Features of Fieldbus Systems

- MAC: Medium Access Control
- Addressing
- Transmission Media
- Topology
- Node Hierarchy
Medium Access Control

- **decentralized Control (no Medium Access Master required)**
  - Unsolicited media access
  - CSMA/CD
    - Ethernet
    - DeviceNet
    - CANopen
    - SDS
  - CSMA/CA
    - (LON)
- **Controlled (solicited) media access**
  - Token Passing
  - Arcnet
    - (Profibus)
  - Polling
    - Profibus
  - Time Slice Method
    - Sercos
    - ControlNet

- **Centralized Control (Medium Access Master)**
  - Controlled (solicited) media access
    - Polling
    - Profibus
    - Bitbus
    - WorldFIP
    - Sensoplex
    - Lightbus
Medium Access Control: CSMA/CD

Carrier

Signal Propagation Delay

Sense

Multiple

A starts sending

Access /

Collision

B starts sending

Detection
Medium Access Control: CSMA/CA

Carrier
Sense
Multiple Access /
Collision Avoiding
(CAN based systems)

Nodes check if Bus is idle

Node A
Node B

Bus Idle?

Node A
A starts sending

Node B
B starts sending

If Bits differ, Arbitration avoids Collision

Node A

„Winning“ node continues sending, „loosing“ node stops and repeats afterwards

Node B
Medium Access Control: Token Passing

The node that holds the token controls the network traffic
Medium Access Control: Token Passing

The node that holds the token controls the network traffic.
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The node that holds the token controls the network traffic.
Medium Access Control: Polling

One master node polls the slave nodes
Medium Access Control: Time Slicing

All nodes are synchronized and send within their time slice

[Diagram showing Master and Slave nodes with data blocks labeled Nd.1 to Nd.7 and a Master Data block, with cycle time indicated.]
Addressing

Node-Addressing

• Node processes Data with its destination address

• Peer to Peer, Multicast or Broadcast possible
Addressing

Telegram-Addressing

- Node processes Daten with the Ident-Number that he is interested in.
- Requires Broadcast
Transmission Media (Examples)

Copper:

- RS 485, 2/3/5-Wire
  (Profibus, -DP, Interbus-S, LON, Bitbus...)
- ISO 11898, 2-Wire (+ GND)
  (CAN "High Speed")
- Power Supply Line
  (AS-Interface, LON, Interbus-Loop)
- Unshielded Twisted Pair (UTP)
  (Ethernet 10BaseT)
- Koax-Wire
  (Arcnet, Ethernet 10Base5, 10Base2)
Transmission Media (Examples)

Fiber Optics:

- Plastic Optical Fiber (POF) + HCS (hard clad silica) (Beckhoff-Lightbus, Sercos, Interbus-S, Profibus)
- Glass Fibre (Single Mode + Multi Mode)

<table>
<thead>
<tr>
<th>Type</th>
<th>Peak Wave Length</th>
<th>Damping</th>
<th>Max Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>POF</td>
<td>640..675nm</td>
<td>~2000 dB/km</td>
<td>40m</td>
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<tr>
<td>HCS</td>
<td>640..675nm</td>
<td>~7 dB/km</td>
<td>300m</td>
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<tr>
<td>Multi Mode</td>
<td>790..910nm</td>
<td>~3dB/km</td>
<td>1700m</td>
</tr>
<tr>
<td>Single Mode</td>
<td>1260..1380nm</td>
<td>~0.4 dB/km</td>
<td>10000m</td>
</tr>
</tbody>
</table>

POF: Made of PMMA (Polymethylmethacrylate)
Topology

Bus / Line
• (electrical)

Star
• (electrical and optical)

Ring
• (electrical and optical)
• With special types

Tree
• (electrical)
Node Hierarchy

Definitions:
Master: Node that controls the bus access and bus communication
Slave: Can only communicate with Master

Multi-Master System

Master-Slave-System