Sample Questions on Network Layer

1) IP Packets on a certain network can carry a maximum of only 500 bytes in the data portion. An application using TCP/IP on a node on this network generates a TCP segment with 1,000 bytes in the data portion. How many IP packets are transmitted to carry this TCP segment, and what are their sizes (including the header)?

2) What is the difference between routing and forwarding?

3) Consider a VC network with a 2-bit field for the VC number. Suppose that the network wants to set up a virtual circuit over four links: link A, link B, link C and link D. Suppose that each of those links is currently carrying two other virtual circuits, and the VC numbers of these other VCs are as follows:

Link A	Link B	Link C	Link D
00	01	10	11
01	10	11	00

Assume that each of the existing VCs may only traverse one of the four links.

a) If each VC is required to use the same VC number on all the four links along its path, what VC number could be assigned to the new VC?
b) If each VC is permitted to have a different VC number in the different links along its path, how many different combinations of four VC numbers (one for each of the four links) could be used?

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

Prefix Match	Interface
00	0
01	1
10	2
11	3

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

5) The only entries in a certain route table are (128.59.28.0/22, port 0), (128.59.28.0/23, port 1) and (128.59.28.0/24, port 2). These entries indicate CIDR network number, the prefix indication and the corresponding port to which a packet should be forwarded. If a packet arrives with a destination IP address equal to 128.59.29.18, which port will this router forward the packet to? (QUESTION FROM PREVIOUS EXAM)

6) Suppose datagrams are limited to 1,500 bytes (including header) between source Host A and destination Host B. Assuming a 20-byte IP header, how many datagrams would be required to send an MP3 consisting of 4 million bytes.

7) Consider a subnet with prefix 101.101.101.64/26. Given an example of one IP address (of form xxx.xxx.xxx.xxx) that can be assigned to this network.

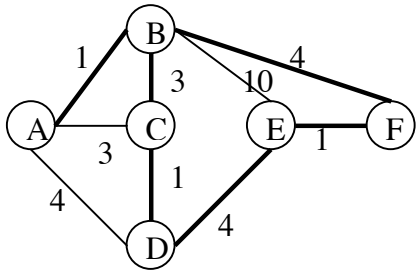
8) Suppose an ISP owns the block of addresses of the form 101.101.128/17. Suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the prefixes (of form a.b.c.d/x) for the four subnets?

9) Consider sending a 3,000 byte datagram into a link which has an MTU of 500 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are their characteristics?

10) Consider the network shown below.

(a) Show the operation of Dijkstra's (Link State) algorithm for computing the least cost path from F (the rightmost node in the figure below) to all destinations. Also explicitly list all the shortest path routes from F to all destinations that are the result of the algorithm's computation.

(b) Show the distance table that would be computed by the distance vector algorithm in B. (Note: you do not have to run the distance vector algorithm; you should be able to compute the table by inspection.)

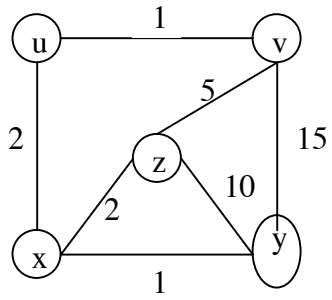


11) Suppose a peer with user name Arnold discovers through querying that a peer with user name Bernard has a file it wants to download. Also suppose that Bernard is behind a NAT whereas Arnold isn't. Let 138.76.29.7 be the WAN-side address of the NAT and let 10.0.0.1 be the internal IP address for Bernard. Assume that the NAT is not specifically configured for the P2P application.

(a) Discuss why Arnold's peer cannot initiate a TCP connection to Bernard's peer, even if Arnold knows the WAN-side address of the NAT, 138.76.29.7.

