Before the

FEDERAL COMMUNICATIONS COMMISSION

Washington, DC 20554

In the Matter of	)	
	)	
THE BOEING COMPANY	)	
	)	
Application for Authority	)	
to Launch and Operate a	)	File No.
Non-Geostationary Satellite Orbit	)	
System in the Fixed-Satellite Service	)	

APPLICATION

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APPLICATION

The Boeing Company ("Boeing"), by its attorneys and pursuant to Sections 308 and 309 of the Communications Act of 1934, as amended, 47 U.S.C. §§ 308 and 309, hereby requests authority to launch and operate a non-geostationary satellite orbit ("NGSO") fixed-satellite service ("FSS") system operating in the 37.5-42.0 GHz (space-to-Earth), and the 47.2-50.2 and 50.4-51.4 GHz (Earth-to-space) bands (collectively, the "V-band"), herein referred to as the "V-band Constellation." The V-band Constellation also includes inter-satellite links ("ISLs") operating in the V-band and on a non-conforming, non-interference basis in the 17.8-19.3 GHz and 19.7-20.2 GHz (downlink) and the 27.5-29.1 GHz and 29.5-30.0 GHz (uplink) bands (the "Ka-band").

I. INTRODUCTION

The Boeing V-band Constellation represents a cost effective means to achieve global coverage using a combination of low earth orbit ("LEO") satellites and highly inclined NGSO satellites operating in the range of geostationary ("GSO") altitude to provide high speed broadband communications to consumers wherever they are located, while also providing the benefits of very low latency through LEO communications. The V-band Constellation consists of 147 LEO and highly inclined NGSO satellites, the careful management of which will achieve global coverage and a clear path to universal access to broadband services.

Boeing is uniquely qualified to launch and operate the V-band Constellation. The Company is a leader in the global aerospace and satellite communications industries, providing technical expertise, manufacturing, launch services and on-orbit network control for a wide variety of commercial and government satellite systems. Boeing seeks to use this expertise to operate the proposed V-band Constellation in order to provide broadband Internet and communications services to residential consumers, governmental, and professional users across the United States, Puerto Rico, and US Virgin Islands. The hybrid LEO and inclined NGSO constellation also enables high speed data connectivity to users around the world.

Part II of this Application details the tremendous public interest benefits that could be achieved through the launch and operation of the V-band Constellation. A detailed description of the V-band Constellation, along with the narrative information required by Part 25 of the Commission's rules, is provided in Part III. Part IV of this Application contains the waiver requests, with full justifications, that are necessitated by this Application. Boeing urges the Commission to promptly grant this Application.

II. PUBLIC INTEREST CONSIDERATIONS IN SUPPORT OF GRANT

> *One of the most significant things that I've seen during my time here is that there is a digital divide in this country — between those who can use . . . cutting-edge communications services and those who [can]not.*[1]

Information connects the world. Broadband is the facilitator. Unfortunately, billions of people remain disconnected from the global information pipeline that provides the rest of the world with taken-for-granted resources: news, education, medical services, communication tools, jobs, education, and public safety. Those isolated without reliable broadband, most often in rural and underserved markets, are falling behind. The answers to addressing this pressing problem and connecting the unconnected are right above us – satellites.

Satellite broadband uses a satellite dish on Earth to communicate with orbiting satellites to provide two-way, high-speed, Internet access. Because the technology does not require infrastructure such as landlines or fiber optics, satellite broadband can bring essential Internet access to the parts of the globe removed from the fiber optic network or unreached by cell phone towers. Satellite broadband coverage is ubiquitous. Unlike other broadband technologies, the power of satellite is available to anyone with a clear line of sight to satellites orbiting overhead, whether they are on an airplane in the sky, a ship in the ocean, in mountainous America, or abroad. Its reach potential and inherent technological capabilities make satellite broadband uniquely capable of resolving the most complex connectivity problems and providing a robust competitive alternative to terrestrial broadband distribution technologies.

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[1]Remarks of Ajit Pai, Chairman, Federal Communications Commission (Jan. 24, 2017).

Bridging the Digital Divide in the United States

Millions of Americans lack broadband access in an unfortunate disparity called the "Digital Divide."[2] Commissioner Mignon Clyburn acknowledged the vast impact of this challenge, noting that she has "met consumers so desperate for connectivity that they literally beg for broadband to be deployed in their community because they know all too well that they are stuck on the wrong side of the digital divide."[3] Indeed, the divide is especially pronounced in rural areas where it may be difficult or inefficient to connect Americans with fiber optics and other terrestrial broadband channels.

Only 39 percent of those living in the rural United States have broadband capability. In an interview with the New York Times, Commissioner Clyburn acknowledged that, "[t]ens of millions of people are caught in the divide, and what we know is many are low-income and in rural areas. In total, 10 percent of Americans, or 34 million people, lack access to high-speed Internet."[4]

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[2] *See* Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act, *2016 Broadband Progress Report*, 31 FCC Rcd 699, Appendix D (2016) ("*2016 Broadband Progress Report*").

[3]In the Matter of Connect America Fund, ETC Annual Reports and Certifications, Rural Broadband Experiments, WC Docket Nos. 10-90, 14-58, 14-259, *Report and Order and Further Notice of Proposed Rulemaking,* FCC 16-64 (2016).

[4] Cecelia Kang, *The Challenges of Closing the Digital Divide*, N.Y. Times, June 7, 2016.

	Population (millions)	Percentage of Population
United States	33.982	10%
Rural Areas	23.430	39%
Urban Areas	10.552	4%
Tribal Lands	1.574	41%
Rural Areas	1.291	68%
Urban Areas	0.283	14%
U.S. Territories	2.628	66%
Rural Areas	1.078	98%
Urban Areas	1.550	54%

Table II-1. Americans Without Access to Fixed Advanced Telecommunications Capability[5]

Commissioner Michael O'Rielly also recognized the serious gap separating the broadband haves from the have-nots, noting that "[t]he fact that there's a gap should come as a shock to no one given that a key purpose of universal service for decades has been to extend connectivity to rural parts of the nation."[6] Regrettably, the sought-after goal of universal service is still not a reality.

A significant part of the solution to this enduring problem must come from satellites. Many of those without broadband access live in isolated communities or are surrounded by natural obstacles. Depending on the landscape, it may not be feasible to install the infrastructure necessary to provide terrestrial broadband to these users. Even if installation were possible, the investment in terrestrial technology may be prohibitive for providers. Choosing to run fiber cables or install telephone wires or radio towers for difficult-to-reach households, businesses, and schools is an expensive proposition and

[5] *See 2016 Broadband Progress Report*, ¶ 78.

[6] Modernizing the E-rate; Program for Schools and Libraries; Connect America Fund, FCC 14-189, *Second Report and Order and Order on Reconsideration*¸ 29 FCC Rcd 15538 (2014), Separate Statement of Commissioner O'Rielly.

may make little to no financial sense. After meeting with carriers attempting to serve "certain states, localities, or Tribal lands," Commissioner O'Rielly acknowledged that carriers have a particular concern with areas that are "rural, difficult to access, far from existing providers, or otherwise extremely costly to serve."[7]

None of these are concerns for satellite broadband. Once a satellite system is orbiting in space, the broadband signal reaches anywhere in the region where it is serving. Consequentially, there is no place, no matter how remote or geographically treacherous, that satellite broadband cannot reach. The capabilities of satellite broadband are not frustrated by a harsh landscape, deserted field, dearth of cables, nor a high elevation. No other broadband technology compares in this regard. Further, in those areas where existing broadband technologies are available, satellite broadband provides an attractive, competitive alternative to incumbent service providers.

Satellite Broadband for Health

Satellite is not just the best way to bring general Internet capability into the homes, businesses, and schools of rural and underserved America. Satellites can also provide critically necessary broadband access in numerous complex situations, including, for example, in the growing field of telemedicine. Telemedicine refers to "the use of

[7] Connect America Fund, ETC Annual Reports and Certifications, Rural Broadband Experiments, WC Docket Nos. 10-90, 14-58, 14-259, *Report and Order and Further Notice of Proposed Rulemaking,* FCC 16-64 (2016).

electronic communications. . . to provide clinical services" for remote patients.[8] Broadband facilitates communication in the field of medicine, which leads to novel approaches to healthcare benefitting doctors, patients, and society as a whole.

For example, broadband-enabled medical technology allows health care professionals to connect electronically to underserved clinics, hospitals, and patients' homes to monitor patients in real-time and to provide in-home care from afar. Without satellite broadband, members of communities left behind in the digital divide might either be forced to take a long trip to seek care or choose not to seek help at all. But telemedicine can offer those with otherwise minimal medical options a creative new way to receive prescriptions, diagnose disease, and see specialists who may be impossible to visit face-to-face because of geographic limitations. Patients who are not traditional victims of the divide may benefit as well. For example, through satellite, medicine can be administered remotely in extreme situations such as those involving mountainous falls or airplane emergencies thousands of feet in the air.

