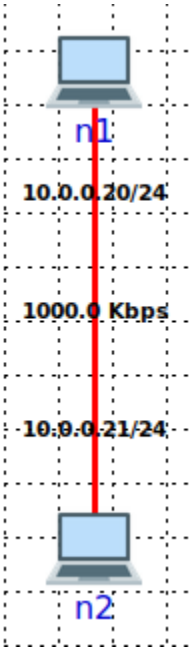
HW4 (6 points)

Tools:

- iperf: https://iperf.fr/iperf-doc.php

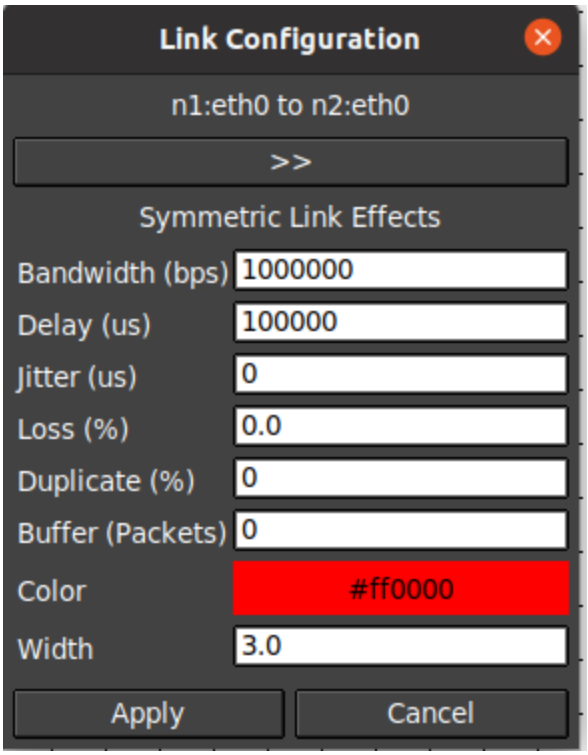
Setup:

