## EXHIBIT 1

## DESCRIPTION OF PROPOSED EXPERIMENTAL OPERATIONS

Pursuant to Sections 5.54(a)(1) and 5.63(c) of the Commission's rules,[1] MITRE Corporation ("MITRE") respectfully requests a two-year conventional experimental license, commencing on January 6, 2025, or as soon as possible thereafter, to test its planned Space Experimentation Lab ("M-SEL") non-geostationary satellite orbit ("NGSO") satellite and associated ground station in Bedford, Massachusetts. Specifically, MITRE seeks to test a flexible communications and sensing research radio platform that involves on-orbit radio frequency data collection, packetizing, and downlinking data to the Bedford ground station. Expeditious grant of this application will serve the public interest by permitting testing and development of new satellite network equipment and technology in conjunction with a planned March 1, 2025 launch of the M-SEL satellite.

***Purpose and Experimental Operations*:** This experimental license will allow MITRE to test the ability of its new satellite transceiver equipment, based on MITRE's Frequency-scaled Ultra-wide Spectrum Element (FUSE™) antenna technology, to switch between frequency bands and change the instantaneous bandwidth of operation, and quantify communication data throughput and error rates at different frequencies and instantaneous bandwidths in an on-orbit environment. M-SEL satellite experimental operations will commence following launch and are planned for several phases of experimentation, as described in more detail below. Testing is expected to continue for the operational lifetime of the satellite. MITRE acknowledges that it is constructing the satellite at its own risk and has provided information regarding orbital debris mitigation in Exhibit 2 (Orbital Debris Assessment Report).[2]

*Frequency Usage*: M-SEL telemetry, tracking, and control ("TT&C") will be performed using any of five non-U.S. antennas located in Kaspichan, Bulgaria; Lomazzo, Italy; Vimercate, Italy; Santa Maria, Spain; and Pretoria, South Africa. TT&C downlinks (space-to-Earth) will occur at 400.5 MHz, and TT&C uplinks (Earth-to-space) will occur at 2025-2110 MHz.

The M-SEL experimental radio-frequency payload will communicate with the Bedford, MA ground station in the following downlink frequencies: 1518-1544 MHz, 1545-1559 MHz, 2170-2200 MHz, 2483.5-2500 MHz, 2500-2520 MHz, 4900-5000 MHz, and 6875-7055 MHz. Uplink transmissions from the Bedford, MA ground station will be received by the M-SEL satellite in the 1980-2010 MHz, 2670-2690 MHz, 4900-5000 MHz, and 5250-5350 MHz bands. All requested frequency bands are necessary to test the wideband experimental FUSE™ transceiver onboard the M-SEL satellite and will be conducted on a non-interference basis with respect to

[1] 47 C.F.R. §§ 5.54(a)(1), 5.63(c).

[2] *See id.* §§ 5.64(a), (b); *see also* Exhibit 2.

other authorized services in the requested bands.[3] Information regarding the frequency usage is included in the application form as well as Appendix A and B attached hereto.[4]

*Orbital Parameters*: The satellite will launch on a SpaceX rideshare mission. Accordingly, the exact orbital altitude and inclination will be confirmed by the launch provider (SpaceX) closer to the March 1, 2025 launch date. At this time, the launch is anticipated to place M-SEL into an altitude of 510 km ±15 km in Sun-synchronous orbit ("SSO"). However, as SpaceX will control the insertion altitude, MITRE requests authority to operate the satellite from 400-600 km to account for any changes in delivery within low-Earth orbit.

*Satellite Subsystems*: The satellite will use Astro Digital's Corvus bus platform, which has a well-established on-orbit track record.[5] Below is a brief description of the key subsystems:

- Navigation and Control: The system will use GPS for position tracking and an onboard propulsion interface for fine-tuning orbit adjustments.
- Power: The satellite will feature a pre-packaged Electrical Power System that manages power distribution and battery charging.
- Thermal Control: Passive thermal management techniques will be used to regulate temperature.
- Satellite TT&C Communications: The satellite will communicate via a Turva TT&C radio, ensuring reliable data transmission.

