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VIII Sem BE (CSE)

Computer Networks

Question Bank

CHAPTER-1

Introduction

1. In the future, when everyone has a home terminal connected to a computer network, instant public referendums on important pending legislation will become possible ultimately, existing legislatures could be eliminated, to let will of the people be expressed directly. The aspects of such a direct democracy are fairly obvious: discuss some of then negative aspects.
2. An alternative to a LAN is simply a big timesharing system with terminals for all users. Give two advantages of a client-server system using a LAN
3. A collection to a five routers is to be big 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 to fine the one that best matches the expected load?
4. A group of 2n -1 routers are interconnected in a centralized binary tree, with a router at each tree mode. Router I communicate with router j by sending a massage back down to j. Derive an approximate expression for the mean number of hope per massage for large n, assuming that all router pairs are equally likely.
5. A disadvantage of a broadcast subnet is the capacity wasted due to multiple hosts attempting to access the channel at the same time. As a simplistic example, suppose that time is divided into discrete slots, with each of the n hosts attempting to use the channel with probability p during each slot. What fraction of the slots are wasted due to collisions?
6. What are the SAP addresses in FM radio broadcasting?
7. What is the principal difference between connectionless communication and connection- oriented communication?
8. Two each provide reliable connection- oriented service. One of them offers a reliable byte stream and the other offers a reliable message stream. Are these identical? If so, why is the distinction made? If not, give an example of how they differ.
9. What is the difference between a confirmed service and an unconfirmed service? For each of the following, tell whether it might be a confirmed service, an unconfirmed service, both or neither.
    (a) Connection establishment
    (b) Data transmission

(c) Connection release

10 What does "negotiation "mean when discussing network protocols? Give an example of it

11 What are two reasons for using layered protocols?

12 List two ways in which the OSI reference model and the TCP/IP reference model are the same. Now list two ways in which they differ?

13 The president of the Specialty Paint Corp. Gets the idea to work together with a local beer brewer for the purpose of producing an invisible beer can (as an anti litter measure) The president tells her legal department to look into it and they turn ask engineering for help. As a result, the chief engineer calls his counterpart at the other company to discuss the technical aspects of the project. The engineers then report back to their respective legal departments, which the confer by financial side of the deal. Is this an example of a multilayer protocol in the sense of the OSI model?

14 In most networks, the data link layer handles transmission errors by requesting damaged frames to be retransmitted. If the probability of a frame's being damaged is p, what is the mean number of transmissions required to sent a frame if acknowledgements ments are never lost?

15 Which of the OSI layers handles each of the following
(a) Breaking the transmitted bit stream into frames
(b) Determining which route thorough the subnet to use

16 Do TPDUs encapsulate packets or the other way around? Discuss

17 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?

18 What is the main difference between TCP/and UDP?

19 Does the Novell Net Ware architecture look more like X.25 or like the internet? Explain your answer

20 The Internet is roughly doubling in size every 18 months. Although no one really knows for sure, one estimate put the number of hosts on it at 7 million in January 1996. Use these data to computer the expected number of internet hosts in the year 2008.

21 Why was SMDS designed as a connectionless network and frame relay as a connection-oriented one

22 Imagine the you have trained your St. Bernard, Bernie, to carry a box of three 8mm Exabyte tapes instead of a flask of brandy. (When your disk fills up, you consider that an emergency) These tapes each contain 7 gigabytes. The dog can travel to your side, wherever you may be, at 18 km/hour. For what range of distances does Bernie have a higher data rate than a 155-Mbps ATM line?

23 When transferring a file between two computers (at least) two acknowledgement strategies are possible. In the first one, the first is chopped up into packets, which are individually acknowledged by the receiver, but the file transfer as a whole is not acknowledged. In second one, the packets are not acknowledged individually, but the entire file is acknowledged when it arrives. Discuss these two approaches.

24 Imagine that the SMDS packet of Fig. 1-28 were to be incorporated in OSI protocol hierarchy. In which layer would it appear?

25 Give an advantage and a disadvantage of frame relay over a leased telephone line

26 Why does ATM use small, fixed- length cells?

27 List two advantages and two disadvantages of having international standards for net work protocols

28 When a system has a permanent part and a removable part, such as a diskette drive and the diskette, it is important that the system be standardized, so that different companies can make both the permanent and removable part and have everything work together. Give three examples outside the computer industry where they do not exist.

CHAPTER-2

THE PHYSICAL LAYER

1. Computer the Fourier coefficients for the function f (t) = t (0<t < 1).
2. a noiseless 4-khz channel is sampled every 1 msec. What is the maximum data rate?
3. Television channels are 6 MHz wide. How many bits /sec can be sent if four level digital signals are used? Assume a noiseless channel.
4. 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?
5. What is the difference between a passive star and an active on a 50-kHz line?
6. What is the difference between a passive star and an active repeater in a fiber optic network?
7. How much bandwidth is there in 0.1 micron of spectrum at a wavelength of 1 micron?
8. It is desired to send a sequence of computer screen image over an optical fiber. The screen is 480x640 pixels, each pixel being 24 bits. There are 60 screen image per second. How much bandwidth is needed, and how many microns of wavelength are needed for the band at 1.30 microns?
9. Is the Nyquist theorem true for optical fiber, or only for copper wire?
10. In Fig 2-6 the left hand band is narrower than the other. Why?
11. 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?
12. Multipath fading is maximized when the two beams arrive 180 degrees out of phase. How much of a path difference is required to maximize the fading for a 50 km long 1 GHz microwave link?
13. A laser beam 1 mm wide is aimed at a detector 1 mm wide 100 m away on the roof of a building. How much of an angular diversion (in degrees) does the laser have to have before it misses the detector?
14. A simple telephone system consists of two end offices and a single toll office to which each end office is connected by a 1-MHz full-duplex trunk. The average telephone is used to make four calls per 8 hour workday. The mean call duration is 6 min ten percent of the calls are long distance (i e. pass though the toll office) What is the maximum number of telephones an end office can support? (Assume 4 kHz per circuit.)
15. A regional telephone company has 10 million subscribers. Each of their telephone is connected to a central office by a copper twisted pair. The average length of these twisted pairs is 10 km. How much is the copper in the local loops worth ?

