TECHNICAL EXHIBIT FOR EXPERIMENTAL LICENSE APPLICATION
File #: 0215-EX-PL-2014
Submitted: March 13, 2014

Overview

In 2007, FCC Auction 69 released 8 MHz of spectrum in the 1.4 GHz band (1390-1395 MHz / 1432-1435 MHz). Originally intended for Land Mobile Radio (LMR) and utility applications, flexible treatment in Part 27 provides a basis for efficient use of this spectrum in 4G mobile networks.

Beyond the regulatory foundation for flexible commercial broadband use of 1.4 GHz, the advantageous noise and propagation characteristics of this band suggest a potential for unusually high urban spectral efficiencies. This suggestion is supported by the recent buildout of 3GPP Band 11 (1427.9-1447.9 MHz / 1475.9-1495.9 MHz) in Japan, which has demonstrated throughput (bps / MHz) ratios well in excess of those achievable in other parts of the commercial wireless spectrum.

By 2015, it is anticipated that the FCC will release AWS-3 spectrum for auction. A portion of the AWS-3 auction may include 15 MHz of unpaired uplink spectrum in the 1.7 GHz band (1695-1710 MHz). This spectrum has physical characteristics that are complementary to those observed at 1.4 GHz. Thus, it is possible that this "orphaned" segment of AWS-3 may enable a compelling Frequency Division Duplex (FDD) uplink pair to the 1.4 GHz band, which can be used in its entirety for downlink (*see* Part 27.802 / 27.50)

The proposed experimental program will seek to thoroughly evaluate the collective potential of the 1.4 GHz and 1.7 GHz bands to create a new commercial 4G resource. Specifically, the experimental program will study the channel throughput and reuse potential of a hypothetical paired FDD band, where 1.4 GHz is used for base station downlink and 1.7 GHz is used for mobile device uplink.

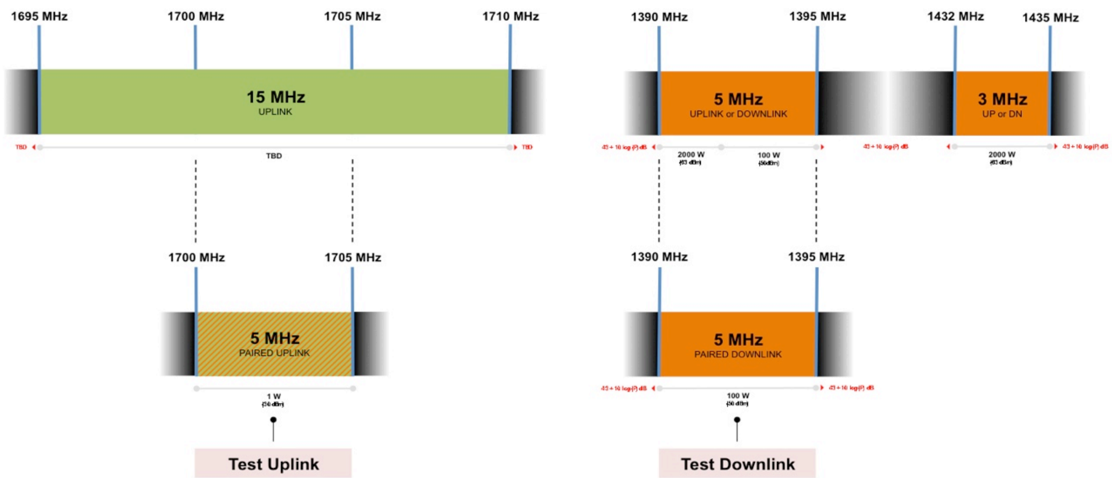

Figure 1: 5 x 5 MHz FDD Band Plan for Proposed Experiment.

Unique Qualities of 1.4 GHz and 1.7 GHz Bands

Current and emerging 4G standards use sophisticated modulation techniques to deliver high spectral efficiencies relative to their 2G and 3G predecessors. However, as modulation becomes more sophisticated, it also becomes more delicate. This means that the astonishingly high theoretical spectral efficiencies of 4G standards can only be achieved and maintained in environments where the underlying spectrum is free from noise and interference.

