CPEG 572 Data and Computer Communications

ASSIGNMENT #5

Ch8:

Q.1

A path in a digital circuit-switched network has a data rate of 1 Mbps. The exchange of 1000 bits is required for the setup and teardown phases. The distance between two parties is 5000 km.
Answer the following questions if the propagation speed is 2×10^8 m:

$Distance = 5000\ km$
$Speed = 2 * 10^8 ms$
$Transmission\ rate = 1\ Mbps$
$Total\ bits = 1000\ bits$
$Total\ Delay = Delay\ of\ setup\ and\ teardown + delay\ of\ data\ transfer$
$delay\ of\ data\ transfer = propagation\ delay + transmission\ delay$
$Delay\ of\ setup\ and\ tear\ down = (3 * propagation\ delay) + (3 * transmission\ delay)$

1. What is the total delay if 1000 bits of data are exchanged during the data transfer phase?
   $$Total\ Delay = \left(3 * \left(\frac{5{,}000\ km}{2 * 10^8\ mps}\right)\right) + \left(3 * \left(\frac{1{,}000\ bits}{1 Mbps}\right)\right) + \left(\frac{5{,}000\ km}{2 * 10^8\ mps}\right) + \left(\frac{1{,}000\ bits}{1\ Mbps}\right)$$
   $Total\ Delay = 104\ ms$

2. What is the total delay if 100,000 bits of data are exchanged during the data-transfer phase?
   $$Total\ Delay = \left(3 * \left(\frac{5{,}000\ km}{2 * 10^8\ mps}\right)\right) + \left(3 * \left(\frac{1{,}000\ bits}{1 Mbps}\right)\right) + \left(\frac{5{,}000\ km}{2 * 10^8\ mps}\right) + \left(\frac{100{,}000\ bits}{1\ Mbps}\right)$$
   $Total\ Delay = 203\ ms$

3. What is the total delay if 1,000,000 bits of data are exchanged during the data-transfer phase?
   $$Total\ Delay = \left(3 * \left(\frac{5{,}000\ km}{2 * 10^8\ mps}\right)\right) + \left(3 * \left(\frac{1{,}000\ bits}{1 Mbps}\right)\right) + \left(\frac{5{,}000\ km}{2 * 10^8\ mps}\right) + \left(\frac{1{,}000{,}000\ bits}{1\ Mbps}\right)$$
   $Total\ Delay = 1103\ ms$

4. Find the delay per 1000 bits of data for each of the above cases and compare them. What can you infer?
   The delay for 1 is 104 ms, 2 is 203 ms, and 3 is 1103 ms. The ratio is smallest in 3. because of using one setup and tear down phase for sending more data.

Q.2

Figure 1 shows a switch (router) in a datagram network. Find the output port for packets with the following destination addresses:

1. Packet 1: 7176
   Output port: 2
2. Packet 2: 1233
   Output port: 3
3. Packet 3: 8766
   Output port: 3
4. Packet 4: 9144
   Output port: 2

