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Performance Evaluation of Duplex Mode Parameter in A Wired Local Area Network

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Abstract- This paper discusses the performance evaluation of duplex mode parameter in a wired local area network (IEEE 802.3 wired LAN) with four nodes. IEEE802.3 is a protocol standard used for a Wired Local Area Network (Wired LAN). A wired LAN connects computers that are placed relatively close to each other with wires. In this paper, two duplex mode parameters were considered: Full duplex and Half duplex; but the metrics studied were traffic received and bit error rate. A software called OPNET was used in this research to simulate the wired LAN with four nodes by varying the full and half duplex mode parameters so as to study the effects on the qualities of service: the Traffic received and Bit error rate. Graphical results obtained show that when full duplex mode was implemented, the traffic received was increased, but for half duplex mode, it was lower. The result also confirmed that when full duplex mode was implemented, the bit-error rate reduced to zero. These results validated the theoretical concept on the usage of full duplex mode parameter at all times.

Keywords: Bit error rate, duplex mode, Media Access Control layer, packet delay, software, traffic received, Wired LAN.

1. INTRODUCTION

A local area network (wired or wireless LAN) is a group of computers and associated devices that share a common communications line or wireless link. Typically, connected devices share the resources of a single processor or server within a small geographic area (for example, within an office building). Usually, the server has applications and data storage that are shared in common by multiple computer users. A local area network may serve as few as two or three users (for example, in a home network) or as many as thousands of users (for example, in an FDDI network) [1].

IEEE802.3 is a protocol standard for a Wired Local Area Network (Wired LAN). A wired LAN connects computers that are placed relatively close to each other with wires. For example, a wired network within an office connecting users, allowing them to share resources such as files, printer or modem can be categorized as a wired LAN [2].

To achieve this, switches or hubs are used to connect such multiple hosts together to form the wired LAN network. Unlike a hub, a switch can

forward a message to a specific host. When a host forwards a message to another host on the switch, the switch accepts and decodes the frames to read the physical Media Access Control address (MAC Address) portion of the message.

A table on the switch, called a MAC address table, contains a list of all of the active ports and the host MAC addresses that are attached to them. When a message is sent between hosts, the switch checks to see if the destination MAC address is in the table list; if it is, the switch builds a temporary connection called a circuit between the source and destination ports [3]. This new circuit provides a dedicated channel over which the two hosts can communicate.

Other hosts attached to the switch do not share bandwidth on this channel and do not receive messages that are not addressed to them. A new circuit is built for every new conversation between hosts. These separate circuits allow many

conversations to take place at the same time, without collisions occurring [4].

What happens when the switch receives a frame addressed to a new host that is not yet in the MAC address? If the destination MAC address is not in the table, the switch does not have the necessary information to create an individual circuit. When the switch cannot determine where the destination host is located, it uses a process called flooding to forward the message out to all attached hosts [5]. Each host compares the destination MAC address in the message to its own MAC address, be only the host with the correct destination address process, the message and responds to the sender.

IEEE 802.3 standard is used for 1-peristent CSMA/CD (Carrier Sense Multiple Access/Collision Detection) LAN, which is commonly known as Ethernet. Using the transmission media idle. Due to this, it is known as 1-persistent CSMA. The IEEE 802.3 standard is used for Ethernet. The IEEE 802.2 standard falls under MAC sub layer of the Data Link layer and the OSI physical layer. The IEEE 802.3 standard falls under Network Access layer of the TCP/IP architecture [6].

Ethernet is an inexpensive, reasonably fast, and very popular LAN technology. The other LAN technologies such as Token FDDI and ATM are more complex and expensive as compared to Ethernet. Ethernet was developed by Digital, Intel, and Xerox Corporation and was known as DIX Ethernet. It was originally developed by Bob Metcalfe and David Boggs of the Xerox Paid Alto Research Centre (PARC). It interconnected Xerox Alto computers and laser printers at a data transmission rate of 2.94 Mbps. The first version, referred to as experimental Ethernet, operated at 3 Mbps and used 8-bit address. This version was later upgraded to Ethernet version 1 and 2 then to Ethernet version 2.

