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COMPARISION OF NETWORK WITH CLOUD SERVERS USING OPNET MODELER

Vijaya Lakshmi Singh[1], Dr. Dinesh Rai[2]

[1]*School of Engineering and Technology, Ansal University, (India)*
[2]*School of Engineering and Technology, Ansal University, (India)*

ABSTRACT

Wired nodes form a multi-hop network. In this paper there are two scenarios of multi-hop wired network setup with multiple subnet and cloud internet connections would be simulated using OPNET Modeler. In the first, there are ten nodes, four servers named File server, HTTP server, Email server and Database server. In the second scenario there are 15 nodes with same servers. Using these two scenarios, performance of the network will be analyzed.

Key Words: Cloud Computing; OPNET Modeler; Performance Metrics; Performance Parameters.

I INTRODUCTION

The network diagram that represents the internet as a cloud as shown in Fig. 1 describes the cloud computing concept. According to the NIST definition, cloud computing is considered as a model that enables easy ,on-demand network access to share various computer resources , application, services, networks, storage[19]. In this paper there is IP32_ cloud which connects the subnets in these multi-hop networks.

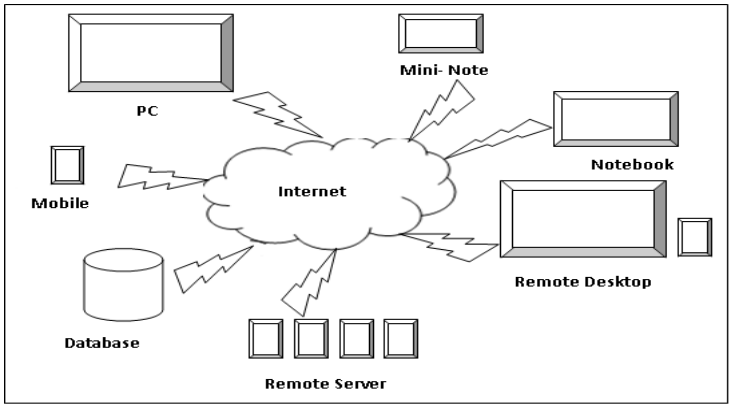

Figure 1 - The term cloud computing seems to originate from computer network diagram that represents the internet as a cloud etc. that can be provided to the user with minimum management effort.

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Performance is the major concern of every network. There are various performance metrics such as [8]:-

i. Thread Task Level Metrics
   - Average Power Expended
   - Task Completion Time

ii. Scenario Metrics
   - Nodal Movement/Topology Rate of Change- Average speed of nodes
   - Number of Network Nodes
   - Area Size of Network
   - Density of Nodes per Unit Area
   - Offered load and traffic patters
   - Number of Unidirectional Links

iii. Diagnostic Packet Level Metrics
   - End –to- End Throughput
   - End –to-End Delay
   - Link Utilization
   - Packet Loss

However According to the study done in paper [21] based on various other papers [1] - [18], and recommendation by RFC 2501[20], it had been concluded that:

The most effective performance metrics are

- Throughput
- End to End Delay
- Packet delivery ratio
- Routing message overhead

The important parameters that highly influence the performance of these three network are

- Traffic type
- Traffic received/ sent (packets/s, bytes/s)
- Response time
- Application
- Number of nodes
- Mobility type

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The performance metric and parameter considered in this paper are mentioned in Table 1.

Table 1: Performance Metric and Parameters of Multi-hop network

Global Statics
DB Query • Response Time (Sec) Time elapsed between sending a request and receiving the response packet. Measured from the time when the Database Query Application sends a request to the server to the time it receives a response packet. Every response packet sent from a server to a Database Query application is included in this statistic. • Traffic Received (Bytes/Sec) Average bytes per second forwarded to all Database Query Applications by the transport layers in the network. • Traffic Received (Packets/Sec) Average number of packets per second forwarded to all Database Query Applications by the transport layers in the network. • Traffic Sent (Bytes / Sec) Average bytes per second submitted to the transport layers by all Database Query Applications in the network. • Traffic Sent (Packets / Sec) Average number of packets per second submitted to the transport layers by all Database Query Applications in the network.
Email • Download Response Time (Sec) • Traffic Received (Bytes/Sec) • Traffic Received (Packets/Sec) • Traffic Sent (Bytes / Sec) • Traffic Sent (Packets / Sec) • Upload Response Time (Sec)
FTP • Download Response time • Traffic Received (Bytes/Sec) • Traffic Received (Packets/Sec) • Traffic Sent (Bytes / Sec) • Traffic Sent (Packets / Sec) • Upload Response Time (Sec)

