Written examination in Computer Networks

February 14th 2014

Last name: _____

First name: _____

Student number: _____

- 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:

1	2	3	4	5	6	7	8	9	10	11	12	13	Σ	Grade

Question 1)

Maximum points: 7

An image has a size of 2000x1000 pixels. 2 Bytes per pixel are used for the color information. Assume the image is uncompressed. How long does it take to transmit the image via a. . .

a) 64 kbps ISDN connection?

b) 16 Mbps DSL connection?

c) 100 Mbps Ethernet connection?

Question 2)

Maximum points: 1+1+1+1+1+1+1=7

a) Computer networks usually implement...

☐ serial data transmission   ☐ parallel data transmission

b) Computer networks with coaxial cables operate in...

☐ simplex mode   ☐ full-duplex mode   ☐ half-duplex mode

c) The global positioning system (GPS) operates in...

☐ simplex mode   ☐ full-duplex mode   ☐ half-duplex mode

d) Computer networks with twisted pair cables operate in...

☐ simplex mode   ☐ full-duplex mode   ☐ half-duplex mode

e) Wireless networks with just a single channel operate in...

☐ simplex mode   ☐ full-duplex mode   ☐ half-duplex mode

f) What describes the physical topology of a computer network?

g) What describes the logical topology of a computer network?

Question 3)   Points: ....

Maximum points: 3.5+0.5+0.5+0.5+0.5+0.5=6

a) Write on the dotted lines the names of the layers.

Hybrid Reference Model   **OSI Reference Model**

5		7
4		6
3		5
2		4
1		3
		2
		1
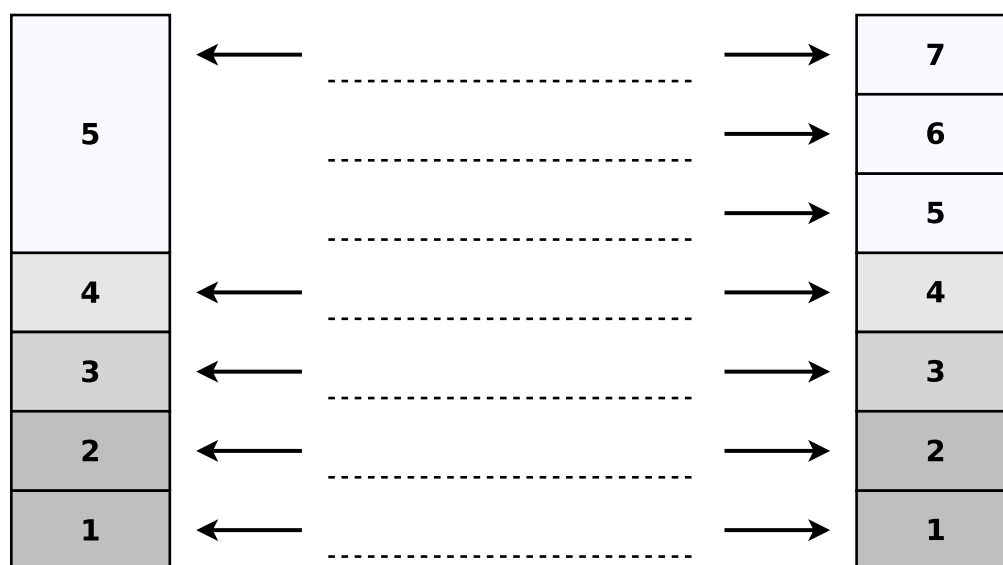
b) Ethernet frames are created in the   ....   layer.

c) UDP segments are created in the   ....   layer.

d) IP packets are created in the   ....   layer.

e) Signals are created in the   ....   layer.

f) TCP segments are created in the   ....   layer.

Question 4)   Points: ....

Maximum points: 4+2+1+1+1=9

a) Assign the devices in the table to the layers of the hybrid reference model.

Column 1 stands for the bottom layer and column 5 for the top layer of the hybrid reference model. If more than just a single layer is a correct answer, it is sufficient to select at least one correct layer.

