CSCE 416: Homework 1   
  
  
**Chapter 1**

**R1. 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?**

There is no difference. End systems include: PCs, Web servers, mail servers, game consoles (internet connected).

**R13. Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 1 Mbps when transmitting, but each user transmits only 50 percent of the time. (See the discussion of statistical multiplexing in Section 1.3.)**

1. **When circuit switching is used, how many users can be supported?** two users
2. **For the remainder of this problem, suppose packet switching is used. Why will there be essentially no queuing delay before the link if two or fewer users transmit at the same time? Why will there be a queuing delay if three users transmit at the same time?**
3. **Find the probability that a given user is transmitting.**   
   0.5  
     
   **--Suppose there are 4 users using packet switching. What is the probability that more users are transmitting simul. than that supported by circuit switching?**  
     
   Four users, active 1/2 the time.

P(4) users = 1/16 (1/2 ^ 4)

P(3) users = Users A, B, C, D

ABC /D = (1/2)^4 = 1/16

ABD /C = (1/2)^4 = 1/16

ACD /B = 1/16

BCD /A = 1/16

P(3) users = 4/16

The probability that more users are active is P(4) + P(3) = 1/16 + 4/16 = 5/16

**R16. Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?**

nodal processing (constant), queueing delay(variable, based on traffic), transmission delay(variable, based on packet length), propagation delay(constant).

**R18. How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed 2.5 · 108 m/s, and transmission rate 2 Mbps? More generally, how long does it take a packet of length L to propagate over a link of distance d , propagation speed s , and transmission rate R bps? Does this delay depend on packet length? Does this delay depend on transmission rate?**   
  
10msec; d/s; no; no  
  
**-How many round trips would it take to dl a web page that contains 8 embedded objects from the same server? Assume that the page and each of the embedded objects are small and their transmission times are negligible. Answer this question for each of the following versions of HTTP.**

-Non persistent HTTP with no parallel TCP connections.

2 round trips times + 2 RTT\*8 = 18RTT

-Non persistent HTTP with 2 parallel TCP connections.

2RR + 8(#of images)/2(#ofparallel) x 2RTT(cost per) = 10RTT

-Persistent HTTP connection w/o pipelining.

2RTT + 8RTT = 10RTT

-Persistent HTTP connection with pipelining.

2RTT + 1RTT = 3RTT

**R19. 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 R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps.**

1. **Assuming no other traffic in the network, what is the throughput for the file transfer?**
2. **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. **Repeat (a) and (b), but now with R2 reduced to 100 kbps.**   
     
   9. a) 500 kbps   
   b) 4\*10^6 \* 8 (to convert to bits) / 5+10^3 = 64 seconds  
   c) 100kbps;   
   320 seconds

**R23. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?**   
  
the application layer, - network application protocols (HTTP, SMTP, FTP)  
the transport layer, -application messages between applications(TCP, UDP)  
the network layer, moves packets from one point to another via (IP)  
the link layer, moves data between routers (ethernet, wifi)  
and the physical layer. Moves the bits (copper wire, fibre optic)

**R25. 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?**router processes network, link and physical layers.  
Link layer switches process link and physical layers.  
Hosts process all five layers.

**P5. Review the car-caravan analogy in Section 1.4. Assume a propagation speed of 100 km/hour.**

1. **Suppose the caravan travels 150 km, beginning in front of one tollbooth, passing through a second tollbooth, and finishing just after a third tollbooth. What is the end-to-end delay?**90 minutes (travel time = propogation delay) + 6 minutes (toll booths = queueing delay). 96 minutes.
2. **Repeat (a), now assuming that there are eight cars in the caravan instead of ten.**90 + 1.6\*3

**P6. This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. 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.**

1. **Express the propagation delay, dprop , in terms of m and s .**dprop = m/s
2. **Determine the transmission time of the packet, dtrans , in terms of L and R .**dtrans = L/R
3. **Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.**dprop + dtrans
4. **Suppose Host A begins to transmit the packet at time t = 0. At time t = dtrans, where is the last bit of the packet?**still not out of host A
5. **Suppose dprop is greater than dtrans . At time t = dtrans , where is the first bit of the packet?** It has travelled (s x L/R) meters.
6. **Suppose dprop is less than dtrans . At time t = dtrans , where is the first bit of the packet?** It has arrived and been received by the destination end system.
7. **Suppose s = 2.5 · 108, L = 120 bits, and R = 56 kbps. Find the distance m so that dprop equals dtrans.**

