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P8. Consider a router that interconnects three subnets: Subnet 1, Subnet 2 and Subnet 3. Suppose all of the interfaces in each of these three subnets are required to have the prefix 223.1.17/24. Also suppose that Subnet 1 is required to support at least 60 interfaces, Subnet 2 is to support at least 90 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.

Subnet 1: $2^6 \geq 60$ 32 – 6 = 26

Subnet 2: $2^7 \geq 90$ 32 – 7 = 25

Subnet 3: $2^4 \geq 12$ 32 – 4 = 28

Subnet 2: 223.1.17.01111111 = **223.1.17.0 / 25** to 223.1.17.127 / 25

Subnet 1: 223.1.17.10111111 = **223.1.17.128 / 26** to 223.1.17.191 / 26

Subnet 3: 223.1.17.11111111 = **223.1.17.192 / 28** to 223.1.17.255 / 28

P11 Consider a subnet with prefix 128.119.40.128/26. Give an example of one IP address that can be assigned to this network

Any address within 128.119.40.10000000/26 to 128.119.40.10111111/26

128.119.40.129

Suppose an ISP owns a block of addresses of the form 128.119.40.64/26. Suppose it wants to create 4 subnets from this block, with each block having the same number of IP addresses. What are the prefixes for the four subnets

Base: 128.119.40.**10**000000/26

Subnet 1: 128.119.40.**1000**0000/28 = **128.119.40.128**

Subnet 2: 128.119.40.**1001**0000/28 = **128.119.40.144**

Subnet 3: 128.119.40.**1010**0000/28 = **128.119.40.160**

Subnet 4: 128.119.40.**1011**0000/28 = **128.119.40.172**

P18. In this problem we'll explore the impact of NATs on P2P applications. Suppose a peer with username Arnold discovers through querying that a peer with username Bernard has a file it wants to download. Also suppose that Bernard and Arnold are both behind a NAT. Try to devise a technique that will allow Arnold to establish a TCP connection with Bernard without application-specific NAT configuration. If you have difficulty devising such a technique, discuss why.

Since both users are both behind a NAT, trying to establish such connection is impossible as NAT routers do not support end-to-end connectivity; in other words, hosts cannot communicate directly with other hosts. What this means is that the required TCP connection for P2P applications to work, will never be established due to interference from the NAT router.

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P3. Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from x to all network nodes

Step	N'	D(t), p(t)	D(u), p(u)	D(v), p(v)	D(w), p(w)	D(y), p(y)	D(z), p(z)
0	**x**	**∞**	**∞**	**3,x**	**6,x**	**6,x**	**8,x**
1	**xv**	**7,v**	**6,v**		**6,x**	**6,x**	**8,x**
2	**xvu**	**7,v**			**6,x**	**6,x**	**8,x**
3	**xvuw**	**7,v**				**6,x**	**8,x**
4	**xvuwy**	**7,v**					**8,x**
5	**xvuwyt**						**8,x**
6	**xvuwytz**						

P5. Consider the network shown below, and assume that each node initially knows the cost to each of its neighbors. Consider the distance-vector algorithm and show the distance table entries at node z.

			Cost to			
		u	v	x	y	z
From	u	0	∞	∞	∞	∞
	v	∞	0	∞	∞	∞
	x	∞	∞	0	∞	∞
	y	∞	∞	∞	0	∞
	z	∞	6	2	∞	0

			Cost to			
		u	v	x	y	z
From	u	0	1	∞	2	7
	v	1	0	3	∞	6
	x	∞	3	0	3	2
	y	2	∞	3	0	5
	z	7	5	2	5	0

Final Table

			Cost to			
		u	v	x	y	z
From	u	**0**	**1**	**4**	**2**	**6**
	v	**1**	**0**	**3**	**3**	**5**
	x	**4**	**3**	**0**	**3**	**2**
	y	**2**	**3**	**3**	**0**	**5**
	z	**6**	**5**	**2**	**5**	**0**

P13. Will a BGP router always choose the loop-free route with the shortest AS-path length? Justify your answer.

No, a BGP router will not always choose the shortest AS-path because BGP is inter-AS based routing. What this means is that BGP is policy based, so even if a shorter path exists, due to policy reasons, the chosen route may be a longer loop-free path. An example would be as mentioned in the notes, the preferred route may be to the longer, but direct route from Shaw to Telus instead of taking the shorter route that passes through Bell, due to policy reasons.

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P11. Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

a. What is the probability that node A succeeds for the first time in slot 5?

   $p(A) \times (1 - p(A))^{5-1}$ = $\mathbf{p(A) \times (1 - p(A))^4}$

b. What is the probability that some node (either A, B, C or D) succeeds in slot 4?

   $\mathbf{4p\,(1 - p)^3}$

c. What is the probability that the first success occurs in slot 3?

   P(no success in first 2 slots) x P(success in slot 3) = $\mathbf{(1 - 4p\,(1 - p)^3)^2 \times (4p\,(1 - p)^3)}$

d. What is the efficiency of this four-node system?

   $\mathbf{4p\,(1 - p)^3}$

Assignment 2: CMPT 371 **Alan Ou**
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1. Discuss how to set up a web server (port 80) behind a NAT. Can we set up two web servers (both with port 80) behind a NAT?

The implementation would be similar to how is mentioned in the class notes, however, this time from the **web servers' prospective**:

incoming datagrams: replace (NAT IP address, port #) in destination fields of every incoming datagram with corresponding (source IP address, port #80) stored in NAT table

outgoing datagrams: replace (source IP address, port #80) of every outgoing datagram to (NAT IP address, new port #)

Yes, you can set up two web servers, both with port 80, behind a NAT. The reason behind this is that outgoing datagrams are provided with a new, unique port #, as a result, when the incoming datagram arrives, it knows to translate the NAT IP address and port # back to the original source using the Nat translation table.

2. Consider the network and the switch table in slide 5b-8. For each of the following sending requests (executed one by one), list the interface(s) that will forward the frame. (1) node C sends a frame to node A; (2) node A sends a frame to node C; (3) node G sends a frame to node A; (4) node A sends a frame to node F; (5) node A sends a frame to node F.

Before the start of any request

Address	Interface
A	1
B	1
E	2
G	3
C	1

1) node C sends a frame to node A

   Interface(s) that will forward the frame: none, will be dropped because in table

2) node A sends a frame to node C

   Interface(s) that will forward the frame: none, will be dropped because in table

3) node G sends a frame to node A

   Interface(s) that will forward the frame: 1

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4) node A sends a frame to node F

   Interface(s) that will forward the frame: 2,3

5) node A sends a frame to node F

   Interface(s) that will forward the frame: 2,3