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WINGS TO YOUR THOUGHTS.....

Performance Analysis of IEEE 802.11n and IEEE 802.11ac Standards-Physical Layer and Mac Layer

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Abstract: *Broadband Wireless technologies are increasingly gaining popularity by the successful global deployment of the Wireless Personal Area Networks (Bluetooth-IEEE 802.15.1), Wireless Local Area Networks (WiFi-IEEE 802.11), and Wireless Metropolitan Area Networks (WiMAX-IEEE 802.16). In this paper, the performance parameters in the WLANs are discussed and evaluate the superior performance of the IEEE 802.11ac standard with respect to802.11n. IEEE 802.11n (Oct 2009) sought to increase the achievable speeds of Wi-Fi networks beyond that achievable using 802.11g.*

Keywords*: IBSS, RF, STBC*

I. Introduction

Wireless Local Area Networks (Wi-Fi-IEEE 802.11), Wi-Fi is known as wireless fidelity using WiFi you can connect to a network through radio waves without using wires. The first WLAN standard was launched in 1997 by the Institute of Electrical and Electronic Engineers (IEEE) and called IEEE 802.11[9]. The term 'Wi' referring to the fact that a wire traditionally served as the physical medium for LANs, and 'Fi' referring to the Physical Layer of the OSI Reference Model. So Wireless PHY became Wi-Fi. This version of 802.11 provides for 1 Mbps and 2 Mbps data rates and a set of fundamental signaling methods and other services [29]. Like all IEEE 802 standards, the 802.11 standards focus on the bottom two levels the ISO model, the physical layer and link layer.

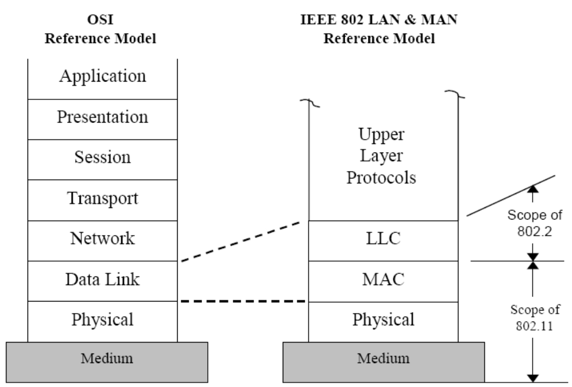

Figure 1: IEEE 802.11 standard and OSI reference model

Any LAN application, network operating system, protocol, including TCP/IP and Novell NetWare will run on an 802.11-compliant WLAN as easily as they run over Ethernet**.** Wirelesses Local Area Networks (WLANs) have become more prevalent and are widely deployed in many popular places like university campuses, airports, residences, etc. However, WLAN security is a very important but usually neglected issue. All smart-phone have it incorporated into the phone enabling low cost connectivity to be provided. In addition to the computers, laptops, tablets, cameras and very many other devices use Wi-Fi including many IoT sensors and nodes. There are two types of WLAN network that can be formed using a WiFi system: infrastructure networks and ad-hoc networks. The 802.11 family consist a series of half-duplex over-the-air modulation techniques that use the same basic protocol 802.11-1997.There are several different forms of Wi-Fi. The first that widely available were IEEE802.11a and 802.11b. These have long been superseded with a variety of variants offering much higher speeds and generally better levels of connectivity 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac, 802.11ad WiGig Gigabit Wi-Fi, 802.11ac, 802.11af White Fi, 802.11ah sub-GHz Wi-Fi, 802.11ax.

The rest of research paper is design as follows. The overall previous work is described in Section II. Section III describes problem formulation. Performance parameter describe in section IV. Finally, Section V describes the conclusion of paper.

II. Literature Review

This section will provide the brief description and highlights the contribution, remarks and factors of the work done by the researchers. Many attempts have been made in the past to achieve clustering coefficient.

Wi-Fi has become such an amazingly successful technology because it has continuously advanced while remaining backwards compatible. The number of wireless devices and the amount of transmitted data was small and userscould tolerate an imperfect Wi-Fi network. Today, 802.11 networks should be designed primarily for capacity. Wi-Fi is a technology that allows many electronic devices to exchange data or connect to the internet wirelessly using radio waves. The Wi-Fi Alliance defines Wi-Fi devices as any "Wireless Local Area Network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards". The key advantage of IEEE 802.11 devices is that they allow less expensive deployment of Local Area Networks (LANs). Products from every brand name can interoperate at a basic level of service thanks to their products being designated as "Wi-Fi Certified" by the Wi-Fi Alliance. Today, millions of IEEE 802.11 devices are in use around the world and they operate in the same frequency bands, this makes the need for their coexistence critical. In IEEE 802.11a, IEEE 802.11b and IEEE 802.11g, new PHY features were introduced, whereas new MAC standards were developed in IEEE 802.11e and IEEE 802.11s. Recently with the extensive demand for capacity and physical data rates, the Wi-Fi