Assume that the cross section of each strand is a circle 1 mm in diameter the specific gravity of copper is 9.0 and that copper sells for 3 dollars per kilogram

16. The cost of a powerful microprocessor has dropped to the points where it is now possible to include one in each modem. How does that affect the handling of telephone line errors?
17. A modem constellation diagram similar to Fig 2-19 has data points at the following coordinates: (1,1),(1,-1),(-1,1),and (-1,-1).How many bps can a modem with these parameters
18. A modem constellation diagram similar to Fig. 2-19 has data points at (0,1) and (0,2). Does the modem use phase modulation or amplitude modulation?
19. Does FTTH fit into the telephone company model of end offices, and so on, or does the model have to be changed in a fundamental way? Explain your answer
20. At the low end, the telephone system is star shaped, with all the local loops in a neighborhood converging on an end office, In contrast, cable television consists of a single long cable snaking its way past all the houses in the same neighborhood. Suppose that a future TV cable were 10 Gbps fiber instead of copper. Could it be used to simulate the telephone model of everybody having their own private line to the end office? If so how many one –telephone house could be booked up to a single fiber?
21. A cable TV system has 100 commercial channels, all of them alternating programs with advertising. Is this more like TDM or like FDM?
22. Why has the PCM sampling time been set at 125 μsec?
23. What is the percent overhead on a T1 carrier; that is , what percent of the 1.544 Mbps are not delivered to the end user ?
24. Compare the maximum data rate of a noiseless 4-kHz channel using
    (a) Analog encoding with 2 bits per sample.
    (b) The T1 PCM system.
25. If a T1 carrier system slips and loses track of where it is tries to resynchronize using the 1st bit in each frame. How many frames will have tc be inspected on the average to resynchronize with a probability of 0.001 of being wrong
26. What is the difference, if any between the demodulator part of a modem and the coder part of a codec? (After all, both convert analog signals to digital ones.)
27. A signal is transmitted digitally over a 4-kHz noiseless channel with one sample every 125 μsec. How many bits per second are actually sent for each of these encoding methods?
    (a) CCITT 2.048 Mbps standard.
    (b) DPCM with a 4- bit relative signal value
    (c) Delta modulation
28. A pure sine wave of amplitude A is encoded using delta modulation with x samples/sec. An output of +1 corresponds to a signal change of + A/8, and an output signal of -1 corresponds to a signal change of –A/8.what is the highest frequency that can be tracked without cumulative error?
29. SONET clocks have a drift rate of about 1 part in 10^9. How long does it take for the drift to equal the width of 1 bit? What are the implication of this calculation?
30. In Fig 2-32 the user data rate for OC-3 is stated to be 148.608 Mbps. Show how this number can be derived from the SONET OC- 3 parameters.
31. What is the available user bandwidth in an OC-12c connection?
32. Three packet-switching networks each contain n nodes. The first network has a stat topology with a central switch, the second is a (bidirectional) ring, and the

third is fully interconnected with a wire from every node to every other node. What are the best average, and worst case transmission paths in hops?

33 Compare the delay in sending an x-bit massage over a k-hop path in a circuit-switched network and in a (lightly loaded) packet- switched network. The circuit setup time in s sec, the propagation delay is d sec hop, the packet size is p bits, and the data rate is b bps. Under what condition does the packet network have a lower delay?

34 Suppose that x bin of user data are to be transmitted over a k-hop path in a packet-switched network as a –series of packets, each containing p data bits and h header bits, with x > p + h. The bit rate of the lines is b bps and the propagation delay is negligible. What value of p minimizes the total delay ?

35 How many crosspoints do the switches of Fig 2-39(a) and Fig 2-39 (b) have? Compare this to a full 16 X 16 single –stage crossbar switch.

36 In the space division switch of fig 2-39 (a) and, what is the smallest number of existing connections that can block a new outgoing call?

37 An alternative design to that of Fig. 2-39(a) is one in which the 16 lines are divided into two blocks of eight, instead of four blocks of four (i.e., $n = 8$ instead of $n = 4$). Such a design would save on hardware costs, since only two concentrators would be needed on the input and output sides. What is the strongest argument against this alternative?

38 How many lines can a time division switch handle if the RAM access time is 50 nsec?

39 How many bits of RAM buffer does a time switch interchanger need if the input line samples are 10 bits and there are 80 input lines?

40 Does time division switching necessarily introduce a minimum delay at each switching stage? If so, what is it?

41 How long does it take to transmit an 8 inch by 10 inch image by facsimile over an ISDN B channel? The facsimile digitizes the image into 300 pixels per inch and assigns 4 bits per pixel. Current FAX machines go faster than this over ordinary telephone lines. How do you think they do it?

42 Give an advantage and a disadvantage of NT12 (as opposed to NTI and NT2) in an ISDN network.

43 In Fig. *2-50(a)* we saw collisions between cells traveling through a banyan switch. These collisions occurred in the first and second stages. Can collisions also occur in the third stage? If so, under what conditions?

44 For this problem you are to route some cells through a Batcher-banyan ATM switch step by step. Four cells are present on input lines 0 through 3, headed for 3, *5,* 2, and I respectively. For each of the six stages in .the Batcher switch and the four steps in theow this banyan switch (including the input and output), list which cells are there as an eight tuple (cell on line 0, cell on line I, and so on). Indicate lines with no cell by —.

45 Now repeat the previous problem starting from (7, —, 6, **—,** *5, —4,* **—).**

46 An ATM switch has 1024 input lines and 1024 output lines. The lines operate at the SONET rate of 622 Mbps, which gives a user rate of approximately *594* Mbps. What aggregate bandwidth does the switch need to handle the load? How many cells per second must it be able to process?

47 In a typical cellular telephone system with hexagonal cells, it is forbidden to reuse a frequency band in an adjacent cell. If a total of 840 frequencies are available, how many can be used in a given cell?

48 Make a rough estimate of the number of PCS microcells 100 m in diameter it would take to cover San Francisco (120 square km).

49 Sometimes when a cellular user crosses the boundary from one cell to another, the current call is abruptly terminated, even though all transmitters and receivers are functioning perfectly. Why?

50 The 66 low-orbit satellites in the Iridium project are divided into six necklaces around the earth. At the altitude they are using, the period is 90 minutes. What is the average interval for handoffs for a stationary transmitter?

Chapter-3

EXAMPLE DATA LINK PROTOCOLS

PROBLEMS

1. An upper layer message is split into 10 frames, each of which has an 80 percent chance of arriving undamaged. If no error control is done by the data link protocol, how many times must the message be sent on the average to get the entire thing through?
2. The following data fragment occurs in the middle of a data stream for which the character-stuffing algorithm described in the text used: DLE, STX, A, DLE, B, DLE, ETX. What is the output after stuffing?
3. If the bit string 0111101111101111110 is bit stuffed, what is the output string?
4. When bit stuffing is used, is it possible for the loss, insertion, or modification of a single bit to cause an error not detected by the checksum? If not, why not? If so, how? Does the checksum length play a role here?
5. 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?
6. To provide more reliability than a single parity bit can give, an error-detecting coding scheme uses one parity bit for checking all the odd numbered bits and a second parity bit for all the even numbered bits. What is the Hamming distance of this code?
7. One way of detecting errors is to transmit data as a block of n row and adding parity bits to each row and each Column. Will this scheme detect all single errors? Double errors? Triple errors?
8. A block of bits with n rows and k columns uses horizontal and vertical parity bits for error detection. Suppose that exactly 4 bits are inverted due to transmission errors. Derive an expression for the probability that the error will be undetected.
9. What is the remainder obtained by dividing $\chi 7+\chi 5+1$ by the generator polynomial $\chi+1$?
10. Data link protocols almost always put the CRC in a trailer, rather than in a header. Why?

