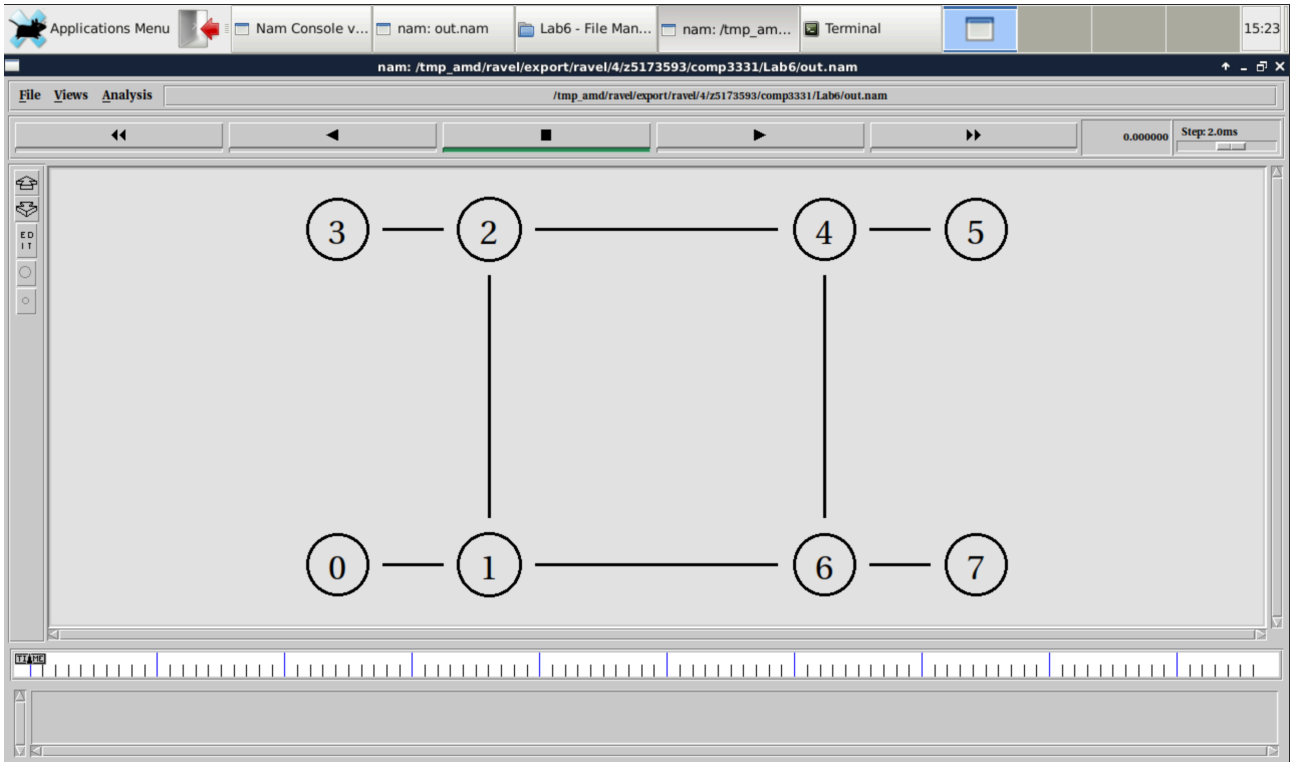
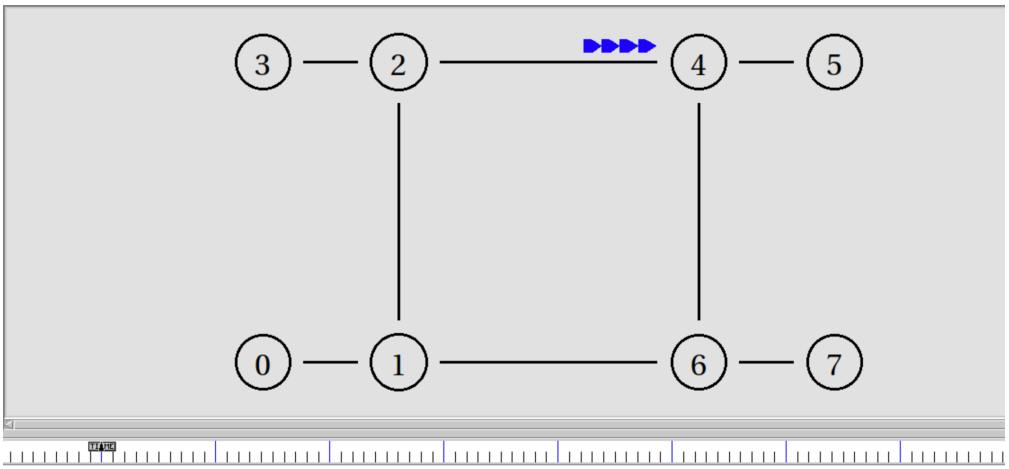
Lab Exercise 6: Throughput, IP Fragmentation and Routing