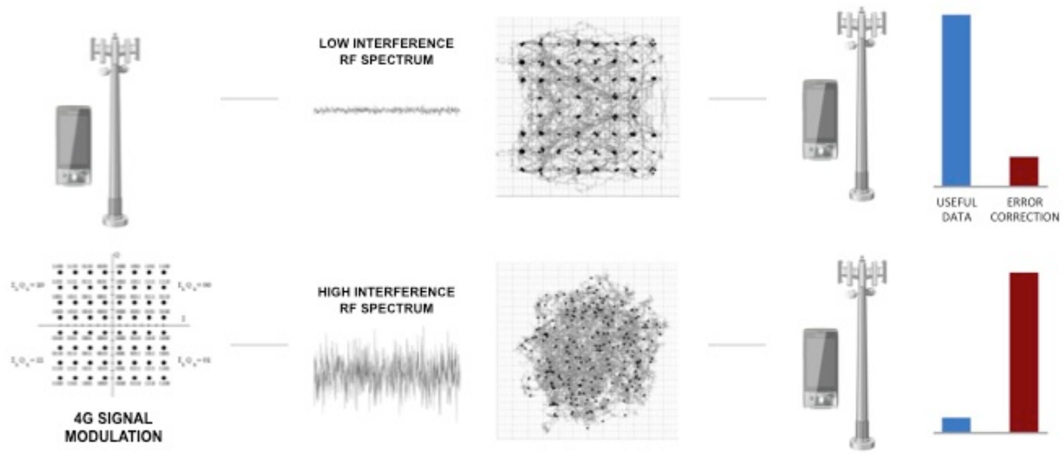

Figure 2: Impact of Noise and Interference on Modulation Efficiency and Throughput.

In some of the most hostile RF environments, the 1.4 GHz band displays noise floor levels that are the lowest of any commercial wireless allocation below 3 GHz. An unusually low noise floor points to the ability of this spectrum to maintain aggressive (i.e. spectrally efficient) modulation that is meaningfully superior to that of urban noise / interference limited allocations like those found in the 700 MHz band. Most importantly, we believe that the 1.4 GHz band will retain these advantageous low noise and interference characteristics, even as other parts of the RF spectrum continue to degrade. This is due to the band's location amongst extremely low emission services like medical telemetry (WMTS) and radio astronomy (RAS)

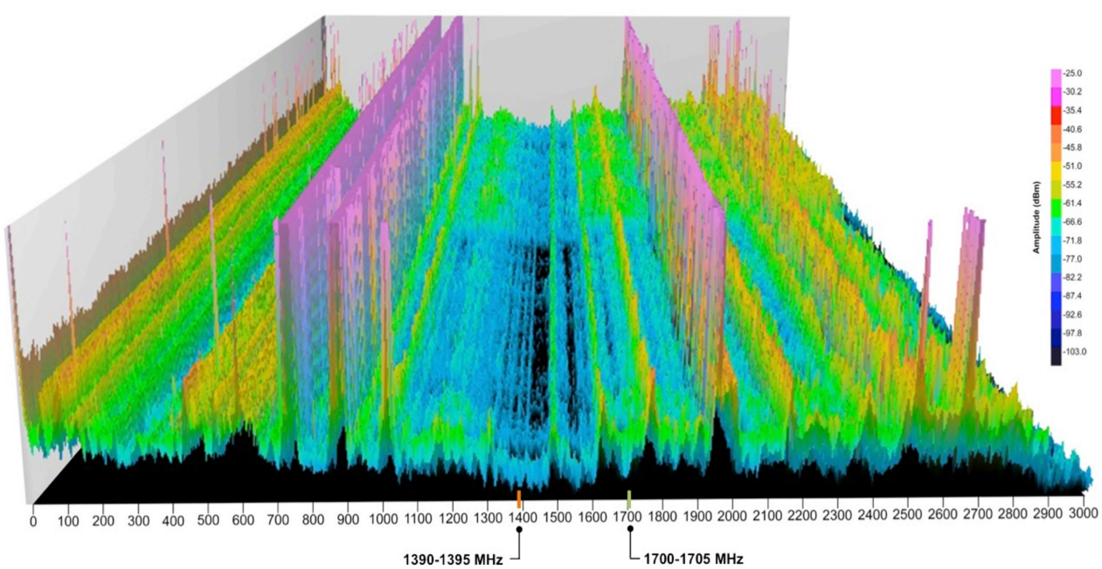

Figure 3: 3D Spectrogram (0 – 3000 MHz) Taken in Midtown Manhattan.

