Department of Electrical and Computer Engineering

COMPE-560
COMPUTER AND DATA NETWORKS

OPNET ASSIGNMENT-1

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INTRODUCTION

AIM: To build a 2-floor office scenario to analyse individual as well combined network statistics.

Brief Summary: The given problem statement presents a scenario where we have to first build a first-floor network and then expand it to the second-floor. Both the individual networks have their own loads and hence their own unique datas. After expanding the network, a thorough analysis is done to compare and examine the observed results. Also an analysis is done to understand if the expansion will/will not cause the network to fall.

OPNET (Optimized Network Engineering Tools) is a software tool used to for computer network modelling and simulation purposes. The OPNET Modeler enables users to create, simulate and study a network's performance in the Project editor. For simulating the first project assignment, I used the Student version of OPNET.
The first and the foremost objective of the assignment was to create the first floor space of an office scenario. To do so, the following issues were needed to be addressed:

1. Selecting appropriate topology
2. Determining the spread of the network
3. Choosing appropriate network objects
4. Obtaining statistics from individual nodes
5. Executing and saving the obtained results

After undertaking the above mentioned steps for the first floor, we incorporated the same steps for our second floor.
The scenario was duplicated and the Cisco CS_2514_1s_e2_s12 router was used to connect the 3Comm switches of both the floors. Individual graphs for load and delays were observed and to answer the questions posed about the addition of a second network to the existing LAN, we compared the results from both the simulations.

• FLOOR 1

Size of the network: 100 m X 100 m
Topology used: Star
Number of nodes: 30
Network objects used: Sm_Int_server, 10BaseT link, Sm_Application_Config and Sm_Profile_Config

Procedure: After determining the space the network will span upto, the network topology is selected. Star topology is used because here all the components of first floor network are connected to a single central device(3Comm) and this switch is also used to communicate with the switch of the second floor network. The Sm_Int_server is connected to 3Comm using the 10BaseT link.
Individual statistics (Load) of the server and Global statistics (Delay) the network as a whole are selected. These parameters reflect the performance of the whole network and would be the key values when the comparisons will be made between the 2 floor scenarios.
A low load is assigned to the Application Definition(Node 32) which creates a light traffic of data. Simulations are run, following which we view the results.

Fig. 1 Depicts the first floor network with all the network objects used.

