CTH, GU Computer Science and Engineering

Computer Communication
EDA343/EDA344, DIT 423

Time and Place: August 19, 2019, 14.00-18.00, SB

Course Responsible: Marina Papatriantafilou, Ali Salehson/Tomas Olovsson (Tel: 772 5413, 772 5746/1688)

Allowed material:

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

Grading:

CTH: 3: 30-40 p, 4: 41-50 p, 5: 51-60 p

GU: Godkänd 30-48, Väl godkänd 49-60 p

Instructions

- **Write clearly your course-code (EDA343/EDA344/DIT423)**
- **Start answering each assignment on a new page; use only one side of each sheet of paper; sort the sheets according to the question-ordering and number them.**
- Write in a **clear manner** and **motivate** (explain, justify) your answers. If some answer is not explained/justified, it will get **significantly** lower 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 how much 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.

Good Luck !!! Lycka till !!!!

1. Overview and application-layer networking (12 p)

   (a) (6 p) A popular www-site can quickly become overwhelmed if it has only one server handling all of its requests. How is this tackled in practice? Mention two methods and describe how they work.

   (b) (6 p) Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is cached in your local host, so a local DNS lookup is done quickly. Further suppose that the Web page associated with the link contains m very small objects on the same server. Since all objects are small, we assume zero transmission time of each object. Let also the round-trip latency between the local host and the web server be equal to RTT (Round Trip Time) time units. Give an expression of the time that elapses between your click on the link until your browser receives all the objects for this Web page in the following cases: (i) Non-persistent HTTP with no parallel TCP connections. (ii) Non-persistent HTTP with the browser configured for m parallel connections. (iii) Persistent HTTP. Use space-time diagrams to facilitate and to explain your calculations.

2. Reliable Data Transfer and Security Issues (12 p)

   (a) (2 p) Describe the requirements for reliable data transfer.

   (b) (5 p) TCP applies acknowledgements for reliable data transfer. Describe carefully how its method works, including policies for acknowledgements and a couple of examples.

   (c) (2 p) Mention an alternative approach for reliable data transfer and a couple of methods to achieve it.

   (d) (3 p) 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?

3. Addresses, subnetting and routing issues (12 p)

   (a) (7 p) Consider an ISP that has an unused address block 122.211.52.0/22 and has four new customers A, B, C, and D with different needs of IP host addresses, namely in need of 500, 250, 125 and 6 host addresses respectively. Your task is to propose a possible allocation of subnets by the ISP for these four customers (one subnet per customer) such that the address space of the available prefix will be used optimally (minimal waste). When answering the following questions, please explain your answers and calculations carefully.

      i. Give the address and subnet mask for all customers subnets using CIDR-notation, i.e. xxx.xxx.xxx.xxx/yy.

      ii. How many valid host addresses are there in each subnet?

      iii. Will be there any addresses that are not allocated and can be used by the ISP in future for other customers? If so, give the remaining addresses in the form of available (not allocated yet) subnets using CIDR-notation.

   (b) (5 p) (i) What are two main problems with IP's destination-address-only-based routing? (ii) Consider the OpenFlow protocol. Describe its basic functionality and give an example of how it can help to address the problems that you mentioned.

4. End-to-end communication and timing/rate-related topics (12 p)

   (a) (5 p) 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, explain 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) (4 p) Both congestion control and flow control in TCP limit the sender's sending rate. Then how are they different?

   (c) (3 p) Are TCP's methods for reliable data transfer and congestion control helpful for applications that are sensitive to jitter? What do they imply? Explain carefully your answer. Discuss the receiving rates of data, including what is required and what is expected by TCP.

5. Ethernet, LAN, Wireless (12 p)

   (a) (2 p) Why does collision occur in CSMA, if all nodes perform carrier sensing before transmission?

   (b) (4 p) Consider the operation of a learning switch in the context of a network in which 6 nodes labeled A through F are star connected into an Ethernet switch. Suppose that (i) B sends a frame to E, (ii) E replies with a frame to B, (iii) A sends a frame to B, (iv) B replies with a frame to A. The switch table is initially empty. Show the state of the table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded and justify your answers.

   (c) (6 p) Consider a home-network which may have a number of PCs, laptops, smart phones and other units that are connected to a wireless home-router. The home-network will necessarily have a broadband connection to the Internet via a local ISP. Assume that the ISP has assigned the global IP-address, 80.112.34.151 to the customers home-router. Describe clearly the services and functions used by the home-router to achieve this access. Explain how the home-router will be able to give all the connected home-devices simultaneous access to the Internet although the customer has been assigned only one global IP address. Describe the routing table of the home-router.