Ethernet is currently used for approximately 85 percent of the World's LAN-connected PCs and workstations. One of the main reasons for the popularity of Ethernet is the Ethernet's protocol [7]. In the OSI model, Ethernet technology operates at the physical and data link layers. In the TCP/IP architecture, Ethernet operates at the network access layer. Ethernet supports all higher-level, implement, manage, and maintain. These protocols provide extensive topological flexibility for network installation. Ethernet protocols can run on different network topologies such as bus topology and star topology [8].

An Ethernet LAN can use a coaxial cable, a twisted pair wiring, or a fiber optic cable. Ethernet cables can use a coaxial cable, a twisted pair wiring, or a fiber optic cable. Ethernet cables can transmit data from 10Mbps to 10 Gigabits per second. The most popular cable used in the Ethernet technology is Category 5 (CAT5) and category 5e (CAT5e) [9].
With the growing popularity of the Ethernet technology, Ethernet hardware has also become a product. The Ethernet hardware consists of many hardware devices such as network adapter card, cables, connectors, and hubs. The most popular among these are network adapter or Network Interface Card (NIC). Network Interface Cards are also known as Ethernet cards. They are used to connect Ethernet cables to a computer with the help of a connector. They come with an Ethernet address embedded in it [10].

2. WIRED LAN IMPLEMENTATION

In this wired network, two duplex mode parameters were considered: Full duplex and Half duplex; but the metrics studied were traffic received and bit error rate.

The Wired LAN network for this research paper involves four terminals, and these terminals or nodes were placed within 75.0metres x 62.5metres. Figure 1 below shows the implementation using Opnet IT Guru Academic edition software.

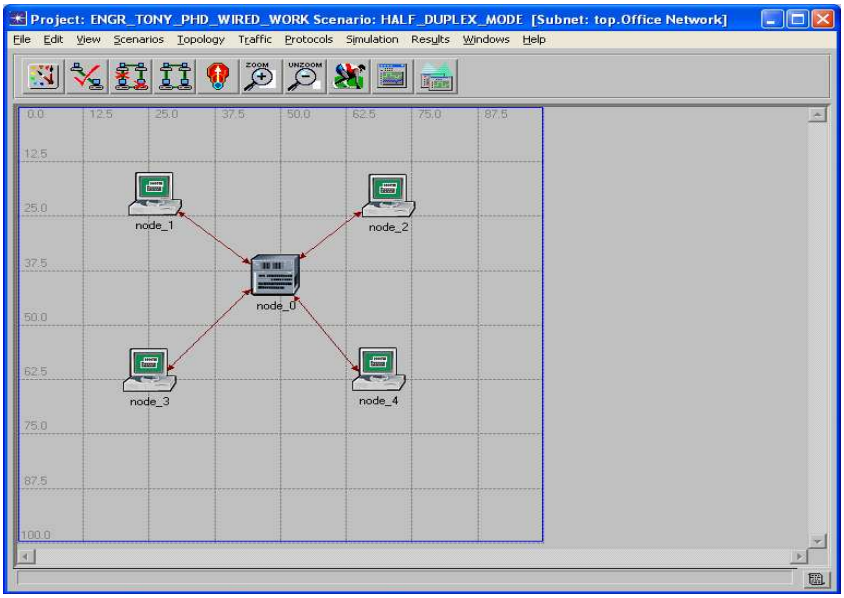

Fig. 1: WLAN Implementation using Opnet simulator

In implementing Wired LAN network for this paper, the duplex mode parameter was varied. The variation was from full-duplex mode to half-duplex mode. This is shown in Table 1.

Table 1: Wired LAN parameter and its scenarios

Attribute	Scenario 1	Scenario 2
Duplex mode	Full duplex	Half duplex

3. SIMULATION RESULTS AND ANALYSIS

(a) Traffic Received

Figure 2 shows that when full duplex mode was implemented, the traffic received was increased, but for half duplex mode, it was lower.

