CESIUM

Application for Experimental Authorization
Over-the-Air Ground Station and Nightingale 1 Testing
Narrative Statement

Rev. A

CesiumAstro, Inc.
13215 Bee Cave Parkway Suite A-300
Austin, Texas 78738

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1 LICENSE PURPOSE

CesiumAstro, Inc. (“Cesium”) respectfully requests a 24-month FCC experimental authorization to test and validate operation and performance characteristics of Cesium’s fully-integrated phased array communication system, Nightingale 1 (NG1), and an experimental ground station. Specifically, Cesium seeks an experimental license for the authority to perform over-the-air RF testing between a NG1 and an experimental ground station, as well as coexistence/isolation testing with two NG1s. Grant of the requested authority will allow Cesium to continue development of its RF systems which are of interest to the US DoD, NASA, and commercial businesses. This testing supports development of these RF systems for operation in future programs and use cases.

This experimental filing is an extension of filing 1301-EX-ST-2022. Per Special Condition (6) of this special temporary authorization (STA), Further requests for extension of the authority granted herein must be filed on Form 442.

2 TECHNICAL DETAILS

2.1 DESCRIPTION OF EQUIPMENT

2.1.1 Nightingale 1

The Cesium Nightingale 1 is a fully-integrated Ka-band phased array communication system that provides a complete hardware and software solution for high-speed RF links with a dynamically-steerable beam. This communication system includes a Cesium single board computer (SBC), software defined radio (SDR), up/down converter (UDC), and active phased array antenna (APA), along with two VPT power converters and an electromagnetic interference (EMI) filter. These individual components are interfaced by a backplane and integrated into an aluminum housing. Connectors are externally mounted on the structure to provide mechanical, electrical, thermal, and data connections. The NG1 is capable of beam steering ± 60° from boresight. NG1 is depicted in Figure 1, and Table 1 provides additional technical parameters.

Table 1: NG1 technical parameters for experimental operations.

Parameter	Value
Transmit Frequencies	27.0 – 29.5 GHz
ERP	609.54 W
Gain	27 dBi (max)
Beamwidth	8 degrees (boresight)
Polarization	LHCP
Modulation	BPSK, QPSK, 8PSK, 16APSK, 32APSK, 64APSK, 128APSK, 256APSK
Bandwidth	170 MHz

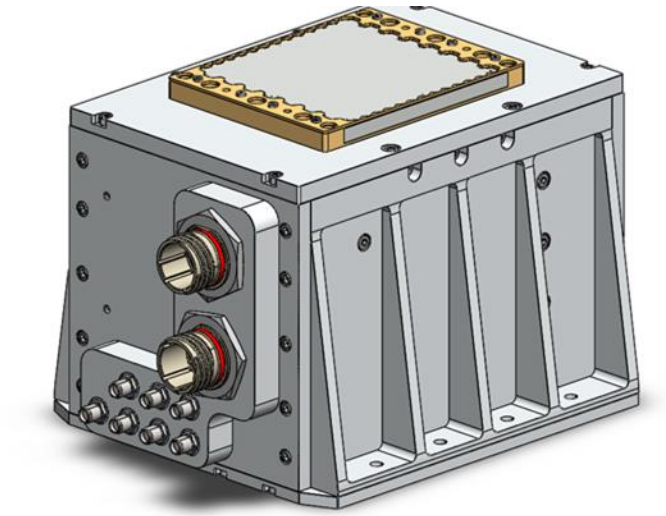

Figure 1: External view of the NG1, with APA and electrical interfaces visible.

2.1.2 Ground Station

The Cesium ground station is a Cobham Tracker 2400, located at the Cesium facility in Texas. The ground station antenna is 3.7 meters above the terrain attached to its own structure, including a radome installed over the antenna. Technical details for the Cesium ground station are provided in Table 2 below.

Table 2: Cesium ground station technical parameters for experimental operations.