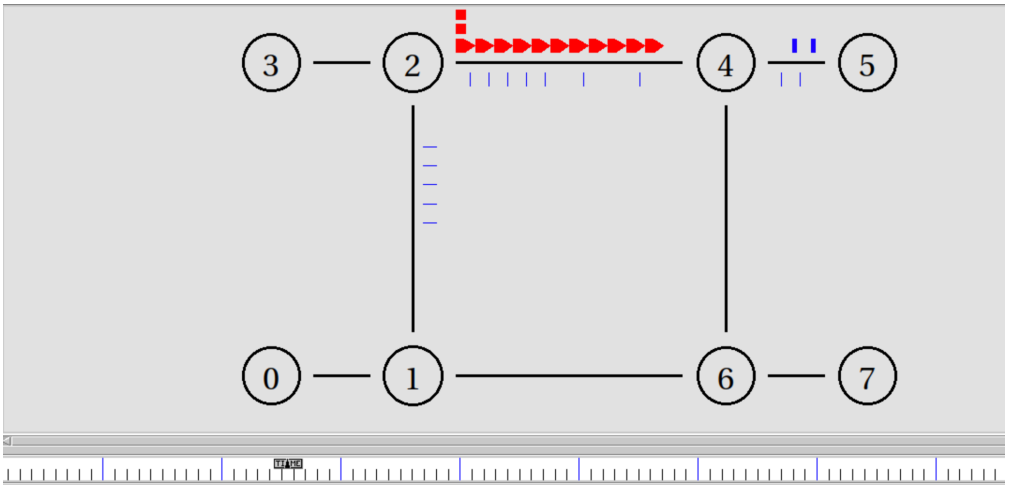
Exercise 1: Setting up NS2 simulation for measuring TCP throughput