Moreover, Commissioner Clyburn has highlighted the significance of telemedicine and the potential it has for decreasing medical costs in the United States. Clyburn stated that, "[i]n a pilot project in Ruleville, Mississippi, 100 diabetics used broadband to regularly connect with doctors online. In the first year [using broadband], none of those patients had hospital visits. It saved $339,000 in Medicaid spending."

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[8] *See* Issue Paper, Telemedicine, Telehealth, and Health Information Technology, American Telemedicine Association, at 3 (May 2006), available at http://www.americantelemed.org/files/public/policy/HIT_Paper.pdf.

The range of telemedicine benefits – just one of many important capabilities – potentially provided by satellite broadband, is exciting and limitless.

The Commission's Role in Facilitating Satellite Services

Universal broadband capability benefits everyone. Connectivity in rural areas leads to economic development, an increase in the availability of news, information gathering, communication, education, and health. Connectivity in harsh environments when health and safety are on the line is essential in our modern society. Further, competition in the choice of broadband service providers leads to more robust, higher quality services, and lower prices. It is therefore no surprise that newly-appointed Chairman Pai noted in his introductory statement that closing the digital divide will be one of the Commission's "core priorities going forward." In 2014, Pai committed to "[m]ake the United States the most desirable country in the world for licensing and operating satellites."[9] This promise supports his stated goal as Chairman "to do what's necessary to help the private sector build networks, send signals, and distribute information to American consumers, regardless of race, gender, religion, sexual orientation, or anything else." We "must work to bring the benefits of the digital age to all Americans,"[10] and the best way to do this is with the help of satellites.

Boeing therefore urges the Commission to promptly grant this Application and to continue to work with Boeing and others in the satellite industry to ensure that broadband

[9] Comprehensive Review of Licensing and Operating Rules for Satellite Services, IB Docket No. 12-267, *Further Notice of Proposed Rulemaking*, FCC 14-142 (2014).

[10] Remarks of Ajit Pai, Chairman, Federal Communications Commission (Jan. 24, 2017).

satellite systems have sufficient access to spectrum resources in millimeter wave ("mmW") spectrum bands to provide very high speed communications services to all Americans, and globally.

III. NARRATIVE INFORMATION REQUIRED BY PART 25

The following narrative information is required by Part 25 of the Commission's rules for NGSO FSS satellite system applications and is not addressed either by Form 312 or Schedule S.

§ 25.111 ITU Publication Information

Boeing will submit to the Commission the materials necessary for filing with the International Telecommunication Union ("ITU") to support the V-band Constellation. In relation to this submission, Boeing has included with this Application an executed declaration that it unconditionally accepts all consequential ITU cost-recovery responsibility for the ITU filings.

§ 25.114(c)(4)(v) Minimum Gain-to-Temperature Ratio

Section 25.114(c)(4)(v) of the Commission's rules requires the identification of the minimum gain-to-temperature ratio within the proposed coverage area of each shapeable beam. Schedule S, however, does not appear to have input fields for this data. The values are provided below using the same beam identification numbers ("IDs") that were included in the "Receiving Beam" section of the Schedule S for this Application.

Table III-1. Minimum Gain-to-Temperature Ratio

Beam ID	Min G/T, dB/K
L2L0	15.1
L2L1	8.5
L3L0	15.1
L3L1	8.5
L2R0	15.1
L2R1	8.5
L3R0	15.1
L3R1	8.5
G2L0	18.4
G2L1	18.4
G3L0	18.4
G2R0	18.4
G2R1	18.4
G3R0	18.4
LTLC	-31.5
LTRC	-31.5
GTLC	-31.5
GTRC	-31.5

§ 25.114(c)(8) Maximum Power Flux Density Levels

Section 25.114(c)(8) of the Commission's rules requires applicants for FSS space station authorizations to provide the calculated maximum power flux density ("PFD") levels within each coverage area and energy dispersal bandwidths, if any, needed for compliance with Section 25.208. This information is provided in the "Transmitting Beams" section of the Schedule S for this Application. The V-band Constellation will comply with the PFD limits illustrated in Figure III-1 and specified in Sections 25.208(r), 25.208(s), and 25.208(t) of the Commission's rules for NGSO FSS satellite systems operating in the 37.5-40.0, 40.0-40.5 and the 40.5-42.0 GHz bands, respectively.

Pursuant to the Note to Paragraph (r) of Section 25.208(r),[11] during conditions of rain fade, Boeing's satellites may exceed the PFD limits indicated in Section 25.208(r) for space-to-Earth operations in the 37.5-40.0 GHz band. Boeing recognizes, and requested, that the Commission determine in the context of the *Spectrum Frontiers* proceeding the conditions and the extent to which the PFD limits can be exceeded by NGSO FSS systems during rain fade events. Boeing's V-band Constellation will comply with the outcome of these proceedings and will therefore accept the grant of a license conditioned on this outcome. Therefore, no need exists for Boeing to request herein a waiver of Section 25.208(r).

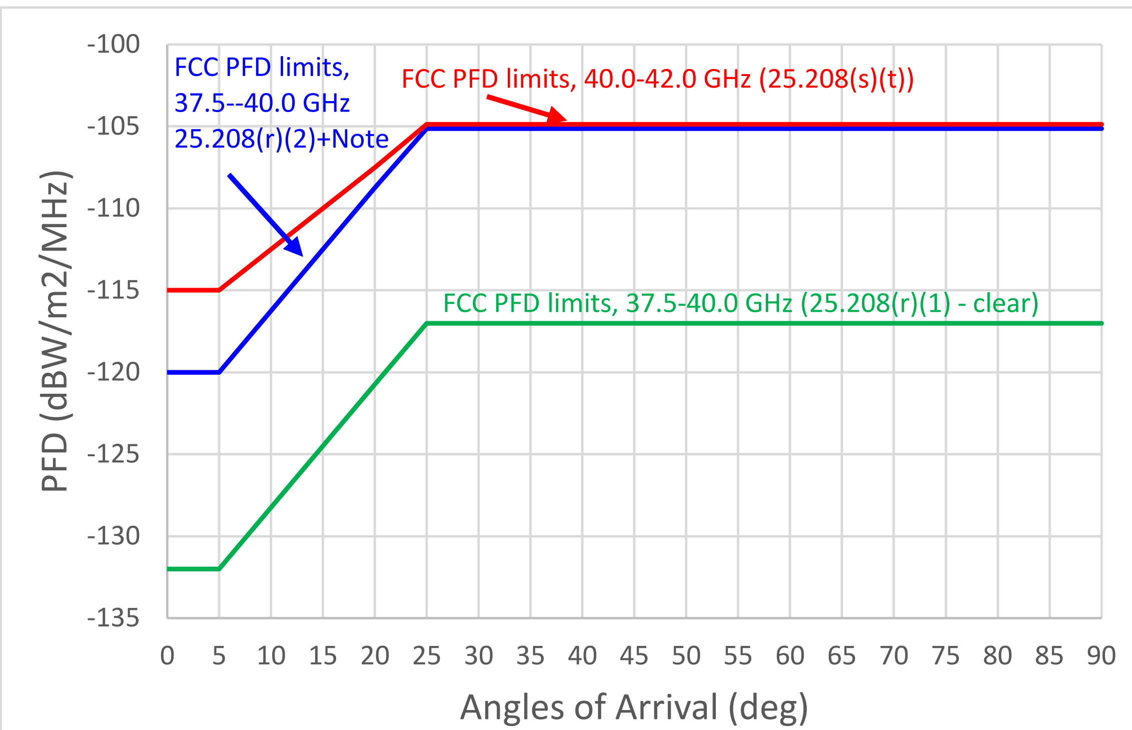

Figure III-1. FCC PFD Levels

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[11] 47 C.F.R. Section 25.208(r), Note to Paragraph (r).

§ 25.114(d)(1) System Facilities, Operations and Services and How Uplink Frequency Bands Connect to Downlink Frequency Bands

A. System Facilities, Operations, and Services

The V-band Constellation is primarily comprised of an NGSO space segment, ground segment, and a user equipment segment. This Application is seeking authorization for launch and operation of the NGSO space segment.

The hybrid NGSO space segment consists of 132 LEO satellites and 15 inclined NGSO satellites operating in the range of GSO altitude, not including spares. The LEO satellites will be virtually identical to each other. Similarly, the inclined NGSO satellites will be very similar to each other. Both types of satellites will have advanced beamforming antennas to provide shapeable and steerable V-band beams for user and gateway feeder communications links.

The LEO constellation is made up of 132 active satellites in 11 orbital planes with 12 spacecraft per plane. The planes are inclined at 54° and the circular altitude is at 1056 kilometers. The satellites will have a primary coverage area defined by a 25° elevation footprint with very low round-trip latency.

Wide area coverage will be provided by 15 highly inclined NGSO satellites operating in the range of GSO altitude in three distinct constellations. There are five active satellites in each of the "figure 8" constellations – one serving the Americas, one for Europe/Africa/Middle East, and one for the Asia-Pacific region. Figure III-2 illustrates the sub-satellite tracks of the final deployment of all three inclined NGSO constellations.

