

Assignment 1

CS39006 : Spring 2020
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Note 1 : *The key steps involve setting the **filters** and executing **commands** on terminal. These have been mentioned at the beginning of each answer as and where necessary.*

Note 2 : *Justifications are written in italics.*

Question 1

List the different protocols that you observe in the packet trace, at application, transport and network layer for each of the UDP and TCP test cases.

Answer

TCP

Command : `wget --no-proxy http://10.5.18.163:8000/1.jpg`

```
Frame 480: 217 bytes on wire (1736 bits), 217 bytes captured (1736 bits) on interface en0, id 0
Ethernet II, Src: Apple_c4:82:1c (9c:f3:87:c4:82:1c), Dst: All-HSRP-routers_50 (00:00:0c:07:ac:50)
Internet Protocol Version 4, Src: 10.147.178.147, Dst: 10.5.18.163
Transmission Control Protocol, Src Port: 49859, Dst Port: 8000, Seq: 1, Ack: 1, Len: 151
Hypertext Transfer Protocol
```

1. Application Layer : HTTP
2. Transport Layer : TCP
3. Network Layer : IPv4

wget is an application layer tool for sending HTTP requests.

UDP

Command : `iperf3 -c 10.5.18.163 -u -b 28000`

```
Frame 63: 1416 bytes on wire (11328 bits), 1416 bytes captured (11328 bits) on interface en0, id 0
Ethernet II, Src: Apple_c4:82:1c (9c:f3:87:c4:82:1c), Dst: All-HSRP-routers_50 (00:00:0c:07:ac:50)
Internet Protocol Version 4, Src: 10.147.178.147, Dst: 10.5.18.163
User Datagram Protocol, Src Port: 61849, Dst Port: 5201
Data (1374 bytes)
```

1. Transport Layer : UDP
2. Network Layer : IPv4

iperf is a transport layer tool and -u flag is used to send UDP packets.

Question 2

Analyse the packet trace using Wireshark and compute the following:

(a)

How many TCP packets are transferred for each cases while accessing the files 1.jpg to 5.jpg ? Are all packets of same size? What are the different packet size you observe for each of the file access?

Answer

Filters : `ip.addr==10.5.18.163 && ip.addr==client_ip`

Screenshots of Packet Lengths

Count value of the first row shows the total no. of packets.

1.jpg

Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
▼ Packet Lengths	1870	637.58	42	1440	0.0129	100%	10.4700	68.951
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	852	66.09	42	78	0.0059	45.56%	3.8400	68.951
80-159	142	114.78	83	159	0.0010	7.59%	0.0700	15.446
160-319	68	225.26	161	307	0.0005	3.64%	0.0400	21.138
320-639	40	505.77	324	639	0.0003	2.14%	0.0400	20.816
640-1279	39	895.87	640	1248	0.0003	2.09%	0.0400	102.365
1280-2559	729	1439.22	1283	1440	0.0050	38.98%	6.6000	68.955
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

2.jpg

Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
▼ Packet Lengths	14002	749.35	42	1440	0.0388	100%	10.4200	35.551
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	5150	66.93	42	79	0.0143	36.78%	3.8000	35.551
80-159	796	122.56	83	159	0.0022	5.68%	0.6600	285.760
160-319	523	224.33	160	318	0.0014	3.74%	0.6200	279.959
320-639	681	456.00	320	638	0.0019	4.86%	0.3500	282.598
640-1279	432	880.01	640	1270	0.0012	3.09%	0.2900	282.468
1280-2559	6420	1439.59	1280	1440	0.0178	45.85%	6.6000	35.551
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

3.jpg

Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
▼ Packet Lengths	6832	1205.74	42	1440	0.6571	100%	18.7400	4.141
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	1137	66.28	42	78	0.1094	16.64%	3.8400	3.825
80-159	16	116.00	83	159	0.0015	0.23%	0.0800	5.717
160-319	7	216.71	161	267	0.0007	0.10%	0.0300	6.760
320-639	7	533.71	404	608	0.0007	0.10%	0.0300	8.884
640-1279	5	960.00	778	1182	0.0005	0.07%	0.0100	4.239
1280-2559	5660	1439.99	1365	1440	0.5444	82.85%	16.5700	4.141
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

4.jpg

Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
▼ Packet Lengths	5413	1110.31	54	1440	0.3289	100%	12.7800	4.276
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	1112	67.06	54	78	0.0676	20.54%	4.0300	4.260
80-159	142	101.71	83	159	0.0086	2.62%	0.6500	6.877
160-319	29	224.55	161	318	0.0018	0.54%	0.0300	0.978
320-639	23	516.83	374	612	0.0014	0.42%	0.0400	16.116
640-1279	20	922.30	654	1182	0.0012	0.37%	0.0200	0.500
1280-2559	4087	1439.75	1338	1440	0.2484	75.50%	10.8500	4.405
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

