Shared & Switched Ethernet Network Simulation using Riverbed Modeller (OPNET)

Kangyan XU

Brief Abstract

This report uses Riverbed Modeler to analyze collision related factors.
The first part focuses on factors like the nodes' interarrival time, number of nodes (stations) and packet size.
The second part compares the network performance when using hubs and switches.

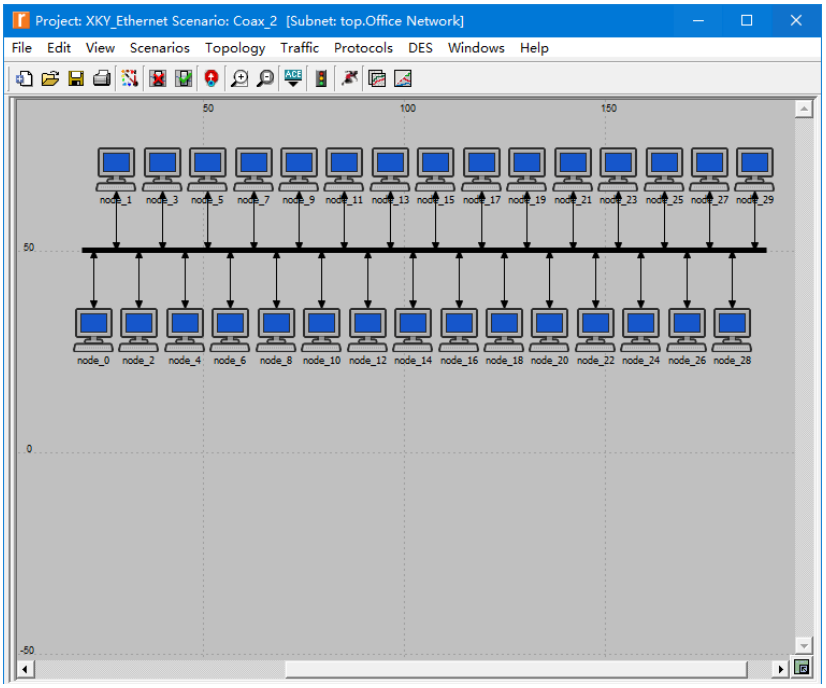

Fig 1 - The Simulation Model

CSMA Questions

1. Explain the graph we received in the simulation that shows the relationship between the received (throughput) and sent (load) packets.

Why does the throughput drop when the load is either very low or very high?

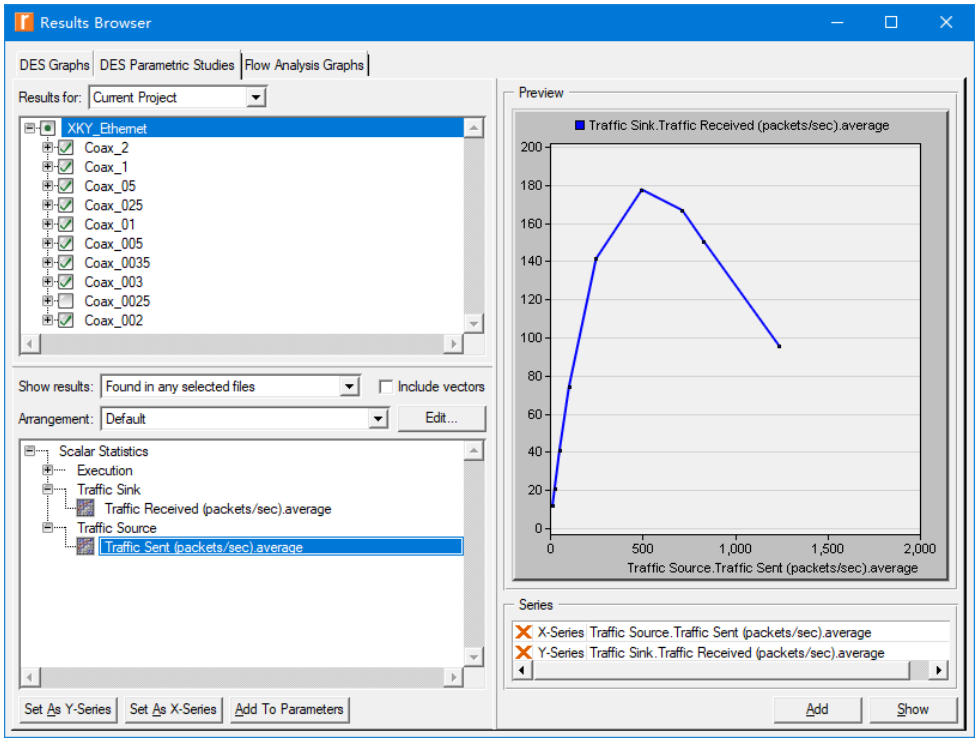

Fig 2 – The Resulting Graph

A: From Fig 2, when the average traffic sent less than 500 packets per sec, the throughput is rising but the growth rate is decreasing. When the traffic sent over 500 packets per sec, the throughput goes down.
When the load is very low, the throughput is also very low.
When the load is very high, there may exist high collisions, so the packets are more likely to require retransmitting, thus the throughput goes down.

