Northeastern University

**EECE5155: Wireless Sensor Networks and the Internet of Things**
**Laboratory Assignment 3 Report**

**Author:**

- Soniya Nitin Kadam
- Group number on Canvas: 27

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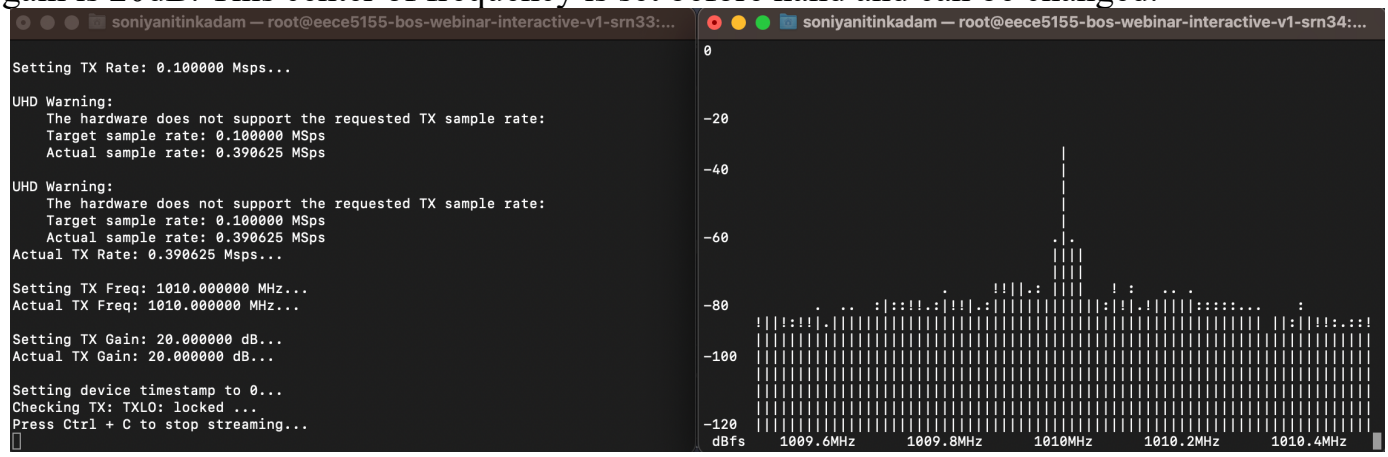
## 1. Experimental setup

a. Download Cisco AnyConnect Secure Mobility Client and install it
b. Specify Colosseum VPN URL (vpn.colosseum.net/user) to connect
c. Generation of SSH key using 'ssh-keygen -t rsa -b 4096 -C your_email@example.com'
d. Copy pasting the SSH public key with extension .pub to the 'Your SSH Key' section on Colosseum Portal add press add key.
e. Creating a config in .ssh directory using 'vi ~/.ssh/config' command. Make the changes necessary in the given code.
f. Once all this is done we have to book nodes and time slot to use Colosseum.
g. We have to book 2 nodes and in interactive nodes.
h. Once this is done we can start performing our practical.

