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

In the Matter of	)	
	)	
The Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band	)	IB Docket No. 06-123

SECOND REPORT AND ORDER

Adopted: June 8, 2011 **Released: June 14, 2011**

By the Commission:

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I. INTRODUCTION

1. With this Second Report and Order (R&O), we adopt rules to mitigate space path interference between the 17/24 GHz Broadcasting-Satellite Service (BSS)[1] space-to-Earth transmissions and the feeder link receiving antennas of Direct Broadcast Satellite Service (DBS) space stations that operate in the same frequency band. We adopt an off-axis power flux density (pfd)[2] coordination trigger for 17/24 GHz BSS space stations, require a minimum orbital separation requirement of 0.2º between 17/24 GHz BSS space stations and DBS space stations, and place bounds on orbital inclination and eccentricity of 17/24 GHz BSS space stations. We also revise our informational requirements to require 17/24 GHz BSS space station applicants to file predicted and measured transmitting antenna off-axis gain information. Finally, we adopt procedures to enable pending applicants and existing authorization holders to file relevant information related to these rules. By these actions, we facilitate the introduction of the 17/24 GHz BSS and anticipate that it will provide new and innovative services, including video, audio, data, and video-on-demand, to consumers in the United States and promote increased competition among satellite and terrestrial services.

II. BACKGROUND

2. *International Allocation and Commission Proceedings*. The 1992 World Administrative Radio Conference (WARC-92) of the International Telecommunication Union (ITU)[3] adopted an additional frequency allocation for BSS in Region 2 which became effective on April 1, 2007.[4] In 2000, the Commission implemented, in large part, the ITU Region 2 allocation for BSS domestically.[5] The Commission allocated the 24.75-25.25 GHz (Earth-to-space) band, on a primary basis, for Fixed Satellite Service (FSS) uplink operations limited to the 17/24 GHz BSS feeder links.[6] The 25.05-25.25 GHz

[1] BSS is the term used for a radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception by the general public. *See e.g.,* 47 C.F.R. § 2.1. In this item, the term "17/24 GHz BSS" generally refers to the broadcasting-satellite service operating on space-to-Earth (downlink) frequencies in the 17.3-17.8 GHz band and the corresponding Earth-to-space (uplink) frequencies in the 24.75-25.25 GHz band.

[2] Power flux density is defined as the amount of power flow through a unit area within a unit bandwidth. The units of power flux density are those of power spectral density per unit area, namely watts per hertz per square meter. These units are generally expressed in decibel form as dB(W/Hz/m^2), dB(W/m^2) in a 4 kHz band, or dB(W/m^2) in a 1 MHz band. 47 C.F.R. § 25.201.

[3] The ITU, based in Geneva, Switzerland, is a United Nations specialized organization that deals with international communications issues.

[4] International Telecommunication Union, Final Acts of the World Administrative Radio Conference (Malaga-Torremolinos, 1992). The ITU Radio Regulations divide the world into three regions. Generally, Region 1 includes Africa, Europe, and northern and western portions of Asia; Region 2 includes the Americas and Greenland; Region 3 includes southern portions of Asia, Australia, and the South Pacific. ITU Radio Regulations, Article 5, Section 1.

[5] Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Stations in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of Additional Spectrum in the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite-Service Use, *Report and Order,* IB Docket No. 98-172, 15 FCC Rcd 13430, 13478, 13482, ¶¶ 99 and Appendix A (2000) ("*18 GHz Report and Order"*).

[6] *Id.* at 13476, 13479, ¶¶ 96, 102. A feeder link is a transmission path between a space station and a "gateway" earth station. In both DBS and 17/24 GHz BSS systems, feeder links are used to uplink programming to the space station, where it is translated in frequency, amplified and broadcast to consumers' receiving earth station terminals. Feeder links operate in frequencies assigned to the FSS.

portion of the band is shared with the 24 GHz Fixed Service (FS).[7] The Commission allocated the 17.3-17.7 GHz (space-to-Earth) band, on a primary basis, to the BSS for both international and domestic downlink transmissions[8] with the 17.7-17.8 GHz portion of the band limited to international service only. The 17.3-17.8 GHz band (Earth-to-space) is also allocated to the FSS for use by DBS feeder links. Thus, the same spectrum is used bi-directionally - *i.e*., transmission is in the space-to-Earth direction from 17/24 GHz BSS space stations to consumer antennas, and transmission is in the Earth-to-space direction from DBS feeder link earth stations to DBS space stations.[9] Consequently, there is a potential for interference from service-link and telemetry transmitters of 17/24 GHz BSS space stations into the feeder-link and telecommand antennas of nearby DBS space stations.

3. In 2006, the Commission adopted a *Notice of Proposed Rulemaking* (*NPRM*) which proposed processing and service rules for the 17/24 GHz BSS.[10] In May 2007, the Commission released a *Report and Order and Further Notice of Proposed Rulemaking* (*Order and FNPRM*) adopting processing and service rules for the 17/24 GHz BSS.[11] The *Order and FNPRM* included a framework in which 17/24 GHz BSS space stations would operate at orbital locations spaced at 4.0º intervals, as set forth in Appendix F of the *Order and FNPRM* (known as Appendix F locations).[12] The Commission also determined to apply the first-come, first-served licensing process to applications in this service.[13] In addition, the Commission adopted geographic service rules to require space station licensees to provide service to Alaska and Hawaii.[14] Further, the Commission established uplink earth station antenna performance standards, limits for uplink and downlink power levels to minimize the possibility of harmful interference, and stipulated criteria to facilitate sharing in the 24.75-25.25 GHz and 17.3-17.8 GHz bands.[15] The *FNPRM* sought comment on coordination parameters relating to space path and ground path interference in the 17 GHz band.[16] In September 2007, the Commission, *sua sponte*, released

[7] *18 GHz Report & Order*, 15 FCC Rcd at 13479-80, ¶¶ 102-106.

[8] *Id.* at 13476-13478, ¶¶ 96-99.

[9] In light of this sharing scenario, 17/24 GHz BSS transmissions are sometimes referred to as "reverse band operations."

[10] The Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band, *Notice of Proposed Rulemaking,* IB Docket No. 06-123, 21 FCC Rcd 7426 (2006) ("*NPRM*").

[11] The Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band, *Report and Order and Further Notice of Proposed Rulemaking*, IB Docket No. 06-123, 22 FCC Rcd 8842 at 8914-17, ¶¶ 180-188 (2007) ("*Order and FNPRM*" or "*Order*" and "*FNPRM*" individually).

[12] *Id.* at Appendix F.

[13] *Id.* at 8845-49, ¶¶ 6-11.

[14] *Id.* at 8860-62, ¶¶ 47-49.

[15] *Id.* at 8873-75, ¶¶ 77-81.

[16] *Id.* at 8902-17, ¶¶ 148-188. Four parties commented in response to the *FNPRM.* Appendix A lists the filed comments. The commenters are EchoStar Satellite L.L.C., DIRECTV Inc., SES Americom Inc., and Telesat Canada. In response to the *Order*, DIRECTV filed a Petition for Reconsideration. *See* Appendix A for a list of the Comments, Reply Comments and Ex Parte submissions filed.

an Order on Reconsideration to provide 17/24 GHz BSS space station operators additional flexibility in their choice of orbital locations.[17] On November 1, 2010, the Commission released a Second Order on Reconsideration denying two petitions for reconsideration filed by Telesat Canada (Telesat).[18] In the *17/24 GHz BSS Second Order on Reconsideration*, the Commission disagreed with Telesat's argument that the Commission's technical and procedural rules concerning assignment of orbital locations and frequencies are inapplicable to requests filed by non-U.S.-licensed 17/24 GHz BSS space station operators seeking to access the United States market.[19]

III. DISCUSSION

4. Space path interference arises when the downlinked signals transmitted by 17/24 GHz BSS space stations are received by the feeder link and/or telecommand antennas of nearby DBS space stations.[20] The amount of space path interference received by the DBS space station will depend upon the specific orientation of, and separation between, the transmitting 17/24 GHz BSS space station and the receiving antenna on DBS space stations; the power level transmitted by the 17/24 GHz BSS space station; the off-axis gain discrimination characteristics of the transmitting antenna on the 17/24 GHz BSS space station; and the off-axis gain discrimination characteristics of the receiving antenna on the DBS space station. Management of space path interference is expected to be more challenging when a receiving DBS space station is located within a few tenths of a degree in orbital location longitude of a transmitting 17/24 GHz BSS space station.

5. The issue of space path interference is somewhat complicated by the different spacing schemes for the two services. Under the terms of the Region 2 BSS and Feeder Link Plans, the United States is assigned eight orbital locations for DBS space stations separated by at least 9.0º.[21] Further, there

[17] The Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band, *Order on Reconsideration*, IB Docket No. 06-123, 22 FCC Rcd 17951 (2007).

[18] The Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band, *Second Order on Reconsideration*, IB Docket No. 06-123, 25 FCC Rcd 15718 (2010).

[19] *Id.* at 15726, ¶ 15. In the 17/24 GHz BSS service, as in all other satellite services, non-U.S.-licensed operators seeking access to the United States market are required to satisfy the same eligibility and operating requirements as a U.S.-licensed operator. As such, the technical and licensing rules adopted in this order today apply equally to both U.S.- and non-U.S.-licensed operators, including non-U.S.-licensed operators seeking access to the United States market as well as a non-U.S.-licensed earth station operator seeking to communicate with either a U.S.-licensed or a non-U.S.-licensed space station. *Id.* at 15726-27, ¶¶ 14-16.

[20] Analogously, ground path interference arises when the off-axis transmissions from DBS feeder links or telecommand earth stations are received by nearby 17/24 GHz BSS subscriber or telemetry earth stations. Ground path interference issues will be addressed in a separate order.

[21] *See* Appendices 30 and 30A of the ITU's Radio Regulations. In the United States, space stations operating in the 12.2-12.7 GHz band (space-to-Earth) and the 17.3-17.8 GHz band (Earth-to-space) are referred to as the Direct Broadcast Satellite Service (DBS). Policies and Rules for the Direct Broadcast Satellite Service, *Report and Order*, IB Docket No. 98-21, 17 FCC Rcd 11311, 11391, ¶ 129 (2002). These eight U.S. orbital positions, proceeding from east to west (all West Longitude), are 61.5°, 101°, 110°, 119°, 148°, 157°, 166°, and 175°. Three of these orbital locations – 101°, 110°, and 119°– can provide coverage of the 48 contiguous United States (CONUS). We also note (continued…)

is a pending proceeding in which the Commission has sought comment on whether to permit operations of DBS space stations from satellites located at orbital locations *not* assigned to the United States in the ITU Region 2 BSS and feeder link plans (*i.e.*, non-9.0º or reduced orbital spacing locations).[22] In contrast, the Commission adopted a 4.0º spacing scheme (with an ability to offset) for 17/24 GHz BSS space stations starting at 43° W.L. and ending at 179° W.L.[23] In light of the different spacing schemes in the two services, and the open DBS proceeding, there exists a wide variety of possible orbital separations between DBS space stations and 17/24 GHz BSS space stations.[24] While many of these scenarios do not raise the possibility of harmful interference into existing DBS space stations because of ample orbital separations, the rules we adopt here are designed to provide clear guidance under all potential spacing scenarios. Our rules are also designed to address the fact that during the course of its useful life – generally 15 years – a space station may operate at a variety of orbital locations.

6. As a result of the bi-directional use of the 17.3-17.8 GHz band, in the *NPRM*[25] and again in the *FNPRM*,[26] the Commission sought comment on general approaches to mitigate space path interference that may occur between 17/24 GHz BSS systems operating in the space-to-Earth direction and DBS networks operating in the Earth-to-space direction, and also sought comment on the more

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that the Commission has given market access to foreign-licensed DBS space stations operating at the orbital positions of other Administrations. For example, the Commission authorized market access from Canadian orbital locations (72.5º W.L. and 129º W.L.) and a Mexican orbital location (77º W.L.).

[22] Amendment of the Commissions Policies and Rules for Processing Applications in the Direct Broadcast Satellite Service; Feasibility of Reduced Orbital Spacing for Provision of Direct Broadcast Satellite Service in the United States*, Notice of Proposed Rulemaking*, IB Docket No. 06-160, 21 FCC Rcd 9443 (2006).

[23] *Order and FNPRM*, 22 FCC Rcd 8842, Appendix F. The Appendix F Locations are (all West Longitude): 43º, 47º, 51º, 55º, 59º, 63º, 67º, 71º, 75º, 79º, 83º, 87º, 91º, 95º, 99º, 103º, 107º, 111º, 115º, 119º, 123º, 127º, 131º, 135º, 139º, 143º, 147º, 151º, 155º, 159º, 163º, 167º, 171º, 175º, and 179º. As of the date of this order, 17/24 GHz BSS space stations are authorized at the following orbital locations proceeding from east to west (all West Longitude): 62.15º, 75º, 79º, 99.175º, 102.825º, 107º, 110.4 º, 110.9º and 115°. Policy Branch Information, Actions Taken, *Public Notice*, DA 09-651, Report No. SAT-00590 (rel. Mar. 20, 2009); Policy Branch Information, Actions Taken, *Public Notice*, Report No. SAT-00598 (rel. Apr. 24, 2009); Policy Branch Information; Actions Taken, *Public Notice*, DA 09-1724, Report No. SAT-00620 (rel. Jul. 31, 2009); *DIRECTV Enterprises, LLC*, Order and Authorization, DA 09-1624 (Int'l Bureau, rel. Jul. 28, 2009); and Policy Branch Information, Actions Taken, *Public Notice*, DA 08-2733, Report No. SAT-00570 (rel. Dec. 19, 2008). In addition, SES-1 was constructed with a small 17/24 GHz payload. We authorized launch only and no operations other than in-orbit testing. Application of SES Americom, Inc. for Authority to Launch and Operate a C/Ku-band Replacement Spacecraft for AMC-4, Call Sign S2807, IBFS File Nos. SAT-RPL-20100120-00014; SAT-AMD-20100309-00040, granted Apr. 20, 2010. DIRECTV RB2A was constructed with a more robust, but not a full 17/24 GHz BSS payload, attached to the DIRECTV-12 Ka-band space station. The Commission authorized launch and operations at 102.825º W.L. Application of DIRECTV Enterprises, LLC (DIRECTV) to Operate a 17/24 GHz BSS Hybrid Space Station, DIRECTV RB-2A (RB-2A, Call Sign S2796, IBFS File No. SAT-LOA-20090807-00085, FCC 07-76, 22 FCC Rcd 8842 (2007) (*Petition for Reconsideration pending*). There were eight other licenses granted for this service, however, the applicants surrendered their licenses prior to filing a bond. Policy Branch Information; Actions Taken, *Public Notice*, DA No. 09-2036*,* Report No. SAT-00632 (rel. Sept. 11, 2009). More recently, EchoStar submitted a letter surrendering five 17/24 GHz BSS authorizations. Letter from Pantelis Michalopoulos and Christopher Bjornson, Counsel for EchoStar Corporation and EchoStar Satellite Operating Corporation, to Marlene H. Dortch, Secretary, Federal Communications Commission, dated May 24, 2011.

[24] *See* Appendix D for a chart showing Appendix F orbital locations, U.S. DBS Region 2 Plan Locations and BSS Grants and Pending Applications.

[25] *NPRM*, 21 FCC Rcd at 7460-63, ¶¶ 71-79.

[26] *Order and FNPRM*, 22 FCC Rcd at 8914-17, ¶¶ 180-188.

particular question of locating 17/24 GHz BSS space stations at close distances to co-frequency DBS space stations (*i.e*., at nearby adjacent locations or within the same cluster).[27] The Commission asked what measures, including a minimum orbital separation requirement, off-axis equivalent isotropically radiated power (e.i.r.p.)[28] limits, antenna discrimination requirements for both services, or other requirements might be adopted to protect DBS receiving antennas from unacceptable interference. Finally, the *NPRM* sought comment on the particular problem of interference to DBS telemetry, tracking, and telecommand (TT&C) transmissions in the 17 GHz band that could result in loss of satellite control. In the *FNPRM*, the Commission summarized the comments received on the topic of space path interference but explained that the Commission would benefit from more detailed comment on these issues.[29] In summarizing the comments received, as elaborated below, the *FNPRM* also sought comment on the various proposals submitted in response to the *NPRM*.

