

Raytheon Missile Systems  
Experimental STA Application  
File Number: 1542-EX-ST-2019

## **Explanation of Experiment and Need for STA**

### **Overview:**

Raytheon Missile Systems (Raytheon) develops, tests, and builds a number of advanced technology systems that are sold to the US government and selected foreign governments. This application seeks authorization for the testing of such a system that includes both optics integrated with radar and a flight terminate radio system.

The platforms to be used for this demonstration are still under development, based on early experimentation. Raytheon's DoD customers are now seeking demonstrations to show the progress of the technology development.

### **Technical Synopsis:**

#### **Radar System:**

Spectrum Requested: 10175-10500 MHz  
Time of use: less than 4 hours daily, during business days  
Power: 80 W, with 27 dBi gain, 24.4 kW ERP

#### **FTS System:**

Directional Antenna: 7 dBi gain antenna with 75 degree half power beamwidth  
Power level: 500 W HPA Flange Power, 1800 W ERP  
Time of Use is limited: fifteen minutes of RF operation per day, but only on select frequencies

### **Need for an STA:**

Raytheon's customers have asked for demonstration of several systems at once starting in late September 2019. Those demonstrations are expected to continue into the beginning of 2020.

### **Explanation of Experiment for Radar System:**

#### **Description of Operations of Radar System:**

The proposed operations will include the use of two radio systems. The first is a radar that is integrated with an optical tracking system, and the second is a flight terminate system that will be integrated into other aspects of the final product.

The radar system has three operating modes:

Mode one: is a 1 kHz wide signal that is used for TX F1 CW. This mode help to send out TX transmit frequency. It will be in use off and on throughout the entire day.

Mode two: is a 4 MHz wide signal that is used for TX F2 CW. This mode helps to send out TX transmit frequency (along with the 1 kHz simultaneously). It will be in use off and on throughout the entire day.

Mode three: is a 300 MHz wide signal that is used for TX FM-CW modulation. This mode helps as the alternate from mode two proving a FM-CW modulation. It will be in use off and on throughout the entire day.

The goal of the experimentation, testing, and integration is to integrate a COTS radar system with an optical scanning system to be able to detect threats at airports. The radio system is not experimental, but the work being done will involve testing various configurations to optimize performance of the integrated system.

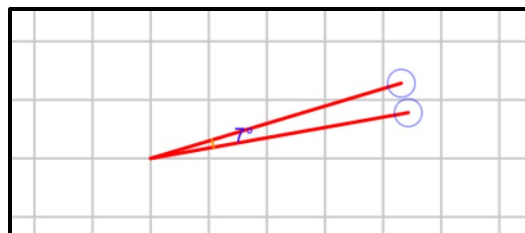
The radar system will have its directional antenna oriented down. The image below is a generic version of the proposed testing vehicle.



*Figure 1. Quadcopter with testing technology mounted underneath*

Power Levels, no interference likely:

The nominal power level is 80 W with an ERP of 24.4 kW. The beamwidth of the antenna is approximately 7 degrees.



*Figure 2. Approximate beamwidth of antenna*

This is a highly directionalized antenna which operates above 10 GHz with the antenna directed downward. Because signals at this high frequency are subject to significant attenuation, it is unlikely that any of the proposed operations would cause harmful interference to any other operations.

#### Time of Use:

The time of use is limited each day. The quadcopter on which the radar will be mounted is battery-powered as is the radio. Thus, operations are limited to the duration of the battery. Then, the systems will be recharged, and possibly run again during the day. This means that testing is expected to last no more than 4 hours per day. Should Raytheon need to coordinate these operations with others, it is possible to set up a schedule.

#### **Explanation of Experiment for FTS System:**

##### Description of Operations:

FTS System: The testing is being done to validate antenna operations. Raytheon is developing a smaller FTS system that can more easily be transported and deployed. A typical FTS system has used a large dish to generate the signal gain needed to reach a missile in flight to send the flight terminate signal. In recent years, Raytheon's customers have needed to develop more flexible systems that can be sent to and used in a wider variety of settings to improve the functionality and flexibility of its systems. The FTS system under development uses a high power amplifier and smaller parabolic antenna to deliver the FTS signal across distances while keeping the system small enough to move to and from various locations easily.

##### Time of Use:

Raytheon anticipates testing the FTS system for four hours per day across about 30 days of testing. This STA request is for 60 days to allow for rescheduling of testing in the event of inclement weather during the monsoon season in New Mexico or for other scheduling reasons.

When the system is in use, it will not be using all the frequencies in the band at the same time. The bandwidth required ranges from 40 kHz to 1 MHz. The signals will be used to send continuous IRIG tones.

