NS-2 Offline Project

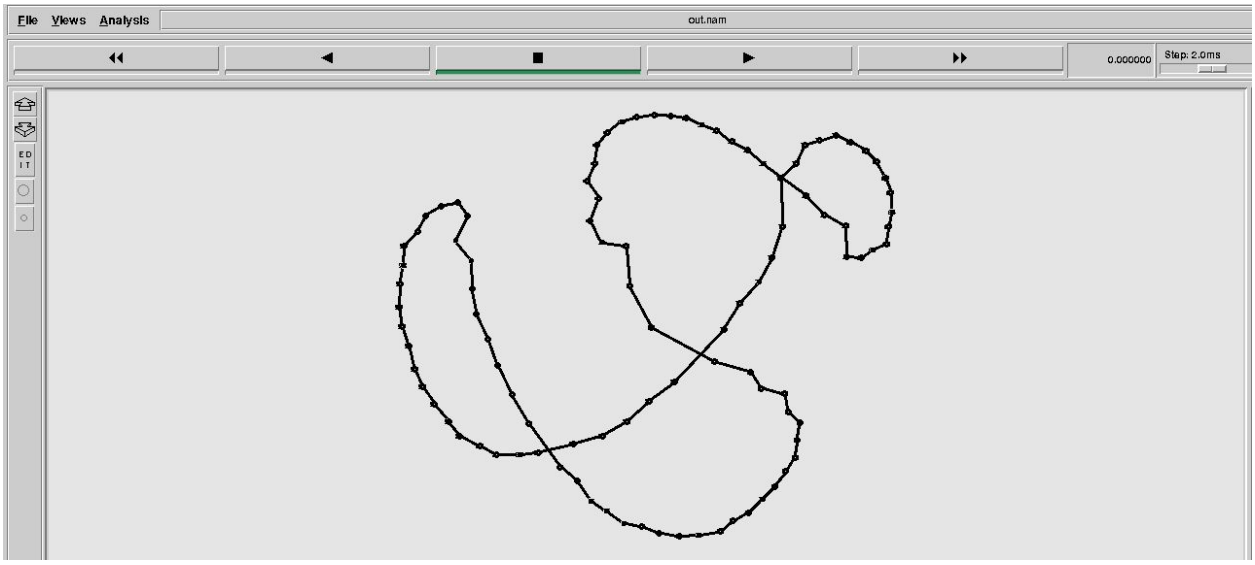
Protik Bose Pranto (1505044)

Syed Zami Ul Haque (1505056)

We worked with two different networks- Wired network and Wireless network(802.15.4) . We considered two different topologies . For the wired network, we are using chain topology and for the wireless one, we are using grid topology .

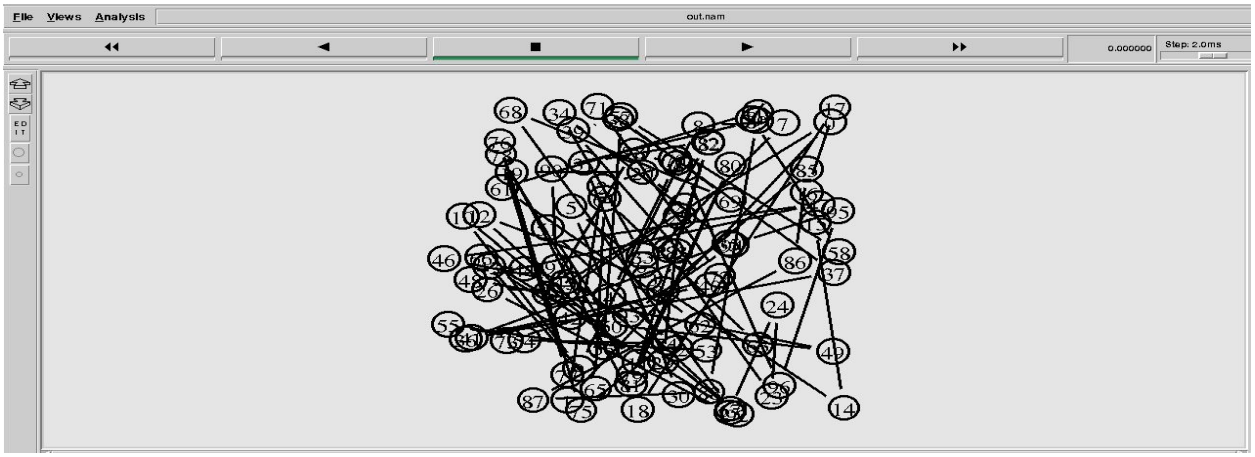
Wired Network Topology

The first image represents the wired network topology (without layout button clicked) for 100 nodes .

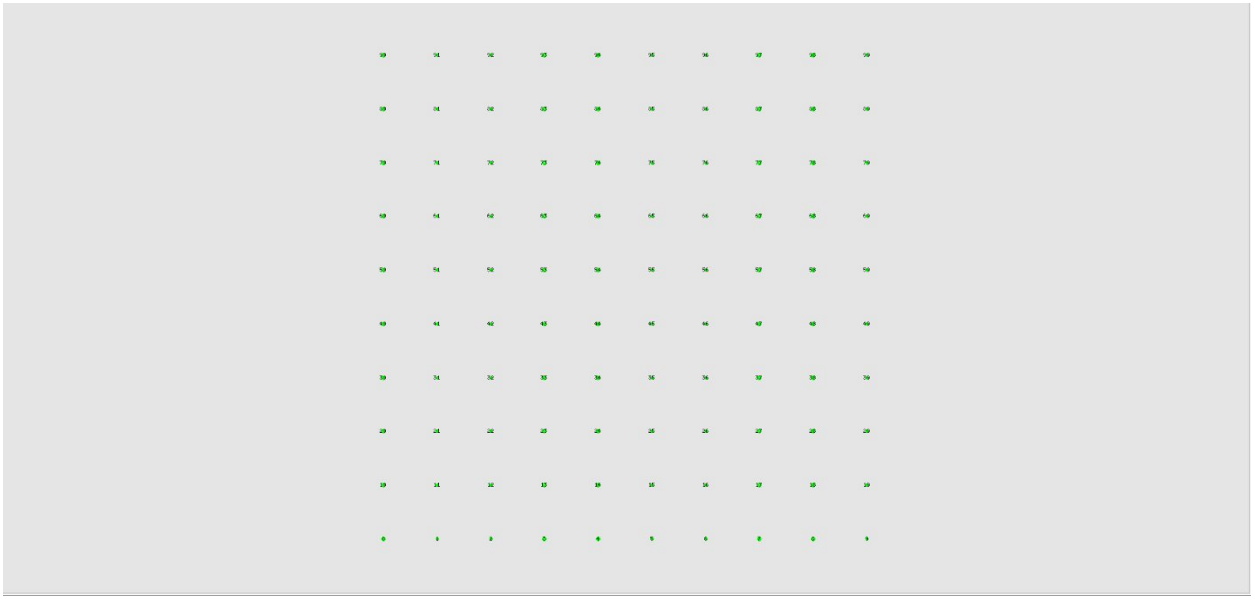


The second image represents the same network but with layout button clicked in the simulator. .

We are using topology.txt to store the coordinates of the nodes in the “Nam Simulator” .



Wireless Network Topology



The topology we've considered for wireless network is a grid topology. For all simulations we have 10 rows and number of column waver between 2 to 10. Also, ith node in the aforementioned topology communicates with "(i+2)%row_no"th node.

Parameter Under Variation

In the wired network , we are varying three parameters - number of nodes, number of flows and number of packets per second . But for the wireless network, we have used an additional one - speed of nodes (for mobile network) .

- The number of nodes varies as 20,40,60,80 and 100 . (for wired and wireless network both)
- The number of flows varies as 10,20,30,40,50 . (for wired and wireless network both)
- The number of packets per second varies as 100,200,300,400 and 500 . (for wired and wireless network both)
- Speed of nodes varies as 5m/s,10m/s,15m/s,20m/s and 25m/s (only for mobile wireless network)

So, the total iteration number for wired network is ,

the number of nodes * the number of flows * number of packets per second
= 5*5*5
=125

On the other hand, this becomes 125*5=625 for the wireless mobile network.

Modifications made in the simulator

We are using NS-2.35 . At first we used the existing mechanisms. Then we modified RTT (Round Trip Time) calculation, the Congestion Control Algorithm and the RTO values . After that we compared the new values with the previous one .
For our wired network, we don't have any drop packets . That's why, changing RTT calculations doesn't put any difference with the previous value. But after changing the congestion control and RTO default values , we found a massive positive change with previous value.

On the other hand, RTT calculations ,congestion control and RTO default values all make difference for the wireless network . Though for some nodes , some values decline . But for most of the cases, values changes positively. Although throughput declined by a slight margin, we witnessed positive change regarding delay, drop ratio and delivery ratio(after modifying RTT calculations). When we modified congestion control along with RTT calculations and RTO values, we saw slight increase in throughput. Also delay increased. Delivery ratio decreased. Drop ratio increased in most cases.

Modified RTT Calculation Effect

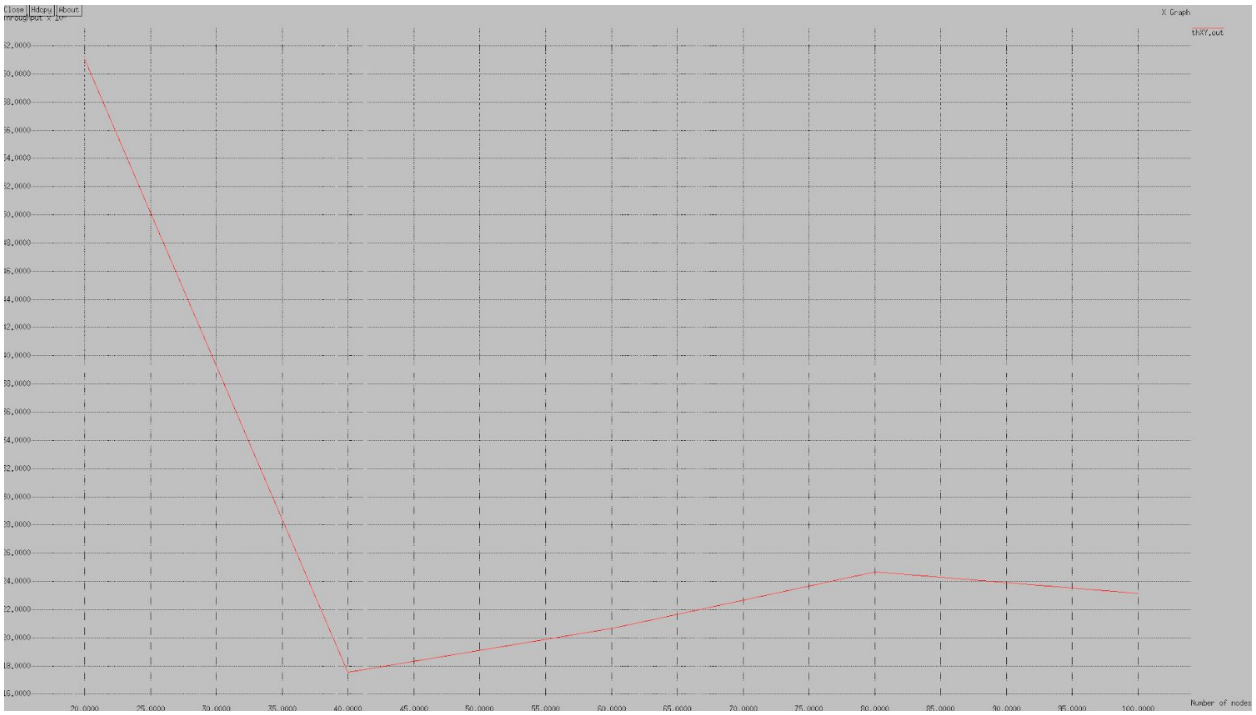
The RTT formula used for the existing NS2 was like,

