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A Strategy to Support Bandwidth Hungry Applications Over the Cloud

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Abstract: ***Bandwidth management over the cloud has become very essential today due to the increased utilization of real time traffic. Further inter-networking of physical devices over the internet, popularly called Internet of Things (IoT) to collect and exchange their data, added extra emphasis to the resource management over cloud for the designer. When two nodes in a computer network are not connected by a direct link, they are connected by the use of a switch. Packet switching is a digital networking communications method that groups all transmitted data into suitably sized blocks, called packets, which are transmitted via a medium that may be shared by multiple simultaneous communication sessions. In such a network if two or more than two nodes tries to send their packets at the same time, there is a possibility of collision to be occurred. In this paper an attempt has been made to get optimized performance in the context of collision count and several other parameters using a simulation model. Simulation results have been obtained and analysed by varying the number of nodes in the packet switched network.***

Keywords: Switched Network, Switches, Ethernet, Hubs, CSMA/CD, MAC, IoT

1. Introduction

In a data communication network, there must exist some protocol to handle the simultaneous transmission of data or packets, to avoid the lost of packet due to collision. Such mechanisms are of importance when the bandwidth is shared by multiple hosts. In general these protocols are referred as collision detection methods [1-2].

Carrier Sense Multiple Access/Collision Detection (CSMA/CD) is a commonly used method used by Ethernet for this purpose. Certain rules are being followed by the communication process. For example, when a peripheral device wishes to communicate, it sends the request for communication that reaches the switch. If another peripheral device communicates already, two messages are found at the same time on the network. The message from the first host is taken at the beginning of a queue, and the second host waits for trying again to communicate a few milliseconds later [3].

Internet of Things (IoT) is an advanced automation and analytics system which exploits networking, sensing, big data, and artificial intelligence technology to deliver complete systems for a product or service. In such systems physical devices are connected with each other over the internet for the purpose of exchanging information. These systems allow greater transparency, control, and performance when applied to any industry or system. IoT systems have applications across industries through their unique flexibility and ability to be suitable in any environment. They enhance data collection, automation, operations, and much more through smart devices and powerful enabling technology [2-4].

The Media Access Control (MAC) data communication Networks protocol sub-layer, also known as the Medium Access Control, is a sub-layer of the data link layer specified in the seven-layer of OSI model. The medium access layer was made important by systems that share a common communications channel. According to the IEEE standard this layer is again sub divided in two layers, above is the control layer the logical connection (Logical Link Control, LLC) and down the control layer the medium access (MAC) [4].

In this paper a platform has been implemented for performance assessment of Ethernet for different scenarios by varying the number of network devices and studied some network parameters like collision count, throughput and latency. The rest of the paper is organized as follows. In section 2, MAC layer protocols have been discussed. Thereafter, in section 3, the network topology has been demonstrated. After that, we have compared the obtained results from simulation in section 4. Finally, conclusion is presented in section 5.

2. MAC Layer Protocols

Ad-hoc networks have no fixed network infrastructure or administrative support. As mobile nodes join or depart the network, the topology of the network changes dynamically. This topology changes are also based on radio links between nodes become unstable. Numerous challenges must be overcome to realize the practical benefits of ad-hoc networking. These include effective routing, medium access and mobility management, power management and security, quality of services like delay and bandwidth management.

We can consider the data link layer as two sub layers. The upper sub layer is responsible for data link control and the lower sub layer is responsible for resolving access to the shared media. If the channel is dedicated, we do not need the lower sub layer. When nodes are connected and use a common link, we need a multiple access protocol to coordinate access to the link. The problem is similar to the rules of speaking in an assembly [5-6].

In general, multi access methods are of three types, fixed assignment, random access and demand assignment. For bursty traffic environment fixed assignment techniques such

as TDMA, FDMA are efficient. Random access methods, such as ALOHA and CSMA/CD, are enable to guarantee the performance of integrated traffic. Also, carrier sensing is not effective in the radio environment where transmission from adjacent nodes interface with one another. Demand assignment access methods are the most appropriate for radio environment. Here the users use a control channel to request or reserve access bandwidth as needed. Several demand assignment MAC protocols have been proposed in the recent years, such as dynamic TDMA protocols, extended packet reservation multiple accesses, the hybrid TDMA/CDMA protocol and the contention free reservation protocol [7].

For the random access mechanisms no station or node is superior to the other to control the exchange of data. No scheduling time is there for a node to transmit data. The nature of transmission is random among the stations. No rule is specified for which station will send next. All the nodes compete with one another to access the medium that is why it is also called contention method. In channelization method the available bandwidth of the link is shared in time (TDMA), frequency (FDMA) or through code (CDMA) between different stations [8].

