Network Systems (201300179), Test 2

March 7, 2014, 15:45–17:15

- Only 1 double-sided sheet of notes / summary (any font size/density!), and a dictionary are allowed as reference material. Use of the book by Peterson & Davie or any other written material is not allowed. Use of a simple (non-graphical) calculator is allowed. Use of laptops, tablets, graphical calculators, mobile phones, etc., is 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, encoding, and medium access

Consider a step-index glass fiber.

2 pt (a) Is the cladding's index of refraction higher or lower than the core's? Explain.

2 pt (b) The firm "fly-by-night" unfortunately got the previous question wrong (oops) and makes a fiber which has the two types of glass interchanged. Will this fiber still be usable or not? Explain.

Now let us compare two glass fibers; both have the same attenuation, but the second fiber has more dispersion. Both are used with the same equipment (lasers, light detectors etc.).

2 pt (c) Which one has the highest Shannon capacity? Motivate your answer by giving the appropriate formula and discussing how the parameters in the formula depend on the given information.

In order to send data over the fiber, we need framing.

2 pt (d) Consider HDLC's bit-oriented framing protocol that uses bit-stuffing and flags. What is the purpose of bit-stuffing?

2 pt (e) Why do NRZI-encoding and bitstuffing go well together?

One possible architecture for Fiber-To-The-Home networks is the so-called Passive Optical Network, in which a single fiber comes from a central node (which is connected to the rest of the internet), and is split using passive splitters to individual fibers to individual homes. Any optical signal from the central node thus reaches all homes ("downlink"); and the optical signals from the homes ("uplink") get combined together onto the fiber going to the central node (but the signal from one home does not reach the other homes).

4 pt (f) Clearly, the uplink direction needs some kind of multiple-access mechanism. Propose two solutions for this, and give an advantage and a disadvantage of each of them.

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2. Link-state routing

A router running a link-state routing protocol has received the following Link-State Packets (LSPs) of the form `(ID, {(Neighbour ID, Cost),....}, sequence number, time-to-live)`:

`(B, {(A, 5), (C, 1), (D, 2)}, 1, 20);`
`(C, {(A, 3), (B, 1)}, 2, 20);` and
`(D, {(B, 2)}, 1, 19).`

The router has created the following LSP himself:
`(A,{(B,5),(C,3)},1,21)`.

1 pt (a) Describe the network as this router observes it, as a graph

The router above uses the forward search algorithm (realization of Dijkstra algorithm) to calculate the shortest paths through the network. This algorithm maintains known paths to destinations (of the form `(Destination, Cost, NextHop)` in two lists: `Tentative` and `Confirmed`.

4 pt (b) 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 column per iteration.

An ISP deploys in its network a link-state routing protocol implemented by the firm "fly-by-night". This firm has made programming errors while implementing the link-state routing protocol. More specifically, the programming errors are such that some fields in the Link-State Packets (LSPs) created or forwarded are not set correctly.
In the subquestions below, you will be asked to describe the consequences of a specific error, assuming the rest of the protocol has been implemented correctly.
For each subquestion, describe the consequences for the operation of the routing protocol, and for the delivery of packets (with user data) by the network, both initially, and after topology changes.

2 pt (c) What happens if the protocol sets the `time-to-live` field in all generated link-state packets to 0?

2 pt (d) What happens if the `sequence number` of created LSPs is always set to 1, and not incremented?

2 pt (e) What happens if nodes that forward an LSP increment its `sequence number` by 1?

2 pt (f) What happens if nodes that forward an LSP decrement its `sequence number` by 1

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3. Naming and addressing

2 pt (a) Explain the difference between a root domain name server and a top-level domain name server. Which one, do you think stores more resource records?

2 pt (b) In the domain name system (DNS) names are typically resolved with recursive queries to a local name server. Alternatively, a host could use iterative queries, without using a local name server. Explain why in the first solution the DNS caching is much more effective than in the second solution.

3 pt (c) Suppose you want to intercept IP datagrams transferred between two hosts on the Ethernet in de Spiegel building. You can connect your computer also to the same network. The IP addresses of these hosts are known to you. Outline a strategy to (mis)use the address resolution protocol (ARP) to do so, by sending fake ARP packets.

End of this exam.