

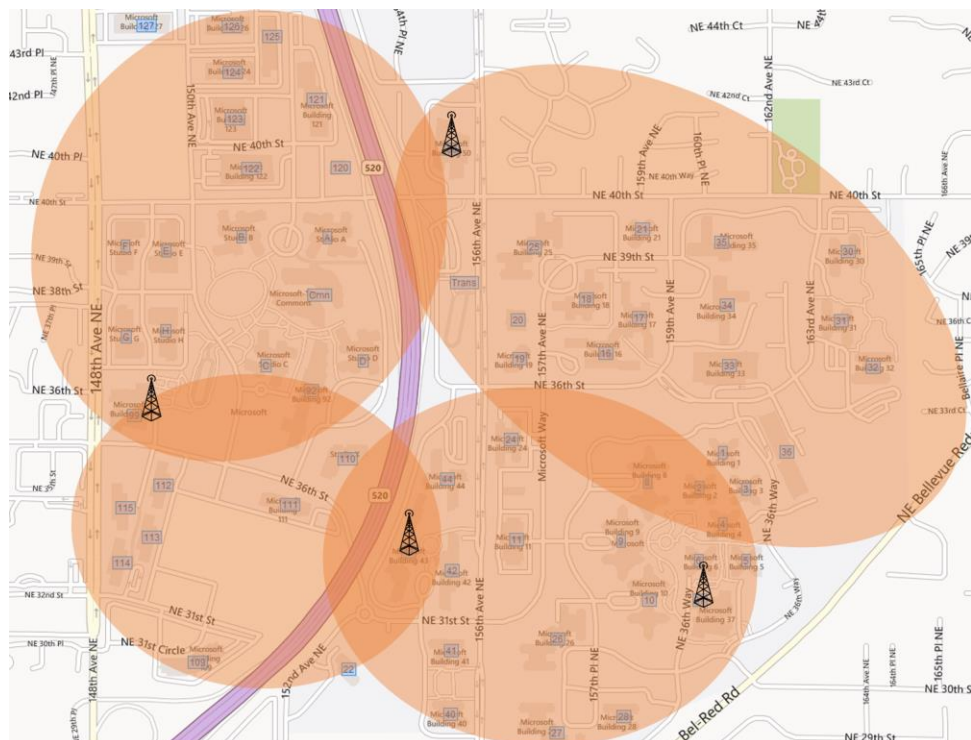
Exhibit 1: Description of Research and Experimental Deployment

Microsoft Corp. respectfully requests the issuance of an experimental license using the equipment and operating parameters set forth in File No. 0547-EX-PL-2014. Grant of this license will enable Microsoft to deploy a UHF White Space research platform which intends to provide coverage over the entire Microsoft campus in Redmond, WA, using multiple programmable base stations which support MIMO operation. The goal of the platform is to provide a state-of-the-art testbed for researchers to evaluate novel ideas on every layer of the wireless stack using a realistic network which experiences interference from adjacent base stations. The two motivating goals for deploying this platform are:

- 1) Collect real world channel, interference, and performance traces in a realistic deployment of multiple UHF White Space base stations.
- 2) Leverage MIMO techniques to mitigate inter-base station interference and develop new systems and protocols to optimize these gains.

However, we intend for this platform to be further used to explore a plethora of other research ideas and projects on UHF White Spaces and Cognitive Radio. To the best of our knowledge, this will be the first White Space platform which supports MIMO and multiple co-located base stations. Our experimental results will be used to guide the design, development, and optimization of White Space hardware, protocols, and deployment.

All base stations will be located on Microsoft campus, and, where applicable, will use directional antennas to focus the emission downwards, and towards the intended campus coverage area, thus mitigating interference to surrounding areas. While various experiments may require different configurations, our initial/primary setup utilizes base stations mounted on buildings 37, 43, 50, and 99, with antenna coverage roughly outlined by the figure below. Note that the MIMO base stations leverage multiple directional antennas, typically 4, which enables fine tuning directivity to improve coverage on campus, while reducing interference to outside areas.



In order to meet FCC regulations in Title 47 CFR Part 15 regarding unlicensed transmissions of Television-Band Devices, all fixed test locations in this deployment will be verified with GPS devices. An authorized spectrum database will be consulted every 24 hours to confirm that transmissions at the given location, channel bandwidth, and transmit power and ERP conform to the limits in Title 47 CFR Part 15.

The primary device we will be using in the deployment is the Sora UHF software defined radio. This device, which was developed by Microsoft Research and manufactured by V3 Technologies, supports transmissions in the 500-700 MHz range. The MIMO version, which is used in the base stations, supports up to 4 radios, while the single-antenna/mobile version supports only a single antenna. Additionally we are using Volo Wireless' WSD card which supports transmission from 400 MHz to 700 MHz. While these devices are completely programmable, our focus will be on 802.11-like OFDM modulation. Finally, to test interference from other devices, some experimental setups may also leverage devices from Adaptrum.

Part of our research is testing the performance of many different types of antennas, ranging from low-grade commercial DTV antennas to high-grade base station antennas. Some examples include the Antennas Direct DB8, the August DTA240, and the Shenglu SL12948B. The latter has horizontal and vertical 3 dB beamwidths of 90° and 35° respectively, and has a gain of 11 dBi. While using any high-gain antenna we reduce our transmission power accordingly, so that we do not exceed the limits in Title 47 CFR Part 15.