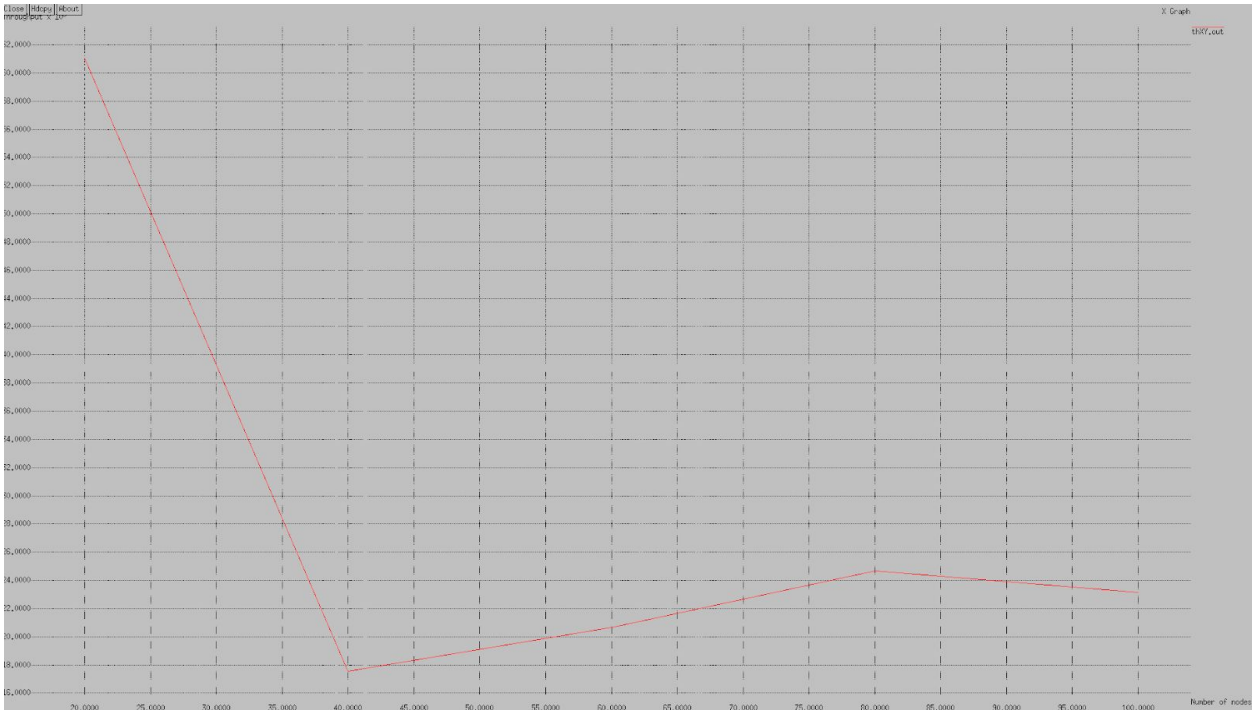
D = previous RTT- error //here error=smooth RTT / 8
new_RTT = previous RTT + D
= 2 * previous RTT - smooth RTT

But we modified this formula according to Jacobson's formula like,

D = previous RTT- error //here error=smooth RTT / 8
New_RTT = error + D/8
= error + (previous RTT- error)/8
=7 * error/8 + previous RTT/8
New_Smooth_RTT = 3 * RTT_deviation/4 + modulus(D)/4

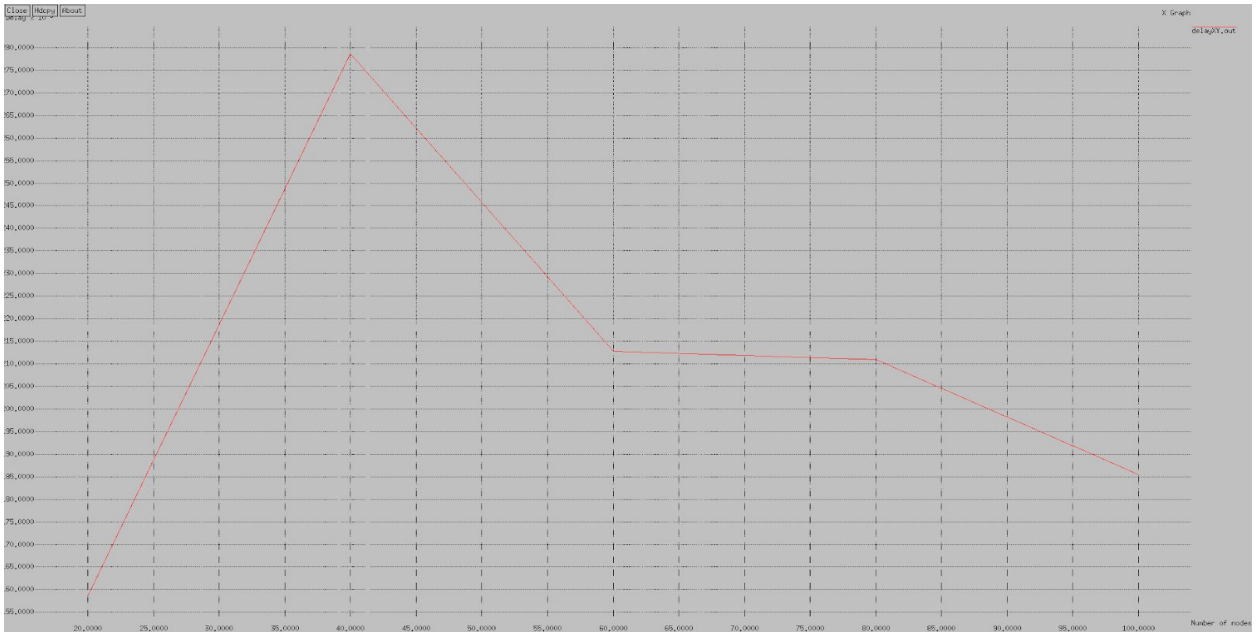
Throughput: (Before and After) : (No significant changes)

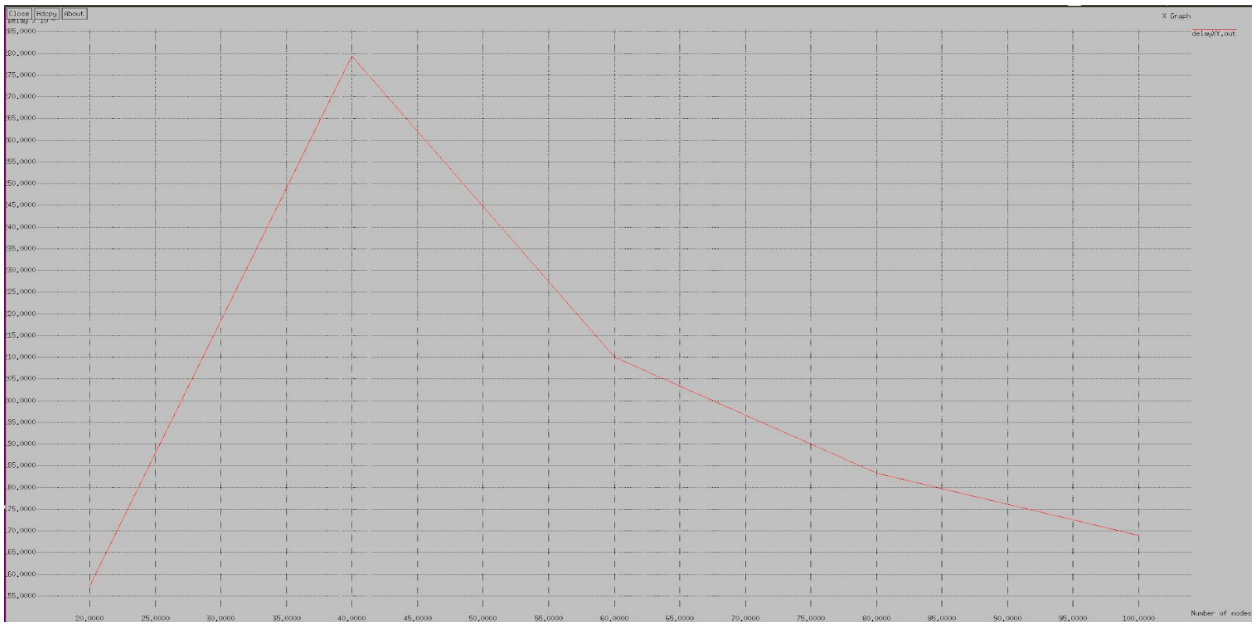




End to End Delay : (Before and After)

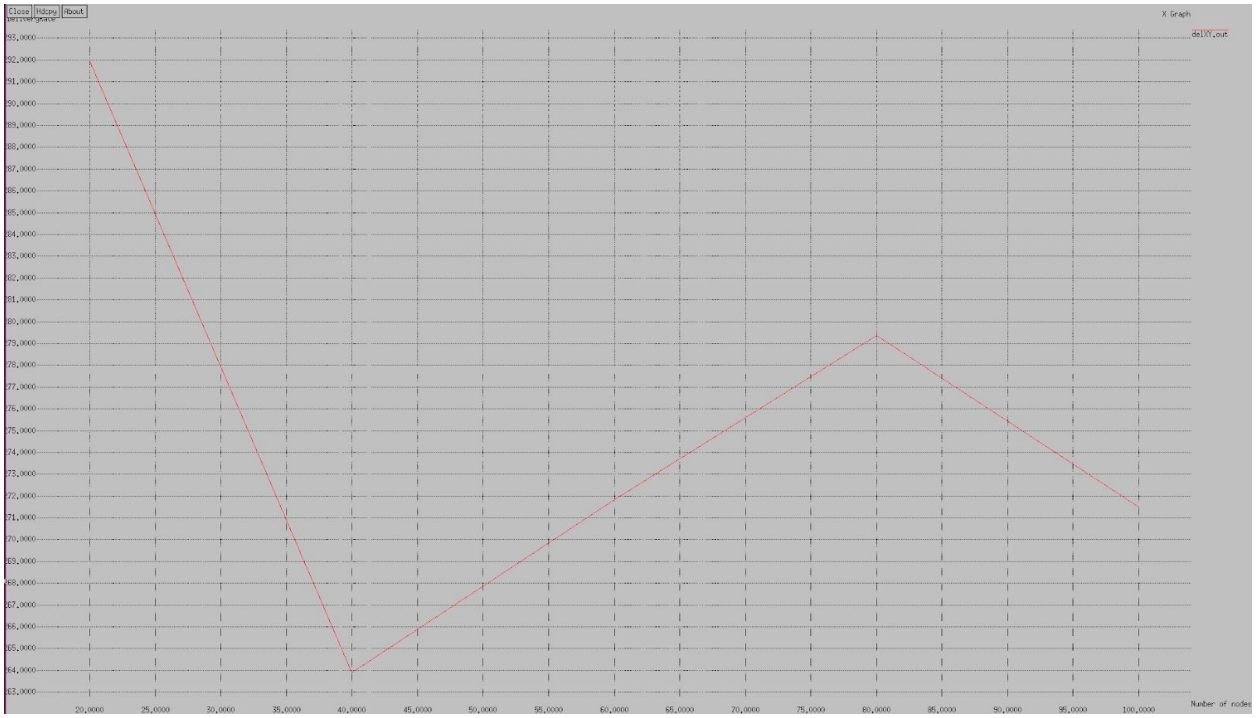
For node number 60 and 80, the delay declines significantly.