5.jpg

Topic / Item	Count	Average	Min val	Max val	Rate (ms)	Percent	Burst rate	Burst start
▼ Packet Lengths	4512	1138.19	54	1440	0.3183	100%	12.4400	7.090
0-19	0	-	-	-	0.0000	0.00%	-	-
20-39	0	-	-	-	0.0000	0.00%	-	-
40-79	945	66.86	54	78	0.0667	20.94%	3.9600	6.961
80-159	32	108.75	83	143	0.0023	0.71%	0.0600	1.741
160-319	10	219.70	161	267	0.0007	0.22%	0.0200	8.806
320-639	6	550.00	435	608	0.0004	0.13%	0.0100	0.193
640-1279	8	965.88	651	1203	0.0006	0.18%	0.0200	14.163
1280-2559	3511	1439.94	1314	1440	0.2477	77.81%	10.9700	7.090
2560-5119	0	-	-	-	0.0000	0.00%	-	-
5120 and greater	0	-	-	-	0.0000	0.00%	-	-

Justification

1. Since the pictures are of different sizes and downloaded using a TCP protocol, number of data packets are different in all the cases.
2. All the packets are not of the same size and there were various sizes ranging from 45 to a few thousands. Generally, the ACK packets are of less size compared to the data packets.

(b)

For the test case with UDP, are all the UDP packets of the same size? If not, what are the different UDP packet sizes you observe?

Answer

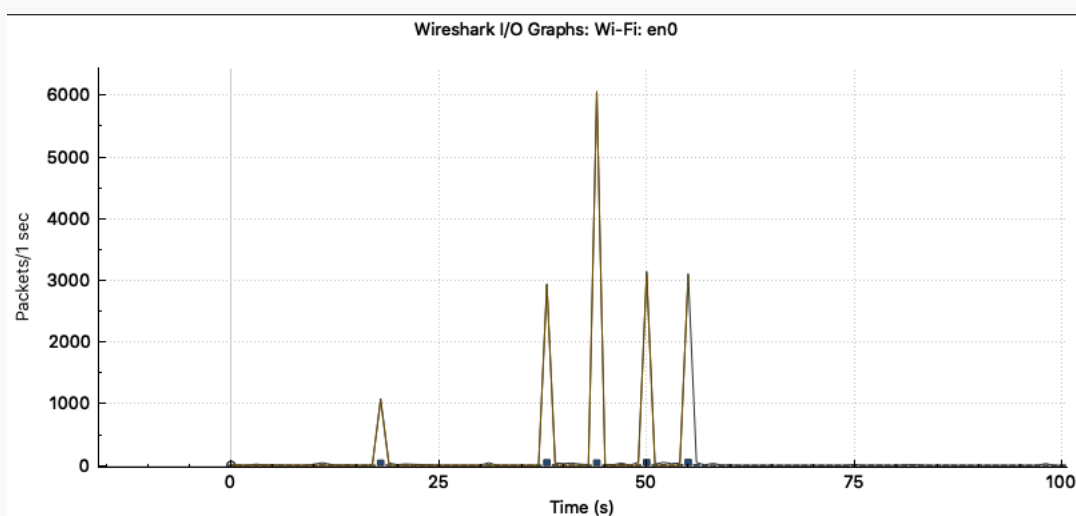
All packets are of the same size i.e. 1416

(c)

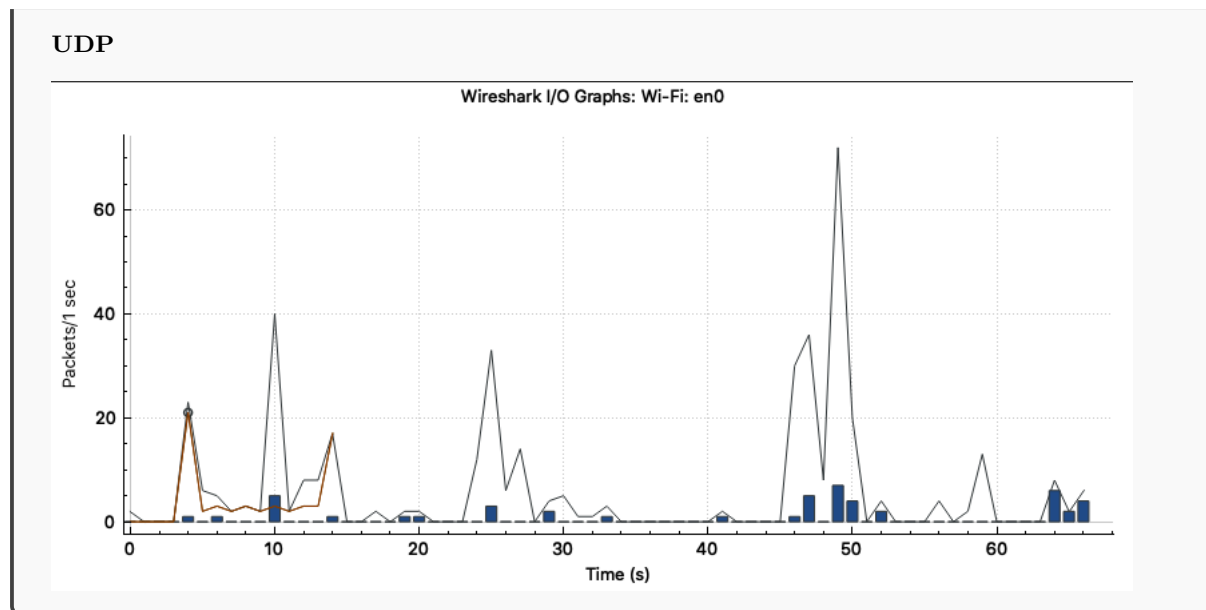
Observe the TCP and UDP throughput using Wireshark (Menu - Statistics - IO Graphs)

