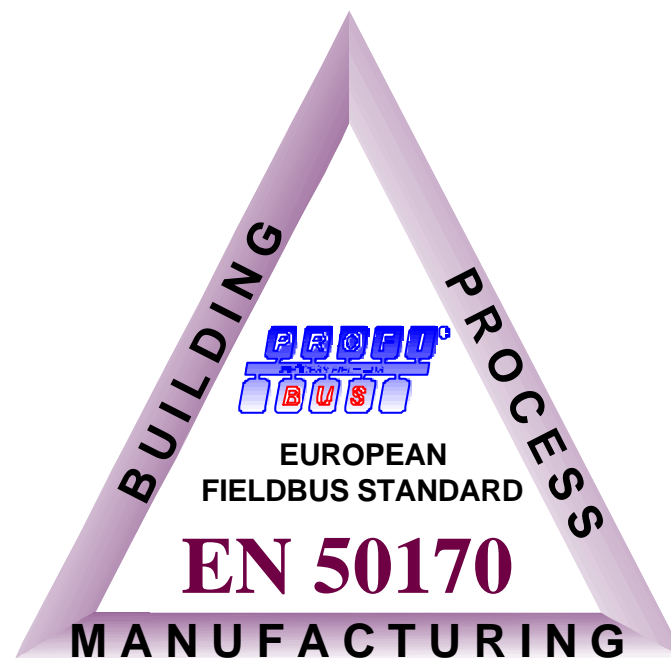




Workshop for PC based Controller





PROFIBUS



≡ Overview chapter 1

- 🌐 PROFIBUS EN 50170
- 🌐 PTO
- 🌐 Protocols FMS, DP, PA
- 🌐 wiring

≡ DP-details chapter 2

- 🌐 functions
- 🌐 configuration tool
- 🌐 data base
- 🌐 DP-V1 / PA

≡ Siemens interface chapter 3

≡ OPC chapter 4



PROFIBUS



≡ Why select a fieldbus system

- 🌐 independent of proprietary solution
- 🌐 vendor independent
- 🌐 cost savings
- 🌐 increase of productivity in terms of
 - 🚀 faster
 - 🚀 more flexible
 - 🚀 easy expandable
 - 🚀 customized



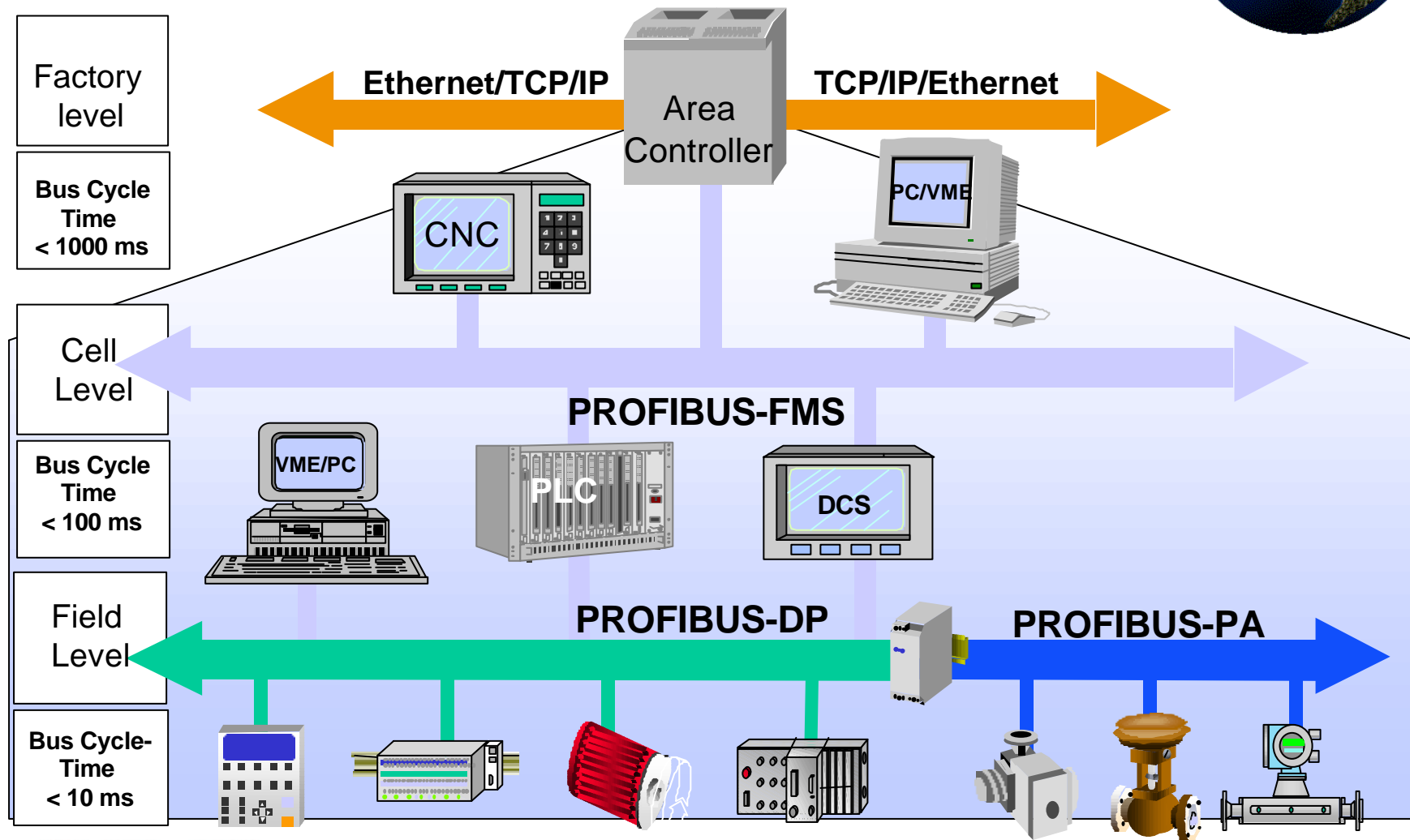
PROFIBUS



≡ What a fieldbus system needs to offer

- 🌐 deterministic (since parallel wiring will be replaced)
- 🌐 flexible
- 🌐 interoperable (multi vendor use)
- 🌐 cost effective (installation, startup, service)
- 🌐 reliable and safe
- 🌐 easy to use
- 🌐 solution for all your automation needs
- 🌐 openness and vendor independent

≡ standardization





EN 50170 Volume 2

**General Purpose
Automation**

PROFIBUS-FMS
RS 485 / FO

Universal

- Large variety of applications
- Multi-master communication

Factory Automation

PROFIBUS-DP
RS 485 / FO

Fast

- Plug and play
- Efficient and cost effective

Process Automation

PROFIBUS-PA
IEC 1158-2

Application Oriented

- Powering over the bus
- Intrinsic safety

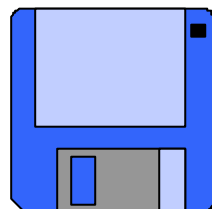


PRODUCT variety

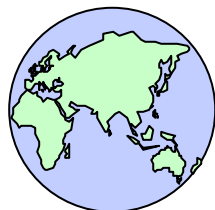


≡ Today there are more than 1,100 products from more than 250 different vendors available