	Hybrid reference model layer				
	1	2	3	4	5
Bridge					
Gateway					
Hub					
Modem					
Multiport Bridge					
Repeater					
Router					
Switch					

b) Name two examples of Bridge implementations.

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

d) Why do Bridges try to avoid loops?

e) Which device connects wireless network devices in infrastructure mode?

Question 5)

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

a) Which two problems can occur, when the line code NRZ is used to encode data?

b) How can the problems from subtask a) be avoided?

c) Why do not all line codes ensure a signal level change for each transmitted bit?
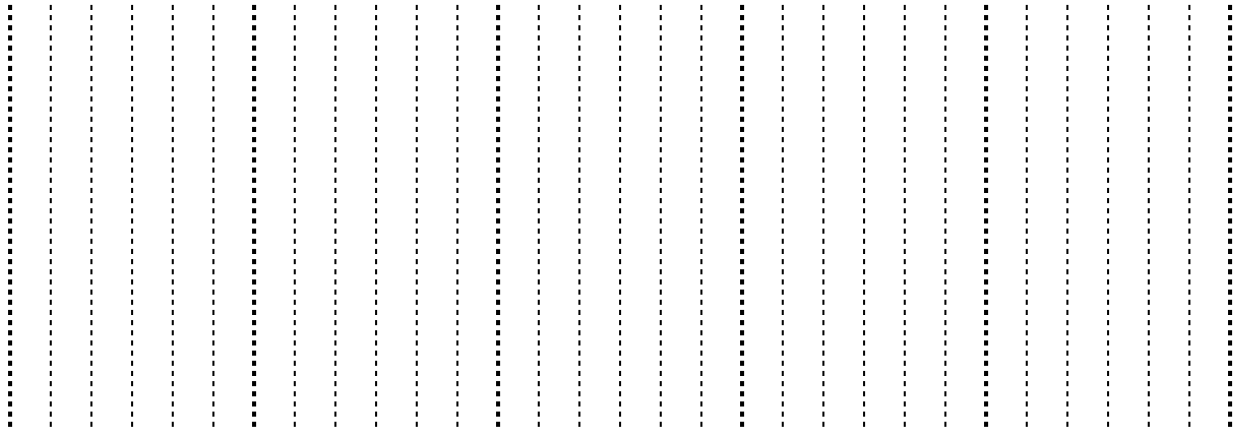
d) How is the efficiency of a line code calculated?

Question 6)

Maximum points: 5

Encode the bit sequence with 5B6B and NRZ and draw the signal curve.

Bit sequence: `10111 10010 01001 01011 00100`

5B	6B neutral	6B positive	6B negative	5B	6B neutral	6B positive	6B negative
00000		001100	110011	10000		000101	111010
00001	101100			10001	100101		
00010		100010	101110	10010		001001	110110
00011	001101			10011	010110		
00100		001010	110101	10100	111000		
00101	010101			10101		011000	100111
00110	001110			10110	011001		
00111	001011			10111		100001	011110
01000	000111			11000	110001		
01001	100011			11001	101010		
01010	100110			11010		010100	101011
01011		000110	111001	11011	110100		
01100		101000	010111	11100	011100		
01101	011010			11101	010011		
01110		100100	011011	11110		010010	101101
01111	101001			11111	110010		

Question 7)   Points: . . . .

Maximum points: 7

Which protocol. . .

a) provides congestion control and flow control?

b) resolves logical addresses into physical addresses?

c) <u>avoids</u> collisions inside physical networks?

d) provides routing within autonomous systems via the Bellman-Ford algorithm?

e) allows remote control of computers in an <u>encrypted</u> way?

f) provides routing within autonomous systems via the Dijkstra algorithm?

g) assigns the network configuration to network devices?

h) allows remote control of computers in a <u>unencrypted</u> way?

i) realizes connectionless inter-process communication?

j) resolves domain names into logical addresses?

k) <u>detects</u> collisions inside physical networks?

l) allows downloading and uploading files in an unencrypted way?

m) exchanges diagnostic and control messages?

