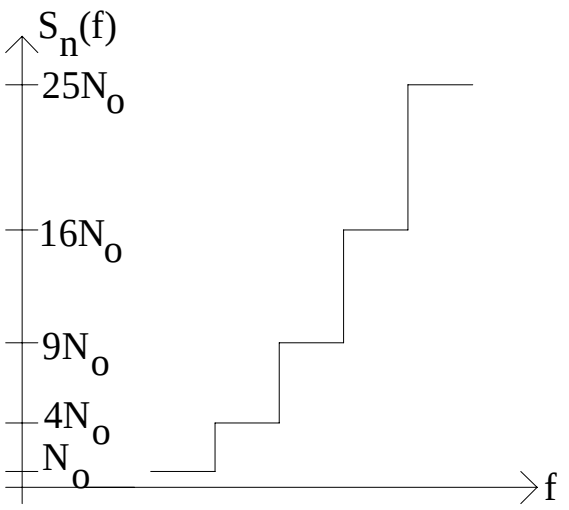
S-72.3230 Radio transmission and network access
Exercise 9 – 10

P29 The single-sided power spectral density of a radio channel is shown in the adjacent figure. $N_o = 10^{-20}$ W/Hz.



a) Differentially encoded 16QAM is transmitted through the channel using matched raised cosine filtering with the roll-off parameter $\alpha = 0.25$. The bit rate is 200 Mbit/s. Determine the required received power to obtain the bit error probability $P_b = 10^{-6}$.

b) Instead of single carrier 16QAM multicarrier MQAM ($M = 2^n$) with 5 sub-carriers and the same roll-off parameter is used without overlapping subcarrier spectra. The available total RF-power from subtask a is divided so that the signal to noise ratio of each sub-carrier is constant. The largest possible M-value, that enables $P_b \leq 10^{-6}$, is used on all sub-carriers. How many % can the bit rate be increased from the value given in sub-task a?

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P30 In a packet radio system the average rate of *transmitted* packets is 10 packets/s. What is the optimum packet length in seconds which maximizes the throughput:

a) in basic ALOHA,
b) in slotted ALOHA?

P31A packet radio system for 100 identical users is constructed. he packet length is 1000 bit and the radio channel transmission rate is 100 kbit/s. Slotted ALOHA is used.

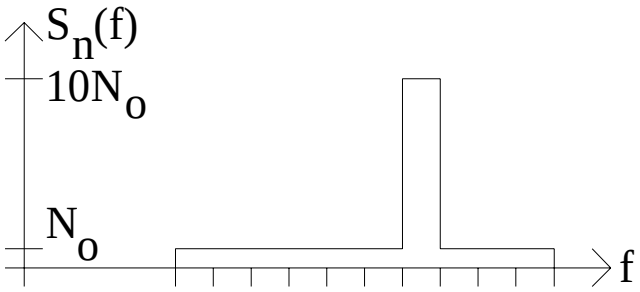
a) Calculate the maximum throughput in bit/s.
b) Each user receives in average 0.05 packets/s. Estimate the average transmission delay (s) when the average retransmission delay is 50 packets.

P32 In a taxi communication system the radio channel data rate is 1200 bit/s. A message (packet) contains 30 bytes of information. The system will use either basic ALOHA or slotted ALOHA.

a) How many taxis can be served with these access methods if every taxi produces a message once in two minutes on average (Poisson-distributed)?

b) Estimate the expected transmission delay in seconds when 100 taxis are served and the average retransmission delay is 3 s.

Homework 9.



The power spectral density of noise in a radio channel contains a peak occupying 1/10 of the channel bandwidth. To avoid the degradation caused by this narrow noise spectrum peak multicarrier modulation with 10 sub-carriers is used, and the sub-carrier containing the noise peak is left unused. How many dB can the total power in the multicarrier system be reduced compared to a single carrier system to give the same error performance? The same modulation method is used in both systems, and the traffic situation allows a 10 % reduction of the bit rate.

Homework 10

If both packet collisions and errored packets due to noise are considered in slotted-ALOHA, the normalised throughput is given by ***S* = Normalised total traffic · Probability of no collisions and no error packets** = $G \cdot \left(e^{-2G} \cdot \left(1 - P_{ep} \right) \right)$**.** The packet error probability P_{ep} in case of independent bit errors is given by $P_{ep} = 1 - (1-p)^N$, where p is the bit error probability and N is the packet length.

a) How large packet error probability can be allowed before the throughput based on collisions only is reduced by 10 %?

b) What is the maximum packet length under the conditions in part a), if the bit error probability is i) 10^{-2}, ii) 10^{-4}?