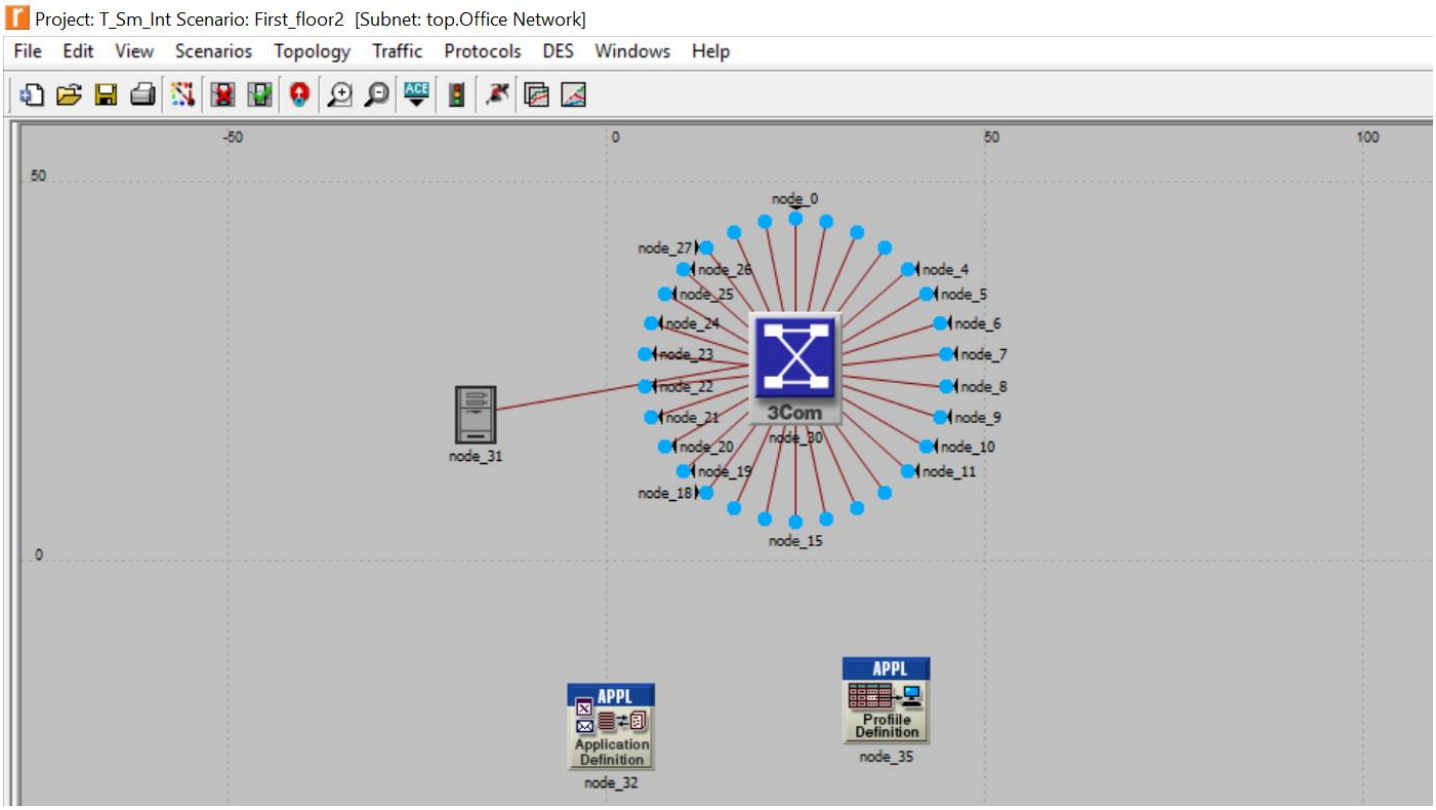

Fig.1: Layout of the first floor

Fig. 2 Shows the Output at node 31, when a low load is applied. The graph shows a flat line in case of no load. Throughput is the average number of successful messages delivered over a communication link/channel. It is measured in bits per second (bps). At its peak, the ethernet load touches up a maximum value of 1,900 bits/sec.

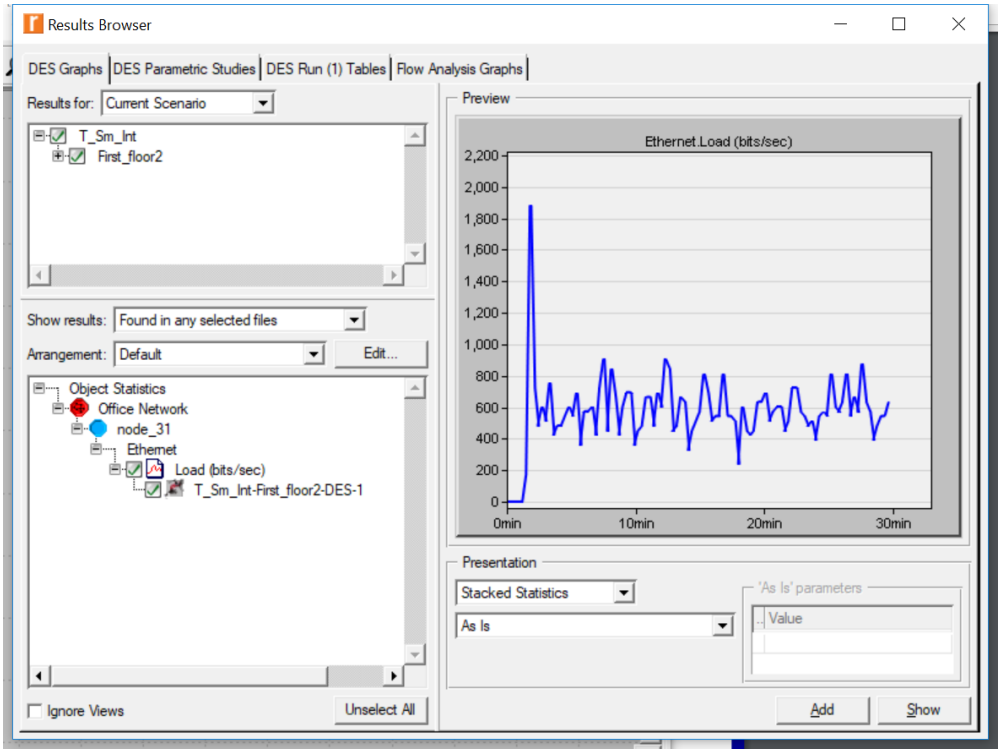

Fig.2: Ethernet Low load graph for Node 31

Fig. 3 Represents the Ethernet Delay graph for the network in whole. Delay is the time taken for messages to be passed between nodes or users in a network. The maximum delay recorded for the whole duration the simulation is run is approximately 0.43miliseconds.

