CSC645/745 COMPUTER NETWORKS

Homework 1

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1. What advantage does a circuit-switched network have over a packet-switched network? Consider an application that transmits data at a steady rate. Also, when such an application starts, it will continue running for a relatively long period of time. Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why? (10 Points)

A:

a) A circuit-switched network can guarantee a certain amount of end-to-end bandwidth for the duration of a call. Most packet-switched networks today (including the Internet) cannot make any end-to-end guarantees for bandwidth.

b) A circuit-switched network would be well suited to the application, because the application involves long sessions with predictable smooth bandwidth requirements. Since the transmission rate is known and not bursty, bandwidth can be reserved for each application session without significant waste. In addition, the overhead costs of setting up and tearing down connections are amortized over the lengthy duration of a typical application session.

2. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers? (10 Points)

A:

1.Application Layer

· Applications with appropriate requirement for user.

· It is reserved for network applications and their application protocols such as HTTP, SMTP, and FTP etc. · Its protocol uses transport layer protocols for establishing host-to-host connection.

2.Transport Layer

· It is responsible for End-to-Communication

· Transport layer transports messages from application layer between client and server of application

· It uses two protocol for transporting messages: TCP and UDP.TCP provides reliable connection oriented services, while UDP provides connectionless service

3.Network Layer

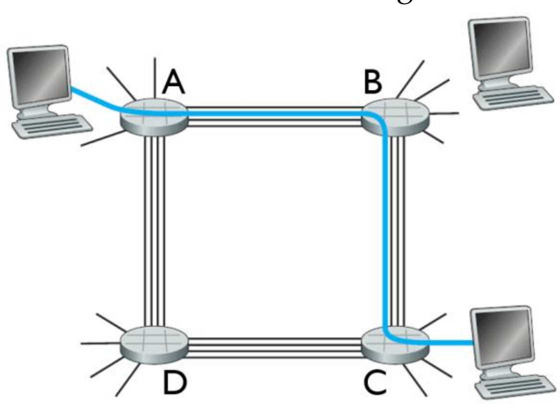
· Network Layer moves packets from one host to destination.

· It has two principal component: IP protocol:-It defines the datagrams and decide how the end system and router will work Routing protocols: these protocols decide the routing path between source and destination.

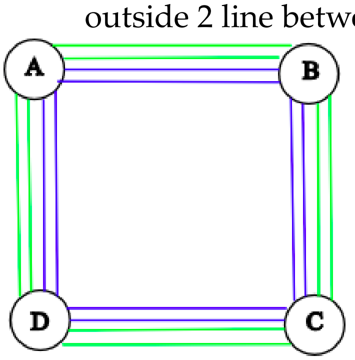
4.Link Layer
· It is responsible for link-level communication
· Link layer receives the data gram from network layer at each node and delivers it to next node, the next node passes the datagram to network layer.so This layer moves entire frames from one network element to adjacent one.
· The service provided by link layer is protocol dependent

5.Physical Layer
· It provides Physical media
· At each node, it moves individual bits of frames to next node.

3. Consider the following circuit-switched network. There are 4 circuits on each link.
    a. Suppose that all connections are between switches A and C. What is the maximum number of simultaneous connections that can be in progress? (5 Points)
    b. Suppose we want to make four connections between switches A and C, and another four connections between switches B and D. Can we route these calls through the four links to accommodate all eight connections? (5 Points)



A:
a) Suppose that all connections are between switches A and C. So it mean a->b->c, so it mean 4+4= 8, Max is 8
b) Yes, it possible to make 4 connections between A and C and other 4 connections between B and D. Because each link has 4 circults, So we can use the inside 2 link between A->B and use inside 2 link between B->C, therefore it has 4 Connections. Then we can use the outside 2 line between B->C and outside 2Link between C->D. Like the following graph.



The green colored represent the paths in clockwise direction
The Blue colored represent the path in couter-clockwise direction.

4. Consider two hosts, A and B, connected by a single link of rate *R* bps. Suppose that 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*. (3 Points)
   b. Determine the transmission time of the packet, d_{trans}, in terms of *L* and *R*. (3 Points)
   c. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay. (3 Points)
   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? (3 Points)
   e. Suppose d_{prop} is greater than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet? (3 Points)
   f. Suppose d_{prop} is less than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet? (3 Points)

A:

a) $d_{prop} = m/s$
b) $d_{trans}=L/R$
c) end-to-end delay = $d_{prop} + d_{trans}$ =m/s+ L/R
d) the bit will be sent from host A at that moment ,and it will moved just from host A
e) somewhere between A and B, will be reached at B but left from A
f) First will be destination Host B

5. Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R_1 = 500 kbps, R_2 = 2 Mbps, and R_3 = 1 Mbps.
   a. Assuming no other traffic in the network, what is the throughput for the file transfer? (3 Points)
   b. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B? (3 Points)
   c. Repeat (a) and (b), but now with R_2 reduced to 100 kbps. (6 Points)

A:

a) R_1 = 500 kbps, R_2 = 2 Mbps, and R_3 = 1 Mbps.
   The throught for the file transfer =Min{R_1,R_2,R_3}
   = Min{500kb,2Mb,1Mb}
   = 500kb
b) File size = 4million byte=$4*10^6$byte=$4*8*10^6$bit=$32*10^6$bits
   File transfer = 500kb =$5*10^5$bps
   T= File size/ File transfer =$32*10^6$bits /$5*10^5$bps =64 s
c) R_1 = 500 kbps, R_2 = 100kbps, and R_3 = 1 Mbps.
   The throught for the file transfer =Min{R_1,R_2,R_3}
   = Min{500kbps,100kbps,1Mbps}

