and Space Administration ("NASA") tracking data and relay satellite system ("TDRSS"). The Commission proposes to permit NGSO FSS licensees to operate in the 13.80-14.0 GHz band on a shared basis with existing services. The Commission also proposes, however, to exclude for the present NGSO FSS systems from the 13.75-13.80 GHz band. The Commission also requests comment on specific sharing issues involving NGSO FSS earth stations, U.S. Department of Defense radiolocation operations and TDRSS/LEO links in the 13.75-13.80 GHz band.

1. The Commission Should Permit NGSO FSS Operations in the 13.80-14.0 GHz Band Subject to Appropriate Sharing Requirements. (¶¶ 38-44)

Boeing supports the Commission's proposal to permit NGSO FSS operations in the 13.8-14.0 GHz band.[39] Ku-band NGSO FSS Gateway uplink operations can share the 13.8-14.0 GHz band with incumbent government and GSO FSS operations, subject to proper coordination and spectrum sharing criteria. Specifically, the FCC proposes to apply the same EIRP and minimum antenna diameter limits applicable to GSO FSS operations to NGSO FSS operations in the band.[40] Boeing supports the Commission's tentative decision to extend these limits to NGSO FSS operations. The use of a minimum antenna size of 4.5 meters will provide consistent requirements for all NGSO FSS Gateway earth stations and will facilitate efficient spectrum sharing in the band. In the *NPRM*, the FCC also proposes to extend existing coordination procedures to NGSO FSS

[39] *See NPRM*, ¶ 39.

[40] *See id.*, ¶ 42 (*citing* ITU-R Radio Regulations, footnotes S5.502 and S5.503).

earth stations operating in the 13.8-14.0 GHz band.[41] Boeing supports the extension of these procedures to NGSO FSS earth stations in the band.

In the *NPRM*, the FCC requests comment on the appropriate technical requirements to enable NGSO FSS Gateway uplink operations to share the 13.8-14.0 GHz band with GSO FSS operations and Government operations. The FCC should adopt for the 13.8-14.0 GHz band the same interference limits proposed for the 12.75-13.25 GHz band.[42] Specifically, the Commission should adopt the new definition of APFD (now $EPFD_{UP}$), along with the associated reference Ku-band NGSO antenna pattern developed by JTG 4-9-11.[43] The FCC should also protect inclined GSO satellites by applying to the 13.8-14.0 GHz band the same $EPFD_{UP}$ limits that Boeing proposed for the 12.75-13.25 GHz band.[44]

Boeing's proposed APFD definition allows multiple NGSO systems to operate with insignificant interference impact to GSO normal and inclined operations. Uniform rules for all the proposed NGSO FSS Gateway uplink bands (12.75-13.25 GHz, 13.8-14.0 GHz, and 14.4-14.5 GHz) allows a common design and operational approach for NGSO FSS Gateway operations. These proposed modifications provide inclined GSO operational protection for the vast majority of the time and minimizes the impact to NGSO FSS system design and operations.

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[41] *See id.*

[42] *See supra* Part 1, Section III, subsection B.

[43] *See* Doc. 4-9-11/TEMP/40-E (Rev. 2).

[44] *See supra* Part 1, Section III, subsection B1.

2. The Commission Should Withhold Judgment on Whether Spectrum Sharing is Feasible Between Ku-band NGSO FSS Systems and NASA's TDRSS in the 13.75-13.80 GHz Band Until Studies are Completed by JTG 4-9-11. (¶ 43)

In the *NPRM*, the Commission concludes that it currently should not permit NGSO FSS systems to operate in the 13.75-13.80 GHz segment in order to protect NASA's TDRSS operations.[45] The Commission acknowledges, however, that JTG 4-9-11 is continuing to study the feasibility of NGSO FSS sharing with NASA operations. Because of this work, the Commission indicates that it may permit NGSO FSS operations in the 13.75-13.80 GHz band segment if the results of international studies warrant such operations.

Boeing acknowledges that the Commission must take whatever steps are necessary to protect NASA TDRSS operations in the 13.75-13.80 GHz band. The Commission should withhold judgement, however, on whether spectrum sharing is feasible between NGSO FSS systems and TDRSS until examination of the issue by JTG 4-9-11 is completed. If the international technical group develops a spectrally efficient means for NGSO FSS systems to share the same spectrum with TDRSS, the Commission should permit NGSO FSS operations in the band.

It should be noted that through the use of satellite diversity, NGSO FSS systems can avoid causing harmful interference to TDRSS/LEO links in the 13.75-13.80 GHz band. The Boeing NGSO FSS system was designed with sufficient assets to utilize satellite diversity to avoid inline interference events with TDRSS/LEO links. Boeing may have to add additional space segment assets to its system, however, in order to share

[45] *See NPRM*, ¶ 43.

spectrum with both TDRSS/LEO links and one or more co-frequency inhomogeneous NGSO FSS systems.

D. NGSO Gateway Uplink Operations Can Share the 14.4-14.5 GHz Band With the Incumbent Services Subject to Appropriate Sharing Criteria. (¶¶ 45-46)

In the *NPRM*, the FCC asks for comment and proposals on the appropriate technical requirements to enable NGSO FSS Gateway uplink operations to share the 14.4-14.5 GHz band with GSO FSS uplink operations.[46] The FCC should support the provisional limits developed by JTG 4-9-11.[47] These limits were developed as a result of lengthy international deliberations in which representatives of the United States government and industry were well represented.

Boeing also believes that NGSO FSS user terminals could be accommodated in the 14.4-14.5 GHz band. If a NGSO FSS system meets the spectrum sharing requirements discussed previously, the NGSO user terminal would appear to be just another "VSAT like" terminal in the 14.0-14.5 GHz band – a band that already accommodates "several hundred or thousand VSAT antennas."[48]

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[46] *See id.*, ¶ 46. The Commission also makes inquiry regarding APFD limits, TT&C protection and protecting GSOs in the 14.0-14.5 GHz band. Boeing's position on these issues is included *supra* at Part 1, Section 1, subsection B.

[47] *See* Doc. 4-9-11/TEMP/40-E (Rev. 2).

[48] *See NPRM*, ¶ 45, n. 82.

IV. THE COMMISSION SHOULD AUTHORIZE NGSO FSS SYSTEMS TO PROVIDE DOWNLINK SERVICE TRANSMISSIONS IN THE 11.7-12.7 GHz BANDS. (¶¶ 53-62)

A. NGSO FSS Systems can Operate in the 11.7-12.2 GHz Band On a Shared Basis With Incumbent Spectrum Users. (¶¶ 53-54)

Boeing supports the Commission's tentative decision to permit NGSO FSS service downlink operations in the 11.7-12.2 GHz band subject to appropriate spectrum sharing criteria to protect GSO FSS downlinks. In Part 1, Section II, of these Comments, Boeing discussed the efforts that are underway by international technical groups to develop EPFD interference limits that will be appropriate to protect GSO receive antennas in the 10.7-11.7 GHz band. As the Commission acknowledges in the *NPRM*, studies conducted to date by ITU-R indicate that the appropriate EPFD levels are not likely to vary greatly from the WRC-97 provisional limits.[49] Accordingly, Boeing is confident that the efforts of ITU-R will be concluded successfully.

The same EPFD values eventually adopted for the 10.7-11.7 GHz band will also be adequate to protect GSO FSS receive antennas in the 11.7-12.2 GHz band. This is because the EPFD interference level to GSO FSS earth stations is identical, regardless of whether the NGSO transmissions are being directed to NGSO Gateway earth stations or NGSO customer terminals. In both cases, the performance degradation of GSO earth stations can be stated as a loss in the C/N due to the additional interference produced by the NGSO satellites. This can be shown as:

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[49] *Id.*, ¶ 26.

$$\frac{C}{N+I} = \frac{C}{N \cdot \left(1 + \frac{I_o}{N_o}\right)}$$

A constant value of I_o/N_o will therefore lead to consistent performance impacts to GSO earth stations. From I_o/N_o, an EPFD value can be developed which is independent of frequency.

$$EPFD = 4\pi \cdot \frac{I_o}{N_o} \cdot kT_{sys} \cdot \frac{BW_{ref}}{5.89 \cdot D^2} \qquad \frac{D}{\lambda} < 100$$

$$EPFD = 4\pi \cdot \frac{I_o}{N_o} \cdot kT_{sys} \cdot \frac{BW_{ref}}{6.92 \cdot D^2} \qquad \frac{D}{\lambda} > 100$$

Where k is Boltzman's Constant,
Tsys is the GSO receive noise temperature,
BWref is the reference bandwidth (4kHz in Ku-band),
D is the diameter of the GSO antenna.
and λ is the transmission wavelength.

Therefore, the same level of EPFD in this band would produce the same level of link degradation in each frequency band.[50]

In addition, the EIRP transmitted by a NGSO satellite, along with the EPFD at the Earth's surface, will be the same independent of the number of NGSO user terminals that are receiving the transmission. Therefore, the same EPFD limits applied across both bands will produce essentially the same performance impact on the GSO earth stations in both bands.

[50] Boeing's comments on EPFD interference levels discussed *supra* for different band segments also apply in the case of large GSO earth station antennas, inclined GSO operations and TT&C operations.

With respect to secondary mobile operations in the band, such operators would experience the same interference impact resulting from NGSO FSS satellites as would be caused by GSO satellites. This is because the source of interference is the satellites, regardless of whether they are GSO or NGSO.

