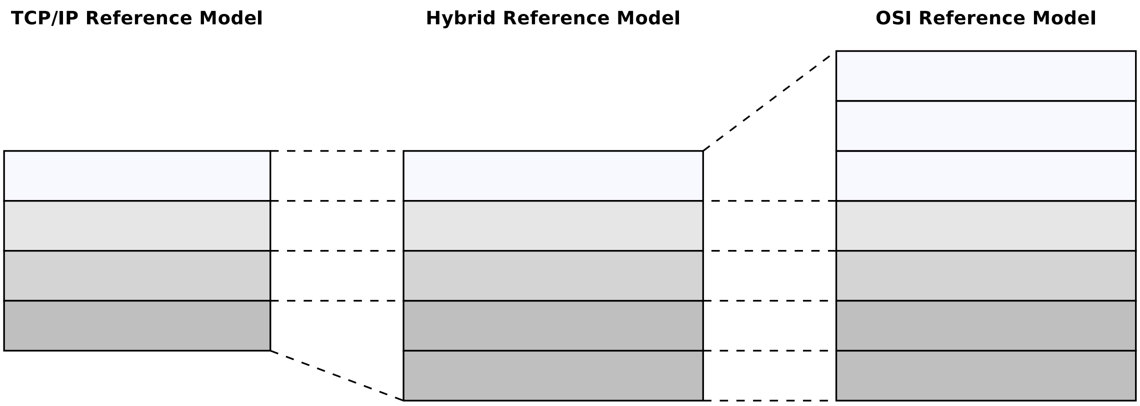
Exercise Sheet 2

Exercise 1 (Layers of Reference Models)

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



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

Exercise 2 (Transmission Media)

1. Explain why the outer conductor (the shield) of coaxial cables is kept at ground potential and does completely surround the inner conductor.
2. Explain what a Transceiver is.
3. Explain what the purpose of AUI cables is.
4. Explain why modern Ethernet standards use twisted pair cables with twisted signal wires and not cables with parallel signal wires.
5. Show by calculation that regardless of the level of a noise signal, the difference between the payload signal and the complementary signal remains the same when using twisted-pair cables. Assume that a signal to be transmitted has an electrical voltage of 0.5 V. This transmission is affected by an interfering signal, which has an electrical voltage of 0.25 V.

6. Explain if it is possible to use patch cables, that are wired according to the T568A wiring standard in an computer network infrastructure that uses the the T568B wiring standard.
7. Explain why is it impossible to connect different buildings with shielded cables.
8. Name a benefit and a drawback of mono-mode (single-mode) fibers compared with multi-mode fibers.
9. Name a benefit and a drawback of multi-mode fibers compared with mono-mode (single-mode) fibers.

Exercise 3 (Shielding of Twisted Pair Cables)

The following information come from existing twisted pair network cables. What information is provided about the **cable and pair shielding** of these cables?

1. `E138922 RU AWM 2835 24 AWG 60°C CSA LL81295 FT2 ETL VERIFIED EIA/TIA-568A CAT.5 UTP EVERNEW G3C511`
2. `E188601 (UL) TYPE CM 75°C LL84201 CSA TYPE CMG FT4 CAT.5E PATCH CABLE TO TIA/EIA 568A STP 26AWG STRANDED`
3. `E324441 RU AWM 2835 24AWG 60°C 30V CHANGJIANG TIA/EIA 568B.2 UTP CAT.5e`
4. `SSTP ENHANCED CAT.5 350MHZ 26AWG X 4P PATCH TYPE CM (UL) C(UL) E200579 CMG CSA LL81924 3P VERIFIED`
5. `EC-net 7.5 m 11184406 13/03 PremiumNet 4 PAIR 26AWG S-FTP HF IEC 332-1 ENHANCED CATEGORY 5 PATCH CORD EN0173+ISO/IEC`
6. `(UL) E228252 TYPE CM 75°C 24AWG 4PR UTP C(UL) E228252 CMR 73°C ETL VERIFIED TIA/EIA 568B.2 CAT.5e`

Exercise 4 (Network Cables)

On network cables, strings of letters, numbers and special characters are printed. Their content is at first sight difficult to understand.

