

Full Length Research Paper

Evaluation of bandwidth performance in a corporate network by using simulation model

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In this work a corporate network model consists of two separate buildings with four departments on different virtual local area network (VLAN) for the security purpose had been developed. The implementation was achieved using OPNET technology which really helped to reveal the traffic characteristics of network just like in a real life network. The central idea of this work is focused on the choice of likely bandwidth suitable for a corporate network design; this work categorically suggested that larger bandwidth is more preferable which is capable of handling large volume of traffic compare to the narrow bandwidth which usually suffers from delay and congestion that limits the number of the throughput at the destination.

Key words: Virtual local area network (VLAN), bandwidth, IP address, Traffic and OPNET technology.

INTRODUCTION

Years ago, telecommunication service use different technologies to achieve their communication means. However, today most of the technologies are harmonized in a single modern technology with the aim of achieving the same purpose with the separate technologies (Jeannine et al., 2008). Due to this massive demand imposed on a single communication technology, the structure of telecommunication infrastructure and traffic become more complex (http://sssmag.com/pdf/802_11tut.pdf) and as a result of that, communication technologies needs adequate design and proper traffic monitoring to ensure better quality of service (QoS) more especially the bandwidth (Adas, 1997).

When studying general communication bandwidth, usually the question of constructing a model of input characteristics [number of users] arises; therefore to effectively choose a suitable bandwidth for any network and to develop fast algorithms of free flow of information across a network from source to destination, concept of bandwidth technology must be critically understood. This

is because the fundamental aim of any service provider is to deliver an outstanding quality of service to the end user with little or no interference.

Many researches in this field show that most communication networks, such as global system for mobile communication [GSM], GPRS, Ethernet and others suffer network congestion and delay (Abhinav et al., 2008; Beyers, 2007; Hamibindu et al., 2007; Nagurney and Qiang, 2007).

In order to address the congestion and delay problems that are inherent in most networks, a simulation model of corporate network had been designed using OPNET Technology (http://www.esat.kuleuven.be/telemic/networking/opnetwork02_johan.pdf) to test the free flow of information [packets] in dedicated channels with the same traffic volume on different bandwidth sizes. The simulation method is chosen because it can help us design the network structure, provide information about the traffic structure and save us from the cost of buying equipments and building the entire physical network structure.

This work consider corporate network that consist of two separate buildings and four separate departments; each building consist of two floors with at least one department on a floor. The departments are Administrative, Sale, Technical and Information with the total of 50 host users.

EXPERIMENTAL DESIGN AND SIMULATION

The entire corporate network may utilize the following (http://sss-mag.com/pdf/802_11tut.pdf; Behrouz, 2007); four segments with backbone (for example one segment on each floor or wing of different buildings), more than one network protocols, area configured with Open Shortest Path First (OSPF) (Beyers, 2007), Dial-up connections for users who connect from home or while traveling, Leased-line connections to branch offices, Demand-dial connections to branch offices and Internet connections; the implementation could be achieved using the following equipments below (www.cisco.com/en/US).

Materials and reasons for choosing the major network equipments

The equipments consist of edge router, switches, application configuration, profile configuration, personal computers and links of different types; 100 Kb/s, 10 Mb/s and 1 Gb/s. Switch is chosen because it has less collision domain and support scalability, while Edge Router is used to forward packets to the appropriate destination (www.cisco.com/en/US).

Network implementation

The simulation model of the corporate network is implemented in Figure 1 which consists of two switches separated by edge router connected together by crossover cable at Fa0/0 – Fa0/23 and Fa0/1 and Fa0/20 ports; thereafter each switch is connected to PCs by straight through cables at the appropriate port.

Address planning

Here address planning scheme with a starting IP address of 192.168.0.0/24 was used, which also creates a virtual local area network (VLAN) for the purpose of management and security on each segment (www.cisco.com/en/US).

Starting Address	192.168.0.0	255.255.254.0
VLAN 1 Building 1 Floor 1	192.168.1.2-12	255.255.255.0
VLAN 2 Building 1 Floor 2	192.168.1.13-27	255.255.255.0
VLAN 3 Building 2 Floor 1	192.168.2.1-21	255.255.255.0
VLAN 4 Building 2 Floor 2	192.168.2.23	255.255.255.0

Router configuration

```
R1 > En
R1#conf t
R1[conf]#interface fa0/0
R1[conf if]# ip add 192.168.1.2 255.255.255.0
R1[conf if]# no shut
R1[conf if]# exit
R1[conf]#interface fa0/1
R1[conf if]# ip add 192.168.2 255.255.255.0
```

```
R1[conf if]# no shut
R1[conf if]# exit
R1[conf if]# exit
```

Switch configuration for VLAN

```
Switch > En
Switch#conf t
Switch[conf]#hostname S1
S1[conf]#int Vlan1
S1[conf if]# ip add 192.168.2.100
S1[conf if]# no shut
S1[conf if]# int fa0/23
S1[conf if]# switchport mode access
S1[conf if]# switchport access Vlan1
S1[conf if]# exit
S1[conf if]# exit
```

Other Vlan can also be configured in the same manner (www.cisco.com/en/US).

