MASSACHUSETTS INSTITUTE OF TECHNOLOGY LINCOLN LABORATORY

11 July 2019

TO: FCC

FROM: John Meklenburg

SUBJECT: FCC 442 Exhibit Submission

MIT Lincoln Laboratory (MIT LL) is a Federally Funded Research and Development Center (FFRDC) under contract with the United States Air Force to conduct advanced research related to national security missions. MIT LL frequently conducts field experiments like the one outlined in this application both locally and at remote sites.

USG Contract Agency: US Air Force Contract Number: FA8702-15-D-0001 POC: Pino D'Orazio / 781-225-5206

Purpose of Experiment

MIT Lincoln Laboratory will be conducting a series of outdoor experiments in support of the LOCIT (Laser Optimized Coherence in Transmission) program. The purpose of these experiments is to coordinate optical and RF range measurements to ultimately enable coherent transmissions from disjoint RF emitters.

Experimental Setup / Geometry

Two transmitters will be located on the roof of Hanscom Air Force Base Building 1715. One receiver will be located on the MIT Lincoln Laboratory main campus, in a laboratory on the top floor of Building C. The two transmitter antennas will be steered towards the receiver, at an azimuth heading of approximately 110 degrees and an elevation angle of approximately 0 degrees (horizontal).



FOR LABORATORY USE ONLY

Hardware

The experiment will include the following hardware related to the RF transmissions:

- Ettus x310 radio with UBX-160 RF daughterboards (x2) [transmitters]
- Ettus B210 radio (x1) [receiver]
- Data Alliance A24 2.4 GHz Antenna (x3) [antenna used for both transmitters and receivers]
 - 24 dBi of gain
 - 8 degree azimuth beamwidth
 - 4 degree elevation beamwidth

Emissions

The transmitters utilize a direct sequence spread spectrum waveform and will emit a sequence of QPSK-modulated pulses.

The signal has the following characteristics:

Pulse width:	12 microseconds
Pulse repetition rate:	13.89 kHz
Bandwidth:	50 MHz
Transmit Power:	6 dBm
ERP:	30 dBm (including antenna gain)

Several measurements have been made on this signal and are shown below:

- Agilent 02:21:33 Oct 28, 1973 Marker -2<u>14</u>-Mkr3 2.465 5 GHz Select Marker Ref 15 dBm Atten 30 dB 0.87 dBm 2 3 Peak \$ 3 0 Log 10 Normal dB/ Delta Marker 2.465500000 GHz Delta Pair (Tracking Ref) Ref gAv 0.87 dBm Center 2.440 0 GHz Res BW 910 kHz Span 100 MHz Span Pair VBW 8 MHz Sweep 1 ms (601 pts) <u>Span</u> Center Type Freq Freq Marker X Axis Amplitude Trace (1) (1) (1) 2.429 0 GHz 6.82 dBm 0.97 dBm GHz Off Frea 0.87 dBm More 1 of 2 File Operation Status, A:\TRACE034.CSV file saved
- Center frequency and 6 dB bandwidth

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3		(1)	Fred		7	.34 GHz			-29.18 (¦Bm		
												More 2 of 2
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- Harmonics out to 50 GHz (#1 is transmit signal, #2 and 3 are harmonics)

- Transmit power

# Agilent 02:34:58 Oct 28, 1973	Trace					
Ch Freq 2.44 GHz Trig Free Channel Power	Trace <u>1</u> 2 3					
	Clear Write					
Ref 20 dBm Atten 30 dB #Avg	Max Hold					
	Min Hold					
Center 2.440 00 GHz Span 75 MHz #Poo BU 150 kHz #UBU 15 MHz Skoop 9.76 mc (601 pto)	View					
Channel Power Power Spectral Density	Blank					
6.66 dBm /50.0000 MHz -70.33 dBm/Hz	More 1 of 2					
File Operation Status, A:\TRACE040.CSV file saved						