Re-Exam Computer Communication
EDA344, DIT423

Time and Place: Tuesday 29 May, 2018, 08.30-12.30 SB-MU

Course Responsible: Marina Papatriantafilou (Tel: 772 5413), Ali Salehson (Tel 772 5746)

Allowed material:

- English-X (X can be French, German, Swedish, etc) dictionary
- *No other books, no notes, no calculators, no electronic devices.*

Grading:

CTH students (EDA344 or EDA343): 3: 30-40 p, 4: 41-50 p, 5: 51-60 p

GU students (DIT423): Godkänd 30-45, Väl godkänd 46-60 p

Instructions

- **Write clearly your course-code (EDA344/DIT423)**
- **Start answering each assignment on a new page; use only one side of each sheet of paper; please sort the sheets according to the question-ordering and number them.**
- Write in a **clear manner** and **motivate** (explain, justify) your answers. If it is not clear what is written for some answer, it will be considered wrong. If some answer is not explained/justified, it will get **significantly lower or zero** marking.
- If you make any **assumptions** in answering any item, do not forget to clearly state what you assume.
- A good rule-of-thumb for the extend of detail to provide, is to include enough information/explanation so that a person, whose knowledge on computer communication is at the level of our introductory lecture, can understand.
- Please answer in English, if possible. If you have large difficulty with that (with all or some of the questions) and you think that your grade might be affected, feel-free to write in Swedish.
- Inspection of exam: date, time will be announced through pingpong and the web page www.cse.chalmers.se/edu/course/EDA344DIT423/

Good Luck !!! Lycka till !!!!

1. General questions (12 p)

   (a) (5p) Consider the following outcome to the execution of the `tracert` program:

```
C:\>tracert www.uva.nl
Tracing route to cms-prd-www.lb.uva.nl [145.18.12.36]over a max of 30 hops:
1       4 ms     2 ms    2 ms   gw-1.chalmers.se [129.16.140.10]
2       2 ms     4 ms    3 ms   cth29a-gw.chalmers.se [129.16.29.1]
3       2 ms     2 ms    3 ms   core1-hall-gw.chalmers.se [129.16.2.113]
4     108 ms    2 ms    2 ms   cth-r1.sunet.se [130.242.6.8]
5     236 ms    3 ms    2 ms   goteborg-gbg7-r1.sunet.se [130.242.4.172]
6     230 ms    5 ms    4 ms   halmstad-hsd1-r1.sunet.se [130.242.4.49]
7      98 ms    5 ms    6 ms   lund-lnd88-r1.sunet.se [130.242.4.73]
8       6 ms    6 ms    6 ms   malmo-mcen1-r1.sunet.se [130.242.4.71]
9       8 ms    7 ms    6 ms   dk-ore.nordu.net [109.105.102.122]
10      7 ms    7 ms    7 ms   dk-uni.nordu.net [109.105.97.133]
11     27 ms   27 ms   27 ms   uk-hex.nordu.net [109.105.97.127]
12     33 ms   33 ms   50 ms   something.surf.net [109.105.98.110]
13     26 ms   61 ms   26 ms   ae0.500.jnr01.asd001a.surf.net[145.145.176.0]
14     34 ms   34 ms   37 ms   uva-100g.customer.surf.net [145.145.19.230]
15     28 ms   26 ms   26 ms   cms-prd-www.lb.uva.nl [145.18.12.36]
Trace complete.
```

   i. Considering any arbitrary row, wxplain what it describes.
   ii. Observe that in rows 4-7 the first numbers (108, 236, 230, 98) are significantly higher than the others. Also rows 11-15 contain higher numbers. What can these depend on?

   (b) (7p) Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host receives the IP address from DNS; this incurs an RTT of D1 per DNS. Further suppose that the Web page associated with the link contains m very small objects. Suppose the HTTP running is nonpersistent and let RTT D2 denote the RTT between the local host and the server for each object. Assuming negligible transmission time of each object. Explain, using time-space diagrams, how you can estimate how much time elapses from when the client clicks on the link until the client receives all the objects. Consider:
   i. Nonpersistent HTTP with no parallel TCP connections.
   ii. Nonpersistent HTTP with the browser configured for m parallel connections.
   iii. Persistent HTTP

2. Reliable Data Transfer and Transport layer (12 p)

   (a) (6p) Suppose 8 TCP segments with the following sequence numbers are sent by node A to node B: 9260, 10720, 12180, 13640, 15100, 16560, 18020, 19480. Assume that the second segment (ie the one with seq. nr. 10720) does not arrive, while the other ones arrive correctly. Assume that the Round Trip Time between A and B is considerably longer than A's TCP-timeout and that the first segment is immediately acknowledged by B. Draw a space-time diagram with the above details and explain:
   i. How does the receiver react upon each arrival?
   ii. How does the sender react upon the arrival of each acknowledgment?
   iii. What is the effect of the congestion-control protocol in this session? (assume that A has much more segments to send to B after the aforementioned ones).

   (b) (4p) Explain the addressing and de-multiplexing provided by UDP and by TCP. Accompany your explanations with appropriate figures.

(c) (2p) If two end-systems are connected through multiple routers in the Internet and the data-link layer between them ensures reliable data delivery, is transport-layer reliability necessary? why/why not?

3. Security, performance and Internet in evolution(12p)

   (a) (5p)
   i. Explain what we mean by the term *throughput* of a connection.
   ii. Consider a session of reliable data transfer of a big file between a client and a server in the Internet. Explain why the throughput of this session can be much lower than the bit rate of the links connecting the client and the server to the Internet. Name 3 factors that can influence the throughput of this session and explain carefully how exactly they do that.

   (b) (4p)
   i. Describe a main problem with TCP's approach for congestion control, in the context of interactive multimedia applications.
   ii. Describe what the QUIC and http2e protocols propose for coping with this issue.

   (c) (3p) Considering that an encryption technique itself is known, i.e. published, standardized, and available to everyone, even a potential intruder: where does the security of an encryption technique come from?

4. Data Link Layer protocols and synergies (12p)

   (a) (7p) Consider a host A connecting to a web server X to get a document. A is in the same local network with B and C, connected to the Internet through an Ethernet switch and an access router R. Hosts A, B, C and the router R are connected to the switch through ports 1, 2, 3 and 4 respectively. Assume the ARP table at A is empty and the the switch's table contains an entry mapping R.MAC to port 4. (For explaining your answer use a notation such as A.IP, A. MAC to denote the respective addresses.). Explain:
   i. How and why A starts with using ARP (Address Resolution Protocol) before sending packets addressed to X.
   ii. Explain how the switch handles the forwarding of the Ethernet frames involved; include a description of how the switch table is updated.
   iii. Explain the steps and protocols involved, until the packet containing A's request reaches X. List any assumptions you might make reagrding how X is connected to the Internet.

   (b) (5p) What are the approaches taken to handle (i) medium sharing (ii) and bit errors in Ethernet and 802.11 link layer protocols? Compare and justify the choices made in each case.

5. Internet's infrastructure (12 p)

   (a) (8p)
   i. Describe the structure of the DNS system and the role of the DNS servers at the different levels of hierarchy.
   ii. If a DNS client sends a request for the IP address of URL www.chalmers.se to a server at each level of the hierarchy, what is the reply?
   iii. Describe the role of DNS in supporting Content Distribution Networks. Provide an example to elaborate on the description.

   (b) (4p)
   i. Describe the concept of Software Defined Networks.
   ii. How is it motivated?
   iii. What are the purposes of having such an infrastructure?