n) reduces a computer network to a loop-free tree?
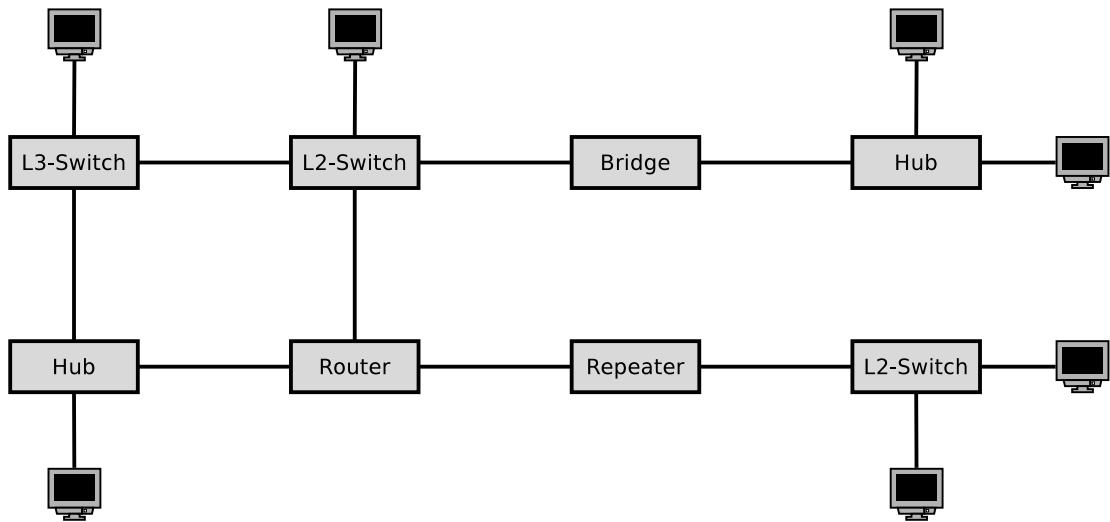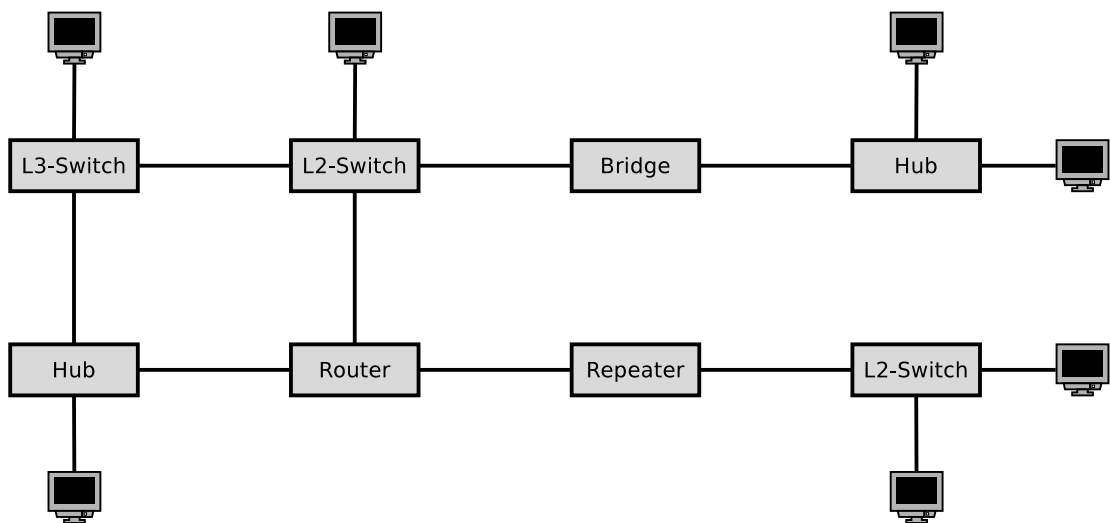
Question 8)

Maximum points: 4+2=6

a) Sketch in the diagram of the network topology all collision domains.

b) Sketch in the diagram of the network topology all broadcast domains.

Question 9)

Maximum points: 4+4=8

a) Error Detection via CRC: Check, if the received frame was transmitted correctly.

Received frame: 1011010110110   Generator polynomial: 100101

b) Error Correction via simplified Hamming Distance (Hamming ECC method). Verify, if the received message was transmitted correctly.

