

**ECE 465/565 Computer Networks and Protocols
Fall 05**

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**Solutions
Homework 3**

Problem 14

From 214.97.254/17, possible assignments are

- a) Subnet A: 214.97.255/24 (256 addresses)
 Subnet B: 214.97.254.0/25 - 214.97.254.0/29 (128-8 = 120 addresses)
 Subnet C: 214.97.254.128/25 (128 addresses)

- Subnet D: 214.97.254.0/31 (2 addresses)
 Subnet E: 214.97.254.2/31 (2 addresses)
 Subnet F: 214.97.254.4/30 (4 addresses)

- b) To simplify the solution, assume that no datagrams have router interfaces as ultimate destinations. Also, label D, E, F for the upper-right, bottom, and upper-left interior subnets, respectively.

Router 1

Longest Prefix Match	Outgoing Interface
11010110 01100001 11111111	Subnet A
11010110 01100001 11111110 0000000	Subnet D
11010110 01100001 11111110 000001	Subnet F

Router 2

Longest Prefix Match	Outgoing Interface
11010110 01100001 11111110 0000000	Subnet D
11010110 01100001 11111110 0	Subnet B
11010110 01100001 11111110 0000001	Subnet E

Router 3

Longest Prefix Match	Outgoing Interface
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11010110 01100001 11111110 000001	Subnet F
11010110 01100001 11111110 0000001	Subnet E
11010110 01100001 11111110 1	Subnet C

Problem 18.

- Consider what happens when Arnold attempts to establish a TCP connection with Bernard. Arnold might send a TCP SYN packet with destination address 138.76.29.7 and some destination port number, say, x. When the NAT receives this TCP SYN packet, it doesn't know to which internal host it should direct the packet, since it doesn't have an entry for a connection initiated from the WAN side. Thus the NAT will drop the SYN packet.
- There is an existing TCP connection between Arnold and Cindy and between Cindy and Bernard. Via these two TCP connections, Arnold can send a message to Bernard. In particular, Arnold can ask Bernard to initiate a direct TCP connection from Bernard to Arnold. Since Bernard is initiating this TCP connection, it can be established through Bernard's NAT. Once this direct TCP connection is established between Arnold and Bernard, Arnold can ask Bob to send the file over the direct TCP connection.

Problem 19.

It is not possible to devise such a technique. In order to establish a direct TCP connection between Arnold and Bernard, either Arnold or Bob must initiate a connection to the other. But the NATs covering Arnold and Bob drop SYN packets arriving from the WAN side. Thus neither Arnold nor Bob can initiate a TCP connection to the other if they are both behind NATs.

Problem 23

		Cost to				
		u	v	x	y	z
From	v	∞	∞	∞	∞	∞
	x	∞	∞	∞	∞	∞
	y	∞	∞	∞	∞	∞
	z	∞	5	2	10	0

		Cost to				
		u	v	x	y	z
From	v	1	0	∞	15	5
	x	2	∞	0	1	2
	y	∞	15	1	0	10
	z	4	5	2	3	0

		Cost to				
		u	v	x	y	z
From	v	1	0	3	15	5
	x	2	3	0	1	2
	y	3	15	1	0	3
	z	4	5	2	3	0

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

NOTE: Node u is not included in the table because it is not directly attached to node z.

Bonus Problem

If k is the diameter of the network then:

$$1 + m + m^2 + m^3 + \dots + m^k = (1 - m^{k+1}) / (1 - m) = N$$

This means that a node has to visit all other nodes in the entire network (hence the largest distance) before the destination is reached.

From the above equation, k is roughly on the order of:

$$\log_m(N)$$