ECHOSTAR-25

ATTACHMENT A
Technical Information to Supplement Schedule S

Scope
This attachment contains the technical information required by § 25.114(d) and other sections of Part 25 of the Commission's rules that cannot be entered into the Schedule S software.

A.1.1 General Description of Overall System Facilities, Operations, and Services 47 C.F.R. § 25.114(D)(1), 47 C.F.R. § 25.114(D)(11)

The ECHOSTAR-25 satellite, designed and built by Maxar Space Systems (Maxar), will operate at the nominal 110.00° W.L. orbital location consistent with the ITU Region 2 BSS Plan. The spot beam satellite will provide Broadcasting-Satellite Service/Direct Broadcast Satellite ("BSS" or "DBS") services to the Contiguous United States (CONUS), Alaska, Hawaii, Puerto Rico, and the U.S. Virgin Islands.

The ECHOSTAR-25 satellite solely utilizes spot beams for transmission of communications carriers. The Ku-band spot beams will be uplinked from six earth station feeder link facilities located in Cheyenne, Wyoming; Gilbert, Arizona; Spokane, Washington; New Braunfels, Texas; Monee, Illinois; and Mount Jackson, Virginia. Four satellite payload antennas will be used to receive feeder link transmissions from the six earth stations.

The ECHOSTAR-25 satellite will operate in the 17.3-17.8 GHz BSS feeder uplink band (ITU Appendix 30A) and the 12.2-12.7 GHz BSS downlink band (ITU Appendix 30). The satellite's frequency plan is identical to that prescribed in the ITU's Region 2 BSS Plan. Full frequency re-use is achieved using dual orthogonal polarizations. At the nominal 110.00° W.L. orbital location, DISH Network (DISH) is licensed by the Federal Communications Commission to operate on BSS channels 1-27, 29, and 31.

The ECHOSTAR-25 satellite includes thirty-six 150 W saturated transmit power capability TWTAs, nineteen 165 W saturated transmit power capability TWTAs, and two (2) 35 W TWTAs for telemetry in contingency mode. At the nominal 110.00° W.L. orbital location, ECHOSTAR-25 will use up to fifty-one active transponders producing peak EIRP levels as high as 61 dBW for CONUS spot beams and 60.9 dBW for a Puerto Rico spot beam.

Spacecraft Telemetry, Tracking, and Control (TT&C) functions will take place from DISH's TT&C earth station and satellite control facilities located in Gilbert, Arizona and Cheyenne, Wyoming. The TT&C carrier uplink supports two flex frequency command receivers operating at 17.300 to 17.310 GHz and 17.790 to 17.800 GHz, which are at the edges of the 17.3-17.8 GHz uplink band for all phases of the mission. The TT&C carrier downlink uses two flex frequency transmitters operating at 12.200 to 12.210 GHz and 12.690 to 12.700 GHz, which are at the edges of the 12.2-12.7 GHz downlink band for all phases of the mission.

A Radio Frequency AutoTrack (RFAT) system is used to provide highly accurate downlink spot beam pointing. This involves the transmission of a beacon at 17.309 MHz from the ground. The satellite can receive RFAT transmissions uplinked from Cheyenne, Wyoming and Gilbert, Arizona.

A.1.2 Services to be Provided

47 C.F.R. § 25.114(d)(1)

The ECHOSTAR-25 satellite will provide DBS spot services to millions of DISH customers within CONUS, Alaska, Hawaii, and Puerto Rico.

There will be one wideband, digitally modulated signal transmitted in each of the active transponders supporting a range of data rates depending on the modulation (e.g., 8PSK) and FEC coding used. Representative link budgets, which include details of the transmission characteristics, performance objectives, and earth station characteristics, are provided in the Schedule S. The representative modulation/coding schemes provided in the Schedule S submission are:

8PSK; rates 2/3 and 3/4 inner coding (25.8 MHz bandwidth).

A.2 ITU Radio Regulations
47 C.F.R. § 25.114(d)(13)

The ECHOSTAR-25 satellite network will operate under the US ITU filing "USABSS- 26 and USABSS 41." The ECHOSTAR-25 satellite will meet the criteria and operate in compliance with Annex 1 to Appendices 30 and 30A. There were initially six adjacent Region 2 BSS networks that were deemed to be affected, which are discussed below:

- Canada's networks at 129° W.L. and 138° W.L. EchoStar and TeleSat completed coordination in August 2017.
- The UK's BERMUDASAT-1 network at 96.2° W.L. were deemed to be affected. Coordination has been possible due to the large separation of the satellite networks.
- Holland's network at 125° W.L. has been suppressed by the ITU.
- The UK's networks at 105.5° W.L. and 133.5° W.L. have been suppressed by the ITU.

