Voice over IP

Outputs

- Report to IEEE conference regarding VoIP degradation over 802.11 networks under Bluetooth interference.
- Standards contributions (ITU, TR-41.1) detailing the behavior of Government Emergency Telecommunications System (GETS) calls over VoIP based systems.

Advances in quality of service (QOS) and greater market availability have resulted in increased utilization of Voice over IP (VoIP) on enterprise networks. VoIP technology offers substantial benefits including efficient resource utilization, a homogeneous network offering both voice and data, potential for other multimedia transmission (e.g. video), and lower data bandwidth requirements than traditional telephony.

As wireless local area networks (LANs) based upon IEEE 802.11b (Wi-Fi) technologies become more ubiquitous, attempts are being made to utilize VoIP over radio channels as well as the fixed location wired networks more traditionally associated with VoIP systems. However, interference problems within the wireless channel can substantially degrade the QOS of a VoIP system. This effect is of particular concern in Wi-Fi systems, which share the same spectral allocation as Bluetooth (IEEE 802.15) devices.

In order to evaluate some of the effects of radio interference on VoIP transmission over wireless channels, ITS has investigated the degradation of estimated mean opinion scores (MOS) in VoIP transmissions over Wi-Fi channels with nearby Bluetooth interferers. This experiment simulated the effects of multiple active Bluetooth piconets (small networks of devices connected in an ad hoc fashion using Bluetooth technology) operating in close proximity to VoIP-encoded Wi-Fi transmissions at various signal to noise ratios (SNR).

In this experiment, standardized Harvard phonetically balanced sentences were transmitted using an H.323-based VoIP system. The packet telephony devices used the G.723.1 codec at a bit rate of 5.3 Kbps. The information was carried over a Wi-Fi channel at 11 Mbps, where the transmitter and receiver were in close proximity to as many as four independent Bluetooth piconets that were sending large files using FTP. Forty sentences were transmitted during each experimental iteration, and the audio signal transmitted was compared with the audio signal received. Estimates of MOS were derived using the perceptual evaluation of speech quality (PESQ) algorithm (ITU-P.862) and packet loss was measured using a software-based protocol analyzer.

The experimental results were analyzed over multiple planes. The percentage of packets dropped versus the number of Bluetooth piconet interferers was investigated, as well as the estimated MOS compared to number of piconets. Both of these comparisons were made for three different SNR values. A third comparison, shown in Figure 1, indicates the degradation of MOS with increasing packet loss percentages. The target MOS for toll quality telephony (and VoIP systems) is 4, so these results indicate that

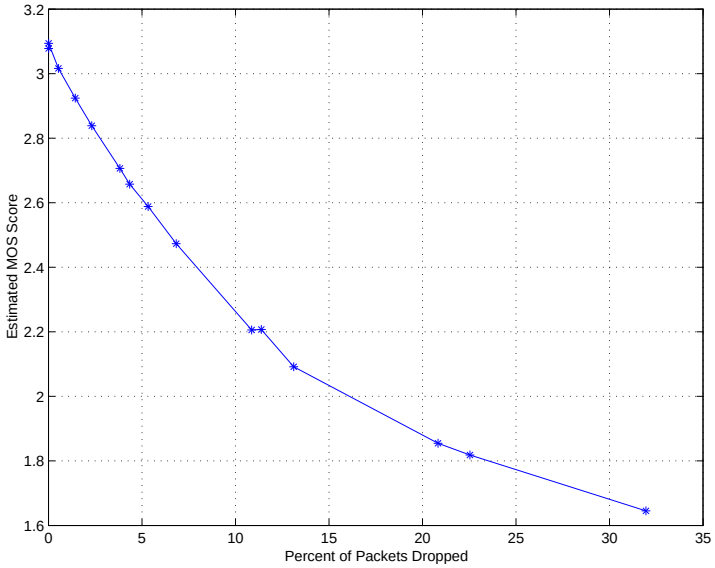

Figure 1. Mean opinion score (MOS) versus dropped packets in Wi-Fi transported VoIP.