While the low noise and interference levels observed at 1.4 GHz are unique amongst commercial wireless applications, the noise floor at 1.7 GHz is attractive and more directly comparable to that at 1.4 GHz than other bands. While the 1.4 GHz band noise floor dips significantly below that of any commercial spectrum below 3 GHz, 1.7 GHz background levels are more frequently within 2-5 dBm of that seen at 1.4 GHz. We believe that this makes 1.7 GHz the most logical uplink pair to downlink FDD operations at 1.4 GHz.

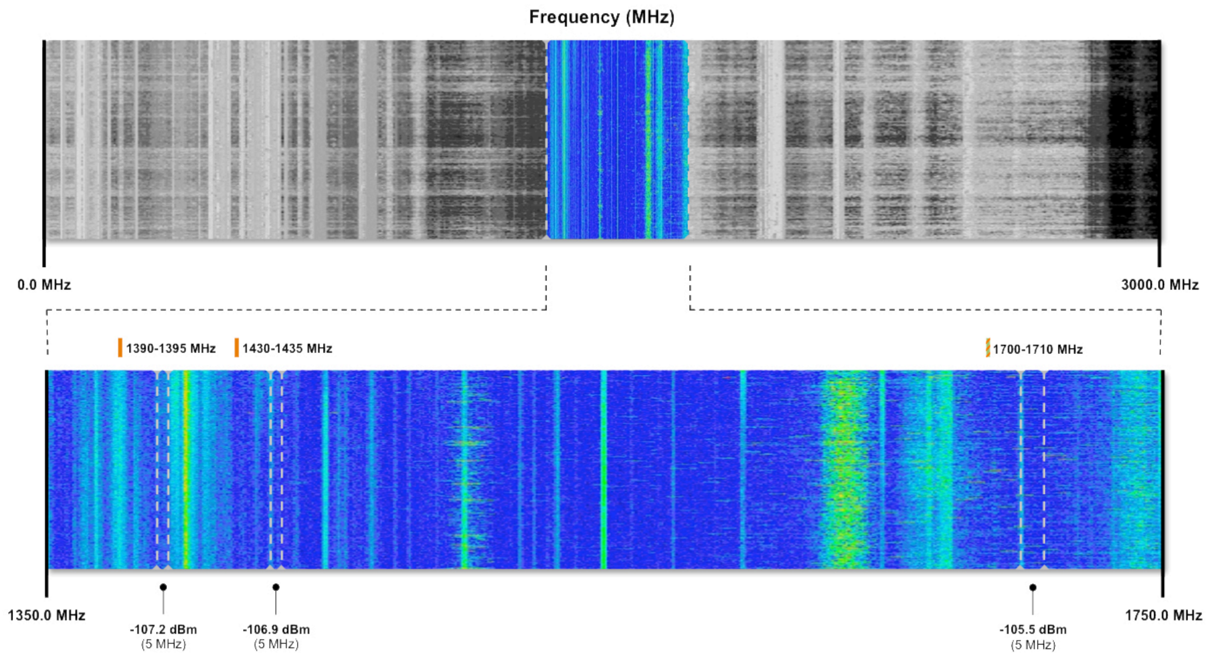

Figure 4: Comparable Average Urban Noise Floor Across 1.4 GHz and 1.7 GHz Bands.

Frequency reuse via cell splitting represents the most effective long-term strategy for commercial network capacity expansion. However, frequency specific RF propagation characteristics play a critical role in the efficacy and economy of aggressive cellular reuse strategies. High frequency bands like 2600 MHz allow for extremely dense cellular planning, but are very difficult to economically build in a way that provides ubiquitous signal coverage. Conversely, propagation at low frequency bands efficiently enables canopy coverage, but frustrates attempts at dense urban small cell deployment.