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technology has been augmented with high to very high throughput extensions like IEEE 802.11n, IEEE 802.11ac and more recently, IEEE 802.11ad. In July 2003, the 802.11n task group was formed to create a new wireless LAN standard. The main goal of this new standard is to give a throughput of at least 100 Mbps at the MAC data service access point. The 802.11n standard defines a range of mandatory and optional data rates in both 20 and 40MHz channels. There are several other optional rates. One optional feature is to use a reduced guard interval of 400 ns instead of 800 ns, which increases the maximum data rate for 2 spatial streams in a 40MHz channel to 300 Mbps. Other optional rates use 3 or even 4 spatial streams. The highest optional data rate defined by 802.11n is 600 Mbps, which is achieved by using 4 spatial streams in a 40MHz channel with a 400 ns guard interval. But with the addition of millions of wireless devices daily and the increasing demand on access to information all time and everywhere, IEEE 802.11ac has become the go to standard to bring users evident advancements. IEEE 802.11ac and IEEE 802.11n in both error free channel.

III. Methodology

Aggregation of MAC protocol data units (MPDUs) at the bottom of the MAC (MPDU aggregation or A-MPDU). After the addition of MAC header to each MSDU, multiple MAC Protocol Data Units (MPDUs) are aggregated to create an A-MPDU. It is created before sending the MSDU (or A-MSDU) to the PHY layer for its transmission. The Transmission Identifier (TID) of each MPDU within the same A-MPDU may differ. A-MPDU has the maximum size of 65535 bytes. Aggregate-MAC Protocol Data Unit (A-MPDU) allows bursting 802.11n frames up to 64KB. A-MPDU is performed in the software. More efficient than A-MPDU as only one radio-and 802.11 MAC header is applied aggregation.

A-MSDU and A-MPDU both can be combined to produce multi-level frame aggregation. A-MSDU is created in the first level. Then multiple A-MSDUs are aggregated to form a single A-MPDU considering TID, source, destination and the size of A-MSDU. An A-MPDU can hold complete A-MSDUs or MSDUs. Any fragment of A-MSDUs or MSDUs is not allowed in an A-MPDU.

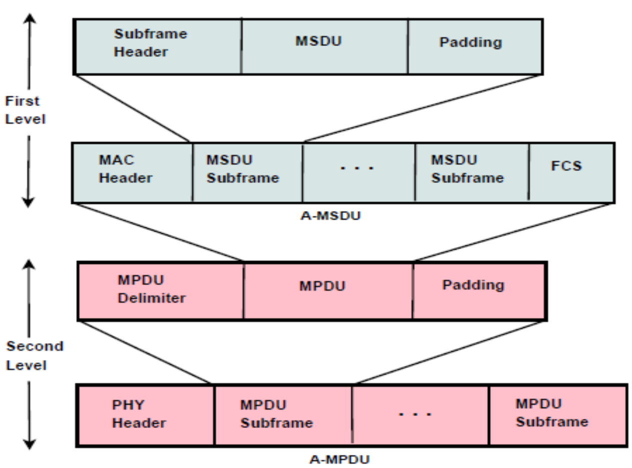

Figure 2: Two level frame aggregation

IV. Result Analysis

Mean jitter is studied, with channel bonding concept when bandwidth is 20 MHz for both and 40 MHz for short GI.In Figures 12 to Figue 14 throughtput, mean delay and mean jitter is studied, with channel bonding concept when bandwidth is 20 MHz, 40 MHz, 80 MHz and 160 MHz for both short GI and long GI

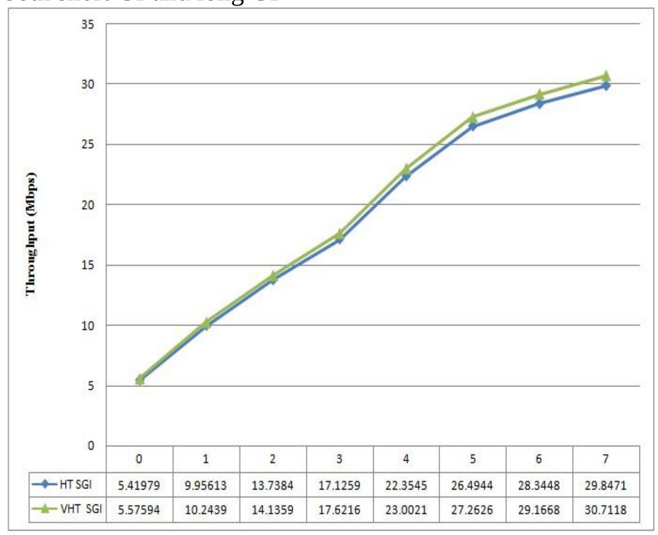

Figure 3: Throughput vs. MCS; Short GI and 20 MHz bandwidth.