Destination address	Output port
1233	3
1456	2
3255	1
4470	4
7176	2
8766	3
9144	2

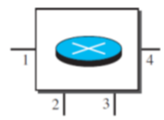
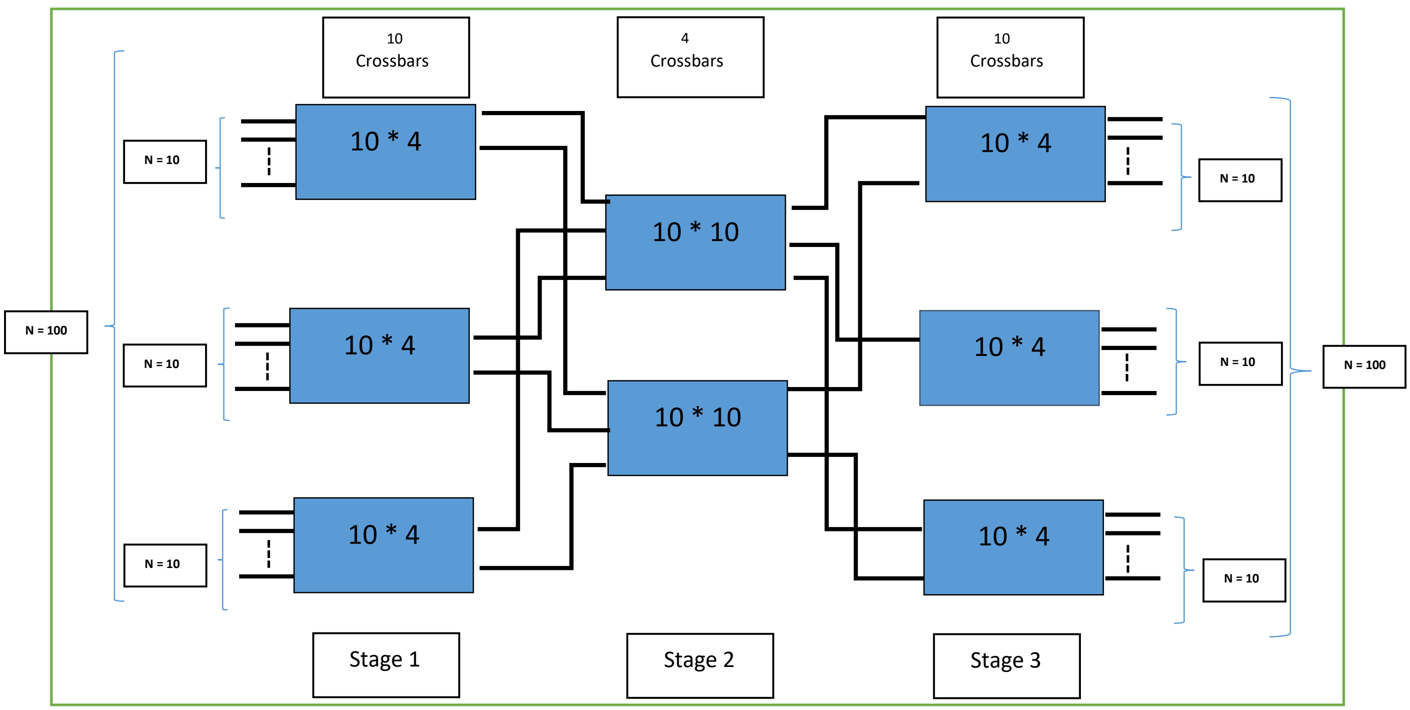


Figure 1 Router in a datagram Network

Q.3

We need a three-stage space-division switch with N = 100. We use 10 crossbars at the first and third stages and 4 crossbars at the middle stage.

1. Draw the configuration diagram



21. Calculate the total number of cross points.
    N=100, n=10, k=4
    The total number of cross points =$2 * k * N + k * (\frac{N}{n})^2$
    = $2 * 4 * 100 + 4 * (\frac{100}{10})^2$
    $= 1200$
22. Find the possible number of simultaneous connections.
    = 4 * 10 = 40
23. Find the possible number of simultaneous connections if we use a single crossbar (100 × 100).
    Possible number of simultaneous connections = 100
24. Find the blocking factor, the ratio of the number of connections in part c and in part d.
    Blocking factor = $\left(\frac{40}{100}\right) * 100 = 40\%$

Q.4

We mentioned that two types of networks, datagram and virtual-circuit, need a routing or switching table to find the output port from which the information belonging to a destination should be sent out, but a circuit-switched network has no need for such a table. Give the reason for this difference.

In these two types of networks, each packet has a routing table that is based on destination address, and routing tables are dynamic that means they are updating after period of time. Also, the destination address and the corresponding forwarding output ports are saved in the tables of datagram and virtual circuits, so datagram and virtual circuits need a routing table to find the output port from which the information belonging to a destination should be sent out, and the circuit switches network has no need for such a table because the data is not packetized and no routing information is carried with the data in which entry is created after the setup phase is done and deleted.

Q.5

List four major components of a packet switch and their functions.