Get your free copy of the latest PROFIBUS product guide:



on disk available from every user group world-wide



or visit the Web - Site:
<http://www.profibus.com>



PRODUCT variety



Drives

AC Drives
DC Drives

Controllers

PLC/NC/RC
VME, PC
Workstation

Software Drivers

DOS/Windows/NT/95
RT-OS/OS9/VRTX
VxWorks/PSOS+
OS2, QNX
UNIX/VMS

Tools

Configuration
Bus Monitor
Engineering

Decentralized I/O

Binary I/O
Analog I/O
Regulators
Timer
Counter
Ident-Systems

Network components

Repeaters
Fiber optics
Cables

Services

Development Support
Implementation Support
Training

Host Interfaces

VAX computers
VME computers

MMI

Operator Panels
Text Displays

Valves

Pneumatic Valves
Magnetic Valves

Instruments

Level
Flow
Pressure
Temperature

Gateways

AS-Interface
Proprietary networks

SIEMENS



Product profiles



≡ **PROFIBUS has defined profiles for the easy interconnectivity of certain product ranges**

🌐 **NC/RC Profile (3.052)**

🌐 **Encoder Profile (3.062)**

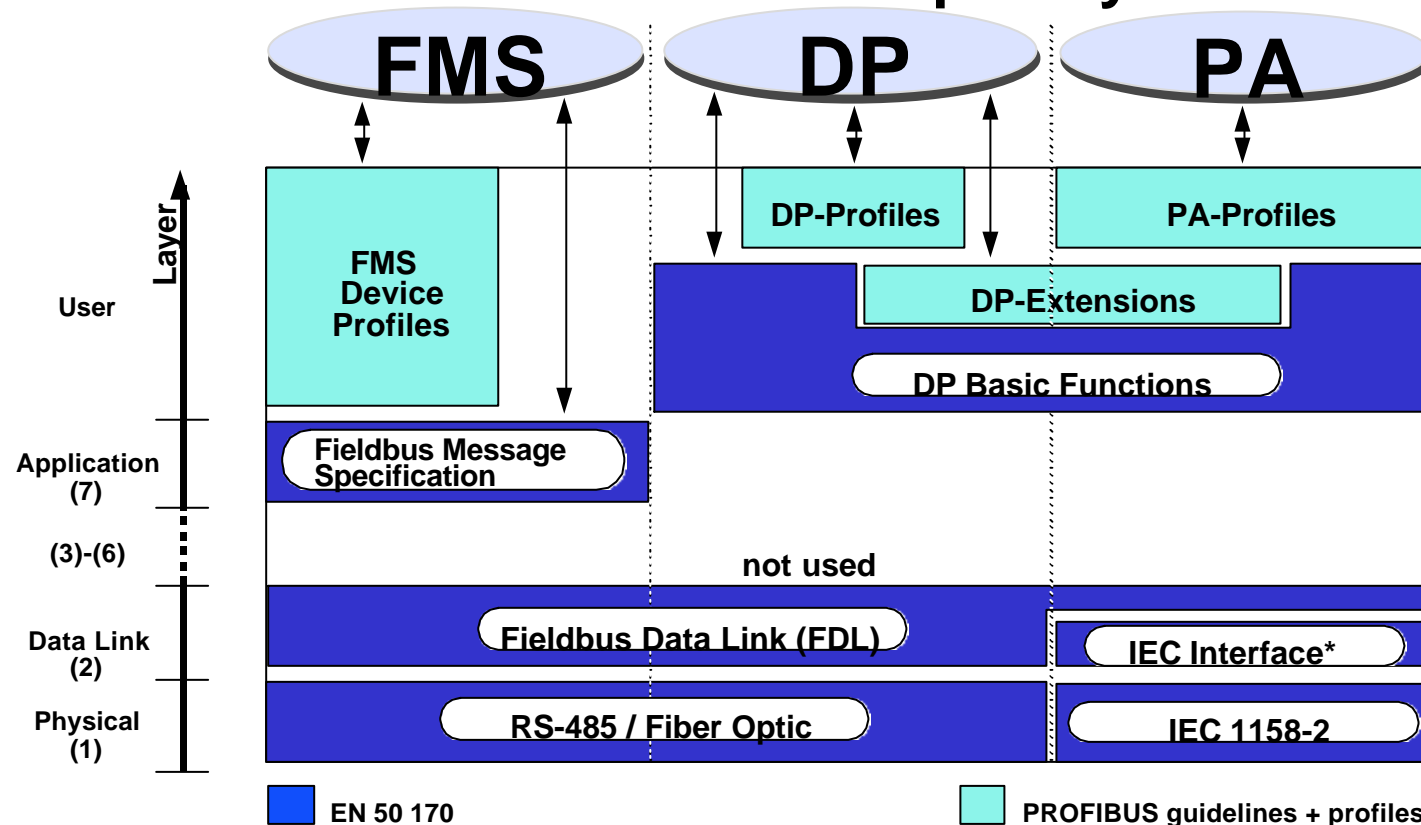
🌐 **Variable-Speed Drive Profile (3.071)**

🌐 **Operator control and process monitoring profile (HMI)**



PC based controller could offer integrated basic functions

≡ The PROFIBUS Protocol is in Accordance with the ISO/OSI Reference Model for Open Systems



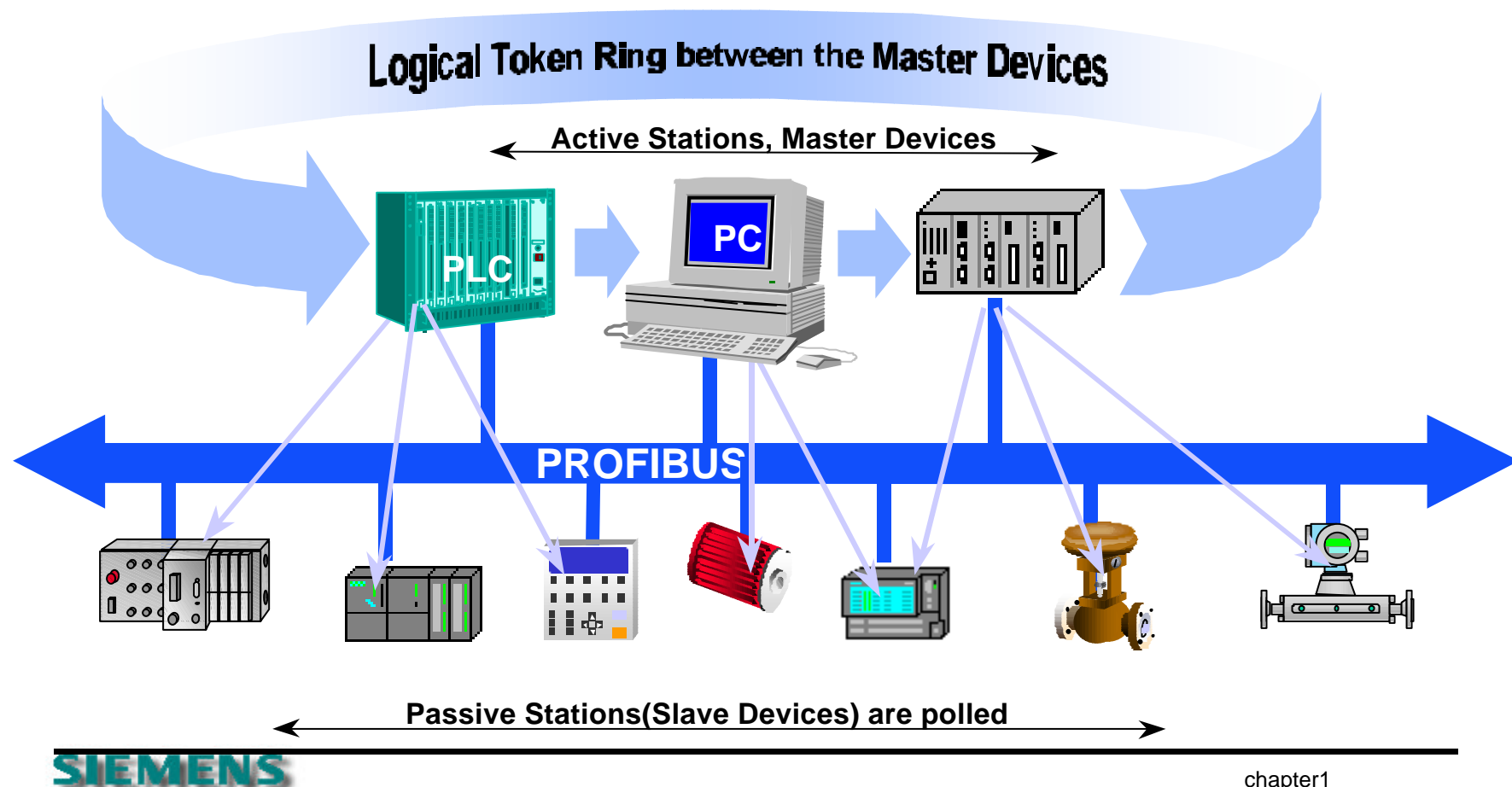
* Proposed amendment A2 to EN 50170 Volume 2 under vote until Q1 / 1998