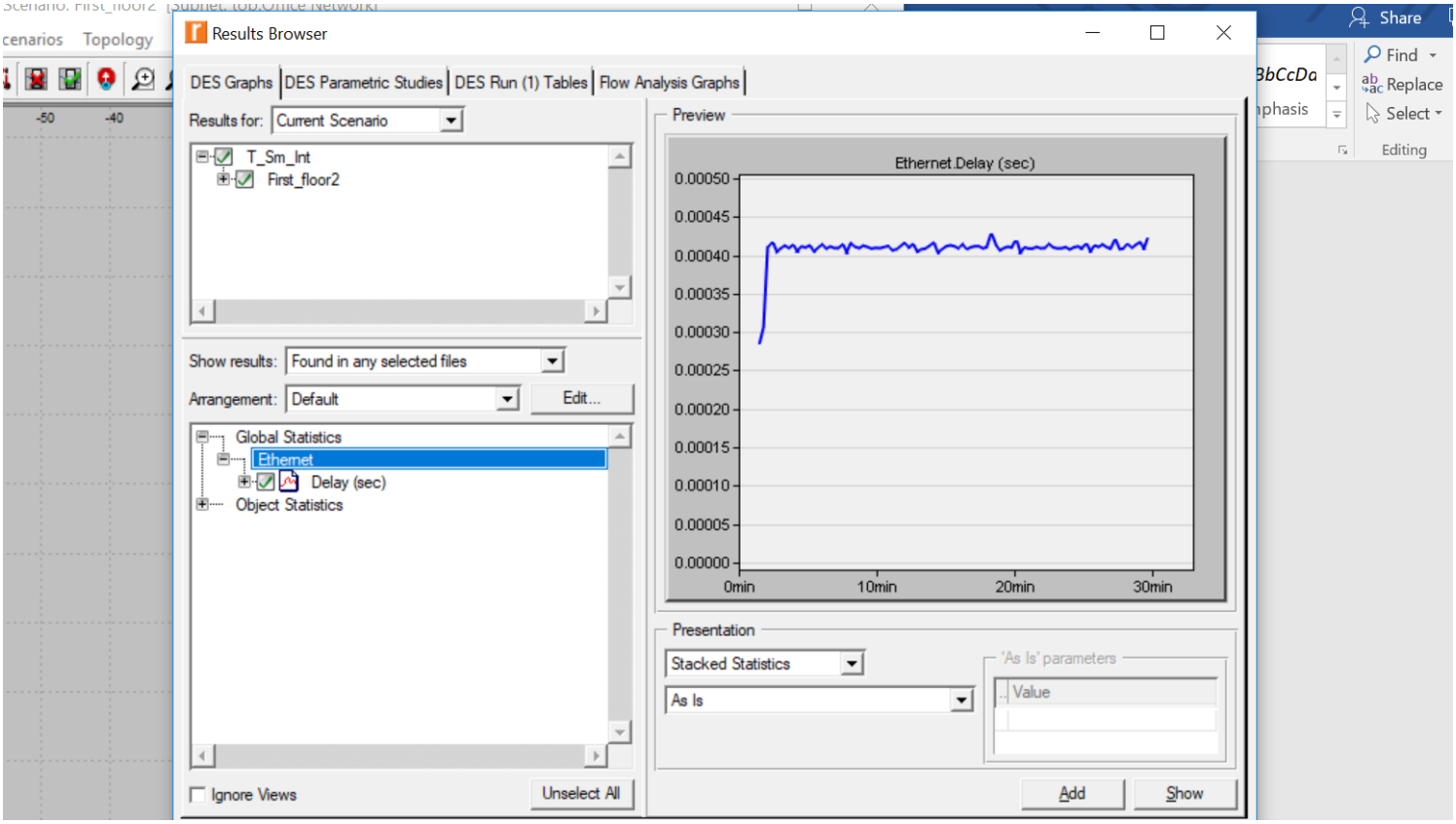

Fig.3 Ethernet Delay for the first floor plan

- **The Expansion Network**

To create the second floor office space, we duplicate the existing scenario of the first floor and make the required changes to it. The network objects used however remain the same as in the first floor. We make use of Cisco CS_2514_1s_e2_s12 router to connect the switches of both the networks. Subsequent to running the simulation of the expansion scenario, results (Load and delay) of both the workspaces are compared.

