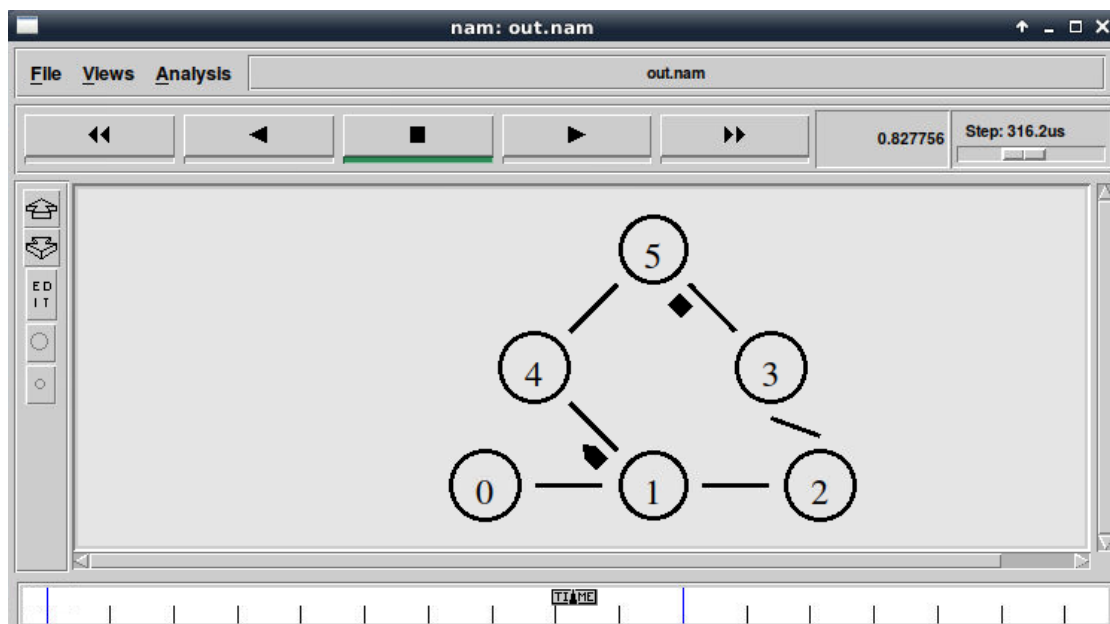
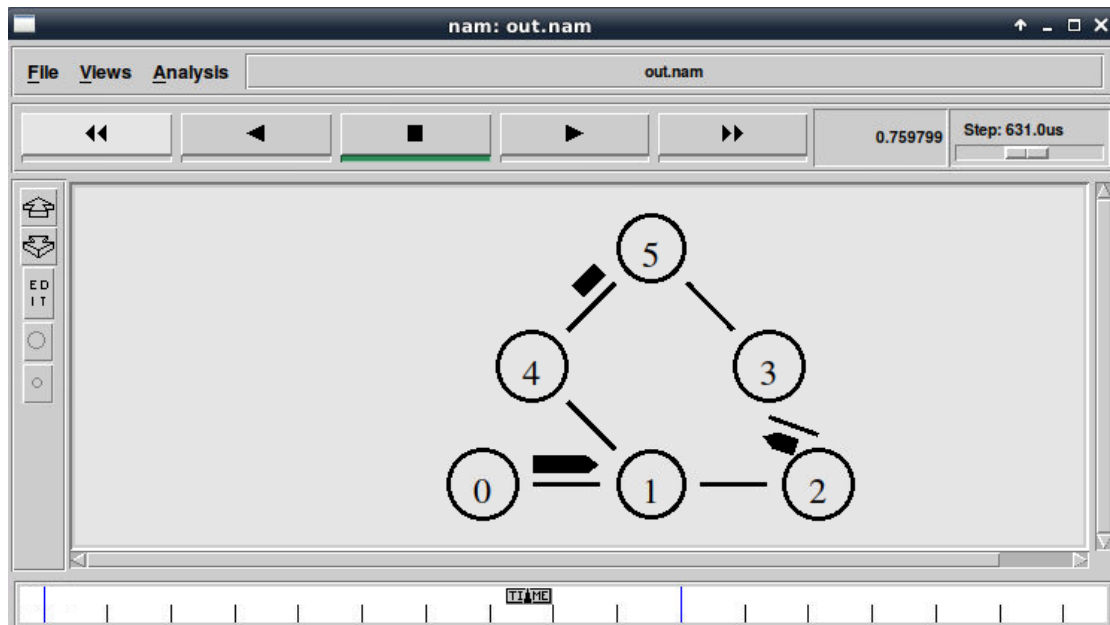


Written by Maowen Zhou, z5166834, for COMP9331 Lab6.

