PES UNIVERSITY

COMPUTER NETWORKS

Unit1: Computer Networks and the Internet

Topic: Introduction to Computer Networks- What is Internet? A Nuts and Bolts description

1. What is the difference between a host and an end system? List several different types of end systems. Is a Web server an end system?
2. Describe the protocol that might be used by two people having a telephonic conversation to initiate and end the conversation.

Topic: What is a Protocol

1. Design and describe an application-level protocol to be used between an automatic teller machine and a bank's centralized computer. Your protocol should allow a user's card and password to be verified, the account balance (which is maintained at the centralized computer) to be queried, and an account withdrawal to be made (that is, money disbursed to the user). Your protocol entities should be able to handle the all-too-common case in which there is not enough money in the account to cover the withdrawal. Specify your protocol by listing the messages exchanged and the action taken by the automatic teller machine or the bank's centralized computer on transmission and receipt of messages. Sketch the operation of your protocol for the case of a simple withdrawal with no errors, using a diagram similar to that in Figure 1.2. Explicitly state the assumptions made by your protocol about the underlying end-to-end transport service.

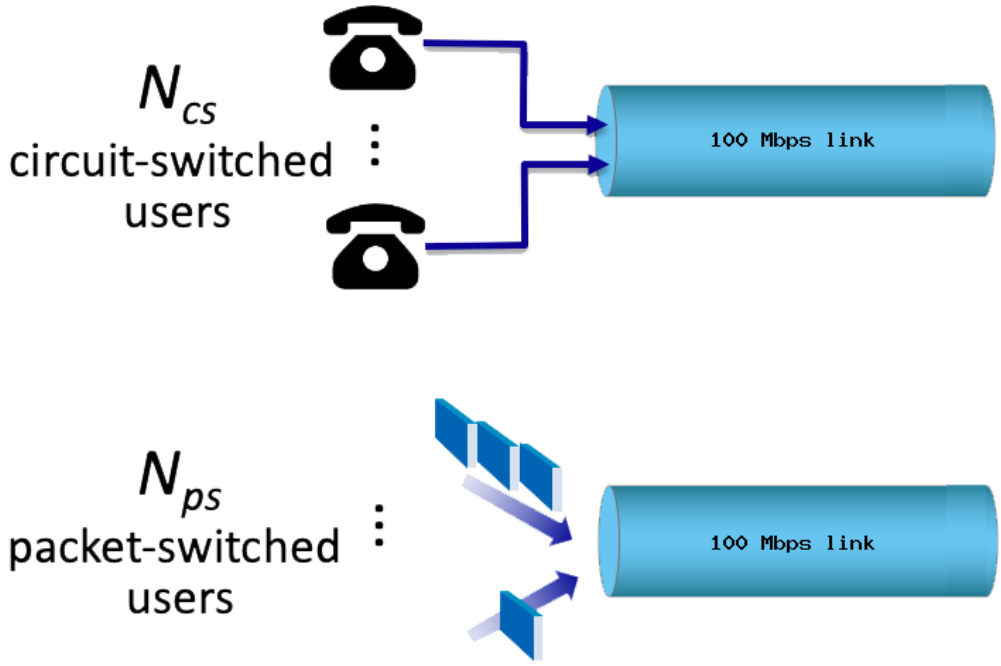
Topic: Access Networks

1. List six access technologies. Classify each one as home access, enterprise access, or wide-area wireless access.
2. Is HFC transmission rate dedicated or shared among users? Are collisions possible in a downstream HFC channel? Why or why not?
3. What access network technologies would be most suitable for providing Internet access in rural areas?

3. Dial-up modems and DSL both use the telephone line (a twisted-pair copper cable) as their transmission medium. Why then is DSL much faster than dial-up access?
4. What are some of the physical media that Ethernet can run over?
5. Dial-up modems, HFC, DSL and FTTH are all used for residential access. For each of these access technologies, provide a range of transmission rates and comment on whether the transmission rate is shared or dedicated.
6. Describe the different wireless technologies you use during the day and their characteristics. If you have a choice between multiple technologies, why do you prefer one over another?

Topic: Circuit Switching Vs Packet Switching

1. Consider the two scenarios below:
   A circuit-switching scenario in which Ncs users, each requiring a bandwidth of 25 Mbps, must share a link of capacity 100 Mbps.
   A packet-switching scenario with Nps users sharing a 100 Mbps link, where each user again requires 25 Mbps when transmitting, but only needs to transmit 20 percent of the time.