The propagation physics at 1.4 GHz and 1.7 GHz are similar and collectively represent a compelling amalgam of low and high frequency characteristics. Thus, we believe that a paired 1.4 GHz / 1.7 GHz FDD resource will permit operators to achieve significant urban network capacities without the buildout inflexibility of high frequency commercial spectrum.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

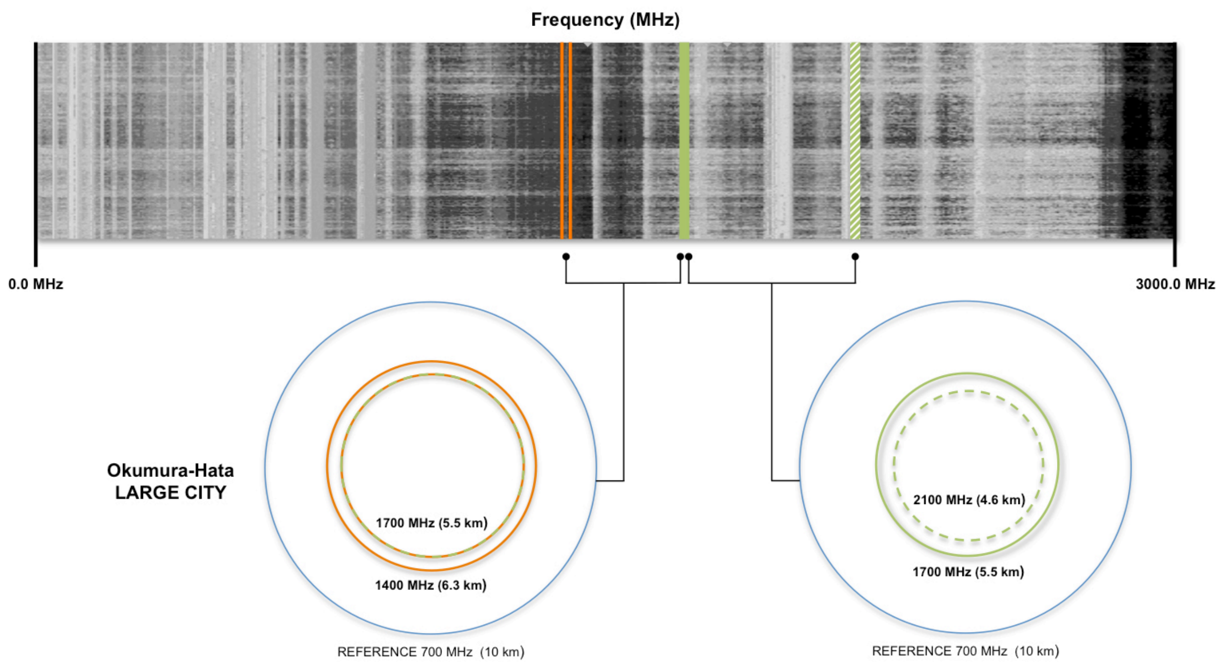

Figure 5: Comparable Dense Urban Propagation Characteristics Across 1.4 GHz and 1.7 GHz Bands.

Experimental Objectives

- Evaluate the urban data channel throughput potential of the 1.4 GHz and 1.7 GHz bands.
- Evaluate the urban cellular reuse potential of the 1.4 GHz and 1.7 GHz bands.
- Evaluate the overall compatibility of the 1.4 GHz and 1.7 GHz bands as a paired resource.

Description of Experimental Locations

Thorough evaluation of 1.4 GHz and 1.7 GHz physical characteristics will require dense urban areas that contain high noise floors and complex propagation environments. For the proposed experiments, we have selected three locations in the Boston, MA and New York, NY metropolitan areas. We believe that these locations represent places where the need for increased capacity is most acute.

