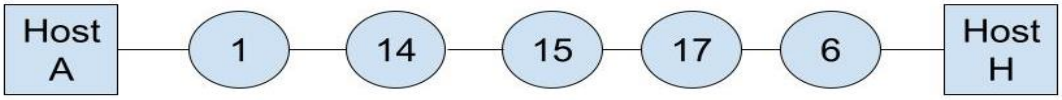
Evaluating Delays in Packet Switching Network

Name: Girish S

Roll no: AM.EN.U4AIE22044

Part1 – Understanding theoretical delay calculations.

1. What is the end-to-end packet delay in this store and forward subnet from Router1 to Router6?



Assume the following:

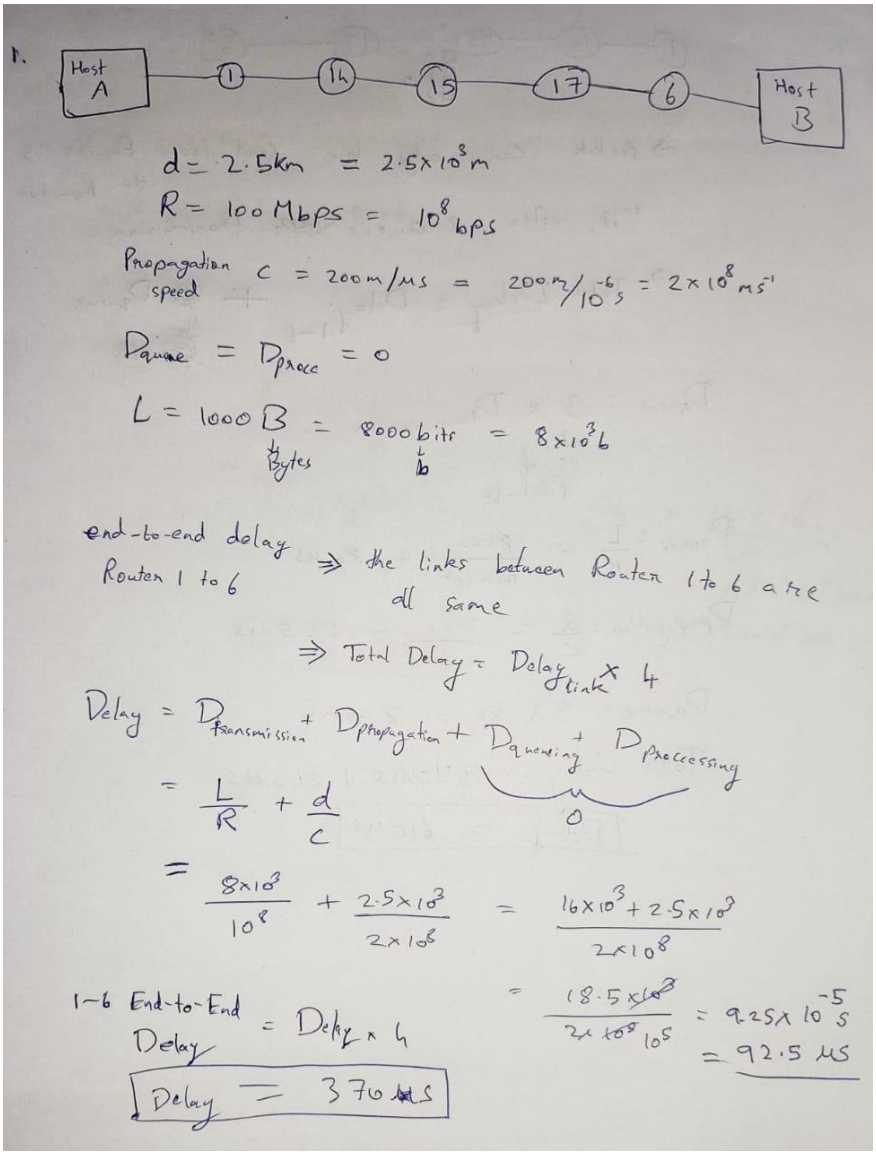
all links are of distance d = 2.5km.

