

Question 1.1

Because the tcp2 has 100 ms delay from n0 to n5 and tcp1 only has 60 ms delay from n3 to n5. Tcp2 take longer time to reach so it takes a larger bandwidth.

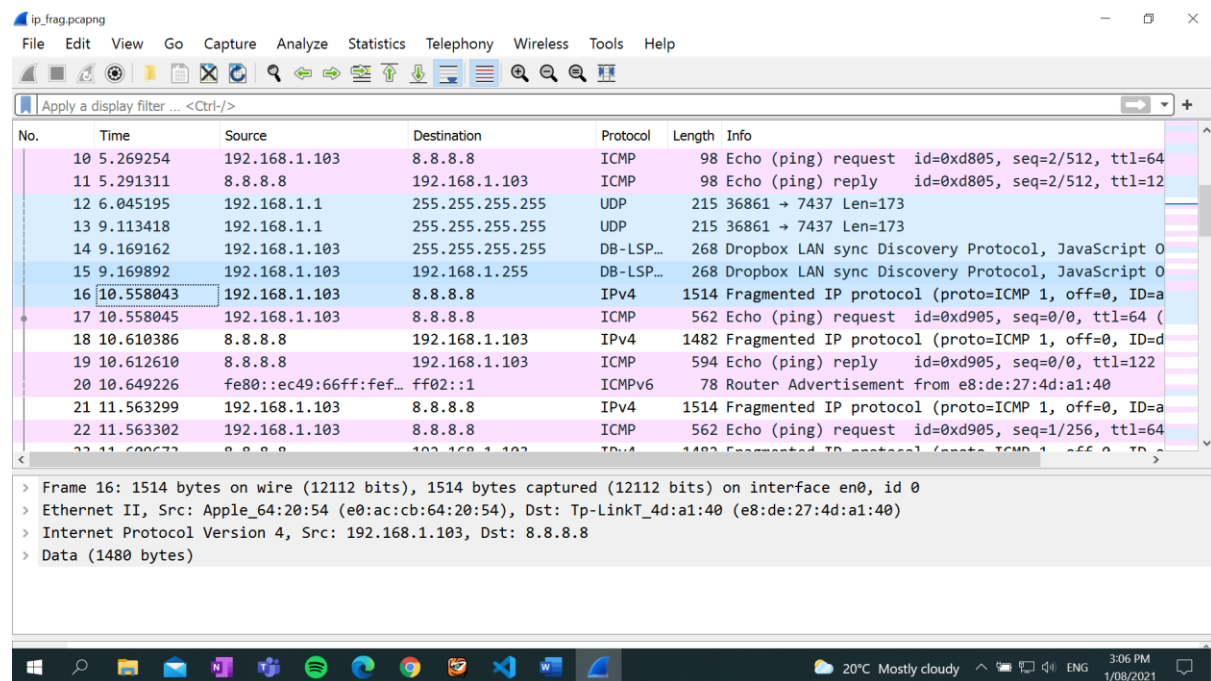
Question 1.2

Because it is in slow start phase. The windows size increases exponentially.

Question 1.3

Between 0.5-2 seconds, the tcp1 is in the slow start phase. Then after 2 seconds, the tcp1 share the bandwidth with tcp2, so it can not have higher bandwidth.

Question 2.1



No.	Time	Source	Destination	Protocol	Length	Info
10	5.269254	192.168.1.103	8.8.8.8	ICMP	98	Echo (ping) request id=0xd805, seq=2/512, ttl=64
11	5.291311	8.8.8.8	192.168.1.103	ICMP	98	Echo (ping) reply id=0xd805, seq=2/512, ttl=12
12	6.045195	192.168.1.1	255.255.255.255	UDP	215	36861 → 7437 Len=173
13	9.113418	192.168.1.1	255.255.255.255	UDP	215	36861 → 7437 Len=173
14	9.169162	192.168.1.103	255.255.255.255	DB-LSP...	268	Dropbox LAN sync Discovery Protocol, JavaScript 0
15	9.169892	192.168.1.103	192.168.1.255	DB-LSP...	268	Dropbox LAN sync Discovery Protocol, JavaScript 0
16	10.558043	192.168.1.103	8.8.8.8	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=a)
17	10.558045	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=0/0, ttl=64
18	10.610386	8.8.8.8	192.168.1.103	IPv4	1482	Fragmented IP protocol (proto=ICMP 1, off=0, ID=d)
19	10.612610	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=0/0, ttl=122
20	10.649226	fe80::ec49:66ff:fef...	ff02::1	ICMPv6	78	Router Advertisement from e8:de:27:4d:a1:40
21	11.563299	192.168.1.103	8.8.8.8	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=a)
22	11.563302	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=1/256, ttl=64