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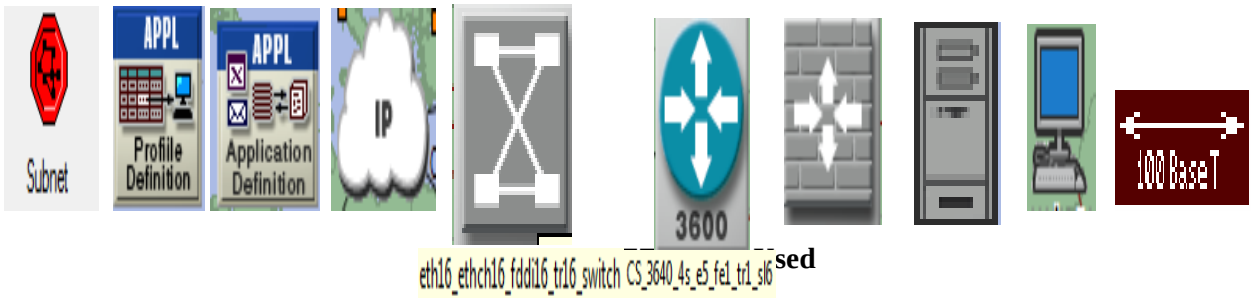
II SIMULATION MODEL

The OPNET models used in these simulations are fixed subnet, profile configuration, application configuration, Ip32_cloud, Ethernet switch, router, firewall, Ethernet server, Ethernet Workstation and 100 BaseT Link respectively as shown below in Figure 2. In this work, the multi-hop network consist of three subnets which are located at different locations. Subnets are named as subnet_branch_china, subnet_branch_maleshiya, and subnet_HQ_cameroon. Out of which subnet_HQ_cameroon contains four dedicated servers. Dedicated applications are run on each server namely File Server, HTTP Server, Database Server and Email server. All these servers run on cloud. The other two subnets namely subnet_branch_china and subnet_branch_maleshiya consists of ten nodes. There will be two scenarios, one with 10 nodes and the other with 15 nodes. This multi-hop network is implemented using a network simulator named OPNET Modeler 14.5. Based on this simulation the performance metrics and parameters are observed, analyzed and compared through graphs.



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As shown in Figure 3, the multi-hop network consists of three subnets located at different locations and are connected to IP32_cloud with 100 BaseT link. Each subnet consists of 10 wired nodes as shown in Figure 4.