*Experimental Phases*:

- Phase 0 – Orbital Insertion and Commissioning: During the orbit insertion and initial commissioning phase, M-SEL will test the onboard systems to ensure that they are functioning nominally consistent with the frequencies requested described in Appendix A and Figure 1 below. In particular, M-SEL will test UHF downlink and S-band receive antennas for TT&C with certain earth stations located outside the United States (*See* Appendix B). Such TT&C links will be used throughout the operational lifetime of the satellite. M-SEL will utilize its FUSE™ antenna to test L-band data downlink, S-band downlink and uplink, and C-band downlink and uplink communications with the Bedford, MA ground station. M-SEL will also utilize the dedicated X-band transmit antenna to test data downlink with the Bedford, MA ground station.

[3] *See id.* § 2.106; *see also id.* § 5.85(a)(1).

[4] The M-SEL satellite will not be capable of submitting the station ID in clear voice or morse code and MITRE respectfully requests a waiver of 47 C.F.R. 5.115 to the extent necessary to permit the requested operations.

[5] Astro Digital, *Systems*, https://astrodigital.com/systems (Last visited Oct. 15, 2024).

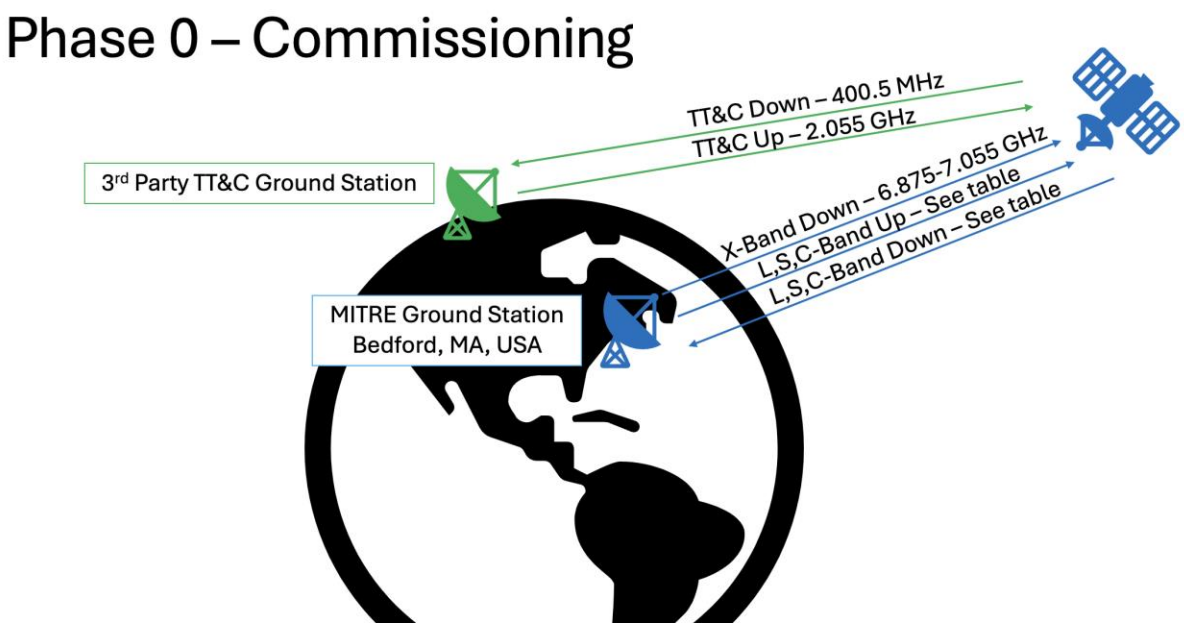


*Figure 1: Phase 0 – Commissioning*

- Phase 1 – Bedford Performance Characterization and Foundational Testing: Phase 1 experiments will demonstrate functionality of the radio frequency payloads, validate link budgets for all data links, and test foundational software applications required to support future testing. Command and control of the satellite will be sent over the TT&C link using third-party communication equipment. In particular, as shown in Figure 2, Phase 1 testing seeks to:

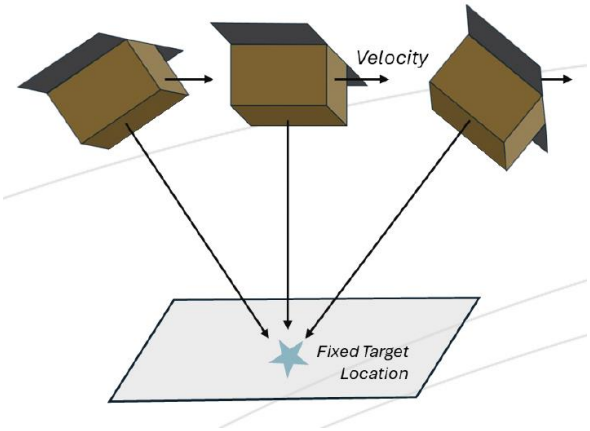


*Figure 2: Phase 1 Testing*

  - *Phase 1A – Validate link performance*: Test link performance between satellite and Bedford ground station will be measured for all configurations. The boresight of the antenna under test will track the ground station first using satellite

body pointing, and second using a combination of body pointing and electronic steering of the FUSE™ antenna. The Bedford ground station will track the satellite throughout the pass. The minimum test angle will be 25 degrees above the horizon. Link margin will be recorded at 25 degrees (or first angle link closes) and at peak link margin (*i.e.*, 90-degree elevation). Testing will also include identifying the most reliable link for bulk data downlink to the Bedford ground station.

- *Phase 1B – Two-way communication testing, for store-and-forward data collection and analysis*: Using standard DVB-S2 waveform for both satellite transmit and receive, this phase will test switching between FUSE™ transmit and receive for store and forward applications on the same pass while communicating with the Bedford ground station. Testing will also include uplink transmissions to the FUSE™ antenna and downlink transmissions on the X-band antenna in the same pass.

- *Phase 1C – Receive IQ and downlink for post-processing*: This experiment will demonstrate the ability to capture raw IQ data from Bedford ground station transmissions on any of the four (4) experimental uplink frequency allocations. The IQ data will be packaged and sent back to the MITRE Bedford ground station using the standard DVB-S2 waveform over any of the seven (7) experimental transmit allocations for the satellite. Data may be downlinked during the same pass or on a subsequent pass for post-processing.

- *Phase 1D – Downlink TT&C data to Bedford ground station for post-processing*: This experiment will test telemetry logging from various satellite subsystems and data downlink to the MITRE Bedford ground station support new areas of research. Data will be sent using the standard DVB-S2 waveform over any of the seven (7) experimental transmit allocations for the satellite. Data will include but not be limited to telemetry from the following satellite subsystems:

  - FUSE™ Transceiver Payload
  - Navigation and Attitude Control System
  - Thermal data from multiple systems

- Phase 2 – Mission-Driven Experimentation: Phase 2 experiments will research new CONOPs and capabilities. Phase 2 experiments will include software and firmware updates to the experimental radio-frequency payload to test new waveforms, communication and sensing concepts within the constraints of the experimental license. During Phase 2 experiments, the satellite will use the Bedford ground station for downlinking experimental data. Command and control of the satellite will be sent over the TT&C link using third party communication equipment.

- Phase 3 – Additional Mission-Driven Experimentation: Phase 3 experiments will research new CONOPs and capabilities. Phase 3 experiments will include software and firmware updates to the experimental radio-frequency payload to test new waveforms,

communication and sensing concepts. To the extent any Phase 3 experimentation requires amendment to regulatory approvals for testing with additional earth stations or in different frequency bands, such approvals will be requested at a later time.

- Phase 4 – De-orbit: Approximately 40 months after completion of testing, M-SEL will use the expected remaining propellant on board to lower its orbit altitude to below 400 km. During this phase, M-SEL will use only its S- and UHF-band TT&C links. Once the satellite is below 400 km orbital altitude and runs out of propellant, the satellite will then be decommissioned, and it will deorbit shortly thereafter. The exact timing will depend on coordination with NASA's ISS operations.

***Point of Contact***: The following contact at MITRE is responsible for satellite and ground station operations:


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Email: erenda@mitre.org
Phone: 978-500-5534

