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Effects Of Different Fragmentation Thresholds On Data Dropped And Retransmission Attempts In A Wireless Local Area Network

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Abstract

This paper discusses the effects of different fragmentation thresholds on data dropped and retransmission attempts in a wireless local area network. A wireless local area network (LAN) is a network that connects computer systems and devices within the same geographical area but without the use of wire. Fragmentation threshold is one of the parameters used in a wireless local area network which specifies the values to decide if the Media Access Control (MAC) Service Data Unit (MSDU) received from the higher layer network needs fragmentation before transmission. The number of fragments to be transmitted is calculated based on the size of the MSDU and the fragmentation threshold. OPNET IT guru 9.1 software was used for the analysis. Based on the graphical results obtained, it can be said that fragmentation increases the size of queue and the number of data dropped in a transmission, and also the smaller the fragmentation, the more increase in the retransmission attempts.

Keywords: Data dropped, fragmentation threshold, LAN, packet drop probability, retransmission attempts.

1.0 Introduction

A local area network (LAN) is a network that connects computers that are placed relatively close to each other. For example, a network within an office connecting users, allowing them to share resources such as files, printer or modem can be categorized as LAN or a college campus connecting laboratory, rooms, library and administrative offices [1]. Fig. 1 shows a typical Local Area Network set-up.

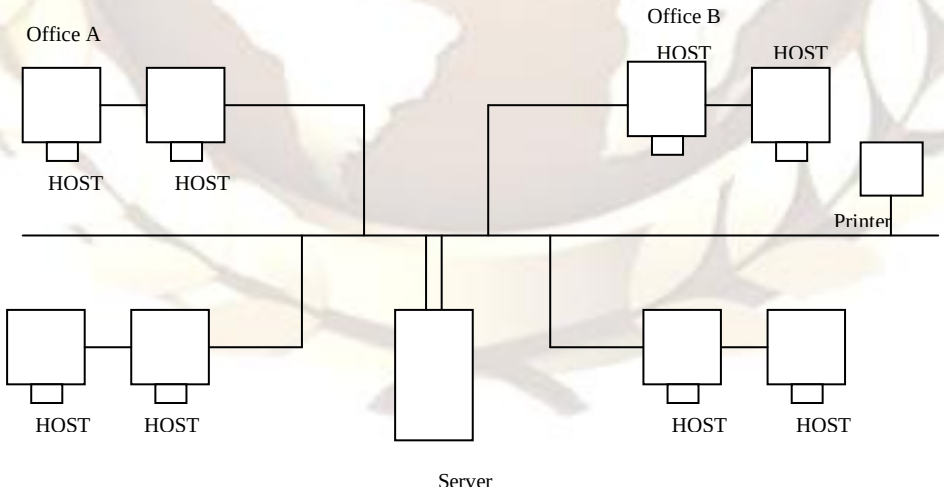

Fig. 1: A Local Area Network set-up

Generally, LANs are confined to a single building, or buildings within an area. The maximum distance from one end of a network to another is usually limited by the signal strength. Ordinarily, a LAN network can be wired or wireless [2]. A wireless local area network (WLAN) is a network connection without using wire.

Wireless local area network has many parameters such as Data rates, Buffer sizes, Fragmentation Threshold, Physical characteristics, etc. These parameters or attributes are normally tuned or varied to different scenarios in order to get the results of different qualities of service or metrics like throughput, data dropped, delay, media access delay, retransmission attempts, etc [3]. This paper thus examines the effects of tuning or varying different fragmentation thresholds on the data dropped and retransmission attempts in a wireless local area network.

As earlier stated, fragmentation threshold specifies the values to decide, if the MAC Service Data Unit (MSDU) received from the higher layer needs fragmentation before transmission. The number of fragments to be transmitted is calculated based on the size of the MSDU and the fragmentation threshold [4]. If the size of the MSDU received from a higher layer exceeds the threshold, the packet is fragmented.

OPNET IT guru 9.1 academic edition software was used for the analysis. In OPNET, the default value of fragmentation threshold is none, which means that no fragmentation will take place regardless of the MSDU size. The destination station receives these fragments and stores them in the re-assembly buffer until all fragments are received. This fragmentation and re-assembly is implemented using the built-in Segmentation and Reassembly (SAR) packed in OPNET IT guru 9.1 academic edition. If there is fragmentation of packets before transmission, this will definitely increase the load on both the transmitter and the receiver [5]. It is necessary to mention some analytical theories associated with transmission and dropping of packets such as Receive To Send/Clear To Send (RTS/CTS) threshold, Packet inter-arrival time, and packet drop probability.

1.1 RTS/CTS Threshold

This network parameter specifies a threshold that is used to determine whether or not RTS/CTS packet exchange is required for a particular data packet. If the MAC Service Data Unit (MSDU) received from higher layer in the protocol stack is larger than the RTS threshold, RTS/CTS exchange is needed for medium reservation [6]. The default value for this attribute in OPNET is none, which means that no RTS/CTS exchange takes place regardless of the MSDU size. Note that although RTS/CTS exchange is optional in the protocol, all stations should be able to respond to the CTS sent by any remote station when necessary.