The planned testing will use three discrete frequencies per day. The system will be on each frequency for approximately five minutes. The time of use is very limited.

##### Frequencies Requested:

Raytheon is building this system to comply with the standards set forth in Range Commander Council standards. The FTS systems need to be capable of working across the band from 370 to 450 MHz. Based on the frequencies that were approved for FTS testing under WO9XRL, Raytheon is seeking authorization for operations on four specific frequencies: 435 MHz, 394.4 MHz, 422 MHz, and 449 MHz. This application seeks authorization that would allow Raytheon to demonstrate compliance with the DOD specification.

#### **Areas of Operations for both systems:**

In this application, Raytheon is seeking authorization for operations at 12 separate locations in New Mexico. Only one site will be in use at a time.

| Description                               | lat/long (° min, sec)      | lat/long (°)           | radius (km) |
|-------------------------------------------|----------------------------|------------------------|-------------|
| RABQ Gibson carpark                       | 35°03'27.0"N 106°31'31.0"W | 35.057500, -106.525278 | 0.1         |
| RABQ Eubank carpark                       | 35°03'27.0"N 106°31'54.0"W | 35.057500, -106.531667 | 0.1         |
| RABQ empty field North of Eubank facility | 35°3'33"N 106°31'45"W      | 35.059167, -106.529167 | 0.1         |
| Moriarity Airport                         | 34°59'04.2"N 106°00'22.6"W | 34.984505, -106.006282 | 1.0         |
| Open Pit Explosives Test Facility         | 34°58'08.5"N 105°57'52.6"W | 34.969017, -105.964608 | 0.8         |
| Double Eagle Airport                      | 35°09'03.3"N 106°48'00.4"W | 35.150919, -106.800106 | 3.0         |
| Kirtland AFB range                        | 34°59'04.7"N 106°31'04.3"W | 34.984626, -106.517861 | 6.2         |
| Spaceport America                         | 32°59'25.8"N 106°58'28.6"W | 32.990493, -106.974599 | 10.0        |
| Belen Airport                             | 34°38'52.0"N 106°49'42.9"W | 34.647763, -106.828582 | 5.0         |
| White Sands Missile Range (base coord)    | 32°22'46.8"N 106°28'45.4"W | 32.379678, -106.479288 | 100 ??      |
| Laguna Pueblo                             | 35°01'07.8"N 107°24'54.3"W | 35.018838, -107.415073 | 1.0         |
| Stallion Airfield                         | 33°48'59.6"N 106°38'48.8"W | 33.816555, -106.646886 | 10.0        |

The quadcopter, in keeping with FAA regulations, will be flown by a licensed pilot and remain below 400 feet in elevation at each location.

Below are images of each site, numbered 1-12 based on the order of sites in the table above.

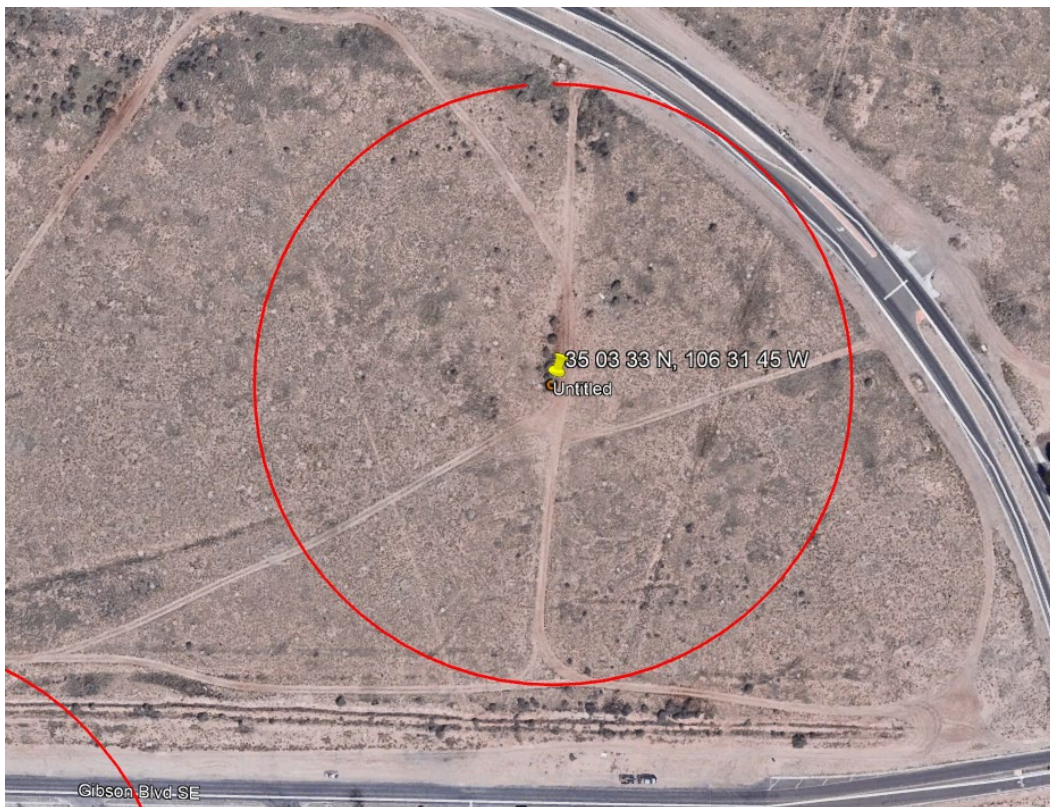
#### Site 1.