Fig.4 Displays the expansion scenario created. As shown in the figure, the two networks are interfacing with each other using the common cisco router.

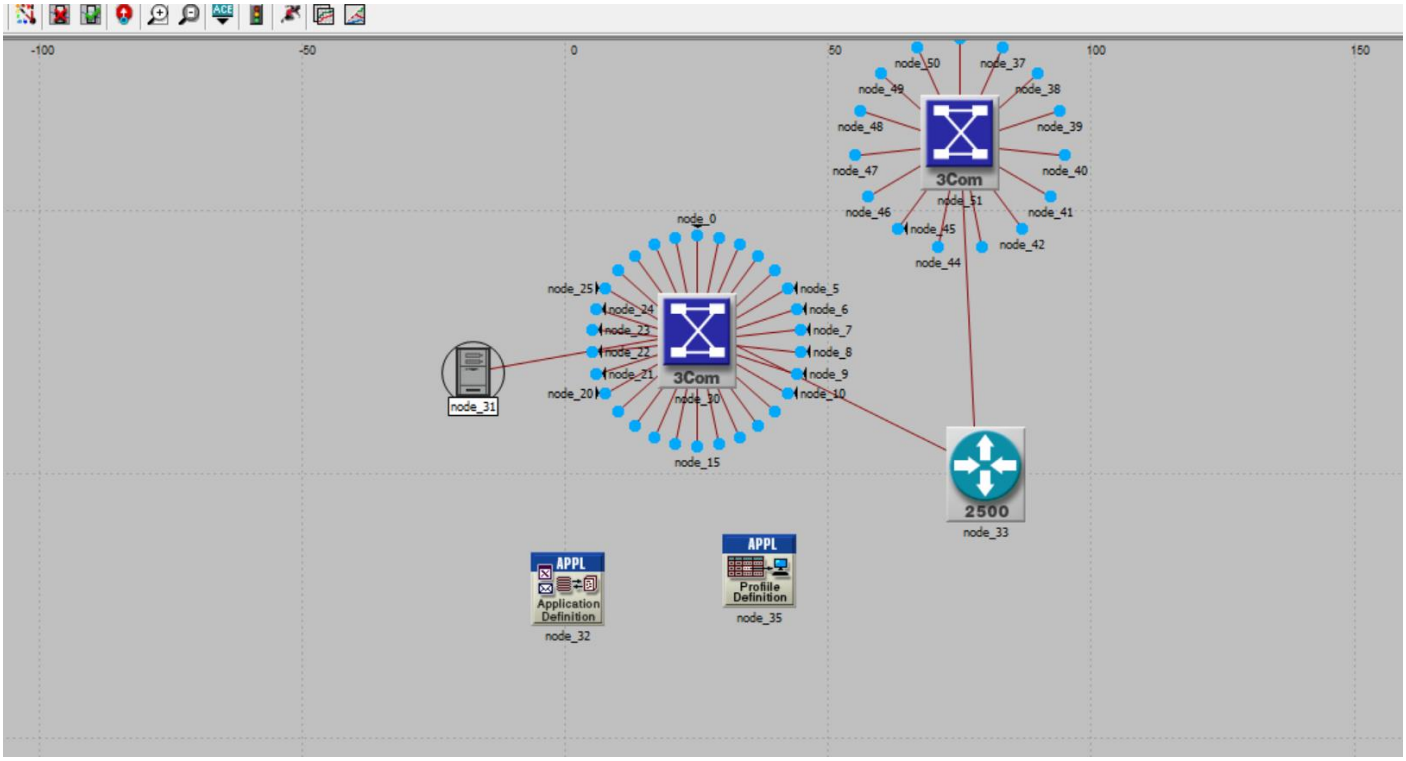

Fig.4: **The expansion network (second floor)**

Fig.5 Displays the graph obtained for the load(bits/sec) observed on node 31 for the expansion network. The peak of the load observed is at approximately 2,900 bits/sec.

