Summary Computer Networks

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Contents

1 Motivation

1.1 Communication Metaphors

- Phase 1: Person to person
- Phase 2: Person to machine
- Phase 3: Machine to machine/Network of computers
- Phase 4: The internet of Things

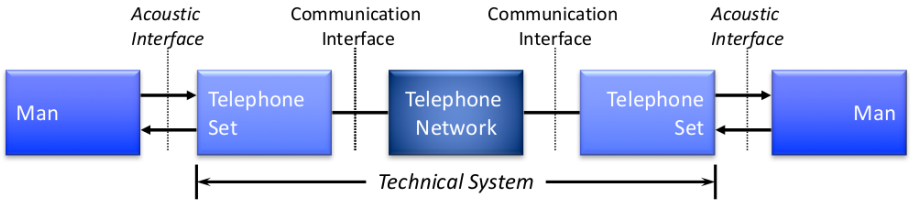
1.2 History

- 1837: Samuel Morse develops the telegraph
- 1953: First transatlantic Telephone line
- 1876: Alexander Graham Bell patents the telephone (tele=distant, phone=voice)

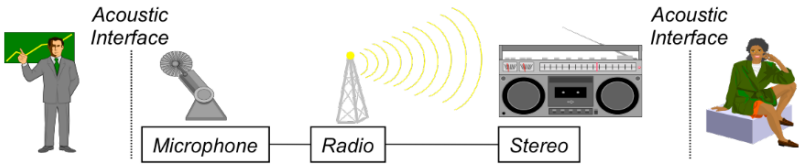
1.3 Telephone Network

Existing networks are going to be integrated

- **Model of telecommunication**



- **Model of broadcasting**



1.4 The Internet

7 The internet consists of

- a set of computers, which
  - use the TCP/IP protocols
  - are somehow (directly or indirectly) connected
  - offer or use particular services
- a set of users, which have access to these services
- a set of other networks, which (somehow) are accessible

Design Principles

- Minimalism and autonomy - The network operates by itself , does not require internal changes when new networks are added
- Best-effort service model
- Soft-state (stateless) - The routers do not need to maintain end-to-end communication information
- Decentralization

2 Introduction

2.1 Data Communication

Data communication is the processing and the transport of digital data over connections between computers (generally over large distances).
Data communication comprises two areas: Computer Networks and Communication Protocols

2.2 What is Digital Data?

- Data: Representation of facts in a formal way, processable by humans and machines, e.g. a language
- Information: is whatever contributes to a reduction in the uncertainty of the state of a system, can only be handled by humans
- Signal: is the physical representation of data by spatial or timely variation of physical characteristics
- Example: Sounds of a language (Data) during speaking are acoustic waves (Signals)

2.3 Data Communication

- Sharing resources saves costs
- Exchange of information

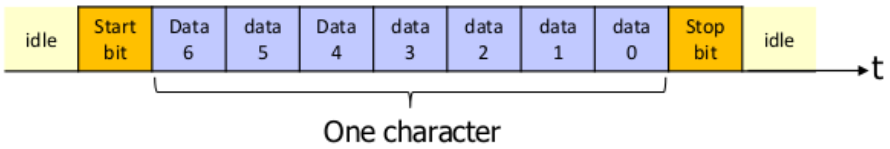
2.4 Networking Principles

Communication Peers

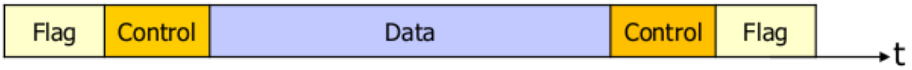
- Unicast: Two communication peers communicate over a Point-to-Point connection.
- Multicast: One sender communicates to several receivers, which are known.
- Broadcast: One sender transmits to all other peers. Typically the other peers are (partially) unknown.
- Others: Anycast, Geocast, etc.

Transmission

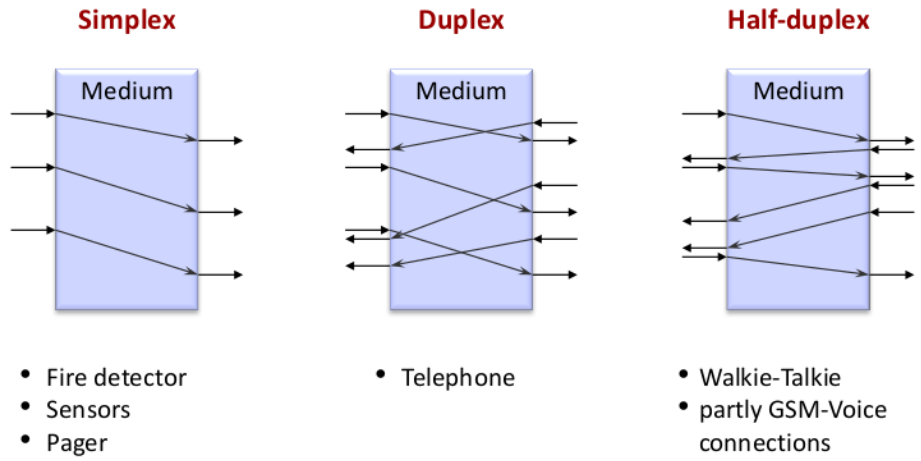
- Serial Transmission
- Parallel Transmission (Problem: synchronisation of the data)
- Asynchronous Transmission: Transmission in which each block (character) is individually synchronized