BUS access



- ≡ The PROFIBUS Bus Access Method combines Multi-Master and Master-Slave communications

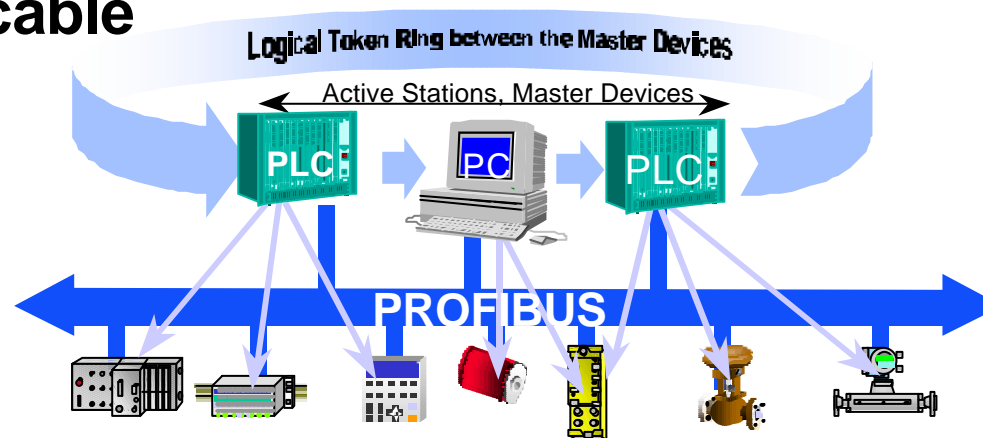




Bus access



- ≡ the PROFIBUS Bus Access Protocol (Layer 2) is identical for all three PROFIBUS variations
- ≡ this enables transparent communication and easy combinations of FMS/DP/PA Network sections
- ≡ Because FMS/DP are using the same Physical Media (RS-485/FO) they can be combined on the same cable





Bus access



≡ Hybrid Bus Access Protocol

- 🌐 Token-Passing between Masters
Master - Slave Protocol between Master and Slaves

≡ Master

- 🌐 active stations with the right to control the bus for a limited amount of time (Token - Hold - Time)

≡ Slave

- 🌐 Slaves only respond on request of a Master
they have no rights to control the bus



Bus access



- 🌐 in Multi Master Networks the Token Passing procedure must ensure that each master has enough time to fulfill it's communication tasks
- 🌐 the user therefore configures the overall Target Token Rotation Time (TTR) taking into account the communication tasks of all masters
- 🌐 each Master calculates the available amount of time for it's communication tasks at token receipt according to the following rule:

T_{TH} = Token Hold Time

T_{TR} = Target Token Rotation Time

T_{RR} = Real Token Rotation Time





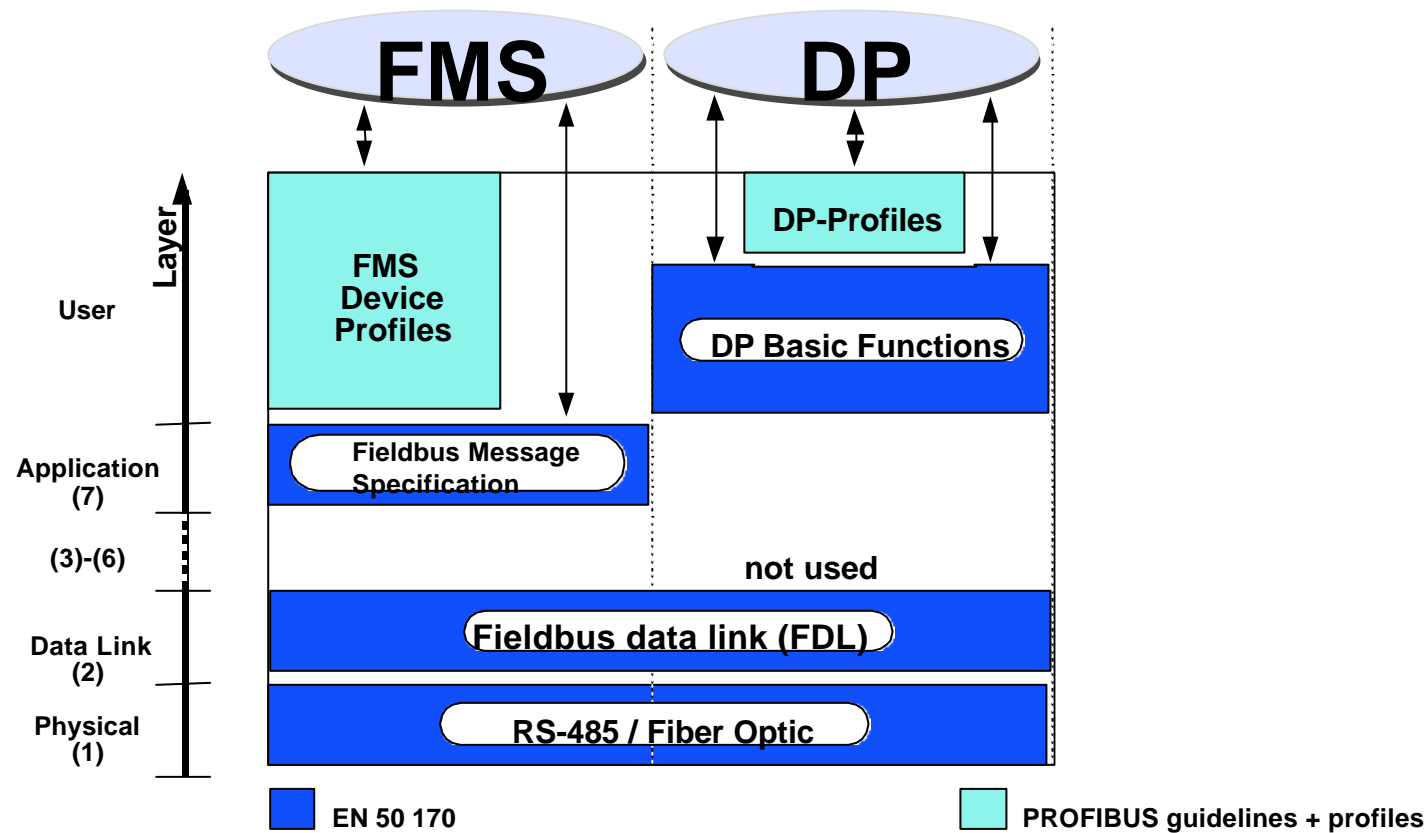
FMS, DP, PA



- ≡ **FMS stands for Fieldbus Messaging System**
 - 🌐 peer to peer communication
- ≡ **DP stands for Decentralized Pheripherie**
 - 🌐 fast data exchange
- ≡ **PA stands for Process Automation**
 - 🌐 intrinsically safe environment



