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Analyzed Throughput of Fast Ethernet and FDDI LANs using OPNET Modeler

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Abstract-In the recent years, LAN services have evolved from simple file printing, service sharing to applications that include large files, multimedia, and Internet access. The growing pressure on backbones over the years has first led to the deployment of faster shared-media LAN technologies such as FDDI, and, more recently, to the use of switched high-speed LAN technologies including fast Ethernet. The aim of this research paper is to analyze and compare the throughput of LANs using Fast Ethernet and FDDI under two scenarios of different no. of users using simulator OPNET-MODELER. By analyzing the graphs, it is concluded that performance of FDDI backbone is better than Fast Ethernet. Even when no. of users is increased beyond the certain limit that a network can deploy, the throughput of FDDI is better.

Keywords- Fast Ethernet,FDDI,OPNET-MODELER,Network Simulation,Throughput.

1. INTRODUCTION

As the volume of LAN traffic increases, typical 10 Mbps shared Ethernet backbones are becoming insufficient to handle the traffic.

A. Introduction to Backbones: Fast Ethernet and FDDI

Being the first high-speed (100-Mbps) LAN technology, FDDI saw great success in enterprise LAN backbones because of its two attributes: First, its dual-ring topology provides a high degree of fault tolerance. Second, FDDI’s token-passing access scheme provides deterministic performance, which means, as the number of end stations on an FDDI ring increases, performance will not degrade fast. Fast Ethernet is another LAN backbone which can deliver 100Mbps bandwidth [1]. It has same frame format and frame length as Ethernet, which makes it can easily be integrated with traditional Ethernet. Due to its low cost and high performance, Fast Ethernet has once gained widespread acceptance over FDDI for client and server connectivity.

Ethernet is a family of frame-based computer networking technologies local area network (LAN) [4]. It defines a number of wiring and signaling standards for the Physical layer of the OSI networking model as well as a common addressing format and Media Access Control (MAC) at the Data Link Layer. The most common forms used are 10BASE-T, 100BASE-TX, and 1000BASE-T. Fast Ethernet is also known as 100Base-T [3].

The fiber distributed data interface (FDDI) is a multi-access, packet-switching local area network (LAN) that operates at 100 megabits (Mb) per second [2]. The standard uses optical fibers as the transmission medium and allows rings with default maximum size of 1000 physical connections with a total fiber path length up to 200 kilometers [6]. Normal data traffic and time-constrained traffic, such as voice, video, and real-time applications, are supported. All major computer and communications vendors and integrated circuit manufacturers offer products that comply with this standard.

B. Throughput as Performance Metrics

In communication networks, such as Ethernet or packet radio, throughput or network throughput is the average rate of successful message delivery over a communication channel [5]. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot. The analog limitations of wires or wireless systems inevitably provide an upper bound on the amount of information that can be sent [8].

C. Overview of OPNET MODELER Simulator

OPNET Modeler is a popular network simulation software package that provides a flexible and accurate platform for evaluating the performance of a variety of networking technologies. OPNET Modeler gives access to a rich set of API calls and process models usually implemented in the programming language called Proto-C which is a combination of the C/C++ programming language and state transition diagrams. These features of OPNET software make almost any aspect of simulated networking technologies modifiable and allow for the development and study of new communication devices, protocols, and networking paradigms. A number of editors are provided to simplify the different levels of modeling that the network operator requires. Modeler is not open source software though model parameters can be altered, and this can have a significant effect on the simulation accuracy [7].

II. PERFORMANCE EVALUATION

The Ethernet is a multi-access network, meaning that a set of nodes sends and receives frames over a shared link. It implements the capability of transmitting and monitoring a connected bus link at a same time. It has full duplex capability. For Successful performance evaluation, we will consider two scenarios, one of 16 users and other of 100 users.

A. Simulation set-up for Fast Ethernet

The Fast Ethernet network model operating at a data rate of 100 Mbps in a star topology using OPNET Modeler with 16 users can be made by using the parameters as shown in Table1.

Table 1: Parameters for Fast Ethernet Model

Start > New > File > Project_name > scenario-1 > create empty scenario > campus > X,Y =10 miles > Model family - Ethernet	
Topology	Rapid Configuration
Configuration	Star
Centre Node Model	Ethernet 16_switch
Periphery Node Model	Ethernet_station
Link Model	100 Base T
Number	16
Centre X,Y	5.0
Radius	2.5

The network is as shown in Fig. 1. Similarly this baseline network can be expanded for scenario-2 with 100 users and is as shown in Fig. 2.