B. NGSO FSS Systems can Operate in the 12.2-12.7 GHz Band Using the Interference Limits Under Consideration by JTG 4-9-11 to Adequately Protect BSS Satellite Networks. (¶¶ 55-62)

As the Commission observes in the *NPRM*, at the close of WRC-97 United States direct broadcast satellite ("DBS") operators were not satisfied with the provisional limits that were adopted to protect DBS systems.[51] Since that time, U.S. DBS interests have played a major role in developing techniques and interference limits intended to protect DBS systems. The U.S. DBS industry's efforts have been focused on ITU-R technical groups JTG 4-9-11 and JWP 10-11S and, as a result, considerable progress has been made in establishing an international consensus. In fact, JTG 4-9-11 is poised to recommend text to the WRC-00 Conference Preparatory Meeting ("CPM") that, Boeing believes, more than adequately protects DBS interests. Thus, although international deliberations are not yet complete, the Commission should be able to rely on the final outputs of ITU-R technical groups as a reasonable basis for FCC rules to protect DBS systems in the United States.

In the *NPRM*, the Commission also requests comment on the criteria that should be used in determining appropriate EPFD limits for the Broadcast Satellite Service

[51] *See NPRM*, ¶ 56.

("BSS").[52] Boeing believes that the work completed by ITU-R technical groups provides a well-reasoned consensus approach to setting EPFD limits. In recent months, both JWP 10-11S and JTG 4-9-11 have generally agreed on a Preliminary Draft New Recommendation ("PDNR") that includes interference criteria that should be used to develop appropriate EPFD limits.[53]

The interference criteria indicates that for BSS networks, the aggregate inter-network interference caused by NGSO FSS satellite networks should: (1) be responsible for at most 10% of the time allowance(s) for unavailability of the given C/N value(s) as specified in the performance objectives of the desired network,[54] and (2) not lead to loss of synchronization in the desired GSO BSS and associated feeder-link network under clear sky conditions.[55] DBS industry representatives were involved heavily in developing

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[52] *See id.*, ¶ 57.

[53] The Preliminary Draft New Recommendation ("PDNR") is entitled "Protection of the Broadcasting-Satellite Service in the 12 GHz Band and the Associated Feeder-Links in the 17 GHz Band From Interference Caused By NGSO FSS Systems" *See* Doc.10-11S/TEMP/41 (Oct. 9, 1998) and Addenda and Revisions. It was adopted by JWP 10-11S at its October 1998 meeting. The JTG 4-9-11 meeting of January 1999 endorsed the elements of the JWP 10-11S PDNR with only one minor change. *See* Doc. 4-9-11/TEMP/93. The aforementioned change to the PDNR was recommended to JWP 10-11S at the January 1999 meeting of JTG 4-9-11. *See* Doc. JTG 4-9-11/TEMP/93, Section 2 and Annex 6. The change proposed was to substitute in "Recommends 1.2" "the onset of 'freeze frame'" instead of "loss of synchronization." It is anticipated that JWP 10-11S will accept this recommendation since the consequence of the change is expected to be insignificant.

[54] The C/N value(s) are determined where N is the total noise level of the wanted carrier including all other non-time-varying sources of interference.

[55] At the January 1999 meeting of JTG 4-9-11, agreement was reached to employ a "freeze-frame" criterion instead of considering synchronization loss. The views of JWP 10-11S have been sought on this issue.

these interference criteria. Boeing believes that the Commission should adopt the same criteria in recognition that it is adequate to protect BSS transmissions.

In the *NPRM*, the Commission also acknowledges that JTG 4-9-11 has been considering the impact of non-symmetrical receive patterns for BSS antennas, as well as how EPFD limits can be applied to antenna diameters different than those specified in the WRC-97 provisional limits.[56] Considerable progress has been made in the area of non-symmetrical BSS receive antenna patterns. The January JTG 4-9-11 agreed on many of the issues and has asked JWP 10-11S for corroboration and/or to perform limited further analysis. While not much work was accomplished on the question of how "intermediate" diameter antenna can be addressed, the JTG has asked both WP4A and JWP 10-11S to carry on that work. Boeing will submit contributions in the U.S. preparatory committees for both WP 4A and JWP 10-11S that will include a methodology to develop continuous curves of long-term EPFD limits as a function of antenna size. When Boeing contributions achieve international consensus, the Commission's concerns in the area should be alleviated.

The Commission also requests comment on the impact that the WRC-97 provisional EPFD limits will have on current and future DBS operations and flexibility.[57] First, the underlying assumption in the Commission's request for comment appears to have been overtaken by events. The January 1999 meeting of JTG 4-9-11 reached tentative agreement on significant changes to the WRC-97 provisional EPFD limits in the

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[56] *See NPRM*, ¶ 58.

[57] *See id.*

BSS bands.[58] The new EPFD limits are considerably more stringent and more extensive than the provisional limits adopted by WRC-97. The changes were made primarily at the request of U.S. DBS interests. Thus, when these newly proposed limits are adopted, it is extremely unlikely that the current or future flexibility of DBS operations in the U.S. would be unnecessarily encumbered.

Additionally, the *NPRM* seeks comment on whether the provisional EPFD limits of WRC-97 will adequately protect the 0.45-meter antennas widely used in the U.S. for DBS reception.[59] A new EPFD mask for a 0.45-meter antenna based on U.S. inputs was tentatively agreed to during the January 1999 meeting of JTG 4-9-11.[60] In addition, Boeing will be presenting a document to US JWP 10-11S that shows that the long-term interference levels inherent in its system design will not cause unacceptable interference to 0.45-meter antennas.

In the *NPRM*, the Commission asks for comment on the need to identify additional time periods for specifying EPFD limits.[61] Annex 3 of ITU-R Document JTG 4-9-11/TEMP/93 shows additional agreed-to time periods and EPFD limits for antennas with diameters of 0.30, 0.45, 0.60, 0.90 and 1.2 meters. In addition, Annex 5 of the document shows these new factors for an EPFD mask developed at the most recent JTG 4-9-11 meeting for 0.45-meter antennas. Boeing believes the new EPFD masks for these antennas will be able to protect U.S. DBS operations from NGSO FSS interference both

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[58] *See* Doc. JTG 4-9-11/TEMP/93.

[59] *See NPRM*, ¶ 59.

[60] *See* Doc. JTG 4-9-11/TEMP/93, ¶ 3 and Annex 5.

[61] *See NPRM*, ¶ 60.

now and in the future. Moreover, the unique interference mitigating techniques inherent in the proposed Boeing NGSO FSS system will readily meet the requirements of these new, tentative EPFD masks.

The Commission also requests comments regarding the reception of DBS signals aboard aircraft.[62] Boeing believes that the same NGSO system EPFD limits used to protect DBS downlink transmissions should be applied regardless of whether a DBS receive antenna is on the ground or affixed to a mobile platform, such as an airplane. It is arguably implausible to require NGSO FSS systems to transmit at different EIRP levels depending on whether DBS receive antennas are fixed or mobile. Thus, in order to encourage efficient spectrum use, DBS operators wishing to provide satellite services to aircraft should utilize receive antennas with radiation patterns that are adequate to meet the interference avoidance levels that are eventually adopted by WRC-00.

Finally, the *NPRM* solicits comments on the impact of NGSO FSS system interference on BSS TT&C operations.[63] As indicated in Boeing's Ku-band NGSO FSS application, the interference mitigation technique employed in the Boeing NGSO FSS system provides more than sufficient protection for the large earth station antennas that are used by BSS operators for TT&C purposes. Boeing also believes that its response in Part 1, Section II, subsection E, of these Comments regarding GSO FSS TT&C operations are also applicable to BSS TT&C transmissions. Furthermore, any difficulties that may exist can be resolved through the Commission's proposal to require GSO and

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[62] *See id.*, ¶ 61.

[63] *See id.*, ¶ 62.

NGSO operators to coordinate their transfer orbit operations and to provide protection for emergency TT&C operations.

V. THE COMMISSION SHOULD PERMIT KU-BAND NGSO FSS SERVICE UPLINK OPERATIONS IN THE 14.0-14.4 GHz BAND. (¶¶ 63-66)

The Commission is correct in concluding that Ku-band NGSO FSS systems can effectively share the 14.0-14.4 GHz band with existing operators utilizing the same uplink APFD limits discussed *supra* in Part 1, Section III, subsection B, of these comments.[64] Furthermore, secondary operations in the band should not suffer any greater impact than they would from existing GSO FSS uplinks, including ubiquitously deployed VSAT terminals.

A. NGSO FSS User Terminals can Operate in the 14.0-14.4 GHz Band Using $EPFD_{up}$ Limits to Protect GSO FSS Networks. (¶¶ 63-66)

The ITU-R developed $EPFD_{up}$ limits to protect GSO systems from unacceptable levels of interference caused by the introduction of NGSO FSS systems in the same band. In previous discussions, it has been shown that the signal degradation in GSO networks for a given level of EPFD/APFD is independent of frequency. Therefore, whether considering the Gateway uplink band (12.75-13.25 GHz, and 13.75-14.5 GHz) or the service uplink band (14.0-14.5 GHz), the same APFD limit applied across both bands will provide the same level of protection to the GSO networks.

The fact that the 14.0-14.4 GHz band may be used by an unlimited number of NGSO user terminals does not compromise the protection that APFD limits will provide

[64] Boeing's comments relative to the issues regarding APFD limits, TT&C protection, GSO inclined orbit concerns and others discussed above relative to Gateway uplinks are also applicable to this section.

GSO FSS networks. This is because, by definition, an APFD is an aggregate PFD from all earth stations of a NGSO system that are transmitting within an area.[65] As long as this aggregate value is not exceeded, the interference into the GSO network will not exceed acceptable levels.