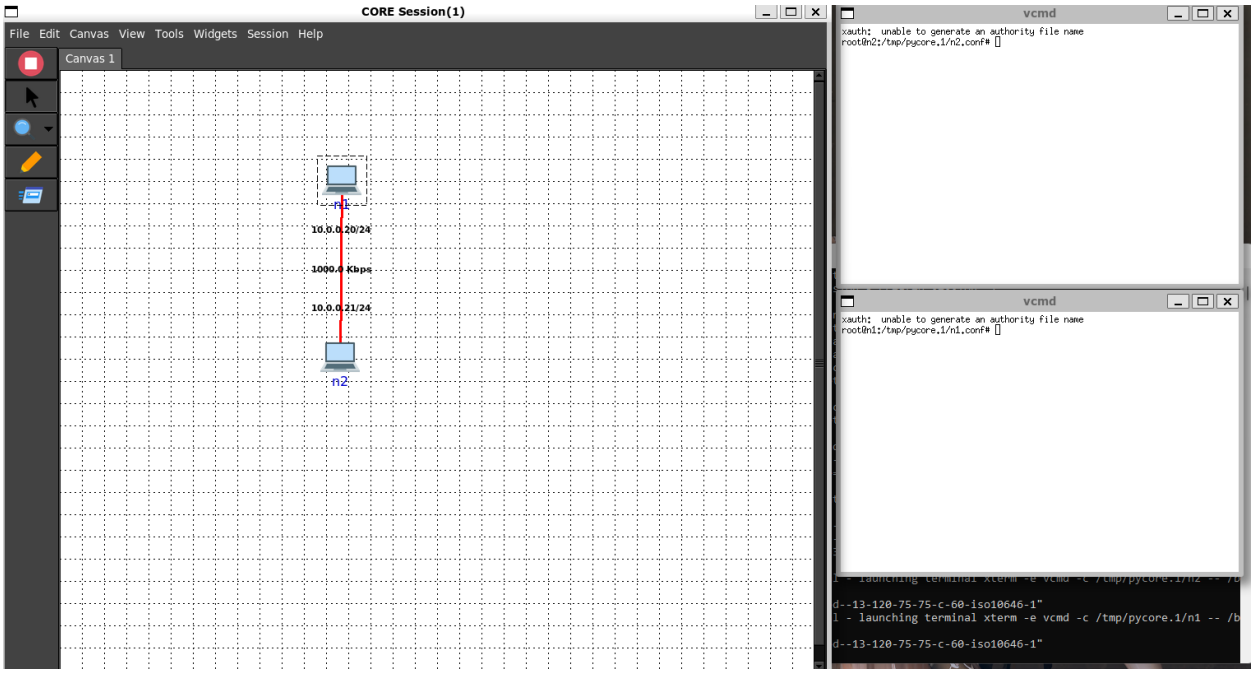
1) Setup a CORE scenario as shown below



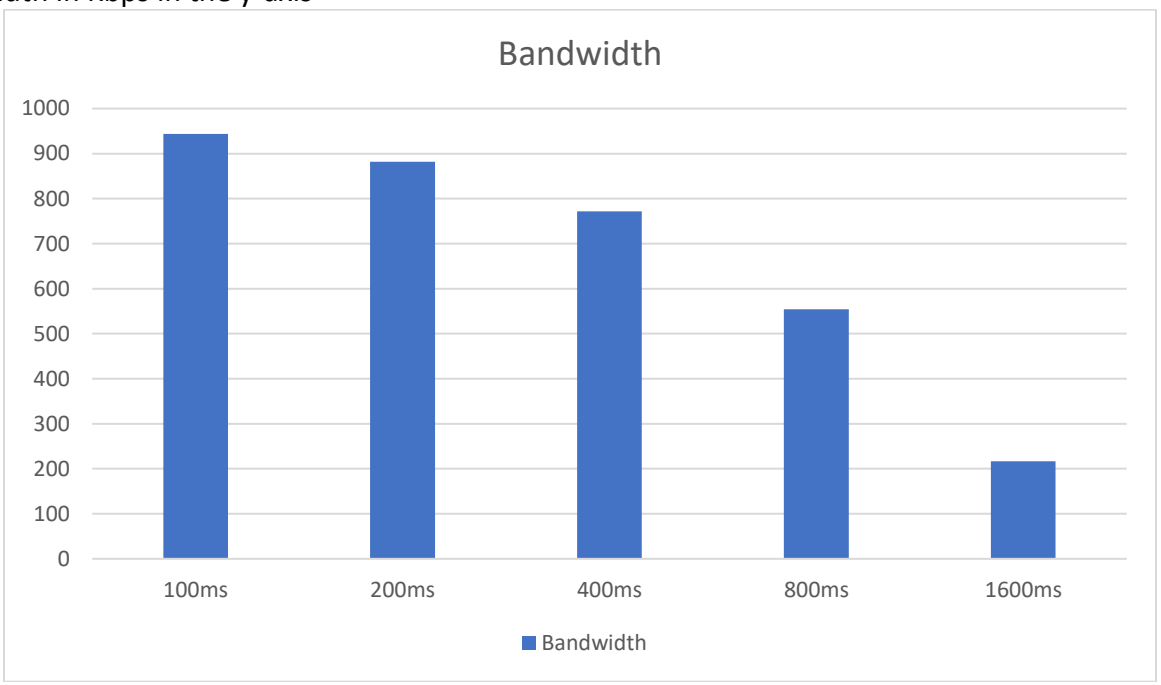
Part 1: Analyzing impact of delay on TCP (3 points)

1) Set the delay of the link from n1 to n2 to 100ms as shown below



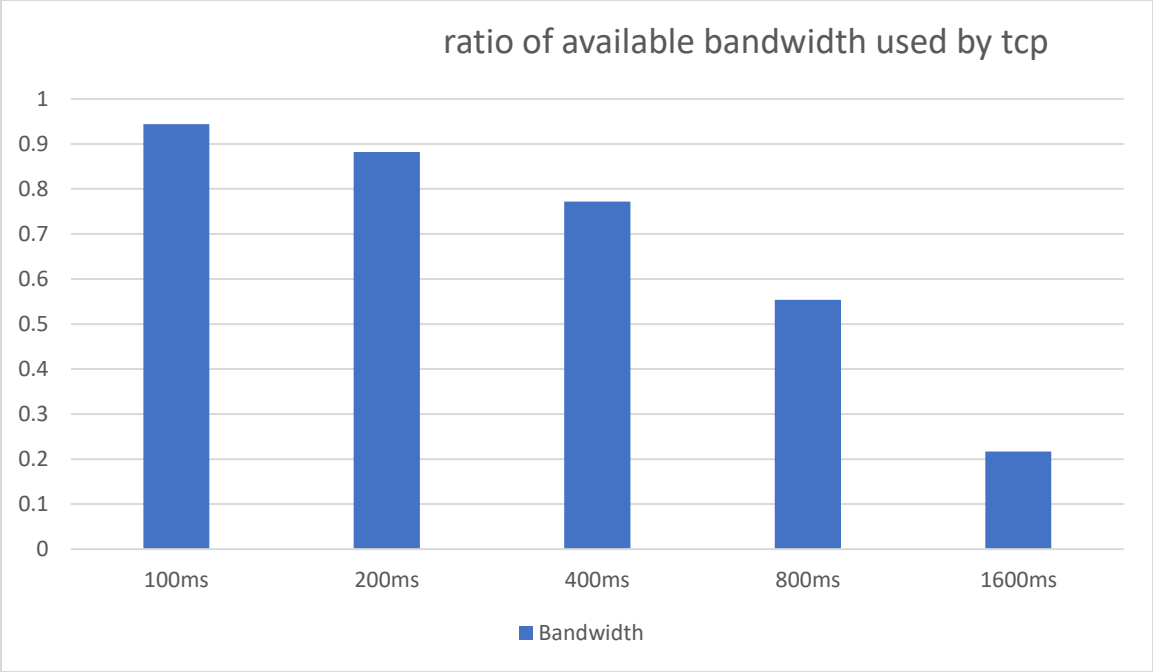
2) Run the CORE scenario
   a. 

