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Battelle Memorial Institute
Experimental License Application
STA File Number: 0350-EX-ST-2013

Explanation of Experimentation

Overview:

Battelle is seeking Special Temporary Authority to continue experiments on a point-to-point communications link operating at millimeter-wave (mmW) frequencies. The link uses optical components to generate and modulate millimeter waves and has the capability of transmitting 10.3 Gb/s on a 105.75 GHz carrier.

For the past six years, Battelle researchers have been developing a mmW data link capable of transmitting digital information. We have demonstrated an operational wireless link transmitting 10 Gb/s Ethernet data error-free using on-off keying (OOK) modulation on carriers near 100 GHz carrier over a 1-mile distance. The transmission distance was achieved using 2-foot Cassegrain antennas. Additional experiments are needed to validate a bidirectional link operating at distances up to 1-mile as well as new components.

Synopsis:

- Frequency Requested: 105.75 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 102.1 to 109.4 GHz band, make interference with others highly unlikely;
- Use of millimeter wave frequencies for communications requires lengthy outdoor test and evaluation to ensure continuity of connectivity and error free capability.

Project Description:

Fixed transmitters will be positioned within Battelle's West Jefferson Ohio facility that provides line of sight to the receivers. Two-foot 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 105.75 GHz which lies in the center of the 102.1 to 109.4 GHz band designated for fixed station operation.

- Frequencies requested: 105.75 GHz
- Peak output power: 10 mW
- Modulation: On-off keying (OOK)
- Modulation rate: 10.3 Gb/s
- Frequency tolerance: ±0.0002%

- Antenna: 2-foot Cassegrain
- Antenna gain: 53 dBi
- ERP: 2040.4 W
- Necessary bandwidth: 10.3 GHz
- Emission designator: 10G3A1D

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 = 5.15 GHz. Therefore, the Necessary Bandwidth is $B_n = 10.3$ GHz.

Potential for Interference:

Few radios operate in the spectrum band of 102.1 to 109.4 GHz. The designated uses are for fixed, mobile, radio-astronomy and space research. The use of the spectrum for development of point-to-point communication systems falls within the category of fixed use of the spectrum. The proposed use is just a continuation of operations that have been ongoing for the past six years. There have been no complaints of any type of interference in the past six years, and it is not anticipated that there will be any in the next six years. This radio outputs very low power within a narrow beam (0.8 degrees) that is rapidly attenuated from atmospheric absorption (1.4 dB/km). As for signal power spillover into adjacent bands, our system has minimal –37 dBm/MHz in the 100 to 102 and 109.5 to 111.8 GHz bands and rolls off to –54 dBm/MHz in the 94 to 94.1 band. These levels are very low (24 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.