Capacity of the link R=100Mbps

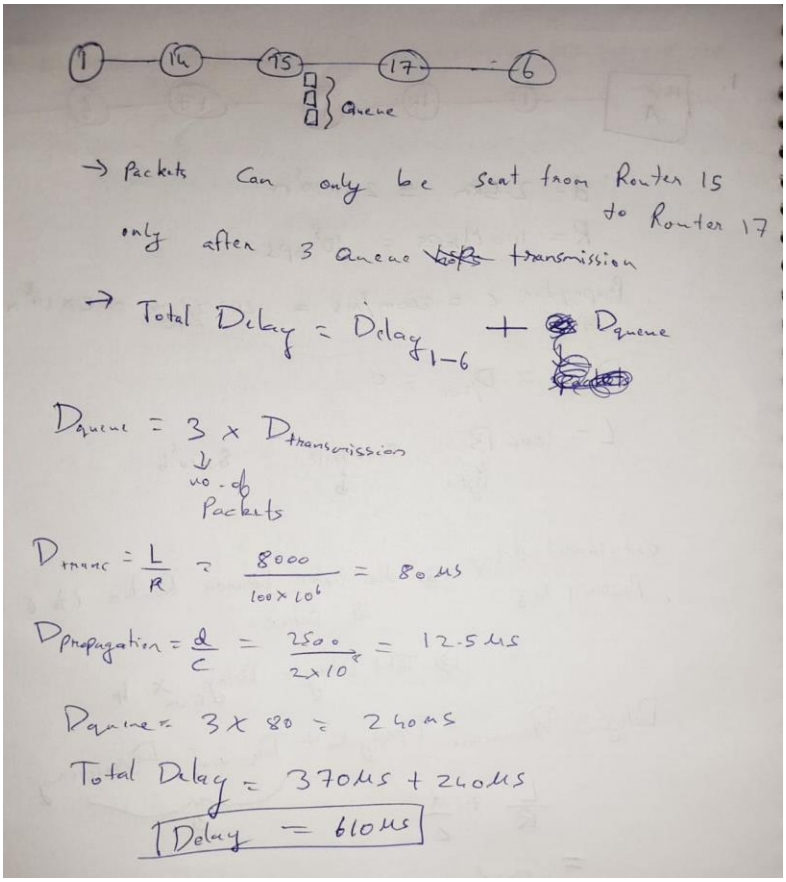
Propagation speed s = 200m/microseconds

Queuing delay = Processing delay = 0

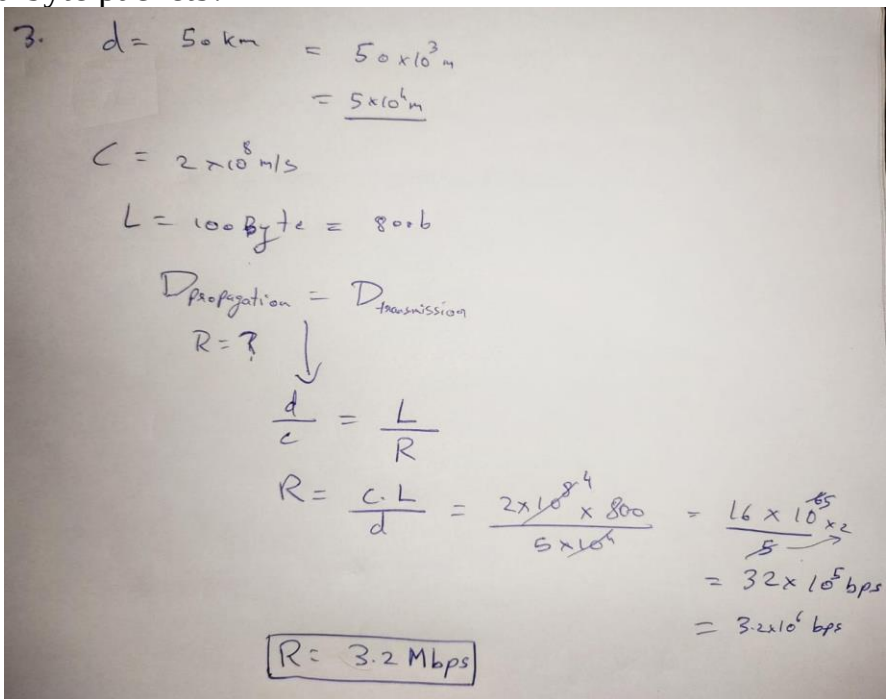
Packet size L = 1000 bytes



2. What is the end-to-end packet delay in this store and forward subnet from router 1 to router 6, under the scenario that when a packet from router 1 arrives at **router 15** there are 3 packets enqueued for the link to router 17?



