Chair of Distributed Systems and Security
Department of Computer Engineering
Technical University of Munich

Eexam
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Note:

- During the attendance check a sticker containing a unique code will be put on this exam.
- This code contains a unique number that associates this exam with your registration number.
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Computer Networking and IT Security

Exam:	INHN0012 / Midterm	**Date:**	Thursday 12$^{\text{th}}$ December, 2024
Examiner:	Prof. Dr.-Ing. Stephan Günther	**Time:**	14:15 – 15:00
	Prof. Dr.-Ing. Georg Carle		

Working instructions

- This exam consists of **8 pages** with a total of **3 problems**.
  Please make sure now that you received a complete copy of the exam.
- The total amount of achievable credits in this exam is 45 credits.
- Detaching pages from the exam is prohibited.
- Allowed resources:
  - one **non-programmable pocket calculator**
  - one **analog dictionary** English ↔ native language
- Subproblems marked by * can be solved without results of previous subproblems.
- **Answers are only accepted if the solution approach is documented.** Give a reason for each answer unless explicitly stated otherwise in the respective subproblem.
- Do not write with red or green colors nor use pencils.
- Physically turn off all electronic devices, put them into your bag and close the bag.

Left room from ________ to ________ / Early submission at ________

Problem 1 Multiple Choice (15 credits)

The following subproblems are multiple choice / multiple answer, i. e. at least one answer per subproblem is correct. Subproblems with a single correct answer are graded with 1 credit if correct. Those with more than one correct answers are graded with 1 credit per correct answer and -1 credit per wrong answer. Missing crosses have no influence. The minimal amount of credits per subproblem is 0 credits.

Mark correct answers with a cross ☒

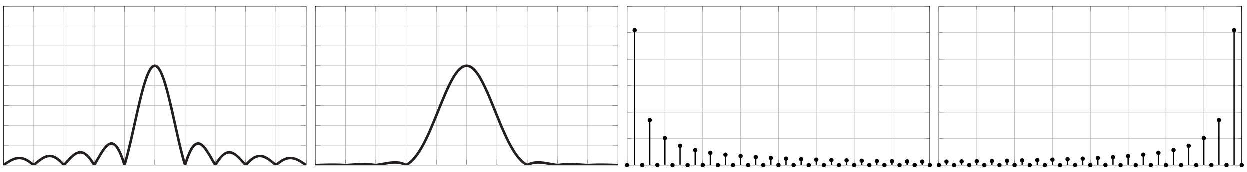
To undo a cross, completely fill out the answer option ■

To re-mark an option, use a human-readable marking ×■

a)* The internet is based on the ...

☐ Usenet. ☐ CIVILNET. ☐ ARPANET. ☐ DARPANET.

b)* Let the be given the rectangular impulse rect(t) and the $\cos^2$ impulse $\cos^2(t)$, both known from the lecture. Figure 1.1 shows four differen frequency domains. Which spectrum belongs to rect(t) and $\cos^s(t)$, respectively?



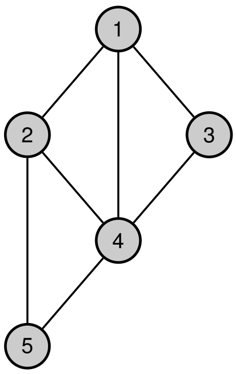
(a) $S_1(f)$ (b) $S_2(f)$ (c) $S_3(f)$ (d) $S_4(f)$

Figure 1.1: Frequency domains

☐ $\text{rect}(t) \circ\!\!-\!\!\bullet\, S_1(f)$ ☐ $\text{rect}(t) \circ\!\!-\!\!\bullet\, S_3(f)$ ☐ $\cos^2(t) \circ\!\!-\!\!\bullet\, S_1(f)$ ☐ $\cos^2(t) \circ\!\!-\!\!\bullet\, S_3(f)$

☐ $\text{rect}(t) \circ\!\!-\!\!\bullet\, S_2(f)$ ☐ $\text{rect}(t) \circ\!\!-\!\!\bullet\, S_4(f)$ ☐ $\cos^2(t) \circ\!\!-\!\!\bullet\, S_2(f)$ ☐ $\cos^2(t) \circ\!\!-\!\!\bullet\, S_4(f)$

c)* Which distance matrix $\boldsymbol{D}$ describes the network to the right?