(b) Now, suppose that Bernard has established an ongoing TCP connection to another peer, Cindy who is not behind a NAT. Also suppose that Arnold learned from Cindy that Bernard has the desired file and that Arnold can establish (or already has established) a TCP connection with Cindy. Describe how Arnold can use these two TCP connections (one from Bernard to Cindy and the other from Arnold to Cindy) to instruct Bernard to initiate a direct TCP connection (that is, not passing through Cindy) back to Arnold. This technique is sometimes called *connection reversal*. Note that even though Bernard is behind a NAT, Arnold can use this direct TCP connection to request the file, and Bernard can use the connection to deliver the file.

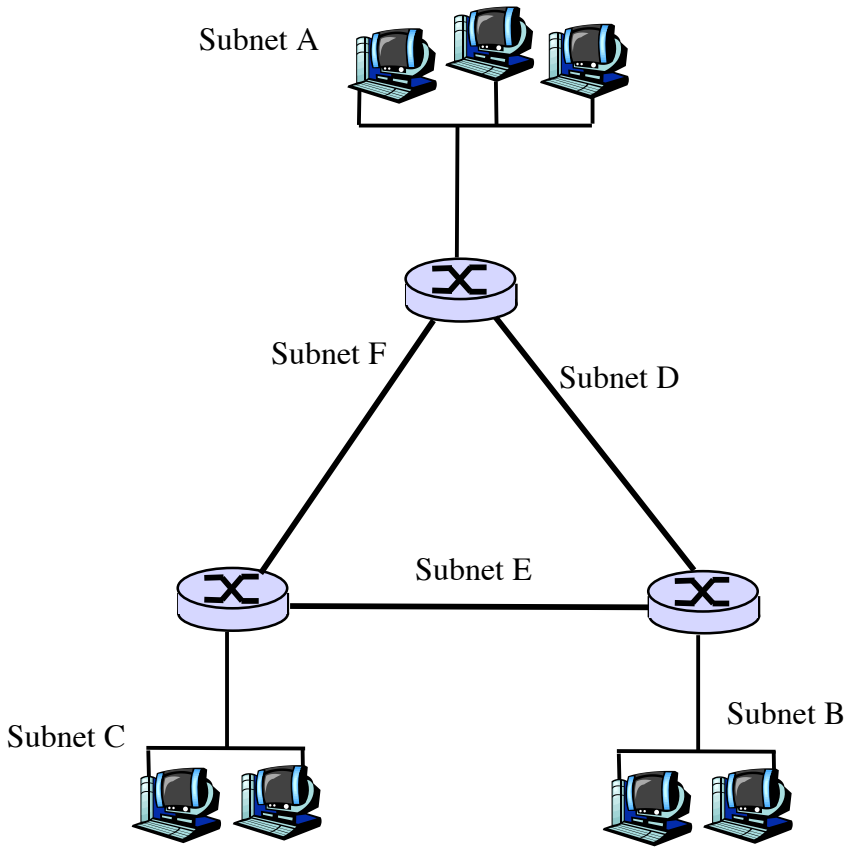
12) Consider the network shown below, and assume that each node initially knows the costs to each of its neighbours, Consider the distance vector algorithm and show the distance table entries at node z.



13) What is head of line blocking? Does it occur in input ports or output ports?

14) Suppose you purchase a wireless router/ADSL modem and connect it to your telephone socket. Also suppose that your ISP dynamically assigns one IP address to your connecting device (i.e. your router/modem). 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 five PCs? Does the wireless router use NAT? Why or why not?

15) Consider the following topology



Assign network addresses to each of these 6 subnets, with the following constraints:

- All addresses must be allocated from 214.97.254/23
- Subnet A should have enough addresses to support 250 interfaces

- Subnet B should have enough addresses to support 120 interfaces
- Subnet C should have enough addresses to support 120 interfaces
- Of course, subnets D, E and F should each be able to support 2 interfaces

For each subnet, the assignment should either take the form *a.b.c.d/x* or *a.b.c.d/x – e.f.g.h/y*

Now using the address assignments from above, provide the forwarding tables (using longest prefix matching) for each of the three routers.