SIMULATION RESULTS AND DISCUSSION

The address used in the address plan is called internet protocol version 4 [IPv4] which are usually derived from 16 bits binary number from 0000.0000.0000.0000 to 1111.1111.1111.1111; the zeros part represents the network address and the host number while ones' part represents the subnet mask which allows multi network creation from single address scheme. After achieving the IP address plan which play key role in directing the packets to their respective destinations, an OPNET Modeler was used to realize the entire structure of the corporate network as shown in Figure 1. The application configuration and its properties were set to defaults to enable us get any application that will be needed. Profile configuration and the server attributes were also set to support the application configuration while the personal computers were adjusted to support the profile. In order to evaluate the bandwidth performance, three separate scenarios were considered with the bandwidth of 100 Kb/s, 10 Mb/s and 1 Gb/s.

In the first scenario, 100 Kb/s bandwidth was used on the developed corporate network where some global statistics were imposed to see how the traffic are successfully sent and received at their respective destinations. For example database, email, file transfer protocols and delay in the transmission was also noted while in the second and third scenarios, 10 Mb/s and 1 Gb/s bandwidth were used respectively with the same volume of traffic and statistics as in the first scenario; the detailed observations are as shown in Figures 2, 3 and 4. Figure 2 described the amount of the packets received for email, the blue color graph represent the packets received through 100 Kb/s, red color graph represent packets received through 10 Mb/s and light green color represent packets received through 1 Gb/s bandwidth. It can be seen clearly that the packets received through 100 Kb/s bandwidth were not all successfully delivered

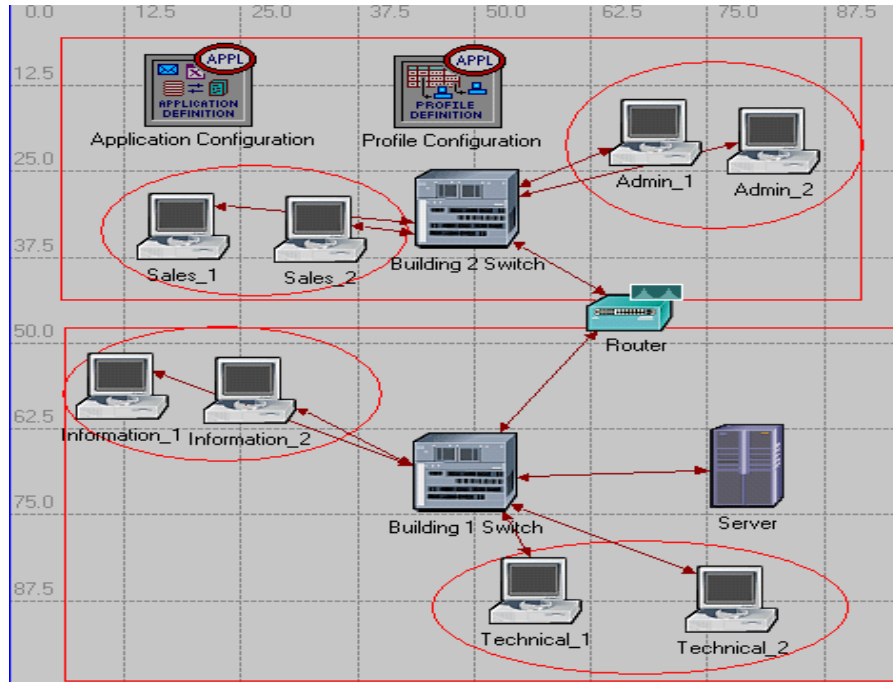


Figure 1. The structure of the corporate network.