In order to ensure that the total number of simultaneous users does not exceed the aggregate APFD level, the Boeing Ku-band NGSO system will implement a number of system level constraints. An example of these constraints is preventing an earth station from transmitting to a satellite until the earth station has first detected and is tracking the beacon signal of a satellite outside of the exclusion zone. Inclusion of this constraint ensures that earth station antennas operating with the Boeing NGSO FSS system are not mispointed toward the GSO arc.

A concurrent constraint is the use of an order-wire architecture to assign channel resources to user terminals. Pursuant to this method, user terminals operating with the Boeing system initiate a transmission by sending a "request for service" message to a Gateway through the satellite. The Gateway then responds to the user terminal by assigning a channel through the satellite, but only if capacity is available without exceeding the APFD limit. Utilizing this architecture, Boeing can control the number of simultaneous users and therefore limit the APFD being produced at the GSO arc. Additionally, Boeing may implement other constraints as necessary in order to ensure

[65] Furthermore, even the inclusion of Gateway uplink operations in the 14.2-14.4 GHz band will not compromise the protection provided to GSO FSS networks because the NGSO FSS operator must still comply with the APFD levels.

that the simultaneous number of user terminals transmitting with the Boeing NGSO FSS system do not exceed the requisite APFD limit.

In light of the adequacy of the APFD limits that have been developed by international technical groups to protect GSO FSS operations in the 14.0-14.4 GHz band, the Commission should incorporate the limits in its rules and authorize NGSO FSS uplink service transmissions in the band.

B. Boeing Does Not Object at This Time to NGSO FSS Gateway Operations in the 14.2-14.4 GHz Band. (¶¶ 63-66)

In the *NPRM*, the Commission proposes to permit NGSO FSS licensees to operate both service uplinks and Gateway uplinks in the 14.2-14.4 GHz segment.[66] Boeing believes that the 14.2-14.4 GHz spectrum segment should be used primarily for NGSO FSS user terminal uplink transmissions. This is because the 14.0-14.4 GHz band is the only spectrum identified in the *NPRM* as available for user terminal uplinks.

At this time, however, Boeing is not raising a formal objection to the use of the 14.2-14.4 GHz segment for Gateway uplink transmissions. This is because preliminary analysis of NGSO/NGSO sharing issues indicates that the avoidance angle between two NGSO satellites necessary to minimize interference does not significantly change whether the link being considered is a service link or a Gateway link. Boeing is concerned, however, that additional analysis may reveal a different result – specifically that Gateway operations in the 14.2-14.4 segment may make NGSO/NGSO spectrum sharing appreciably more difficult. Accordingly, Boeing expressly reserves the right to object at a later time to Gateway operations in the 14.2-14.4 GHz segment if further

[66] *See NPRM*, ¶ 66.

analysis determines that NGSO/NGSO sharing is significantly impacted by the inclusion of Gateway links in the service link band.

PART TWO
MULTIPLE NGSO SPECTRUM SHARING

I. THE COMMISSION SHOULD ENABLE MULTIPLE NGSO FSS LICENSEES TO OPERATE WITH OTHER SPECTRUM USERS USING AGGREGATE EPFD/APFD VALUES TO APPROPRIATELY ALLOCATE INTERFERENCE. (¶¶ 72-74)

The Ku-band NGSO FSS sharing criteria developed at WRC-97 are based upon a single NGSO FSS satellite or NGSO FSS satellite system.[67] In order for the WRC-97 limits to protect GSO systems adequately, the criteria must take into account the anticipated number of NGSO FSS systems that will be able to share the same spectrum. As the Commission correctly observes, adopting an accurate prediction is extremely important.[68] If the predicted number of NGSO FSS systems is too large, the allowable interference criteria for each individual system will be so small that no party will be able to launch and operate a NGSO FSS system. On the other hand, if the predicted number is too small, the aggregate interference produced by co-frequency NGSO systems may exceed the WRC-97 criteria.

In predicting the number of NGSO FSS systems that can operate co-frequency, JTG 4-9-11 agreed during its January 1999 meeting that the effective number of NGSO systems to be considered in determining single entry EPFD/APFD values from the

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[67] *See id.*, ¶ 72.

[68] *See id.*

aggregate values was in the range of 3 to 5.[69] As discussed in the following Section, Boeing is beginning to believe that the number of inhomogeneous NGSO systems that can economically share the same spectrum may be three.[70]

The number of NGSO systems that can share spectrum is limited by the need to avoid interference among NGSO systems, while adequately protecting GSO networks. Interference among NGSO systems will occur when satellites from two or more NGSO systems are aligned with a NGSO earth station. The interference mitigation techniques that have been proposed are satellite diversity or earth station diversity, meaning that a signal is switched to a different asset that is not in an interference alignment condition.

The use of these diversity techniques requires that NGSO operators have unused system assets available to switch to, which requires that NGSO operators have more space and ground assets available than would be required if they were the only NGSO system operating in the spectrum. The more NGSO systems there are, the more inline events will occur, and the more assets each NGSO system will have to have in order to provide reliable service. Like a code division multiple access ("CDMA") system, the number of asynchronous users that can be handled in a channel is severely limited by the self-interference. The is also true for multiple NGSO systems.

When all of these factors are considered together, Boeing believes that it may be difficult for more than three inhomogeneous systems to share the same spectrum. Any

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[69] *See* Doc. JTG 4-9-11/TEMP/77E ("Derivation of Number of NGSO FSS Networks to be Considered in Sharing Studies").

[70] In reaching this tentative conclusion, Boeing observes that all of the applications filed in response to the FCC's January 8, 1999 cut-off deadline designed inhomogeneous systems.

spectrum sharing prediction that exceeds three systems is likely to burden Ku-band NGSO FSS systems unnecessarily and could compromise the ability of any operator to launch a viable system.

In the *NPRM*, the Commission also considers how the interference criteria adopted by WRC-97 should be divided between multiple co-frequency NGSO systems. Boeing notes that JTG 4-9-11 has responded to this issue by developing aggregate EPFD/APFD values that will not cause unacceptable interference to the GSO systems.

The JTG is also studying how transmissions from multiple NGSO systems combine to produce an aggregate level of EPFD/APFD. Three different zones have been identified.[71] Zone A represents the region of long-term interference. In this region, the interference power from multiple NGSO systems is directly cumulative. Zone B represents the short-term interference region. In this region, the power from multiple systems is not cumulative because there is an extremely low probability that two short-term events will occur simultaneously at the same location. Instead, the time percentages of these interference events are cumulative. Finally, Zone C has been identified for very short percentages of time where the worst case interferer produces single entry interference that is equivalent to the aggregate interference allowable. The existence of Zone C has been questioned by some parties and will not be considered further here.

Using the above criteria, a permissible interference level for a single NGSO system can be determined based on the cumulative characteristics of the various zones and the number of NGSO systems that can be accommodated. For example, the Boeing

[71] *See* Doc. JTG 4-9-11/TEMP/59 (Rev. 1).

Ku-band NGSO FSS system produces only long-term interference into GSO networks and, therefore, would only contribute to the cumulative total of Zone A interference.[72] Through the use of JTG 4-9-11's aggregate level of interference methodology, the Commission would be able to ensure that Ku-band NGSO FSS systems will not cause unacceptable interference into the GSO systems simply by dividing the aggregate level of interference between the effective number of systems.

II. THE COMMISSION SHOULD ADOPT TECHNICAL RULES THAT FACILITATE SPECTRUM SHARING BETWEEN MULTIPLE NGSO FSS SYSTEMS. (¶¶ 67-71)

In the *NPRM*, the Commission requests comment on technical rules that would facilitate sharing among NGSO FSS systems.[73] Boeing has included in other sections of its comments proposed technical requirements that would aid in NGSO spectrum sharing. For example, Boeing believes that the Commission should adopt minimum size requirements for NGSO Gateway earth stations. While Boeing's suggested technical rules would help facilitate spectrum sharing, Boeing has not yet completed a detailed methodology for spectrum sharing between two or more of the pending applicants in the FCC's Ku-band NGSO FSS processing round. As a result of analysis conducted to date, however, a number of important facts have become clear, which are outlined below.

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[72] This is because the Boeing NGSO FSS system does not produce inline interference events into GSO networks.

[73] *See NPRM*, ¶ 69.

A. Multiple Inhomogeneous NGSO FSS Systems Should be Accommodated in Any NGSO/NGSO Spectrum Sharing Rules That are Adopted.

First, as is evident, none of the pending Ku-band NGSO FSS applicants have proposed homogeneous systems. Furthermore, the systems that have been proposed are sufficiently inhomogeneous that it is unlikely that any of the systems can be "homogenized" without discarding the constellation and systems designs that have been prepared by each applicant. In light of this fact, Boeing believes that any NGSO/NGSO sharing rules that are adopted by the Commission should anticipate the likelihood that inhomogeneous NGSO FSS systems will be built.

B. All Ku-band NGSO FSS Systems Licensed in the Current Processing Round Must be Responsible for an Equal Portion of the Spectrum Sharing Burden.

Second, the Commission is correct in concluding that all NGSO FSS systems licensed in the current proceeding must be responsible for some portion of the burden of spectrum sharing.[74] Without an equitable distribution of the burden sharing, a NGSO FSS operator unencumbered by the spectrum sharing burden would be able to externalize the costs of spectrum sharing and, as a result, would have no incentive to construct a spectrally efficient satellite system. At the same time, licensees encumbered with the burden of spectrum sharing would be forced to bear a significant and disproportionate portion of the cost of constructing the redundant satellite and earth station assets that are

[74] In order to ensure an equitable division of the spectrum-sharing burden, the Commission should not give special preference to any of the qualified applicants in the same processing round, even if an applicant has already launched satellites.

needed for inhomogeneous spectrum sharing. This significant additional cost could compromise the ability of encumbered operators to compete in the marketplace.