2. Get two graphs: one to compare node 0's collision counts in these three scenarios and the other graph to compare the received traffic from the three scenarios. Explain the graphs and comment on the results.

A: From Fig 3, it can be found that node 0 in Scenario Coax_0025 has more collisions than other two scenarios, and in all 3 scenarios the node's collision eventually become stable around certain counts. Given that Coax_0025 has the shortest interarrival time, the packets are sent more frequently and more likely to collide. The less the interarrival time, the more the collision.

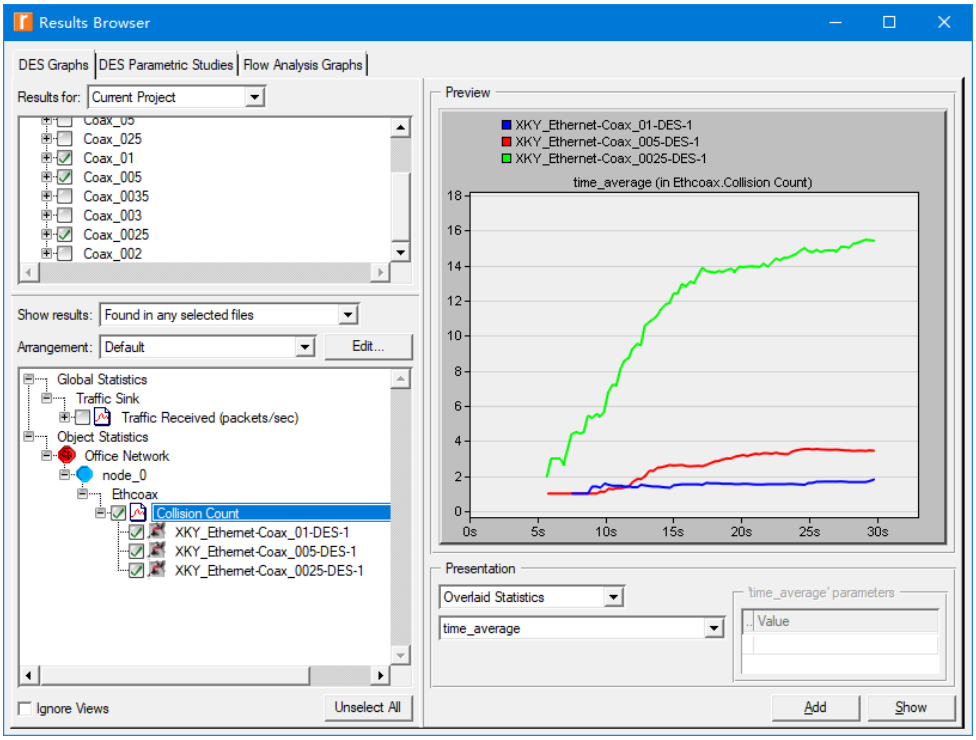

Fig 3 – Node 0's collision counts Compare

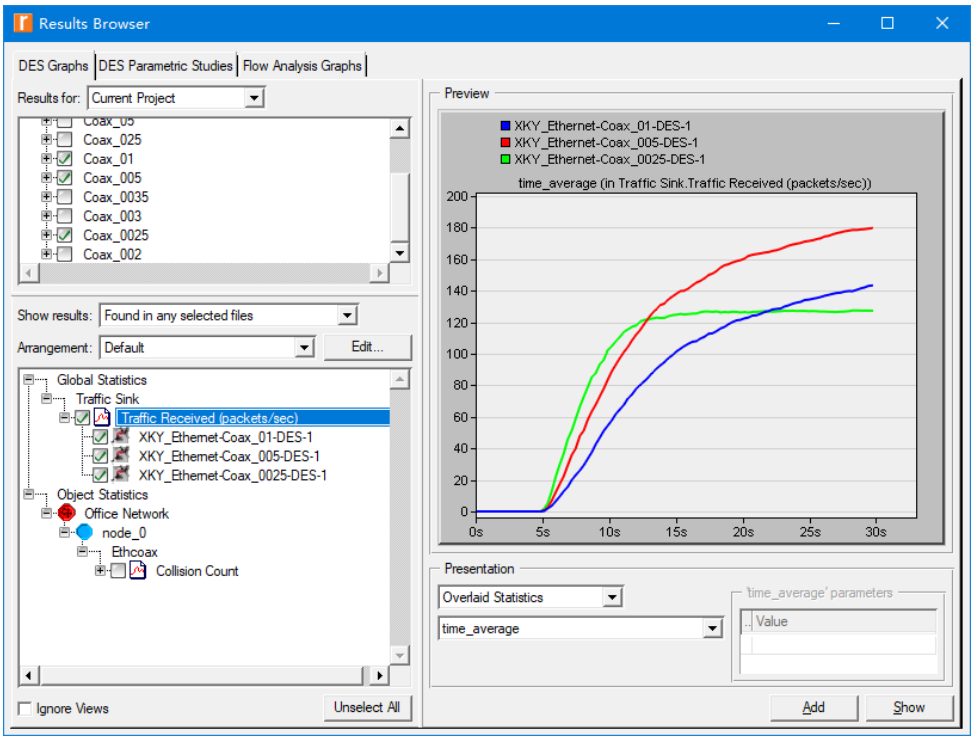

Fig 4 – Received traffic from three scenarios

From Fig 4, during the period ‘5s’ to ‘10s’, the less the interarrival time, the more the traffic received. Later, the collision has impacts on the received traffic, so Coax_0025’s received traffic becomes stable and fall behind other two scenarios as the latter two are not seriously affected by the collision.