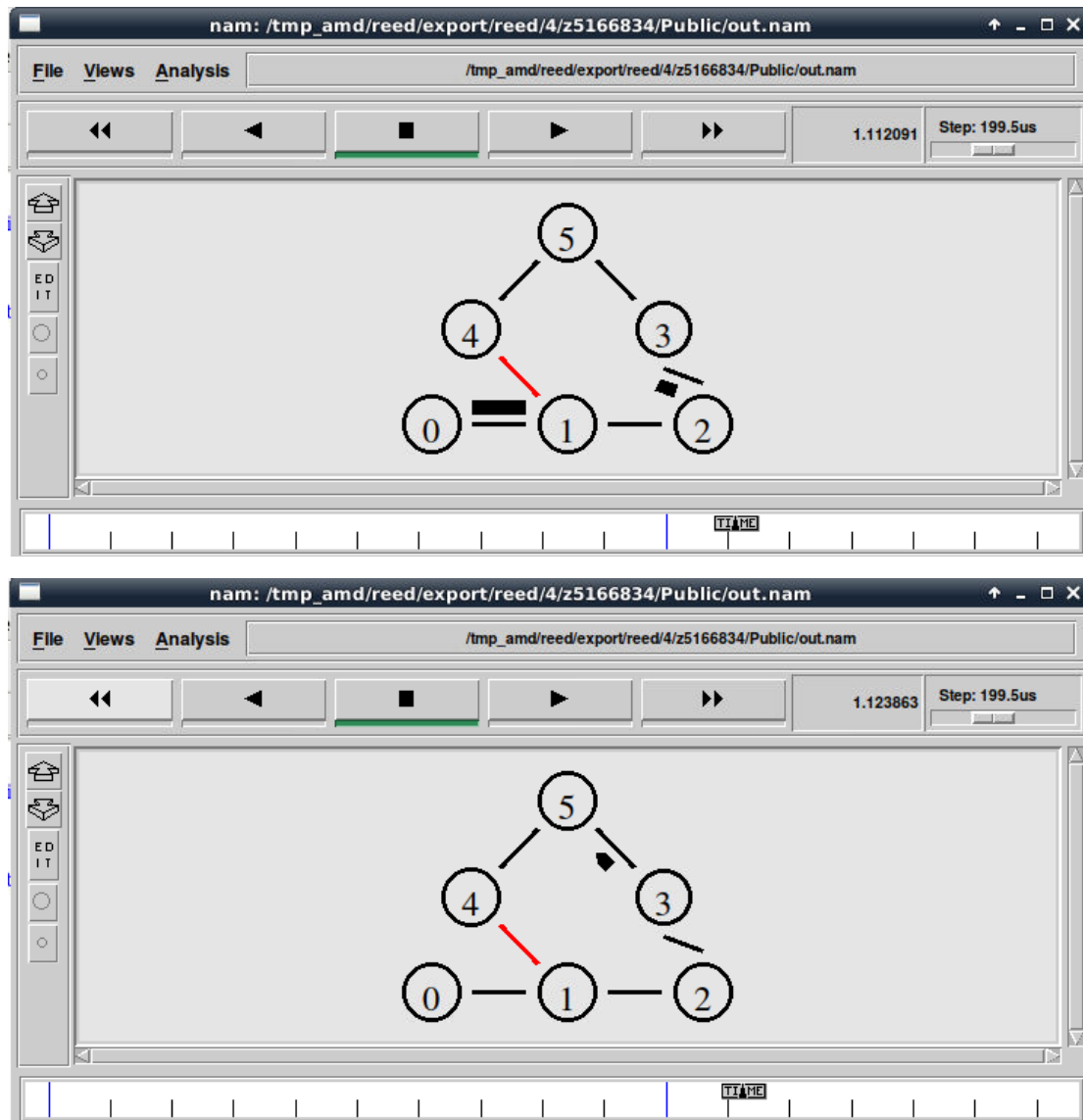
Exercise 1:

Q1:



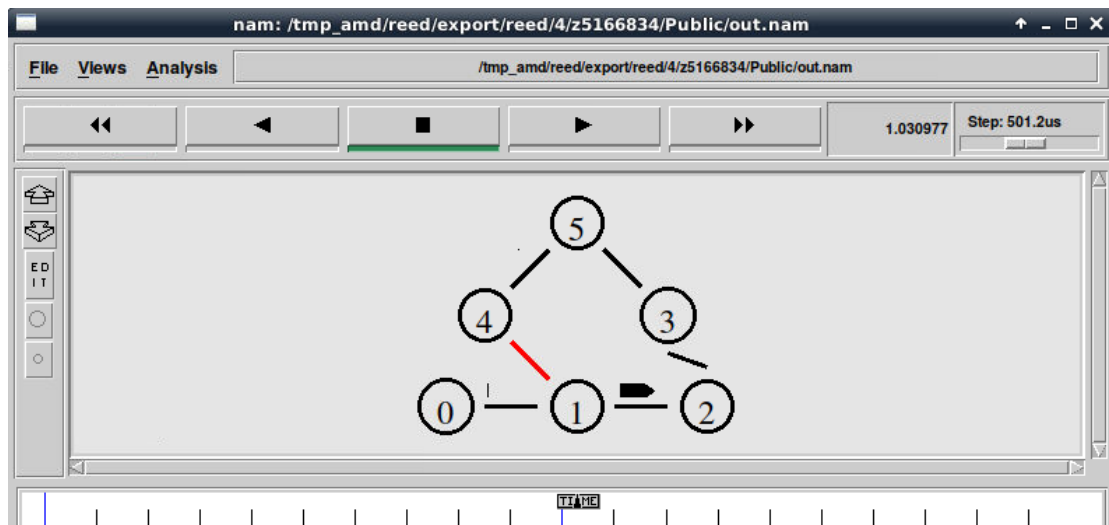
Node 0 communicates with node 1, node 1 communicates with node 4, and node 4 communicates with node 5. Node 2 communicates with node 3, node 3 communicates with node 5. There are two routes, one is $0 - 1 - 4 - 5$, another is $2 - 3 - 5$. They do not change over time.

Q2:

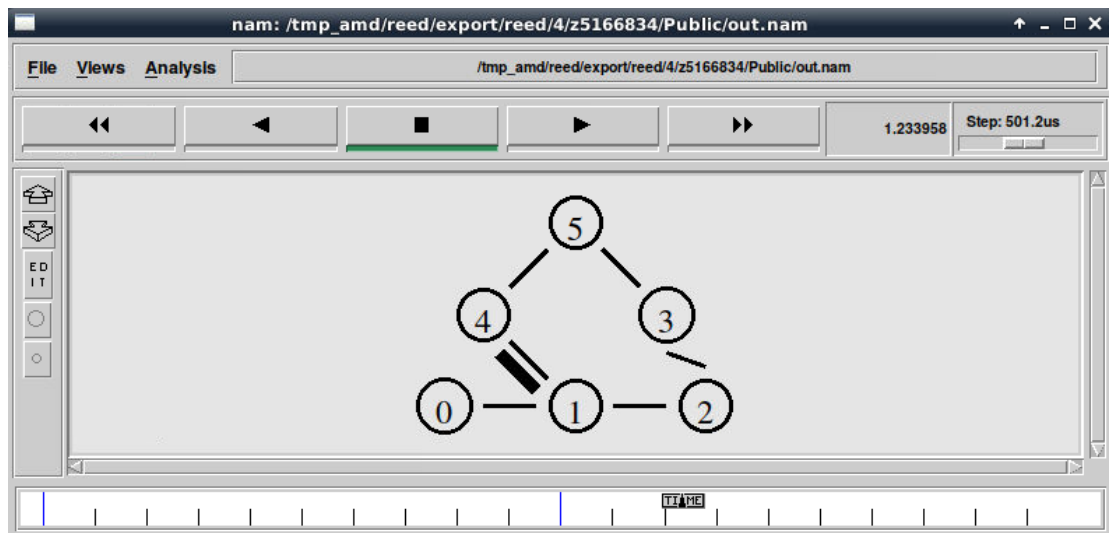


At time 1.0 the link between node 1 and node 4 goes down and at time 1.2 the link restores its connection. The route is actually affected, all the data sent from node 0 is lost.