Delivery Ratio (Before and After)

For node number 40,60 and 80, the ratio improves significantly.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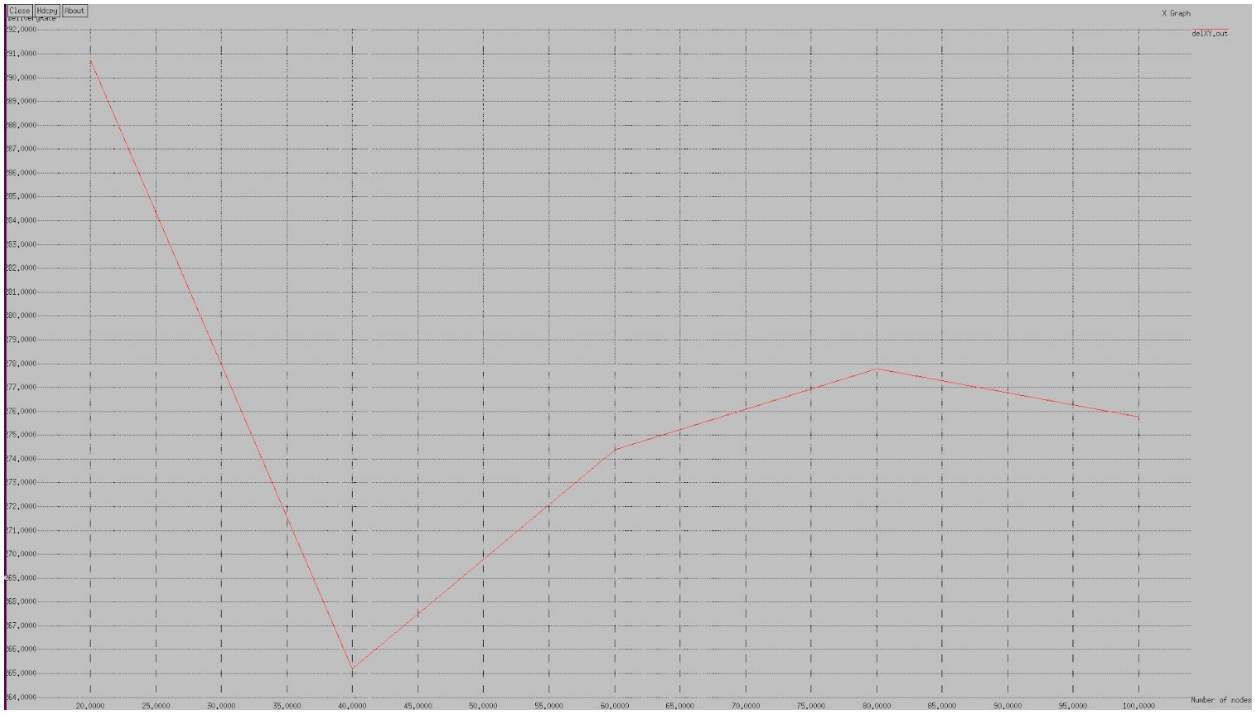
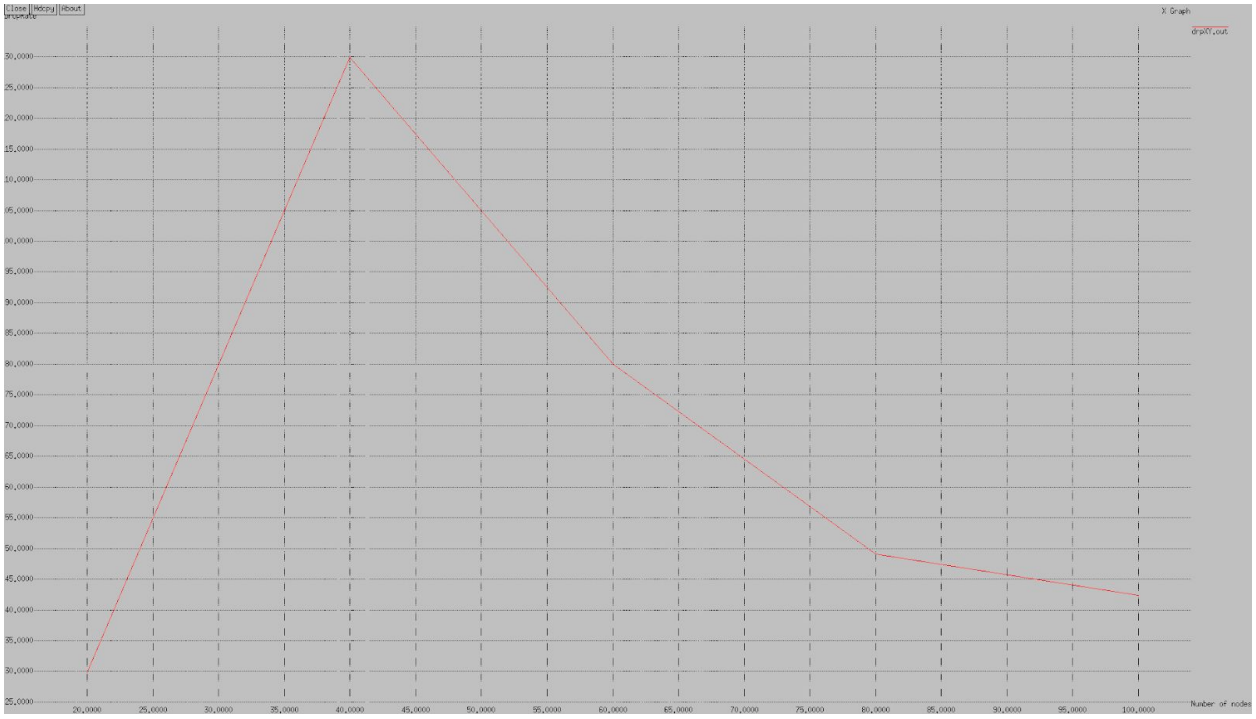
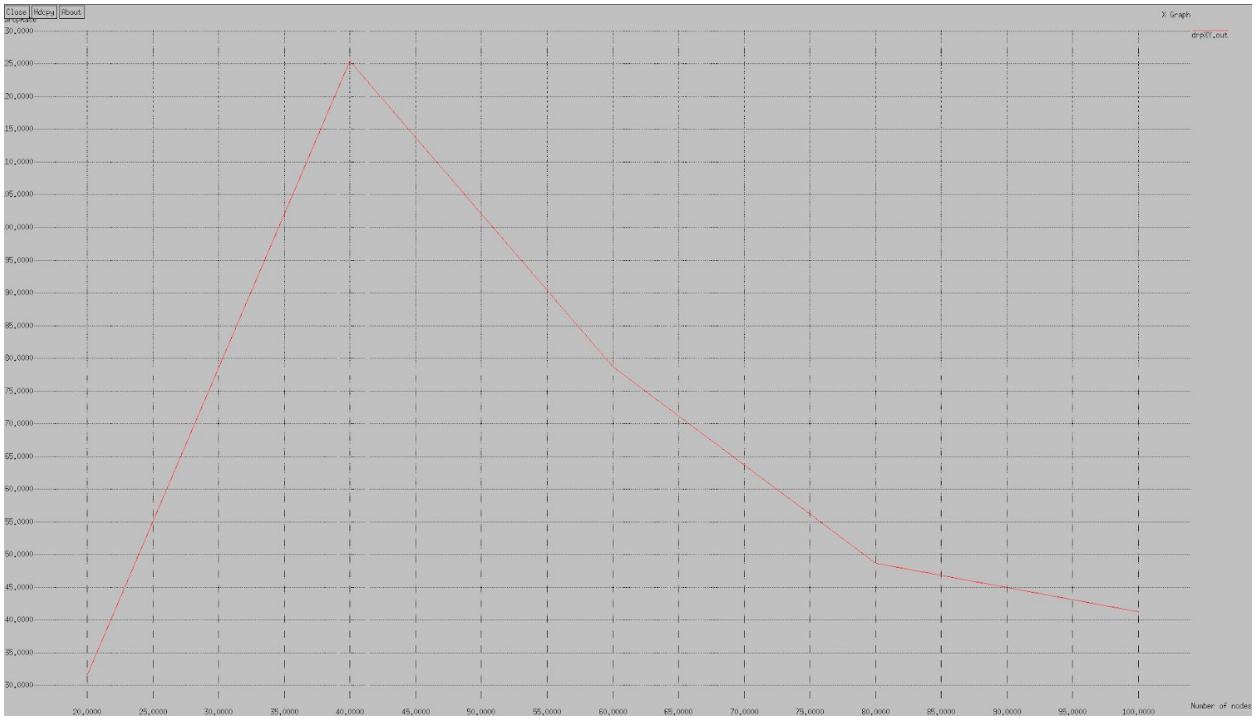
Hdcpy
About
X Graph
delXY.out
Number of nodes


