A REAL-TIME SOFTWARE BASED END-TO-END WIRELESS VISUAL COMMUNICATIONS SIMULATION PLATFORM

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ABSTRACT

For visual communication services to be truly ubiquitous, transmission of video signals over the wireless medium should be feasible with acceptable quality. Wireless transmission characteristics are dominated by channel effects like multipath propagation and Doppler frequency which result in severe error bursts and time-varying signal strengths. Such channel effects pose serious challenges to real-time visual communications systems. In this paper, we describe a software based wireless visual communications simulation platform which can be used to evaluate wireless video performance in real-time. The platform consists of two personal computers serving as hosts. Major components of each PC host include a real-time programmable video codec, a wireless channel simulator, and a network interface for data transport between the two hosts. These three components are interfaced in real-time to show the interaction of various wireless channels and video coding algorithms. The programmable features in the above components give us the flexibility to study various wireless channel effects without physically carrying out these experiments. Physically building such systems can be very time-consuming, costly, and the experiments are only limited in scope.

Using this simulation platform as a testbed, we have experimented with several wireless channel effects including Rayleigh fading, various multipath delays, Doppler frequency, various transmitted signal power, antenna diversity, and packet loss.
1 INTRODUCTION

With the new advancements in signal processing and circuit technologies, real-time visual communications is becoming an important service in multimedia communications. Conventionally, real-time visual communications requires isochronous and low delay transport and is achieved using digital networks like ISDN or T1/E1. In the communication and networking area, however, wireless access is becoming the fastest growing business. In planning visual communications for the future, it is thus necessary to consider wireless transport because of its growing potential and flexibility.

Wireless communications conventionally carry only voice and data. Noisy channels, power and complexity limitations have limited the transport bandwidth to mainly low bit-rate operations. To extend wireless communications to carry real-time video, bandwidth needs to be increased and performance needs to be improved. The video source coding algorithm also needs to be robustly designed for error mitigation. These requirements pose technical challenges on both wireless communications and video source coding.

To verify the performance of a wireless visual communications system, it is necessary to investigate the overall combined operation. Since hardware implementation takes considerable time and money, it is desirable to simulate as much of the overall operation in software as possible. Currently, video signal processors are becoming popular and it is practical to have real-time programmable video codecs. However, to simulate various wireless access scenarios, a programmable modem used over various transport environments is required. This part of the process is time consuming and requires much effort. To speed up the turn-around time, it is desirable to simulate the modem and transport environments to the largest extent such that both emulate the effects of real operations.

In this paper, we describe the experimental prototyping of a real-time software-based end-to-end wireless visual communications simulation platform. This paper is organized as follows. Section 1 gives an overview of the simulation platform which is built upon several important components. The programmable video codec and the related software are described in section 2. The packet network interface over Ethernet is described in section 3. Section 4 presents the third component, the wireless channel simulator. Some low bit-rate simulation results are presented in section 5. A summary of the investigation is given in section 6.

2 PLATFORM

A high level system diagram of the simulation platform is shown in Fig. 1.

![Figure 1: A real-time software-based wireless video simulator](image-url)