Assignment 1: Analyzing Wi-Fi Performance

(SN 706 Wireless Security)

Question a)

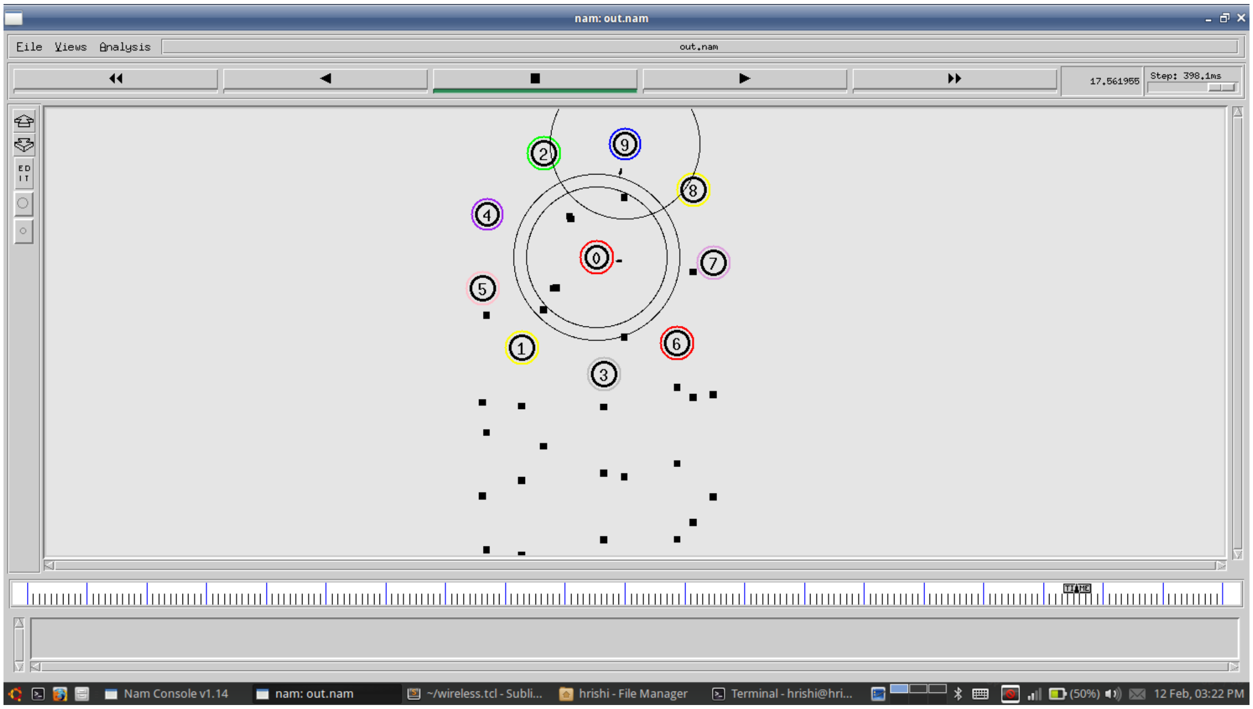
Task to be accomplished: Create a WiFi network - Simulate a WiFi network with a single access point and a variable number of clients, ranging from 1 to 10. Arrange the clients equally spaced on a circle around the AP. For each number of clients, simulate 20 seconds worth of network traffic using the existing parameters. Repeat (or batch) the simulation for 20 trials, using a different seed for the random number generator each time, and compute the average total data delivered to the AP over the 20 simulation runs. Plot this quantity as a function of the number of clients, and describe your findings.

