S-72.1130 Telecommunication Systems Fall 2006

Preparing for the Course Exam

When preparing for the course exam, please keep in mind that such issues that are mentioned **both** in the lecture slides (powerpoint slides) **and** in the supporting material (see next slides) are of prime importance.

In the exam, 3 out of 5 questions are selected from the list at the end of this slide set or from exercises or from "Review Questions" found in the lecture slides. Please note, one exam question may consist of several questions from the list. In addition, the exam may include "true/false" and "fill-in words" types of questions.

Regarding acronyms, you don’t have to remember what they stand for, but rather in which connection they are used and what is their true meaning.

The exam paper is in English. However, you may answer the questions in English, Finnish or Swedish.

Overview to Telecommunication Systems

X.25 and Frame Relay*

Kurose, Ross: Computer Networking, 2th ed, Section 5.10

Standardization Overview*

W. Stallings: Data and Computer Communications, 7th ed (http://www.williamstallings.com/DCC/DCC7e.html)

Quality of Service

Microsoft: Quality of Service Technical White (available in course homepage)

* Distributed by Edita

Transport and Signaling in the PSTN

SDH

Acterna SDH pocket guide (link on the course exercise web-page) (http://www.acterna.com/commex/commex_pdf_win/index.html?PDF=/united_states/technical_resources/downloads/white_papers/sdh_and_sonet/sdh_ptg_ae.pdf)

See also: http://www.iec.org/online/tutorials/sdh

SS7*

Chapter 4 in ”Engineering Networks for Synchronization, CCS7, and ISDN” by P.K.Bhatnagar 1997

See also: http://www.iec.org/online/tutorials/ss7

* Distributed by Edita

IN and Mobile Networks

Intelligent Network (IN) concept

See: http://www.iec.org/online/tutorials/in (especially Section 10)

Mobile Application Part (MAP) signalling*

Sections 17.6 - 17.9 of the book “Signaling in Telecommunication Networks” by J.G. van Bosse

(This material is intended to show MM and CC in action, it is not important to remember all the details but rather the general idea how signalling works in practice in a mobile network)

Mobile network technology (core network, not radio access network)

For example: http://en.wikipedia.org/wiki/GSM

(See those parts that are relevant for the course, in other words the topic is mentioned on the lecture slides)

* Distributed by Edita

Digital Subscriber Loop

Informative tutorial of DSL at:
http://www2.rad.com/networks/2005/adsl/main.htm

Matlab tutorial on DMT principle:
http://cnx.rice.edu/content/m11710/latest

Wireless Local Area Networks

IEEE 802.11 Architectures and Services*

W. Stallings: Data and Computer Communications, 7th ed., pp. 553-567

ARQ and HDLC*

Duck, Read: Data Communications and Computer Networks, 2nd ed., pp. 200-204

A. Leon-Garcia, I. Widjaja: Communication Networks, 2nd ed., pp. 332-340

* Distributed by Edita

IP Technology, Part 1

TCP/IP general source material

http://www.inetdaemon.com/tutorials/internet

(See those sublinks that are relevant for the course, in other words the topic is mentioned on the lecture slides)

SCTP

http://www.isoc.org/briefings/017/index.shtml

(Good comparison between SCTP / TCP / UDP)

RTP

http://www.ietf.org/rfc/rfc1889.txt

(Relevant sections: 1 Introduction)

IP Technology, Part 2

GPRS

http://www.comsoc.org/livepubs/surveys/public/3q99issue/bettstetter.html

(Relevant sections: System Architecture; Session Management, Mobility Management & Routing)

SIP

http://www.ietf.org/rfc/rfc3261.txt

(Relevant sections: 1 Introduction, 2 Overview of SIP Functionality, 4 Overview of Operation)

MPLS

http://www.iec.org/online/tutorials/mpls
(Just to get the general idea, the details are not important)

Questions

Overview to Telecommunication Systems

- What is the most important difference between TCP and UDP when QoS requirements of applications are concerned?
- Which one would you use TCP/UDP for a) Streaming Video/Audio (Real Audio/Video), b) Data-file transfer (ftp), c) http-traffic?
- Describe the function of physical layer and name two protocols that work especially in this layer
- In which layer does HDLC Protocol work? Name its major functionalities.
- Discuss the differences of design philosophy of X.25 and Frame Relay.
- Briefly describe the sending of IP datagram from Ethernet to Frame Relay and back to Ethernet.
- Discuss the benefits and drawbacks of standards.
- A) What is meant by “regulatory use of voluntary standards”? B) What are the respective benefits?
- Describe how standards are developed in IETF?
- Sketch and explain Internet RFC publication process.
- Describe the six steps in developing of ISO standard from first proposal to actual publication standard.

Questions (cont.)

Public Switched Telephone Network

- What are the three general MAC techniques to apply with fully distributed networks?
- Listen before talk (LBT) gives rise to a couple of problems A) What are they ? B) How can they be overcome?
- Describe the principle and motivation for CSMA/CD algorithm.
- What kind of device is a multistage switch? Why it was developed?
- Describe the realization and function of a time-space-time switch.
- How can PSTN user services be categorized? Name few example of these services.
- Describe the functionalities of Digital Circuit Multiplexing Equipment (DCME).
- Summarize properties of ISDN exchange interface Q.512.
- Describe the functional modules of a modern local exchange.
- Summarize modules and functions of Line Interface Circuit (LIC).