= 100kbps

File transfer = 100kb =$1*10^5$bps

T== File size/ File transfer =$32*10^6$bits /$1*10^5$bps =320s

6. Consider a packet of length L which begins at end system A and travels over three links to a destination end system. These three links are connected by two packet switches. Let d_i, s_i, and R_i denote the length, propagation speed, and the transmission rate of link i, for i = 1, 2, 3. The packet switch delays each packet by d_{proc}. Assuming no queuing delays, in terms of d_i, s_i, R_i, (i = 1,2,3), and L, what is the total end-to-end delay for the packet? Suppose now the packet is 1,500 bytes, the propagation speed on all three links is 2.5×10^8 m/s, the transmission rates of all three links are 2 Mbps, the packet switch processing delay is 3 msec, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. For these values, what is the end-to-end delay? (10 Points)

A:

Packet size L= 1500 bytes = 1500*8= 12000bits

The progration speed S=2.5×10^8 m/s

The transmission rate R_1=R_2=R_3= 2 Mbps = $2*10^6$ bps

Switch processing delay d_{proc}= 3 msec

Length of link l_1=5000km

Length of link l_2=4000km

Length of link l_3=1000km

End- to –end delay d =L/R_1+L/R_2+L/R_3+l1/S+l2/S+l3/S+ d_{proc} + d_{proc}

=12000bits/$2*10^6$ bps *3 +5000km/2.5×10^8 m/s +4000km/2.5×10^8m/s+ 1000km/2.5×10^8 m/s +0.003+0.003

=0.018+ 0.02+0.016+0.004+0.003+0.003

=0.064 s

7. Suppose you would like to urgently deliver 40 terabytes (1 terabyte = 10^{12} bytes) data from Boston to Los Angeles. You have available a 100 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use FedEx overnight delivery? Explain. (5 Points)

A:

Date Size = 40 terabytes =$320*10^{12}$=$3.2*10^{14}$bits

Rate = 100 Mbps =10^8bps

FedEx can deliver 40TB of data overnight

T=Data size/Rate =$3.2*10^6$s=888.89 hr=37 days

Since using the data visa this link need more than 37 days, it wil cause some data missing and due to transmission issue, maybe it will increase the time. So prefeered to the data use FedEx overnight delivery.

8. In modern packet-switched networks, including the Internet, the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as message segmentation. Figure 1.27 illustrates the end-to-end transport of a message with and without message segmentation. Consider a message that is 8×10^6 bits long that is to be sent from source to destination in Figure 1.27. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays.
   a. Consider sending the message from source to destination without message segmentation. How long does it take to move the message from the source host to the first packet switch? Keeping in mind that each switch uses store-and-forward packet switching, what is the total time to move the message from source host to destination host? (10 Points)
   b. Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. How long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source host to the first switch. At what time will the second packet be fully received at the first switch? (10 Points)
   c. How long does it take to move the file from source host to destination host when message segmentation is used? Compare this result with your answer in part (a) and comment. (5 Points)

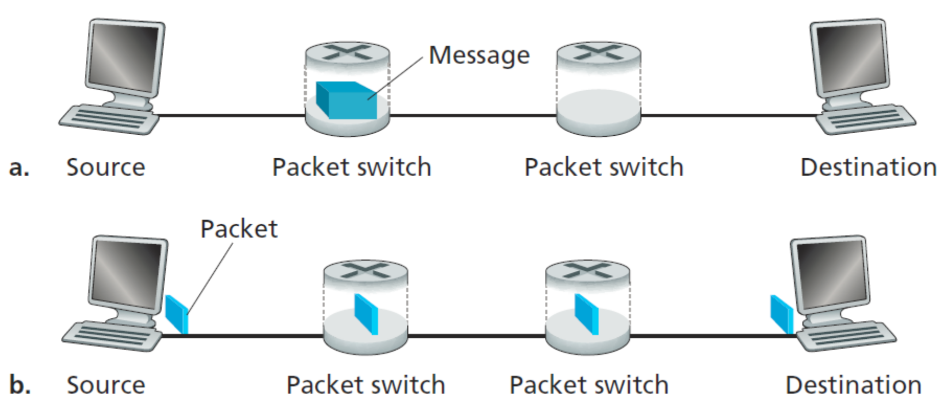


Figure 1.27 ♦ End-to-end message transport: (a) without message segmentation; (b) with message segmentation

A:

a. Size L = 8×10^6 bits
   Rate R=2 Mbps =2×10^6 bps
   t_a = L/R= 4s it take 4 sec to move the message from the source host to the first packet switch.

$T_a = t_a*3 = 12s$ the total 12 sec to move the message from source host to destination host

b. Size of each l= 10000 bits

$t_b = l/R = 5*10^{-3}s = 5msec$ it take 5 msec to move the first packet from source host to the first switch.

$T = t_b*2 = 10msec$ after 10msec will the second packet be fully received at the first switch

c. $T_b = T+(800-1)*t_b = 15+799*5 = 4010msec = 4.01$ s

Since $T_b < T_a$, $3T_b \approx T_a$, therefore, it is clear that message can be transmitted 3 times faster using segmentation when compared with message transferring using without segmentation.

Bonus Question

In class, we know that the end-to-end delay of sending one packet of length *L* over 2 links of transmission rate *R* from source host to destination host is $2 \cdot L/R$. What is the end-to-end delay for sending one packet of length *L* over *N* links of transmission rate *R*? What is the end-to-end delay for sending *P* such packets back-to-back over the *N* links? (10 Points)

A:

The general case of sending one packet from source to destination over a path consisting of N links each of rates R. so,

the end-to-end delay (d) = N(L/R)
one packet = the end-to-end delay (d) = N(L/R)

P packets = d_1
one packet x d_1 = d x p
1 x d_1 = [N(L/R)] x P
therefore, the end-to-end delay is
d_1 = [N(L/R)] x P