

Chapter 5

Mesh Wi-Fi Networks: Architectures and Experimental Results

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ABSTRACT

Wi-Fi mesh is a fast growing and mature technology which is widely used and has been proven very useful for healthcare including applications for ambient people. In this chapter, we attempt a quick introduction of the principles of 802.11s protocol that refers to mesh topology Wi-Fi networks. Specifically, we describe the main operations and functions performed in a Wi-Fi mesh network such as routing procedures, synchronization as well as QoS capabilities and security mechanisms that are crucial for carrying sensitive information like medical data. Finally, in the second part of this chapter, actual measurements

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are presented from an experimental network that consisted of four dual radio (2.4 GHz and 5 GHz) mesh access points. Key parameters are evaluated, such as maximum throughput for different distances, jitter, delay and data loss which affect the transmission of sensitive data. Moreover, the handover capability of the system is presented in terms of data throughput and voice quality degradation during the transition.

INTRODUCTION

The hot spot networks also called Wide Local Area Network (WLAN) was proved unable to offer high bit rate capacities in large geographical areas. WLAN mesh technologies declare that they can offer an economic way of deploying broadband, large scale wireless networks. As the mesh technology became very popular and many vendors started to adopt it, there was an extended need for standardization and interoperability, mainly due to market requirements. For this reason, IEEE 802.11s Task Group was formed (September 2004). At the time of this article, 802.11s draft version 2.02 has been approved while the final 802.11s was scheduled for completion in August 2009.

The aim of this Task is to work out all the essential operations and energies to extend the traditional WLAN networks in order to efficiently support further mesh networking. The existing standard needs to be amended so that it will include new operations or modifications of the already existing ones, like Quality of Service (QoS), power saving, routing and forwarding as much as the management and configuration of a mesh network is concerned. The ultimate goal is to address all the issues for the creation of a self-configuring, self-healing, and self-monitoring WLAN mesh network. The main effort of the Task is to make the necessary changes to the basic 802.11 MAC protocol so that the delivery of unicast, multicast and broadcast frames would be feasible, by using radio-aware metrics; on the contrary, the PHY layer is not expected to change at all.

TECHNOLOGY OVERVIEW

WLAN mesh networks are targeted primarily for home, commercial, neighborhood, community, municipality, rural broadband, emergency and first responder, and public safety. Also for small to medium business, large enterprise and military networks.

The 802.11 mesh network is created from a collection of access points (APs) interconnected via wireless transmission that enables automatic topology learning and dynamic path configuration to occur. The network is decentralized and simplified because each node needs to transmit only as far as the next node. The frequency used for the communication between access points is either 2.4 GHz (802.11g) or 5 GHz (802.11a). The maximum throughput in all cases is 54 Mbps. At this point it is important to mention that the upcoming 802.11n standard which uses Multiple Input- Multiple Output (MIMO) techniques promises rates up to 300 Mbps. The mesh access points (MAPs) are typical 802.11 access points that have routing and/or forwarding capabilities so that they can connect to each other and identify all the possible hops from source to destination. If one mesh point has also the capability to serve client stations or non-mesh nodes, it is called mesh point (MP). In most mesh Wi-Fi networks; there exists an access point (often called as “root MP”) that has two interfaces. The one is a wireless interface so that it establishes connections with all neighboring MPs, while it has also a contact to the wired network. This MP is referred as Mesh Portal (MPP).

WLAN mesh networks are defined as:

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