

Raytheon Missile Systems
Exhibit to Experimental License Renewal Application
Call Sign: WF2XQR
File Number: 0368-EX-CR-2018

Explanation of Experimentation, Need for Spectrum, Advancement of Radio Art

Overview:

Raytheon Missile Systems (Raytheon) builds and tests various missiles which are developed for the US military and other US-government approved customers. Those missiles are tested by Raytheon in a number of ways including testing the command and control radio systems on the missiles and testing of the telemetry systems which send data back to control points to deliver key information on the missile flight and the health of the missile systems while in flight. The results of this testing advance the technologies built into the systems.

In this application, Raytheon is seeking authority to renew its ongoing testing of radio systems which will provide enhanced and more efficient telemetry systems which are essential to monitoring the flight of the missiles.

At the 2007 World Radio Conference, there was tentative international agreement to allocate additional spectrum in the "C Band" for aeronautical telemetry use. The spectrum expected to be used for aeronautical telemetry in the US includes 4400 to 4940 MHz, 5091 to 5150 MHz, and 5925 to 6700 MHz. Raytheon is developing advanced systems, and it needs to continue experimenting with these radio systems that will deliver key telemetry data for using this spectrum.

Synopsis:

- Spectrum requested: renewal of currently licensed frequencies
- Power levels: renewal of currently licensed power levels
- Purpose: Development of C band aeronautical mobile telemetry technology

Purpose of Experimentation:

Raytheon is renewing its experimental license for developing radio systems that operate in the soon-to-be-available spectrum to advance aeronautical telemetry. Raytheon's engineers and scientists are investigating the properties of the spectrum and how information is transmitted most efficiently over this spectrum. They are optimizing use of the spectrum to ensure secure, reliable, timely transmission of the essential telemetry data. Development of these radio systems, testing their functioning, improving the systems, and honing the technology, so that the new radio systems can be developed into systems that are ready for use on Raytheon's products to better serve its customers takes years of work. The radio systems now under development examine ways of maximizing

telemetry data throughput on this spectrum, minimizing the need for re-transmission of data, securing the data transmission, and ensuring that the transmission stream can withstand any potential for RF interference.

The experiments involve both the development of new radios and new software that can be used in conjunction with the radios to ensure the most efficient and secure use of spectrum for aeronautical telemetry. The radio development includes development of specialized antennas and use of various signals and modulations to create the best telemetry system possible.

Locations of the testing:

Raytheon is renewing its authorization to operate in two locations. The first is in the lab at the Raytheon facility in Tucson, Arizona. This experimentation will be where much of the development of the new systems will take place.

The second location on this application is for airborne, mobile use of the antennas in an area within a 100-mile radius of the Raytheon facility. Because the new radio development is exploring how the spectrum can be most effectively used to transmit telemetry data, it is necessary to test the systems in flight to see how they operate and determine what limitations need to be addressed and how to optimize operations in a real-world environment.

Radius of Operations:

Raytheon's requests renewal of its currently licensed locations: 1) a fixed location in a laboratory at Raytheon's main Tucson facility, and 2) airborne operations in a 100-mile radius around Raytheon's main Tucson facility. Operations in the laboratory are expected to have a radius of operations of .16 km, or about a tenth of a mile. The proposed airborne operations would have a radius of operation of 160 km, 100 miles, around the Tucson facility and would operate at altitudes up to 10,000 feet, but not above 10,000 feet.

Lab testing:	0.1 miles
Airborne testing:	100 miles

Basis for testing:

Raytheon is currently seeking renewed authorization for its independent research and development of improved technologies to be deployed on its products.

Testing uses “listen-before-transmit” technology in radios:

A key part of the developing test plan for any airborne operation is to sort out which spectrum is best by “listening” for existing spectrum use and not using spectrum that is in use by other authorized operators. In sum, the airborne operations specifically include bringing a 4400-4940 MHz receiver on the aircraft and always listening for spectrum use prior to any proposed AMT transmission from the aircraft.

Stop Buzzer Point of Contact:

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Conclusion:

In sum, the goal of the testing is to maximize the efficiency of new aeronautical mobile telemetry equipment that must be designed and built for AMT users who will be forced to move into the C band spectrum. The experiments ongoing under experimental license WF2XQR are designed to optimize performance and throughput, including HD video, with the goal of advancing the use of telemetry spectrum for more operations.

If there are any questions, please contact Anne Linton Cortez, Counsel, 520-360-0925, alc@conspecinternational.com.