Q3:

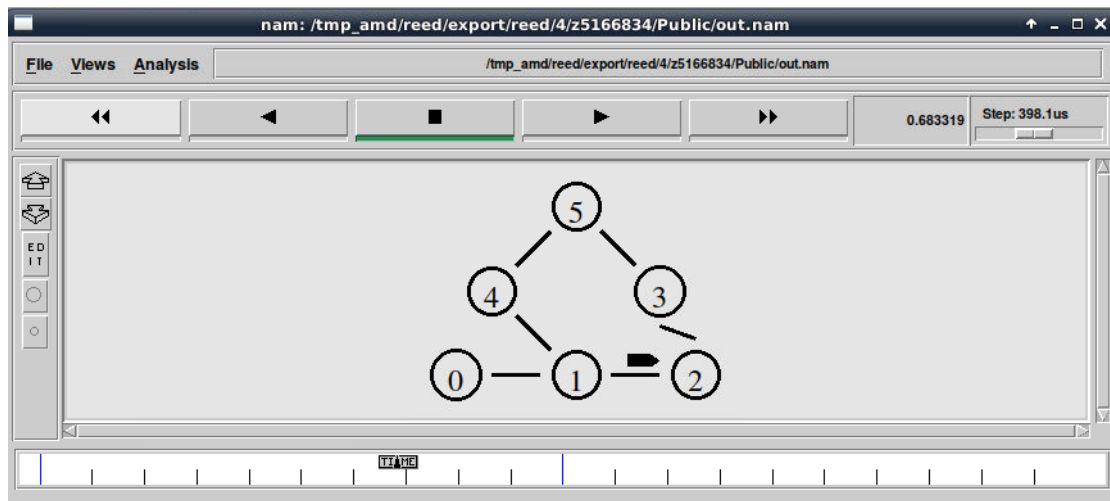


Yes, there is additional traffic between node 1 and node 2 now. At time 1.0 the data sent from node 0 is transmitted through the link between node 1 and node 2.



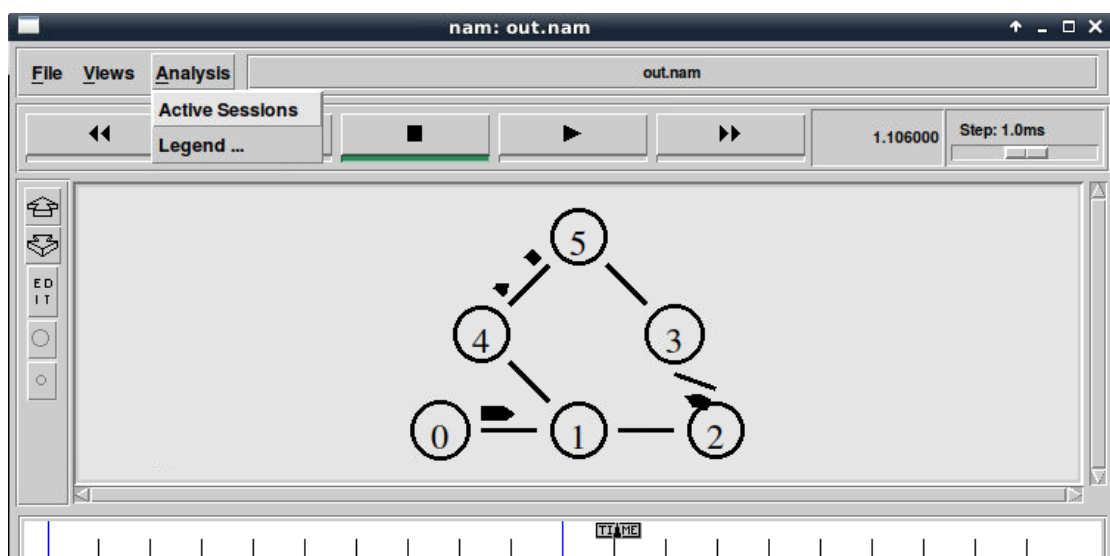
And at time 1.2, the link between node 1 and node 4 is back online, so the data is transmitted through this link again.

