Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
International Bureau Seeks Comment	)	Report No. SPB-196
On Proposals To Permit Reducing	)	
Orbital Spacings Between U.S. Direct	)	
Broadcast Satellites	)	

To: Chief, International Bureau

COMMENT OF THE BOEING COMPANY

The Boeing Company ("Boeing"), by its attorneys, hereby submits the following comments in response to the above-referenced public notice addressing orbital spacing between U.S.-licensed satellites operating in the Direct Broadcast Satellite ("DBS") service.[1]

As a leading manufacturer of satellite systems, and a provider of communications services that could be affected by the Commission's decision in this proceeding, Boeing has a substantial interest in this important issue.

I. INTRODUCTION

Boeing supports the Commission's efforts to promote the efficient use of spectrum by DBS networks in the 12.2-12.7 GHz and 17.3-17.8 GHz bands. By

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[1] *See* Public Notice, *International Bureau Seeks Comment On Proposals To Permit Reducing Orbital Spacings Between U.S. Direct Broadcast Satellites*, Report No. SPB-196, DA 03-3903 (Dec. 16, 2003).

authorizing additional DBS orbital positions to serve the United States, the Commission can enhance competition in the DBS industry and make possible the provision of new and innovative direct-to-user satellite services.

In considering improvements to DBS orbital spacing, the Commission should not confine itself to the specific proposals advanced by various satellite operators. Rather, the Commission should consider more broadly the optimal spacing to maximize the number of DBS orbital positions that can provide service to the entire continental United States. Such an investigation should include consideration of whether other Region 2 administrations should be consulted regarding potential adjustments in the Region 2 plan for DBS that could increase the number of satellite networks that are able to provide DBS services in the United States and elsewhere in the Americas. Consideration should also be given to whether changes to the technical provisions or procedures of the Appendix 30 Plan for Region 2 would be appropriate to simplify the process of coordinating DBS networks that are not in conformance with the Plan.

In considering changes to the present DBS orbital spacing, however, the Commission should protect existing services and current subscribers. More specifically, the Commission should refrain from authorizing any short-spaced DBS network if the new satellite system will cause harmful interference to existing services. This protection should extend to all services provided by DBS networks, including aeronautical DBS services such as the one currently provided by Connexion by Boeing^{SM}. As the Commission is aware, the DBS industry and U.S. consumers have invested billions of dollars in DBS transmission and reception equipment. Any effort to improve the efficiency of DBS orbital spacing should not jeopardize this investment.

II. IN INCREASING THE EFFICIENCY OF DBS ORBITAL SPACING, THE COMMISSION SHOULD PROTECT THE QUALITY AND AVAILABILITY OF EXISTING DBS SERVICES

As the Commission acknowledges in its Public Notice, wide agreement exists, even among proponents of reduced DBS orbital spacing, regarding the underlying principle governing this proceeding, namely, "any potential benefits must be achieved in a way that ensures that consumers continue to enjoy the benefits of existing DBS services."[2]

In order to preserve these consumer benefits, the Commission should undertake a comprehensive survey of the DBS services currently available to consumers in the United States and the technical specifications of their operations. As the Commission is aware, the provision of DBS services to aircraft is one of the unique DBS services now enjoyed by U.S. consumers.[3]

On December 21, 2001, Boeing was authorized by the Commission to begin providing its broadband AMSS service in the United States through its Connexion by Boeing[SM] business.[4] Connexion is the leading provider of real-time, two-way advanced broadband communications services to commercial, government and private aircraft

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[2] *Id.* at 2.

[3] See, *e.g.*, *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range and Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates*, Notice of Proposed Rule Making, 14 FCC Rcd 1131, 1165 (1998) ("*Ku-band NGSO FSS NPRM*") (observing that DBS licensees are providing services to aircraft).

[4] *See The Boeing Company,* Order and Authorization, 16 FCC Rcd 22645 (Int'l Bur./OET 2001) ("*Transmit-Receive Order*").

customers. Connexion's two-way Internet service will begin commercial service this year to passengers on major international airlines through agreements with such carriers as Lufthansa, Scandinavian Airlines Systems ("SAS"), All Nippon Airways, Japan Airlines ("JAL") and China Airlines. As part of its broadband services, Connexion offers to its executive aircraft customers the ability to receive aeronautical DBS services in the United States. Boeing has recently teamed with Rockwell Collins to extend this service offering to the general aviation market under the name "Collins eXchange."[5] The ability to receive DBS signals will be an important component of the Collins eXchange service offering.