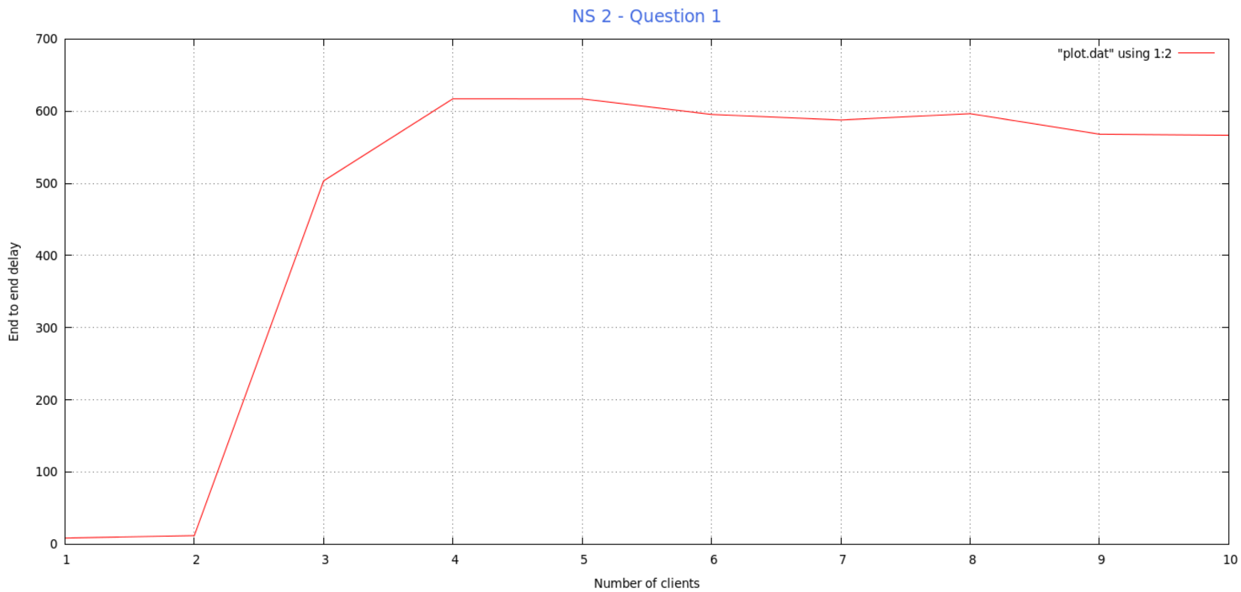
Steps involved:

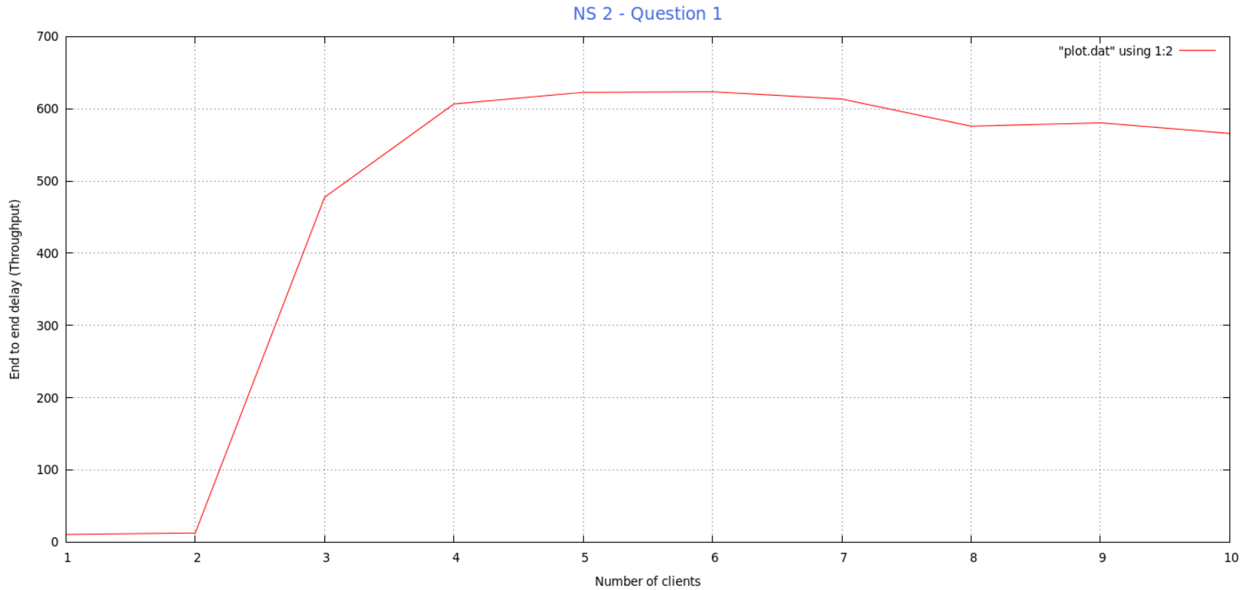
1. To fulfill given task a .tcl script was written with the following parameters :
    a. Routing protocol was set to DSDV
    b. Number of nodes were taken as command line arguments
    c. Interface queue type was set to Droptail