Received message: 101110100010

Question 10)   Points: ....

Maximum points: 5+5=10

Calculate for each subtask the subnet mask and answer the questions.

a) Split the class B network `175.8.0.0` for implementing 50 subnets.

   ```
   Network ID:     10101111.00001000.00000000.00000000     175.8.0.0
   ```

   Number of bits for subnet IDs? ....

   Subnet mask: _____._____._____._____   ___.___.___.___

   Number of bits for host IDs? ....

   Number of host IDs per subnet? ....

b) Split the class C network `200.111.222.0` into subnets, which contain 7 hosts each.

   ```
   Network ID:     11001000.01101111.11011110.00000000     200.111.222.0
   ```

   Number of bits for host IDs? ....

   Subnet mask: _____._____._____._____   ___.___.___.___

   Number of bits for subnet IDs? ....

   Number of possible subnets? ....

binary representation	decimal representation
10000000	128
11000000	192
11100000	224
11110000	240
11111000	248
11111100	252
11111110	254
11111111	255

Question 11)

Points: . . . .

Maximum points: 8

Calculate the first and last host addresses, the network address and the broadcast address of the subnet.

```
IP Address:         167.199.31.131    10100111.11000111.00011111.10000011


Subnet mask:        255.255.254.0     11111111.11111111.11111110.00000000


Network address?    ___.___.___.___   _____._____._____._____


First host address? ___.___.___.___   _____._____._____._____


Last host address?  ___.___.___.___   _____._____._____._____


Broadcast address?  ___.___.___.___   _____._____._____._____
```

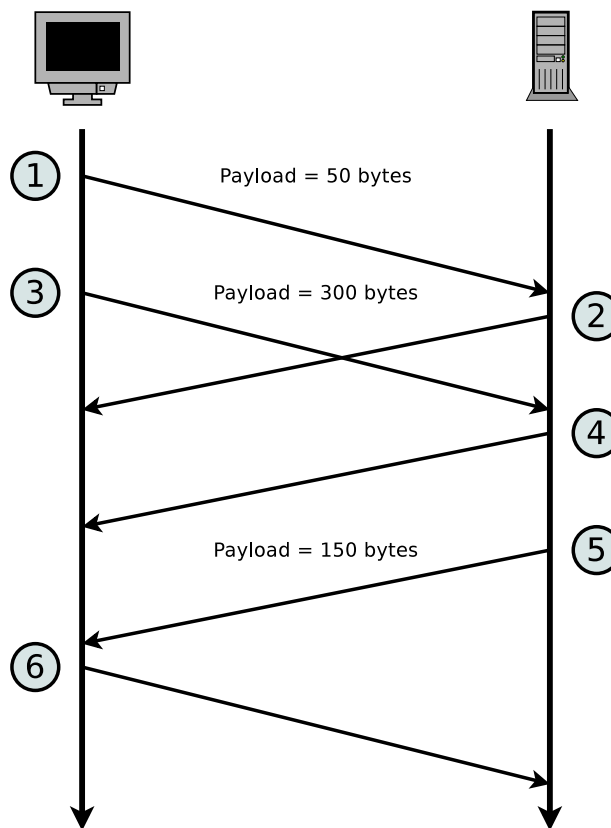| binary representation	decimal representation
10000000	128
11000000	192
11100000	224
11110000	240
11111000	248
11111100	252
11111110	254
11111111	255

Question 12)

Points: ....

Maximum points: 8

The diagram shows an excerpt of the transmission phase of a TCP connection. Complete the table.

Message	ACK	SYN	FIN	Payload length	Seq number	Ack number
1	1	0	0	50	220	931
2	1	0	0	0	931	270
3	1	0	0	300	270	931
4	1	0	0	0	931	570
5	1	0	0	150	931	570
6	1	0	0	0	570	1081

Question 13)   Points: ....

Maximum points: 1+1+1=3

a) Which two possible reasons for the occurrence of congestion exist?

b) Mark in the figure the slow-start phase.

c) Mark in the figure the congestion avoidance phase.

Congestion Window [kB]

Transmission