FCC Experimental License Application for Communication Over TV Whitespaces in UW-Madison Campus

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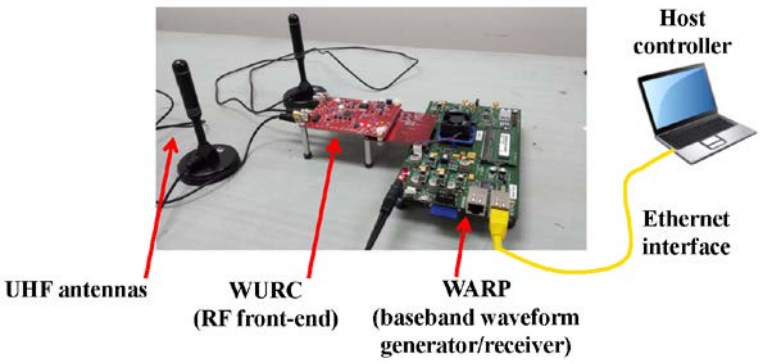
1. Research Objectives

We are a group of researchers (including Assistant Professor Xinyu Zhang and graduate research assistants) at the University of Wisconsin-Madison. This experimental license application is intended for research in indoor and outdoor communications over the unoccupied UHF channels ranging from 470MHz to 698MHz, known as TV whitespaces. The objective is to understand the potential of opportunistic utilization of TV whitespaces, and to explore novel system architectures, protocols and algorithms to achieve optimal performance as well as efficient spectrum utilization.

This project is supported by NSF program CNS-1343363, in collaboration with Professor Suman Banerjee's research group at the Department of Computer Science, University of Wisconsin-Madison. We are aware that Professor Banerjee's WiNGS Lab holds an FCC experimental license (CallSign WF2XZG). But we need a separate license because the experiments will be carried out in a separate location.

2. Experiment Platform

The platform we intend to use is called WURC, manufactured by Volo Wireless Inc. Its main function is to perform carrier modulation using whitespace frequencies from 470 MHz to 698 MHz. A power amplifier is built in WURC to boost the EIRP to 1 Watt. We use an FPGA-based platform, called WARP (manufactured by Mango Communications, Inc.), to generate the baseband waveform and feed it to WURC.



The modulated signal waveforms, frequencies, power-level, and other parameters can be

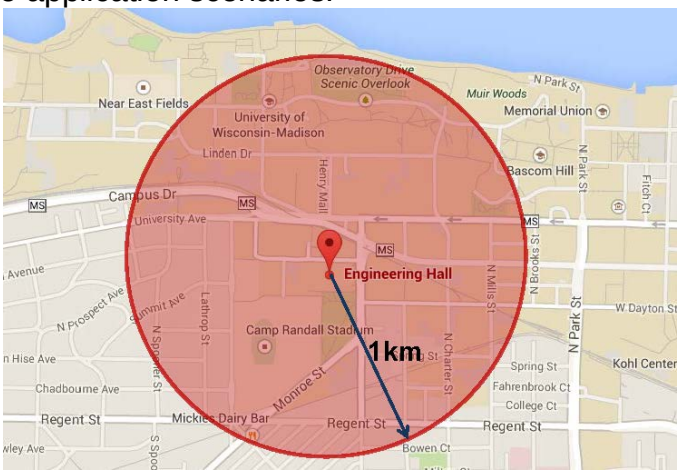
reconfigured by a host controller, and will be chosen in a way that follows the whitespace rules specified in FCC 10-174.

***Modulating signal description*.** The baseband waveforms will follow the IEEE 802.11 standard, which uses either DSSS or OFDM modulation schemes.

***Necessary bandwidth description*.** The bandwidth of the modulated signals can be reconfigured by the host controller. The above platform can reach a maximum bandwidth of 20 MHz. But the actual bandwidth usage will be configured according to the availability of continuous whitespace spectrum, strictly following the FCC ruling.

3. Experiment Scenarios

All our experiments will be carried out around the Engineering Hall (1415 Engineering Dr. WI 53706) at the University of Wisconsin-Madison (see figure below). Our experimental research targets the following two application scenarios.



Fixed point-to-point backhauling

This application is intended to improve the inter-building Internet connectivity at the UW campus (Figure 2). In this scenario, a handful of whitespace radios will be mounted on top of several teaching buildings at the campus area. Each pair of radios will establish a point-to-point link of up to 1km and communicate through omni-directional antennas over the whitespace spectrum. Each radio might have another WiFi interface to provide WiFi access to the users inside the building, thus enabling communications among users from different buildings. Finally, as a fixed whitespace device, each radio will register with a spectrum database before operating and will periodically query the database about channel availability information to comply whitespace rules - 47CFR15.701 though 15.717.

Vehicular networking

The second application is to explore the possibility of providing Internet access to moving vehicles over whitespaces (Figure 3). As whitespace base stations, a small number of whitespace radios will be placed on towers beside the road, operating as fixed devices. As mode-I devices, a handful of whitespace radios will be mounted on vehicles, serving as whitespace clients. Each base station will use omni-directional antenna with a coverage of up to 1km radius and provide Internet access to nearby clients. Each client radio will have an additional WiFi interface, operating as a WiFi AP to provide Internet access inside the vehicle.

Each whitespace base station has an EIRP of 1 Watt, well within the 4 Watt limit in the whitespace rules – 47CFR 15.701 though 15.717. The mobile client has an EIRP of 100 mW following the whitespace rules. The whitespace base stations will register with the spectrum database and query it periodically to verify channel availability.

To prevent clients from interfering TV broadcasts, the base stations will periodically send spectrum availability information to client radios on the vehicles. Such information will be delivered through a separate, reliable control channel. More specifically, as shown below, each client radio is collected to its host controller via Ethernet. The host controller is tethered to a mobile phone that has 3G Internet access. The base stations are also connected to the Internet via their WiFi-enabled host controller.