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CSC/ECE 570
OPNET LAB 1
Based on “Small Internetworks” Tutorial
9/15/2012

SUMMARY

One of the objectives in this lab is to become familiar with Opnet Modeler 17.1 Simulation Software. This is done through a walk-through of the tutorial - “Small Internetworks.” Once we become familiar with this software the next objective is to understand its capabilities by scaling up models via additional devices and traffic.

IMPLEMENTATION

In order to develop familiarity with OpNet Modeler one will go through the “Small Internetworks” tutorial:

- New project with appropriate models needed during simulation
- Object Pallet
- “Rapid Configuration” feature to create Star Topologies quickly
- Editors
- Additional scenarios to simulate future expansion

After fully understanding these features one can take advantage to implement new designs. Here we will explore a few different scenarios.

RESULTS

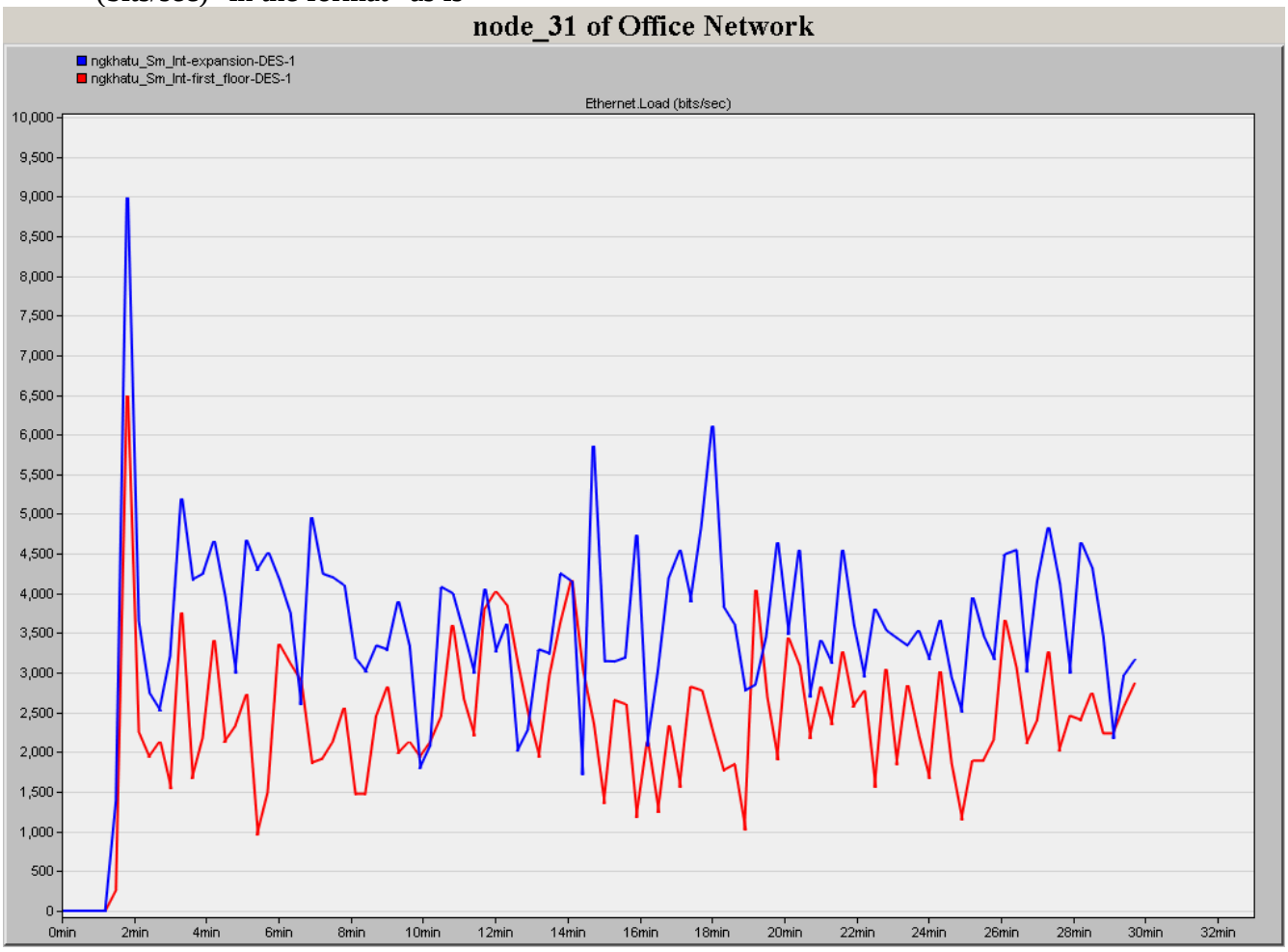
After implementing the lab assignment the resulting data is consistent with the expected results. More workstations connected to the server resulted in a higher load with increasing delay times. This is shown repeatedly; server load and delay times increase when the number of workstations in the star increase and when we expand the network.

QUESTIONS

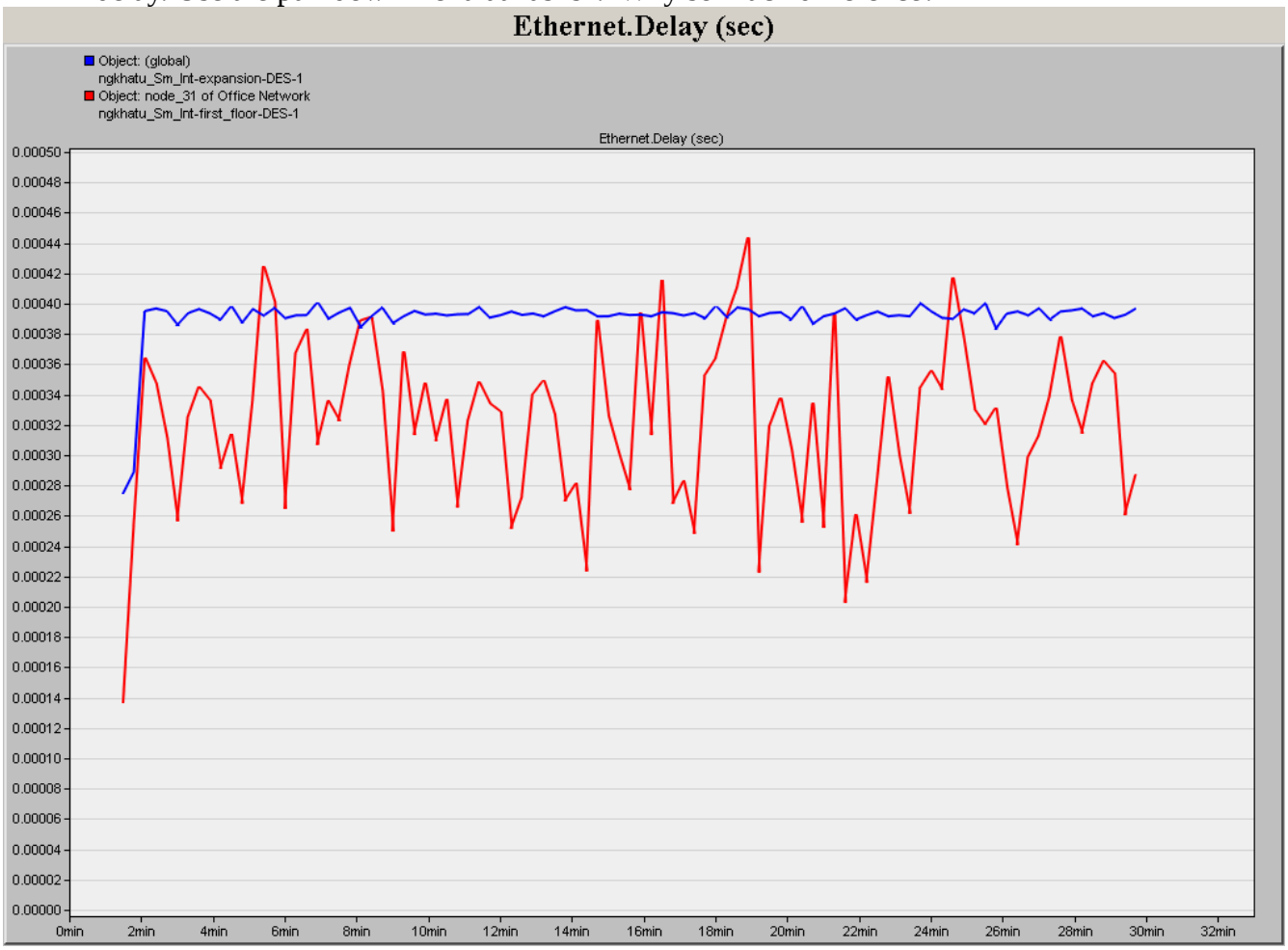
Question 1: Do the tutorial "Small Internetworks"

