# Chapter 40 Hospital Environment Scenarios using WLAN over OPNET Simulation Tool

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# ABSTRACT

For the past ten years, heterogeneous networks wired and wireless had tended to integrate seamlessly, offering effective and reliable service for medical operations. One of the problems encountered by network practitioners is the seamless integration of network components into healthcare delivery. As a multiplexing hospital model, the implementation certainly presents some challenges. The major technical and performance issues involve are as following. The operating parameters should keep aligned to the Quality of Service (QoS) requirement throughout simulation. Bandwidth utilisation of wireless networking is a challenging issue for real-time multimedia transmission. IEEE 802.11 provides relatively lower data rate than wired networks, thus the developer tends to adopt a more compromised solution: either reduce the file size or compress the image packets. Communication performance that varies constantly with the impact of signal strength, traffic load and interference. As stated radio signal senses as a curve and attenuates greatly while metallic object and microwave exist within the active range. To ensure devices do not interfere with other electronic equipments (e.g. heart monitors), assert wireless spectrum has to be managed appropriately. This research paper aims to develop a generic hospital network scenarios using Wireless Local Area Network (WLAN) over OPNET Simulation, to evaluate the performance of the integrated network scenario for Intensive Care Units (ICU). This research makes use of computer simulation and discusses various aspects of the network design, so as to discover the performance behaviour pertaining to effect of traffic type, traffic load and network size. In the ICU scenario, the performance of video conference degrades with network size, thus, a QoS-enabled device is recommended to reduce the packet delay and data loss. IEEE 802.11a suits in hospital environment because it mitigates interference

DOI: 10.4018/978-1-4666-6339-8.ch040

on the 2.4GHz band where most wireless devices operate. Experiment examines the effect of signal strength in WLAN. It is convinced that -88dBm is the best signal strength threshold. Although 802.11a generates slightly lower throughput than 802.11g, this issues can be addressed by placing more APs in the service area. It is convinced that 802.11a suits the hospital environments, because it mitigates interference on the popular 2.4GHz band where most wireless devices operate. It is important for medical devices which require future upgrade and Bluetooth deployment.

# **1. INTRODUCTION**

For the past ten years, heterogeneous networks wired and wireless had tended to integrate seamlessly, offering effective and reliable service for medical operations. The major driver for adopting Wireless Local Area Network (WLAN) technology in hospital environments is accuracy (Evans, & Sarkar, 2004). An official statistic conducted by Bates, et al. (2001), show that there are more than 10,000 fatal events associated with drug delivery throughout 100 US hospitals in 2004. As reported by Istepanian and Lacal (2003), high speed wireless technology is expected for pharmaceutical track and trace, so as to minimise the misuse of medicine. Other examples that harness Wireless Fidelity (WiFi) connectivity have been successfully implemented in Watson (2003).

The ease of use and mobility advantages of WLAN significantly improves the efficacy of healthcare delivery. For instance, the patient records associated with monitoring can be acquired by authorized users using a Personal Digital Assistant (PDA). X-ray images are also retrievable in the forms of File Transfer Protocol (FTP), Hyper Text Transfer Protocol (HTTP) and Database (DB) query, thereby radiologists can share the information more effectively. Last but not least, it is quite common that doctors fulfil a consultation task through video conference or Internet Protocol (IP) telephony on a handheld device.

This research paper aims to develop a generic hospital network model and evaluate its performance for the integrated network scenario for Intensive Care Units (ICU). This research makes use of computer simulation and discusses various aspects of the network design, so as to discover the performance behaviour pertaining to effect of traffic type, traffic load and network size. Intuitive insight is also sought to provide guidelines for novice users in developing hospital simulation models.

ICU is another scenario that captures attention. This scenario consists of certain portable devices (like laptops and PDAs) that support web browsing, video conferencing and IP telephony. An AP here allows airborne transmission of various traffic types (e.g. data, video and voice). The embedded Virtual Private Network (VPN) ensures that only the authenticated users, such as doctors and nurses, can access and communicate with the training programs. Although similar scenarios are implemented by researchers (Su & Shih; Cocoradal 2007; Szekelyl, 2005) efficient propagation scheme is still required for QoS delivery. Performance improvement is the focus of this scenario.

The advent of IEEE 802.11 standards significantly stimulates wireless connectivity in hospital circumstances. Due to the Media Access Control (MAC) design, WLAN standards vary greatly in data rate, coverage, and other features. IEEE 802.11b resides in 2.4GHz frequency band and operates High Rate/Direct Sequence Spread Spectrum (HR-DSSS) as MAC. The cost and coverage advantage makes it a lead in the home networking market. Although 802.11a and 802.11g infrastructures are relatively more expensive, they provides 4 times data rate faster than 802.11b. As reported by LeMay (2006), Since 802.11a has greater number of channels, it mitigates the interference with other devices in the 2.4 GHz ISM bands (802.11 b/g).

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