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hanThroughput Evaluation of IEEE 802.11a,b,g by Measuring the Impact of Multi-rate Shifting and Delays in a Large Multi-hop Wireless Network

Abstract

The emergence of several IEEE 802.11 Physical Layer (PHY) standards such as IEEE 802.11 a, b & g operating in the range of 2.4 GHz unlicensed Industrial Scientific Medical (ISM) and 5.8 GHz UNII frequency band may lead to delays and multi-rate shifting over a large distance in a multi-hop wireless network environment; result in significance throughput degradation when devices coexist in the wireless network. There are also several impacts on throughput when selecting the wireless mode such as Point Coordination Function (PCF) and Distributed Coordination Function (DCF) during the configuration of wireless LAN devices. The multi-rate shifting creates unavoidable throughput degradation when the distance is increased; and result in getting higher delays between wireless nodes. Although in previous research a limited effort was made to determine the throughput under DCF mode without considering the impact of multi-rate shifting over a larger distance; and also the impact of PCF mode especially in coexistence of IEEE 802.11b & g.

In this paper, the original formulas are taken from previous research which is slightly modified to obtain the fair and unbiased results in terms of end-to-end throughput and delays by considering the impact of wireless nodes and multi-rate shifting which was not studied in earlier research. Also, there was no simulator available which can help the wireless administrator to chalk out the placement of costly wireless LAN equipments and calculate the actual throughput and delay by manually provided variables such as distance (in feet) and frame size (in bytes) for various topologies or network paths.

The main goal of this paper is to present a simulation environment for modeling the impact of multi-rate shifting and delays based on factors such as wireless mode, distance, variable slot times, coexistence of non-similar IEEE standards. Four system models are devised to study and compare the impacts of coexistence

of non-similar access points and wireless stations for throughput performance and also these system models are formulated to identify the configuration of various IEEE 802.11 PHY standards that best provide throughput.

Simulation results also help the wireless LAN planner to analyze the throughput before placing the expensive access points and wireless stations in their real locations. A Simulator suggests the wireless LAN planner about the best configuration of wireless LAN devices to acquire the best possible throughput on the basis of delays over manually provided distance between the nodes.

Furthermore, several simulation scenarios are used to measure the throughput in terms of delays, multi-rate shifting, distance and wireless modes etc. Finally, the performance in conjunction with throughput and delays are evaluated for a variety of IEEE 802.11 PHY standards through a simulator which is intended to investigate the several parameters of wireless LAN.