Location 1: Boston, MA - "Post Office Square"

Coordinates:

Lat. 42.356257°
Long. -71.055683°

Radius: 1 km

1400 MHz TX ERP: 100 W

1700 MHz TX ERP: 1 W

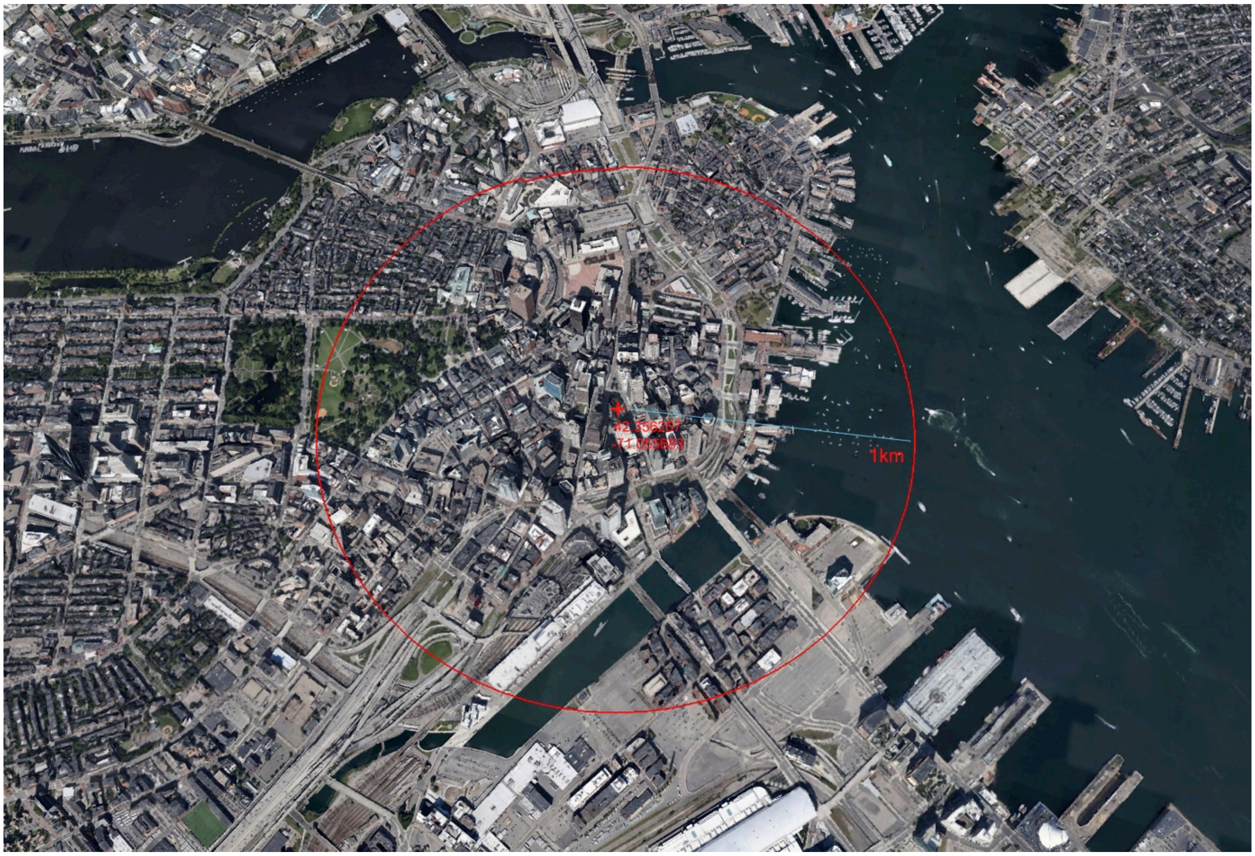

Figure 6: Geographic Boundaries of Proposed Experiment in Boston Area.

The Boston downtown financial district is a classic example of an operational environment where a mix of canopy and extremely dense small cell deployment is required. Boston displays high variability in propagation and in-building penetration due to the meaningful diversity of construction materials and techniques.