Close
Hdcpy
About
X Graph
delXY.out
Number of nodes

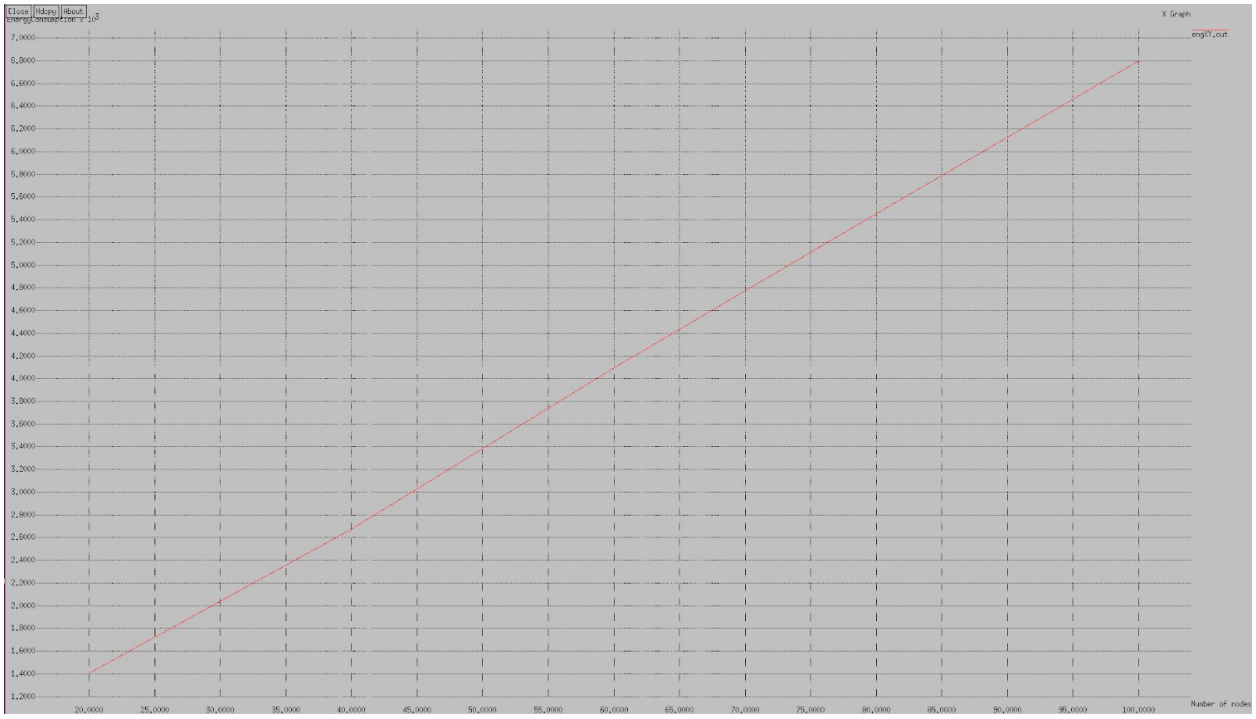
Drop Ratio (Before and After)

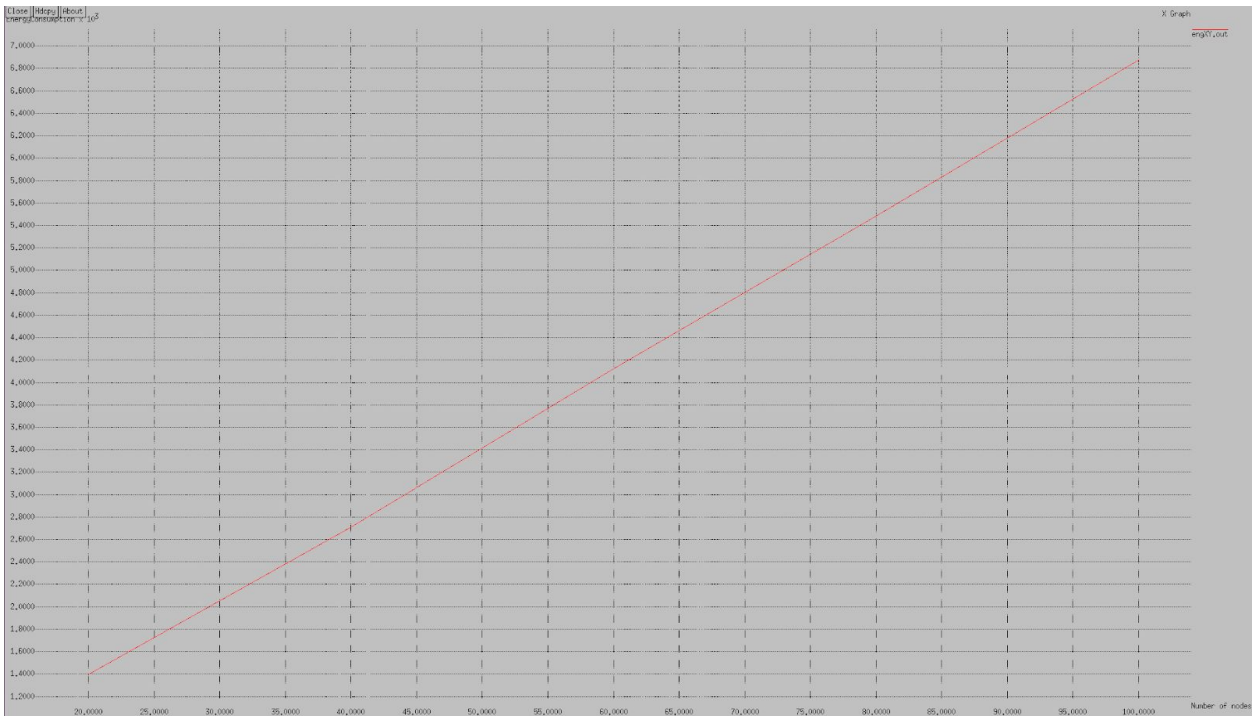
For node number 60,80 and 100, the ratio declines by a slight margin.
Although for 40 nodes, the ratio decreases by a significant margin.





Energy Consumption (Before and After) : Slight Increase





Modified Congestion Control, Updated RTO Values Effect

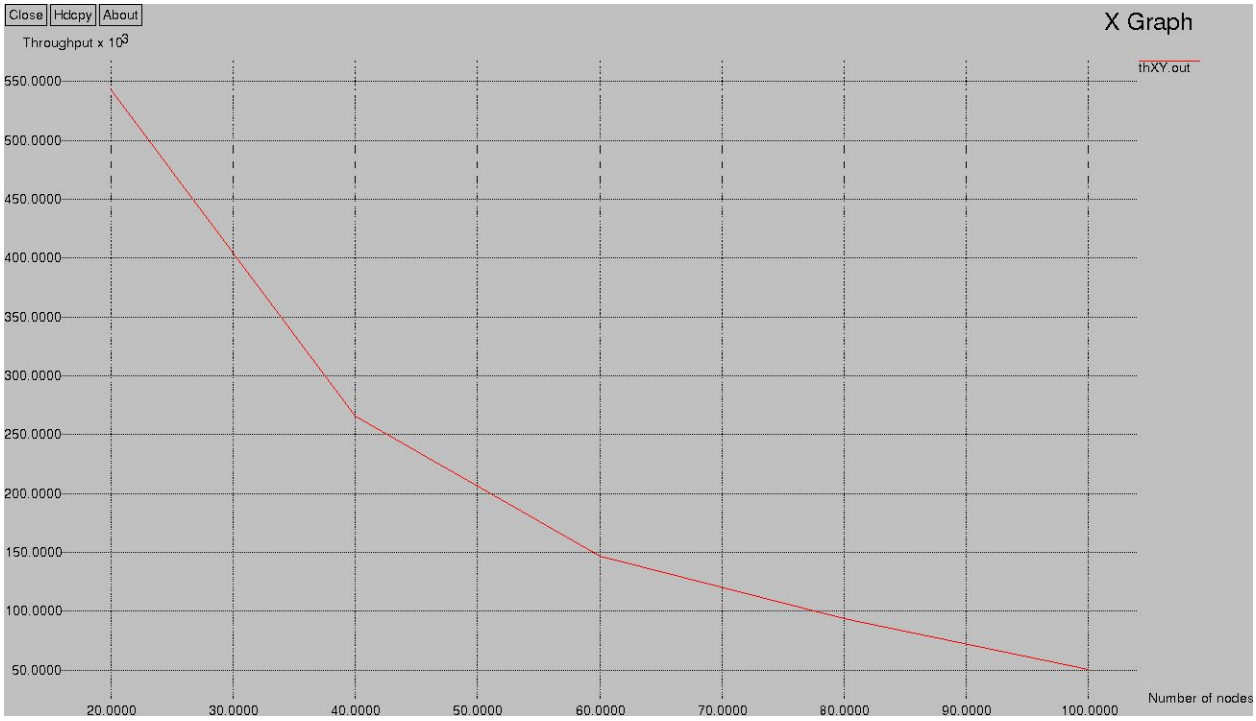
After each ack is received, we are going to calculate the bandwidth which is available bandwidth (R') for every arrival of ack signal by using the equation R =b/t . Here, b is packet size in bytes and t is time gap between two ack signal to be received at the sender end.

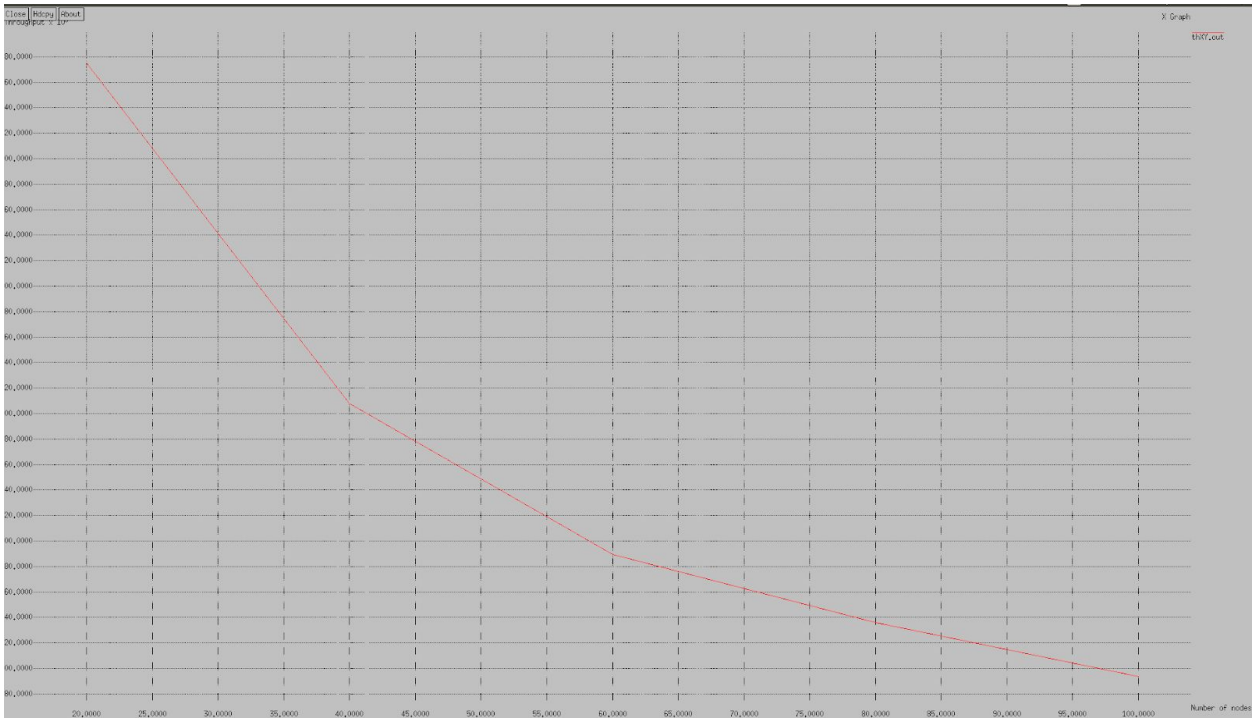
By the start of next slot, sender adjusts its congestion window size (cwnd) to (R × RTT)/b. Here RTT is round trip time.

