Chair of Distributed Systems and Security
School of Computation, Information, and Technology
Technical University of Munich

Eexam
Place student sticker here

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.
- This number is printed both next to the code and to the signature field in the attendance check list.

Computer Networking and IT-Security

Exam:	INHN0012 / Midterm	**Date:**	Thursday 14th December, 2023
Examiner:	Prof. Dr.-Ing. Stephan Günther	**Time:**	12:15 – 13:00

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)* Which statements regarding MLT-3 are correct?

- ☐ It is a line code
- ☐ It is a source code
- ☐ It is guranteed to be DC-free
- ☐ It is a channel code
- ☐ One symbol encodes 3 bit
- ☐ The spectrum is narrower than Manchester

b)* What is the correct shortened form of `2001:000a:0000:0000:0001:0002:1122:0101/64`?

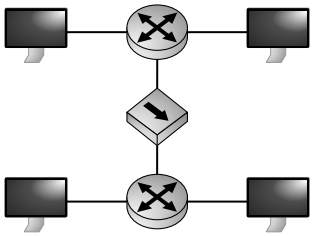
- ☐ `2001:a::1:2:1122:101/64`
- ☐ `2001:000a:0000:0000:0001:0002:1122:0101/64`
- ☐ `2001:a:0000:1:2:1122:101/64`
- ☐ `2001:a:0:0:1:2:1122:0101/64`

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

☐ 4 ☐ 2 ☐ 3 ☐ 1 ☐ 6 ☐ 5

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

☐ 2 ☐ 5 ☐ 3 ☐ 4 ☐ 6 ☐ 1



e)* What subnet can `192.168.8.0/23` and `192.168.12.0/23` directly be aggregated to?

- ☐ `192.168.8.0/24`
- ☐ `192.168.8.0/22`
- ☐ `192.168.0.0/16`
- ☐ Cannot be aggregated

f)* How long is an IPv6 address in octets?

☐ 12 ☐ 20 ☐ 16 ☐ 10 ☐ 8 ☐ 6 ☐ 4

g)* ~~What subnet can `192.168.8.0/23` and `192.168.12.0/23` directly be aggregated to?~~ (Duplicate)

- ☐ `192.168.0.0/16`
- ☐ `192.168.8.0/22`
- ☐ Cannot be aggregated
- ☐ `192.168.8.0/24`

h)* Which address type is used to send ARP requests?

- ☐ Unicast
- ☐ Multicast
- ☐ Broadcast
- ☐ Turbocast

i)* Which are IPv4 private address ranges?

- ☐ 127.0.0.0/8
- ☐ 169.254.0.0/16
- ☐ 192.168.0.0/16
- ☐ 192.168.0.0/8
- ☐ 172.16.0.0/12
- ☐ 0.0.0.0/8
- ☐ 10.0.0.0/8
- ☐ fe80::/10

j)* Which feature of the IPv4 header does a traceroute directly rely on?

- ☐ Flags
- ☐ Identification
- ☐ TTL
- ☐ Fragment Offset
- ☐ IHL

k)* CRC in Ethernet is used for . . .

- ☐ error detection.
- ☐ error propagation.
- ☐ error correction.
- ☐ error translation.

l)* What is true regarding 16-QAM?

- ☐ At the same baudrate it needs more bandwidth than 2-PSK
- ☐ It is more robust than 2-PSK
- ☐ It uses only the phase of the signal to encode data
- ☐ It is short for Quart-Archimedes Modulation

Problem 2 Waternet (15 credits)

Figure 2.1 shows a hypothetical network that uses pipes filled with water as a transmission medium instead of copper cables. The distribution unit *V* essentially consists only of a sphere filled with water without any further logic. To simplify matters, we assume that reflections do not play a role. The distance between *PC*1 or *PC*3 and *V* is 20 m and 10 m, respectively. The distance between *V* and *PC*2 is so small that it can be neglected.

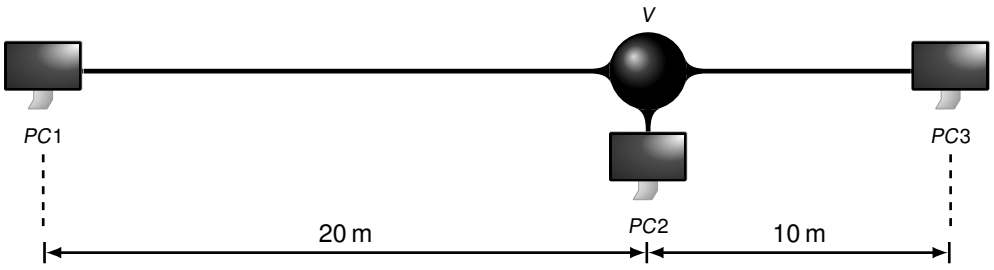


Figure 2.1: Waternet consisting of three computers and one distribution unit.

The propagation speed c_{sw} of sound in water at 20 °C is approx. 1500 m/s. This technology, known as Waternet, uses CSMA/CD as the media access method, just like conventional Ethernet. The transmit rate is 1 Mbit/s.

0 1 2

a)* Which device does the distribution unit *V* in an ordinary Ethernet correspond to? Give a reason for your answer.

At time $t_0 = 0$ *PC*1 starts to transmit a frame of 1500 B.

0 1 2

b)* Determine the serialization time t_s.

