

### Exercise 1 (Transmission Media)

1. What transmission media are used for computer networks?
2. Why are we not using one transmission medium for all wired and wireless computer networks?

### Exercise 2 (Transfer Time)

An image has a size of 1920x1080 pixels (Full HD) with true color, which means that 3 Bytes per pixel are used for the color information.

1. How long does it take to transmit the uncompressed image via a ...
  - 56 kbps Modem connection?
  - 64 kbps ISDN connection?
  - 1 Mbps DSL connection?
  - 10 Mbps Ethernet connection?
  - 16 Mbps DSL connection?
  - 100 Mbps Ethernet connection?
  - 1 Gbps Ethernet connection?
2. Assume the image is compressed with a compression algorithm that reduces the image size by 85%. How long does it take to transmit the image via a ...
  - 56 kbps Modem connection?
  - 64 kbps ISDN connection?
  - 1 Mbps DSL connection?
  - 10 Mbps Ethernet connection?
  - 16 Mbps DSL connection?
  - 100 Mbps Ethernet connection?
  - 1 Gbps Ethernet connection?

### Exercise 3 (Parallel and Serial Data Transmission)

1. Explain the difference between serial data transmission and parallel data transmission.
2. Name an advantage of serial data transmission compared with parallel data transmission.
3. Name an advantage of parallel data transmission compared with serial data transmission.

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4. Do computer networks usually implement parallel or serial data transmission?  
(Explain your answer!)

#### Exercise 4 (Storing and transmitting Data)

Common assumptions about data are:

- It is easy to store data today.
- It is easy to transport or transmit data today.

In this exercise, we verify the correctness of these statements.

1 PB byte is  $10^{15}$  bytes

1. A scientific experiment produces 15 PB of data per year, which need to be stored. What is the height of a stack of storage media, if for storing the data...
  - CDs (capacity:  $600 \text{ MB} = 600 * 10^6 \text{ Byte}$ , thickness: 1.2 mm) are used?
  - DVDs (capacity:  $4.3 \text{ GB} = 4.3 * 10^9 \text{ Byte}$ , thickness: 1.2 mm) are used?
  - Blu-rays (capacity:  $25 \text{ GB} = 25 * 10^9 \text{ Byte}$ , thickness: 1.2 mm) are used?
  - HDDs (capacity:  $2 \text{ TB} = 2 * 10^{12} \text{ Byte}$ , thickness: 2.5 cm) are used?

Attention: Calculate the solutions for both options:

- $15 \text{ PB} = 15 * 10^{15} \text{ Byte}$  (= this way, the hardware manufacturer calculate)
  - $15 \text{ PB} = 15 * 2^{50} \text{ Byte}$  (= this way, the operating systems calculate)
2. The data of the scientific experiment is transmitted via networks that use fiber-optic cables and provide a bandwidth of 40 Gbit/s.
    - How long does it take to transfer the 15PB via a 40 Gbit/s network?
    - How long does it take to transfer the 15PB via a 100 Mbps Ethernet?

Attention: Calculate the solutions for both options:

- $15 \text{ PB} = 15 * 10^{15} \text{ Byte}$
- $15 \text{ PB} = 15 * 2^{50} \text{ Byte}$

#### Exercise 5 (Physical and Logical Topology)

1. What describes the physical topology of a computer network?
2. What describes the logical topology of a computer network?

#### Exercise 6 (Network Topologies)

Several network topologies (Bus, Ring, Star, Mesh, Tree and Cellular) exist. Consider the following sentence and in the boxes of the network topologies for which the sentences are true



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Statement	Topology
Cable failure can separate the network in two functioning parts	tree, bus topology
Topology contains a single point of failure (A single point of failure can be a device or a cable)	star topology
Topology used for Thin Ethernet and Thick Ethernet	ring topology, bus
Topology contains a performance bottleneck	bus
Topology used for WLAN, when no Access Point exists	tree, star
Topology used for Token Ring (logical)	mesh
Topology used for mobile phones (GSM standard)	ring
Topology used for Token Ring (physical)	cellular topology
Cable failure leads to complete network failure	star topology
Topology contains no central component	ring, bus
Topology used for WLAN, when an Access Point exists	ring, bus, mesh
Topology used with modern Ethernet standards	cellular
	star

