

Raytheon Missile Systems  
Experimental License Application  
File Number: 0794-EX-PL-2015

### **Explanation of Experiment**

Raytheon Missile Systems is a defense contractor that builds and sells a variety of missile systems to the US military and select allies upon approval of the government.

#### Nature of Experiment:

Raytheon is seeking an authorization for continued testing and demonstration of a Persistent Radios Quad Router System for incorporation into several missile systems. The purpose of this particular testing and demonstration is to show how the radios can be configured to deliver interactive communication between operators at one location and the missile in use. The testing will be used to set up and configure the systems. This application is for operations at various Raytheon locations in Tucson, Arizona. Engineers will be working with the radios undertaking testing for incorporation of the radios into a range of other Raytheon Missile System products. After extensive testing, there will be demonstrations for Raytheon's DOD customers, followed by additional testing.

The nature of the Persistent Systems radio operation makes it ideal for incorporation Raytheon's missile systems and UAV platforms. The radios are designed to create a readily deployable network, which does not require a network hub for operations. The radios are set up to be both communications devices and hubs all in one. This speeds the deployment of ad hoc networks.

The military is developing increased demands for information on the spot to provide while warfighters are in the heat of the moment. Therefore, top level military officials have developed new requirements for Raytheon's missile systems to deliver interactive communication and two-way information flow when the systems are in use. This is different from the current telemetry data that is traditionally transmitted by the missile systems – which addresses health of the system, flight conditions, flight path, position, etc. The new information is more extensive, and it can be changed, updated and corrected to add precision and effectiveness to the missile system.

The Persistent Systems radios offer an opportunity to advance the missile systems' communications if they can be effectively integrated into the missile systems. This experiment is all about demonstrating the capabilities of the radios by testing their ability to transmit the information needed in a quickly deployed setting, determining how to integrate the Persistent Systems radio into a missile system, testing its effectiveness, and demonstrating the capabilities of the system for customers to determine how to define next-generation needs.

#### Locations of Testing:

Raytheon is seeking authorization for experimentation at five locations. The chart below provides some details.

Table 1. Details of Locations

<b>Site Name</b>	<b>Coordinates</b>	<b>Nature of Operation</b>	<b>Radius, if applicable</b>
Test Lab 7	32-08-13 N, 110-55-20 W	Indoors, primarily	n/a
Test Lab 9	32-08-17 N, 110-55-16 W	Indoors, primarily	n/a
Test Lab 10	32-08-12 N, 110-55-14 W	Indoors, primarily	n/a
Rita Road	32-05-39 N, 110-48-30 W	Indoors, primarily	n/a
RMS headquarters	32-06-25 N, 110-58-18 W	Indoors and outdoors	1.2 km

The testing, will allow these various labs to continue to work on testing the radio system to learn its capabilities and characteristics prior to testing and integration into various Raytheon products. Each lab will have approximately 4 radios which will be used to create an ad hoc network in the lab that can be studied and tested for applicability to this use.

The RMS headquarters site will be used for longer range testing and portable demonstrations. Because the headquarters site allows for outdoor operations, the radios will be portable, and used as needed for testing and demonstration. Any radio installation will be either on an existing building, no higher than the roofline or on a table on the ground.

Spectrum Needed:

The demonstration will use all of the frequency bands that the radio is capable of employing: 5180-5320 MHz, 5500-5700 MHz, and 5745-5825 MHz. The operation of the radios in the 5745-5825 MHz band would appear to fall under the provisions of Part 15 of the FCC's rules, 47 C. F. R. Section 15.247. However, operation under that rule requires that the radio in question have a proper FCC equipment certification. In this case, the radios are designed for sale to the federal government (military). So, Raytheon is seeking this experimental license to allow for use of this radio for the testing and demonstration described above.

Operation of the radios in the 5180-5320 MHz and 5500-5700 MHz bands is for testing of the capabilities of the radios, although the demonstration will focus on the use of the 5745-5825 MHz band. All of the bands will be in use for this testing. The radios are designed with two alternative back up spectrum bands to help ensure that essential data is not delayed in the communications process. However, the radios favor seeking an open channel in the 5745-5825 MHz band. This will also help minimize any chance of harmful interference to other uses of the spectrum bands requested.

Testing and Demonstration Activities; time of use:

Raytheon engineers will begin testing under an STA WI9XRS. This authorization seeks to continue testing the operation of the radios. They are working to see if the radios can deliver the performance that Raytheon's customers are requiring in its products. This requires examining various emission wave forms, as listed on the application, and exploring the way the radios form and use their proprietary networks. As soon as there are demonstrable results, Raytheon will schedule a

customer demonstration. This will allow the customer to refine its requirements based on the knowledge learned from testing. Then, the engineering teams will go back to work examining how to meet those requirements.

The radios will NOT be used continually. They will be in use sporadically during the workday. At times, the engineering teams will turn the systems off to test the system configuration time.

Furthermore, the nature of these radios is that they use frequency hopping, just as a Wi-Fi system does. The radios seek a clear channel, communicate with the network, listen for another open channel, hop to that open channel, transmit, listen, hop, transmit, etc. The spectrum use is sporadic, and it is designed to avoid interference by listening prior to transmission.

The radios will use a small whip antenna for this testing. The antenna is an omnidirectional antenna with 3 dBi of gain. This will ensure that the radio signal propagation is limited to the radius of operations. This is just enough to demonstrate the capabilities of the radios without causing any harmful interference to any other spectrum users in the area.

Stop Buzzer Point of Contact:

If there is a need to shut off any experimental operations, please contact:

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Conclusion:

Raytheon is seeking an experimental license for the use of Persistent Systems radios for testing and demonstration purposes at several of its Tucson, Arizona locations. The radios are part of a demonstration of how a new communications network infrastructure can be used to provide advanced two-way communications to and from a missile system when the system is in use. This advance in communications will significantly improve the information available to the warfighter in the field and provide strategic information and allow for alternatives that will improve the quality and performance of the systems.

Should there be any questions about this application, please contact Tom Fagan, Spectrum Manager, Raytheon Missile Systems at 520-794-0227 or [tjfagan@raytheon.com](mailto:tjfagan@raytheon.com) or Anne Linton Cortez, WFS, 520-344-8525 or [alc@conspecinternational.com](mailto:alc@conspecinternational.com).