## Appendix A

## Technical Parameters

| Transmitter Type (fixed, mobile) | Use | Lower Freq. (MHz) | Upper Freq.(MHz) | Carrier Selectivity (kHz) | Power at Transmitter Output (W) | ERP (W) | Freq. Tol (%) | Emission Designator | Bandwidth (MHz) | Digital Modulation Rate (kbps) | Digital Modulation Type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fixed | Exp | 1980 | 2010 | 1 | 50 | 3000 | 0.001 | 30M0G1D<br>5M00G1D | 30<br>5 | 10,000 | DVB-S2/X |
| Fixed | Exp | 2670 | 2690 | 1 | 50 | 7600 | 0.001 | 20M0G1D<br>5M00G1D | 20<br>5 | 10,000 | DVB-S2/X |
| Fixed | Exp | 4900 | 5000 | 1 | 50 | 24200 | 0.001 | 100MG1D<br>5M00G1D | 100<br>5 | 10,000 | DVB-S2/X |
| Fixed | Exp | 5250 | 5350 | 1 | 50 | 24200 | 0.001 | 100MG1D<br>5M00G1D | 100<br>5 | 10,000 | DVB-S2/X |
| Mobile | Exp | 1518 | 1544 | 1 | 7.4 | 19.3 | 0.001 | 26MG1D<br>5M00G1D | 26<br>5 | 10,000 | DVB-S2/X |
| Mobile | Exp | 1545 | 1559 | 1 | 7.4 | 19.3 | 0.001 | 14M0G1D<br>5M00G1D | 14<br>5 | 10,000 | DVB-S2/X |