3. To study the effect of the number of stations on Ethernet segment performance. Create a graph that compares node 0’s collision counts in scenarios Coax_0025 and Coax_Q3. Explain the graph and comment on the results.

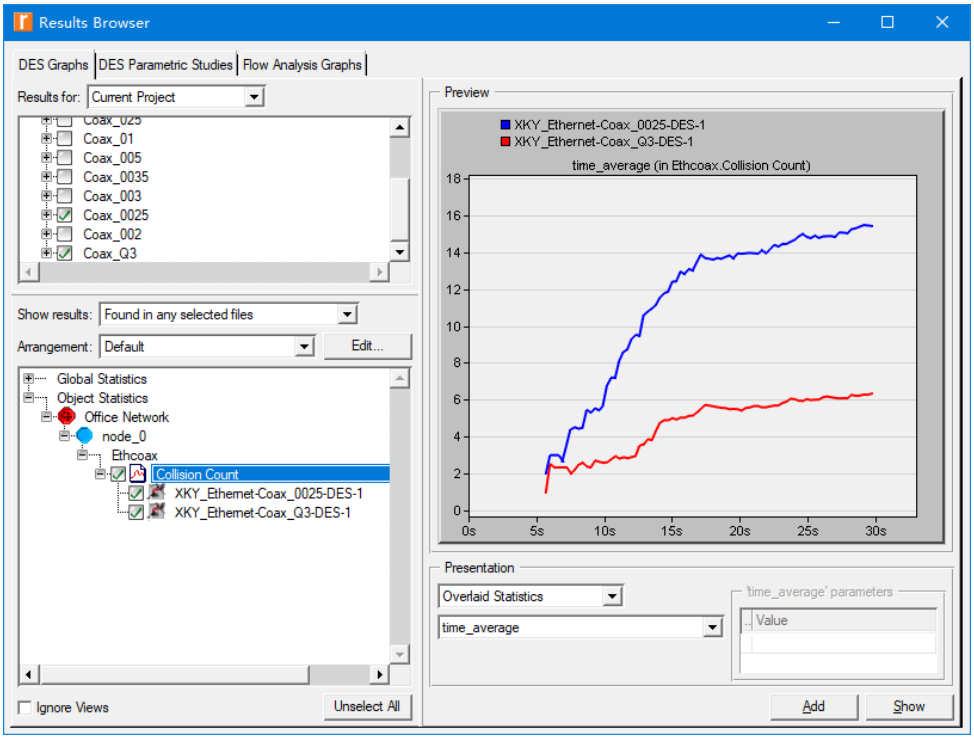

Fig 5 – Node 0’s collision counts Compare

A: From Fig 5, node 0 in Scenario Coax_Q3 has less collisions than Coax_0025, given that in Q3 there is only half the nodes on the network, less packets are sent and the occurrence of collisions is much lower.

4. To study the effect of the packet size on the throughput of the created Ethernet network. Create a graph that compares the throughput as packets/sec and another graph that compares the throughput as bits/sec in Coax_0025 and Coax_Q4 scenarios.

