



S-72.423 Exercise 1.

Return your answer no later than on Tuesday 12.10.2004 at 16:00 into the course's P.O. box at the third floor of the E-wing.

Please, include the following information in your answers:

- *Your name (+ team member names)*
- *Your student number (+ team member student numbers)*

It may be that you won't find answers to the questions straight from the lecture material. You may have to look for information from the textbooks and Internet. Good luck for information search!

To this exercise you may answer in English, Finnish or Swedish.

- 1. In telecommunications**, bit rate (or bitrate) is the speed at which bits are transmitted via radio or wire. It is usually expressed as bits per second, abbreviated bit/s, b/s, or informally bps. In telecommunications bit rates are impressed with SI-prefixes.

What are the (nominal) bit rates of

(Please, use the prefixes and also write the bit rates out; for example: 1,2 kbit/s = 1200 bit/s)

- I) N-ISDN (narrowband-ISDN, usually written "ISDN")
- II) Modem V.34
- III) LAN, 10baseT

In computing, common usage of "kilobyte" means 1024 bytes, while the SI kilo means 1000. So there is a risk of confusion and we have to be very careful what those prefixes means.

Find and write out how many bytes and bits can be stored in:

- IV) 1.44 MB floppy disk
- V) 512 MB RAM (computer memory)

- 2. Define, what is meant by value added services. Mention at least 5 of them.**

- 3. Describe how operation and maintenance functions are categorized and realized in the PSTN; briefly explain the functions.**

- 4. Write in full length the following acronyms:**

- OSI
- PSTN
- N-ISDN
- GSM
- ATM
- WCDMA
- SS7
- IP
- IN
- SMS
- PLMN
- TCP
- UDP
- LAN
- SDH
- STM
- EDGE
- QoS
- TDMA

5. Fill the missing words:

- PSTN switching is based on (A)_____. ATM uses (B)_____ switching.
- Recommendation (C)_____ specifies PCM (Pulse Coded Modulation) of voice frequencies. To generate a PCM signal, an analogue speech signal is sampled at (D)_____ Hz and converted into a (E)_____ bit code word. Two encoding laws are recommended and these are commonly referred to as the (F)_____ and the (G)_____.
- Attenuation of voice signals represented a problem for network planners - solution is to use (H)_____.
- Modern telephone terminals use (I)_____ dialing. Earlier (J)_____ was applied (very rare nowadays).
- The hybrid circuit transforms (K)_____ connection into (L)_____ connection.

6. Bonus (not compulsory): SHANNON'S THEOREM

[Reference: Voipio, Uusitupa: Tietoliikenneaapinen (in Finnish) or Internet]

- a) Shannon's third and the most famous theorem 'information capacity theorem' determines a theoretical upper limit to an error-free transmission. Up to this limit it is possible to reduce amount of errors into arbitrarily small by choosing a suitable error coding.

$$C = B \cdot \log_2 \left(1 + \frac{P}{N_0 B} \right) \frac{\text{bit}}{s}$$

, where C is the highest possible bit rate, B is a bandwidth of the channel, P is an average received power and term N_0 is caused by a Gaussian distributed noise (additive white Gaussian noise, AWGN) whose one-sided power spectral density is N_0 .

Calculate the maximum theoretical bit rate if the signal to noise ratio (SNR) of a telephone connection is 30 dB. The bandwidth of the connection is 3,1 kHz.