Chair of Distributed Systems and Security
School of Computation, Information and Technology
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Esolution
Sticker will be generated

Compliance to the code of conduct
I hereby assure that I solve and submit this exam myself under my own name by only using the allowed tools listed below.

Signature or full name if no pen input available

Computer Networking and IT-Security

Exam:	INHN0012 / Quiz 2	**Date:**	Thursday 18th January, 2024
Examiner:	Prof. Dr.-Ing. Stephan Günther	**Time:**	14:30 – 14:45

Working instructions

- This exam consists of **4 pages** with a total of **2 problems**.
  Please make sure now that you received a complete copy of the exam.
- The total amount of achievable credits in this exam is 15 credits.
- Detaching pages from the exam is prohibited.
- Allowed resources:
  - everything **except team work and any kind of AI**
  - the **cheatsheet** from `https://cns.net.in.tum.de`
- 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.

Problem 1 Data over tin cans (10 credits)

Given the network shown below, consisting of tin cans 1 and 2, which are connected to each other by a taut cord.

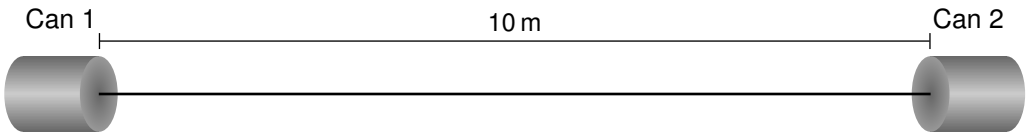


Figure 1.1: Direct connection of two tin cans with a tensioned cord

Information is encoded in the form of the duration of a tone of a certain frequency:

- a tone of 200 ms means a start bit
- a tone of 100 ms means a logical 1
- a tone of 75 ms means a logical 0
- individual tones are separated by a 75 ms idle period

The propagation delay of sound between both tin cans as assumed to be 2000 m/s.

0 1 a)* Name the analog to the start bit for Ethernet. (no reasoning)

Preamble plus the start frame delimiter

0 1 b)* Determine the propagation delay between both tin cans.

$$\frac{10\,\text{m}}{2000\,\text{m/s}} = 5\,\text{ms}$$

0 1 c)* On which technical aspect does the maximum achievable data rate depend?

In and of itself only from the temporal resolution of the transmitter and receiver.The higher the resolution, the shorter the tones that can be used.

0 1 2 d)* Derive the average achievable data rate in bit/s assuming that a redundancy-free data stream is to be sent.

Start bit may be neglected for longer transmissions.
$\Rightarrow \frac{1000\,\text{ms}}{175\,\text{ms}/2+75\,\text{ms}} \frac{\text{bit}}{\text{s}} = 6.15\,\text{bit/s}$

The ASCII string “DWT” (without quots) is being transmitted.

0 1 2 e)* Determine the binary representation of that string. Mark start and end of each codeword.

`01000111 01000001 01000100`
(ASCII is a 7 bit code. Since the cheatsheet prints 8 bit per code word, both variants are considered correct.)

0 1 f) Derive the serialization time (including start bit) for the message.

$$8 \cdot (100\,\text{ms} + 75\,\text{ms}) + 13 \cdot (75\,\text{ms} + 75\,\text{ms}) + 200\,\text{ms} = 3.55\,\text{s}$$

With 8 bit code words: $8 \cdot (100\,\text{ms} + 75\,\text{ms}) + 16 \cdot (75\,\text{ms} + 75\,\text{ms}) + 200\,\text{ms} = 4.00\,\text{s}$

g)* Reason whether or not under these circumstances a full-duplex communication would be possible.

0 1 2

Yes, if both directions use different frequencies (frequency multiplex).

Problem 2 Short problems (5 credits)

a)* For a path in the internet we have determined an MTU of 1240 B. Derive the most meaningful MSS for TCP connections over IPv4. Assume that neither TPC nor IP options / extensions are being used.

0 1

The MSS is the size of the L4 SDU. Thus, the can be determined as

$$\texttt{MSS} = \texttt{MTU} - \texttt{IP-Header} - \texttt{TCP-Header}$$

b)* Explain why it is important to choose a MSS for TCP in dependency of the MTU instead of using an arbitrary value.

0 1

The MSS should be choosen such that the packet size is maximized but fragmentation avoided.

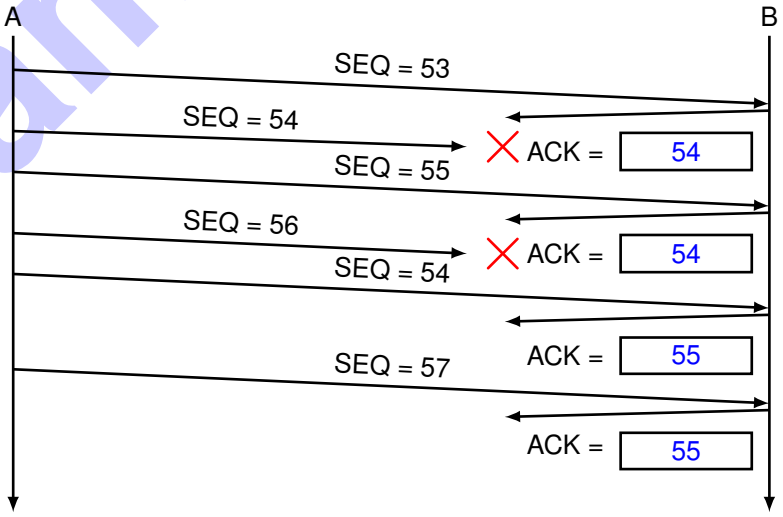
c)* Why do we need a connection establishment with TCP in contrast to UDP?

0 1

TCP is connection-oriented, i. e., initial squence numbers (state) have to be exchanged before data can be transferred.

d)* The following diagram shoes multiple segments on Layer 4 being sent from *A* to *B*. Two of those segments get lost. Determine the correct acknowledgement numbers (assume forward acknowledgements) sent by *B* when receiving the segments. **Assume that Go-Back-N is being used.**

0 1 2



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