Coláiste na Tríonóide, Baile Átha Cliath
Trinity College Dublin
Ollscoil Átha Cliath | The University of Dublin

Faculty of Engineering, Mathematics and Science

School of Computer Science & Statistics

Integrated Engineering
Year 3 Annual Examinations

Trinity Term 2016

Computer Networks

20 May 2016 **Regent House** **09:30 – 11:30**

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Instructions to Candidates:

Attempt **two** questions. All questions carry equal marks. Each question is scored out of a total of 50 marks.

You may not start this examination until you are instructed to do so by the invigilator.

Materials Permitted for this Examination:

Non-programmable calculators are permitted for this examination — please indicate the make and model of your calculator on each answer book used.

1. (a) Ethernet frames must be at least 64 bytes long to ensure that the sender is still transmitting in the event of a collision at the far end of the cable (CSMA/CD). 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? Explain your answer within the context of the Ethernet "Slot-Time" protocol. [8 marks]

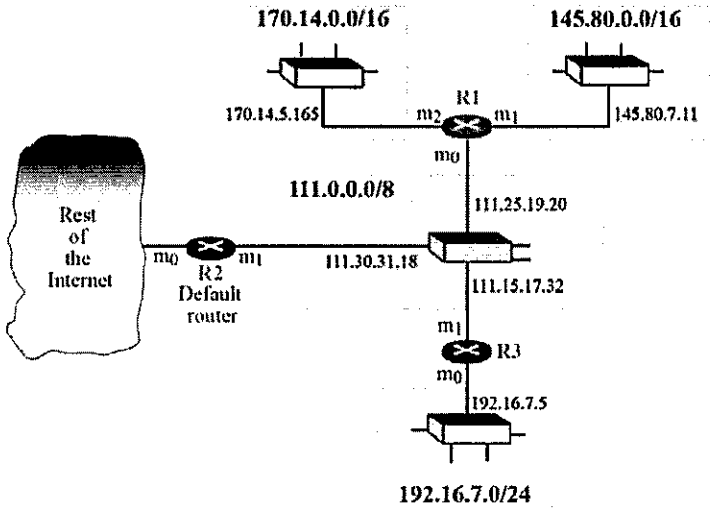
   (b) Sketch the NRZ-I encoding for the bit stream: 0101000111. Describe the 4B/5B encoding scheme used in Fast Ethernet networks and its advantages over schemes like Differential Manchester. [6 marks]

   (c) An organization is granted the block 134.226.0.0/16. The administrator wants to create 1024 subnets. Find:

   - The subnet prefix.
   - The number of addresses in each subnet.
   - The subnet mask.
   - The first and last address of the first subnet.

   [12 marks]

   (d) Make a routing table for router R1 in the figure below. Required fields in the routing table are the Subnet Mask, Destination and Next Hop fields.



   [16 marks]

   (e) Distinguish between Unicast, Broadcast and Multicast addressing. What is the advantage of Anycast addressing in IPv6 networks? [8 marks]

2. (a) Describe the functionality of the seven layers that make up the OSI reference model. How are peer layers able to communicate with each other in this model? Give an example of this logical communication exchange at the Datalink layer. [9 marks]

   (b) Distinguish between Circuit and Packet switching techniques, highlighting the advantages and disadvantages of each approach. Explain how the Virtual Circuit approach provides the user with the best of both worlds? [9 marks]

   (c) Explain the difference between Asynchronous and Synchronous transmission. Assuming asynchronous transmission, one start bit, two stop bits, one parity bit, and two bits per signalling element, derive the useful information transfer rate in bps for each of the following signalling (baud) rates:

   - 300
   - 4800

   [12 marks]

   (d) The following character encoding is used in a datalink protocol: A:01000111; B:11100011; FLAG:01111110; DLE:11100000. Show the bit sequence transmitted (in binary) for the four-character frame: A B DLE FLAG when each of the following methods is used:

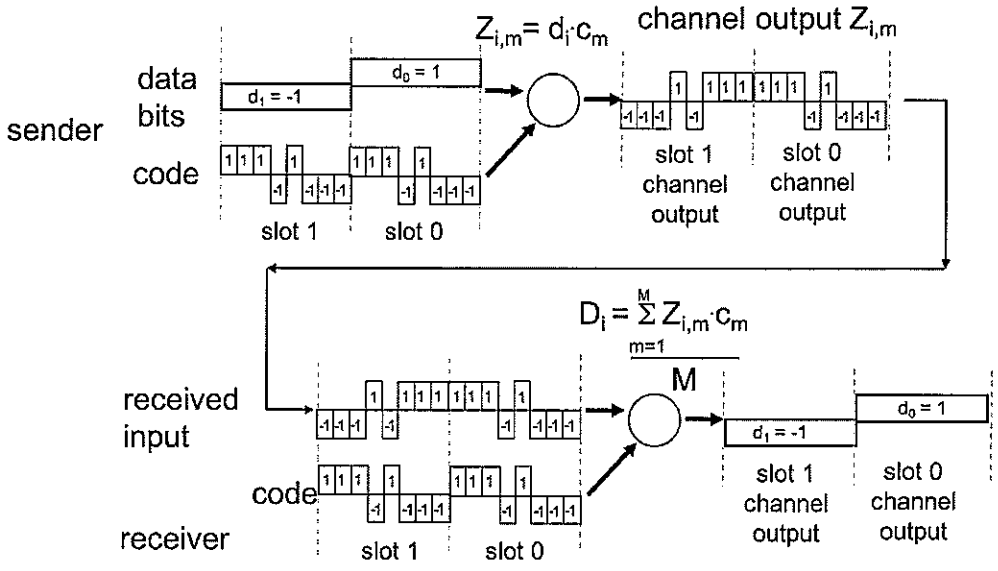
   - Flag bytes with byte stuffing
   - Starting and ending flag bytes with bit stuffing

   [8 marks]

   (e) With the aid of an example compare and contrast the Stop-and-Wait and Go-Back-N ARQ schemes. [12 marks]

3. (a) Describe in detail the functionality of the various medium access control schemes employed in cellular networks (FDMA, TDMA, SDMA, CDMA & OFDM), highlighting the advantages and disadvantages of each. [15 marks]

(b) Consider the single-sender CDMA example in the figure below. What would be the sender's output (for the 2 data bits shown) if the sender's CDMA code were (1, 1, -1, 1, 1, -1, -1, 1)?



[4 marks]

(c) With the aid of an example describe "hidden node" and "exposed node" problems in wireless networks. How is the RTS/CTS protocol used to solve both of these issues? [10 marks]

(d) Show with the aid of a diagram how a call is routed to a "roaming user" in the GSM system. Why are "handoffs" required in GSM? Show how a handoff occurs within the GSM with a "common MSC" serving the two base station involved in the handover. [12 marks]

(e) Briefly describe the architecture of the third (3G), fourth (4G) and fifth (5G) generation mobile systems. [9 marks]