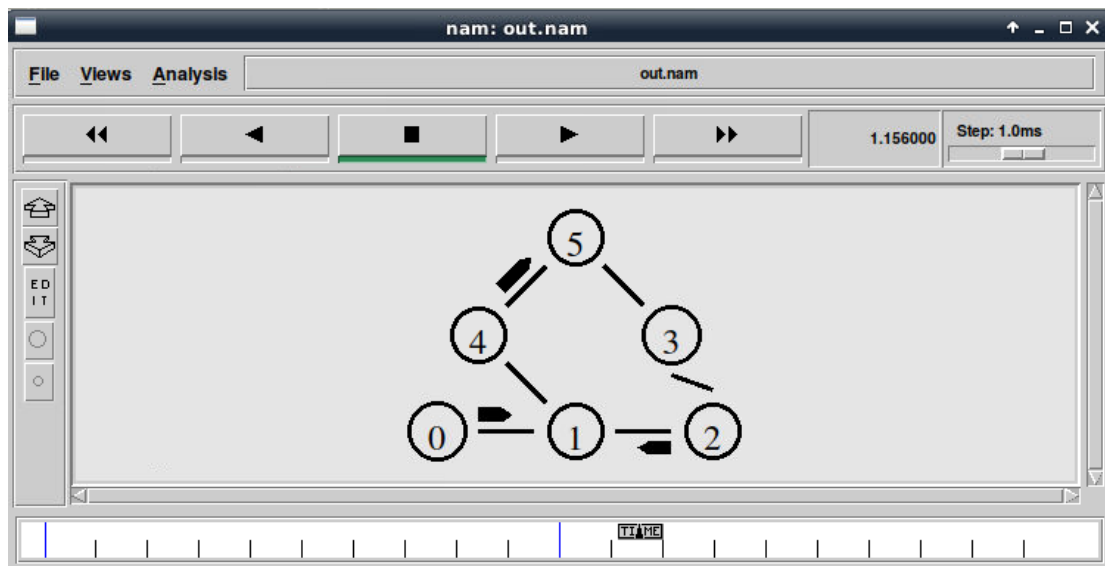
Q4:



The default cost of a link is 1. The cost to reach node 4 from node 1 is set to 3 now, so the data sent from node 0 is transmitted through the link between node 1 and node 2 to reach node 5, because the cost of the route 1 – 2 – 3 – 5 is cheaper.

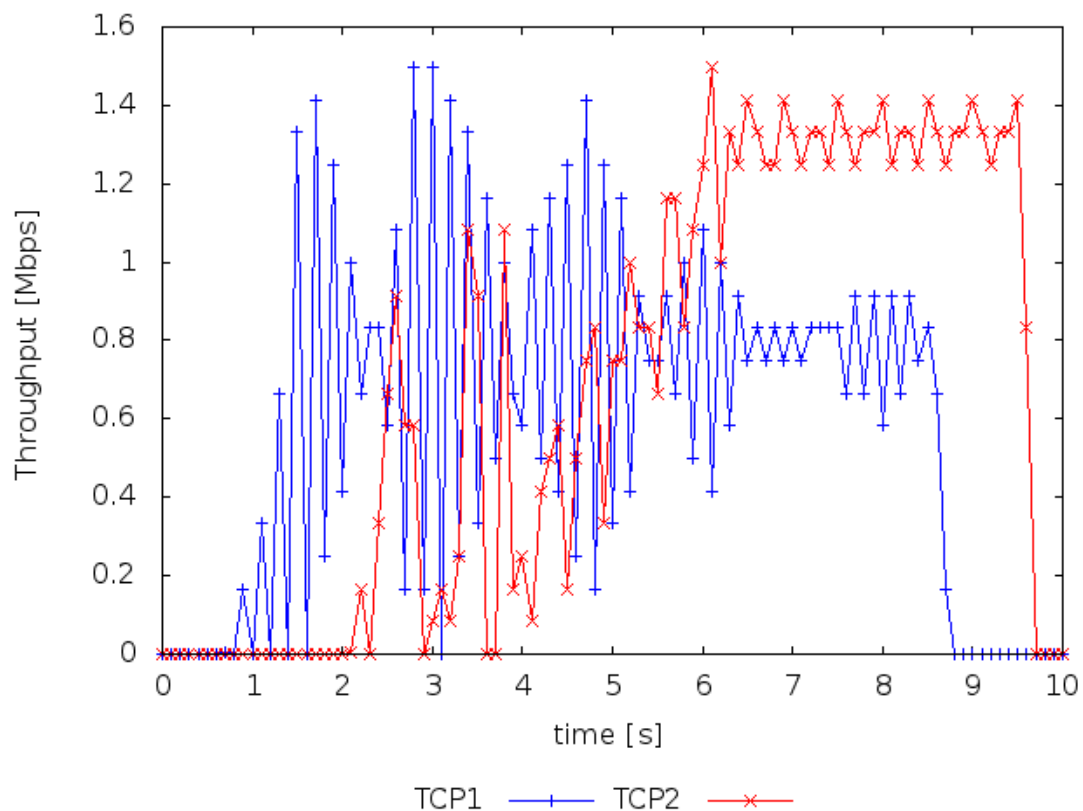
Q5:





The node 2 is transmitting its data using two routes to reach node 5, one is 2-1-4-5, another is 2-3-5. The effect of “Node set multipath_1” is allow all nodes in the simulation use multipaths where applicable, to choose different path to transmit data.

Exercise 2:



Exercise 3:

Q1:

No.	Time	Source	Destination	Protocol	Length	Info
4	3.262721	192.168.1.103	8.8.8.8	ICMP	98	Echo (ping) request id=0xd805, seq=0/0, ttl=64 (reply in 5)
5	3.287081	8.8.8.8	192.168.1.103	ICMP	98	Echo (ping) reply id=0xd805, seq=0/0, ttl=122 (request in 4)
8	4.264498	192.168.1.103	8.8.8.8	ICMP	98	Echo (ping) request id=0xd805, seq=1/256, ttl=64 (reply in 9)
9	4.286191	8.8.8.8	192.168.1.103	ICMP	98	Echo (ping) reply id=0xd805, seq=1/256, ttl=122 (request in 8)
10	5.269254	192.168.1.103	8.8.8.8	ICMP	98	Echo (ping) request id=0xd805, seq=2/512, ttl=64 (reply in 11)
11	5.291311	8.8.8.8	192.168.1.103	ICMP	98	Echo (ping) reply id=0xd805, seq=2/512, ttl=122 (request in 10)
17	10.558045	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=0/0, ttl=64 (reply in 19)
19	10.612610	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=0/0, ttl=122 (request in 17)
22	11.563302	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=1/256, ttl=64 (reply in 24)
24	11.609956	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=1/256, ttl=122 (request in 22)
27	12.568394	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=2/512, ttl=64 (reply in 29)
29	12.610937	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=2/512, ttl=122 (request in 27)
41	19.395871	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=0/0, ttl=64 (reply in 44)
44	19.460869	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=0/0, ttl=122 (request in 41)

Total Length: 548
Identification: 0xa13d (41277)
Flags: 0x00b9
 0... .. = Reserved bit: Not set
 .0... .. = Don't fragment: Not set
 ..0... .. = More fragments: Not set
 ...0 0000 1011 1001 = Fragment offset: 185
Time to live: 64
Protocol: ICMP (1)
Header checksum: 0x04c4 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.103
Destination: 8.8.8.8
[2 IPv4 Fragments (2008 bytes): #16(1480), #17(528)]
 [Frame: 16, payload: 0-1479 (1480 bytes)]
 [Frame: 17, payload: 1480-2007 (528 bytes)]
 [Fragment count: 2]
 [Reassembled IPv4 length: 2008]
 [Reassembled IPv4 data: 080008f5d90500005b51dd800009a51108090a0b0c0d0e0f...]
> Internet Control Message Protocol

The size of 2000 bytes of data has caused fragmentation, because the MTU of the link is 1500 bytes(1480 bytes payload and 20 bytes header). Router has fragmented the original datagram, and two fragments have been created when data size is specified as 2000.