2. The steps involved in solving the given problems were
    a. Assign number of client nodes using command line argument
    b. Create a global Access Point(AP) node
    c. Create client nodes and randomly place nodes around AP using seed value
    d. Create a UDP agent and attach from and to AP and client nodes
    e. Trace file was parsed using an awk script
    f. Awk script used to parse calculates the throughput – i.e. the end to end delay between the AP and the client nodes
    g. Bash file run.sh was used to automate the 20 random trials and parse the throughput from the trace file
    h. A plot.dat file was finally generated in order to generate a graph to capture the performance and throughput estimation of the simulation.

3. The following images show the plot obtained for two separate simulation runs :


nam: out.nam
File Views Analysis
out.nam
17.561955
Step: 398.1ms
Nam Console v1.14
nam: out.nam
~/wireless.tcl - Subli...
hrishi - File Manager
Terminal - hrishi@hri...
(50%)
12 Feb, 03:22 PM


NS 2 - Question 1
"plot.dat" using 1:2
End to end delay
Number of clients
0
100
200
300
400
500
600
700
1
2
3
4
5
6
7
8
9
10



4. Two separate simulations were run each with randomized positions of clients with 20 trials for each number of clients
5. From the given graphs the following summarization is made:
    a. As the number of clients grow the end to end delay increases almost exponentially
    b. When the number of clients reach a certain threshold the throughput ceases to grow and stabilizes even with increasing number of clients

Conclusion:

Throughput computed from end-end delay more or less normalizes and attains a stable graph after a certain number of nodes present in the topography. This happens because after the certain threshold value (number of clients) packets start dropping as they are no longer received by the clients. Every AP has a certain number of clients that it can properly accommodate without dropping packets. In this scenario the end to end delay stabilizes after it has crossed that number of clients per AP.

Question b)

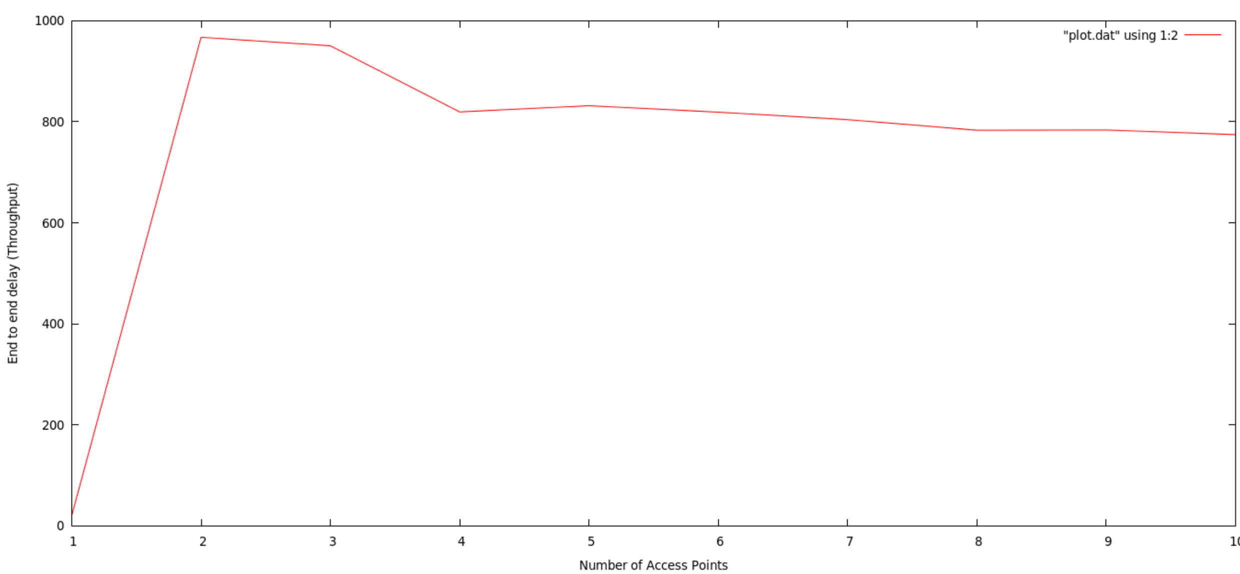
Create several competing Wi-Fi networks - Building on the previous task, add more Wi-Fi access points with different numbers of users, simulating what you might expect to happen in an apartment complex where each unit has their own WiFi network sharing the same channel. Choose the locations of the multiple APs as you see appropriate for the apartment scenario. Perform a similar study to the previous, but for different numbers or densities of APs in the apartment. Plot your results and describe your findings.

