Jason Lai
204995126
Dis 1A

CS 118
May 27, 2020

Homework 7

1 Problem 1

a)

NAT Translation Table

`IP:port` within private network	`IP:port` outside private network
`10.0.0.5:5000`	`128.97.27.37:8000`
`10.0.0.6:5000`	`128.97.27.37:8001`
`10.0.0.10:6000`	`128.97.27.37:8002`
`10.0.1.101:6001`	`128.97.27.37:8003`
`10.0.0.7:7000`	`128.97.27.37:8004`
`204.79.197.200:80`	`128.97.27.37:8005`

b)

(1) Message Received from Host: `MSG <10.0.0.6:5000, 172.217.11.78:80>`
Message Sent from Router: `MSG <128.97.27.37:8001, 172.217.11.78:80>`

(2) Message Received from Host: `MSG <10.0.0.10:6000, 204.79.197.200:80>`
Message Sent from Router: `MSG <128.97.27.37:8002, 204.79.197.200:80>`

Jason Lai
204995126
Dis 1A

2 Problem 2

a) The network layer in Host A knows it should pass the segment (that is, the payload of the datagram) to TCP rather than to UDP or to something else, because the IP header has the Upper Layer field, which indicates what upper layer protocol e.g. TCP or UDP that the datagram is meant for at the transport layer.

b) A host can have more than one IP address, because IP addresses are allocated per interface, not per host device, so if a host has multiple Network Interface Cards installed, it is possible for the host to have multiple IP addresses, one for each interface.

c) Skype works between two hosts which are behind two different NAT boxes, by using supernodes to relay communications between the two hosts. The two hosts simply establish a connection to the supernode, which in turn bridges the packets sent by either end host and relays them to their intended destination. By using this approach, the two hosts, despite being behind different NAT boxes, can communicate as the relaying supernode makes either client believe that the other is using the public IP address and port number of the supernode.

d) No, if we are only concerned about NAT's original intended purpose, then it would not still be needed if IPv6 was globally deployed. This is because NAT was developed as a short-term solution to the limitations of the IPv4 32-bit IP address space exposed by the allocation of IP address blocks to ISPs and their subnets; the IPv4 address space is diminishing. However, IPv6 is the long-term solution to these limitations, as the protocol now expands the IP address space from 32 bits to 128 bits, so NAT would no longer be needed. However, NAT may still be used if, for some reason, a local network wants the indirection that NAT provides.

Jason Lai
204995126
Dis 1A

Homework 7

3 Problem 3

Step	N'	D(t),p(t)	D(u),p(u)	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)
0	z	∞	∞	∞	∞	8,z	12,z
1	zx	∞	∞	11,x	14,x		12,z
2	zxv	15,v	14,v		14,x		12,z
3	zxvy	15,v	14,v		14,x		
4	zxvyu	15,v			14,x		
5	zxvyuw	15,v					
6	zxvyuwt						

Work:

Step 0: Initialization: x and y are direct neighbors to z; we choose x, the shorter of the two.
Step 1: We can now reach v and w via node x, and we choose v.
Step 2: From v, we can reach t and u, but we choose y from z, since it is the shortest.
Step 3: We have a tie between u and w, so we choose u, by order of precedence.
Step 4: We then choose w, which has a shorter path than t.
Step 5: We are finally left with t, so we choose t.
Step 6: Done.

Homework 7

Jason Lai
204995126
Dis 1A

4 Problem 4

a) Router 3c learns about prefix x by the routing protocol eBGP, since it will learn of x from a different AS.

b) Router 3a learns about prefix x by the routing protocol iBGP, since it will learn of x from within the same AS.

c) Router 1c learns about prefix x by the routing protocol eBGP, since it will learn of x from a different AS.

d) Router 1d learns about prefix x by the routing protocol iBGP, since it will learn of x from within the same AS.

Homework 7

Jason Lai
204995126
Dis 1A

5 Problem 5

The one-way propagation delay from Customer 1 to Customer 2 is 85 msec, while the one-way propagation delay from Customer 2 to Customer 1 is 35 msec. The routing between the two customers is asymmetric, as the routing each way between Customer 1 and Customer 2 is different.

Work:

Hot-potato routing means that the route chosen (from among all possible routes) is that route with the least cost to the next hop router beginning that route. This means we consider the one-way propagation delays for links connected at a given node, and take the least-cost edge (smallest delay). We have to consider both one-way communication cases: Customer 1 to Customer 2 and vice versa.

For Customer 1 to Customer 2, the routing path would follow the nodes in the order: J, H, I, F, D, C, B; since we take the path that follows a series of "cheap" edges of cost 5, which lead us to ISP2 down the left path and eventually to Customer 2. The delay is then $5 + 5 + 5 + 10 + 35 + 20 + 5 = 85$ msec.

For Customer 2 to Customer 1, the routing path would follow the nodes in the order: B, C, A, G, H, J; since we take the path along the edge from node C to A, which lead us to ISP1 up the right path and eventually to Customer 1, taking the smallest delay option at each node. The delay is then $5 + 10 + 5 + 10 + 5 = 35$ msec.

Since the routing paths are different for each way of the one-way propagation, we see that the routing is asymmetric.