1. Input ports
   It does the physical and data link functions of the packet switch.
2. Output ports
   It does the same work as the input port, but it revers the order.
3. Routing processor
   It does the function of table lookup in the network layer.
4. Switching fabric
   It does the moving of packets from the input queue to the output queue.

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ASSIGNMENT #5

Ch9:

Q.6

Assume we have an internet (a private small internet) in which all hosts are Connected in a mesh topology.

- Do we need both network and data-link layers?
  As we use mesh topology, we don't need network and data link layer, because the network layer performs the mechanism of addressing the packet to the destination by the help of data link and physical layers. The data link layer takes the frames from the packets of data which are received from network layer, and it gives them to physical layer. Also, it states the information which needs to be transmitted over the data.
- Do we need routers in this internet? Explain.
  As we use mesh topology we don't need routers because in mesh topology each node is connected to at least two nodes. Also when we use a mesh topology, there is no centralized point hence the system will not fail even if one node fails the other nodes will operate and communicate with each other. Also, the mesh topology has a direct connection with the server and the path is straightforward.

Q.7

In Figure below,

1. Do you think that system A should first check its cache for mapping from N2 to L2 before even broadcasting the ARP request?

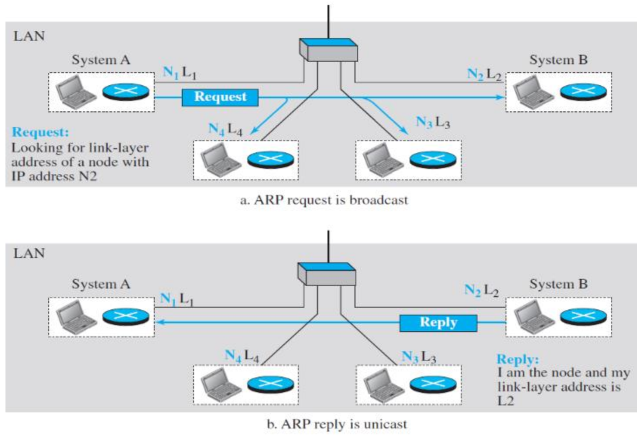

Figure 2 APR OPREATION

It does not need to check its catch because it will wait until it gets the response from system B with its data link layer address

2. Assume system B is not running the ARP program. What would happen?
Without using ARP, system A cannot deliver the packet to system B unless system A broadcast it, system B and any other connected system will receive the frames, decapsulate the frames, remove the datagram and pass it to their network-layer to find out the datagrams do not belong to them.

3. Assume the network in Figure 9.7 does not support broadcasting. What do you suggest for sending the ARP request in this network?
There are two ways can be used. In the first way, system A has a table to match the network-layer addresses to data-link addresses so that it can use the table to find the data-link address of system B. In the second way, system A has only the list of all data-link layer addresses so that it can send unicast ARP packet to all stations to find out the one which matches the network-layer address. In addition, none of these two ways are practical because a host may change its data-link layer address, and that system will not receive the request.

Q.8

Assume Alice is travelling from 2020 Main Street in Los Angeles to 1432 American Boulevard in Chicago. If she is travelling by air from Los Angeles Airport to Chicago Airport,

1. Find the end-to-end addresses in this scenario.
   Source:
   2020 Main Street, Los Angeles
   Destination:
   1432 American Boulevard, Chicago
2. Find the link-layer addresses in this scenario.
   Source: 2020 Main Street
   Destination: Los Angeles Airport
   Second link
   Source: Los Angeles Airport Destination:
   Denver Airport
   Third link

   Source: Denver Airport
   Destination: Chicago Airport
   Fourth link
   Source: Chicago Airport
   Destination: 1432 American Boulevard

Q.9

How many IP addresses and how many link-layer addresses should a router have when it is connected to five links?
A router needs to have a MAC address which is link layer and IP address on each network interface or link. Thus, there are five IP addresses and five link layer addresses

Q.10

Can two hosts in two different networks have the same link-layer address? Explain.
Yes. Two hosts in two different networks can have the same link-layer address because the link layer address has a local jurisdiction.