Arab Academy for Science, Technology & Maritime Transport

COLLEGE OF ENGINEERING & TECHNOLOGY

Department	**Computer Engineering**
Course Code	**CC431**
Course	**Computer Networks**
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Sheet 1

Chapter 1

1. Consider an application that transmits data at a steady rate (for example, the sender 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 relatively 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 the application and 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?
2. Consider the circuit-switched network in the below figure:
    a. What is the maximum number of simultaneous connections that can be in progress at any one time in this network?
    b. Suppose that all connections are between the switch in the upper-left-hand corner and the switch in the lower–right-hand corner. What is the maximum number of simultaneous connections that can be in progress?

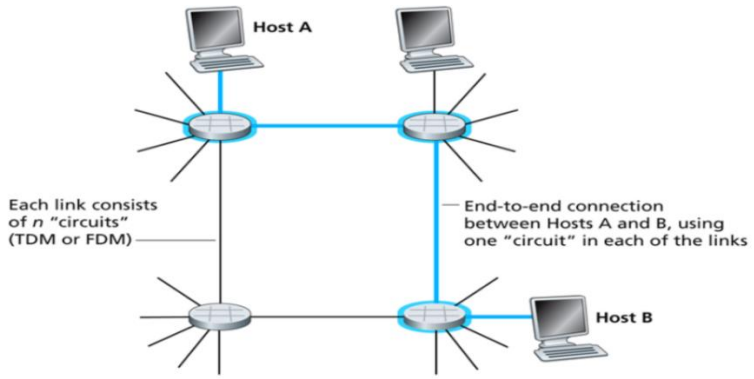

Figure 1.8 ♦ A simple circuit-switched network consisting of four switches and four links

3. Suppose we want to send a file of 160000 bits from host A to Host B over a circuit switched network. Suppose that all links in the network use TDM with 12 slots and have a bit rate of 1.536 Mbps. Also, suppose that it takes 600 msec to establish an end-to-end circuit before Host A can begin to transmit the file. How long does it take to send the file?
4. Consider two hosts, A and B, connected by a single link of R bps. Suppose the two hosts are separated by m meters, and suppose the propagation speed along the link is s meters/ sec. Host A is to send a packet of size L bits to Host B.
    a. Express the propagation delay, d_{prop}, in terms of m and s.
    b. Determine the transmission time of the packet, dt_{rans}, in terms of L and R.
    c. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
    d. Suppose Host A begins to transmit the packet at time t=0. At time t= d_{trans}, where is the last bit of the packet?
    e. Suppose d_{prop} is greater than d_{trans}. At t= d_{trans}, where is the first bit of the packet?
    f. Suppose d_{prop} is less than d_{trans}. At t= d_{trans}, where is the first bit of the packet?
    g. Suppose s= $2.5x10^8$, L= 100 bits, and R = 28 kbps. Find the distance m so that d_{prop} equals d_{trans}
5. In this problem we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64 kbps bit stream on the fly. Host A then groups the bits into 48-byte packets. There is one link between host A and B; its transmission rate is 1 Mbps and its propagation delay is 2msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet's bits to analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?
6. Consider a packet of length L which begins at end system A, travels over one link to a packet switch, and travels from the packet switch over a second link to a destination end system. Let d_i, s_i, and R_i denote the length, propagation speed and the transmission rate of the link I, for i=1, 2. The packet switch delays each packet by d_{proc}. Assuming no queuing delays, in terms of d_i, s_i, and R_i, (i=1, 2), and L, what is the total end-to-end delay for the packet? Suppose now the packet is 1000 bytes, the propagation speed on both link is 2.5 x 10^8 m/s, the transmission rates of both

links are 1 Mbps, the packet length is 1000 bytes, the packet switch processing delay is 1 msec, the length of the first link is 4000km, and the length of the last link is 1000km. For these values, what is the end-to-end delay?

7. In the above problem, suppose $R_1=R_2=R$ and $d_{proc}=0$. Further suppose the packet switch does not store-and-forward packets but instead immediately transmits each bit it receives before waiting for the packet to arrive. What is the end-to-end delay?
8. A packet switch receives a packet and determines the outbound link to which the packet should be forwarded. When the packet arrives, one other packet is halfway done being transmitted on the outbound link and three other packets are waiting to be transmitted. Packets are transmitted in order of arrival. Suppose all packets are 1000 bytes and the link rate is 1 Mbps. What is the queuing delay for the packet? More generally, what is the queuing delay when all packets have length L, the transmission rate is R, x bits of the currently- being transmitted packet have been transmitted, and n packets are already in the queue?
9. Suppose N packets arrive simultaneously to a link at which no packets are currently being transmitted or queued. Each packet is of Length L and the link has a transmission rate R. What is the average queuing delay for the N packets?