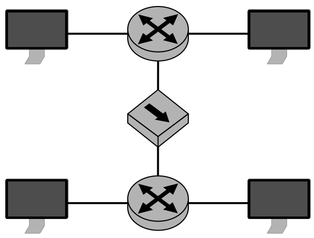
☐ $\begin{bmatrix} 0 & 1 & 1 & 1 & \infty \\ 1 & 0 & \infty & 1 & 1 \\ 1 & \infty & 0 & 1 & \infty \\ 0 & 1 & 1 & 0 & 1 \\ \infty & 1 & \infty & 1 & 0 \end{bmatrix}$ ☐ $\begin{bmatrix} 0 & 1 & 1 & 1 & \infty \\ 1 & 0 & \infty & 1 & 1 \\ 1 & \infty & 0 & 1 & \infty \\ 1 & 1 & 1 & 0 & 1 \\ \infty & 1 & \infty & 1 & 0 \end{bmatrix}$ ☐ $\begin{bmatrix} 0 & 1 & 1 & 1 & \infty \\ 1 & 0 & \infty & 1 & 0 \\ 1 & \infty & 0 & 1 & \infty \\ 1 & 1 & 1 & 0 & 1 \\ \infty & 1 & \infty & 1 & 0 \end{bmatrix}$

d)* Determine the minimal $n > 0$ such that $\boldsymbol{D}^{n+1} = \boldsymbol{D}^n$ holds for the distance matrix $\boldsymbol{D}$ of an **arbitrary** network with five nodes.

☐ 4 ☐ 7 ☐ 2 ☐ 3 ☐ 10

☐ 9 ☐ 8 ☐ 6 ☐ 5 ☐ 1

e)* How many broadcast domains does the network to the right contain?



☐ 4 ☐ 1 ☐ 3 ☐ 2 ☐ 6 ☐ 5

f)* How many collision domains does the network to the right contain?

☐ 6 ☐ 1 ☐ 5 ☐ 4 ☐ 3 ☐ 2

g)* Given the binary message `01101` and the CRC polynomial `1101`. Determine the CRC checksum as done in the lecture.

☐ `011` ☐ `101` ☐ `111` ☐ `010`

☐ `100` ☐ `110` ☐ `000` ☐ `001`

Space for auxiliary calculations

h)* IEEE 802.11 networks operating in infrastructure mode usually use . . .

- [ ] 1 MAC address per frame.
- [ ] 3 MAC addresses per frame.
- [ ] 2 MAC addresses per frame.
- [ ] 4 MAC addresses per frame.

i)* Which statements are correct with respect to IEEE 802.11 access points (APs)?

- [ ] APs are transparent for all nodes outside a wired network.
- [ ] APs are transparent for all nodes.
- [ ] APs are only transparent for nodes within the wireless network.
- [ ] APs are always directly addressed and thus never transparent.

j)* Can the subnets 172.16.32.0/20 and 172.16.40.0/21 be combined into a single network?

- [ ] Yes because both networks are adjacent.
- [ ] No because they differ in size.
- [ ] Yes because one is a subset of the other one.
- [ ] No because they are not adjacent.

k)* Which of the following IP addresses are publicly routable?

- [ ] 10.0.0.1
- [ ] fe80::95:13:42
- [ ] 2a01:9:4a:4::10:1
- [ ] 10.11.12.13
- [ ] 192.168.36.2
- [ ] 172.32.0.5

l)* Determine the MAC address from which the IPv6 address `FF62::DD66:77F6:88B8` was derived from.

- [ ] 33:33:77:F6:88:B8
- [ ] DD:66:77:F6:88:B8
- [ ] FF:62:DD:66:77:F6
- [ ] FF:FF:FF:FF:FF:FF

m)* Which MAC address belongs to the automatically derived IPv6 address `FE80::B287:44FF:FE24:BCF4`?

- [ ] B2:87:44:24:BC:F4
- [ ] FE:80:B2:87:44:24
- [ ] 33:33:44:24:BC:F4
- [ ] B0:87:44:24:BC:F4

Problem 2 **Media Access (15 credits)**

In this problem we discuss CSMA-based media access schemes, in particular thos with collision detection (CD) and collision avoidance (CA). Figure 2.1 shows the media access procedure for CSMA/CA with DCF in use. However, it is also applicable to CD with minimal modifications / simplifications as we discussed in the lecture.

