第一章作业如下：

1-1. Five routers are to be connected in a point-to-point subnet . Between each pair of routers, the designers may put a high-speed line, a medium-speed line, a low-speed line, or no line. If it takes 100 ms of computer time to generate and inspect each topology, how long will it take to inspect all of them?  
  
1-2. What are two reasons for using layered protocols? What is one possible disadvantage of using layered protocols?  
  
1-3. What is the principal difference between connectionless communication and connection-oriented communication? Give one example of a protocol that uses  
(i) connectionless communication  
(ii) connection-oriented communication  
  
1-4. In some networks, the data link layer handles transmission errors by requesting that damaged frames be retransmitted. If the probability of a frame's being damaged is p, what is the mean number of transmissions required to send a frame? Assume that acknowledgements are never lost.  
  
1-5. A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers?

1-6. What is the main difference between TCP and UDP?  
  
1-7. When a file is transferred between two computers, two acknowledgement strategies are possible. In the first one, the file is chopped up into packets, which are individually acknowledged by the receiver, but the file transfer as a whole is not acknowledged. In the second one, the packets are not acknowledged individually, but the entire file is acknowledged when it arrives. Discuss these two approaches.

1-8. An image is 1024 X 768 pixels with 3 bytes/pixel. Assume the image is uncompressed. How long does it take to transmit it over a 56-kbps modem channel?  
Over a 1-Mbps cable modem?  
Over a 10-Mbps Ethernet?   
Over 100-Mbps Ethernet?  
Over gigabit Ethernet?  
  
1-9. Suppose the algorithms used to implement the operations at layer k is changed. How does this impact operations at layers k − 1 and k + 1?

1-10. Suppose there is a change in the service (set of operations) provided by layer k. How does this impact services at layers k-1 and k+1?

第二章作业如下：

2-1. A noiseless 4-kHz channel is sampled every 1 msec. What is the maximum data rate? How does the maximum data rate change if the channel is noisy, with a signal-to-noise ratio of 30 dB?

2-2. If a binary signal is sent over a 3-kHz channel whose signal-to-noise ratio is 20 dB, what is the maximum achievable data rate?

2-3. How much bandwidth is there in 0.1 microns of spectrum at a wavelength of 1 micron?

2-4. It is desired to send a sequence of computer screen images over an optical fiber. The screen is 1920x1200 pixels, each pixel being 24 bits. There are 50 screen images per second. How much bandwidth is needed?

2-5. Radio antennas often work best when the diameter of the antenna is equal to the wavelength of the radio wave. Reasonable antennas range from 1 cm to 5 meters in diameter. What frequency range does this cover?

2-6. Ten signals, each requiring 4000 Hz, are multiplexed onto a single channel using FDM. What is the minimum bandwidth required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

2-7. Why has the PCM sampling time been set at 125 μsec?

2-8. Compare the maximum data rate of a noiseless 4-kHz channel using  
(a) Analog encoding (e.g., QPSK) with 2 bits per sample.  
(b) The T1 PCM system.

2-9. A CDMA receiver gets the following chips: (-1 +1 -3 +1 -1 -3 +1 +1). Assuming the chip sequences defined in Fig. 2-28(a), which stations transmitted, and which bits did each one send?

2-10. A cable company decides to provide Internet access over cable in a neighborhood consisting of 5000 houses. The company uses a coaxial cable and spectrum allocation allowing 100 Mbps downstream bandwidth per cable. To attract customers, the company decides to guarantee at least 2 Mbps downstream bandwidth to each house at any time. Describe what the cable company needs to do to provide this guarantee.

第三章作业如下：

3-1. The following data fragment occurs in the middle of a data stream for which the byte stuffing algorithm described in the text is used: A B ESC C ESC FLAG FLAG D. What is the output after stuffing?

3-2. Can you think of any circumstances under which an open-loop protocol (e.g., a Hamming code) might be preferable to the feedback-type protocols discussed throughout this chapter?