11. 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 percent?
12. A 3000-km long T1 trunk is used to transmit 64-byte frames using protocol 5. If the propagation speed is 6 usec/km, how many bits should the sequence numbers be?
13. Imagine a sliding window protocol using so many bits for sequence numbers that wraparound never occurs. What relations must hold among the four window edges and the window size?
14. If the procedure between in protocol 5 checked for the condition $\alpha \leq b \leq c$ instead of the condition $\alpha \leq b \leq c$, would that have any effect on the protocol's correctness or efficiency? Explain your answer.
15. In protocol 6, when a data frame arrives, a check is made to see if the sequence number differs from the one expected and NoNak is true. If both conditions hold, a NAK is sent. Otherwise, the auxiliary timer is started. Suppose that the else clause were omitted. Would this change affect the protocol's correctness?
16. Suppose that the three-statement while loop near the end of protocol 6 were removed from the code. Would this affect the correctness of the protocol or just the performance? Explain your answer.
17. Suppose that the case for checksum errors were removed from the switch statement of protocol 6. How would this change affect the operation of the protocol?
18. In protocol 6 the code for Frame Arrival has a section used for NAKS. This section is invoked if the incoming frame is a NAK and another condition essential.
19. Imagine that you are writing the data link layer software for a line used to send data to you, but not from you. The other end uses HDLC, with a 3-bit sequence number and a window size seven frames. You would like to buffer as many out of sequence frames as possible to enhance efficiency, but you are not allowed to modify the software on the sending side. Is it possible to have a receiver window greater than one, and still guarantee that the protocol will never fail? If so, what is the largest window that can be safely used?
20. Consider the operation of protocol 6 over a 1-Mbps error-free line. The maximum frame size is 1000 bits. New packets are generated about 1 second apart. The timeout interval is 10 msec. If the special acknowledgement timer were eliminated, unnecessary timeouts would occur. How many times would the average message be transmitted?
21. In protocol 6 MaxSeq= 2η-1. White this condition is obviously desirable to make efficient use of header bits; we have not demonstrated that it is essential. Does the protocol work correctly for MaxSeq = 4, for example?
22. Frames of 1000 bits are sent over a 1-Mbps satellite channel. 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.
23. Compute the fraction of the bandwidth that is wasted on overhead (headers and retransmissions) for protocol 6 on a heavily loaded 50-kbps satellite channel with data frames consisting of 40 header and 3960 data bits. ACK frames never occur. NAK frames are 40 bits. The error rate for data frames is 1 percent, and the error

Rate for NAK frames is negligible. The sequence numbers are 8 bits.

24. Consider an error-free 64-kbps satellite channel used to send 512-byte data Frames in one direction, with very short acknowledgements coming back the other way. What is the maximum throughput for window 1, 7, 15, and 127?

25. A 100 km long cable runs at the T1 data rate. The propagation speed in the cable is 2/3 the speed of light. How many bits fit in the cable?

26. Redraw Fig. 3-21 for a full-duplex channel that never loses frames. Is the protocol failure still possible?

27. Give the firing sequence for the Petri net of Fig. 3-23 corresponding to the state Sequence (100), (01A), (01-), (010), (01A),in Fig. 3-20. Explain in words what The sequence represents.

28. Given the transition rules AC-B, B-AC, CD-E, and E-CD, draw the Petri net described. From the Petri net, draw the finite state graph reachable from the initial state ACD. What well-known computer science concept do these transition rules model?

29. PPP is based closely on HDLC, which uses bit stuffing to prevent accidental flag Bytes within the payload from causing confusion. Give at least one reason why PPP uses character stuffing instead.

30. What is the minimum overhead in sending an IP packet using PPP? Count only the overhead introduced by PPP itself, not the IP header overhead.

31. Consider the ATM cell delineation heuristic with a=5,δ=6, and a per-bit error rate of 10^{-5}. One the system is synchronized, how long will it remain so, despite occasional header bit errors? Assume the line is running at OC-3

32. Write a program to stochastically simulate the behavior of a Petri net. The program should read in the transition rules as well as a list of sates corresponding to the network link layer issuing a new packet or the accepting a new packet. From the initial state, also read in, the program should pick enabled transitions at random and fire them, checking to see if a host ever accepts two messages without the other host emitting a new one in between.

Chapter-4

THE MEDIUM ACCESS SUBLAYER

PROBLEMS

1. A group of N stations share a 56-kbps pure ALOHA channels. Each station outputs a 1000-bit frame on an average of once every 1000 sec, even if the previous one has not yet been sent (e.g., the stations are buffered). What is the maximum value of N?
2. Consider the delay of pure ALOHA versus slotted ALOHA at low load. Which one is less? Explain your answer.
3. Ten thousand airline reservation stations are competing for the use of a single slotted ALOHA channel. The average station makes 18 request/hour. A slot is 125 usec. What is the approximate total channel load?
4. A large population of ALOHA users manages to generate 50 request/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?
5. Measurements of a slotted ALOHA channel with an infinite number of users show that 10 percent of the slots are idle.
   (a) What is the channel load, *G*?
   (b) What is the throughput?
   (c) Is the channel underloaded or overloaded?
6. In an infinite-population slotted ALOHA system, the mean number of slots a Station waits between a collision and its retransmission is 4, Plot the delay versus throughput curve for this system.
7. A LAN uses Mok and Ward's version of binary countdown. At a certain instant, the ten stations have the virtual station number 8, 2, 4, 5, 1, 7, 3, 6, 9, a and 0. The next three stations to send are 4, 3, and 9, in that order. What are the new virtual station numbers after all three have finished their

transmissions?