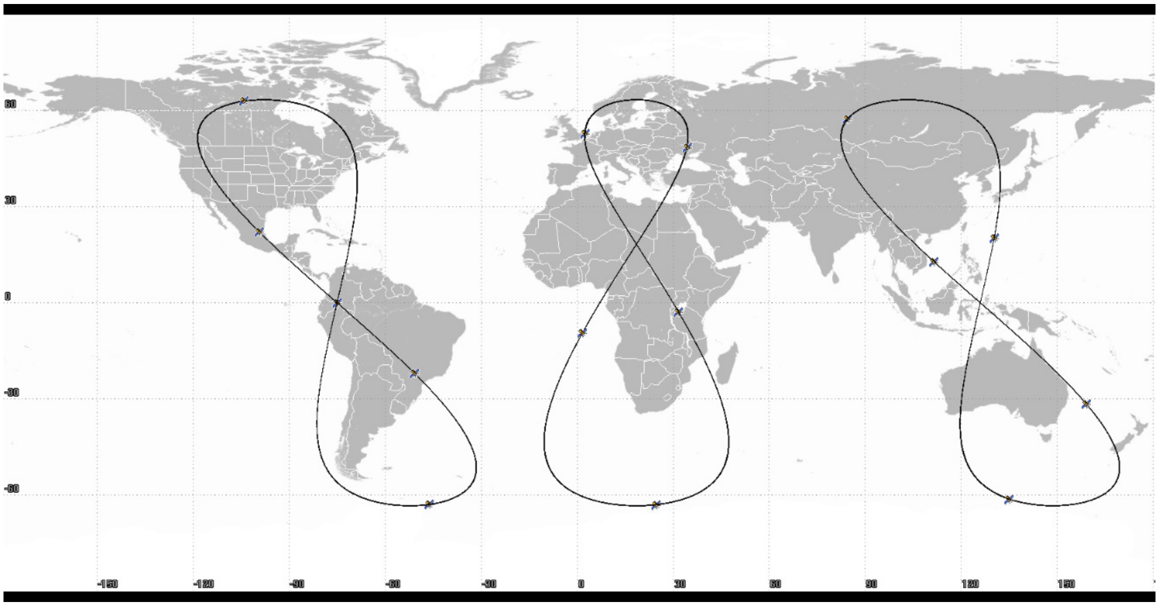

Figure III-2. Inclined NGSO Satellite Tracks for Final Deployment

For more than two decades, Boeing (including the former Hughes Space and Communications Company) has developed and implemented proprietary and patented constellations incorporating highly inclined orbits. By design, this V-band Constellation will enable efficient spectrum reuse and avoid interference to GSO satellites. Each of Boeing's inclined NGSO satellites would operate in its own eccentric-orbit plane operating at a 63.4 degree inclination and at altitudes between approximately 27,355 kilometers and 44,221 kilometers. A detailed description of the satellite constellation parameters is included in the "Non-geostationary Satellite Orbital Information" section of the Schedule S for this Application.

Each NGSO satellite will employ advanced antennas to generate and dynamically shape and steer the beams over the coverage area to connect users and the gateways. Figures III-3 and III-4 show the LEO satellite coverage at 25° elevation angle and a sample cell laydown example, respectively. The spot beams can be configured as either user or gateway beams on-orbit. Because the V-band gateway and user beams on both types of NGSO satellites are steerable and shapeable, coverage can be provided out to a 5° elevation angle footprint. Figure III-5 shows the primary command and telemetry coverage area for the LEO spacecraft. Global T&C coverage can be provided.

