LUND
UNIVERSITY

EITG05 – Digital Communications

Lecture 12

Course Summary and Outlook

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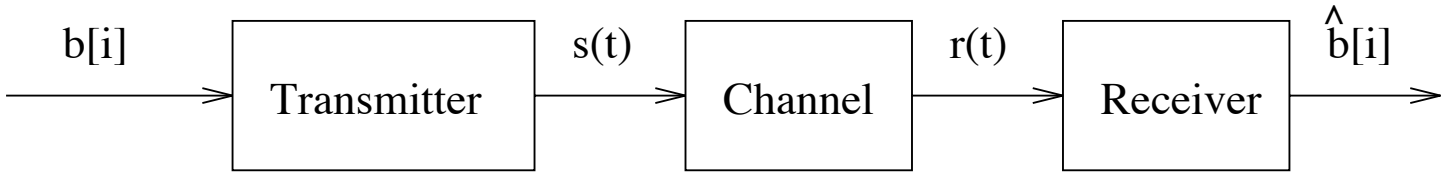
Monday, October 14, 2019

What this course was about



- Transmitter principles: bits to analog signals (Chap. 2)
- Characteristics of the communication link (Chap. 3,6)
- Receiver principles: analog noisy signals to bits (Chap. 4,5,6)

Requirements:

- Data should arrive correctly at the receiver
- High bit rates are desirable
- Energy/power efficiency
- Bandwidth efficiency

What are the technical solutions and challenges?

Final Exam

- Written exam
- Thursday, October 31, 2019, 14.00 – 19.00 in Vic 1A–C
  Victoriastadion, Svenshögsvägen 23
- Five problems with 10 points each
- 20 points or more are required to pass

You are allowed to use:

- the course compendium
- a printout of the lecture slides
- your own handwritten notes: (new this year)
  limited to 2 sheets (= 4 pages), no copy
- a pocket calculator
  (but no devices that can connect to the internet)
- paper will be provided

About the exam

- The aim of the exam is to test all parts of the course
- All material covered in the lectures and exercises is relevant
- Questions change from exam to exam

Some advices:

- Work with the compendium and lecture slides
- Train by solving exercise problems and previous exam problems
- Try to understand the connections between parts of the course
- Subproblems in exam have different difficulty
- Move on to other problems if you get stuck
- Solving two problems completely (10 points) may be harder than solving 4 or 5 problems partially

Course evaluation (CEQ)

- Course evaluations are done online
- You will receive an invitation and reminders
- Please participate!

Your feedback is valuable:

- What did you like / not like about this course?
- What could be done better next years?
- You can also provide comments to the course representatives

More courses about communications

Communication theory

- Digital Communications, Advanced Course, ETTN01 (HT2)
- Information Theory, EITN45 (VT 2)
- Channel Coding for Reliable Communication, EITN70 (HT 2)
- Cryptography, EDIN01 (HT 2)

Wireless systems

- Wireless Communication Channels, EITN85 (VT 1)
- Wireless System Design Principles, EITN75 (VT 2)
- Modern Wireless Systems - LTE and Beyond, ETTN15 (VT 2)
- Multiple Antenna Systems, EITN10 (HT 1)
- Project in Wireless Communications, EITN21 (HT 1+2)

Networks

- Network Architecture and Performance, ETSN10 (VT 1)
- Internet Protocols, ETSF05 / ETSF10 (HT 1+2 / HT 2)
- High Performance Fiber Networks, EITP10 (HT 2)

Digital Communications, Advanced Course

Contents:

- MAP receiver (using prior knowledge)
- Detailed treatment of OFDM
- More about MIMO (multiple antenna systems)
- Trellis-coded signals: combining coding with modulation
- Time-varying multipath channels

Project:

- The course includes some project to be done in groups of two
- Study a relevant application/technical problem
- Topic can be chosen by each group (based on scientific articles)
- Written report, oral presentation and opponent to other group