> Frame 16: 1514 bytes on wire (12112 bits), 1514 bytes captured (12112 bits) on interface en0, id 0
> Ethernet II, Src: Apple_64:20:54 (e0:ac:cb:64:20:54), Dst: Tp-LinkT_4d:a1:40 (e8:de:27:4d:a1:40)
> Internet Protocol Version 4, Src: 192.168.1.103, Dst: 8.8.8.8
> Data (1480 bytes)

The data size 2000 and 3500 bytes. Because the maximum transmission unit is 1500 bytes. 2 segments have been created.

Question 2.2

Yes, it does. Because the maximum transmission unit is 1500 bytes.

Question 2.3

ID	Flag	Length	Offset
0xf4a3	0x20, more arguments	1468	0
0xf4a3	0x20, more arguments	1468	1448
0xf4a3	0x01	632	2896

ip_frag.pcapng

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Source Destination Protocol Length Info

98621	192.168.1.103	8.8.8.8	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=1480, ID=377e) [Rea...
98622	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=1/256, ttl=64 (reply in 5...
56307	8.8.8.8	192.168.1.103	IPv4	1482	Fragmented IP protocol (proto=ICMP 1, off=0, ID=f4a3) [Reasse...
58825	8.8.8.8	192.168.1.103	IPv4	1482	Fragmented IP protocol (proto=ICMP 1, off=1448, ID=f4a3) [Rea...
58833	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=1/256, ttl=122 (request i...
96617	192.168.1.1	255.255.255.255	UDP	215	36861 → 7437 Len=173
03495	192.168.1.103	8.8.8.8	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=0, ID=8fa9) [Reasse...
03497	192.168.1.103	8.8.8.8	IPv4	1514	Fragmented IP protocol (proto=ICMP 1, off=1480, ID=8fa9) [Rea...
03497	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=2/512, ttl=64 (reply in 5...
66211	8.8.8.8	192.168.1.103	IPv4	1482	Fragmented IP protocol (proto=ICMP 1, off=0, ID=fc73) [Reasse...
66404	8.8.8.8	192.168.1.103	IPv4	1482	Fragmented IP protocol (proto=ICMP 1, off=1448, ID=fc73) [Rea...

.... 0101 = Header Length: 20 bytes (5)

> Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)

Total Length: 1468

Identification: 0xf4a3 (62627)

