**Communication systems**

Academic year 2012/2013

List of questions: DRAFT

1. QAM constellations. Describe the behavior of the spectral efficiency and the BER performance as a function of the constellation cardinality. Write the expression of the Bingham formula and discuss all the terms. Provide some examples of QAM constellation cardinality used by modern systems.

2. Write the expression of the achievable bit rate according to the Shannon theorem. Write the expression of the bit rate achievable by a realistic single-carrier system by using the Bingham formula. Discuss the differences.

3. Choose a LOS scenario. Fix the transmitted power to $P_{TX}$ = 1 W and the band to B = 5 MHz. Choose realistic values for all the other involved parameters and compute the bit rate via the Bingham formula.

4. Given a Line-Of-Sight wireless link, present the path loss formula and discuss the dependence on the involved parameters. Make a numerical example with realistic values.

5. Multipath: define the delay spread D; discuss the conditions involving it (both in the time domain and the frequency domain) under which InterSymbol Interference is limited. Provide an example of delay spread computation using a realistic environment.

6. For a simple AWGN channel of band B, write the expression of the noise power. Describe all the involved parameters and, in particular,

the noise figure F. Use realistic values to provide an example of noise power computation.

7. Given a 2-PSK constellation transmitted over an AWGN channel, show by an example why ISI decreases the BER performance.

8. Describe the three most important properties of OFDM?.

9. Discuss why OFDM systems typically use a cardinality N which is a power of two. Explain how it is possible to do this when the number of used tones is not a power of two. Discuss why the external tones of an OFDM are typically not used.

10. OFDM: discuss the connection between the carrier separation and the symbol rate in ideal and real situations. Make a numerical example referred to a practical system.

11. Discuss the differences between DMT and OFDM. Draw the complete scheme of a DMT modulator and a DMT demodulator (or an OFDM modulator and an OFDM demodulator) by describing the purpose of each block.

12. Water filling. Present the problem. Discuss the formula. What are the active tones? When do you obtain large gains with respect to a uniform allocation on the entire band?

13. By using a numerical example with realistic values, show the advantages of OFDM with respect to a single carrier solution for limiting ISI due to non-ideal channel response.

14. Cyclic prefix. Explain what it is. By a numerical example, show how to proper design its length. Discuss which are the advantages

and the disadvantages of using a cyclic prefix. By referring to sinusoidal signals, explain why the cyclic prefix solves the problem of ICI.

15. OFDM frequency equalization. Describe the problem by using a simple example with N=4. Which is the usual technique for estimating the bins frequency response coefficients? Which is the difference with respect to a simple average? Which is the connection between the number of symbols to be used and the signal-to-noise ratio?

16. What is the purpose of an interleaver? Use an example to clarify how it works.

17. DSLAM. What is it? Where can it be located? Discuss why and how its position impacts on the maximum frequency value used by a DSL system.

18. Which is the typical behavior of a copper line frequency response? Which are the consequences on the DSL water filling procedure? Which tones receive more power? What are the active tones?

19. Which are the most important impairments of a DSL system?

20. Given a DVB-T system, use realistic values for all the involved parameters and give a numerical example for computing the SNR at the receiver side.

21. DVB-T: present the Single Frequency Network paradigm and discuss it advantages and disadvantages. Provide a numerical example of the delay spread introduced by artificial echoes by using realistic values.

22. DVB-T: discuss the trade-off between bit rate and covered distance.