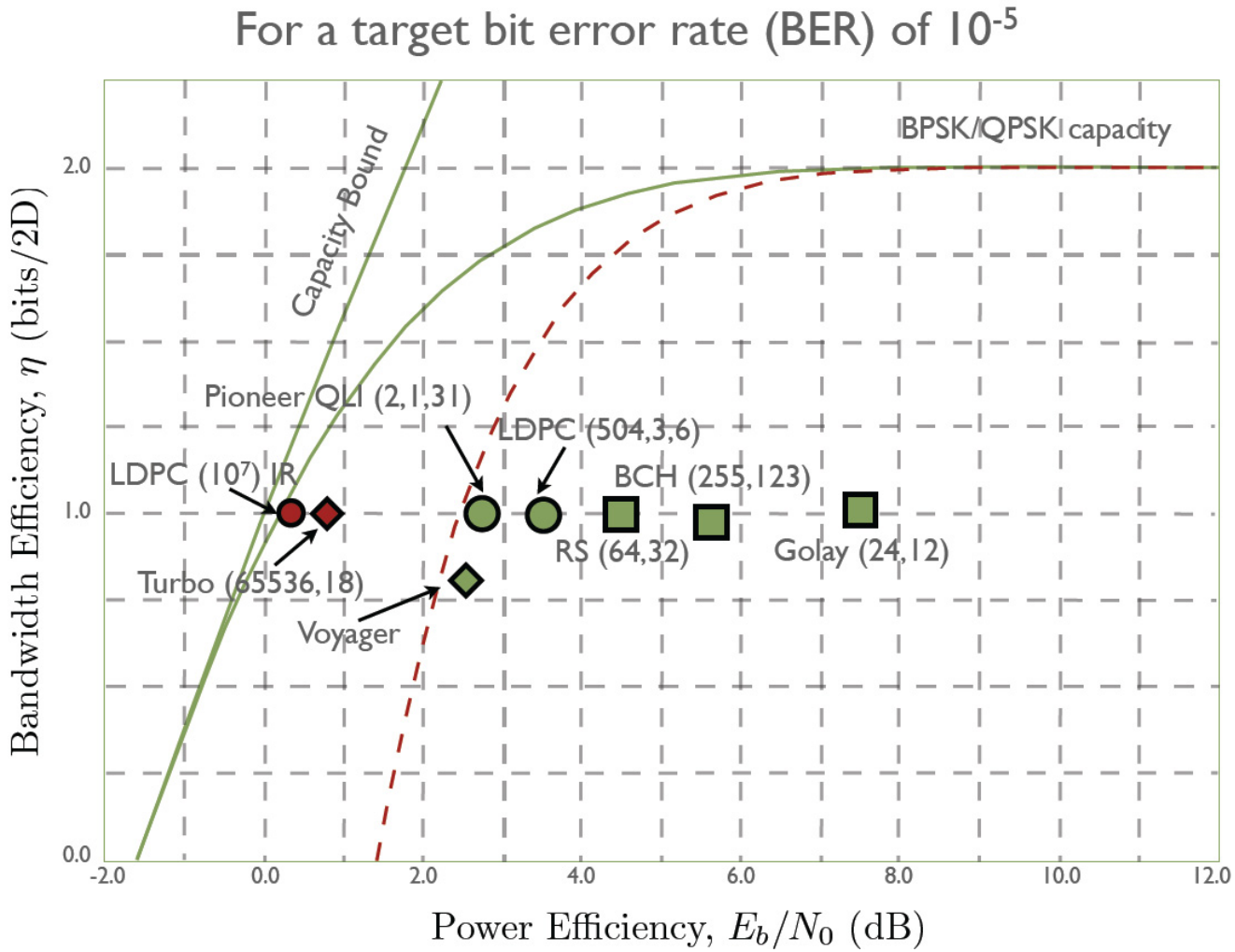
Teacher: Fredrik Rusek

Information Theory

- Studies fundamental limits of communication
- How can we define a quantitative measure of information?
- What is the ultimate compression rate?
  $\Rightarrow$ source coding theorem
- What is the ultimate data rate?
  $\Rightarrow$ channel coding theorem / capacity
- Fundamental limits are studied for:
  - single-user channels
  - OFDM systems
  - MIMO systems
- Practical algorithms for data compession are studied:
  Huffman coding, Lempel-Ziv coding

Teacher: Stefan Höst

The coding theory challenge



Source: D.J. Costello, Jr., "Modern Coding Theory", Lecture at the Third Canadian Summer School on Communications and Information Theory, Banff, Alberta, Canada, August 19, 2008

Channel Coding for Reliable Communication

Content:

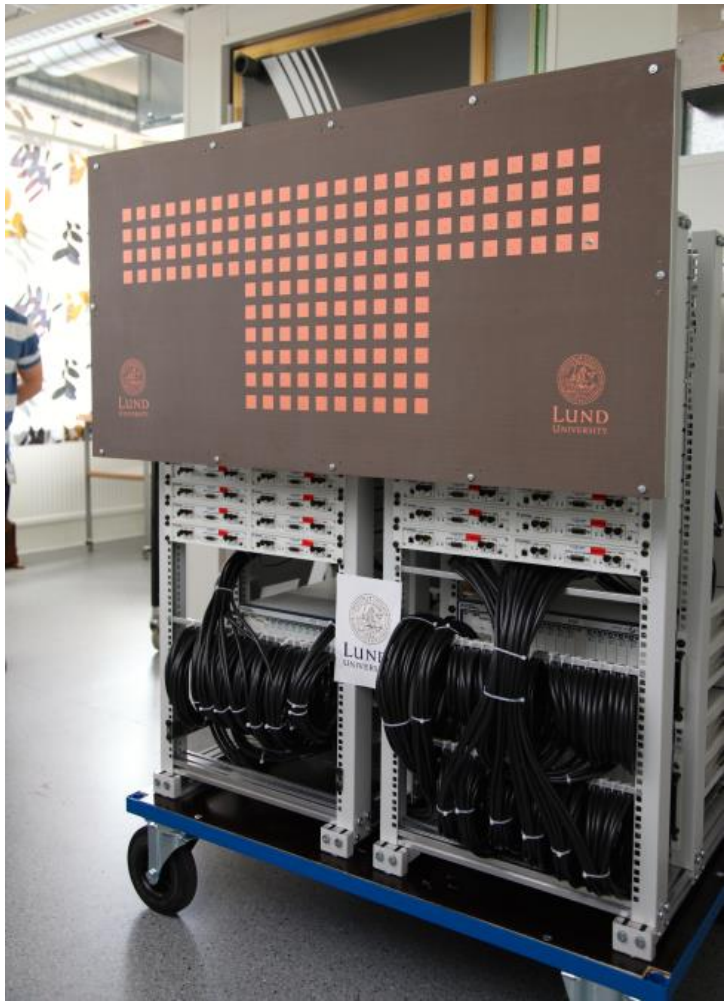
- Chapter 1: Introduction
- Chapter 2: Principles of Error Control Coding
- Chapter 3: Optimal Decoding Methods
- Chapter 4: Iterative Decoding of Concatenated Codes
- Chapter 5: Reed-Solomon Codes

After this course you should understand:

- general principles of coding
- important coding schemes: binary block codes, RS codes, convolutional codes, concatenated codes
- common methods of decoding: algebraic decoding, ML/MAP decoding, iterative decoding

Teacher: Michael Lentmaier

Increasing spectral efficieny: Massive MIMO



$\Rightarrow$ Multiple Antenna Systems, Teacher: Fredrik Rusek

Modern Wireless Systems – LTE And Beyond

- Overview of exciting technologies and how they work together to meet tough requirements
- Critical knowledge & constantly updated: 5G focus from HT 2019 (5G NR ready in June 2018)

Special features:

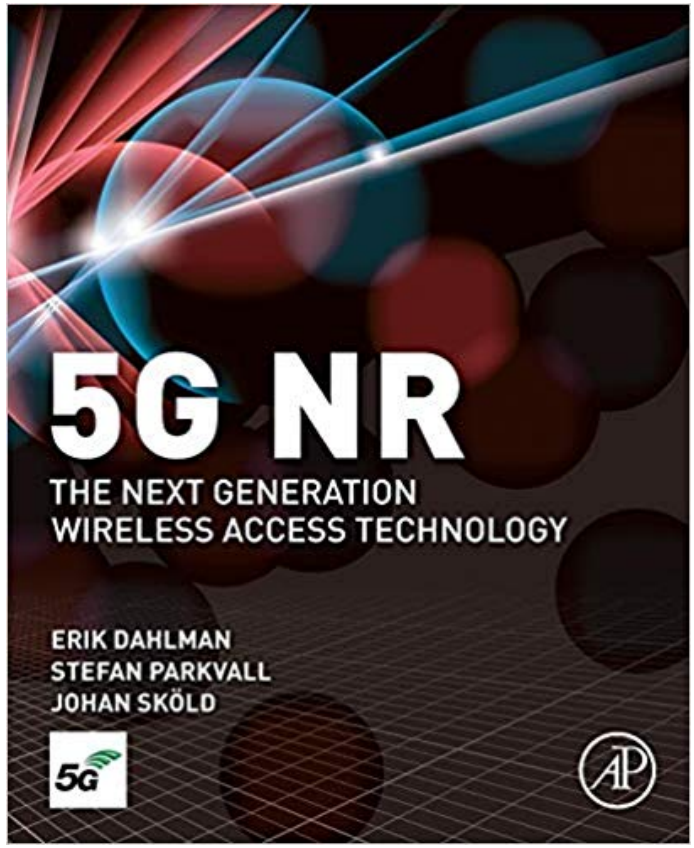
- Discovering how technologies work in real systems
- Industry-relevant LTE Toolbox exercises for better understanding
- Literature review project designed for in-depth study
- Development of important skills through project work

Teacher: Aleksei Fedorov, Buon Kiong Lau

New Book

Find out how 5G works!

- 20 Gbps data rates
- 1 ms latency
- Optimized for IoT
- Applying millimeter-waves
- Massive MIMO
- and more ...



Project in Wireless Communications

Ultimate goals of the project:

1. Two computers should communicate via speaker/microphones
2. Two computers should communicate using software defined radios

Setup:

- Some lectures and exercises give a direct introduction to the project
- The main part of the course is a simulation project where the students in groups analyze, implement, simulate and test a communication system
- The projects are performed in groups of two students

Teacher: Fredrik Tufvesson