

Application for Conventional Experimental License

Pursuant to Part 5 of the Commission's rules,^{1/} AST&Science LLC ("AST") seeks experimental authority to perform testing using a non-geostationary orbit ("NGSO") satellite operating in the Low-Earth Orbit ("LEO"), the BlueWalker 3 ("BW3"). The purpose of the testing is to conduct technical radio research and demonstrate equipment and techniques to determine the performance of a planned satellite-based communication system. Ultimately, test results will inform the technical refinement and management of AST's planned SpaceMobile constellation, which will provide 4G and 5G broadband connectivity to unserved and underserved areas.^{2/} AST plans to begin construction of the spacecraft at its own risk.^{3/}

Background

AST holds two experimental licenses that have allowed it to perform the initial stage of testing for the SpaceMobile system with another satellite, the BW1.^{4/} The testing requested here for experimental operations with the BW3 will be different from testing with the BW1 in several ways. First, the BW3 is a significantly larger satellite than the BW1 (although not as large as the satellites that will be part of the SpaceMobile constellation). Second, the testing will be comparable to planned SpaceMobile operations as AST will test the ability of the constellation to connect directly with off-the-shelf handsets (*e.g.*, unmodified mobile phones), as opposed to the testing being conducted with BW1 where the LTE device is located in space and the satellite arrays are on the ground.

The BW3 will operate under the authority of Papua New Guinea ("PNG"), and AST has attached a copy of the PNG license to this application. The BW3 satellite will orbit between 500 km and 600 km above the earth. The satellite launch window is expected to start mid-2021, and AST expects to test with it for a period of two years from the date it is operational. At the end of the satellite mission life, it will be switched off and deorbited following the plan set out in the orbital debris mitigation and end-of-life disposal plan that is attached to this application. AST also has attached a Technical Annex and a Schedule S form, both of which provide specific technical details regarding the BW3 and the planned testing.

Payloads:

The BW3 will operate with three payloads: 1) Telemetry, Tracking and Command ("TT&C") in the V band and UHF; 2) gateway feeder links in the V band; and 3) broadband transmissions to off-the-shelf handsets on frequencies authorized to certain wireless licensees.

^{1/} 47 C.F.R. Part 5.

^{2/} AST is seeking FCC authority to operate the SpaceMobile system through a Petition for Declaratory ruling filed last year. *See* IBFS File Nos. SAT-PDR-20200413-00034, SAT-APL-20200727-00088 and SAT-APL-20201028-00126.

^{3/} *See* 47 C.F.R. § 5.64(a).

^{4/} *See* File No. 0884-EX-CN-2018, Call Sign WJ2XZZ and File No. 0047-EX-CN-2019, Call Sign WK2XCX.

V Band Testing

AST will conduct testing of the V band gateway feeder links, and engage in nominal TT&C operations, from two fixed earth stations locations: 1) AST's facility at Midland International Air and Space Port in Midland, TX; and 2) Hawaii Pacific Teleport in Kapolei, HI:

- Midland – 2901 Enterprise Lane, Midland, TX 79706
 - LAT: 31°55'49.2033'' North
 - LONG: 102°12'31.7398'' West
 - GROUND ELEVATION: 2857.4'
- Kapolei – 91-340 Farrington, Kapolei, HI 96707
 - LAT: 21.336505 21°20'11.418'' North
 - LONG: 158°5'18.7152'' West
 - GROUND ELEVATION: 52.49'

This testing additionally will allow AST to evaluate the performance of various systems that will be used for its planned SpaceMobile constellation. Testing of V band communications, including V band TT&C, will take place during up to three passes per day at each location, for approximately 10-15 minutes per pass.

AST will maintain control over the satellite worldwide, conducting TT&C from various locations around the globe through facilities licensed to third parties. AST will have authority to operate in the S band and UHF from multiple locations outside of the U.S. through its agreement with these third parties.

In the event of an emergency situation, AST's agreements will provide that it may transmit high priority messages to support the emergency.

Handset Testing

AST will evaluate the performance of BW3 communications with off-the-shelf handsets. As noted in the application, testing of the handsets will involve commercially available 4G/LTE/5G phones. With these, AST will test: (a) single and multiple phone connection to users outside of the BW3 cell; (b) multiple phones connections within BW3 cell and cells; and (c) combinations of (a) and (b). AST will test successive connections and then simultaneous connections to determine communication performance.

Like the V band testing, testing of handset communications will take place up to three passes per day, at each location, for approximately 10-15 minutes per pass. The BW3 will first connect to the V band fixed location antennas and then to the off-the-shelf handsets during the same pass.