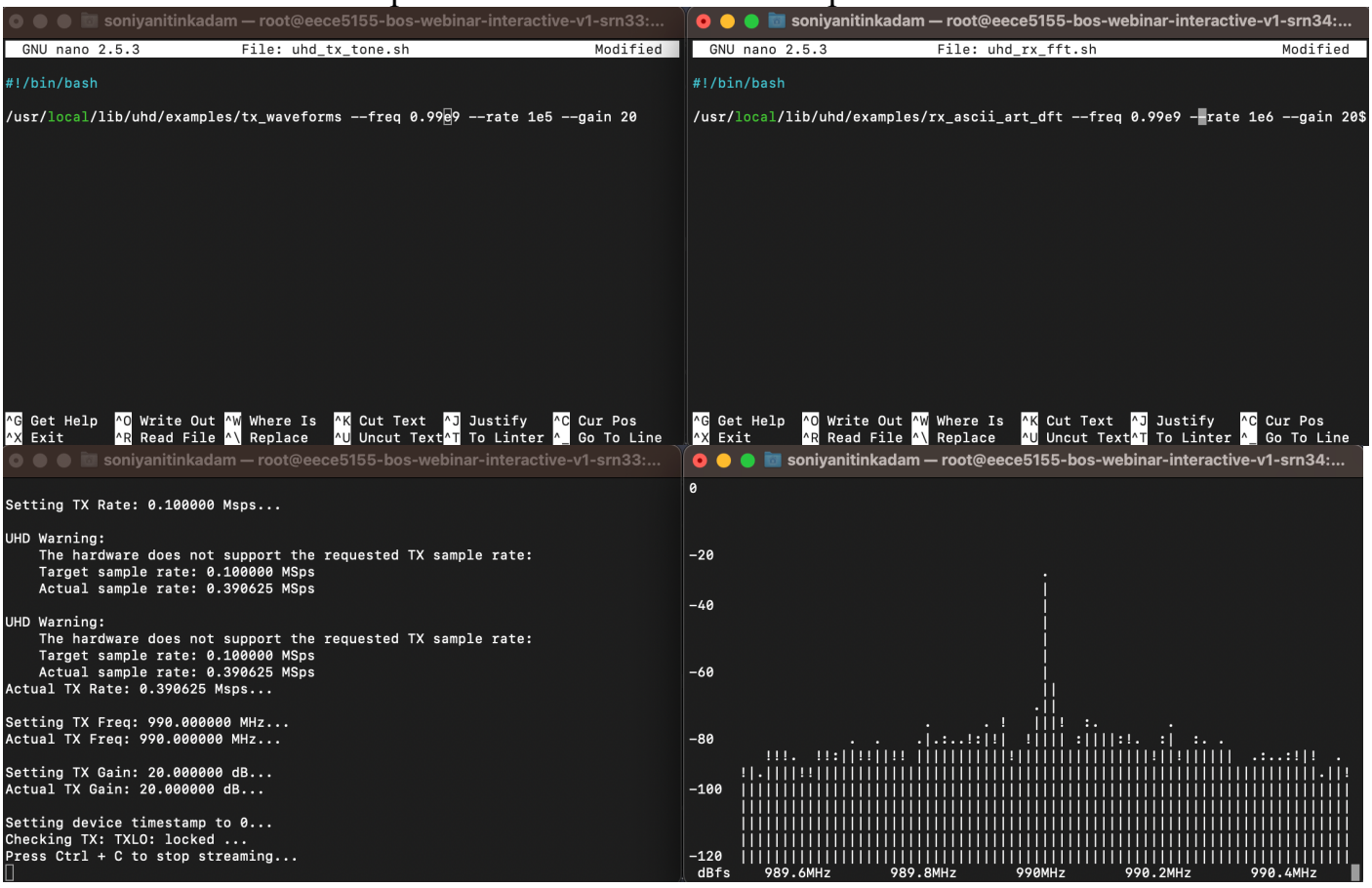
## 2. Results

**Question 1: What is the frequency at which the tone is sent? Report your findings, including a screenshot similar to the one above. Comment your results. (15 points)**
Solution: The frequency which the tone is sent to is 1010Mhz or 1.010Ghz. This is the Setting TX frequency, Actual TX Frequency and the Setting RX frequency, Actual RX Frequency at the transmitter and receiver both. Because of this we are getting o/p at the 1010Mhz where the gain is 20dB. This center of frequency is set before hand and can be changed.



**Question 2: Edit uhd_tx_tone.sh and the uhd_rx_fft.sh scripts to change the center frequency to 0.99 GHz. Repeat the previous steps. Which modifications are necessary to work with the new center frequency? Report your findings and a screenshot similar to the one above. Comment your results. (20 points)**