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With handheld transceivers, often called walkie-talkie, two or more participants can talk to each other at the same time. At any one time, more than one participant can speak. Please describe the

Topology used for Token Ring (physical)	Star Topology
Cable failure leads to complete network failure	Ring, bus
Topology contains no central component	Ring, bus, Mesh
Topology used for WLAN, when an Access Point exists	Cellular
Topology used with modern Ethernet standards	Star

### Exercise 7 (Directional Dependence )

- With handheld transceivers, often called walkie-talkie, two or more participants can talk to each other. However, at no time, more than one participant can speak. Please describe the reason for this limitation.
- According to what directional dependence principle do walkie-talkies operate?
 

Simplex       Full-duplex       Half-duplex
- Name 2 systems that operate according to the simplex principle.
- Name an advantage and a drawback of communication systems that operate according to the simplex principle?
- Name 2 systems that operate according to the full-duplex principle.
- Name an advantage and a drawback of communication systems that operate according to the full-duplex principle?

### Exercise 9 (Transfer Time = Latency)

A MP3 file with a size of  $30 \times 10^6$  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 5,000 km. The file is transferred as a single message that has a size of  $30 \times 10^6$  bits. No network protocol headers or trailers exist (*i.e. there's no waiting time*)

- Calculate the transfer time (latency) of the file, when the data rate of the computer

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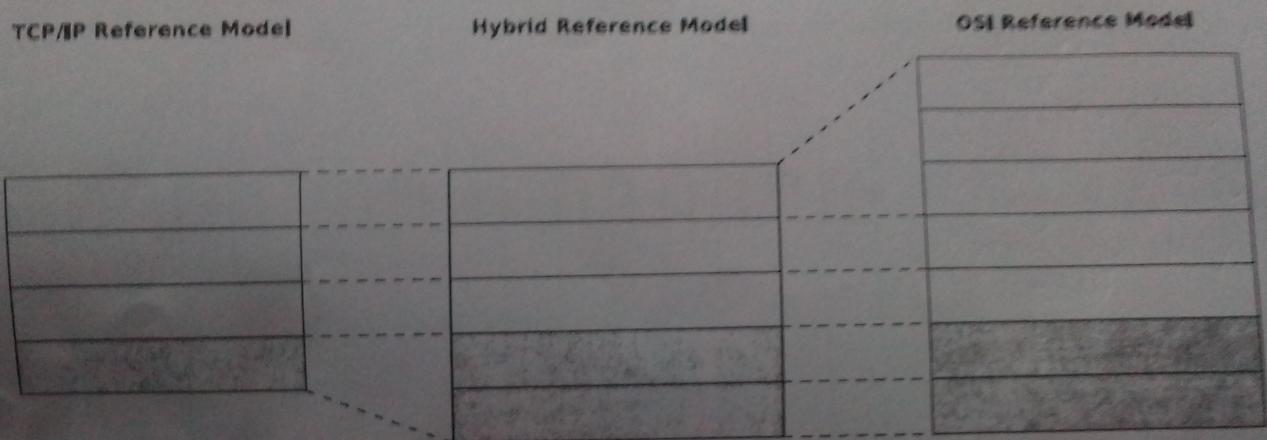
- 56 kbps
- 64 kbps
- 1 Mbps
- 16 Mbps
- 100 Mbps

2. What is the maximum number of bits that can reside inside the line between the sender and receiver?

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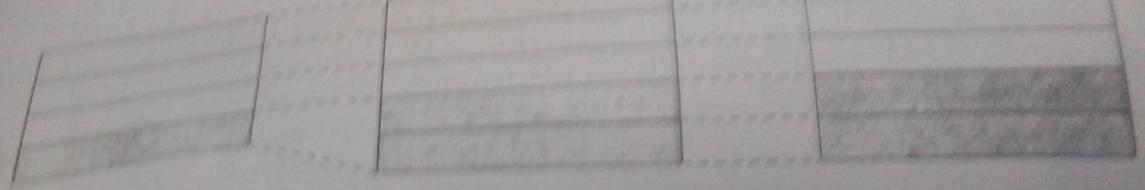
## Exercise 1 (Layers of Reference Models)

1. Fill in the names of the layers of the reference models in the figure.



2. Assign to technical terms „Frames”, „Packets”, „Segments” and „Signals” to the layers of the reference models in the figure.
3. Why are the Presentation Layer and the Session Layer not intensively used?
4. Why is the hybrid reference model closer to reality, compared with the TCP /IP reference model?

