

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554**

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<i>Application of</i>)	
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DIRECTV ENTERPRISES, LLC)	Call Sign:
)	
For Authorization to Launch and)	File No. SAT-RPL-_____
Operate DIRECTV 15 at 103° W.L.)	
_____)	

**APPLICATION FOR AUTHORIZATION
TO LAUNCH AND OPERATE DIRECTV 15**

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**APPLICATION FOR AUTHORITY
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DIRECTV Enterprises, LLC (“DIRECTV”) hereby requests that the Commission authorize the launch and operation of DIRECTV 15, a geostationary Ka-band satellite¹ to be located at the nominal 103° W.L. position, where it will be collocated with, and serve to replace and/or supplement the existing on-orbit capacity of, the SPACEWAY 1, DIRECTV 10, and DIRECTV 12 satellites. DIRECTV 15 will operate within the Ka-band spectrum already licensed to DIRECTV at the 103° W.L. slot. The capabilities of this satellite will be carefully integrated with those of DIRECTV’s existing on-orbit Ka-band satellites in order to optimize the efficient use of valuable spectrum resources at that location and to incorporate redundancy to DIRECTV’s high definition (“HD”) programming operations. Grant of this application will promote the continuing

¹ Note that DIRECTV 15 is a hybrid multi-band satellite, which includes payloads operating in three frequency bands: Ka FSS, 17/24 GHz BSS, and 12/17 GHz DBS. DIRECTV has been licensed for the 17/24 GHz BSS portion of this satellite under call sign S2712. See *DIRECTV Enterprises, LLC*, 24 FCC Red. 9393 (Int’l Bur. 2009). This application seeks operating authority for only the Ka-FSS portion of this satellite at the 103° W.L. orbital location, but provides information on the 12/17 GHz DBS payload as well.

development of HDTV services, enable DIRECTV to maintain its position as the leader in digital home video entertainment and innovation, and enhance DIRECTV's ability to continue to offer U.S. consumers a powerful alternative to the services of incumbent cable operators.

DIRECTV has begun construction of DIRECTV 15, at its own risk,² and expects the satellite to be ready for launch and operation in the relatively near future.

Accordingly, DIRECTV requests that the Commission grant this application as expeditiously as possible.

I. GRANT OF THIS APPLICATION WOULD SERVE THE PUBLIC INTEREST

Over the past nine years, DIRECTV has demonstrated the suitability of Ka-band spectrum for delivery of high quality multichannel video programming directly to consumers, helping to unlock the enormous potential of this band. With five Ka-band satellites currently providing direct-to-home services ("DTH"),³ DIRECTV has been able to achieve a quantum leap in the amount of HD digital television programming – including local broadcast stations in HD – available to consumers throughout the country. Nearly 70% of new DIRECTV subscribers, and over 50% of the total DIRECTV customer base, subscribe to HD services. Continuing its tradition as the leader in innovative digital television services, DIRECTV intends to continue its development of advanced services and augment its impact for American consumers. In this application, DIRECTV seeks authority to launch and operate another vital element in its strategy to

² See 47 C.F.R. 25.113(f).

³ DIRECTV transmits programming directly to consumers from the DIRECTV 10, DIRECTV 12 and SPACEWAY 1 satellites at the nominal 103° W.L. location and from the DIRECTV 11 and SPACEWAY 2 satellites at the nominal 99° W.L. location. DIRECTV also operates Ka-band payloads on the DIRECTV 8 and DIRECTV 9S satellites at the nominal 101° W.L. location, but those are used for backhaul distribution rather than provision of programming directly to subscribers.

maintain its leadership position as an innovator in the digital revolution and to continue to build upon the nation's transition from analog to HD television.

DIRECTV 15 will be used to further expand DIRECTV's capability to provide HD services to American consumers. The satellite is fully compliant with Commission rules relating to Ka-band blanket earth station licensing.⁴ Its operations will be carefully integrated with those of DIRECTV's existing on-orbit Ka-band satellites at the nominal 103° W.L. orbital location in order to optimize the efficient use of valuable spectrum resources at that location and to incorporate redundancy to DIRECTV's HD operations. Combined with the SPACEWAY 1, DIRECTV 10, and DIRECTV 12 satellites operating at 103° W.L., this satellite will give DIRECTV the ability to broadcast a significant number of additional channels of national HD programming. The satellite will also be capable of supporting multiple other missions, which will thereby afford DIRECTV in-orbit redundancy within its growing satellite fleet.⁵

By granting this application, the Commission will enable DIRECTV to continue at the forefront of the development and delivery of video services. This capability will allow DIRECTV to maintain its leadership in digital entertainment and innovation and further enhance DIRECTV's ability to compete with incumbent cable operators to provide the best possible programming service to American consumers. The satellite's

⁴ See 47 U.S.C. §§ 25.138, 25.208.