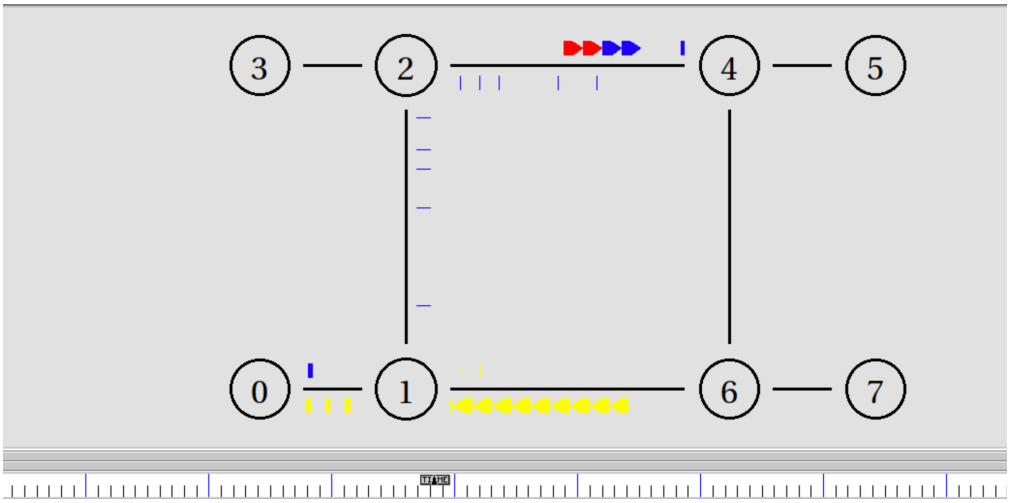
n0 -> n5: 0.5s~8.5s, n0->n1->n2->n4->n5



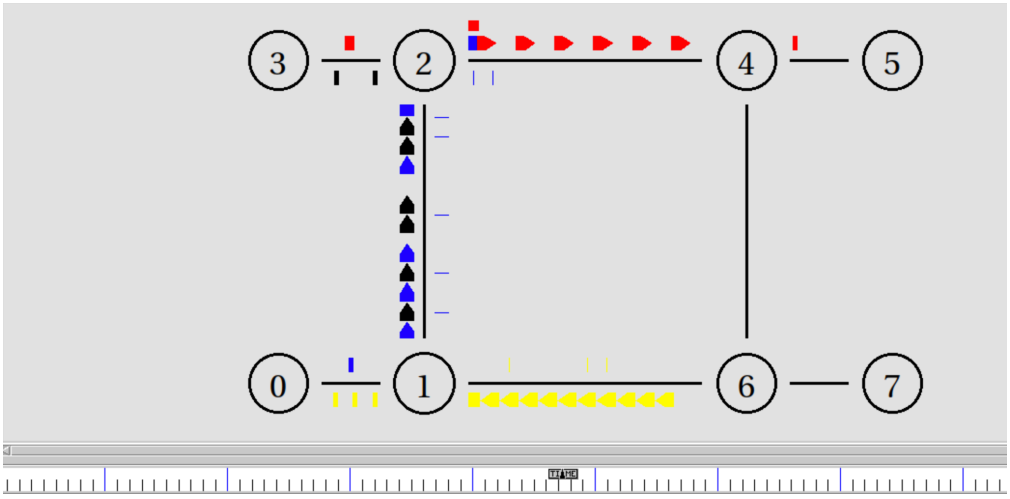
n3 -> n5: 2.0s~9.5s, n3->n2->n4->n5



n7 -> n0: 3s~9.5s, n7->n6->n1->n0



n7 -> n3: 4s~7s, n7->n6->n1->n2->n3



Question 1:

n3->n2 has larger bandwidth than n0->n1->n2.

At 6s, n3->n2 has more packages.

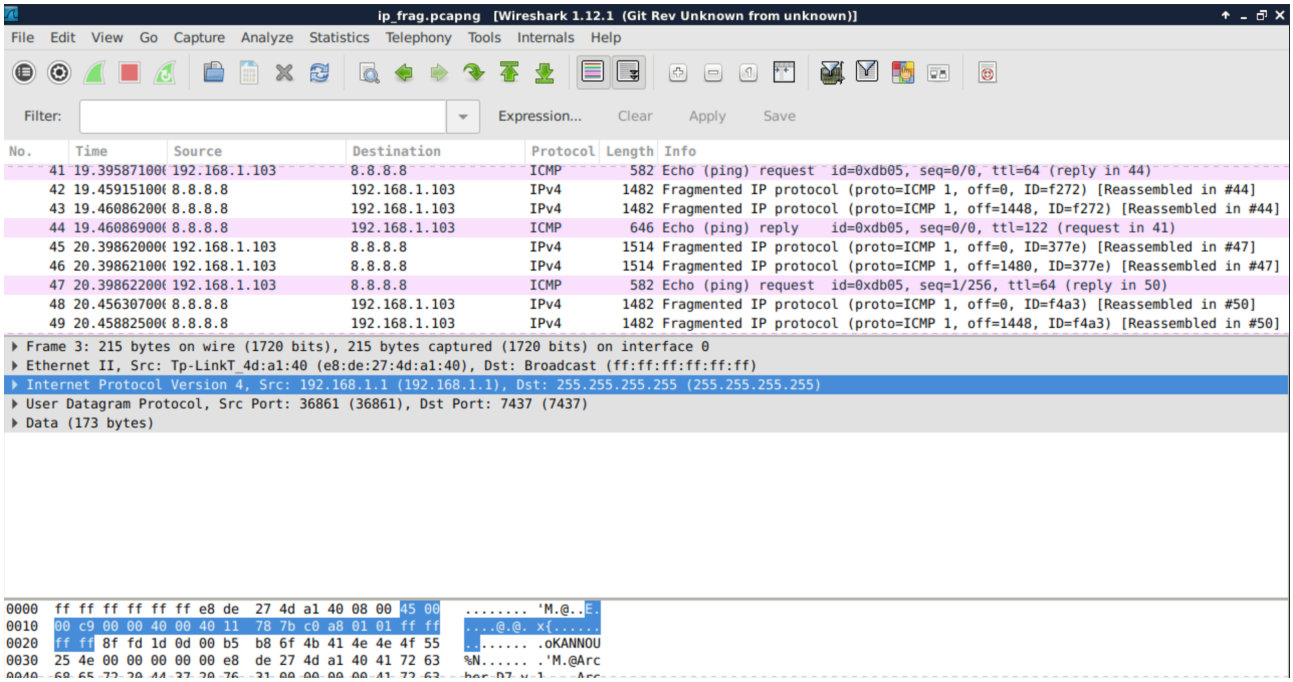
Question 2:

Between 0.5s~2s, tcp1 is on slow start phase, tcp will try to find all the available bandwidth it can use, so the throughput will fluctuating.