1 = m {m} / 2.5·108{m/s} + 120 {bits} / 56000 {b/s}

1 = m {m}/ 2.5·108{m/s}+ 0.002142857 {s}

1 – 0.002142857 {s} = m / 2.5·108{m/s}

0.99785714 {s}= m {m}/ 2.5·108{m/s}

0.99785714 {s}/ 2.5·108{m/s} = m {m}

**SOLUTION:**               = (3.991429e–9) m

**-Suppose 2 hosts. A and B, are seperated by 10^6 meters and are connected by a direct link of R=1mbps. Suppose the propagation speed over the link is 2.5 \* 1-^8 meters/sec. Suppose a file of 800,000 bits form host A to host B is sent continuoously as one large message. What is the max number of bits that will be in the link at any given time?**

Distance = 10^6 meters

Bandwith = 1MBPS (10^6bitspersecond)

Speed = 2.5\*10^8m/s

**Find the propogation delay, then use that to figure out how many bits.**

Prop Delay = Distance/Speed

= 10^6 / 2.5\*10^8

= 1 / 2.5\*10^2

= 1 / 250 seconds

**How many bits will be in the link at any given time?**

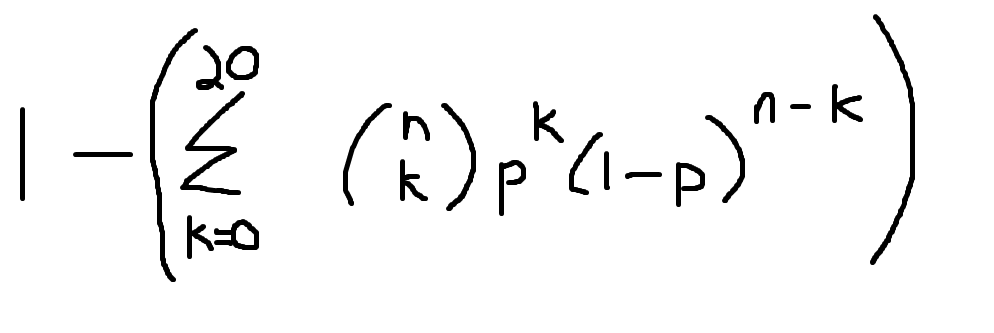
10^6 / 250 = 1/250 \* 10^3 \* 10^3 = 4 x 10^3 = 4000bits.

**P8. Suppose users share a 3 Mbps link. Also suppose each user requires**

**150 kbps when transmitting, but each user transmits only 10 percent of the time.**

**(See the discussion of packet switching versus circuit switching in**

**Section 1.3.)**

1. **When circuit switching is used, how many users can be supported?**3 x 10^6MBPS | 150 x 10^3kbps 0.1 transmission rate  
     
   20 users
2. **For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.**0.1
3. **Suppose there are 120 users. Find the probability that at any given time, exactly n users are transmitting simultaneously. (Hint : Use the binomial distribution.)**(n choose k) p^k (1-p)^n-k  
     
   (120 choose n)0.1^n(0.9)^120-n
4. **Find the probability that there are 21 or more users transmitting simultaneously.   
     
   **

**P24. Suppose you would like to urgently deliver 40 terabytes 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.**\*convert to bits, terabyte is 10^12, gigabyte is 10^9, megabyte is 10^6, kilobyte is 10^3  
  
( 40 \* 10^12 ) / (100 \* 10^6) = 40/100 \* 10^6 seconds =

**P25. Suppose two hosts, A and B, are separated by 20,000 kilometers and are connected by a direct link of R = 2 Mbps. Suppose the propagation speed over the link is 2.5 x 108 meters/sec.**