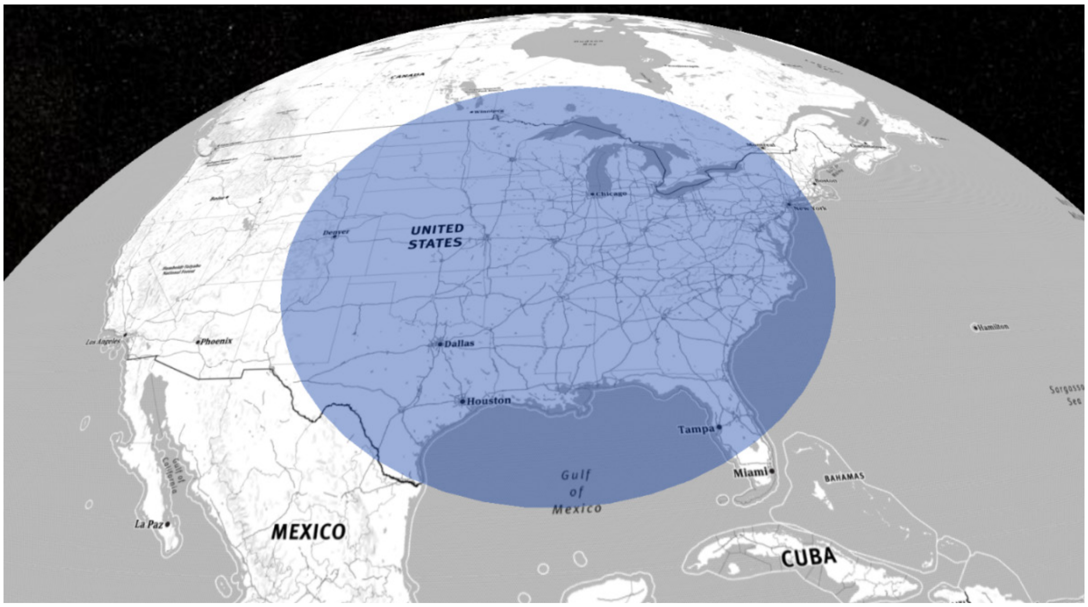

Figure III-3. LEO Spacecraft Coverage Area Snapshot

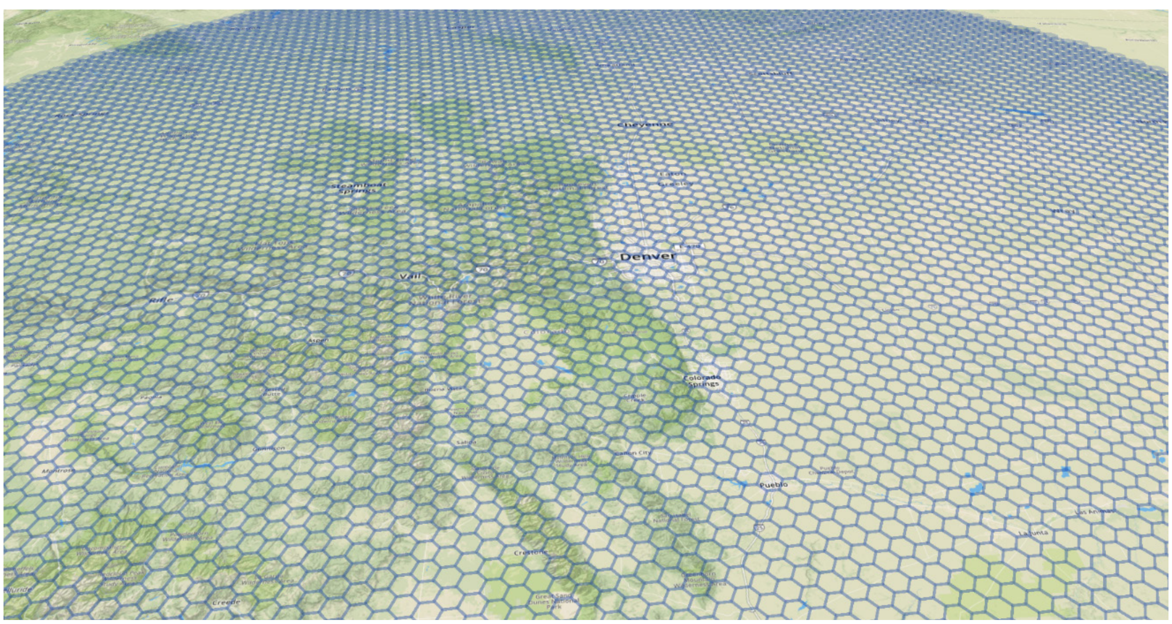

Figure III-4. LEO Spacecraft Sample Cell Pattern

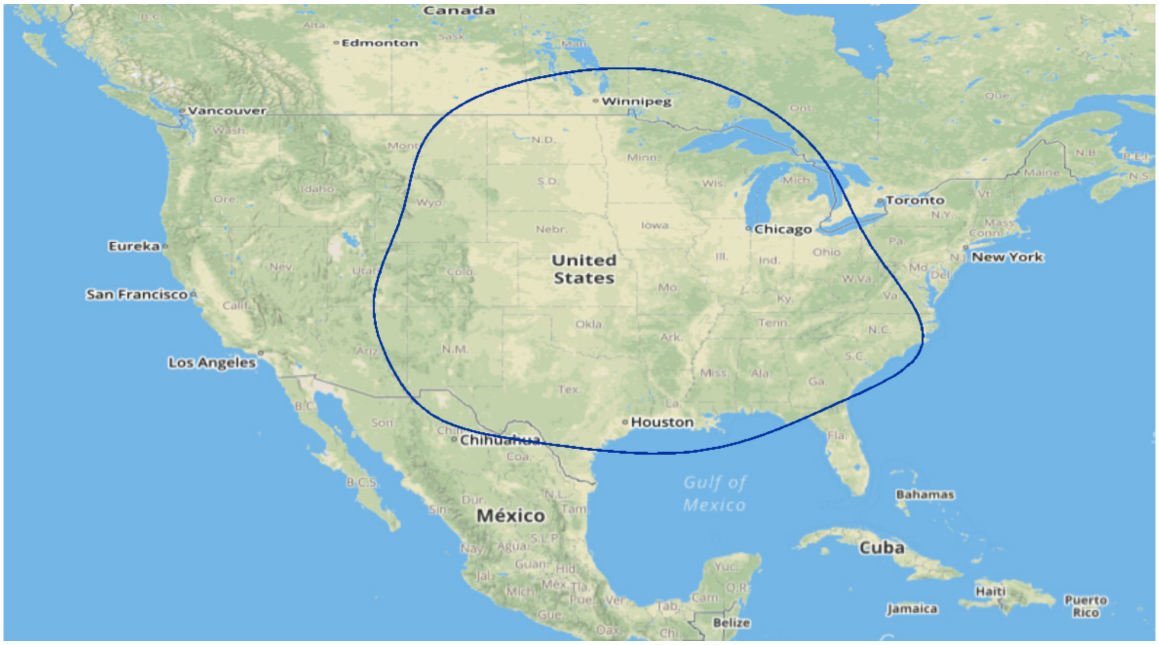

Figure III-5. Primary LEO Command and Telemetry Coverage Pattern

Figure III-6 shows an example of spot beam coverage over North America, Hawaii, and the US Virgin Islands that can be served by the inclined NGSO satellites from the Americas figure 8 constellation. These spot beams can also be configured as either user or gateway beams. The advanced antennas employed on the inclined NGSO satellites enable broader coverage regions than those illustrated in the figure. A large variety of beam shapes are possible, but these beams will be operated within the maximum EIRP density and PFD limits stated for the spot beam coverage in the "Transmitting Beams" section of Schedule S. Figure III-7 shows the primary command and telemetry beam contour for the inclined NGSO spacecraft. Global coverage can be provided. The complete set of antenna patterns is included in Schedule S.

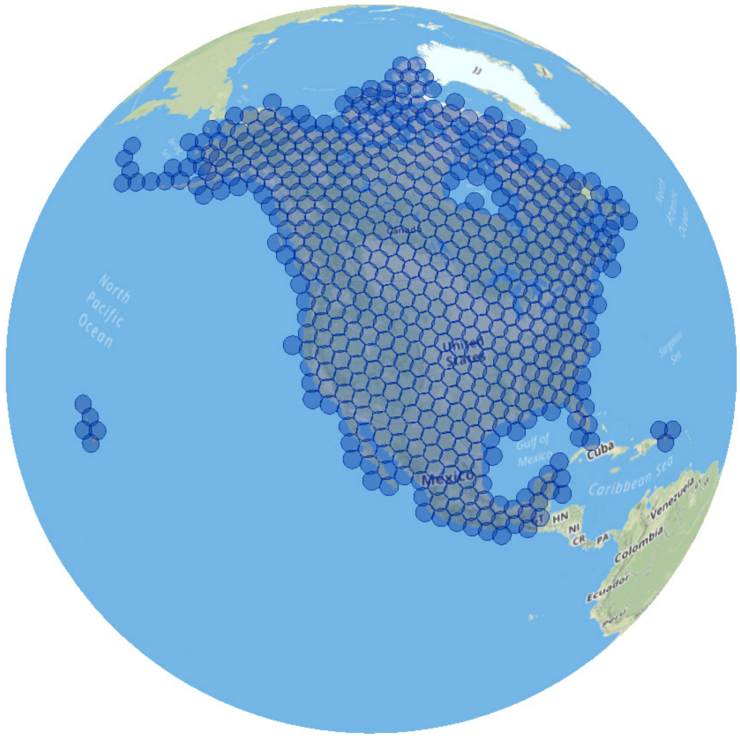

Figure III-6. Inclined NGSO Sample Cell Pattern

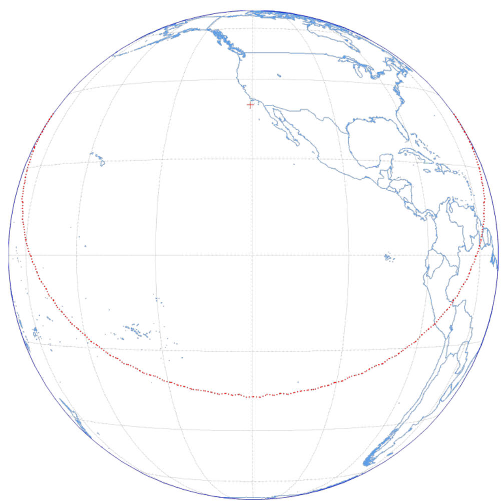

Figure III-7. Inclined NGSO Command and Telemetry Coverage Area

The ground segment portion of the system is comprised of the TT&C earth stations, Satellite Operations Centers ("SOC"), Network Operations Centers (collectively referred to as the "NOC"), gateways, points-of-presence ("PoPs"), and the fiber network backbone that connects them. The TT&C earth stations provide V-band command uplinks to control and telemetry downlinks to monitor the satellites. The SOC controls both the LEO and inclined NGSO constellations, configures the satellites, and manages collision avoidance. The NOC coordinates and dynamically provides the resource management of the satellites, earth stations, SOC, gateways, PoPs, fiber backbone, user equipment, and communications traffic over the worldwide system. The NOC also manages interference mitigation such as GSO satellite arc avoidance. The gateways provide bidirectional V-band feeder link communications to the satellites within their field of view.

The user equipment will provide a range of capability for different types of users, including consumers and professionals. The V-band bidirectional user equipment will support high speed data links to and from the hybrid constellation. These terminals will have the capability to track the satellites and accommodate handovers within the coverage area.

The V-band Constellation will provide broadband data to consumers throughout the United States, Puerto Rico, and the US Virgin Islands. The system will extend terrestrial networks to provide broadband access to all Americans, especially in rural and remote areas. This will help fulfill the mandate and regulatory objectives for universal broadband access. In addition, as the deployment phases are completed, this 147-satellite system will provide high speed data connectivity for people around the world.

B. System Frequency Usage and Frequency Plan

The uplink and downlink frequency plans for the V-band Constellation are shown in Figures III-8 through III-11, and in the "Operating Frequency Bands" section of Schedule S. The LEO and inclined NGSO satellites will have similar frequency plans.

The user and gateway channels, and the T&C links will use dual circular polarization. The channels are flexible and subchannel bandwidths can be adjusted on-orbit.

1. Uplink Frequency Plan—Communication Channels

User uplink data communication channels will use the frequency band from 47.2-50.2 GHz. Gateway uplink data communications channels will range from 47.2-50.2 and 50.4-51.4 GHz, as depicted in the figure below.

Figure III-8. Uplink Communications Frequency Plan

2. Uplink Command Channels

The uplink spacecraft command channels will be located within the 51.15–51.4 GHz segment, as shown in Figure III-9. The spectrum sharing between command and communications in this band will be managed by the NOC.

Figure III-9. Uplink Command Frequency Plan

3. Downlink Frequency Plan—Communication Channels

Both user and gateway downlink data communication channels will use the frequency band from 37.5-42.0 GHz, as depicted in the figure below.

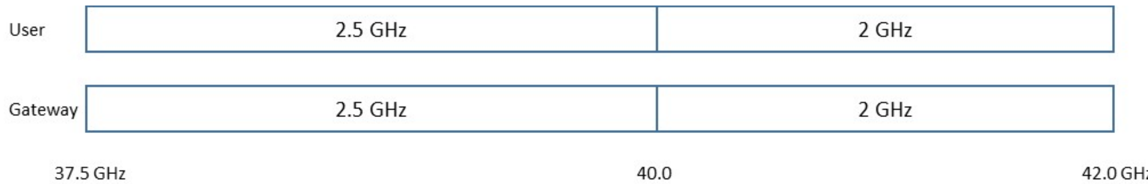

Figure III-10. Downlink Communications Frequency Plan

4. Downlink Telemetry Channel

The downlink spacecraft telemetry channels will be located within the 41.75-42.0 GHz segment, as depicted in Figure III-11. The spectrum management between telemetry and communications in this band will be performed by the NOC.

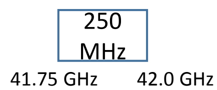

Figure III-11. Downlink Telemetry Frequency Plan

5. Uplink to Downlink Communication Channels and Frequency Band Connectivity

Each satellite will have uplink and downlink beams that will be capable of operating over the entire communications frequency band as defined above. The uplink beam signals will be channelized and the designated subchannels will be combined and routed to the appropriate downlink beam. In general, each communications channel can be routed to and from any communications beam. The satellite payloads will use advanced beamforming antennas and digital technology. This flexibility allows the system capacity to be optimized as the satellites move over different coverage areas and adjusted over the mission life.

