Datakommunikation I - HT05

Theoretical Exercise 3 - Updated

Deadline Friday October 7, 2005, 12:00. Preferably, hand it in via mailbox 73 outside room P1457, mail is possible as well[1].

Realisation You can work in groups of two and answer in either English or Swedish.

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Exercise 1: Short Questions

a) What is the difference between routing and forwarding? (1P)

b) Outline how IP fragmentation and reassembly works: Where and why are packets fragmented, and where are they reassembled. What is the fragment size before reassembly? (2P)

c) Explain how the netmask is used when doing forwarding. (2P)

d) Assuming that an attack would succeed in bringing down all of the root servers in the DNS system, what implications would that have to the operation and usability of the Internet? (1P)

e) To configure a new computer to be attached to the Internet without using autoconfiguration services such as DHCP, you need to specify four parameters in order to make the Internet- working part work properly. Name these parameters, and for each parameter describe why it is important. (2P)

Exercise 2: Distance-Vector Routing

Consider a network as illustrated in figure 1 with the indicated link cost. Use the distance-vector algorithm as discussed in the course to provide the forwarding tables of all the nodes.

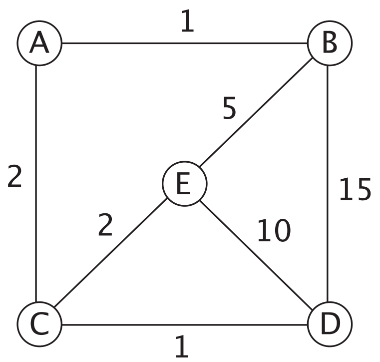

Figure 1: Network topology for exercise 2.

[1] Be aware that mail is an unreliable communication protocol.

a) Provide the initial forwarding tables for all nodes (initial: after switching on the nodes at the same time). (1P)

b) Assume that every iteration is simultaneously executed at every node. Execute the distance-vector algorithm and for every iteration provide the *changed* entries of the forwarding tables. (4P)

c) Provide the *complete* final forwarding tables for every node, that is, the forwarding tables after the algorithm completed. How many iterations were necessary until convergence? In what relation is that number to the characteristics of the graph? (2P)

Exercise 3: Forwarding Table Update

a) A routing domain is illustrated in figure 2. The link between router 2 and router 3 goes down. After this event, routing information is exchanged between the routers to reflect the new topology. What will the forwarding tables in each of the routers look like after all update messages have been processed? (3p)

b) After the link between router 2 and 3 is working again, the network gets modified such that two of the links between the routers become one-way links. The link between router 1 and 3 can only forward packets in the direction towards router 3, and the link between router 2 and 3 can only forward packets in the direction towards router 2. What will the forwarding tables look like in the routers after all update messages have been updated? (4p)

