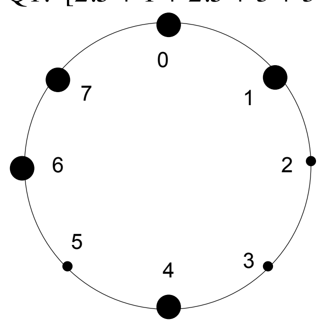
INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
Date 20.04.2015 FN Time: 3 Hrs. Full Marks: TBD
Spring Semester: 2015 Department: CSE
Sub. No: CS CS31006 Sub. Name: Computer Networks

Answer as much as you can

Q1. [2.5 + 1 + 2.5 + 3 + 3 = 12]



1. Construct the finger table for the node 0, 1, 4, 6, 7 (assume that node identifier consists of 3 bits) [2.5]
2. Place the file having key values 0, 2, 3, 4, 5, 6. [1]
3. Show the visited nodes and intermediate steps when one search for a file having key value 6 and one has started your search from node 0. [2.5]
4. Show the effect of a node join with node (key) value 3. [3]
5. What will happen when node 6 leaves the network? [3]

Q2. [2 + 5 + 3 + 4 = 14]

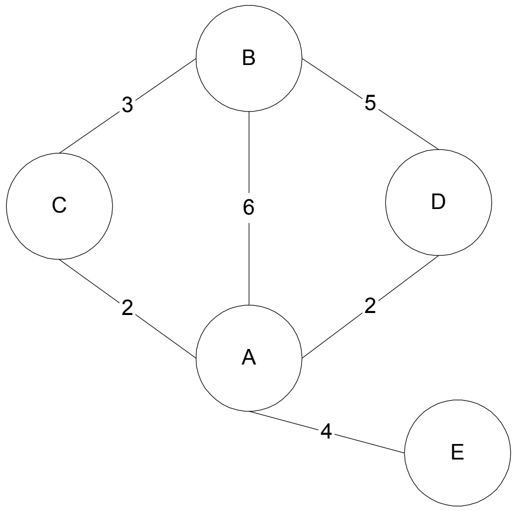
(a). For hierarchical routing with 4800 routers, what region and cluster sizes should be chosen to minimize the size of the routing table for a three-layer hierarchy? An optimal configuration would have the number of regions, clusters, routers as same. [2]

(b). A datagram network allows routers to drop packets whenever they need to. The probability of a router 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 router-router lines are counted as hops, what is the mean number of
(i) hops a packet makes per transmission?
(ii) transmissions a packet makes?
(iii) hops required per received packet? [1 + 2 +2]

(c). 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. [3]

(d). Consider the following network running the distance vector routing protocol. In the diagram, vertices represent routers and edges (arcs) represent links between routers. The numerical annotation on the links represents link costs. Higher costs indicate worse links

(i). Show the routing table at node A when the distance vector routing algorithm stabilizes (ii). Suppose the link between node A and node E fails, show the routing table at node B when the distance vector algorithm stabilizes. Show all important steps in your analysis. [2+2]



Q3. [2 + 3 + 1 + 1 + 5 = 12]

(a). A token bucket scheme is used for traffic shaping. A new token is put into the bucket every 5 μ sec. Each token is good for one short packet, which contains 48 bytes of data. What is the maximum sustainable data rate? [2]

(b). A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 1 Mbps. It is initially filled to capacity with 8 megabits. How long can the computer transmit at the full 6 Mbps? [3]

(c). Convert the IP address whose hexadecimal representation is C22F1582 to dotted decimal notation. [1]

(d). A network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts it can handle? [1]

(e). 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-R_1 can support a maximum frame size of 1024 bytes including a 14-byte frame header, link R_1-R_2 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]

Q4. [7 + 2 + 2 = 11]

(a). Draw the TCP connection management finite state diagram. At first clearly (i). list the states – describe them and (ii). then draw the finite state diagram. [3 + 4]

(b). Draw a figure showing TCP connection establishment in (i). normal case (ii). Call collision. [1 + 1]

(c). Draw and illustrate four protocol scenarios for releasing a connection. [2]

Q5. [2 + 3 + 2 + 2 + 3 + 3 = 15]

(a). Consider two networks, N1 and N2, that have the same average delay between a source A and a destination D. In N1, the delay experienced by different packets is uniformly distributed with maximum delay being 10 seconds, while in N2, 99% of the packets experience less than one second delay with no limit on maximum delay. Discuss how RTP may be used in these two cases to transmit live audio/video stream. [2]

(b) (i) 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? Speed of light in fiber optics is 200 km/msec.

(ii) 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? [1.5 + 1.5 =3]

(c). 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? [2]

(d). Suppose that the TCP congestion window is set to 18 KB 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. [2]

(e). 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 RTT estimate using the Jacobson algorithm? Use $\alpha = 0.9$. [3]

(f). Consider a telnet connection to an interactive editor that reacts on every keystroke. What would be the worst-case overhead of sending one character assuming TCP connection (consider only TCP and IP headers). [3]

Q6. [5 + 3 = 8]

(a). A large population of ALOHA users manage to generate 50 requests/sec, including both originals and retransmissions. Time is slotted in units of 40 msec. [1 + 2 + 2]
(i) What is the chance of success on the first attempt?
(ii) What is the probability of exactly k collisions and then a success?
(iii) What is the expected number of transmission attempts needed?

(b). A 1024-bit message is sent that contains 992 data bits and 32 CRC bits. CRC is computed using the IEEE 802 standardized, 32-degree CRC polynomial. For each of the following, explain whether the errors during message transmission will be detected by the receiver:

(i). There was a single-bit error.
(ii). There were two isolated bit errors.
(iii). There were 18 isolated bit errors.
(iv). There were 47 isolated bit errors.
(v). There was a 24-bit long burst error.
(vi) There was a 35-bit long burst error. [6 x 0.5 = 3]