

# Week 2. Review Questions

## Section 1.4

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?

R17. Visit the Transmission Versus Propagation Delay interactive animation at the Companion Website. Among the rates, propagation delay, and packet sizes available, find a combination for which the sender finishes transmitting before the first bit of the packet reaches the receiver. Find another combination for which the first bit of the packet reaches the receiver before the sender finishes transmitting.

R18. A user can directly connect to a server through either long-range wireless or a twisted-pair cable for transmitting a 1500-bytes file. The transmission rates of the wireless and wired media are 2 and 100 Mbps, respectively. Assume that the propagation speed in air is  $3 * 10^8$  m/s, while the speed in the twisted pair is  $2 * 10^8$  m/s. If the user is located 1 km away from the server, what is the nodal delay when using each of the two technologies?

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  $R_1 = 500$  kbps,  $R_2 = 2$  Mbps, and  $R_3 = 1$  Mbps.

- Assuming no other traffic in the network, what is the throughput for the file transfer?
- 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?
- Repeat (a) and (b), but now with  $R_2$  reduced to 100 kbps.

R20. Suppose end system A wants to send a large file to end system B. At a very high level, describe how end system A creates packets from the file. When one of these packets arrives to a router, what information in the packet does the router use to determine the link onto which the packet is forwarded? Why is packet switching in the Internet analogous to driving from one city to another and asking directions along the way?

R21. Visit the Queuing and Loss interactive animation at the Companion Website. What is the maximum emission rate and the minimum transmission rate? With those rates, what is the traffic intensity? Run the interactive animation with these rates and determine how long it takes for packet loss to occur. Then repeat the experiment a second time and determine again how long it takes for packet loss to occur. Are the values different? Why or why not?

## Section 1.5

R22. 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?

R23. What are the five layers in the Internet protocol stack? What are the principal responsibilities of each of these layers?

R24. What do encapsulation and de-encapsulation mean? Why are they needed in a layered protocol stack?

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?