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Exercise 2 (Repeaters and Hubs)



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## Exercise 2 (Repeaters and Hubs)

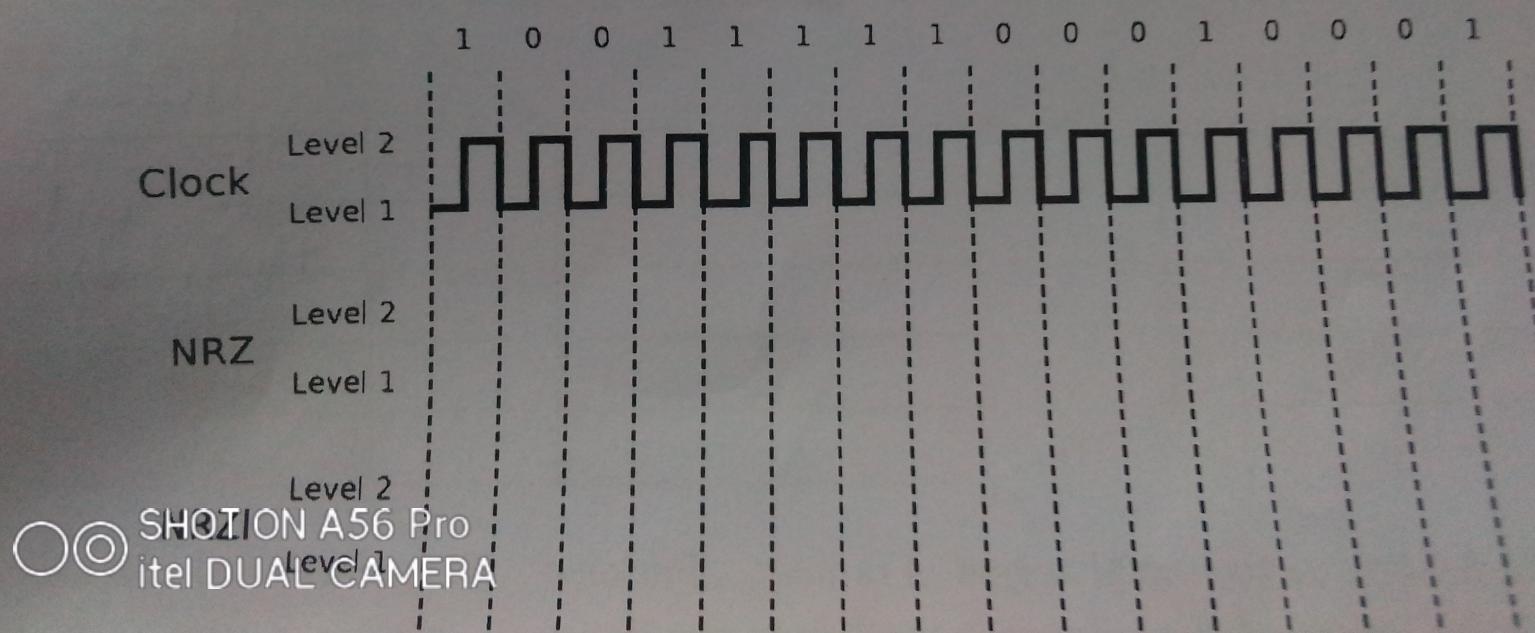
1. What is the purpose of Repeaters in computer networks?
2. What is the major difference between Repeaters and Hubs?
3. Why do Repeaters and Hubs not require physical or logical addresses?
4. What network topology(s) do Hubs implement?
5. Name two advantages of using a Hub compared to a physical Bus network
6. What is a collision domain?