The proposed experiment will use the Boston environment to create baseline performance metrics that can be used to evaluate a paired 1.4 GHz / 1.7 GHz band against other commercial wireless allocations.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

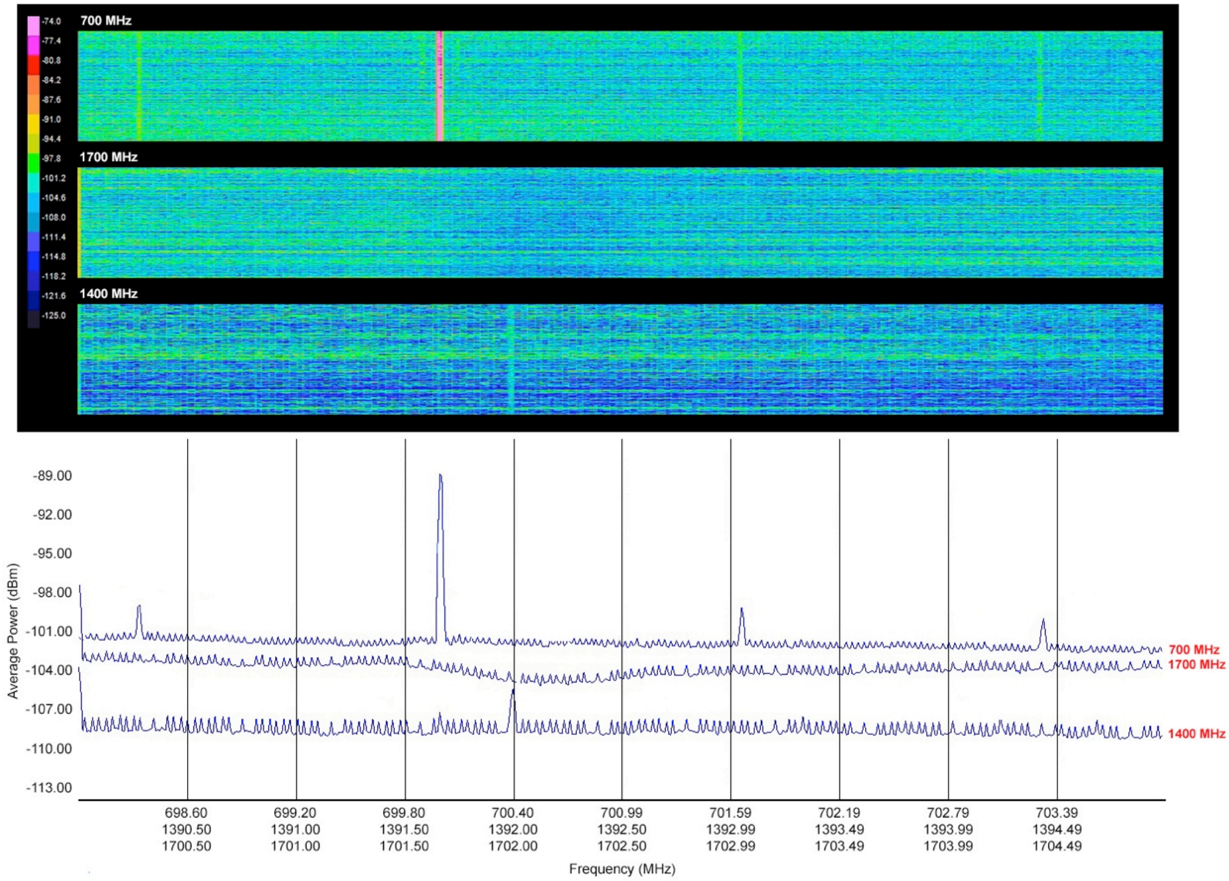

Figure 7: Comparative Average Noise Floor Across 700 MHz, 1400 MHz, and 1700 MHz in Boston Area.

Location 2: New York, NY – "Midtown Manhattan"

Coordinates:

Lat. 40.760134°
Long. -73.972145°

Radius: 1 km

1400 MHz TX ERP: 100 W

1700 MHz TX ERP: 1 W

Figure 8: Geographic Boundaries of Proposed Experiment in Midtown Manhattan.