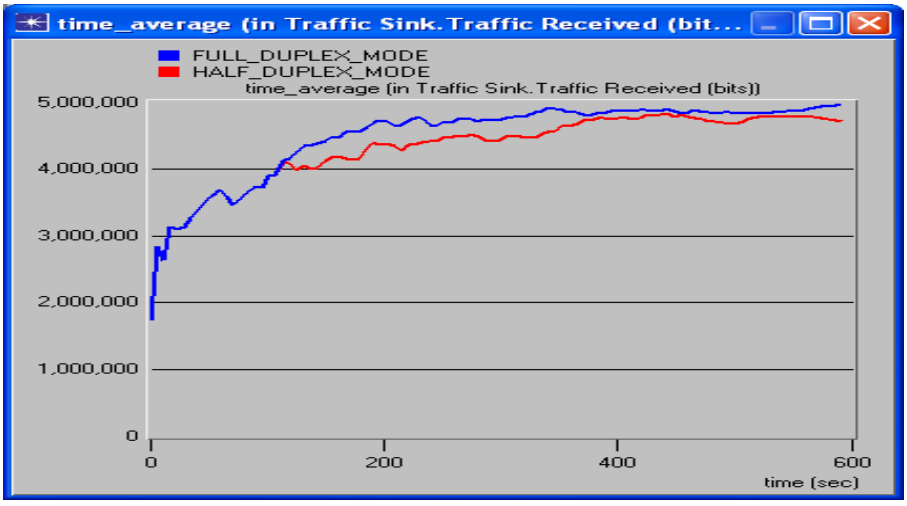

Fig. 2: Traffic received in full duplex mode and half duplex mode

(b) Bit Error Rate

The number of bits corrupted or destroyed as data was transmitted from its source to destination increased when half duplex mode was used on this network. When full duplex mode was implemented, the bit-error rate reduced to zero. Figure 3 confirms this.

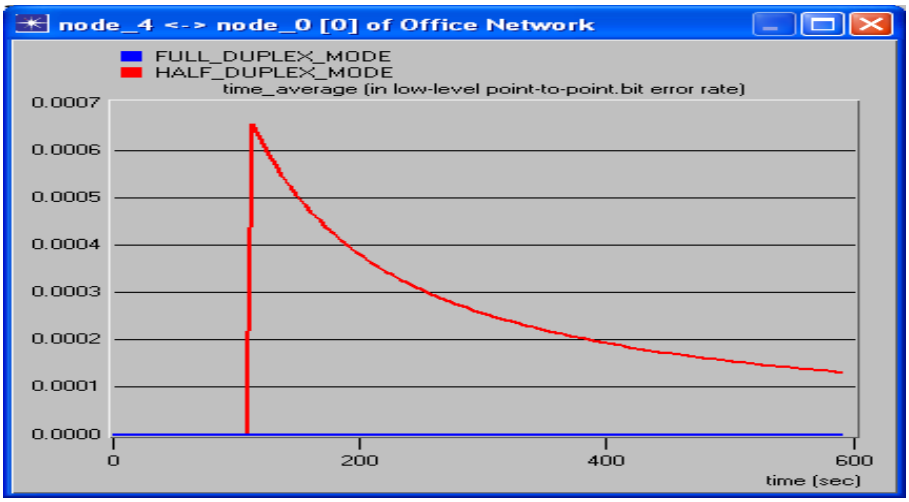

Fig. 3: Bit error rate for full duplex mode and half duplex mode

4. CONCLUSION

A Local Area Network (LAN) is a group of computers and associated devices that share a common communications line or wireless link. Typically, connected devices share the resources of a single processor or server within a small geographic area. A Local Area Network (LAN) can either be wireless and wired LAN. For a LAN device to be used its parameters are to be tuned to valid positions so as to obtain good qualities of service.

However this research paper analyzed the effects of full and half duplex mode parameters on the performance of wired local area network (IEEE 802.3) by examining two qualities of service: the Traffic received and Bit error rate. The graphical results showed that when full duplex mode was implemented, the traffic received was increased, but for half duplex mode, it was lower. The result also confirmed that when full duplex mode was implemented, the bit-error rate reduced to zero. These results validated the theoretical concept on the usage of full duplex mode parameter in a wired local area network. In a full duplex, switch and station can communicate with each other simultaneously, and therefore modern Ethernets are completely collision-free.

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