JARVINIAN

TECHNICAL EXHIBIT FOR EXPERIMENTAL LICENSE APPLICATION
File #: 0518-EX-CN-2019
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Overview

A hallmark of 5G network service is the use of ultra-wideband channels for downlink connectivity. However, conventional allocations below 6 GHz (3GPP FR1) do not have sufficiently large licensed channels to support new forms of advanced network functionality. It is for this reason that major carriers in the United States have focused on deploying mobile services in the mmWave spectrum above 24 GHz (3GPP FR2), where sufficiently large licensed channels exist that may fully realize the potential of new 5G standards. Globally, mobile broadband spectrum above 24 GHz is currently supported by 3GPP bands n257, n258, n260, and n261, with channel bandwidths spanning 50 MHz to 400 MHz.

While bands above 24 GHz hold significant promise for 5G mobility, the extremely challenging propagation physics of mmWave spectrum has placed fundamental limitations on the practical functionality of these new bands. Due to the significantly increased environmental absorption rates of FR2 bands relative to their FR1 counterparts, early 5G mobile network deployments have exhibited extremely limited effective ranges. This is especially true in urban and semi-urban environments, where there is significant local environmental clutter.

The propagation limitations of mmWave spectrum can be mitigated on the downlink through the use of significantly higher radiated powers, and FCC rules for mobile operation in the 24 GHz, 28 GHz, and 39 GHz band were designed to accommodate this physical requirement. However, 5G mobile terminals generally cannot provide correspondingly high radiated powers due to form factor, battery, and user safety issues. Therefore, mobile mmWave networks suffer from extreme uplink limitation, which has become the primary factor in reducing their effective operating range.

A solution is seen in the pairing of mmWave downlinks with conventional longer wavelength spectrum below 3 GHz. By using more readily propagating uplink spectrum, many of the conventional distance limitations associated with mmWave mobile service are remedied. This solution is already possible within existing 3GPP standards through the use of Supplemental Up-Link (SUL) mechanisms.

Experimental Objectives

- Evaluate the operational range of high power (up to 59 dBm) mmWave downlinks at 28 GHz in urban and semi-urban environments.

- Match effective operational range of high power (up to 59 dBm) mmWave downlinks at 28 GHz with operational range of low power (up to 23 dBm) long wavelength uplinks at 1.7 GHz.

- Demonstrate operational viability of 1.7 GHz UL / 28 GHz DL using features of existing 3GPP standards.

Experimental Configuration

The proposed experiment will service outdoor ground level and indoor variable height mobile units (UEs) from a series of fixed rooftop and transportable tower mounted locations (gNBs) within the authorized experimental license radius. Mobile units (UEs) will uplink to fixed locations using a 10 MHz NR channel placed across the entire 1700 MHz - 1710 MHz allocation. Fixed base stations (gNBs) will downlink to mobile units using a 100 MHz NR channel selectively placed across the 27500 MHz to 28350 MHz allocation to avoid interference with licensed operations within the experimental license radius.

