

MIEEC / MIEIC

Communication Services / System and Network Services

Winter Semester 2017/2018

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Duration: 90 min

Instructions

Please write your name and student number on all answer sheets.

This exam is open book.

Each question is worth 1 value /20.

The use of communication devices (e.g., computer, smartphone, mobile phone, etc) during the exam is strictly forbidden.

The points assigned to each question are shown in parenthesis next to the question number. Partial credit is possible, so give each question a try.

Show all your work and reasoning. This is the only way to be able to give partial credit to your answers.

If you get stuck in a question, leave it for later and go on to solve the others.

Voluntary Code of Ethics

Please sign below if you agree to comply with the following sentence.

I give my word of honour that I shall not use any unauthorised means to answer this exam.

Good luck!

Short Questions

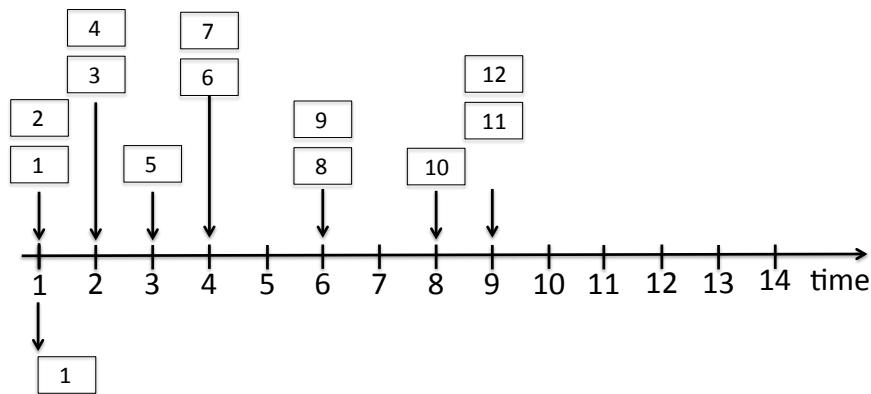
1. Zero rating is the commercial name of a mechanism to allow traffic from certain applications not to be accounted for in monthly flat rate budgets. Discuss briefly (around 1 paragraph) why this may be considered to violate network neutrality in the light of the BEREC guidelines.
2. Can a flooding search by name (or hash of the name) in a peer-to-peer network return false positives or false negatives? Why/ why not?
3. Consider a chord ring with space $[0, 2^7-1]$, and with the following set of nodes $\{23, 25, 40, 97, 106, 108, 116, 120\}$
 - a. Build the finger table for node 23.
 - b. Considering an average inter-hop delay of 250ms, in how much is the search time for node 120 reduced?
4. True or False. If false, please correct. 1 value for both.
 - a. The most likely reason that a peer-to-peer network might be preferred to a content-delivery network to host the webpage of a commercial company is improved delay performance.
 - b. Any new peer wanting to join a peer-to-peer network needs to learn about at least one participating member through an out-of-band mechanism.
5. True or False. If false, please correct. 1 value for both.
 - a. HTTP 2.0 promises to improve the bandwidth efficiency of the web by enabling multiplexing the transmission of various objects.
 - b. HTTP 2.0 server push can improve user experience by proactively sending objects without waiting for the corresponding request, provided that the server is adequately configured.
6. True or False. If false, please correct. 1 value for both.
 - a. DiffServ is less scalable than IntServ because it requires maintenance of per flow state in each router.
 - b. While Assured Forwarding provides absolute per flow guarantees, Expedited Forwarding provides only stochastic guarantees.
7. True or False. If false, please correct. 1 value for both.
 - a. MPLS uses globally unique identifiers to force packets to follow a pre-defined path in the network.
 - b. MPLS has a much simpler route lookup than IP since it uses fixed length tags.
8. True or False. If false, please correct. 1 value for both.

