Throughput Analysis of Ethernet and Fiber Distributed Data Interface using OPNET IT Guru Academic Edition 9.1

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Abstract: *Network performance is very important factor affecting telecommunication and distributed network applications. So this is crucial to understand overall network performance parameters such as throughput, delay and collision count. In all the experiments mentioned in this paper, some of the metrics has been benchmarked for evaluating network performance by creating two networks - Ethernet and Fiber Distributed Data Interface with the help OPNET IT Guru software. The tests were designed to measure a combination of network throughput, delay and collision count. The performance results provided interesting insights into the behavior of these networks under various load conditions. This paper covers the details about the experiments performed, their results and analysis of the performance.*

1. Introduction

This section includes the introduction of Ethernet, Fiber Distributed Data Interface and OPNET respectively. The Ethernet LAN (Local Area Network) has been in existence for about 25 years. The first implementation developed was at 3 Mbps data rate, in the Xerox research environment. Standardized in IEEE 802.3, Ethernet has largely replaced competing wired LAN technologies. The Fiber Distributed Data Interface (FDDI) specifies a 100-

Mbps token-passing, dual-ring LAN using fiber-optic cable [2]. FDDI is frequently used as high-speed backbone technology because of its support for high bandwidth and greater distances than copper. FDDI uses dual-ring architecture with traffic on each ring flowing in opposite directions (called counter-rotating). The dual rings consist of a primary and a secondary ring. During normal operation, the primary ring is used for data transmission, and the secondary ring remains idle. The primary purpose of the dual rings is to provide superior reliability and robustness.

The simulation tool for our global needs had to meet the following criteria:

- A network oriented simulation tool providing most of the standard protocols.
- Ability to model specific protocols and specific applications.
- Ability to bind these models to standard ones.
- Ability to provide timing aspects as accurately as possible for network exchanges

OPNET meets most of these criteria. OPNET (Optimized Network Engineering Tools) is a tool for modeling, simulation and performance analyzing of communication networks and communications protocols. OPNET was developed by MIL3, Inc. and runs on both UNIX and Windows NT machines. The tool can be used by developers to:

- Develop new protocols.
- Optimize existing protocols.
- Study the performance of existing protocols in different network topologies during varying traffic loads.

OPNET IT GURU Academic Edition has been chosen for this research because it provides the set of complete tools and a complete user interface for topology design and development. It is being extensively used and there is wide confidence in the validity of the results it produces.

2. Related Work

This section presents the literature survey on various aspects of throughput. The work done on Ethernet and Fiber Distributed Data Interface is also carried out in this section.

L.Pushparani Devi, S. Birendra Singh and Sanasam Bimol [2] investigated the existing Ethernet system (10Mbps) to find out the effective utilization of the system for obtaining the high performance with setting up the minimum changes in system parameters under exponential distribution method. Their research elaborates the simulation approach of Ethernet, Ethernet simulation parameters and mean values and Ethernet simulation model.

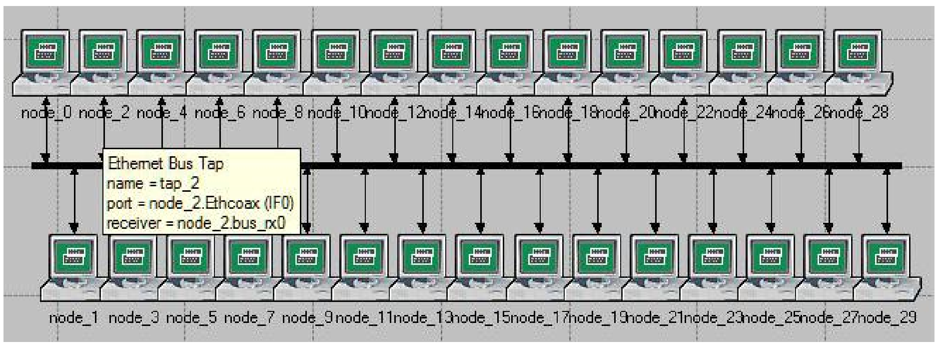
Nazy Alborz, Maryam Keyvani, Milan Nikolic, and Ljiljana Trajkovic in their research [3] describes the use of OPNET simulation tool for modeling and analysis of packet data networks such as Fiber Distributed Data Interface and Asynchronous Transfer Mode. To simulate the performance of Fiber Distributed Data Interface two distinct network topologies, FDDI hub configuration and FDDI client-server configuration are used.

Y. Y. Yang and R. Sankar in their research [6] evaluate the performance of Fiber Distributed Data Interface using CSIM simulation model. The FDDI uses timed token rotation as its timing scheme. A timed token network operates by passing a token sequentially, and whichever node holds the available token has the right to transmit frames. The station forwards the token as soon as its transmission is completed, even if none of the transmitted frames has returned.