A. Off-Axis Power Flux Density Coordination Trigger

7. *Proposal*. In the *FNPRM*, the Commission concurred with a proposal by EchoStar to avoid harmful levels of space path interference into DBS space station antennas by establishing a pfd value at the victim DBS space station receiving antenna above which coordination would be required. The Commission noted that this approach was consistent with ITU procedures and has proved workable for international coordination.[30] Specifically, the Commission proposed an off-axis pfd coordination trigger of -93 dBW/m^2/24 MHz at the victim DBS space station, and sought comment on this proposal, asking whether it would be sufficient to protect both existing and future DBS operations from space path interference.[31]

8. *Comments*. Commenters generally support the proposal to adopt an off-axis pfd coordination trigger, although they differ somewhat in how it should be implemented. EchoStar reiterates its support for an off-axis pfd coordination trigger level at the receiving space station, above which coordination should be required, arguing that this is the most measurable and hence most effective approach to managing space path interference.[32] EchoStar also notes that the narrower bandwidths of DBS telecommand links necessitate a different reference bandwidth to ensure their protection, and recommends scaling the currently proposed value of -93 dBW/m^2/24 MHz over a 1 MHz bandwidth so that it applies equally to communication and telecommand links.[33] SES Americom stresses that the Commission should adopt a technically neutral approach to managing space path interference and concurs that adopting an off-axis pfd coordination trigger is an acceptable method.[34] DIRECTV agrees with the

[27] Appendices 30 and 30A of the ITU Radio Regulations base the Region 2 BSS and feeder-link Plans on grouping of the space stations at locations of ± 0.2º from a nominal center location. At a given orbital location, oppositely polarized channels ("RHCP" or "LHCP") are placed at opposite sides of the central location. The resulting grouping of satellite payloads about the central location is referred to as the cluster.

[28] E.i.r.p. is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna. 47 C.F.R. § 2.1.

[29] *Order and FNPRM*, 22 FCC Rcd at 8914-17, ¶¶ 180-188.

[30] *Id.* at 8915-16, ¶¶ 183-184.

[31] *Id.*

[32] EchoStar Comments at 2-3.

[33] *Id.* at 4, n.5.

[34] SES Americom Comments at 11-12. SES Americom also finds requiring a minimum orbital separation of 0.2º-0.3º acceptable. *Id.*

approach of adopting an off-axis pfd coordination trigger, and with the proposed value of -93 dBW/m^2/24 MHz. DIRECTV, however, believes that the pfd level should be measured at the edge of a DBS cluster[35] (*i.e.*, ±0.2º from the nominal orbital locations of the eight U.S. Region 2 BSS Plan assignments) rather than at the DBS space station assigned location.[36] DIRECTV further asserts that a 17/24 GHz BSS operator that exceeds the pfd level at the edge of this DBS cluster should be required to coordinate with operators of all DBS space stations at the affected DBS cluster prior to commencing operations.[37] DIRECTV notes that at several of the Region 2 Plan locations assigned to the United States, multiple DBS space stations are in operation, and that over time the precise location of these space stations has changed as operators' needs have evolved. DIRECTV contends that measurement of the off-axis pfd at the edge of the cluster is necessary so that DBS operators will continue to retain the flexibility to operate multiple DBS space stations at a single nominal location as permitted under the Region 2 BSS and Feeder Link Plans.[38]

9. Telesat also encourages the Commission to adopt a coordination methodology whereby a 6% increase in system noise temperature[39] is used to identify coordination requirements.[40] Although Telesat differs slightly from other commenters by voicing a preference for a percentage increase in noise temperature coordination criteria, it agrees that if the Commission chooses to adopt a pfd coordination

[35] *See supra* n. 27.

[36] DIRECTV Comments at 4-6 and DIRECTV Ex Parte Letter of June 2, 2011. *But see* SES Americom Ex Parte Letter of May 26, 2011.

[37] DIRECTV Comments at 4-6. DIRECTV argues that this approach is necessary so that DBS operators will continue to have the flexibility to locate within the cluster. EchoStar, who initially advocated measuring the pfd level at the victim receiver, implies support for DIRECTV's proposed approach in its later comments, suggesting that the pfd limit should be measured at the nearest edge of the ±0.2º cluster location range. EchoStar Ex Parte letter of October 7, 2008, at 2.

[38] DIRECTV Comments at 5-6. Historically, interference between overlapping DBS channels was mitigated in part through the use of spatial isolation. Even and odd-numbered channels were spatially separated by grouping them ± 0.2º on either side of the nominal location, resulting in a "cluster" with overlapping channels spatially separated by 0.4º. Today's digital and spot-beam technology does not require such strict spatial separation and U.S. operators typically make use of the cluster concept to permit a single consumer earth station to point at a nominal orbital location, around which multiple space stations operated by the same service provider may be located. The ITU Radio Regulations provide a mechanism whereby Administrations may locate DBS space stations at positions within the cluster other than those specifically designated in the Region 2 Plans. *See* Section B of Annex 7 to Appendix 30 and § 4.13.1 of Annex 3 to Appendix 30A of the ITU Radio Regulations. The ITU Radio Regulations permit Administrations to deviate from the precise structure defined in Appendices 30 and 30A, and to locate their satellites at any orbital position within this cluster, provided that they obtain the agreement of all Administrations having assignments within the same cluster. *Id.* In the case of the United States, the requirement to obtain the agreement of all other Administrations with frequency assignments at that location is moot because the U.S. is assigned all 32 channels at each of its eight Region 2 Plan locations.

[39] Telesat Reply Comments at 3. Noise is an unwanted addition to a desired electromagnetic signal. In this context, interference from one telecommunication network into another constitutes a source of signal noise. Noise temperature is a figure of merit that describes the influence of noise in a communications system. It is a mathematical convenience, measuring the noise power generated by a practical device. The noise power is expressed as the equivalent temperature of a resistor, which, when placed at the input of a perfect noise-free device, generates the same amount of output noise. Noise temperature is usually expressed in kelvins or dBK.

[40] Telesat Reply Comments at 3. In advocating for its proposed methodology, Telesat points out that DIRECTV's space-path interference analysis also used relatively conservative values of 600K for the satellite receiver noise temperature and 0 dBi off-axis gain at the victim receiver. *Id*.

trigger, that the proposed value appears most reasonable for this purpose.[41] Telesat did not elaborate or provide any technical analysis to explain why it preferred one approach to the other,[42] nor did it include any discussion as to how such a methodology might be applied as a regulatory measure for the 17/24 GHz BSS.

10. *Discussion*. We agree that adopting an off-axis pfd coordination trigger at the DBS space station is an effective, measurable, and technically-neutral approach to managing space path interference into DBS space station receiving antennas. PFD is a well-understood metric used for interference mitigation and its use here is fully consistent with established Commission practice.[43] Further, we agree with EchoStar's proposal to protect DBS telecommand links by scaling the pfd level over a narrower bandwidth. Filings before the Commission, however, show that some 17/24 GHz BSS applicants plan analog telemetry transmissions with bandwidths as narrow as 200 or 300 kHz.[44] Consequently, scaling the pfd over a 1 MHz bandwidth as proposed by EchoStar could underestimate its value by several dB at the DBS receiver. Moreover, the bandwidth ratio between the 17/24 GHz BSS telemetry transmission and the DBS telecommand signals could vary considerably. Consequently, we believe that to best protect DBS telecommand transmissions, scaling the pfd calculation over a much narrower bandwidth within the DBS guardbands[45] would be a more judicious approach. We recognize, however, that adopting separate coordination trigger values for different transmission types (*i.e.*, service or telecommand) or for different frequency bands could introduce confusion, particularly because 17/24 GHz BSS service transmissions may operate in the same spectrum as DBS telecommand signals.

11. We find that a single off-axis pfd coordination trigger value referenced to the narrower bandwidth of 100 kHz that will apply to the entire 17.3-17.8 GHz band provides a more workable and clearer approach. Accordingly, we will adopt an off-axis pfd trigger level of -117 dBW/m^2/100 kHz[46] at the receiving antenna of any licensed U.S. DBS space station, any foreign DBS space station authorized to provide service in the United States, and any DBS space station proposed in a previously filed application for a U.S. license or U.S. market access.[47] We also recognize that, at some orbital locations, a

[41] Telesat Reply Comments at 4.

[42] We note that the pfd coordination trigger value adopted in this Order and the 6% increase in system noise temperature advocated by Telesat share a common technical origin. This is true because the pfd coordination trigger value adopted in this Order is derived using an assumed percentage increase in noise temperature no greater than 6%. EchoStar Reply Comments at 30.

[43] 47 C.F.R. § 25.208.

[44] Application of SES Americom Inc., IBFS File No. SAT-LOA-20080910-00173 (Call Sign S2763), Table S12, Analog Modulation Parameters, Schedule S Attachment at 8; Application of Skynet Satellite Corporation, IBFS File No. SAT-LOA-20080910-00174 (Call Sign S2764), Table S.12, Analog Modulation Parameters, Schedule S Attachment at 8.

[45] DBS networks are required to locate their TT&C operations within specially designated band segments. The DBS guardbands consist of 12 MHz of spectrum at either end of the 17.300-17.800 GHz band. Specifically they are the band segments between 17.300 GHz-17.312 GHz and between 17.788-17.80 GHz. These guardbands are defined in Section 4.1 of Annex 3 to Appendix 30A of the ITU Radio Regulations.

[46] In adopting this pfd trigger value we have not changed the power per unit of area that is permitted at the victim antenna. We have only reduced the bandwidth over which it is being measured. Hence, -117 dBW/m^2/100 kHz is proportional to our proposed value of -93 dBW/m^2/24 MHz, but is scaled by the ratio of the two bandwidths, *i.e.*, 100 kHz: 24 MHz.

[47] The coordination trigger only applies to DBS space stations that were previously authorized to provide service to in the United States by the Commission (*e.g.*, through licenses issued by the Commission or through grants of market access issued by the Commission to non-U.S. licensed operators). Where a non-U.S. licensed DBS space (continued…)

particular DBS or 17/24 GHz BSS network may not be authorized to operate throughout the entire 17.3-17.8 GHz band. Thus, we make clear that this coordination requirement applies only in the case of co-frequency operations between the DBS network and the 17/24 GHz BSS network. We will require each 17/24 GHz BSS applicant to identify all relevant DBS networks for which the off-axis pfd coordination trigger is exceeded. The off-axis pfd level should be determined for all transmitting beams in the 17.3-17.8 GHz band, over both polarizations,[48] and at a minimum must take into account three key factors: (1) the power level delivered into the 17 GHz transmitting antenna; (2) the off-axis gain[49] of the 17 GHz transmitting antenna in the direction of the DBS space station; and (3) the particular geometric configuration between the 17/24 GHz BSS and DBS space stations.

12. While we adopt an off-axis pfd coordination trigger, we decline to adopt DIRECTV's methodology for measuring the pfd at the edge of the DBS cluster. As discussed above, the ITU established the cluster as a mechanism to address adjacent-channel interference arising in an analog transmission environment.[50] In the nearly thirty years since adoption of the ITU BSS and Feeder Link Plans, advances in digital and spot-beam technology have changed the interference environment in which DBS systems now operate. The cluster was not created, nor was it intended, to provide U.S. DBS operators with the ability to foreclose new entrants in another service from using portions of the GSO arc.[51]

13. In 2000, the Commission decided to afford the 17/24 GHz BSS co-primary status with DBS. As such, our rules should favor neither service but rather ensure that both services can operate harmoniously by adopting reliable measures to determine the potential for interference, and requiring appropriate remedies in the event that interference is considered likely to occur. When satellite services share a frequency band on such an equal basis, new space station entrants are required to avoid causing harmful interference to incumbent operators, and radio stations/facilities are protected based on the order in which the license applications are either received or authorized.[52] The coordination trigger we adopt in

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station has not been granted authority to provide service to the United States by the Commission, coordination in the 17.3-17.8 GHz band is conducted using the existing procedures established in the ITU Radio Regulations.

[48] Polarization is the property of an electromagnetic wave that describes the time-varying direction and amplitude of the electric field vector (*i.e*., orientation). States of polarization are described in terms of the figures traced as a function of time by the projection of the extremity of a representation of the electric vector onto a fixed plane in space that is perpendicular to the direction of propagation. In general, the polarization is elliptical and is traced in a clockwise or counterclockwise sense, as viewed in the direction of propagation. If the major and minor axes of the ellipse are equal, the polarization is said to be "circular*."* If the minor axis of the ellipse is zero, the polarization is said to be "linear." Rotation of the electric vector in a clockwise sense is designated "right-hand polarization," and rotation in a counterclockwise sense is designated "left-hand polarization."

[49] Off-axis gain refers to the gain of the antenna at an angle θ that is larger than the reference angle of θ = 0º. The reference angle is often called the boresite direction and is typically taken to be the direction in which the maximum power is radiated.

[50] *See supra* n. 38.

[51] *Id*.

[52] *SDARS Report and Order*, 25 FCC Rcd 11710, 11787, ¶ 186 (2010) ("as is typically the case when co-primary services coordinate, we find a first-in, first-protected coordination approach is appropriate to address future AMT deployments."); *Amendment of Parts 2, 25 of the Commission's Rules*, 16 FCC Rcd 4096, 4117, ¶ 42 (2000) ("In frequency bands with co-primary services, new entrants in a band must coordinate their operations with incumbent operations in order to minimize the possibility of harmful interference between the sharing services."); *Amendment of Parts 2, 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-band*, 18 FCC Rcd 2324, ET Docket 98-206 (2003) ("consistent with the co-primary status of NGSO FSS downlink and fixed service operations in the 10.7-11.7 GHz band, we also clarify that our (continued…)

this Order identifies those DBS space stations at whose assigned locations the pfd levels are sufficiently high to justify imposing the burden of coordination upon the 17/24 GHz BSS applicant. In contrast, the methodology requested by DIRECTV would require a new 17/24 GHz BSS operator to engage in coordination even though its technical demonstration showed no harm to any existing or proposed DBS space stations.[53] Such an approach would be inconsistent with Commission practice and burdensome to the new service.

14. Our decision in this regard is similar to a decision made in the *Order and FNPRM* where we declined to adopt a proposed requirement that we award licenses for 17/24 GHz BSS space stations that are to be co-located with DBS space stations only to the existing DBS operators. In doing so, we stated that adopting such a requirement would confer a benefit on existing DBS licensees while hindering competition.[54] Although less severe in scope, we believe that adopting DIRECTV's methodology would similarly hinder competition by favoring existing DBS operators at the expense of new 17/24 GHz BSS applicants by granting superior negotiating power to DBS operators. Mandating coordination at the cluster edges would provide DBS operators a great deal of power with respect to their competitors in the new service. Further, it might undermine trust in the coordination process we adopt here because of a concern that U.S. DBS operators would have the power to effectively choose the 17/24 GHz BSS operators (including themselves) who could successfully pursue orbital locations near a U.S. DBS cluster edge.

15. The approach we adopt here is similar to the Commission's approach to address interference between DBS operations. The Commission allows DBS operators a wide degree of flexibility regarding the specific location of DBS space stations within a cluster, while providing other DBS operators located within the cluster protection from unacceptable interference.[55] In particular, in a 2002 Order, the Commission concluded that allowing DBS operators to coordinate the location of their satellites and use of their associated frequency assignments amongst themselves would result in maximum flexibility and efficient use of the orbit and spectrum resource.[56] Similarly, the off-axis coordination trigger adopted here will afford both services the desired flexibility regarding specific location of their satellites, while precluding unacceptable interference into nearby DBS systems.

16. Finally, while we do not adopt DIRECTV's proposal to determine coordination requirements relative to the DBS cluster edges, we adopt a minimum 0.2º orbital separation requirement between 17/24 GHz and DBS space stations to ensure that the pfd coordination trigger and accompanying transmitting antenna off-axis information requirements we adopt herein remain valid over the specified angular ranges.[57] We believe that this minimum orbital separation may address some of DIRECTV's concerns.

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Rules protect "first-in" operations from harmful interference caused by subsequently deployed operations"); *PanAmSat Licensee Corp.*, 20 FCC Rcd 14642, 14647, n.23 (2005); and 47 C.F.R §§ 2.104(d) and 2.105(c).

[53] In this regard, we note that to the extent an operator has planned to launch a DBS space station but fails to file its application until months before launch, it does so at its own risk.

[54] *Order and FNPRM*, 22 FCC Rcd at 8853-54, ¶¶ 24-25.

[55] Policies and Rules for the Direct Broadcast Satellite Service, *Report and Order*, IB Docket No. 98-21, 17 FCC Rcd 11331, 11386-87, ¶¶ 118-119 (2002).

[56] *Id.* at 11386-87, ¶ 119.

[57] *See infra* ¶¶ 20-31.

