EE 122: Introduction to Communication Networks

MIDTERM PREPARATION

Refreshing individual topics

- What are the basic concepts? Do you **really** understand them?
- Has there bin some **basic formulae**? Memorize them…
- Do you understand the implication of the major rules and formulae? What do they influence in the system design?
- Revise shortly problems for homework, problems in the books related to the topic, do you understand what is expected?

During the midterm

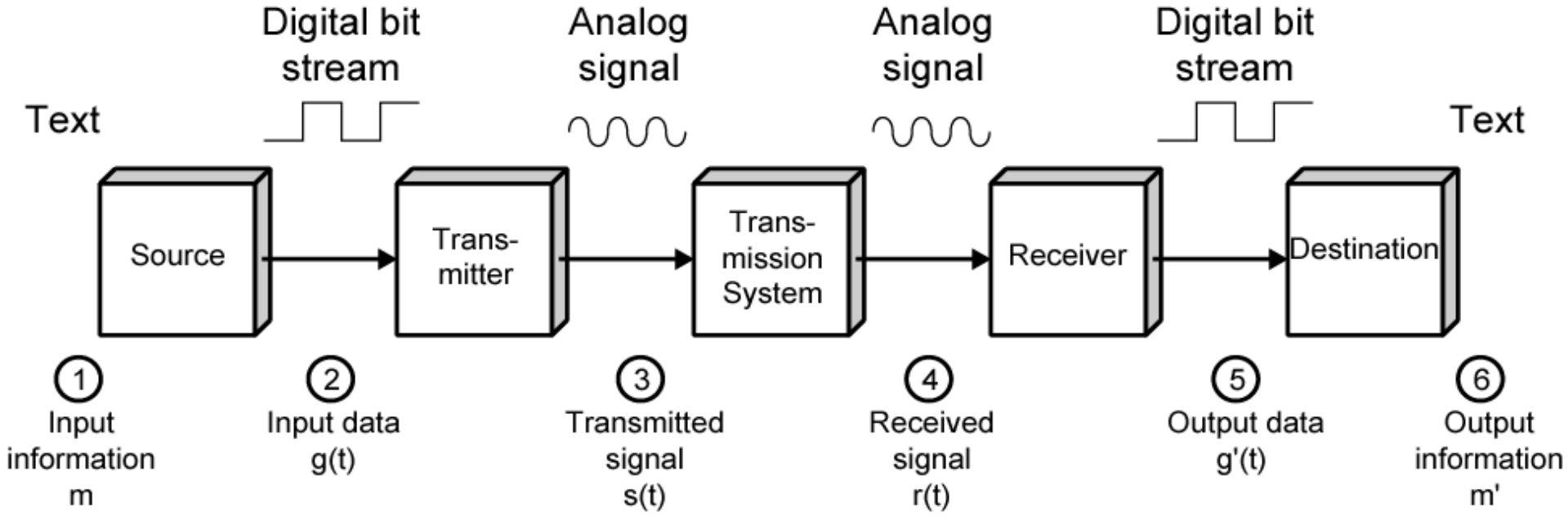
- Read the problems carefully – the time devoted to proper understanding of the problem is the best invested time!!!
- It might be a good idea to look at ALL the problems first, and starting solving them form what seems to be easiest for you!!! (but be sure that you have understood it !)
- Avoid getting stuck on a single problem (or part thereof!) which seems very difficult to you, and loosing to much time trying to master this one!

Summary of some key- topics

NOTE: THE FOLLOWING LIST OF TOPICS/ISSUES IS NOT INTENDED TO BE COMPLETE!!

Multimedia Communication

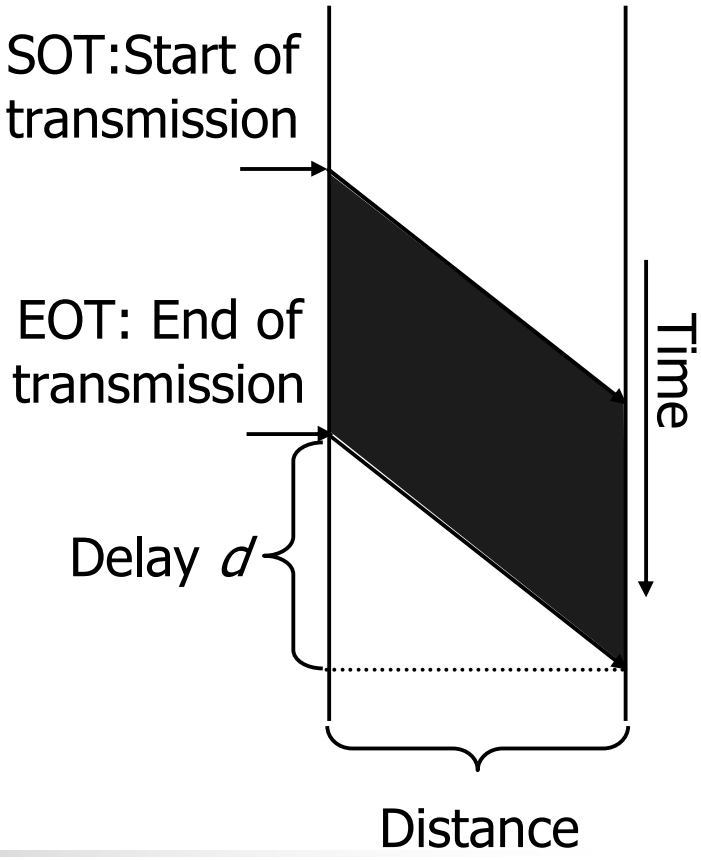
- The information is stored/exchanged in MEDIA
  - Voice, Video, Data, …