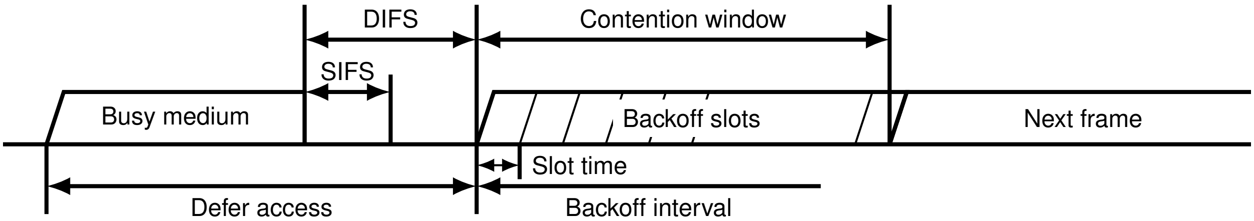


Figure 2.1: Meda access for CSMA-based protocols

0
1

a) Give an example where CD is being used

0
1

b)* Briefly explain the basic principle of CSMA.

0
1
2

c) Explain the extension CD and how the transmitting node reacts in case of a collision.

0
1
2

d) Which two parts of Figure 2.1 are not applicable in case of CD?

We now turn towards collision avoidance.

e)* Give an example where CSMA/CA is used.

0
1

f)* What is the basic difference compared to CD?

0
1

g)* How are collisions avoided?

0
1
2

h)* Is there any difference with respect to the contention window between CD and CA?

0
1

i)* Why is there a differentiation of the IFS into SIFS and DIFS?

0
1
2

j)* Describe the *hidden station* problem. (A small sketch can be helpful.)

0
1
2

Problem 3 **Wireshark (15 credits)**

Consider the Ethernet frame depicted in Figure 3.1. In the following, we will analyze this frame step by step.

0x0000	52	98	12	24	06	c9	3c	a6	2f	78	3b	96	86	dd	60	00
0x0010	00	00	00	44	3a	3a	20	01	07	f8	00	00	00	00	00	00
0x0020	02	a8	00	00	00	02	2a	02	24	55	18	9d	00	00	64	af
0x0030	ee	f9	3e	a7	39	51	03	00	25	55	00	00	00	00	60	03
0x0040	09	00	00	14	11	01	2a	02	24	55	18	9d	00	00	64	af
0x0050	ee	f9	3e	a7	39	51	20	01	4c	a0	20	01	00	18	0e	c4
0x0060	7a	ff	fe	f9	fe	9a	f0	3a	82	ac	00	14	46	36	00	00
0x0070	00	00	00	00	00	00	00	00	00	00	9a	f1	07	7a		

Figure 3.1: Ethernet frame including checksums.

For each of the following subproblems, clearly mark the respective header fields in Figure 3.1. **Take care that markings can uniquely be related to individual subproblems**, i. e., note the subproblem above markings. Answers that cannot be followed **will not be graded**.

a)* Mark the transmitter address of layer 2 in Figure 3.1.

b)* Mark the receiver address of layer 2 in Figure 3.1.

c)* Mark the frame check sequence in Figure 3.1.

d)* What protocol is used as L3 PDU? Mark the respective header field in in Figure 3.1.

e) State the layer 3 source address in its usual and fully abbreviated form.

f) State the layer 3 destination address in its usual and fully abbreviated form.

g) What is the type of the L3 SDU? Mark the respective header field in in Figure 3.1.

We are now given the L3 SDU of a **different** frame. We know that the type of this SDU is ICMPv6.

0x0000	03	00	1b	25	07	00	00	00	60	00	07	00	00	14	11	01
0x0010	2a	02	24	55	18	9d	00	00	64	af	ee	f9	3e	a7	39	51
0x0020	20	01	48	60	48	60	00	00	00	00	00	00	00	00	88	88
0x0030	6a	3f	82	a7	00	14	a6	ff	00	00	00	00	00	00	00	00
0x0040	00	00	00	00												

Figure 3.2: L3 SDU

h)* Determine type and Code of the ICMP message. Mark the respective field(s) in Figure 3.2. 0 1 2

Type: Subtype:

i) Name two possible causes of such a message. 0 1 2

j) What is the payload of this ICMP message? 0 1 2

k)* Mark the beginning of the ICMPv6 message's SDU in Figure 3.2. 0 ½

Additional space for solutions–clearly mark the (sub)problem your answers are related to and strike out invalid solutions.