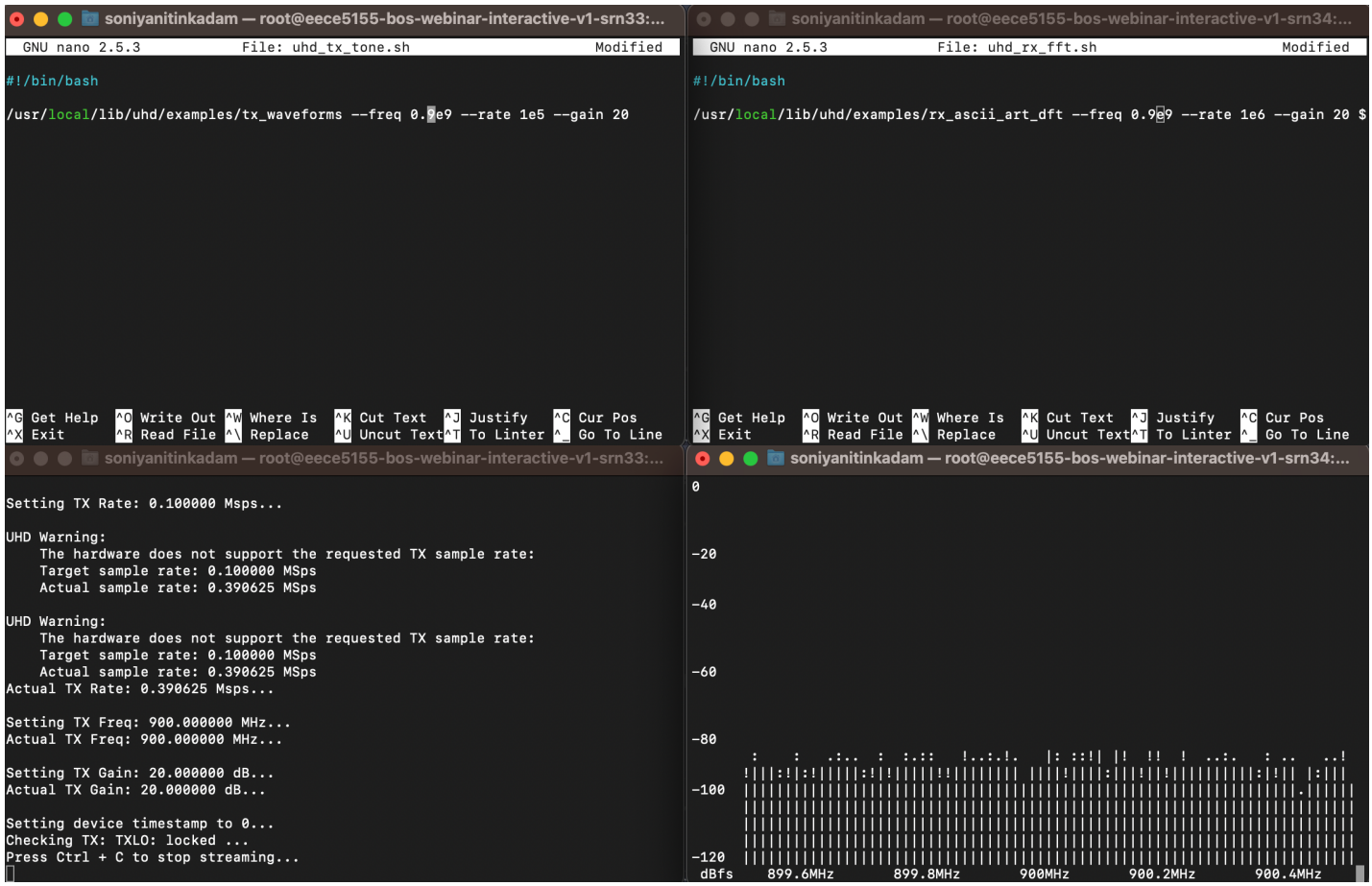
Solution: We can change the frequency from 1010Mhz to 0.99Ghz or 990Mhz by entering the command ‘vi uhd_tx_tone.sh’ and change the freq value to 1.010e9 to 0.99e9. After vi command we need to press ‘I’ to start editing this . Once this is done , we have to do the same for the other node and to save the changes we have to press ‘esc’ and then give the command ‘:wq!’to save the changes made. After this when we run uhd_tx_tone.sh and the uhd_rx_fft.sh commands we can see the peak waveform at 990Mhz in place of 1010Mhz.