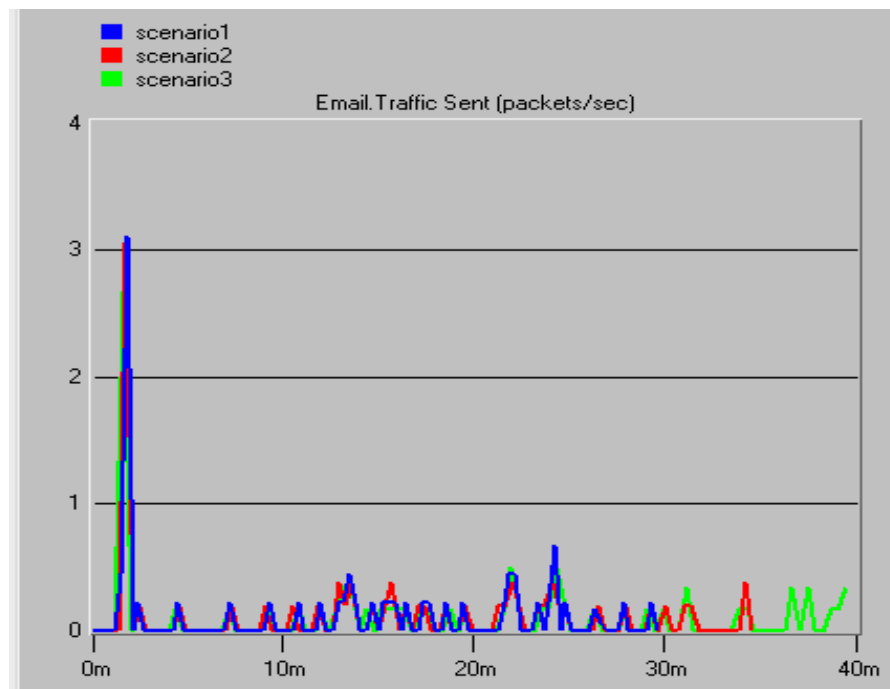


Figure 2. Email packets received [packets/s].

(Oleg et al., 2007); this is followed by packet through 10 Mb/s while packets through 1 Gb/s were tremendous at the destination (Nagurney and Qiang 2007).

Figure 3 represents ethernet delay during the

transmission in all the scenarios as we can see that on average the packets were more delayed through 100 Kb/s, followed by 10 Mb/s, then 1 Gb/s bandwidth with an average delay of 0.003 bits/s in 1 Gb/s and others above

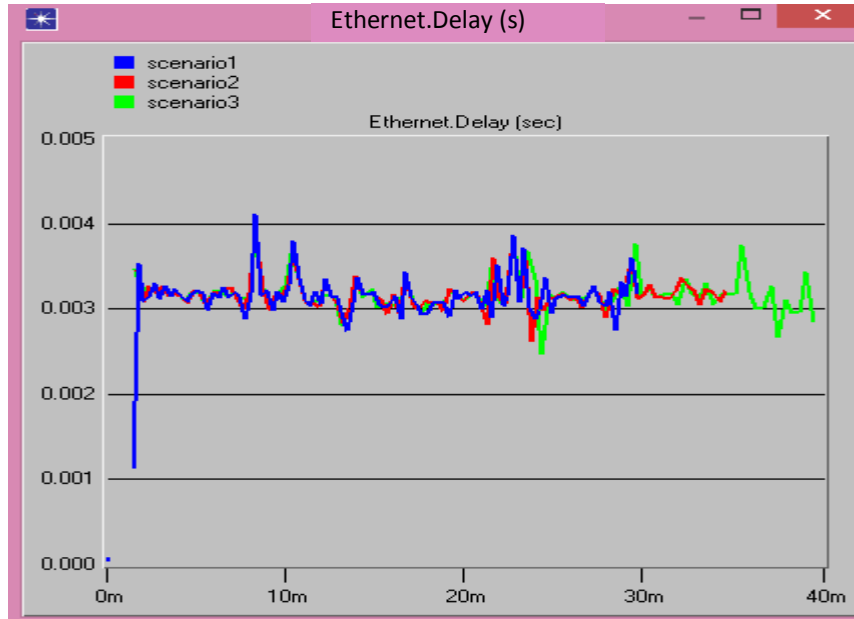


Figure 3. Ethernet delay [s].