8. Sixteen stations are contending for the use of a shared channel using the adaptive tree walk protocol. If all the stations whose addresses are prime numbers suddenly ram become ready at once, how many bit slots are needed to resolve the contention?
9. A collection of 2^n stations uses the adaptive tree walk protocol to arbitrate access to a shared cable. At a certain instant two of them become ready. What are the minimum, maximum, and mean number of slots to walk the tree if $2^n >> 1$?
10. The wireless LANs that we studied used protocols such as MACA instead of CSMAJ/CD. Under what conditions would it be possible to use CSMA/CD instead?
11. What properties do the WDMA and GSM channel access protocols have in common?
12. Using the GSM framing structure as given in Fig. 4-14, determine how often any given user may send a data frame.
13. Suppose that *A, B,* and *C* are simultaneously transmitting 0 bits using a CDMA system with the chip sequences of Fig. 4-16(b). What is the resulting chip sequence?
14. In the discussion about orthogonally of CDMA chip sequences, it was stated that if S.T =0 then S.T is also 0. Prove this.
15. Consider a different way of looking at the orthogonally property of CDMA chip Sequences. Each bit in a pair of sequence can match or not match. Express the ortho- gonality property in terms of matches and mismatches.
16. A CDMA receiver gets the following chips: (—1 +1 —3 +1 —l —3 +1 +1). Assuming The chip sequences defined in Fig. 4-16(b), which stations transmitted, and which bits bits. Did each one send?
17. A seven-story office building has 15 adjacent offices per floor. Each office contains a Wall socket for a terminal in the front wall, so the sockets form a rectangular grid in The vertical plane, with a separation of 4 m between sockets, both horizontally and Vertically. Assuming that it is feasible to run a straight cable between any pair of sockets, horizontally, vertically, or diagonally, how many meters of cable are needed to connect all to connect all sockets using
    (a) a star configuration with a single router in middle?
    (b) an 802.3 LAN?
    (c) a ring net (without a wire center)?
18. What is the baud rate of the standard 10 Mbps 802.3 LAN?
19. A L-km –long, 10 Mbps CSMA/CD (not 802.3) has a propagation speed of 200 m/usec. Data frames are 256 bits long , including 32 bits of header, checksum, and other overture. The first bit slot after a successful transmission is reserved for the receiver to capture the channel to sen a 32-bit acknowledgement frame. ‘What is the ective data rate, excluding overhead, assuming that there are no collisions?
20. Two CSMA/CD stations are each trying to transmit long (multiframe) files. After each frame is sent, they contend for the channel using the binary exponential backoff algorithm. What is the probability that the contention

ends on round *k,* and what is the mean number of rounds per contention period?

21. 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?

22. Sketch the Manchester encoding for the bit stream: 0001110101.

23. Sketch the differential Manchester e'coding for the bit stream of the previous problem. Assume the line is initially in the low state.

24. A token bus system works like this. When the token arrives at a station, a timer is reset to 0. The station then begins transmitting priority 6 frames until the timer reaches T6. Then it switches over to priority 4 frames until the timer reaches T4. This algorithm is then repeated with priority 2 and priority 0. If all stations have timer values of 40, 80, 90, and 100 msec for T6 through TO, respectively, what fraction of the total bandwidth is reserved for each priority class?

25. What happens in a token bus if a station accepts the token and then crashes immediately? How does the protocol described in the text handle this case?

26. At a transmission rate of *5* Mbps and a propagation speed of 200 m/psec, to how many meters of cable is the 1-bit delay in a token ring interface equivalent?

27. The delay around a token ring must be enough to contain the entire token. If the wire is not long enough, some aitificial delay must be introduced. Explain why this extra delay is necessary in the content of a 24-bit token and a ring with only 16 bits of delay.

28. A very heavily loaded 1-km-long, 10-Mbps token ring has a propagation speed of 200 m/usec. Fifty stations are uniformly spaced around the ring. Data frames are *256* bits, including 32 bits of overhead. Acknowledgements are piggybacked onto the data frames and are thus included as spare bits within the data frames and are effectively free. The token is 8 bits. Is the effective data rate of this ring higher or lower than the effective data rate of a 10-Mbps CSMAICD network?

29. In a token ring the sender removes the frame. What modifications to the system would be needed to have the receiver remove the frame instead, and what would the consequences be?

30. A 4-Mbps token ring has a token-holding timer value of 10 msec. What is the longest frame that can be sent on this ring?

31. Does the use of a wire center have any influence on the performance of a token ring?

32. A fiber optic token ring used as a MAN is 200 km long and runs at 100 Mbps. After sending a frame, a station drains the frame from the ring before regenerating the token. The signal propagation speed in the fiber is 200,000 km/sec and the maximum frame size is 1K bytes. What is the maximum efficiency of the ring (ignoring all other sources of overhead)?

33. In Fig. 4-32, station ***D*** wants to send a cell. To which station does it want to send it?

34. The system of Fig. 4-32 is idle. A little later, stations *C, A,* and *B* become ready to send, in that order and in rapid succession. Assuming that no data frames are transmitted until all three have sent a request upstream, show the *RC* and *CD* values after each request and after the three data frames.

35. Ethernet is sometimes said to be inappropriate for real-time computing because the worst case retransmission interval is not bounded. Under what circumstances can the same argument be leveled at the token ring? Under what circumstances does the token ring have a known worst case? Assume the number of stations on the token ring is fixed and known.

36. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in. the event of a collision at the far end of the cable. Fast Ethernet has the same 64 byte minimum frame size, but can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?

37. Imagine two LAN bridges, both connecting a pair of 802.4 networks. The first bridge is faced with 1000 512-byte frames per second that must be forwarded. The second is faced with 200 4096-byte frames per second. Which bridge do you think will need the faster CPU? Discuss.

38. Suppose that the two bridges of the previous problem each connected an 802.4 LAN to an 802.5 LAN. Would that change have any influence on the previous answer?

39. A bridge between an 802.3 LAN and an 802.4 LAN has a problem with intermittent memory errors. Can this problem cause undetected errors with transmitted frames, or will these all be caught by the frame checksums?

40. A university computer science department has 3 Ethernet segments, connected by two transparent bridges into a linear network. One day the network administrator quits and is hastily replaced by someone from the computer center, which is an IBM token ring shop. The new administrator, noticing that the ends of the network are not connected, quickly orders a new transparent bridge and connects both loose ends to it, making a closed ring. What happens next?

41. A large FDDI ring has 100 stations and a token rotation time of 40 msec. The token-holding time is 10 msec. What is the maximum achievable efficiency of the ring?

42. Consider building a supercomputer interconnect using the HIPPI approach, but modern technology. The data path is now 64 bits wide, and a word can be sent every 10 nsec. What is the bandwidth of the channel?

43. In the text it was stated that a satellite with two uplink and one downlink slotted ALOHA channels can achieve a downlink utilization of 0.736, given an infinite amount of buffer space. Show how this result can be obtained.

