Assignment 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?

A host is an end system and an end system is a host. These can include systems, desktops, phones, tablets, and even sensors. Even a web server is an end system.

R2. The word protocol is often used to describe diplomatic relations. How does Wikipedia describe diplomatic protocol?

A diplomatic protocol is the rules of etiquette for heads of state.

R3. Why are standards important for protocols?

Standards set how both communicating computers send and interpret data so that they do so in the same manner.

R4. List six access technologies. Classify each one as home access, enterprise access, or wide area wireless access.

* DSL(Digital Subscriber Line) - Home Access
* Cable - Home Access
* FTTH(Fiber to the Home) - Home Access
* Dial-Up - Home Access
* Satellite - Home Access
* LTE - Wide Area Network Access

R5. Is HFC transmission rate dedicated or shared among users? Are collisions possible in a downstream HFC channel? Why or why not?

The transmission rate is shared among users. Also, collisions are not possible since all packets come from the same source, known as the head end.

R6. List the available residential access technologies in your city. For each type of access, provide the advertised downstream rate, upstream rate, and monthly price.

* Dial-Up
* DSL
* Cable Modem
* FTTH

R7. What is the transmission rate of Ethernet LANs?

The transmission rates of Ethernet LANs are 10 Mbps, 100 Mbps, 1 Gbps and 10 Gbps.

R8. What are some of the physical media that Ethernet can run over?

Ethernet usually runs over twisted copper wire or fiber optic links.

R9. Dial-up modems, HFC, DSL and FTTH are all used for residential access. For each of these access technologies, provide a range of ­transmission rates and comment on whether the transmission rate is shared or dedicated.

* Dial Up Modems: Up to 56 Kbps; dedicated.
* HFC: Up to 42.8 Mbps down, 30.7 Mbps upstream; shared
* DSL: Up to 24 Mbps down, 2.5 Mbps upstream; dedicated
* FTTH: 10-20 Mbps down, 2-10 Mbps upstream; dedicated

R10. Describe the most popular wireless Internet access technologies today. ­Compare and contrast them.

WIFI and 4G are the most popular wireless internet access technologies today. WIFI transmits/received packets from a base station and has a smaller radius between the two (a few tens of meters). The base station is usually wired to connect wireless users. 4G on the other hand transmit the packets over the wireless infrastructure used for cell phones. This means the access radius can be tens of kilometers.

R11. Suppose there is exactly one packet switch between a sending host and a receiving host. The transmission rates between the sending host and the switch and between the switch and the receiving host are R1 and R2, respectively. Assuming that the switch uses store-and-forward packet switching, what is the total end-to-end delay to send a packet of length L? (Ignore queuing, propagation delay, and processing delay.)

(L/R1) + (L/R2)

R12. What advantage does a circuit-switched network have over a packet-switched network? What advantages does TDM have over FDM in a circuit-switched network?

A circuit-switched network can guarantee a certain amount of end-to-end bandwidth for a call unlike most packet-switched networks. An advantage TDM has over FDM is that each host gets the same slot in a revolving TDM frame.

R13. Suppose users share a 2 Mbps link. Also suppose each user transmits continuously at 1 Mbps when transmitting, but each user transmits only 20 percent of the time. (See the discussion of statistical multiplexing in Section 1.3.)

a. When circuit switching is used, how many users can be supported?

2 users since each user requires 1 Mbps.

b. 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?

There will essentially be no queuing delay before the link with two or fewer users since the users share 2 Mbps and each user uses 1 Mbps. Therefore, there would be no delay with two or less users. With three or more, there will be delay since the required bandwidth would be 3 Mbps.

c. Find the probability that a given user is transmitting.

Probability: 0.2

d. Suppose now there are three users. Find the probability that at any given time, all three users are transmitting simultaneously. Find the fraction of time during which the queue grows.

Probability: 0.2^3 = 0.008

R14. Why will two ISPs at the same level of the hierarchy often peer with each other? How does an IXP earn money?

By peering with each other, they will be able to reduce their spending as they would not have to send traffic through a provider ISP.

R15. Some content providers have created their own networks. Describe Google’s network. What motivates content providers to create these networks?

Google's private network connects all its data centers and the traffic goes through the private network due to this. Also, the data-centers tend to be close to low-tier ISPs, which bypasses the higher-tier ones. This gives content providers more control which motivates them more.

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?

Delay components:

* Processing delays; Constant
* Transmission delays; Constant
* Propagation delays; Constant
* Queuing Delays; Variable

R17. Visit the Transmission Versus Propagation Delay applet at the companion Web site. 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.

* s = Propagation speed = 2.8 \* 108 m/s
* d = link length = 1000 km
* E = End-to-End delay = 3.620 ms
* L = Packet length = 1 Kbps
* R = Transmission rate = 10Mbps

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 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?

(2500 \* 10^3) /(2.5\*10^8) = 0.01s = 10ms.

The delay does not depend on packet length nor transmission rate.

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

a. Assuming no other traffic in the network, what is the throughput for the file transfer?

500 kbps

b. 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?

32000000bits/500000 bps = 64s

c. Repeat (a) and (b), but now with R reduced to 100 kbps.

32000000 bits/100000 bps = 320s

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?

End system A breaks the file into chunks, adding a header to each one. This generates multiple packets and the header of each has the IP address for end system B. The packet switch then uses the IP to determine the outgoing link. Its like driving to another city since it has to find out how to go to the other place based on the address given.

R21. Visit the Queuing and Loss applet at the companion Web site. What is the maximum emission rate and the minimum transmission rate? With those rates, what is the traffic intensity? Run the applet 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?

The max is 500 packets per second and minimum is 350. The intensity is 1.43 > 1. The loss occurs for each experiment, and the time loss occurs is random.

R22. List five tasks that a layer can perform. Is it possible that one (or more) of these tasks could be performed by two (or more) layers?

* Flow Control
* Error Control
* Segmentation and Reassembly
* Multiplexing
* Connection setup

Tasks can be duplicated at different layers.

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

* Application layer: Sends data over multiple end systems.
* Transport layer: Transfers the content between two endpoints.
* Network layer: Move the packets between any two hosts in the network.
* Data link layer: Move the packets from one node to the next another node.
* Physical layer: Transfer the individual bits from one node to the next node with in the frame.

R24. What is an application-layer message? A transport-layer segment? A network-layer datagram? A link-layer frame?

* Application-layer message: Data which an application wants to send.
* Transport-layer segment: Encapsulates application-layer message with transport layer header
* Network-layer datagram: Encapsulates transport-layer segment with a network-layer header
* Link-layer frame: Encapsulates network layer datagram with a link-layer header

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 process network, link, and physical layers. Link-layer switches process link and physical layers. Host processes all 5 of them.

R26. What is the difference between a virus and a worm?

A virus requires a form of user interaction while a worm does not.

R27. Describe how a botnet can be created and how it can be used for a DDoS attack.

The attacker finds a vulnerability and scans for hosts that are vulnerable due to it. The target is to compromise a series of systems through this vulnerability and the botnet can be remotely controlled and issues commands. This then allows issue commands to all nodes to target a single node.

R28. Suppose Alice and Bob are sending packets to each other over a computer network. Suppose Trudy positions herself in the network so that she can capture all the packets sent by Alice and send whatever she wants to Bob; she can also capture all the packets sent by Bob and send whatever she wants to Alice. List some of the malicious things Trudy can do from this position.

Trudy can modify the messages between the two, acting as one of them or even drop packets being sent, causing miscommunication.