Written examination in Computer Networks

June 10th 2016

Last name: _____

First name: _____

Student number: _____

I confirm with my signature that I will process the written examination alone and that I feel healthy and capable to participate this examination.
I am aware, that from the moment, when I receive the written examination, I am a participant of this examination and I will be graded.

Signature: _____

- Provide on all sheets (including the cover sheet) your *last name*, *first name* and *student number*.
- Use the provided sheets. Own paper must *not* be used.
- Place your *ID card* and your *student ID card* on your table.
- You are allowed to use a *self prepared*, *single sided DIN-A4 sheet* in the exam. Only *handwritten originals* are allowed, but no copies.
- You are allowed to use a non-programmable calculator.
- Answers, written with pencil or red pen are *not* accepted.
- Time limit: *90 minutes*
- Turn off your mobile phones!

Result:

Question:	1	2	3	4	5	6	7	8	9	10	11	12	13	**Σ**	Grade
Maximum points:	10	3	8	8	9	4	6	4	8	8	10	6	6	90	—
Achieved points:															

Last name: First name: Student number:

Question 1)

Points: .....

Maximum points: 2+5+1+1+1=10

a) Explain the difference between serial data transmission and parallel data transmission.

b) Several network topologies (Bus, Ring, Star, Mesh, Tree and Cellular) exist. Write into the following table in each row <u>one</u> network topology that matches the respective statement.

Statement	**Topology**
Mobile phones (GSM standard) used this topology	
This topology contains a single point of failure	
Thin Ethernet and Thick Ethernet use this topology	
WLAN with Access Point uses this topology	
WLAN without Access Point uses this topology	
Token Ring (logical) uses this topology	
A cable failure causes a complete network failure	
This topology contains no central component	
Modern Ethernet standards use this topology	
Token Ring (physical) uses this topology	

Each correct answer results in 0.5 points. Each wrong answer results in 0 points.

c) Name two systems, that operate according to the simplex principle.

d) Name two systems, that operate according to the full-duplex principle.

e) Name two systems, that operate according to the half-duplex principle.

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Question 2)

Points: .....

Maximum points: 3

A MP3 file with a size of $30 * 10^6$ bits must be transferred from terminal device A to terminal device B. The signal propagation speed is 200,000 km/s. A and B are directly connected by a link with a length of 10,000 km. The file is transferred as a single message, that has a size of $30 * 10^6$ bits. No network protocol headers or trailers exist.

Calculate the transfer time (latency) of the file, when the data rate of the computer network between both terminal devices is 1 Mbps.

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Question 3)

Points: .....

Maximum points: 2+2+2+2=8

a) Why is the outer conductor (the shield) of coaxial cables kept at ground potential and does completely surround the inner conductor?

b) What is a Transceiver?

c) Why is this equation useful in computer networks?
(*For what purpose is this equation used?*)

$$((+\text{Payload Signal}) + (\text{Noise})) - ((-\text{Payload Signal}) + (\text{Noise})) = 2 * \text{Payload Signal}$$

d) Why is it impossible to connect different buildings with shielded cables?

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Question 4)

Points: .....

Maximum points: 2+2+1.5+1+0.5+0.5+0.5=8

a) Name two advantages of using a Hub.

b) What is a collision domain?

c) What says the 5-4-3 rule?

d) Why does the 5-4-3 rule exist?

e) The format of what addresses is defined by Data Link Layer protocols?

☐ physical network addresses ☐ logical network addresses

f) How are physical network addresses called?

g) What protocol uses Ethernet for the address resolution?

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Question 5)

Points: .....

Maximum points: 1+1+1+1+1+2+2=9

a) Name two line codes that use two signals levels.

b) Name two line codes that use three signals levels.

c) Name two line codes that ensure a signal level change for each logical 1 bit?

d) Name two line codes that ensure that the signal levels are equally distributed?

e) Why do not all line codes ensure a signal level change for each transmitted bit?

f) What is a scrambler and for what purpose is it used?

g) How is the efficiency of a line code calculated?