B. Direct Broadcast Satellite Service Telecommand Transmissions

17. The *FNPRM* recognized the possibility that space path interference into the telecommand links of DBS networks, particularly in instances when the DBS space station and 17/24 GHz BSS satellite are located in close proximity, could result in a loss of control of a DBS space station.[58] To prevent this from occurring, the Commission proposed to adopt a requirement that applicants make a technical showing demonstrating that adequate margin will be maintained in the DBS telecommand links when a 17/24 GHz BSS space station and DBS space station would be operating in close proximity.[59] The Commission sought comment on these proposals, asking under what circumstances such a technical showing should be required, *e.g.*, co-location at less than some minimum distance, or on the basis of a threshold pfd value. In addition, the *FNPRM* sought comment on whether the off-axis pfd coordination trigger was also a suitable coordination trigger for DBS telecommand links, or whether some minimum frequency separation should be required between the signals transmitted by a 17/24 GHz BSS space station and the telecommand frequencies of DBS space stations.[60]

18. No commenter addressed the Commission's proposed technical showings, or more specifically, addressed under what conditions such showings should be required. Commenters have however, expressed general support for the pfd coordination trigger as an effective mechanism for protecting DBS telecommand links.[61]

19. As discussed above, we have adopted EchoStar's suggestion that the bandwidth of the off-axis pfd coordination trigger should be reduced, and the pfd value scaled accordingly, so that it applies equally to feeder links and telecommand links.[62] We believe that the pfd coordination trigger value that we are adopting here, in combination with the narrower measurement bandwidth of 100 kHz, provide sufficient protection to DBS telecommand links. The associated information showings and the requirement to coordinate in cases where the pfd of the 17/24 GHz BSS downlink signal at the adjacent DBS space station is in excess of the coordination trigger level will afford the DBS operator sufficient opportunity for detailed examination of the effect of the 17/24 GHz BSS downlink transmissions on its telecommand links, and a mechanism to remedy the situation if it is deemed necessary. Accordingly, we do not adopt a technical showing specific to DBS telecommand links but instead rely upon the off-axis pfd coordination trigger adopted above.

C. Required Angular Ranges for Antenna Off-Axis Gain Data

20. *Proposal and Comments*. Implementation of an effective coordination process based on an off-axis pfd coordination trigger requires the establishment of an accurate antenna off-axis e.i.r.p. from the transmitting 17/24 GHz BSS satellite toward the DBS satellite. To this end, commenters are generally in agreement regarding the need for 17/24 GHz BSS applicants to provide transmitting antenna off-axis

[58] *Order and FNPRM*, 22 FCC Rcd at 8917, ¶ 187.

[59] *Id*. The requirement to make such a showing would have been placed either upon the 17/24 GHz BSS applicant seeking to locate near an existing DBS space station, or upon the DBS applicant seeking to locate near an existing 17/24 GHz BSS space station, depending on which application was filed first.

[60] *Id*.

[61] EchoStar recommends scaling the proposed pfd coordination trigger value over a narrower bandwidth to protect DBS telecommand links. *See supra* ¶ 8; EchoStar Comments at 4, n.5. DIRECTV believes that combining a pfd coordination trigger measured at the cluster edge with a requirement to coordinate with all DBS operators within the cluster should also be sufficient to protect DBS TT&C operations. DIRECTV Comments at 6, n.11.

[62] EchoStar Comments at 4, n.5. *See supra* ¶ 8.

gain information.[63] To implement this approach, we must specify the information to be provided, identify which applicants should be required to submit data, and determine at what point in the licensing process the data should be submitted. Only two commenters provided proposals regarding the nature, applicability, and timing of transmitting antenna off-axis gain information requirements.[64]

21. The *FNPRM* sought comment on the transmitting antenna off-axis gain characteristics that 17/24 GHz BSS applicants should be required to submit to the Commission, and in particular over what angular ranges such information should be provided.[65] DIRECTV proposes that transmitting antenna off-axis performance specifications should be provided for both polarizations in the X-Z plane[66] over a range of ±30º from the X axis, as well as in planes rotated around the Z axis at ±10º and ±20º intervals.[67] DIRECTV claims that this range of information should support potential interference analyses over a wide variety of operational scenarios. DIRECTV believes that this measurement range will also take into account instances where a space station that was designed to operate at one location might later be moved to another location, and as a consequence might be biased[68] in either the east/west or the north/south directions.[69]

22. EchoStar agrees that DIRECTV's proposals capture the most pertinent data range lying in the general direction of other satellites in the geostationary orbit (GSO), but believes that the measurement ranges should be expanded to fully account for worst-case operational scenarios and all potential geometric configurations, including those where satellites are closely spaced.[70] Specifically, EchoStar believes that measurements in the X-Z plane should be extended all the way to the Z axis in the direction of the center of the Earth.[71] Thus, data measurements would be made over a range of ±120° in the X-Z plane with respect to the +Z axis.[72] EchoStar contends that this additional measured data would provide a fuller picture of the antenna's gain distribution, and would not be overly burdensome because satellite operators are likely to evaluate the antenna's performance in this range anyway. EchoStar believes that the antenna gain data in the X-Z plane should be measured in 5º rather than 10º increments.[73]

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[63] DIRECTV Comments at 6; EchoStar Comments at 3-4; SES Americom Comments at 12; Telesat Reply Comments at 4.

[64] EchoStar Reply Comments at 2, n.2; EchoStar Ex Parte filing of October 7, 2008 at 1-4; DIRECTV Ex Parte filing of June 16, 2008 at 2-3.

[65] *Order and FNPRM*, 22 FCC Rcd at 8916, ¶ 185.

[66] DIRECTV defines a Cartesian coordinate system in which the X axis is tangent to the geostationary arc with the positive direction pointing east, *i.e*., in the direction of travel of the satellite, the Y axis is parallel to a line passing through the geographic north and south poles of the Earth, with the positive direction pointing south, and the positive Z axis points toward the center of the Earth. DIRECTV Ex Parte filing of June 16, 2008 at 1-2. We will use this same reference coordinate system throughout this discussion.

[67] *Id.* at 2-3.

[68] Satellite bias refers to the orientation of a satellite in 3-dimensional Euclidean space. In a typical XYZ reference coordinate system, satellite bias can be described by the angle(s) of rotation of the body of the spacecraft about any of these three axes. Satellite bias typically determines the direction the satellite's instruments face.

[69] DIRECTV Ex Parte filing of June 16, 2008 at 2-3.

[70] EchoStar Ex Parte filing of October 7, 2008 at 3-4.

[71] *Id*. at 3-4.

[72] *Id*. at 3.

[73] *Id*.

EchoStar argues that this more granular measurement is necessary given the potential gain variation within a 10º span, and that it will provide more certainty to DBS and 17/24 GHz BSS providers without materially affecting the cost or complexity of antenna testing.[74] Like DIRECTV, EchoStar advocates that antenna gain data should be provided not only in the equatorial plane but also in planes rotated from the equatorial plane around the Z axis. EchoStar would also expand this range to include measurements in 10º increments up to ±60° relative to the equatorial plane.[75]

23. *Discussion*. In addressing the question of transmitting antenna off-axis gain information, we note that DIRECTV's proposal considers only the case of adjacent satellites that follow perfectly circular orbits within the same orbital plane, or space stations that may have been biased as a result of a location change away from the position for which the satellite was originally designed. It does not consider variations in a satellite's relative position that might arise from orbital inclination or eccentricity. Moreover, DIRECTV has not addressed the question of how variations in the antenna gain pattern could result from the interaction of the electromagnetic field radiated by the antenna with the spacecraft bus and other structures on the spacecraft once the antenna is mounted. EchoStar proposes a more extensive measurement range than DIRECTV does, and claims to take into account "all potential geometric cases," but does not make clear what geometric cases it does consider. EchoStar, however, does not claim to have taken satellite bias into account.

24. Small variations in satellite orbital eccentricity and inclination[76] can produce significant variation in the geometry occurring between two adjacent spacecraft, particularly as the separation between those spacecraft decreases. To illustrate this more clearly, Appendix E[77] presents the results of a basic geometric analysis that examines the range of off-axis angles occurring between two adjacent satellites as a result of variations in orbital eccentricity and orbital inclination. As the parametric curves demonstrate, two spacecraft with a difference of 40 km in their orbital apogee and perigee[78] values that are separated by 0.1° in longitude will experience an angular offset between the two spacecraft in the X-Z plane of about 30°. Similarly, for two spacecraft at a longitudinal separation of 0.1°, each with an inclined orbit at 0.05° above and below the X-Z plane respectively, the resulting offset in the X-Y plane is on the order of 45°. Among other things, the analyses demonstrate that inter-spacecraft geometry is generally more sensitive to variations in orbital inclination than to variations in eccentricity, when typical values for these parameters are taken into account.

25. A review of the orbital parameters of operating DBS space stations reveals that the

[74] *Id.* at 3-4, and n.10. Based on its consultation with antenna designers, EchoStar has revised its earlier proposal for a 10º measurement increment. EchoStar Reply Comments at 2, n.2.

[75] EchoStar Ex Parte filing of October 7, 2008 at 4.

[76] The eccentricity of a satellite orbit can be interpreted as the extent to which the orbit deviates from a perfect circle. It represents the ratio of the distance between the foci of the ellipse and the length of the orbit's major axis. The foci in highly eccentric orbits are spread farther apart than those of an orbit with a lower eccentricity. The value of eccentricity ranges from 0 (a perfect circle) and approaches a value of 1 as the ellipse becomes increasingly eccentric. The inclination of a satellite orbit describes the tilt of the orbital plane with respect to a reference plane. For Earth-orbiting satellites, this reference plane is typically equatorial plane of the Earth, and an orbit with an inclination angle of 0º lies in the same plane as the Equator.

[77] *See* Appendix E.

[78] Apogee is the point in the orbit of a satellite at which it is farthest from the Earth. Conversely, perigee is the point in the satellite's orbit at which it is nearest to the Earth.

largest orbital apogee-perigee variation is 26.3 km.[79] Thus, the measurement range of ±30º from the X axis in the X-Z plane proposed by DIRECTV should be sufficient to address cases where the 17/24 GHz BSS space station is operating with a non-biased configuration (*i.e*., lying in the X-Z plane and pointed toward the Earth along the Z axis) and is separated in longitude from an adjacent DBS spacecraft by as little as 0.1º.[80]

26. Similarly, a review of DBS orbital parameters indicates that most currently operating DBS satellites are stationkept in the north/south direction to within 0.075º of the equatorial plane.[81] A similar north-south stationkeeping tolerance for a nearby 17/24 GHz BSS space station will yield a worst-case total inclination separation of 0.15º between the two space stations.[82] If we were to adopt a ±20º range for measurements in planes rotated about the Z axis, as proposed by DIRECTV, the submitted transmitting antenna off-axis gain data would cover cases in which DBS and 17/24 GHz BSS spacecraft could be located as close as 0.45º in longitude along the GSO arc.[83] Allowing for a worst-case inclination separation of 0.15º between the two space stations, a ±60º angular range of measurements made in planes rotated about the Z axis, as proposed by EchoStar, would cover space station longitudinal separations as closely spaced as 0.1º.[84]

27. In specifying the angular ranges over which transmitting antenna off-axis gain data must be provided, we attempt to strike a balance among competing, but inter-related factors. Specifically, we seek to provide operators with the flexibility to locate at small orbital separations while adopting data submission requirements that are within ranges considered to be reasonable by commenters. Simultaneously, we seek to provide sufficient flexibility to accommodate typical operating variations in orbital inclination and eccentricity.[85] Thus, we believe that transmitting antenna off-axis gain measurements made over a range of ±30º from the X axis in the X-Z plane, and over a range of ±60º in planes rotated about the Z axis, should permit accurate off-axis pfd information to be calculated for 17/24 GHz BSS space stations separated in longitude by as little as 0.1º from DBS space stations.[86] EchoStar

[79] A review from 2010 shows that the largest variation was exhibited by the DIRECTV 5 satellite with an orbital apogee of 35,806.7 km and an orbital perigee of 35,780.4 km. *See* http://www.n2yo.com/satellite/?s=25331 (visited December 14, 2010). This assessment did not take into account space stations operating with highly inclined orbits, for which it was presumed that stationkeeping maneuvers had been relaxed.

[80] Although even smaller orbital separations might be considered, the associated angular measurement range rapidly becomes impracticably large.

[81] http://www.n2yo.com/ and http://www.lyngsat.com/america.html (visited December 14, 2010). We have not considered those few satellites currently operating in highly-inclined orbits.

[82] Worst-case inclination separation between two adjacent spacecraft will occur when one space station is at the peak of its inclination excursion above the equatorial plane, and the other is at the corresponding peak below the equatorial plane.

[83] An orbital separation of 0.45º and a worst-case inclination separation of 0.15º results in an 18.4º angle between the two spacecraft in the X-Y plane. If an east/west stationkeeping tolerance of ±0.05º for each spacecraft is taken into account, the permissible separation becomes 0.55º.

[84] An orbital separation of 0.1º and a worst-case inclination separation of 0.15º results in a 56.3º angle between the two spacecraft in the X-Y plane. If an east/west stationkeeping tolerance of ±0.05º for each spacecraft is taken into account, the permissible separation becomes 0.2º.

[85] *See infra* Sections D and E within this item for a discussion of the constraints placed upon orbital separation, eccentricity, and inclination that are necessary to ensure that the angular ranges over which off-axis antenna gain data must be provided are meaningful.

[86] If an east/west stationkeeping tolerance of ±0.05º for each spacecraft is taken into account, the permissible assigned separation becomes 0.2º.

has advocated extending the measurement range to include a full ±120º in the X-Z plane. We do not believe, however, that the rationale offered by EchoStar justifies adopting a requirement for such a large quantity of measured data. We do, however, concur with EchoStar's assertion that the antenna gain data in the X-Z plane should be measured in 5º rather than 10º increments in light of the potential gain variation within a 10º span. Accordingly, we will require 17/24 GHz BSS applicants to submit transmitting antenna off-axis gain information in both polarizations in the X-Z plane over an angular range of ±30º from the positive and the negative X axes, at 5º intervals, and through a range of ±60º in planes rotated from the X-Z plane about the Z axis at 10º intervals.[87]

28. We note that antenna off-axis gain is a frequency dependent parameter, and performance characteristics will not be identical when measured at different frequencies within the 17.3-17.8 GHz band. Although commenters were in general agreement regarding the need to provide transmitting antenna off-axis gain data within the 17.3-17.8 GHz band, no commenter provided input regarding the granularity of the frequency steps at which gain measurements should be made. In order to adequately characterize the off-axis gain performance of the 17 GHz transmitting antennas, but without unduly burdening the applicant, we will require that off-axis antenna gain measurements be made at a minimum of three frequencies. These frequencies should be determined with respect to the entire portion of the 17.3-17.8 GHz frequency band over which the space station is designed to transmit.[88] Accordingly, at a minimum, transmitting antenna off-axis gain measurements should be made at the following three frequencies: 5 MHz above the lower edge of the band; at the band center frequency; and 5 MHz below the upper edge of the band.

29. The transmitting antenna off-axis gain data submission requirements discussed above are suitable for a space station that is operating with a non-biased orientation. As DIRECTV correctly points out, however, a space station eventually may be operated at a location different from the one where it was originally designed to operate. As a consequence, it may be rotated relative to the reference coordinate system in order to achieve the desired service area coverage.[89] DIRECTV suggests that the interference analysis for such scenarios could be best accomplished if the information requirements we adopt take such an eventuality into account, and recommends that sufficient data be provided by the applicant to permit evaluation of potential interference in such instances. Specifically, DIRECTV suggests that applicants should provide sufficient data to allow for interference analysis when the satellite is biased up to ±30º in the X-Z plane, and up to ±20º in planes rotated about the Z axis.[90]

30. We agree with DIRECTV that satellite bias must be taken into account in antenna off-axis performance information. We find, however, that the range of bias proposed by DIRECTV is overly large.[91] Rather than presume a likely maximum bias and encumber all 17/24 GHz BSS applicants with information submission requirements intended to address this possible situation, we believe that a more

[87] These measurements should be symmetrical with respect to the origin, *i.e.*, including values along both the positive and negative X axis.

[88] Not all space stations may be designed to transmit over the entire 17.3-17.8 GHz band, particularly if international service is not contemplated. Conversely, some space stations may be designed to operate over a bandwidth greater than that for which they are licensed, for example, if spectrum-sharing conditions are included in the license.