1. **Calculate the bandwidth-delay product, R \* dprop .**R \* dprop = 2 \* 10^6 \* (20,000 \* 10^3 / 2.5 \* 10^8) = 1.6 \* 10^5
2. **Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one large message. What is the maximum number of bits that will be in the link at any given time?**1.6\*10^5
3. **Provide an interpretation of the bandwidth-delay product.**It is the maximum number of bits that the link can contain in the same time.
4. **What is the width (in meters) of a bit in the link? Is it longer than a football field?**20000 x 10^3 / 1.6 \* 10^5
5. **Derive a general expression for the width of a bit in terms of the propagation speed s, the transmission rate R, and the length of the link m.**m / R\*(s/m) = s/R

**Chapter 2**

**R3. For a communication session between a pair of processes, which process is the client and which is the server?**The process waiting to be contacted is the server, the process doing the contacting is the client.

**R5. What information is used by a process running on one host to identify a process running on another host?**ip address and port

**R6. Suppose you wanted to do a transaction from a remote client to a server as fast as possible. Would you use UDP or TCP? Why?**you would use UDP, as it will only take on RTT because you don’t have to perform multiple TCP connections.

**R11. Why do HTTP, FTP, SMTP, and POP3 run on top of TCP rather than on UDP?**

These all need sequential ordering without gaps, UDP does not provide this.

**R13. Describe how Web caching can reduce the delay in receiving a requested object. Will Web caching reduce the delay for all objects requested by a user or for only some of the objects? Why?**Webcaching will ‘save’ information on the local machine to help reduce traffic required to load a page next time.

**R19. Is it possible for an organization’s Web server and mail server to have exactly the same alias for a hostname (for example, foo.com )? What would be the type for the RR that contains the hostname of the mail server?**Yes, it can. The protocols would be different (HTTP and SMTP). MX-record would send mail requests to the correct mail server.

**R21. In BitTorrent, suppose Alice provides chunks to Bob throughout a 30-second interval. Will Bob necessarily return the favor and provide chunks to Alice in this same interval? Why or why not?**No, Bob may not be in Alice’s top four uploaders.

**R22. Consider a new peer Alice that joins BitTorrent without possessing any chunks. Without any chunks, she cannot become a top-four uploader for any of the other peers, since she has nothing to upload. How then will Alice get her first chunk?**She will be selected by optimistic unchoking.

**R23. What is an overlay network? Does it include routers? What are the edges in the overlay network?**The nodes in a P2P network, and the logical links between them., the edges are the logical connections between peers.

**R26. In Section 2.7, the UDP server described needed only one socket, whereas the TCP server needed two sockets. Why? If the TCP server were to support n simultaneous connections, each from a different client host, how many sockets would the TCP server need?**Already answered.

**R27. For the client-server application over TCP described in Section 2.7, why must the server program be executed before the client program? For the client-server application over UDP, why may the client program be executed before the server program?**TCP requires a connection so there server must be ready in order to communicate. UDP does not require a connect so it does not worry about the server.

**P1. True or false?**

1. **A user requests a Web page that consists of some text and three images. For this page, the client will send one request message and receive four response messages.**false, each request will have 2 rtt
2. **Two distinct Web pages (for example, www.mit.edu/research.html and www.mit.edu/students.html ) can be sent over the same persistent connection.**true
3. **With non-persistent connections between browser and origin server, it is possible for a single TCP segment to carry two distinct HTTP request messages.**false
4. **The Date: header in the HTTP response message indicates when the object in the response was last modified. “**false
5. **HTTP response messages never have an empty message body.**false

**P25. Consider an overlay network with N active peers, with each pair of peers having an active TCP connection. Additionally, suppose that the TCP connections pass through a total of M routers. How many nodes and edges are there in the corresponding overlay network?**n \* (n-1)/2

**P26. Suppose Bob joins a BitTorrent torrent, but he does not want to upload any data to any other peers (so called free-riding).**

1. **Bob claims that he can receive a complete copy of the file that is shared by the swarm. Is Bob’s claim possible? Why or why not?**Yes, if there are peers he can be optimistically unchoked.
2. **Bob further claims that he can further make his “free-riding” more efficient by using a collection of multiple computers (with distinct IP addresses) in the computer lab in his department. How can he do that?**Yes, it will be more efficient because he can combine the chunks into a single file.