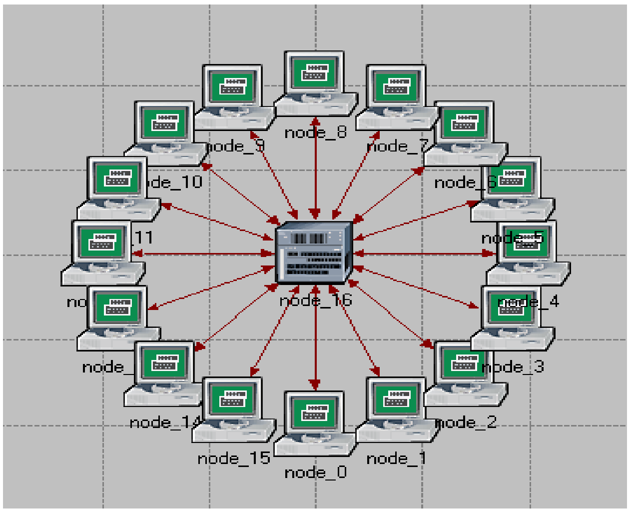

Figure. 1: Fast Ethernet Network for 16 Ethernet Stations

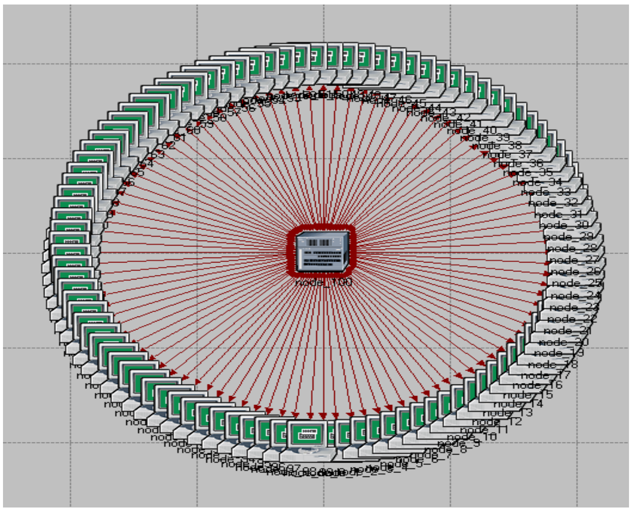

Figure. 2: Fast Ethernet Network Model for 100 Ethernet Stations

B. Simulation set-up for FDDI

The parameters for creating the FDDI network model are almost same as that of Fast Ethernet operating at a data rate of 100 Mbps in a star topology using OPNET Modeler except a few as shown in Table 2.

Table 2: Parameters for FDDI Model

Model Family	FDDI
Centre Node Model	FDDI 16_switch
Periphery Node Model	FDDI_station
Link Model	FDDI

After selecting all the desired parameters, the network appears as shown in Fig. 3. Similarly this baseline network can be expanded for scenario-2 with 100 users and is as shown in Fig. 4.