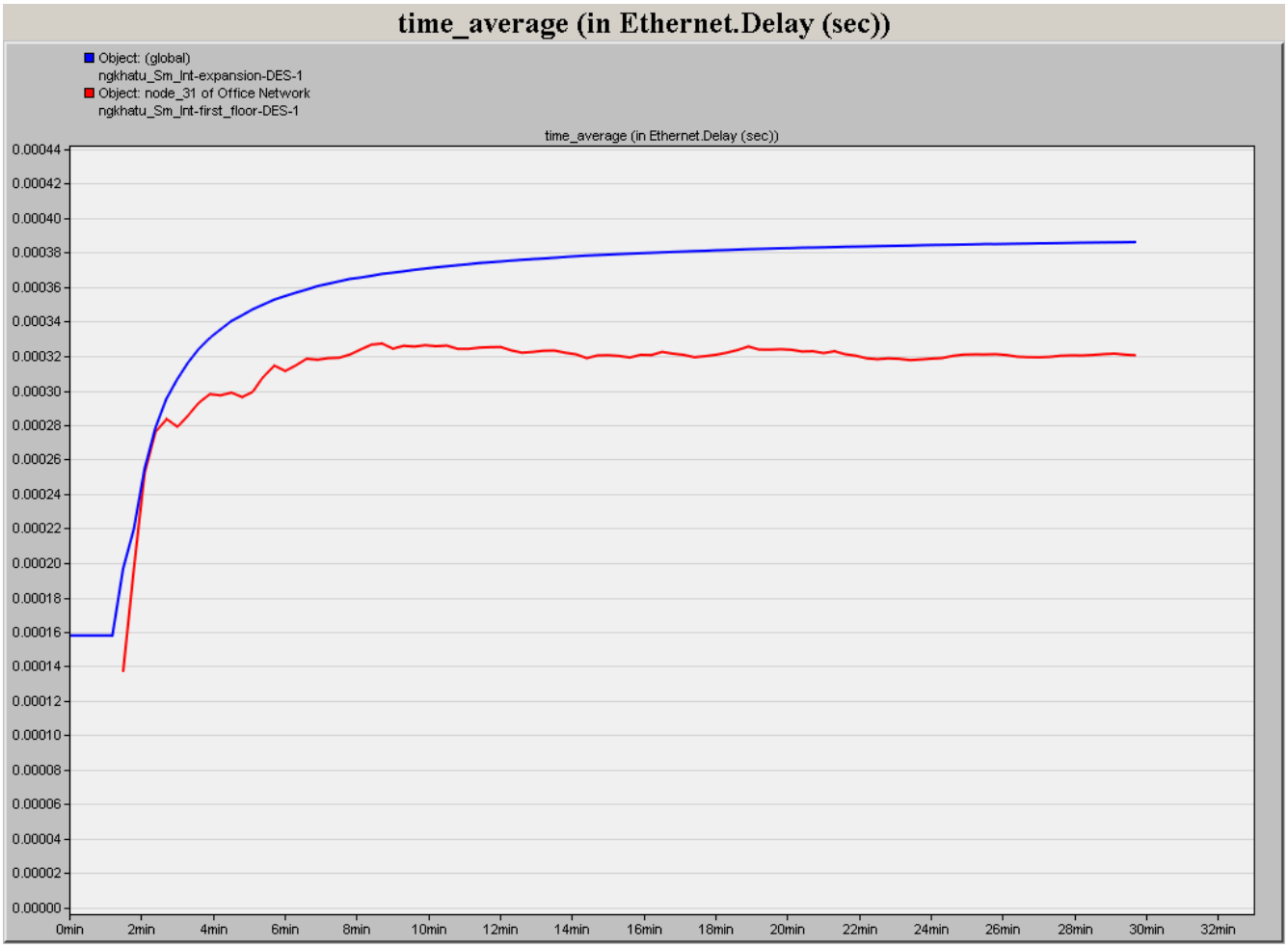
Submit the following:

a. For the two scenarios first_floor and expansion, compare on a single graph the Server "Load (bits/sec)" in the format “as is”



b. For the two scenarios first_floor and expansion, compare on a single graph the Global Ethernet Delay and the server (node31) Ethernet Delay the format “as is” and in the time_average delay. Use the pull down menu at “as is”. Why so much difference?





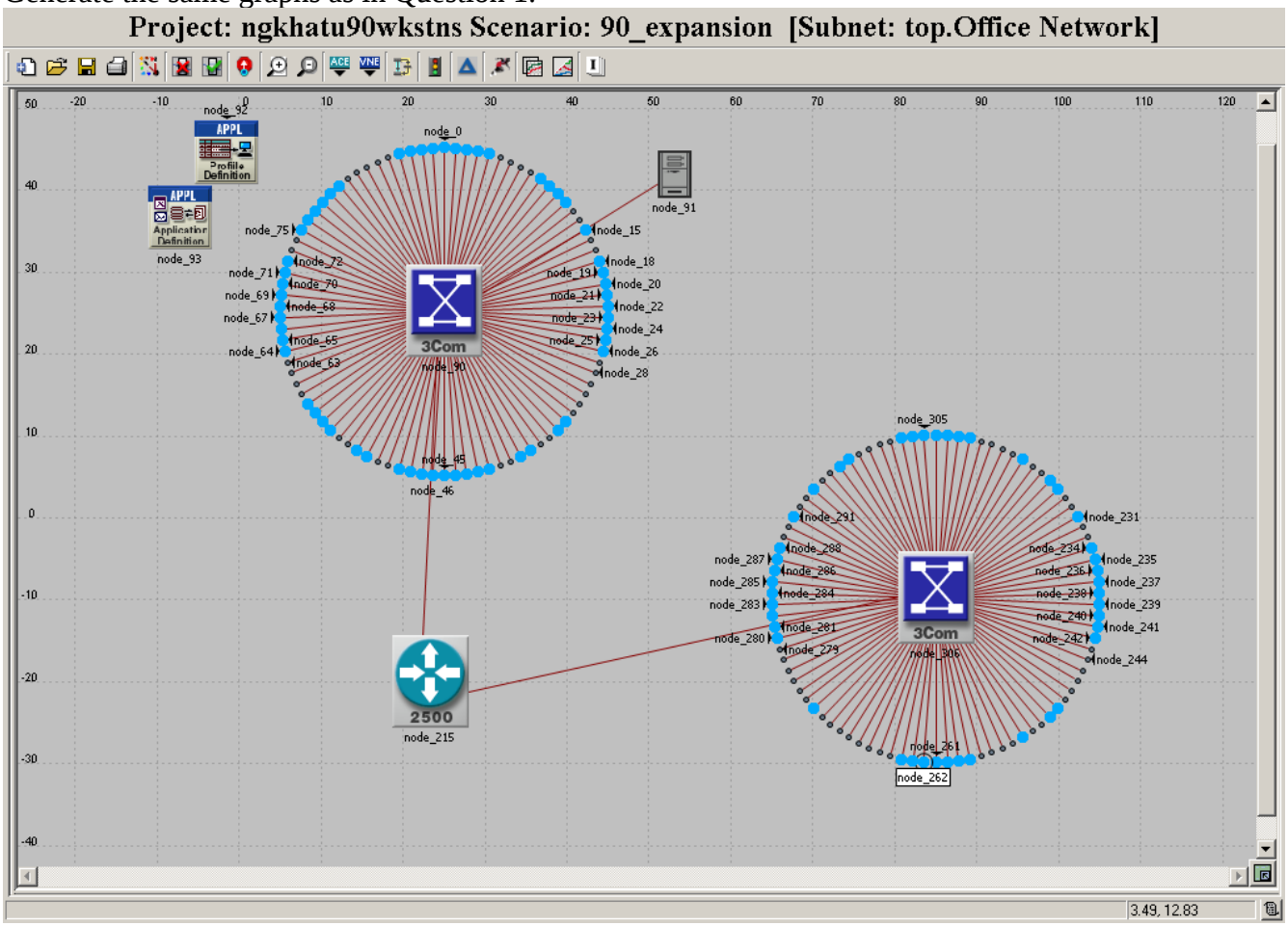
Question 2:

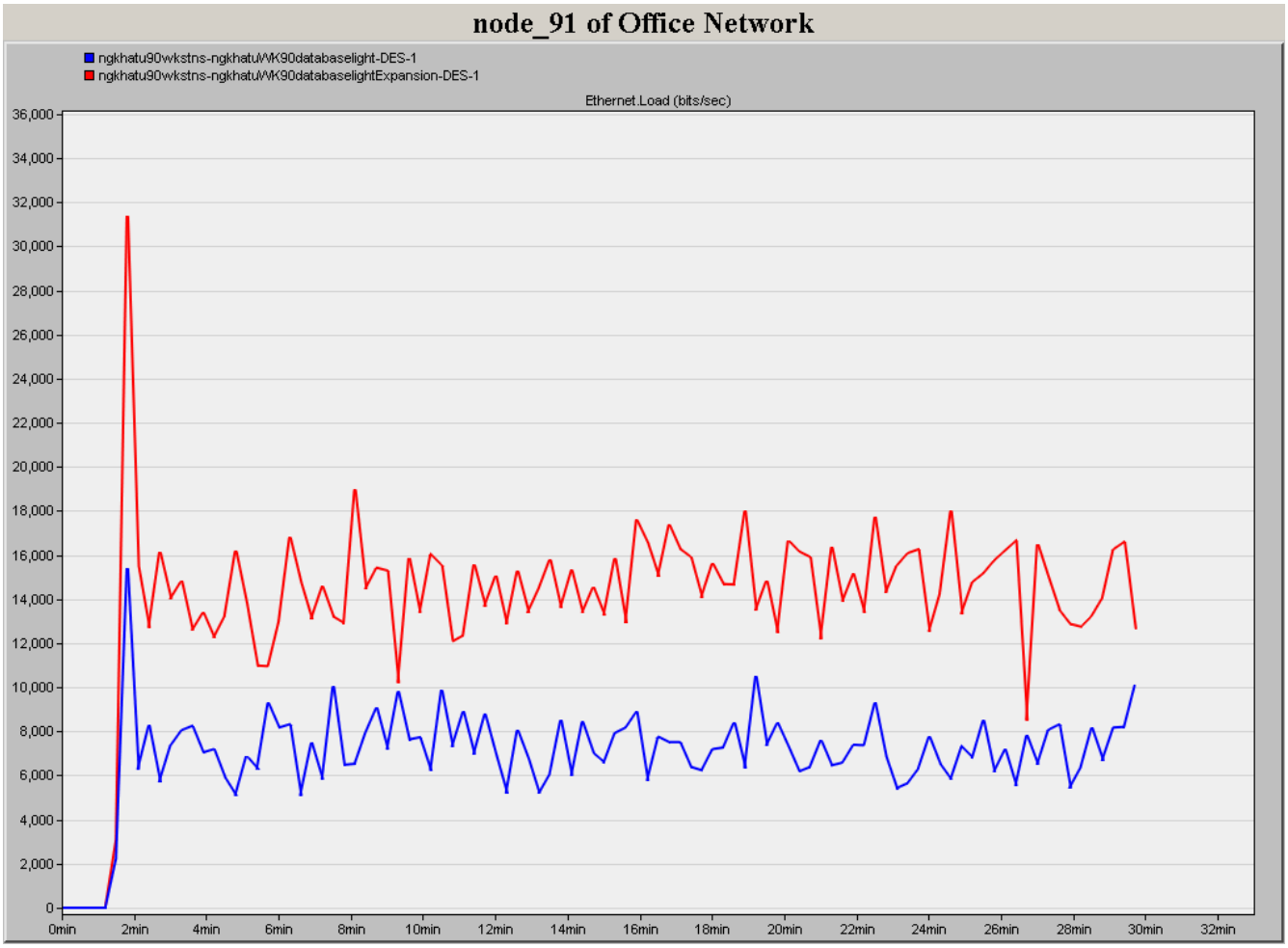
Create another new project <initials>90wkstns.
Also a scenario <initials>WK90databaselight.
Repeat the tutorial except:

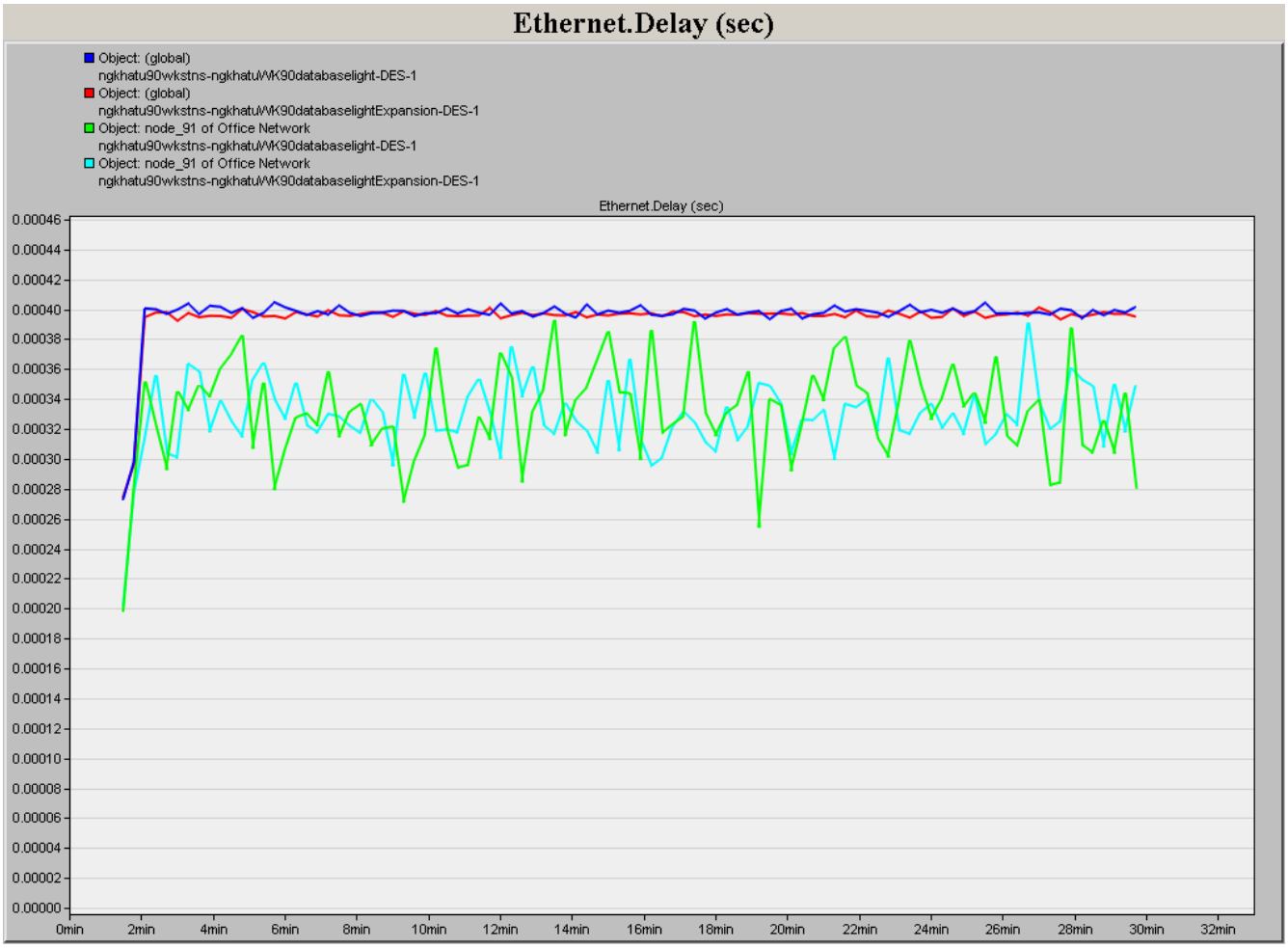
a. In Select Technologies include “links” as well as “Sm_Int_Model_List”
b. Instead of 30 use 90 workstations for the first floor. (you will also use 90 workstations for the second floor.
c. Run this as in tutorial "Small Internetworks" and look at various statistics. Need not turn this in.
d. **Please answer:** Why can’t you use 100 workstations here?
OpNet Modeler 17.1 Simulation software lets us add both 100 and 120 workstations to the star topology. This number should be restricted by the limitations of the switch in the center of the topology. If the number of ports are less than the desired workstations we will expect an issue.

Question 3:

Use the same project <initials>90wkstns.
Create/duplicate a new scenario <initials>WK90databaselightExpansion with 90 nodes on the second floor.
Generate the same graphs as in Question 1.




node_91 of Office Network
ngkhatu90wkstns-ngkhatuWK90databaselight-DES-1
ngkhatu90wkstns-ngkhatuWK90databaselightExpansion-DES-1
Ethernet.Load (bits/sec)
36,000
34,000
32,000
30,000
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
0min
2min
4min
6min
8min
10min
12min
14min
16min
18min
20min
22min
24min
26min
28min
30min
32min


Ethernet.Delay (sec)
Object: (global)
ngkhatu90wkstns-ngkhatuWK90databaselight-DES-1
Object: (global)
ngkhatu90wkstns-ngkhatuWK90databaselightExpansion-DES-1
Object: node_91 of Office Network
ngkhatu90wkstns-ngkhatuWK90databaselight-DES-1
Object: node_91 of Office Network
ngkhatu90wkstns-ngkhatuWK90databaselightExpansion-DES-1
Ethernet.Delay (sec)
0.00046
0.00044
0.00042
0.00040
0.00038
0.00036
0.00034
0.00032
0.00030
0.00028
0.00026
0.00024
0.00022
0.00020
0.00018
0.00016
0.00014
0.00012
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
0min
2min
4min
6min
8min
10min
12min
14min
16min
18min
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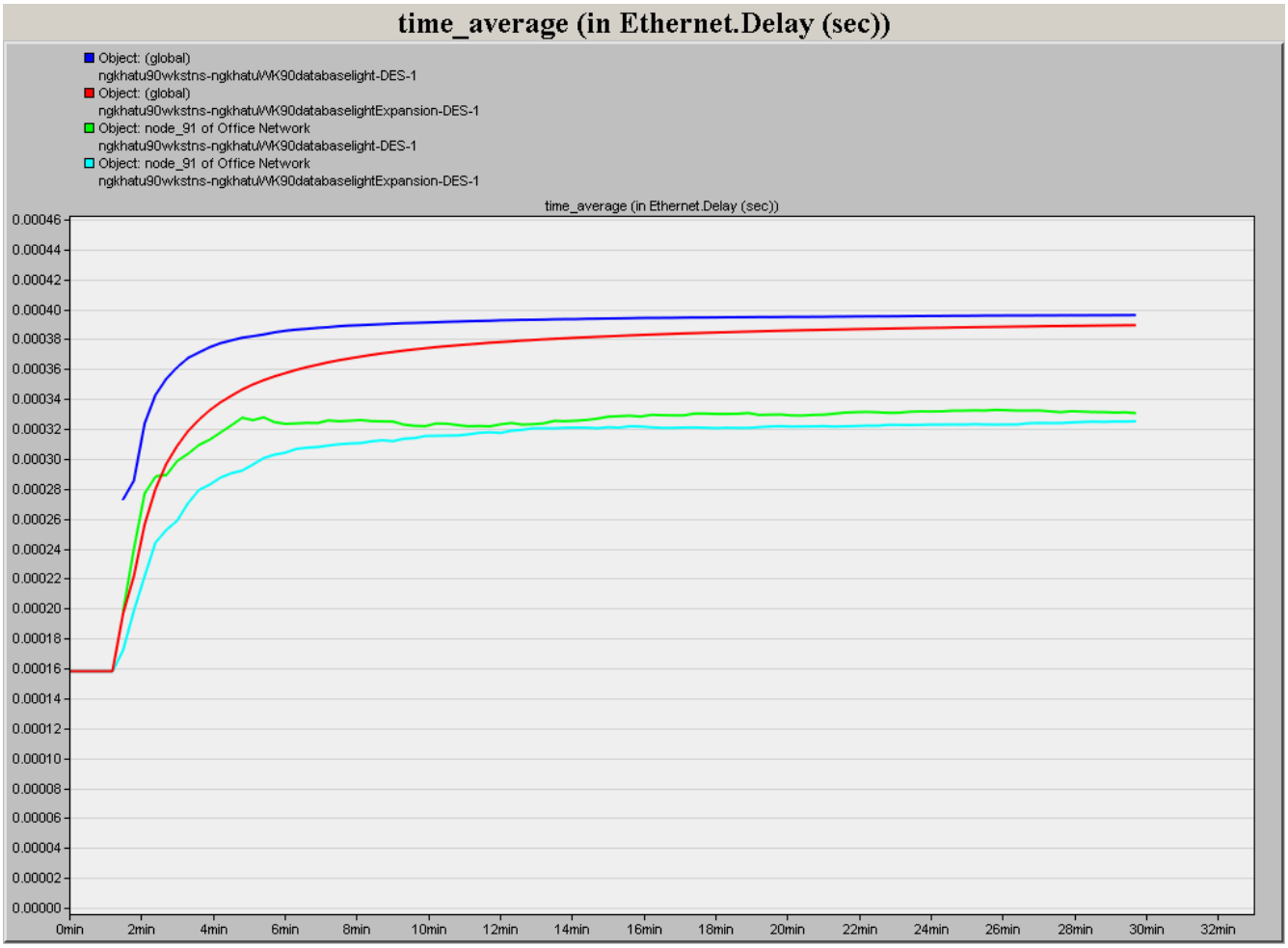
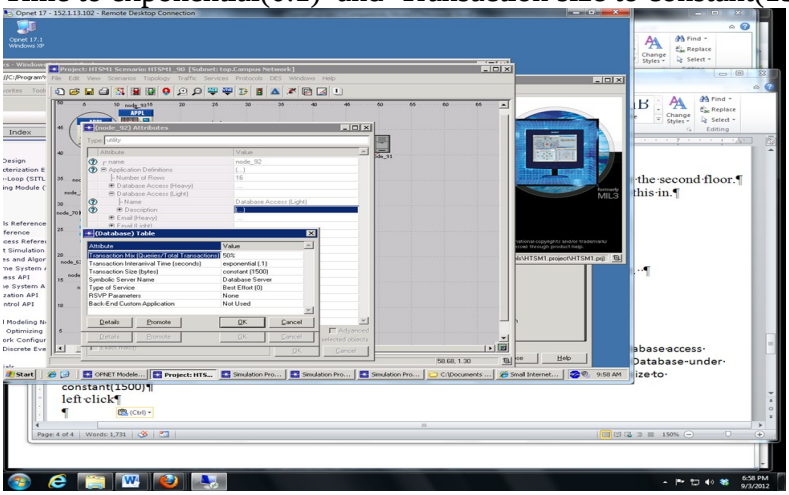
22min
24min
26min
28min
30min
32min



