HOMEWORK

**R1.** What is the difference between a host and an end system? List several differenttypes of end systems. Is a Web server an end system?

* There is no difference. Throughout this text, the words “host” and “end system” are usedinterchangeably. End systems include PCs, workstations, Web servers, mail servers, PDAs,Internet-connected game consoles, etc.

**R3.** Why are standards important for protocols?

* Standards are important for protocols so that people can create networking systems andproducts that interoperate.

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

* 1. Dial-up modem over telephone line: home; 2. DSL over telephone line: home or small office;3. Cable to HFC: home; 4. 100 Mbps switched Ethernet: enterprise; 5. Wifi (802.11):homeand enterprise: 6. 3G and 4G: wide-area wireless.

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

* HFC bandwidth is shared among the users. On the downstream channel, all packets emanatefrom a single source, namely, the head end. Thus, there are no collisions in the downstreamchannel.

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

* In most American cities, the current possibilities include: dial-up; DSL; cable modem; fiber-to-the-home.

**R7.** What is the transmission rate of Ethernet LANs?

* Ethernet LANs have transmission rates of 10 Mbps, 100 Mbps, 1 Gbps and 10 Gbps.

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

* Today, Ethernet most commonly runs over twisted-pair copper wire. It also can run over fibersoptic links.

**R11**. At time t0 the sending host begins to transmit. At time t1 = L/R1, the sending host completes transmission and the entire packet is received at the router (no propagation delay). Because the router has the entire packet at time t1, it can begin to transmit the packet to the receiving host at time t1. At time t2 = t1 + L/R2, the router completes transmission and the entire packet is received at the receiving host (again, no propagation delay). Thus, the end-to-end delay is L/R1 + L/R2.

**R12**. A circuit-switched network can guarantee a certain amount of end-to-end bandwidth for the duration of a call. Most packet-switched networks today (including the Internet) cannot make any end-to-end guarantees for bandwidth. FDM requires sophisticated analog hardware to shift signal into appropriate frequency bands.

**R13**. a) 2 users can be supported because each user requires half of the link bandwidth.

b) Since each user requires 1Mbps when transmitting, if two or fewer users transmit simultaneously, a maximum of 2Mbps will be required. Since the available bandwidth of the shared link is 2Mbps, there will be no queuing delay before the link. Whereas, if three users transmit simultaneously, the bandwidth required will be 3Mbps which is more than the available bandwidth of the shared link. In this case, there will be queuing delay before the link.

c) Probability that a given user is transmitting = 0.2

d) Probability that all three users are transmitting simultaneously = = (0.2)3 = 0.008. Since the queue grows when all the users are transmitting, the fraction of time during which the queue grows (which is equal to the probability that all three users are transmitting simultaneously) is 0.008.

**R14**. If the two ISPs do not peer with each other, then when they send traffic to each other they have to send the traffic through a provider ISP (intermediary), to which they have to pay for carrying the traffic. By peering with each other directly, the two ISPs can reduce their payments to their provider ISPs. An Internet Exchange Points (IXP) (typically in a standalone building with its own switches) is a meeting point where multiple ISPs can connect and/or peer together. An ISP earns its money by charging each of the the ISPs that connect to the IXP a relatively small fee, which may depend on the amount of traffic sent to or received from the IXP.

**R15**. Google's private network connects together all its data centers, big and small. Traffic between the Google data centers passes over its private network rather than over the public Internet. Many of these data centers are located in, or close to, lower tier ISPs. Therefore, when Google delivers content to a user, it often can bypass higher tier ISPs. What motivates content providers to create these networks? First, the content provider has more control over the user experience, since it has to use few intermediary ISPs. Second, it can save money by sending less traffic into provider networks. Third, if ISPs decide to charge more money to highly profitable content providers (in countries where net neutrality doesn't apply), the content providers can avoid these extra payments.

**R26**. A virus requires some form of user interaction to infect a system.  
A worm on the other hand, requires no interaction. Instead a hacker may send a piece of malware to a vulnerable network application, and have the application run it, creating the worm.  
a) Virus Requires some form of human interaction to spread. Classic example: E-mail viruses.   
b) Worms No user replication needed. Worm in infected host scans IP addresses and port numbers, looking for vulnerable processes to infect

**R27**. Creation of a botnet requires an attacker to find vulnerability in some application or system (e.g. exploiting the buffer overflow vulnerability that might exist in an application). After finding the vulnerability, the attacker needs to scan for hosts that are vulnerable. The target is basically to compromise a series of systems by exploiting that particular vulnerability . Any system that is part of the botnet can automatically scan its environment and propagate by exploiting the vulnerability. An important property of such botnets is that the originator of the botnet can remotely control and issue commands to all the nodes in the botnet. Hence, it becomes possible for the attacker to issue a command to all the nodes, that target a single node (for example, all nodes in the botnet might be commanded by the attacker to send a TCP SYN message to the target, which might result in a TCP SYN flood attack at the target).

**P5**. a. We know the propagation speed is 100km/hr, travelling distance is 150 km and each tollbooth services a car at a rate of one car per 12 seconds. In additional, there are 10 cares. The time taken by a car to travel 150km is 150km/100km/hr = 1.5 hr = 90 min The overall tollbooths service time for 10 cars is 12\*3\*10 = 360 seconds = 6 min Finally, the end to end time delay for 10 cars is 90 min + 6 min = 96 min

b. For 8 cars, the overall tollbooths service time should be 12\*3\*8= 288 seconds = 4.8 min Finally, the end to end time delay for 8 cars is 90 min + 4.8 min = 94.8 min.

**P6**.

a. Express the propagation delay, dprop, in terms of m and s.

b. Determine the transmission time of the packet, dtrans, in terms of L and R.

c. Ignoring processing and queuing delays, obtain an expression for the end-

to-end delay.

d. Suppose Host A begins to transmit the packet at time t = 0. At time t = dtrans, where is the last bit of the packet?

e. Suppose dprop is greater than dtrans. At time t = dtrans, where is the first bit of the packet?

f. Suppose dprop is less than dtrans. At time t = dtrans, where is the first bit of the packet?

g. Suppose s = 2.5 · 108, L = 120 bits, and R = 56 kbps. Find the distance m so that dprop equals dtrans.

**P7**. Since this is a packet switched network, the data will be transmitted packet by packet. A packet is 56 byte and the analog to digital conversation rate is 64 kbps, thus the preparing time Tp for a packet is (56\*8)/(64\*1000)= 0.007 s =  7 ms. The transition time Dtrans for a packet is (56\*8)/(2\*1000\*1000) =0.000224 s = 0.224ms. Tprop = 10ms Finally, the total time elapses from the time a bit is create until the bit is decoded is Tp+Dtrans+Tprop= 7+0.224+10 = 17.224 ms

**P8.**

a. There are 3Mbps/150kbps = 20 users can be supported.

b. According to the article, each user transmits only 10 percent of the time. Hence, suppose the probability that a given user is transmitting is p, we have p = 0.1 1

c. As we have known from the question 2, we can compute the probability as

The probability =

d. Because we want to know the probability that there are 21 or more users transmitting simultaneously, according to the question 3, we can say that

The probability = 1 −