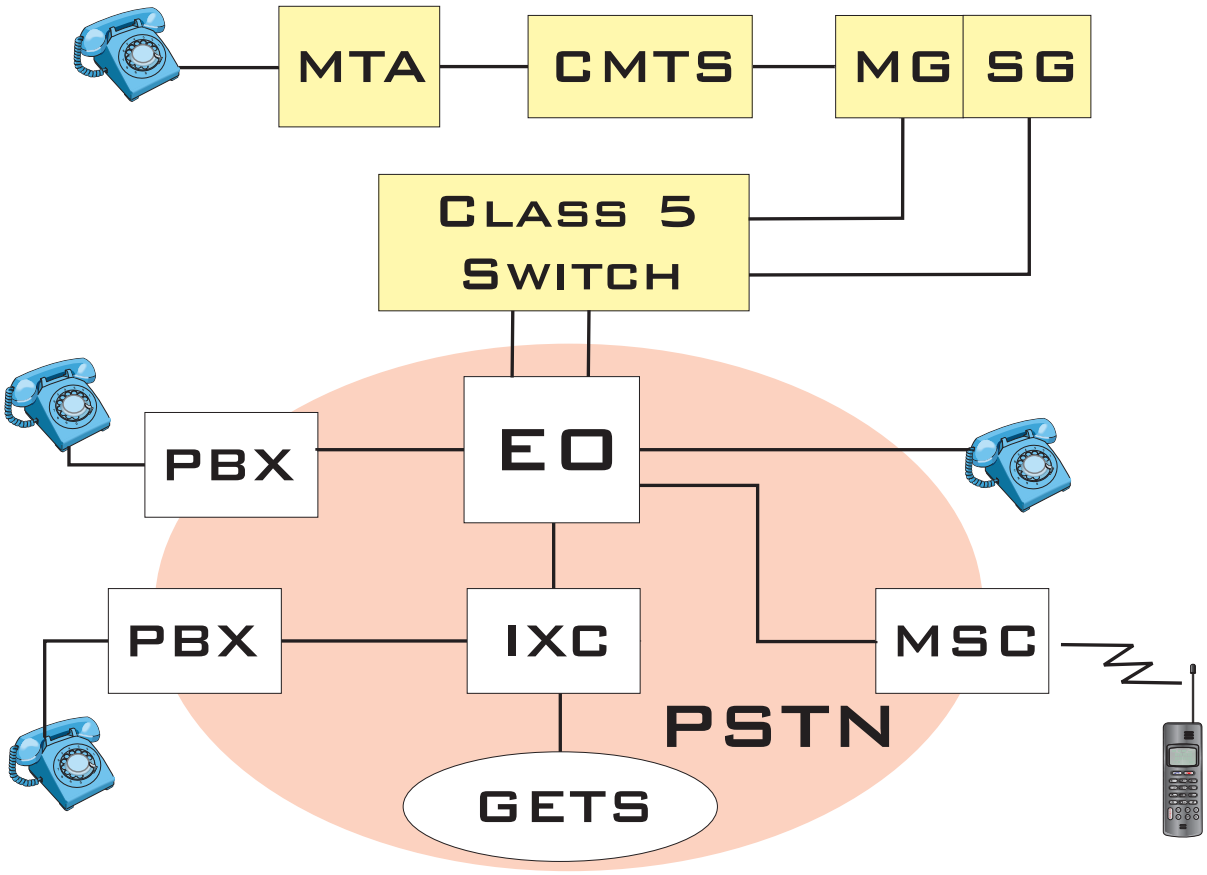

Figure 2. Test setup for GETS calling over VoIP-based media.

low percentages of packet loss due to radio interference can severely degrade the intelligibility of these systems.

Recognizing the growing availability of VoIP-based packet telephony, as well as a heightened awareness of government emergency communications, ITS has also embarked on a series of investigations regarding the capabilities of current VoIP signaling implementations for this process. During emergencies, the public switched telephone network (PSTN) may encounter congestion, precluding emergency calls from getting through. Even government emergency telecommunications service (GETS) calls, which enjoy enhanced priority, may be impossible to place using normal telephone connections. However, VoIP-based enterprise networks might be used to route calls around the congested area, through gateways into non-congested portions of the PSTN. In order to test the viability of using alternative VoIP-based media to make such calls, experimental GETS call placements over existing alternative systems like the one diagrammed in Figure 2 are being made. Here, the enterprise network includes a cable modem system with a media terminal adaptor (MTA) and a cable modem termination system (CMTS) as well as media and signaling gateways (MG and SG). The calls may be terminated through a variety of equipment including local phone and private branch exchange (PBX) equipment as well as cellular telephones and long-distance PBX (e.g., through an interexchange carrier or IXC). This is an ongoing effort, in connection with other ITS projects studying the emergency telecommunications service (ETS).

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