6. Inter-Satellite Links

In addition to communications between the satellites and the Earth, the LEO satellites will be capable of ISL communications with GSO satellites or the V-band Constellation NGSO satellites. The V-band LEO satellites will operate bi-directional ISLs both in the FSS portions of the V-band and in the FSS portions of the Ka-band. In each case, the V-band LEO satellites operate as a "user" of the corresponding GSO or higher altitude NGSO satellites. The ISLs will enable data on the LEOs satellite to be routed directly to an alternative ground terminal that is not in view of the V-band LEO satellite.

Boeing's ISL capability will enable high-speed connectivity for LEO satellites that may not be in view of a normal V-band Constellation system gateway. Thus, the LEO ISL capabilities expand the ability of the LEO portion of the V-band Constellation to provide data directly to user processing centers from remote points across the globe. The ISL capability also increases the robustness of constellation management by providing contact through either the V-band inclined NGSO spacecraft or via any number of Ka-band GSO satellites deployed around the world.

The Commission's Table of Frequency Allocations does not include an allocation for ISLs in the spectrum that is allocated for FSS in the Ka-band and the V-band. The definition of FSS, however, does indicate that satellite-to-satellite links may be operated in FSS spectrum that is not specifically designated for the ISL service.[12] In any event,

[12] *See* 47 C.F.R. §§ 2.1 and 25.103 (indicating in the definition of FSS that "in some cases this service includes satellite-to-satellite links, which may also be operated in the inter-satellite service").

Boeing proposes to operate its Ka-band ISLs on a non-conforming, non-interference basis as compared to all other authorized users of the Ka-band. Given the fact that Boeing's ISLs will operate in the Ka-band on a non-interference basis, the Ka-band portion of this Application is not mutually exclusive with, and Boeing does not seek comparative consideration with, those NGSO FSS applications that were filed in response to the November 15, 2016 processing round date for Ka-band NGSO FSS systems.[13] The Commission can therefore authorize Boeing's Ka-band ISL communications without waiting for completion of the November 15, 2016 processing round, and also without initiating an additional Ka-band NGSO FSS processing round.

Boeing acknowledges that portions of the 17.8-19.3 GHz band do not currently include an allocation for FSS, or, in some portions, a designation for NGSO FSS operations. Boeing is not requesting a waiver of the Commission's Frequency Allocation Table for these ISL operations, however, because Boeing's LEO satellites will not transmit and will only receive signals from GSO satellites that have been authorized by the Commission to operate in all or portions of this spectrum.

The Commission's current filing requirements for NGSO FSS systems do not permit including ISL beams within the Schedule S format. The following ISL data in Tables III-2 and III-3 is included in this narrative in order to provide emissions data associated with the ISL terminals on the Boeing V-band Constellation LEO satellites. Note that the operation of the LEO-to-inclined NGSO V-band ISLs cause no changes to

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[13] *See* Satellite Policy Branch Information, OneWeb Petition Accepted for Filing, IBFS File No. SAT-LOI-20160428-00041, DA 16-804 (July 15, 2016).

the V-band Constellation inclined NGSO satellite parameters because the V-band LEO satellites are designed to operate as a user of the V-band inclined NGSO satellites.

Table III-2. Ka-band ISL Key Parameters

Service Description (Ka-band ISL)	Frequency Band(s)	Mode/Type
LEO – GSO Ka-band ISL (Tx)	27.5-29.1 GHz 29.5-30.0 GHz	Transmit
LEO – GSO Ka-band ISL (Rx)	17.8-19.3 GHz 19.7-20.2 GHz	Receive

Ka-band ISL Receiving Beam	
LEO Receive Beam Frequency Bands	17.8-19.3 GHz, 19.7-20.2 GHz
Polarization	Dual CP (LHCP & RHCP)
Maximum Gain	40.4 dBi
Maximum G/T	14.0 dB/K
Min/Max. Sat Flux Density	N/A
Channel Bandwidths	Variable (125, 250, 500 or 1000 MHz)
3 dB Beamwidth	1.7 deg
Field-of-View	Visible GSO arc
Ka-band ISL Transmitting Beam	
LEO Transmit Beam Frequency Bands	27.5-29.1 GHz, 29.5-30.0 GHz
Polarization	Dual CP (LHCP & RHCP)
Maximum Gain	43.6 dBi
Maximum Transmit EIRP	61.0 dBWi
Maximum Transmit EIRP Density	34.0 dBWi / MHz
Channel Bandwidths	Variable (125, 250, 500 or 1000 MHz)
3 dB Beamwidth	1.2 deg
Field-of-View	Visible GSO arc

Table III-3. V-band ISL Key Parameters

Service Description (V-band ISL)	Frequency Band(s)	Mode/Type
LEO – GSO/NGSO V-band ISL (Tx)	47.2-50.2 GHz 50.4-51.4 GHz	Transmit
LEO – GEO/NGSO V-band ISL (Rx)	37.5-40.0 GHz 40.0- 42.0 GHz	Receive
V-band ISL Receiving Beam		
LEO Receive Beam Frequency Bands	37.5-40.0 GHz, 40.0-42.0 GHz	
Polarization	Dual CP (LHCP & RHCP)	
Maximum Gain	45.4 dBi	
Maximum G/T	18.5 dB/K	
Min/Max. Sat Flux Density	N/A	
Channel Bandwidths	Variable (125, 250, 500 or 1000 MHz)	
3 dB Beamwidth	0.9 deg	
Field-of-View	Visible GSO arc and inclined NGSO orbits	
V-band ISL Transmitting Beam		
LEO Transmit Beam Frequency Bands	47.2-50.2 GHz, 50.4-51.4 GHz	
Polarization	Dual CP (LHCP & RHCP)	
Maximum Gain	48.0 dBi	
Maximum Transmit EIRP	66.5 dBWi	
Maximum Transmit EIRP Density	39.5 dBWi / MHz	
Channel Bandwidths	Variable (125, 250, 500 or 1000 MHz)	
3 dB Beamwidth	0.7 deg	
Field-of-View	Visible GSO arc and inclined NGSO orbits	

§ 25.114(d)(6) Public Interest Considerations

Public interest considerations supporting the grant of this Application are set forth in Part II of this Application.

§ 25.114(d)(14) Mitigation of Orbital Debris (including § 25.283)

The V-band Constellation will employ the following design and operational strategies to mitigate orbital debris. Unless otherwise noted, the following narrative describing the design and operation to mitigate orbital debris applies to both the LEO and inclined NGSO satellites.

A. Control of Debris Released During Normal Operations

Boeing has assessed and limited the amount of debris released in a planned manner during normal operations. By design, the Boeing satellites limit debris released consistent with U.S. Government Orbital Debris Mitigation Standard Practice. Release devices, *e.g.*, bolts, are captured and there are no nominal jettisons of any equipment. All exterior surfaces are designed to avoid production of debris due to space exposure. In addition, Boeing has assessed and limited the probability of the satellite becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control and prevent post-mission disposal. Standard environmental models and standard Boeing design practices have been utilized to predict the environment and provide sufficient protection via bumper shields, *etc.* to limit the probability of the satellite from becoming a source of debris.

B. Minimizing Debris Generated by Accidental Explosions

Boeing has assessed and limited the probability of accidental explosions during and after completion of mission operations. The onboard energy sources are as follows: pressurized fuel tank(s), reaction wheels, batteries, constant conductance heat pipes, and pumped fluid loops. The pressurized tanks are designed and operated with industry standards of margin to avoid accidental explosions. Similarly, the reaction wheels (spin rate) and batteries (state of charge) are operated well within their safe operating limits. The heat pipes are similar in design to those with more than twenty years of flight heritage operating with low pressure ammonia with no incidents of explosion. The pumped fluid loop operates at even lower pressure and consequently a lower explosion risk. As mentioned above, all satellite equipment is evaluated and protected from environmentally induced failure, *e.g.*, micrometeroids. After maneuvering to the disposal orbit stored energy will be removed from the spacecraft as follows: depletion of all propellant and venting of the propulsion system, shutdown of the pumped loop system, despinning of the reaction wheels, and discharge of the batteries.

C. Selection of Safe Flight Profile and Operational Configuration

Boeing has assessed and limited the probability of the space station becoming a source of debris by collisions with large debris or other operational space stations by acquiring data from the Space Surveillance Network ("SSN"), propagating the orbits, and if necessary (probability of collision greater than 10^{-4}), coordinating the potential close approach, and if required, employing satellite propulsion to alter the satellite orbit to avoid a collision and generation of debris. For the inclined NGSO satellites, the primary risk of collision is during the earliest mission operations when orbit perigee is low. The operational orbit does not intersect the GSO belt and, as a result, the risk of collision is very low.

D. Post-Mission Disposal of Space Structures

Post mission at the end of life, the LEO satellites are disposed by atmospheric reentry. This reentry is realized by an initial propulsive maneuver which lowers the spacecraft orbital altitude to 500 kilometers, followed by passive reentry resulting from drag. The total time is estimated to be five years, well within the 25 year NASA and international guideline. Sufficient satellite fuel will be reserved for the LEO disposal maneuvers.

The LEO satellites are designed to employ demisable materials that limit the survivability of these materials upon reentry thereby minimizing the risk of human casualties. The risk is estimated to be less than 1 in 10,000, in accordance with NASA-STD 8719.14, requirement 4.7-1.

