

Part A

1. There are three TCP flows.

2.(a) From the 'flow' directory, packets from the source port and destination port are separated. Take flow between 43498 and 80 port for example, take the fourth and fifth packet from each side, and read the required information from their headers. The output are as follows.

Again, take flow between 43498 and 80 port for example. The ack number of the first packet from 80 port is to tell 43498 that message has been received and next desired sequence number is '1921750144'. Then the second packet sequence number from 43498 to 80 is '1921750144', and ack number is the same as the last sequence number in the sending packet from 80. The window size shown here is not the calculated window size.

First 2 transactions for port 43498 :

Source Port: 43498

Destination Port: 80

Seq Number: 705669103

Ack Number: 1921750144

Window Size Value: 3

Source Port: 80

Destination Port: 43498

Seq Number: 1921750144

Ack Number: 705669127

Window Size Value: 3

Source Port: 43498

Destination Port: 80

Seq Number: 705669127

Ack Number: 1921750144

Window Size Value: 3

Source Port: 80

Destination Port: 43498

Seq Number: 1921750144

Ack Number: 705670575

Window Size Value: 3

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First 2 transactions for port 43500 :

Source Port: 43500

Destination Port: 80

Seq Number: 3636173852

Ack Number: 2335809728

Window Size Value: 3

Source Port: 80

Destination Port: 43500

Seq Number: 2335809728

Ack Number: 3636173876

Window Size Value: 3

Source Port: 43500

Destination Port: 80

Seq Number: 3636173876

Ack Number: 2335809728

Window Size Value: 3

Source Port: 80

Destination Port: 43500

Seq Number: 2335809728

Ack Number: 3636175324

Window Size Value: 3

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First 2 transactions for port 43502 :

Source Port: 43502

Destination Port: 80

Seq Number: 2558634630

Ack Number: 3429921723

Window Size Value: 3

Source Port: 80

Destination Port: 43502

Seq Number: 3429921723

Ack Number: 2558634654

Window Size Value: 3

Source Port: 43502

Destination Port: 80

Seq Number: 2558634654

Ack Number: 3429921723

Window Size Value: 3

Source Port: 80

Destination Port: 43502

Seq Number: 3429921723

Ack Number: 2558636102

Window Size Value: 3

2. (b) (c)(d)

Calculation method:

Empirical throughput = total bytes sent / total connection time

Loss rate = (retransmitted / packet sent) * 100%

RTT (for each packet that has) = Time of TSecr – Time of TSval

When source port sends a packet, the TSecr number is created in the TCP option section. If the destination port received this packet, it will include a TSecr number, which is the same as the TSval, in its ACK packet. Using the time interval between these two packets, the RTT for the sending packet is known. Calculate and sum all the RTTs, and divided the sum by packet number, the average RTT could be known. The results are:

Port 43498 empirical throughput is 41.07 Mbit/sec

Port 43498 loss rate is 0.0573%

Port 43498 average RTT is 0.0715504405 seconds

Port 43498 theoritical throughput is 8.35 Mbit/sec

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Port 43500 empirical throughput is 10.05 Mbit/sec

Port 43500 loss rate is 1.3441%

Port 43500 average RTT is 0.0724355667 seconds

Port 43500 theoritical throughput is 1.7 Mbit/sec

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Port 43502 empirical throughput is 11.58 Mbit/sec

Port 43502 loss rate is 0.1372%

Port 43502 average RTT is 0.0722404221 seconds

Port 43502 theoritical throughput is 5.35 Mbit/sec