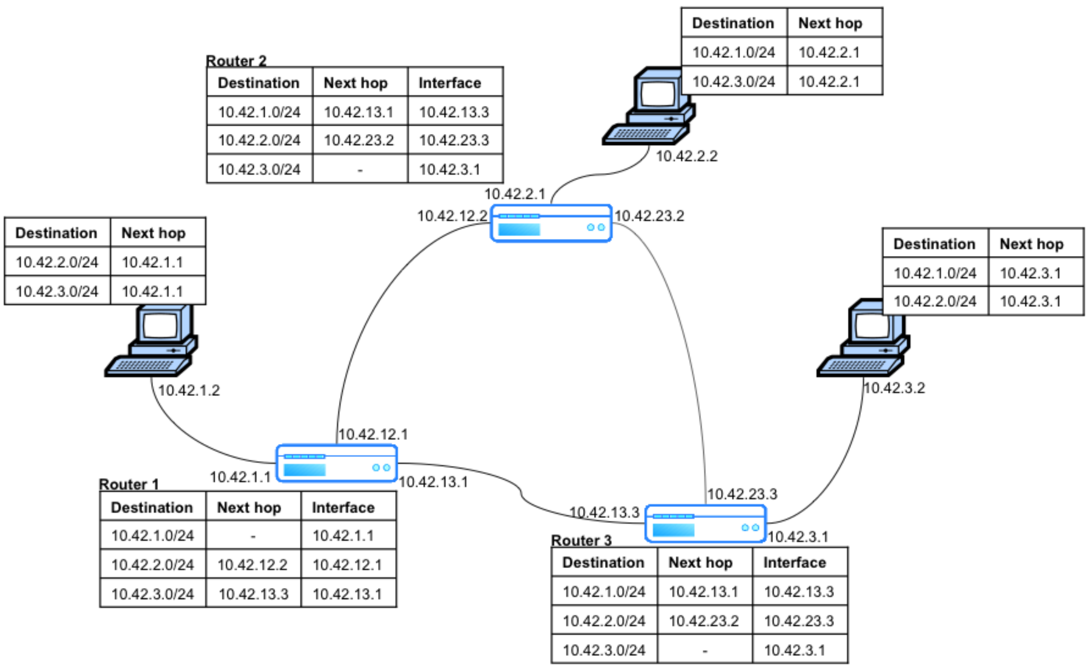

Figure 2: Network topology and forwarding tables for exercise 3.

Note: the forwarding table of router 2 in figure 2 is wrong.

Exercise 4: Address Allocation

A student who recently finished a course in computer networks is asked to set up two routers - R1 and R2 - in the domain illustrated in figure 3. Numbers in the figure identify the different interfaces on each router. The student has the network 10.42.0.0/16 to her disposal. Give an example of how this addresses can be distributed in the domain by presenting the network identifiers for each of the four network plus the forwarding tables for each of the two routers. The amount of nodes in each domain are indicated in the figure. (7p)

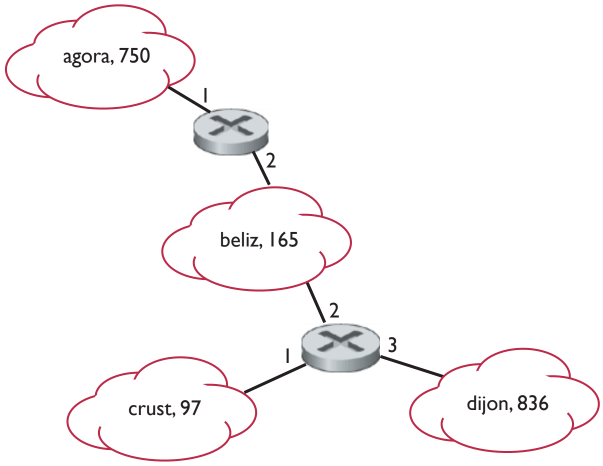

Figure 3: Routing domain and number of nodes for exercise 4.

Exercise 5: Multiple Access

a) Protocols like ALOHA and CSMA/CD are also called *statistical multiplexing* protocols. Why? What are the advantages as compared to TDMA, FDMA, and CDMA? (2P)

b) Suppose nodes A and B are on the same 10Mbit/s Ethernet segment (CDMA/CD). Node A begins transmitting a frame and, before it finishes and before the frame reaches B, also node B begins transmitting a frame. What is the condition that both A and B can detect the collision? Assuming that the propagation delay between the two nodes is 225 bit times (1 bit time = 1 bit / 10Mbit/s), what is the minimum frame size allowing collision detection? (3P)

c) (Kurose Ross, Problem 5.14): In this problem you will derive the efficiency of a CSMA/CD-like multiple access protocol. In this protocol, time is slotted and all adapters are synchronised to the slots. Unlike slotted ALOHA, however, the length of a slot (in time) is much less than a frame time (the time to transmit a frame). Let T be the length of a slot. Suppose all frames are of constant length $L = kRT$, where R is the transmission rate of the channel and k is an integer. Suppose there are N nodes, each with an infinite number of frames to send. We also assume that P (propagation time) is smaller than T, so that all nodes can detect a collision before the end of a slot time. The protocol is as follows:

- If, for a given slot, no node has possession of the channel, all nodes contend for the channel; in particular, each node tranmits in the slot with probability p. If exactly one node transmits in the slot, that node takes possession of the channel for the subsequent $k - 1$ slots and transmits its entire frame.
- If some node has possession of the channel, all other nodes refrain from transmitting until the node that possesses the channel has finished transmitting its frame. Once this node has transmitted its frame, all nodes contend for the channel.

Note that the channel alternates between two states: the productive state, which lasts exactly k slots, and the nonproductive state, which lasts for a random number of slots. Clearly, the channel efficiency is the ratio of $k/(k+x)$, where x is the expected number of consecutive unproductive slots.

(a) For fixed N and p, determine the efficiency of this protocol.

(b) For fixed N, determine the p that maximises the efficiency.

(c) Using the p (which is a function of N) found in (b), determine the efficiency as N approaches infinity.

(d) Show that this efficiency appraoches 1 as the frame length becomes large.

(4P)