Post mission at the end of life, the inclined NGSO satellites are disposed by propulsive maneuvering to a 'graveyard' disposal orbit. The required altitude for GSO satellites is 35,786 km + 200 km + 35 km + (1000 CR A/m). Two hundred kilometers provides a buffer relative to the GSO arc, 35 kilometers accounts for orbital perturbations other than solar pressure, and the remaining term accounts for solar pressure perturbations. Solar perturbation for the inclined NGSO satellites based on this formula is 94 kilometers, hence the graveyard orbit minimum altitude is 36,115 kilometers. As the operational orbit has an apogee of 44,221 kilometers and a perigee of 27,355 kilometers, it is only necessary to raise the perigee to achieve the graveyard orbit. An appropriate amount of fuel will be reserved to perform this maneuver.

§ 25.143(b)(2) Geographic Coverage Requirements

The hybrid V-band Constellation will comply with the default geographic service rules applicable to NGSO FSS systems. Following Initial Deployment, the V-band Constellation will be capable of providing service, as described in Section 25.143 (b)(2)(iii) (domestic coverage), on a continuous basis throughout the fifty states, Puerto Rico and the U.S. Virgin Islands, *i.e.*, that at least one satellite will be visible above the horizon at an elevation angle of at least 5° at all times within the described geographic areas. In addition, because the Initial Deployment consists of the inclined NGSO satellites over North and South America, it will provide service as far north as 70° North latitude and as far south as 55° South latitude regionally over North America, Central America, South America, Hawaii, the Caribbean, Greenland, and Iceland.

Regarding Section 25.143(b)(2)(ii) (international coverage), upon Final Deployment, the hybrid V-band Constellation will be capable of providing service to all locations as far north as 70° North latitude and as far south as 55° South latitude for at least 75% of every 24-hour period, *i.e.*, that at least one satellite will be visible above the horizon at an elevation angle of at least 5° for at least 18 hours each day within the described geographic area. Due to the high inclination and placement of the inclined NGSO satellites, full earth coverage can be provided with a minimum elevation angle of 20° for at least 18 hours each day.

§ 25.145(e) Prohibition of Certain Agreements

Boeing hereby certifies that it will not, nor will any persons or companies controlling or controlled by the applicant, acquire or enjoy any right, for the purpose of handling traffic to or from the United States, its territories or possessions, to construct or operate space segment or earth stations, or to interchange traffic, which is denied to any other United States company by reason of any concession, contract, understanding, or working arrangement to which the licensee or any persons or companies controlling or controlled by the licensee are parties.

§ 25.156(d)(4) Separate Treatment of Feeder Links and Service Links

Boeing is requesting a waiver of this rule section, which is addressed in Part IV of this Application.

§ 25.156(d)(5) NGSO Versus GSO Systems

Boeing is requesting a waiver of certain aspects of this rule section, which are addressed in Part IV of this Application.

§ 25.157(e) Bandwidth Assignments Resulting From Processing Rounds

Boeing is requesting a waiver of certain aspects of this rule section, which are addressed in Part IV of this Application.

§ 25.164(b) Construction Milestones

Section 25.164(b) of the Commission's recently adopted rules requires licensees of NGSO systems to "launch the space stations, place them in the assigned orbits, and operate them in accordance with the station authorization no later than six years after the grant of the license, unless a different schedule is established by Title 47, Chapter I, or the Commission."[14] Boeing herein requests that the Commission establish a different schedule that ensures the launch and operation of the Initial Deployment of the V-band Constellation within the time frame contemplated by the Commission's rules, but also affords Boeing the flexibility to enhance the system's capabilities over time.

Boeing proposes to launch its V-band Constellation in two phases. The Initial Deployment of the NGSO System would be completed within six years after the grant of a license to Boeing and would include a sufficient number of satellites to satisfy the Commission's domestic geographic coverage requirements of providing service on a continuous basis throughout all fifty states, Puerto Rico and the U.S. Virgin Islands and

[14] 47 C.F.R, § 25.164(b).

would provide enough capacity to meet the anticipated needs of the initial customers. The inclined NGSO constellation consisting of five active satellites over North and South America will provide the domestic coverage required by Section 25.143(b)(iii) of the Commission's rules with an estimated minimum elevation angle of 25 degrees. The minimum elevation angle increases to 45 degrees over the contiguous 48 states and much of Alaska.

The Final Deployment would provide additional capacity to meet growing demand requirements using the remaining ten inclined NGSO satellites operating over the other parts of the world and the full 132 satellite LEO constellation. The Final Deployment would be completed within twelve years after the grant of a license to Boeing and would achieve the international coverage required by Section 25.143(b)(ii) of the Commission's rules.

§ 25.202(a)(1) Spectrum Bands Available for FSS

As noted above, Boeing is requesting authority to operate the V-band Constellation in the United States using the 37.5-42.0 GHz (space-to-Earth) and the 47.2-50.2 and 50.4-51.4 GHz bands (Earth-to-space). Although Section 2.106 of the rules does identify the 50.4-51.4 GHz band as allocated for FSS, the band is not identified in Section 25.202(a)(1) as available for FSS. In addition, footnote 3 of Section 25.202(a)(1) restricts the use of the 37.5-40.0 GHz band by FSS to gateway earth station operations. Boeing requests a waiver of these allocation and operational restrictions in Part IV of this Application.

§ 25.202(j) 50.2-50.4 GHz Out-of-Band Emissions Limits

Boeing herein affirms that the V-band Constellation will comply with the limits established by Section 25.202(j) of the Commission's rules, which indicates that out-of-band emissions into the 50.2-50.4 GHz band under clear-sky conditions shall not exceed −20 dBW/200 MHz (measured at the input of the antenna), except that the maximum unwanted emission power may be increased to −10 dBW/200 MHz for earth stations having an antenna gain greater than or equal to 57 dBi. Boeing observes, however, that ITU Radio Regulations No. 5.340.1 indicates that the use of the 50.2-50.4 GHz band by passive services "should not impose undue constraints on the use of the adjacent bands by the primary allocated services in those bands."

§ 25.204(e) Uplink Adaptive Power Control

In compliance with Section 25.204(e), earth station transmissions under conditions of uplink fading will use power control methods to not exceed 1 dB above the actual uplink excess attenuation over clear-sky conditions in order to meet the desired link performance while minimizing interference between networks.

§ 25.207 Cessation of Emissions

The V-band Constellation NOC will be able to command and effectuate the cessation of emissions from any or all of the spacecraft if the need arises.

§ 25.210(f) Frequency Re-use

The V-band Constellation will use V-band spectrum for both uplink and downlink, including the use of both polarizations (LHCP and RHCP), as illustrated by the frequency plan in the narrative for Section 25.114(d)(1). The satellites will use advanced beamforming antennas to generate adjustable beams within the satellite coverage footprint. The system will employ extensive frequency re-use to provide a very high rate broadband data service to user terminals and to communicate with gateways. This approach meets the requirements in Section 25.210(f) regarding start-of-the-art full frequency reuse for the user and feeder communications links.

IV. REQUESTED WAIVERS

Pursuant to Section 25.112(b)(1) of the Commission's rules, Boeing requests waivers of all or portions of the following rules:

- Section 2.106 and 25.202(a)(1) available FSS spectrum bands,
- Section 25.156(d)(4) treating feeder links as separate applications,
- Section 25.156(d)(5) NGSO versus GSO license grant,
- Section 25.157(e) band segmentation, and
- Section 25.159(b) limits on pending applications.

The Commission's standards for the grant of waivers and the specific justifications for each of the requested waivers is discussed below.

A. The Waiver Standard

The Commission's rules permit the FCC to grant waivers of its rules on a showing of "good cause."[15] The Commission's authority to grant waivers is firmly rooted. The U. S. Supreme Court has indicated that the FCC not only has the legal right, but also the obligation to consider and grant waivers of its rules.[16] The Court has indicated that the

[15] 47 C.F.R. § 1.3 (1999).

[16] National Broadcasting Co. v. U.S., 319 U.S. 190 (1943) (upholding the Commission's "chain broadcasting regulations," which prohibit exclusive arrangements between

Commission's responsibility to consider waivers stems from its statutory obligation to serve the "public interest, convenience, or necessity."[17] "If time and changing circumstances reveal that the 'public interest' is not served by application of the Regulations, it must be assumed that the Commission will act in accordance with its statutory obligations."[18]

Pursuant to this obligation to consider and grant waivers, the Commission maintains Section 1.3 of its rules, which indicates that the FCC will waive its rules "if good cause therefor is shown." In each circumstance discussed below, good cause is presented for the grant of each waiver requested. Granting each waiver would serve the public interest and would not undermine any existing policy consideration that originally formed the basis for the rule in question.

