Homework #2

1. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

Prefix	Match
00	0
01	1
10	1
11	2
111	3

For each of the four interfaces, give the associated range of destination host addresses and the number of addresses in the range.

# interface	range	#
0	[00000000 – 00111111]	$2^6 = 64$
1	[01000000 – 01111111] [10000000 – 10111111]	$2^6 \times 2 = 128$
2	[11000000 – 11011111]	$2^5 = 32$
3	[11100000 – 11111111]	$2^5 = 32$

2. Consider a router that interconnects three subnets: Subnet 1, Subnet 2, and Subnet 3. Suppose all interfaces in these three subnets are required to have the prefix 222.0.16.0/24. Also suppose that Subnet 1 is required to support at least 90 interfaces, Subnet 2 is to support at least 60 interfaces, and Subnet 3 is to support at least 12 interfaces. Provide three network addresses (of the form a.b.c.d/x) that satisfy these constraints, please show the calculation procedure.

Subnet 1: $2^6 < 90 < 2^7$ So it need 7 bits

So the last 8 bits is x0000000

So the network address can be 222.0.16.128/25

(10000000)

Subnet 2: $2^5 < 60 < 2^6$ So it need 6 bits

the last 8 bits is xx000000

(11000000)

the network address can be 222.0.16.192/26

subnet 3: $2^3 < 12 < 2^4$ So it need 4 bits

the last 8 bits is xxxx0000

(11110000)

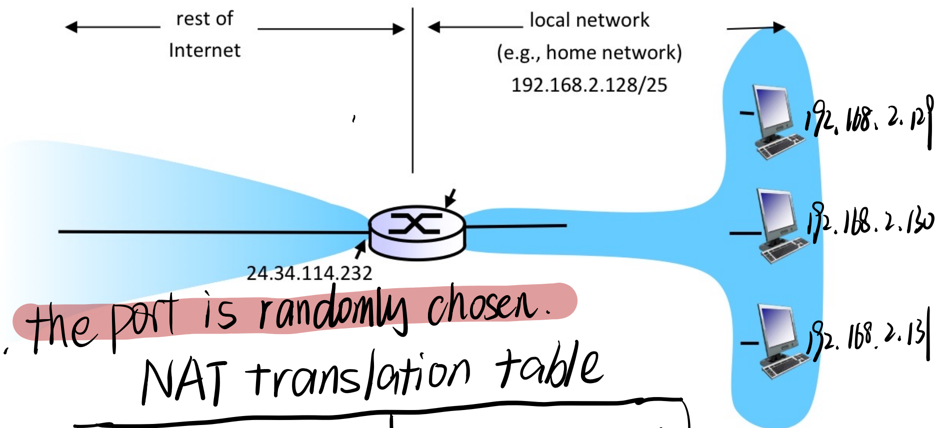
the network address can be 222.0.16.240/28

3. Consider the network setup in the figure below. Suppose that the ISP instead assigns the router the address 24.34.114.232 and the network address of the home network is 192.168.2.128/25.

a. Assign addresses to all interfaces in the home network.

a. 192.168.2.129 & 192.168.2.130 & 192.168.2.131

b. Suppose each host has two ongoing TCP connections, all to port 80 at host 128.121.40.87. Provide the six corresponding entries in the NAT translation table.

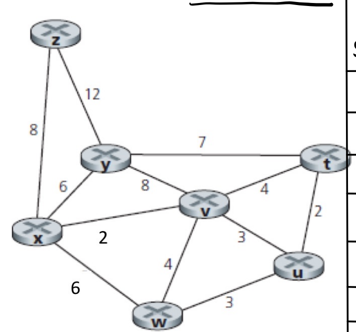


b. the port is randomly chosen.

NAT translation table

WAN side addr	LAN side addr
24.34.114.232, 5001	192.168.2.129, 3345
24.34.114.232, 5002	192.168.2.129, 3346
24.34.114.232, 5003	192.168.2.130, 3345
24.34.114.232, 5004	192.168.2.130, 3346
24.34.114.232, 5005	192.168.2.131, 3345
24.34.114.232, 5006	192.168.2.131, 3346

4. Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from w to all network nodes. Show how the algorithm works and show the final forwarding table in w.