**Question 3: Do the same as asked in Question 2 but set the center frequency to 0.9 GHz. Report your findings and a screenshot similar to the one above. Comment your results. (5 points)**

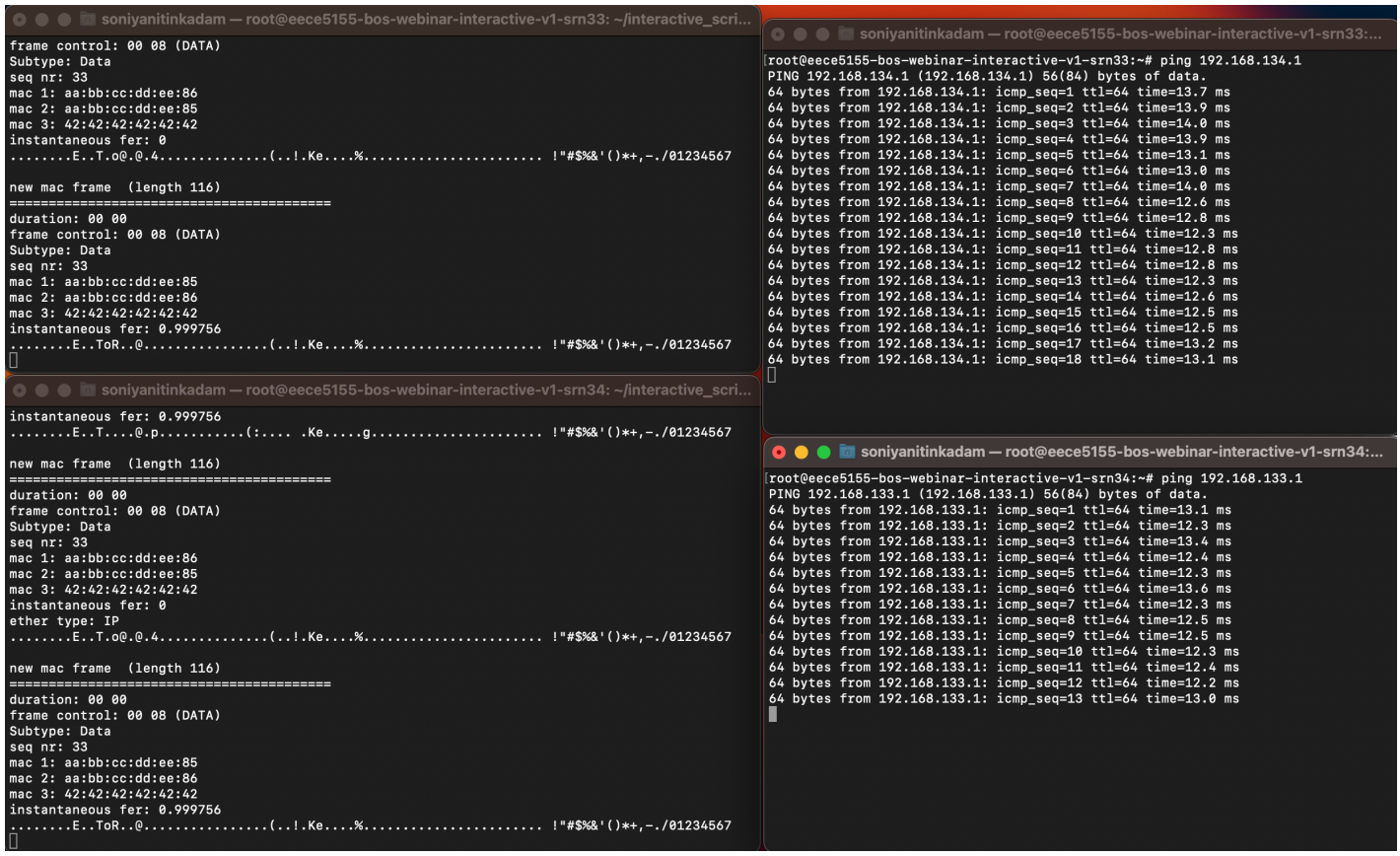
Solution: We can change the frequency from 990 Mhz to 0.9Ghz or 900Mhz by entering the command ‘vi uhd_tx_tone.sh’ and change the freq value to 0.99 e9 to 0.9e9. After vi command we need to press ‘I’ to start editing this . Once this is done , we have to do the same for the other node and to save the changes we have to press ‘esc’ and then give the command ‘:wq!’to save the changes made.