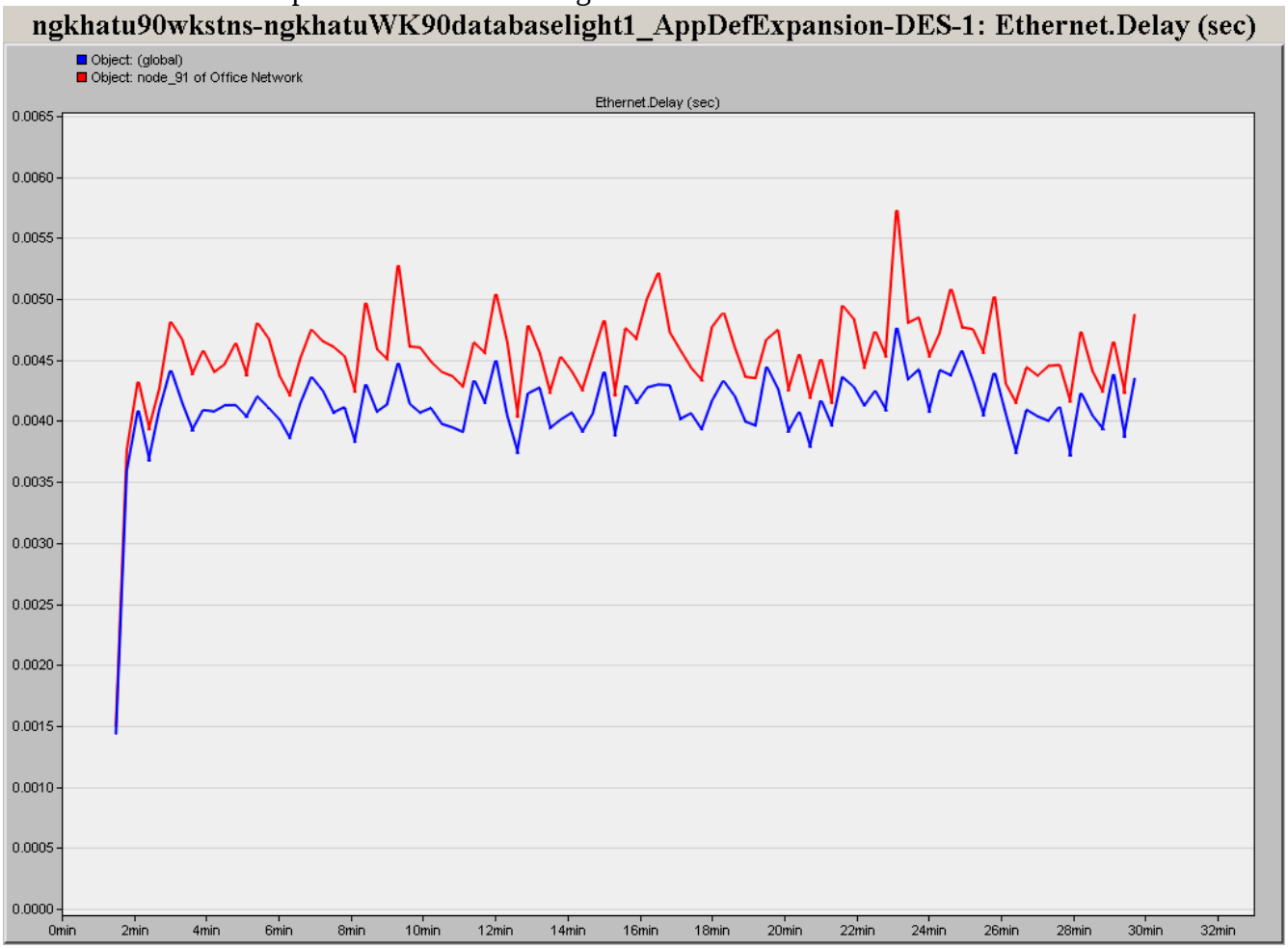
Question 4: Make a duplicate scenario: you choose names/labels carefully

Right click on Application Definition, then left Edit Attributes, left on Application Definitions, left on Database access (light), right column Value opposite description, left click , left click on edit, left click on value opposite Database under Values, edit, change to the following Transaction Interarrival Time to exponential(0.1) and Transaction size to constant(1500)

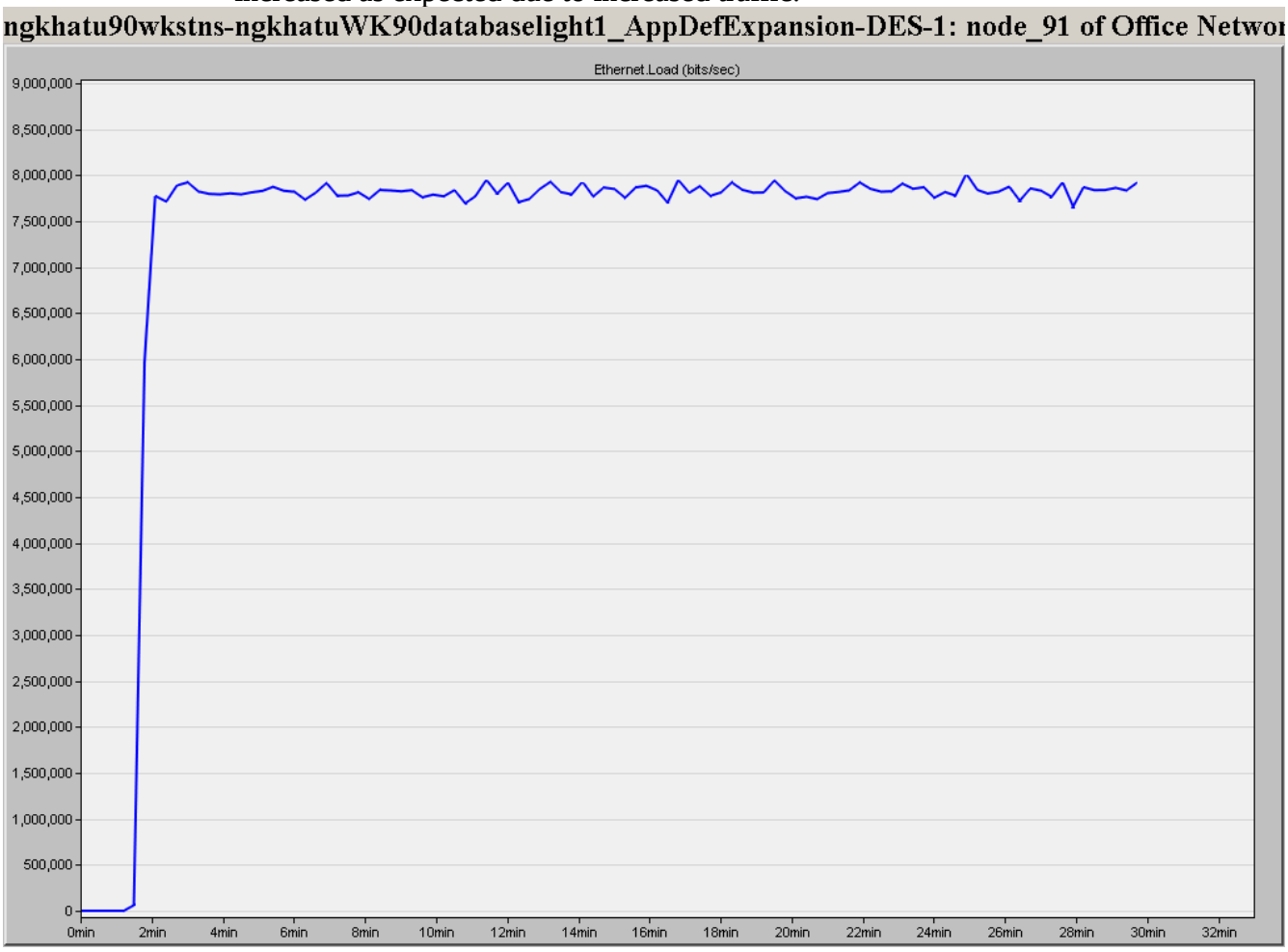


You have now increased the traffic significantly.