Round your answer to two decimals after leading zeros.

Questions

a. When circuit switching is used, what is the maximum number of users that can be supported?
b. Suppose packet switching is used. If there are 7 packet-switching users, can this many users be supported under circuit-switching? Yes or No.
c. Suppose packet switching is used. What is the probability that a given (specific) user is transmitting, and the remaining users are not transmitting?
d. Suppose packet switching is used. What is the probability that one user (any one among the 7 users) is transmitting, and the remaining users are not transmitting?
e. When one user is transmitting, what fraction of the link capacity will be used by this user? Write your answer as a decimal.
f. What is the probability that any 3 users (of the total 7 users) are transmitting and the remaining users are not transmitting?
g. What is the probability that more than 4 users are transmitting?

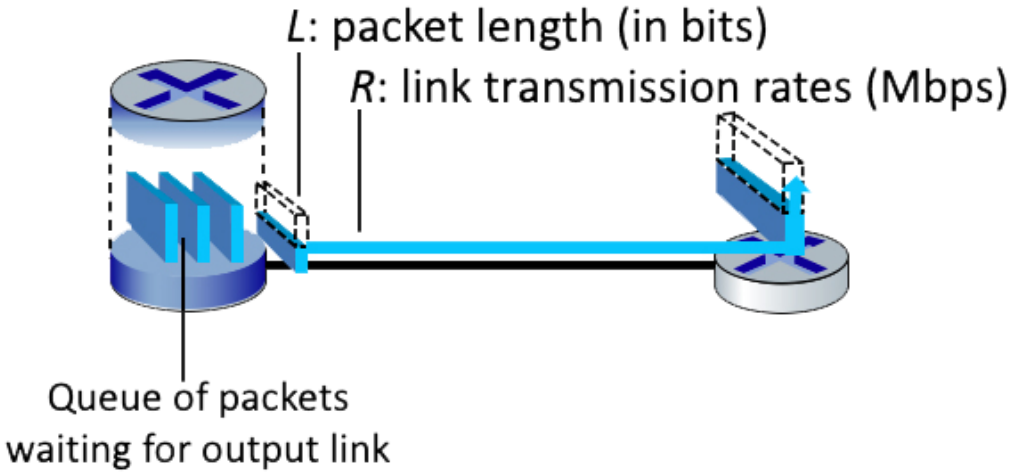
Topic: Internet Structure

1. Why will two ISPs at the same level of the hierarchy often peer with each other? How does an IXP earn money?
2. Why is a content provider considered a different Internet entity today? How does a content provider connect to other ISPs? Why?

Topic: Overview of delay in Packet-switched networks, Queuing delay and Packet

Problems on Delay - 1

1. Consider the figure below, in which a single router is transmitting packets, each of length L bits, over a single link with transmission rate R Mbps to another router at the other end of the link.



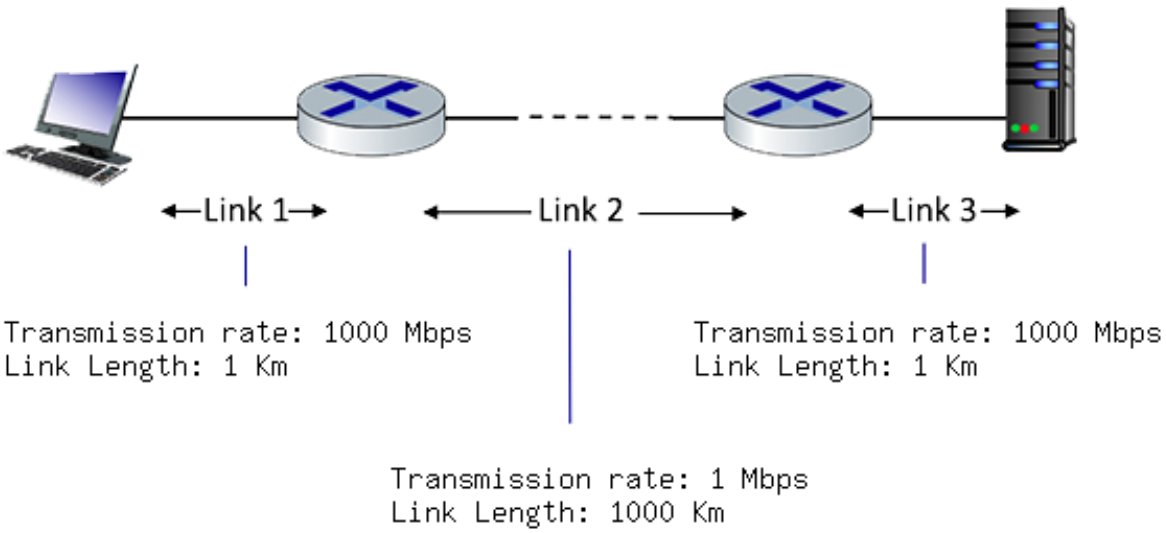
Suppose that the packet length is L= 16000 bits, and that the link transmission rate along the link to router on the right is R = 100 Mbps. Round your answer to two decimals after leading zeros.