Sender sticks to this window size until it finds any congestion in network, and decreases its window size immediately after crossing the threshold value.

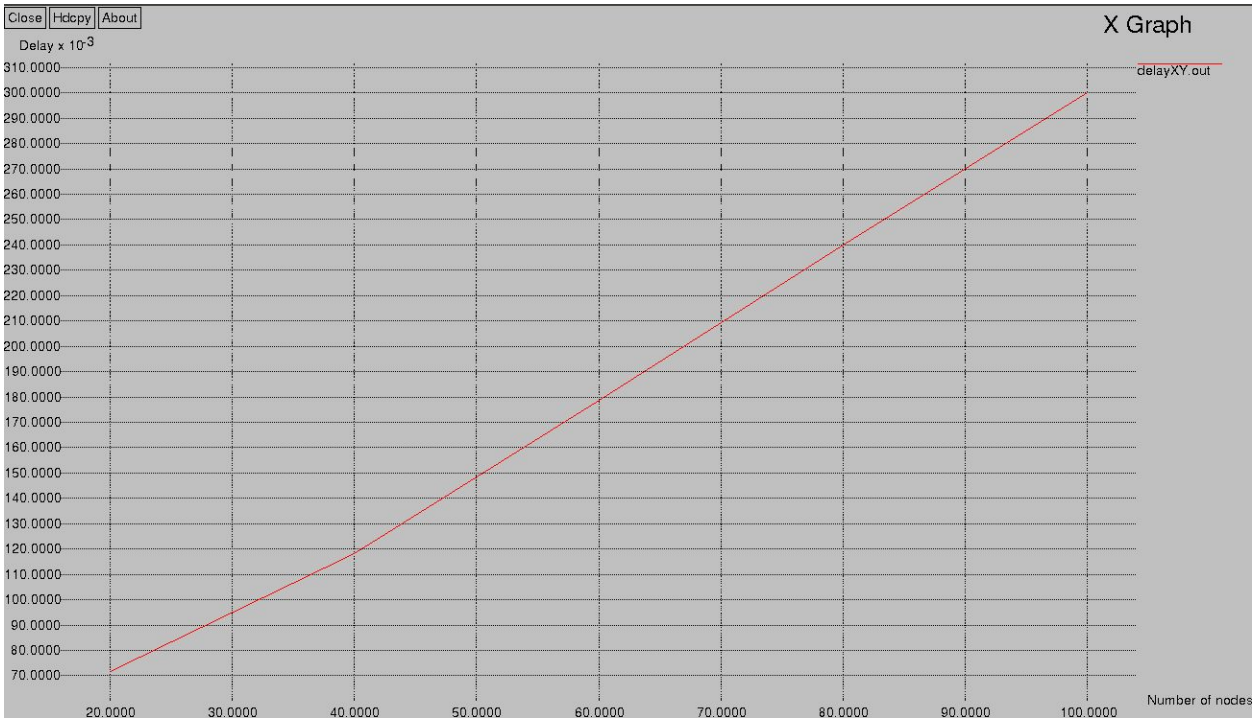
On the other hand, RTO values of initial maxrto is increased to 100 which also plays a valuable role in the modification.

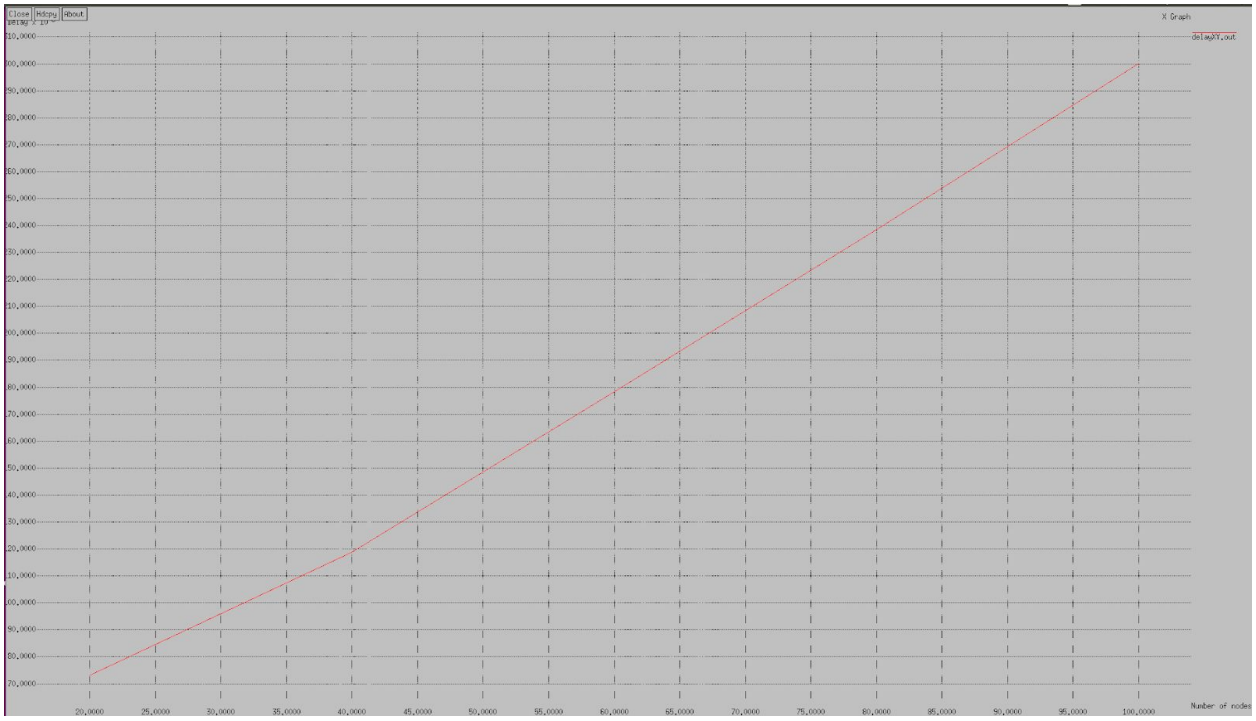
Throughput(wired) : (Before and After) : (Massive Improvement)





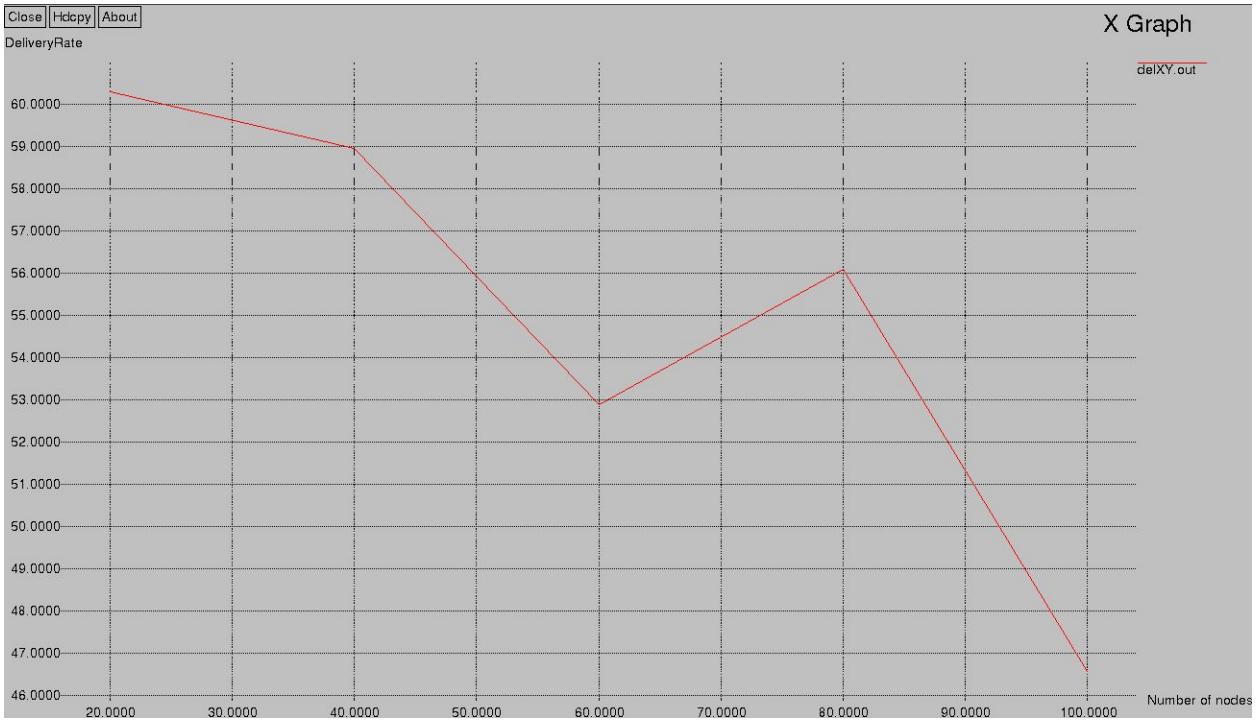
End to End Delay(Wired) : (Before and After) : (No Significant Change)