FMS/DP in common





FMS/DP in common



- ≡ **DP and FMS are based on Layer 1 and 2, that is**
 - 🌐 **DP and FMS can be operated on the same bus**
 - 🌐 **Message header and data length are identical**
 - 🌐 **The bus physics are identical**
- ≡ **One master can service several slaves**
- ≡ **Several masters can participate on the bus**
- ≡ **Baudrates from 9.6 kBd up to 12 MBd are possible**



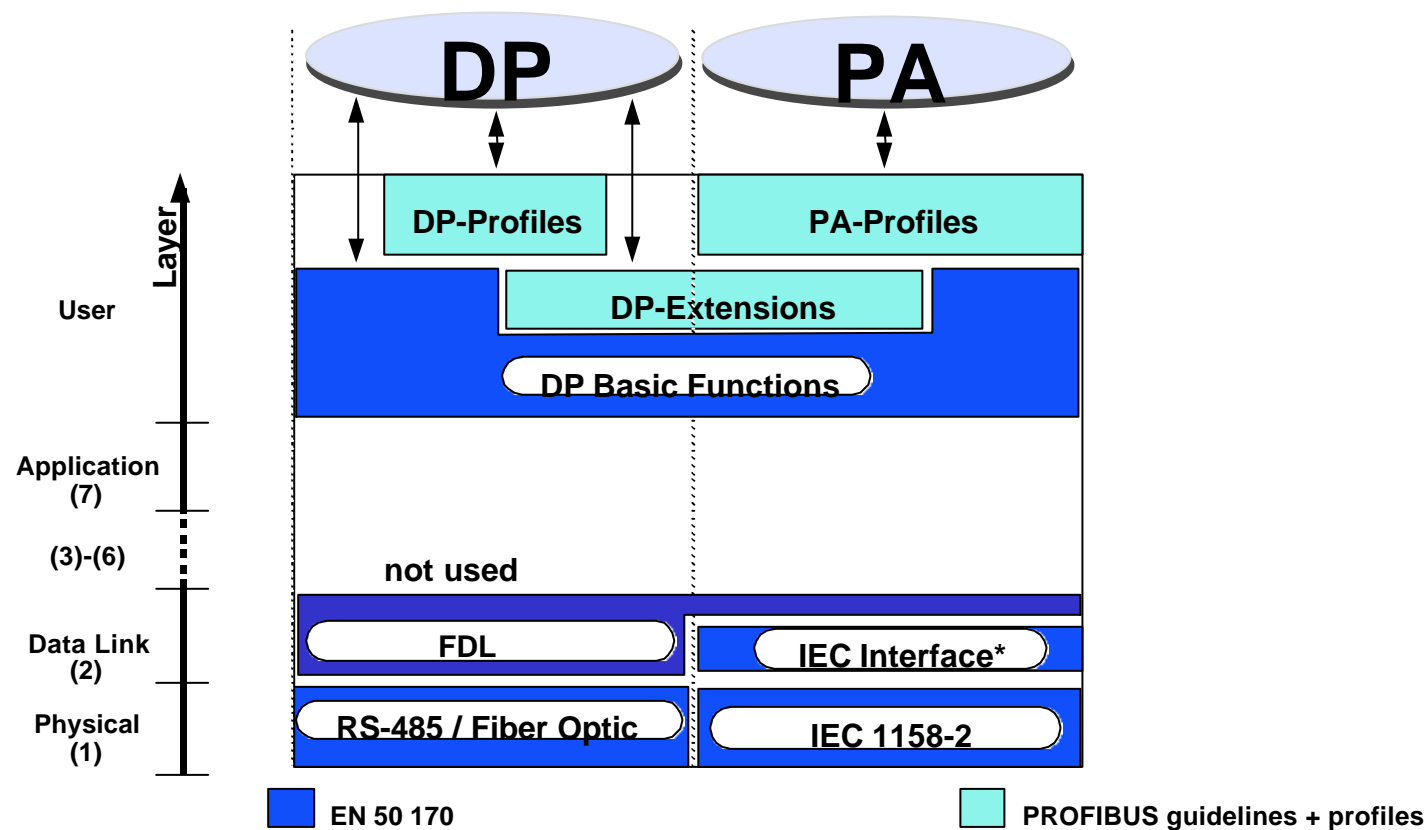
FMS/DP in common



- ≡ **Data transmission can be between 1 and 244 bytes**
- ≡ **126 stations can be connected**
- ≡ **System can consist of several segments**
- ≡ **32 stations (RS 485 drivers) per segment**
- ≡ **Common components**
 - 🌐 **Cabling, connectors, repeater, fibre optic**
- ≡ **Savings in maintenance and spare parts inventory**