After this when we run uhd_tx_tone.sh and the uhd_rx_fft.sh commands we can not see the center frequency peak at 900Mhz.



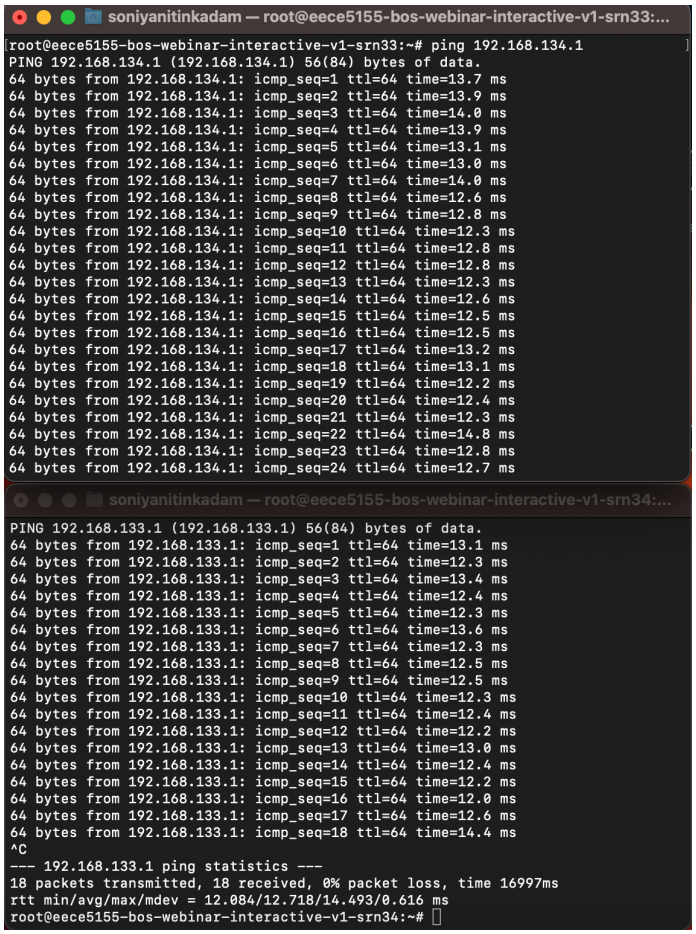

**Question 4: What is going on in the two nodes? What kind of messages are the two nodes exchanging? Report your findings, including a screenshot similar to the one above. Comment your results. (20 points)**

Solution: The two nodes are communicating with each other using a TCP connection. This is evident from the fact that the frame control field is set to 0x08 08, which indicates that this is a data packet with the SYN flag set. The SYN flag is used to initiate a new TCP connection. The two nodes are also using the Ethernet protocol to communicate with each other. This is evident from the fact that the EtherType field is set to 0x0800, which indicates that this is an IPv4 packet. Overall, the image shows that the two nodes are communicating with each other in order to coordinate the operation of the Minecraft server. They are using a TCP connection and the Ethernet protocol to communicate.




**Question 5: What is the average round-trip time between the two Wi-Fi nodes? What is the one-way delay? What is the packet loss experienced by the two nodes? Report your findings and comment your results. (20 points)**

