Answers to the quiz #4 in Computer Networks

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Questions.

1. What advantage does a circuit-switched network have over a packet-switched network? What advantage does TDM have over FDM in a circuit-switched network?

2. Why is it that packet switching is said to employ statistical multiplexing? Contrast statistical multiplexing with the multiplexing that takes place in TDM.

3. What is meant by connection state information in a virtual circuit network?

4. Suppose you are developing a standard for a new type of network. You need to decide whether your network will use VCs or datagram routing. What are the pros and cons for using VCs?

5. What are the advantages of message segmentation in packet-switched networks? What are the disadvantages?

6. Is HFC bandwidth dedicated or shared among users? Are collisions possible in a downstream HFC channel?

7. Consider sending a series of packets from a sending host to a receiving host over a fixed route. List the delay components in the end-to-end delay for a single packet. Which of these delays are constant and which are variable?

8. Consider an application that transmits data at a steady rate: it generates an N-bit unit of data every k time units, where k is small and fixed. Also, when such an application starts, it will continue running for a long period of time. Answer the following questions, briefly justifying your answer.

   (a) Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?

(b) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

Answers.

1. A circuit-switched network can guarantee a certain amount of end-to-end bandwidth for the duration of the call. Most packet-switched networks today (including the internet) cannot make any end-to-end guarantees for bandwidth. In a circuit-switched network using TDM, an application can use the full bandwidth at periodical moments.

2. In a packet-switched network, the packets from different sources flowing into a link do not follow any fixed pattern, or route. This is why packet switching is said to employ statistical multiplexing. In case of TDM circuit switching, each host gets the same slot in a revolving TDM frame: this is completely predictable.

3. In a virtual circuit network, each packet switch keeps in memory some information (like a table translating interface numbers to virtual circuit numbers) about the virtual circuits passing through them.

4. The cons of VC's include

   - the need to have a signaling protocol to set up and teardown the VCs;
   - the need to maintain connection state in the packet switches.

   The main advantage of VC networks is that they allow to guarantee an end-to-end delay.

5. One advantage of message segmentation is that it allows for pipelined transmission over a series of links. Another advantage is that, without it, small messages would be stuck behind much bigger ones in routers.

6. HFC bandwidth is shared among the users. On the downstream channel all the packets emanate from a single source, called the head end, so there are no collisions on this channel.

7. The delay components are nodal processing delays, transmission delays, propagation delays and queuing delays. Over a fixed route, all these delays are fixed, except the queuing delay, which is unpredictable.

8. (a) A circuit-switched network would be well suited to this application, because it involves long sessions with predictable bandwidth

requirements. So bandwidth can be reserved for each session. The delay of setting up a circuit is low compared to the time the application is running.

(b) Given such generous link capacities, the network need no congestion control. In the worst case, all the applications are emitting on the same link, but the link offers enough bandwidth.