C. Technical Considerations Appear to Place a Limit on the Number of NGSO FSS Systems That can Share the Same Spectrum.

Third, while international studies are continuing on NGSO/NGSO spectrum sharing, it is becoming evident that it may be difficult technically for more than three NGSO FSS systems to share the same spectrum. In order for two or more satellite systems to engage in inhomogeneous spectrum sharing, each system operator must be aware of, and be responsive to, the daily and hourly operational characteristics of its co-frequency systems. Interference events between two NGSO systems occur when satellites from the two systems are in alignment with a NGSO FSS earth station. The commonly proposed interference mitigation technique to rectify the problem is satellite diversity. Using satellite diversity, the earth station of one system switches its traffic to a different satellite of the same system that is not in the interference alignment condition.

At first blush, it would appear that the best means to implement satellite diversity would be for all co-frequency satellite operators to engage in traffic switching to avoid inline conditions. Studies have shown, however, that having two satellite systems mitigate interference at the same time does not reduce the interference below the level achieved if only one system engages in mitigation efforts.[75] Thus, if only two NGSO FSS systems share the same spectrum, an efficient solution (from a technical standpoint) would be for only one system to engage in mitigation efforts, while the unencumbered

[75] *See, e.g.*, Doc. JTG 4-9-11/288 ("Assessing the Potential Benefits of Having Two Non-GSO FSS Systems Simultaneously Implementing In-line Avoidance").

system provides financial compensation to the first for its share of the cost of the mitigation effort.[76] A major drawback of this option, however, is that it heavily penalizes the encumbered operator if the unencumbered system is never built.[77]

Another possible solution would be for two NGSO FSS systems to share traffic switching obligations. It would be inefficient for the two systems to occasionally alternate in the traffic switching duties, however, since this would require both systems to have enough redundant satellite and earth station assets to carryout the switching duties, resulting in a redundant layer of redundant facilities. Instead, it might be practical for the two operators to map out every inline event in advance and divide the switching requirements evenly between them. Such a pre-planned approach, however, would be extremely complex and may still require both systems to have more redundant satellite and earth station assets than would be necessary if only one system accepted the sharing burden in exchange for compensation.

What may be counterintuitive is that while inhomogeneous spectrum sharing between two NGSO FSS systems involves some difficulties, spectrum sharing between three NGSO FSS systems may actually be easier (at least from a coordination standpoint). When three systems operate co-frequency, a round robin approach could be used in which NGSO system-1 gives priority to NGSO system-2, which gives priority to

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[76] For example, the unencumbered system would be required to pay the encumbered system half the expense of the redundant (from a satellite diversity standpoint) satellite assets, earth station assets, replacement of these assets and additional ground control operations.

[77] Furthermore, it would be inadequate to simply designate the first system operating as the unencumbered system, since decisions about which system would be encumbered and which system would be unencumbered must be made at the system design stage.

NGSO system-3, which gives priority to NGSO system-1. A round robin might provide an effective and efficient means to resolve spectrum-sharing issues. In fact, in certain rare circumstances, a round robin approach may be too effective, such as when satellites from all three systems come into alignment (traffic from all three satellites would be scheduled to switch over).

One drawback to a round robin approach is that it does not necessarily distribute the sharing burden evenly between the three systems. For example, if one of the systems has a relatively large constellation as compared to the other two, the NGSO system required to protect the larger system would have to carry a disproportionate burden (although this is another case in which equity might be reached through compensation).

Unfortunately, while certain difficulties exist with sharing scenarios involving two or three systems, they may be insignificant compared to the problems that may exist with respect to sharing between four or more systems. If four or more systems attempt to share spectrum, it becomes almost inevitable that the spectrum-sharing burden will not be distributed equally. Furthermore, the magnitude of the disproportionate burden is likely to be substantial, bringing into question the financial viability of encumbered systems. Inter-system compensation also becomes far less manageable, particularly since the failure of any one co-frequency system to fulfill its compensation obligations could compromise the financial viability of the other parties. Finally, since all parties most likely would have some role in the daily mitigation effort, the construct, launch and initial operation of each co-frequency system would have to be scheduled in advance.

Recognizing the difficulties that may result from attempting to operate four or more NGSO systems co-frequency, Boeing believes that the Commission should help

ensure the viability of all potential Ku-band NGSO FSS licensees by employing a healthy dose of skepticism when assessing potential sharing scenarios involving four or more NGSO FSS systems.

D. Because Each Co-Frequency NGSO FSS System will be Heavily Dependent on its Spectrum Sharing Partners, the Commission Should Only License Operators That are Truly Qualified.

This brings Boeing to its fourth observation about NGSO/NGSO spectrum sharing: no matter how many systems attempt to share the same spectrum, the design, cost and launch schedule of each system will be heavily influenced by the designs of its co-frequency partners. Boeing believes that this realization should guide the Commission's deliberations throughout this proceeding.

The Commission has never before administered a satellite proceeding in which the eventual licensees will be as dependent on each other's plans to the degree that the Ku-band NGSO FSS licensees are likely to be dependent on each other. Competing Ku-band NGSO FSS operators will be forced to cooperate in constellation designs, increase satellite and earth station assets at each other's behest, synchronize launch and start-up schedules, regularly modify sharing procedures to accommodate disabled and spare satellites, and continually employ a global in-orbit control staff to constantly compare notes and make mutual accommodations.

Furthermore, since many of the cooperative obligations between NGSO FSS licensees will have to be carved in stone on the drafting table, the licensees must be able to rely on their competitor's commitments to follow through with its obligations. For example, a NGSO FSS operator in a three-way round robin scenario (NGSO system-1) cannot construct a system designed to protect NGSO system-2, only to discover that

NGSO system-2 was unable to obtain sufficient financing and, as a result, the satellite diversity needs of NGSO system-3 must be accommodated.[78]

In order for Ku-band NGSO FSS licensees to be able to adequately rely on their co-frequency partners, the Commission must ensure that each licensee is truly qualified to construct, launch and operate its proposed system. It is extremely important that each licensee has the technical and financial qualifications necessary to bring its satellite system into use on a construction schedule that accommodates its fellow licensees. If any licensee falls into arrears, with respect to either its construction schedule or compensation payment obligations, it could compromise the financial viability of every other licensed system.

Such an outcome would clearly be adverse to the public interests – reducing the likelihood that a new generation of broadband telecommunication services will be made available on a global basis and increasing the possibility that important spectrum resources will remain indefinitely fallow. Furthermore, it is unlikely that any licensee would be willing to spend the assets necessary to construct a multi-billion dollar satellite system, if such a system is required by the Commission to depend on a financially questionable satellite licensee to fulfill its spectrum sharing obligations.

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[78] Of course, in the event of such a scenario, spectrum sharing between the two remaining systems technically could occur. This is because NGSO system-3 has already been designed to protect NGSO system-1. Unfortunately, NGSO system-1 would then face double the expense – having constructed redundant assets to protect NGSO system-2 and then being faced with compensating NGSO system-3, not only for the expense of protecting its necessary satellites, but also any redundant assets that have already been launched. (It should be noted, however, that this potential fix is only available in a three-way sharing scenario, as compared to scenario involving more or fewer systems.)

In light of the significant importance of ensuring that all licensees are truly qualified to construct, launch and operate their systems, Boeing urges the Commission to adopt each of the financial, technical and applicant qualification rules discussed *infra* in these comments.

E. Band Segmentation Should be Employed Only as a Final Option to Enable Spectrum Sharing.

Boeing's fifth observation about NGSO/NGSO spectrum sharing involves the possibility of dividing the available spectrum into multiple sharing groups. In previous Comments filed with the FCC, Boeing urged the Commission to consider band division as an appropriate means to make spectrum available for Ku-band NGSO FSS systems that may be unable to share spectrum with SkyBridge on a cost effective basis. The Commission indicated in its *NPRM* that it is considering this option.

In the past fourteen months, however, several developments have prompted Boeing to question the need for, and the advisability of, adopting band division for Ku-band NGSO FSS systems. First, U.S. concerns about spectrum sharing with other commercial and government services may diminish the total amount of Ku-band spectrum available in the United States for NGSO FSS licensees. Second, international technical studies have produced promising results with respect to spectrum sharing between a limited number of inhomogeneous systems. Third, the number of qualified applicants that responded to the Commission's January 8, 1999 cut-off deadline is lower than what Boeing had anticipated.

Boeing believes that no more than three parties that filed applications with the FCC are truly qualified to construct, launch and operate NGSO FSS systems.[79] Coincidentally, this is the same number of operators that may be able to share spectrum on a technically manageable basis. Thus, while the Commission should keep the option of band division "on the table" for future consideration, Boeing believes that band division may not produce the most beneficial outcome for consumers in this proceeding. Instead, the Commission should take aggressive steps to identify those applicants that are truly qualified and serious about constructing Ku-band NGSO FSS systems. Once these applicants are identified, the Commission (with the assistance of the qualified applicants) may find it very easy to devise a spectrum sharing approach that accommodates all qualified parties without segmenting the Ku-band.

F. First Round Licensees Should Not be Required to Modify Their Systems to Accommodate Licensees From Subsequent Processing Rounds.

Boeing's sixth observation about NGSO/NGSO spectrum sharing involves the possibility of subsequent Ku-band NGSO FSS processing rounds. Boeing believes that first round licensees should not be required to redesign their satellite systems in order to accommodate NGSO FSS applicants resulting from subsequent processing rounds. As discussed above, the spectrum sharing methodologies for each co-frequency NGSO system will have to be designed carefully at the earliest stages of system construction. First round applicants cannot be expected to modify their systems once construction and/or launch is underway in order to protect currently undisclosed applicants. This does

[79] Boeing acknowledges that more than three qualified *applications* may be pending before the Commission in this proceeding, but the applications were filed by about three qualified *applicants*.

not mean that the Commission should refuse to issue licenses in subsequent Ku-band NGSO FSS application processing rounds. It simply means that licensees from subsequent processing rounds must agree to protect the operations of first round licensees using satellite diversity or other means.