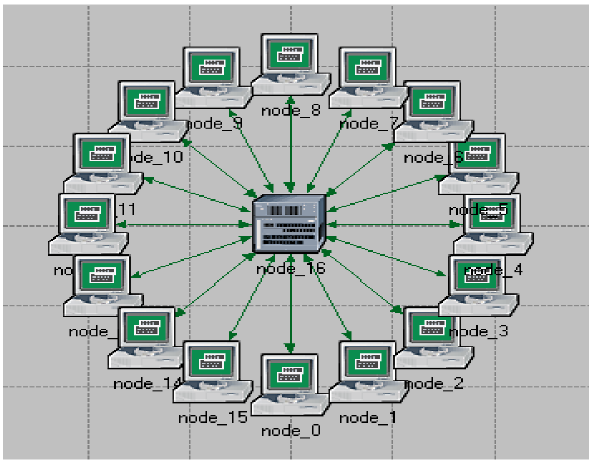

Figure. 3: FDDI Network Model for 16 Stations

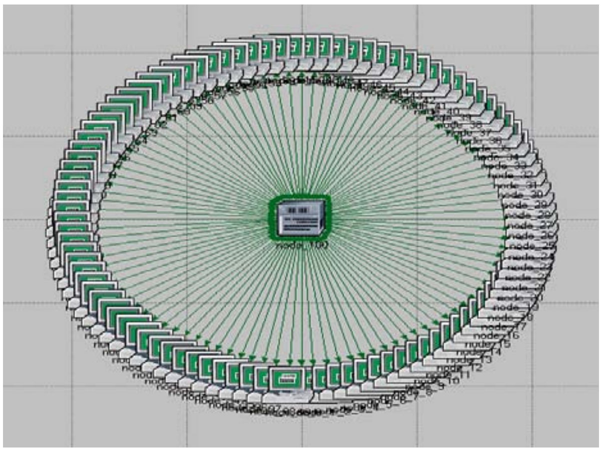

Figure. 4: FDDI Network Model for 100 Stations

III. PERFORMANCE ANALYSIS

A. Result Analysis for Fast Ethernet

After creating the network models, run the Configure Discrete event simulation for particular duration. Then result of Scenario-1 of 16 Ethernet users for Global Statistics is as shown in Fig. 5. It is observed that the throughput range when 16 users are deployed is about 3,000 to 10,000 bits/sec. In this LAN, ethernet16_switch is used which shows better performance when maximum 16 users are connected. So, increasing the number of users will affect the performance and throughput of the network. Throughput increases and decreases relative to collision count and traffic at that time. During large traffic, the rate of collision count increases which further affects the throughput of the system. For scenario-2 as shown in Fig. 6 when the number of users is increased to 100, the throughput in less as compared to previous scenario because more overhead and delay is encountered.

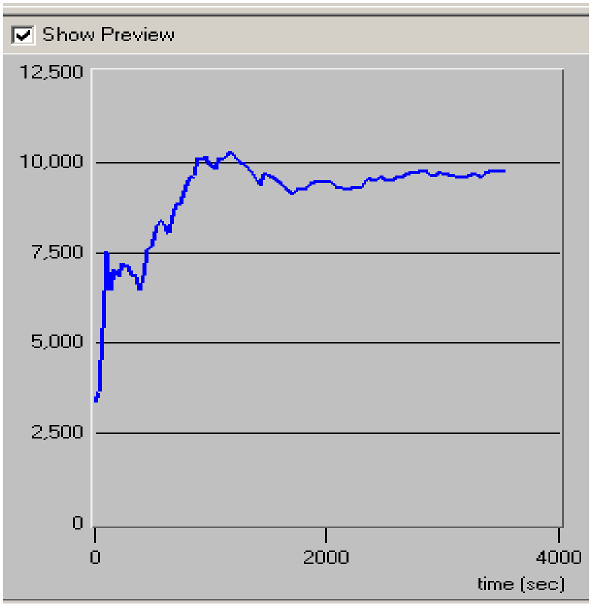

Figure. 5: Throughput (bits/sec) of 16 users for Fast Ethernet

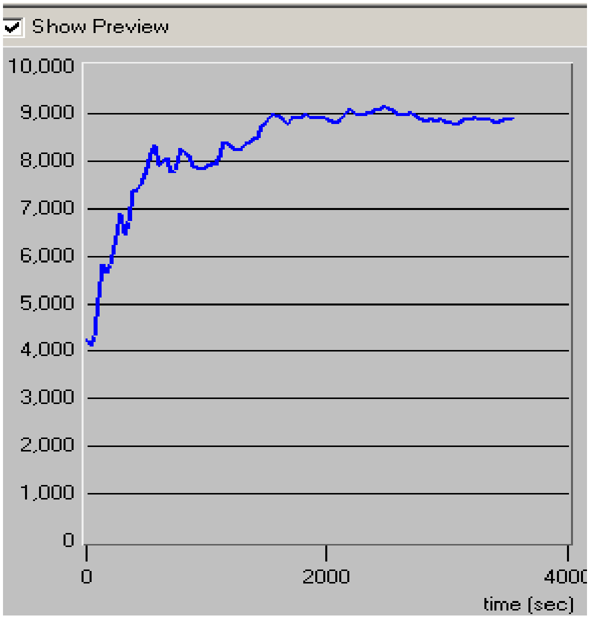

Figure. 6: Throughput (bits/sec) of 100 users for Fast Ethernet

B. Result Analysis for FDDI

The Result of Scenario-1 of 16 FDDI users for Global Statistics is as shown in Fig. 7. It is observed that the throughput range when 16 users are deployed is about 7,500 to 14,500 bits/sec. For scenario-2 as shown in Fig. 8, when the number of users is increased to 100, the throughput in less as compared to scenario-1.

