

HWK4&5: Chapter-5: 9, 10, 11, 17, 18, 21 -- Due Date 9 April 2017

- P8. In Section 5.3, we provided an outline of the derivation of the efficiency of slotted ALOHA. In this problem we'll complete the derivation.
- Recall that when there are N active nodes, the efficiency of slotted ALOHA is $Np(1-p)^{N-1}$. Find the value of p that maximizes this expression.
 - Using the value of p found in (a), find the efficiency of slotted ALOHA by letting N approach infinity. *Hint:* $(1 - 1/N)^N$ approaches $1/e$ as N approaches infinity.
- P9. Show that the maximum efficiency of pure ALOHA is $1/(2e)$. *Note:* This problem is easy if you have completed the problem above!
- P10. Consider two nodes, A and B, that use the slotted ALOHA protocol to contend for a channel. Suppose node A has more data to transmit than node B, and node A's retransmission probability p_A is greater than node B's retransmission probability, p_B .
- Provide a formula for node A's average throughput. What is the total efficiency of the protocol with these two nodes?
 - If $p_A = 2p_B$, is node A's average throughput twice as large as that of node B? Why or why not? If not, how can you choose p_A and p_B to make that happen?
 - In general, suppose there are N nodes, among which node A has retransmission probability $2p$ and all other nodes have retransmission probability p . Provide expressions to compute the average throughputs of node A and of any other node.
- P11. Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability p . The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.
- What is the probability that node A succeeds for the first time in slot 5?
 - What is the probability that some node (either A, B, C or D) succeeds in slot 4?
 - What is the probability that the first success occurs in slot 3?
 - What is the efficiency of this four-node system?

- P17. Recall that with the CSMA/CD protocol, the adapter waits $K \cdot 512$ bit times after a collision, where K is drawn randomly. For $K = 100$, how long does the adapter wait until returning to Step 2 for a 10 Mbps broadcast channel? For a 100 Mbps broadcast channel?
- P18. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 325 bit times. Suppose CSMA/CD and Ethernet packets are used for this broadcast channel. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame. Can A finish transmitting before it detects that B has transmitted? Why or why not? If the answer is yes, then A incorrectly believes that its frame was successfully transmitted without a collision. *Hint:* Suppose at time $t = 0$ bits, A begins transmitting a frame. In the worst case, A transmits a minimum-sized frame of $512 + 64$ bit times. So A would finish transmitting the frame at $t = 512 + 64$ bit times. Thus, the answer is no, if B's signal reaches A before bit time $t = 512 + 64$ bits. In the worst case, when does B's signal reach A?
- P21. Consider Figure 5.33 in problem P14. Provide MAC addresses and IP addresses for the interfaces at Host A, both routers, and Host F. Suppose Host A sends a datagram to Host F. Give the source and destination MAC addresses in the frame encapsulating this IP datagram as the frame is transmitted (i) from A to the left router, (ii) from the left router to the right router, (iii) from the right router to F. Also give the source and destination IP addresses in the IP datagram encapsulated within the frame at each of these points in time.

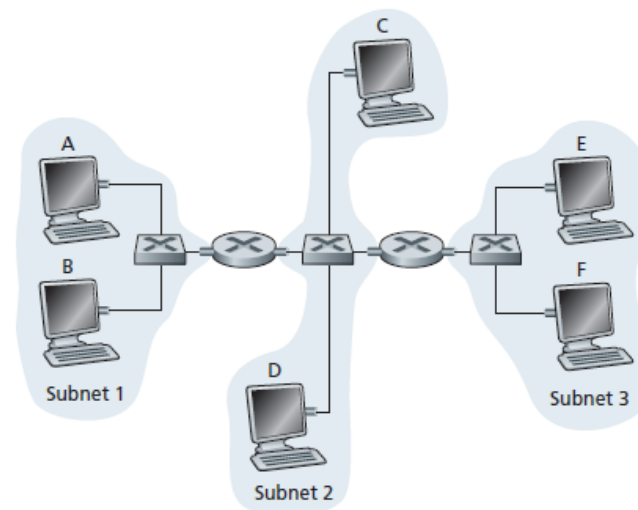


Figure 5.33 ♦ Three subnets, interconnected by routers