[89] DIRECTV Ex Parte filing of June 16, 2008 at 2-3. This bias can occur following space station relocation as DIRECTV suggests, or upon initial commencement of operations, as might happen when a spacecraft initially designed for one location is instead launched into another.

[90] *Id.* These values do not take into account variations in orbit due to eccentricity or inclination.

[91] As viewed from geostationary orbit altitude, the visible Earth subtends an angle of only approximately 17.2º.

reasonable approach is to require the applicant to take into account any anticipated satellite bias. Thus, we will require that 17/24 GHz BSS applicants submit transmitting antenna off-axis performance information to cover the specified angular measurement ranges that will account for planned bias relative to the reference coordinate system. Therefore, depending upon the direction and magnitude of the planned bias, the applicant must determine whether measurements must be taken over a greater angular range – when compared with the angular range over which measurement is required for a space station operating with zero bias – to accommodate any change of operating orientation. The applicant must submit its antenna performance measurements over this expanded angular range, and must explain its rationale for doing so, and indicate the planned spacecraft orientation bias in its application.[92]

31. In addition, a 17/24 GHz BSS operator seeking to relocate a space station must include in its relocation application a discussion of any planned spacecraft orientation bias and, if necessary, submit additional transmitting antenna off-axis gain information to take into account such biased orientation. We note that if an operator is unable to provide this additional data, the Commission may be prevented from taking a favorable action on the operator's proposed modification. Thus, we caution 17/24 GHz BSS applicants that it is their responsibility to anticipate the possibility of future changes in operating orientation. Thus, while initial antenna performance information may be required over a particular angular range, applicants might consider measuring the antenna performance over a larger range, so that the antenna off-axis performance information will be available in the event the operator seeks a change in operating orientation at some point in the future.

D. Minimum Orbital Separation Requirement of 0.2º Adopted

32. *Proposal and Comments*. The *FNPRM* noted proposals by some commenters to adopt a minimum orbital separation requirement between 17/24 GHz BSS and DBS space stations in the event of co-frequency operations. The Commission sought comment on this approach, questioning whether such a requirement was necessary, and asking what minimum orbital separation might be appropriate should we decide to adopt such a rule.[93]

33. Commenters express differing opinions regarding the need to impose a minimum orbital separation distance between 17/24 GHz BSS and DBS space stations. DIRECTV urges the Commission to take a cautious approach in establishing rules for near-collocation of DBS and 17/24 GHz BSS satellites, citing the lack of off-axis performance information for current DBS satellite receive antennas as well as the lack of knowledge and experience regarding in-orbit interactions between such operating space stations.[94] Specifically, DIRECTV proposes that the Commission adopt a minimum required orbital separation of 0.4º between a 17/24 GHz BSS and an operating DBS space station.[95] DIRECTV concedes, however, that there may be cases where coordination can be achieved with closer spacing.[96]

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[92] This requirement addresses on-station biased operations. Space station bias associated with in-orbit testing should be addressed separately.

[93] *Order and FNPRM,* 22 FCC Rcd at 8917, ¶ 187.

[94] DIRECTV Comments at 3.

[95] DIRECTV Reply Comments at 2-3. If the Commission were also to adopt DIRECTV's recommended protection of the DBS cluster concept, this separation distance would increase to 0.6º. DIRECTV also supports adoption of a requirement that 17/24 GHz BSS operators cease operations immediately upon notification of interference into DBS systems.

[96] *Id.* at 3. In the case of the Region 2 BSS Plan locations, DIRECTV asserts that this 0.4º separation should be measured from the nearest edge of the cluster in order to maintain flexibility for future DBS operators to locate their (continued…)

DIRECTV bases its proposal primarily on an ITU-R recommendation that presents a parametric analysis of two general cases where coordination might be required between DBS networks and 17/24 GHz BSS networks operating in the 17.3-17.8 GHz band.[97]

34. SES Americom considers either a pfd coordination trigger or a minimum orbital separation requirement to be an acceptable regulatory approach.[98] SES Americom believes, however, that the 0.4º minimum separation that DIRECTV proposes is too conservative and reflects unrealistic assumptions.[99] SES Americom believes that a separation of 0.2º-0.3º is sufficient to provide protection from space path interference into DBS operations, although it offers no detailed supporting technical analysis.[100]

35. Both EchoStar and Telesat oppose a minimum orbital separation requirement.[101] Telesat notes that the ITU recommendation itself does not advocate a minimum orbital separation. Telesat asserts that establishing any separation value that does not reflect the true coordination situation between two satellite networks would be overly restrictive and rigid.[102] EchoStar argues that commenters' varying responses on the issue of minimum orbital separation reflect differences in underlying assumptions regarding satellite design and operation. Accordingly, EchoStar claims that an analysis based solely on a fixed separation distance can be both over-inclusive and under-inclusive, and believes that operators should be afforded maximum flexibility.[103] EchoStar specifically opposes DIRECTV's 0.4º proposed minimum orbital separation value. EchoStar argues that this value was derived by assuming the worst-case combination of parameter values contained in the ITU-R recommendation, and the recommendation demonstrates that even this most conservative case is still adequately protected by the off-axis pfd coordination trigger.[104]

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satellites anywhere within ±0.2º of the nominal location. Thus, the total separation between 17/24 GHz BSS and DBS satellites at certain locations could be as high as 0.6º. DIRECTV Comments at 4-5; DIRECTV Reply Comments at 2-3.

[97] ITU, *Sharing between broadcasting-satellite service (BSS) networks using the Region 2 17.3-17.8 GHz BSS allocation and feeder links of BSS networks using the worldwide 17.3-17.8 GHz fixed-satellite service (FSS) (Earth-to-space) allocation*, Recommendation ITU-R BO.1835 (2008) ("Recommendation ITU-R BO.1835") (Considering four key operating parameter variables: (1) DBS receiving system noise temperature; (2) interfering satellite peak e.i.r.p.; (3) transmitting off-axis antenna gain of the interfering satellite; and (4) victim satellite antenna gain in the direction of the interferer. For the adjacent-satellite case, DIRECTV selects the worst-case assumptions corresponding to a minimum separation distance of 0.3º. To that value, DIRECTV then adds an additional 0.1º to account for stationkeeping. As a result, DIRECTV concludes that 0.4º is an appropriate minimum separation distance.

[98] SES Americom Comments at 11-12; SES Americom Reply Comments at 7.

[99] SES Americom Reply Comments at 7 (disputing the worst-case peak e.i.r.p. assumption of 65 dBW, which it points out exceeds the limits adopted in the *Order and FNPRM*).

[100] *Id.*

[101] Telesat Reply Comments at 2; EchoStar Reply Comments at 2-4.

[102] Telesat Reply Comments at 2.

[103] EchoStar Comments at 3.

[104] The specific scenario considered a DBS receiving system noise temperature of 27.8 dBK (600 K), an interfering satellite peak e.i.r.p. of 65 dBW, 40 dB transmitting off-axis gain of the interfering satellite and 0.0 dBi victim satellite gain in the direction of the interferer. These values yielded a minimum separation value of 0.3º. EchoStar Reply Comments at 4; Recommendation ITU-R BO.1835, Annex 1, Table 3, Case 9.

36. *Discussion*. During the course of this proceeding, many commenters have presented arguments and supporting analyses for various minimum orbital separation values. These commenters have relied on varying assumptions with regard to specific design and operating parameters of the DBS and 17/24 GHz BSS space stations. Most recently, DIRECTV has referred to an ITU-R recommendation that demonstrates that given the variations in operational parameters of the two types of networks, the necessary minimum orbital separation required to achieve a 6% increase in $\Delta T/T$[105] can be as small as 0.02º or as large as 0.3º.[106] In the nascent 17/24 GHz BSS, however, "typical" operating parameters that might be used to better limit such an analysis are not yet well established. Thus, we do not believe that a requirement based solely on orbital separation will adequately provide an accurate measure of space path interference or prove to be a reliable regulatory tool on its own.

37. While we do not believe that a minimum orbital separation requirement alone will constitute an effective interference mitigation tool, we recognize that *some* longitudinal separation is necessary to effectively administer our off-axis pfd coordination trigger. However, we reject DIRECTV's proposed orbital separation of 0.4º. As EchoStar points out, our pfd coordination trigger was derived using virtually the same worst-case parameter values used in determining DIRECTV's proposed separation value of 0.4º.[107] Further, both DIRECTV's methodology and the one we adopt here today are based on the ITU-R interference criterion of a 6% increase in $\Delta T/T$.[108] Thus, we believe that the pfd coordination trigger achieves the same result while best preserving sufficient flexibility for satellite operators in both services. We note too, that although a conservative minimum orbital separation requirement may initially restrict the choice of orbital locations for new 17/24 GHz BSS space stations, in the future it may equally restrict the choice of locations for new or replacement DBS space stations seeking to locate near established 17/24 GHz BSS space stations. Accordingly, we believe that the shortcomings of adopting a 0.4º minimum orbital separation outweigh its advantages.

38. As discussed above, small variations in satellite orbital eccentricity and inclination can produce significant variation in the geometry occurring between two adjacent spacecraft, particularly as the separation between those spacecraft decreases. The off-axis pfd coordination trigger and consequent transmitting antenna off-axis performance submission requirements are based on analyses that sought to accommodate typical operating variations in orbital inclination and eccentricity, while simultaneously permitting close orbital separation, and while maintaining information measurement requirements within ranges asserted to be reasonable by the commenters. Our analysis determined that these conditions could best be met with a minimum longitudinal separation of 0.1º between the DBS and 17/24 GHz BSS spacecraft.[109] In the event of smaller longitudinal separations, critical assumptions regarding the value

[105] The ITU uses a single-entry criterion of $\Delta T/T = 6\%$ to establish a threshold level for coordination. The apparent increase in the equivalent satellite link noise temperature (ΔT) caused by the interfering emission is calculated. The ratio of this increase to the equivalent satellite link noise temperature (T) is compared with the threshold value of 6%. ITU Radio Regulations, Appendix 8, § 2.

[106] DIRECTV Comments, Appendix 1, Tables 1-3. As DIRECTV notes, if ± 0.05º stationkeeping allowance is included in the assessment, the separation distances range between 0.12º and 0.4º.

[107] Both analyses consider a victim satellite system noise temperature of 600K, a victim satellite receive gain toward the interferer of 0 dBi, and a peak transmitting e.i.r.p. of 65 dBW. Only the assumptions for the transmitting off-axis discrimination of the interfering satellite differ slightly at 40 dB in the ITU-R worst-case and 50 dB in the pfd derivation.

[108] EchoStar Reply Comments at 4; Erratum to EchoStar Comments, Annex A, at 30, filed Oct. 19, 2006.

[109] *See supra* ¶ 25. At this orbital separation, we determined that an orbital inclination of 0.75º and an orbital apogee/perigee variation of 40 km could be accommodated, while requiring antenna off-axis gain measurements over a range of ±30º from the X axis in the X-Z plane, and over a range of ±60º in planes rotated about the Z axis.

chosen for the coordination trigger and the ranges of transmitting antenna off-axis gain information would no longer be valid. Accordingly, to maintain a longitudinal separation of 0.1º between DBS and 17/24 GHz BSS space stations at all times, and taking into account the east/west stationkeeping tolerance of 0.05°,[110] we will require a minimum orbital separation of 0.2º between the assigned locations of 17/24 GHz BSS and DBS space stations, absent an explicit agreement between the two licensees to permit closer operations.[111] We believe this requirement best protects existing DBS networks, while promoting orbital efficiency and affording 17/24 GHz BSS operators sufficient flexibility to develop efficient and viable systems.

E. Bounds on Orbital Inclination and Eccentricity

39. The range of transmitting antenna off-axis gain measurement defined above assumes that the orbits of the DBS and 17/24 GHz BSS space stations do not exceed certain worst-case values of orbital eccentricity or orbital inclination.[112] To ensure that the geometric assumptions underlying our antenna off-axis angular measurement requirements are valid, some bound must be placed on the orbital eccentricity and orbital inclination of both 17/24 GHz BSS and DBS space stations. Of these two parameters, the geometry between the two spacecraft is most affected by variations in orbital inclination. The Commission's rules do not explicitly specify a stationkeeping limit in the north/south direction.[113] Rather, our rules permit satellite operators to cease north/south stationkeeping maneuvers for the satellite as long as such operations do not increase interference.[114] Specifically, our rules require that while a satellite is in inclined orbit, operators must maintain the interference levels experienced by adjacent satellites at levels that do not exceed those that would be caused by the satellite operating without an orbital inclination.[115] At present, our rules also preclude licensees operating in inclined orbit from claiming protection from interference in excess of that which they would receive in the absence of inclined operations.[116]

40. We anticipate that most DBS and 17/24 GHz BSS satellites will typically operate with orbits that are not highly inclined, in large part to avoid the need for satellite-tracking earth stations.[117] In

[110] 47 C.F.R. § 25.210(j) (requiring that space stations in the GSO be maintained within of 0.05º of their assigned orbital longitude in the east/west direction). To prevent the two spacecraft from ever coming closer than 0.1º, an additional 0.1º (*i.e.,* 0.05º+0.05º) must be included in the separation requirement. We note that if we do not allow for stationkeeping tolerance, it is possible that the stationkeeping boxes of the two satellites might overlap. This could result in one space station periodically crossing in front of, or behind, the other, resulting in the DBS space station passing directly through the 17/24 GHz BSS transmitting beam.

[111] The Commission recognizes that in some instances DBS operators might accept smaller separation distances between their space stations and those operating in 17/24 GHz BSS. For example, the DBS operator might be willing to tolerate increased levels of interference, or to modify its own operations to accommodate closer spacing. We anticipate that such agreements between operators may be particularly likely in cases where the DBS and 17/24 GHz BSS space station are licensed to the same entity, although they are in no way limited to such cases.

[112] Specifically, they presume that the variation in apogee and perigee values between the two satellites do not exceed 40 km, and that the combined angular separation in the two orbits due to inclination variation is not greater that 0.15º.

[113] 47 C.F.R. § 25.210(j).

[114] 47 C.F.R. § 25.280(a).

[115] 47 C.F.R. § 25.280(b)(2).

[116] 47 C.F.R. § 25.280(b)(3).

[117] We envision that 17/24 GHz BSS satellites will frequently be used to provide services to consumers via a consumer antenna. Such consumer antennas are not capable of tracking satellites.

the reverse-band sharing environment, however, where space path interference occurring between two networks can be significantly influenced by relatively small variations in orbital inclination, we believe that more specificity regarding angular inclination is required. To ensure that the 17/24 GHz BSS space station remains within the range of locations relative to the DBS space station that is assumed by our angular measurement requirements, a maximum permissible orbital inclination must be established. Accordingly, we will require that operating 17/24 GHz BSS space stations be maintained in orbits that do not exceed 0.075º of inclination.[118] Similarly, we will protect DBS networks from space path interference from nearby 17/24 GHz BSS networks only to the extent that the DBS space station is maintained in an orbit with an inclination less than 0.075º.

41. The 30º angular off-axis gain information in the X-Z plane assumes that at a longitudinal separation of 0.1º there will be no more than 40 km difference in the apogee and perigee values of the two adjacent spacecraft.[119] Presuming that this difference can be equally distributed between the DBS and 17/24 GHz BSS space stations, we will require that 17/24 GHz BSS space stations be maintained in orbits whose orbital altitude does not exceed 35,806 km or fall below 35,766 km above the Earth's surface when transmitting 17/24 GHz BSS service-link signals.[120] Similarly, we will protect DBS networks operating in the geostationary orbit from space path interference from nearby 17/24 GHz BSS networks only to the extent that the DBS space station orbit is maintained within these same maximum and minimum altitude values. While our rules permit DBS operators to operate in orbits with higher inclination or eccentricity values, it is the responsibility of the DBS operator exceeding these inclination or eccentricity values to assess the potential for interference from nearby 17/24 GHz BSS systems, and to accept any such additional interference arising as a result of its inclined or eccentric operations.[121] To best facilitate the calculation of potential off-axis interference between 17/24 GHz BSS and DBS space stations, in addition to the east/west and north/south stationkeeping information already required, we will require applicants in both services to provide predicted maximum orbital eccentricity values with their applications. We adopt these limits on orbital eccentricity and orbital inclination as a logical outgrowth[122] to the off-axis pfd

[118] In some instances more highly inclined orbits may be preferred during end-of-life operations. Waivers of the 0.075º inclination requirement sought by 17/24 GHz BSS licensees at this operational stage will be considered on a case-by-case basis. Grant will depend, among other factors, upon the degree of inclination and the longitudinal separation from adjacent DBS space stations.