Chapter-5

THE NETWORK LAYER

1. Give two example applications for which connection-oriented service is appropriate. Now give two examples for which connectionless service is best.
2. Are there any circumstances when a virtual circuit service will (or at least should) deliver packets out of order? Explain.
3. Datagram subnets route each packet as a separate unit, independent of all others. Virtual circuit subnets do not have to do this, since each data packet follows a predetermined route. Does this observation mean that virtual circuit subnets do not need the capability to route isolated packets from an arbitrary source to an arbitrary destination? Explain your answer.
4. Give three examples of protocol parameters that might be negotiated when a connec tion is set up.
5. Consider the following design problem concerning implementation of virtual circuit service, If virtual circuits are used internal to the subnet, each data packet must have a 3- byte header, and each router must tie up 8 bytes of storage for circuit identification. If data grams are used internally, 15-byte headers are needed, but no router table space is required. Transmission capacity costs 1 cent per **106** bytes, per hop. Router memory can be purchased for I cent per byte and is depreciated over two years (business hours only). The statistically average session runs for 1000 sec, in which time 200 packets are transmitted. The mean packet requires four hops. Which implementation is cheaper, and by how much?
6. Assuming that all routers and hosts are working properly and that all software in both is free of all errors, is there any chance, however small, that a packet will be delivered to the wrong destination?
7. Give a simple heuristic for finding two paths through a network from a given source to a given destination that can survive the loss of any communication line (assuming two such paths exist). The routers are considered reliable enough, so it is not necessary to worry about the possibility of router crashes.
8. Consider the subnet of Fig. 5-15(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 measured delays 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 expected delay.

9. If delays are recorded as 8-bit numbers in a 50-router network, and delay 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.
10. In Fig. 5-16 the Boolean OR of the two sets of ACF bits are 111 in every row. Is this just an accident here, or does it hold for all subnets under all circumstances?
11. For hierarchical routing with 4800 routers, what region and cluster sizes should be chosen to minimize the size of the routing table for a three-layer hierarchy?
12. In the text it was stated that when a mobile host is not at home, packets sent to its home LAN are intercepted by its home agent. For an IP network on an 802.3 LAN, how does the home agent accomplish this interception?

13. Looking at the subnet of Fig. *5-5,* how many packets are generated by a broadcast, from *B,* using
    (a) reverse path forwarding?
    (b) the sink tree?
14. Compute a multicast spanning tree for router *C in* the subnet below for a group with members at routers *A, B, C, D, E, F, I,* and *K.*
15. As a possible congestion control mechanism in *a* subnet using virtual circuits inter nally, a router could refrain from acknowledging a received packet until (1) it knows its last transmission along the virtual circuit was received successfully and (2) it has a free buffer. For simplicity, assume that the routers use a stop-and-wait protocol and that each virtual circuit has one buffer dedicated to it for each direction of traffic. If it takes *T* sec to transmit a packet (data or acknowledgement) and there are ***n*** routers on the path, what is the rate at which packets are delivered to the destination host? Assume that transmission errors are rare, and that the host-router connection is infinitely fast.
16. A datagram subnet allows routers to drop packets whenever they need to. The probability of a muter discarding a packet is p. Consider the case of a source host connected to the source router, which is connected to the destination router, and then to the destination host. If either of the routers discards a packet, the source host eventually times out and tries again. If both host-router and muter-router lines are counted as hops, what is the mean number of
    (a) hops a packet makes per transmission?
    (b) transmissions a packet makes?
    (c) hops required per received packet?
17. 17. Give an argument why the leaky bucket algorithm should allow just one packet per tick, independent of how large the packet is.
18. The byte-counting variant of the leaky bucket algorithm is used in a particular system. The rule is that one 1024-byte packet, two 512-byte packets, etc. may be sent on each tick. Give a serious restriction of this system that was not mentioned in the text,
19. An ATM network uses a token bucket scheme for traffic shaping. A new token is put into the bucket every 5 usec. What is the maximum sustainable net data rate (i.e., excluding header bits)?
20. A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate of I Mbps. It is initially filled to capacity with 8 megabits. How long can the computer transmit at the full 6 Mbps?
21. Figure *5-27* shows four input characteristics for a proposed flow specification. Imagine that the maximum packet size is 1000 bytes, the token bucket rate is 10 million bytes/sec. the token bucket size is I million bytes, and the maximum transmission rate

with I is 50 million bytes/sec. How long can a burst at maximum speed last?

22. A device accepts frames from the Ethernet to which it is attached. It removes the packet inside each frame, adds framing information around it, and transmits it over a leased telephone line (its only connection to the outside world) to an identical device at the other end. This device removes the framing, inserts the packet into a token ring frame, and transmits it to a local host over a token ring LAN. What would you call the device?

23. Is fragmentation needed in concatenated virtual circuit internets, or only in datagram systems?

24. Tunneling through a concatenated virtual circuit subnet is straightforward: the multiprotocol router at one end just sets up a virtual circuit to the other end and passes packets through it. Can tunneling also be used in datagram subnets? If so, how?
25. An IP datagrarn 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.
26. Suppose that instead of using 16 bits for the network part of a class B address, 20 bits had been used. How many class B networks would there have been?

27. Convert the II' address whose hexadecimal representation is C22F1582 to dotted decimal notation.

28. A class B network on the Internet has a subnet mask of *255.255.240.e.* What is the maximum number of hosts per subnet?

29. You have just explained the APP protocol to a friend. When you are all done, he says: "I've got it. ARP provides a service to the network layer, so it is part of the data link layer." What do you say to him?

30. APP and RARP both map addresses from one space to another. In this respect, they are similar. However, their implementations are fundamentally different. In what major way do they differ?

31. Describe a way to do reassembly of IP fragments at the destination.
32. Most IP datagram reassembly algorithms have a timer to avoid having a lost fragment tie up reassembly buffers forever. Suppose a datagram is fragmented into four fragments. The first three fragments arrrive, but the last one is delayed. Eventually the timer goes off and the three fragments in the receiver's memory are discarded. A little later, the last fragment stumbles in. What should be done with it?
33. Most IP routing protocols use number of hops as the metric to bç minimized when doing routing computations. For ATM networks, number of hops is not terribly important. Why not? *Hint* Take a look at Chap. 2. to see how ATM switches work. Do they use store-and-forward?
34. In both IP and ATM, the checksum covers only the header and not the data. Why do you suppose this design was chosen?
35. A person who lives in Boston travels to Minneapolis, taking her portable computer with her. To her surprise, the LAN at her destination in Minneapolis is a wireless IP LAN, so she does not have to. Plug in. Is it still necessary to go through the entire

business with home agents and foreign agents to make email and other traffic arrive correctly?