Site 2.



Site 3.



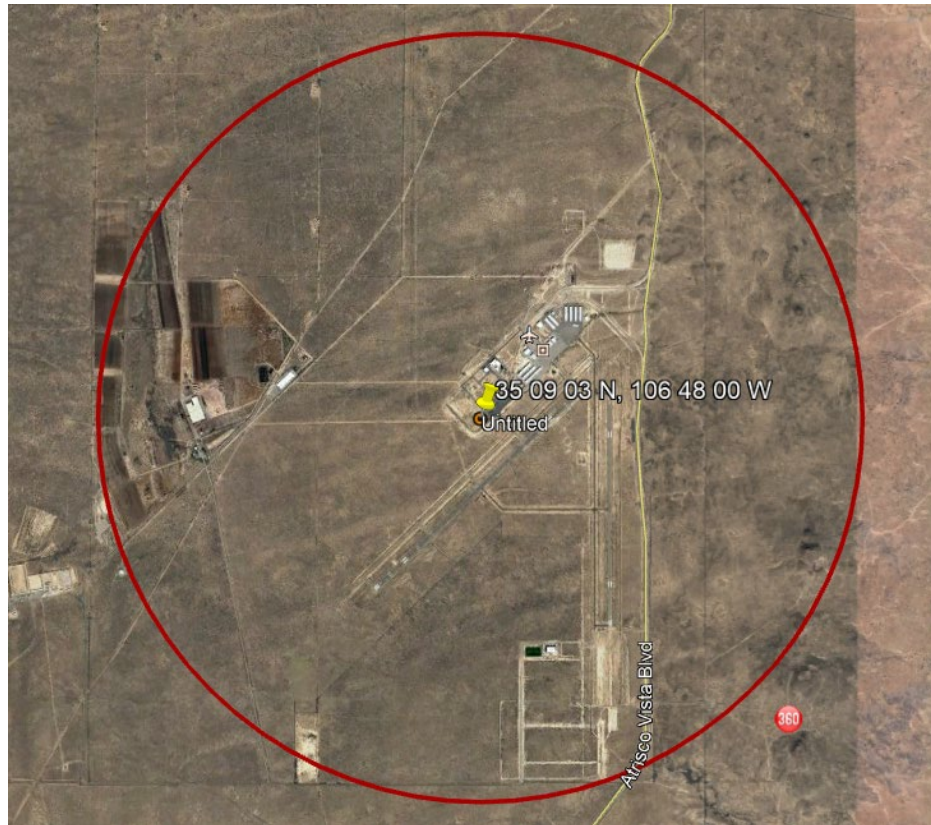
Site 4.



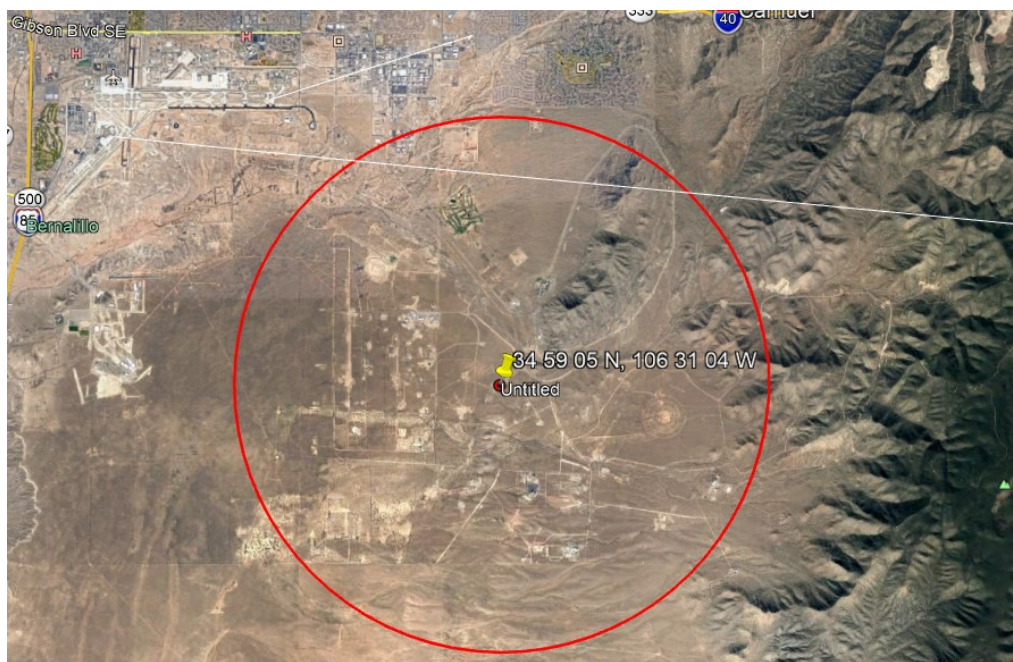
Site 5.