Question 3:

All links competing together, they need to share bandwidth, so they must be lower than max bandwidth — 2.5Mbps.

Exercise 2: Understanding IP Fragmentation



Question 1:

MTU= 1500 bytes

IP = 2000 + 8 = 2008 bytes > 1500 bytes, caused fragmentation.

host: 192.169.1.103

2008 - 20 = 1988 bytes, p1 = 1480+20=1500 bytes, p2 = 528+20=548 bytes

2 fragments.

Question 2:

Yes, 3500 bytes > 1500 bytes. So it also get fragmented.

Question 3:

ID	Length	Flag	Offset
7a7b	1514	0x2000, more fragments	0
7a7b	1514	0x20b9, more fragments	185
7a7b	582	172	370

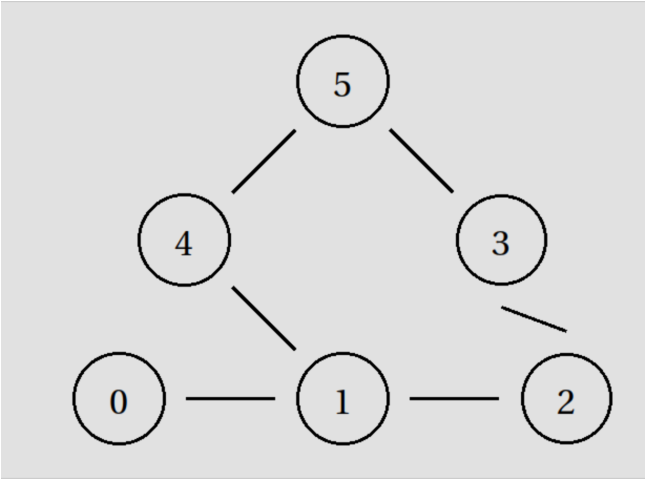
Question 4:

Yes, 3500 bytes > 1480 bytes.

Question 5:

When one fragment lost, it will retransmit the whole package, so 3 fragments will be retransmit for 192.168.1.103.

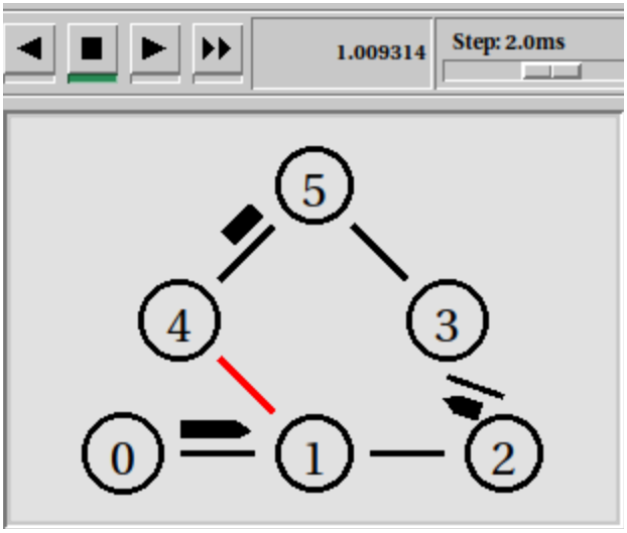
Exercise 3: Understanding the Impact of Network Dynamics on Routing

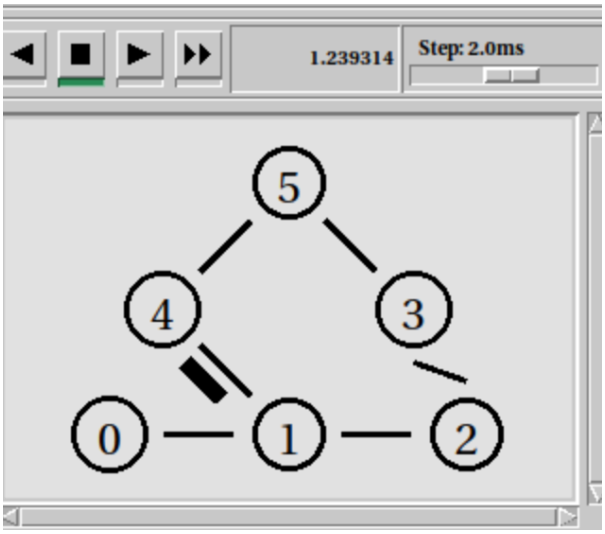


Question 1:

n0 communicate with n5, n2 communicate with n5
route 1: n0->n1->n4->n5
route 2: n2->n3->n5
not change.