[119] *See* Appendix E. Two spacecraft that are separated by 0.1° in longitude, with a difference of 40 km in their orbital apogee and perigee values, will experience an angular offset between the two spacecraft in the X-Z plane of 28.5°.

[120] These maximum and minimum values for orbital altitude correspond to an orbital eccentricity of value of 4.7×10^{-4}.

[121] The two line element data for eleven U.S.-licensed DBS satellites currently providing service to the United States were examined. Of these, none was operating with orbital eccentricities greater than the proposed 0.00047. Most space stations were operating with inclination angles less than 0.05º, although three space stations slightly exceeded this value with orbital inclinations of 0.0520º, 0.0534º, and 0.0586º. *See* http://www.space-track.org (visited May 11, 2010). The operational parameters explored (regarding basic orbital variations) will not have changed greatly in less than a year.

[122] *See, e.g.*, *Public Service Commission of the District of Columbia v. FCC*, 906 F2d 713, 717 (D.C. Cir. 1990) (stating that "it is well established that the exact result reached after a notice and comment rulemaking need not be set out in the initial notice for the notice to be sufficient. Rather, the final rule must be 'a logical outgrowth' of the rule proposed"). As explained above, a bound must be placed on the orbital eccentricity and orbital inclination in order to ensure that the geometric assumptions underlying our antenna off-axis angular measurement requirements are valid. Thus, this aspect of implementing an off-axis pfd coordination trigger should have been reasonably contemplated by parties to the proceeding.

coordination trigger and the transmitting antenna off-axis gain information requirements adopted in this order.

F. Two-Part Submission Process for Antenna Off-Axis Gain Data

42. *Proposal and Comments*. The *FNPRM* sought comment on the specific information that 17/24 GHz BSS applicants should be required to submit to the Commission to ensure that sufficient data is available to evaluate whether DBS systems are adequately protected from unacceptable levels of interference, and asked what form this information should take.[123]

43. Recognizing that analytical modeling or measurement of the antenna subsystem does not typically occur until some time after the satellite construction contract is awarded, commenters suggest that the transmitting antenna off-axis gain information be provided as part of a two-stage process. DIRECTV contends that although design specifications should be available at an early stage, actual modeled or measured data will likely not be available until approximately 9 to 12 months prior to launch.[124] Thus, DIRECTV recommends that at the application stage, applicants make a preliminary interference assessment of their transmitting antennas based on design specifications in the application. This preliminary assessment would be confirmed by the submission of measured or modeled data approximately 9 to 12 months prior to launch.[125] DIRECTV further argues that all 17/24 GHz BSS applicants should be required to submit transmitting antenna off-axis performance data whether or not they propose to locate in the vicinity of a currently operating DBS space station, so that the information will be available for future contingencies. DIRECTV does suggest, however, that applicants proposing to locate more than 1.0º from an operational DBS cluster might be relieved of the obligation to submit an initial analysis at the application stage because interference is unlikely to be an issue for systems operating with such a sizeable spatial separation from an operational DBS cluster.[126] DIRECTV believes that ultimately all licensees must be required to submit modeled or measured data prior to launch.[127]

44. EchoStar also endorses a two-part submission procedure for transmitting antenna off-axis gain information.[128] Under EchoStar's proposed approach, 17/24 GHz BSS applicants would be required at the application stage, to submit specifications and associated analyses that demonstrate that the off-axis pfd coordination trigger will not be exceeded for existing DBS satellites. EchoStar concurs with DIRECTV that applicants seeking to operate more that 1.0º from an operational DBS cluster (*i.e.*, ±1.2º from the nominal location of the eight U.S. DBS orbital locations,[129] including tolerance for stationkeeping) should not be required to file such data with their applications. EchoStar believes this to be a "fair compromise" that balances the needs of the Commission and DBS operators for information, with the limited probability of interference in such instances.[130] EchoStar further proposes that the 17/24

[123] *Order and FNPRM,* 22 FCC Rcd at 8916, ¶ 185.

[124] DIRECTV Ex Parte filing of June 16, 2008 at 4.

[125] *Id.* at 3.

[126] *Id*.

[127] *Id.* at 4.

[128] EchoStar Ex Parte filing of October 7, 2008 at 2-3.

[129] *See supra* n.21 for a list of the eight locations.

[130] EchoStar Ex Parte Filing of October 7, 2008 at 2, n.4. EchoStar would still require these 17/24 GHz BSS applicants to submit actual measured data at a later date prior to launch of the satellite. We note that EchoStar had previously advocated measuring the pfd level at the victim satellite receiver, but now implies agreement with (continued…)

GHz BSS license be conditioned to require licensees to submit measured data demonstrating conformance with the off-axis pfd trigger not less than 9 months prior to launch.[131] EchoStar does not believe that submitting modeled data alone is sufficient, asserting that licensees could rely on the use of non-rigorous modeling techniques that could result in near-meaningless data, as contrasted with the more precise data obtainable through measurement.[132] If the measured data shows that the off-axis pfd coordination trigger is exceeded, EchoStar would require the 17/24 GHz BSS licensee to coordinate with impacted DBS operators before they are permitted to commence operations. EchoStar contends that requiring this information 9 months before launch should afford satellite operators sufficient time to provide antenna subsystem measurements, while still allowing affected DBS operators sufficient time to review the data and raise objections if necessary. EchoStar further argues that consistent with industry practice, and in order to ensure the most reliable measured data, operators should be required to test the antenna subsystem with additional simulated spacecraft equipment (*e.g.*, spacecraft side panels) in place.[133] Finally, EchoStar agrees with DIRECTV that all 17/24 GHz BSS licensees should provide this measured antenna off-axis gain data, even if the assigned orbital location is not in close proximity to a DBS orbital location.[134]

45. SES Americom disagrees that the Commission should require detailed off-axis gain information from all 17/24 GHz BSS applicants regardless of whether they seek to locate near an existing DBS space station.[135] SES Americom believes that the argument that antenna off-axis gain information should be available in the event of a later proposal to operate the 17/24 GHz BSS space station in close proximity to a DBS space station is insufficient justification for imposing this burden on all 17/24 GHz BSS applicants.[136] Instead, SES Americom believes the Commission should require applicants to file off-axis gain data only when the application involves a new or modified 17/24 GHz BSS space station that will be operated within close proximity to a DBS orbital position.[137]

46. *Discussion*. We concur with the majority of commenters that all 17/24 GHz BSS applicants should provide transmitting antenna off-axis gain information. We are not persuaded by SES Americom that this information is unnecessary.[138] Nor do we believe that it is sufficient to require transmitting antenna off-axis gain information only from those applicants proposing to locate near an operational DBS cluster. Clearly, in cases where the 17/24 GHz BSS operator seeks to operate near an established DBS satellite, the transmitting antenna off-axis gain information for the 17 GHz transmitting antenna needs to be available to determine whether the 17/24 GHz BSS network will cause harmful

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DIRECTV's proposal to make this measurement at the edge of the DBS cluster. *Id. See also* DIRECTV Comments at 4-5.

[131] EchoStar Ex Parte filing of October 7, 2008 at 2.

[132] *Id.* at 3, n.7.

[133] *Id.* at 3. EchoStar argues that these measurements should be made prior to attaching the antenna to the satellite bus, since acquisition of the required range and granulation of measurements would be nearly impossible once the satellite is fully assembled, and that the testing facilities for such measurements are not generally available today. *Id.* at 2-3, n.6.

[134] *Id.* at 2, n.4.

[135] SES Americom Reply Comments at 7.

[136] *Id*.

[137] *Id.* at 7-8. SES Americom is not specific regarding what distance might constitute sufficiently close proximity.

[138] Noting the regularity with which space stations in the FSS and DBS services seek to relocate, we believe that this will become common practice with 17/24 GHz BSS space stations as well.

interference into the existing DBS system. It also must be available for the benefit of DBS operators who may eventually seek to launch replacement satellites at that same location. As discussed earlier, however, orbital separation distance alone cannot reliably predict the potential for space path interference.[139] Absent additional information, we cannot determine how far apart two space stations must be in order to conclude that interference will not occur.

47. In addition, it is possible that future new entrants may seek to operate at locations that are not designated in the Region 2 BSS and Feeder Link Plans, but that are in the vicinity of established 17/24 GHz BSS space stations.[140] Thus, we believe that the off-axis gain information of the transmitting 17 GHz band antennas should be publicly available at all locations so that such future DBS operators can make the appropriate system design decisions necessary to avoid receiving harmful interference from an established 17/24 GHz BSS space station. For these same reasons, we are not persuaded by EchoStar's or DIRECTV's proposal to require antenna performance information at the application stage only from those operators seeking to locate within 1.0º of an operational DBS cluster. The time between filing an application and launch of the space station can span several years, during which time applicants seeking to operate at locations other than established U.S. DBS cluster locations would have no access to any type of 17/24 GHz BSS antenna performance information upon which to base their choice of orbital location and other system design decisions.[141] Moreover, although at present we have little empirical experience with predicting the off-axis gain performance characteristics of 17/24 GHz BSS space station transmitting antennas in the 17.3-17.8 GHz band, it is our expectation that as familiarity with such systems and the associated analysis increases, we may place more confidence in the predicted characteristics. Accordingly, it is conceivable that in the future, operators may come to rely with increased certainty upon the results of predicted information, thereby lessening the need to wait for measured data as confirmation.

48. We agree with the general two-part approach proposed by both EchoStar and DIRECTV, and believe that it best addresses the need to make some degree of information publicly available at the time of application, while simultaneously recognizing that the most accurate antenna characterization will not be available until space station construction is nearly complete. We also agree that measured antenna data should be submitted no later than 9 months prior to launch.[142] We believe that requiring measured data no later than 9 months prior to launch best balances the interests of all parties, by providing the Commission and potentially affected DBS operators sufficient time to review the information and to carry out any necessary coordination, while maximizing the time in which space station operator's have to design, construct and test the antennas. We recognize, however, that requiring licensees to submit measured data no later than 9 months prior to launch can create a situation in which the interference environment in the vicinity of the 17/24 GHz BSS space station will not be well characterized until the

[139] *See supra* ¶¶ 36-37.

[140] Such new entrants could include reduced spaced DBS systems or non-U.S. licensed DBS space stations granted access to the United States market.

[141] As a consequence, the DBS applicant could lack sufficient information for the link budget and interference analysis information required by the Commission's application process. 47 C.F.R. § 25.114(d)(4).

[142] Due to the nature of the satellite construction cycle and the limited number of opportunities for commercial space station launch in any given year, satellite operators are reasonably expected to know the approximate launch date (or "launch window") at least 9 months in advance. In many instances, an operator will launch its space station prior to the launch milestone date included on the face of the license. In those cases, the measured data should be filed no later than 9 months prior to the actual launch date.

antenna is built and operational – which could be several years after the predicted data is submitted.[143] This level of uncertainty is not acceptable for subsequent DBS applicants seeking to locate nearby, and is particularly problematic when the 17/24 GHz BSS station locates near or within an existing DBS cluster. Accordingly, we seek an approach that will best balance the needs of both services by providing a reasonable degree of certainty to the DBS operator with regard to interference levels, while simultaneously permitting the 17/24 GHz BSS operator the flexibility to design and build its antenna.

49. To achieve these goals, we adopt the following approach. We will require all 17/24 GHz BSS applicants to submit with their applications predicted transmitting antenna off-axis gain information over the angular ranges described above.[144] Applicants must provide pfd calculations that, on the basis of this predicted antenna gain data, (1) identify all prior-filed[145] DBS networks at whose location that the applicant's pfd level exceeds the coordination trigger of -117 dBW/m^2/100 kHz; and (2) demonstrate to what extent the coordination trigger value is exceeded. If the applicant exceeds the coordination trigger at any prior-filed DBS location, the applicant must also provide certification that all affected DBS operators acknowledge and do not object to the applicant's higher off-axis pfd levels. Although we will not require 17/24 GHz BSS applicants to submit the details of the analytical model used to generate the predicted antenna performance data, applicants should be prepared to provide this information upon our request.

50. Further, at least 9 months prior to launch, we will require the 17/24 GHz BSS licensee[146] to confirm the predicted data by submitting measured off-axis antenna gain information over the same angular ranges described above. Because the presence of the spacecraft body can significantly affect the off-axis antenna gain pattern, to the extent practical these measurements should be made under conditions as close to flight configuration as possible. This could be done with the antenna mounted on the spacecraft or may include the use of simulated spacecraft components. In addition, we require the licensee to: (1) demonstrate that the pfd level at any prior-filed DBS space station does not exceed the coordination trigger of -117 dBW/m^2/100 kHz; or (2) demonstrate to what extent the coordination trigger is exceeded at any DBS space station location. Where the pfd coordination trigger is exceeded, the licensee must provide a certification that all affected DBS operators acknowledge and do not object to the applicant's higher off-axis pfd levels.

51. We recognize that there is likely to be a number of years between the filing of the initial application containing the predicted off-axis antenna gain information and the filing of the measured data based upon testing of the actual antenna. This could lead to the situation in which a DBS applicant files an application after the 17/24 GHz BSS operator submits predicted data for its antenna, but before the 17/24 GHz BSS licensee submits the measured data. In such a case, the DBS applicant could choose an

[143] 47 C.F.R. § 25.164(a)(4) requires that the satellite be launched and operated within 5 years from the date the license was issued. Taking into account the time between filing the application and granting of the authorization, the time between submission of the predicted and measured data may approach or even exceed 5 years.

[144] *See supra* ¶¶ 20-31.

[145] In this context, we use the phrase "prior-filed DBS network" to mean any DBS application that was filed with the Commission (or authorization granted by the Commission) prior to the filing of an initial 17/24 GHz BSS application containing predicted antenna off-axis gain information. Prior-filed DBS networks may include foreign-licensed networks seeking authority to serve the United States market. The term does not refer to foreign-licensed DBS networks that have not filed applications for market access in the United States with the Commission.

[146] The Commission recognizes that parties may commence construction at their own risk pursuant to 47 C.F.R. § 25.113(f) of our rules. In such instances, if a space station authorization has not been granted 9 months prior to launch, the 17/24 GHz BSS applicant is equally subject to these measured information submission requirements and any associated coordination and operational requirements.

orbital location and system parameters for its DBS system that are optimized for an environment defined by the 17/24 GHz BSS antenna's predicted parameters, but not for its actual measured parameters. To provide some protection for DBS systems in these circumstances, we will also require that the 17/24 GHz BSS licensee provide its measured data and accompanying pfd calculations not only with respect to DBS satellites that were filed prior to the time it submitted its original application, but also with respect to any subsequently-filed DBS networks.[147]

52. In the event that the pfd level at any prior-filed or subsequently-filed DBS space station determined from the measured off-axis antenna gain information exceeds that determined from the earlier predicted data, the 17/24 GHz BSS licensee must modify its license (or amend its application, as appropriate) based upon this new information. Further, if the pfd level exceeds the coordination trigger value of -117 dBW/m^2/100 kHz at the antenna of any prior-filed DBS space station, the 17/24 GHz BSS licensee must either modify its operations or coordinate its operations with each affected prior-filed DBS licensee or applicant. In the event that coordination is not achieved with the prior-filed DBS space station operators, the 17/24 GHz BSS pfd levels must be reduced to conform to the coordination trigger value of -117 dBW/m^2/100 kHz at the DBS location. In the case of subsequently-filed DBS space stations, the 17/24 GHz BSS applicant/licensee must coordinate or modify its operations only if the pfd levels at the location of the subsequently-filed DBS space station calculated from the measured data, exceed *both* the trigger level of -117 dBW/m^2/100 kHz, *and* the pfd levels that can be calculated on the basis of the predicted off-axis antenna gain data. In such instances, the 17/24 GHz BSS operator must either modify its operations to conform to: (1) the -117 dBW/m^2/100 kHz coordination trigger level, or (2) the off-axis pfd level at the victim DBS space station that can be calculated on the basis of the predicted off-axis antenna gain data that were on file with the Commission at the time the DBS application was filed, whichever is greater.

53. Where measured pfd levels exceed those predicted, and the 17/24 GHz BSS licensee is required to coordinate its operations under the above mentioned circumstances, the 17/24 GHz BSS licensee must provide certification that all affected DBS licensees acknowledge and do not object to the higher off-axis pfd levels. If the 17/24 GHz BSS licensee cannot coordinate (or does not wish to coordinate) its operations with affected DBS systems, it must instead adjust its operating parameters (*e.g.*, power levels, orbital location) so that the required pfd level is not exceeded. We wish to make clear to 17/24 GHz BSS applicants and operators that they assume the risk that any required adjustments may affect the 17/24 GHz BSS system's technical and economic viability.

