# Chapter 2.14
# QoS Provisioning in Sensor Enabled Telemedicine Networks

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## ABSTRACT

Enabled by the advances of the wireless sensor network technologies, wireless LANs will play a critical role in providing ubiquitous connectivity for future telemedicine applications. This paper focuses on how to provide QoS over the wireless channel between the Body Sensor Network (BSN) Gateway and the wireless Access Points (AP). Telemedicine applications require the periodic report data and the emergency messages transmitted to the remote health care center in a timely manner. However, unlike the voice and multimedia applications which can be supported by traditional QoS techniques, the sporadic nature of the emergency data in telemedicine systems makes it nontrivial to provide sufficient QoS. This article investigates several alternative schemes for QoS support in the telemedicine systems, and an express dual channel (EDC) based QoS mechanism is proposed. Not only is the proposed mechanism simple and resource efficient, but also it provides the bounded maximum delay guarantee for the unpredictable emergency data transmission for telemedicine applications.

## INTRODUCTION

With the advances in wireless technology, the realization of seamless connectivity to support "anywhere" and "anytime" communications becomes more and more plausible. One of the most important advancements is the development of low cost wireless sensors networks to collect data in various environments. In this paper, we explore one such environment, namely the telemedicine systems. Chronic diseases such as diabetes and heart attacks are the most common and costly health problems in the United States. Fortunately, with the help of adequate support infrastructure and seamless connectivity, many fatal situations may be prevented. If the data related to the periodic monitoring reports and potential emergency

situations of the patients can get across to medical facilities in a timely manner, even though the patient is free to roam about, many life-death critical situations can be taken care of.

A telemedicine system which can support such application, is depicted in Figure 1, where the data regarding various physiological parameters such as heart rate, blood pressure, and so forth, collected by the in-body sensors, is fed to and aggregated by the Body Sensor Network (BSN) gateway which can be some handheld device (e.g., a modified palmtop or PDA). This BSN gateway then sends this data to a wireless Access Point (AP, supported by IEEE 802.11) connected to the Internet, which further relays the data to the remote medical facilities. In such a telemedicine system, the BSN gateway fuses information from wearable, ingestible, and implantable sensors to provide continuous diagnostic monitoring and generate early warnings. It may also provide control over critical implantable devices such as drug delivery pumps. The emergency or the periodic data fused by a BSN gateway is then relayed via a WLAN access point to remote health care centers. The communication between the WLAN access point and remote health care center takes place via an all IP-based network.

To deploy such a telemedicine application which is life-death critical, certain QoS guarantees have to be provisioned so the data can reach the remote health care center in a reliable and timely manner. This paper focuses on the QoS provisioning between the BSN gateway and the wireless access points (e.g., IEEE 802.11 based Hot Spots) in the telemedicine applications.

We assume that the underlying media access control (MAC) protocol of the WLAN access point network is the IEEE 802.11e standard which supports the traditional QoS service to various classes of applications. Compared to the baseline IEEE 802.11 which does not support any QoS service, IEEE802.11e provides a basic platform to support different priority of the wireless media access to different data traffics if the traffic

*Figure 1. Conceptual system architecture of the sensors-enabled telemedicine system*