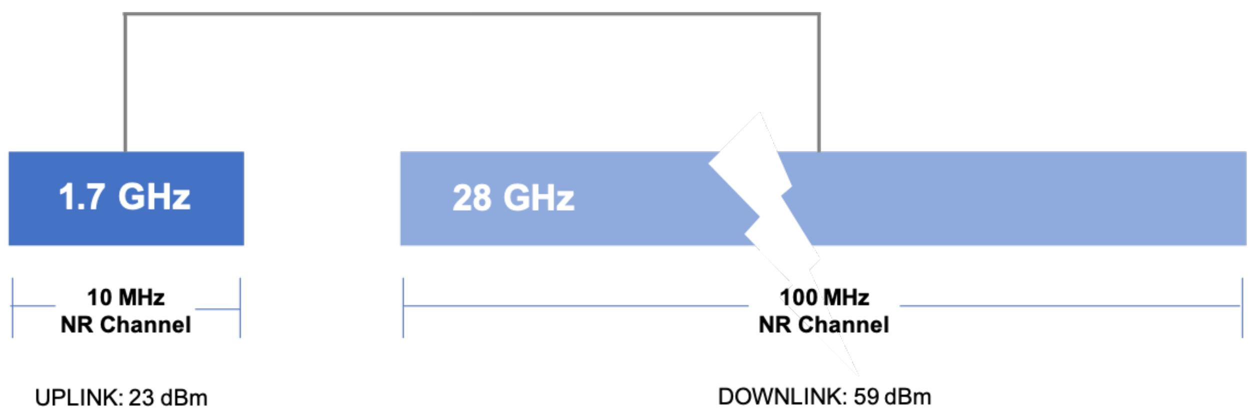

Figure 1: Experimental Uplink and Downlink Configuration

Directional antennas with beamforming capabilities will be used at 28 GHz downlink locations. The orientation and horizontal / vertical planes of these antennas will vary in accordance with experimental requirements.

Description of Experimental Locations

Experimental locations have been chosen due to (a) their proximity to network deployment and evaluation teams, (b) their diversity of urban and semi-urban clutter, and (c) their diversity of environmental conditions that impact 28 GHz propagation.

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Location 1: Boston, MA

Coordinates:

Lat.   42°21'36.25"N
Long. 71° 3'34.46"W

Radius:

3 km

Frequency and Power:

1700 - 1710 MHz TX EIRP: 23 dBm

27500 - 28350 MHz TX EIRP: 59 dBm

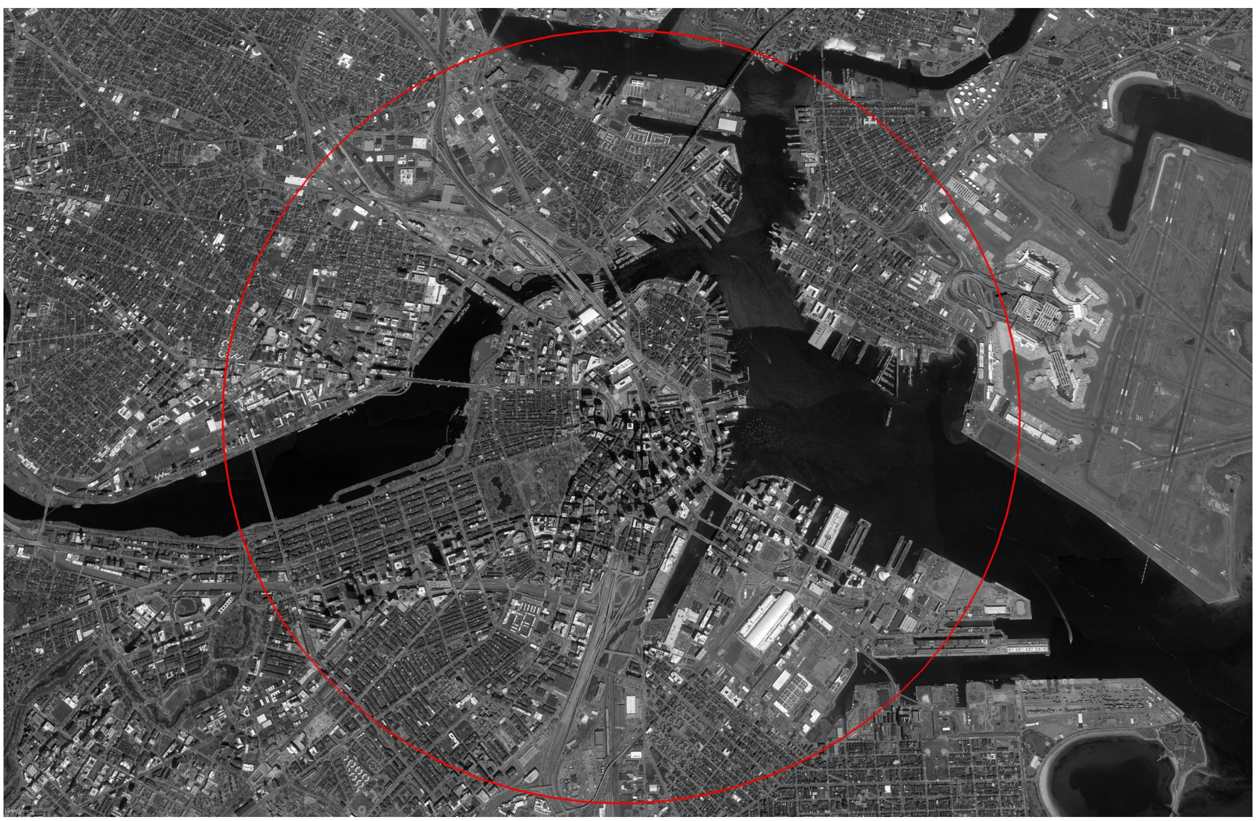

Figure 2: Geographic Boundaries of Proposed Experiment in Boston, MA.