The proposed ECHOSTAR-25 satellite network will meet the criteria in Annex 1 to Appendix 30 and 30A of the ITU Radio Regulations.

A.3 Orbital Debris Mitigation Plan
47 C.F.R. § 25.114(d)(14)

A.3.1 Debris Release Assessment for Planned Operations
47 C.F.R. § 25.114(d)(14)(i)

Maxar has assessed the launch, orbit raising, deployment, and normal operations portions of the mission and determined that no debris will be released by the spacecraft except during deployment when portions of the spacecraft are separated from the main spacecraft body.

Separation and deployment mechanisms are intended to contain the debris generated when activated. There are several reflector deployment hold-down electro-explosive devices (EED) that have the potential to expel a small amount of debris – up to 3 mg of titanium debris from the hold-down and 2 mg of "soot" per firing. These EEDs have flown on over 45 spacecraft and had no failures. The assessment found no other sources for debris throughout the mission.

A.3.2 Debris Release Assessment for Small Collisions 47 C.F.R. § 25.114(d)(14)(ii)

To protect the spacecraft from small body collisions, the design of the ECHOSTAR-25 spacecraft allows for individual faults without losing the entire spacecraft. All critical components (i.e., computers and control devices) have been built within the structure and shielded from external influences. Items that could not be built within the spacecraft nor shielded (such as antennas) are redundant and/or are able to withstand impact. The ECHOSTAR-25 spacecraft can be controlled through the normal global horn transmit and receive antenna, either of the two medium-beam transmit and receive omni-directional antennas, or either of the two wide-beam transmit and receive omni-directional antennas. Based on the above structural design and critical component redundancy, EchoStar believes this satellite has a limited probability of becoming a source of debris from small body collisions.

Maxar has evaluated the likelihood of the spacecraft becoming a source of debris due to collisions with small debris or meteoroids, which could lead to a loss of control and hinder post-mission disposal and determined that the probability that EchoStar 25 would become a source of debris is less than 0.01. The satellite's design takes into account collisions with the natural environment, including meteoroids, using statistical methods to assess collision risk. Meteoroid environments are part of Maxar's Environmental Requirement Specifications, which are informed by literature reviews of large space objects and technical papers presenting collision probability estimates for relevant orbital conditions. The satellite's requirement incorporates these technical papers and NASA models for debris and meteoroids of various sizes.

The satellite's design incorporates measures to mitigate the effects of such collisions through shielding, component placement, and redundant systems. The satellite's six-sided enclosure serves as a shield for sensitive electronics, thermal control elements, and the fuel system. Component placement, such as locating fuel tanks in the central region of the satellite body and propulsion lines inside the satellite bus, has been carefully considered. Bumper-type shields or similar protections are used for certain sensitive components. Redundancy is a key aspect of the overall satellite design to prevent functional failures and ensure the ability to control subsystem functions against unintended debris generation.

A.3.3 Accidental Explosion Assessment
47 C.F.R. § 25.114(d)(14)(iii)

To ensure that the spacecraft does not explode on orbit, the satellite operator takes specific precautions. All batteries and bipropellant tanks are monitored for pressure or temperature variations. Alarms in the Satellite Control Center inform operators of any variations. Additionally, long-term analysis is performed to monitor any unexpected performance trends.

Operationally, batteries are managed using the manufacturer's automatic recharging scheme. This ensures that charging terminates normally without building up additional heat. As this process occurs wholly within the spacecraft, it also affords protection from ground command link failures.

To protect the propulsion system, bipropellant tanks are operated in a "blow down" mode. This means that, at the completion of the orbit-raising phase of the mission, the pressurant is isolated from the bipropellant system, thereby causing the pressure in the tanks to decrease over the life of the spacecraft. This also protects against pressure valve failure causing the bipropellant tanks to become over-pressurized.

To ensure that the spacecraft has no explosive risk after it has successfully reached disposal altitude, all stored energy sources onboard the spacecraft will be discharged. This is accomplished by venting excess propellant, discharging batteries, relieving pressure vessels, and any other appropriate measures per manufacturer recommended procedures. These steps will ensure that no buildup of energy can occur resulting in an explosion in the years after the spacecraft's end-of-life.

