Department of Electrical and Information Technology

Final Exam – 2011 ht1 *(korttenta)*

2011-10-19, 09:00 – 11:00

ETSF05 – Internet Protocols

The questions in this exam give a total of **100** points. Minimum **60** points are needed to pass the exam. You get part of the points for a question if your answer is only partially correct.

Use all the time given to you. Choose your words carefully in order not to write answers too long. **Always motivate your answers, especially when they are calculation-based.** Unclear, confused, and too generic answers will decrease the grading!

You may use a pocket calculator if you want.

Good luck!

Kaan & Jens

Questions

1. **[10 points]** A demultiplexer in a synchronous time division multiplexing (TDM) system has 1 incoming link and 10 identical outgoing links. The frames on the incoming link arrive at a bit rate of 10 Mbps. There is 1 byte of control data at the beginning of each frame, and one time slot contains exactly 2 bytes.

   1.1. What is the frame size in bits and frame duration in seconds?

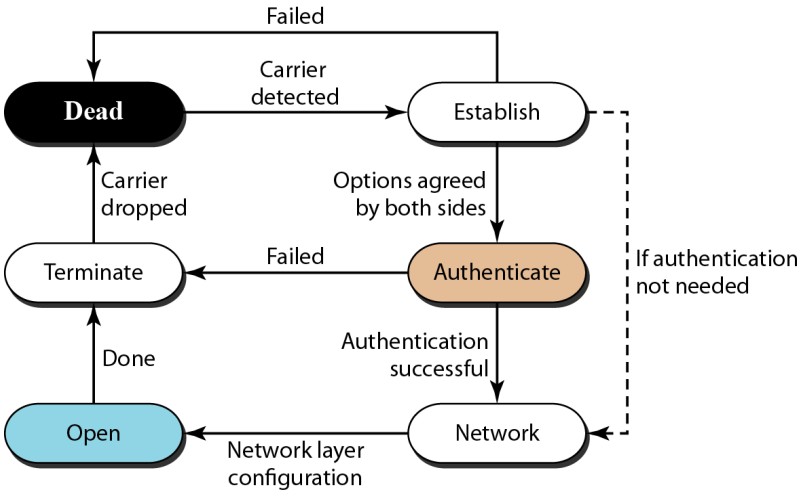
   1.2. What is the bit rate of the outgoing links?

2. **[5 points]** Given $S_f = 17$ (first frame sent but not yet acknowledged), $S_n = 43$ (next frame to send), assuming the sender's window size is set to the maximum value allowing Go-Back-N ARQ to function correctly:

   2.1. What is the number of the last frame in the sender's "sliding window"?

   2.2. What is the minimum number of bits that can have been allocated to sequence numbers?

3. **[10 points]** Point-to-Point Protocol (PPP) uses the following (sub)protocols to maintain connections through the various phases shown in the diagram below: Link Control Protocol (LCP); Password Authentication Protocol (PAP); Challenge Handshake Authentication Protocol (CHAP); Internet Protocol Control Protocol (IPCP). Match each protocol to the phase it is used in and explain briefly its purpose.



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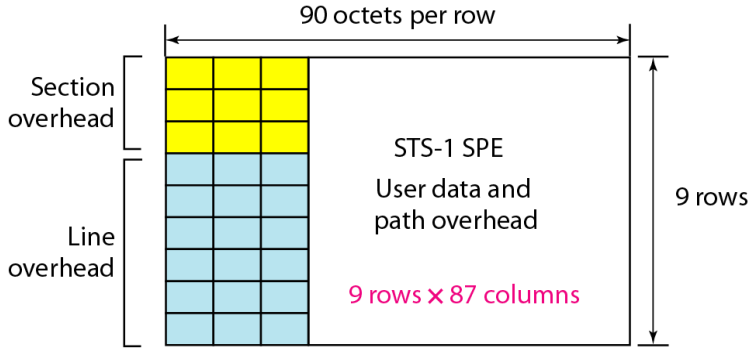
4. **[10 points]** When frames of a lower bit rate are multiplexed into a higher bit-rate frame in SONET, synchronous TDM with interleaving is used. Name one advantage and one disadvantage of interleaving and explain why.

5. **[10 points]** In SONET, small bit rate adjustments can be made if the data rate of the payload is close to but slightly different from the user data rate of the STS level being used. If the payload's data rate is slightly lower, for instance, 1 byte needs to be left empty in each SONET frame for this transmission. Given that a data stream with a data rate of 49 530 Mbps is being carried by STS-1 frames, shown below, how many frames per second should leave one byte empty?



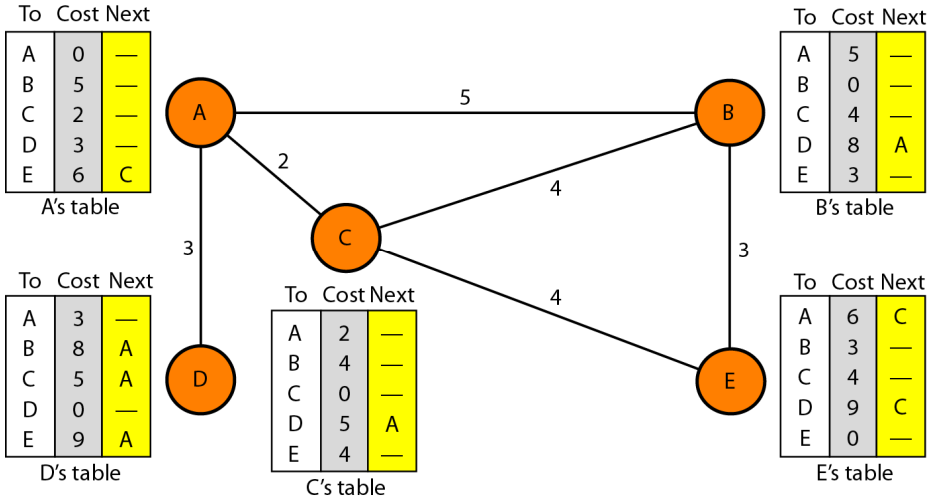
6. **[10 points]** Explain the following ATM concepts and their relation to each other: Transmission path (TP), virtual path (VP), virtual circuit (VC). Describe how routing is performed by an ATM switch using VP and VC.

7. **[10 points]** ATM uses fixed-size cells (53 bytes) and asynchronous TDM, also known as "statistical multiplexing". These two features together eliminate two problems, one of which is associated with variable frame sizes and the other with synchronous TDM, at once. What are these two problems and how do ATM's features mentioned here solve these?

8. **[10 points]** Network Address Translation (NAT), in its basic form, cannot support two internal hosts trying to connect to the same external IP address. There are two solutions to this problem. Explain these.

9. **[5 points]** What is the fundamental difference between IPv6 and IPv4 addresses? What is the motivation behind this? What are the address notations used? Answer by giving one example for each address type.

10. **[10 points]** Use the network topology (with the cost of each link also given) shown in the diagram below. Start with the distance vector routing tables of nodes C and D. Assume that a new link with cost 2 is established between C and D. Show the updated version of C's table. Then, assume that C sends its updated table to D and show how D processes this information step-by-step and row by row to update its own table. Finally, show the updated version of D's table.



11. **[10 points]** Use once again the initial network topology shown in the diagram above (ignore all the routing tables). Assume that the whole topology is known to all the nodes after the flooding of the individual "link state" knowledge. Perform Dijkstra's shortest path tree algorithm, draw the tree step-by-step and derive the routing table for node B.