Parameter	Value
Transmit Frequencies	27.0 – 29.5 GHz
ERP	2188 W
Gain	55.5 dBi (max)
Beamwidth	0.25 degrees
Polarization	LHCP
Modulation	BPSK, QPSK, 8PSK, 16APSK, 32APSK, 64APSK, 128APSK, 256APSK
Bandwidth	170 MHz

2.2 TEST OBJECTIVES

The objectives sought to be achieved through this authorization are to:

- Validate the operational performance of the Cesium ground station with a Cesium NG1 including pointing performance
- Validate the performance characteristics of the NG1, specifically coexistence/isolation sensitivity between co-located transmitting and receiving NG1s

Experimental data verifies performance of the Cesium ground station and the NG1 communication system, and provides insight on updates and error corrections to be implemented in future revisions of the systems. Software defined phased arrays in space are a key infrastructure for delivering information around the globe in the new space age, and these ground experiments allow Cesium to further develop their technology for the aerospace market and beyond.

2.3 EXPERIMENTAL OPERATIONS

Cesium requests experimental authority for the operations stated below for 24 months, beginning as soon as March 2nd, 2023, the expiration date of the previous STA. If experimental authority cannot be granted before or on this date, Cesium requests a 24-month period beginning as soon as possible to continue experimentation.

All operations will be monitored by Cesium personnel to ensure the safety of operating personnel and the general public, as well as to mitigate the potential for harmful interference. Experimental operations will only be performed under the control and supervision of Cesium personnel. Cesium personnel will ensure that keepout zones around the transmitters are enforced during operation as defined in the radiation hazard analysis. Cesium personnel will cease transmissions if harmful interference and/or safety hazards are present during experimental operations. The demonstrations will utilize Ka-band frequencies. Cesium acknowledges that operations under this experimental authorization will be performed on a non-interference basis.

2.3.1 Ground Station & NG1 Transmissions

Testing between the Cesium ground station and NG1 will be performed to test and validate the operational performance of these systems, including pointing performance. The NG1 will be located on the roof top of the Cesium TX facility and pointed downward towards the nearby ground station. The frequency ranges requested are necessary for testing and validating the performance characteristics of the systems. Transmissions from the ground station will be at reduced power to reduce risk for safety hazards and/or harmful interference.

2.3.2 NG1 Tx to Rx Coexistence/Isolation

Testing with two NG1s will be performed to test the Tx-to-Rx coexistence/isolation when the Tx NG1 is transmitting at max power. This test is to be performed over-the-air as opposed to in a range, as our range is too small to test the coexistence at full power. Both the transmitting and receiving NG1s will be placed on the roof top of the Cesium TX facility next to one another and pointed downward towards the ground in the direction of the nearby Cesium ground station. The frequency range requested is necessary for testing and validating the performance characteristics of the system.

2.3.3 Testing Location

Operations under this experimental authority will be performed at the Cesium TX facility and adjacent land where the Cesium ground station is located. Address and coordinates for these locations are listed below:

Cesium TX Facility		**Ground Station Location**	
Address:	13215 Bee Cave Parkway, Building B Austin, Texas 78738	Address:	13301 Galleria Parkway, Austin, TX 78738
Latitude:	30° 18' 49" N	Latitude:	30° 18' 54" N
Longitude:	097° 56' 47" W	Longitude:	097° 56' 48" W

The height of the building the transmitting NG1 antenna will be located on is approximately 12 meters. The NG1 antenna will not extend beyond 6 meters above the building. Figure 2 below provides an overview of the demonstration setup.

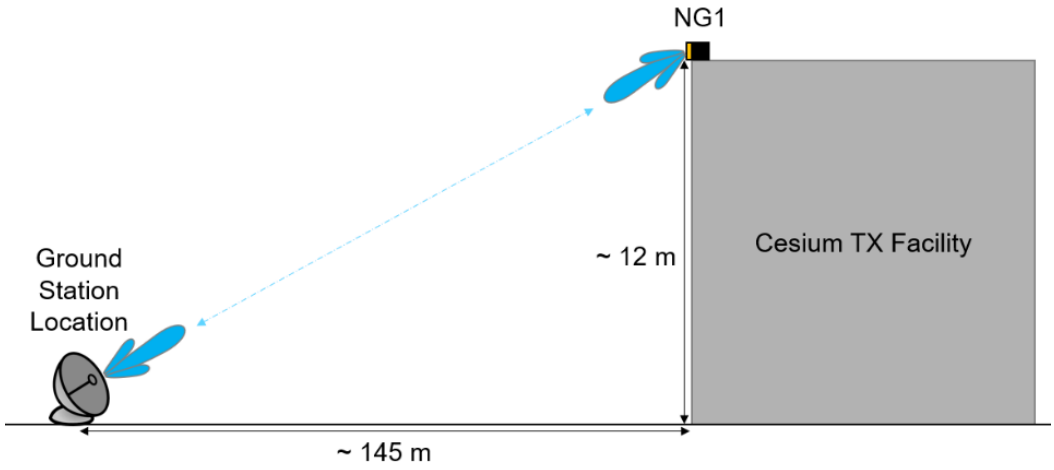

Figure 2: Overview of the test setup (image not to scale).