Q2:

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 (reply in 11)
11	5.291311	8.8.8.8	192.168.1.103	ICMP	98	Echo (ping) reply id=0xd805, seq=2/512, ttl=122 (request in 10)
17	10.558045	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=0/0, ttl=64 (reply in 19)
19	10.612610	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=0/0, ttl=122 (request in 17)
22	11.563302	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=1/256, ttl=64 (reply in 24)
24	11.609956	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=1/256, ttl=122 (request in 22)
27	12.568394	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=2/512, ttl=64 (reply in 29)
29	12.610937	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=2/512, ttl=122 (request in 27)
41	19.395871	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=0/0, ttl=64 (reply in 44)
44	19.460869	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=0/0, ttl=122 (request in 41)
47	20.398622	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=1/256, ttl=64 (reply in 50)
50	20.458833	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=1/256, ttl=122 (request in 47)
54	21.403497	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=2/512, ttl=64 (reply in 57)
57	21.467259	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=2/512, ttl=122 (request in 54)

Identification: 0xf272 (62066)
Flags: 0x016a
0... .. = Reserved bit: Not set
.0... .. = Don't fragment: Not set
..0... .. = More fragments: Not set
...0 0001 0110 1010 = Fragment offset: 362
Time to live: 122
Protocol: ICMP (1)
Header checksum: 0x7889 [validation disabled]
[Header checksum status: Unverified]
Source: 8.8.8.8
Destination: 192.168.1.103
[3 IPv4 Fragments (3508 bytes): #42(1448), #43(1448), #44(612)]
[Frame: 42, payload: 0-1447 (1448 bytes)]
[Frame: 43, payload: 1448-2895 (1448 bytes)]
[Frame: 44, payload: 2896-3507 (612 bytes)]
[Fragment count: 3]
[Reassembled IPv4 length: 3508]
[Reassembled IPv4 data: 00005e5cdb0500005b51dd8900072b8e08090a0b0c0d0e0f...]

Internet Control Message Protocol

The reply from the destination for 3500-byte data also get fragmented, I think it is because the MTU of the link is fixed and both directions will be constrained by this.

Q3:

22	11.563302	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=1/256, ttl=64 (reply in 24)
24	11.609956	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=1/256, ttl=122 (request in 22)
27	12.568394	192.168.1.103	8.8.8.8	ICMP	562	Echo (ping) request id=0xd905, seq=2/512, ttl=64 (reply in 29)
29	12.610937	8.8.8.8	192.168.1.103	ICMP	594	Echo (ping) reply id=0xd905, seq=2/512, ttl=122 (request in 27)
41	19.395871	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=0/0, ttl=64 (reply in 44)
44	19.460869	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=0/0, ttl=122 (request in 41)
47	20.398622	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=1/256, ttl=64 (reply in 50)
50	20.458833	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=1/256, ttl=122 (request in 47)
54	21.403497	192.168.1.103	8.8.8.8	ICMP	582	Echo (ping) request id=0xdb05, seq=2/512, ttl=64 (reply in 57)
57	21.467259	8.8.8.8	192.168.1.103	ICMP	646	Echo (ping) reply id=0xdb05, seq=2/512, ttl=122 (request in 54)

Header checksum: 0x2ab9 [validation disabled]
[Header checksum status: Unverified]
Source: 192.168.1.103
Destination: 8.8.8.8
[3 IPv4 Fragments (3508 bytes): #39(1480), #40(1480), #41(548)]
[Frame: 39, payload: 0-1479 (1480 bytes)]
[Frame: 40, payload: 1480-2959 (1480 bytes)]
[Frame: 41, payload: 2960-3507 (548 bytes)]
[Fragment count: 3]
[Reassembled IPv4 length: 3508]
[Reassembled IPv4 data: 00005e5cdb0500005b51dd8900072b8e08090a0b0c0d0e0f...]

Internet Control Message Protocol

Type: 8 (Echo (ping) request)
Code: 0
Checksum: 0x565c [correct]
[Checksum status: Good]

	ID	Length	Flag	Offset
Frame 39	31355	1500	1	0
Frame 40	31355	1500	1	185
Frame 41	31355	568	0	370

Q4:

No, fragmentation of fragments does not occurred. Because the size of the fragments are smaller than the MTU of the link, there is no need to further fragment.

Q5:

If one fragment is lost, then the whole packet needs to be transmitted again. The packet with one fragment missing will be discarded.