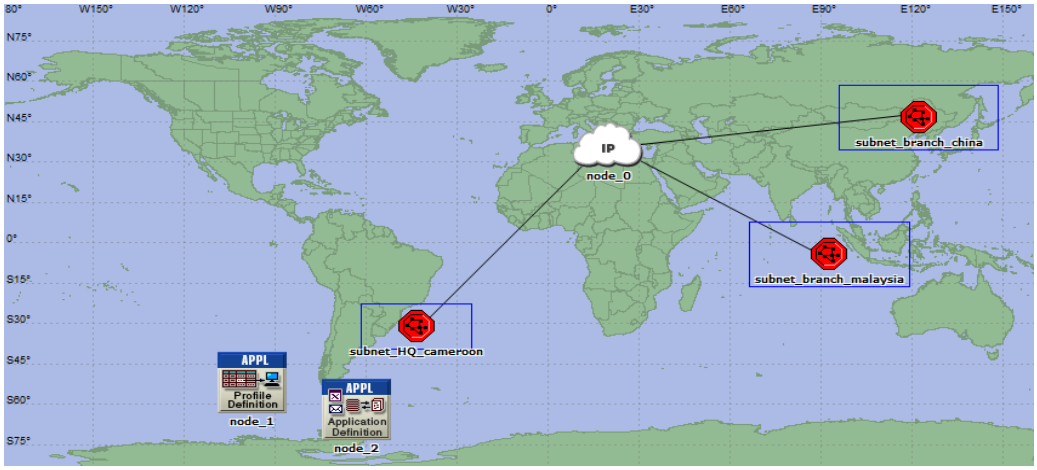

Figure 3 - Parent subnet multi-hop network having three subnets

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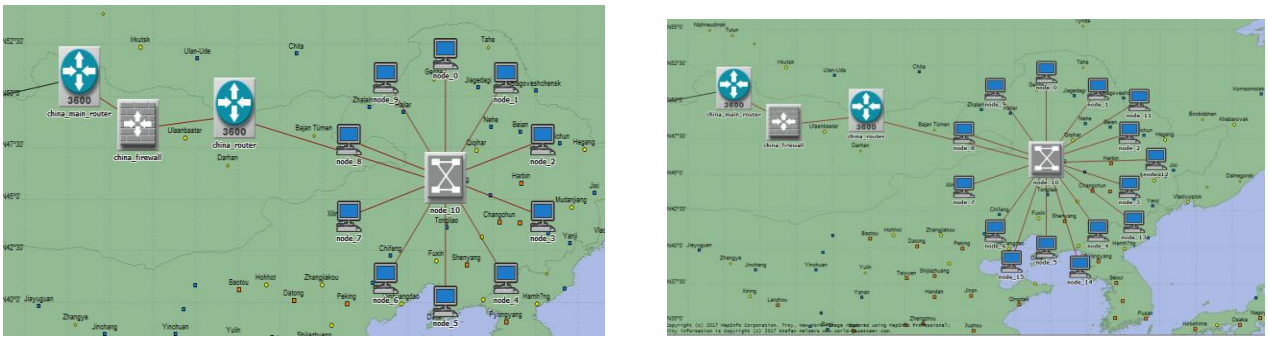

Figure 4 - Wired fixed 10 and 15 node in subnet respectively (Scenario1 and Scenario2)

As shown in Figure 5 the headquarter subnet consists of four servers connected with wired LAN, namely File server, Email Server, HTTP Server and Database Server. Since the profile has been created, each server performs their respective tasks efficiently.

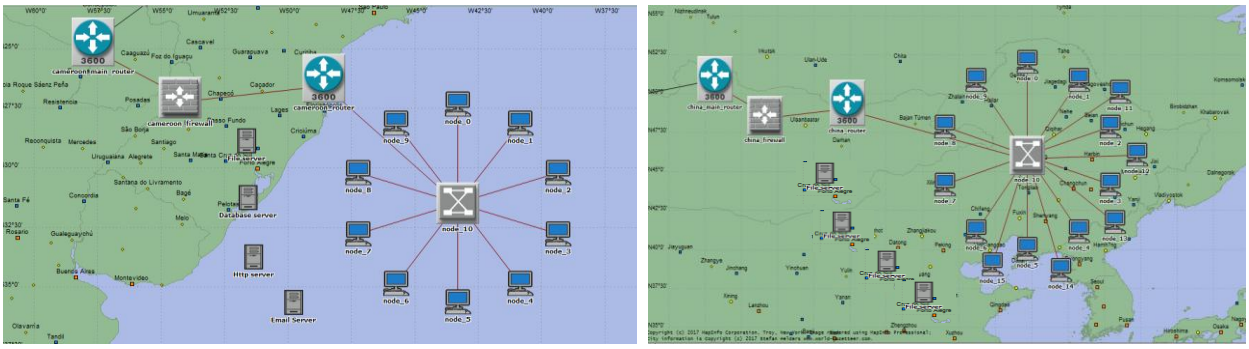

Figure 5 - Servers in Head quarter subnet (Scenario1 and Scenario2)

Simulation configurations taken in this simulation scenario (as shown in Figure 6) are: - Duration is 0.5 hours; Seed is 128; Values per Statics are 100; Update interval is 100000 events; Simulation Kernel is Based on 'kernel_type' preference; Simulation set name is scenario.

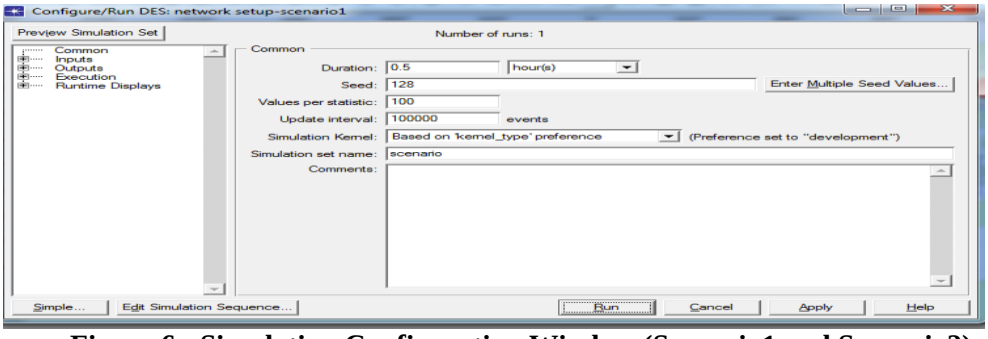

Figure 6 - Simulation Configuration Window (Scenario1 and Scenario2)

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Also Fig. 7 and Fig. 8 show the simulation speed and simulation message respectively for Scenario1 and Scenario2 respectively.