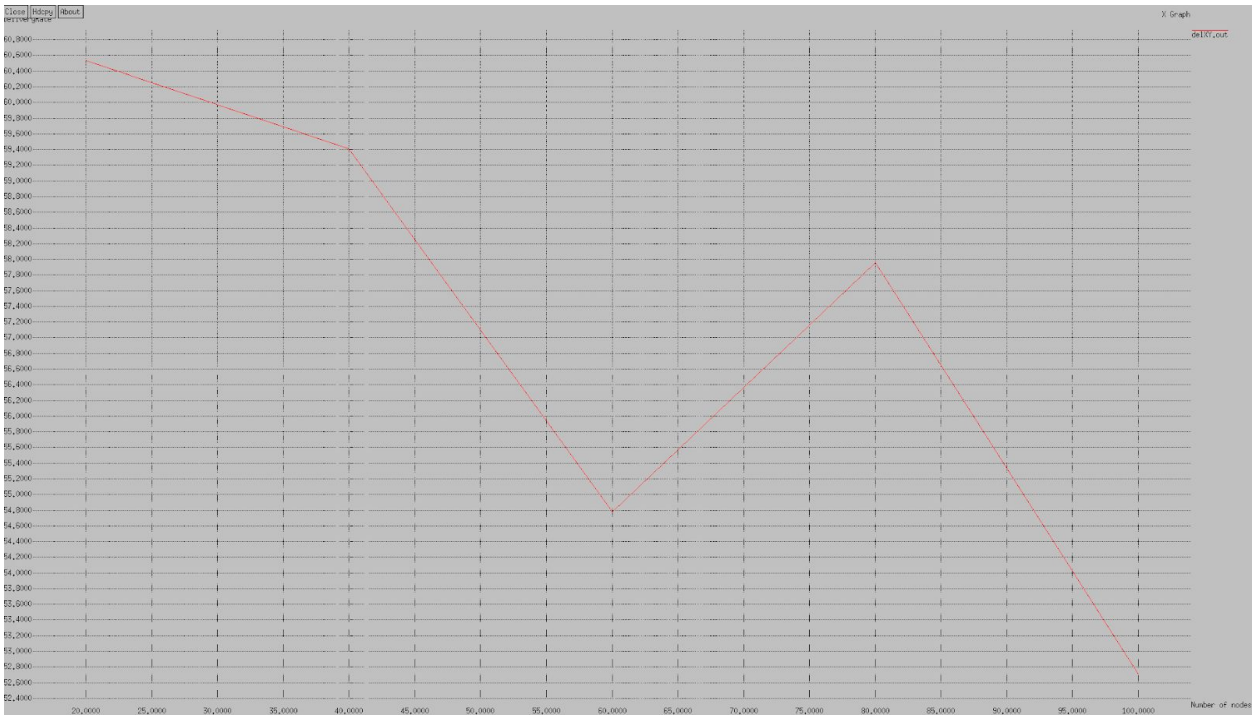




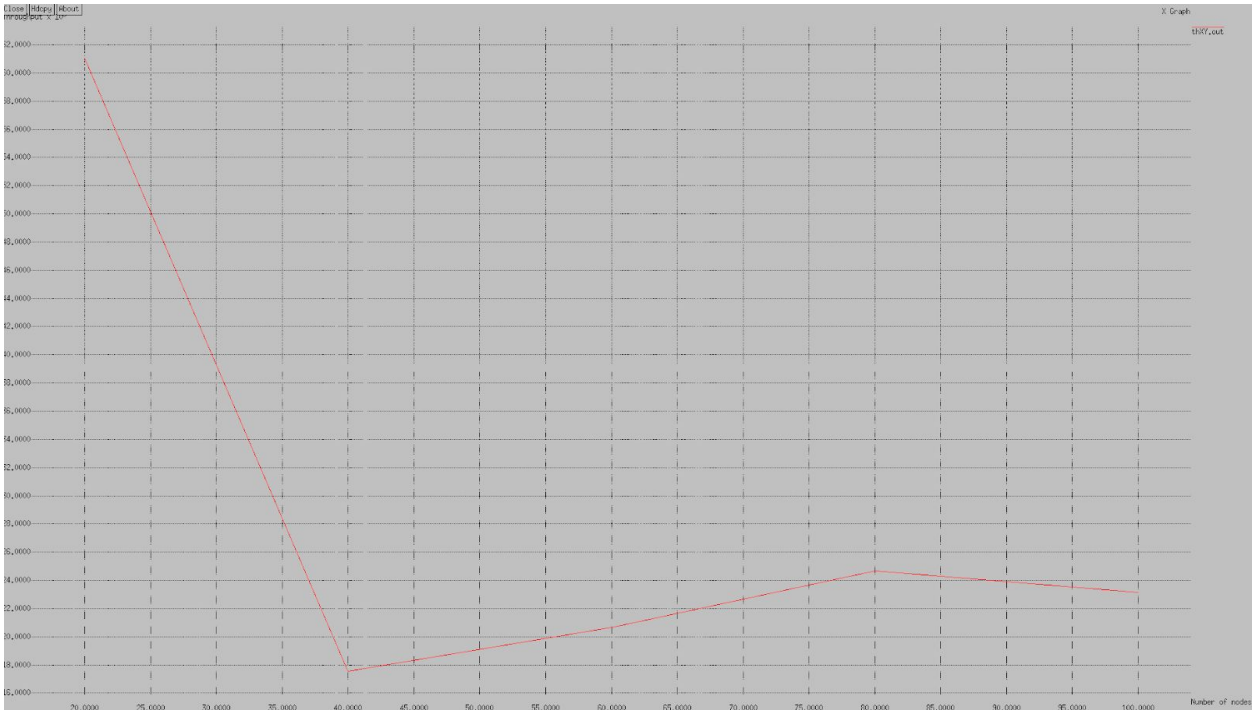
Delivery Packet Ration(wired) : (Before and After)

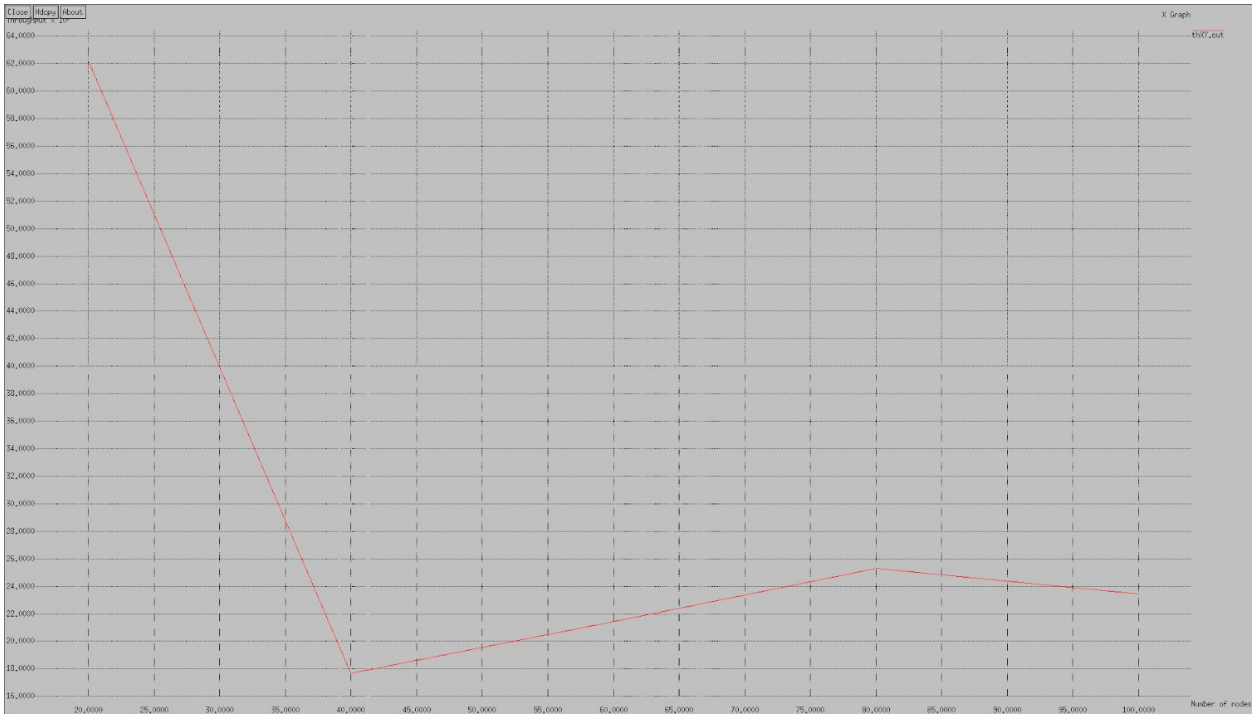
For node number 40,60,80 , the ratio declines by a slight margin. But for 100, it performs a moderate change.





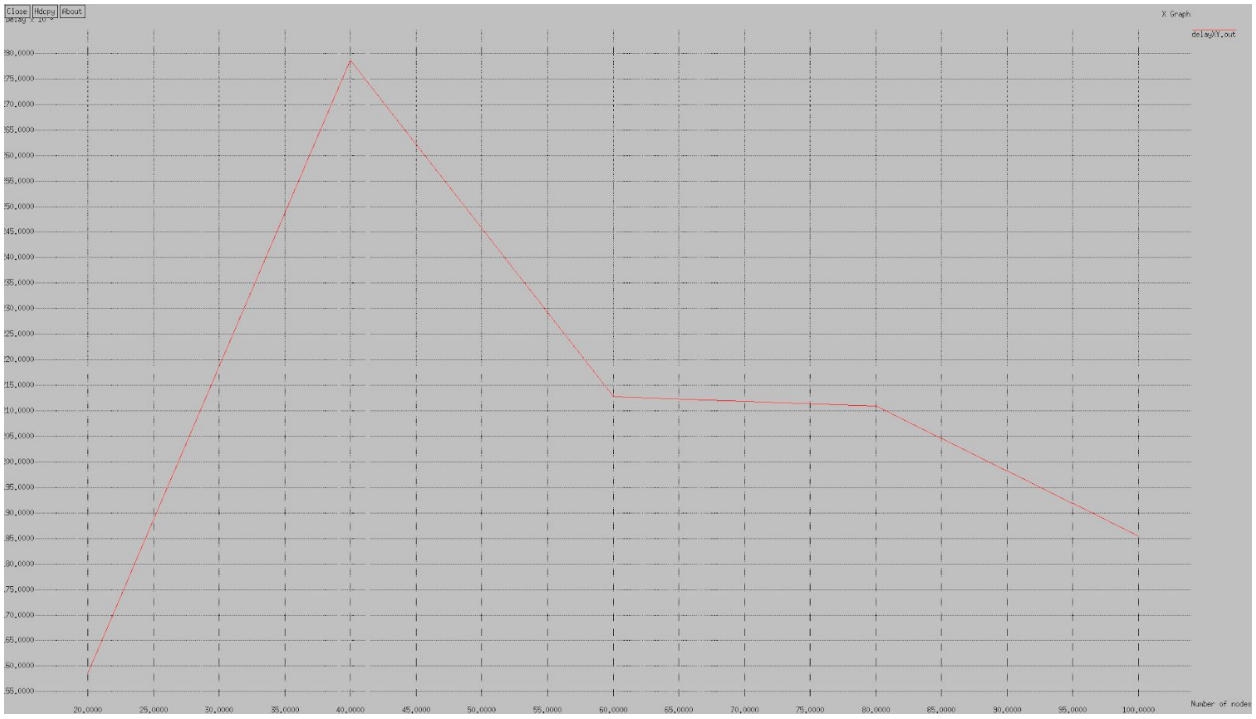
Throughput (Wireless) : (Before and After) : (Slight Increase)