⁵ DIRECTV 15 has been designed with the capability of performing national Ka-band transmissions from the nominal 103° W.L. or 99° W.L. location (should it be repositioned to 99° W.L. at some time in the future). In addition, DIRECTV 15 carries a DBS payload capable of national transmissions from the 101° W.L., 110° W.L., or 119° W.L. orbital locations. DIRECTV 15 also carries a 17/24 GHz BSS payload that will operate under DIRECTV's existing license at the 103° W.L. location (call sign S2712). This BSS payload can also support the mission of DIRECTV's 17/24 GHz BSS license at the nominal 99° W.L. location. In this application DIRECTV is only seeking authority to operate the Ka-band payload of DIRECTV 15 at the 103° W.L. location.

multi-band, multi-mission capabilities will also provide valuable redundancy to ensure continuity of service to over 20 million DIRECTV subscribers in the United States.

For the foregoing reasons, DIRECTV respectfully submits that grant of this application would serve the public interest and requests that the Commission act expeditiously so that DIRECTV can proceed to complete construction and launch DIRECTV 15 early in 2015.

II. INFORMATION REQUIRED UNDER SEC. 25.114 OF THE COMMISSION'S RULES⁶

1. Name, Address, and Telephone Number of Applicant

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3. Type of Authorization Requested

DIRECTV hereby applies for authority to launch and operate the Ka-band payload of the DIRECTV 15 satellite at the nominal 103° W.L. orbital location and to

⁶ In a recent Public Notice, the International Bureau set forth an interim waiver policy with regard to a number of satellite application information requirements. (*See* Public Notice, "International Bureau Adopts Policy of Granting Interim Waiver of Certain Requirements for Space Station Applications," 29 FCC Rcd. 664 (Int'l Bur. 2014)). The information contained in this application and the accompanying Schedule S is consistent with the policy set forth in that Public Notice. Accordingly, DIRECTV requests grant of a waiver of the information requirements covered by the policy set forth therein. Notably, DIRECTV seeks a waiver of Section 25.114(c)(4)(vi), which requires applicants to specify the gain of each transponder channel including any adjustable gain step capabilities. As required by Footnote 6 of the Public Notice, DIRECTV has entered a value of "1" in columns q and r of Table S7 and column b of Table S10 of the Schedule S. Further in accordance with the instructions provided in Footnote 6, and in reliance thereon, DIRECTV states that such entries in these data fields are outside the scope of DIRECTV's certification concerning the accuracy of information provided in this application.

launch (but not operate) the 12/17 GHz Direct Broadcast Satellite (“DBS”) payload on the spacecraft. DIRECTV will use the Ka-band capacity to support additional channels of national HD programming. In addition, through incorporation of its multi-band/multi-mission capabilities, this satellite will provide DIRECTV with significant in-orbit redundancy functionality.

4. General Description of Overall System Facilities, Operations and Services

DIRECTV 15 is a multi-band/multi-mission satellite designed to operate at any of DIRECTV’s currently licensed Ka-band, 17/24 GHz BSS, or 12/17 GHz DBS orbital locations. The primary mission of this satellite is to supplement existing DIRECTV DTH services in the Ka-band and to provide new DTH services in the 17/24 GHz BSS band at the requested 103° W.L. orbital location. DIRECTV is already licensed for services in the 17/24 GHz BSS band at this orbital location, and the technical capabilities of the 17/24 GHz BSS payload on DIRECTV 15 will be consistent with the technical details associated with that license.⁷

In this application, DIRECTV is requesting launch and operating authority for the Ka-band mission of this satellite at the 103° W.L. location. DIRECTV also requests launch authority for the spacecraft’s 12/17 GHz DBS payload, which is capable of operating at the 101° W.L., 110° W.L., or 119° W.L. orbital locations and will provide valuable in-orbit redundancy for DIRECTV’s currently operating DBS assets at these locations. DIRECTV is including technical details of this DBS payload in this application for information purposes only. DIRECTV will seek Commission operating authority and provide any required additional information for this DBS payload should this be required at some point in the future.

⁷ See *DIRECTV Enterprises, LLC*, 24 FCC Rcd. 9393 (Int’l Bur. 2009).

4.1 Ka-band DTH Description⁸

The DIRECTV 15 satellite is capable of transmitting up to twenty-four of thirty-eight Ka-band transponders (nineteen LHCP and nineteen RHCP) providing national channels at any given time. The national channels will be delivered to the forty-eight contiguous states (“CONUS”) plus Alaska through a single beam and to Hawaii and Puerto Rico through dedicated spot beams. All of these beams will carry identical national HD programming material. All Ka-band national programming material will be distributed from the DIRECTV broadcast facilities in Los Angeles, CA, (“LABC”) and Castle Rock, CO (“CRBC”). Note that both of these Ka-band facilities operate in conjunction with diversity sites in order to ensure that the required uplink availability is achieved. The diversity site for LABC is located in Long Beach, CA, and for CRBC in Englewood, CO. Using this combination of uplink facilities, the DIRECTV 15 system will have the capability to transmit more than one hundred additional national channels of HD programming, although the number of channels actually transmitted will depend upon how DIRECTV 15 is integrated with DIRECTV’s other Ka-band assets.