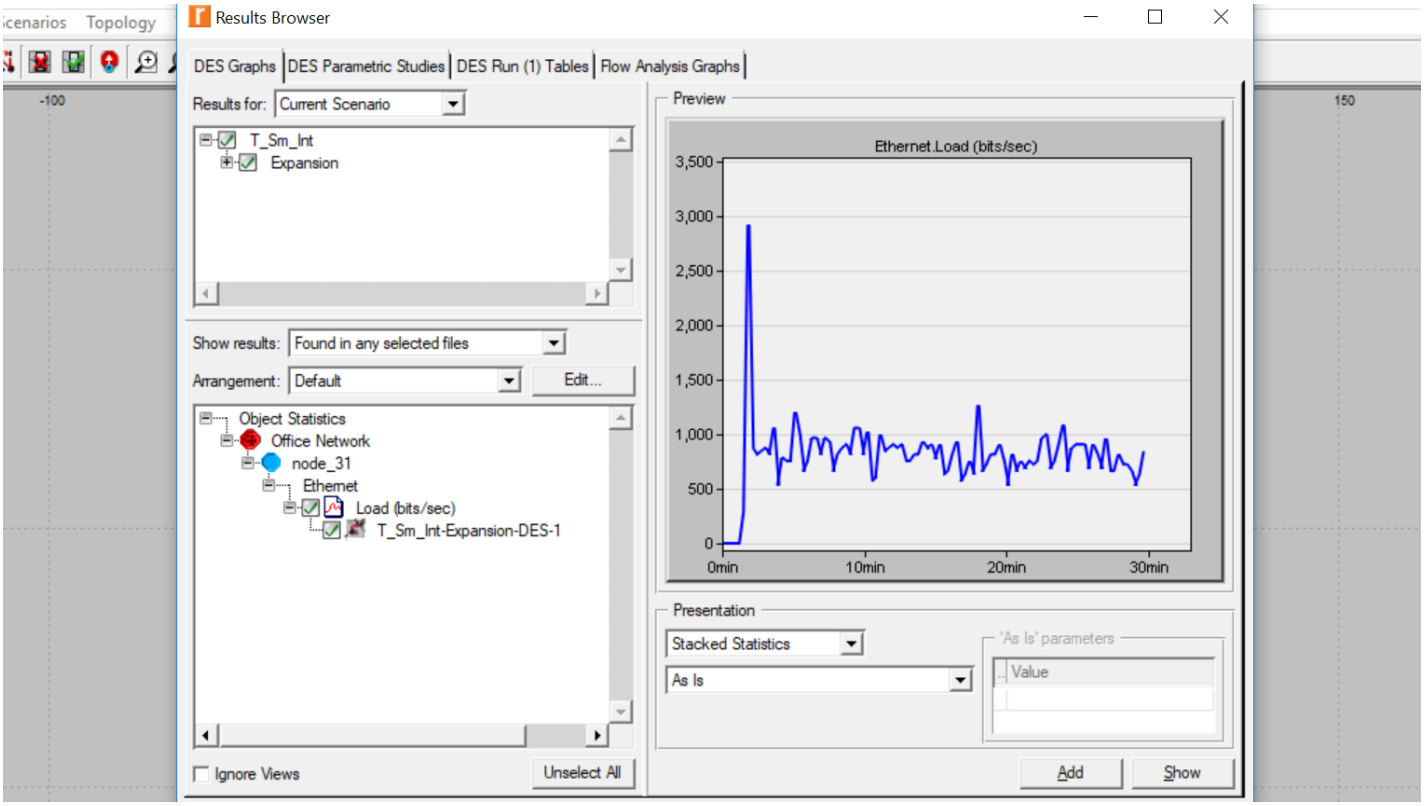

Fig.5 Ethernet Load for expansion network

Fig.6 Depicts the Ethernet Delay(secs) for the second floor. This is similar to what we did above for the load graph and the maximum delay observed is 0.43 millisecond, similar to the first floor scenario.

