Network Systems (201300179/201400431), Test 2

February 26, 2016, 13:45–15:15

- 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.

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1. Physical media and framing

2 pt (a) Consider a glass fiber without cladding, immersed in water. The index of refraction of the glass is 1.45, that of the water is 1.5. Is this fiber suitable for communication? Explain.

2 pt (b) The IPv4 header has a "length" field. That means that if we send lots of IPv4 packets one after the other, we can always count bytes to find out where the next one starts, without needing any further framing. Is this a good idea? Explain.

3 pt (c) Design a framing method which uses 2 bytes for each flag; i.e., specify appropriate rules for adding flags and for doing and undoing any stuffing you deem necessary.

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2. Medium Access Control

On a cable are 4 nodes, A, B, C, and D. A and D are at the two ends of the cable. The nodes use Carrier Sense Multiple Access (CSMA).

3 pt (a) Describe a scenario where A and D transmit a packet, and where B experiences a collision between the two packets, and C not. You may use a space-time diagram (analogue to Figure 5.12 in part 5 of the reader) to describe the scenario.

3 pt (b) To guarantee that a collision is always detected by all nodes, systems that use CSMA with collision detection use a minimum packet length. For each of the following cases describe if, how, and why this minimum packet length (in bits) should change as a result of the modification given.
(1) the cable length is doubled
(2) the number of nodes is 8 instead of 4
(3) the data rate at which the nodes are sending is increased with a factor 10.

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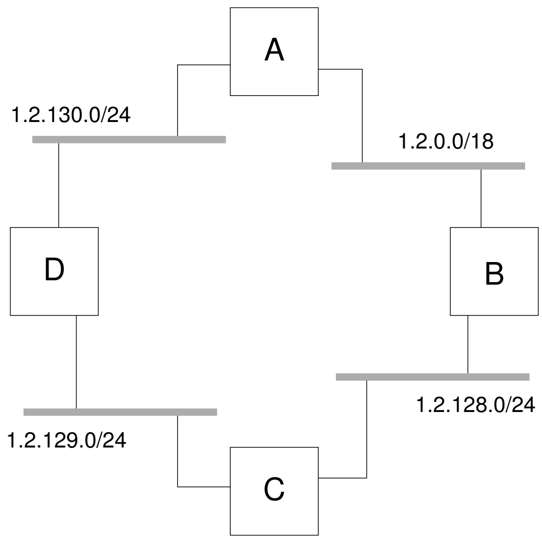
3. (Inter)networking



Consider the network sketched here, consisting of a number of Ethernet LANs (the thick gray lines), connected via "boxes" (the squares). Each LAN also has 10 computer connected to it (not shown in the figure); assume all of these computers are actively exchanging packets with each other via this network.

2 pt (a) If all of the boxes are bridges, how many entries does each of them have in its forwarding table? Explain.

2 pt (b) Still assume the boxes are bridges, with bridge IDs 2, 5, 9, 13 for boxes A. . . D, respectively. Which ports will be switched off, and why?

Next, assume that the boxes are routers, and the computers on each of the LANs are assigned IPv4 addresses from the ranges indicated.

2 pt (c) How many forwarding table entries does each router have, if the forwarding is such that each LAN is reached via the smallest number of hops?

2 pt (d) How many entries does each of the *computers* have in its ARP table? Explain.

2 pt (e) Suppose we would connect this network, consisting of four ethernets and four routers, to the world-wide Internet, keeping the address ranges assigned as in the figure. Preferably, only a single entry would be needed for all of this in the Internet forwarding tables. Give a /16 address block which covers this entire network. Is a longer prefix possible?

Finally, assume the routers A—D apply the Dijkstra algorithm to find the cheapest path to each other.[1] The link costs are all 1, except for the link between A and D which has a cost of 5.

4 pt (f) Show how the Dijkstra algorithm works for node A, by giving a table in which tentative and confirmed paths are listed for each step of the algorithm.

End of this exam.

[1] In reality, the routers wouldn't be so much interested in finding paths to each other, but to the IP (sub)networks. We'll ignore that detail here.