| Mobile | Exp | 2170 | 2200 | 1 | 5.6 | 18 | 0.001 | 30M0G1D<br>5M00G1D | 30<br>5 | 10,000 | DVB-S2/X |
| Mobile | Exp | 2483.5 | 2500 | 1 | 5.5 | 29.2 | 0.001 | 16M0G1D<br>5M00G1D | 16<br>5 | 10,000 | DVB-S2/X |
| Mobile | Exp | 2500 | 2520 | 1 | 5.5 | 29.2 | 0.001 | 10M0G1D<br>5M00G1D | 10<br>5 | 10,000 | DVB-S2/X |
| Mobile | Exp | 4900 | 5000 | 1 | 1.6 | 71.6 | 0.001 | 10M0G1D<br>5M00G1D | 10<br>5 | 10,000 | DVB-S2/X |

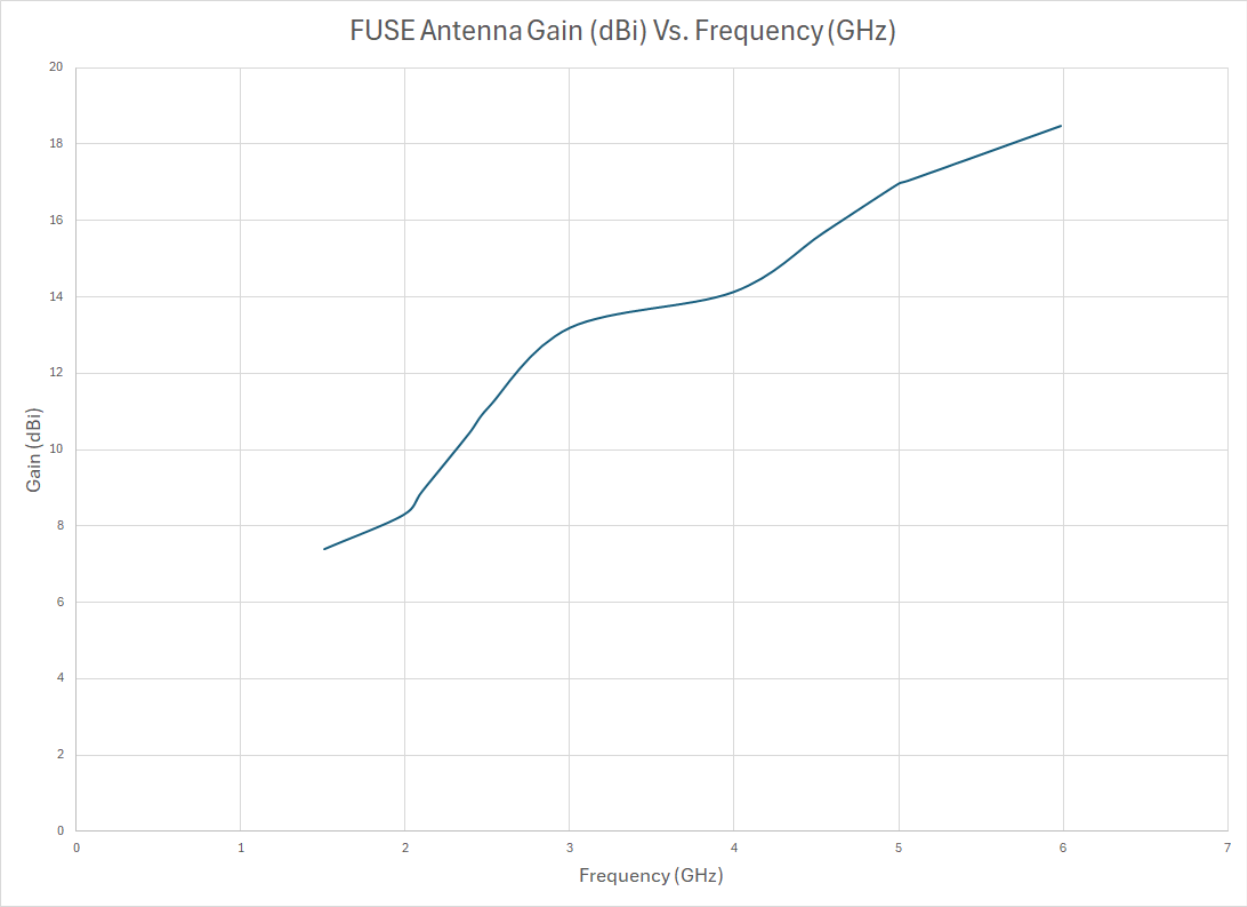
| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mobile | Exp | 6875 | 7055 | 1 | 5.4 | 15.8 | 0.001 | 180MG1D<br>5M00G1D | 180<br>5 | 10,000 | DVB-S2/X |
| Fixed | TT&C | 2025 | 2110 | 1 | 7.4 | 19953 | 0.001 | 300KF1D | 0.3 | 34.8 | 2-GFSK |
| Fixed | TT&C | 2025 | 2110 | 1 | 28 | 2042 | 0.001 | 300KF1D | 0.3 | 34.8 | 2-GFSK |
| Fixed | TT&C | 2025 | 2110 | 1 | 80 | 630957 | 0.001 | 300KF1D | 0.3 | 34.8 | 2-GFSK |
| Mobile | TT&C | 400.45 | 400.55 | 1 | 4 | 3.1 | 0.0001 | 60K0F1D | 0.06 | 34.8 | 2-GFSK |

