50.012 Networks (2020 Term 6)

Homework 3

Hand-out: 12 Nov

Due: 24 Nov 23:59

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1. (textbook chapter 4, problem P14) Consider sending a 1,600-byte datagram into a link that has an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 291. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

1580/480 = 3.292
4 Fragments

Identification for each fragment will be 291
Length of each first three is 500, length of last is 180
One bit in the "flags" field will be bit 1 for the first 3 fragments except for last fragments which will be bit 0.
Fragment offset will be 0, 60, 120, 180

2. (textbook chapter 4, problem P17) Suppose you are interested in detecting the number of hosts behind a NAT. You observe that the IP layer stamps an identification number sequentially on each IP packet. The identification number of the first IP packet generated by a host is a random number, and the identification numbers of the subsequent IP packets are sequentially assigned. Assume all IP packets generated by hosts behind the NAT are sent to the outside world.

a. Based on this observation, and assuming you can sniff all packets sent by the NAT to the outside, can you outline a simple technique that detects the number of unique hosts behind a NAT? Justify your answer.

b. If the identification numbers are not sequentially assigned but randomly assigned, would your technique work? Justify your answer.

a) Packet sniffer/analyzer using wireshark.
   Assuming that the initial identification number of each host that start are no where near, if there is a chain of IP packets with sequential identification number, it is safe to assume that each chain belongs to one host.
b) No. If they are random, a chain cannot be made and it will not be possible to assume a chain is a host.

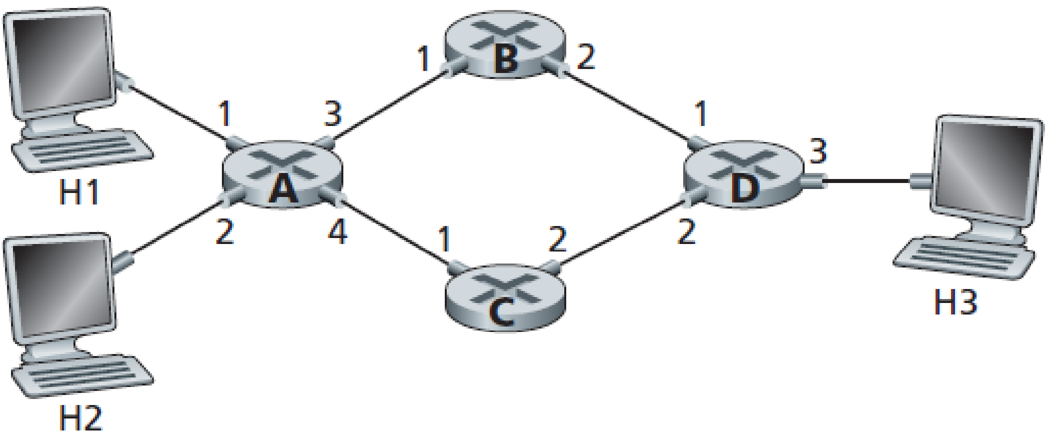
3. (textbook chapter 4, adapted from review problem R33 and problem P1):

a) What is the difference between a forwarding table for destination-based forwarding and OpenFlow's flow table?

b) Consider the network in the figure below. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.

c) Can you write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4?

d) Can you write down a flow table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4?



a) The forwarding table for destination-based forwarding is for the router to look up which output port to forward a incoming packet to based on it's destination.
   However, open-flow's flow table is for the router to do 'match' and 'action', using incoming packet headers for matching to specific actions.
b) Destination Interface
   H3 3
c) No. It's destination based, not source.
d) Assuming you have IP address of hosts

Match	Action
IngressPort=1, IP Dst=H3's IP	Forward(3)
IngressPort=2, IP Dst=h3'sIP	Forward(4)

4. (textbook chapter 4, review problem R26): Suppose you purchase a wireless router and connect it to your cable modem. Also suppose that your ISP dynamically assigns your connected device (that is, your wireless router) one IP address. Also suppose that you have five PCs at home that use 802.11 to wirelessly connect to your wireless router. How are IP addresses assigned to the five PCs? Does the wireless router use NAT? Why or why not?

Assuming router has DHCP, IP addresses are assigned dynamically.
Yes, so that the ISP only needs to assign 1 IP address to our router instead of 5.

5. (textbook Chapter 3, problem 45 and 53) Recall the macroscopic description of TCP throughput. In the period of time from when the connection's rate varies from W/(2 · RTT) to W/RTT, only one packet is lost (at the very end of the period).

a. Show that the loss rate (fraction of packets lost) is equal to

$$L = \text{loss rate} = \frac{1}{\frac{3}{8}W^2 + \frac{3}{4}W}$$

b. Use the result above to show that if a connection has loss rate L, then its average rate is approximately given by

$$\approx \frac{1.22 \cdot MSS}{RTT\sqrt{L}}$$

c. Let's assume 1500-byte packets and a 100 ms round-trip time. If TCP needed to support a 1Gbps connection, what would the tolerable loss rate be? How about 100Gbps?

a)

Vary from $\frac{W}{2}$ to W

$\frac{W}{2} + \left(\frac{W}{2}+1\right) + \left(\frac{W}{2}+2\right) \dots + \left(\frac{W}{2}+\frac{W}{2}\right)$

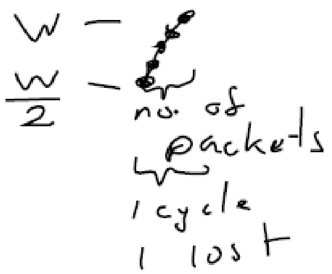
$= \sum_{i=0}^{\frac{W}{2}} \left(\frac{W}{2}+i\right)$

$= \sum_{i=0}^{\frac{W}{2}} \left(\frac{W}{2}\right) + \sum_{i=0}^{\frac{W}{2}} (i)$

$= \frac{W}{2}\left(\frac{W}{2}+1\right) + \sum_{i=0}^{\frac{W}{2}} i$

$= \frac{W^2}{4} + \frac{W}{2} + \frac{\frac{W}{2}\left(\frac{W}{2}+1\right)}{2}$

$= \frac{3}{8}W^2 + \frac{3}{4}W$



$\sum_{i=0}^{n} = \frac{n(n+1)}{2}$

$\frac{1}{\frac{3}{8}W^2 + \frac{3}{4}W} = L$