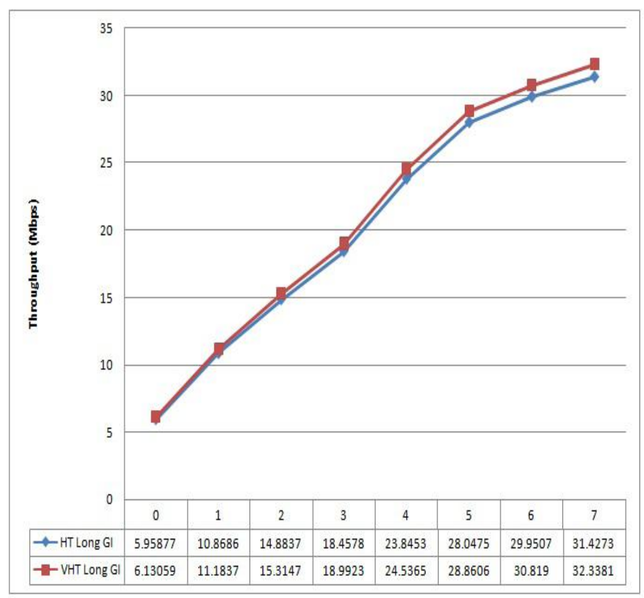

Figure 4: Throughput vs. MCS; Long GI 20 MHz bandwidth.

In Figures 4 from the values of throughput it is observed that higher MCS values give a better throughput of GI value. Long GI exhibits better throughput as compared to short GI at all MCS values in both 802.11n and 802.11ac protocols.

In Figure 1 VHT is 26 Mbps for MCS-5 but only 27.35 Mbps in HT. This trend is observed for the other MCS values too and also for long GI in Figure 2 and observe that VHT is 28.04 Mbps for MCS-5 but only 29 Mbps in HT. The

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improvement in throughput in 802.11ac protocol is proportionately more at higher MCS values. Hence, 802.11ac is exhibiting better throughput as compared to 802.11n even at 20 MHz.

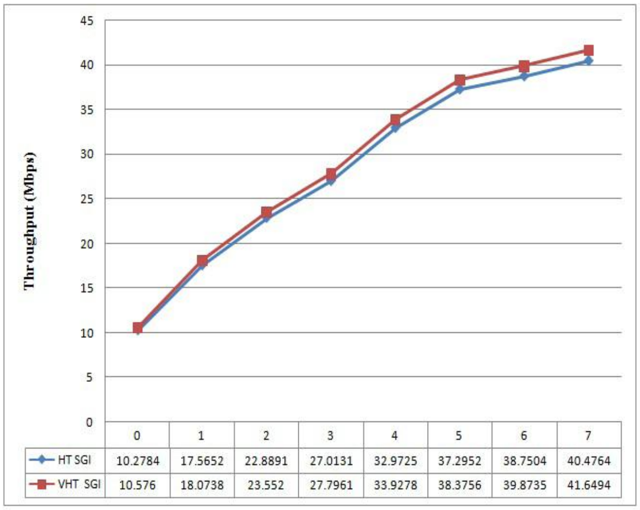

Figure 5: Throughput vs. MCS; Short GI and 40 MHz bandwidth.

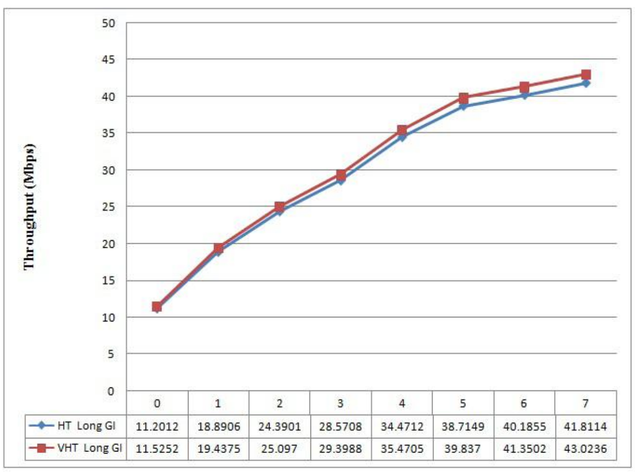

Figure 6: Throughput vs. MCS; Long GI and 40MHz.

In Figures 5 and Figure 6 from the values of throughput it is observed that higher MCS values give a better throughput of GI value. Long GI exhibits better throughput as compared to short GI at all MCS values in both 802.11n and 802.11ac protocols.

V. Conclusion

The version of ns3 (ns-3.24.1) used in this paper, does not support simulations using MIMO, transmit beam forming and MU-MIMO. Only "Constant Rate Wi-fi Manager" is supported by 802.11n or 802.11ac. Presently, there is no model for cross-channel interference or coupling. It is proposed to analyze in further detail other performance aspects of IEEE802.11ac, including effect of aggregation and interference, using upcoming ns3 releases.

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