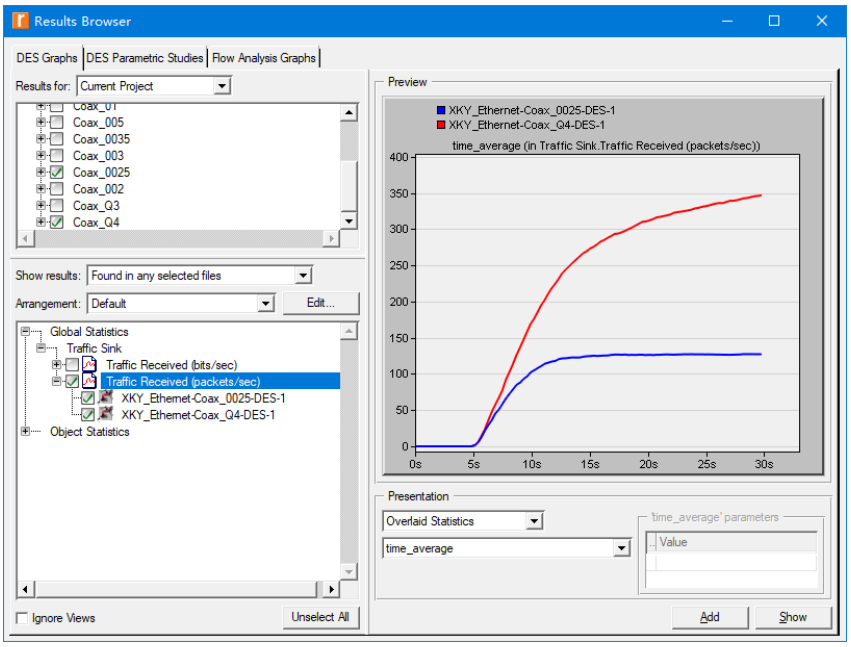

Fig 6 – throughput (packets/sec) compare

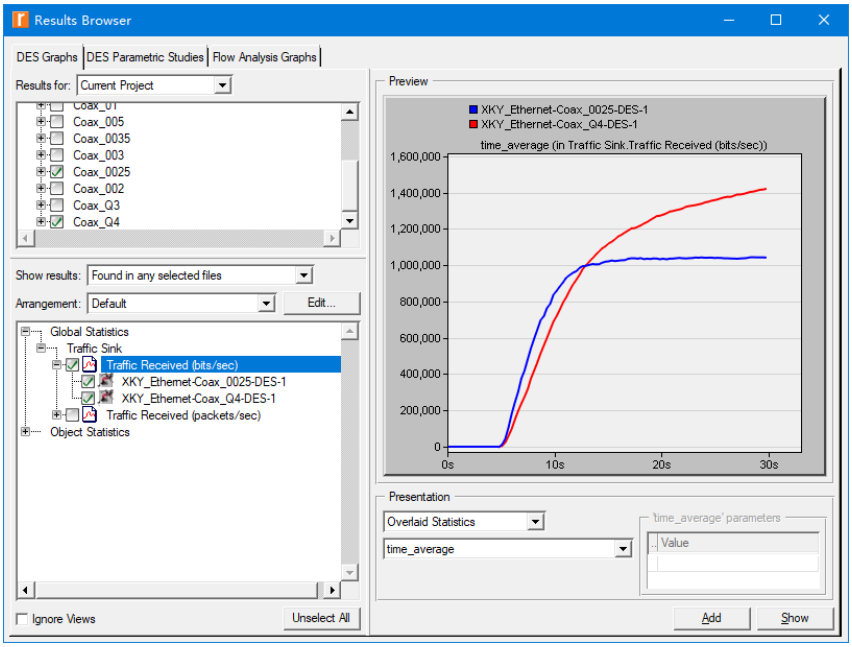

Fig 7 – throughput (bits/sec) compare

A: From Fig 6, the throughput (packets/sec) in Coax_Q4 is larger than Coax_0025, given that the latter has larger packet size and is more likely to have collisions. Besides, throughput in Q4 didn't meet its upper bound as quickly as 0025.
From Fig 7, at first the throughput (bits/sec) in Coax_0025 is larger given the collision's impact is small in this period and the 0025's packet size is larger. Later, 0025's throughput reaches its upper bound due to collision while Q4's keeps increasing.

Switched LANs Questions

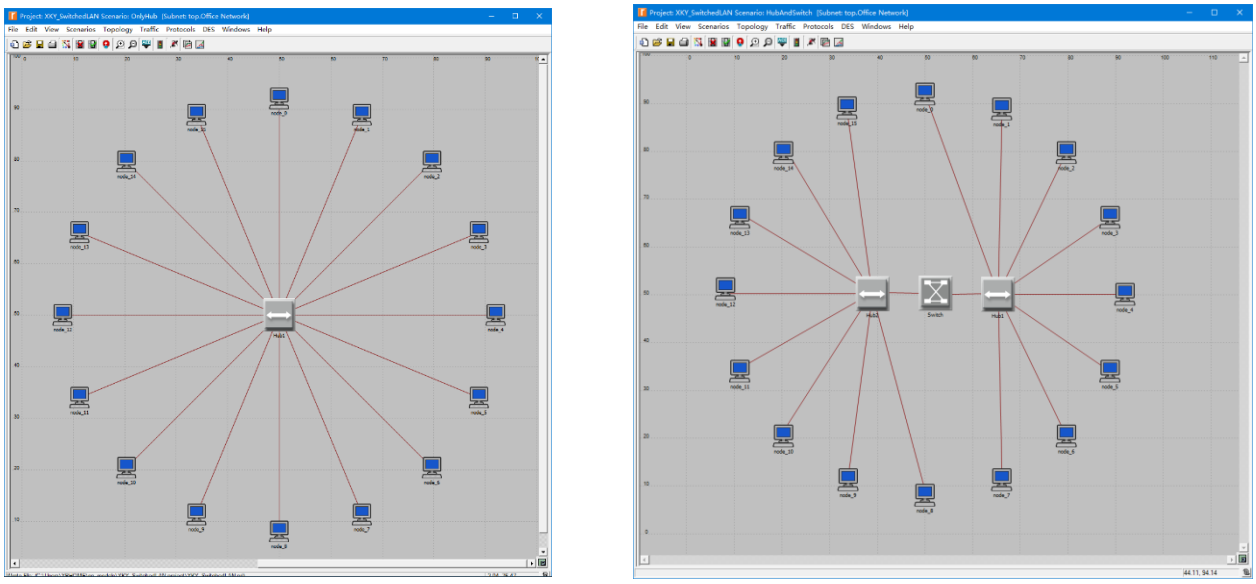

Fig 8 – The Simulation Model: OnlyHub and HubAndSwitch

1. Explain why adding a switch makes the network perform better in terms of throughput and delay.

A: From Fig 10 and 11, traffic received in HubAndSwitch is higher, and the dalay is lower.
A switch can forward the incoming packets only to their destinations, so a number of collisions can be avoided using a switch, which makes network perform better.