2.3.4 Directional Antennas

The Cesium ground station and NG1 are directional antennas and the widths of their beams at the half power point can be found in their respective technical parameter tables above ("Beamwidth" entry). For testing, the NG1s will be pointed towards the ground (below the horizon) where the ground station is located. The ground station will point at an NG1 on the Cesium TX facility rooftop. The reference antenna patters for these systems can be found below.

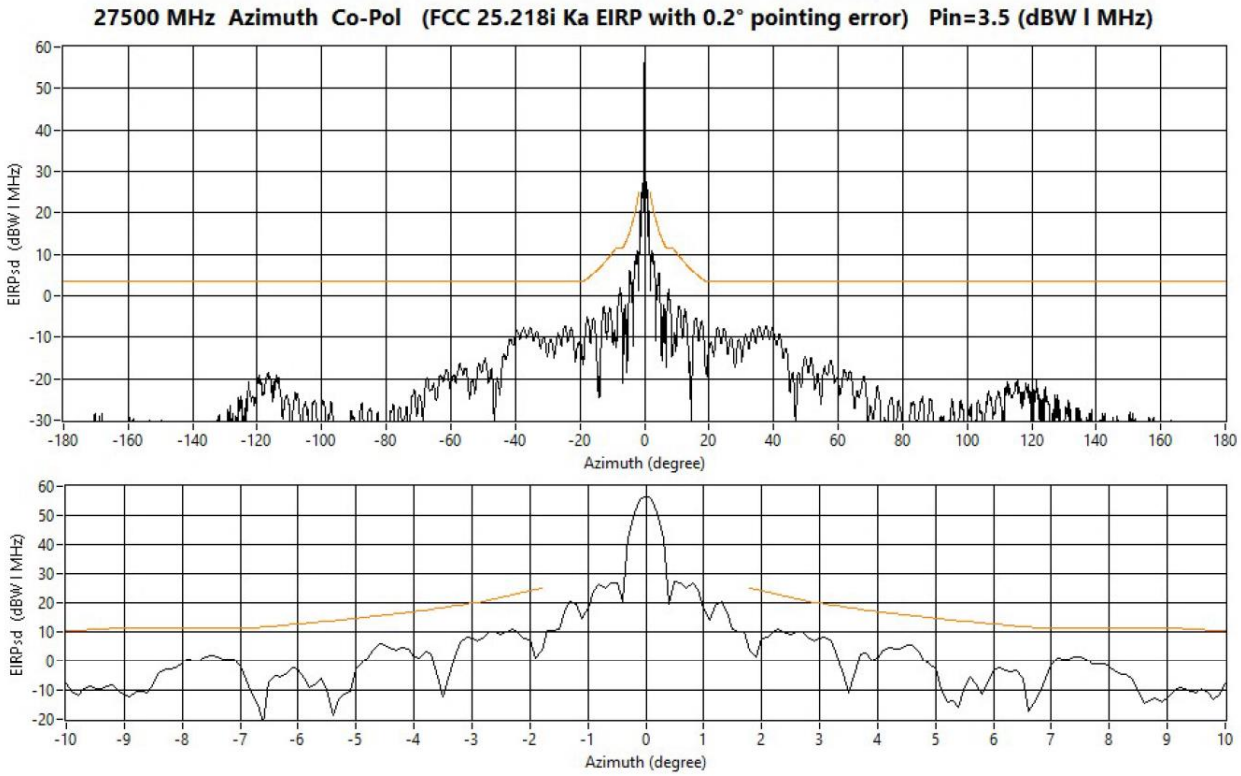

Figure 3: Cesium ground station antenna patterns.