Connexion currently offers executive aircraft customers in the continental United States the option of receiving DirecTV's DBS services in the United States using the same transmit/receive antenna that Connexion uses to deliver broadband Internet services. Connexion provides most of its Internet services in North America using the AMC-4 satellite, which is co-located with DirecTV's satellites at 101° W.L., further enabling the provision of both DBS and Internet services to aircraft passengers and crews. Serving a customer base that has been largely neglected by other communications technologies, Connexion allows passengers and flight crew to stay connected with colleagues, increase their productivity, and make more efficient use of their time in the air.

The Commission concluded in 1998 that aeronautical DBS service is not a secondary service, but is "consistent with the allocation because the DBS definition in the

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[5] *See http://www.boeing.com/news/releases/2003/q4/nr_031007j.html*

Commission's Rules does not limit transmissions to fixed receive earth stations."[6] As such, aeronautical DBS is entitled to the same protection as other DBS services. In this regard, Boeing has conducted an interference analysis of the proposals that have been presented to the Commission to launch and operate DBS satellites with 4.5° orbital spacing. This interference analysis, which appears as an attachment to these comments, clearly indicates that short-spaced DBS satellites operating without technical restraints are likely to disrupt the reception of Connexion's DBS services. The increased interference would result in a negative link budget margin to Connexion's aeronautical receive antennas that would prevent customer reception.

Boeing therefore urges the Commission to take into account the attached interference analysis when developing the technical restrictions that should be imposed on short-spaced DBS satellites to enable their launch and operation while at the same time preventing harmful interference to existing services. In particular, the Commission may need to require satellites authorized at short-spaced DBS orbital positions to operate using a maximum effective isotopically radiated power ("eirp") level that is lower than the level authorized for existing DBS satellites.

Once adequate operating limits have been developed, the Commission can authorize a new generation of short-spaced DBS satellites capable of providing additional competition and services for the benefit of consumers, without disrupting existing DBS

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[6] *Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range and Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates*, First Report and Order and Further Notice of Proposed Rule Making, 16 FCC Rcd. 4096, 4173 (2000) (*citing Ku-band NGSO FSS NPRM* at 1165; 47 C.F.R. § 100.3 (*renumbered as* 47 C.F.R. § 25. 201)).

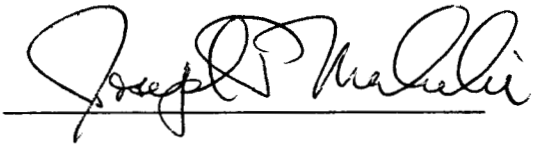
services. Such an approach would promote the more efficient use of DBS spectrum, protect existing DBS services from harmful interference, and preserve the investment of consumers in existing DBS equipment.

III. CONCLUSION

For the reasons set forth above, the Commission should develop rules and operating restrictions for short-spaced DBS satellites that will enable the Commission to adopt more efficient orbital spacing for DBS satellites, while ensuring that the quality and availability of existing DBS services are not harmed or disrupted.

Respectfully submitted,

THE BOEING COMPANY

By: 

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Engineering Analysis of Interference to 30 cm Airborne DBS Receive Earth Stations due to Reducing Spacecraft Orbital Spacing from 9 Degrees to 4.5 Degrees

Introduction

DBS service is routinely received by aircraft using tail mounted and fuselage mounted antennas. Due to size, weight and aerodynamic factors, the largest antenna that can be accommodated on board aircraft for this purpose is 30 centimeters. Although this size antenna can provide satisfactory service using spacecraft spaced at 9 degree intervals, reducing the orbital spacing of the spacecraft to 4.5 degrees could cause interference to stations using these antennas and significantly degrade performance to the stations.

Link Budget

In order to estimate the increase in interference caused by reducing orbital spacing from 9 degrees to 4.5 degrees, link budgets have been calculated for hypothetical aircraft earth stations using both 30 and 45 centimeter antennas. These budgets were calculated for both the DirecTV and Echostar systems and are shown in the accompanying Table.

The performance of both the 30 and 45 centimeter antennas is assumed to meet the requirements given in ITU-R Recommendation BO.1443-1. The following parameters for the link budgets were taken from FCC Document DA 01-441[1]: satellite longitude, frequency, required operating threshold, receive noise bandwidth, average satellite EIRP, 45 centimeter G/T and C/I for other assignments in the BSS Plan.

The earth station latitude, earth station longitude, earth station altitude were assumptions. The atmospheric attenuation was derived from ITU-R Recommendation 676-3. The rain attenuation was an assumed worst case considering

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[1] *See Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range; Amendment of the Commission's Rules to Authorize Subsidiary Terrestrial Use of the 12.2-12.7 GHz Band by Direct Broadcast Satellite Licensees and Their Affiliates*, Fourth Erratum, DA 01-441, ET Docket No. 98-206 (Feb. 16, 2001).

that the aircraft would usually be operating at altitudes where rain was not present. The pointing loss was an assumed worst case. The G/T for the 30 cm station was assumed as a reasonable value obtainable with existing technology.