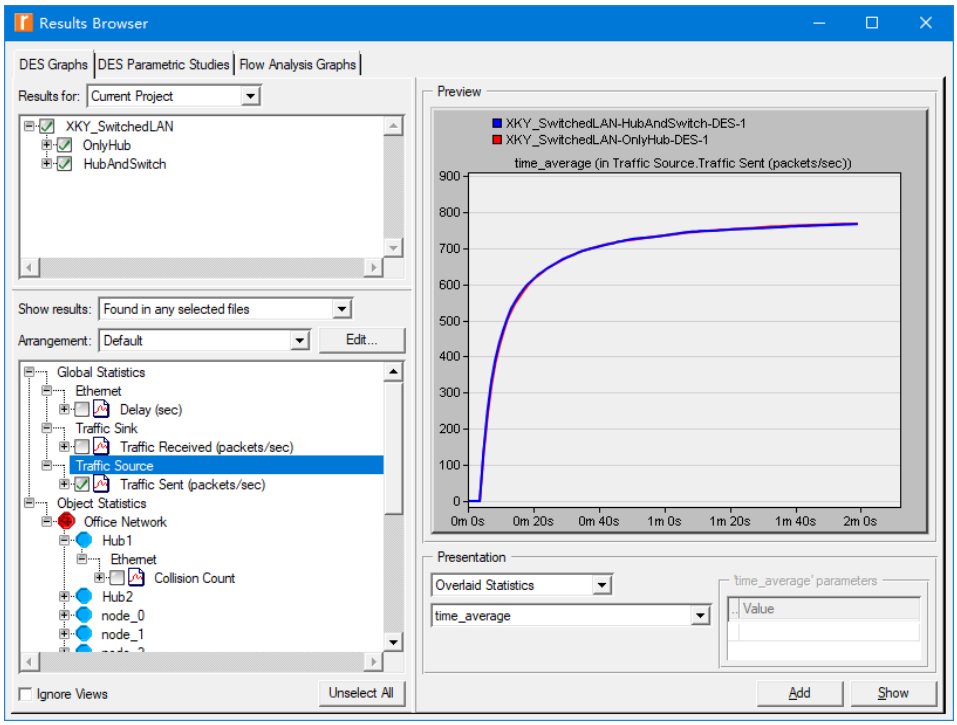

Fig 9 – Traffic Sent (packets/sec)

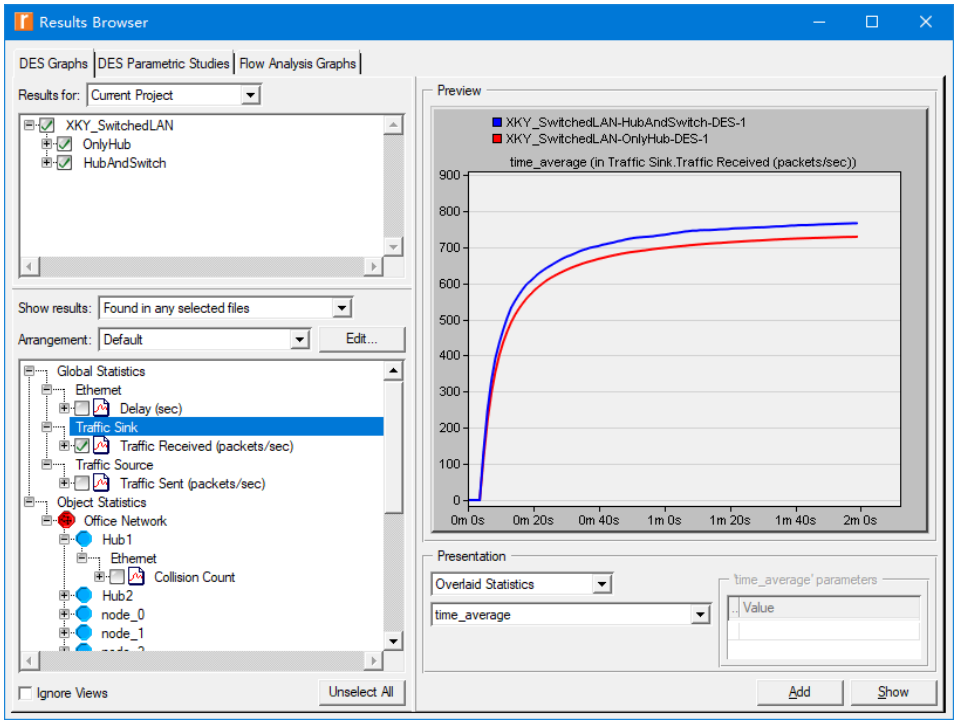

Fig 10 – Traffic Received (packets/sec)