3. Consider a point-to-point link 50 km in length. At what bandwidth would propagation delay (at a speed of 2 × 10^8 m/sec) equals transmit delay for 100-byte packets?



Part2 – Use Wireshark to view the traffic.

Capture and Analyze ICMP Data in Wireshark

Step1: Start capturing data on the active interface (wi-fi or Ethernet)

a. Start the data capture again.

b. A window prompts you to save the previously captured data before starting another capture. It is not necessary to save this data. Click **Continue without Saving**.

c. With the capture active, ping and tracert the following three website URLs from a Windows command prompt:

Open a Windows command prompt

1) Domain name specified in the interface you had connected to internet.

2) www.amrita.edu

Note: When you ping the URLs listed, notice that the Domain Name Server (DNS) translates the URL to an IP address. Note the IP address received for each URL.

d. You can stop capturing data by clicking the **Stop Capture** icon.

Step 1: Examining and analyzing the data from the remote hosts.

Review the captured data in Wireshark and examine the IP addresses of the two locations that you pinged.

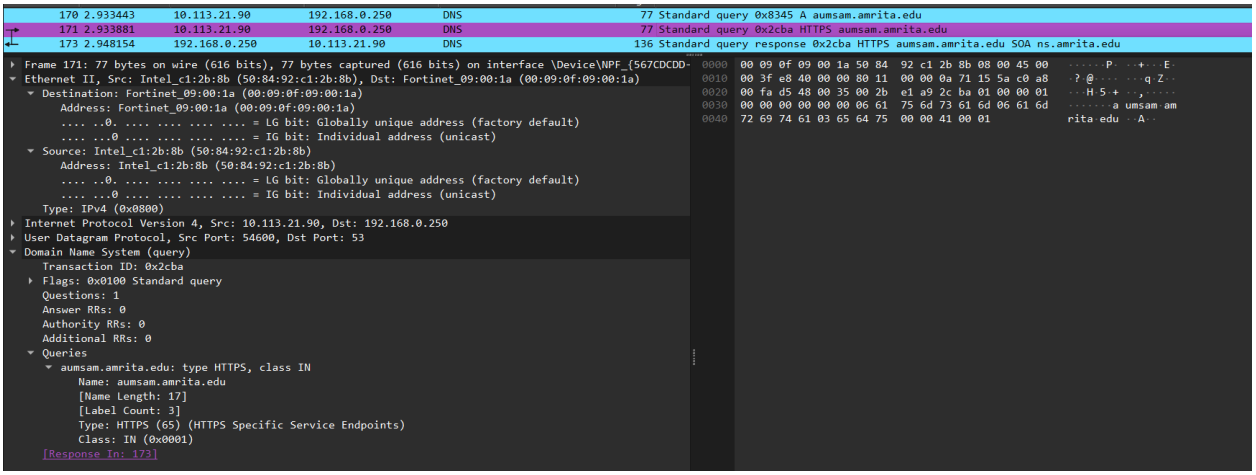
Questions:

IP address for **am.studentds.amrita.edu**: 192.168.0.252

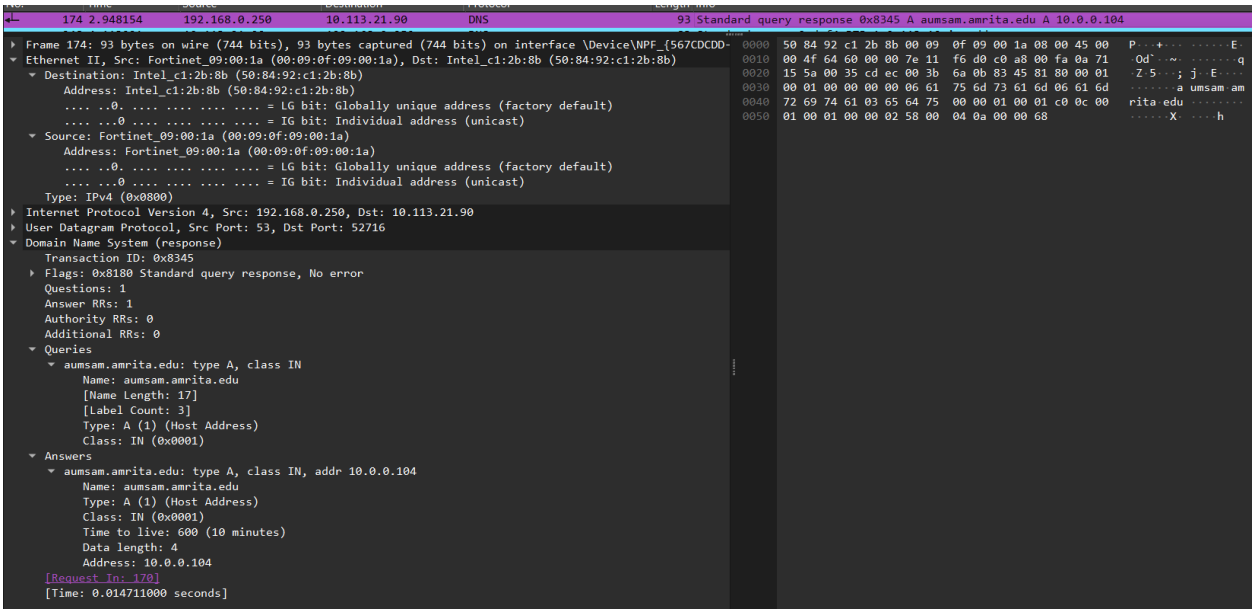
How many Ping request and reply packets are captured?