G. The Possibility That Non-U.S. Licensed NGSO FSS Systems May Need to be Accommodated is Likely to Resolve Itself Without Commission Action.

Boeing's seventh and final comment on NGSO/NGSO spectrum sharing involves administrations that filed Advance Notices with the ITU-R for Ku-band NGSO FSS systems, but did not participate in the Commission's application cut-off deadline. A possibility exists that some U.S. licensed NGSO FSS systems may have to coordinate spectrum-sharing arrangements with foreign licensed NGSO FSS systems outside of the United States. The possibility that such coordination may have to occur creates certain risks for U.S. licensed NGSO FSS systems. For example, a non-U.S. system could compromise a three-way round robin sharing scenario if the non-U.S. system is included in the planning for the scenario and is then never built.

The spectrum sharing difficulties posed by non-U.S. licensed systems may resolve themselves, however, without the need for Commission action. Recognizing that the ITU now enforces a five-year due diligence milestone requirement (with a possible two-year extension), it should be very clear by the close of WRC-00 (halfway through the initial five-year period) whether any of the non-U.S. systems are serious about initiating construction. Only at that time will the Commission need to determine whether the non-U.S. systems must be included in the Commission's final spectrum sharing arrangement.

PART THREE
NGSO FSS LICENSING RULES

I. IN LIGHT OF THE SUBSTANTIAL INTER-DEPENDENCE THAT WILL BE NECESSARY BETWEEN CO-FREQUENCY NGSO FSS SYSTEMS, THE COMMISSION SHOULD ADOPT AND ENFORCE STRICT FINANCIAL QUALIFICATION RULES.

Boeing strongly supports the Commission's tentative conclusion to adopt strict financial qualification standards for Ku-band NGSO FSS applicants. The Commission bases its use of financial qualification rules on its frequently repeated conclusion that an applicant's financial capacity is a "significant factor" in determining whether it is qualified to hold a license.[80] This is because "licensees without sufficient available resources spend a significant amount of time attempting to raise the necessary financing and . . . those attempts often end unsuccessfully."[81]

A. The Use of Strict Financial Qualification Rules is Warranted Because of the Scarcity of Spectrum Available and the Reliance That Each NGSO FSS System will be Required to Place on Co-Frequency Systems.

As the Commission notes in the *NPRM*, strict financial qualification standards are usually adopted in proceedings where the available spectrum is insufficient to

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[80] *See Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands*, 9 FCC Rcd 5936, 5948-5949 (1994) ("*Big LEO Order*").

[81] *Id.* (*citing National Exchange Satellite, Inc.*, 7 FCC Rcd 1990 (Com. Car. Bur. 1992); *Rainbow Satellite, Inc.*, Mimeo No. 2584 (Com. Car. Bur., Feb. 14, 1985); *United States Satellite Systems, Inc.*, Mimeo No. 2583 (Com. Car. Bur., Feb. 14, 1985) (domestic satellite licenses declared null and void for failure to begin implementation as required by license)).

accommodate all qualified applicants.[82] In this case, applications and amendments for eight NGSO FSS systems have been filed with the FCC. Almost all of the eight applications request the use of nearly all of the Ku-band spectrum available. At the same time, technical studies indicate that it may be feasible for no more than three NGSO FSS systems to share the same spectrum. Thus, the number of applicants may be double the number that can be licensed to construct systems.

Furthermore, with estimated construction and launch costs of as much as $4.6 billion,[83] the FSS systems proposed in this proceeding would be tremendously expensive to deploy. In order to ensure that authorized systems are capable of financing these potential expenses, the adoption of strict financial qualification rules for Ku-band NGSO FSS systems would be appropriate.

The need to ensure financial viability is particularly important in light of the substantial dependence that each NGSO FSS licensee will be forced to have on every other co-frequency NGSO FSS system. As explained in Part 2, Section 2, subsection C

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[82] In the *NPRM*, the Commission suggests that strict financial qualification rules may also be justified by the fact that the Ku-bands are already congested with existing operators. The Commission questions whether issuance of a license to an under financed NGSO FSS applicant "might preclude or limit expansion by existing operators of the services they provide to the public." *NPRM*, ¶ 85. Boeing believes that the licensing of NGSO FSS systems in the Ku-band would not preclude or limit expansion by existing operators. Instead, the interference protection rules advocated by Boeing in earlier sections of these comments will be sufficient to permit existing operators to expand their services in later-generation systems.

[83] *See Amendment to Application of SkyBridge L.L.C.*, FCC File No. 130-SAT-AMEND-98 at 8-9 (June 30, 1998); *see also The Boeing Company Application for Authority to Launch and Operate a Non-Geostationary Medium Earth Orbit Satellite System in the Fixed Satellite* Service, FCC File No. [__]-SAT-P/LA-99/20 at 62 (Jan. 8, 1999) (estimating the total costs to construct, launch and operate the system for one year at $4.15 billion).

of these comments, competing Ku-band NGSO FSS operators will be forced to cooperate in nearly every phase of deployment, including constellation design, launch and start-up schedules, contingency planning for disabled and spare satellites, and on going in-orbit control. In order to remain financially viable, each licensee will need to be able to rely on its competitor's commitments to follow through with its obligations. The only way to ensure that such reliance is not misplaced is for the Commission to issue licenses only to those applicants that are financially and otherwise qualified to construct, launch and operate NGSO FSS systems.

B. In Determining the Financial Status of an Applicant, The Commission Should Take into Account Pre-existing Authorizations for Unbuilt Satellite Systems.

In implementing strict financial qualification rules, the Commission should consider the pre-existing obligations of the various applicants. A number of the Ku-band NGSO FSS applicants hold FCC authorizations for unbuilt satellite systems. The Commission should carefully scrutinize the financial qualifications of these incumbent licensees by requiring them to demonstrate that they have assets or committed financing that is separate and apart from the funding necessary to construct and operate their previously-licensed systems.

Separate treatment prevents a FCC satellite system licensees from circumventing the underlying intent of the Commission's financial qualification rules by attributing the same financial resources to its Ku-band NGSO FSS system that is also slated to be used to support previously licensed satellite systems. Such scrutiny is particularly warranted with respect to Ku-band NGSO FSS applicants that received prior FCC authorizations for satellite systems without being required to demonstrate financial qualifications to

construct such systems. Without such scrutiny, Ku-band NGSO FSS authorizations may be issued to entities that are unable to construct their systems, resulting in the warehousing of scarce spectrum resources that could be used by qualified parties to expeditiously provide new telecommunication services to users worldwide.

II. BOEING SUPPORTS THE COMMISSION'S PROPOSED MILESTONE REQUIREMENTS AS LONG AS THEY ARE NOT USED AS A SUBSTITUTE FOR STRICT ENFORCEMENT OF NGSO FSS LICENSEE QUALIFICATION RULES.

Boeing supports the Commission's proposal to require all NGSO FSS Ku-band licensees to adhere to a strict timetable for system implementation.[84] Boeing does not believe, however, that strict enforcement of milestone requirements can substitute for equally strict enforcement of threshold qualification rules for NGSO FSS applicants. Particularly in this proceeding, it is extremely important that NGSO FSS licenses are issued only to parties that are fully qualified to construct, launch and operate their systems so that any spectrum sharing approach adopted in this proceeding is not disabled by a non-compliant licensee. As discussed in Part 2, Section II, subsection C of these comments, NGSO FSS licensees will be heavily dependent on their NGSO FSS competitors in order to design and operate systems that can operate co-frequency without resulting in substantial and potentially compromising expenses.

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[84] Specifically, the Commission proposes that each NGSO FSS Ku-band licensee must begin construction of its first two satellites within one year of the grant of its authorization, and complete construction of those first two satellites within four years of grant. The Commission would require construction of the remaining authorized operating satellites in the constellation to begin within three years of the initial authorization, and the entire authorized system would have to be operational within six years.

III. IN ORDER TO ENSURE THAT NGSO FSS APPLICANTS ARE QUALIFIED TO HOLD LICENSES, THE COMMISSION SHOULD STRICTLY ENFORCE ITS APPLICATION FILING REQUIREMENTS.

The Commission should further the public interest by issuing FCC authorizations only to those parties that complied with the Commission's application filing requirements. As the International Bureau recently observed, the volume of applications filed with the Commission has increased three-fold in the past five years.[85] The Commission staff cannot be expected to process this increasing number of applications unless all parties comply with the filing rules.

The FCC's application filing rules, however, do not exist simply for administrative convenience. The filing requirements serve two essential purposes. First, the filing rules give the Commission a clear indication of whether an applicant is technically qualified to build its system and whether the applicant is serious about its proposal. For example, some pending applicants expressed interest in constructing NGSO FSS systems, but failed to comply with the Commission's requirement that applicants "demonstrate" how their systems can share spectrum with incumbent spectrum users. Applicants that failed to include a thorough analysis and provide information required by the Commission's rules and applicable public notices should be viewed as lacking in the necessary technical expertise, or lacking in the will to invest the resources necessary to examine the technical issues. In either event, such an applicant should not be deemed qualified to hold a Ku-band NGSO FSS authorization.

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[85] *See* Public Notice, "*International Bureau to Streamline Satellite and Earth Station Processing*," Report No. SPB-140 (Oct. 28, 1998) ("*October 28th Public Notice*").