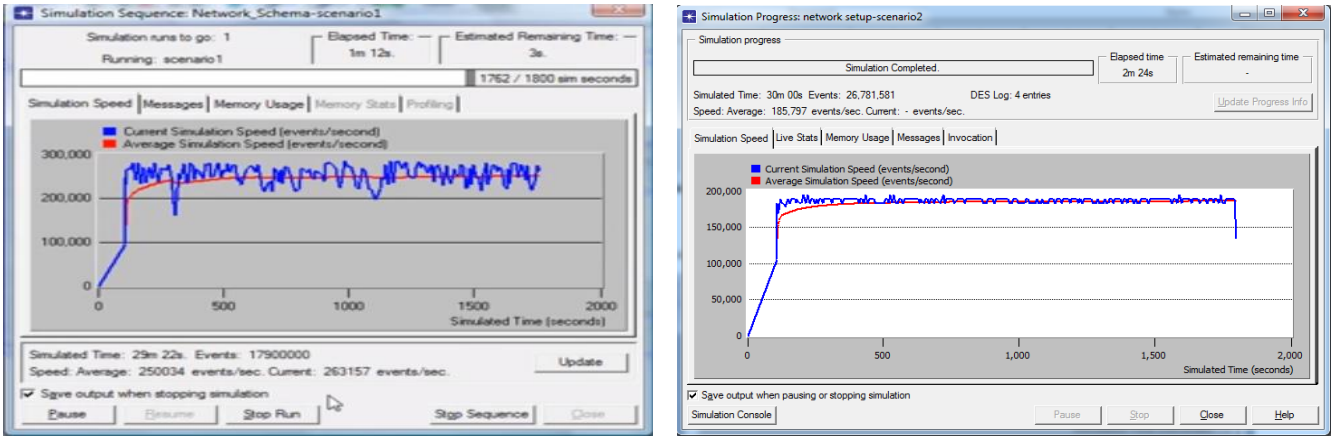

Figure 7- Simulation Speed (Scenario1 and Scenario2)

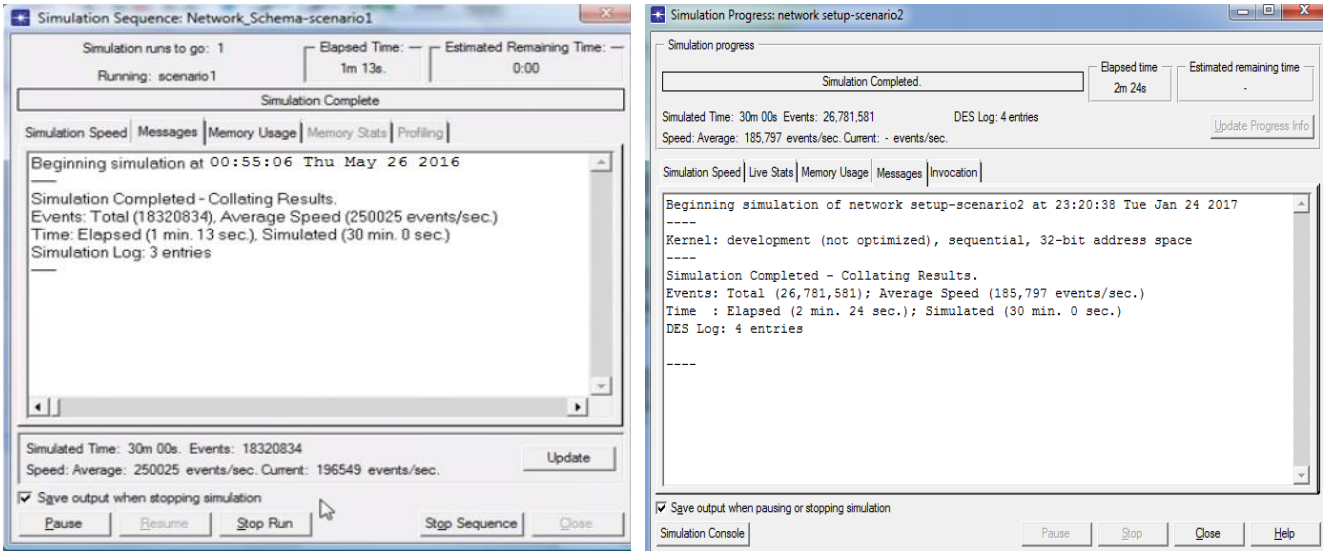

Figure 8- Simulation Message (Scenario1 and Scenario2)

III SIMULATION GRAPH AND RESULTS

According to the simulation performed based on the simulation Scenario1 and Scenario2, the graphs are generated, analyzed and compared. Also the tables show their average, maximum and minimum values.