4.2 DBS Description⁹

The DIRECTV 15 satellite is capable of supporting up to thirty-two DBS transponders (sixteen LHCP and sixteen RHCP) providing national channels. The national channels will be delivered to CONUS plus Alaska through a single beam and to Hawaii and Puerto Rico through dedicated spot beams. All of these beams will carry

⁸ The description of the Ka-band DTH capabilities provided throughout this application is for DIRECTV 15 operating at the nominal 103° W.L. location. Capabilities for operation at the nominal 99° W.L. location would be very similar and will be provided if and when DIRECTV requests authority to operate the satellite at that location.

⁹ The description of the Ku-band DBS capabilities provided throughout this application are for DIRECTV 15 operating at the nominal 101° W.L. location. Capabilities for operation at the nominal 110° W.L. or 119° W.L. locations would be very similar and will be provided if and when DIRECTV requests authority to operate the satellite at either of those locations.

identical national HD programming material. All DBS national programming material will be distributed from DIRECTV's LABC and CRBC facilities.

5. Operational Characteristics

5.1 Ka-band Description of Frequencies and Beams

DIRECTV 15 will provide DTH service in the FSS Ka-band (28.35-28.6 GHz, 29.25-25.29 GHz, and 29.5-30.0 GHz (Earth-to-space); 18.3-18.59 GHz and 19.7-20.2 GHz (space-to-Earth)). The 28.35-28.6 GHz uplink band will be connected to the 18.3-18.55 GHz downlink band, and the 29.25-25.29 GHz band will be connected to the 18.55-18.59 GHz band. The 29.5-30.0 GHz uplink band will be connected to the 19.7-20.2 GHz downlink band. Both senses of circular polarization (RHCP and LHCP) will be supported in all frequency bands. Receive spot beams directed toward DIRECTV's LABC and CRBC facilities will receive the uplink national programming, which will be connected to both the CONUS plus Alaska transmit beam and the Hawaii and Puerto Rico transmit spot beams. Any Ka-band uplink channel, the technical details of which (*i.e.*, center frequency, polarization, bandwidth) are included in the accompanying Schedule S as channels AR001-AR024 and BR001-BR014, can be received in either uplink spot beam defined in the Schedule S (*i.e.*, beams KALA and KACR). The corresponding downlink channels AT001-AT024, whose technical details are also included in the accompanying Schedule S, are retransmitted in beams KAUS, KAHI, and KAPR, and likewise the channels BT001-BT014 are transmitted in beams KBUS, KAHI, and KAPR. Because of the national downlink coverage, each channel can be used only once.

5.2 DBS Description of Frequencies and Beams

DIRECTV 15 will be capable of providing DBS services in the 17.3-17.8 GHz (Earth-to-space) and 12.2-12.7 GHz (space-to-Earth) DBS bands. The channel plan designed into the satellite conforms to that defined in Appendices 30/30A of the ITU Radio Regulations. The satellite will support thirty-two channels using both senses of polarization. Receive spot beams directed towards DIRECTV's LABC and CRBC facilities (*i.e.*, beams KULA and KUCR from Schedule S) will receive national programming, which will be connected to both the CONUS plus Alaska transmit beam (*i.e.*, beam KUUS) and the Hawaii and Puerto Rico transmit spot beams (*i.e.*, beams KUHI and KUPR, respectively). Any DBS uplink channel, the technical details of which (*i.e.*, center frequency, polarization, bandwidth) are included in the accompanying Schedule S as channels KR001-KR032, can be received in either uplink spot beam. The corresponding Schedule S downlink channels KT001-KT032 are retransmitted in beams KUUS, KUHI, and KUPR. Because of the national downlink coverage, each channel can be used only once.

5.3 TT&C Description of Frequencies and Beams

The transfer orbit and on-station Telemetry, Tracking, and Control ("TT&C") functions for DIRECTV 15 will be provided at the edges of the 29.5-30.0 GHz and 19.7-20.2 GHz frequency bands allocated for FSS Ka-band operations. On-station TT&C will be received and transmitted through dedicated telemetry and command horn antennas (one each for RHCP and LHCP for command and for telemetry) providing essentially global coverage.

5.4 Communications Payload

5.4.1 Ka-band Uplink Transmissions

Ka-band uplink transmissions received by DIRECTV 15 are routed through wideband receive filters before low-noise amplification and down-conversion and then through an arrangement of channel filtering. CONUS plus Alaska national channels are amplified by individual channel amplifiers with selectable fixed gain mode (“FGM”)/automatic level control (“ALC”) operating modes prior to final amplification in the TWTA. The filtered national channels for Hawaii and Puerto are combined and routed to wideband amplifiers, also with selectable FGM/ALC operating modes, prior to final amplification in the TWTA. The normal mode of operation is ALC for all channels; this mode has a minimum input dynamic range of 19 dB and a commandable output power range of 13 dB, with a maximum step size of 0.5 dB. The fixed gain mode of operation has 19 dB of gain step attenuation, settable in approximately 1 dB steps.

The maximum expected G/T performance for DIRECTV 15 for the Ka-band receive antennas directed towards the various uplink site locations is shown in the accompanying Schedule S. Note that this G/T value is for beam peak, and the beam pointing will be optimized to place each broadcast site at or near beam peak. Also note that this value of G/T will decrease, dB-for-dB, as the uplink location moves away from beam peak.