Based on the above structural design and planned flight control precautions during and after the mission completion, EchoStar believes this satellite has a limited probability of becoming a source of debris from accidental explosions.

A.3.4 Safe Flight Profiles
47 C.F.R. § 25.114(d)(14)(iv)

In considering current and planned satellites that may have a station-keeping volume that overlaps the ECHOSTAR-25 satellite, EchoStar has reviewed the lists of FCC-licensed satellite networks, as well as those that are currently under consideration by the FCC.

The ECHOSTAR-23, ECHOSTAR-11, ECHOSTAR-10, and DirecTV 5 satellites operate at the nominal 110.00° W.L. orbital location (at 109.90°, 110.00°, 110.20°, and 110.10° W.L., respectively), each having an east-west station-keeping tolerance of ±0.05°.

There are no pending applications before the Commission to use an orbital location within ±0.15° from 110.00° W.L. EchoStar is unaware of any satellite with an overlapping station-keeping volume with the ECHOSTAR-25 satellite that is either in orbit or progressing towards launch pursuant to an ITU filing.

Based on the preceding, EchoStar seeks to locate and operate the ECHOSTAR-25 satellite at 110.00° W.L., with latitude and longitude station-keeping tolerances of ±0.05°, to eliminate the possibility of any station-keeping volume overlap with the adjacent satellites. ECHOSTAR-11 currently operates at 110.00° W.L. ±0.05°. EchoStar plans to move it to 109.85° W.L. shortly before ECHOSTAR-25 is placed at 110.00° W.L. ±0.05°. EchoStar therefore concludes that orbital location management of the ECHOSTAR-25 satellite with another party is not required.

A.3.5 Trackability of Space Station
47 C.F.R. § 25.114(d)(14)(v)

The ECHOSTAR-25 satellite is identified by its telemetry stream, which is received by active tracking antennas.

The ECHOSTAR-25 satellite is identified by the NORAD ID TBD (to be assigned after launch).

A.3.6 Proximity Operations Debris Generation
47 C.F.R. § 25.114(d)(14)(vi)

There will be no planned proximity operations that will result in debris generation. As stated in Section A.3.4 there is no station-keeping volume overlap, and therefore the risk of collision is negligible.

A.3.7 Post Mission Disposal Plan
47 C.F.R. § 25.114(d)(14)(vii)

At the end of the operational life of the ECHOSTAR-25 satellite, EchoStar will maneuver the satellite to a disposal orbit with a minimum perigee of 300 km above the normal GSO operational orbit. This proposed disposal orbit altitude meets the minimum required by § 25.283, which is calculated below.

The input data required for the calculation is as follows:

Total Solar Pressure Area "A" = 95 m^2 (includes the area of the solar arrays, satellite body, and deployed antennas)

"M" = Dry Mass of Satellite = 2929 kg

"C_R" = Solar Pressure Radiation Coefficient (worst case) = 2

Using the formula given in § 25.283, the minimum disposal orbit perigee altitude is calculated as follows:

$$= 36{,}021 \text{ km} + 1000 \times C_R \times A/M$$
$$= 36{,}021 \text{ km} + 1000 \times 2 \times 95/2929$$
$$= 36{,}086 \text{ km}$$
$$= 300 \text{ km above GSO } (35{,}786 \text{ km})$$

The amount of bipropellant reserved to reach an altitude of 300 km minimum perigee above geostationary orbit, including unusable and uncertainty amounts, is estimated to be 47 kg. This calculation was based upon a pre-launch dry mass estimate as of March 2025 and propellant load estimates that will be finalized prior to launch.

Propellant tracking is accomplished throughout the satellite's life using multiple manufacturer-recommended methods, including bookkeeping; pressure, volume, and temperature (PVT); Propellant Depletion Gauge Operations (PDGO) for the bipropellant system; and a statistical combination method. These methods are used regularly, and results are reviewed with the spacecraft manufacturer.

A.4 Predicted Space Station Antenna Gain Contours 47 C.F.R. § 25.114(c)(4)(vi)

The ECHOSTAR-25 satellite's antenna gain contours for the receive and transmit beams are embedded in the associated Schedule S submission. Four (4) of the beams used for TT&C operations (OMTL, OMTR, OMRL and OMRR) have gain contours that vary by less than 8 dB below peak across the surface of the visible Earth. The information for these beams is included in the Schedule S form except for the gain contours.

CERTIFICATION OF PERSON RESPONSIBLE FOR PREPARING ENGINEERING INFORMATION

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

/s/

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