- a. Content Delivery Networks often leverage the hierarchical delegation of DNS resolution to direct a client to the best server within their domain.
 - b. Directing clients to the nearest server always delivers the lowest response time.
9. Suppose you have a 5Mbps link being shared by 4 flows: 1 MPEG-DASH video stream with adaptive bit rate, two file downloads using TCP, 1 UDP flow of 2Mbps. The MPEG-DASH flow offers the following possible rates {275241, 548104, 745370, 1502455, 3709841} bps. Consider a perfect adaptation mechanism, i.e. disregard the known harmful interactions with TCP. To which rate will MPEG-DASH adaptive bitrate mechanism converge?
10. Consider a CDN that uses DNS to direct clients to the best server, has 2 levels of hierarchy within its domain, one for directing to distinct geographic clusters, and another one for directing to the least loaded server. Should the TTL to use in the two internal name resolutions be of the same order of magnitude? Why/ why not?

Problems

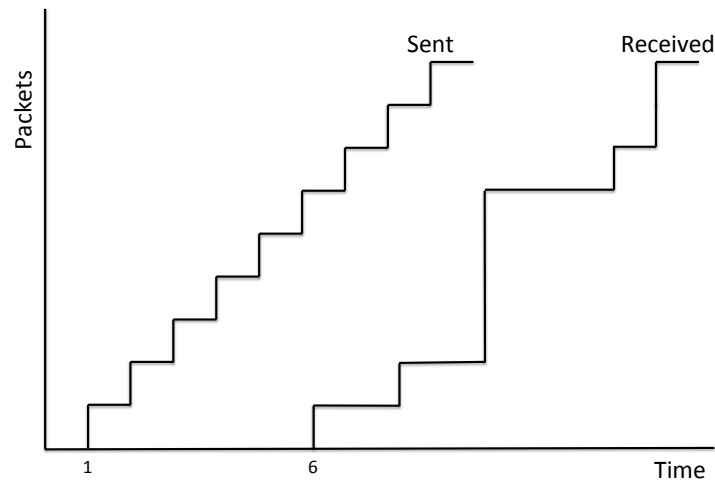
Please show all your calculations and justify your options.

1. Answer the following questions considering the figure below. Assume that one packet can be transmitted per time slot.



- a. Assuming FIFO service, indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and the beginning of the slot in which it is transmitted? What is the average of this delay over all 12 packets?
- b. Now assume a priority service, and assume that odd-numbered packets are high priority, and even-numbered packets are low priority. Indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and the beginning of the slot in which it is transmitted? What is the average of this delay over all 12 packets?
- c. Now assume round robin service. Assume that packets 1, 2, 3, 6, 11, and 12 are from class 1, and packets 4, 5, 7, 8, 9, and 10 are from class 2. Indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and its departure? What is the average delay over all 12 packets?
- d. Now assume weighted fair queueing (WFQ) service. Assume that odd-numbered packets are from class 1, and even-numbered packets are from class 2. Class 1 has a WFQ weight of 2, while class 2 has a WFQ weight of 1. Note that it may not be possible to achieve an idealized WFQ schedule as described in the text, so indicate why you have chosen the particular packet to go into service at each time slot. For each packet what is the delay between its arrival and its departure? What is the average delay overall 12 packets?
- e. What do you notice about the average delay in all four cases (FIFO, RR, priority, and WFQ)?

2. Consider a constant bit rate video stream from a surveillance camera being transmitted over a network. The packet transmission and reception evolves as shown in the figure. The first packet is sent at $t=1$ and received at $t=6$.



- What is the data rate of the stream if each packet has a length of 500 Bytes?
- What is the average delay and jitter of the packets shown?
- If the video starts being played as soon as the first packet is received, which packets will arrive too late?
- What is the minimum size of the playout buffer (in packets) that will allow playing the all 8 packets? What is the delay added by that buffer?
- Name and describe two video quality of experience metrics that are directly influenced by the dimensioning of the playout buffer, and which can be used to quantify the trade-off involved.