Midtown Manhattan represents a worst-case scenario for high-density wireless network traffic loading. On a noise floor basis, it is also one of the most hostile RF environments in the United States.

Jarvinian has archived an extensive noise floor history for 0-3 GHz going back several years in the Midtown environment. Using previous studies as a reference, the proposed experiments will evaluate the relative throughput capacity of 1.4 GHz and 1.7 GHz in this highly noise limited environment.

[REMAINDER OF PAGE INTENTIONALLY LEFT BLANK]

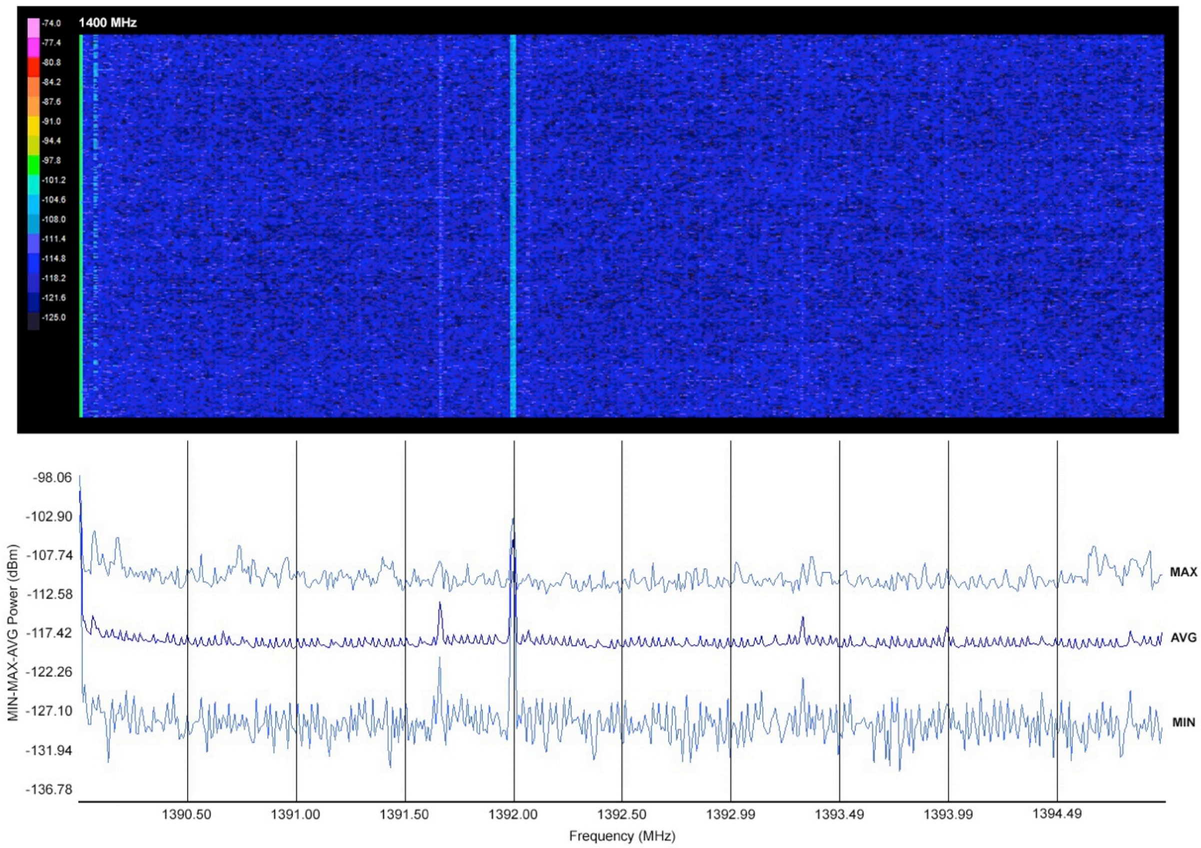

Figure 9: MIN-MAX-AVG 1400 MHz Spectrogram in Midtown Test Area.