1.2 Packet Inter-arrival time Analysis

The packet inter-arrival time is defined as the time interval between two successful packet receptions at the receiver and can be simply obtained from throughput [7]. The inter-arrival time is given as:

$$E[D_{inter}] = \left(\sum_{j=0}^{\infty} p^{j(m+1)} \sum_{i=0}^{m} p^{i} \frac{W+1_i}{2} \right) E[D_{slot}] \quad \ldots (1)$$

Where: $E[D_{inter}]$ is the average packet inter-arrival time and $E[D_{slot}]$ is the average packet slot time.

The average packet delay $E[D]$, average packet inter-arrival time $E[D_{inter}]$, and average packet drop time $E[D_{drop}]$ are related by the expression:

$$E[D] = E[D_{inter}] - \frac{P_{drop}}{1-P_{drop}} E[D_{drop}] \quad \ldots\ldots (2)$$

Where P_{drop} is the packet drop probability

However, the expression:

$$Pdrop/(1-pdrop) = p^{m+1}/(1-p^{m+1}) \quad \ldots (3)$$

represents the average number of dropped packets needed for a successful transmission. The expression in equation (2) is of key importance since it gives insights into the delay characteristics of WLAN back-off mechanism and relates the average packet delay with the packet inter-arrival time, the packet drop probability, and the average time to drop a packet.

1.3 Packet Drop Probability

The packet drop probability is defined as the probability that a packet is dropped when the retry limit is reached. A packet is found in the last back-off stage m if it encounters m collisions in the previous stages and it will be discarded if it experiences another collision [8]. Therefore packet drop probability can be expressed as a function of the last back-off stage and the collision probability P as

$$P_{drop} = P^{m+1} \quad \ldots\ldots\ldots\ldots (4)$$

Where m is the last back-off reached by the packet.
P is the collision probability.

2.0 Implementation using OPNET IT GURU (9.1 Academic Edition Software)

The network was set up and represented as shown in Fig. 2. Four terminals or nodes were used in the implementation. The four terminals were placed within 62.5metres x 62.5metres since it is a WLAN network.

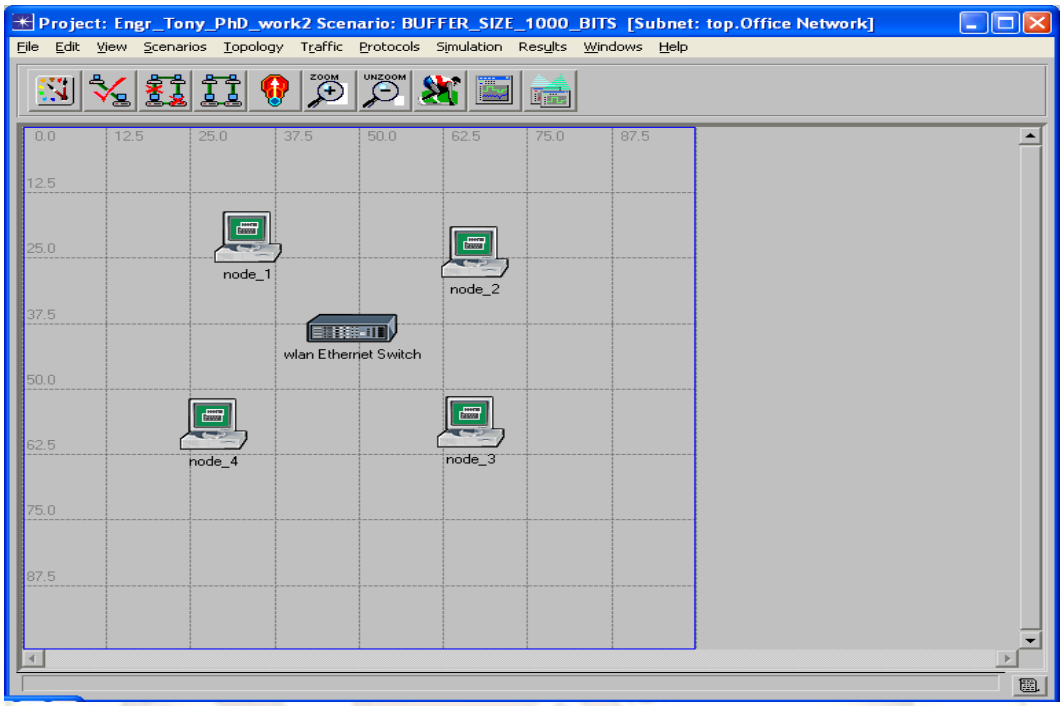

Fig. 2: A WLAN Network with four nodes implemented in an OPNET environment

Since the effects of different fragmentation thresholds on data dropped and retransmission attempts in a WLAN are to be analyzed, all the network parameters are to be kept constant while only the fragmentation threshold is to be tuned or varied to different scenarios. Table 1 shows the three scenarios for the simulation study. The first one was with no fragmentation threshold of incoming packets. The second one was with a fragmentation threshold of 16 bytes, and the third one was with a fragmentation threshold of 256 bytes.