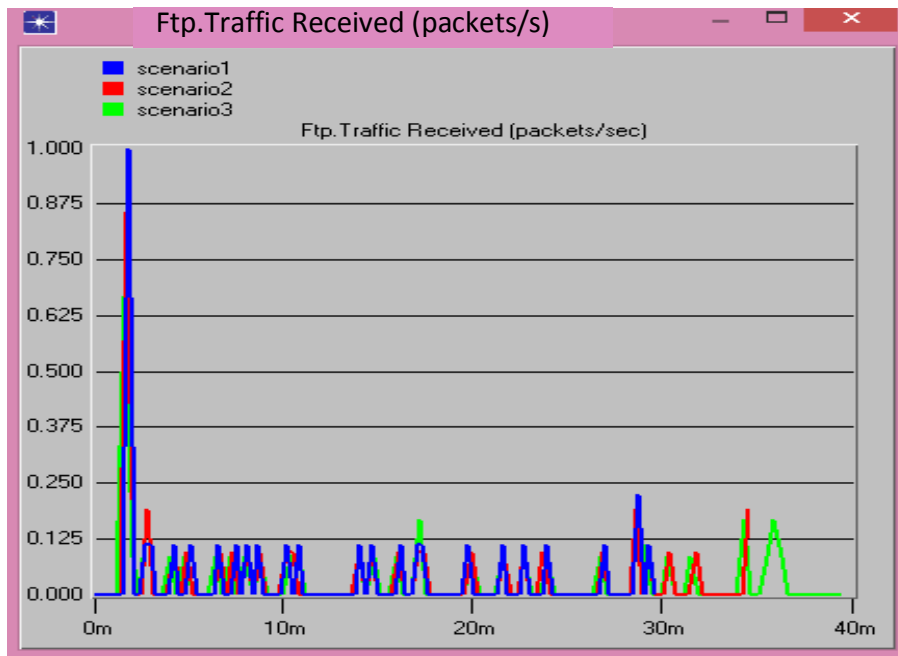


Figure 4. FTP traffic received [packets/s].

0.003 bits/s. Thus, packets that arrive through 1 Gb/s show almost no delay.

Figure 4 represents the file transfer protocol received. It also shows that packets that come through 100 Kb/s are more likely to drop than the packets that come through 10 Mb/s, then 1 Gb/s bandwidth. While Figure 5 shows the total amounts of packets forwarded during transmission,

it can also be seen that more packets are forwarded in 1 Gb/s followed by 10 Mb/s, then 100 Kb/s.

Conclusion

A corporate network had been implemented, simulated

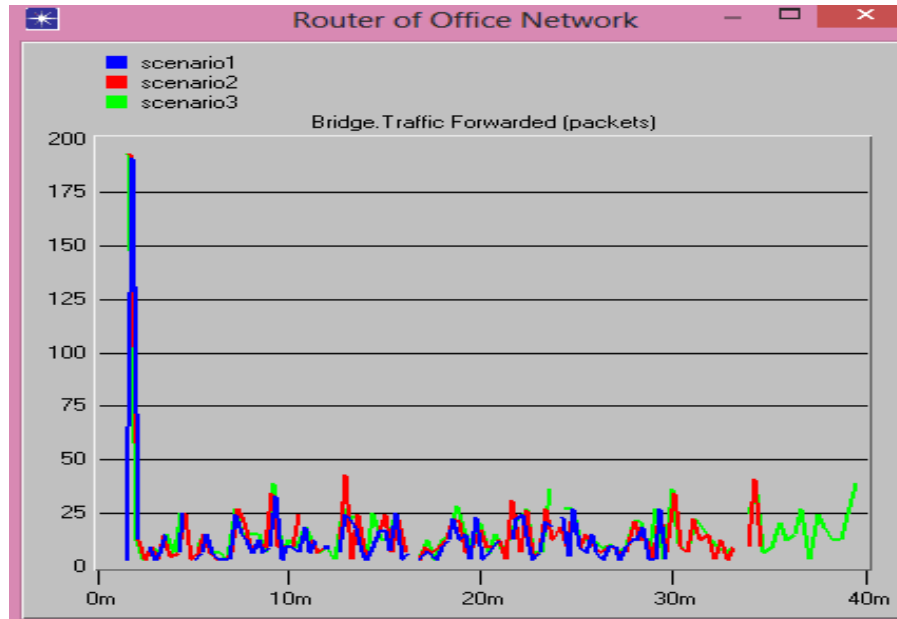


Figure 5. Traffic forwarded (packets).

using OPNET modeler and various traffic such as email, ethernet delay and file transfer protocol had been monitored. This research revealed that packets are less delivered in narrow bandwidth than wide bandwidth although in telecommunication narrow bandwidth is usually used. Therefore when choosing bandwidth, wider should be considered while not ignoring the cost. This research work provide some useful information on a choice of bandwidth when implementing a network and recommends that further research be carried out to investigate other factors that could hamper fast flow of packets in wider bandwidth.

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