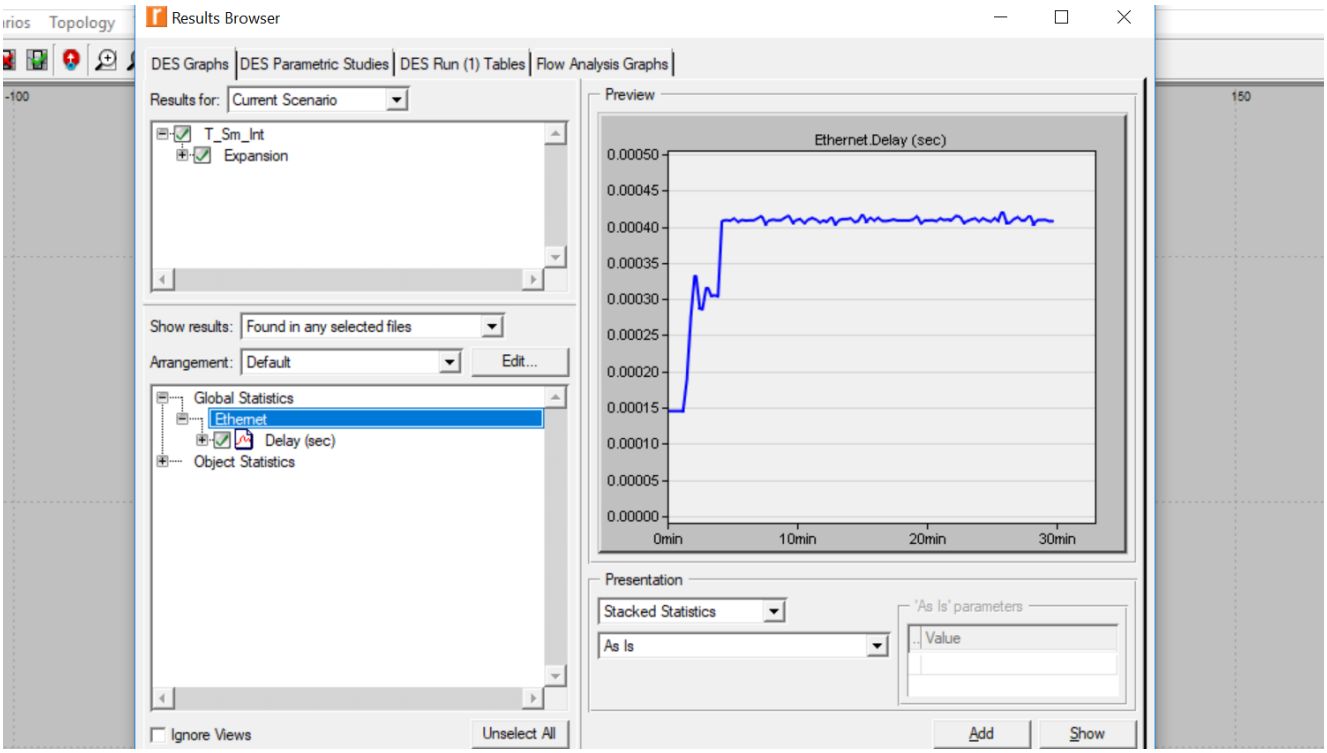

Fig 6. Ethernet Delay(secs) for expansion network

Comparing the Results

Since now we've gathered individual statistics for both the scenarios i.e. first floor network and the expansion network (which is the second floor), we will compare their statistics to know more about how an addition of a second network to the existing LAN will affect the system in whole.

Fig.7 Illustrates the comparison graph of ethernet load(bits/sec) for the 2 networks. The presentation method used is 'overlaid statistics' which helps us to display both the quantities on a single graph. As observed from the graph, the load has increased slightly for the second scenario(1,900 bits/sec vs 2,900 bits/sec).