G. Procedures in the Event of Harmful Interference

54. *Proposal and Comments*. The pfd coordination trigger value we adopt today in Section A[148] was derived in part by assuming a relatively conservative value of 0 dBi for the off-axis receiving gain of the victim DBS space station antenna in the direction of the interfering 17/24 GHz BSS space station.[149] Nonetheless, both DIRECTV and EchoStar stress that the off-axis antenna discrimination[150]

[147] In this context, we use the phrase "subsequently-filed DBS network" to mean any DBS application filed with the Commission (or authorization granted by the Commission) between the filing of the predicted off-axis antenna gain information with an initial 17/24 GHz BSS application and the filing of the measured off-axis antenna gain information and pfd calculations. Subsequently-filed DBS networks may include foreign-licensed networks seeking authorization to serve the United States market. The term does not refer to foreign-licensed space stations that have not filed applications for market access in the United States with the Commission.

[148] *See supra* ¶¶ 7-16.

[149] EchoStar Comments, Appendix A to Technical Annex at 30 (as corrected by Erratum filed Oct. 19, 2006).

[150] Antenna discrimination is the differential gain compared to the maximum gain in a specified direction.

values of currently operating DBS space stations may not necessarily be well known.[151] Thus, as an additional safeguard to avoid disruption of service to DBS subscribers, both commenters propose that if harmful interference is caused in actual operations, the transmitting 17/24 GHz BSS satellite should be required to cease operations immediately.[152]

55. *Discussion*. The Commission's Part 25 rules currently include several requirements that address harmful interference events. Section 25.272 of our rules requires operators to make available points of contact for personnel that may be called upon to resolve interference events.[153] Section 25.273 requires all space station licensees to make available information necessary to avoid unacceptable interference events to other users,[154] and to maintain complete and accurate technical details of current and planned transmissions.[155] Space station licensees are also required to exchange general technical information concerning planned and current transmissions as necessary to "identify and promptly resolve any potential cases of unacceptable interference between their satellite systems."[156] In particular, section 25.273(a)(3) makes clear that no person shall "transmit in any manner that causes unacceptable interference to the authorized transmission of another licensee."[157]

56. Section 25.274 also outlines procedures to be followed in the event of harmful interference.[158] The rule states that upon becoming aware of the harmful interference, and after first ensuring that its own equipment, other earth stations within the satellite network, or terrestrial sources are not the source of the interference problem, the satellite system control center personnel must: observe the interference event(s); make reasonable efforts to determine the source; and maintain records that may be made available to the Commission upon request.[159] When the source of interference is identified as being from another satellite system, the satellite system operator must contact the offending earth station operator to advise them of the problem.[160] Most significantly, Section 25.274(e) makes clear that the earth station operator whose transmissions are suspected of causing the harmful interference must take reasonable measures to determine whether its operations are the source of the interference problem, and if identified as such, must take all measures necessary to resolve the interference.[161]

57. In limited instances, the Commission has adopted service-specific rules requiring licensees to terminate transmissions as a remedy for unwanted interference events, often as a contingency measure when coordination approaches are insufficient or incomplete.[162] For example, the Commission

[151] EchoStar Comments at 4; DIRECTV Reply Comments at 3.

[152] EchoStar Comments at 4; EchoStar Reply Comments at 2; DIRECTV Reply Comments at 3.

[153] 47 C.F.R. § 25.272(b)-(c).

[154] 47 C.F.R. § 25.273(b).

[155] 47 C.F.R. § 25.273(c).

[156] *Id*.

[157] 47 C.F.R. § 25.273(a)(3).

[158] 47 C.F.R. § 25.274.

[159] 47 C.F.R. § 25.274(c).

[160] 47 C.F.R. § 25.274(d).

[161] 47 C.F.R. § 25.274(e).

[162] For example, in the Ku-band and Ka-band NGSO FSS proceedings, the Commission anticipated the occurrence of in-line interference events, and adopted a default sharing mechanism that includes a requirement for cessation of transmissions by NGSO FSS system operators in a pre-determined portion of the frequency band for the duration of (continued…)

adopted rules for the operation of Earth Stations on Vessels (ESVs) that include a number of instances where cessation of transmissions may be required to prevent unwanted interference into either co-frequency terrestrial or FSS systems.[163] Where the Commission has adopted specific rules requiring licensees to terminate transmissions, specific events trigger the requirement to terminate transmissions. While DIRECTV and EchoStar proposed that 17/24 GHz BSS space stations be required to cease operations when they cause harmful interference to a DBS space station, no commenter has submitted proposals regarding what level of reduced availability or degradation in the Carrier-to-Interference ratio (C/I) might constitute sufficiently harmful interference to require a 17/24 GHz BSS operator to cease transmissions from its space station in order to protect the feeder links of a nearby DBS space station.[164] Moreover, any such condition is likely to be highly variable, depending upon a combination of circumstances unique to each location, each operator's business model, and the particular operating parameters for each pair of systems. Thus, without specific technical criteria to determine when cessation of transmissions might be necessary, we do not believe it is appropriate to adopt such a rule as proposed by DIRECTV and EchoStar. Nor do we wish to create a situation whereby one service might unduly constrain development of the other.

58. As DIRECTV correctly notes, our experience with reverse band operations − and particularly with reverse-band operations involving close-proximity space stations − is extremely limited.[165] Further, as commenters have indicated, the off-axis receiving antenna performance characteristics of currently operating DBS satellites may not be documented.[166] As both EchoStar and DIRECTV remind the Commission, there are millions of American consumers who depend upon DBS

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the interference event. The Commission's overall approach to Ku- and Ka-band NGSO FSS sharing encourages the exchange of data by system operators, so that they may predict and avoid such events by any preferred mitigation means. The default sharing mechanism, which includes equal splitting of the available spectrum for the duration of the event, is required only when the system operators have not agreed on a preferred avoidance method. Choice of the preferred, equal portion of spectrum to which it will resort during the event, is accorded to the first-launched NGSO-FSS system. The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ku-Band, *Report and Order*, IB Docket No. 01-96, 17 FCC Rcd 7841 (2002) and The Establishment of Policies and Service Rules for the Non-Geostationary Satellite Orbit, Fixed Satellite Service in the Ka-Band, *Report and Order,* IB Docket No. 02-19, 18 FCC Rcd 14708 (2003).

[163] ESVs may be required to cease operations if they operate outside the terms of their coordination agreement or coordinated area, exceed the required e.i.r.p or e.i.r.p. spectral density toward the horizon, or if the antenna mispointing exceeds a specified angular amount. 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, 20 FCC Rcd 674, 694, 696, 699 and 718, ¶¶ 46, 58 and 104 (2005) ("*ESV Order*"); 47 C.F.R. §§ 25.221, 25.222. The Commission also requires that ESV operators maintain a point of contact in the United States, available at all times, and with authority and ability to cease all emissions from the ESVs. This may be accomplished either directly or through the facilities of a U.S. hub or a hub located in another country with which the U.S. has a bilateral agreement that enables such cessation of emissions. *Id.* at 695-96 and 721, ¶¶ 47-50 and 112-113; and 47 C.F.R. §§ 25.221(a)(3), 25.222(a)(8). In addition, the Commission requires that although C-band ESVs must coordinate their near-shoreline operations prior to commencing operations, in the event objections to the coordination arrangements are received prior to the end of the 30-day Public Notice comment period, the operator must cease transmitting from the ESV until the coordination dispute is resolved. *ESV Order* at, 20 FCC Rcd at 690, ¶ 33; 47 C.F.R. § 25.221(e).

[164] Carrier-to-Interference ratio (C/I) is the ratio of power in an RF carrier to the interference power in the channel.

[165] DIRECTV Comments at 4; DIRECTV Ex Parte Report on 17/24 GHz BSS Operations at 101º W.L. of July 29, 2008 at 4.

[166] *Order and FNPRM*, 22 FCC Rcd at 8916, ¶ 184; EchoStar Comments at 4.

transmissions.[167] Thus, while we do not adopt a service-specific rule regarding cessation of emissions, we remind operators that our existing rules apply to 17/24 GHz BSS.

59. Further, while we do not adopt service-specific rules regarding the cessation of emissions, our licensing process provides an opportunity to address this issue. While it is our intention that bounding the antenna off-axis pfd levels will ultimately provide the best mechanism for mitigating space path interference, its efficacy depends upon sufficient knowledge of the coordination situation between both space stations. Until such information can be better established for DBS receiving antennas, we believe that affording DBS operators the opportunity to raise concerns during the licensing process provides the best temporary remedy. Specifically, we believe that DBS operators are uniquely positioned to provide useful data regarding what level of interference would be sufficiently detrimental to their operations taking into account the distinct circumstances present at the orbital location and to provide this information to the Commission. Thus, we remain open to the possibility of placing additional operating constraints on a 17/24 GHz BSS space station seeking to operate in close proximity (*i.e.*, within 0.4º) to a U.S.-authorized DBS space station that was placed into service at its current location prior to the release date of this Order. The 0.4º distance is a useful threshold within which we would remain open to additional licensing conditions and is based upon the comments and analysis in the ITU document provided by DIRECTV who, in discussing an orbital separation approach to space path interference mitigation, encourages the Commission to adopt a conservative orbital separation of 0.4º.[168] Any such additional licensing conditions would be determined on a case-by-case basis, and would address the conditions under which the 17/24 GHz BSS operator would be required to modify or terminate its transmissions. DBS operators bear the burden of timely requesting and fully justifying any such additional conditions or requirements through the public notice and comment process.

60. Where the Bureau has determined that a DBS operator has timely requested and fully justified inclusion of additional conditions on the grant of a 17/24 GHz BSS application, the Bureau should narrowly tailor the relief granted. Specifically, the conditions placed on the 17/24 GHz BSS operations should be limited to protecting U.S.-authorized DBS space stations (or non-U.S. authorized DBS space station granted market access to the United States) that were placed into service at their assigned location prior to the release date of this Order,[169] and that are separated by 0.4º or less from the 17/24 GHz BSS space station. In these cases, the condition placed on the 17/24 GHz BSS operator would terminate if the DBS space station is relocated to a new orbital location regardless of whether that new location is within 0.4º of a current or planned 17/24 GHz BSS space station. The condition would also terminate at the end of the license term for the DBS space station at issue. We believe that in the short-term, when used as a temporary measure in combination with our other rules, this approach will provide the most effective means of balancing the competing needs of both services.

61. At present, U.S.-licensed DBS space stations and non-U.S. licensed DBS space stations granted market access to the United States are operating at only a small number of orbital locations.[170]

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[167] DIRECTV Comments at 4; EchoStar Comments at 4.

[168] Recommendation ITU-R BO.1835; DIRECTV Comments at 4-6; DIRECTV Reply Comments at 2-3.

[169] The co-primary allocation for this service was adopted by the Commission in 2000 and became effective in 2007. As the comments in this proceeding have shown, DBS operators have been analyzing space path interference issues since 2006. Thus, DBS operators have had an extended time to prepare for the commencement of service by 17/24 GHz BSS operators. As a result, DBS space station operators would reasonably be expected to have designed new satellites in the last few years with these issues in mind. Thus, limiting this particular condition to existing in-orbit DBS space stations is reasonable.

[170] Examples of operational DBS space stations include: EchoStar 12 (S2653) at 61.35º W.L.; EchoStar 3 (S2741) at 61.45º W.L.; EchoStar 15 (S2811) at 61.55º W.L.; DIRECTV 1R (S2369) at 72.5º W.L.; and Nimiq 5 (*See* File No. (continued…)

We have authorized 17/24 GHz BSS space stations to operate within 0.4º of a DBS space station at only one of these locations (*i.e.*, 110º W.L.),[171] and one pending application seeks authority to operate within 0.4º of a DBS space station.[172] For this reason, we believe that instances of unforeseen harmful interference will be exceedingly rare. Moreover, complete cessation of emissions is an extreme remedy. For the rare interference event, it will likely be sufficient for the 17/24 GHz BSS operator to correct the problem with more moderate measures such as reducing its transmitted power levels or redistributing its transponder loading. As required by our existing rules, 17/24 GHz BSS operators are required to coordinate their operations carefully with adjacent DBS systems prior to launch. Further, we strongly encourage, but do not mandate, 17/24 GHz BSS operators to undertake cooperative on-station testing prior to commencing full operations, so that any potential interference problems between the 17/24 GHz BSS and DBS systems can be identified and mitigated at an early stage.

H. Procedures for Pending Applications and Current Authorizations

62. In this Second Report and Order, we amend our rules to require that all 17/24 GHz BSS applicants submit with their applications predicted transmitting off-axis antenna gain information over the angular range described above.[173] In this section, we address how existing licensees and applicants can file new data to conform their licenses and pending applications to these new rules. To implement our decision here, we direct the Bureau to release a Public Notice after publication of the rules in the Federal Register, inviting applicants to amend their pending applications consistent with the rules we adopt today. Any application that is not amended by the date specified by the Bureau will be dismissed as defective.[174] The Bureau will review the amended applications to determine whether they are substantially complete and acceptable for filing. The Bureau will return to the applicant as defective any amended applications that are not substantially complete.[175]

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SES-MFS-20090306-00253) at 72.7º W.L.; EchoStar 6 (S2232) at 76.95º W.L.; EchoStar 4 (S2621) at 77º W.L.; EchoStar 8 (S2439) at 77º W.L.; EchoStar 1 (S2739) at 77.15º W.L.; DIRECTV 8 DBS (S2430) at 100.85º W.L.; DIRECTV 9S DBS (S2669) at 101.1º W.L.; DIRECTV 4S (S2430) at 101.2º W.L.; EchoStar 11 (S2738) at 110º W.L.; DIRECTV 5 (S2673) at 110.1º W.L.; EchoStar 10 (S2694) at 110.2º W.L.; EchoStar 7 (S2740) at 118.8º W.L.; EchoStar 14 (S2790) at 118.9º W.L.; DIRECTV 7S (S2455) at 119.05º W.L.; and Ciel-2 (*See* File No. SES-MFS-20080926-01242) at 128.85º W.L. For complete information, *see* IBFS.

[171] EchoStar EX-1 (S2441) was licensed to operate at 110.4º W.L. *See supra* n. 23 explaining that EchoStar submitted a letter on May 24, 2011 surrendering its 17/24 GHz BSS authorizations.

[172] Spectrum Five has filed an application to operate at 118.8° W.L. Application of Spectrum Five LLC, IBFS File No. SAT-LOI-20081113-00216; SAT-AMD-20091026-00113 (Call Sign S2777). This is in very close proximity to in-orbit DBS space stations located at the 119° W.L. DBS cluster. *e.g.*, EchoStar 14 (S2790) which is operating at 118.9° W.L. EchoStar 7 (S2740) is currently operating at 118.8° W.L. under a 180-day STA, SAT-STA-20110204-00024, commencing March 10, 2011. *See also* EchoStar 7's pending modification, IBFS File No. SAT-MOD-20100329-00058.

[173] *See supra* ¶¶ 20-31.

[174] 47 C.F.R. § 25.112(a)(2).

[175] *See* Amendment of the Commission's Space Station Licensing Rules and Policies and Mitigation of Orbital Debris, *First Report and Order and Further Notice of Proposed Rulemaking in IB Docket No. 02-34, and First Report and Order in IB Docket No. 02-54, IB Docket Nos. 02-34 and 02-54*, 18 FCC Rcd 10760, 10852, ¶ 244 (2003) ("*First Space Station Licensing Reform Order*"). Applications of PanAmSat Licensee Corp. for Authority to Construct, Launch, and Operate a Hybrid Satellite System in its Separate International Communications Satellite System, *Order on Reconsideration*, 18 FCC Rcd 23916 (2003). We note that the Commission reserves the right to return an application which has been placed on Public Notice as acceptable for filing if, upon further examination, it is (continued…)

63. We recognize that the authorizations issued under these technical rules may not be exactly what the applicants expected. This, by itself, is not a barrier to the adoption of these rules or the requirement that applicants amend their applications to come into compliance with the new rules. The Commission has the authority to apply new procedures to pending applications if doing so does not impair the rights an applicant possessed when it filed its application, increase an applicant's liability for past conduct, or impose new duties on applicants with respect to "transactions already completed."[176] Applicants do not gain any vested right merely by filing an application.[177] Filing an application cannot be considered a "transaction already completed" for purposes of this analysis.

64. Similarly, the Public Notice will also require current authorization holders to file a modification application that demonstrates compliance with the rules we adopt here today, and to supplement the file with all required information. The Bureau will review the modification applications to determine whether they are substantially complete and acceptable for filing. The Bureau will return to the applicant as defective any modification applications that are not substantially complete.