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Question 6)

Points: .....

Maximum points: 4

a) Encode the bit sequence with 4B5B and NRZI and draw the signal curve.

- `0010 1111 0001 1010`

Attention: Please assume that the initial signal level of NRZI is signal level 1 (low signal).

Label	4B	5B	Function
0	0000	11110	0 hexadecimal
1	0001	01001	1 hexadecimal
2	0010	10100	2 hexadecimal
3	0011	10101	3 hexadecimal
4	0100	01010	4 hexadecimal
5	0101	01011	5 hexadecimal
6	0110	01110	6 hexadecimal
7	0111	01111	7 hexadecimal
8	1000	10010	8 hexadecimal
9	1001	10011	9 hexadecimal
A	1010	10110	A hexadecimal
B	1011	10111	B hexadecimal
C	1100	11010	C hexadecimal
D	1101	11011	D hexadecimal
E	1110	11100	E hexadecimal
F	1111	11101	F hexadecimal

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Question 7)

Points: .....

Maximum points: 1+2+1+1+1=6

a) What information is stored in forwarding tables of Bridges?

b) What happens, if for a network device, no entry exists in the forwarding table of a Bridge?

c) What protocol use Bridges to handle loops?

d) What is a spanning tree?

e) What is a switched network?

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Question 8)

Points: .....

Maximum points: 4

Transmission errors can be detected via CRC checksums. If it is important to not only recognize errors, but also to be correct them, then the data to be transmitted must be encoded in a way, that error-correction is possible. Error correction can be realized e.g. via the Simplified Hamming Code we discussed in the computer networks course.

Verify, if the following message was transmitted correctly: `00111101`

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Question 9)

Points: .....

Maximum points: 2+2+2+2=8

a) Which two special characteristics of the transmission medium in wireless networks cause undetected collisions at the receiver?

b) What is the Network Allocation Vector (NAV) for what purpose is it used?

c) What is the Contention Window (CW) for what purpose is it used?

d) Name a benefit and a drawback of using the control frames Request To Send (RTS) and Clear To Send (CTS)?

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Question 10)

Points: .....

Maximum points: 2+2+2+2=8

a) What is the purpose of Routers in computer networks?
(*Also explain the difference to Layer-3-Switches.*)

b) What is the purpose of Layer-3-Switches in computer networks?
(*Also explain the difference to Routers.*)

c) What is the purpose of Gateways in computer networks?

d) Why are Gateways in the network layer of computer networks seldom required nowadays?

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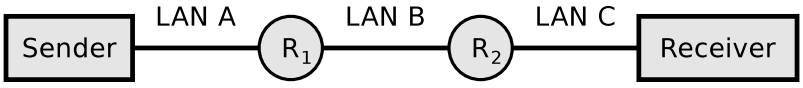
Question 11)

Points: .....

Maximum points: 10

4,000 bytes payload need to be transmitted via the IP protocol.



The resulting packet must be fragmented, because it is transmitted over multiple physical networks, whose MTU is $< 4,000$ bytes.

	LAN A	**LAN B**	**LAN C**
Network technology	Ethernet	PPPoE	ISDN
MTU [bytes]	1,500	1,492	576
IP header [bytes]	20	20	20
max. payload [bytes]	1,480	1,472	556

Display graphically the way, the packet is fragmented, and how many bytes of payload each fragment contains.

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Question 12)

Points: .....

Maximum points: 2+2+1+1=6

a) Describe two examples, where using the Transport Layer protocol TCP makes sense.

b) What is a socket?

c) What specifies the Seq number in an TCP segment?

d) What specifies the Ack number in an TCP segment?

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Question 13)

Points: .....

Maximum points: 2+2+2=6

a) Describe the silly window syndrome and its effect.

b) Describe the Functioning of silly window syndrome avoidance.

c) Why does the sender maintain two windows and not just a single one?