Week 2. Review Question Answers

Answers:

16. The delay components are processing delays, transmission delays, propagation delays, and queuing delays. All of these delays are fixed, except for the queuing delays, which are variable.

17. a) 1000 km, 1 Mbps, 100 bytes
    b) 100 km, 1 Mbps, 100 bytes

18. The nodal delay for the long-range wireless link is $1500 \times 8 / (2 \times 10^6) + 1000 / (3 \times 10^8)$ s = 6.003 ms. That for the twisted pair is $1500 \times 8 / (100 \times 10^6) + 1000 / (2 \times 10^8)$ s = 0.125 ms.

19. a) 500 kbps
    b) 64 seconds
    c) 100kbps; 320 seconds

20. End system A breaks the large file into chunks. It adds header to each chunk, thereby generating multiple packets from the file. The header in each packet includes the IP address of the destination (end system B). The packet switch uses the destination IP address in the packet to determine the outgoing link. Asking which road to take is analogous to a packet asking which outgoing link it should be forwarded on, given the packet's destination address.

21. The maximum emission rate is 500 packets/sec and the maximum transmission rate is 350 packets/sec. The corresponding traffic intensity is 500/350 =1.43 > 1. Loss will eventually occur for each experiment; but the time when loss first occurs will be different from one experiment to the next due to the randomness in the emission process.

22. A reliable data link protocol can recover from errors affecting transmissions on individual links. However, there are more sources of losses in an interconnection network formed by multiple routers. For instance, messages can be dropped by a router whose buffer is completely filled with packets. Moreover, a router may malfunction or break, thus destroying all buffered messages. Thus, it makes more sense to use a transport protocol for reliable data delivery in the considered scenario.

23. The five layers in the Internet protocol stack are – from top to bottom – the application layer, the transport layer, the network layer, the link layer, and the physical layer. The principal responsibilities are outlined in Section 1.5.1.

24. Encapsulation is the process of passing a packet from a higher layer to a lower layer. In the simplest case, it simply appends additional information (i.e., a *header*) to the source packet. In more complicated scenarios, the original packet can be split into multiple packets, each carrying its own header. Decapsulation is the opposite process of encapsulation. It extracts the header from a source packet from a lower layer and passes the payload to the higher layer. If lower layer packets are part of a sequence, the corresponding payloads are put together before they are passed to the higher layer. Each protocol in a layer

of a protocol stack relies on the services of the lower layers but not on their information. Thus, the information a protocol needs to process a packet should entirely be contained in the header of that protocol. Encapsulation and decapsulation are flexible mechanisms to allow each protocol to operate independently from others while being able to interface with each other.

25. Routers process network, link and physical layers (layers 1 through 3). (This is a little bit of a white lie, as modern routers sometimes act as firewalls or caching components, and process Transport layer as well.) Link layer switches process link and physical layers (layers 1 through2). Hosts process all five layers.