3-3. An 8-bit byte with binary value 10101111 is to be encoded using an even-parity Hamming code. What is the binary value after encoding?

3-4. What is the remainder obtained by dividing x7 + x5 +1by the generator polynomial x3+1?

3-5. Suppose that a message 1001 1100 1010 0011 is transmitted using Internet Checksum (4-bit word). What is the value of the checksum?

3-6. A channel has a bit rate of 4 kbps and a propagation delay of 20 msec. For what range of frame sizes does stop-and-wait give an efficiency of at least 50%?

3-7. A 3000-km-long T1 trunk is used to transmit 64-byte frames using protocol 5. If the propagation speed is 6 μsec/km, how many bits should the sequence numbers be?

3-8. In protocol 6, when a data frame arrives, a check is made to see if the sequence number differs from the one expected and no nak is true. If both conditions hold, aNAK is sent. Otherwise, the auxiliary timer is started. Suppose that the else clause were omitted. Would this change affect the protocol’s correctness?

3-9. Suppose that the three-statement while loop near the end of protocol 6 was removed from the code. Would this affect the correctness of the protocol or just the performance? Explain your answer.

3-10. Frames of 1000 bits are sent over a 1-Mbps channel using a geostationary satellite whose propagation time from the earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three-bit sequence numbers are used. What is the maximum achievable channel utilization for

(a) Stop-and-wait?

(b) Protocol 5?

(c) Protocol 6?

第四章作业如下：

4-1. A group of N stations share a 56-kbps pure ALOHA channel. Each station outputs a 1000-bit frame on average once every 100 sec, even if the previous one has not yet been sent (e.g., the stations can buffer outgoing frames). What is the maximum value of N?

4-2. A large population of ALOHA users manages to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec.

(a) What is the chance of success on the first attempt?

(b) What is the probability of exactly k collisions and then a success?

(c) What is the expected number of transmission attempts needed?

4-3. What is the length of a contention slot in CSMA/CD for

(a) a 2-km twin-lead cable(signal propagation speed is 82% of the signal propagation speed in vacuum)?, and

(b) a 40-km multimode fiber optic cable (signal propagation speed is 65% of the signal propagation speed in vacuum)?

4-4. Consider five wireless stations, A, B, C, D, and E. Station A can communicate with all other stations. B can communicate with A, C and E. C can communicate with A, B and D. D can communicate with A, C and E. E can communicate A, D and B.

(a) When A is sending to B, what other communications are possible?

(b) When B is sending to A, what other communications are possible?

(c) When B is sending to C, what other communications are possible?

4-5. What is the baud rate of classic 10-Mbps Ethernet?

4-6. Sketch the Manchester encoding on a classic Ethernet for the bit stream 0001110101.

4-7. A 1-km-long, 10-Mbps CSMA/CD LAN (not 802.3) has a propagation speed of

200 m/μsec. Repeaters are not allowed in this system. Data frames are 256 bits long, including 32 bits of header, checksum, and other overhead. The first bit slot after a successful transmission is reserved for the receiver to capture the channel in order to send a 32-bit acknowledgement frame. What is the effective data rate, excluding overhead, assuming that there are no collisions?

4-8. An IP packet to be transmitted by Ethernet is 60 bytes long, including all its headers. If LLC is not in use, is padding needed in the Ethernet frame, and if so, how many bytes?

4-9. Consider building a CSMA/CD network running at 1 Gbps over a 1-km cable with no repeaters. The signal speed in the cable is 200,000 km/sec. What is the minimum frame size?

第五章作业如下：

5-1. Give three examples of protocol parameters that might be negotiated when a connection is set up.

5-2. Consider the network of Fig. 5-12(a). Distance vector routing is used, and the following vectors have just come in to router C: from B: (5, 0, 8, 12, 6, 2); from D: (16, 12, 6, 0, 9, 10); and from E: (7, 6, 3, 9, 0, 4). The cost of the links from C to B, D, and E, are 6, 3, and 5, respectively. What is C’s new routing table? Give both the outgoing line to use and the cost.

