

Raytheon Missile Systems
Experimental License Renewal Application
File No: 0436-EX-RR-2015

Exhibit – Explanation of Need to Use Radio Spectrum

Overview:

Raytheon Missile Systems builds missiles used by the US military. Those products are used in an increasingly crowded RF environment. Various command and control signals are used when Raytheon's products are in flight to ensure proper operation of the products. The ongoing experimentation being renewed here is being used to develop radio systems and transmissions that will be robust and reliable even in a crowded RF environment to ensure that vital command and control signals are received and not subject to interference.

Raytheon Missile Systems is requesting renewed authority to develop improved, interference resistant communications system for command and control signals used on its missiles.

Technical Synopsis:

- **Spectrum requested:** 420 to 460 MHz and 902 to 928 MHz
- **Power level and ERP:** 100 W output power, up to 200 W ERP, however some test antennas will have -12 dBw gain; most power levels are very low at 6.25 W
- **Testing is localized:** Raytheon is testing only at its facilities in Tucson, AZ
- **Frequency hopping system:** Raytheon is working on an advanced frequency hopping technology that will resist interference AND avoid causing interference, but to be effective, the broader spectrum use is required.
- **Time of use is limited:** The proposed spectrum use will be for testing, but only sporadically in the lab or hangar

Description of Spectrum Use:

This application seeks to renew the use of frequencies on the existing authorization WF2XLX. The radios listen for a clear channel and transmit only on a clear frequency. The radios change to clear channels if a signal appears on the frequency to be used. This aids in the avoidance of any potential interference to other uses in the band.

The power levels are low, less than 100 watts, with no more than 200 watts ERP. The system is being tested with a variety of low gain or negative gain patch antennas, including antennas that have a -12 dBw gain.

Testing will be limited to the Raytheon plant site in Tucson, AZ, at the two locations specified in the application. The testing will be *primarily conducted indoors*. Some testing, particularly at the hangar, will be conducted where there are numerous other

operational radio transmitters to learn the characteristics of the radios and transmissions radios allowing for advanced work on interference-resistance as well as creation of algorithms that ensure that these radios do not cause interference to other radios operating in the area.

The bandwidth per transmission is 200 kHz. These experiments will help Raytheon determine what type of transmissions will guarantee that the command and control signal is received and will withstand interference from the operation of other radios in the area operating on or near the same frequencies.

The experimentation will rely on the RF environment at the Raytheon plant in Tucson as the crowded RF environment to be overcome.

The purpose of the ongoing experiment is to enhance the quality of frequency diversity technologies as well as to develop interference-resistant command and control radio transmissions to make the use of Raytheon products more secure and effective.

The stop buzzer point of contact for the proposed operations is:

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Conclusion:

Raytheon's renewal application requests authority to advance its development of interference-resistant, non-interfering command and control frequencies that are essential to ensuring the effective operation of the missiles it develops for the US Department of Defense. In advancing this technology, Raytheon is taking every precaution to ensure that the development of its new radio systems not cause harmful interference to any other radio operations in the requested frequency bands.

For questions about this application, please contact Thomas J. Fagan, Spectrum Manager, Raytheon Missile Systems, or Anne L. Cortez, WFS, 520-360-0925 or alc@conspecinternational.com.