The second essential purpose of the Commission's application filing requirements is to disclose to the public and to regulatory authorities important details about proposals to use scarce public spectrum resources for private satellite ventures. Without such details, regulators cannot be certain that a satellite system, once launched, will be capable of complying with the Commission's technical and operation rules, including rules intended to protect important commercial and governmental radiocommunication facilities.

Disclosure of such information is also necessary because the Commission cannot, and should not, rely on the unsupported assurances of applicants that they will comply with the Commission's operating and technical rules. Such reliance would be particularly misplaced with respect to applicants that fail to comply with the Commission's application filing rules. As Boeing observed in the 2 GHz MSS proceeding, if an applicant fails to comply with the Commission's rules during the application process, the Commission cannot reasonably expect the same party to comply with the Commission's rules once it has a FCC license in hand.

Finally, requiring full disclosure is important in order to expedite the Commission's licensing process. If an applicant fails to disclose required information by the initial deadline, the Commission is often forced to request the submission of additional materials, delaying licensing for all applicants while the delinquent party assembles the information requested and submits it to the Commission for review. Furthermore, the delay can be exacerbated significantly if the Commission concludes that the additional information must be placed on public notice for comment. In the end, the

issuance of licenses is postponed for all applicants, which harms the public interest by delaying the introduction of new competitive consumer services.

The need for thorough Commission review of satellite system applications is growing in importance because of the FCC's burgeoning role in the international satellite industry. Following the adoption of the World Trade Organization Basic Telecommunications Agreement (along with the FCC's adoption of the DISCO II Order), the Commission is regularly reviewing global satellite system proposals backed by both domestic and foreign corporations. As one foreign satellite operator recently observed, "[t]he FCC is today the only really fully recognized authority that scrutinizes licenses for satellite systems. . . . The FCC provides independent technical validation."[86]

Unfortunately, the FCC's critical role in international satellite system regulation comes at a time when satellite system applications appear to be getting increasingly thin and unresponsive. This trend is likely to continue unless the Commission enforces its rules by refusing to accept satellite system applications that fail to comply with the Commission's filing requirements.

Dismissal of non-compliant applications is particularly warranted in the Commission's Ku-band NGSO FSS proceeding because the International Bureau provided an abundance of notice regarding its application filing requirements. On October 28, 1998, the Bureau issued a Public Notice reminding parties that space station applications must include the information required by Section 25.114 of the

[86] Peter B. de Selding, *Stamp of Approval From FCC Critical for Foreign Operators*, Space News, at 10, Feb. 15, 1999 (quoting Marc Jamy, General Counsel and Senior Vice President for Alcatel Space, in an address before the Space and Satellite Finance Conference in London).

Commission's rules.[87] The Bureau repeated these instructions in the Ku-band application cut-off Public Notice issued on November 2, 1998.[88] The Bureau also indicated that the Section 25.114 information should be provided in the same numerical order as indicated in the Code of Federal Regulations.[89] Finally, the Bureau instructed that, in addition to the Section 25.114 information, applicants for Ku-band NGSO FSS systems "*must* demonstrate how they plan to operate compatibly with other authorized users of the spectrum as well as with other NGSO FSS systems in these frequency bands."[90]

NGSO FSS applicants had clear notice that the Commission planned to enforce its filing rules. The Bureau expressly stated in both of the Public Notices referenced above that applications that fail to include the required information would be dismissed as

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[87] *See October 28th Public Notice* at 2. The disclosure requirements of Section 25.114 are far from modest. Section 25.114 includes twenty-seven items of information required in a space station application and "[m]ost of these questions require detailed technical analysis or narrative responses regarding business plans." *Streamlining the Commission's Rules and Regulations for Satellite Application and Licensing Procedures*, 11 FCC Rcd 21581, 21599 (1996). Of course, some of the information required by Section 25.114 is applicable only to certain satellite services. *Id.*

[88] *See* Public Notice, "*Satellite Policy Branch Information: Cut-off Established for Additional Applications and Letters of Intent in the 12.75-13.25 GHz, 13.75-14.5 GHz, 17.3-17.8 GHz and 10.7-12.7 GHz Frequency Bands*," SPB-141 at 2 (Nov. 2, 1998) ("*November 2nd Public Notice*").

[89] *See October 28th Public Notice* at 2.

[90] *November 2nd Public Notice* at 3 (emphasis added).

unacceptable for filing.[91] The Bureau even added emphasis to its October 28, 1998 admonition.[92]

In light of the growing importance of the Commission's application filing requirements, and the clear notice that the Bureau provided about enforcement of its rules, the Commission should serve the public interest by issuing FCC authorizations only to those entities that complied with the Commission's application filing requirements.

IV. GEOGRAPHIC COVERAGE REQUIREMENTS SHOULD BE ADOPTED THAT TRULY SERVE THE NEEDS OF POPULATIONS IN DEVELOPING REGIONS OF THE WORLD.

Boeing supports the Commission's proposal to adopt geographic coverage requirements for NGSO FSS systems in the Ku-band utilizing the same rules adopted in the *Big LEO Order*.[93] The Commission should clarify the requirements of its geographic coverage rules, however, in order to ensure the success of its goal of "furthering the creation of a seamless global communications network."[94]

Specifically, the Commission should specify that global satellite systems must be capable of providing *comparable* levels of service to communities in all regions of the world. Satellite operators should not be permitted to provide underdeveloped regions

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[91] *Id.* at 3; *October 28th Public Notice* at 1.

[92] The Public Notice indicated that "[I]f an application fails to include *any* of the required information, the Bureau will return the application without prejudice as being unacceptable for filing." *October 28th Public Notice* at 1 (emphasis in original).

[93] *See NPRM*, ¶ 84 (citing *Mobile Satellite Service in the 1610-1626/2483.5-2500MHz Frequency Bands*, 9 FCC Rcd 536 (1994) ("*Big LEO Order*")).

[94] *Id.*

with just a fraction of the transmission capacity available in industrialized regions. Requiring the provision of comparable global coverage is justified for several reasons.

First, by their very nature, the satellite systems proposed in this proceeding are *global* systems, encumbering scarce orbital and spectrum resources in every region of the world. Thus, in assessing the relative public interest benefits of such systems, the Commission should consider the best interests of all populations. In serving these interests, the Commission should refrain from authorizing satellite systems that focus their services on the Northern Hemisphere, while encumbering spectrum and orbital resources in both hemispheres. Adoption of such a Commission requirement would benefit both foreign populations and the United States by increasing this country's stature in the international community as a leader in the development of improved living conditions for global populations.

Second, the Commission should require comprehensive global coverage in order to give populations in underdeveloped regions a realistic opportunity to improve their conditions and enjoy the benefits of new technologies. Foreign governments must be able to attract capital investment and new industry in order to increase productivity and raise the standard of living for their citizens. It is highly unlikely that an underdeveloped country can attract such investment in today's environment unless it can offer a telecommunications infrastructure that is adequate to participate in a seamless network of international commerce. Thus, the Commission should require global satellite systems to offer uniform levels of global service. Without such a requirement, many underdeveloped regions could be permanently isolated from the economic benefits currently enjoyed by industrialized nations.

Third, the Commission should require the provision of comparable global coverage because such service can be provided uniformly by satellite operators without compromising services to industrialized regions. This is demonstrated by the NGSO FSS applications filed in this proceeding. Most of the applicants propose broadband satellite systems that provide uniform broadband coverage to all regions of the world. Only two of the applicants propose systems that fail to offer uniform service to underdeveloped regions. The Commission should not permit these applicants to neglect the public interest by focusing on the immediate needs of industrialized regions at the expense of the rest of the world's populations.

V. NGSO FSS SYSTEMS SHOULD BE PERMITTED TO PROVIDE ANCILLARY MOBILE OPERATIONS IN THE KU-BAND.

A major goal of the Commission in licensing Ku-band NGSO FSS systems should be to maximize the range of innovative services that can be provided to the public. Permitting NGSO FSS systems to provide ancillary mobile operations on a non-interference basis would advance this goal. The provision of broadband mobile services in the Ku-band would serve the public interest by helping to alleviate the severe shortage of spectrum that is currently available for such consumer services. Additionally, such an authorization would serve the public interest by supporting economic development and job growth. Boeing's proposal for ancillary mobile operations achieves these public interest benefits while efficiently employing scarce spectrum resources and avoiding harmful interference to existing spectrum users.

The Commission has recognized that a tremendous demand exists for additional spectrum for broadband mobile satellite services ("MSS").[95] Despite this demand, insufficient spectrum has been allocated to broadband MSS, and no significant additional broadband MSS spectrum allocations are on the horizon.[96] The Commission should help alleviate the critical shortage of MSS broadband spectrum and provide a means for meeting the consumer demand for such services by permitting ancillary mobile operations in the Ku-band.

Permitting mobile operations in the Ku-band will serve the Commission's statutory objective of facilitating the development of new communication services to the public.[97] A broadband mobile capability can provide high-quality voice, high-speed Internet and data transfer, and entertainment services that are currently unavailable to

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[95] The Commission has recently stated that "a need exists for allocating a substantial amount of spectrum for MSS." *Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile-Satellite Service*, 10 FCC Rcd 3230, 3231 (1995). Furthermore, the Commission has noted that "there is significant consumer demand for convenient mobile services such as telephone, high-rate data and fax, and video." *Id.*

[96] This is especially true in light of the failure of the 1997 World Radiocommunications Conference ("WRC-97") to implement a U.S. proposal to expand MSS spectrum allocations in the 2 GHz band.

