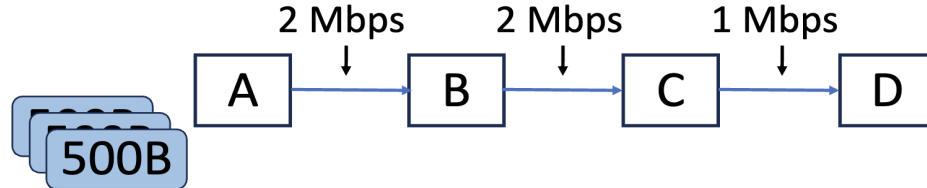


CS422 Computer Networks (Fall 2025): Homework 1

(Due Date: **23:59:59PM Tue Sep 16, 2025**, Total: 40 points)

1. (6 points) The Purdue campus deploys wireless access points and campus routers to offer *PAL*.
 - (a) (2 points) Do these wireless access points belong to the access network or the core network? Why?
 - (b) (2 points) Could you make three other examples of access networks you have used?
 - (c) (2 points) What are two basic functions of network core (routers) in the Internet?
2. (16 points) Consider sending THREE packets from Node A to Node D. They are separated by 1,000 meters and are connected by a direct link with a transmission rate of 2 Mbps ($2\text{Mbps} = 2 \times 10^6$ bits per second). The propagation speed over the link is 1×10^6 meters per second and each packet length is 500 bytes ($500 * 8$ bits). A starts transmitting the first packet at time $t = 0$,
 - (a) (3 points) What are the transmission delay for a single packet and the propagation delay of the A–D link?
 - (b) (3 points) When will the last bit of the 3rd packet arrive at D?
 - (c) (10 points) Assume there is no direct link between A and D. Instead, packets must traverse two routers, B and C (see the figure below). Each packet length is still 500 bytes ($500 * 8$ bits). The propagation delay of links A–B, B–C, and C–D is 1 msec (0.001 second). The transmission rates of links A–B and B–C are 2 Mbps, and the transmission rate of link C–D is 1 Mbps. Assume the routers' buffers are empty, large enough, and that there are no other packets besides these THREE packets. A starts transmitting the first packet at time $t = 0$,



- i. (4 points) When does the first packet arrive at D?
 - ii. (3 points) What is the time gap between the first and second packets when they arrive at D? (i.e. the time gap between receiving the last bit of the first packet and the last bit of 2nd packet)
 - iii. (3 points) When will D receive all the three packets?
3. (10 points) Web browsing and HTTP.
 - (a) (3 points) What is the purpose the following request sent to `www.cs.purdue.edu`? Which web browser is used?
GET / HTTP/1.1\r\n
Host: www.cs.purdue.edu\r\n
User-Agent: Firefox/3.6.10\r\n
Accept: ... \r\n
Accept-Language: ... \r\n
\r\n
 - (b) (2 points) If this HTTP request is served by the website normally, what will be the first line in the response message?

- (c) (3 points) Suppose we want to fetch the image with URL = `www.cs.purdue.edu/images/home/student-new.jpg`. What will be the first line in the request message?
- (d) (2 points) If the previously requested image does not exist on the server, what will be the first line in the response message?
4. (8 points) A client is fetching a base html file with 10 referenced objects from an Internet server. Assume the base html file is extremely small, $<1KB$ and each object file size is $L = 1KB$ ($1B = 8 \text{ bit}$) and it is also small. Assume the transmission rate for each file and referenced objects is constant, if any, is $R = 100Mbps$. Assume that the only transmission/reception bottleneck in the network is the access link through which the client is connected to the Internet and the RTT is also constant, say $RTT = 1s$.
- (a) (3 points) If the client uses HTTP/1.1, compute the delay for non-persistent HTTP connection without parallel TCP connections.
- (b) (3 points) If the client uses HTTP/1.1, compute the delay for the persistent HTTP without pipelining.
- (c) (2 points) Compute the delay for non-persistent HTTP with parallel TCP connections. (no limit on the number of parallel connections)