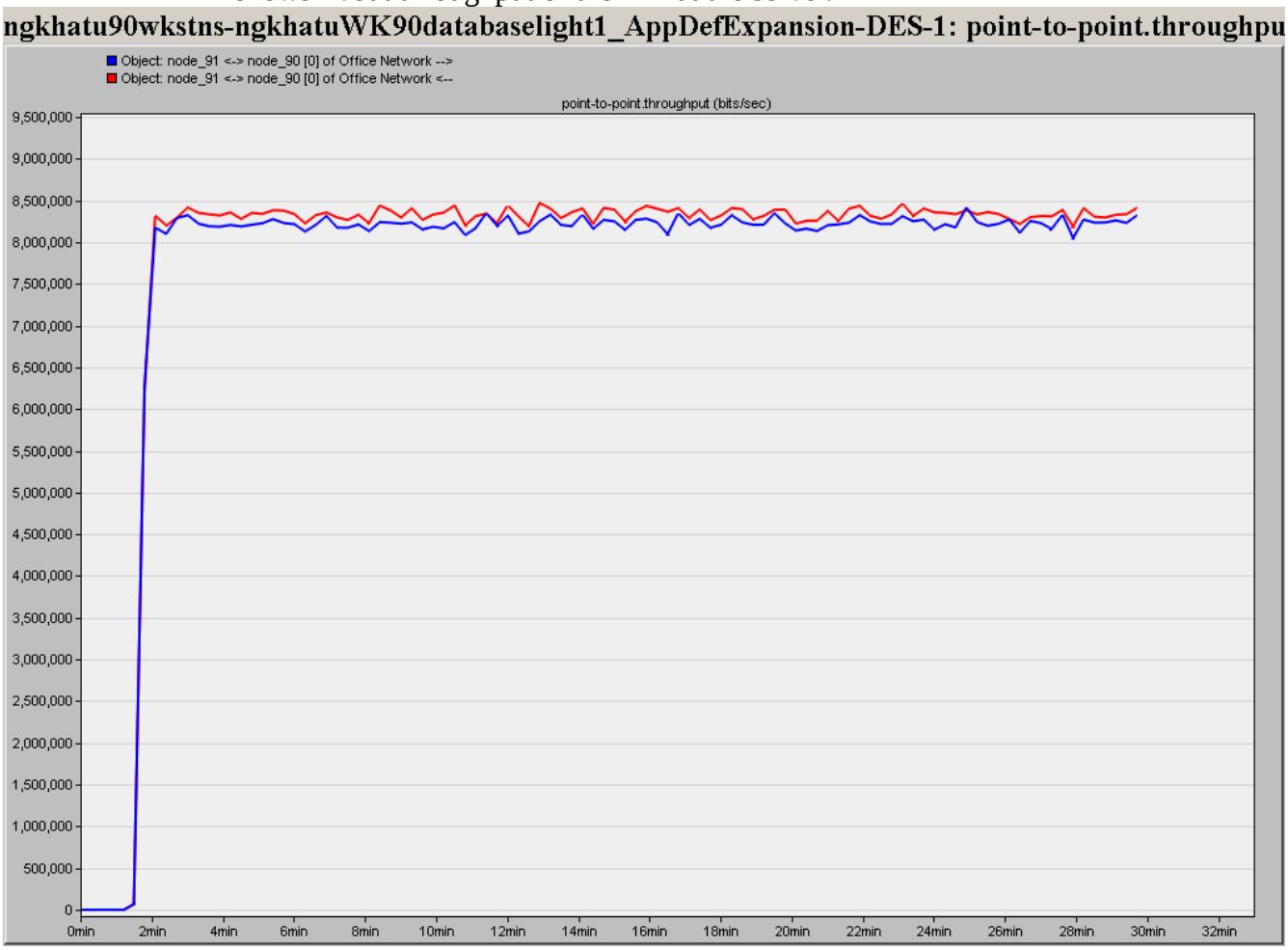
a. Collect stats on Server Ethernet delay, load (bps) and traffic received (bps), link throughput bps (both ways)(here right click on the Ethernet link to the server), and Global Ethernet load.
b. Output and **comment on**
    i. Server and Global Ethernet delay overlaid on one graph- Compared to delays from previous scenarios the delays shown in this scenario has drastically increased. This is expected due to increasing traffic.



ii. Server load- Comparing the server load to previous scenarios we find that this has increased as expected due to increased traffic.

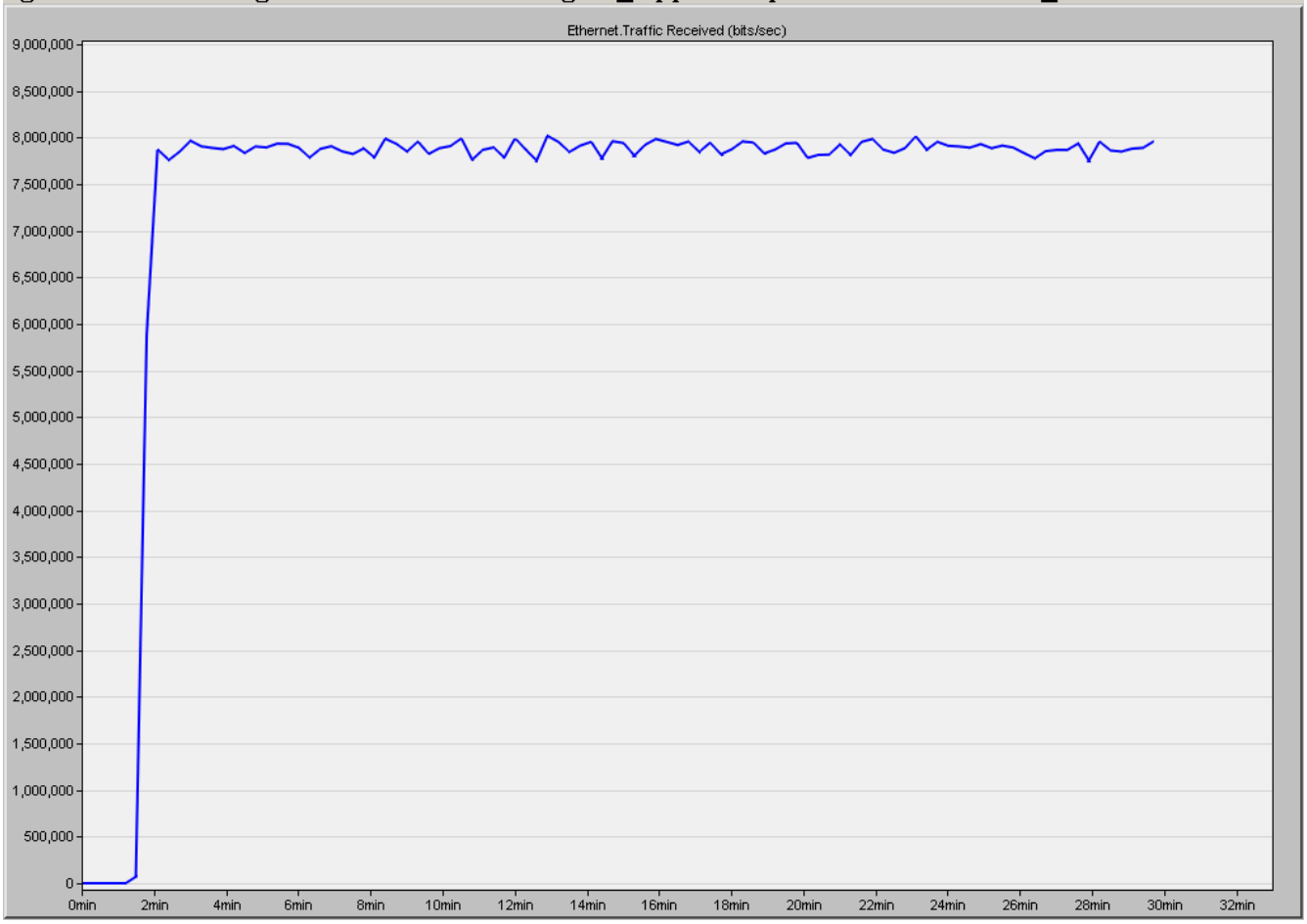


iii. Server link throughput (both ways) overlaid on one graph- The following graph shows in/out throughput of the link at the server.



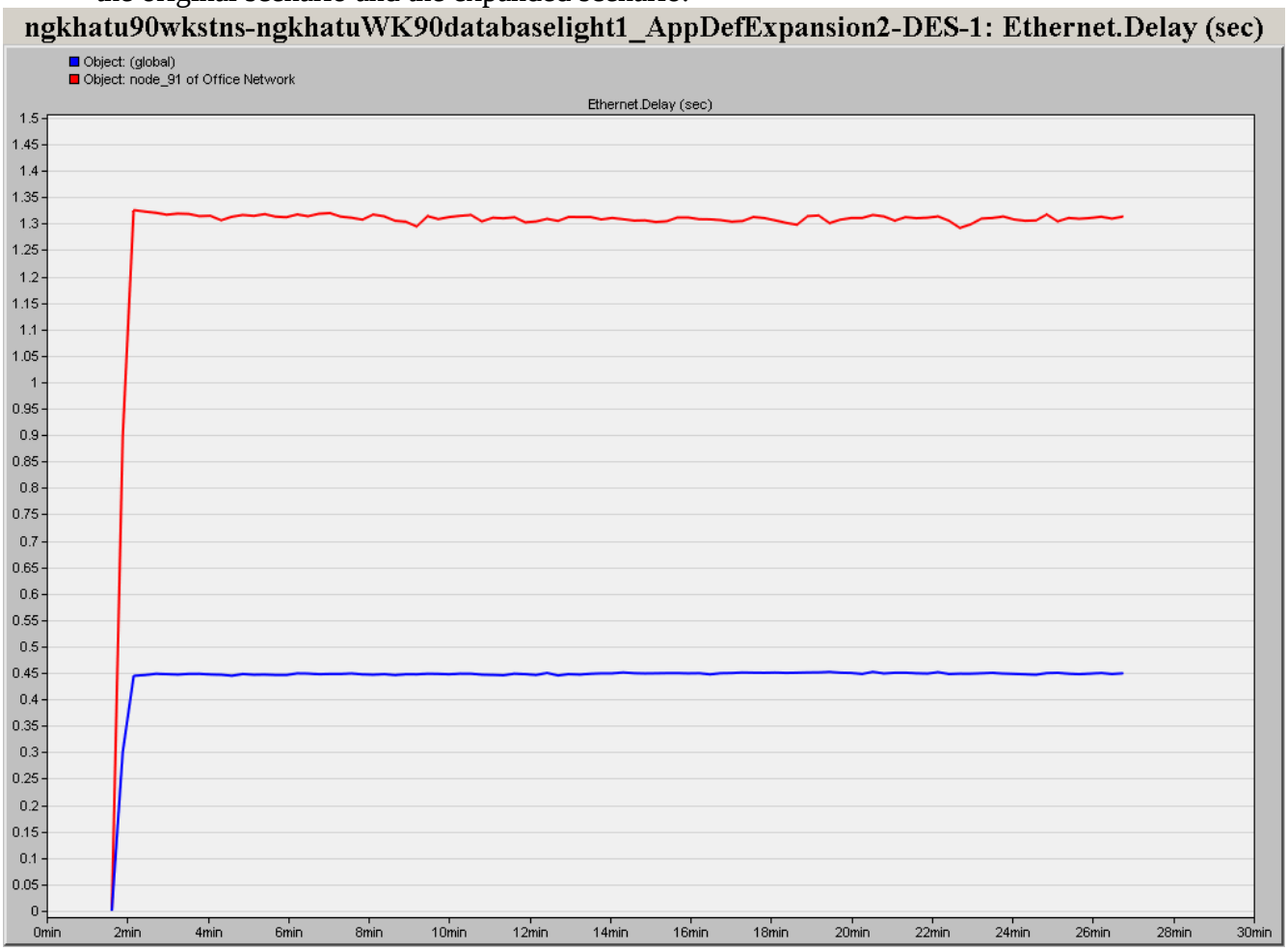
c. Choose another meaningful statistic and collect, output and comment on it.- The following graph shows the traffic being received by the server in bits per second. This is another statistic one can use to monitor server utilization.