Site 6.



Site 7.



Site 8.



Site 9.



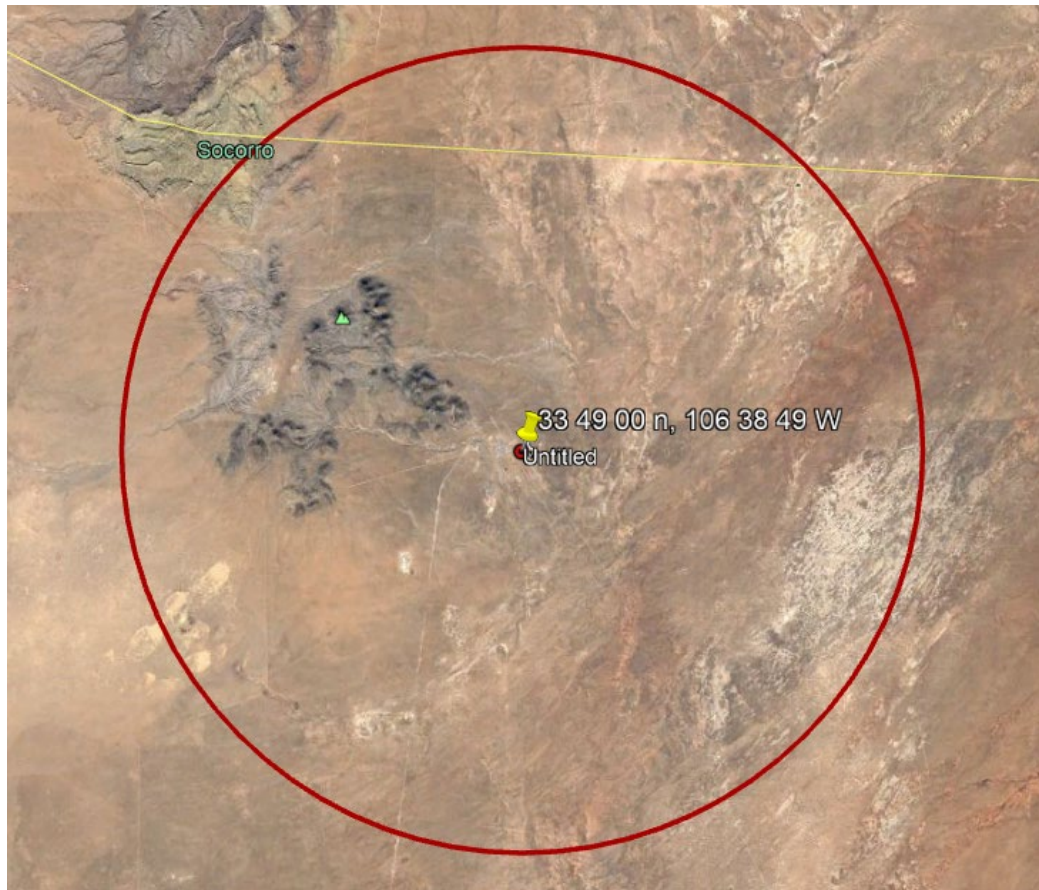
Site 10.



Site 11.



**Site 12.**



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**Conclusion:**

Raytheon is seeking authority for the testing of combined systems that allow for radar integration with optical systems and flight terminate communications. The operations will be conducted one site at a time across 12 locations in New Mexico. The time of use of the radios is limited. Should there be any questions about the proposed operations, please contact Anne E. Cortez, 520-360-0925 or [alc@conspecinternational.com](mailto:alc@conspecinternational.com).