5.4.2 DBS Uplink Transmissions

DBS uplink transmissions received by DIRECTV 15 are routed through wideband receive filters before the satellite receiver and then through either individual channel filters for CONUS plus Alaska national channels, or through wideband transponder filters for the case of Hawaii and Puerto Rico national channels. Filtered signals are amplified

by microwave power modules with selectable FGM/ALC operating modes prior to final amplification in the TWTA. The normal mode of operation for all channels is ALC; this mode has a minimum input dynamic range of 19 dB and a commandable output power range of 13 dB with a maximum step size of 0.5 dB. The fixed gain mode of operation has 19 dB of gain step attenuation, settable in approximately 1 dB steps.

The maximum expected G/T performance for DIRECTV 15 for the DBS receive antennas directed towards the various uplink site locations is shown in the accompanying Schedule S. Note that this G/T value is for beam peak, and the beam pointing will be optimized to place each broadcast site at or near beam peak. Also note that this value of G/T will decrease, dB-for-dB, as the uplink location moves away from beam peak.

5.4.3 Ka-band Downlink Transmissions

The Ka-band downlink transmissions will consist of a set of frequency division multiplexed digital signals carrying DIRECTV programming material. The individual channels used will depend upon the manner in which the operation of DIRECTV 15 is integrated with the operations of the other DIRECTV Ka-band satellites at the requested orbital location. Due to the national coverage nature of the Ka-band downlink beam, each channel can be transmitted only once. The resultant effective transmit power for Ka-band channels from DIRECTV 15 is shown in the accompanying Schedule S.

5.4.4 DBS Downlink Transmissions

The DBS downlink transmissions will consist of a set of frequency division multiplexed digital signals carrying DIRECTV programming material. The channel plan for these signals is consistent with that defined in Appendices 30/30A of the ITU Radio Regulations. Due to the national coverage nature of the DBS downlink beam, each channel can be transmitted only once. The resultant effective transmit power for DBS

channels from DIRECTV 15 is shown in the accompanying Schedule S. Assuming it is authorized for such operations in the future, DIRECTV 15 will be operated in accordance with relevant U.S. ITU DBS satellite network filings at any assigned location.

5.5 TT&C Subsystem

The TT&C subsystem provides redundant telemetry, tracking, and command channels for the spacecraft. The principal functions of the subsystem are:

1. Reception of RF telecommands addressed to the spacecraft.
2. RF modulation and emission of telemetry data.
3. Reception of RF ranging tones, the demodulation and then RF modulation and emission with the telemetry downlink signal.

The subsystem is configurable to accommodate the unique requirements of pre-launch, orbit raising, and on-station synchronous orbit operations. The command and telemetry frequencies and polarization for DIRECTV 15, which fall at the edges of the frequency range allocated for FSS Ka-band operations, are as shown in the accompanying Schedule S. The telecommand and telemetry carriers are modulated with data to a width of approximately 800 kHz. The antenna patterns for the TT&C subsystem are discussed in Section 7.3.

6. Orbital Locations

The DIRECTV 15 satellite will operate in conjunction with the SPACEWAY 1, DIRECTV 10, and DIRECTV 12 satellites at the nominal 103° W.L. orbital location. The precise orbital location will be 102.75° W.L., as is also specified in the accompanying Schedule S.¹⁰ DIRECTV is already authorized to operate over the 18.3-

¹⁰ Note that DIRECTV 10 is currently authorized to operate at 102.815° W.L. and DIRECTV 12 is currently authorized to operate at 102.765° W.L. Before DIRECTV 15 is launched, DIRECTV will file requests to slightly modify the orbital locations of these other two satellites such that the final configuration of these satellites will be DIRECTV 15 at 102.75° W.L., DIRECTV 12 at 102.80° W.L., and DIRECTV 10 at 102.85° W.L., with the east-west station keeping of each satellite maintained to within ±0.025°. DIRECTV will also file a request for modification of its 17/24 GHz BSS license at 103° W.L. (*i.e.*, DIRECTV RB-2) to align its location and technical characteristics with those of the 17/24 GHz BSS payload on this satellite.

18.8 GHz and 19.7-20.2 GHz (space-to-Earth) and 28.35-28.6 GHz and 29.25-30.0 GHz (Earth-to-space) frequency bands at the nominal 103° W.L. location.

7. Predicted Spacecraft Antenna Gain Contours

7.1 Ka-Band Uplink Beams

The satellite will receive national Ka-band communications signals from the DIRECTV broadcast centers in Los Angeles, CA, (LABC) and Castle Rock, CO, (CRBC) using both RHCP and LHCP. Note that both of these facilities operate in conjunction with diversity sites in order to achieve the required uplink availability. The diversity site for LABC is located in Long Beach, CA, and for CRBC in Englewood, CO. The G/T and minimum saturation flux density are included in the accompanying Schedule S. The maximum saturation flux density level for the LABC uplink beam is -82.9 dBW/m^2 and for the CRBC uplink beam is -82.6 dBW/m^2 . Both uplink beams will have a minimum cross-polarization isolation of 27 dB.¹¹ GXTs for all beams are provided in the accompanying Schedule S.