Questions (cont.)

Transport and Signalling in the PSTN (cont.)

- Explain how a voice signal is packed into a 64 kbit/s channel.
- Explain the structure of an E1 frame with a bitrate of 2.048 Mbit/s.
- Describe why and how pointer processing is used in STM-1 frames.
- Channel-associated signalling (CAS) vs. common channel signalling (CCS).
- Why and how are signalling point codes (SPC) used in an SS7 network?
- Explain the difference between SLS and CIC in SS7 signalling.
- Explain the "levels" and functions of MTP (Message Transfer Part) in SS7.
- Where and why is ISUP (ISDN User Part) used?
- Setup of a call using ISUP (ISDN User Part).
- Why and how is analogue subscriber signalling used in the PSTN?
- You should be able to explain the basic signalling steps and network element functions when setting up or disconnecting a circuit switched call.

Questions (cont.)

Digital Subscriber Loop

- Discuss what are the basic capabilities specified in G.992.1 ADSL Standard.
- Summarize the start-up phases of RADSL modems.
- What are the ways of ADSL to copes with the challenging local loop?
- Sketch and explain the principle of quadrature-carrier multiplexing.
- Sketch and explain the basic functionalities of an ADSL modem with respect of A) Channel adaptation in DMT B) error control and correction.
- What is meant by guard interval and why it is used in DMT?
- Explain the principle of DMT.
- Discuss data paths and their realization in ADSL frame structure.
- Sketch and discuss T1.413 ADSL Standard reference model.
- Sketch and describe how ADSL can support other networking technologies in terms of DSLAM functionalities.
- What is the Fast Sync Byte? What kind of functionalities it carries?

Questions (cont.)

Intelligent Networks (IN)

- Explain the basic IN architecture.
- Explain the meaning of IN service provider, subscriber and customer.
- Describe a call-related IN procedure involving an intelligent peripheral.
- Explain how a service control point (SCP) can affect a circuit-switched call.
- List (and shortly explain) 3 typical IN services.

Questions (cont.)

Mobile Networks

- Explain the concepts handover, random access, paging, and location updating in a mobile network.
- List the main management functions (RRM, MM, CC, SM) and their role in the core network of a PLMN.
- Explain why and how random access is used in a PLMN.
- Explain how a user is authenticated in a PLMN (not PIN code …).
- Explain the meaning of location updating in a mobile network.
- Why and where are IMSI, TMSI and MSISDN numbers used in a PLMN?
- You should be able to explain the basic architecture of (the core network part of) a mobile network, as well as the main functions of basic network elements.
- You should be able to explain the main signalling events of a mobile originated call (MOC), mobile terminated call (MTC) or location updating procedure.

Essay Questions (cont.)

Wireless Local Area Network

- Briefly overview IEEE 802 PHY, MAC and LLC functionalities and name some of the related standards.
- Name and explain the basic services of IEEE 802.2 LLC standard.
- Sketch and explain the meaning of packet encapsulation?
- Sketch and explain the principle of SAP addressing.
- Discuss the general criteria in selection of MAC protocol.
- Briefly overview IEEE 802.11 WLAN MAC level functionalities.
- Service sets of 802.11.
- Sketch and describe 802.11 MAC timing in basic access.
- Carrier sensing in 802.11
- Explain the basic functionalities of HDLC.
- Sketch and explain how usage of RTS/CTS signals with NAV vector by clearly indicating functions of each signal.
- Describe the function and realization of Point Coordination Function.
- Structure and functions of 802.11 MAC frame.
- Discuss the physical level options of 802.11 standard.

Essay Questions (cont.)

- **IP Technology, Part 1**
- Explain the IP network concepts client, server and router.
- What is the purpose of using ICMP (Internet Control Message Protocol)?
- What is the purpose of using SCTP (Stream Control Transmission Protocol)?
- Compare the OSI transport layer protocols TCP and SCTP.
- What is the main purpose of DNS (Domain Name System).
- Where and why is RTP (Real Time Protocol) being used?
- Explain the hierarchical IPv4 address structure.
- Give 3 examples how the IPv4 address space can be "extended" (other than moving to IPv6).
- What does Network Address Translation (NAT) mean?
- Why and where is dynamic IP addressing used?
- Explain the hierarchical structure of the Internet.

Essay Questions (cont.)

IP Technology, Part 2

- Explain the difference between terminal and personal mobility.
- Explain the meaning of PDP context.
- You should be able to explain how packet transport takes place between a client in a PLMN and a server in the Internet (both directions).
- What is SIP (Session Initiation Protocol) used for?
- Explain the basic operation of SIP (Session Initiation Protocol).
- Explain the main difference between the protocols HTTP and SIP.
- Describe the meaning of "tunneling" (as related to IP transport).
- What does MPLS (MultiProtocol Label Switching) mean?
- How are IP datagrams packed into ATM cells?
- How are ATM cells packed into STM-1 frames and cell borders found?