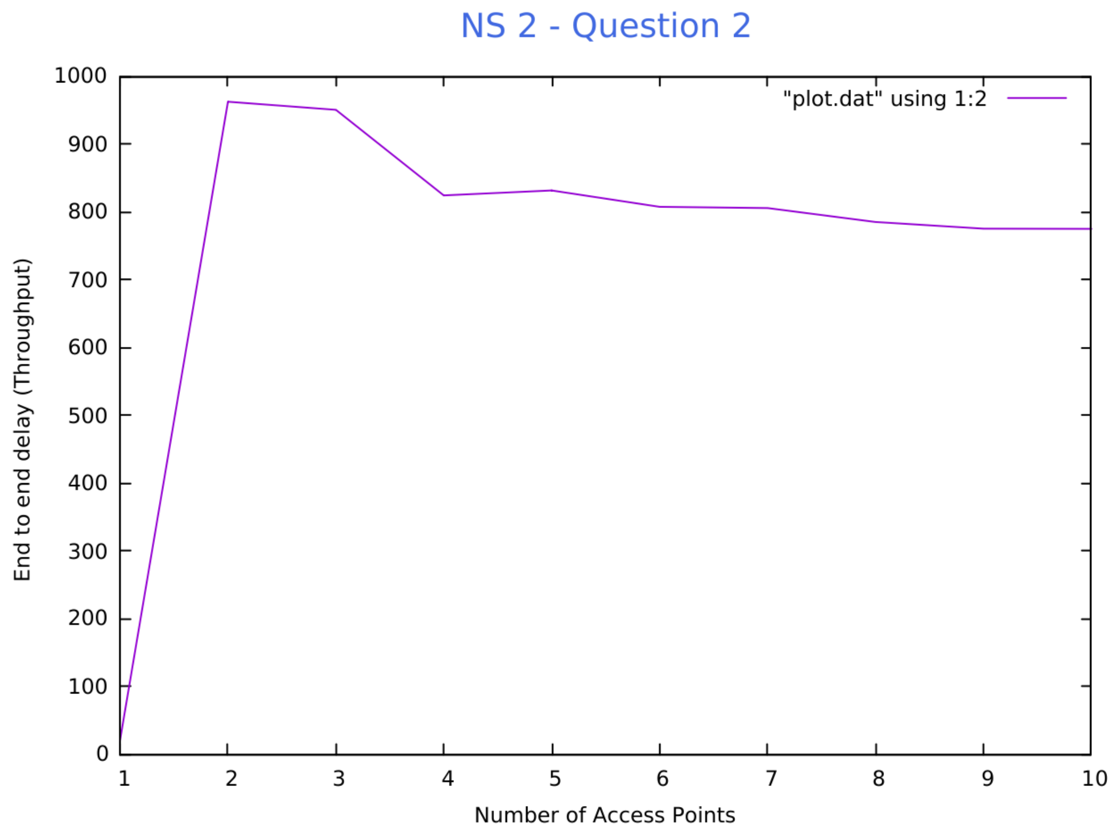
Steps involved:

1. To fulfill given task a .tcl script was written with the following parameters :
    a. Routing protocol was set to DSDV
    b. Number of nodes were taken as command line arguments
    c. Interface queue type was set to Droptail

2. The steps involved in solving the given problems were
    a. Assign number of Access Points(AP) and client nodes using command line argument
    b. No central Access Point. All are competing Wi-Fi APs
    c. Create APs and client nodes and randomly place nodes using seed value
    d. Create a UDP agent and attach from and to different AP and client nodes
    e. Trace file was parsed using an awk script
    f. Awk script used to parse calculates the throughput – i.e. the end to end delay between the different APs and the client nodes
    g. Bash file run.sh was used to automate the 20 random trials and parse the throughput from the trace file
    h. A plot.dat file was finally generated in order to generate a graph to capture the performance and throughput estimation of the simulation.

3. The following images show the plot obtained for two separate simulation runs :





4. Two separate simulations were run each with randomized positions of clients with 20 trials for each number of APs with their corresponding number of clients

5. From the given graphs the following summarization is made:
    a. As the number of APs and clients grow the end to end delay increases almost exponentially
    b. When the number of nodes reach a certain threshold the throughput ceases to grow and stabilizes even with increasing number of nodes

Conclusion:

As seen from the previous problem, throughput computed from end-end delay more or less normalizes and attains a stable graph after a certain number of nodes present in the topography. Throughput computed from end-end delay more or less normalizes and attains a stable graph after a certain number of nodes present in the topography. In this case we vary the number of Access Points as well as the number of clients per Access Point. After the certain threshold value (number of clients), as seen from the similar case of the first problem, packets start dropping as they are no longer received by the clients. Every AP has a certain number of clients that it can properly accommodate without dropping packets. In this scenario the end to end delay stabilizes after it has crossed that number of clients per AP.

Question c)

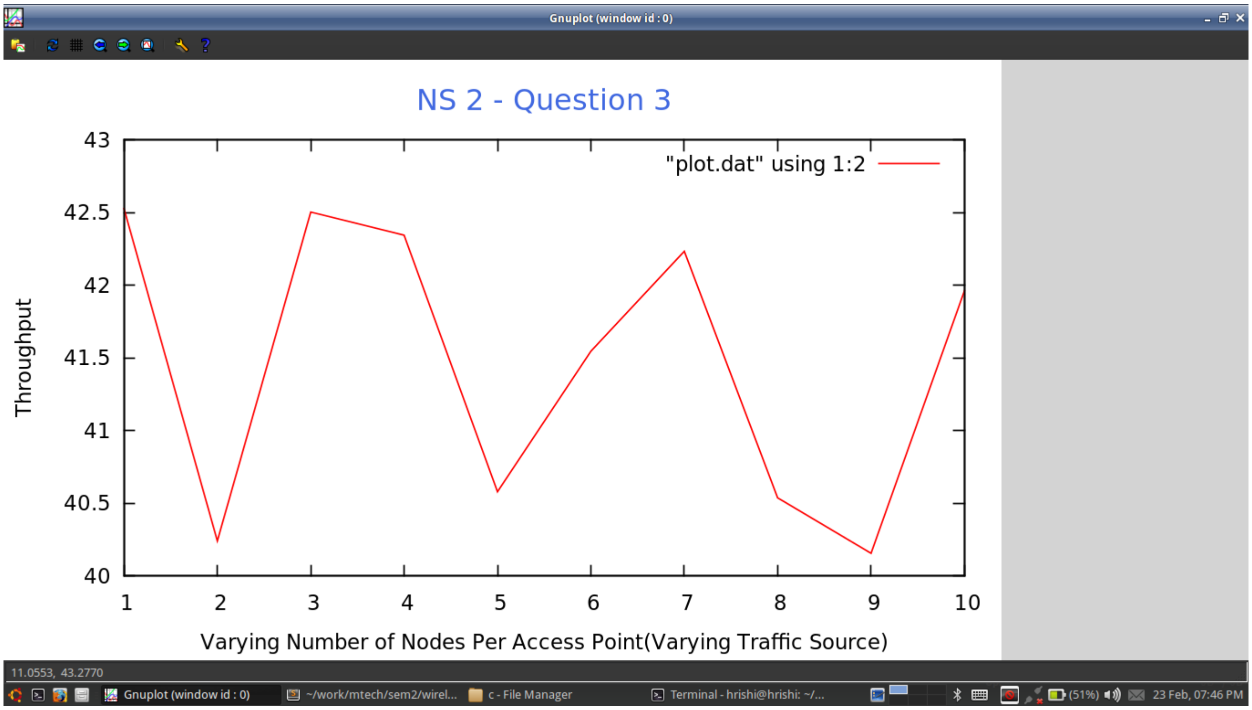
As the number of APs increase, there is increasing amount of network contention among different APs which may negatively impact the performance of clients. Your task is to show the impact on performance such as throughput and delay for varying number of APs. Building on the previous task, vary number of traffic sources and mobility of clients while APs remain static using ns-2. Plot your results for throughput and delay for varying densities of APs and describe your findings.

