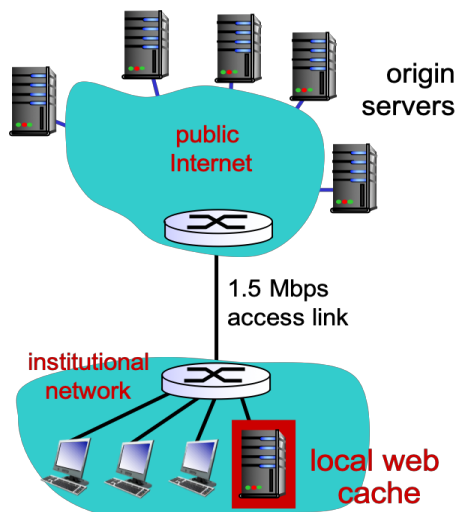


## Homework Assignment

1. (1pt) What are the advantages and disadvantages of circuit-switched network and packet-switched network?
2. (2pt) 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?
3. (2pt) What is the difference between transmission delay and propagation delay? Will the length of the packet affect the propagation delay and why?
4. (5pt) Consider the following institutional network system. Suppose the average object size is 100k bits and the average rate from browsers to origin servers is 15 requests/sec. (ignore the LAN delay in the following questions)



Assume that  $R_{access} = 1.5$  Mbps and the RTT on the Internet side of the access link is 2 sec.

- a. Considering the queueing delay in the access router, the access delay could be calculated with the

$$D_{access} = \frac{R_{Trans}}{(1 - \text{traffic intensity})} \cdot R_{Trans}$$

represents the transmission delay at the access link. Without web cache, what is the total average response time?

- b. Compare this result with the situation where  $R_{access} = 100$  Mbps.

5. (5pt) Two hosts, A and B, are directly connected via a link  $R = 1$  Mbps. The distance between A and B is 10,000 kilometers and the propagation speed over the link is  $2.5 \times 10^8$  m/s.

- a. How long does it take to send a file of 20,000 bits from A to B?
- b. Suppose now the file is broken up into 5 packets with each packet containing 4,000 bits. Suppose that each packet is acknowledged by the receiver and the transmission time of an acknowledgment packet is negligible. Finally, assume that the sender cannot send a packet until the preceding one is acknowledged. How long does it take to send the file?
- c. Now assume there are two separate links between host A and host B, i.e.  $R_1 = 500$  kbps and  $R_2 = 10$

Mbps. Roughly, how long does it take to send the same file?

6. (extra credit – 3pt) Referring to problem 4, suppose the local web cache satisfy 60% of the requests, the remaining 40% requests will be satisfied by the origin web servers. What is the total response time in this case?