B. Waiver of §§ 2.106 and 25.202(a)(1)

Sections 2.106 and 25.202(a)(1) of the Commission's rules identify the spectrum allocations that are available for use by FSS systems in the United States.[19] Although Section 2.106 of the rules does identify the 50.4-51.4 GHz band as allocated for FSS, the band is not identified in Section 25.202(a)(1) as available for FSS. In addition, footnote 3

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networks and radio stations, in part because the Commission may still grant waivers of the rules); *see also* United States v. Storer Broadcasting Co., 351 U.S. 192, 205 (1956) (concluding that the Commission must grant a hearing to consider a justified request for waiver of its multiple ownership rules).

[17] *National Broadcasting Co.*, 319 U.S. at 225.

[18] *Id.*

[19] 47 C.F.R. §§ 2.106, 25.202(a)(1).

of Section 25.202(a)(1) restricts the use of the 37.5-40.0 GHz band by FSS to gateway earth station operations. The Commission should waive each of these provisions.

37.5-40.0 GHz: As Boeing has documented in the Commission's *Spectrum Frontiers* proceeding, advanced beam-forming antennas and other technologies are facilitating significant new spectrum-sharing opportunities that can be employed in the 37.5-40.0 GHz band, both on an intra-service and inter-service basis. Recognizing the potential of such technological solutions, the Commission acknowledged that it is appropriate to review its soft segmentation requirements "in light of evolving technology permitting new options for co-existence of terrestrial and FSS."[20]

Based on these new spectrum-sharing capabilities, the Commission should promote competition in very high data rate mmW communications services by permitting ubiquitously-deployed satellite user terminals to operate on an opportunistic and downlink-only basis in the 37.5-40.0 GHz band with existing and new terrestrial services. Boeing has filed extensive technical materials in the Commission's *Spectrum Frontiers* proceeding explaining why it is appropriate for the Commission to lift the restriction on satellite user terminals in the 37.5-40.0 GHz band and to adopt rules that promote sharing between terrestrial and satellite services in this spectrum.[21] Accordingly, Boeing requests

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[20] Use of Spectrum Bands Above 24 GHz For Mobile Radio Services, GN Docket No. 14-177, Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band, RM-11664, et al., *Notice of Proposed Rulemaking*, FCC 15-138, ¶ 126 (2015) ("*Spectrum Frontiers NPRM*").

[21] *See, e.g.,* Oral Ex Parte Notice of The Boeing Company, GN Docket 14-177, IB Docket Nos. 15-256 and 97-95, RM-11664; WT Docket No. 10-112, at 3 (Jun. 7, 2016) ("*37.5-40.0 GHz Sharing Ex Parte*").

a waiver of the restriction on satellite user terminals that exists in footnote 3 of Section 25.202(a)(1). Boeing would accept such waiver subject to the eventual outcome of the Commission's deliberations on this issue in the *Spectrum Frontiers* proceeding.

50.4-51.4 GHz: The 50.4-51.4 GHz band is allocated for FSS (Earth-to-space) in both the ITU's and the FCC's Table of Frequency Allocations as contained in Section 2.106 of the Commission's rules. The 50.4-51.4 GHz band, however, is not identified as available for FSS uplinks in Section 25.202(a)(1) of the Commission's rules. Good cause exists to waive Section 25.202(a)(1) to permit Boeing to operate a portion of the Boeing V-band Constellation uplinks in the 50.4-51.4 GHz band.

Pursuant to ITU Resolution 159 (WRC-15), the ITU-R is currently studying the development of regulatory provisions to enhance the ability of NGSO FSS systems to operate in V-band spectrum, including the 50.4-51.4 GHz portion of the V-band.[22] Resolution 159 was adopted by WRC-15 based on a proposal and the leadership of the U.S. Administration and acknowledges the need for the implementation of new FSS technologies in higher spectrum bands. Resolution 159 observes that NGSO FSS systems are capable of providing "high-capacity and low-cost means of communication even to the most isolated regions of the world."[23]

[22] Resolution 159 (WRC-15), Studies of technical, operational issues and regulatory provisions for non-geostationary fixed-satellite services satellite systems in the frequency bands 37.5-39.5 GHz (space-to-Earth), 39.5-42.5 GHz (space-to-Earth), 47.2-50.2 GHz (Earth-to-space) and 50.4-51.4 GHz (Earth-to-space) (available at http://www.itu.int/dms_pub/itu-r/oth/0c/0a/R0C0A00000C0006PDFE.pdf).

[23] *Id.*

Resolution 159 identifies a need for studies to ensure that NGSO FSS systems can protect passive Earth Exploration Satellite Services ("EESS") in the adjacent 50.2-50.4 GHz band and radio astronomy services in the adjacent 51.4-54.25 GHz band. The Resolution also identifies a need for studies on spectrum sharing between NGSO and GSO FSS systems throughout the V-band.

Boeing's V-band Constellation is designed to protect EESS and radio astronomy operations in adjacent spectrum bands. The V-band Constellation could also operate in the V-band on a shared basis with other co-frequency GSO and NGSO systems. Therefore, good cause exists to waive Section 25.202(a)(1) to permit the V-band Constellation uplinks in the 50.4-51.4 GHz band. Boeing previously filed a petition for rulemaking seeking the initiation of a Commission proceeding to establish an allocation for FSS uplinks in the 50.4-51.4 GHz band. Boeing would accept a waiver conditioned on the outcome of Boeing's requested rulemaking proceeding and on the Commission's implementation of the outcome of the ITU-R study process for Resolution 159 and its implementation by WRC-19.

C. Waiver of § 25.156(d)(4)

As indicated in the System Description of this Application, Boeing's V-band Constellation will operate both service links and feeder links using the same spectrum, rather than segregating these operations into separate spectrum bands in the same manner as legacy satellite systems. This consolidated approach is much more spectrally efficient because it allows Boeing to allocate all of the spectral resources available to the V-band Constellation toward the support of end user service links in those geographic locations where demand is heavy, while positioning its supporting gateway facilities in geographic regions with lower population density and corresponding less user demand.

In contrast, Section 25.156(d)(4) of the Commission's rules indicates that an application for feeder link authority will be treated by the Commission as a separate application from its associated service band.[24] Given that Boeing will operate its system in a more spectrally efficient manner – with service and feeder links sharing the same spectrum – Boeing herein requests a waiver of Section 25.156(d)(4).

Given the fact that Boeing's approach to spectrum use is far more effective and efficient, good cause exists for the Commission to waive the requirements of Section 25.156(d)(4) and to refrain from applying it to this Application.

D. Waiver of § 25.156(d)(5)

Section 25.156(d)(5) of the Commission's rules indicates that once a license is issued for a GSO or NGSO system in a particular spectrum band that lacks service rules, the FCC will not issue a license for systems in the other service until service rules are adopted.[25] The Commission recently acknowledged in the context of its Notice of Proposed Rulemaking on NGSO FSS operations that this rule has outlived its usefulness.[26] As the satellite industry has documented, GSO and NGSO systems can

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[24] 47 C.F.R. § 25.156(d)(4).

[25] 47 C.F.R. § 25.156(d)(5).

[26] *See* Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters, IB Docket No 16-408, *Notice of Proposed Rulemaking*, FCC 16-170, ¶ 21 (Dec. 15, 2017) ("*NGSO FSS NPRM*").

share spectrum on a co-frequency basis using various techniques. Therefore, a prohibition on their joint operation is unnecessary.

Nevertheless, the Commission has not yet withdrawn Section 25.156(d)(5). The rule is therefore relevant in this case because the Commission did previously issue authorizations to both GSO[27] and hybrid GSO/NGSO[28] satellite systems in portions of the V-band, none of which were ever launched. Boeing therefore requests a waiver of Section 25.156(d)(5) of the Commission's rules. A waiver is appropriate for two reasons. First, as the Commission appears to acknowledge, Section 25.156(d)(5) no longer serves its intended purposes. Further, if left in place, the rule could prevent the development of broadband satellite systems in the V-band that could be used to provide important broadband services to rural populations. Second, as noted above, none of the satellite systems that were authorized to operate in the V-band were ever launched. Therefore, enforcement of the rule in this case would not serve its intended purpose, even if that purpose were still legitimate.

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[27] Application of Hughes Network Systems, LLC, for Authority to Construct, Launch and Operate a Ka-band and V-band Geostationary Orbit Space Station, Jupiter 77W, and the 77.3º W.L. Orbital Location, File Nos. SAT-LOA-20111223-00248 (Aug. 3, 2012).

[28] Application of Northrop Grumman Space & Mission Systems Corporation for Authority to Operate a Global Satellite System Employing Geostationary Satellite Orbit and Non-Geostationary Satellite Orbit Satellites in the Fixed-Satellite Service in the Ka-band and V-band, File Nos. SAT-LOA-19970904-00082 et al., *Order and Authorization*, DA 09-428 (Feb. 23, 2009).