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## Exercise 3 (Encoding Data with Line Codes)

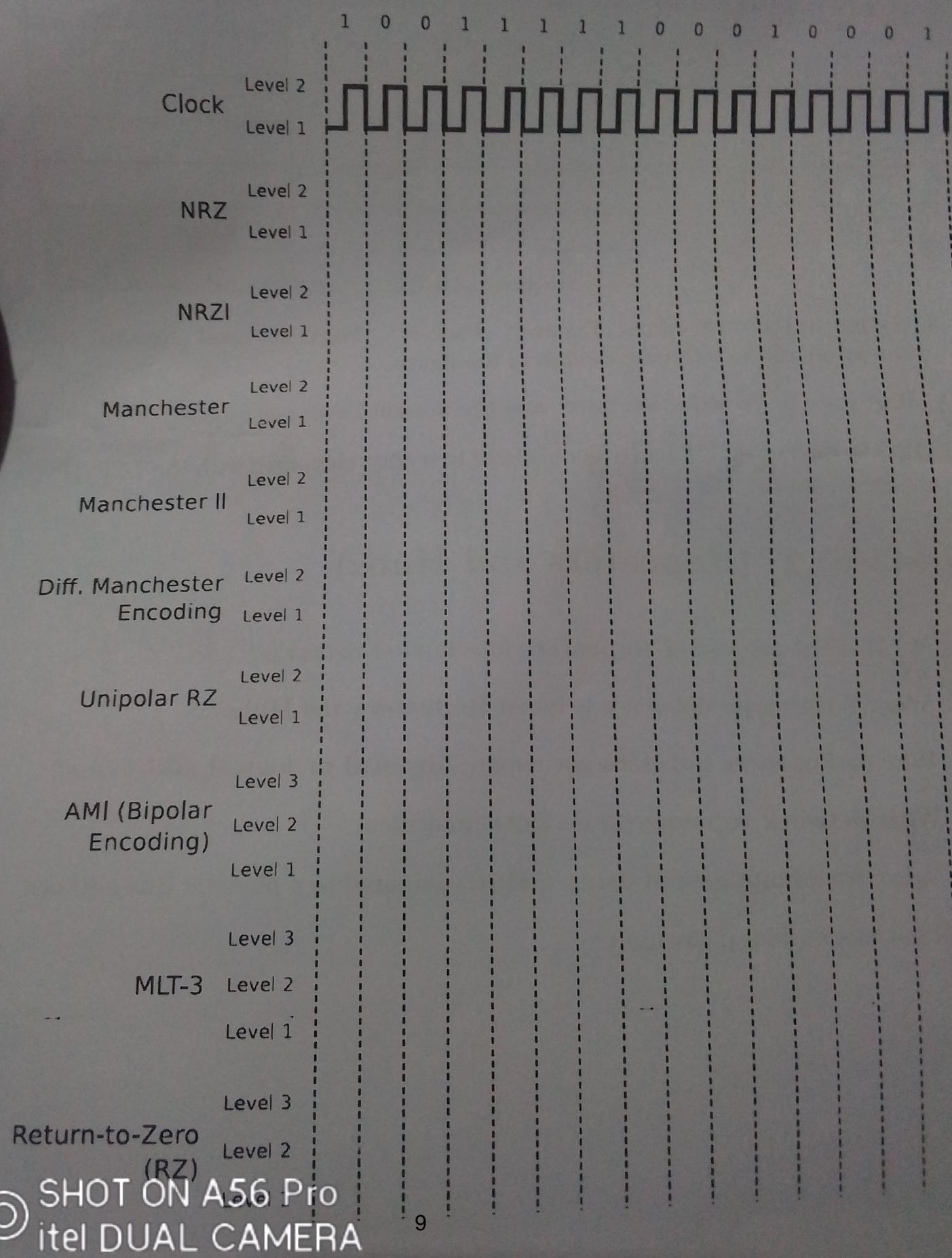
1. Give the encodings for the given bit pattern.

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



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