ngkhatu90wkstns-ngkhatuWK90databaselight1_AppDefExpansion-DES-1: node_91 of Office Networ

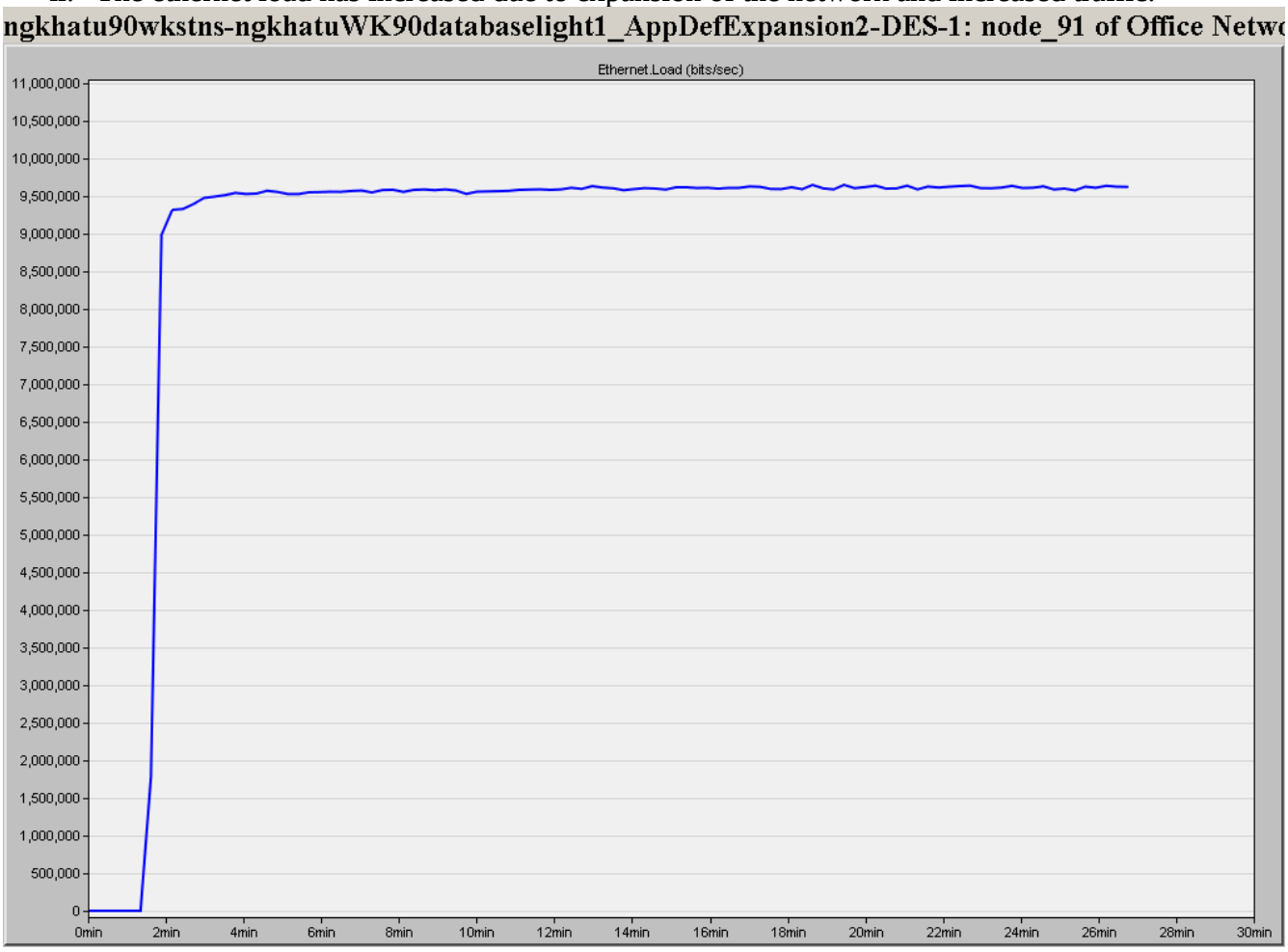


Question 5: Expand question 4 to 90 nodes on the second floor. Answer the same questions as in 4. B)

i. Here we see a more significant delay time difference(compared to previous statistics) between the original scenario and the expanded scenario.

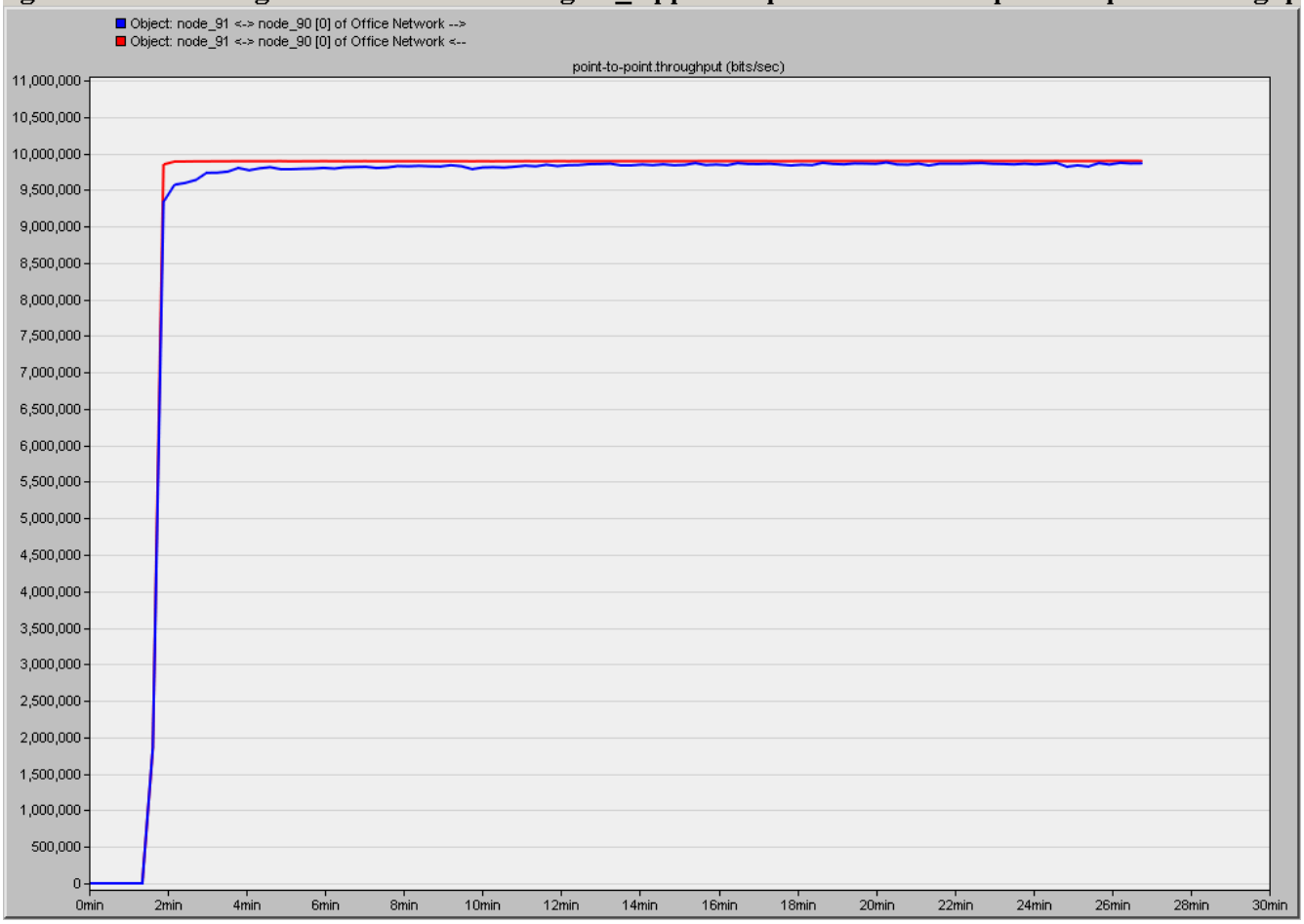


ii. The ethernet load has increased due to expansion of the network and increased traffic.