Location 2: Waltham, MA

Coordinates:

Lat. 42°23'32.80"N
Long. 71°15'58.82"W

Radius:

3 km

Frequency and Power:

1700 - 1710 MHz TX EIRP: 23 dBm

27500 - 28350 MHz TX EIRP: 59 dBm

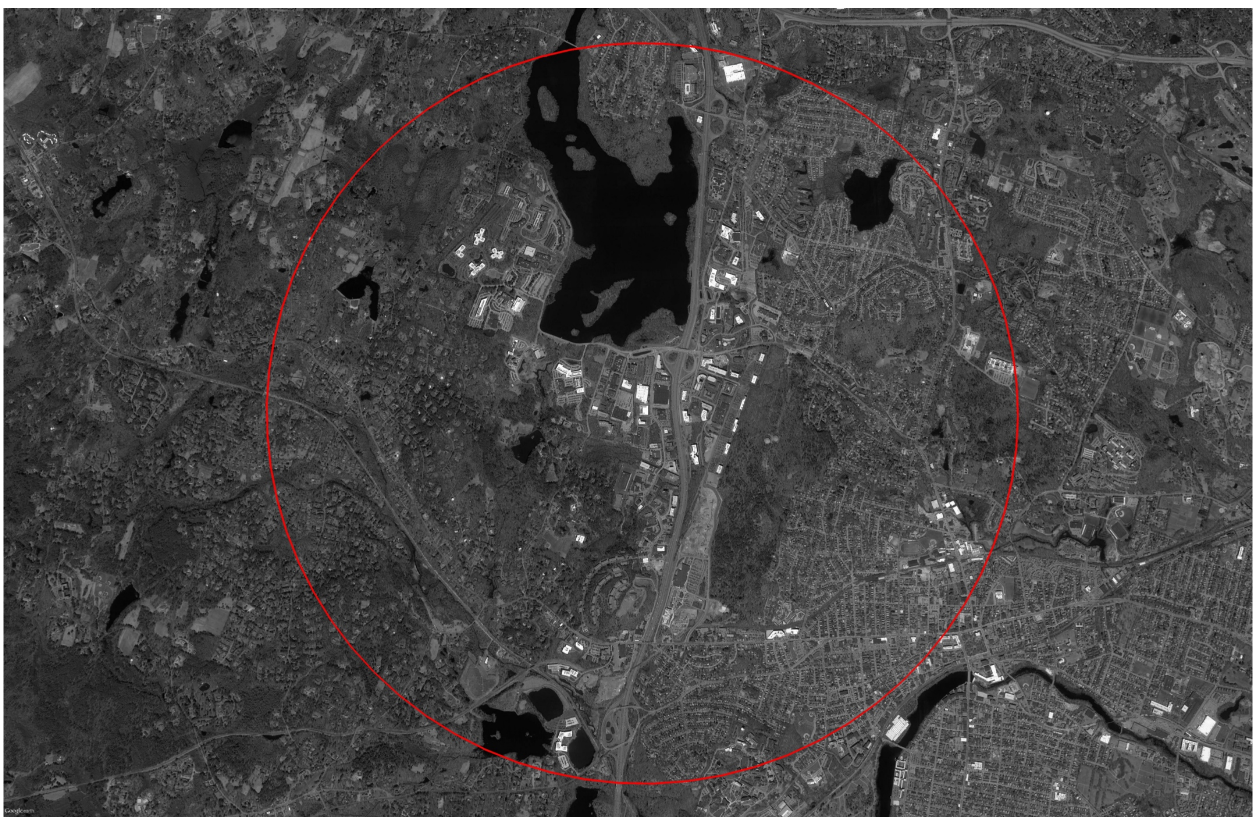

Figure 3: Geographic Boundaries of Proposed Experiment in Waltham, MA.

