

Raytheon Missile Systems  
Experimental License Renewal Application  
Call Sign: WI2XYN  
File No: 0313-EX-CR-2018

## Explanation of Experiment

### Overview:

Raytheon Missile Systems (Raytheon) develops and tests a number of technologies for federal government customers. In the course of that development and testing, Raytheon often needs to test the new technologies to advance their development and see how they function.

This application seeks to renew an experimental license WI2XYN to continue testing of radio systems incorporated into a rocket with both booster and payload. The original testing proved fruitful, but weather conditions precluded sufficient testing, and more time is needed. Therefore, Raytheon is seeking to renew its license to continue that testing.

### Technical Synopsis

Spectrum Requested: 434-436 MHz  
Time of Use: Limited to 3 hours of radio use per launch, 10 additional launches scheduled  
Modulation: GFSK  
Power Level: 40 mW, airborne operations have no antenna gain

### Description of Experiment

Raytheon is testing new ways of delivering telemetry information from rockets by installing radios into the rocket payloads and boosters. This experiment uses small rockets as a test bed for the delivery of telemetry information. The testing uses off-the-shelf radio technology to see if the selected radios can be used for this purpose. The radios selected are small, light-weight, easily deployable, and affordable. These qualities make them ideal radio systems for transmitting the telemetry information needed to track the rocket and its performance in flight.

Prior to flight of the rocket, the radios in the payloads and boosters are calibrated with the radios on the ground. The operations use two frequencies for each flight, one in the payload and one in the booster, from the frequency range requested in the application. The rocket will use two internal whip antennas, each attached to a radio on the circuit board in its section of the rocket. That antenna has no gain. The ground-based radios will transmit *only* during this set up time, using two Yagi antennas. One will be set up with the payload and one will be set up with the booster. When the rocket is in flight, the payload and the booster transmit telemetry data to the ground station.

On the ground, the program uses Yagi antennas, receiving only, to track the rocket and gather telemetry information.

The rocket booster is released from the payload at a designated point during the flight. At that point, the booster releases a parachute that lowers the booster safely to the ground. The payload continues to fly for a certain amount of additional time. At the end of the payload flight, it releases its own parachute for safe landing. Both the payload and the booster have embedded GPS chips, and they use their radios to transmit their locations so that both the booster and payload can be recovered and reused.

The radio link does not control any flight functions. The radio link is being used for telemetry data.

#### Time of Use

The proposed time of use per launch test is 3 hours of radio usage. Much of that time is during the calibration stage on the ground, rather than while the rocket is in flight. Thus, the area of operations should be limited geographically for most of the operational time. Further, the ground stations are only transmitting during the calibration phase. The testing that took place in 2017 was very productive, and the program has asked to renew this license to continue its work. Most of the time, the spectrum will not be in use.

#### Location of Operations

Raytheon will be testing the system configuration at its facilities in Tucson. All of the Tucson testing is expected to be indoors, in the laboratory.

The actual rocket flight tests are conducted in Sierra Blanca, Texas. The area selected for this testing is near a model rocket range, which has been created for this sort of testing and demonstration. These outdoor tests reach an altitude of up to 18,000 feet within a 10-mile radius of the specified coordinates.

The payload may land in a different location from the booster because of different air currents or other conditions. The GPS and telemetry are essential for recovering the payload and boosters.

#### Spectrum Use Limited

The radio operations are pulsed. This means that the spectrum is not in use constantly. The power levels submitted in the application are peak power levels, but with the pulsed use, the average power is much lower. In addition, the emission designator 16K0F1D indicates that only a portion of the spectrum will be in use during these tests. The requested frequency band will allow the program flexibility to test operations.

#### Stop Buzzer Point of Contact

Bart Turner  
Spectrum Manager

520-794-0227 (office)  
[Bartholomew.d.turner@raytheon.com](mailto:Bartholomew.d.turner@raytheon.com)

### **Conclusion**

Raytheon is seeking renewed authorization to test the use of an off-the-shelf radio in a rocket to deliver telemetry data. The proposed testing takes place both in the laboratory in Tucson and near a model rocket range in Sierra Blanca, Texas. The testing will be of limited time.

For additional information or if there are any questions, please contact Anne Cortez, [alc@conspecinternational.com](mailto:alc@conspecinternational.com) or 520-360-0925.