

## **Explanation of Experiment**

### **Overview:**

Raytheon Company (Missiles & Defense – M) (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.

Raytheon's engineering team has developed new rocket motors that require testing as quickly as possible to see if they can deliver performance that could be built into future Raytheon missile systems. The technology development requires this STA to enable the testing to continue.

### **Technical Synopsis**

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

### **Description of Experiment**

Raytheon plans to characterize the performance of these new rocket motors by transmitting in-flight telemetry to the ground station. The testing will use off-the-shelf radio technology to see if the selected radios can be used for this purpose. The radios selected are small, lightweight, 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 radio in the rocket will be calibrated with the radio on the ground. The operations will use one frequency for each flight from the frequency range requested in the application. The rocket will use one internal whip antenna 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. When the rocket is in flight, it will transmit telemetry data to the ground station.

During the rocket flight, the program will use Yagi antenna receivers on the ground to track the rocket and gather telemetry information.

The rocket booster will be released from the payload at a designated point during the flight. At that point, the booster will release a parachute that lowers the booster safely to the ground. The payload will also release its own parachute for safe landing. The embedded GPS chip will use the radio to

transmit the rocket location so that it can be recovered.

The radio link will not control flight functions. The radio link will only be used for telemetry data.

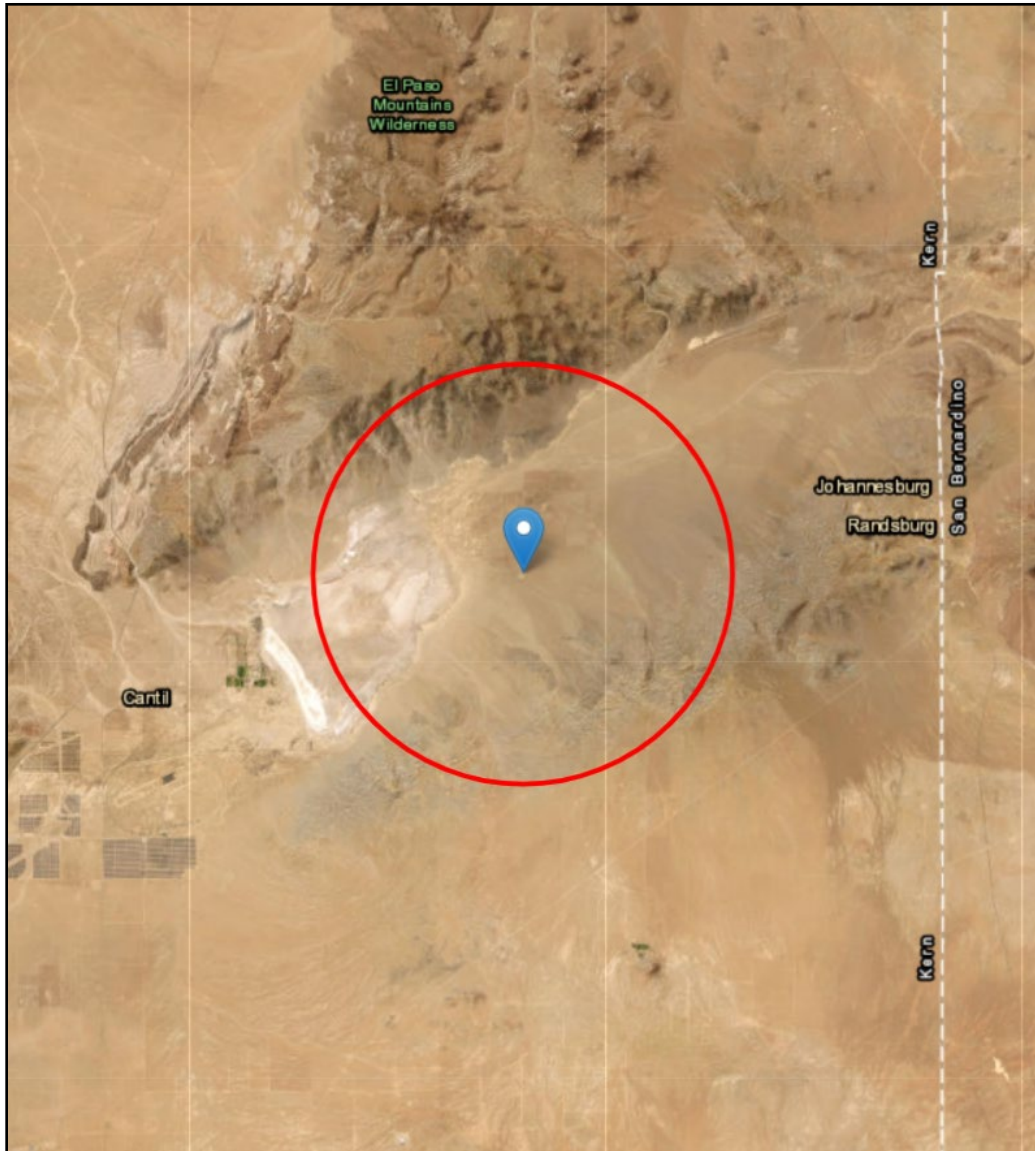
#### Time of Use

The proposed time of use per launch is only 3 hours of radio usage. Much of that time will be during the calibration stage on the ground, rather than while the rocket is in flight. Thus, the area of operations should be mostly limited geographically. Further, the ground stations will only be transmitting during the calibration phase. Rocket flights are conducted only occasionally. Most of the time, the spectrum will not be in use.

#### Location of Operations

This application seeks authorization to operate at the Friends of Amateur Rocketry Range in Kern County California near the city of Randsburg. These outdoor tests will reach an altitude of up to 30,000 feet within a 5-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.



*Figure 1. Center of proposed area of operations: 35°21'12" N, 117°48'25.80" W*

#### Spectrum Use Limited

The proposed 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

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### Conclusion

Raytheon is requesting an STA for testing that will use an off-the-shelf radio in a rocket to deliver telemetry data. The testing will be of limited time near Randsburg, CA.

For additional information or if there are any questions, please contact Joshua Salmon at [joshua.2.salmon@rtx.com](mailto:joshua.2.salmon@rtx.com) or 520-473-6784.