A Proposal for Enhancing Broadband Access by using TV White Spaces in New Jersey

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Project Summary

There are quite a few areas in rural New Jersey, that are underdeveloped and are lacking in infrastructure such as widespread broadband access to the internet. Researchers at the Wireless Information Network Laboratory (WINLAB) at Rutgers have been exploring the possible use of TV white spaces as a means to provide wireless backhaul and distribution of high speed data services to areas that do not have adequate infrastructure. Preliminary investigations reveal that there is significant TV white space bandwidth available, and that using the TV white spaces to enhance broadband access to these areas is feasible. The pilot project proposed here seeks to use cognitive radio technology being developed at WINLAB to lay out a wireless backhaul network that will extend the broadband access to the internet. This pilot project will also serve as a model for developing widespread broadband capabilities for rural areas across New Jersey and the U.S.

1. **Background and Rationale**

In 1996, the U.S. Congress authorized the distribution of an additional broadcast channel to each broadcast TV station so that they could start a digital broadcast channel while simultaneously continuing their analog broadcast channel. The justification for this transition was to enable more spectrally efficient broadcasting, thereby allowing for new services to be offered to the consumer such as HDTV, data streaming, etc. Subsequently, Congress set June 12, 2009 as the deadline for full power television stations to stop broadcasting analog signals. Since June 13, 2009, all full-power U.S. television stations have broadcast over-the-air signals in digital format only. The switch from analog to digital broadcast television is referred to as the Digital TV (DTV) Transition. Consumers benefited from the DTV Transition because digital broadcasting allows stations to offer improved picture and sound quality, and digital is much more spectrally efficient than analog.

Another important benefit of the DTV transition is that it freed up parts of the valuable broadcast spectrum for public safety communications (such as police, fire departments, and rescue squads). A huge chunk of this freed up valuable spectrum has now been auctioned in

part to companies that will be able to provide consumers with more advanced wireless services (such as wireless broadband). The rest of the new spectrum was allocated to unlicensed use. This unlicensed spectrum is what is referred to as *White Spaces*. Specifically, *White Spaces* refers to the unused television spectrum that traditionally existed between channels as buffers or empty spectrum left over or vacated by TV stations through the DTV transition. This TV band spectrum can be used for "Secondary" services in coexistence with "Primary" licensed services. In its Second Report and Order [1], the FCC set forth rules for TVBDs (TV Band Devices) by allowing transmission only in certain channels. These channels are in the high VHF and UHF TV bands and their frequencies range from 54 to 698 MHz with each channel having a bandwidth of 6 MHz. To further protect the licensed TV towers, the FCC has also set forth rules for secondary transmission with restrictions and regulations on antenna heights, radiated power, adjacent channel use and whether the devices are fixed or portable. The FCC's opening up of TV white spaces for unlicensed use, has also led to innovations in cognitive radio technology, spectrum sensing as well as novel proposals for dynamic spectrum access. WINLAB researchers have been at the forefront of this activity and have made seminal contributions to the theory and practice of cognitive radio networks such as dynamic spectrum access algorithms, networking protocols and software radio platform development [2-4]. In our earlier work [5], we had proposed and evaluated the feasibility a TV white space system using fixed towers that would provide backhaul and/or distribution for internet access in places where it is needed and is presently not available. Using New Jersey as a testbed, we have calculated the available white space and backhaul traffic demands and evaluated the feasibility of such backhauling. Our preliminary studies have revealed that around 90 MHz of TV white space spectrum is available in the areas of Cumberland County and it presents a tremendous opportunity for providing wireless backhaul that can enhance the broadband. While optical transport networks are evolving rapidly, having ubiquitous deployment of these, including in rural areas, is far from being a reality. The backhaul network concept we propose is an attractive alternative to laying optical fiber, which is costly, while radio towers using TV white spaces is far less so. New Jersey is an appropriate testbed for evaluating this concept. It is the most densely populated state in the US, it has large pockets of urban, suburban and rural areas; and is adjacent to two large metropolitan areas, New York and Philadelphia.

2. Project Outline

The commercially available TV white space devices will be used (adhering to the rules for fixed TVBD devices) and preexisting structures such as roof tops of existing buildings on the campus will be used to serve as "towers" for these devices. An intensive software and hardware development cycle will be undertaken by WINLAB researchers to develop the sensing radios, local distribution with the appropriate protocol support for backhaul radio router nodes to provide the backhauling capability necessary to accomplish the goals of this project. WINLAB's

existing cognitive radio capability with the WINC2R platform will be leveraged in this accelerated development process. The prototyping effort, testing and deployment will be accomplished in the time framework of a year from commencement of the project.

References:

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