50.012 Networks (2021 Term 6)

Homework 3

Hand-out: 9 Nov

Due: 20 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?

For each fragment, payload size = 480 bytes, header size = 20 bytes

No. of fragments = 1600 / 480 = 4 fragments

If the original datagram is represented as:

Length = 1600	ID = 291	Fragflag = 0	Offset = 0

Then the resulting fragments:

Length = 500	ID = 291	Fragflag = 1	Offset = 0
Length = 500	ID = 291	Fragflag = 1	Offset = 60
Length = 500	ID = 291	Fragflag = 1	Offset = 120
Length = 160 (header = 20 bytes, payload = 140 bytes)	ID = 291	Fragflag = 0	Offset = 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.

Using a packet sniffer, we can record the IP packets generated and sent. The packets can be grouped according to consecutive identification numbers since each host generates packets with sequential ID numbers. The number of clusters will reflect the number of hosts behind the NAT, assuming multiple hosts do not coincidentally generate overlapping ID numbers.

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

The technique would not work since packets generated from any host can have any random number, and the ID would no longer have any viable pattern to associate the packets with others generated from the same host.

3. (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?

Wireless routers usually incorporates a Dynamic Host Configuration Protocol (DHCP) server. IP Addresses are assigned by the router through DHCP. Each PC will broadcast a message requesting for an IP address to the entire subnet. The router will respond to each request with an available IP address, broadcasted to the whole subnet. The PCs will respond with a DHCP request, selecting one out of the 5 IP addresses. The router will then respond to each request with an ack message, allowing the PC to use the IP address it requested.

 The wireless router uses NAT since it assigns a private IP address (802.11) to each PC in its subnet, and the router only receives one IP address from its ISP.

4. (Adapted from 2019 final exam) Consider the network in the Figure below (noticed that there is a direct link between node u and z), where the numbers show the symmetrical link costs. Assume a link state routing protocol is used. **Node x** applies Dijkstra's algorithm to compute the best route to every other node. Step 0 of Dijkstra's algorithm (i.e., immediately after initialization) is shown below. Write down **all** the rows after step 0 until the algorithm completes.
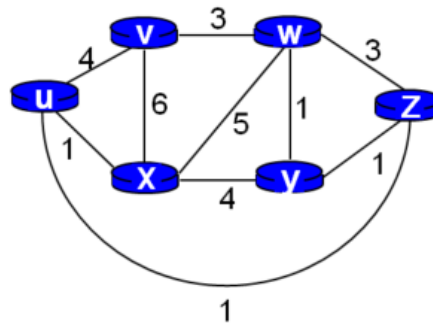
Step	N'	D(u), p(u)	D(v),p(v)	D(w), p(w)	D(y),p(y)	D(z),p(z)
0	X	1,x	6,x	5,x	4,x	∞
1	xu	-	5,u	5,x	4,x	∞
2	Xuy	-	5,u	5,x	-	5,y
3	Xuyv	-	-	5,x	-	5,y
4	Xuyvw	-	-	-	-	5,y
5	Xuyvwz	-	-	-	-	-

5. (textbook chapter 5, problem P11): Consider the network below and suppose that poisoned reverse is used in the distance-vector routing algorithm.
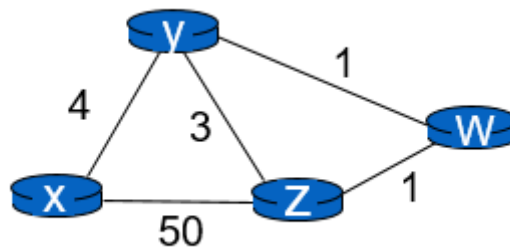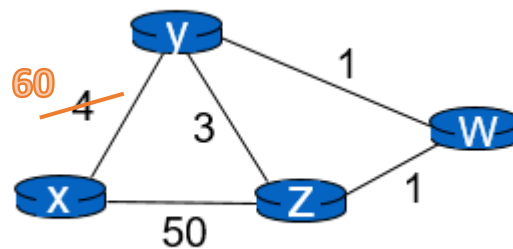

a. When the distance vector routing is stabilized, router w, y, and z inform their distances to x to each other. What distance values do they tell each other?

b. Now suppose that the link cost between x and y increases to 60. Will there be a count-to-infinity problem even if poisoned reverse is used? Why or why not? If there is a count-to-infinity problem, show the first three rounds of message exchanged among w, y, and z and how their DV change.

Solution template:

a)

Router z	Informs w, $D_z(x) = \infty$
	Informs y, $D_z(x) = 6$
Router w	Informs y, $D_w(x) = \infty$
	Informs z, $D_w(x) = 5$
Router y	Informs w, $D_y(x) = 4$
	Informs z, $D_y(x) = 4$

b) If there is a count-to-infinity problem, you can use the following table to fill in the first few iterations.

time	t0	Round 1	Round 2	Round 3
Z	Z informs Y: c(Z,X) = 6 Z informs W: c(Z,X) = ∞	No change	Z informs Y: c(Z,X) = 10+1=11 Z informs W: c(Z,X) = ∞	No change
W	W informs Z: c(W,X) =5 W informs Y: c(W,X) =∞	W updates DV W informs Z: c(W,X) = 9+1 = 10 W informs Y: c(W,X) = ∞	No Change	No change
Y	Y detects change to 60 and updates its DV. Y informs W: c(Y, X)= 6+3=9 Y informs Z: c(Y, X)= ∞	No Change	No Change	Y informs W: c(Y, X)= 11+3=14 Y informs Z: c(Y, X)= ∞