E. Waiver of § 25.157(e)

Sections 25.157(e) of the Commission's rules, as recently revised by the Commission's Second Order on Reconsideration,[29] indicates that, in cases where multiple NGSO FSS systems are granted licenses in the same processing round and insufficient spectrum is available to meet the needs of each licensee, the Commission will divide the available spectrum among them. The Commission, however, has appropriately proposed to eliminate this "band-splitting rule" in favor of its in-line avoidance rule.[30] Boeing and others filed comments supporting this proposal.[31]

The band-splitting approach should be eliminated because a licensing process that divides the V-band spectrum between multiple NGSO FSS system licensees would prevent any of those satellite systems from making available to a large base of subscribers the high data rate communications services that are necessary to achieve the Commission's stated broadband goals. Instead, modern NGSO FSS systems can employ spectrum sharing techniques to enable co-frequency spectrum sharing with other NGSO FSS systems and thereby avoid the need for highly inefficient and counterproductive spectrum segmentation. The Commission should therefore grant Boeing a waiver of the

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[29] *See* Amendment of the Commission's Space Station Licensing Rules and Policies, IB Docket No. 02-34, *Second Order on Reconsideration*, FCC 16-108 (Aug. 16, 2016).

[30] *See NGSO FSS NPRM*, ¶ 23 (explaining that "we propose to clarify in section 25.157 that these band-splitting procedures do not apply to applications granted on the condition of compliance with the avoidance of in-line interference mechanism specified in section 25.261").

[31] *See* Comments of The Boeing Company, IB Docket No. 16-408, at 12 (Feb. 27, 2017).

Section 25.157(e) band-splitting requirement in order to permit Boeing to operate its V-band Constellation across the entire V-band FSS allocation.

A second reason to grant a waiver of Section 25.157(e) is because its existence encourages speculation and arbitrage in NGSO FSS satellite system licenses. This speculation was evident in the response to the Commission's cut-off deadline for NGSO FSS systems operating in the Ka-band, which included far more proposals for the launch of Ka-band NGSO FSS systems than could reasonably be supported by the market. If the Commission's in-line avoidance approach had already applied to every FSS spectrum band, each applicant for an NGSO FSS system license would place no impediment on the plans of other NGSO FSS system applicants in the same spectrum band (and therefore no speculative leverage) because each applicant would know that it would be expected to share spectrum on a co-frequency basis with other systems that are actually launched.

In contrast, pursuant to the band-segmentation approach of Section 25.157(e), each additional applicant for an NGSO FSS system in a particular spectrum band proportionally reduces the spectrum available to other NGSO FSS system applicants, potentially (and likely) precluding their construction and launch. Therefore, the Commission should waive the band segmentation requirements of Section 25.157(e) to encourage more efficient spectrum sharing approaches and to discourage speculation and arbitrage in V-band NGSO system licenses.

F. Waiver of § 25.159(b).

Pursuant to the Commission's authority and discretion to issue waivers,[32] Boeing requests the Commission waive Section 25.159(b) and permit the maintenance of an additional application for an alternative NGSO FSS system operating in the V-band. Boeing currently has pending before the Commission its June 22, 2016 application for an NGSO FSS system operating in the V-band. This application is for a separate constellation that would utilize many of the same V-band frequencies.

The Commission's authority to waive its rules is well-recognized.[33] Allowing Boeing to maintain an additional filing would serve the public interest and is justified in this case for several reasons: (1) the purpose of Section 25.159(b)—to deter applicants from speculating in spectrum—is fully served in this case, (2) other applicants will not be harmed, and (3) applying the Section will unnecessarily hamper Boeing's development plans, which the Commission has made clear it wants to avoid.

First, the Commission's reason for adopting a presumptive restriction on more than one application—preventing speculation and trafficking in spectrum[34]—does not apply here and in fact is no longer necessary. The Commission has itself come to that conclusion in precisely analogous circumstances, involving GSO applications. When the

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[32] 47 C.F.R. § 1.3.

[33] *See*, *e.g.*, *National Broadcasting Co.*, 319 U.S. at 225 ("[i]f time and changing circumstances reveal that the 'public interest' is not served by application of the Regulations, it must be assumed that the Commission will act in accordance with its statutory obligations").

[34] Amendment of the Commission's Space Station Licensing Rules and Policies, *First Report and Order*, 18 FCC Rcd 10760, ¶ 230 (2003) ("*2003 License Reform Order*").

Commission originally adopted Section 25.159(b) in 2003 for both NGSO and GSO satellite systems, the Commission explained that its purpose was to "refrain speculation without restricting applicants' business plans."[35] But in 2015 the Commission eliminated the rule for GSO system applications, explicitly acknowledging that, "in light of the bond and milestone requirements and other safeguards," a prohibition on multiple pending applications is unnecessary "to deter warehousing of spectrum and orbital resources."[36] The Commission further acknowledged that "the restriction on additional license applications could inhibit opportunities for expansion of large satellite fleets."[37]

Boeing's second V-band application, like the first application, is plainly not an attempt to "warehouse spectrum or orbital resources," but rather is part of a legitimate business plan to operate the system described in the application. Moreover, because the same kind of "bond and milestone requirements and other safeguards" exist for NGSO applications to prevent speculation, the Commission's reasons for eliminating the GSO restriction apply in this case and support allowing Boeing to maintain an additional application. [38]

The Satellite Industry Association ("SIA") agrees that the concerns reflected in Section 25.159(d) are now well addressed by other mechanisms and the provision may be

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[35] *Id.*

[36] Comprehensive Review of Licensing and Operating Rules for Satellite Services, IB Docket No. 12-267, Second Report and Order, FCC 15-167, ¶ 337 (Dec. 17, 2015) ("*Second Part 25 Order*").

[37] *Id.*

[38] *Id.*

viewed as "redundant." As the industry explained when it urged the Commission to eliminate the restriction for both GSO and NGSO system applications:

> First, the numerical limits are redundant given the Commission's milestone requirements, which are designed to ensure that there is no waste of orbital and spectrum resources. Second, the Commission's rule imposing additional obligations on licensees that miss three or more implementation milestones in a three-year period (Section 25.159(d)) serve[s] as an effective inhibitor on potential speculation. Third, the limits artificially constrain licensee flexibility and planning for fleet upgrades and expansions. Fourth, as international coordination prospects may become clear only in the future, enhanced flexibility resulting from elimination of the numerical limits will provide operators with more options. And fifth, legitimate business plans may call for investment in a number of new satellites that exceeds the existing limits.[39]

Again, these rationales for eliminating the rule apply equally to the NGSO restriction and, accordingly, are good cause to grant Boeing's request for a waiver of that restriction.

Second, allowing Boeing to maintain an additional V-band application will have minimal impact on other participants in the Commission's V-band NGSO processing round. As the Commission has acknowledged in proposing to eliminate its "band-splitting rule" in favor of an in-line avoidance rule,[40] NGSO systems can share the entire

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[39] Comments of the Satellite Industry Association, IB Docket No. 12-267, at 70 (Jan. 14, 2013) (*internal cites omitted).* The Commission's *Further Notice* in response to the request proposed only to eliminate the restriction for GSO satellite applications and made no mention of the corresponding restriction for NGSO satellite applications, *See* Comprehensive Review of Licensing and Operating Rules for Satellite Services, IB Docket No. 12-267, *Further Notice of Proposed Rulemaking*, 29 FCC Rcd 12116, ¶ 183 (2014), so the order eliminating the restriction for GSO applications did not mention NGSO systems. *See Second Part 25 Order*, ¶ 337. Nothing in the proceedings or the order indicated that the Commission believed that it should treat GSO or NGSO systems differently in this respect, and because the same justifications for eliminating the restriction apply to both kinds of systems, no party advocated doing so.

[40] *See NGSO FSS NPRM*, ¶ 23.

V-band using in-line avoidance. In both its first V-band NGSO FSS application and in this application, Boeing has likewise indicated that Boeing can share the entire V-band with all other NGSO FSS systems using in-line avoidance or other spectrum sharing techniques.[41] Because Boeing and other applicants can share the entire band, allowing Boeing to pursue two NGSO FSS system applications will not prevent any other NGSO FSS system from operating throughout the V-band.

Third and finally, a waiver of Section 25.159(b) is justified because prohibiting Boeing from pursuing a second application is contrary to the Commission's express intent not to restrict applicants' business and development plans. As discussed above, when the Commission adopted the restriction, the Commission made explicit the important caveat that it sought to deter speculation "without restricting applicants' business plans" and without precluding "legitimate applications from consideration."[42] Yet in light of the legitimate business reasons Boeing has identified for pursuing two V-band NGSO FSS systems, if the Commission fails to accept Boeing's second application it will needlessly "restrict[] [Boeing's] business plans" and preclude a "legitimate application[] from consideration," contrary to the Commission's goals and the public interest in investment in broadband solutions.

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[41] *See* The Boeing Company Application for Authority to Launch and Operate a Non-Geostationary Low Earth Orbit Satellite System in the Fixed Satellite Service (S2966), SAT-LOA-20160622-00058, at 91-92 (filed June 22, 2016) ("*2016 V-Band Application*"); *see also supra* at 13 (observing that "[b]y design, this V-band Constellation will enable efficient spectrum reuse and avoid interference to GSO satellites").

[42] *2003 License Reform Order,* ¶ 230.

In summary, because the Commission's reason for adopting the presumptive restriction on more than one application does not apply here, and because doing so will not harm other NGSO FSS system spectrum applicants, there is good cause to permit Boeing to maintain two pending applications for licenses to operate NGSO FSS systems using the V-band and the Commission should grant Boeing's Section 25.159(b) waiver request.