36. IPv6 uses 16-byte addresses. If a block of 1 million addresses is allocated every picosecond, bow long will the addresses last?
37. The *Protocol* field used in the IPv4 header is not present in the fixed IPv6 header. Why not?
38. When the IPv6 protocol is introduced, does the ARP protocol have to be changed? If so, are the changes conceptual or technical?
39. In Chap. 1, we classified interactions between the network and the hosts using four classes of primitives: *request, indication, response,* and *confirm.* Classify the SETUP and CONNECT messages of Fig. *5-65* into these categories.
40. A new virtual circuit is being' set up in an ATM network. Between the source and destination hosts lie three ATM switches. How many messages (including acknowledgements) will be sent to establish the circuit'?
41. The logic used to construct the table of Fig. *5-67* is simple: the lowest unused *VP!* is always assigned to a connection. If a new virtual circuit is requested between NY and Denver, which *VPI* will be assigned to it?
42. In Fig. *5-73(c),* if a cell arrives early, the next one is still due at t~ + 2T. Suppose that the rule were different, namely that the next cell was expected at $t_2 + T$, and the sender made maximum use of this rule. What maximum peak cell rate could then be achieved? For T =10 usec and L =2 usec, give the original and new peak cell rates, respectively.
44. Write a program to simulate routing using flooding. Each packet should contain a counter that is decremented on each hop. When the counter gets~ to zero, the packet is discarded. Time is discrete, with each line handling one packet per time interval. Make three versions of the program: all lines are flooded, all lines except the input line are flooded, and only the (statically chosen) best k lines are flooded. Compare flooding with deterministic routing (k = 1) in terms of delay and bandwidth used.
45. Write a program that simulates a computer network using discrete time. The first packet on each router queue makes one hop per time interval. Each router has only a finite number of buffers. If a packet arrives and there is no room for it, it is discarded and not retransmitted. Instead, there is an end-to-en4 protocol, complete with timeouts and acknowledgement packets, that eventually regenerates the packet from the source router. Plot the throughput of the network as a function of the end-to-end timeout interval, parametrized by error rate,

Chapter-6

THE TRANSPORT LAYER

1. In our example transport primitives of Fig. 6-3, LISTEN is a blocking call. Is this strictly necessary? If not, explain how a nonbiocking primitive could be used. What advantage would this have over the scheme described in the text?
2. In the model underlying Fig. *6-5,* it is assumed that packets may be lost by the net work layer and thus must be individually acknowledged. Suppose that the network layer is 100 percent reliable and never loses packets. What changes, if any, are needed to Fig. 6-5?
3. Imagine a generalized n-army problem, in which the agreement of any two of the armies is sufficient for victory. Does a protocol exist that allows blue to win?
4. Suppose that the clock-driven scheme for generating initial sequence numbers is used with a 15-bit wide clock counter. The clock ticks once every 100 msec, and the packet lifetime is 60 sec. How often need resynchronization take place through
   (a) in the worst case?
   (b) when the data consumes 240 sequence numbers/mm?
5. 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. Imagine that a two-way handshake rather than a three-way handshake were used to set up connections. In other words, the third message was not required. Are deadlocks now possible? Give an example or show that none exist.
7. Consider the problem of recovering from host crashes (i.e., Fig. 6-18). If the interval between writing and sending an acknowledgement, or vice versa, can be made relatively small, what are the two best sender-receiver strategies for minimizing the chance of a protocol failure?
8. Are deadlocks possible with the transport entity described in the text?
9. Out of curiosity, the implementer of the transport entity of Fig. 6-20 has decided to put counters inside the *sleep* procedure to collect statistics about the *conn* array. Among these are the number of connections in each of the seven possible states, *n• (1* = 1, ..., ***7).*** After writing a massive FORTRAN program to analyze the data, our implementer discovered that the relation *En~ = MAX_CONN* appears to always I be true. Are there any other invariants involving only these seven variables?

10. What happens when the user of the transport entity given in Fig. 6-20 sends a zero length message? Discuss the significance of your answer.
11. For each event that can potentially occur in the transport entity of Fig. 6-20, tell whether it is legal or not when the user is sleeping in *sending* state.
12. Discuss the advantages and disadvantages of credits versus sliding window protocols.
13. Datagram fragmentation and reassembly are handled by IP and are invisible to TCP.Does this mean that TCP does not have to worry about data arriving in the Wrong order?
14. 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?

15. The maximum payload of a TCP segment is *65,515* bytes. Why was such a Strange number chosen?
16. Describe two ways to get into the SYN RCVD state of Fig. 6-28.
17. Give a potential disadvantage when Nagle's algorithm is used on a badly Congested network?
18. 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?
19. Suppose that the TCP congestion window is set to 18K bytes and a timeout occurs.How big will the window be if the next four transmission bursts are all successful? Assume that the maximum segment size is 1 KB.
20. If the TCP round-trip time, RTT, is currently 30 msec and the following acknowledgements come in after 26, 32, and 24 msec; respectively, what is the new R17' estimate?Use a = 0.9.
21. A TCP machine is sending windows of *65,535* bytes over a 1-Gbps channel that has a 10-msec one-way delay. What is the maximum throughput achievable? What is the line efficiency?
22. In a network that has a maximum TPDU size of 128 bytes, a maximum TPDU Lifetime of 30 sec, and an 8-bit sequence number, what is the maximum data rate per connection?
23. Why does UDP exist? Would it not have been enough to just let user processes send numb raw IP packets?
24. A group of N users located in the same building are all using the same remote computer via an ATM network. The average user generates L lines of traffic (input + out-put) per hour, on the average, with the mean line length being P bytes, excluding the ATM headers. The packet carrier charges C cents per byte of user data transported, plus X cents per hour for each ATM virtual circuit open. Under what conditions is it cost effective to multiplex all N transport connections onto the same ATM virtual circult, if such multiplexing adds 2 bytes of data to each packet? Assume that even one ATM virtual circuit has enough bandwidth for all the users.
25. Can AAL 1 handle messages shorter than 40 bytes using the scheme with the Pointer field? Explain your answer.
26. Make a guess at what the field sizes for AAL 2 were before they were pulled from the standard
27. AAL 3/4 allows multiple sessions to be multiplexed onto a single virtual circuit. Give an example of a situation in which that has no value. Assume that one virtual

circuit has sufficient bandwidth to carry all the traffic. Hint: Think about virtual paths.