Steps involved:

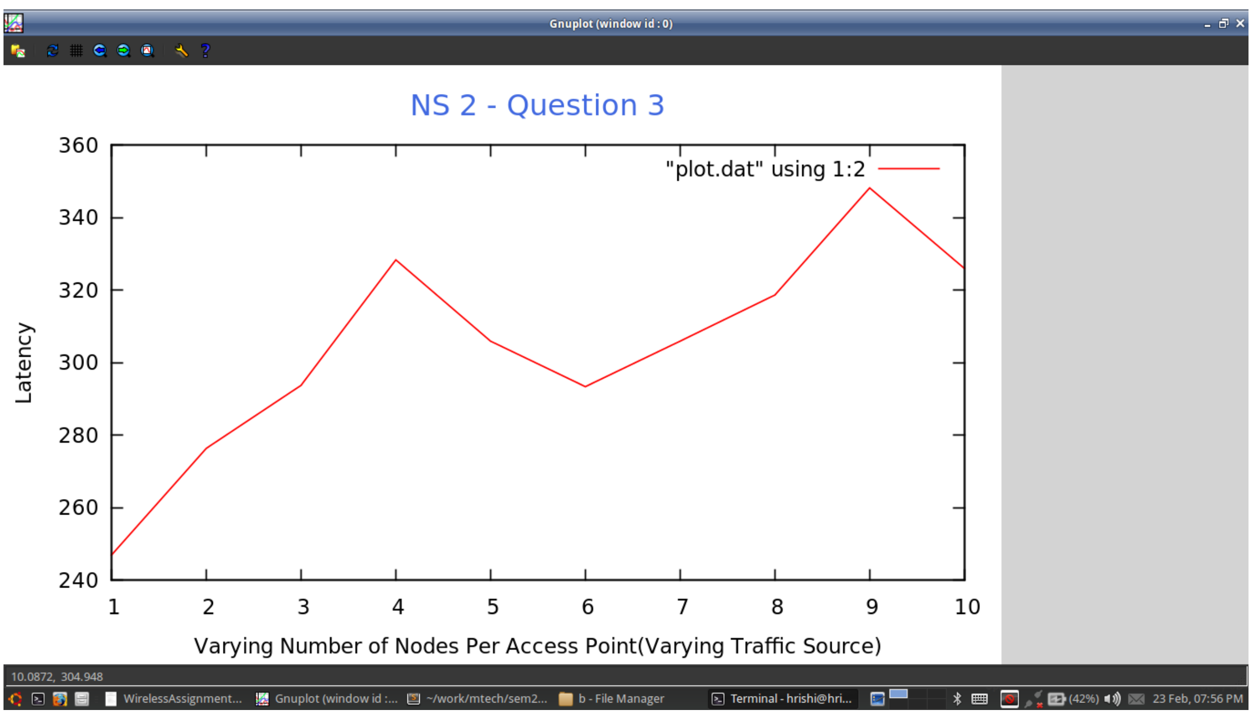
1. To fulfill given task a .tcl script was written with the following parameters :
    a. Routing protocol was set to DSDV
    b. Number of nodes were taken as command line arguments
    c. Interface queue type was set to Droptail