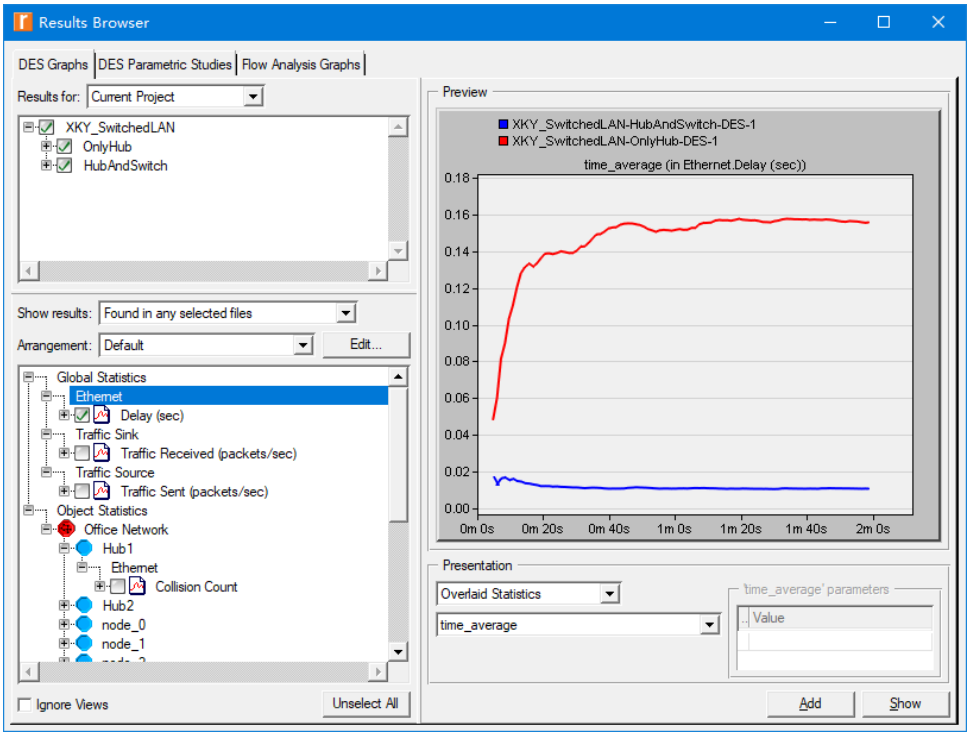

Fig 11 – Delay (sec)

2. We analyzed the collision counts of the hubs. Can you analyze the collision count of the "Switch"? Explain your answer.

A: No. Hub is a shared network, but switch uses data base mapping MAC address to port number, so there is no collision in switch.

3. Create two new scenarios. The first one is the same as the OnlyHub scenario but replace the hub with a switch. The second is the same as the HubAndSwitch scenario but replace both hubs with two switches, remove the old switch, and connect the two switches you just added together with a 10BaseT link.
Compare the performance of the four scenarios in terms of delay, throughput, and collision count.