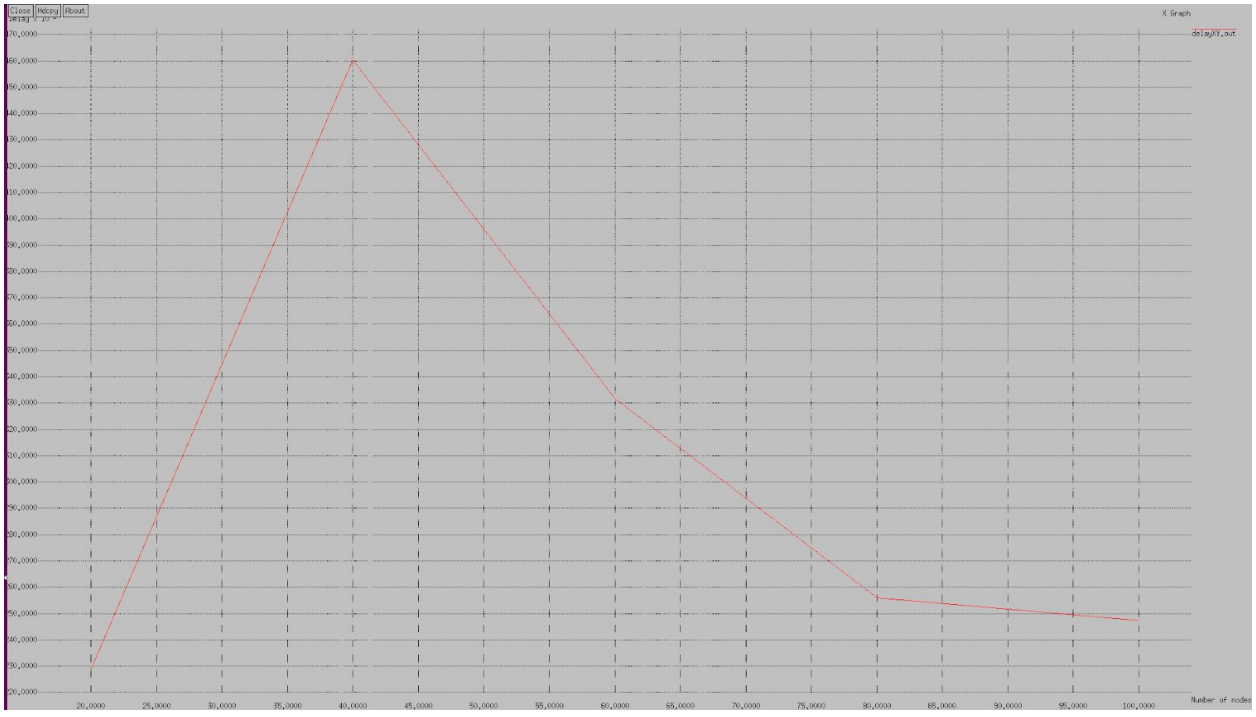




Slight increase seen after introducing modifications.(for all number of nodes considered)

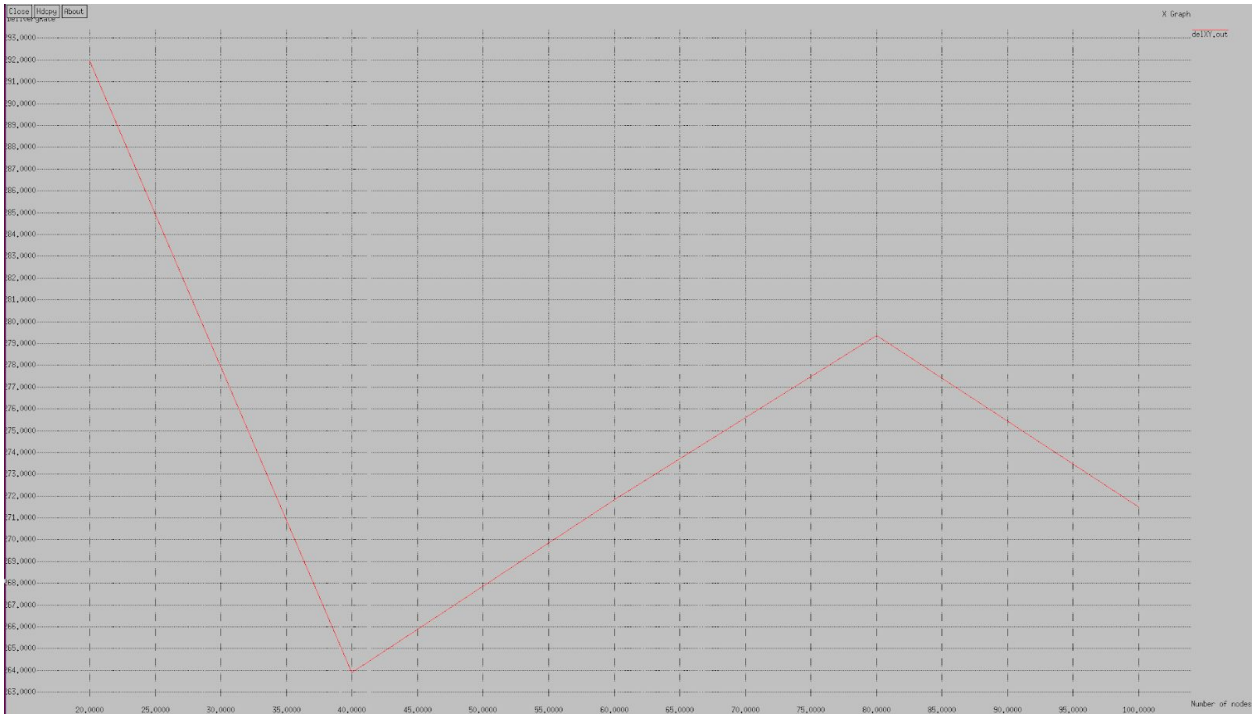
End to End Delay(Wireless) : (Before and After)

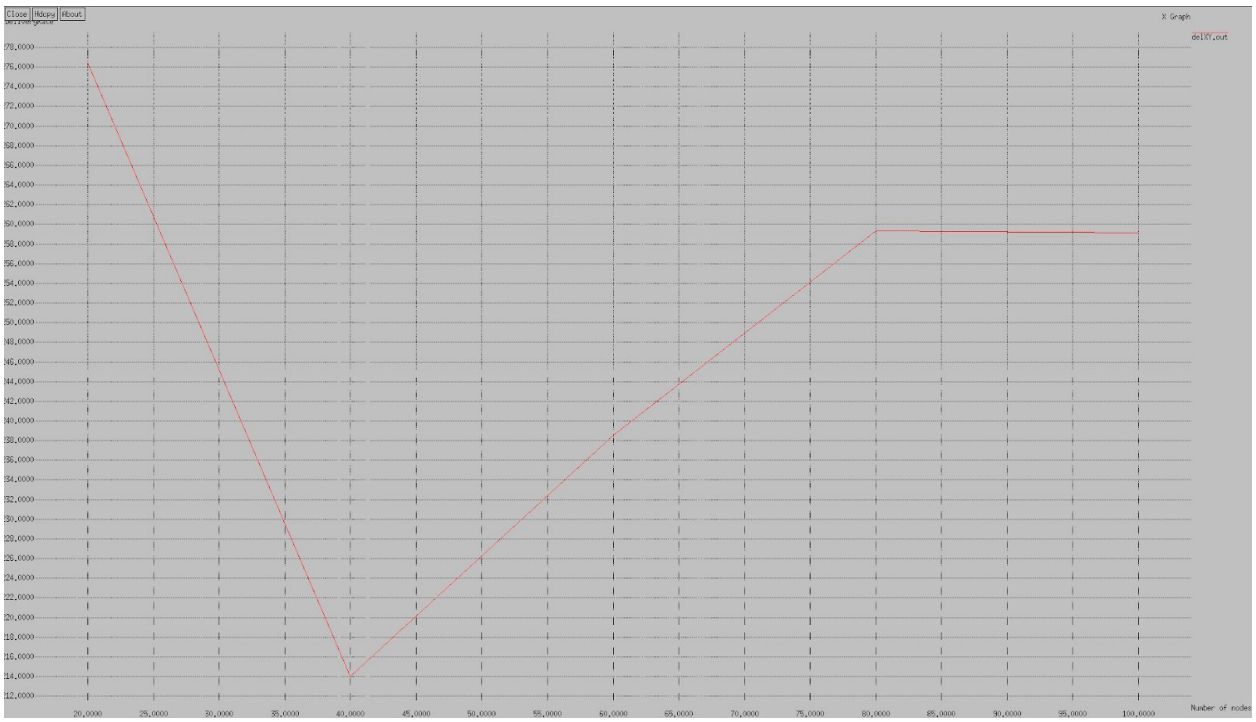




Delay increased for all number of nodes considered.

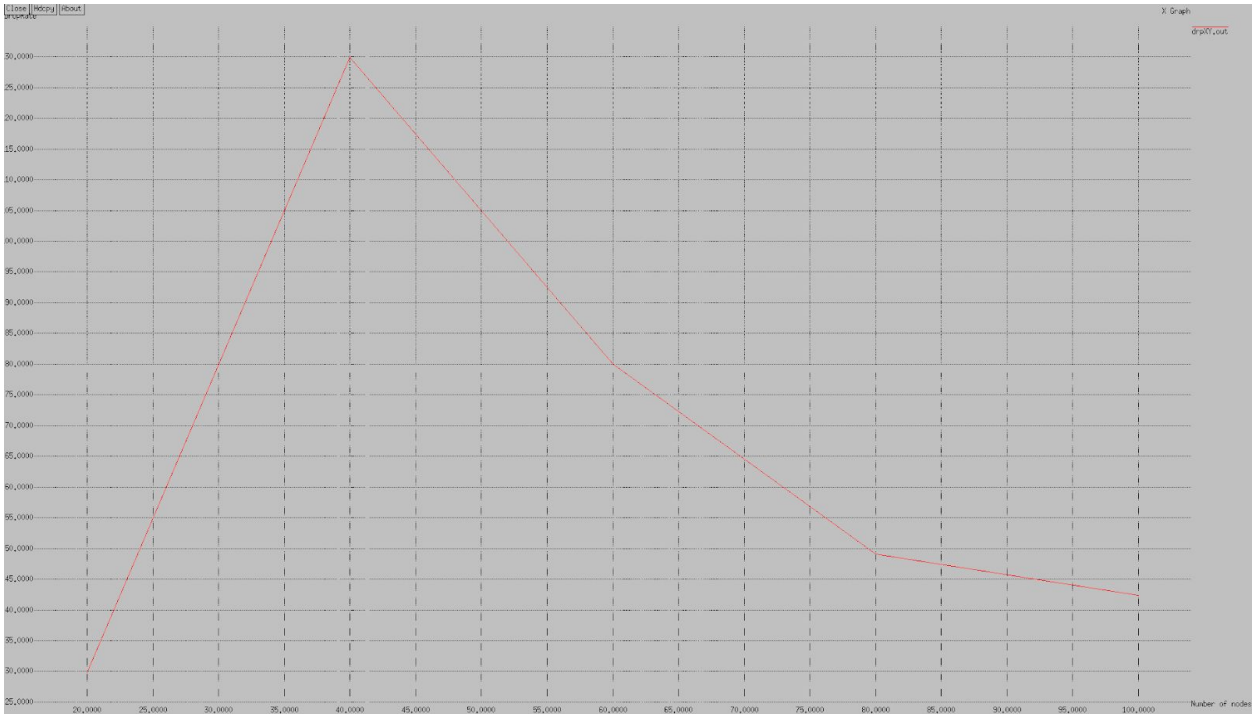
Delivery Ratio (Wireless) : (Before and After)