7.2 DBS Uplink Beams

The satellite will receive national DBS communications signals from DIRECTV's LABC and CRBC broadcast centers using both RHCP and LHCP. The G/T and minimum saturation flux density are included in the accompanying Schedule S. The maximum saturation flux density level for the LABC uplink beam is -76.8 dBW/m^2 and for the CRBC uplink beam is -76.6 dBW/m^2 . Both uplink beams will have a minimum cross-polarization isolation of 27 dB. GXTs for all beams are provided in the accompanying GIMS container database.

¹¹ A request for waiver of the cross-polarization requirements set forth in Section 25.210(i)(1) of the Commission's rules is included with this application.

7.3 Ka-band Downlink Beams

The Ka-band national coverage for DIRECTV 15 will include CONUS plus Alaska, Hawaii, and Puerto Rico using both RHCP and LHCP. The maximum EIRP for the downlink beams is included in the accompanying Schedule S. The maximum EIRP density for each of these beams is 43.9 dBW/MHz. All downlink beams will have a minimum cross-polarization isolation of 27 dB. GXTs for all beams are provided in the accompanying GIMS container database.

7.4 DBS Downlink Beams

The DBS national coverage for DIRECTV 15 will include CONUS plus Alaska, Hawaii, and Puerto Rico using both RHCP and LHCP. The maximum EIRP for the downlink beams is included in the accompanying Schedule S. The maximum EIRP density for these beams is 21.2 dBW/4 kHz for the CONUS plus Alaska beam, 23.0 dBW/4 kHz for the Hawaii spot beam, and 23.2 dBW/4 kHz for the Puerto Rico spot beam. All downlink beams will have a minimum cross-polarization isolation of 27 dB. GXTs for all beams are provided in the accompanying GIMS container database.

7.5 TT&C Beams

Telecommand signals will be received through two hemi antennas (during transfer orbit and in case of emergency) or through one of two Ka-band horns (RHCP or LHCP) (when earth pointed on-station). For transfer and emergency phases, in order to give omni coverage, one hemi antenna is located on +Z and the other one on -Z side of the spacecraft. There is no switch implemented between the omni antennas and the command receivers, both reception paths being simultaneously available. During on-station operations, the telecommands are received through a Ka-band horn, the output of which

is directed toward the command receivers. The command link beam peak flux density at command threshold is -101 dBW/m^2 .

Telemetry signals will be sent either through a hemi antenna (during transfer orbit or in case of emergency) or through one of two Ka-band horns (RHCP or LHCP) (when earth pointed on-station). For transfer and emergency, as for command, in order to give omni coverage, one hemi antenna is located on $+Z$ and the other on $-Z$ side of the spacecraft. In nominal and on-station operation, the telemetry is output by one of the two transmitters and delivered to a Ka-band horn. The maximum EIRP of the telemetry signal is 20 dBW and the maximum EIRP density is 20 dBW/MHz.

The coverage patterns for the on station telecommand and telemetry horn antennas are such that the contour at 8 dB below beam peak falls beyond the edge of the visible Earth. As such, gain contours for these beams are not included in this application. The cross polarization performance of the telecommand horn is 25 dB and of the telemetry horn is 30 dB.

8. Service Description, Link Performance, and Earth Station Parameters

8.1 Service Description

As discussed more fully in Section I of this application, DIRECTV will use the DIRECTV 15 satellite to transmit HD digital video and audio entertainment and educational and informational programming to customers throughout the United States and Puerto Rico who will receive this programming using small dish antennas.

8.2 Ka-band Link Performance

A representative link budget is shown in Appendix A as Table A-1 and assumes a receive antenna size of 65 cm and also includes the interference contribution for adjacent

satellite interference from neighboring Ka-band satellites nominally spaced two degrees away. Note that an availability of 99.7% has been assumed for this budget.

8.3 DBS Link Performance

A representative link budget for the DBS payload will be provided at such time as an operational location is identified and DIRECTV requests operating authority for that payload.

8.4 TT&C Link Performance

Representative link budgets for the telemetry and command links are shown in Appendix B as Tables B-1 and B-2, respectively.

8.5 Earth Station Parameters

There are essentially two types of earth stations that will be used with the DIRECTV 15 satellite – feeder-link earth stations and subscriber terminals. The feeder-link stations are relatively large transmit antennas, typically around 9 meters, that track the satellite and are used for transmitting national HD programming material from the DIRECTV broadcast sites to the satellite. The subscriber terminals are effectively 65 cm receive antennas that are installed at the customers' premises and have fixed pointing, which is optimized at installation. Somewhat larger antennas may have to be used in Alaska, Hawaii, and Puerto Rico.

9. Satellite Orbit Characteristics

The DIRECTV 15 satellite will be maintained in synchronous orbit at its nominal orbital location with a North-to-South drift tolerance of ± 0.05 degrees and an East-to-West drift tolerance of ± 0.025 degrees. The antenna axis attitude will be maintained so as to keep the beam pointing error to within ± 0.1 degrees for the national beam.