[97] Section 303(g) of the Communications Act of 1934, 47 U.S.C. §§ 151 *et seq.*, encourages the "larger and more effective use of radio in the public interest." 47 U.S.C. § 303(g). Section 7 of the Act states that "[i]t shall be the policy of the United States to encourage the provision of new technologies and services to the public." 47 U.S.C. § 157. The Commission has stated that "One of the ways we accomplish these statutory goals is to continually seek opportunities to encourage new product development in the telecommunications industry." *Amendment of Parts 2 and 15 of the Commission's Rules to Permit Use of Radio Frequencies Above 40 GHz for New Radio Applications*, 9 FCC Rcd 7078, 7082 (1994) ("*40+ GHz NPRM*").

people in mobile platforms, such as aircraft, ships and motor vehicles.[98] In addition, a broadband mobile capability can facilitate the development of new and innovative applications.

The development of new telecommunication services would have a positive effect on consumer safety, economic development and job growth.[99] Access to broadband voice, data, and video services would permit consumers to make more productive use of their time. Broadband data transmission would also enable real-time monitoring and diagnostic review of equipment used in airplanes, trains and ships. Such a capability could increase the efficiency of the transportation industry and help reduce the cost of service and maintenance programs. Reducing maintenance costs would promote competition by permitting companies to pass savings on to consumers. Furthermore, the proposed services could be provided on a non-interference and/or secondary basis within the same spectrum identified for Boeing's NGSO FSS operations. As a result, these

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[98] The Commission has already recognized the important public interest benefit of MSS systems in bringing cellular-like telephone and data services to remote locations where such services are not currently available. *See Amendment of Section 2.106 of the Commission Rules to Allocate the 1610-1626.5 MHz and the 2483.5-2500 MHz Bands for Use by the Mobile Satellite-Service, Including Non-geostationary Satellites*, 7 FCC Rcd 6414, 6416 (1992). Although limited voice and data services are currently available to aircraft and ship passengers through geostationary satellites, the lack of sufficient bandwidth makes existing services inadequate for consumer needs and limits the development of these services.

[99] The Commission has indicated that "opening regions of the spectrum to commercial applications and technologies fosters the development and growth of new industries and jobs." *See 40+ GHz NPRM*, 9 FCC Rcd at 7079.

important services could be provided without diverting spectrum resources from other users.[100]

PART FOUR
ADDITIONAL TECHNICAL RULES

I. THE COMMISSION SHOULD ADOPT TECHNICAL RULES FOR NGSO GATEWAY ANTENNAS THAT MAXIMIZE OPPORTUNITIES FOR CO-FREQUENCY SPECTRUM SHARING, WITHOUT UNNECESSARILY BURDENING Ku-BAND NGSO FSS LICENSEES. (¶ 14)

In the *NPRM*, the Commission proposes criteria for Ku-band NGSO FSS Gateway antenna and complexes. The Commission indicates that Gateway operations should be defined as earth station operations that are not intended to originate and terminate traffic but are primarily intended for interconnecting to other networks.[101] Boeing supports this definition, except that Boeing believes TT&C functions can also be provided at some of the same locations. The Commission proposes a number of other rules for Ku-band NGSO FSS Gateway facilities. Boeing believes that adoption of some of the Commission's proposed rules is appropriate.

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[100] Because U.S. firms have traditionally competed vigorously in the development of commercial applications of spectrum, expeditious action by the Commission in opening up spectrum for broadband MSS is likely to increase both overall competition and the competitiveness of U.S. satellite companies. *See Amendment of Parts 2 and 15 of the Commission's Rules to Allocate the 13.75-14.0 GHz Band to the Fixed-Satellite Service*, 11 FCC Rcd 5923, 5927 (1996) (concluding that an allocation of spectrum for the fixed-satellite service "would further the competitiveness of U.S. satellite operators in domestic and international markets and would provide more open and competitive markets for consumers").

[101] *See NPRM*, ¶ 15.

A. In Order to Enhance Co-Frequency Spectrum Sharing, the Commission Should Adopt a Minimum Gateway Antenna Size Requirement. (¶ 15)

The Commission requests comment on whether a Gateway antenna minimum size requirement should be adopted to facilitate spectrum sharing, such as sharing with terrestrial services. Boeing believes that the Commission should adopt a minimum antenna size for Gateway earth stations. Specifically, Boeing recommends that the Commission require a Gateway antenna minimum size of 4.5 meters, which is the same requirement included in ITU Radio Regulation S5.502 for Gateways operating in the 13.75-14.0 GHz band.

The use of a Gateway antenna minimum size requirement will improve sharing opportunities, not just with terrestrial services, but also between co-frequency NGSO systems. The use of larger Gateway antenna can reduce beamwidths and, as a result, reduce the probability of inline interference events between the satellites of co-frequency inhomogeneous NGSO systems. Inline interference events result in high levels of interference into NGSO satellites. The commonly proposed techniques for mitigating such interference are satellite diversity and Gateway diversity, both of which can be very expensive to implement for NGSO operators. Thus, it is in the interests of NGSO operators to encourage the use of large Gateway antennas in order to minimize the use of other expensive interference mitigation techniques.

B. Ku-band NGSO Licensees Should Not be Required to Comply With Gateway Antenna Performance Standards That are More Restrictive Than Deemed Necessary for Comparable Services. (¶ 79)

The Commission also proposes to require Gateway antennas to meet an antenna performance standard that includes a reference pattern of $29 - 25 \log(\theta)$. Boeing

supports the Commission's underlying goal of encouraging improvements in antenna performance standards. Boeing intends to endeavor to minimize the sidelobe characteristics of its antennas.

Boeing does not believe, however, that mandating a strict sidelobe pattern of 29 – 25log(θ) is justified. The proposed performance standard exceeds the level provided for in Section 25.209(2) of the Commission's rules.[102] Furthermore, it appears that the sole reason that this restrictive standard was proposed in the *NPRM* was because SkyBridge indicated an intention to meet the requirement, rather than providing any evidence that enforcement of such a requirement is necessary. Boeing believes that the Commission should continue to employ the antenna reference pattern provided in Section 25.209(a)(1) of its rules and apply this standard to Ku-band NGSO FSS Gateway antennas.

C. The Commission Should Not Adopt Unnecessary Restrictions on Gateway Complexes, Particularly Restrictions That will Make Sharing With Fixed Services More Difficult. (¶ 15)

While Boeing supports the Commission's proposed technical rules for Gateway antennas, Boeing does not believe that the Commission should adopt limitations on the size of Ku-band NGSO FSS Gateway complexes. Specifically, the Commission proposes that the antennas in a Gateway complex must be located within a one-second latitude and longitude square.[103] A one-second latitude and longitude square, measured at the equator

[102] *See id.*, ¶ 79.

[103] *See id.*, ¶ 15.

is only about 30 meters on a side.[104] This is an insufficient area for the Boeing Gateway complex.

For the Boeing Ku-band NGSO FSS system, each Gateway complex will include up to nine large antennas (4.5 meter) in order to track multiple satellites simultaneously at a minimum elevation angle to a satellite of 10°. The Gateway antennas must be constructed with a minimum separation of 25 meters in order to prevent blockage of one antenna by another. Additionally, a larger separation between Gateway antennas may be required in order to reduce possible multipath interference from one antenna to another. In order to accommodate these requirements, a much larger Gateway complex will be required than proposed by the Commission.

Alternatively, in order to comply with the proposed requirement, Boeing would need to construct a larger number of small complexes in order to provide the same operational capabilities as would be provided using a few large complexes. Construction of a larger number of small complexes would increase the requirement for coordination with terrestrial services. In contrast, Boeing's current plan to construct just two large complexes in the United States would minimize coordination requirements.

[104] Locating Gateway antennas within a one-second latitude and longitude square is equivalent to placing all of the NGSO Gateway antennas in a square that is only 101.27 feet (30.87 meters) on a side. The dimension along the north-south axis will lengthen or shorten, however, as a function (*i.e.*, cosine) of the latitude of the Gateway's location.

II. THE COMMISSION SHOULD ADOPT CERTAIN OTHER TECHNICAL RULES TO ENABLE THE OPERATION OF Ku-BAND NGSO FSS SYSTEMS.

A. The Commission Should Not Mandate the Use of Arc Avoidance in Ku-band NGSO FSS Systems. (¶ 75)

The Commission is correct in concluding that it does not need to require Ku-band NGSO FSS systems to employ GSO arc avoidance in order to comply with the EPFD and APFD sharing criteria proposed to protect GSO networks.[105] Currently, Boeing intends to use arc avoidance to share spectrum with GSO systems. Boeing acknowledges, however, that other interference mitigation techniques could be used to comply with interference protection limits intended to protect GSO networks. As a result of the Ku-band NGSO FSS application filing cut-off, several systems have been proposed that use different interference mitigation techniques. Boeing believes that the critical issue is not whether arc avoidance is used, or how large an arc avoidance angle is employed. Instead, the Commission should limit its considerations to whether NGSO FSS systems are able to avoid producing unacceptable interference into GSO systems and other users of the spectrum, and whether they can operate co-frequency with other NGSO FSS systems.

B. GSO Earth Station Off-axis EIRP Density Limits Should be Applied Across the Entire GSO Arc. (¶¶ 76-77)

Boeing supports the Commission's proposal to require GSO FSS earth stations in the 12.75-13.25 GHz, 13.8-14.0 GHz and 14.0-14.5 GHz bands to comply with off-axis EIRP density levels. At its January 1999 meeting, JTG 4-9-11 agreed on a revised set of limits that are increased by 3 dB over the S22 (Section 6) limits that were approved (but

[105] *See NPRM*, ¶ 75.

subsequently suspended) by WRC-97 to cover the case of asymmetrical GSO earth station antennas.

