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TUTORIAL 10

1. **Give two example computer applications for which connection-oriented service is appropriate. Now give two examples for which connectionless service is best.**

   File transfer, remote login, and video on demand need connection-oriented service. On the other hand, credit card verification and other point-of-sale terminals, electronic funds transfer, and many forms of remote database access are inherently connectionless, with a query going one way and the reply coming back the other way.

2. **Datagram networks route each packet as a separate unit, independent of all others. Virtual-circuit networks do not have to do this, since each data packet follows a predetermined route. Does this observation mean that virtual-circuit networks do not need the capability to route isolated packets from an arbitrary source to an arbitrary destination? Explain your answer.**

   No, it does not. In virtual-circuit subnets, routers have to route packets based on the following pieces of information:

   - Virtual-Circuit number
   - Incoming line

   Each packet contains a Virtual-Circuit number and the incoming line identification is known by the router. Hence, virtual-circuit subnets do need the capability to route isolated packets (connection setup packets) from an arbitrary incoming line (which is well known by the router) and with an arbitrary circuit number (information carried in the packet). That means, knowing the original source and the final destination is not required.

3. **Give three examples of protocol parameters that might be negotiated when a connection is set up.**

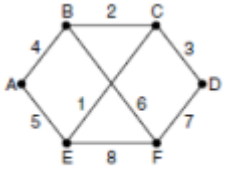
   The negotiation can be on setting the window size for flow control, maximum packet size (MTU or MSS) for congestion control, and timer values for acknowledgement.

4. **Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination?**
   Yes. A large noise burst could garble a packet badly and would be able to undetected using checksum. With k-bit checksum, there is a probability of 2^{-k} that the error is undetected. So, if destination address or VCI fields go undetected, the packet will be delivered to the wrong destination.

5. **Give a simple heuristic for finding two paths through a network from a given source to a given destination that can survive the loss of any communication line (assuming two such paths exist). The routers are considered reliable enough, so it is not necessary to worry about the possibility of router crashes.**
   Consider the router as a node and the communication line as an edge. Then the problem is to find two edge disjoint paths from a source to destination. Apply max flow algorithm with source as a source

and destination as a sink, all communication line has a unit value. If max flow is more than 2, you can easily find the two paths.

6. **Consider the network of Fig. (a). Distance vector routing is used, and the following vectors have just come in to router C: from B: (5, 0, 8, 12, 6, 2); from D: (16, 12, 6, 0, 9, 10); and from E: (7, 6, 3, 9, 0, 4). The cost of the links from C to B, D, and E, are 6, 3, and 5, respectively. What is C's new routing table? Give both the outgoing line to use and the cost.**



(a)

New vectors to C

	From B	From D	From E
A	5	16	7
B	0	12	6
C	8	6	3
D	12	0	9
E	6	9	0
F	2	10	4

New delays from C to neighbours	
B	6
D	3
E	5

C's new routing table

	Via B	Via D	Via E
A	11	19	12
B	6	15	11
C	14	9	8
D	18	3	14
E	12	12	5
F	14	13	9

Going via B gives (11, 6, 14, 18, 12, 8).
Going via D gives (19, 15, 9, 3, 9, 10).
Going via E gives (12, 11, 8, 14, 5, 9).
Taking the minimum for each destination except C gives (11, 6, 0, 3, 5, 8).
The outgoing lines are (B, B, -, D, E, B).

7. **If costs are recorded as 8-bit numbers in a 50-router network, and distance vectors are exchanged twice a second, how much bandwidth per (full-duplex) line is chewed up by the distributed routing algorithm? Assume that each router has three lines to other routers.**

A Network has 50 routers in which every router has a delay of 8-bit.
Hence total size of delay field is 50 * 8bits = 400bits
Also, a router is connected to other routers which means it is a dedicated path, hence full utilization.
This field is updated twice a second onto each line.
Hence, 800 bps is needed in each direction (as it is full duplex) for each line.

8. **For hierarchical routing with 4800 routers, what region and cluster sizes should be chosen to minimize the size of the routing table for a three-layer hierarchy? A good starting place is the hypothesis that a solution with clusters of k regions of k routers is close to optimal, which means that k is about the cube root of 4800 (around 16). Use trial and error to check out combinations where all three parameters are in the general vicinity of 16.**

Clusters × regions × routers=4800
The formula to minimize is (clusters−1) + (regions−1) + routers
Using trial and error we get, (15-1) + (16-1) + 20 = 49
Therefore, it takes 15 clusters, 16 regions and 20 routers to minimize the size of the routing table.