Solution: The RTT is the time it takes for a packet to travel from one node to the other and back again. It is calculated by taking the average of the time it takes for a packet to travel from one node to the other and the time it takes for the response packet to travel back. To calculate the RTT in the image, I used the following steps: I identified the first packet in the image that was sent from Node 1 to Node 2. This packet has a timestamp of 13.1 milliseconds. I then identified the response packet from Node 2 to Node 1. This packet has a timestamp of 13.7 milliseconds. I subtracted the timestamp of the first packet from the timestamp of the response packet to get the RTT. The RTT is 0.6 milliseconds. One-way delay The one-way delay is the time it takes for a packet to travel from one node to the other. It is calculated by dividing the RTT in half. To calculate the one-way delay in the image, I simply divided the RTT in half. The one-way delay is 0.3 milliseconds. Packet loss Packet loss is the percentage of packets that are not successfully delivered to their destination. It is calculated by dividing the number of lost packets by the number of packets sent and multiplying by 100%. To calculate the packet loss in the image, I counted the number of packets that were sent from Node 1 to Node 2 and the number of packets that were received by Node 2. Since all of the packets were received, the packet loss is 0%. The average RTT between the two Wi-Fi nodes is 0.6 milliseconds. The one-way delay is 0.3 milliseconds. The packet loss experienced by the two nodes is 0%. These results indicate that the two Wi-Fi nodes have a good connection with low latency and no packet loss.




**Question 6: What are the characteristics of the traffic flows of this scenario (i.e., packet size and rate)? Report your findings, including a screenshot similar to the one above. Comment your results. (20 points)**

Solution:

a) The largest packet size is 1460 bytes, which is the maximum packet size for Ethernet networks. This suggests that the CLI session is using a large maximum transmission unit. There is no packet loss in the image. This indicates that the network connection between the two nodes is reliable.

b) The packets that are transmitted are transmitted via your DB connection after the TCP dump command the length of the packet is 1400 bytes and there has been no retransmission or packet loss. The capture size of the transmission is 262144 bytes this transmission is taking place between the two nodes that were assigned the port numbers of the nodes are also listed below.

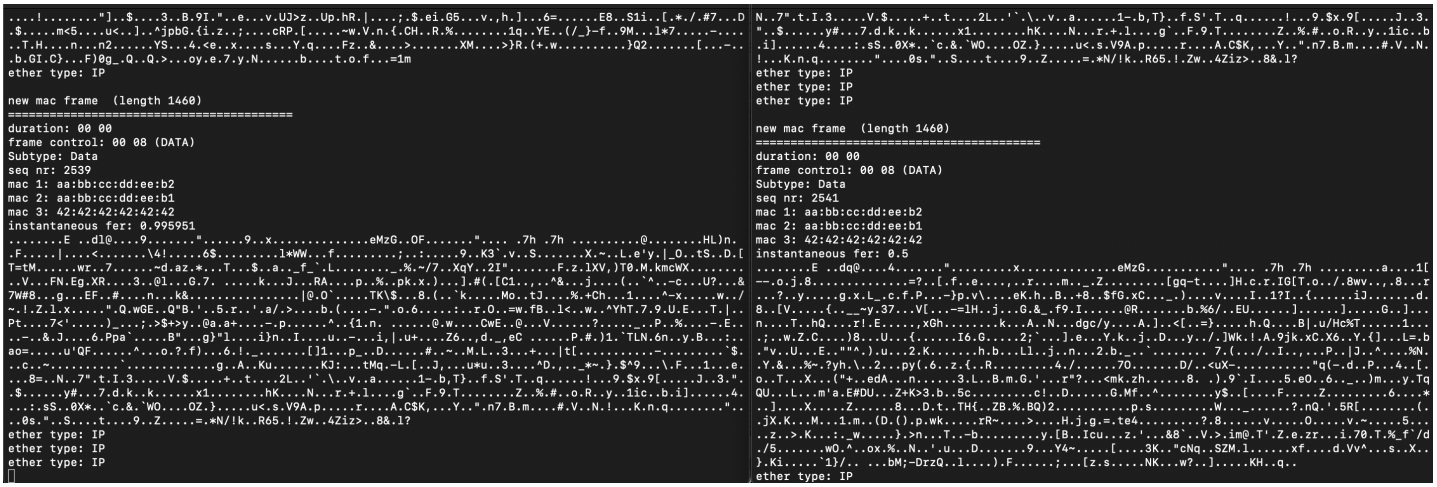


Image (a)