28. What is the payload size of the maximum length message that fits in a single AAL 3/4 cell?
29. When a 1024-byte message is sent with AAL 3/4, what is the efficiency obtained? In other words, what fraction of the bits transmitted are useful data bits? Repeat the problem for AAL 5.
30. An ATM device is transmitting single-cell messages at 600 Mbps. One cell in 100 is totally scrambled due to random noise. How many undetected errors per week can be expected with the 32-bit AAL ***5*** checksum?

31. A client sends a 128-byte request to a server located 100 km away over a 1-gigabit optical fiber. What is the efficiency of the line during the remote procedure call?'
32. Consider the situation of the previous problem again. Compute the minimum possible response time both for the given 1-Gbps line and for a 1-Mbps line. What conclusion can you draw
33. Suppose that you are measuring the time to receive a TPDU. When an interrupt occurs, you read out the system clock in milliseconds. When the TPDU is fully processed, you read out the clock again. You measure 0 msec 270,000 times and 1 msec 730,000 times. How long does it take to receive a TPDU?
34. A CPU executes instructions at the rate of 100 MIPS. Data can be copied 64 bits at a time, with each word copied costing six instructions. If an coming packet has to be acopied twice, can this system handle a l-Gbps line? For simplicity, assume that all is the instructions, even those instructions that read or write memory, run at the full 100- MIPS rate.
35. 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 networks do not have wraparound problems even with 64-bit sequence numbers? Assume that each byte has its own sequence number, as TCP does.
36. In the text we calculated that a gigabit line dumps 30,000 packets/sec on the host, giving it only 1500 instructions to process it and leaving half the CPU time for applications. This calculation assumed a 4-KB packet.. Redo the calculation for an ARPANET-sized packet (128 bytes).
37. For a 1-Gbps network operating over 4000 km. the delay is the limiting factor, not The bandwidth. Consider a MAN with the average source and destination 20 km apart. At what data rate does the round-trip delay due to the speed of light equal the transmission delay for a 1-KB packet?
38. Modify the program of Fig. 6-20 to do error recovery. Add a new packet type, reset, that can arrive after a connection has been opened by both sides but closed by neither. This event, which happens simultaneously on both ends of the connection, means that any packets that were in transit have either been delivered or destroyed, but in either case are no longer in the subnet.
39. Write a program that simulates buffer management in a transport entity using a sliding window for flow control rather than the credit system of Fig. 6-20. Let higher-layer processes randomly open connections, send data, and close connections. To keep it simple, have all the data travel from machine A to machine B, and none the other way. Experiment with different buffer allocation strategies at B, such as dedicating buffers to specific connections versus a common

buffer pool, and measure the total throughput achieved by each one.

CHAPTER-7

THE APPLICATION LAYER

PROBLEMS

1. Break the following monoalphatbetic cipher. The plaintext, consisting of letters Only, is a well-known excerpt from a poem by Lewis Carroll.
   Kfd ktbd fzm eubd kfd pzyiom mztx ku kzyg ur bzha kfthcm
   Ur mfudm zhx mfudm zhx mdzythc pzq ur ezsszcdm zhx gthcm
   Zhx pfa kfd mdz tm sutythc fuk zhx pfdkfdi ntcm fzld pthcm
   Sok pztk z stk kfd uamkdim eitx sdruid pd fzld uoi efzk
   Hu foiia mztx kfd ezinndhkdi kfda kfzhgdx ftb boef rui kfzk
2. Break the following columnar transposition cipher. The plaintext is taken from a popular computer textbook, so "computer" is a probable word. The plaintext consists entirely of letters (no spaces). The ciphertext is broken up into blocks of five characters for readability

   aauan cvlre rurnn ditme aeepb ytust iceat npmey iicgo gorch srsoc
   nntii imiha oofpa gsivt tpsit iboir otoex

3. In Fig. 7-4, the P-boxes and S-boxes alternate. Although this arrangement is esthetically pleasing, is it any more secure than first having all the P-boxes and then all the S-boxes?
4. Suppose that a message has been encrypted using DES in ciphertext block chaining mode. One bit of ciphertext in block *C,* is accidentally transformed from a 0 to a I during transmission. How much plaintext will be garbled as a result?
5. Now consider ciphertext block chaining again. Instead of a single 0 bit being transformed into a 1 bit, an extra 0 bit is inserted into the ciphertext stream after block Ci. How much plaintext will be garbled as a result?
6. Design an attack on DES based on the knowledge that the plaintext consists exclusively of uppercase ASCII letters, plus space, comma, period, semicolon, carriage return, and line feed. Nothing is known about the plaintext parity bits.
7. Compare cipher block chaining with cipher feedback mode in terms of the number of encryption operations needed to transmit a large file. Which one is more

efficient and by how much?

8. Using the RSA public key cryptosystem, with a = 1, *b* = 2, etc.,
   (a) If p = 7 and q = 11, list five legal values for d.
   (b) If p = 13, q =31 and *d* = 7, find e.
   (c) Using p = *5,* q = 11, and *d* = 27, find *e* and encrypt "abcdefghij"
9. The Diffie-Heilman key exchange is being used to establish a secret key between Alice and Bob. Alice sends Bob (719, 3, 191). Bob responds with *(543).* Alice's secret number, x, is 16. What is the secret key?

10 .Change one message in protocol of Fig. 7-14 in a minor way to make it resistant to the reflection attack. Explain why your change works.
11. In the wide-mouth frog protocol, why is A sent in plaintext along with the encrypted session key?
12. In the wide-mouth frog protocol, we pointed out that starting each plaintext message with 32 zero bits is a security risk. Suppose that each message begins with a per-user random number, effectively a second secret key known only to its user and the KDC. Does this eliminate the known plaintext attack?
13. In the Needham-Schroeder protocol, Alice generates two challenges, *RA* and *RA* 2 This seems like overkill. Would one not have done the job?
14. In the public-key authentication protocol of Fig. 7-2 1, in message 3, R_B is encrypted with *Ks.* Is this encryption necessary, or would it have been adequate to send it back in plaintext?
15. The signature protocol of Fig. 7-22 has the following weakness. If Bob crashes, he may lose the contents of his RAM. What problems does this cause and what can he do to prevent them?
16. After Ellen confessed to Marilyn abdut tricking her in the matter of Tom's tenure, Marilyn resolved to avoid this problem by dictating the contenls of future messages into a dictating machine and having her new secretary just type them in. Marilyn then planned to examine the messages on her terminal after they have been typed in to make sure they contain her exact words. Can the new secretary still use the birthday attack to falsify a message, and if so, how? *Hint:* She can.
17. Point-of-sale terminals that use magnetic-stripe cards and PIN codes have a fatal flaw: a malicious merchant can modify his card reader to capture and store all the information on the card as well as the PIN code in order to post additional (fake) transactions in the future. The next generation of point-of-sale terminals will use cards with a complete CPU, keyboard, and tiny display on the card. Devise a protocol for this system after block tern that malicious merchants cannot break.
18. According to the information given in Fig. 7-27, is *little-sister.cs.vu.nl* on a class A, B or C network?
19. In Fig. 7-27, there is no period after *rowboat?* Why not?
20. What is the *OBJECT IDENTIFIER* for the tcp object?
21. An SNMP integer whose value is 200 has to be transmitted. Show the binary representation of the bits sent in the ASN. 1 transfer syntax.
22. What is the representation of the 11-bit binary bit string '11100001111' in the ASN. l transfer syntax?
23. Suppose that you are hired by a bridge vendor to write SNMP-conformant code for one of their bridges. You read all the RFCs and still have questions. You suggest to LAB that a complete, formal grammar of the language used to describe