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3.1 Traffic Received and Traffic Sent

Traffic received is average bytes or packets per second forwarded to all Database Query Applications by the transport layers in the network. Traffic sent is average bytes or packets per second submitted to the transport layers by all Database Query Applications in the network.

3.1.1 Traffic Received (bytes /sec) and Traffic Sent (bytes/sec)

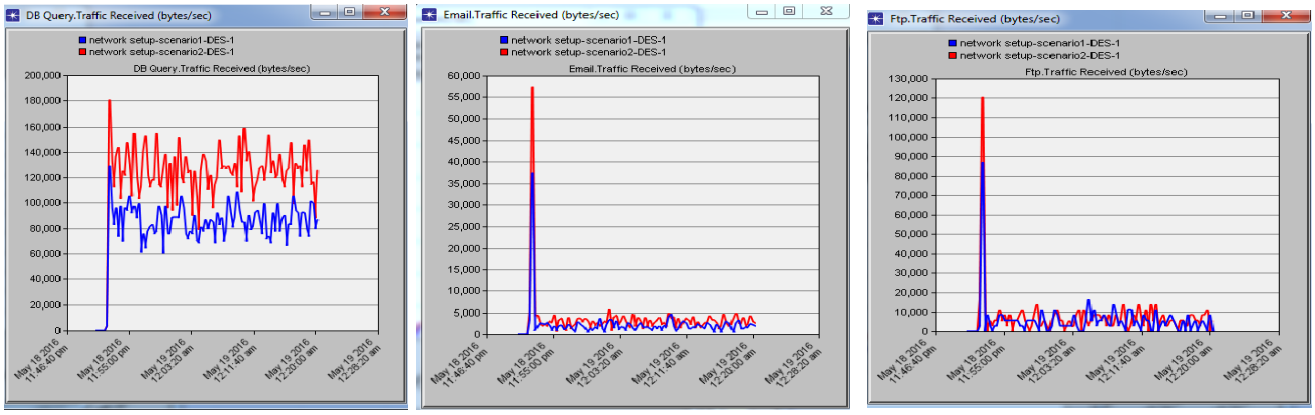

Figure 9 – Db Query Traffic Received (bytes /sec), Email Traffic Received (bytes /sec), FTP Traffic Received (bytes /sec)

In Fig. 9, maximum traffic received (bytes/sec) under DB Query, Email and FTP by both scenarios, Scenario1 and Scenario2 is compared. Red line shows scenario2 and Blue line is for scenario1. According to graph shown in Fig 9, it is observed that traffic received(bytes/sec) is more in Scenario2 as compared to Scenario1 in all(Db query, Email and FTP)

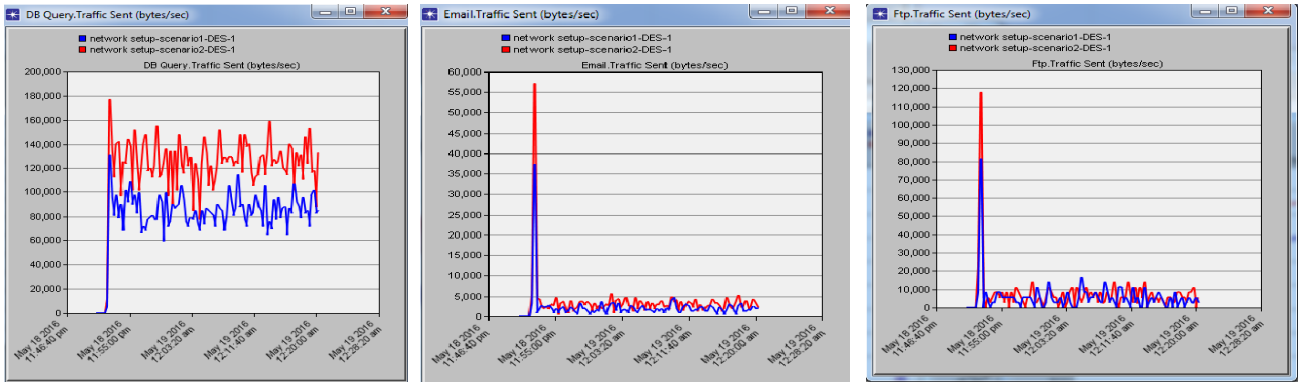

Figure 10 - Db Query Traffic Sent (bytes /sec), Email Traffic Sent (bytes /sec), FTP Traffic Sent (bytes /sec)

Similarly according to graph shown in Fig. 10, maximum traffic sent (bytes/sec) under DB Query, Email and FTP is more in Scenario2 as compared to Scenario1.