PA/DP in common





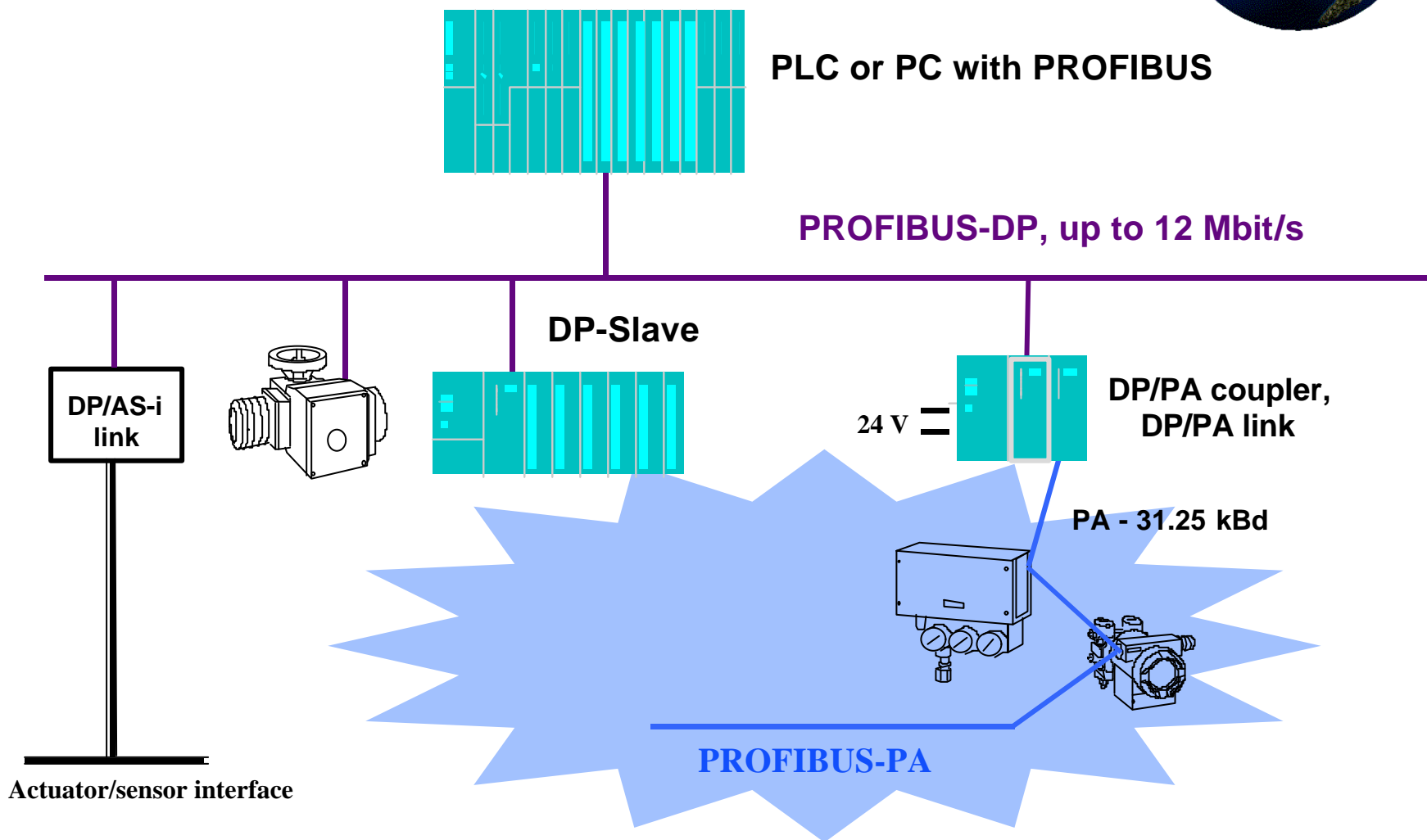
PA/DP in common



- ≡ **DP and PA are based on the same protocol definition - DP/V1 (extended DP)**
 - 🌐 **DP and PA can use the same master systems**
 - 🌐 **Message header and data length are identical**
 - 🌐 **Configuration tools are the same**
 - 🌐 **Data transmission can be between 1 and 244 bytes**
 - 🌐 **System can consist of several segments**
 - 🌐 **32 stations per segment**



PA/DP in common





FMS features



- ≡ **FMS is optimized for universal, object oriented communication of intelligent master devices at the cell level**
- ≡ **FMS permits a subset of the MMS-Functions (Manufacturing Message Specification, ISO 9506)**
- ≡ **A slave can be assigned to several masters**
 - ⊕ **Several masters can write to the same slave**
- ≡ **Communication connections can be temporary or permanent**
- ≡ **Communication is defined in a communication relation list**



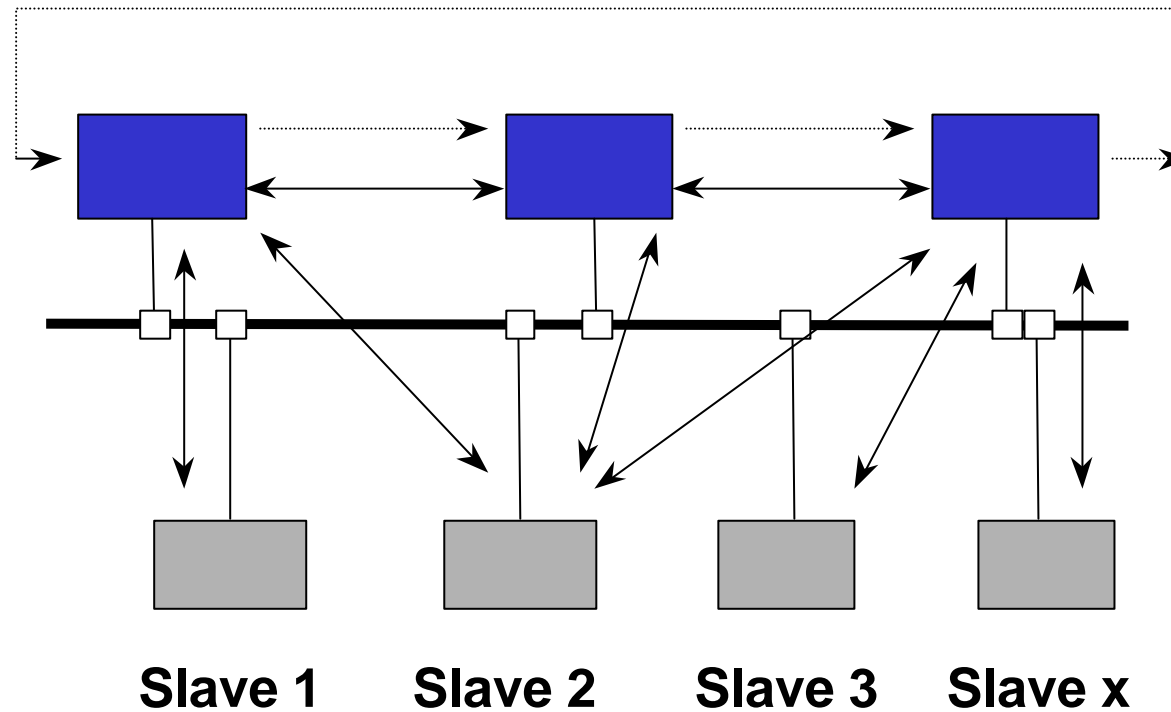
FMS features



≡ **Main application areas are:**

- 🌐 **Transmission of large amounts of data e.g. programs, data blocks....**
- 🌐 **Integration of several decentralized process parts to one common process**
- 🌐 **Communication between intelligent stations**

≡ FMS access procedure





PA features



- ≡ **Based on the extended PROFIBUS-DP Protocol and IEC 1158-2 Transmission**
 - 🌐 **Suitable to replace today's 4...20 mA Technology**
 - 🌐 **Only two wires for data and power**
 - 🌐 **Connects Instruments to the control system via a serial bus**
 - 🌐 **Functional improvements, reliable serial digital transmission**
 - 🌐 **Control, regulation and monitoring via a simple twisted pair cable**
 - 🌐 **A single engineering tool for all devices**



