Raytheon Missile Systems
Outdoor Antenna Test Range
Application for Experimental License
File No: 0156-EX-PL-2010

Explanation of Experiments and Need for Experimental License

Overview:

Raytheon Missile Systems has been operating an outdoor antenna test range at its Tucson facility since 1993 under a Frequency Assignment granted by the DoD Area Frequency Coordinator Arizona. Attached is a copy of the most recent extension of that frequency assignment, which expires July 1, 2010. This outdoor antenna test range supports all programs and contracts for the Navy, Air Force, and the Army. In addition, Raytheon Missile Systems conducts independent research and development at the same range. Currently, RMS is coming to the end of the existing contract that had been the basis for the DOD frequency assignment, and while other contracts are underway, the DoD Area Frequency Coordinator is no longer able to request a frequency assignment to continue operations because our government sponsor is changing and no federal agency is currently available to be our government sponsor. Since testing must continue on the outdoor antenna test range for both Raytheon contract and independent research and development efforts, we are seeking an experimental authorization from the FCC.

Description of operations:

The outdoor antenna test range operates three antennas across a range of frequencies. Those antennas are:

- Q-Par Dual Polarized Quad Ridge Horn 2-18 GHz
- ETS 3164 Dual Polarized Quad Ridge Horn 500 MHz - 6 GHz
- Rozendal Quad LP RA 3390-5 200 MHz - 2 GHz

The antennas are used to conduct tests to determine three-dimensional (3D) far-field radiation patterns with full scale mockups mounted on the motorized Dual-Mount Tower (DMT), and swept in azimuth and roll over a full sphere. For each unique azimuth and roll increment, directional antenna gain relative to that of an isotropic radiator (gain in dBi) will be measured.

The horn antennas are mounted on the rooftop of the Outdoor Range. The horn antennas transmit and the Antenna Under Test (AUT) mounted on the DMT will receive. Due to the principle of reciprocity, the radiation pattern obtained with the AUT receiving will be identical to that of the AUT when transmitting.

In Figure 1 below, we show data for some sample test frequencies, antennas, polarization,

azimuth and roll resolutions, and other parameters for a typical 3D far-field pattern test:

Antenna	Frequency Band	Number of points	Az, Roll Resolution	Polarization	Wings folded	Wings extended
Link-16	960-1216 MHz	8 (every 40 MHz)	2° x 4°	V & H	Yes	Yes
FTS	424-426 MHz	5 (every 500 kHz)	2° x 4°	RHCP	Yes	Yes
TM	2.2-2.3 GHz	5 (every 25 MHz)	2° x 4°	RHCP	Yes	Yes
Beacon	5.6 - 5.8 GHz	2 (Trans & Rcv)	2° x 4°	V & H	Yes	Yes
UHF	200 - 260 MHz	5 (200, 222, 232, 242, & 260 MHz)	2° x 4°	V & H	No	Yes
GPS L1	1565 - 1586 MHz	11 (every 2 MHz)	2.5° x 5°	V & H	No	Yes
GPS L2	1217 - 1238 MHz	11 (every 2 MHz)	2.5° x 5°	V & H	No	Yes

Note: GPS antenna testing is not performed outdoors within 10 MHz of center frequency.

Figure 1, Sample test parameters

The sample frequencies shown here describe how testing is conducted. The application requests authorization to conduct tests on discrete frequencies across wide frequency bands so that it is possible to test in accordance with parameters such as those in Figure 1. The tests use very narrow continuous wave signals with side lobes suppressed. The actual spectrum use is therefore far less than the application would seem to request on its face.

The operations proposed here continue to be at a secure facility (campus) with restricted access and even more tightly controlled access to the transmit area.

Tests conducted by the spectrum management staff at Raytheon have shown that there is no interference experienced at the secure facility, not even near the secured area where the antenna tests are being conducted. This minimizes the chances of any entity experiencing harmful interference adjacent to the secured campus. Operational testing under the frequency assignment has been coordinated with nearby facilities such as the Air National Guard, Davis-Monthan Air Force Base, Tucson International Airport, Kitt Peak Observatory, and the University of Arizona. No interference issues have arisen from past and ongoing operations. The operations proposed in this experimental license application are identical to the currently authorized operations, and so there is no anticipated new interference.

Operations are highly directional:

The beamwidth of the antenna is normally less than 8 degrees and is pointed due west into the desert and sparsely populated Indian Reservation. The sidelobes are suppressed by the building and a steel scatter fence, see Figure 2. The scatter fence diffuses the RF energy in many directions, reducing the potential for interference.

The antennas are very directional with a very narrow beam and the transmitters point out over the desert and sparsely populated Indian reservation land.

Figure 2, Outdoor Antenna Test Range

Need for Outdoor Antenna Test Range:

Because of the nature of work being done, it is important to test the characteristics of a number of different antennas operating across a range of frequencies. Those antennas are installed on various pieces of equipment that Raytheon has built. That equipment and the way that its antennas work must be tested in a free space environment. Therefore, it is necessary to operate this outdoor antenna test range.

Given the sensitive nature of the tests, we are proposing to transmit on a number of discrete frequencies across a wide range of frequencies. However, those tests are limited in time, and for highly sensitive frequencies, we are willing to operate according to a strict schedule to minimize any potential interference issues.