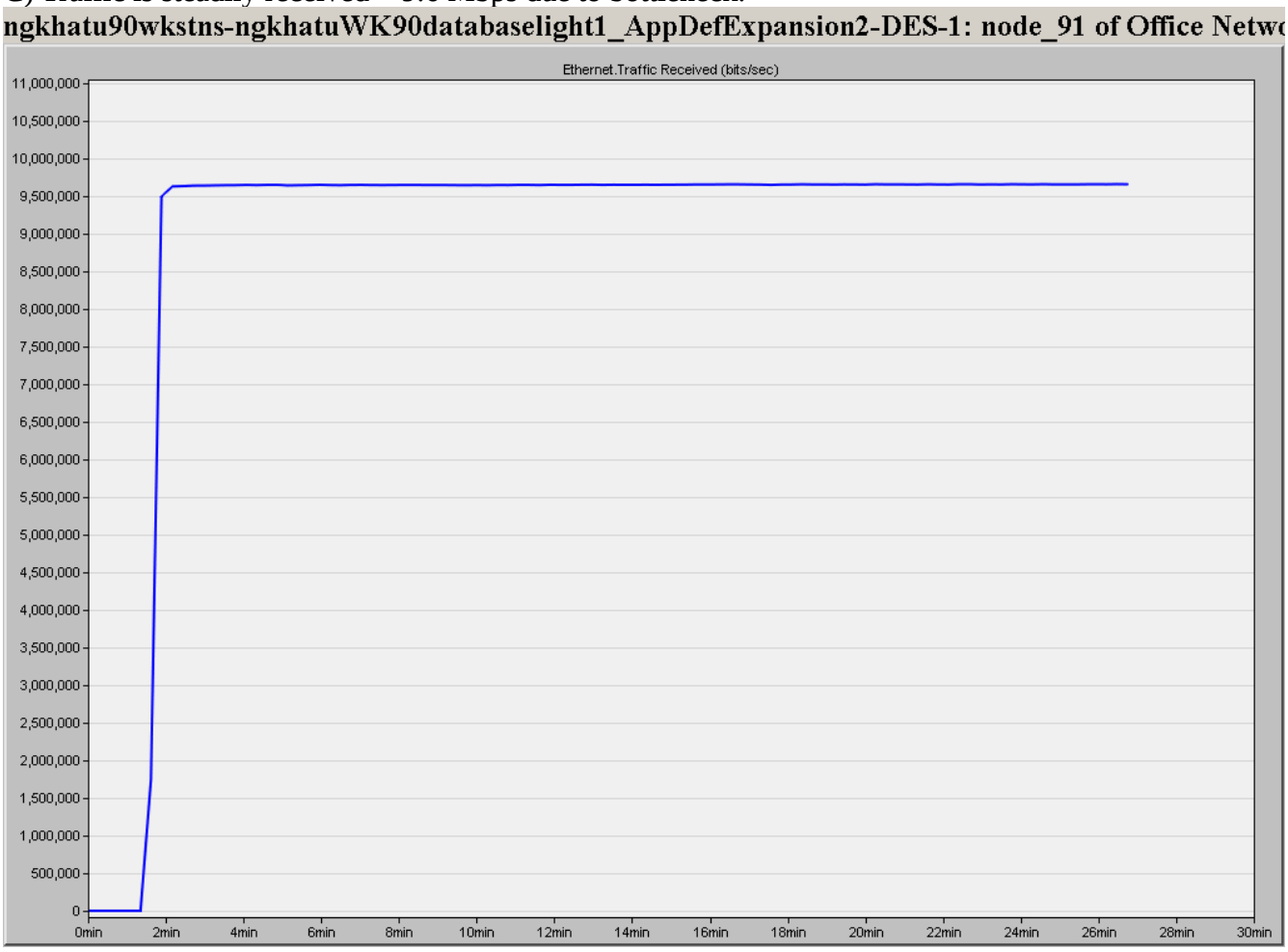


iii. Again, here we see increase in throughput at the server link due to the traffic increase and expansion of the network. We can also notice that this link seems to be a bottleneck at 10Mbps.

ngkhatu90wkstns-ngkhatuWK90databaselight1_AppDefExpansion2-DES-1: point-to-point.throughp



C) Traffic is steadily received ~9.6 Mbps due to bottleneck.

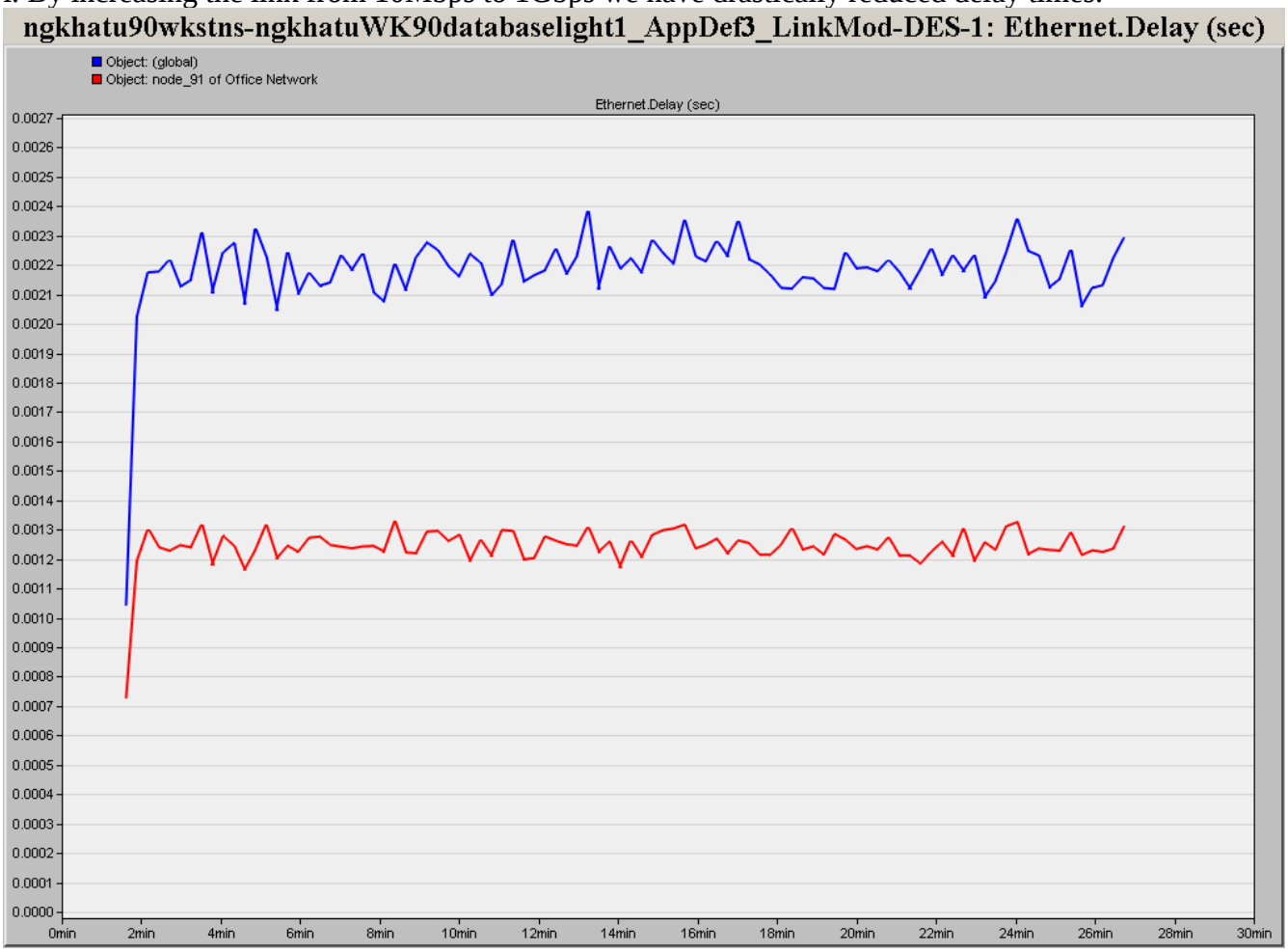


Question 6: From question 5, you may have noticed that the network is not functioning well. Make **one** single change in the model (you can delete a link with Delete and replace it, recall Question 2a above.)

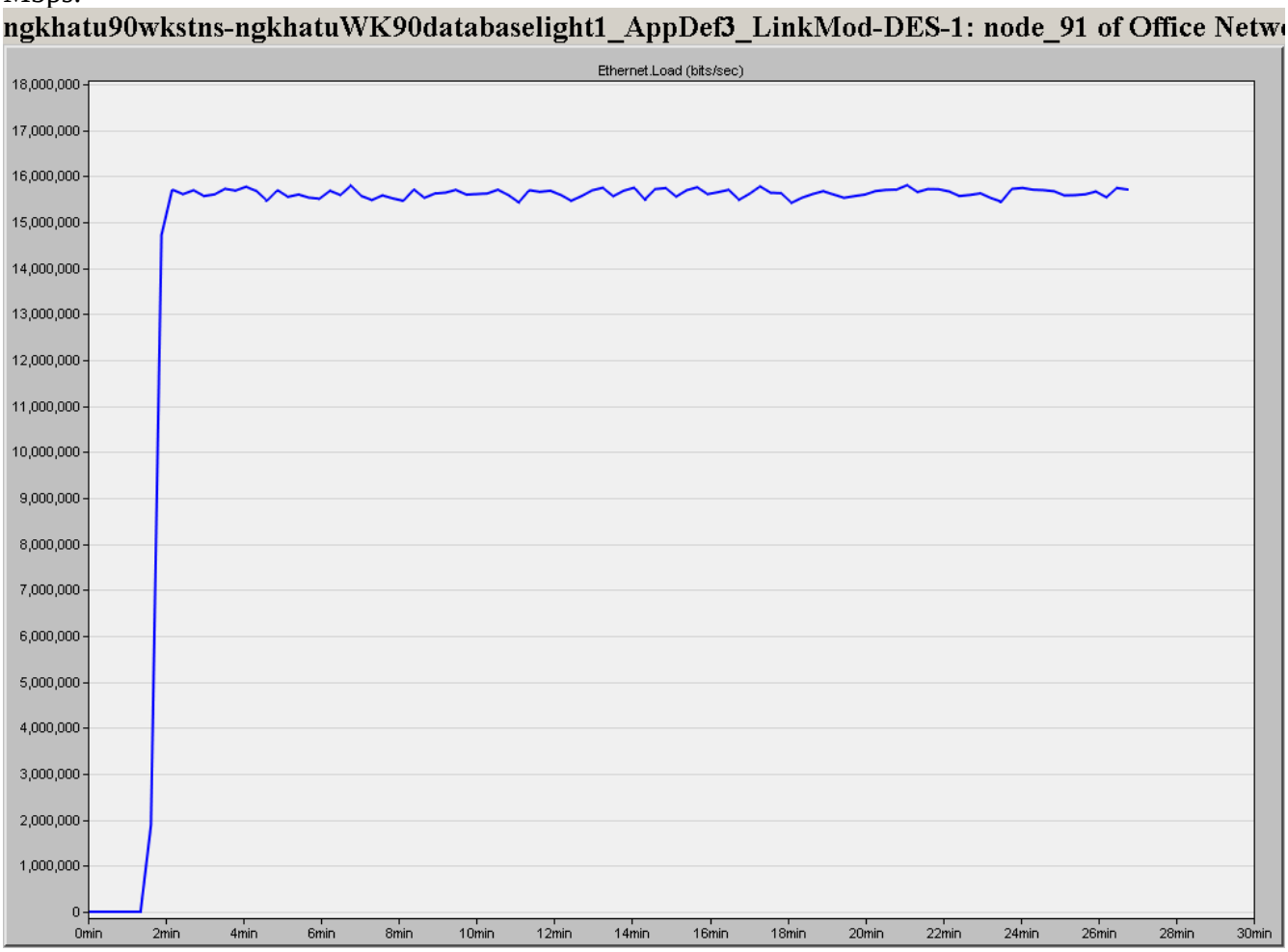
Answer the same questions as in 4.