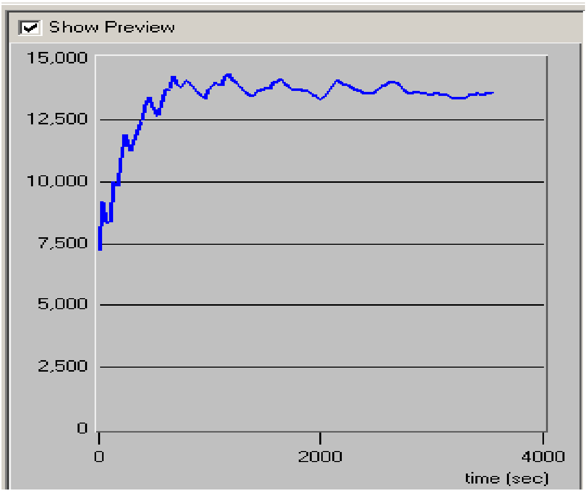

Figure. 7: Throughput (bits/sec) of 16 users for FDDI

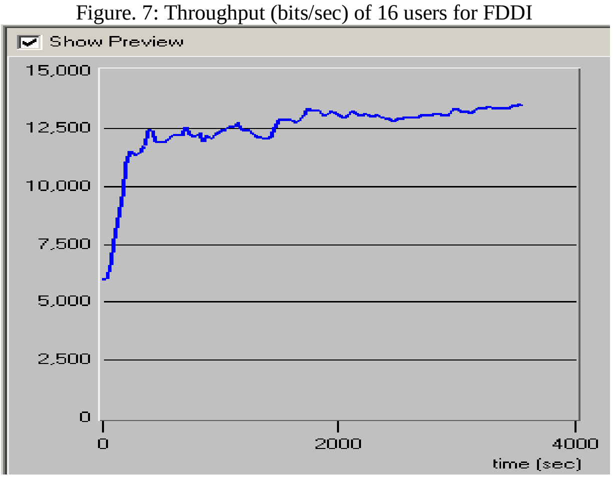

Figure. 8: Throughput (bits/sec) of 100 users for FDDI

C. Comparing Throughput of Fast Ethernet and FDDI

While comparing throughput graph of Fast Ethernet and FDDI in scenario-1 and scenario-2 of 16 and 100 users, the overlaid graph appears as shown in Fig. 9.

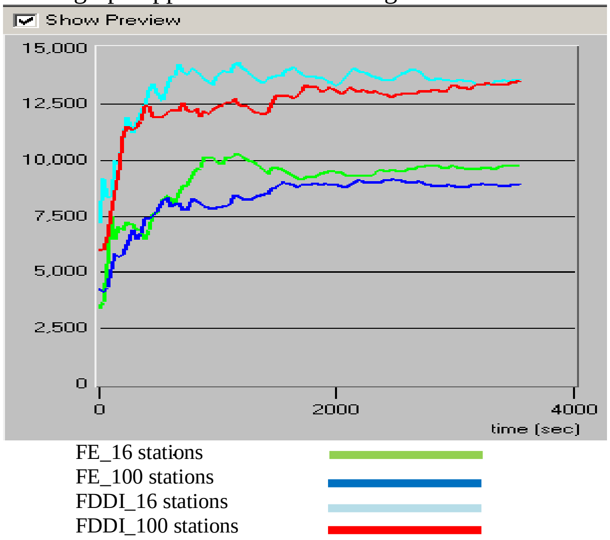

Figure. 9: Graph comparing throughput of Fast Ethernet and FDDI

IV. RESULTS AND CONCLUSIONS

By analyzing the graphs, it is observed that throughput of FDDI is greater than that of Fast Ethernet operating at transmission speed of 100 Mbps. The Fast Ethernet throughput begins with the small value than FDDI. Here, FDDI 16_switch is used which shows better performance when maximum 16 users are connected. When the number of users is increased to 100, the throughput is affected. The reason for this is propagation delay and overhead collisions affecting at that time. During large traffic, the rate of collision count increases which further deteriorates the performance of the system. In both the scenarios, it is observed that the protocols show best performance when appropriate number of users is deployed. Increasing the stations led to degradation of performance. So, throughput of FDDI network is better as compared to Fast Ethernet.

V. REFERENCES

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