Location 3: New York, NY – "Lower Manhattan"

Coordinates:

Lat. 40.716046°
Long. -74.006984°

Radius: 1 km

1400 MHz TX ERP: 100 W

1700 MHz TX ERP: 1 W

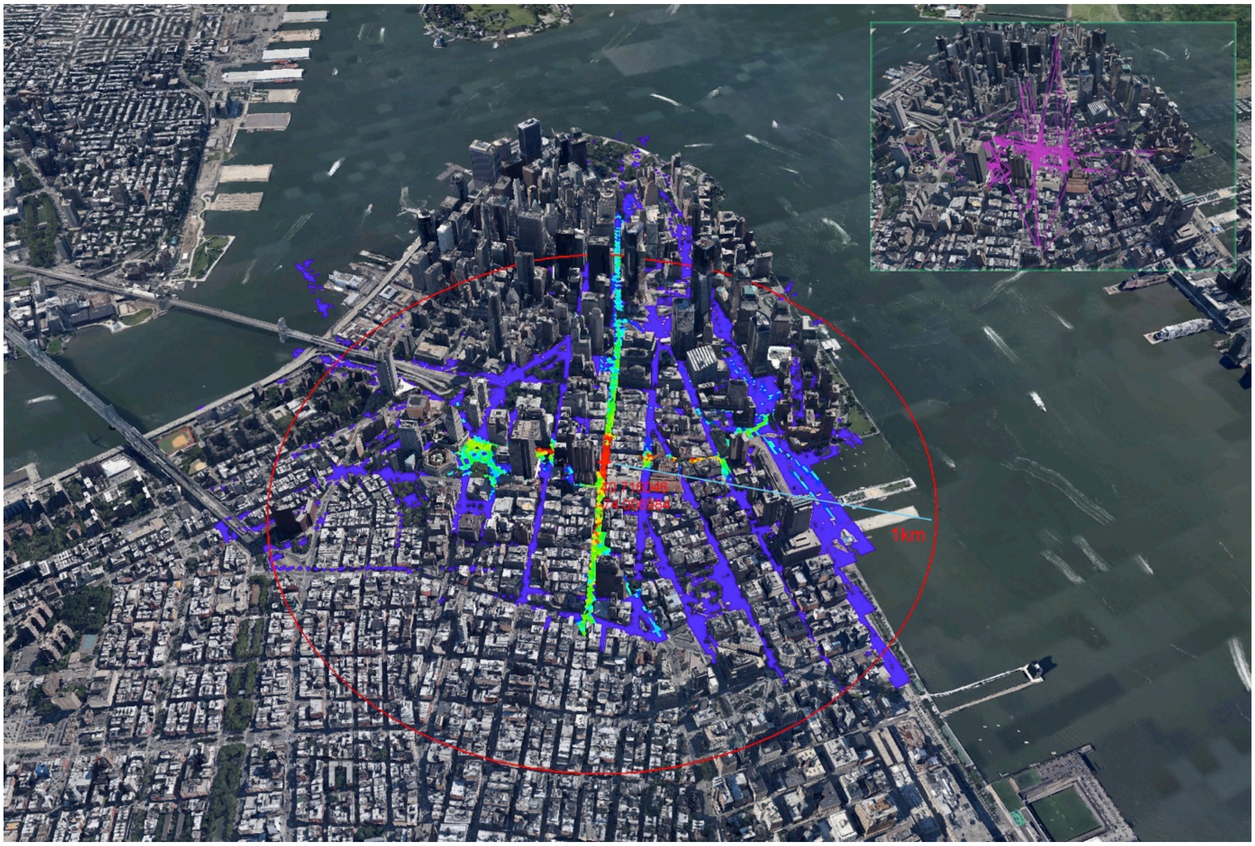

Figure 10: Geographic Boundaries and Propagation Projection in Lower Manhattan Test Area.

Lower Manhattan is a high traffic area with significant time variability in traffic loading. It is also an environment characterized by complex RF propagation caused by significant variability in building design and construction material.

The proposed experiment will evaluate both noise and propagation characteristics of 1.4 GHz and 1.7 GHz in this environment. Specifically, the proposed experiment will study the flexibility and compatibility of 1.4 GHz / 1.7 GHz propagation for diverse macro and small cell applications.