Flags: 0x20, More fragments

0... .. = Reserved bit: Not set

.0.. .. = Don't fragment: Not set

..1. = More fragments: Set

Fragment Offset: 0

Time to Live: 122

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ip_frag.pcapng

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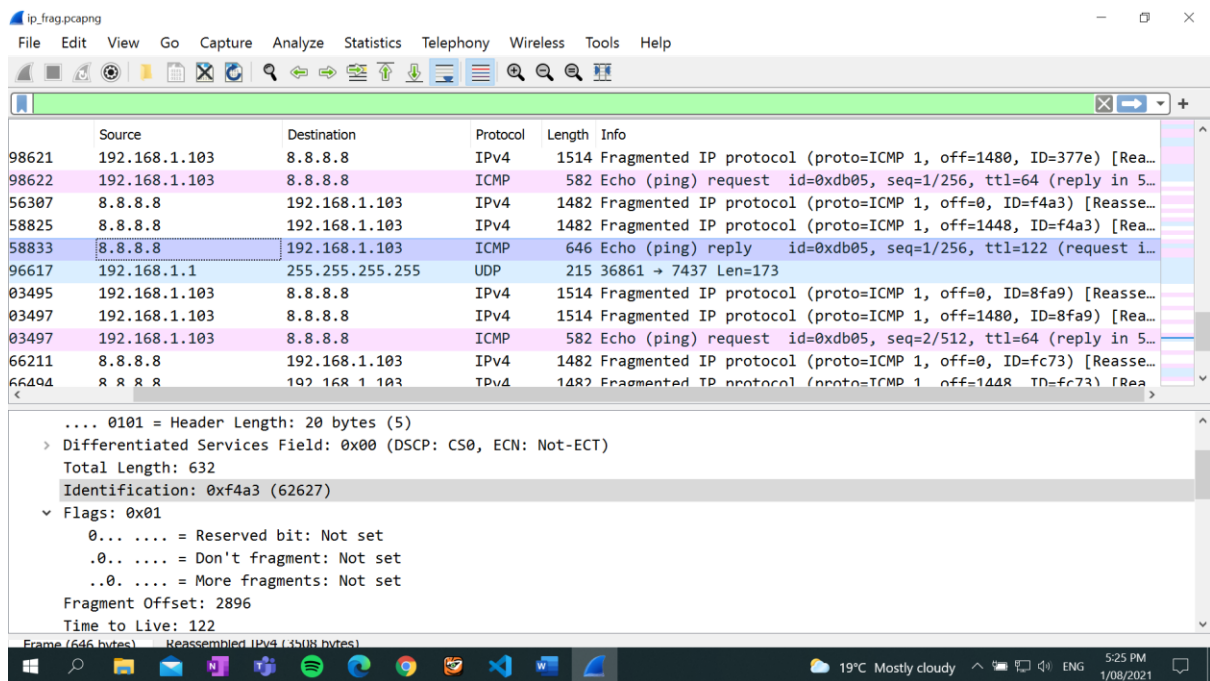
.0.. .. = Don't fragment: Not set

..1. = More fragments: Set

Fragment Offset: 1448

Time to Live: 122

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Question 2.4

For the incoming traffic of it, no fragmentation of fragments occurred. For the outgoing traffic of it, we do not know because we only need to fragment it to our maximum transmission unit.

Question 2.5

Because we are not tracking the fragments, the entire packet will be discarded and the sender have to retransmit it again.

Question 3.1

For route 1:

n0 communicates with other nodes. The route it flows is n0->n1->n4->n5. It does not change.

For route 2:

n2 communicates with other nodes. The route it flows is n2->n3->n5. It does not change.

Question 3.2

At time 1.0, the orientation of link n1->n4 is set to down. Route 1 can not reach n5 and the packets from it are waiting at n1. Route 2 can still reach n5. The routes do not change.

At time 1.2, the orientation of link n1->n4 is set to up. both route 1 and route 2 can reach n5. The routes do not change.

Question 3.3

Yes, I noticed additional traffic. At time 1.0, the link between n1 to n4 is set to down. route 1 uses the new route n0->n1->n2->n3->n5. At time 1.2, the link between n1 to n4 is set to up. Route 1 changes back to its original route.

Question 3.4

Route 1 uses the new route n0->n1->n2->n3->n5. It is because the cost of route n0->n1->n4->n5 was 3, but its cost increases to 5 after we set the cost of link n1->n4 to 3. The cost of the new route n0->n1->n2->n3->n5 is 4 and it is less than the original route, with distance-vector routing protocol, route 1 uses the new route instead.

Question 3.5

Before change:

n0->n1->n4->n5 has a cost of 5

n2->n1->n4->n5 has a cost of 5

n2->n3->n5 has a cost of 2

Route 1 will use n0->n1->n2->n3->n5, route 2 will use n2->n3->n5.

After comment:

n0->n1->n4->n5 has a cost of 4

n2->n1->n4->n5 has a cost of 4

n2->n3->n5 has a cost of 4

Route 1 will use n0->n1->n2->n3->n5, route 2 will split equally between n2->n1->n4->n5 and n2->n3->n5. The uncommented lines change the cost of links and route 2 will split the data between n2->n1->n4->n5 and n2->n3->n5.