10. Power Flux Density

10.1 Ka-band Power Flux Density

The national downlink beam of DIRECTV 15 will be operated so as to generate a maximum downlink EIRP of 59.5 dBW per 36 MHz channel and to thereby comply with the Ka-Band blanket licensing coordination threshold of -118 dBW/m²/MHz. Operation with this EIRP complies with the Commission's requirements as is demonstrated by virtue of the fact that, for a 36 MHz digital carrier, a satellite downlink EIRP of 59.5 dBW results in a maximum PFD of -118.5 dBW/m²/MHz on the surface of the Earth (*i.e.*, 59.5 dBW – 162.4 dB-m² – 10*log (36) dB-MHz).¹² In all cases, the upper bound on system and individual link availability is determined by -118 dBW/m²/MHz (*i.e.* the downlink PFD coordination threshold established in Section 25.138 of the Commission's rules).

The satellite will also comply with the downlink PFD limits established in Section 25.208 of the Commission's rules, which are as follows:

- -115 dB (W/m²) in any 1 MHz band for angles of arrival between 0 and 5 degrees above the horizontal plane;
- -115 + 0.5 (d-5) dB (W/m²) in any 1 MHz band for angles of arrival d (in degrees) between 5 and 25 degrees above the horizontal plane; and
- -105 dB (W/m²) in any 1 MHz band for angles of arrival between 25 and 90 degrees above the horizontal plane.

The simple analysis above illustrates that the DIRECTV 15 operations will result in a PFD on the surface of the Earth that is within the Commission's requirements.

¹² Note that the value of 162.4 dB-m² for spreading loss is the value of such loss from the 103° W.L. location to the approximate beam peak location. Also note that all communications carriers in the Ka-band national downlink beam will have a bandwidth of 36 MHz.

10.2 DBS Power Flux Density

There are no PFD limits associated with the DBS bands.

11. Arrangement for Tracking, Telemetry, and Control

DIRECTV has contracted with Intelsat Satellite Operations to perform the TT&C operations for DIRECTV 15. The Intelsat control center is located in Long Beach, CA. The primary TT&C uplink will come from DIRECTV's Castle Rock Broadcast Center, in Castle Rock, CO. The backup TT&C uplink will come from DIRECTV's Northeast Uplink Facility in New Hampton, NH.

12. Schedule

DIRECTV will comply with all FCC satellite development milestones as specified in Section 25.164 of the Commission's rules.

13. Public Interest Considerations

See Section I above.

14. Interference Analysis

14.1 Ka-band Analysis

The link budget included in Appendix A demonstrates that the DIRECTV 15 satellite design described in this application will operate without exceeding the limits set for the Ka-band by the Commission's two-degree spacing policy and implementing rules. Accordingly, the proposed DIRECTV 15 satellite will remain in compliance with the relevant technical rules established by the Commission.

At Ka-band, in order to achieve maximum compatibility between diverse networks, the Commission established coordination thresholds for spacecraft downlink PFD in the *18 GHz Order*.¹³ This operational threshold was the outcome of the blanket

¹³ *Redesignation of the 17.7-19.7 GHz Frequency Band, Blanket Licensing of Satellite Earth Station in the 17.7-20.2 GHz and 27.5-30.0 GHz Frequency Bands, and the Allocation of additional Spectrum in*

licensing parameters coordinated by the industry for Ka-band earth terminals. This DIRECTV 15 proposal is fully compatible with this aspect of the *18 GHz Order*. For U.S. service, the system complies with the established $-118 \text{ dBW/m}^2/\text{MHz}$ PFD threshold, as well as the PFD limitations established in Section 25.208 of the Commission's rules.

An end-to-end link performance analysis, including both uplink and downlink is presented in Appendix A. The analysis includes the aggregate effects of interference from adjacent satellite networks in evaluating whether the system will operate at acceptable C/(N+I) thresholds.

To properly account for all interference from adjacent operating satellite systems, aggregate interference from earth terminals and satellites associated with pairs of satellites at 2, 4, 6, and 8 degrees of orbit separation were included. The budgets used a level of assumed interference that accounts for the maximum level permissible under the Commission's rules. The aggregate adjacent system interference that results from these assumptions is included in the link budget Table A-1.

14.2 DBS Analysis

A representative link budget for DBS operations will be provided at such time as DIRECTV requests authority for such operations.

15. Orbital Debris Mitigation

DIRECTV has incorporated the material objectives set forth in this application into the technical specifications established for construction of DIRECTV 15.

the 17.3-17.8 GHz and 24.75-25.25 GHz Frequency Bands for Broadcast Satellite Service Use, 15 FCC Rcd. 13430 (2000) ("18 GHz Order").

Spacecraft Hardware Design

DIRECTV has assessed and limited the amount of debris released in a planned manner during normal operations. DIRECTV 15 will not be a source of debris during launch, drift, or operating mode, as DIRECTV does not intend to release debris during the planned course of operations of the satellite.