Packets: Sent = 7, Received = 7.

Try to provide screenshots to show these details in the ICMP frames captured. Justify your answers.



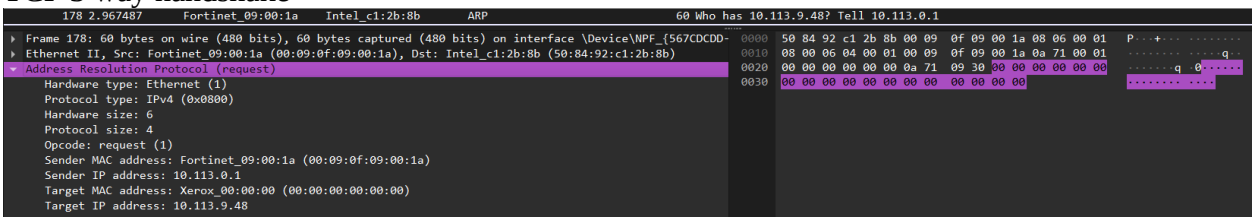
DNS request



DNS Response

10.113.21.90	10.0.0.104	TCP	66 53193 → 443 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM
10.113.21.90	224.0.0.251	IGMPv2	46 Membership Report group 224.0.0.251
10.0.0.104	10.113.21.90	TCP	66 443 → 53193 [SYN, ACK] Seq=0 Ack=1 Win=14600 Len=0 MSS=1460 SACK_PERM WS
Fortinet_09:00:1a	Intel_c1:2b:8b	ARP	60 Who has 10.113.9.48? Tell 10.113.0.1
10.113.21.90	10.0.0.104	TCP	54 53193 → 443 [ACK] Seq=1 Ack=1 Win=131328 Len=0

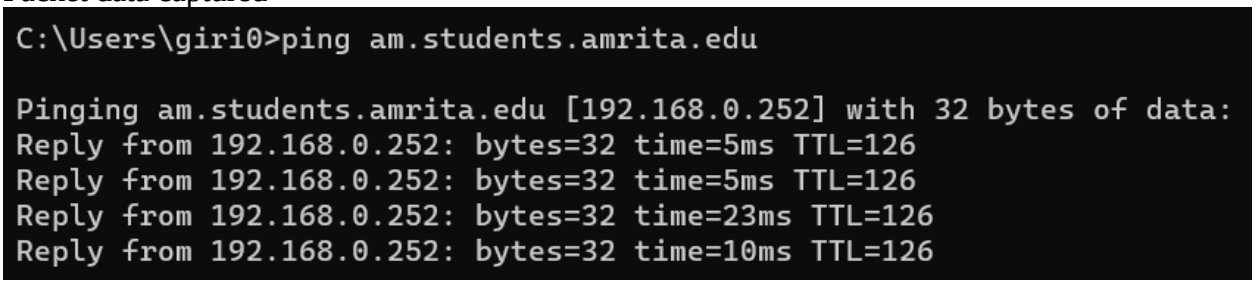
TCP 3 way handshake



Address Resolution Protocol

10.113.21.90	10.0.0.104	TLSv1.2	799 Client Hello (SNI=aumsam.amrita.edu)
10.0.0.104	10.113.21.90	TLSv1.2	191 Server Hello, Change Cipher Spec, Encrypted Handshake Message
10.113.21.90	10.0.0.104	TLSv1.2	105 Change Cipher Spec, Encrypted Handshake Message
10.113.21.90	10.0.0.104	TCP	1514 53193 → 443 [ACK] Seq=797 Ack=138 Win=131072 Len=1460 [TCP segment of a reassembled PDU]
10.113.21.90	10.0.0.104	TLSv1.2	106 Application Data