- Different characteristics of the data stream and expected transmission quality led to use of different technologies (Phone, TV, Data networks) ➔ **convergence**!

Realistic Transmission... [H.Karl, Paderborn]

- *Propagation delay d*:
  - **Propagation speed *v*:**
    - **speed of light *v*=*c*,**
    - **In copper/fiber *v* ~ 2/3 c**
  - *d* = distance / *v*
- ***Data rate r***: How much bits/second can a sender transmit?
  - **(EOT – SOT) = Data size / data rate**
- ***Error rate***: What is the rate of incorrect bits arriving at the receiver?
  - Messages containing incorrect bits might be DELETED…



Design Challenges: **Scalability**

- Distributed System Properties
- Scalability:

  A system is said to be scalable if it will remain (efficiently) operable when there is a significant increase in the number of **resources** and **users**:

  - Controlling the cost of resources
  - Controlling the performance loss
  - Preventing software resources running out (e.g. addresses)

Hard State vs. Soft State

- Introducing state might be necessary. Typically if some resources have to be kept available…
  - Consider the restructured banking example. If several clients would use the same account a „lock" on access would be needed between Checking Balance and setting New Balance.
- Hard State Approach:
  - State information has to be deleted as result of a proper action!
  - What happens with the "Lock" if the computer of CLERK 1 brakes down after "checking the balance"?
- Soft State Approach:
  - The state information removed if not reactivated since XXXX
  - *Like putting shoes in the store on hold for 2 days…*

Names, Addresses, Routing…

- **Name**: WHO (identifies the object)
  - Structured for simple reference
  - E.g. According to organizational structure? Mnemonics?
- **Address**: WHERE TO FIND (the object)
  - Must be REACHABLE
  - The object can move (mobility) ➔ change address
- **Route**: HOW TO GET THERE
  - Has to assure delivery.
  - It is nice, if the address structure helps.. (e.g. street blocks)

Services and protocols

- The Notion of Service
- The conventions for service description
- The notion of the API
- The notion of Protocol
- For whom are protocols relevant
- Protocol specifications – FSMs
- Multilayer Protocol structure
- The ISO_ OSI Protocol Layering

Signal transmission

- Signal: spectrum, bandwidth, effective bandwidth
- Digitization of analog signals, Nyquist sampling theorem
- Fundamental features of media
- Channel coding – principles, basic codes
- Theoretical limits of bit rates available form a given bandwidth
  - **Nyquist Formula**
  - **Shannon Formula**
- Modulation- adaptive modulation

Multiplexing, Switching

- Multiplexing: FDM, TDM, Space
- Static multiplexing vs. Statistical multiplexing
- Switching: Circuit switching – Packet switching
  - Details of the above CONCEPTS !
  - Datagram Packet switching vs. Virtual circuit packet switching
  - Connection oriented services on top of Datagram service vs. on top of Virtual Circuits
  - Routing tables, routing vs. forwarding
- Basics of the Telephone Networks: Data and signaling
  - On the Local loop, In the trunks

Queueing

- Basic concepts of Queuing
- The formula for M/M/1 delay
- Delay/Load basic characteristics, M/m/1, M/M/1/K, M/M/n
- The relation between single and multiple server queues

Framing, Error Detection

- Basic concepts of FRAMING
- Typical FLAG, Bit stuffing/symbol stuffing, features
- Other approaches for Framing
- Error detection principles, redundancy, Hamming Distance
- Forward Error Correction concept
- Polynomial codes for Error Detection - principle, computation of CRC
- **Basic** features of Polynomial codes
- CRC Implementation principles

ARQ, Flow Control

- Send and Wait, details, efficiency with /without errors
- Alternating Bit – details
- Sliding Window Principles
- Go-Back-N operation Principles
- Selective Repeat operation principles
- Acknowledgments usage: cumulative, individual
- Flow Control Principle
  - Window based , Rate based (Very general)
- Acknowledgement Vs. Permit

Multiple Access,

- Taking Turn Approaches – basic features
- Random Access Approaches:
  - Aloha, Slotted ALOHA – efficiency
  - CSMA, CSMA/CD (persistency!)
  - Vulnerability periods, Collision detection conditions!
  - Exponential back-off, Capturing