LiTH, Tekniska högskolan vid Linköpings universitet
IDA, Institutionen för datavetenskap
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2009-10-22

Written examination in TDTS06 and TDTS41 Computer Networks 2009-10-23 at 8–12

Rooms

T1, T2, U1, and U3.

Support materials

A basic calculator with memory erased and an English dictionary (not electronical) are allowed. Also four pages with *handwritten* notes on standard *lined* paper, with one line of text on each line on the paper, are permitted.

Results

The results will be published at latest twelve working days after the exam.

Points

Maximum is 40 points (44 if you passed the optional assignment). For grade 3, 20 points are needed. For grades 4 and 5, 28 points and 36 points, respectively, are needed.

Teacher on duty

Juha Takkinen, 0731-50 03 93, will visit the hall around 9.15pm and at 11pm.

Instructions

In addition to the common instructions given to you on the exam wrapper where your AID is written, the following also apply: Write clearly. Motivate your answers, if not told otherwise. Put down any assumptions that you make in addition to what is stated in the question, but you are not allowed to change the question. Have the same order on your answers as the questions in the exam. You can answer in either Swedish or English.

"You cannot build a corporate network of tcp/ip" —IBM, 1992

Good luck!

1. Protocols

a. Define the terms “protocol” and “network architecture”. (2 p.)

b. Explain how many states the finite state machine for a stop-and-wait protocol (rdt 3.0) does contain and why. What does the receiver of this protocol do when it detects that a packet got lost? (2 p.)

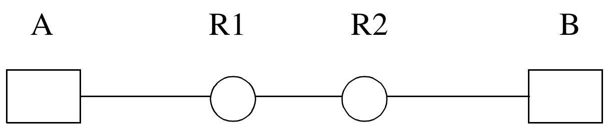
c. Give an example of a protocol stack. (1 p.)

2. Networking basics

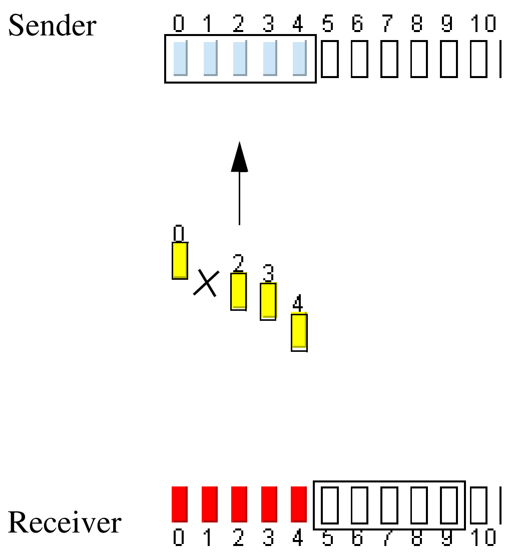
a. Presuppose the below network, consisting of two end nodes and two routers inbetween. The bandwidth on all links is 5 Mbps. Assume node A wants to send 1000 KB of data to B. The nodes will do a handshake taking two RTTs before establishing the data transfer phase. One RTT takes 100 ms. Furthermore, router R1 will fragment the data into four packets.

i. Calculate the total time for B to receive the data from A, including the final ACK from B to A. (2 p.)

ii. What is the average throughput A–B? (1 p.)



c. Assume a selective-repeat type of sliding window. One full window of ACKs has just been sent by the receiver forthe five incoming DATA packets. Unfortunately, one of the ACKs is lost during transmission, as shown by the cross mark in the figure below. Explain what happens next. When will the sender be able to move its window and how much? (2 p.)



3. Applications

a. The following lines show *parts of* a session where an e-mail message is being sent, However, the lines have been mixed up. Place them in the correct order (some lines have deliberately been left out) as they normally occur in a typical session. Also, briefly describe what each line means: (2 p.)

i. DATA

ii. HELO liu.se

iii. Mime-version: 1.0

iv. . (period)

v. RCPT To:<lena.stromback@liu.se>

vi. QUIT

vii. Happy holidays!

viii. MAIL From:<juha.takkinen@liu.se>

ix. 250 hugin.unit.liu.se ESMTP Postfix

x. 250 Ok

b. Explain what the DHT data structure is and how it can be used in a peer-to-peer network. (2 p.)

c. In the DNS system, exemplify what information an authoritative server mainly maintains, as compared to a root server? (1 p.)