All other values in the Table were derived from the data above.

The C/I for other DBS systems for the 30 cm station and for the reduced orbital spacing was calculated from the values given in FCC Document DA 01-441. The sidelobe performance of both the 30 and 45 centimeter antennas was assumed to be given by the formulas in ITU-R Recommendation BO.1443-1. It was assumed that all interference comes from the immediately adjacent satellites. The gain of both the 30 and 45 centimeter antennas is identical at 9 degrees off-axis angle, thus, the C/I due to other systems is the same for stations using these antennas sizes. The C/I for the 45 centimeter antenna at a 4.5 degree satellite spacing was taken as the C/I at the 9 degree spacing minus the difference in the antenna gain at 9 degrees and at 4.5 degrees. As an example, for the DirecTV system, the C/I using a 45 centimeter antenna with a satellite spacing of 9 degrees is 20.7 dB. For the 45 centimeter antenna, the antenna gain at 9 degrees off-axis angle is 5.14 dBi, while the gain at 4.5 degrees off-axis angle is 15.87 dBi. The C/I is, thus:

$$C/I = 20.7 - (15.87 - 5.14) = 9.97 \text{ dB}.$$

The C/I for other systems for the 30 centimeter antenna was computed in a similar fashion.

The overall carrier-to-noise plus interference was taken as the power sum of the carrier-to-thermal noise, the carrier-to-interference due to other systems and the feeder link carrier-to-noise plus interference.

Conclusions

It is apparent from the link budgets in the Table that introducing additional satellites at orbital spacings of 4.5 degrees will increase the interference to existing DBS earth stations. In particular, earth stations with smaller antennas will be affected to a greater extent than those with the typical 45 cm antenna. Aircraft earth

stations using 30 cm antennas can operate with satellites at orbital spacings of 9 degrees but when satellites are spaced at 4.5 degree intervals, link margins become negative. Negative link margins imply that the received signal is degraded to the point of being unusable. Additional constraints may, for example, on satellite EIRP, may be required on new satellites spaced at 4.5 degrees, between the existing satellites, to allow airborne DBS to continue to operate.

Table 1
Link Budgets for DBS Earth Stations

		DirecTV	Echostar	DirecTV 4.5 degree	Echostar 4.5 degree
Satellite Longitude	Degrees	101	119	101	119
Earth Station Latitude	Degrees	40	40	40	40
Earth Station Longitude	Degrees	98	98	98	98
Earth Station Altitude	km	3	3	3	3
Frequency	GHz	12.45	12.45	12.45	12.45
Required Operating Threshold	dB	5	6.1	5	6.1
Rx Noise Bandwidth	MHz	24	24	24	24
Average Satellite EIRP	dBW	51	51	51	51
Satellite Range	km	37501.84	37501.84	37501.84	37501.84
Free Space Path Loss	dB	205.8	205.8	205.8	205.8
Atmospheric Attenuation	dB	0.08	0.08	0.08	0.08
Rain Attenuation	dB	0.5	0.5	0.5	0.5
Pointing Loss	dB	0.5	0.5	0.5	0.5
45 cm G/T	dB/K	14.5	14.5	14.5	14.5
30 cm G/T	dB/K	8.5	8.5	8.5	8.5
Carrier-to-Thermal Noise Ratio 45cm	dB	13.39	13.39	13.39	13.39
Carrier-to-Thermal Noise Ratio 30cm	dB	7.39	7.39	7.39	7.39
C/I Other DBS 45cm	dB	20.7	20	25.84	25.84
C/I Other DBS 30 cm	dB	20.7	20	25.84	25.84
Feeder Link C/(N+I)	dB	24.2	26.2	24.2	26.2
Overall C/(N+I) 45 cm	dB	12.36	12.35	12.82	12.94
Margin 45 cm 45 cm	dB	7.36	6.25	7.82	6.84
Overall C/(N+I) 30 cm	dB	7.11	7.11	7.24	7.27
Margin 30 cm 30 cm	dB	2.11	1.01	2.24	1.17

Constants	
Earth Radius (km)	6378
GSO Altitude (km)	35787
c (m/Sec)	3.00E+08

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION SUBMITTED WITH THESE COMMENTS

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information submitted with these Comments, that I am familiar with Part 25 of the Commission's Rules, that I have either prepared or reviewed the engineering information submitted with these Comments, and that it is complete and accurate to the best of my knowledge.

By: David E. Weinreich

David E. Weinreich
Connexion by Boeing
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January 22, 2004