Table 1: Table showing the fragmentation thresholds (FTS) used on different scenarios.

Attributes (Parameters)	Scenario-1	Scenario-2	Scenario-3
Data-rates	11 Mps	11 Mbps	11Mbps
Buffer Sizes	12800bits	12800bits	12800bits
Fragmentation Threshold	None	16 bytes	256 bytes
Physical characteristics	DSSS	DSSS	DSSS

3.0 Simulation Results and Discussions

Simulations were carried out using the data in table 1. The fragmentation threshold was varied from none to 16 bytes and then to 256 bytes, while other parameters were left constant. The metrics or qualities of service examined were the Data Dropped and Retransmission Attempts.

(a) Data Dropped

From the simulation result of Fig. 3, it can be concluded that fragmentation increases the size of queue and the number of data dropped in a transmission. This increase is more for smaller fragmentation threshold. However fragmentation increases the quality of service in terms of throughput when the bit error rate is high.

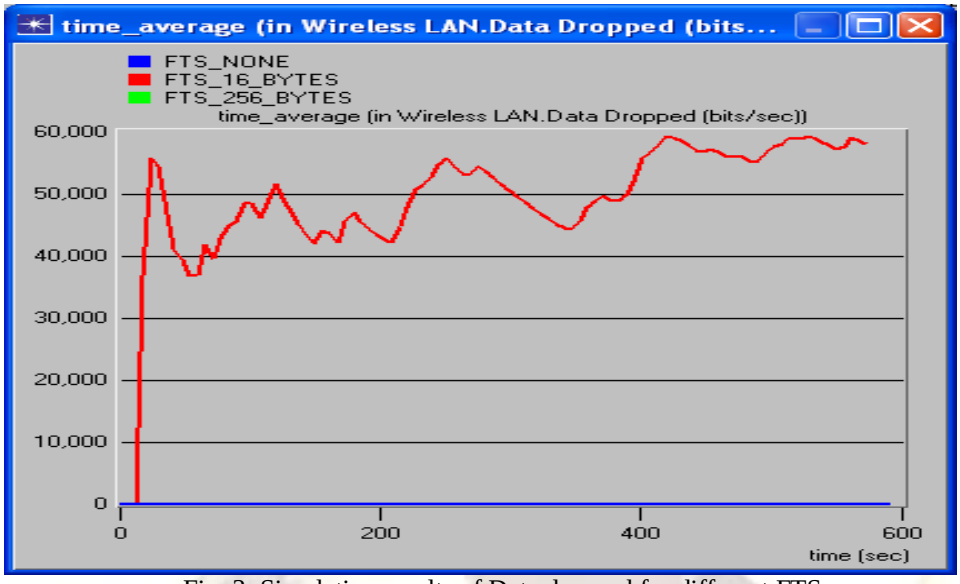

Fig. 3: Simulation results of Data dropped for different FTS

(b) Retransmission Attempts

The simulation graph as shown in Fig. 4 shows that smaller fragmentation increases the retransmission attempts. This is because the buffer will be filled up and this increases the data dropped, hence retransmission of failed packets occurs.

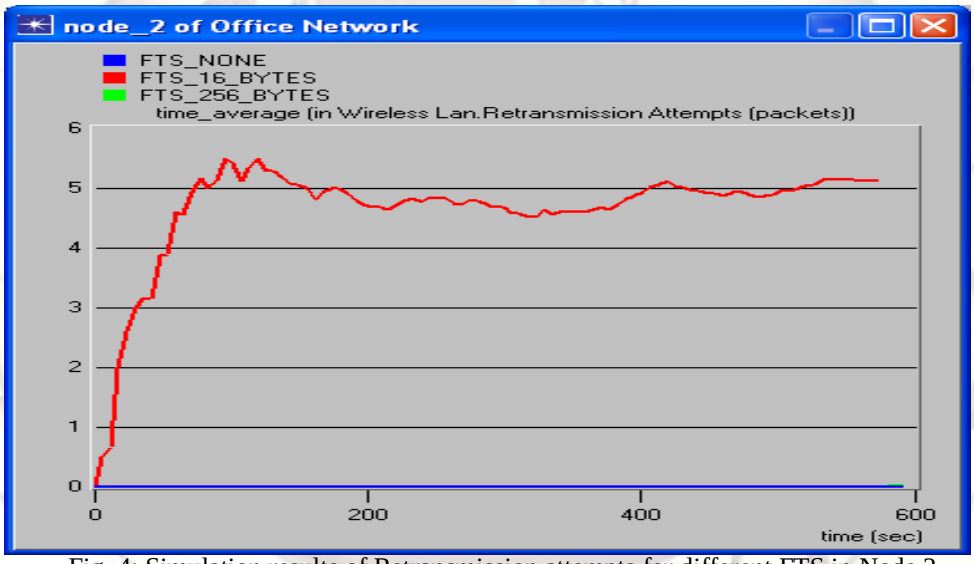

Fig. 4: Simulation results of Retransmission attempts for different FTS in Node 2

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