

November 20, 2014

Battelle Memorial Institute
Experimental License Application
STA File Number: 1047-EX-ST-2014

Explanation of Experimentation

Overview:

Battelle is seeking Special Temporary Authority to conduct experiments on a point-to-point communications link operating at millimeter-wave (mmW) frequencies as a performer Technical Area 1 (TA-1) performer under DARPA's 100 Gb/s RF Backbone (100G) program. The link uses high-order modulation to transmit 25 Gb/s on a 100 GHz carrier. The 100G program requires an outdoor demonstration of the hardware to validate its capabilities at distances up to 10 km.

For the past nine years, Battelle researchers have been developing mmW data link technology capable of transmitting digital information. We have demonstrated operational wireless links transmitting 10 Gb/s Ethernet data error-free using on-off keying (OOK) and phase shift keying modulation on carriers near 100 GHz carrier over a 1-mile distance. The transmission distance was achieved using 2-foot Cassegrain antennas.

Synopsis:

- Frequency Requested: 100 GHz;
- No interference has resulted from past efforts;
- The atmospheric attenuation, tightly focused beam, highly directional antennas, and extremely low power spectral density inside and outside of the 95 to 105 GHz band, make interference with others highly unlikely;

Project Description:

Fixed transmitters will be positioned within Battelle's West Jefferson Ohio and/or tall buildings in the Columbus Ohio area that provide line of sight connectivity to the receivers. Cassegrain antennas will be placed at fixed locations and aligned to the fixed receivers providing a terrestrial link. Tests for received power and attenuation studies to quantify link margin will be performed in outdoor operating conditions.

Technical Parameters:

The radios are operated at fixed locations and directions at a fixed frequency of 100 GHz. The frequency selection is dictated by the operating frequencies of available components.

- Frequencies requested: 100 GHz
- Peak output power: 100 mW
- Modulation: 32 Quadrature-Amplitude Modulation (32QAM)
- Modulation rate: 25 Gb/s
- Frequency tolerance: ± 0.0000005

- Antenna: 3-foot Cassegrain
- Antenna gain: 56.5 dBi
- ERP: 44668 W (46.5 dBW)
- Necessary bandwidth: 10 GHz
- Emission designator: 10G0A1D

Necessary Bandwidth Description:

From FCC table (g) under 47CFR2.202, the experimental system most applies to “Double-sideband radio relay system” in which the Necessary Bandwidth is defined by $B_n = 2M$ where $M = 5$ GHz. Therefore, the Necessary Bandwidth is $B_n = 10$ GHz.

Potential for Interference:

Few radios operate in the spectrum band of 95 to 105 GHz. There have been no complaints of any type of interference in efforts conducted in the past nine years, and it is not anticipated that there will be any resulting from these experiments. This radio outputs very low power (only 14% of the allowable ERP in E-band) within a narrow beam (0.23 degrees) that is rapidly attenuated from atmospheric absorption (1.4 dB/km). As for signal power spillover into adjacent bands, our system has less than -27 dBm/MHz power spectral density at adjacent band edges. These levels are very low (14 dB lower) compared to a similar requirement to be below -13 dBm/MHz for commercial E-band systems, such as the 81 to 86 GHz band adjacent to 86 to 92 GHz radio astronomy bands. Therefore, based on the lack of interference from past operations, extremely low power spectral density, and the localized nature signal, these experiments will not result in interference with others.

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Conclusion:

Battelle requests that the Commission continue to provide an experimental license to allow for the testing and development of communications systems in this spectrum.