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Communications and Computer Networks

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Exercise 2

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1   Data transmission

1. You have a 129MB mp4-video file and would like to transmit it over a 300KBit/s communication channel. How long will it take to transfer the file (without any interferences or noises on the carrier)?

   > **Solution:** $129MB = 129 \cdot 8 = 1032MBit$ (Conversion to Bit)
   > $\Leftrightarrow 1032 \cdot 1000 = 1.032.000 KBit$ (Conversion to KBit)
   > $\Leftrightarrow \frac{1.032.000 KBit}{\frac{300KBit}{s}} = 3440s$

2. What is the data transfer rate according to the Nyquist theorem at a bandwidth from 4MHz at 8 signal levels achievable?

   > **Solution:** Nyquist-theorem: $2 \cdot B \cdot \log_2 n$
   > $\Leftrightarrow 2 \cdot 4MHz \cdot \log_2 8 \Leftrightarrow 2 \cdot 4 \cdot 10^6 \cdot 3 \cdot \frac{1}{s} \Leftrightarrow 24\frac{MBit}{s}$

3. Calculate the maximum data transmission rate of an ADSL-carrier with the following parameters:

- SNR = 20dB
- B = 1MHz

Solution: Calculation of S and N:
$SNR_{dB} = 10 \cdot \log_{10}(\frac{S}{N}) \Leftrightarrow 20dB = 10 \cdot \log_{10}(\frac{S}{N}) \Leftrightarrow 2 = log_{10}(\frac{S}{N}) \Leftrightarrow 10^2 = \frac{S}{N} \Leftrightarrow 100 = \frac{S}{N}$
Calculation of maximum data transmission rate with $\frac{S}{N} = 100$
$B \cdot \log_2(1 + \frac{S}{N})$
$\Leftrightarrow 1MHz \cdot \log_2 101$
$\Leftrightarrow 1 \cdot 10^6 \cdot 6.65 = 6.65 \frac{MBit}{s}$

4. The provider wants to eradicate this limitation, describe two possibilities to reach a maximum data transmission rate of 16MBit/s!

Solution:

- Reducing the noise
  or
- Increasing the signal strength to improve the signal-to-noise ratio.

Improving the medium might be impossible or too expensive due to underground-inhouse-cabling.

2 Encoding

5. What are the main problems when transmitting data over an unmanaged carrier?
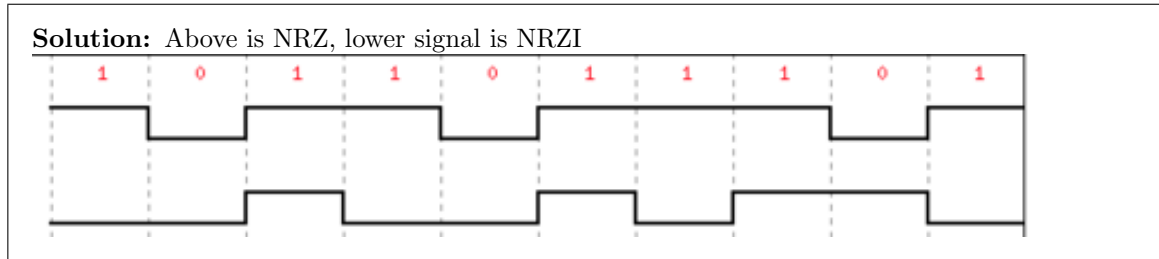
Solution:

- sources of interference creating noises on the channel
- limited channel capacity
- missing self-clocking
- loss of synchronisation because of long sequences of *1* or *0*
- Communication breaks or disruption might appear

6. What is the main purpose of line encoding?

Solution: Optimized data transmission according to the medium, this comprises synchronisation and compression

7. Draw the resulting NRZ and NRZI-Code of the bit sequence *1011011101*:

> **Solution:** Above is NRZ, lower signal is NRZI
>
>

8. You have the given signal of a 4B5B encoded signal, decode the original bit-stream
   11100101110111001010101001010110101111001001

> **Solution:** 1110 1011 0110 0100 0010 0011 0011 0000 0001

9. Fast Ethernet uses a combination of two different line codes. At first, the bit-stream is encoded with 4B5B, the resulting stream is encoded with MLT-3. Convert the following sequence according to this scheme:
   11010010000101101011!

> **Solution:** Encoding to 4B5B:
> *110111010001001010111010111*
> MLT-3:
>
>
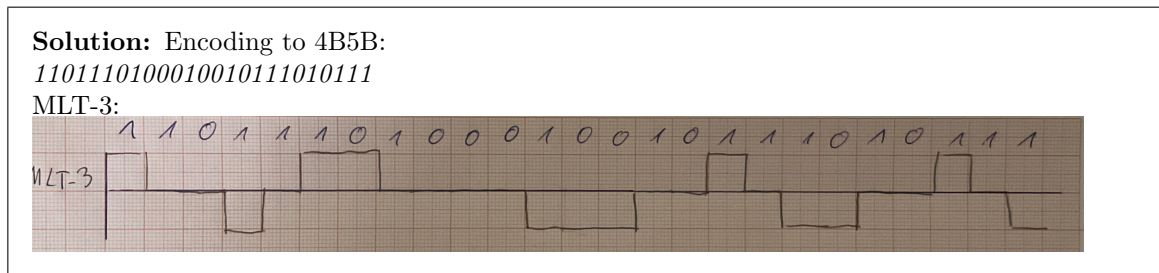
3 Tools

10. Use *Wireshark* to capture network traffic of your wifi network connection **and** (if available) of a cable based network connection. Use the following parameters for the capturing:

    - Duration: 2 minutes
      or
    - 10.000 network packets

    Store the wifi capture in a file named *wifi.pcapng* and the cable based capture in a file named *cable.pcapng*. These files will be used later in the course.

4 Hardware

11. A hub sends all network data to all connected network hosts. What is the main problem of this type of network traffic steering?

> **Solution:** Poor performance, network hosts receive traffic which is not send to them

12. How can this problem be solved?

Solution: Send the network data only to the intended device(s)