CTH, GU | Computer Science and Engineering

Computer Communication
EDA344, DIT 423

Time and Place: Wednesday 20 March, 2019, 14.00-18.00 SB

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 (EDA344): 3: 30-40 p, 4: 41-50 p, 5: 51-60 p
GU (DIT 423): 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 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 extent 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 and time will be announced on the front page of the course in the canvas system

Good Luck !!! Lycka till !!!!

1. Overview (12 p)

   (a) (3 p) Explain the term data encapsulation in layered communication. Provide an example.

   (b) (2 p) How does an end-host know the IP addresses of its first-hop router and its local DNS server?

   (c) (7 p) Consider an end-host connecting to a LAN and placing a request to get its favourite song "Boulevard of Broken Dreams", through a streaming provider application at www.BestSongs.com that relies on www.AlmostBestCDN.com for content distribution. List the network protocols that are involved and their role in making this scenario happen. Support you list with a figure that shows the main nodes (host(s), router(s), server(s)) and the steps associated with the protocols' use.

2. Performance and Security (12 p)

   (a) (4 p) Consider a pipelined protocol, between 2 hosts, A and B, connected with a channel whose transmission rate (R) is 1 Gbps and Round Trip Time (RTT) 30 msec, while the packet-size (L) is 1500 bytes, including both header fields and data. How big should the window size have to be for the channel utilization to be greater than 98 percent?

   (b) (4 p) Usage of small packets for Voice-over-IP (VoIP) applications: One drawback of a small packet size is that a large fraction of bandwidth is consumed by overhead bytes. Suppose that the packet consists of L bytes of data. Consider sending a digitally encoded voice source directly. Suppose the source is encoded at a constant rate of 128 kbps. Assume each packet is entirely filled before the source sends the packet into the network. The time required to fill a packet is the packetization delay. (i) In terms of L, determine the packetization delay in milliseconds. (ii) Determine the packetization delay for L = 1500 bytes (Ethernet packet) and L = 50 bytes (ATM packet). Considering that packetization delays greater than 20 msec can cause a noticeable and unpleasant echo, what can you observe?

   (c) (4 p) In the BitTorernt p2p file distribution protocol, the seed breaks the file F that is distributed into blocks and the peers redistribute the blocks to each-other. Without any protection, an attacker can easily send bogus blocks to a small subset of peers, who could spread them further. Thus it is critical to verify the integrity of a block. Assume that when a peer joins a torrent, it initially gets a `.torrent` file associated with the file F, from a fully trusted source. Describe a scheme that allows peers to verify the integrity of blocks.

3. Internet Transport Layer Protocols (12 p)

   (a) (4 p) Describe TCP's acknowledgement policy.

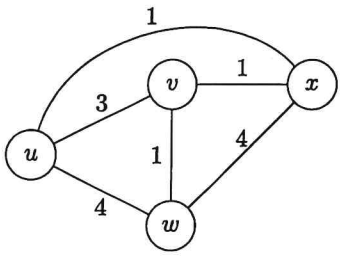
   (b) (4 p) Suppose that two TCP segments sent by a host A arrive in order at the receiver, host B. The first acknowledgment is lost and the second acknowledgment arrives after the first timeout interval. Draw a timing diagram, showing these segments and all other segments and acknowledgments sent. (Assume there is no additional loss.) For each segment in your figure, provide the sequence number and the number of bytes of data; for each acknowledgment that you add, provide the acknowledgment number.

   (c) (4 p) Suppose a hypothetical day when all the network applications on the Internet are streaming applications and run using UDP. (i) Explain and motivate a risk associated with such a scenario. (ii) What could be done to prevent this?

4. Network Layer (12 p)

   (a) (4 p) What can Software-Defined Networking do that is not possible with the standard, destination-based routing and forwarding in the classic Internet routing? How is the new functionality enabled?

   (b) (8p)



Router	IP address
u	129.16.22.0
v	129.16.22.64
w	129.16.22.42
x	129.16.22.48

(i) Using the distance vector algorithm, compute the routing table of all nodes in the above network. Write the distance vector of each node obtained after each iteration of the algorithm till it stabilizes. (ii) Simplify the forwarding tables, if possible, by using the longest prefix rule.

5. Error Detection/Correction and Medium Access (12 p)

   (a) (4p) To what family of MAC protocols CDMA belongs to? Mention one other MAC protocol belonging to this group. What are the advantages and disadvantages of this group?

   (b) (8 p) Let's consider an error detection scheme that adds a single parity bit for error detection after every seven bits; the error bit is set to one when the number of ones in the message is odd.

   (i) Is an error detected for bytes 00101010 and 10111011?

   (ii) To improve the error detection, we add a two dimensional parity bit check by transmitting a column-wise parity bit for the 8 *columns* after every 7 bytes (as described in the course, the last bit is then the parity bit of the 7 previous error bits). Is an error detected in the following situations and can it bit corrected?

(A)

1	0	0	0	1	1	0	1
0	0	0	0	1	0	1	0
1	1	1	0	1	0	0	0
0	0	1	0	1	0	1	1
1	1	1	0	0	1	1	1
1	0	1	0	1	0	0	0
1	0	0	0	0	0	0	1
1	0	0	0	1	0	1	0

(B)

1	0	0	0	1	1	0	1
0	0	0	0	1	0	1	0
1	1	1	0	1	0	0	0
0	0	0	0	1	0	1	1
1	1	1	0	0	1	1	1
1	0	1	0	1	0	0	0
1	0	0	0	0	0	0	1
1	0	0	0	1	0	1	0

(C)

1	0	0	0	1	1	0	0
0	0	0	0	1	0	1	0
1	1	1	0	1	0	0	0
0	0	1	0	1	0	1	1
1	1	1	0	0	1	1	1
1	0	1	0	1	0	0	0
1	0	0	0	0	0	0	1
1	0	0	0	1	0	1	0

(D)

1	0	0	0	1	1	0	1
0	0	0	0	1	0	1	0
1	1	1	0	1	0	0	0
0	0	1	0	1	0	1	0
1	1	1	0	0	1	1	1
1	0	1	0	1	0	0	0
1	0	0	0	0	0	0	1
1	0	1	0	1	0	1	0

(iii) The two dimensional parity bit scheme has the property that "any single error in the message can be corrected" and "any two errors in the message can be detected". Explain briefly how those properties are obtained by considering the different possibilities for the location of errors.