Example:

```
E188601 (UL) TYPE CM 75°C LL84201 CSA TYPE CMG FT4 CAT.5E PATCH CABLE
TO TIA/EIA 568A STP 26AWG STRANDED
```

1. What means `STRANDED`?

2. Do cables exist which are not `STRANDED`?
3. What is the meaning of `PATCH`?
4. Do cables exist which are not `PATCH`?
5. What is the difference between `PATCH` cables and other cables?
6. What is the meaning of the information `24AWG` or `26AWG`?
7. What is the meaning of the information `UL CM FT1/FT4` together with a degree value (e.g. `60°C` or `75°C`)?

Exercise 5 (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**?
7. What says the **5-4-3 rule**?
8. Why does the **5-4-3 rule** exist?

Exercise 6 (Line Codes)

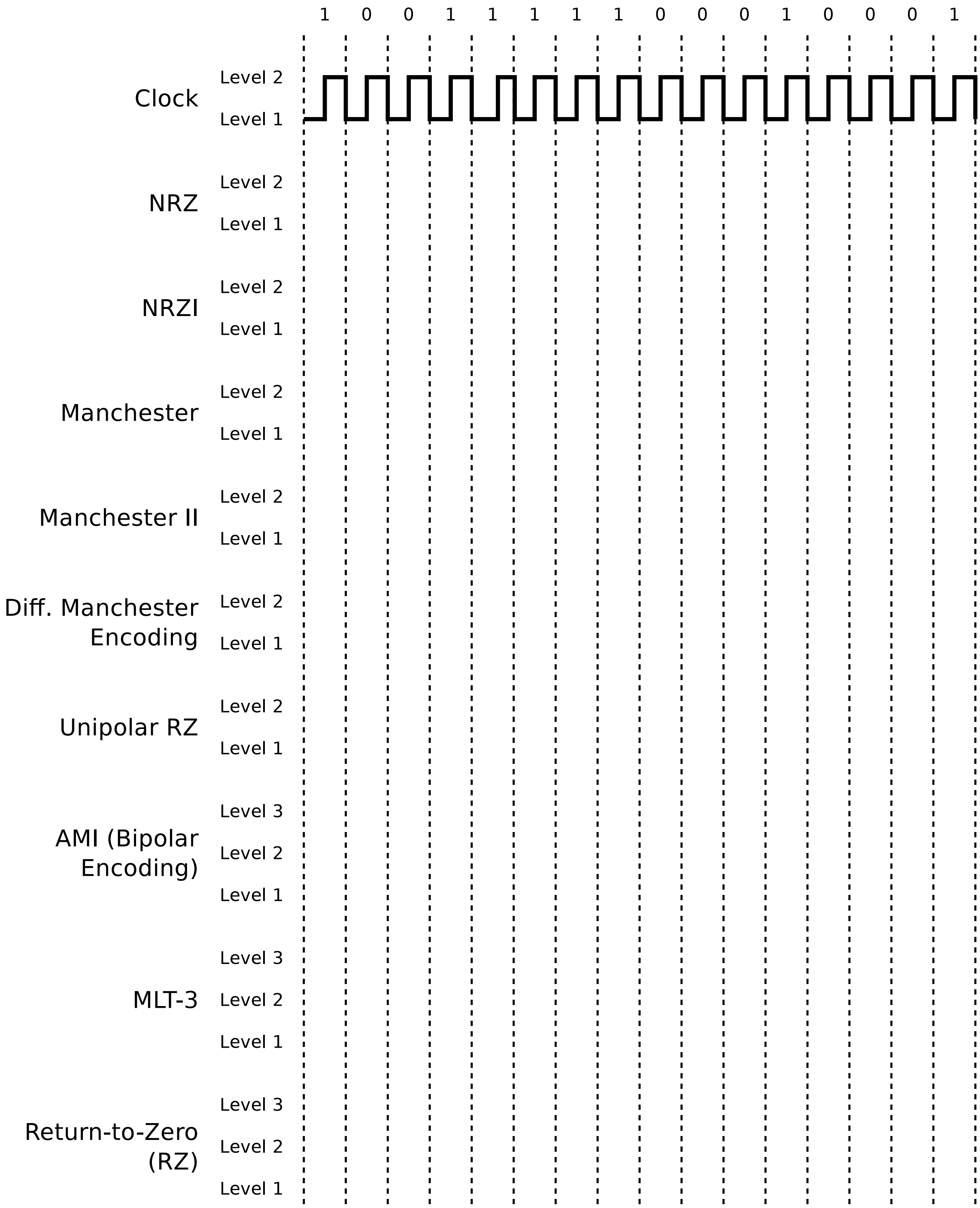
1. Explain why computer networks require line codes.
2. Many different line codes exist. Explain why it is impossible to use one single line code for every network technology.
3. Explain the way Non-Return-To-Zero (NRZ) works.
4. Name the two problems that can occur when NRZ is used to encode data.
5. Explain both problems from subtask 4 in detail.
6. Explain how the problems from subtask 4 can be avoided.
7. Name at least 5 line codes that use 2 signals levels.
8. Name at least 3 line codes that use 3 signal levels.
9. Which line codes ensure a signal level change for each logical 1 bit only?