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3.1.2 Traffic Received (packets /sec) and Traffic Sent (packets/sec)

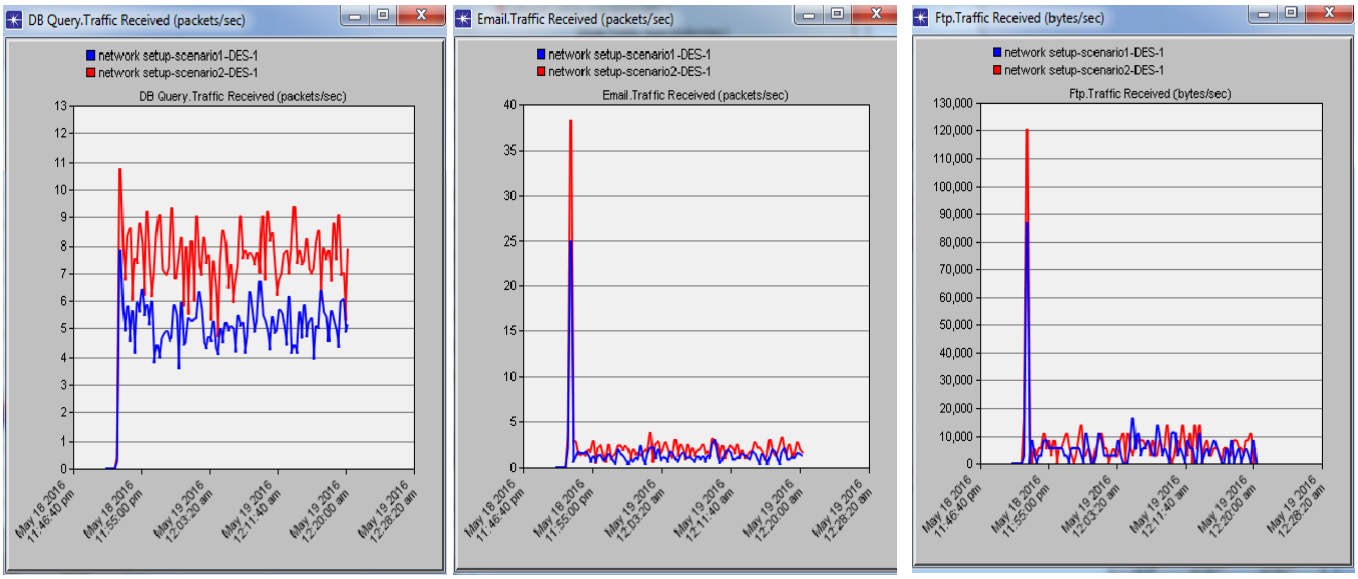

Figure 11- Db Query Traffic Received (packet/sec), Email Traffic Received (packet/sec), FTP Traffic Received (packet/sec)

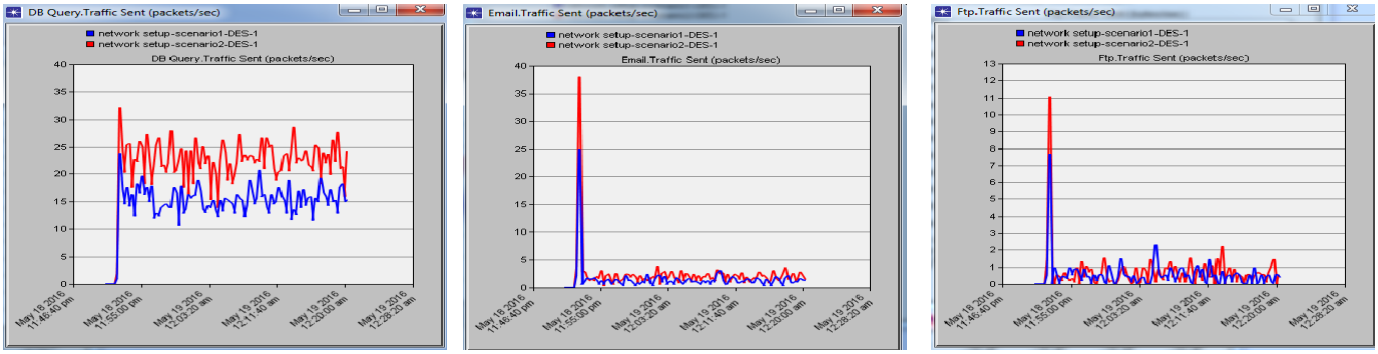

Figure 12- Db Query Traffic Sent (packet/sec), Email Traffic Sent (packet/sec), FTP Traffic Sent (packet/sec)

Now according to graph shown in Fig. 11 and Fig. 12, maximum traffic sent (bytes/sec) and maximum traffic sent (packets/sec) both under DB Query, Email and FTP is more in Scenario2 as compared to Scenario1.

