerns with other licensees and U.S. Government agencies and shall submit a letter to be included in its license file with the name and telephone number of the contact prior to commencing operation.

e) Arclight AES terminals must employ a tracking algorithm that is resistant to capturing and tracking adjacent satellite signals, and each AES terminal must be capable of inhibiting its own transmission in the event it detects unintended satellite tracking.

f) Arclight AES terminals must be monitored and controlled by a ground-based network control and monitoring center. Each Arclight AES terminal must be able to receive "enable transmission" and disable transmission" commands from the network control center and must cease transmission immediately after receiving any "parameter change" command until it receives an "enable transmission" command from the network control center. The network control center will monitor operation of each Arclight AES terminal to determine if it is malfunctioning, and each Arclight AES terminal will self-monitor and automatically cease transmission on detecting an operational fault that could cause harmful interference to the fixed satellite service network.

g) Arclight AMSS operation in the 11.7-12.2 GHz band shall be in accordance with the space station authorization for the AMC-6 satellite.

h) The Arclight AMSS system shall not be used to provide air traffic control communications.

i) The Arclight AMSS system shall operate in compliance with any limits established by the International Telecommunication Union (ITU) to protect other services allocated internationally.

j) Operation pursuant to this authorization shall conform to the requirements of ViaSat's coordination agreements with NASA and NSF as well as its coordination agreement with SES Americom and PanAmSat.

k) The licensee shall notify the Commission of the date when commercial operation of the Arclight AMSS system commences. 12 months after commencing commercial operation, the licensee shall file a report on the system's aggregate off-axis radiation performance since the commencement of commercial operation, based on the most recent available data and taking into account all relevant variables, including the following:

mispointing of AES antennas due to bias, latency, tracking error, and misalignment between transmit and receive apertures;

variation in AES antenna gain patterns due to manufacturing tolerances, aging, environmental effects, scan angle variation, element phase error, amplitude error, and failure rate;

variations in AES transmit e.i.r.p. due to measurement error, control error, and latency affecting closed-loop power control.[57]

l) In the event that another co-frequency FSS satellite commences operation at a location within six degrees of the target satellite, ViaSat must reduce aggregate off-axis radiation from Arclight AES terminals to levels one dB below the routine-processing envelope, pending demonstration of coordination with the operator of the new satellite.

29. IT IS FURTHER ORDERED that Section 2.102 of the Commission's rules IS WAIVED with respect to operation of the Arclight AMSS network in the 11.7-12.2 GHz downlink band consistent with the terms of this authorization.

30. ViaSat may decline this authorization as conditioned within 30 days from the date of release of this *Order and Authorization.* Failure to respond within that period will constitute formal acceptance of the authorization as conditioned.

31. This *Order and Authorization* is issued on delegated authority pursuant to Sections 0.241 and 0.261 of the Commission's rules, 47 C.F.R. §§ 0.241 and 0.261, and is effective upon release.

FEDERAL COMMUNICATIONS COMMISION

Helen Domenici
Chief, International Bureau

Julius Knapp
Chief, Office of Engineering and Technology

[57] *See* Rec. ITU-R M.1643, Annex 1, Part A.