10. Which line codes ensure a signal level change for each transmitted bit?
11. Why do not all line codes ensure a signal level change for each transmitted bit?
12. Which line codes ensure that the signal levels are equally distributed?
13. Why is it important for the receiver of signals, which are encoded according to the Differential Manchester Encoding, to know the initial signal level?
14. What is a scrambler?
15. Why are scramblers used?
16. All line codes have drawbacks. What can be done to avoid the problems, that can result from these drawbacks?
17. Which line code maps groups of **4** payload bits onto groups of **5** code bits?
18. Which line code maps groups of **5** payload bits onto groups of **6** code bits?
19. Why do some line codes, that map groups of payload bits onto groups of code bits, implement variants with neutral inequality, positive inequality and negative inequality?
20. How is the efficiency of a line code calculated?

Exercise 7 (Encoding Data with Line Codes)

1. Give the encodings for the given bit pattern.

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



2. Encode the bit sequences with 4B5B and NRZI and draw the signal curve.

   - `0010 1111 0001 1010`
   - `1101 0000 1001 1110`

   Attention: Assume that the initial signal level of NRZI is signal level 1 (low signal).

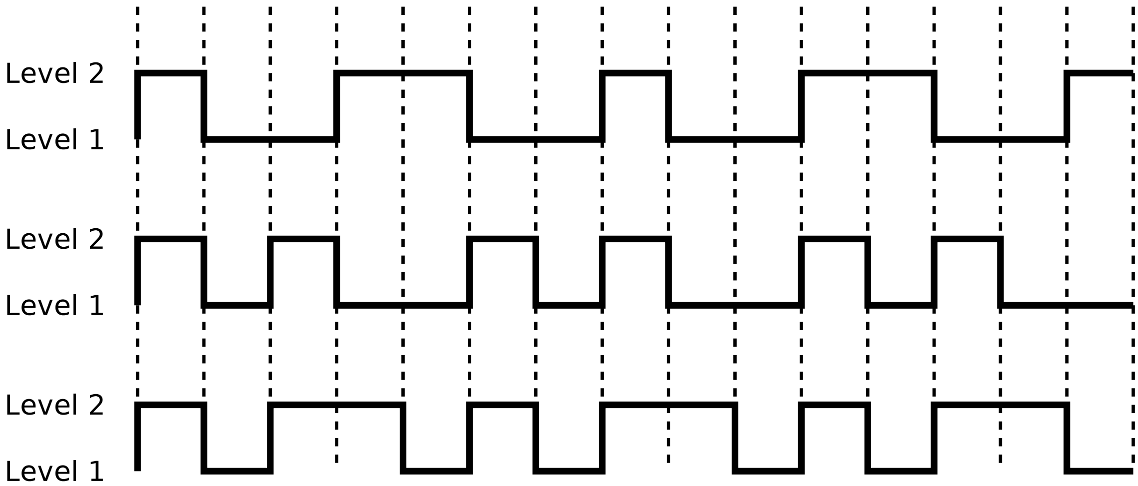
Label	4B	5B	Function
0	0000	11110	0 hexadecimal
1	0001	01001	1 hexadecimal
2	0010	10100	2 hexadecimal
3	0011	10101	3 hexadecimal
4	0100	01010	4 hexadecimal
5	0101	01011	5 hexadecimal
6	0110	01110	6 hexadecimal
7	0111	01111	7 hexadecimal
8	1000	10010	8 hexadecimal
9	1001	10011	9 hexadecimal
A	1010	10110	A hexadecimal
B	1011	10111	B hexadecimal
C	1100	11010	C hexadecimal
D	1101	11011	D hexadecimal
E	1110	11100	E hexadecimal
F	1111	11101	F hexadecimal

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

   - `00001 01011 11000 01110 10011`
   - `11010 11110 01001 00010 01110`

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		

4. These signal curves are encoded with NRZI and 4B5B. Decode the data.



Source: Jörg Roth. Prüfungstrainer Rechnernetze. Vieweg (2010)