The January 1999 meeting of JTG 4-9-11 also agreed that the off-axis EIRP limits must be applied over the entire hemisphere. In contrast, the Commission's proposal to restrict the applicability of the limits to within ± 3° of the GSO arc would provide grossly inadequate protection for NGSO systems. Without adequate EIRP and angular dispersion limits, the interference environment into NGSO FSS satellite receivers would be unknown and NGSO system designers would be forced to guess the amount of interference that may be directed into their satellites. Just as FSS and BSS interests have argued successfully for protection limits that take into account the variation in gain of antennas in directions other than horizontal (*i.e.*, in the GSO arc), NGSO FSS licensees must be protected in relation to asymmetric gain of antennas used in GSO networks.[106] Therefore, Boeing believes that the Commission should modify its proposal for Section 25.204(g) of its rules in order to provide adequate protection for NGSO FSS systems.

C. The Commission Should Maintain its International Systems Only Requirement for GSO FSS Systems in the 10.7-11.7 GHz Band. (¶ 17)

Boeing has no objection to permitting domestic GSO FSS Gateway earth stations to use the 10.7-11.7 GHz band in the United States. Boeing believes that the

[106] ITU-R Document JTG 4-9-11/TEMP/47 (Rev. 2) recommends a 3 dB increase in the off-axis EIRP limits that were adopted by WRC-97 and then suspended. This increase would allow operation with offset feed antennas that might have slightly higher sidelobes in directions away from the GSO arc. Boeing believes that the increase in the off-axis EIRP limits would not cause harmful interference to the Boeing Ku-band NGSO system. JTG 4-9-11 also proposed to grandfather existing GSO earth station antennas that do not meet these requirements. Boeing proposes that the limits should apply to all earth station antennas ready to be put into service after January 1, 2000.

Commission is correct, however, in concluding that it should maintain the international systems only requirement for GSO FSS systems to control the number of earth stations deployed in the band.[107] If GSO networks were permitted to provide domestic service links in the 10.7-11.7 GHz band, it would make coordination extremely difficult for operators of both GSO and NGSO Gateway earth stations.

D. A Software Simulation Tool Should be Used to Verify Compliance by Ku-band NGSO FSS Systems. (¶¶ 80)

Boeing believes that use of a software simulation tool would be adequate for verifying that a Ku-band NGSO FSS licensee satisfies the interference limits of the Commission's rules. Along with the software tool under development by JTG 4-9-11, other simulation tools are commercially available which can be used to model accurately Ku-band NGSO FSS systems. The Commission should refrain from adopting any one of the currently existing simulation tools for official use, however, until the various software tools that have been developed have undergone further analysis.

For example, Boeing has participated extensively in the work of JTG 4-9-11 to develop a software verification tool. Boeing must withhold judgment on JTG 4-9-11's software tool, however, until such time as the tool has been validated and demonstrated to model adequately proposed Ku-band NGSO FSS systems. The JTG 4-9-11 software uses a PFD mask approach for modeling NGSO FSS systems. The parameters of the PFD mask were modified significantly at the JTG 4-9-11 meeting in Long Beach as a result of input documents from France and Russia that showed that the PFD mask approach overestimated the EPFD by 5 to15 dB as compared to a more complete and accurate

[107] *See NPRM*, ¶ 17.

simulation. The modifications made to the PFD mask definition have not yet been tested to ascertain the existence and size of any error produced by this form of modeling.

E. NGSO FSS Applicants Should Disclose Sufficient Information to Adequately Model Co-Frequency Spectrum Interference Conditions. (¶¶ 81)

The Commission should require Ku-band NGSO FSS applicants to disclose the information generally required by ITU-R Recommendation S.1328. The Recommendation lists the parameters of NGSO systems that are needed to perform sharing studies of NGSO systems. The information outlined in the Recommendation is actually far more extensive than the information indicated by the Commission in the *NPRM*.[108]

The Commission should also require disclosure of information on the general switching strategies that will be used to avoid interference into GSO systems. The Commission should recognize, however, that in switching user transmissions between satellite beams, opportunities will exist in which a user terminal can be assigned to one of several overlapping spot beams. Algorithms for determining which beam a user terminal will be assigned to are likely to continue to evolve over the lifetime of the system to provide more efficient operation. These algorithms may also contain embedded information of a proprietary nature. Since the algorithms are not required for the calculation of PFD level, (*i.e.*, either the energy is present or it is not), they would have no effect on the overall interference to the GSO systems. Therefore, the Commission

[108] *See id.*, ¶ 81.

should not require Ku-band NGSO FSS applicants to disclose their beam utilization algorithms.

F. Boeing Will Work to Protect the Radio Astronomy Service in the 10.68-10.7 GHz Band. (¶ 82)

In the *NPRM*, the Commission requests comment on providing protection for radio astronomy operations in the 10.68-10.7 GHz band. Boeing intends to consult with radio astronomy interests in an effort to accommodate the needs of radio astronomy operations. Boeing observes that NGSO FSS operators intend to use the adjacent band – the 10.7-11.7 band – for space-to-Earth feeder links. Boeing's NGSO FSS system employs directive antennas to track its feeder link Gateways. In siting Gateways, Boeing will consult with radio astronomy interests in an attempt to reduce radiation into their facilities.

Boeing will also endeavor to utilize satellite antennas for the space-to-Earth feeder links that minimize sidelobe emission levels. In addition, Boeing will consider the use of adaptive power control for its space-to-Earth feeder links in order to maintain consistent EIRP levels and reduce frequency spillover to the lowest possible level. Finally, Boeing will consider increasing the guard band at the band edge of 10.7 GHz to allow additional roll-off between its feeder link transmissions and the radio astronomy band.

G. The Proposal of Northpoint Technology Should be Rejected as Incompatible With Existing And Future Satellite Networks In The 12.2-12.7 GHz Band. (¶¶ 91-98)

In the *NPRM*, the Commission considers and tentatively rejects a proposal to provide terrestrial video transmission services in the 12.2-12.7 GHz band. Northpoint's

proposal for reusing the band through the use of northward pointing consumer receivers and southward pointing transmitters has a conceptual simplicity that is appealing. Unfortunately, like some other apparently simple ideas, "the devil is in the details" and Boeing believes the details show that the Northpoint concept cannot provide its intended service on a shared basis with DBS and NGSO FSS systems. As a preliminary point, Boeing notes that DBS operators have been very critical of Northpoint's proposal, indicating that it is likely to interfere with the provision of DBS services to millions of customers.[109] Boeing believes that Northpoint's proposed operations would also be unable to share spectrum with NGSO FSS licensees.

A fundamental problem with Northpoint's proposal is that co-frequency NGSO FSS systems would be forced to accept exclusion zones in the vicinity of each of Northpoint's transmitters. Exclusion zones would be necessary because of high levels of unacceptable interference that would be transmitted into the customer receive antennas of co-frequency systems – interference that Northpoint does not dispute.

Because of the need for exclusion zones, Northpoint's proposal would harm Boeing's Ku-band NGSO FSS system in three ways. First, Boeing would be unable to provide services to any consumers within the vicinity of a Northpoint transmitter, locking out scores of potential customers in every community where Northpoint provides service.

Second, Boeing would be unable to sell user terminals to any customer without initially conducting a survey of the customer's premises in order to determine whether the customer is sufficiently clear of a Northpoint exclusion zone. Boeing would also

[109] *See id.*, ¶¶ 91-95.

need to warn customers that, once purchased, they may not be able to freely move their user terminal to a new location.

Finally, Boeing could be subject to a loss of existing customers every time Northpoint expands into a new community and erects dozens of transmission poles that likely will be proximate to Boeing user terminals. Boeing would then likely be forced to permit customers to return their used equipment for a refund, in order to avoid a loss of good will and a further loss in customers in the marketplace.

In the end, the inevitable costs of Northpoint's proposed exclusion zones – the case-by-case customer coordination, the limitations on moving customer equipment and the potential for customers to eventually lose their service – would place Boeing at a significant disadvantage compared to other providers of broadband satellite services.

In the end, if the Commission insists on permitting Northpoint to operate in the Ku-band, despite the protests of incumbent DBS operators, the Commission should permit Northpoint to use only as much spectrum as is necessary to retransmit local television signals. Specifically, Boeing believes that about 18 MHz of spectrum should be sufficient to broadcast local signals. In fact, 18 MHz should be more than enough spectrum if the signals are digitized.

Finally, Boeing strenuously objects to the concept of assigning Northpoint any spectrum for the delivery of one-way broadband data. The Commission has spent much of the last decade allocating spectrum for point-to-multipoint broadband data services such as the Local Multipoint Distribution Service ("LMDS"). These allocations were the result of carefully crafted compromises between LMDS proponents and the commercial satellite industry. The Commission should not permit Northpoint to circumvent these

agreements (and avoid participating in the Commission's recent LMDS auction) by constructing what would essentially amount to a one-way LMDS service using incumbent satellite spectrum.

III. CONCLUSION

As a global leader in space and satellite technology, Boeing has a significant interest in promoting the use of new sharing methods and regulatory policies to increase the number of competitive satellite networks that can be accommodated in increasingly constrained spectrum. Boeing urges the Commission to further its policy of fostering the development of innovative satellite communications services for U.S. consumers by authorizing NGSO satellite networks to operate in the Ku-band. Boeing believes that the interference protection limits under development by the international community provide more than adequate protection for existing satellite networks and terrestrial spectrum

users. Accordingly, the Commission should utilizing these limits as a basis for developing regulations applicable to NGSO FSS licensees operating in the United States.

Respectfully submitted,

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CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING THE ENGINEERING INFORMATION INCLUDED IN THE COMMENTS OF THE BOEING COMPANY

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the Comments of The Boeing Company. I certify that I have either prepared or reviewed the information submitted in these Comments, and that it is complete and accurate to the best of my knowledge.

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