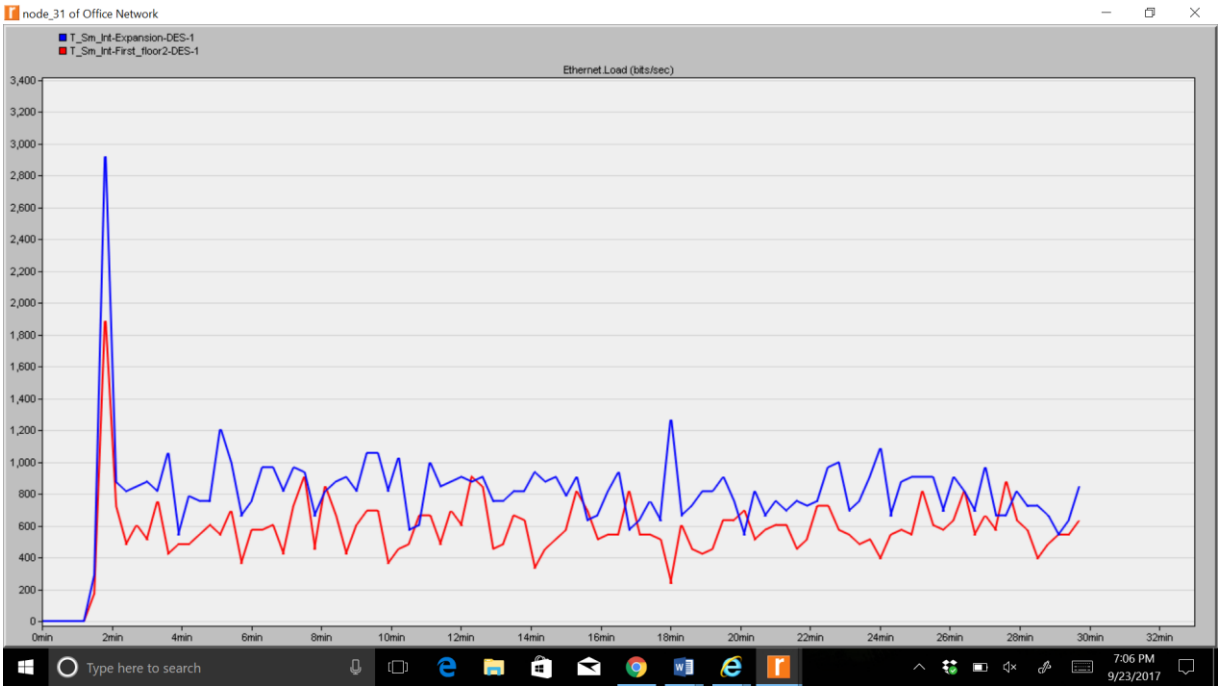

Fig.7 Ethernet load for the two scenarios

Fig.8 Illustrates the Ethernet delay(secs) for both the scenarios. The graph shows there is no significant change in Ethernet delay on the network. Although server load has increased, delay has not.

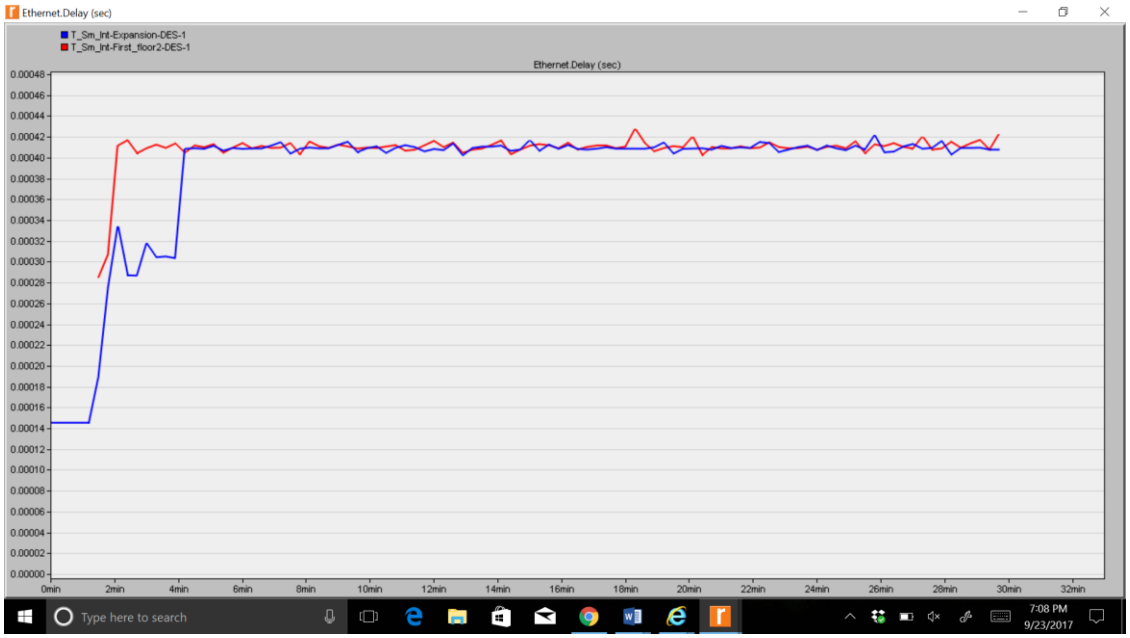

Fig.8 Ethernet delay for the two scenarios

Fig.9 Illustrates the Time average of the Ethernet load (bits/sec) for the two scenarios.As observed from the graph, that while the average load for the expansion scenario is higher (as expected), the load as a whole appears to be settling down, indicating a stable network.