B)

i. By increasing the link from 10Mbps to 1Gbps we have drastically reduced delay times.

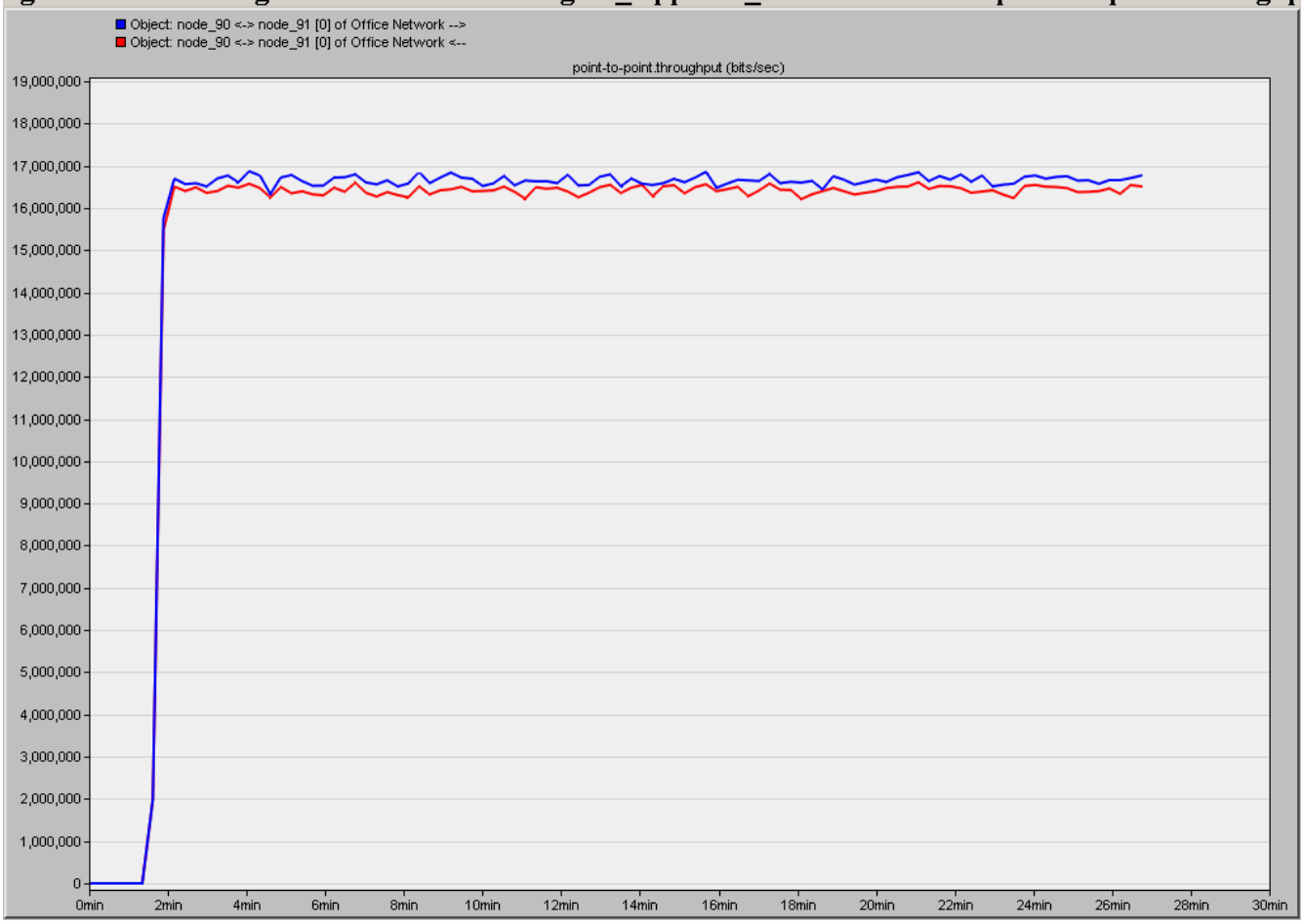


ii. Here we overcome the bottleneck by increasing the link capacity. The previous Ethernet Load is ~9.6 Mbps.

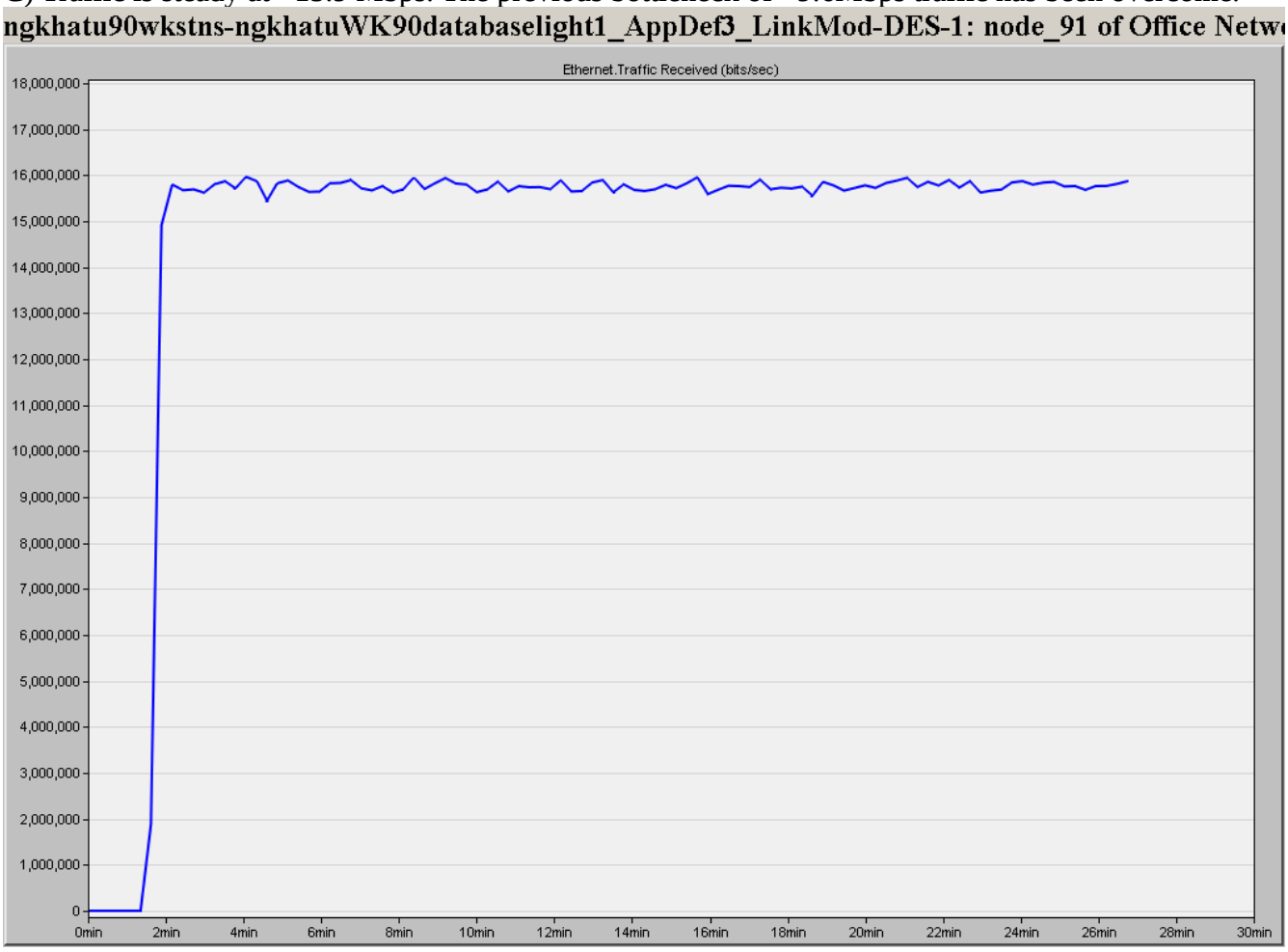


iii. It is now evident that the link is no longer a bottleneck. Throughput has increased from 10Mbps to ~16.5 Mbps.

ngkhatu90wkstns-ngkhatuWK90databaselight1_AppDef3_LinkMod-DES-1: point-to-point.throughp



C) Traffic is steady at ~15.9 Mbps. The previous bottleneck of ~9.6Mbps traffic has been overcome.



CONCLUSION

Question 7:Please give a brief general conclusion about the traffic and utilization on/of these networks and the basis for that conclusion.

The OpNet Modeler confirms expectations of real world scenarios. When the number of workstations increased the amount of overall traffic increases. This in turn creates additional load on the server(s). With the modeler we were able to simulate additional workstations, future expansions while accounting for possible network bottlenecks.