3) Use iperf to run a TCP server on port 8080 on n2
   a. Iperf -s -p 8080
4) Use iperf to run a TCP client connecting to n1. Use bandwidth of 1Mbps
   a. Iperf -c 10.0.0.21 -p 8080 -b 1000000
5) Report the bandwidth you got as reported at the server
   a. 944 Kbits/sec

6) Repeat 4-5 for link delay values 200ms, 400ms, 800ms, 1600ms
    a. 200
        i. 822
    b. 400
        i. 772
    c. 800
        i. 554
    d. 1600
        i. 283
7) Create a bar chart that has delay value in x-axis starting at (100ms to 1600ms) and bandwidth in Kbps in the y-axis
    a. 

8) Create another bar chart that has delay value in x-axis starting at (100ms to 1600ms) and ratio of available bandwidth used by TCP in the y-axis

a.



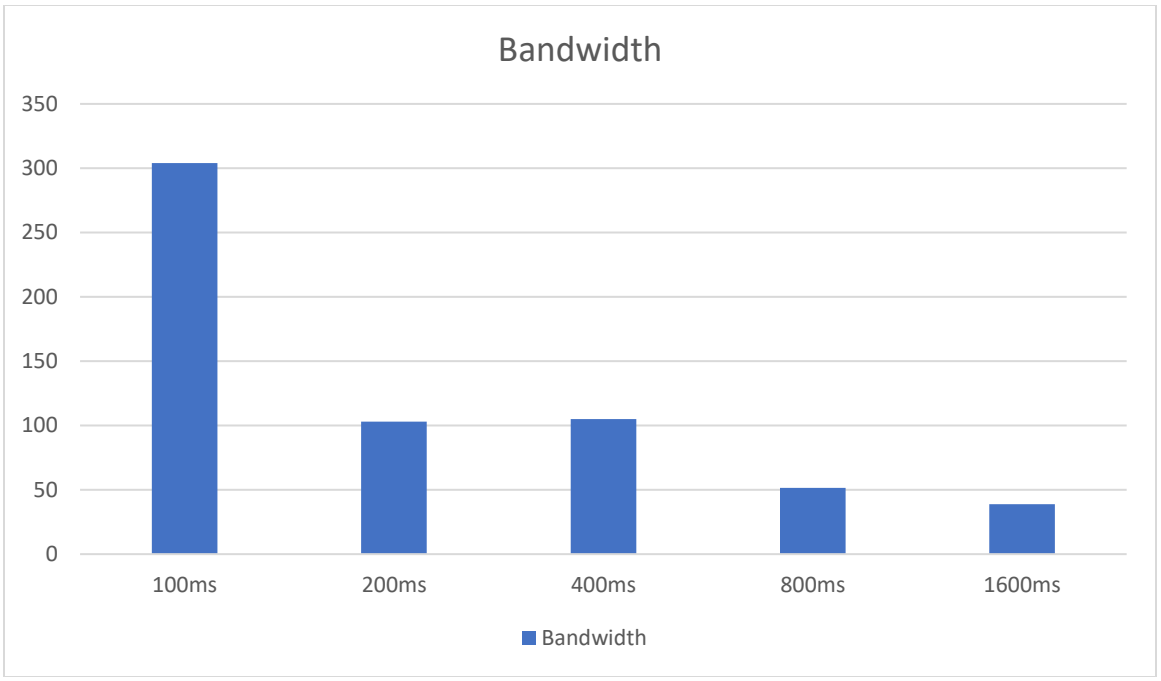
9) Comment on the effect of delay on TCP performance. Explain how TCP is affected by increase in delay.
    a. Higher delay causes lower ratio of bandwidth used by TCP. The higher delay is, the lower TCP performs. And there's a significant drop of ratio between 400ms and 800ms.
    b. When delay is high, the sender will need to wait more time before a ack is received. And the TCP window will be used up more often in higher delays. So given a rather small TCP window size and a higher target bandwidth, the higher the delay is, the more time sender will remain idle. Thus the lower the use ratio of bandwidth will be.