PA features



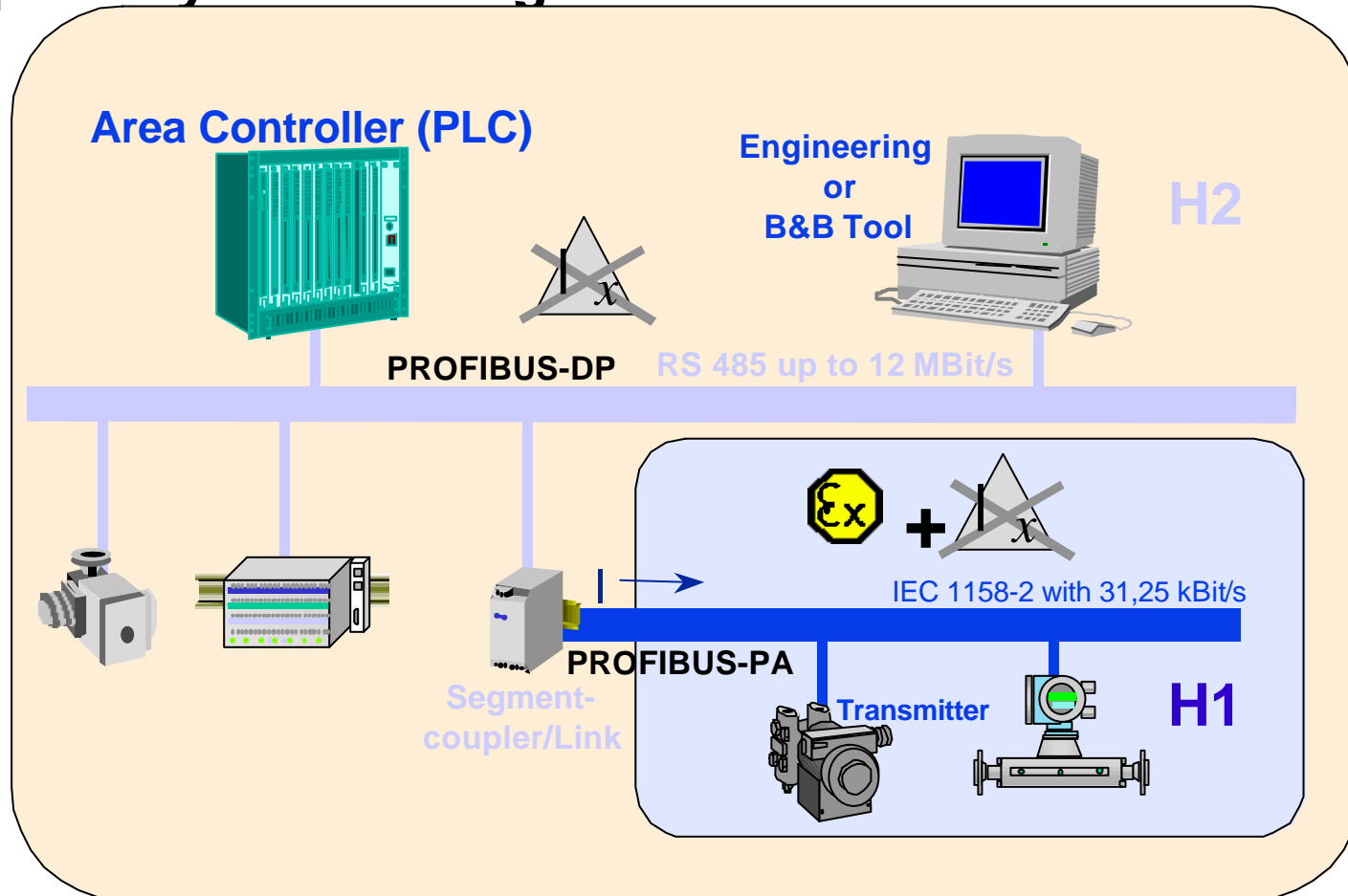
- 🌐 **Interoperability and interchangeability due to the PROFIBUS-PA Profile**
- 🌐 **Maintenance and diagnosis information from the instruments available**
- 🌐 **low power management, therefore suitable for EEx-Applications with Intrinsic Safety**
- 🌐 **Distance up to 1900m per segment, expandable up to 10km**
- 🌐 **10 - 32 stations per segment, up to 125 stations**



PA features



Typical System Configuration with PROFIBUS-PA



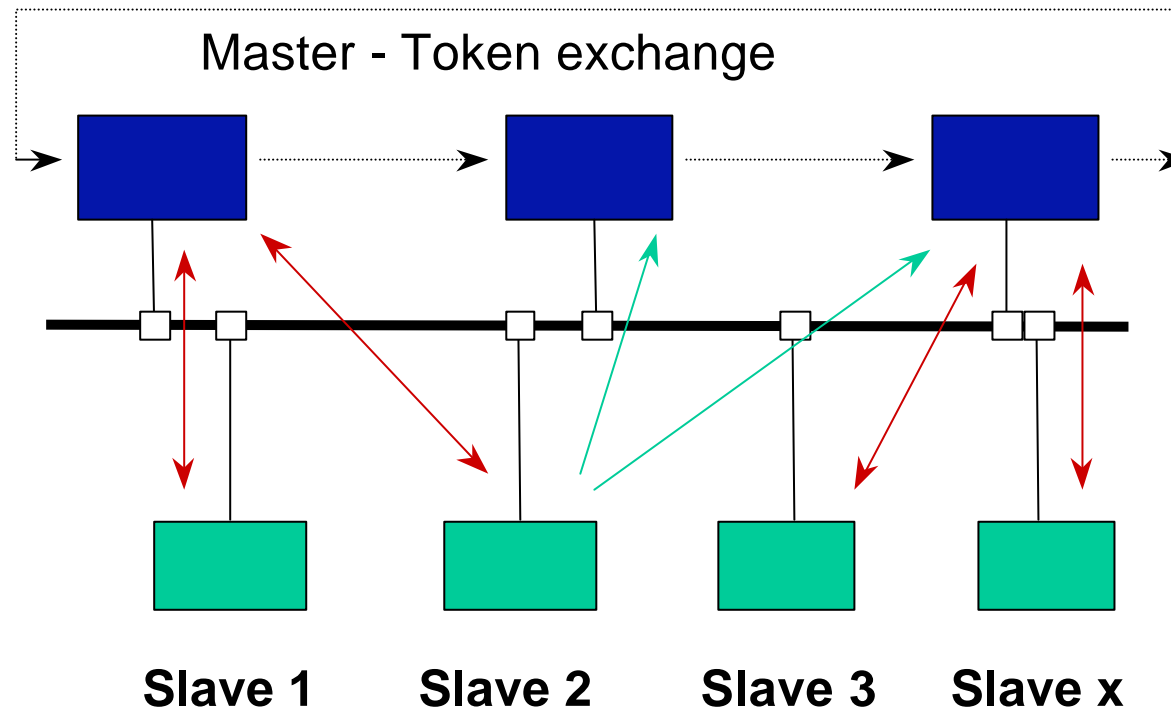


DP features



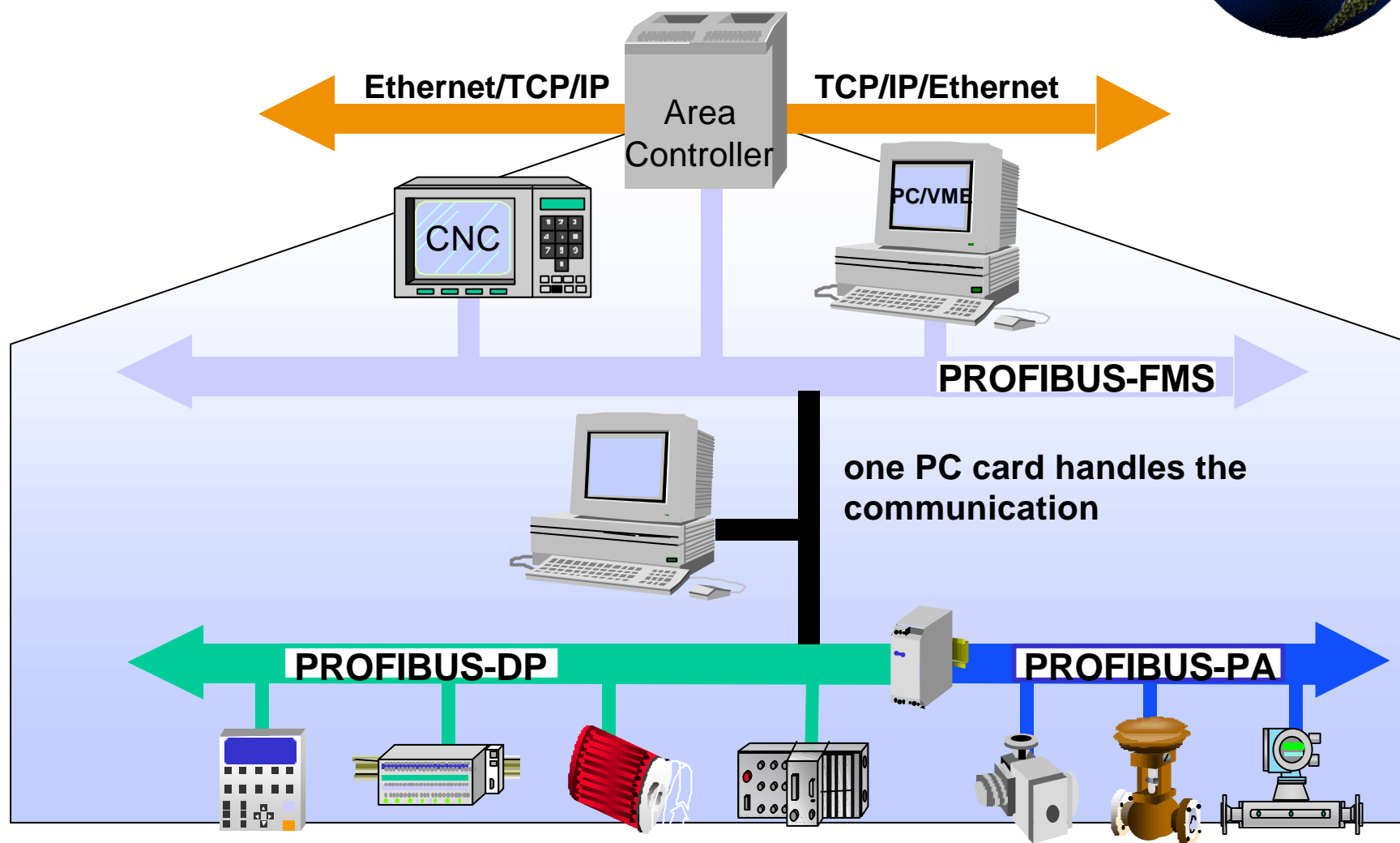
- ≡ **same priority for data exchange**
- ≡ **DP communication is permanent and cyclic**
- ≡ **the transmitted data is specified during the configuration (optimized data exchange)**
- ≡ **only one master can write outputs (safety aspect)**
- ≡ **data can be read by any master**
- ≡ **acyclic data via DP V1 functions**
- ≡ **Alarm acknowledgement**
- ≡ **fastest fieldbus system (up to 12 Mbaud)**
- ≡ **up to 244 byte input and output data per station**

