EITG05 – Digital Communications

Week 6, Lecture 2

Course Summary and Outlook

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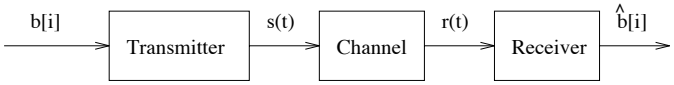
Thursday, October 5, 2017

Scope of this course



- 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 26, 2017, 14.00 – 19.00 in MA 10A–E
- Five problems with 10 points each
- 20 points or more are required to pass
- All material from the lectures and course outline is relevant
- Previous exams can be found on the webpage

You are allowed to use:

- the course compendium
- a printout of the lecture slides
- a pocket calculator
  (but no devices that can connect to the internet)
- paper will be provided

Please participate in the online course evaluation (CEQ)
open: Oct 28 - Nov 14

Digital Communications, Advanced Course

Contents:

- Signal space representation
- Detailed treatment of OFDM
- More about MIMO (multiple antenna systems)
- Trellis-coded signals: combining coding with modulation
- Time-varying multipath channels

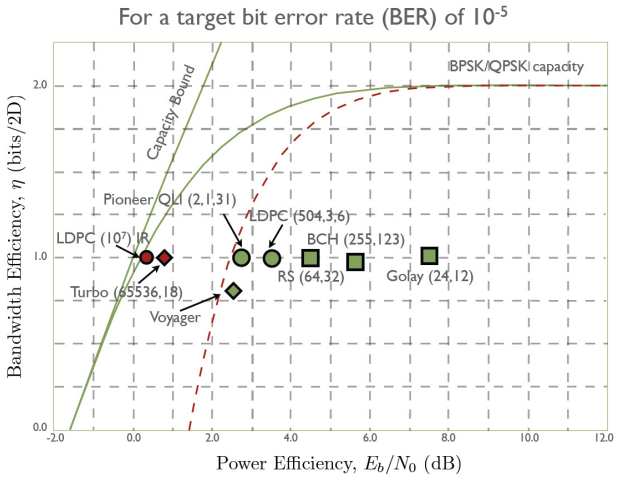
Project:

- 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

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

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

More courses about communications

Communication theory

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

Wireless systems

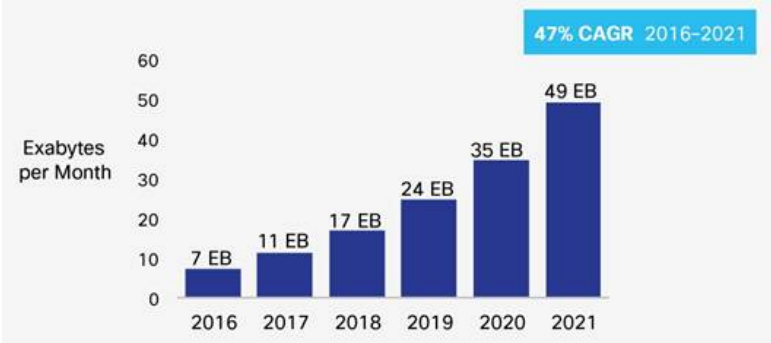
- Wireless Communication Channels, EITN85 (VT 1)
- Wireless System Design Principles, EITN75 (VT 2)
- Modern Wireless Systems - LTE and Beyond, ETTN15 (VT 2)
- Multiple Antenna Systems, EITN10 (HT 1)
- Project in Wireless Communications, EITN21 (HT 1+2)

Networks

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

And how does the future look like?

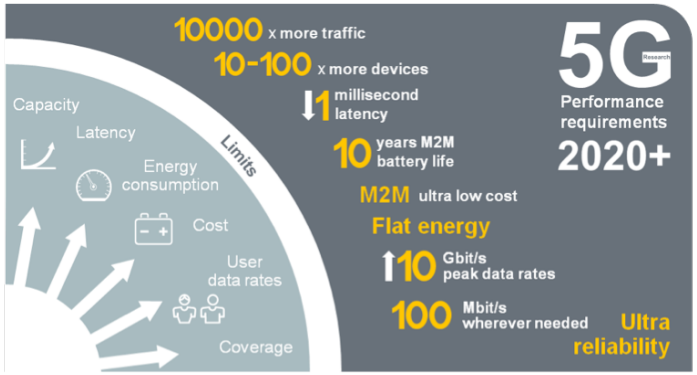
Cisco mobile data traffic forecast



Source: Cisco VNI Mobile, 2017

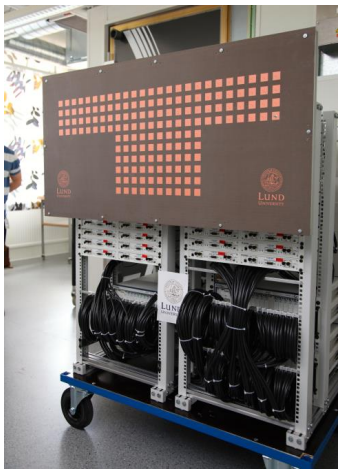
Upcoming wireless standard 5G

Challenging targets



Source:
Nokia Networks: Looking ahead to 5G. White paper, April 2014

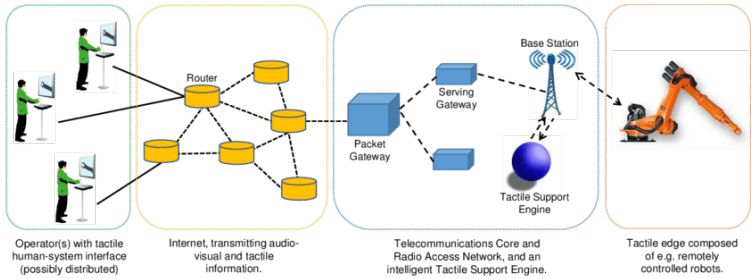
Increasing spectral efficieny: Massive MIMO



Car to Car Communication

Communication links between cars for increasing traffic safety must be very reliable and fast

The Tactile Internet



5G innovation opportunities- A discussion paper - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/ [accessed 3 Oct, 2017]

Internet of Things (IoT) and Cloud Services

Communication links are an integrated part of the cloud and form the basis for efficient and reliable services