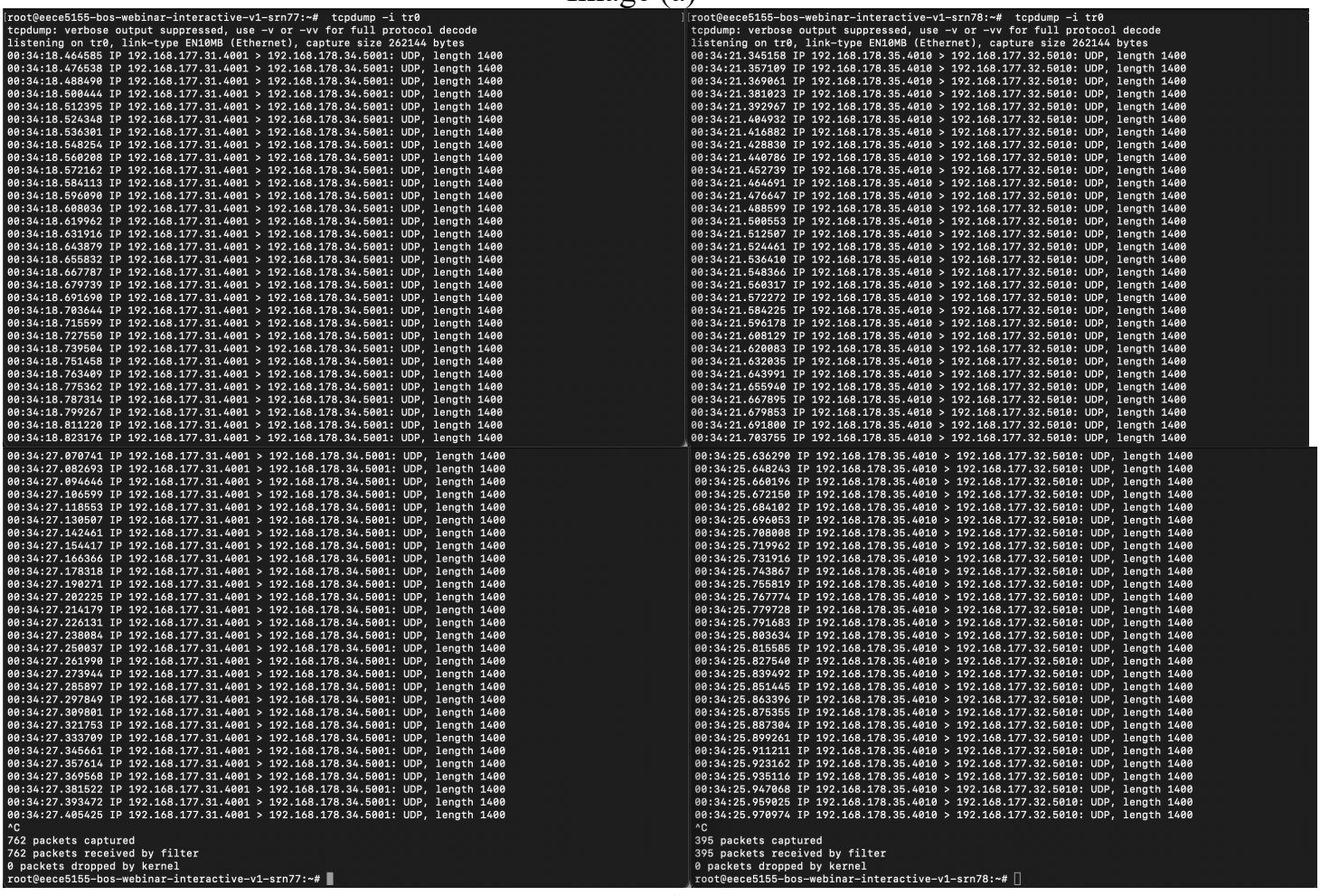


Image (b)

## 3. Learnt Lessons

We have learned how to work on Colosseum and how to connect 2 nodes to form a connection and data transfer between them. We have also studied about central frequency and how to modify it. We have also analyzed traffic flow and the types of transmission taking place. We have also studied about RTT , one time delay and concept and analyzing packet loss, transmission rate and the packet size.