3.2 Response Time

Time elapsed between sending a request and receiving the response packet. Measured from the time when the Database Query Application sends a request to the server to the time it receives a response packet. Every response packet sent from a server to a Database Query application is included in this statistic.

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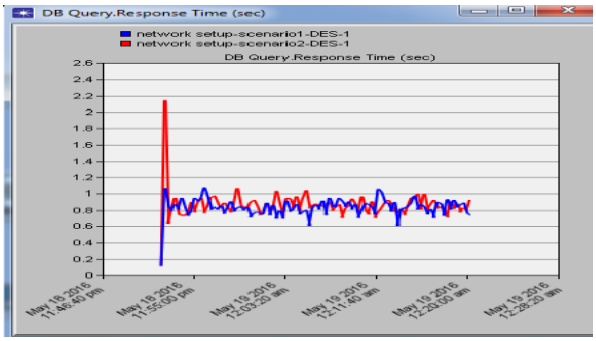
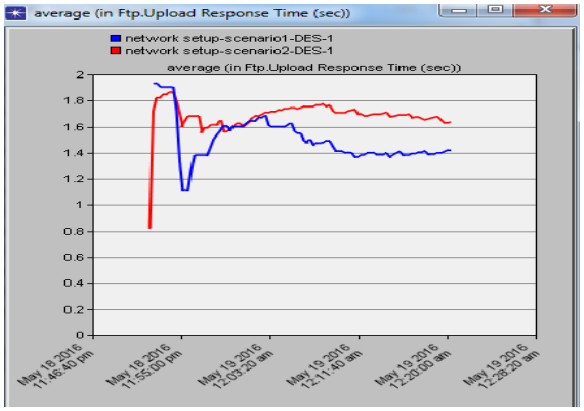


Figure 13- Db Query Response time (sec) of Scenario1 and Scenario2

3.2.1 Average Upload Response time



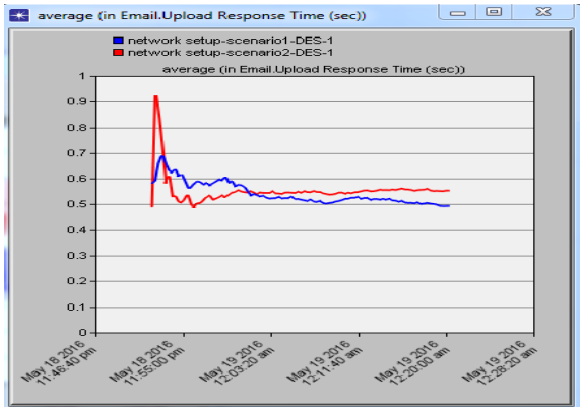
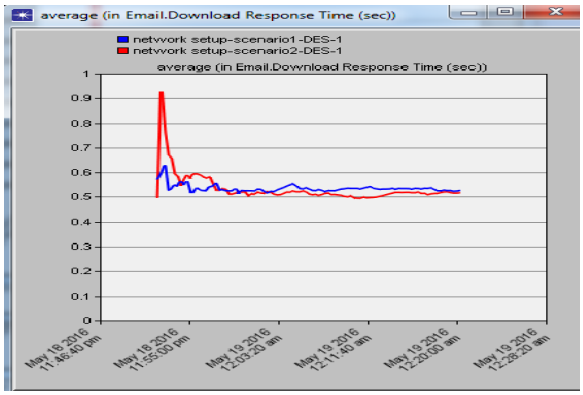


Figure 14- Average upload Response time (sec) under FTP and Email of Scenario1 & Scenario2

3.2.1 Average Download Response time



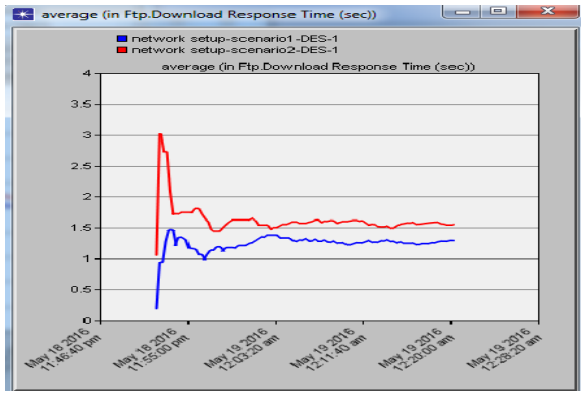


Figure 15- Average Download Response time (sec) under FTP and Email of Scenario1 & Scenario2

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According to Fig. 13, Fig.14 and Fig. 15, the Db Query response time (sec) is of Scenario2 is more than Scenario1. Same is the case with Average FTP upload and Download Response time(sec) and Average Email Upload and Download Response time(sec).