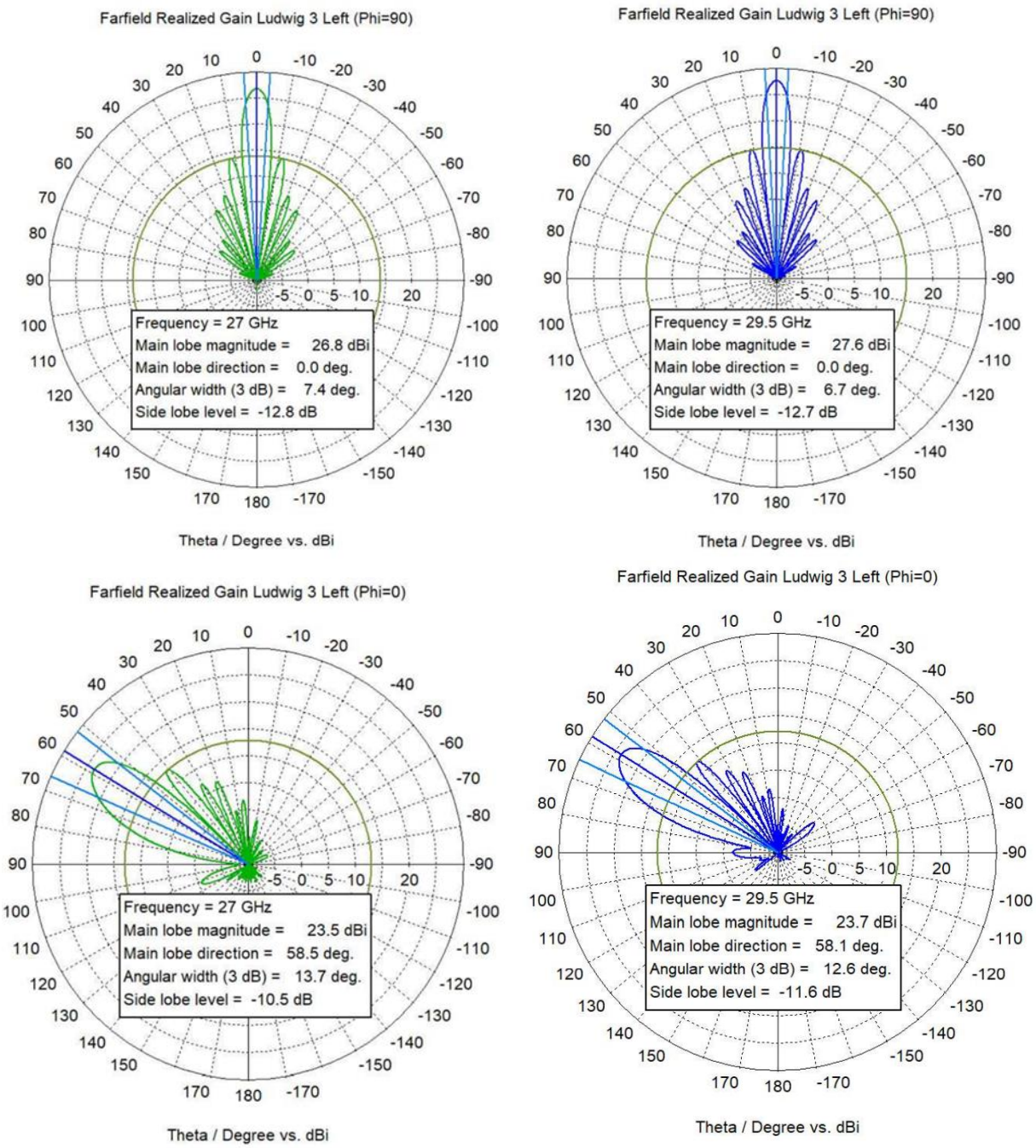

Figure 4: NG1 antenna patterns at various frequencies. The bottom patterns characterize the beam shape when steered 60 degrees.

3 STOP BUZZER CONTACT

Applicant and secondary "Stop Buzzer" name, address, phone number, and E-mail:

Austin Weber
Mission Analyst Engineer II, CesiumAstro, Inc.
105 Edgeview Drive, Suite 310
Broomfield, CO 80021
Phone: (920) 296-4468
E-mail: austin.weber@cesiumastro.com

Primary "Stop Buzzer" POC in the event that harmful interference occurs:

Danilo Dadic
Senior Engineering Manager, Systems, RF & Antenna Design
13215 Bee Cave Parkway Suite A-300
Austin, Texas 78738
Phone: (818) 448-5801
E-mail: danilo.dadic@cesiumastro.com