Answer

TCP



5 elevations in the graphs corresponds to 5 pictures transferred from server to client. Since each picture is requested only after receiving the previous picture each peak corresponds to one picture.



(d)

Compute the UDP throughput (amount of UDP data sent per second) for following cases of UDP traffic generation rates (bandwidth):

(i) 64 Kbps (ii) 128 Kbps (iii) 256 Kbps (iv) 512 Kbps (v) 1024 Kbps (vi) 2048 Kbps

Answer

Command : `iperf3 -c 10.5.18.163 -u -b 28000`

Filters : `ip.addr==10.5.18.163 && ip.addr==client_ip && udp`

Sample Output on Terminal

```
ayushtiwari@Ayushs-MacBook-Air udp % iperf3 -c 10.5.18.163 -u -b 512000
Connecting to host 10.5.18.163, port 5201
[ 5] local 10.147.178.147 port 61849 connected to 10.5.18.163 port 5201
[ ID] Interval      Transfer    Bitrate    Total Datagrams
[ 5] 0.00-1.00 sec  63.1 KBytes  516 Kbits/sec  47
[ 5] 1.00-2.00 sec  63.1 KBytes  517 Kbits/sec  47
[ 5] 2.00-3.00 sec  61.7 KBytes  506 Kbits/sec  46
[ 5] 3.00-4.00 sec  63.1 KBytes  517 Kbits/sec  47
[ 5] 4.00-5.00 sec  61.7 KBytes  506 Kbits/sec  46
[ 5] 5.00-6.00 sec  63.1 KBytes  517 Kbits/sec  47
[ 5] 6.00-7.00 sec  63.1 KBytes  517 Kbits/sec  47
[ 5] 7.00-8.00 sec  61.7 KBytes  506 Kbits/sec  46
[ 5] 8.00-9.00 sec  63.1 KBytes  517 Kbits/sec  47
[ 5] 9.00-10.00 sec 61.7 KBytes  506 Kbits/sec  46
-----
[ ID] Interval      Transfer    Bitrate    Jitter    Lost/Total Datagrams
[ 5] 0.00-10.00 sec  625 KBytes  512 Kbits/sec  0.000 ms  0/466 (0%) sender
[ 5] 0.00-10.00 sec  623 KBytes  510 Kbits/sec  0.847 ms  2/466 (0.43%) receiver
```

Observations

i) 64Kbps

Data Sent : 83544

No. of Packets : 59

Time taken : 9.9588s

Throughput : 8388Kbps

ii) 128Kbps

Data Sent : 165672
No. of Packets : 117
Time taken : 9.9598s
Throughput : 16634Kbps

iii) 256Kbps

Data Sent : 329928
No. of Packets : 233
Time taken : 9.9610s
Throughput : 33121Kbps

iv) 512Kbps

Data Sent : 659856
No. of Packets : 466
Time taken : 9.9619s
Throughput : 66237Kbps

v) 1024Kbps

Data Sent : 1318296
No. of Packets : 931
Time taken : 9.9630s
Throughput : 132319Kbps

vi) 2048Kbps

Data Sent : 2636592
No. of Packets : 1862
Time taken : 9.9641s
Throughput : 264609Kbps

Question 3

Analyze the number of TCP packets retransmitted (Use: tcp.analysis.retransmission filter.) from Wire-shark.

Answer

Filters : **ip.addr==10.5.18.163 && ip.addr==client_ip && tcp.analysis.retransmission**

Observed number of TCP packets retransmitted : 0

Number of retransmissions packets lost will depend on strength and traffic of the network connection.