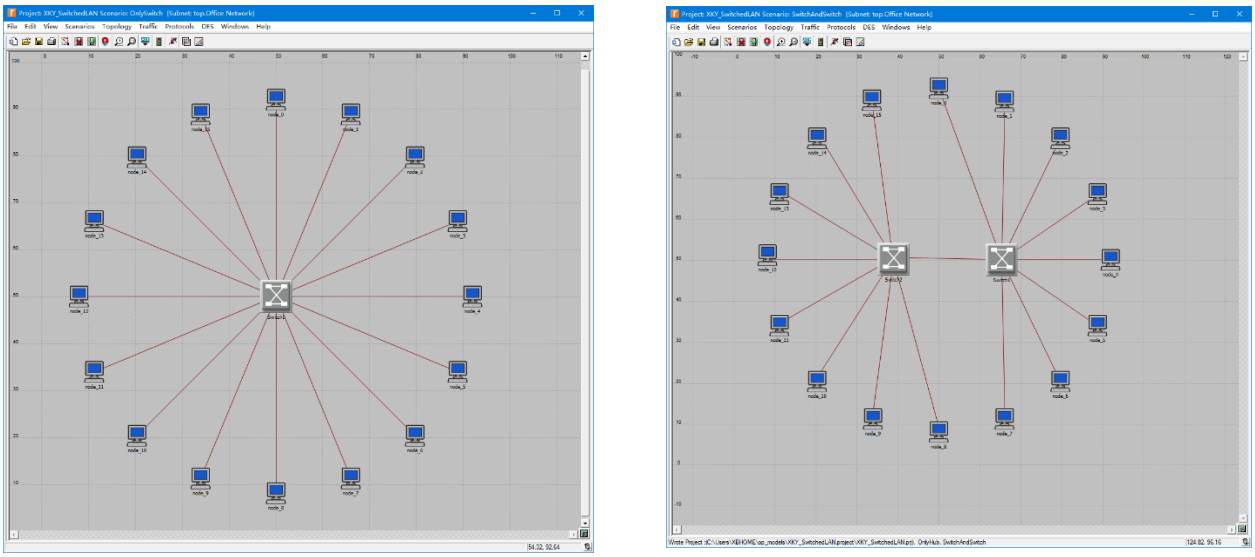

Fig 12 – The Simulation Model: OnlySwitch and SwitchAndSwitch

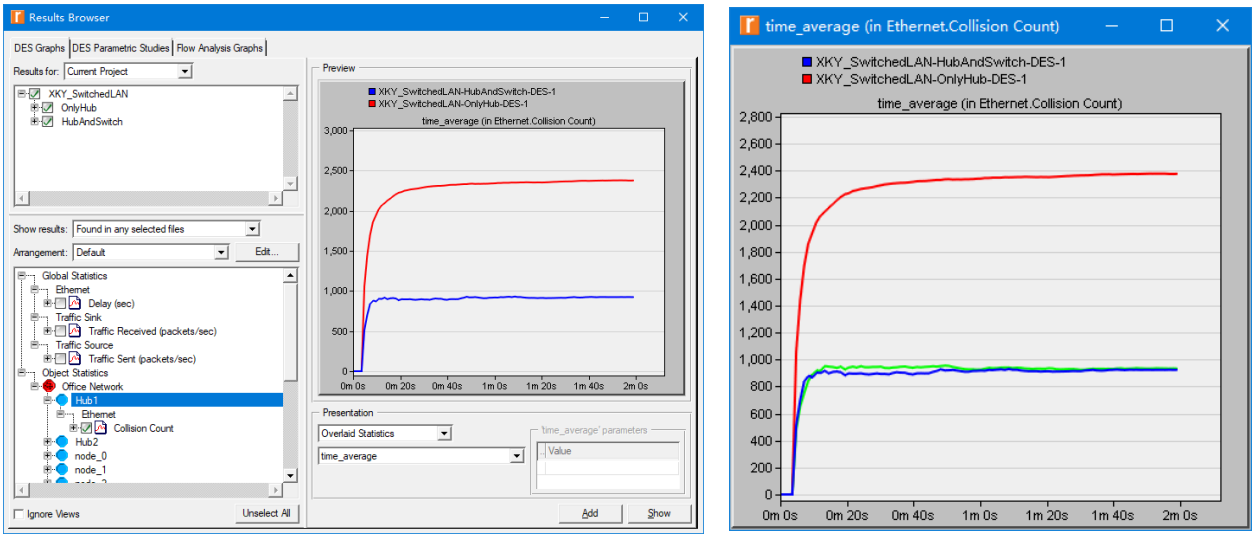

Fig 13 – Hub1's Collision Counts and Hub 2's added

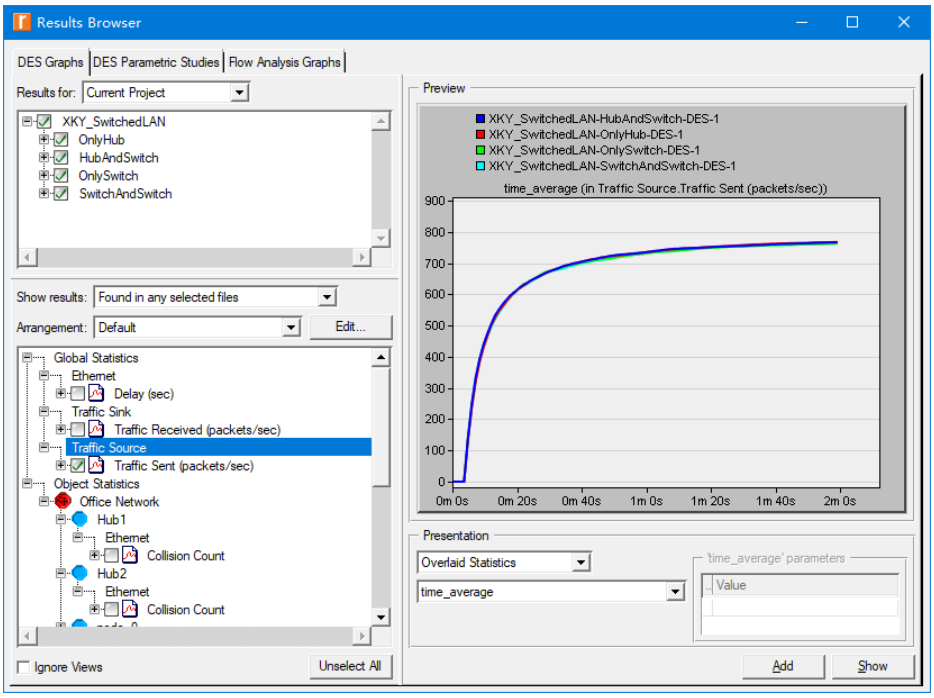

Fig 14 – Traffic Sent (packets/sec)