Testing of the handsets will occur in four locations in the United States. Testing on 846.5-849 and 891.5-894 MHz will occur at the Midland location, within a 48 km geographic radius around the site (*see* geographic coordinates above). Testing on 845-846.5 and 890-891.5 MHz will occur at the Kapolei location, within a 48 km geographic radius around the site (*see*

geographic coordinates above). Testing on 758-768 and 788-798 MHz will occur within a 48 km geographic radius around the following two locations:

- Pine Springs (TX) South Location
 - LAT: 31°34'39'' North
 - LONG: 104°20'43'' West
 - GROUND ELEVATION: Mobile
- Silver (TX) West Location
 - LAT: 32°8'23'' North
 - LONG: 100°50'52'' West
 - GROUND ELEVATION: Mobile

Requested Length of Experiment:

AST expects testing to last two years from the date that the BW3 becomes operational.

Technical Information:

V Band and UHF

Frequencies: Uplink (Earth-to-Space) 47.2-50.2 GHz and 50.4-51.4 GHz (50 MHz maximum bandwidth when operating with five 10 MHz carriers)
Downlink (Space-to-Earth) 37.5-42.5 GHz (50 MHz maximum bandwidth when operating with five 10 MHz carriers)
Uplink and Downlink (Earth-to-Space) 400.15-401 and 437-438 MHz (*Midland location only; will not be used in Kapolei*)

V band Power: 3 W (uplink); *see* Schedule S for downlink information.

V band ERP: 977237 W (uplink); 327.3 W (downlink within 37.5-40 GHz and 42-42.5 GHz) and 495.5 W (downlink within 40-42 GHz) (*Note: The EIRP for these frequencies that is listed on the Schedule S represents the maximum capability of the satellite, which can support multiple channels and overcome large rain attenuation. Therefore, it is different from the power levels requested here, which represent the transmissions used during testing on a particular channel.*)

UHF Power: 2 W (uplink); *see* Schedule S for downlink information

UHF ERP: 28.2 W (uplink); 3.0 W (downlink)

Frequency tolerance: 50 ppb for V band and 10 ppm for UHF

Emission designators: 10M0DXD for V band and 30K0FXD for UHF

Modulating signal: OFDM for V band and FSK for UHF

Antenna location: Ground

Handsets

Frequencies: Midland Downlink (Space to Earth) 891.5-894 MHz
Midland Uplink (Earth to Space) 846.5-849 MHz
Kapolei Downlink (Space to Earth) 890-891.5 MHz
Kapolei Uplink (Earth to Space) 845-846.5 MHz

Pine Spring/Silver Downlink (Space-to-Earth) 758-768 MHz
Pine Spring/Silver Uplink (Earth-to-Space) 788-798 MHz

Bandwidth: 180 kHz, 1.4 MHz, 3 MHz, 5 MHz, or 10 MHz

Power: 0.2 W (uplink); *see* Schedule S for downlink information

ERP: 0.12 W (uplink); 130572.6 W (downlink) (*Note: The EIRP for the user beam downlinks listed on the attached Schedule S is the maximum aggregated EIRP for the satellite, assuming all available RF power from the phased array antenna is used by one beam. Therefore, that information differs from the power levels listed here, which represent the power levels used for testing between handsets and the satellite in one selected beam over five beams in operation.*)

Frequency tolerance: 10 ppm

Emission designators: 180KDXD for uplink and 1M40DXD for downlink

Modulating signal: OFDM

Antenna location: Mobile

Protection of Other Users:

AST's use of the requested frequencies for handset testing will be with the permission of the license holder. AST understands that conditions may be placed on its license in this regard.

In the highly unlikely event that harmful interference is created to another user, AST will cease transmission on the frequency and will work with the FCC and affected party to resolve the interference.^{5/}

A point of contact for this testing will be physically located at the Midland, TX site and will ensure that operations will cease in the event that any licensed users experience interference or as otherwise directed by the FCC. **AST's "stop buzzer" contact will be:** Huiwen Yao, 5825 University Research Court, Building 2, Suite 2300, College Park, MD 20737, (301) 793-3416, hyao@ast-science.com.

Finally, the equipment will be located at ground level. The installation and operation of the equipment will not have a significant environmental impact. Therefore, no Section 1.311 environmental assessment is necessary.^{6/} And, FAA notification of the antenna height is not required.^{7/}

Grant of this application will serve the public interest because it will allow AST to test a number of features related to its planned SpaceMobile system, ensuring that mobile broadband service can be brought to Americans in underserved and unserved markets. Questions should be directed to Sallye Clark at sclark@mintz.com or Laura Stefani at lastefani@mintz.com.

^{5/} AST addresses potential for interference in its Technical Annex.

^{6/} 47 C.F.R. § 1.311.

^{7/} *See* 47 C.F.R. § 17.7.