65. The Commission may adopt rules that modify any station license of general applicability that affect a class of licensees,[178] "if in its judgment such action will promote the public interest, convenience and necessity" and the modification may be accomplished through notice and comment rulemaking.[179] The purpose of the Commission's actions here is to establish revised technical rules that will foster the provision of new services without causing harmful interference to a co-primary service – DBS. Neither DBS nor 17/24 GHz BSS operators possess the right to interfere with co-primary operations. We are not altering the past legal consequences of past actions of 17/24 GHz BSS

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determined that the application is not in conformance with the Commission's rules. *See, e.g.,* Policy Branch Information, Satellite Space Applications Accepted for Filing, *Public Notice,* Report No. SAT-00418 (Feb. 2, 2007).

[176] *Order and FNPRM*, 22 FCC Rcd at 8901, ¶ 144. *See also First Space Station Licensing Reform Order*, 18 FCC Rcd at 10865, ¶ 278 and n.673 (citing *Landgraf v. USI Film Prod*ucts, 511 U.S. 244, 269-70 ("*Landgraf*"); *DIRECTV v. FCC*, 110 F.3d 816, 825-2626 (citing *Bell Atlantic Telephone Cos. v. FCC*, 79 F.3d 1195, 1207 (D.C. Cir., 1996)); *Black Citizens for a Fair Media v. FCC*, 719 F.2d 407, 411 (D.C. Cir., 1983);); *Celotronix Telemetry, Inc. v. FCC*, 272 F.3d 585, 588 (D.C. Cir. 2001) ("*Celotronix*") (citing *Landgraf*, 511 U.S. at 280).

[177] *Order and FNPRM*, 22 FCC Rcd at 8901, ¶ 144; *Chadmoore Communications, Inc. v. FCC*, 113 F.3d 235, 240-41 (D.C. Cir. 1997) ("*Chadmoore*") ("In this case the Commission's action did not increase [the applicant's] liability for past conduct or impose new duties with respect to completed transactions. Nor could it have impaired a right possessed by [the applicant] because none vested on the filing of its application."); *Hispanic Info. & Telecomms. Network v. FCC*, 865 F.2d 1289, 1294-95 (D.C. Cir. 1989) ("The filing of an application creates no vested right to a hearing; if the substantive standards change so that the applicant is no longer qualified, the application may be dismissed."); *Schraier v. Hickel*, 419 F.2d 663, 667 (D.C. Cir.1969) (filing of application that has not been accepted does not create a legal interest that restricts discretion vested in agency). *See also United States v. Storer Broadcasting Co*., 351 U.S. 192 (1952) (pending application for new station dismissed due to rule change limiting the number of licenses that could be held by one owner); *Bachow Communications, Inc. v. FCC*, 237 F.3d 683, 686-88 (D.C. Cir. 2001) (upholding freeze on new applications and dismissal of pending applications in light of adoption of new licensing scheme); *PLMRS Narrowband Corp. v. FCC*, 182 F. 3d 995, 1000-01 (D.C. Cir. 1999) (applicant did not, by virtue of filing application, obtain the right to have it considered under the rules then applicable).

[178] 47 U.S.C. § 316. *See* Amendment of Part 27 of the Commission's Rules to Govern the Operation of Wireless Communication Services in the 2.3 GHz Band, *Report and Order and Second Report and Order,* 25 FCC Rcd 11710, 11774-75, at ¶ 157 (rel. May 20, 2010) ("*2.3 GHz Order*").

[179] *Id.* at 11774-75, ¶ 157 (rel. May 20, 2010); *Committee for Effective Cellular Rules v. FCC,* 53 F.3d 1309 (D.C. Cir. 1995); *WBEN, Inc. v. FCC*, 396 F.2d 601, 618 (2nd Cir. 1968), *cert. denied*, 393 U.S. 914 (1968).

authorization holders.[180] Rather, the scheme we are adopting in this order is a means of bringing current authorization holders and pending applicants into compliance with general operational requirements.[181] Moreover, the 17/24 GHz BSS authorization holders could not have had any reasonable expectation that the Commission would refrain from exercising its regulatory power to change the operational requirements of a service in cases where the public interest is best served by such change. Commission action that upsets expectations held by current authorization holders based on existing rules is not impermissibly retroactive.[182] This is particularly true given the fact that all 17/24 GHz BSS licensees were aware at the time of grant that they would be subject to any additional requirements adopted as a result of this proceeding. [183] In fact, all such licenses were granted with a condition on the face of the license stating that "[t]his authorization and all conditions contained herein are subject to the outcome of the Commission's rulemaking in IB Docket No. 06-123 and any requirements subsequently adopted therein."

66. We invite both 17/24 GHz BSS applicants and authorization holders to file their predicted transmitting antenna off-axis gain data at any time prior to the date that the rules adopted today become effective.[184] We acknowledge that some parties may be close to possessing actual measured data, particularly those who actively participated and commented in this proceeding. If any of these entities have measured data, they are permitted to immediately file a modification (or amendment as appropriate) containing measured data rather than filing predicted data. No fee will be required for amendments or modifications filed for the sole purpose of amending a pending application or modifying a current authorization to comply with the rules adopted here today. Amendments that include changes in requested frequencies, orbital locations, or any other change not required by the rules adopted today, must include the appropriate fee.[185]

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[180] Mitigation of Orbital Debris, *Second Report and Order*, IB Docket No. 02-54, 19 FCC Rcd 11567, 11598 , ¶ 78 (2004) ("*Second Orbital Debris Order*") (applying a rule to satellites that are currently on-orbit or under physical construction is impermissibly retroactive only when an agency "alter[s] the *past* legal consequences of past actions.") *Celotronix,* 272 F.3d at 588 (citing *Bowen v. Georgetown University Hospital*, 488 U.S. 204, 219 (1988).

[181] *Second Orbital Debris Order*, 19 FCC Rcd at 11598, ¶ 78 (stating that the application of rules adopted in the order to existing spacecraft would not be impermissible under the Administrative Procedure Act or Commission precedent).

[182] 47 U.S.C. § 304. *See 2.3 GHz Order*, 25 FCC Rcd at 11774-75, ¶ 157.

[183] *See National Cable & Telecommunications Assn. v. FCC*, 567 F.3d 659, 670 (D.C. Cir. 2009) (citing *Mobile Relay Assocs. v. FCC*, 457 F.3d 1, 11 (D.C. Cir. 2006)); *Chemical Manufacturers Ass'n v. EPA*, 869 F.2d 1526, 1536 (D.C. Cir. 1989) (stating that "[i]t is often the case that a business will undertake a certain course of conduct based on the current law, and will then find its expectations frustrated when the law changes. This has never been thought to constitute retroactive lawmaking, and indeed most economic regulation would be unworkable if all laws disrupting prior expectations were deemed suspect").

[184] We recognize that some parties may seek to file conforming off-axis antenna gain data and associated information prior to the effective date of these rules. We will not prohibit them from doing so. If off-axis antenna gain data and associated information is filed prior to the effective date of these rules, defects in the off-axis antenna gain data will not be grounds for dismissal. After the effective date of the rules, if the off-axis antenna gain data and associated information does not meet our substantially complete standard it will be grounds for dismissal. At all times, modifications for other purposes where the rules are in effect will continue to be reviewed pursuant to the substantially complete standard.

[185] 47 C.F.R. § 1.1111(a).

IV. PROCEDURAL MATTERS

A. Final Regulatory Flexibility Analysis

67. Pursuant to the Regulatory Flexibility Act ("RFA"),[186] the *FNPRM* incorporated an Initial Regulatory Flexibility Analysis ("IRFA"). The Commission sought written public comments on the possible significant economic impact of the proposed policies and rules on small entities in the *FNPRM,* including comments on the IRFA. No one commented specifically on the IRFA. Pursuant to the RFA, Appendix C provides a Final Regulatory Flexibility Analysis. It assesses the effects of adopting space path interference rules on small business concerns.

B. Final Paperwork Reduction Act of 1995 Analysis

68. In the FNPRM, the Commission analyzed the actions we now adopt in this Report and Order with respect to the Paperwork Reduction Act of 1995. The Report and Order modifies the data collection by requiring 17/24 GHz BSS applicants to provide pfd calculations at the time of application and 9 months prior to launch of the space station that either: (1) demonstrate that the pfd level at the location of any prior-filed DBS network does not exceed the coordination trigger of -117 dBW/m^2/100 kHz; or (2) demonstrate to what extent the coordination trigger is exceeded at the receiver input of any prior-filed DBS network. If the coordination trigger is exceeded, the 17/24 GHz BSS applicant must also provide certification that all affected DBS operators acknowledge and do not object to the applicant's higher off-axis pfd levels. 17/24 GHz BSS applicants are also required to submit transmitting antenna off-axis gain measurements made over a range of ±30º from the X axis in the X-Z plane and over a range of ±60º in planes rotated about the Z axis that should permit accurate off-axis pfd information to be calculated for DBS and 17/24 GHz BSS space stations separated in longitude by as little as 0.2º. 17/24 GHz BSS and DBS Applicants seeking to bias their space station orientation are required to file additional information with the Commission in which they provide an explanation of the planned orientation bias and the necessary increased range of antenna off-axis gain measurements. Both 17/24 GHz BSS and DBS applicants are required to file the predicted maximum orbital eccentricity with their application. This document contains new information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and Budget (OMB) for review under section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new information collection requirements contained in this proceeding. In addition, the Commission notes that pursuant to the Small Business Paperwork Relief Act of 2002, Public Law 107-198, *see* 44 U.S.C. 3506(c)(4), we previously sought specific comment on how the Commission might further reduce the information collection burden for small business concerns with fewer than 25 employees.

V. ORDERING CLAUSES

69. Accordingly, IT IS ORDERED that, pursuant to the authority contained in Sections 4(i), 4(j), 7(a), 302(a), 303(c), 303(e), 303(f), 303(g), 303(j), 303(r), and 303(y) of the Communications Act of 1934, as amended, 47 U.S.C. §§ 154(i), 154(j), 157(a), 302(a), 303(c), 303(e), 303(f), 303(g), 303(j), 303(r), 303(y), this Report and Order in IB Docket No. 06-123 IS ADOPTED.

70. IT IS FURTHER ORDERED that Part 25 of the Commission's rules IS AMENDED as set forth in Appendix B, and such rule amendments SHALL BE EFFECTIVE 30 days after the date of publication in the Federal Register, except for Sections 25.114(d)(15)(iv), 25.114(d)(18), 25.264(a),

[186] *See* 5 U.S.C. § 603. The RFA has been amended by the Contract with America Advancement Act of 1996, Pub. L. No. 104-121, 110 Stat. 847 (1996) ("CWAAA"). Title II of the CWAAA is the Small Business Regulatory Enforcement Fairness Act of 1996.

25.264(b), 25.264(c), 25.264(d), 25.264(f), which contain new information collection requirements that require approval by the Office of Management and Budget (OMB) under the PRA. The Federal Communications Commission will publish a document in the Federal Register announcing such approval and the relevant effective date.

71. IT IS FURTHER ORDERED that the International Bureau is delegated authority to issue Public Notices consistent with this Report and Order.

72. IT IS FURTHER ORDERED that the final regulatory flexibility analysis, as required by section 604 of the Regulatory Flexibility Act, IS ADOPTED.

73. IT IS FURTHER ORDERED that the Commission's Consumer and Governmental Affairs Bureau, Reference Information Center SHALL SEND a copy of this Report and Order, including the final regulatory flexibility analysis, to the Chief Counsel for Advocacy of the Small Business Administration, in accordance with section 603(a) of the Regulatory Flexibility Act, 5 U.S.C. § 601, *et seq*.

74. IT IS FURTHER ORDERED that the Commission SHALL SEND a copy of this Report and Order in a report to be sent to Congress and the General Accountability Office pursuant to the Congressional Review Act, 5 U.S.C. § 801(a)(1)(A).

FEDERAL COMMUNICATIONS COMMISSION

Marlene H. Dortch
Secretary

APPENDIX A

List of Comments and Reply Comments

Comments
EchoStar Satellite LLC (11/5/2007)
DIRECTV (11/5/2007)
SES Americom (11/5/2007)

Reply Comments
EchoStar Satellite LLC (12/5/2007)
DIRECTV (12/5/2007)
Telesat Canada (12/5/2007)
SES Americom (12/5/2007)

Ex Parte Filings
DIRECTV, Inc. (6/2/2011)
DIRECTV, Inc. (6/1/2011)
DIRECTV, Inc. (5/27/2011)
SES Americon, Inc. (5/26/2011)
DIRECTV, Inc. (5/24/2011)
DIRECTV, Inc. (5/16/2011)
DIRECTV, Inc. (5/5/2011)
DIRECTV, Inc. (4/29/2011)
DIRECTV, Inc. (4/29/2011)
DIRECTV, Inc. (4/28/2011)
DIRECTV, Inc. (4/28/2011)
SES Americom (2/9/2011)
EchoStar Corporation (2/7/2011)
EchoStar Corporation (10/8/2008)
EchoStar Corporation (8/8/2008)
DIRECTV, Inc. (7/30/2008)
DIRECTV, Inc. (7/14/2008)
DIRECTV, Inc. (6/17/2008)
DIRECTV, Inc. (5/1/2008)
DIRECTV, Inc. (4/21/2008)

APPENDIX B

Final Rules

For the reasons discussed above in the preamble, the Federal Communications Commission amends 47 CFR Part 25 as follows:

PART 25 – SATELLITE COMMUNICATIONS

1. Section 25.114 by adding paragraphs (d)(15)(iv) and (d)(18) to read as follows:

§ 25.114 Applications for space station authorizations.

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(d) ***

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(15) ***

(iv) The information required in Section 25.264(a)-(b).

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(18) For space stations in the Direct Broadcast Satellite service or the 17/24 GHz broadcasting - satellite service, maximum orbital eccentricity.

2. Create new Section 25.264 to read as follows:

§ 25.264 Requirements to facilitate reverse-band operation in the 17.3-17.8 GHz band of 17/24 GHz Broadcasting-satellite Service and Direct Broadcast Satellite Service space stations.

(a) Each applicant for a space station license in the 17/24 GHz broadcasting-satellite service (BSS) must provide a series of tables or graphs with its application, that contain the predicted transmitting antenna off-axis gain information for each transmitting antenna in the 17.3-17.8 GHz frequency band. Using a Cartesian coordinate system wherein the X axis is tangent to the geostationary orbital arc with the positive direction pointing east, *i.e.*, in the direction of travel of the satellite; the Y axis is parallel to a line passing through the geographic north and south poles of the Earth, with the positive direction pointing south; and the Z axis passes through the satellite and the center of the Earth, with the positive direction pointing toward the Earth, the applicant must provide the predicted transmitting antenna off-axis antenna gain information:

(1) in the X-Z plane, *i.e.*, the plane of the geostationary orbit, over a range of ±30 degrees from the positive and negative X axes in increments of 5 degrees or less.

(2) in planes rotated from the X-Z plane about the Z axis, over a range of ±60 degrees relative to the equatorial plane, in increments of 10 degrees or less.

(3) in both polarizations.

(4) at a minimum of three measurement frequencies determined with respect to the entire portion of the 17.3-17.8 GHz frequency band over which the space station is designed to transmit: 5 MHz above the lower edge of the band; at the band center frequency; and 5 MHz below the upper edge of the band.

(5) over a greater angular measurement range, if necessary, to account for any planned spacecraft orientation bias or change in operating orientation relative to the reference coordinate system. The applicant must also explain its reasons for doing so.

(b) Each applicant for a space station license in the 17/24 GHz BSS must provide power flux density (pfd) calculations with its application that are based upon the predicted off-axis transmitting antenna gain information submitted in accordance with paragraph (a) of this section, as follows:

(1) the pfd calculations must be provided at the location of all prior-filed U.S. DBS space stations where the applicant's pfd level exceeds the coordination trigger of -117 dBW/m^2/100 kHz in the 17.3-17.8 GHz band. In this rule, the term prior-filed U.S. DBS space station refers to any Direct Broadcast Satellite service space station application that was filed with the Commission (or authorization granted by the Commission) prior to the filing of the 17/24 GHz BSS application containing the predicted off-axis transmitting antenna gain information. The term prior-filed U.S. DBS space station does not include any applications (or authorizations) that have been denied, dismissed, or are otherwise no longer valid. Prior-filed U.S. DBS space stations may include foreign-licensed DBS space stations seeking authority to serve the United States market, but do not include foreign-licensed DBS space stations that have not filed applications with the Commission for market access in the United States.