Question 4

Plot the following:

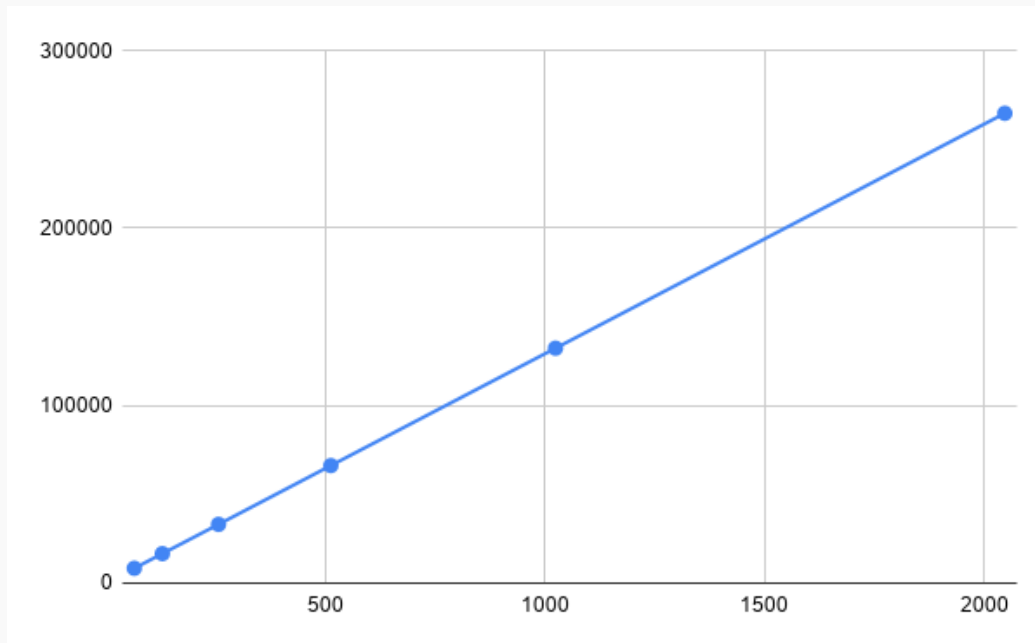
(a)

UDP throughput with respect to the UDP bandwidth.

Answer

i) x-axis : Bandwidth (Kbps)

i) y-axis : Throughput (Kbps)



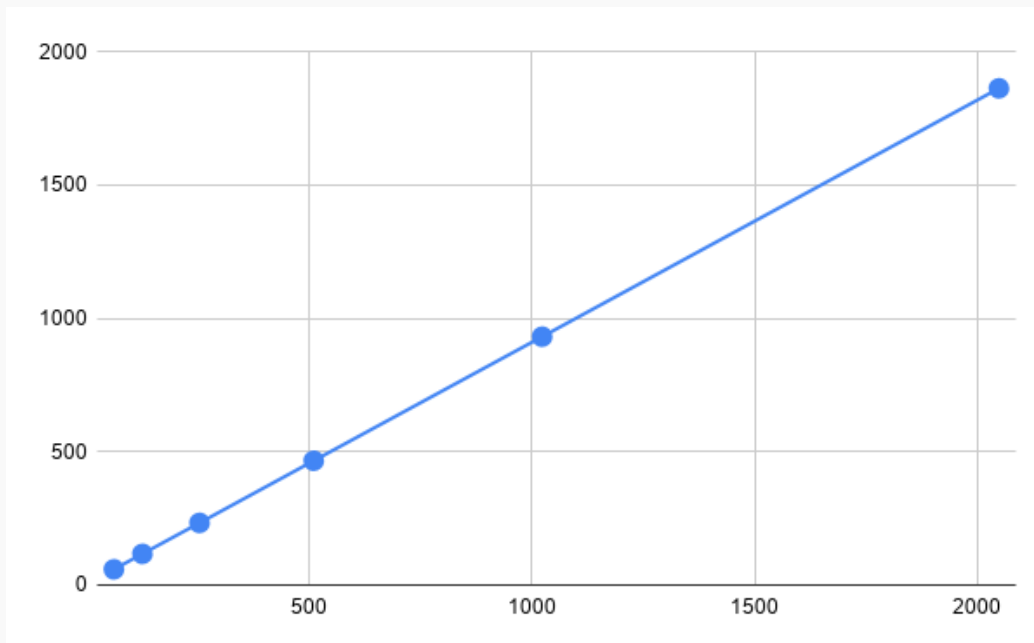
(b)

Number of UDP packets transmitted with respect to UDP bandwidth.

Answer

i) x-axis : Bandwidth (Kbps)

i) y-axis : No of packets



What are your observations from these plots?

Answer

As **bandwidth** increases, the number of packets being transferred in the same time (about 10s) and throughput also increase. The relationship observed is linear.