≡ DP- access procedure





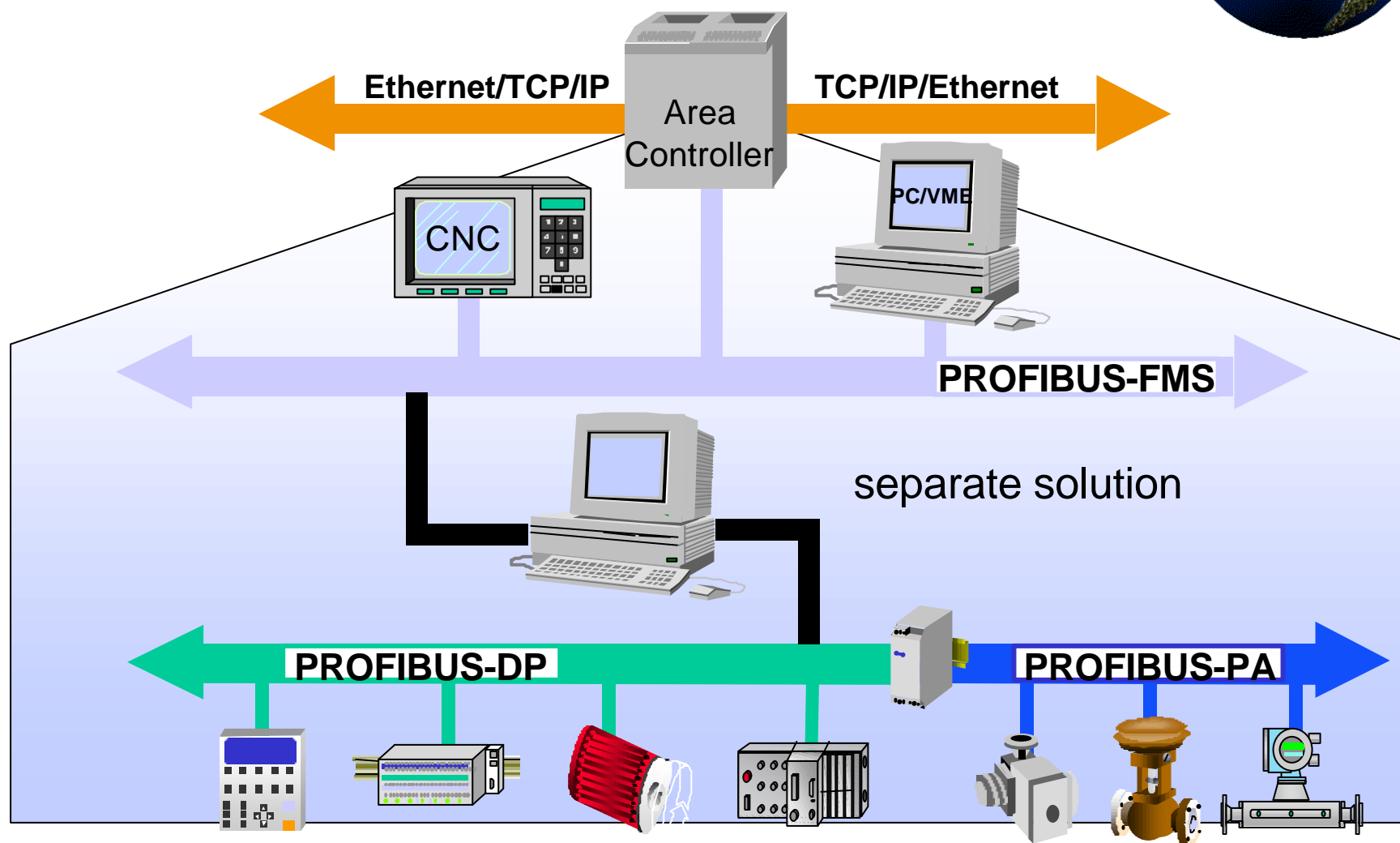
Combination



SIEMENS



Combination



SIEMENS



PROFIBUS wiring



- ≡ **PROFIBUS DP/FMS wiring can be done with:**
 - 🌐 **twisted shielded pair copper cable**
 - 🌐 **fiber optic components**
 - 🌐 **infrared components**
- ≡ **detailed installation guideline is available**
PTO order no. 2.112



PROFIBUS wiring



≡ **twisted shielded pair cable**

🌐 **line parameters are defined in EN 50170**

🌐 **standard cable available from Belden and Siemens**

🌐 **standard connectors available**

| Baudrate | Max. Segment length | Max. Expansion |
|----------|---------------------|---------------------|
| 9.6 | 1000m / 3278feet | 10,000m / 32786feet |
| 19.2 | 1000m / 3278feet | 10,000m / 32786feet |
| 93.75 | 1000m / 3278feet | 10,000m / 32786feet |
| 187.5 | 1000m / 3278feet | 10,000m / 32786feet |
| 500.0 | 400m / 1311feet | 4,000m / 13114feet |
| 1,500.0 | 200m / 655feet | 2,000m / 6557feet |
| 3,000.0 | 100m / 327feet | 1,000m / 3270feet |
| 6,000.0 | 100m / 327feet | 1,000m / 3270feet |
| 12,000.0 | 100m / 327feet | 1,000m / 3270feet |

max. expansion is done with 9 repeaters in a row



PROFIBUS wiring



≡ Special requirements for baudrates >1.5 MBaud

- 🌐 use of Baudrates greater than 1.5 MBaud requires special connectors. The connector or the device has to have built in Inductors in order to run with higher baudrates (as stated in the PROFIBUS guidelines)
- 🌐 spur lines are not allowed when using baud rates greater than 1.5 MBaud
- 🌐 the maximum length between optical link components is: 300m / 981feet
- 🌐 in some applications, several bus connectors are used at electrically short distances, 12 Mbaud installations require a minimum cable length between two stations of 1m/ 3feet