3. Network Topology

To support all ATM services to an end user, a MAC protocol must be able to provide bandwidth on demand. For some services bandwidth requirements vary over the duration of the connection; therefore a MAC protocol also has to be able to assign bandwidth in a dynamic manner. In CDMA paradigm it is suggested that more than one code may be assigned to a single user. This of course increases the complexity of the system.

In order to demonstrate the performance of different networks, a hypothetical network topology has been considered. Riverbed modeller academic edition 17.5 simulator is used to carry out the simulation. The link between the hubs and switch are considered as 10BaseT. All other links are also taken 10BaseT. Bandwidth requirement are much more for the nodes responsible for handling real time applications as multimedia traffics. So the workgroup should be appropriately segmented to keep the traffic low in that particular LAN segment. FTP, voice, and video traffics are considered for each scheduling disciplines. Separate server is taken for each traffic type.

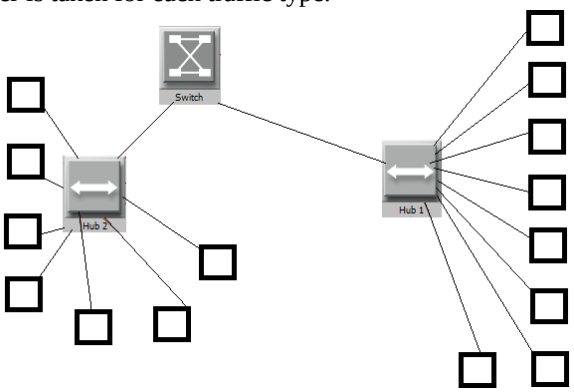

Figure 1: The Network Topology.

The effective transmission bandwidth to each user can be increased by replacing repeaters or hubs. Again bandwidth availability can be enhanced by full duplex operation. Workgroup switches should be provided with high speed ports for connecting to servers [5].

Traffic Generation Parameters	(...)
Start Time (seconds)	constant (5.0)
ON State Time (seconds)	exponential (100.0)
OFF State Time (seconds)	exponential (0.00001)
Packet Generation Arguments	(...)
Interarrival Time (seconds)	exponential (0.02)
Packet Size (bytes)	constant (1500)

Figure 2: Traffic generation parameters.

Simulation start time is kept constant (5.0 second). ON state and OFF state times are kept exponential in nature. Packets are allowed to transmit with exponential inter arrival time of 0.02 seconds. The size of the packets is kept at constant value 1500 bytes. Simulation results are collected after consecutive simulation runs, for selected global statistics. These results are discussed in the next section.

RED Parameters	(...)
RED Status	RED Enabled
Exponential Weight Factor	8
Minimum Threshold	200
Maximum Threshold	400
Mark Probability Denomi...	12
CE Marking	Disabled
Queue Category	None

Figure 3: Random Early Drop definition.

For proper queuing mechanism at the switch, the effect of random early drop policy is also verified. The minimum and maximum threshold is kept between the ranges 200 to 400. When the average queue size is at maximum threshold, the fraction of packets drop is mentioned by mark probability denominator. This value is considered 12 in this case. To calculate the average queue size based on the previous average and current queue size we use exponential weight factor. In this paper its value is kept at 8.

4. Simulation Results

Bandwidth requirement is much higher for real time traffic like multimedia traffic. To keep the load at lower level in any local area network, the nodes should be properly segmented. Introduction of hubs along with a switch can sufficiently increase the effective transmission bandwidth for each node. Bandwidth availability is further increased by the full duplex mode of operation. Nodes are connected with the servers with high speed ports. In this study we will see how the throughput and latency characteristics are improved with the application of switch [2].

There is a significant amount of improvement in collision count in the network due to the application of switch. The result can be observed from Figure 4. Carrier Sense Multiple Access/Collision Detection (CSMA/CD) is a commonly used

method used by Ethernet for this purpose. Certain rules are being followed by the communication process. For example, when a peripheral device wishes to communicate, it sends the request for communication that reaches the switch. If another peripheral device communicates already, two messages are found at the same time on the network. The message from the first host is taken at the beginning of a queue, and the second host waits for trying again to communicate a few milliseconds later. Since the decoding of the MAC address is fast and the switch can, in very little time, respond with a jam message, collision or packet loss can be avoided [5, 8].