- Synchronous Transmission: Transmission in which the time of occurrence of each signal representing a bit is related to a fixed time frame



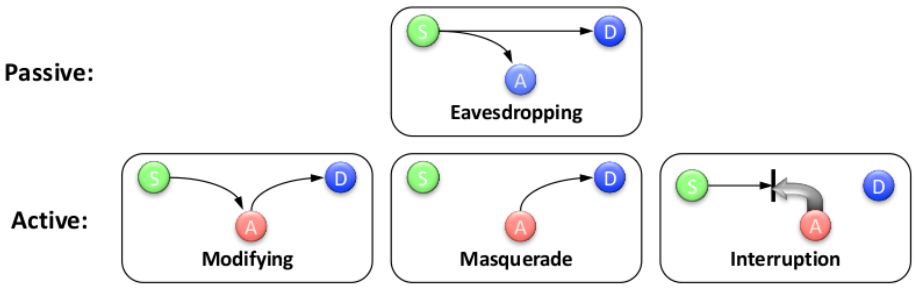
Connection Properties



Multiplexing: Combining multiple data channels into a single data channel at the source

Quality

- Technical Performance (Delay-Bandwidth-Product = Store capacity of the line)
  - Delay [s]
  - Jitter [s]
  - Throughput [bit/s]
  - Data rate [bit/s] (wird vorgegeben)
- Costs
- Reliability
- Security and Protection
  Safety measures: Encryption, Trustworthy systems



The Client/Server Principle

- Client → Server: Request
- Server → Client: Reply
- Advantages
  - Cost reduction

  - Better usage of resources
  - Modular extensions
  - Reliability by redundancy
- Server: Program (process) which offers a service over a network.
- Client: Program (process) which uses a service offered by a server.

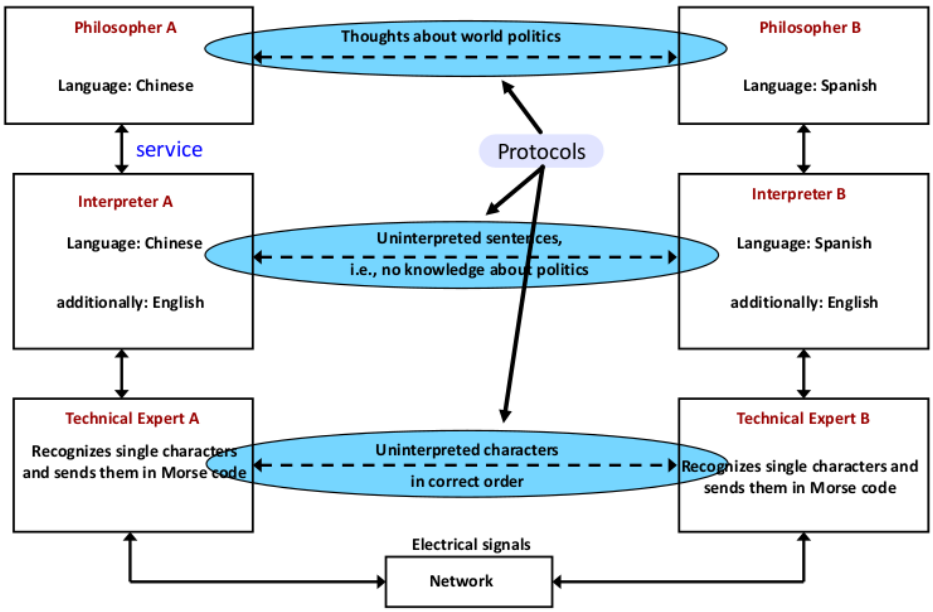
Peer-to-Peer Principle (ursprüngliche Kommunikation im Internet)

- Equal partners, no fixed client and server roles
- Connections between any pair of computers
- Establishment of a whole network of connections
- Best example: File Sharing, e.g., Napster, Gnutella

2.5 Communication Protocols

WHY Protocol!

A protocol is the set of agreements between (application) processes with the purpose of communication.



Peer of a Layer

- use one service (except the bottom)
- offer a service (except the top)
- do not need to know other than the next lower one
- talk according to the rules

Communication architectures are based on

- Service = Communication Service
- Rules = Communication Protocol