Packet data captured



10.113.21.90	192.168.0.252	ICMP	106 Echo (ping) request id=0x0001, seq=236/60416, ttl=1 (no response found
10.113.0.1	10.113.21.90	ICMP	134 Time-to-live exceeded (Time to live exceeded in transit)
0.0.0.0	239.255.255.250	IGMPv2	46 Membership Query, specific for group 239.255.255.250
10.113.21.90	192.168.0.252	ICMP	106 Echo (ping) request id=0x0001, seq=237/60672, ttl=1 (no response found
10.113.0.1	10.113.21.90	ICMP	134 Time-to-live exceeded (Time to live exceeded in transit)
Fortinet_09:00:1a	Intel_c1:2b:8b	ARP	60 Who has 10.113.22.45? Tell 10.113.0.1
10.113.21.90	192.168.0.252	ICMP	106 Echo (ping) request id=0x0001, seq=238/60928, ttl=1 (no response found
10.113.0.1	10.113.21.90	ICMP	134 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	192.168.0.250	DNS	83 Standard query 0xdcf4 PTR 1.0.113.10.in-addr.arpa

Ping Request and response

537 10.098513	10.113.21.90	192.168.0.252	ICMP	106 Echo (ping) request	id=0x0001, seq=239/61184, ttl=2 (reply in 538)
538 10.103961	192.168.0.252	10.113.21.90	ICMP	106 Echo (ping) reply	id=0x0001, seq=239/61184, ttl=126 (request in 537)
541 10.108058	10.113.21.90	192.168.0.252	ICMP	106 Echo (ping) request	id=0x0001, seq=240/61440, ttl=2 (reply in 542)
542 10.112887	192.168.0.252	10.113.21.90	ICMP	106 Echo (ping) reply	id=0x0001, seq=240/61440, ttl=126 (request in 541)
544 10.117554	10.113.21.90	192.168.0.252	ICMP	106 Echo (ping) request	id=0x0001, seq=241/61696, ttl=2 (reply in 545)
545 10.121453	192.168.0.252	10.113.21.90	ICMP	106 Echo (ping) reply	id=0x0001, seq=241/61696, ttl=126 (request in 544)
832 16.594376	10.113.21.90	192.168.0.252	ICMP	74 Echo (ping) request	id=0x0001, seq=242/61952, ttl=128 (reply in 834)
834 16.599252	192.168.0.252	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=242/61952, ttl=126 (request in 832)
882 17.609832	10.113.21.90	192.168.0.252	ICMP	74 Echo (ping) request	id=0x0001, seq=243/62208, ttl=128 (reply in 884)
884 17.614536	192.168.0.252	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=243/62208, ttl=126 (request in 882)
922 18.645150	10.113.21.90	192.168.0.252	ICMP	74 Echo (ping) request	id=0x0001, seq=244/62464, ttl=128 (reply in 926)
926 18.668604	192.168.0.252	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=244/62464, ttl=126 (request in 922)
975 19.680606	10.113.21.90	192.168.0.252	ICMP	74 Echo (ping) request	id=0x0001, seq=245/62720, ttl=128 (reply in 977)
977 19.690859	192.168.0.252	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=245/62720, ttl=126 (request in 975)

7 Request and 7 replies captured

```
C:\Users\giri0>ping amrita.edu

Pinging amrita.edu [3.33.154.67] with 32 bytes of data:
Reply from 3.33.154.67: bytes=32 time=22ms TTL=249
Reply from 3.33.154.67: bytes=32 time=23ms TTL=249
Reply from 3.33.154.67: bytes=32 time=22ms TTL=249
Reply from 3.33.154.67: bytes=32 time=23ms TTL=249

Ping statistics for 3.33.154.67:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 22ms, Maximum = 23ms, Average = 22ms
```