Questions

a. What is the transmission delay?
b. What is the maximum number of packets per second that can be transmitted by this link?

Problems on Delay - 2

Consider the figure below, with three links, each with the specified transmission rate and link length.



Assume the length of a packet is 8000 bits. The speed of light propagation delay on each link is 3x10^8 m/sec. Round your answer to two decimals after leading zeros.

Questions

a. What is the transmission delay of link 1?

b. What is the propogation delay of link 1?

c. What is the total delay of link 1?

d. What is the transmission delay of link 2?

e. What is the propogation delay of link 2?

f. What is the total delay of link 2?

g. What is the transmission delay of link 3?

h. What is the propogation delay of link 3?

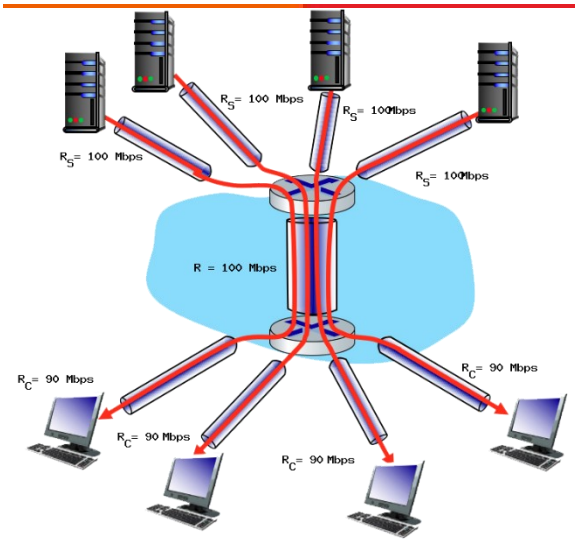
i. What is the total delay of link 3?

j. What is the total delay?

Topic: End-to-End delay, Throughput in computer networks

1. Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of R = 100 Mbps. The four links from the servers to the shared link have a transmission capacity of RS = 100 Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of RC = 90 Mbps.

You might want to review Figure 1.20 in the text before answering the following questions.



Questions

a. What is the maximum achievable end-end throughput (in Mbps) for each of four client-to-server pairs, assuming that the middle link is fairly shared (divides its transmission rate equally)?

b. Which link is the bottleneck link? Format as Rc, Rs, or R.

c. Assuming that the servers are sending at the maximum rate possible, what are the link utilizations for the server links (RS)? Answer as a decimal.

d. Assuming that the servers are sending at the maximum rate possible, what are the link utilizations for the client links (RC)? Answer as a decimal.

e. Assuming that the servers are sending at the maximum rate possible, what is the link utilizations for the shared link (R)? Answer as a decimal.

2. 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?

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?

c. Repeat (a) and (b), but now with R2 reduced to 100 kbps.

Topic: Protocol layers - The OSI model Layered Architecture

1. If two end-systems are connected through multiple routers and the data-link level between them ensures reliable data delivery, is a transport protocol offering reliable data delivery between these two end-systems necessary? Why?
2. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?
3. What do encapsulation and de-encapsulation mean? Why are they needed in a layered protocol stack?
4. Which layers in the Internet protocol stack does a router process? Which layers does a link-layer switch process? Which layers does a host process?

Topic: TCP variants located in the ISO/OSI protocol stack

1. Early versions of TCP combined functions for both forwarding and reliable delivery. How are these TCP variants located in the ISO/OSI protocol stack? Why were forwarding functions later separated from TCP? What were the consequences?