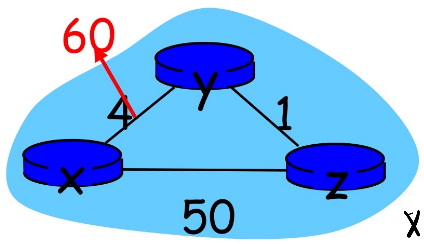


step	N'	D(x) p(x)	D(v) p(v)	D(u) p(u)	D(t) p(t)	D(y) p(y)	D(z) p(z)
0	w	6,w	4,w	3,w	∞	∞	∞
1	wu	6,w	4,w		5,u	∞	∞
2	wuv	6,w			5,u	12,v	∞
3	wuvt	6,w				12,v	∞
4	wuvtx					12,v	14,x
5	wuvtxy						14,x
6	wuvtxyz						

so the forwarding table in w is

destination	link
x	(w,x)
v	(w,v)
u	(w,u)
y	(w,v)
t	(w,u)
z	(w,x)

5. Consider a network as shown in the figure below. Distance vector algorithm is used to calculate the forwarding table. Assume that the distance vectors have already been calculated correctly, then both x and y detect that the link cost c(x,y) changed from 4 to 60, if poisoned reverse is used (z tells y that Dz(x) is infinite if packets from z to x go through y, similar for x), write down how distance vectors of these routers change from the change of the link cost change until the algorithm converges, and what messages are transmitted during the procedure.



①: x, y detect the link cost change and update link vector

x: $d_x(y) = \min\{60+0,\ 50+1\} = 51$

$d_x(z) = \min\{50+0,\ 60+1\} = 50$

y: $d_y(z) = \min\{1,\ 60+\text{Infinity}\} = 1$

$d_y(x) = \min\{60,\ 1+\text{infinity}\} = 60$

② probe

X

	x	y	z
x	0	~~4~~ 51	~~5~~ 50
y	4	0	1
z	5	1	0

y

	x	y	z
x	0	4	5
y	~~4~~ 60	0	1
z	5	1	0

Z

	x	y	z
x	0	4	5
y	4	0	1
z	5	1	0

	x	y	z
x	0	51	50
y	60	0	1
z	5	1	0

	x	y	z
x	0	51	50
y	60	0	1
z	5	1	0

min{60, 1+inf}

	x	y	z
x	0	51	50
y	60	0	1
z	50	1	0

	x	y	z
x	0	51	50
y	60	0	1
z	50	1	0

	x	y	z
x	0	51	50
y	51	0	1
z	50	1	0

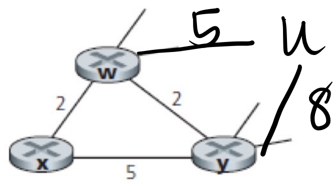
	x	y	z
x	0	51	50
y	51	0	1
z	50	1	0

	x	y	z
x	0	51	50
y	51	0	1
z	50	1	0

	x	y	z
x	0	51	50
y	51	0	1
z	50	1	0

	x	y	z
x	0	51	50
y	51	0	1
z	50	1	0

6. Consider the network fragment shown below. x has only two attached neighbors, w and y. w has a minimum-cost path to destination u (not shown) of 5, and y has a minimum-cost path to u of 8. The complete paths from w and y to u (and between w and y) are not shown. All link costs in the network have strictly positive integer values.



a. Give x's distance vector for destinations w, y, and u.
b. Give a link-cost change for either c(x,w) or c(x,y) such that x will inform its neighbors of a new minimum-cost path to u as a result of executing the distance-vector algorithm.
c. Give a link-cost change for either c(x,w) or c(x,y) such that x will not inform its neighbors of a new minimum-cost path to u as a result of executing the distance-vector algorithm.

a.

	w	y	u	x
x	2	4	7	0

b. if c(x,y) becomes 1 $d_x(y)=1$ in x's distance vector then x will inform it's neighbor of this change.

x.

	w	y	u	x
x	2	1	7	0
w	0	2	5	2
y	2	0	7	4

w.

	w	y	u	x
x	2	4	7	0
w	0	2	5	2
y	2	0	7	4

y

	w	y	u	x
x	2	4	7	0
w	0	2	5	2
y	2	0	7	1

	w	y	u	x
x	2	1	7	0
w	0	2	5	2
y	2	0	7	1

	w	y	u	x
x	2	1	7	0
w	0	2	5	2
y	2	0	7	4

converge

	w	y	u	x
x	2	1	7	0
w	0	2	5	2
y	2	0	7	1

c. if c(x,y) becomes 4, $d_x(y)=4$ doesn't change x's distance-vector.