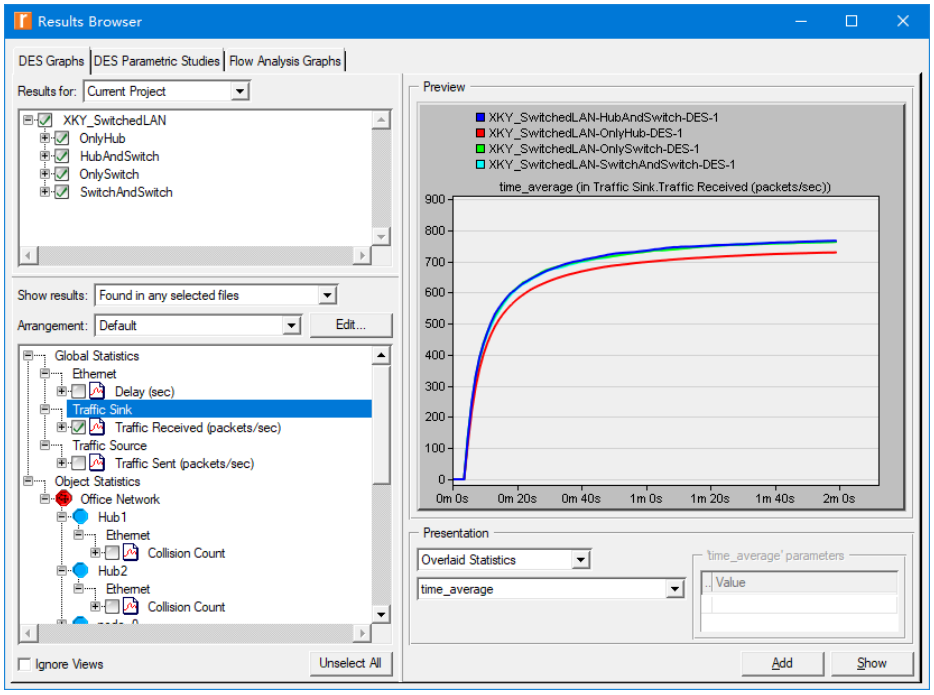

Fig 15 – Traffic Received (packets/sec)

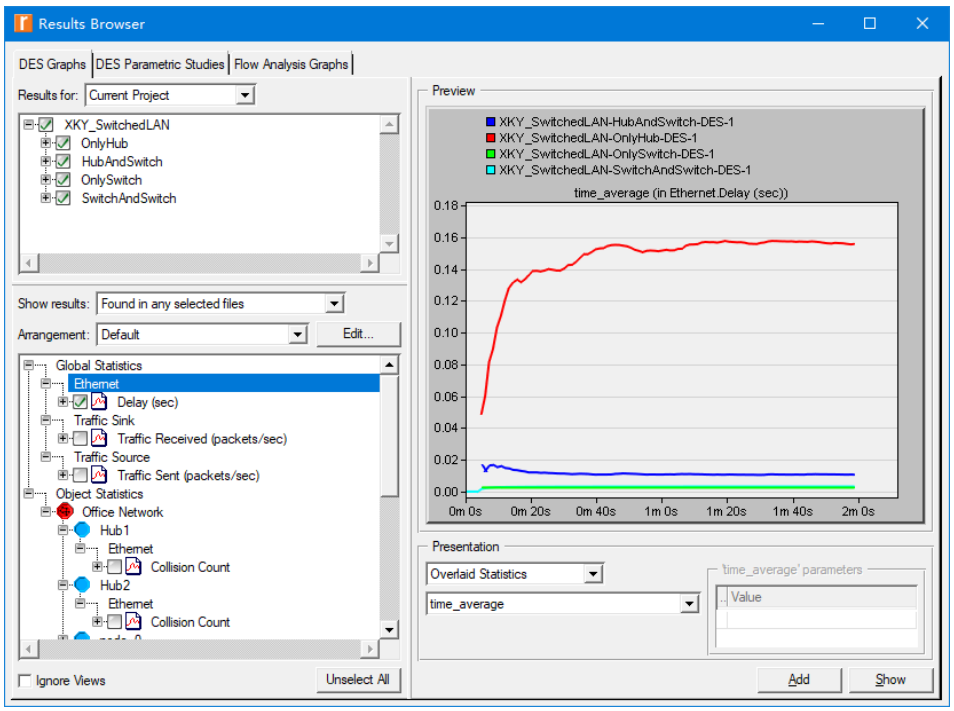

Fig 16 – Delay (sec)

From Fig 13 to 16. Fig 13 shows collision counts, only occurred in hubs. Fig 15 shows the received throughput, OnlyHub is a bit lower than other three scenarios given they all have switches. Fig 16 shows the delay, the two scenarios with only switches almost have no delay, HubAndSwitch has a little delay, and OnlyHub has largest delay due to collisions.
In conclusion, switch is necessary for network to perform better.

Conclusion

This lab is mainly focused on those related to collisions.
In the CSMA part, it is showed that high collision will restrain the throughput, packets sent quite frequently are more likely to collide, short packets and less sending nodes can decrease collisions.
In the Switched LANs, as long as a switch is introduced in the network, the impacts of collisions can be relieved, leading to less delay and larger throughput, so switch is good for improving network performance.
All these results have reached expectation.
The software is suitable for analyzing, however, while working on the HubAndSwitch scenario, it seems that only starts the 10BaseT link from the hubs, the simulation can be carried out. This is a little weird.

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