Lab6: Throughput, IP Fragmentation and Routing

Exercise 1: Setting up NS2 simulation for measuring TCP throughput

Question 1: Why the throughput achieved by flow tcp2 is higher than tcp1 between time span 6 sec to 8 sec?

N3 has a larger bandwidth in n2 (10MBps) than n0 does in n2 (2.5MBps). It's more likely that n2 will drop the packet from n3 because of the higher traffic coming into it. However, once the adjustment from n3 to n5 occurs around 2-6 seconds, the throughput of tcp2 becomes larger than tcp1.

Question 2: Why the throughput for flow tcp1 is fluctuating between time span 0.5 sec to 2 sec?

The Acks need to be received between the nodes. After sending these Acks, there won't be traffic in the link for a little while.

Question 3: Why is the maximum throughput achieved by any one flow capped at around 1.5Mbps?

Since the lines are shared between the nodes, none of them are able to capitalise on the full bandwidth potential. Therefore, the flows are capped at 1.5Mbps and can't go any faster

Exercise 2: Understanding IP Fragmentation

Question 1: Which data size has caused fragmentation and why? Which host/router has fragmented the original datagram? How many fragments have been created when data size is specified as 2000?

- Both data sizes of 2000 and 3500 have caused fragmentation. This is because the maximum data size is 1500 bytes so anything larger will be fragmented into something smaller
- Host 192.168.1.103 has fragmented the original datagram
- Two fragments are created when the data size is 2000

Question 2: Did the reply from the destination 8.8.8.8. for 3500-byte data size also get fragmented? Why and why not?

Yes it is also fragmented. Since the ping reply echoes the input, it means that the datagram has to be fragmented into smaller segments.

Question 3: Give the ID, length, flag and offset values for all the fragments of the first packet sent by 192.168.1.103 with data size of 3500 bytes?

ID	Length	Flag	Offset Values
7a7b	1514	0x2000 More Fragments	0
7a7b	1514	0x20b9 More Fragments	1480
7a7b	582	0x0172	2960

Question 4: Has fragmentation of fragments occurred when data of size 3500 bytes has been used? Why and why not?

- No, there has been no further fragmentation. Further fragmentation of fragments would only occur if there was more than one skip and the MTU gets smaller between nodes

Question 5: What will happen if for our example one fragment of the original datagram from 192.168.1.103 is lost?

- Since it is being transferred over TCP the entire packet will be sent again.

Exercise 3: Understanding the Impact of Network Dynamics on Routing

Question 1: Which nodes communicate with which other nodes? Which route do the packets follow? Does it change over time?

- Node 0 talks to Node 2
- Node 0 talks to Node 5 via Node 1,4
- Node 2 talks to Node 5 via Node 3
- Node 0 path: 0 → 1 → 4 → 5
- Node 2 path: 2 → 3 → 5

The route does not change over time

Question 2: What happens at time 1.0 and at time 1.2? Does the route between the communicating nodes change as a result of that?

- Link 1-4 is down, meaning some packets from node 0 is lost. The routes do not change

Question 3: Did you observe any additional traffic as compared to Step 3 above? How does the network react to the changes that take place at time 1.0 and time 1.2 now?

- Yes, there is some additional traffic. This is the router telling its neighbour about its distance vectors.
- Router 1 reroutes the traffic from node 0 to node 2 when links 1-4 are down

Question 4: How does this change affect the routing? Explain why.

- The route goes from 0 → 1 → 2 instead of 0 → 1-4.
- This increases the cost of route 1-4 from 1 to 3.
- The cost of route 1 – 4 – 5 becomes 4
- The cost of route 1 – 2 – 3 – 5 becomes 3
- This means that it becomes cheaper to take route 1-2-3-5 even though it passes through more routers

Question 5: Describe what happens and deduce the effect of the line you just uncommented.

- The traffic from 2-5 takes two routes: 2-1-4-5 and 2-3-5
- The line turns multipathing to true, meaning that multiple paths can be taken to a destination. Since the cost of 2-1-4-5 and 2-3-5 are both 4, this means that either path can be taken.

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