4. TCP

a. Describe how TCP estimates the timeout value for a retransmission. (2 p.)

b. Explain how a TCP sender interprets the following events and what will happen in the next transmission round:

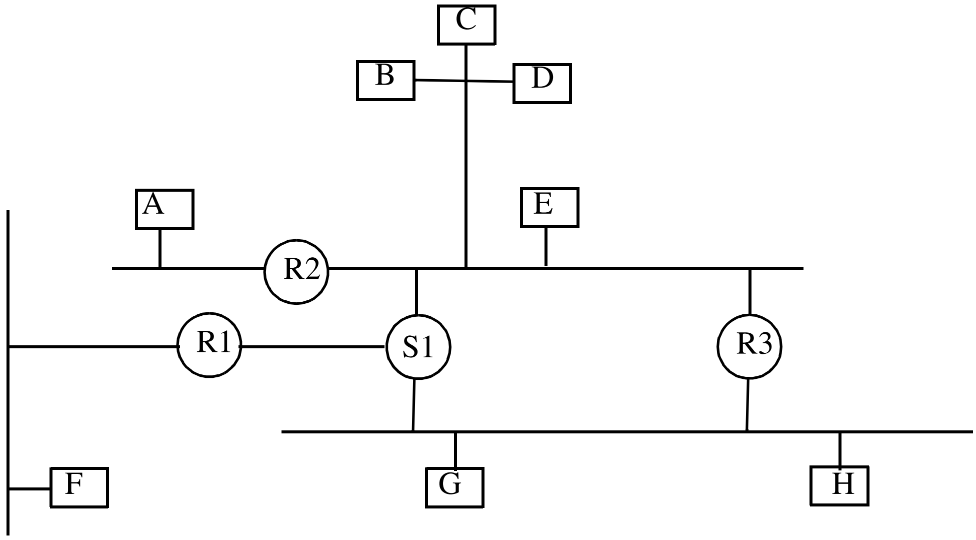
- single ACK for sequence number 1023
- duplicate ACK for sequence number 1023
- triple-duplicate ACK for sequence number 1023. (3 p.)

5. IP

a. Explain how and why IP packets can get lost in a router. (1 p.)

b. Give the details for how fragmentation is done in IPv4. Where and when are the fragments joined together? (2 p.)

c. Describe what subnets that are present in the below network. Components marked A–H are hosts, S1 is a switch and R1–R3 are routers. If each subnet is expected to grow 33% with regard to the number of hosts, what would be a suitable subnet mask for that future network of subnets? (2 p.)



6. LANs

a. Consider the network in question 5c above.

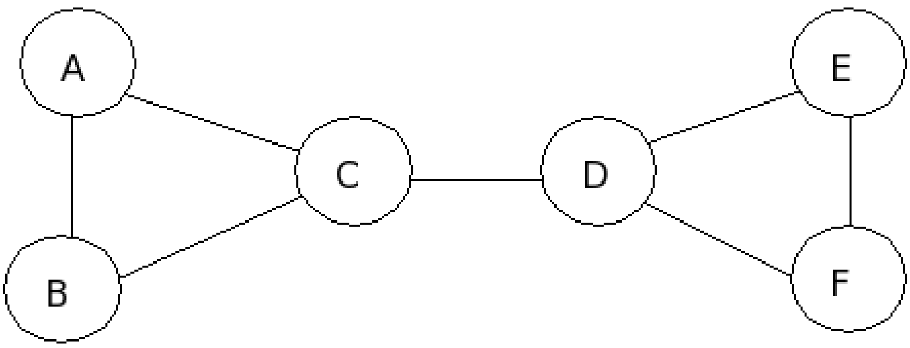
   i. Assume host A knows host G's IP address but not the MAC address. Describe how A can solve this problem by using ARP. (2 p.)

   ii. Assume the switching table in S1 initially is empty. Explain how the switch operates during the following communication: Router R1 starts by sending a frame to host C. Host C responds to R1 with another frame. Thereafter, host H sends a frame addressed to R2 and R2 responds to H with another frame. Finally, host E sends a frame addressed to R1. (2 p.)

b. Describe how the hidden terminal problem in wireless networks can be solved by using RTS, CTS and ACK frames. (1 p.)

7. Routing

a. Show how router A builds its forwarding table using Dijkstra's algorithm (link-state routing) for the network below. The cost of each link is 1 except the cost of link A–C which is 3 and the cost of the link D–F which is 7. (2 p.)



b. Explain why different inter-AS and intra-AS routing protocols are used in the Internet. How does an inter-AS algorithm and an intra-AS algorithm interplay to configure the forwarding table of a router? (2 p.)

c. Briefly describe one problem regarding the convergence or stability that can occur in a routing algorithm. (1 p.)

8. Network security

a. Motivate why the handshake is required for the correct operation of SSL. (1 p.)

b. Explain if the following collection of operations is true or false, in order to create confidential e-mail in PGP: (2 p.)

$$K_S(m) \oplus K_{B+}(K_S)$$

c. Describe the principle for authentication as used in WEP, which includes protection from playback attacks. (2 p.)