SNMP variable be given in one place. lAB's reaction is to agree and appoint you to do the job. Should the grammar be added to RFC 1442 or RFC 1213? Why? *Hint:* You do not need to fetch the RFCs; enough information is given in the text.

24. Some email systems support a header field *Content Return:*. It specifies whether the lie encrypted body of a message is to be returned in the event of nondelivery. Does this field belong to the envelope or to the header?
25. Electronic mail systems support need directories so people's mail address can be looked up. To build such directories, names should be broker up into standard components (e.g. first name last name) to make searching possible. Discuss aome problems that must be solved for a worldwide standard standard to be acceptable
26. A binary file is 3072 bytes long. How long will it be if encoded using base64 encoding, with a CR+LF pair inserted after every 80 bytes sent and at the end?
27. Consider the quoted-printable MIME encoding scheme. Mention a problem not discussed in the text and propose a solution.
28. Give *two* reasons why PGP compresses messages.
29. Suppose that someone set up a vacation daemon and then sends a message just before logging out. Unfortunately, the recipient has been on vacation for a week and also has a vacation daemon in place. What happens next? Will canned replies go back and forth until somebody returns?
30. Assuming that everyone on the Internet used POP, could a POP message be sent to an arbitrary Internet address and be decoded correctly by all concerned? Discuss your answer
31. POP does not support canonicalization as does PEM. Why not?
32. Make a guess about what the smiley : —x (sometimes written as : —#) might mean.
33. How long does it take to distribute a days' worth of news over a 50-Mbps satellite channel?
34. Which of the commands listed in Fig. 7-56 are theoretically redundant?
35. A large network consists of an *n x n* grid of machines. All the interior nodes have four neighbors; the ones on the edges (corners) have three (two) neighbors. If an mbyte article is posted on some machine using NNTP, how many bytes of bandwidth are consumed getting it to all other machines (ignoring the NNTP overhead and just counting the message bytes)?
36. Repeat the previous problem, but now compute the approximate bandwidth that would be needed to distribute the message using a mailing list. How much more is it than in the previous problem?
37. When Web pages are sent out, they are prefixed by MIME headers. Why?
38. When are external viewers needed? How does a browser know which one to use?
39. Imagine that someone in the CS Department at Stanford has just written a new program that he wants to distribute by FTP. He puts the program in the FTP directory *ftp/pub/freebies/newprog.c.* What is the URL for this program likely to be?
40. In Fig. 7-60, the *ALT* parameter is set in the <1MG> tag. Under what conditions does the browser use it, and how?
41. How do you make an image clickable in HTML? Given an example
42. Show the <A> tag that is needed to make the string "ACM" be a hyperlink to http://www.acm.org.
43. Design a form for a new company, Interburger, that allows hamburgers to be ordered via the Internet. The form should include the customer's name, address, and city, as well as a choice of size (either gigantic or immense) and a cheese

option. The burgersaIe4Qe paid for in cash upon delivery, so no credit card information is.needed.

44. Java does not have structures as in **C** or records as in Pascal. Is there some other Way to achieve the same effect of bundling a group of dissimilar variables together to form a single data type? If so, what is it?
45. Using the data structures of Fig. *7-75,* list the exact steps needed to check a new URL to see if it is already in url_table.
46. Suppose that in its effort to become more market oriented, the KGB goes commercial and hires an advertising agency that designs a Web page for it. Your company has been hired as an outside consultant to implement it. Write the HTML to produce the Web page below.

. **WELCOME TO THE KGB'S WWW HOME PAGE**

As a consequence of its recent privatization, the KGB is pleased to announce the commercial availability of many fine products and services previously available only to major governments.

Competitive prices! Discreet service ensured!

- Products
  - ☐ Nuclear weapons (small, medium, large, jumbo)
  - ☐ Spy satellites (keep tabs on your neighbors)
  - ☐ ow-radar-profile supersonic aircraft (buzz your friends' houses unseen)

- Services
  - ☐ M~kplaccment in the organization of your choice
  - ☐ Ct_ups (corporate as well as governmental)
  - ☐ Assistance in setting up your very own germ-warfare laboratory

- Bargain basement specials
  - ☐ The collected works of Felix Dzerzhinsky (limited edition)
  - ☐ Aeaaal photographs of Afghanistan (Ca. 1984)
  - ☐ Quality Bulgarian-made tanks *(95* percent discount)

Webmaster@kgb.ru

47. In C and C++, the size of an integer is not specified by the language. In Java it is. Give an argument for the C way and one for the Java way.
48. Suppose that the Web contains 10 million pages, each with ~n average of 10 hyperlinks. Fetching a page averages 100 msec. What is the minimum time to index the entire Web?
49. A compact disc holds 650 MB of data. Is compression used for audio CDs?

Explain your reasoning.

50. What is the bit rate for transmitting uncompressed VGA color with 8 bits/pixel at 40 frames/sec
51. In Fig. 7-76(c) quantization noise occurs due to the use of 3-bit samples. The first sample, at 0, is exact, but the next few are not. What is the percent error for the samples at 1/32, 2/32, and 3/32 of the period?
52. Can a 1-bit error in an MPEG frame affect more than the frame in which the error occurs? Explain your answer.
53. Consider the 100,000 customer video server example given in the text. Suppose that half of all movies are served from 8 P.M to 10 P.M. How many movies does the server have to transmit at once during this time period? If each movie requires 4 Mbps, how many OC-12 connections does the server need to the network?

54. Suppose that Zipf's law holds for accesses to a 10,000-movie video server. If the Server holds the most popular 1000 movies on magnetic disk and the remaining 9000 on optical disk, give an expression for the fraction of all references that will be to magnetic dsik. Write a little program to evaluate this expression numerically.
55. MPEG PES packets contain a field giving the copyright status of the current transmission. Of what conceivable use is this field?