Part 2: Analyzing impact of delay and loss on TCP (3 points)

Repeat part 1 but add a 10% loss to the link for all delay values

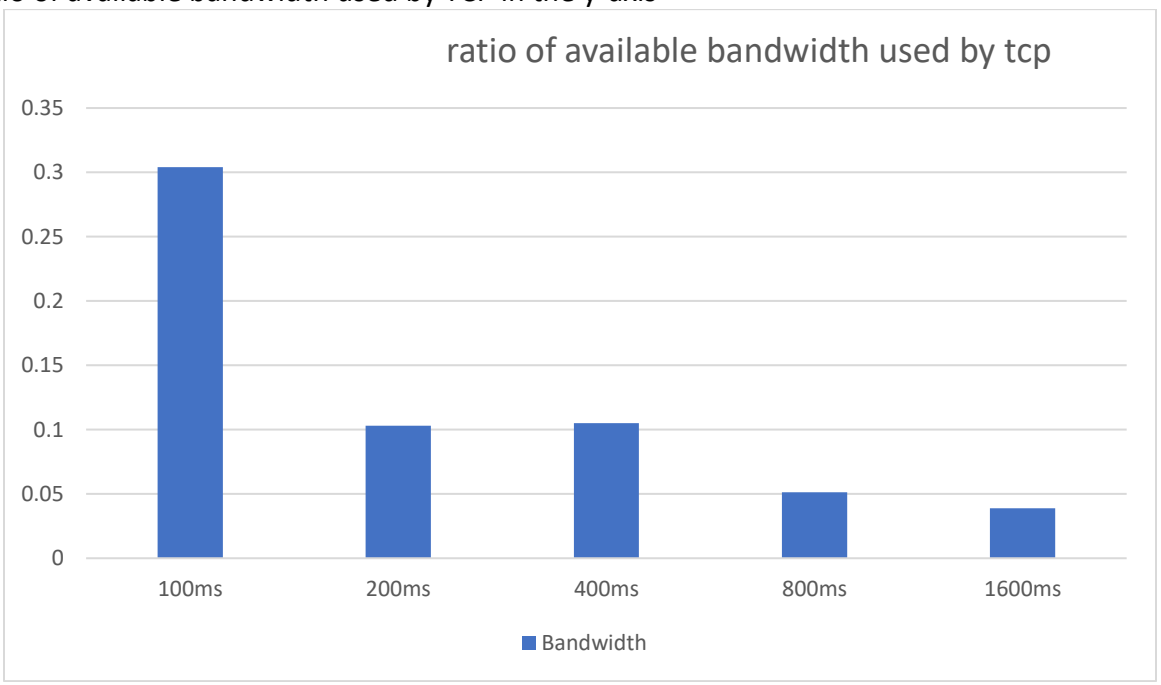
1) Repeat 4-5 for link delay values 100ms, 200ms, 400ms, 800ms, 1600ms
    a. 100
        i. 304
    b. 200
        i. 103
    c. 400
        i. 105
    d. 800
        i. 51.4
    e. 1600
2) Create a bar chart that has delay value in x-axis starting at (100ms to 1600ms) and bandwidth in Kbps in the y-axis

a.



3) Create another bar chart that has delay value in x-axis starting at (100ms to 1600ms) and ratio of available bandwidth used by TCP in the y-axis

a.



4) Comment on the effect of delay on TCP performance. Explain how TCP is affected by increase in delay.
    a. Introduction of loss causes worse performance of TCP
    b. This should be the case of congestion control. When loss occurs, the congestion control in TCP drops it's window size by half. So in a high loss rate environment, the TCP tend to have a bad performance due to it's default congestion control policy