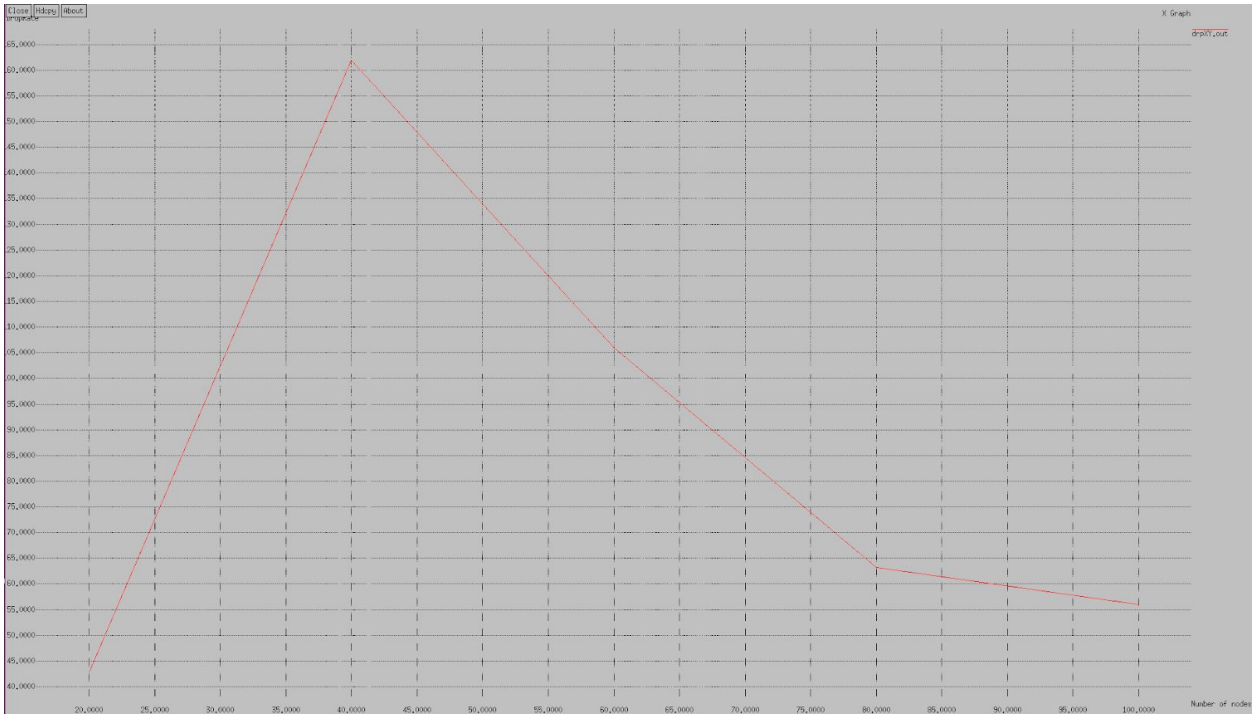




Delivery ratio decreased for all number of nodes considered.

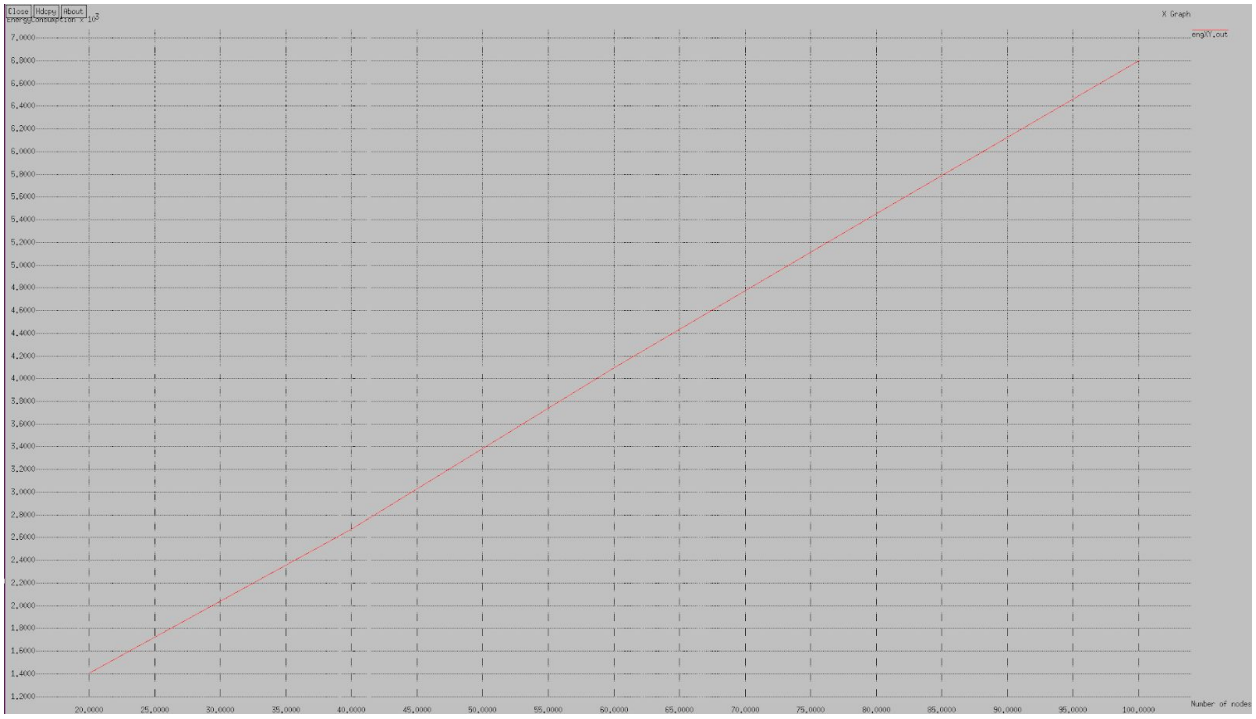
Drop Ratio (Wireless) : (Before and After)

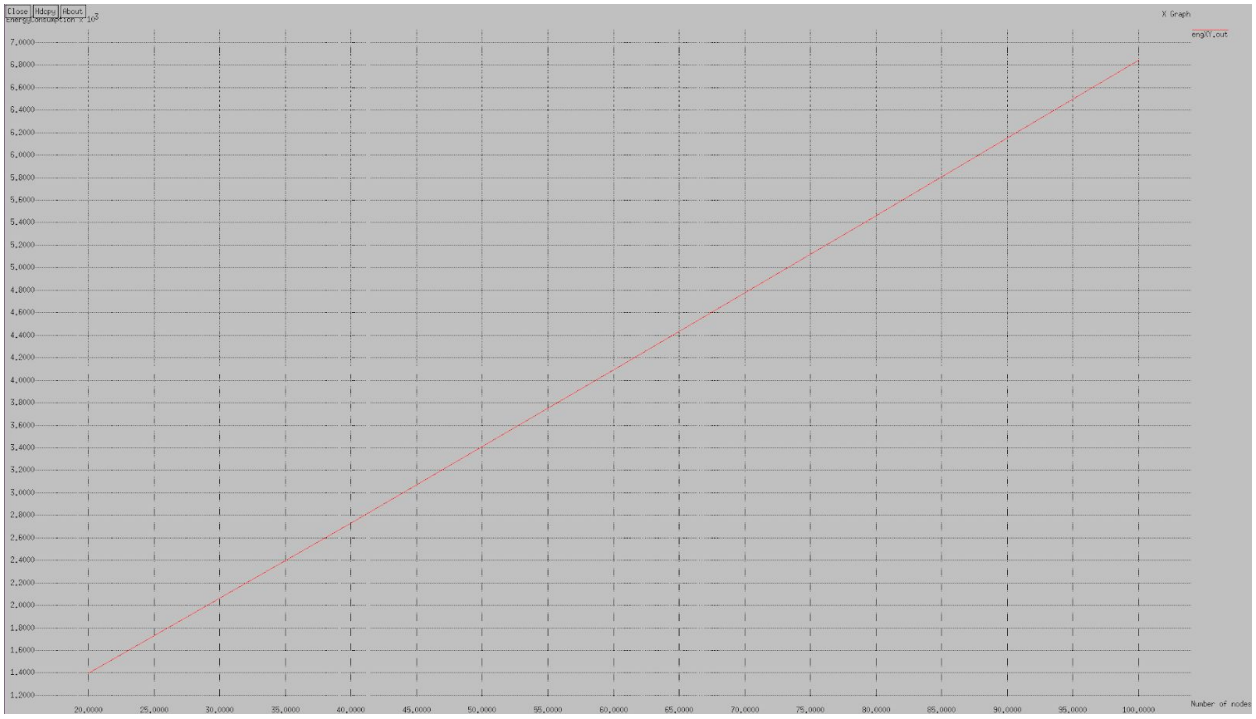




Drop ratio increased for all number of nodes considered.

Energy Consumption(Wireless) : (Before and After)





Energy parameters more or less remained the same.

Summary

We have witnessed the decline of throughput with increased number of nodes. Both delivery ratio and drop declined when more nodes were introduced. The default congestion control system used in ns doesn't allow the links to use the bulk of the available bandwidth. Our proposed changes regarding congestion control did allow the wired network to use a bit more of the bandwidth. That change resulted in increased throughput, better delivery ratio. On the other hand, we saw decline in delivery ratio and an increased drop ratio when we introduced those changes in the context of wireless network. On the contrary, throughput increased. Hence our proposed changes didn't necessarily make improvements to wireless communication.

Reference:

1) https://cdn.fbsbx.com/v/t59.2708-21/50127628_368751670580702_8998777889025425408_n.pdf/angsh2006.pdf?_nc_cat=103&_nc_ht=cdn.fbsbx.com&oh=0df30c5ceb709b42ffcdb6177c68a9b9&oe=5C3C52FF&dl=1&fbclid=IwAR0q3qy9GwsBfzxR8MHFiU7EYRtG30nCoZnl87t9uhPNLos2hPOJ-YQ9UYk
2) " Introduction to NS2 " - Teerawat Issariyakul and Ekram Hossain
3) https://s3.amazonaws.com/academia.edu.documents/40842157/20071138.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1547303950&Signature=k4EvzbpRYEhTJed1PXr3d5dcHvQ%3D&response-content-disposition=inline%3B%20filename%3DOne_Source_Multicast_Model_Using_RTP_in.pdf
4) http://delab.csd.auth.gr/bci1/Panhellenic/90develekos.pdf