DIRECTV has also considered the possibility of DIRECTV 15 becoming a source of debris by collisions with small debris or meteoroids that could cause loss of control of the spacecraft and prevent post-mission disposal. As such, DIRECTV has taken steps to address this possibility by incorporating redundancy, shielding, separation of components, and other physical characteristics into the satellite's design. For example, omni-directional antennas have been mounted on opposite sides of the spacecraft, and either will be sufficient to support orbit raising. The command receivers and decoders, telemetry encoders and transmitters, and the bus control electronics are fully redundant, physically separated, and located within a shielded area to minimize the probability of the spacecraft becoming a source of debris due to a collision. DIRECTV will continue to review these aspects of on-orbit operations with the spacecraft manufacturer and will make such adjustments and improvements as appropriate to assure that its spacecraft will not become a source of debris during operations or become derelict in space due to a collision.

Minimizing the Chance of Accidental Explosions

DIRECTV, in direct consultation with the spacecraft manufacturer, has assessed and limited, to the maximum extent possible, the probability of accidental explosions during and after completion of mission operations. The key areas reviewed for this purpose have included leakage of propellant and mixing of fuel and oxidizer as well as

battery pressure vessels. The basic propulsion design (including component and functional redundancy, and the placement of fuel tanks inside a central cylinder which provides a high level of shielding), propulsion subsystem component construction, preflight verification through both proof testing and analysis, and quality standards have been designed to ensure a very low risk of propellant leakage and fuel and oxidizer mixing that can result in subsequent explosions. During the mission, batteries and various critical areas of the propulsion subsystem will be continually monitored (for both pressure and temperature) to preclude conditions that could result in the remote possibility of explosion and subsequent generation of debris.

After DIRECTV 15 reaches its final disposal orbit, all on-board sources of stored energy will be depleted, all fuel line valves will be left “open,” and all batteries will be left in a permanent discharge state. The solar cells will be slewed away from the sun to minimize power generation.

Safe Flight Profiles

DIRECTV has assessed and limited the probability of DIRECTV 15 becoming a source of debris by collisions with large debris or other operational space stations through detailed and conscientious mission planning. DIRECTV has reviewed the list of licensed systems and systems that are under consideration by the Commission for the 102.75° W.L. orbital location it has requested. In addition, in order to address non-U.S. licensed systems, DIRECTV has reviewed the list of satellite networks in the vicinity of 102.75° W.L. for which a request for coordination has been submitted to the ITU. Only those networks that are operating, or are planned to be operating, within $\pm 0.2^\circ$ of DIRECTV 15 have been taken into account in this review.

As a consequence of this review, it has been determined that only two other

systems have been licensed by the Commission for, and are currently operating within 0.2° of, the requested location for DIRECTV 15: DIRECTV 10 at 102.815° W.L. and DIRECTV 12 at 102.765° W.L.. As for physical coordination with DIRECTV 10 and DIRECTV 12, as previously indicated, DIRECTV will be filing requests in the future to slightly modify the orbital locations of these two satellites such that the final configuration of all three satellites will be DIRECTV 15 at 102.75° W.L., DIRECTV 12 at 102.80° W.L., and DIRECTV 10 at 102.815° W.L., with the station keeping of each satellite maintained to within ±0.025°. In this way there will be no overlap of station keeping volumes of any of these satellites with each other, or with any other satellite.

With regard to ITU filings within ±0.2 degrees of the requested location for DIRECTV 15, the only satellite networks for which the ITU has published any information are USASAT-70W and USABSN-12B. Both of these networks were submitted to the ITU by the United States on behalf of DIRECTV.

Post-Mission Disposal

Consistent with the requirements of Section 25.283(a) of the Commission's rules, at the end of the operational life of the satellite, DIRECTV will maneuver DIRECTV 15 into a disposal orbit with an altitude no less than that calculated using the IADC formula:

$$36,021 \text{ km} + (1000 \cdot C_R \cdot A/m)$$

where C_R is the solar pressure radiation coefficient of the spacecraft, and A/m is the Area to mass ratio, in square meters per kilogram, of the spacecraft. The relevant values for the DIRECTV 15 satellite are:

$$C_R = 1.25$$

$$A = 123.9 \text{ m}^2$$

$$m = 3381 \text{ kg}$$

Inserting these values into the equation yields the following results:

$$36,021 \text{ km} + (1000 * 1.25 * (123.9 / 3381)) = 36066.8 \text{ km}$$

Since geostationary altitude is generally considered to be 35,786 km,¹⁴ this yields a desired disposal orbit of at least 280.8 km above the geostationary arc. DIRECTV intends to boost DIRECTV 15 to at least this height, and in fact will target a height of approximately 300 km above geostationary altitude.

DIRECTV currently intends to allocate and reserve approximately 16.8 kg of propellant for final orbit raising maneuvers to this altitude. This value was determined through a detailed launch vehicle propellant budget analysis applied to the parameters of one of DIRECTV's most recently designed satellites. In addition, DIRECTV has assessed fuel gauging uncertainty and this budgeted propellant provides an adequate margin of fuel reserve to ensure that the disposal orbit will be achieved despite such uncertainty.

III. ITU COST RECOVERY

DIRECTV is aware that, as a result of the actions taken at the ITU's 1998 Plenipotentiary Conference, as modified by the ITU Council in 2005, processing fees are now charged by the ITU for satellite network filings. As a consequence, Commission applicants are responsible for any and all fees charged by the ITU. DIRECTV hereby states that it is aware of this requirement and accepts responsibility to pay any ITU cost recovery fees associated with this application. Invoices for such fees may be sent to the contact representative listed in the accompanying FCC Form 312.