# Appendix B

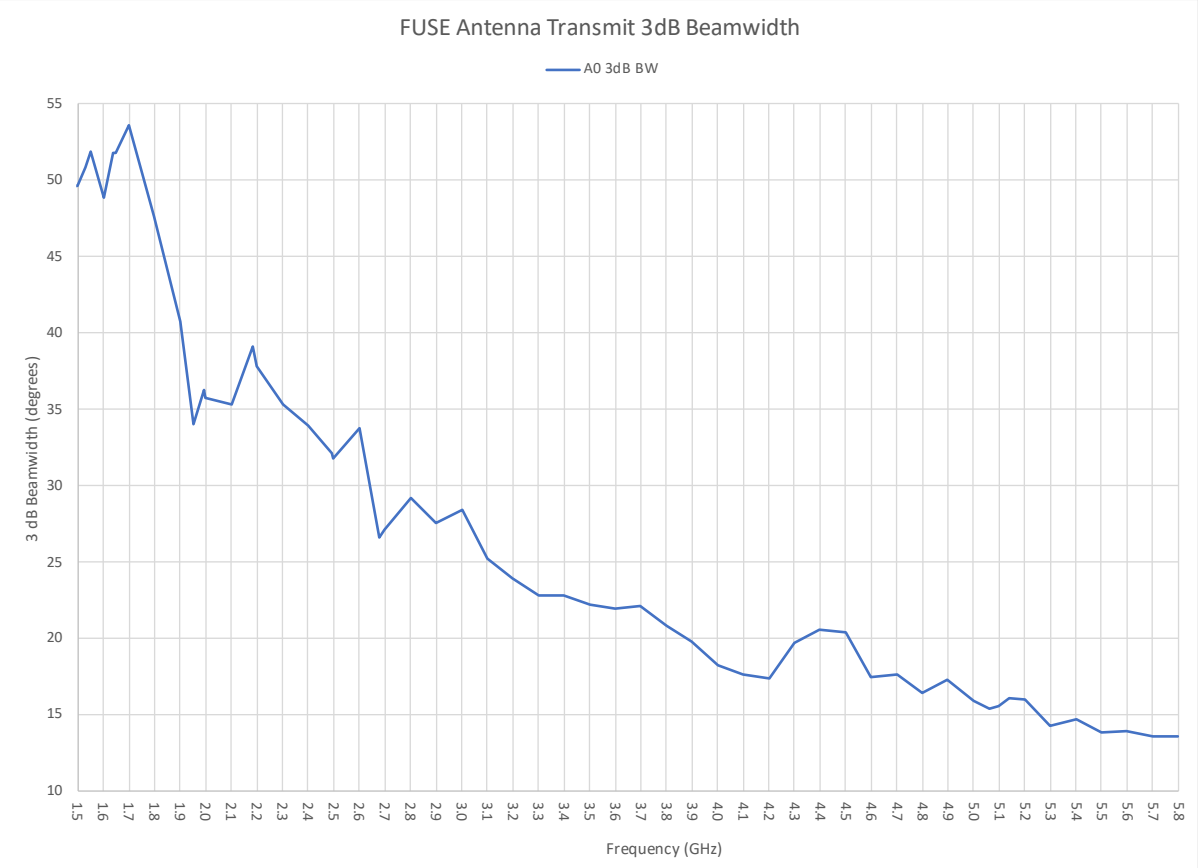
## Additional Parameters

### M-SEL FUSE™ Antenna

The FUSE™ antenna (non-electronic, passive) gain is as follows:

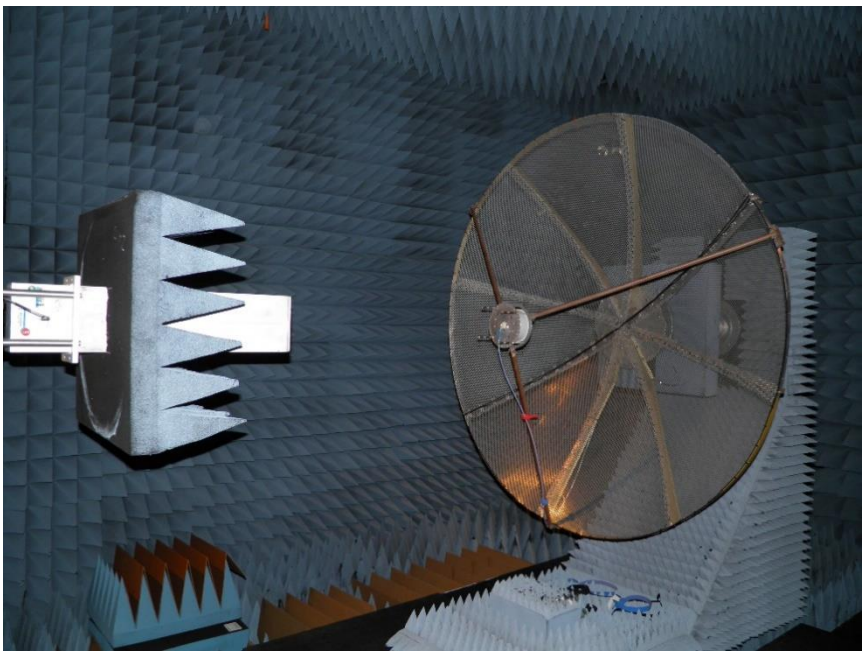



The FUSE™ antenna beamwidth is as follows:

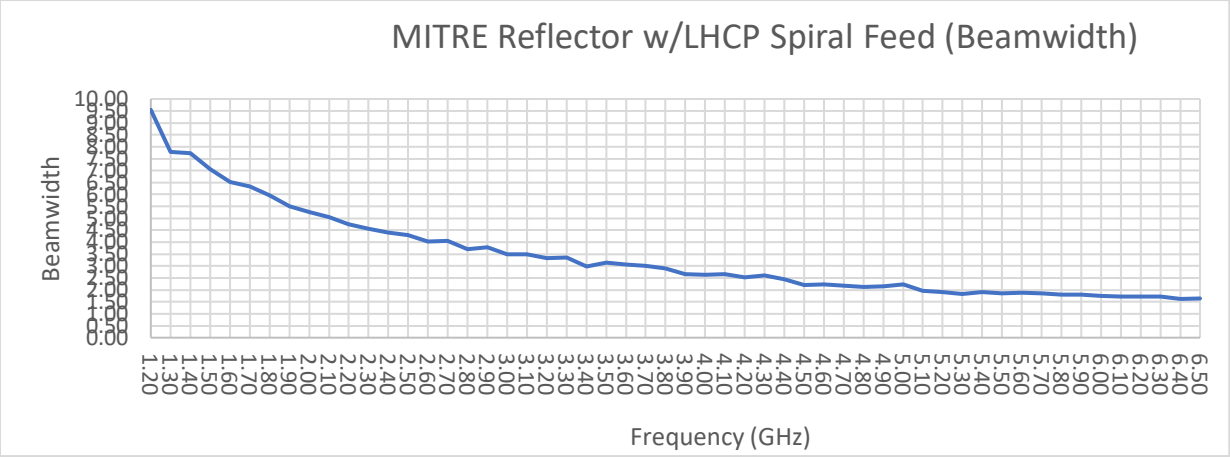



## Bedford Ground Station

The Bedford ground station includes a custom 6-foot parabolic dish with LHCP feed (RHCP polarization), as shown in the figure below:



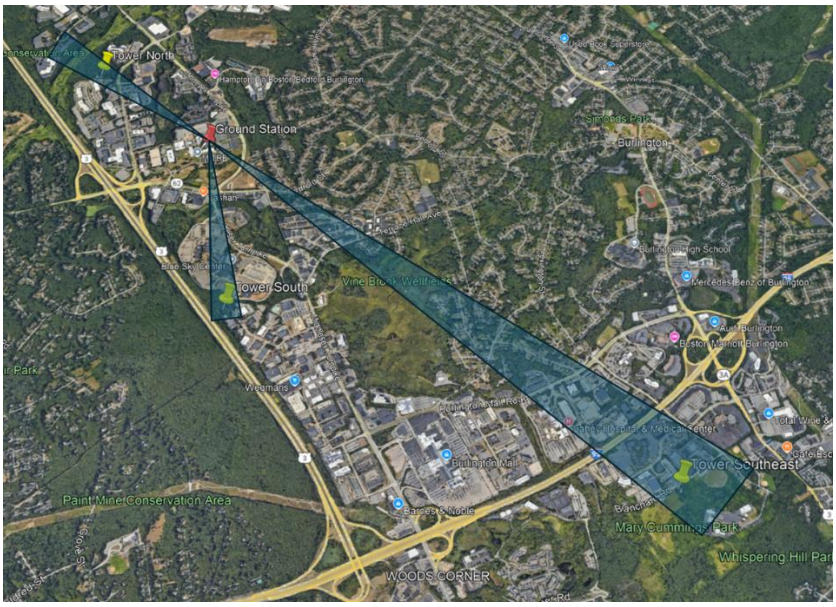
**Width of beam in degrees at the half-power point:**




The ground station located at 202 Burlington Rd, Bedford, MA will only attempt to communicate with the satellite when it is above 25 degrees elevation. Additionally, masking in certain azimuth and elevation angles will be controlled so that interference with local cellular and other terrestrial transmitters is avoided. Known transmitters visible from the ground station include the following locations (note, these are NOT transmitters associated with this experiment):

- 42°30'42.54", 71°14'46.29"W, range 1.15km
- 42°29'33.70"N, 71°13'55.57"W, range 1.44 km
- 42°28'48.16"N, 71°11'44.25"W, range 4.33 km

For context, a diagram showing the relative location between the ground station and these cellular and terrestrial transmitters is included below, the Bedford ground station is the red pin, located at **42°30'18.7"N, 71°14'07.1"W.**




**TT&C Ground Stations**

Location 2 (TT&C):
City: **Kaspichan, Bulgaria**
Latitude / Longitude (NAD 83 datum): **43°18'48.6"N, 27°09'26.7"E**

Location 2 (TT&C Downlink Only):
City: **Lomazzo, Italy**
Latitude / Longitude (NAD 83 datum): **45° 41' 50.0" N, 09° 02' 05.0" E**

Location 3 (TT&C):
City: **Vimercate, Italy**
Latitude / Longitude (NAD 83 datum): **45° 35' 36.0" N, 09° 21' 44.0" E**

Location 4 (TT&C):
City: **Santa Maria, Spain**
Latitude / Longitude (NAD 83 datum): **36°59'51.3"N, 25°08'10.4"W**

Location 5 (TT&C):
City: **Pretoria, South Africa**
Latitude / Longitude (NAD 83 datum): **25°51'39.1"S, 28°27'12.0"E**