Network Systems (201300179/201400431), Test 2

March 6, 2015, 08:45–10:15

- This is an open-book exam: you are allowed to use the book by Peterson & Davie and the reader that belongs to this module, and the handout about peer-to-peer communication (i.e., the part of the Kurose&Ross book distributed via Blackboard). Furthermore, use of a dictionary is allowed. Use of a simple (non-graphical) calculator is allowed.
- Other written materials, and laptops, tablets, graphical calculators, mobile phones, etc., are not allowed. *Please remove any such material and equipment from your desk, now!*
- Although the questions are stated in English, you may answer in English or Dutch, whichever you are more comfortable with.
- You should always explain or motivate your answers, with so much detail that the grader can judge whether you understand the material; so just saying "yes" or giving a formula without explanation is not enough.
- Visiting the toilet without explicit permission of the supervisor is not allowed. During the last 30 minutes of the exam, no toilet visits are allowed.

---

1. Physical media and encoding

3 pt (a) As a step-index glass fiber is made longer, its (Shannon) capacity decreases. Give and explain two reasons for this.

2 pt (b) Explain in your own words the purpose of 4B5B encoding.

Some physical media can distinguish between more than 2 levels, e.g., a twisted pair cable with 3 levels: 0 volts, +5 volts, or –5 volts. This is called a "ternary" signal.

4 pt (c) Design a "3B2T" encoding, to encode groups of 3 bits into groups of 2 of these ternary levels. Can you make your encoding such that it achieves the same goal as in question (b)?

---

2. Medium access

One way to classify shared mediums is by whether the nodes can hear each other's signals:

- (i) a transmission from a node cannot be detected by any other nodes (except by some central node or base station; otherwise, it would be pretty useless);
- (ii) a transmission from a node can only be detected by other nodes that are *not* transmitting at the same time;
- (iii) a transmission from a node can even be detected by other nodes that *are* transmitting at the same time.

2 pt (a) In which category is a typical 802.11 WiFi network? Explain.

2 pt (b) Can ALOHA be used in a network of category (ii)? If not, why not? If yes, is it a good choice?

2 pt (c) Can CSMA/CD be used in a network of category (ii)? If not, why not? If yes, is it a good choice?

Continued on next page...

3. **(Inter)Networking**

2 pt (a) Consider two packets belonging to the same connection in a virtual-circuit based network. Do these two packets have the same VCI values when they are on the same link? And do they have the same VCI values when they are on different links? Explain.

2 pt (b) We've learnt that first DNS is used to find the IP address for a hostname, and then ARP is used to find the MAC address for the IP address. So what's the point of having IP addresses? Couldn't we just put MAC addresses in the DNS and abolish IP?

Suppose a host with IP address 1.1.1.1 receives the following IP fragments:

source address	destination address	identifier	fragment offset	'more' flag	data
2.2.2.2	1.1.1.1	123	3	0	ABCD
2.2.2.2	1.1.1.1	123	0	1	CDE
3.3.3.3	1.1.1.1	456	9	0	DEFG
3.3.3.3	1.1.1.1	456	2	1	FGH
4.4.4.4	1.1.1.1	456	0	1	GH
4.4.4.4	2.2.2.2	456	2	0	GH
5.5.5.5	1.1.1.1	456	0	1	GHIJKLM
5.5.5.5	1.1.1.1	456	5	0	LMNO

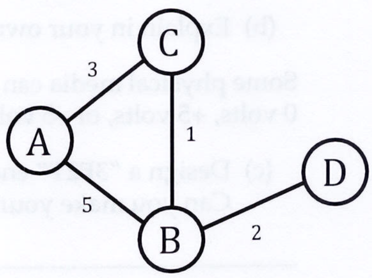
The column labeled 'data' in this table is the data part of the packet, with each letter ('A' through 'O') representing one byte.

For simplicity, the data in these example packets is ridiculously short (3 to 7 bytes). Furthermore, the fragment offset is expressed here in units of bytes, whereas in reality it is expressed in multiples of 8 bytes.

4 pt (c) What does the host do with these fragments? Specify the resulting defragmented packet(s).

4. **Routing and flooding**

Consider the network in the figure. A, B, C and D are routers using link-state routing, and the numbers are link costs.



4 pt (a) Consider the Dijkstra algorithm running in node **D**. This algorithm maintains known paths to destinations (of the form `(Destination, Cost, NextHop)` in two lists: `Tentative` and `Confirmed`. Show for each iteration of the algorithm the entries in both lists. Suggestion: make a table with 3 columns (`Step`, `Confirmed`, `Tentative`), and at least one row per iteration.

The LSAs (Link State Advertisements) for link state routing are flooded through the network using a specific algorithm.

2 pt (b) How does this algorithm prevent the LSAs from running around endlessly in loops in the network?

3 pt (c) You've learnt about two flooding algorithms (so far): the one used for distributing LSAs, and the one used by learning bridges for packets whose destinations are not yet in the forwarding tables. One of these algorithms has the property that each node sees the flooded packet exactly once, while in the other a node may receive the same flooded packet more than once. Which one is which? Explain.

End of this exam.