Based on the above simulation and graph the following tables, Table 2, Table 3 and Table 4 are derived that summarizes the analysis in terms of average, maximum and minimum values of all the global statics of both the scenarios, Scenario1 and Scenario2

Table 2: Db Query statistical average, maximum and minimum value of Scenario1 and Scenario2

DB Query Scenario1

Statistic	Average	Maximum	Minimum
DB Query Response Time (sec)	0.8266	1.0113	0.1185
DB Query Traffic Received (bytes/sec)	81.925	112.796	0
DB Query Traffic Received (packets/sec)	4.9239	6.8056	0.0000
DB Query Traffic Sent (bytes/sec)	81.943	113.721	0
DB Query Traffic Sent (packets/sec)	14.773	20.528	0.000

DB Query Scenario2

Statistic	Average	Maximum	Minimum
DB Query Response Time (sec)	0.8589	2.1482	0.1214
DB Query Traffic Received (bytes/sec)	117.463	181.134	0
DB Query Traffic Received (packets/sec)	7.064	10.778	0.000
DB Query Traffic Sent (bytes/sec)	117.608	177.550	0
DB Query Traffic Sent (packets/sec)	21.204	32.111	0.000

Table 3: Email statistical average, maximum and minimum value of Scenario1 and Scenario2

Email Scenario1

Statistic	Average	Maximum	Minimum
Email Download Response Time (sec)	0.51554	0.77064	0.05778
Email Traffic Received (bytes/sec)	2,059	19,218	0
Email Traffic Received (packets/sec)	1.369	12.778	0.000
Email Traffic Sent (bytes/sec)	2,059	19,218	0
Email Traffic Sent (packets/sec)	1.369	12.778	0.000
Email Upload Response Time (sec)	0.52995	0.80148	0.21640

Email Scenario2

Statistic	Average	Maximum	Minimum
Email Download Response Time (sec)	0.5165	1.3561	0.0566
Email Traffic Received (bytes/sec)	3,329	57,486	0
Email Traffic Received (packets/sec)	2.213	38.222	0.000
Email Traffic Sent (bytes/sec)	3,329	57,152	0
Email Traffic Sent (packets/sec)	2.213	38.000	0.000
Email Upload Response Time (sec)	0.5535	1.3582	0.0573

Table 4: FTP statistical average, maximum and minimum value of Scenario1 and Scenario2

Ftp Scenario1

Statistic	Average	Maximum	Minimum
Ftp Download Response Time (sec)	1.2796	2.2093	0.1956
Ftp Traffic Received (bytes/sec)	4,322	43,496	0
Ftp Traffic Received (packets/sec)	0.1711	1.7222	0.0000
Ftp Traffic Sent (bytes/sec)	4,322	40,719	0
Ftp Traffic Sent (packets/sec)	0.4228	3.8333	0.0000
Ftp Upload Response Time (sec)	1.4643	2.0916	0.1956

Ftp Scenario2

Statistic	Average	Maximum	Minimum
Ftp Download Response Time (sec)	1.5529	4.9912	0.1956
Ftp Traffic Received (bytes/sec)	6,651	120,668	0
Ftp Traffic Received (packets/sec)	0.2633	4.7778	0.0000
Ftp Traffic Sent (bytes/sec)	6,651	117,890	0
Ftp Traffic Sent (packets/sec)	0.643	11.056	0.000
Ftp Upload Response Time (sec)	1.6349	2.6243	0.1956

IV CONCLUSIONS

In this paper comparison analysis of two multi-hop network, in two different scenario is analyzed. The network consisted of three subnets, each have 10 nodes in scenario 1 and 15 nodes in scenario 2. In the headquarter subnet

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there are four servers. The performance metrics considered were traffic received and traffic sent (bytes/sec and packets/sec), point-to-point queuing delay, point-to-point throughput bits/sec), point-to-point throughput (packets/sec) and point-to-point utilization. According to the graph and tables presented in simulation graph and result it is concluded that all the global statistic parameter values increases as the number of nodes is increased in the network.

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