

Practice Questions MOBCOM

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- 1) Starting from encoding bits at the transmitter, label the communication process up to decoding bits at the receiver (in other words, start with bits, then baseband-discrete, ... de-modulation, ...)
- 2) Describe a reason why are we mostly interested in the discrete baseband representation of channel rather than the actual continuous analog form
- 3) Describe the probability density function of a real Gaussian random variable $\mathcal{N}(0, 1)$
- 4) Describe the probability density function of a complex n -dimensional Gaussian random vector (uncorrelated)
- 5) Describe the probability density function of a complex n -dimensional Gaussian random vector (uncorrelated)
- 6) Give an approximation of the tail of a Gaussian random variable $\mathcal{N}(0, N_0/2)$
- 7) What is the projection of a vector \mathbf{u} onto a space V spanned by $\{\mathbf{v}_i\}_i$?
- 8) Describe in words the meaning of , coherence bandwidth W_c , coherence time T_c , delay spread T_d , Doppler spread D_s
- 9) Relate the above W_c, T_c, T_d, D_s to each other
- 10) What is the probability of error (wrt to SNR) in AWGN channels
- 11) Describe the standard AWGN detection problem of two signals $\pm a$ in $\mathcal{N}(0, N_0/2)$ noise.
- 12) What is the main difference in communications in AWGN channels v.s. fading channels
- 13) Write the channel model for fading channels? Do it for SISO and then for MIMO, including dimensions.
- 14) What is the main cause of (fast) channel variations in time?
- 15) When can a channel be considered fast fading and when slow fading?
- 16) What is the main cause of error in fading channels?
- 17) Describe the concept of degrees of freedom.
- 18) What is the relationship between degrees-of-freedom and the number of input-output equations that can be solved?
- 19) Describe the reasoning why using QPSK is more efficient than using BPSK (in AWGN or fading channels)
- 20) What is a deep fade?
- 21) What are some ways that allow for the negative effect of deep fade be reduced?
- 22) What is a valid statistical characterization for the fading coefficients, and their magnitude square?
- 23) What is the average probability of error (averaged over the fading realizations), in a SISO Rayleigh fading channel (high snr approximation)?
- 24) What is the average probability of error (averaged over the fading realizations), in a $1 \times n_r$ SIMO Rayleigh fading channel (high snr approximation)?
- 25) What is the average probability of error (averaged over the fading realizations), in a $1 \times n_r$ SIMO Rayleigh fading channel (high snr approximation)?
- 26) What is temporal, spatial, and frequency diversity
- 27) Give examples of when is temporal, spatial, and frequency diversity suitable (in terms of coding duration T , of T_c, W_c, T_d and W (signal bandwidth))
- 28) Describe the standard MIMO channel model
- 29) Describe the rank criterion in MIMO communications
- 30) Describe the rate of the Alamouti code carrying QPSK elements
- 31) How many degrees of freedom can you have in a

- SISO channel
- $n_t \times 1$ MISO channel
- $n_t \times n_r$ MIMO channel

- 32) Why is the repetition code (for time diversity) very inefficient?
- 33) Describe the relation between the cardinality of the code $|\mathcal{X}|$, the rate of transmission R and the coding duration T