2. The steps involved in solving the given problems were
    a. Assign number of Access Points(AP) and client nodes using command line argument
    b. No central Access Point. All are competing Wi-Fi APs
    c. Create APs and client nodes and randomly place nodes using seed value
    d. Create a UDP agent and attach from and to different AP and client nodes
    e. Trace file was parsed using an awk script
    f. Awk script used to parse calculates the throughput – i.e. the end to end delay between the different APs and the client nodes
    g. Bash file run.sh was used to automate the 20 random trials and parse the throughput from the trace file
    h. Simulation was run for a large number of nodes – 500 to 600 nodes and was then parsed using the awk script

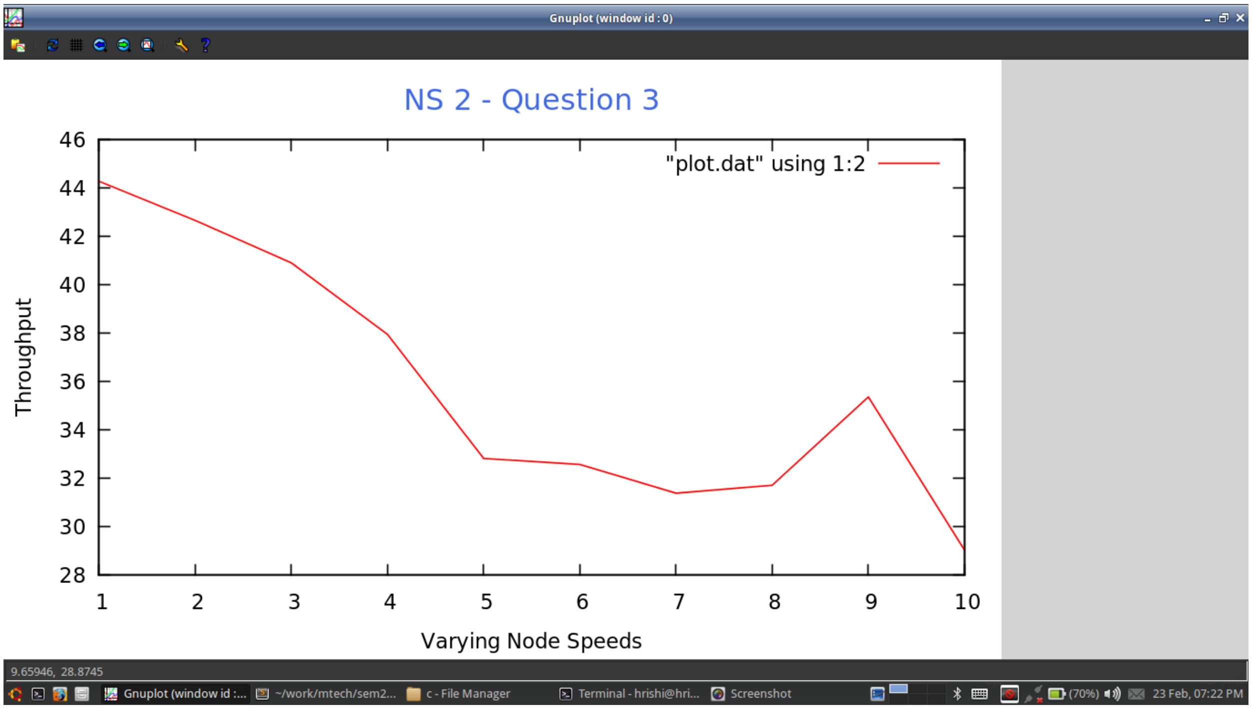
3. A plot.dat file was finally generated in order to generate a graph to capture the latency and throughput estimation of the simulation. The following graphs and their inferences are presented:



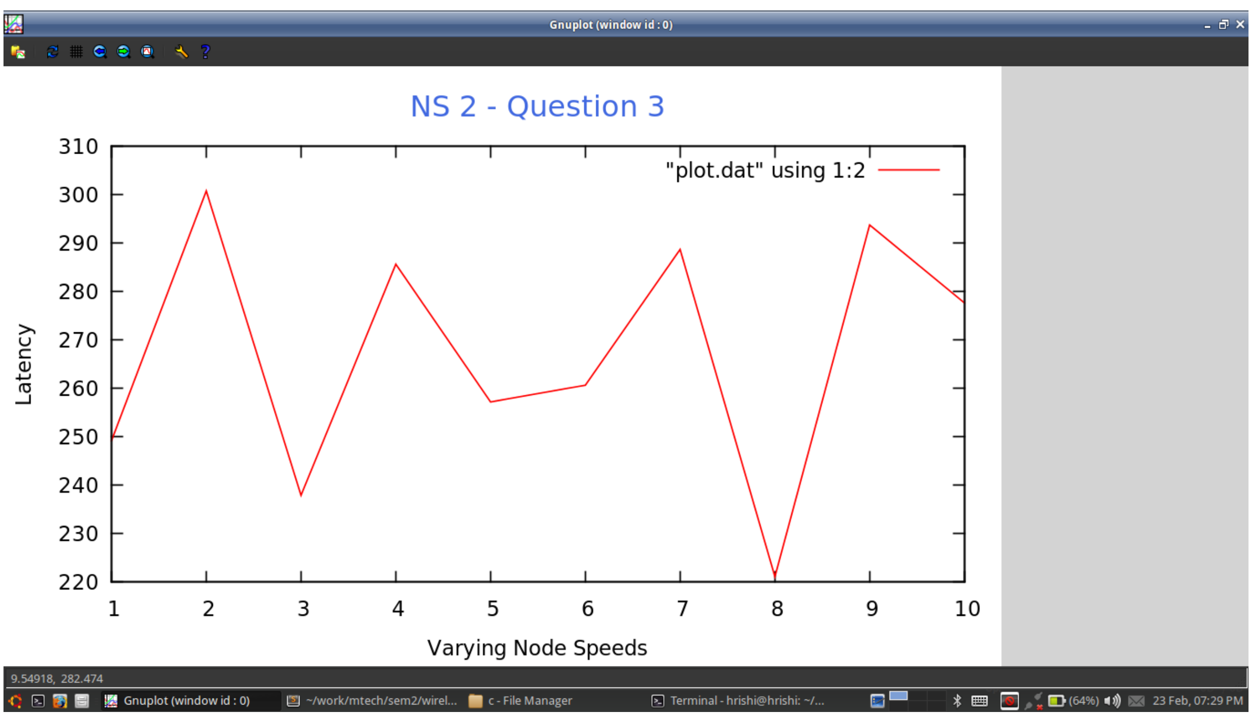
In the above given graph the throughput varies when the number of nodes per access point varies (Density). The throughput in this scenario varies because it moves in and out of range of APs due to mobility of the client nodes, no matter the number of nodes per AP. The first highest throughput is taken to be a case where the students are accessing their hostel AP (say). As the students then move from one building to another there is a decrease and increase correspondingly in the throughput as they move out and in to the range of the APs.



In the above graph Latency vs Density is plotted. This shows a gradual increase in the latency as the number of clients per AP increase and as well as taken into consideration that the clients are constantly mobile. As the number of mobile clients increase, the latency also increases.



In the above graph the throughput vs mobility of clients are plotted. It is evident from the graph that when the number of mobile clients increase their speeds of mobility, they fall faster from their range of AP and hence packets are dropped more. This causes the throughput to drop for increasingly faster clients.



In the above presented graph the increase and decrease in the latency due to mobility is described by the nodes falling in and out of range. As with random mobile speeds, the clients may fall out faster from the range of an AP and hence the increase in latency and vise-versa.