List of essay questions Mobile communication systems/ Mobile communication networks, autumn 2016
Basics:
1. Describe the basic challenges of mobile communications and solution areas (mobility, radio channel). Outline the properties of radio channels.
2. Outline Shannon's formula, describe the parameters in it and its consequences.
3. Describe the basics of mobility management: meaning and role of of handover, location update and paging processes. The meaning of location area.
4. Sketch the basic structure of mobile networks. Describe the principle of frequency reuse: presentation of the basic idea through an example. Outline why mobile networks are based on radio cells.

Networking basics

5. Describe the basic properties of circuit switched and packet switched communications.
6. Outline general network hierarchy, describe the different geographic scales of networks.
7. Describe the general layered view of networks. Define what is a protocol and what is a protocol stack. Describe how layers are built on top of each other and how layers communicate.
8. Describe the main functionalities of the first four layers of the OSI layered model.
9. Outline the basics of IP based networking: list some examples of IP based application, transport and management protocols. Outline the roles of IP layer and the structure of IP packets.
10. Describe the main principles of addressing in IP (roles, types, meanings of the addresses). Outline the solutions to be used for the problem of not enough addresses.
11. Outline the idea of tunneling in IP.
12. Describe the main features of IPv6.
13. Describe the TCP and the UDP protocols.

GSM systems
14. What are the subsystems of the GSM network? What kind of functional entities (equipments) are present in the GSM system and what functions do these provide?
15. What kind of databases can be found in the GSM system and what are the roles of these?
16. Describe the basic properties of the GSM air interface: multiple access, duplexity, frequency bands, timeslot and frame structure.
17. Describe the logical channels of GSM and their mapping to physical channels (timeslots).
18. Describe the process of network attach and receiving a call in GSM, in terms of the logical channels used.
19. What is timing advance and why is it important?
HSCSD, GPRS
20. Briefly describe High Speed Circuit Switched Data (HSCSD)!
21. What are the new nodes (compared to GSM) in GPRS system? What are the roles of these?
22. Describe the novelties (compared to GSM) of the GPRS radio interface in terms of logical channels, higher bitrate and flexibility.
23. Describe how timing advance is controlled in GPRS. Describe scheduling principles in GPRS.
3G:
24: Describe the architecture and main features of UMTS network (UTRAN + Core Network). Describe the roles of new devices in the UTRAN.
25: Describe the main concept of CDMA. Show the basic principle of CDMA using an example. Why is it working, what is code orthogonality.
26: Walsh-Hadamard codes: how to generate (matrix and tree). How can it be used to create different bitrate channels to different users.

27:Describe main properties of UMTS radio interface. How are channels of users distinguished in UMTS? How W-H and scrambling codes are used? Derive the physical gross bitrates in UMTS. List the typical implemented bitrates.

28: Describe the features and solutions of HSDPA. Describe the advancements of HSPA+.

4G:

29: Describe the architecture and main features of LTE network (EUTRAN + EPC). Describe the roles of nodes in the LTE network.

30: Describe the basic properties and structure of the radio interface in LTE. Describe the PRB, derive the available physical bitrates in LTE.

31: Describe the problem of LTE resource scheduling. Describe how the system solves this.

32: Describe LTE-Advanced improvements. Show examples of what advancements high-speed deployments are using.

WiFi

33: List five versions of the 802.11 standards, with their properties very briefly.

34: Describe the elements, functionalities and notions of WiFi networks.

35: Describe the operation of the WiFi MAC protocol's DCF function.

36: Describe how DCF and PCF operate together. Outline the basic operation of PCF mode.

37: Describe the main ideas and the purposes of 802.11e.

38: Describe the hidden terminal problem and how to mitigate it. Describe the basic ideas of virtual carrier sense.

39: Outline what kind of frames are used and for what purposes in WiFi.

40: Describe the roles of various address fields in the WiFi MAC frame, how the addresses are used depending on the FromDS/ToDS fields?

41: Define how power save mode is working in WiFi.

Bluetooth:

42: Outline the basic radio procedures of Bluetooth.

43: Describe the basic networking properties of Bluetooth.

44: Present the link types used in Bluetooth.

45. Describe the low power modes of Bluetooth.

5G:

46: List and discuss the main 5G network concepts.

47: Describe the special requirements of key application areas of 5G.

48: Describe the basic idea, benefits and challenges of NFV.

49: Describe the basics of virtualization and the types of virtualization.

50: Describe the concept of forwarding graphs.

51: Describe the basic architecture of SDN.