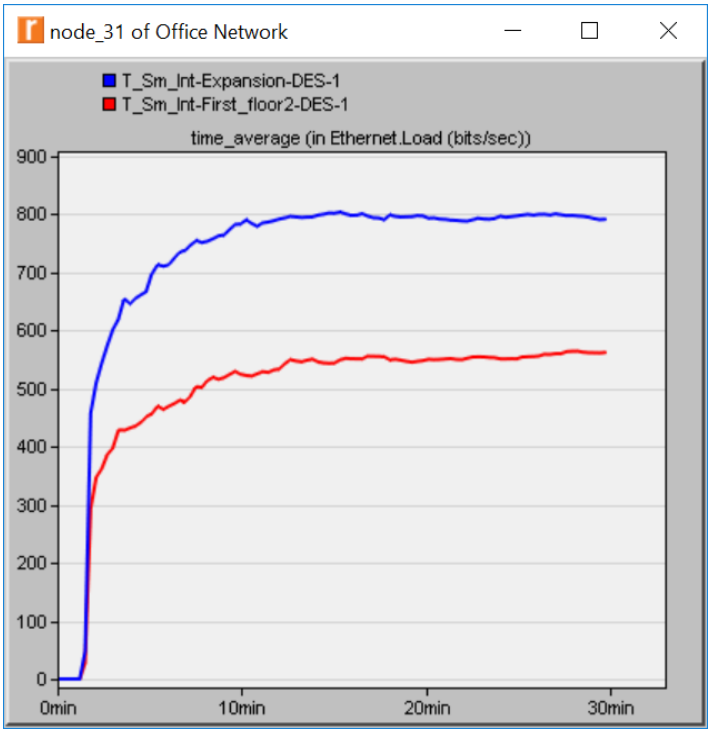

Fig.9 Graph for the Time average of the Ethernet load (bits/sec) for the two scenarios

Fig.10 Illustrates time average of the Ethernet Delay(sec). The average delay for the expansion network is significantly lower initially(~0.15 milliseconds) but it tracks a converging path and soon becomes equable to first floor's network delay, the difference between the two being just about 0.03 milliseconds.

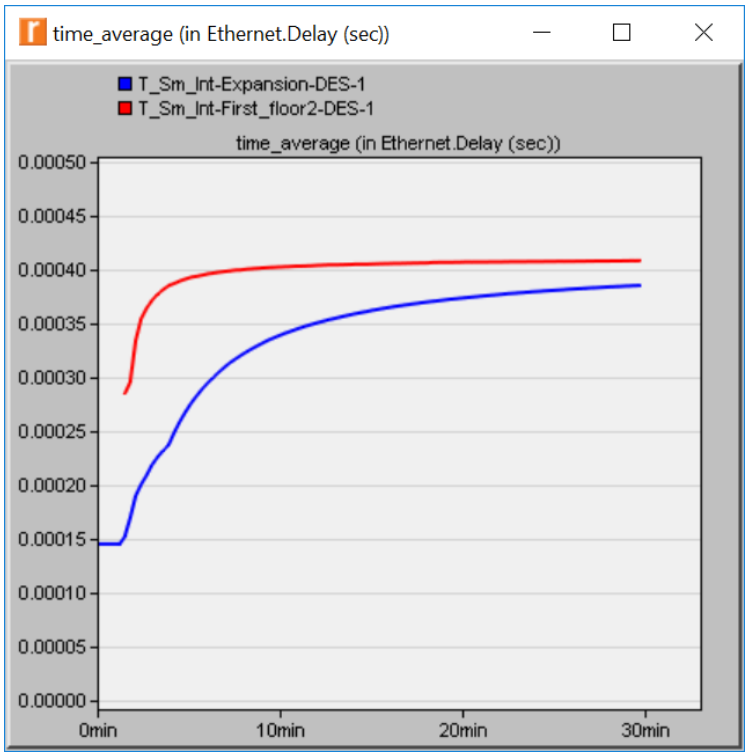

Fig.10 Time Average of the Ethernet delay(sec) for the two scenarios

Answer the following questions (2 points):

1. From the graphs, comment on how the expansion affected the overall delay and the server load?

Ans: From what is observed from the obtained individual and comparison graphs, the load has significantly increased but the delay has somewhat remained the same for both the scenarios. A point that is to be noted is that although the load increased, it did not fail the system. The values observed becomes a bit unvarying after a point, indicating a stable system.

2. State precisely what statistics did you need to collect the relevant information (i.e. the network load and the delay)?

Ans: The output graphs for load and delay depends upon the initial parameter values (X-center, Y-center, radius) we entered for node placement and link length. Also, the specifications of centre node, periphery node and link model played a vital role in collecting the information we got.

For load, Individual DES statistics of the server node was used. From its dialog box, the Ethernet statistics are chosen from which the load(bits/sec) parameter is chosen.

For Delay, Global Statistics Hierarchy is used. Here also, the Ethernet statistic is used from which the delay(sec) parameter is selected for observation purposes.