¹⁴ *Orbital Debris Mitigation*, ¶ 65.

IV. CONCLUSION

In summary, the satellite proposed in this application will provide DIRECTV with a highly capable spacecraft that will support a significant increase in the availability of high quality HD multichannel video programming for millions of Americans while at the same time providing in-orbit redundancy for DIRECTV's DBS capabilities. This new capability will advance the ongoing development of HD services, provide redundancy or replacement for DIRECTV's Ka-band and DBS operations, and enhance DIRECTV's ability to offer a powerful alternative to incumbent cable operators. Due to the advanced design of the proposed satellite, DIRECTV will be able to provide these benefits without the allocation of any additional spectrum or orbital locations.

For these reasons, DIRECTV submits that the proposed satellite will serve the public interest and respectfully requests that the Commission expeditiously grant this application.

Respectfully submitted,

DIRECTV ENTERPRISES LLC.

By: /s/
Romulo Pontual
Executive Vice President and Chief
Technology Officer

ENGINEERING CERTIFICATION

The undersigned hereby certifies to the Federal Communications Commission as follows:

- (i) I am the technically qualified person responsible for the engineering information contained in the foregoing Application,
- (ii) I am familiar with Part 25 of the Commission's Rules, and
- (iii) I have either prepared or reviewed the engineering information contained in the foregoing Application, and it is complete and accurate to the best of my knowledge and belief.

Signed:

/s/

Jack Wengryniuk
Senior Director
DIRECTV Engineering

August 25, 2014

Date

APPENDIX A

DIRECTV 15 LINK BUDGET ANALYSIS

CONUS Ka-band	Clear Sky	Rain Dn
LABC Uplink		
Transmit power, dBW	2.6	8.6
Transmit losses, dB	-2.0	-2.0
Ground antenna gain, dB	66.7	66.7
Antenna pointing loss, dB	-0.5	-0.5
Free space loss, dB	-213.4	-213.4
Atmospheric loss, dB	-1.0	-1.0
Uplink rain loss, dB	0.0	-6.0
Satellite G/T, dB/K	21.0	21.0
Bandwidth, dB-Hz	-74.8	-74.8
Boltzmann's constant, dBW/Hz K	228.6	228.6
Uplink C/N (thermal) (dB)	27.2	27.2
Washington, DC		
Satellite EIRP, dBW/36 MHz	55.5	55.5
Free space loss, dB	-209.9	-209.9
Downlink rain loss, dB	N/A	-4.6
Atmospheric loss, dB	2.6	2.6
Rain temp increase, dB	0.0	-3.1
Rcv. antenna pointing loss, dB	-1.0	-1.0
Antenna wetting + noise increase, dB	0.0	-1.0
Ground G/T, dB/K	18.4	18.4
Bandwidth, dB-Hz	-74.8	-74.8
Boltzmann's constant, dBW/Hz K	228.6	228.6
Downlink C/N (thermal) (dB)	19.4	15.3
	Clear Sky	Rain Dn
Uplink C/N (thermal), dB	27.2	27.2
Downlink C/N (thermal), dB	19.4	15.3
Total inter and intra-system C/I, dB (incl. x-pol, ASI, ACI, ABI, TX E/S)	7.8	7.8
Total C/(N+I), dB	7.5	7.0
Required C/(N+I), dB (includes implementation margin)	4.7	4.7
Margin, dB	2.8	2.3

Table A-1. DIRECTV 15 Link Budget – Ka-band National Coverage

APPENDIX B
TT&C LINK BUDGETS

Telemetry Link Analysis - On Station		
S/C altitude (km)	35786	35786
G/S elevation (deg)	44.5	30.8
S/C antenna	TM Horn	TM Horn
S/C coverage	Over G/S	Over G/S
Link Availability (%)	99.9	99.9
Ground Station	CRBC	NEUF
TX Output power (W)	0.56	0.56
S/C EIRP (dBW)	19.6	19.6
G/T at ground station (dBK)	38	38
G/T degradation due to rain (dB)	0.8	1.3
Predetection C/No (dB-Hz)	71.3	65.2
Acquisition margin (dB)	25.2	19.1
TM margin (dB)	18.2	12.1

Table B-1. On-Station Telemetry Link Budget

Command Link Analysis - On Station		
S/C altitude (km)	35786	35786
G/S elevation (deg)	44.5	30.8
S/C antenna	TC Horn	TC Horn
S/C coverage	Over G/S	Over G/S
Link Availability (%)	99.9	99.9
Ground Station	CRBC	NEUF
G/S EIRP (dBW)	88	88
Atmospheric losses (dB)	7.6	17.5
S/C flux density (dBW/m ²)	-82	-92.2
RX input power (dBW)	-122.1	-132.2
Predetection C/No (dB-Hz)	65.9	62
Receiver threshold (@1 kbps) (dB-Hz)	57.1	57.1
Acqu Command margin (dB)	8.8	5

Table B-2. On-Station Command Link Budget