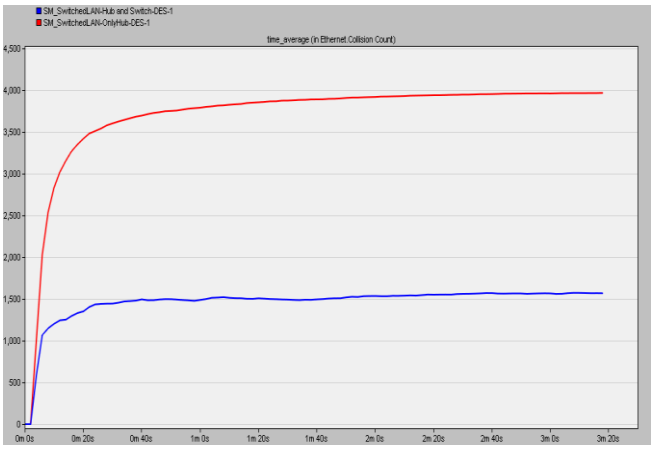

Figure 4: Collision count

For the two different simulation scenarios, it is very much clear from the results that, although the traffic considered for transmission is nearly similar, but the receiving of traffic is improved for the scenario where both hub and the switch is used. Application of switch in the network also dramatically improved the network performance in terms of end-to-end delay. A network is a set of connected devices. Whenever we have multiple devices, we have the problem of how to connect them to make one-to-one communication possible. One solution is to make a point-to-point connection between each pair of devices or between a central device and every other device. These methods, however, are impractical and wasteful when applied to very large networks. A better solution is switching. A switched network consists of a series of interlinked nodes, called switches. Switches are devices capable of creating temporary connections between two or more devices linked to the switch. In a packed switched network there is no resource reservation; resources are allocated on demand. The further simulated results are demonstrated in Figure 5, Figure 6 and in Figure 7.

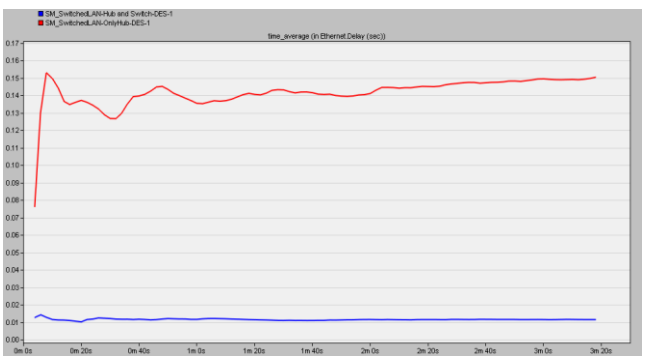

Figure 5: Network Delay (sec).

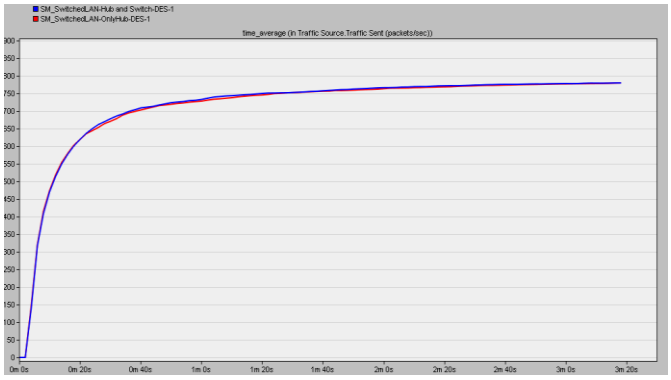

Figure 6: Packet transmission.

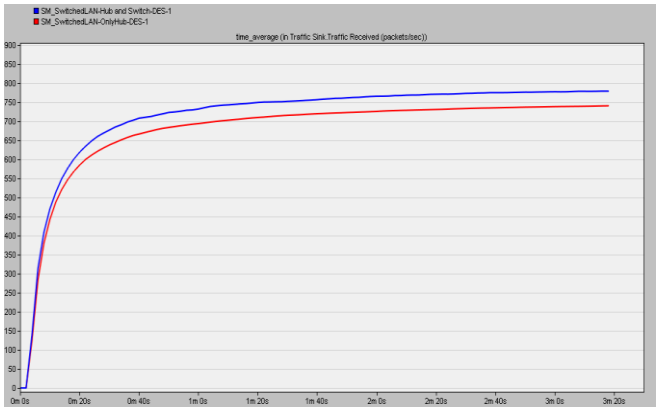

Figure 7: Packet received.

5. Conclusion

In this paper a platform has been implemented for performance assessment of Ethernet for different scenarios by varying the number of network devices and studied some network parameters like collision count, throughput and latency. For every case it has been proved that, the application of switch has improved the performance level of the network up to some significant level. Bandwidth availability is further increased by the full duplex mode of operation.

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