5-3. If costs are recorded as 8-bit numbers in a 50-router network, and distance vectors are exchanged twice a second, how much bandwidth per (full-duplex) line is chewed up by the distributed routing algorithm? Assume that each router has three lines to other routers.

5-4. Suppose that host A is connected to a router R 1, R 1 is connected to another router, R 2, and R 2 is connected to host B. Suppose that a TCP message that contains 900 bytes of data and 20 bytes of TCP header is passed to the IP code at host A for delivery to B. Show the Total length, Identification, DF, MF, and Fragment offset fields of the IP header in each packet transmitted over the three links. Assume that link A-R1 can support a maximum frame size of 1024 bytes including a 14-byte frame header, link R1-R2 can support a maximum frame size of 512 bytes, including an 8-byte frame header, and link R2-B can support a maximum frame size of 512 bytes including a 12-byte frame header.

5-5. A router is blasting out IP packets whose total length (data plus header) is 1024 bytes. Assuming that packets live for 10 sec, what is the maximum line speed the router can operate at without danger of cycling through the IP datagram ID number space?

5-6. An IP datagram using the Strict source routing option has to be fragmented. Do you think the option is copied into each fragment, or is it sufficient to just put it in the first fragment? Explain your answer.

5-7. Suppose that instead of using 16 bits for the network part of a class B address originally, 20 bits had been used. How many class B networks would there have been?

5-8. A large number of consecutive IP addresses are available starting at 198.16.0.0. Suppose that four organizations, A, B, C, and D, request 4000, 2000, 4000, and 8000 addresses, respectively, and in that order. For each of these, give the first IP address assigned, the last IP address assigned, and the mask in the w.x.y.z/s notation.

5-9. A router has the following (CIDR) entries in its routing table:

|  |  |
| --- | --- |
| Address/mask | Next hop |
| 135.46.56.0/22 | Interface 0 |
| 135.46.60.0/22 | Interface 1 |
| 192.53.40.0/23 | Router 1 |
| default | Router 2 |

For each of the following IP addresses, what does the router do if a packet with that  
address arrives?  
(a) 135.46.63.10  
(b) 135.46.57.14  
(c) 135.46.52.2  
(d) 192.53.40.7  
(e) 192.53.56.7

第六章作业如下：

6-1. In both parts of Fig. 6-6, there is a comment that the value of SERVER PORT must be the same in both client and server. Why is this so important?

6-2. In the Internet File Server example (Figure 6-6), can the connect( ) system call on the client fail for any reason other than listen queue being full on the server? Assume that the network is perfect.

6-3. One criteria for deciding whether to have a server active all the time or have it start on demand using a process server is how frequently the service provided is used. Can you think of any other criteria for making this decision?

6-4. Why does the maximum packet lifetime, T, have to be large enough to ensure that not only the packet but also its acknowledgements have vanished?

6-5. Discuss the advantages and disadvantages of credits versus sliding window protocols .

6-6. Why does UDP exist? Would it not have been enough to just let user processes send raw IP packets?

6-7. A process on host 1 has been assigned port p, and a process on host 2 has been assigned port q. Is it possible for there to be two or more TCP connections between these two ports at the same time?

6-8. Consider the effect of using slow start on a line with a 10-msec round-trip time and no congestion. The receive window is 24 KB and the maximum segment size is 2 KB. How long does it take before the first full window can be sent?

6-9. In a network whose max segment is 128 bytes, max segment lifetime is 30 sec, and has 8-bit sequence numbers, what is the maximum data rate per connection?

6-10. To get around the problem of sequence numbers wrapping around while old packets still exist, one could use 64-bit sequence numbers. However, theoretically, an optical fiber can run at 75 Tbps. What maximum packet lifetime is required to make sure that future 75-Tbps networks do not have wraparound problems even with 64-bit sequence numbers? Assume that each byte has its own sequence number, as TCP does.