1158 23.230741	10.113.21.90	3.33.154.67	ICMP	74 Echo (ping) request	id=0x0001, seq=246/62976, ttl=128 (reply in 1160)
1160 23.252842	3.33.154.67	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=246/62976, ttl=249 (request in 1158)
1224 24.251275	10.113.21.90	3.33.154.67	ICMP	74 Echo (ping) request	id=0x0001, seq=247/63232, ttl=128 (reply in 1226)
1226 24.274440	3.33.154.67	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=247/63232, ttl=249 (request in 1224)
1271 25.286842	10.113.21.90	3.33.154.67	ICMP	74 Echo (ping) request	id=0x0001, seq=248/63488, ttl=128 (reply in 1273)
1273 25.309509	3.33.154.67	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=248/63488, ttl=249 (request in 1271)
1314 26.321996	10.113.21.90	3.33.154.67	ICMP	74 Echo (ping) request	id=0x0001, seq=249/63744, ttl=128 (reply in 1315)
1315 26.345300	3.33.154.67	10.113.21.90	ICMP	74 Echo (ping) reply	id=0x0001, seq=249/63744, ttl=249 (request in 1314)

4 request and 4 replies captured

```
C:\Users\giri0>tracert amrita.edu

Tracing route to amrita.edu [3.33.154.67]
over a maximum of 30 hops:

  1     4 ms     4 ms     4 ms  10.113.0.1
  2     5 ms     4 ms     4 ms  123.63.2.1
  3    11 ms    10 ms    10 ms  122.15.45.170
  4    41 ms    26 ms    29 ms  182.19.108.198
  5    29 ms    26 ms    28 ms  99.83.90.14
  6     *        *        *     Request timed out.
  7     *        *        *     Request timed out.
  8     *        *        *     Request timed out.
  9    24 ms    25 ms    34 ms  52.93.19.47
 10    49 ms    56 ms    29 ms  52.93.19.46
 11    25 ms    35 ms    22 ms  a572ab1d134af1b1e.awsglobalaccelerator.com [3.33.154.67]

Trace complete.
```

10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=250/64000, ttl=1 (no response found!)
10.113.0.1	10.113.21.90	ICMP	134 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=251/64256, ttl=1 (no response found!)
10.113.0.1	10.113.21.90	ICMP	134 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=252/64512, ttl=1 (no response found!)
10.113.0.1	10.113.21.90	ICMP	134 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=253/64768, ttl=2 (no response found!)
123.63.2.1	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=254/65024, ttl=2 (no response found!)
123.63.2.1	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=255/65280, ttl=2 (no response found!)
123.63.2.1	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=256/1, ttl=3 (no response found!)
122.15.45.170	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=257/257, ttl=3 (no response found!)
122.15.45.170	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=258/513, ttl=3 (no response found!)
122.15.45.170	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=259/769, ttl=4 (no response found!)
182.19.108.198	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=260/1025, ttl=4 (no response found!)
182.19.108.198	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=261/1281, ttl=4 (no response found!)
182.19.108.198	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=262/1537, ttl=5 (no response found!)
99.83.90.14	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=263/1793, ttl=5 (no response found!)
99.83.90.14	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=264/2049, ttl=5 (no response found!)
52.93.19.47	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=275/4865, ttl=9 (no response found!)
52.93.19.47	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=276/5121, ttl=9 (no response found!)
52.93.19.47	10.113.21.90	ICMP	70 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=277/5377, ttl=10 (no response found!)
52.93.19.46	10.113.21.90	ICMP	182 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=278/5633, ttl=10 (no response found!)
52.93.19.46	10.113.21.90	ICMP	182 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=279/5889, ttl=10 (no response found!)
52.93.19.46	10.113.21.90	ICMP	182 Time-to-live exceeded (Time to live exceeded in transit)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=280/6145, ttl=11 (reply in 6859)
3.33.154.67	10.113.21.90	ICMP	106 Echo (ping) reply id=0x0001, seq=280/6145, ttl=249 (request in 6858)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=281/6401, ttl=11 (reply in 6863)
3.33.154.67	10.113.21.90	ICMP	106 Echo (ping) reply id=0x0001, seq=281/6401, ttl=249 (request in 6862)
10.113.21.90	3.33.154.67	ICMP	106 Echo (ping) request id=0x0001, seq=282/6657, ttl=11 (reply in 6866)
3.33.154.67	10.113.21.90	ICMP	106 Echo (ping) reply id=0x0001, seq=282/6657, ttl=249 (request in 6864)

IP address for **amrita.edu**: 3.33.154.67

How many Ping request and reply packets are captured?

Packets: Sent = 4, Received = 4.