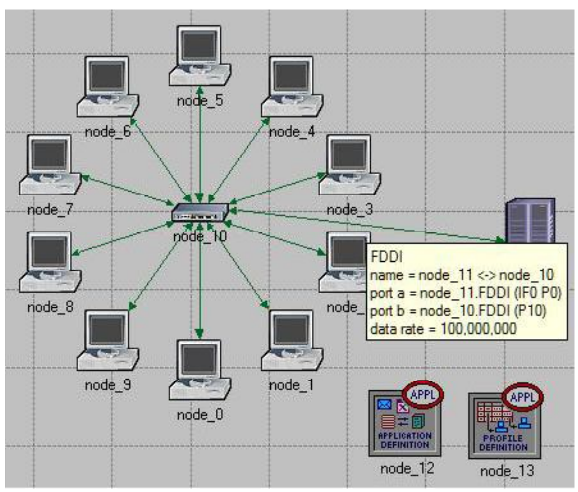
3. Experiments and Results

In this section two network models i.e. Ethernet and Fiber Distributed Data Interface are created with the help of OPNET IT Guru Academic Edition 9.1. Ethernet and FDDI model has been created in three different scenarios. In 1st scenario 10 nodes, in 2nd scenario 50 nodes and in 3rd scenario 100 nodes were taken respectively. The idea behind using 3 different scenarios is that it would produce better results for the network by comparing throughput and traffic analysis. Various metrics such as throughput, collision count, traffic analysis and delay were also compared in those 3 different scenarios.

The results for all three different scenarios are compared in the form of graphs as shown in the fig given below. Here, Ethernet network model is connected via coaxial link operating at a data rate of 10Mbps in a bus topology and Fiber Distributed Data Interface network model operating at 100Mbps transmission rate in a ring or hub topology as shown in scenario I and scenario II respectively.



SCENARIO I (Ethernet)



SCENARIO II (FDDI)

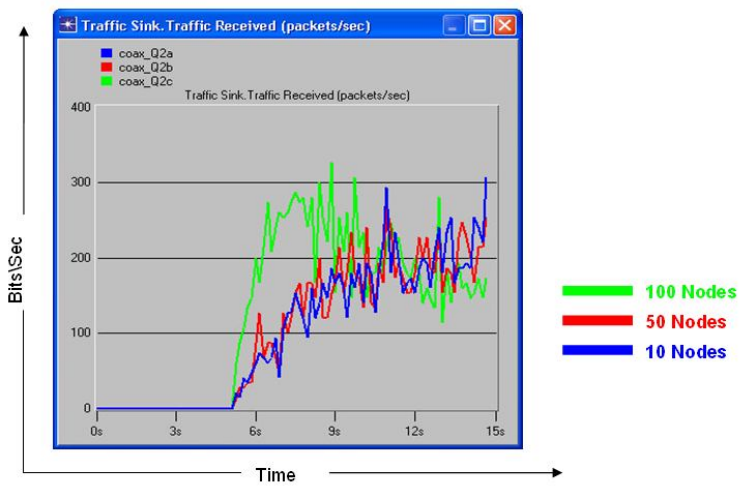


Fig 1 Throughput Traffic Received vs. Inter-Arrival Time

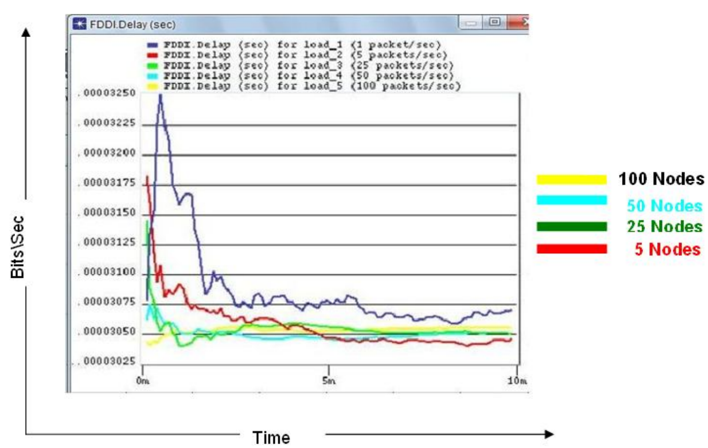


Fig 2 FDDI Delay (sec)

Some graphs were selected after simulating Ethernet and FDDI network model as shown in the Fig 1 and Fig 2. The Fig 1 graph shows the effect of the packet size on the throughput of the Ethernet network. The results shown in Fig 5.3 indicate that the throughput (traffic received) for the 512 byte packet (the coax_Q4 case) is greater than that one for the 1024 byte packets (the coax_Q2c case). The Fig 2 graph indicates the Fiber Distribution Data Interface (FDDI) Delay (sec) with inter-arrival time. As we can see from the graph that delay kept on varying w .r. t time in order to acquire a certain maximum level.

The performance of Ethernet and Fiber distributed data interface with network parameters such as throughput, delay and collision count using OPNET IT guru software has been evaluated. Non-monotonous relationship between the throughput and sent packets in traffic characteristics has been generated. In the case of throughput it increases with offered load and reached a certain value but once the maximum value is attained any further load leads to decrease in throughput.

In the Ethernet, collisions increases as the network is loaded, and this causes retransmission in load that causes even more collisions. On the other hand, in fiber distributed data interface collisions increases up to certain limit depending upon load. In both, cases Ethernet and fiber distributed data interface collision count is characterized by the average number of collisions.

Increasing the number of packets (load) in the network also increase the length of the queues at each server. Longer queues, means packets are delayed longer in the network, and, hence, the traffic received is dropped. Therefore, in order to maximize the throughput in the network, the load must be chosen carefully. The fact is that, as the traffic on the network increases, more collisions occur causing retransmission of frames and increasing their overall delay.

4. References

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