Computer Networks
26th of June 2009

- This exam consists of 8 questions with subquestions. Every subquestion counts for 10 points (except the last one which counts for 1 point of your final grade).
- Mark every page with name and student number.
- Use of books, additional course material or electronic devices is prohibited.
- Always explain your answers. At the same time, keep your answers short and to the point. Do not use pencil or red ink.

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1. **Multiple choice**

   Please answer the following questions. For each question, mark the correct answer. There is exactly one correct answer per question. The full question is worth 10 points: you are awarded 2 points for each correctly answered subquestion. However, each wrongly answered question results in 2 negative points. Don't answer at random since this will decrease your score. Concentrate on the questions you can answer with certainty.

   i. Which of the following statements about Manchester endoding is true?

      (a) Manchester encoding helps to distinguish between senders when multiple stations transmit at the same time

      (b) Manchester encoding helps to detect errors in transmissions

      (c) Manchester encoding helps to distinguish between idle senders and senders that send a 0 bit and requires no extra bandwidth

      (d) Manchester encoding helps us to detect bit boundaries and to keep sender and receiver synchronised

      (e) Manchester encoding is used in phase shift keying

   ii. Which of the following statements about bridges is true?

      (a) When bridges that offer backward learning first boot, they broadcast a request to all hosts connected to the extended LAN to discover their MAC addresses

      (b) Backward learning allows a bridge to infer the port on which to send a frame for a specific destination by looking at the source addresses of the frames it receives

      (c) By means of backward learning we automatically build a spanning tree

      (d) Spanning tree bridges do not have much use in situations where multiple bridges connect two LANs

   iii. Which statement about routing algorithms is true?

      (a) Link state routing may suffer from stale data: by the time all routing info is received from all hosts, the state in the network (and indeed, the topology) may already have changed.

      (b) Hierarchical routing increases the accuracy of the routing

      (c) Link state routing is mostly used between autonomous systems

      (d) One advantage of *link state routing* over *path vector routing* is that it does not suffer from the count-to-infinity problem

   iv. Which of the following protocols does not use a binary format?

      (a) DHCP

      (b) DNS

      (c) TCP

(d) SMTP
(e) HDLC

v. Which of the following flags must always be set in at least one packet for a TCP connection to send data successfully?

(a) RST
(b) URG
(c) PSH
(d) SYN
(e) FIN

2. **Physical**

(a) i. What is the difference between a 1200-baud line, and a line that supports a transmission speed of 1200 bits per second?
ii. Wat is meant by (i) frequency modulation, and (ii) phase modulation?

(b) We are trying to transmit a single byte with a bit rate of 2400 bps.
i. What is the period T of the first harmonic?
ii. If your link supports a maximum frequency of 3000 Hz, how many harmonics can we have?

(c) What is the purpose of modulation?

3. **Datalink**

(a) Error detection occurs both in the datalink layer (e.g., CRC) *and* in the transport layer (e.g., the TCP checksum). This appears to be needless duplication. Explain whether you agree.

(b) Error detection also occurs both in the network layer (e.g., the IP checksum) *and* in the transport layer (e.g., the TCP checksum). This appears to be needless duplication. Explain whether you agree.

(c) In datalink layer headers such as the Ethernet header, the *destination address* is at the very beginning of the header and is followed by the source address. In IP and TCP, on the other hand, the destination address is either at the end or somewhere in the middle and is (perhaps more logically) preceded by the source address. Why do you think they did not do this in Ethernet?

(d) We have seen how the datalink layer provides framing (putting bits in distinct frames). Someone says: "Who cares about frames? If there are only 2 communicating parties on a link, we do not need frames at all - we can just send streams of bits." Explain why you agree or disagree.

(e) What is the CRC checksum of the following message: $\boxed{100101101}$ (given in binary), using a CRC generator polynomial of $x^3 + 1$? Show your working.

(f) Carrier-Sense Multiple Access protocols share a communication medium (such as a bus) by sensing when the medium is not being used before transmitting. Despite this, collisions still occur - explain why.

4. **Address resolution**

Show the steps taken within a local ethernet network when a machine herbert with IP address 192.168.1.10 wishes to send an IP packet to a machine andy with IP address 192.168.1.53. Assume that all ARP caches are empty, and that herbert already knows andy's IP address, and has a direct IP route to andy.

5. **TCP**

A man in a mid-life crisis goes sailing across the Atlantic. To stay in touch with his students he purchases a shortwave radio which he uses to carry Internet connections. All is well, except that his TCP connections suffer from the large number of lost packets. Sometimes the packet loss occurs as a burst of lost packets.

(a) Explain what will happen to the TCP connections if there is frequent packet loss by discussing TCP congestion control.

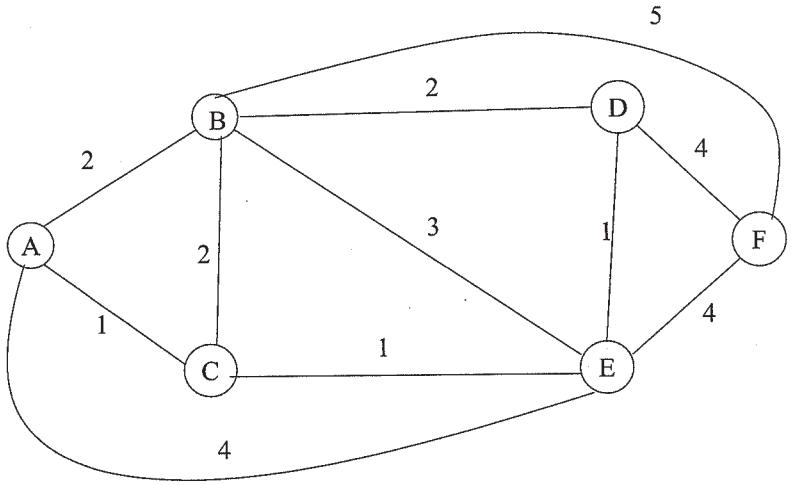
(b) Can you think of a solution to improve the connections without modifying TCP?

6. **TCP Timeouts.**

The TCP protocol sets retransmission timeouts based on network round-trip time (RTT) measurements, and timeout values have a large impact on perforamnce. What happens is the timeout is set too low? What happens if it is set too high? Show how TCP estimates the RTT, and give the basic formula for setting the retransmission timeout.

7. **Routing**

The Dijkstra Routing Algorithm is a link state routing algorithm where every node knows the topology of the network and the cost of every link. For the network shown in the figure, indicate all the steps taken by node A until it establishes the shortest path route to every other node in the network. Show each iteration of the protocol.



8. **The question question**

Give an interesting question of your own about the course material (*and* include the answer). 'Knowledge' questions (questions that aim at reproducing some material from the course material directly) contribute 0.5 points to your final grade, while 'insight' questions contribute a maximum of 1.0 points to your final grade. In both cases, the answers have to be correct,