Experiment Description:

Five transmitters will be utilized as part of a federal research contract. These include two payload transmitters mounted on a single high altitude balloon (one is designated an air-to-ground transmitter and the second is a designated crosslink transmitter), two transmitters mounted on two separate Mobile Ground Stations (MGS) (one per MGS), and a single ground beacon transmitter. The launch point of the balloon/payload is Elko, NV and current predictions are that the balloon will move east with flight termination (impact) in the Carr, CO area South of the Wyoming/Colorado border. The maximum altitude of the balloon will be 95,000 feet. Maximum duration of the flight (payload/MGS transmitters active) is 36 hours. Minimum duration of the flight is 24 hours. Only one flight will occur in a launch window as specified in the Start/Stop dates of this application filing.

Each of the two balloon/payload transmitters will utilize a low gain omni directional vertically polarized ½ dipole antenna. Each balloon/payload radio system (RFM69HCW module from Hope RF, which is based on the Semtech SX1231 RFIC) will have a maximum power level of +33 dBm, into a 3.5dBi omni antenna, for a maximum Effective Isotropic Radiated Power (EIRP) level of +36.5 dBm. The balloon overflight area is estimated to be over a rectangular geometric area bordered by the following points:

1. 42.604086 N, -115.800974 W
2. 39.160048 N, -115.723969 W
3. 42.247927 N, -104.129773 W
4. 42.472056 N, -104.379687 W

There are two separate MGSs employed for the experiment. The launch area stationary MGS will be deployed at the Elko, NV launch location. The second MGS will be forward deployed on the ground along the balloon flight path. Both MGS utilize a small directional antenna. Both MGS directional antennas will track the balloon payload and thus Azimuth and Elevation angles of the ground system antenna will be constantly changing as the geometry between these MGS and the Balloon change throughout the flight. The launch area stationary MGS will monitor payload housekeeping data and provide payload command and control (C2) transmissions during pre-launch checks, during ascent, and throughout float operations for as long as the link range will allow. The deployed MGS, upon reception of the payload housekeeping data, will provide payload command and control (C2) capabilities for the remainder of the float, descent, and recovery phases of the flight test. Maximum power of the MGS radios (RFM69HCW module from Hope RF, which is based on the Semtech SX1231 RFIC) is +33 dBm, into an 11.5dBi directional yagi antenna, for a maximum EIRP of +44.5dBm.

The ground beacon transmitter will transmit location information to a balloon payload beacon receive only terminal during the float phase of the flight test. Maximum power of the ground beacon transmitter (also a RFM69HCW module from Hope RF, which is based on the Semtech SX1231 RFIC) is +33 dBm, into a 3.5dBi vertically polarized ½ dipole omni antenna, for a maximum EIRP level of +36.5 dBm.

The forward deployed MGS terminal and the ground beacon transmitter will be primarily located near the Wendover, UT Airport (40.718903 N, -114.032749 W) with a region of potential operation along Interstate 80, across the Utah salt flats to an eastern limit at 40.745650 W, -112.652940 N.

All transmissions (1 minute periodic bursts from both balloon payload transmitters, command uplinks from the MGS, and location information from the ground beacon transmitter) will be short duration (approximately 50 milliseconds), narrowband (<25 kHz), 9600 baud, and GMSK modulated.

Applicability of Experimental / STA licensing:

The radio system will be used as part of a high altitude balloon mission under federal contract (FA8002-17-C-0196). The radio system exceeds FCC limits for use as an unlicensed lower power system, and since it is being operated under a federal contract, it is not acceptable to operate under Part 97 Rules due to monetary compensation for operation of the radio as part of the larger federal contract goals. However, the radio system will be used in future missions as a cube satellite crosslink radio system, which will likely be licensed under Part 97 rules (or Part 5 Rules as details of the mission become more defined). For the Federal Contract, to which this application for an STA pertains, the radios are being utilized as part of the primary payload command and control system as described in the Experiment Description section of this exhibit. As a byproduct of this operation, experimental data will be collected concerning the utility of these low power radios for long range communications (10-100 km), which is relevant to the future cubesat crosslink mission.

Below are Excerpts from '§ 5.3 Scope of service' showing the relevant applicability of the Experimental Service (and due to the short duration of the mission, specifically the Special Temporary Authority license) for this license request. Sections below in brackets [] indicate comments inserted from the author of this exhibit.

§ 5.3 Scope of service:

Stations operating in the Experimental Radio Service will be permitted to conduct the following type of operations:

(a) Experimentations in scientific or technical radio research.

[Testing future experimental cubesat crosslink radio system.]

(c) Experimentations under contractual agreement with the United States Government, or for export purposes.

[Virginia Tech Applied Research Corporation research program under Federal Contract: FA8002-17-C-0196]

(d) Communications essential to a research project.

[Yes, radio system required as primary payload command and control system to help ensure test objectives are achieved.]

(e) Technical demonstrations of equipment or techniques.

[Testing future experimental cubesat crosslink radio system.]

j) Development of radio technique, equipment, operational data or engineering data, including field or factory testing or calibration of equipment, related to an existing or proposed radio service.

[In future use of this technology, and based on the data collected during the mission, the specific radio system will be used aboard a cube satellite licensed in the Amateur Radio Service under Part 97 Rules in the spirit of advancing the radio art which is a fundamental tenant of the Amateur Radio Service.]

Stop Buzzer / Questions:

Transmissions under this License may be stopped by contacting Zach Leffke at (540) 231-4174 or (540) 808-6305.