(2) the pfd calculations must take into account the maximum permitted longitudinal station-keeping tolerance, orbital inclination and orbital eccentricity of both the 17/24 GHz BSS and DBS space stations, and must:

(i) identify each prior-filed U.S. DBS space station at whose location the coordination threshold pfd level of -117 dBW/m^2/100 kHz is exceeded; and

(ii) demonstrate the extent to which the applicant's transmissions in the 17.3-17.8 GHz band exceed the threshold pfd level of -117 dBW/m^2/100 kHz at those prior-filed U.S. DBS space station locations.

(3) if the calculated pfd level is in excess of the threshold level of -117 dBW/m^2/100 kHz at the location of any prior-filed U.S. DBS space station, the applicant must also provide with its application certification that all affected DBS operators acknowledge and do not object to the applicants higher off-axis pfd levels. No such certification is required in cases where the DBS and 17/24 GHz BSS assigned operating frequencies do not overlap.

(c) No later than 9 months prior to launch, each 17/24 GHz BSS space station applicant or authorization holder must confirm the predicted transmitting antenna off-axis gain information provided in accordance with §25.114(d)(15)(iv) by submitting measured transmitting antenna off-axis gain information over the angular ranges, measurement frequencies and polarizations described in paragraphs (a)(1)-(5) of this section. The transmitting antenna off-axis gain information should be measured under conditions as close to flight configuration as possible.

(d) No later than 9 months prior to launch, each 17/24 GHz BSS space station applicant or authorization holder must provide pfd calculations based upon the measured transmitting antenna off-axis gain information that is submitted in accordance with paragraph (c) of this section as follows:

(1) the pfd calculations must be provided:

(i) at the location of all prior-filed U.S. DBS space stations as defined in paragraph (b)(1) of this section, where the applicant's pfd level in the 17.3-17.8 GHz band exceeds the coordination trigger of -117 dBW/m^2/100 kHz; and

(ii) at the location of any subsequently-filed U.S. DBS space station where the applicant's pfd level in the 17.3-17.8 GHz band exceeds the coordination trigger of -117 dBW/m^2/100 kHz. In this rule, the term subsequently-filed U.S. DBS space station refers to any Direct Broadcast Satellite service space station application that was filed with the Commission (or authorization granted by the Commission) after the 17/24 GHz BSS operator submitted the predicted data required by paragraphs (a)-(b) of this section, but prior to the time the 17/24 GHz BSS operator submitted the measured data required in this paragraph. Subsequently-filed U.S. DBS space stations may include foreign-licensed DBS space stations seeking authority to serve the United States market. The term does not include any applications (or authorizations) that have been denied, dismissed, or are otherwise no longer valid, nor does it include foreign-licensed DBS space stations that have not filed applications with the Commission for market access in the United States.

(2) the pfd calculations must take into account the maximum permitted longitudinal station-keeping tolerance, orbital inclination and orbital eccentricity of both the 17/24 GHz BSS and DBS space stations, and must:

(i) identify each prior-filed U.S. DBS space station at whose location the coordination threshold pfd level of -117 dBW/m^2/100 kHz is exceeded; and

(ii) demonstrate the extent to which the applicant's or licensee's transmissions in the 17.3-17.8 GHz band exceed the threshold pfd level of -117 dBW/m^2/100 kHz at those prior-filed U.S. DBS space station locations.

(e) If the pfd level calculated from the measured data submitted in accordance with paragraph (d) of this section is in excess of the threshold pfd level of -117 dBW/m^2/100 kHz:

(1) at the location of any prior-filed U.S. DBS space station as defined in paragraph (b)(1) of this section, then the 17/24 GHz broadcasting-satellite operator must either:

(i) coordinate its operations that are in excess of the threshold pfd level of -117 dBW/m^2/100 kHz with the affected prior-filed U.S. DBS space station operator, or

(ii) adjust its operating parameters so that at the location of the prior-filed U.S. DBS space station, the pfd level of -117 dBW/m^2/100 kHz is not exceeded.

(2) at the location of any subsequently-filed U.S. DBS space station as defined in paragraph (d)(1) of this section, where the pfd level submitted in accordance with paragraph (d) of this section, is also in excess of the pfd level calculated on the basis of the predicted data submitted in accordance with paragraph (a) of

this section that were on file with the Commission at the time the DBS space station application was filed, then the 17/24 GHz broadcasting-satellite operator must either:

(i) coordinate with the affected subsequently-filed U.S. DBS space station operator all of its operations that are either in excess of the pfd level calculated on the basis of the predicted antenna off-axis gain data, or are in excess of the threshold pfd level of -117 dBW/m^2/100 kHz, whichever is greater, or

(ii) adjust its operating parameters so that at the location of the subsequently-filed U.S. DBS space station, either the pfd level calculated on the basis of the predicted off-axis transmitting antenna gain data, or the threshold pfd level of -117 dBW/m^2/100 kHz, whichever is greater, is not exceeded.

(3) no coordination or adjustment of operating parameters is required in cases where the DBS and 17/24 GHz BSS operating frequencies do not overlap.

(f) The 17/24 GHz BSS applicant or licensee must modify its license, or amend its application, as appropriate, based upon new information:

(1) if the pfd levels submitted in accordance with paragraph (d) of this section, are in excess of those submitted in accordance with paragraph (b) of this section at the location of any prior-filed or subsequently-filed U.S. DBS space station as defined in paragraphs (b)(1) and (d)(1)of this section, or

(2) if the 17/24 GHz BSS operator adjusts its operating parameters in accordance with paragraphs (e)(1)(ii) or (e)(2)(ii) or this section.

(g) Absent an explicit agreement between operators to permit more closely spaced operations, U.S. authorized 17/24 GHz BSS space stations and U.S. authorized DBS space stations with co-frequency assignments may not be licensed to operate at locations separated by less than 0.2 degrees in orbital longitude.

(h) All operational 17/24 GHz BSS space stations must be maintained in geostationary orbits that:

(1) do not exceed 0.075º of inclination.

(2) operate with an apogee less than or equal to 35,806 km above the surface of the Earth, and with a perigee greater than or equal to 35,766 km above the surface of the Earth (*i.e.*, an eccentricity of less than $4.7x10^{-4}$).

(i) U.S. authorized DBS networks may claim protection from space path interference arising from the reverse-band operations of U.S. authorized 17/24 GHz BSS networks to the extent that the DBS space station operates within the bounds of inclination and eccentricity listed below. When the geostationary orbit of the DBS space station exceeds these bounds on inclination and eccentricity, it may not claim protection from any additional space path interference arising as a result of its inclined or eccentric operations and may only claim protection as if it were operating within the bounds listed below:

(1) the DBS space station's orbit does not exceed 0.075º of inclination, and

(2) the DBS space station's orbit maintains an apogee less than or equal to 35,806 km above the surface of the Earth, and a perigee greater than or equal to 35,766 km above the surface of the Earth (*i.e.*, an eccentricity of less than $4.7x10^{-4}$).

APPENDIX C

Final Regulatory Flexibility Analysis

As required by the Regulatory Flexibility Act of 1980, as amended (RFA),[1] the Further Notice of Proposed Rulemaking (*FNPRM*) in this proceeding, *Establishment of Policies and Service Rules for the Broadcasting-Satellite Service at the 17.3-17.7 GHz Frequency Band and at the 17.7-17.8 GHz Frequency Band Internationally, and at the 24.75-25.25 GHz Frequency Band for Fixed Satellite Services Providing Feeder Links to the Broadcasting-Satellite Service and for the Satellite Services Operating Bi-directionally in the 17.3-17.8 GHz Frequency Band*, IB Docket No. 06-123, adopted on May 2, 2007 and released on May 4, 2007, incorporated an Initial Regulatory Flexibility Analysis (IRFA).[2] The Commission sought written public comment on the proposals in the *FNPRM,* including comment on the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.[3]

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

The *FNPRM* sought to mitigate space path interference for the 17/24 GHz Broadcasting-Satellite Service (BSS). It sought comment and developed a record on approaches to mitigate space path interference in the 17.3-17.8 GHz band that may occur when the transmitted signals from 17/24 GHz BSS space stations are received by the feeder link receivers on space stations operating in the DBS service. Further, the *FNPRM* sought comment on avoiding harmful levels of space path interference into DBS space station receivers by establishing a power flux density (pfd) value at the victim (*i.e*., DBS) space station receiver, on proposed minimal orbital separation requirements and the specific information that 17/24 GHz BSS applicants should be required to submit to the Commission.

The objective of the Second Report and Order is to mitigate space path interference from 17/24 GHz Broadcasting-Satellite Service (BSS) received by adjacent DBS space stations. To this end, the Second Report and Order adopts a pfd coordination trigger and antenna off-axis gain information requirements. We also adopt a minimum orbital separation requirement of 0.2º and place bounds on orbital inclination and eccentricity. Further, we adopt procedural requirements for information submission, procedures to follow in the event of harmful interference, in the event of BSS space path interference into the telecommand links of DBS networks. Finally, we adopt procedures to bring current authorizations and current applications in line with the new rules adopted today.

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

No parties filed comments that separately or specifically addressed the IRFA.

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

[1] *See* 5 U.S.C. § 603. The Small Business Regulatory Enforcement Fairness Act of 1996, Pub. L. No. 104-121, Title II, 110 Stat. 857 (1996) amended the RFA (*see* 5 U.S.C. § 601-612).

[2] *See Report and Order and FNPRM*, 22 FCC Rcd 8842, Appendix H.

[3] *See* 5 U.S.C. § 604.

The RFA directs agencies to provide a description of and, where feasible, an estimate of the number of small entities that may be affected by the rules adopted herein.[4] The RFA generally defines the term "small entity" as having the same meaning as the terms "small business," "small organization," and "small governmental jurisdiction."[5] In addition, the term "small business" has the same meaning as the term "small business concern" under the Small Business Act.[6] A small business concern is one that: (1) is independently owned and operated; (2) is not dominant in its field of operation; and (3) satisfies any additional criteria established by the Small Business Administration (SBA).[7] Below, we further describe and estimate the number of small entity licensees that may be affected by the adopted rules.

Satellite Telecommunications and All Other Telecommunications.

Regarding future satellite use of the bands that are the subject of this rulemaking, the applicable definition of small entity is the definition under the Small Business Administration (SBA) rules applicable to Satellite Telecommunications. This definition provides that a small entity is one with $12.5 million or less in annual receipts. According to 2007 Census Bureau data, there are 512 satellite communication firms that operated for the entire year.[8] Of this total, 464 firms had annual receipts of under $10 million, and 18 firms had receipts of $10 million to $24,999,999.[9] Generally, GSO systems, such as the 17/24 GHz BSS and DBS systems at issue here, cost hundreds of millions of dollars to construct, launch and operate. Therefore, the GSO companies, or their parent companies, rarely qualify under this definition as a small entity. There are no small entities affected by this action because only Federal agencies currently make use of these services.

The second category, ie. "All Other Telecommunications" comprises "establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems."[10] For this category, Census Bureau data for 2007 show that there were a total of 2,383 firms that operated for the entire year.[11] Of this total, 2,347 firms had annual receipts of under $10

[4] 5 U.S.C. § 604(a)(3).

[5] 5 U.S.C. § 601(6).

[6] 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 15 U.S.C. § 632). Pursuant to the RFA, the statutory definition of a small business applies "unless an agency, after consultation with the Office of Advocacy of the Small Business Administration and after the opportunity for public comment, establishes one or more definitions of such term which are appropriate to the activities of the agency and publishes such definition(s) in the Federal Register." 5 U.S.C. § 601(3).

[7] Small Business Act, 15 U.S.C. § 632 (1996).

[8] U.S. Census Bureau, 2007 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization)," Table 4, NAICS code 517410 (issued Nov. 2010) *available at* http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-lang=en. ("*2007 Census Data*").

[9] *Id*.

[10] U.S. Census Bureau, 2007 NAICS Definitions, "517919 All Other Telecommunications"; http://www.census.gov/naics/2007/def/ND517919.HTM#N517919.

[11] U.S. Census Bureau, 2007 Economic Census, Subject Series: Information, "Establishment and Firm Size (Including Legal Form of Organization)," Table 4, NAICS code 517910 (issued Nov. 2010) *available at*
(continued…)

million and 12 firms had annual receipts of $10 million to $24,999,999.[12]

Space Station Licensees (Geostationary). Commission records reveal that there are nine space station licensees operating BSS and DBS space stations. While we do not request or collect annual revenue information concerning such licensees and operators, GSO FSS systems, such as the 17/24 GHz BSS and DBS systems at issue here, cost hundreds of millions of dollars to construct, launch and operate. Therefore, the NGSO and GSO FSS companies, or their parent companies, rarely qualify under this definition as a small entity.

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

The *FNPRM* sought comment on various issues related to the mitigation of harmful interference in the reverse band operating environment, which is unique to operation in the 17/24 GHz BSS. None of the proposed methods are intended to increase the projected reporting, recordkeeping, and other compliance requirements. Specifically, we adopt a pfd coordination trigger and antenna off-axis gain information requirements. We also adopt a minimum orbital separation requirement of 0.2º and place bounds on orbital inclination and eccentricity. The Second Report and Order also adopts procedural requirements for information submission, and procedures to follow in the event of harmful interference into the telecommand links of DBS networks. Finally, we adopt procedures to bring authorizations and pending applications in line with the new rules.

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

The RFA requires that, to the extent consistent with the objectives of applicable statutes, the analysis shall discuss significant alternatives such as: (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance and reporting requirements under the rule for small entities; (3) the use of performance, rather than design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.[13]

As discussed above, small entities will not be affected by this Second Report and Order. The *FNPRM* solicited comment on methods to mitigate against space path interference between DBS and 17/24 GHz BSS satellites (space path interference). The *FNPRM* sought comment on what requirements including setting power level limits – including a pfd coordination trigger and projected antenna off-axis gain information requirements – and requiring technical showings would be reasonable to request from applicants seeking to operate 17/24 GHz BSS space stations. The *FNPRM* sought input from commenters to ensure that the information provided by the 17/24 GHz BSS space station applications would be sufficient to prevent interference with DBS providers, while at the same time ensuring that these submissions would not be overly burdensome. The Second Report and Order adopts rules requiring 17/24 GHz BSS applicants to provide with their applications technical showings demonstrating that they comply with the pfd coordination trigger and the off-axis gain information.

(Continued from previous page)_____
http://factfinder.census.gov/servlet/IBQTable?_bm=y&-geo_id=&-_skip=900&-ds_name=EC0751SSSZ4&-_lang=en.

[12] *Id*.

[13] 5 U.S.C. § 603(c)(1), (c)(4).

F. Federal Rules that May Duplicate, Overlap, or Conflict With the Proposed Rules

None.

Report to Congress: The Commission will send a copy of the Second Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act. In addition, the Commission will send a copy of the Second Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the Second Report and Order and FRFA (or summaries thereof) also will be published in the Federal Register.[14]

[14] *See* 5 U.S.C. § 604(b).

APPENDIX D

Appendix F Locations, BSS Grants and Pending Applications and U.S. DBS Region 2 Plan Locations

Appendix F Locations (all locations are W.L.)	**BSS Grants and Pending Applications**[1] (all locations are W.L.)	**U.S. DBS Region 2 Plan Locations** (all locations are W.L.)
43.0º		
47.0º		
51.0º		
55.0º		
59.0º		
63.0º	62.15º	61.5º
67.0º	67.5º	
71.0º	70.0º	
75.0º	75.0º	
79.0º	79.0º	
83.0º		
87.0º		
91.0º		
95.0º	95.0º	
99.0º	99.175º	101.0º
103.0º	102.825º; 103.15º	
107.0º	107.0º	
111.0º	110.4º; 110.9º	110.0º
115.0º	115.0º	
119.0º	118.8º	119.0º
123.0º		
127.0º		
131.0º		
135.0º		
139.0º		
143.0º		
147.0º		148.0º
151.0º		
155.0º		157.0º
159.0º		
163.0º		
167.0º		166.0º
171.0º		
175.0º		175.0º
179.0º		

[1] One operator recently submitted a letter surrendering five 17/24 GHz BSS authorizations. Letter from Pantelis Michalopoulos and Christopher Bjornson, Counsel for EchoStar Corporation and EchoStar Satellite Operating Corporation, to Marlene H. Dortch, Secretary, Federal Communications Commission, dated May 24, 2011.

APPENDIX E

Satellite Angular Separation Values as a Function of Orbital Eccentricity and Orbital Inclination