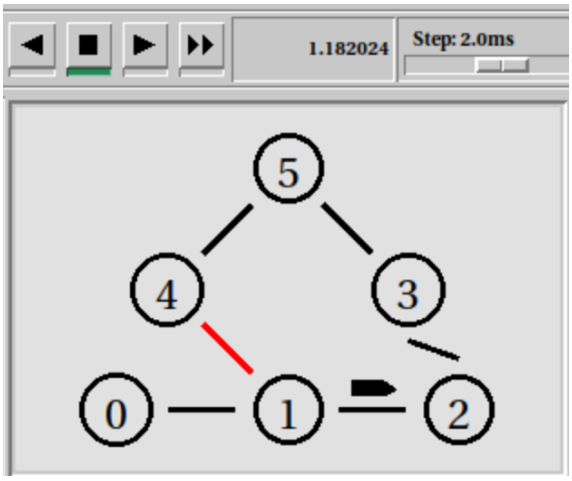
Question 2:





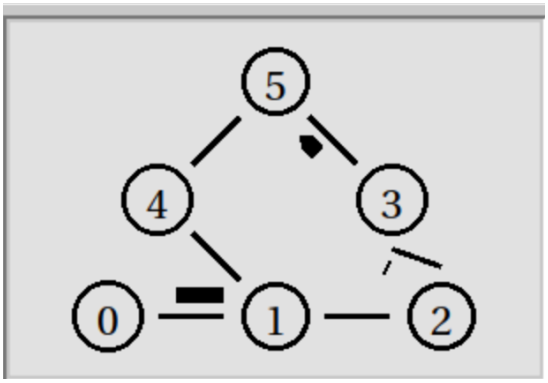
At time 1.0s~1.2s, because node 1 and node 4 down, the link from n1->n4 can not use.
After 1.2s, node 1 and node 4 up again, the link can be use again.

Question 3:



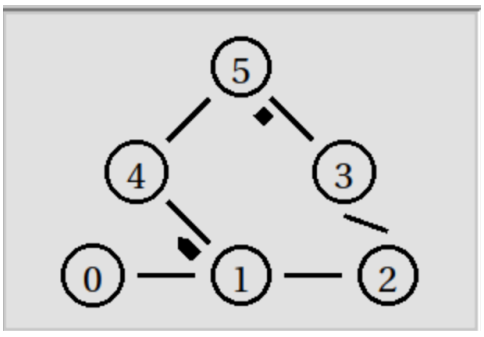
Between 1.0s~1.2s, when link between n1->n4 down, the package transfer from n0->n1->n2->n3->n5.

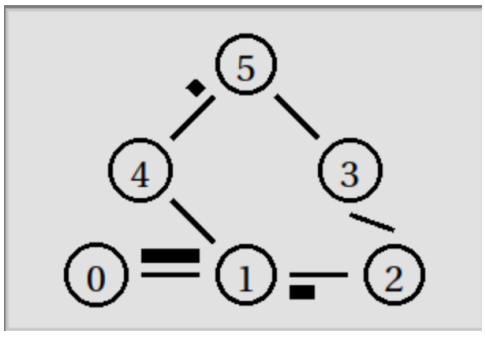
Question 4:



No package transfer using link n1->n4->n5, they all use n2->n3->n5
route 1: n0->n1->n2->n3->n5
route 2: n2->n3->n5
Because the cost from n1->n4 is 3, which means from n0->n1->n2->n3->n5 will cheaper than n0->n1->n4->n5.

Question 5:





Cost for n0->n1->n4->n5 = 4, n0->n1->n2->n3->n5 = 5, n2->n3->n5 = 4, n2->n1->n4->n5 = 4. So cheapest cost was chosen for route 1: n0->n1->n4->n5. The cost for two ways are same for route 2, and we 'set multiPath', so the path for route 2 will vary.