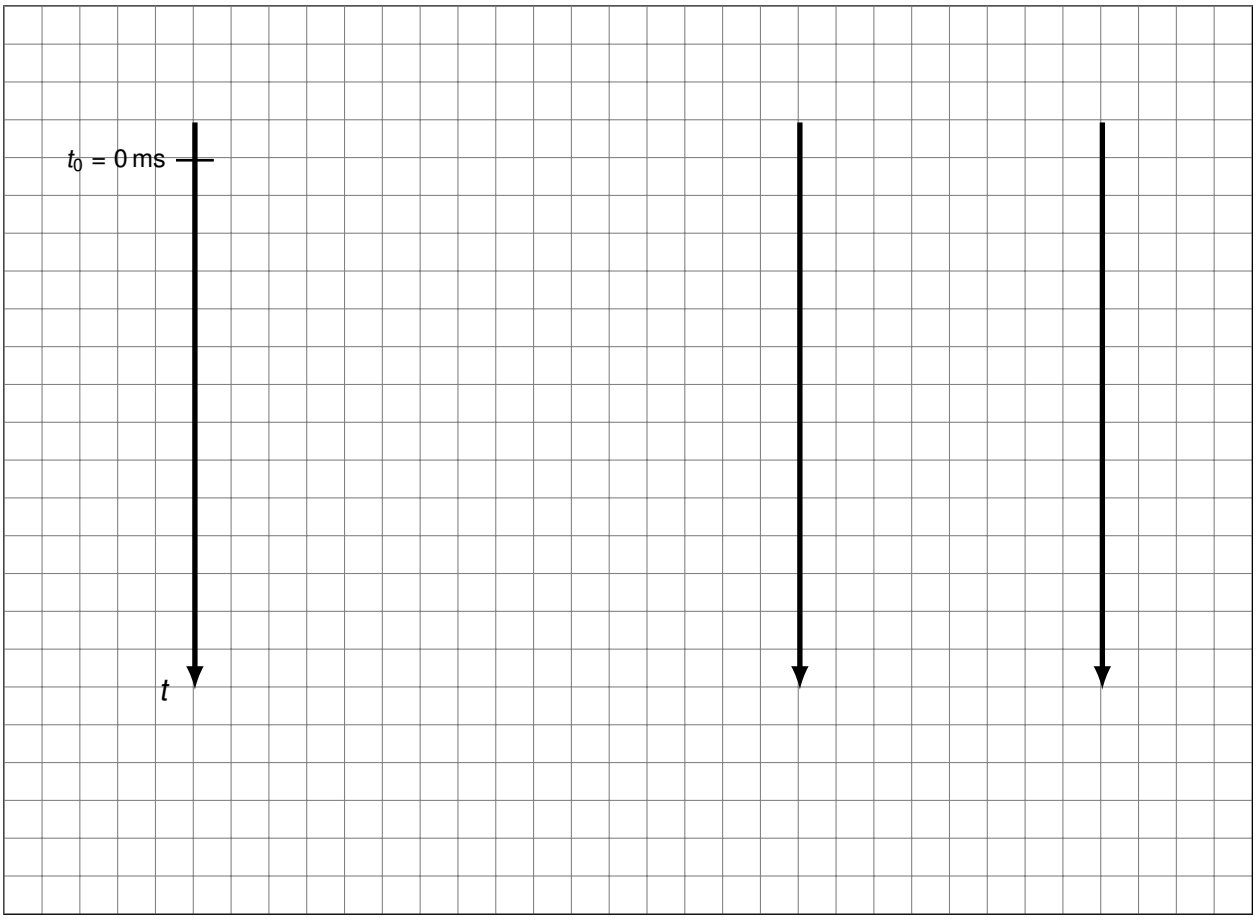
0 1 2

c)* Determine the propagation delay t_p between *PC*1 and *PC*2.

At time t_1 = 15 ms *PC*2 and *PC*3 also have data to be transmitted, 1500 B each.

d) Draw a network communication diagram that shows all events starting at t_0 = 0 ms. In case there is a jam signal, it is sufficient to mark its starting time. Completely mark the diagram (devices, serialization time, and propagation delay). **Scale:** horizontally 1 cm ≙ 2.5 m, vertically 1 cm ≙ 10 ms.

0 1 2 3 4 5



e) Reason whether or not CSMA/CD correctly works under these conditions.

0 1 2

f) Suggest a modification so that CSMA/CD works correctly. We expect a calculation here.

0 1 2

Problem 3 CRC (15 credits)

In this problem we consider the binary message `00100110` which should be protected by a CRC as we introduced it for Ethernet-based networks in the lecture. We assume the reduction polynomial $r(x) = x^2 + 1$.

0 1

a)* Briefly explain what CRC is used for in the context of Ethernet.

0 1

b)* What is the reduction polynomial being used for?

0 1

c)* What does it mean if the reduction polynomial is *irreducible*.

0 1 2

d)* Reason whether or not CRC requires an irreducible reduction polynomial.

0 1

e)* Show whether or not $r(x)$ is irreducible.

0 1

f)* Assuming **Ethernet**, what is the reaction of the receiving node when a bit error is detected.

0 1

g)* Assuming **IEEE 802.11**, what is the reaction of the receiving node when a bit error is detected.

h)* Determine the CRC checksum for the given message (see beginning of the problem).

0 1 2 3 4

i) Explicitly state the transmitted message.

0 1

Let us assume a different message (including its checksum): `111011010010111001`. Assume that this message is transmitted and arrives as `11101101001011100` at the receiver.

j)* Argue whether or not the error is being detected.

0 1 2

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