Location 3: Orlando, FL

Coordinates:

Lat.   28°32'28.47"N
Long. 81°23'20.61"W

Radius:

8 km

Frequency and Power:

1700 - 1710 MHz TX EIRP: 23 dBm

27500 - 28350 MHz TX EIRP: 59 dBm

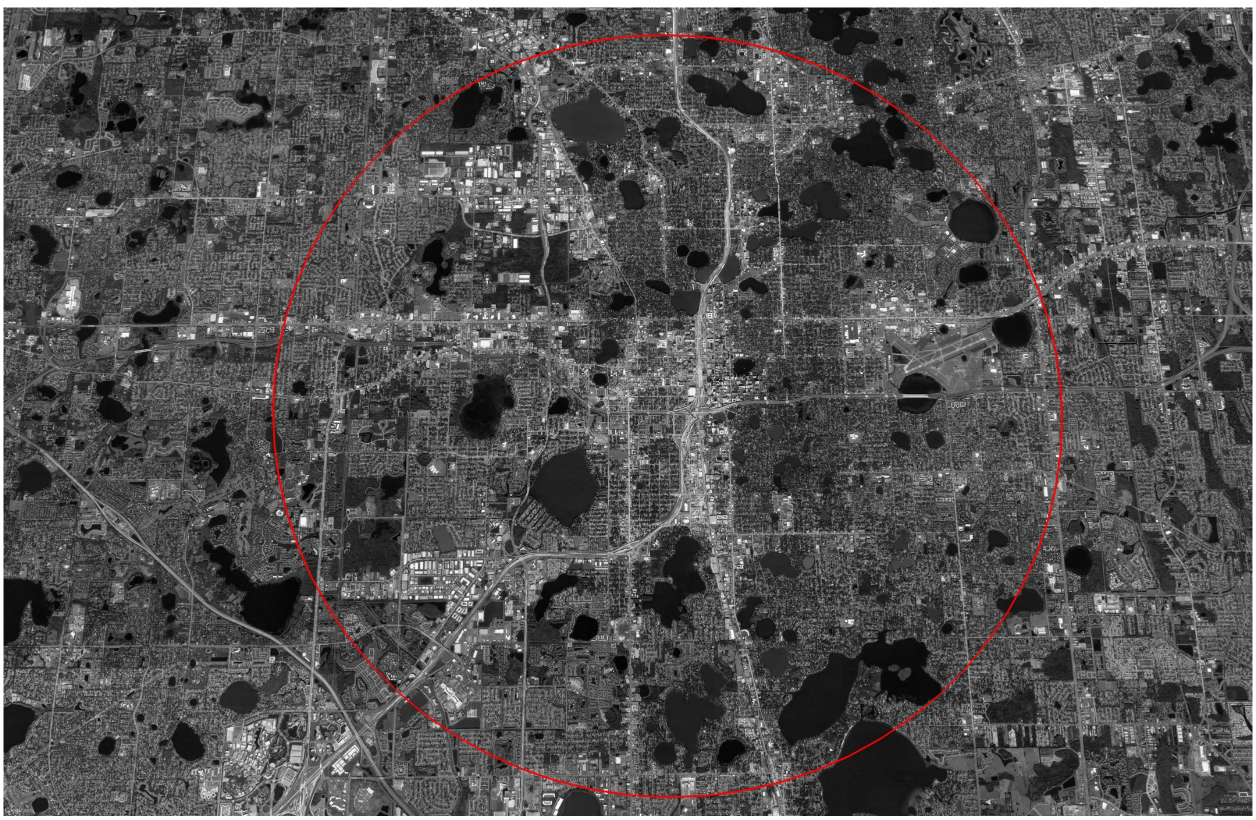

Figure 4: Geographic Boundaries of Proposed Experiment in Orlando, FL.

Stop Buzzer

A stop buzzer will be manned continuously during all active phases of the proposed experiment.

Stop buzzer contact:

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