Demo: A Cognitive Solution for Commercial Wireless Conferencing System

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ABSTRACT

In a modern conference room, various of video and audio devices are provided to ensure efficient communications. This is commonly referred to as a conferencing system. Compared to wired conferencing systems, wireless systems require less deployment effort, but may become unreliable when the selected radio spectrum is highly occupied. This demo focuses on improving the quality of service of a commercial wireless conferencing system using dynamic channel selection based on real-time spectrum sensing. The proposed solution is verified in a large-scale wireless testbed, and the result shows that the link of the conferencing system is indeed more robust against interference when cognitive solution is applied.

Keywords

Wireless conferencing system; Cognitive Radio

1. INTRODUCTION

In a modern conference room, audio infrastructures (eg, micro phones and loudspeakers) are provided to ensure clear and efficient communications. In addition, video devices and real-time interpretation units are also widely used for remote and international conferences. In general, the infrastructures deployed in a conference room to facilitate communication is called a conferencing system. Most existing conferencing systems rely on wired connections, which usually require heavy deployment efforts. In addition, it is difficulty to reorganize the layout of the conference room once the deployment is finished.

To overcome the limitations of wired conferencing system, Televic [1] proposes the Confidea wireless conferencing system [2]. It contains two types of devices: the wireless centralized access point (WCAP) and the wireless delegate unit, as shown in Figure 1. A conference room equipped with the Confidea system is shown in Figure 2. The WCAP and delegate units operate in the unlicensed Industrial, Scientific, Medical (ISM) frequency band, which allows the conferencing system to be used without extra licensing cost. However, the existing wireless technologies in the ISM bands (eg, Bluetooth, Zibee, Wi-Fi) may cause severe interference to the connection between the WCAP and the delegate units.

Figure 1: The Confidea WCAP and delegate unit

Figure 2: A conference room equipped with Confidea system

To this end, Cognitive Radio (CR) techniques are used to improve the connection quality. More specifically, the WCAP's operating channel is updated in real-time according to the radio spectrum utilization. In this demo, the spectrum sensing is performed by a dedicated application together with the Software-Defined Radio (SDR) — USRP[3] . The complete solution is tested and verified in a large scale wireless testbed — w-iLab.t[4].

The rest of the paper is organized as follows: Section 2 briefly introduces the implementation of the demo setup; Section 3 describes the demo scenario as well as the expected result; Finally Section 4 concludes this demo and points out the direction for future work.

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2. DEMO IMPLEMENTATION

The w-iLab.t testbed is a generic and heterogeneous wireless testbed. It is located at a utility room where no regular human activity is present. The majority of devices in the w-iLab.t testbed are embedded PCs equipped with Wi-Fi, Bluetooth interfaces and sensor devices. Each embedded PC are attached to a poll, and can be remotely configured via a backbone Ethernet interface. For simplicity, an embedded PC together with the attached wireless devices is referred to as a "node". The overall testbed topology forms a grid.

Two Confidea delegate units and one WCAP are deployed in w-iLab.t testbed. The two delegate units are mounted on two adjacent nodes respectively. On one node, the audio output of the embedded PC is connected to the audio input of the delegate unit via the audio jack cable, which forms the "speaker" node. On the other node, the audio output of the delegate is connected to the microphone input on the embedded PC via an audio jack cable, which can act as the "listener". During testing, the audio signal is transferred via the WCAP from the delegate at the "speaker" to the delegate at the "listener". The "listener" node records the audio into an "mp3" file, which can be used for audio quality analysis. The complete setup is illustrated in Figure 3.

The WCAP updates its channel in real-time, based on the spectrum information collected by a dedicated sensing application. This application uses the raw samples from USRP to perform Fast Fourier Transfer (FFT) based energy detection. Parallelism and multi-threading are used to increase the processing speed of the sensing application [5]. The sensing application together with USRP hardware forms a USRP sensing engine. Each USRP sensing engine has an instantaneous bandwidth of 20 MHz, we use sweeping in frequency domain and cooperation of multiple USRP's to cover a wider frequency range. The sensing result is stored into a database at run time, which can be queried by the WCAP periodically.

3. DEMO SCENARIO

The demo consists of three stages. In all the stages, a piece of music is played at the "speaker" node and recorded at the "listener" node. At the same time, spectrum information is provided by USRP sensing engines and plotted in spectrogram in real-time.

In the first stage, the WCAP is configured to stay on a static channel and no background interference is introduced. The audience can hear that the recorded audio has a similar quality with the original audio file. In the second stage, the WCAP is still using a static channel, in addition, background interference is generated on the same channel. The audience can hear that the recorded audio quality has dropped compared to the first recording. In the third stage, the WCAP is configured to use dynamic channel configuration based on the spectrum information from USRP sensing engines. We can see on the spectrogram that the WCAP becomes "aware" of the interferer, and is able to actively avoid the interference. Audiences are encouraged to catch the channel of the WCAP by configuring the interferer in real-time. The recorded audio in this stage may contain short interruptions, but the we observe that the overall audio quality is much better than the recording from the second stage.

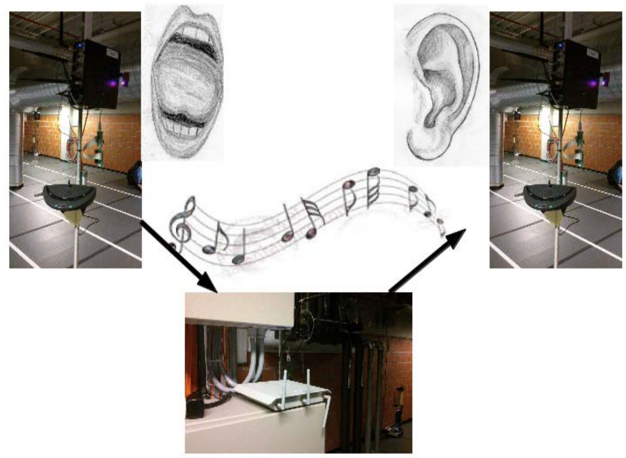

Figure 3: Demo scenario

4. CONCLUSIONS

This demo proves that dynamic channel selection can greatly improve the quality of service for the wireless conferencing system. In addition, it is shown that the custom-developed sensing application based on SDR can cooperate with commercial devices to achieve better performance. Finally, this demo also illustrates how to test a real-life application on a remote infrastructure in a convenient approach.

5. ACKNOWLEDGMENTS

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