PROFIBUS wiring



≡ Cable shielding

- 🌐 use only cables with braided shields.
- 🌐 the shield density should be more than 80 %
- 🌐 always connect the cable shields at both ends
- 🌐 if a potential difference occurs between the grounding points, an equalization current can flow through a shield connected at both ends. In this case, install an additional potential equalization line



PROFIBUS wiring



- ≡ **one preferred connector type - 9 pin Sub-D**
 - 🌐 **connectors with integrated termination available**
 - 🌐 **for use of higher baudrates Inductivity built in**
 - 🌐 **easy plug and unplug without interrupting the communication to other devices**
 - 🌐 **other connector types are possible, mandatory signals (A,B, Gnd, 5V) must be provided as well as a possibility for termination**

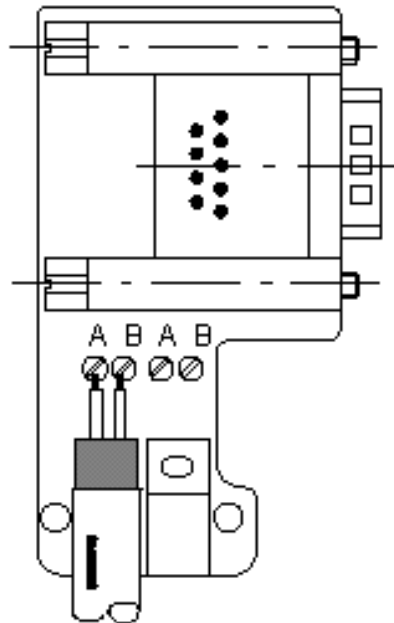


PROFIBUS wiring

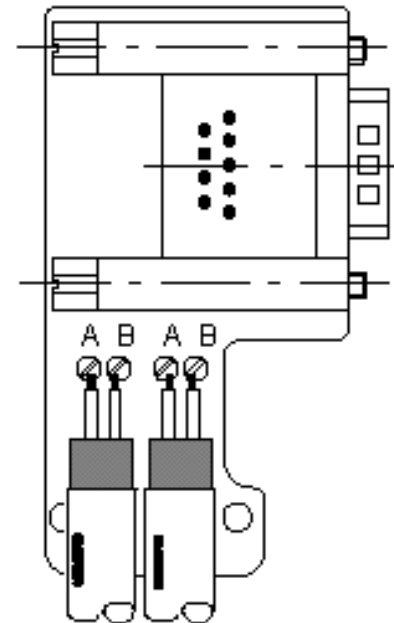


≡ 9 pin sub D

Bus cable connection for **first and last stations** on the bus¹



Bus cable connection for **all other stations** on the bus



¹: The bus cable can be connected to either the left or right set of terminals!



PROFIBUS wiring



≡ fiber optic components

- 🌐 plastic and glass fiber optic is available
- 🌐 optical plugs and modules are available
- 🌐 distances up to 20 miles are possible

🏙 noise immune

🏙 potential difference independent

🏙 longer distances

🏙 redundant operating is possible

🏙 line, ring and star configuration



PROFIBUS wiring



≡ infrared components

- 🌐 wireless linking of devices in close up ranges
- 🌐 communication with moving devices
- 🌐 communication with changing devices
- 🌐 noise immune
- 🌐 ground independent



PROFIBUS wiring



≡ **PROFIBUS FMS / DP are based on RS 485**

- 🌐 **Termination is necessary**
- 🌐 **Expansion of network through segments**
- 🌐 **the two wire cable is usually color coded**

!! recommendation:

use always the red wire for signal B (pin3 - TXD/RXD-positiv)

and the green wire for signal A (pin 8 - TXD/RXD-negativ)

- 🌐 **the shield is connected to housing**

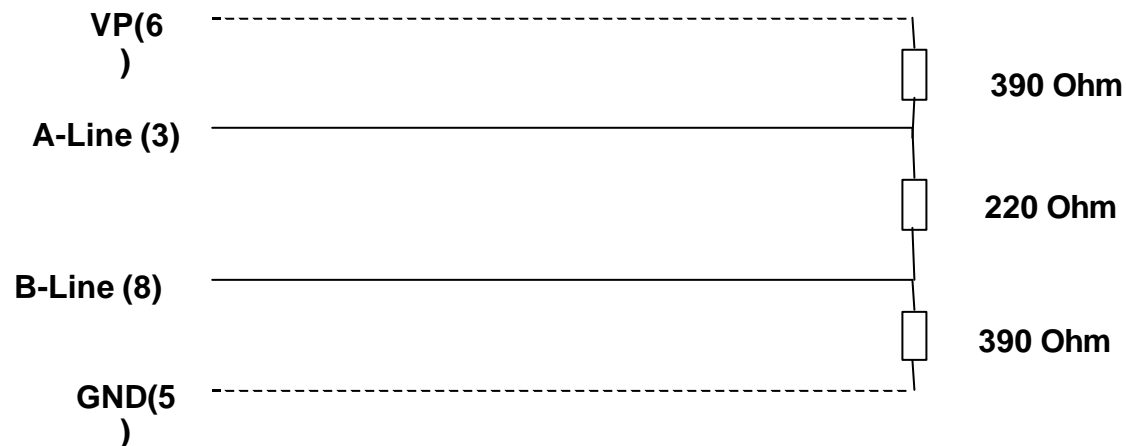


PROFIBUS wiring



≡ Termination

- 🌐 each segment needs to be terminated at both ends
- 🌐 termination needs to be powered at all time
- 🌐 if possible use one termination at the master
- 🌐 power for termination or the termination itself needs to be provided by the device

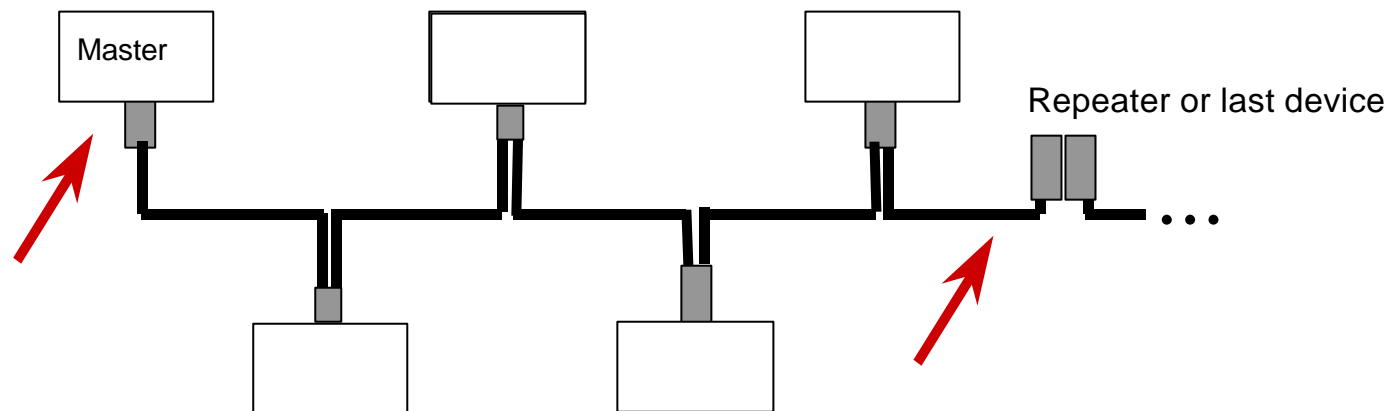




PROFIBUS wiring



≡ Segment structure with termination



Termination “on” (usually whenever only one cable is connected to a device the termination needs to be “on”)



PROFIBUS wiring



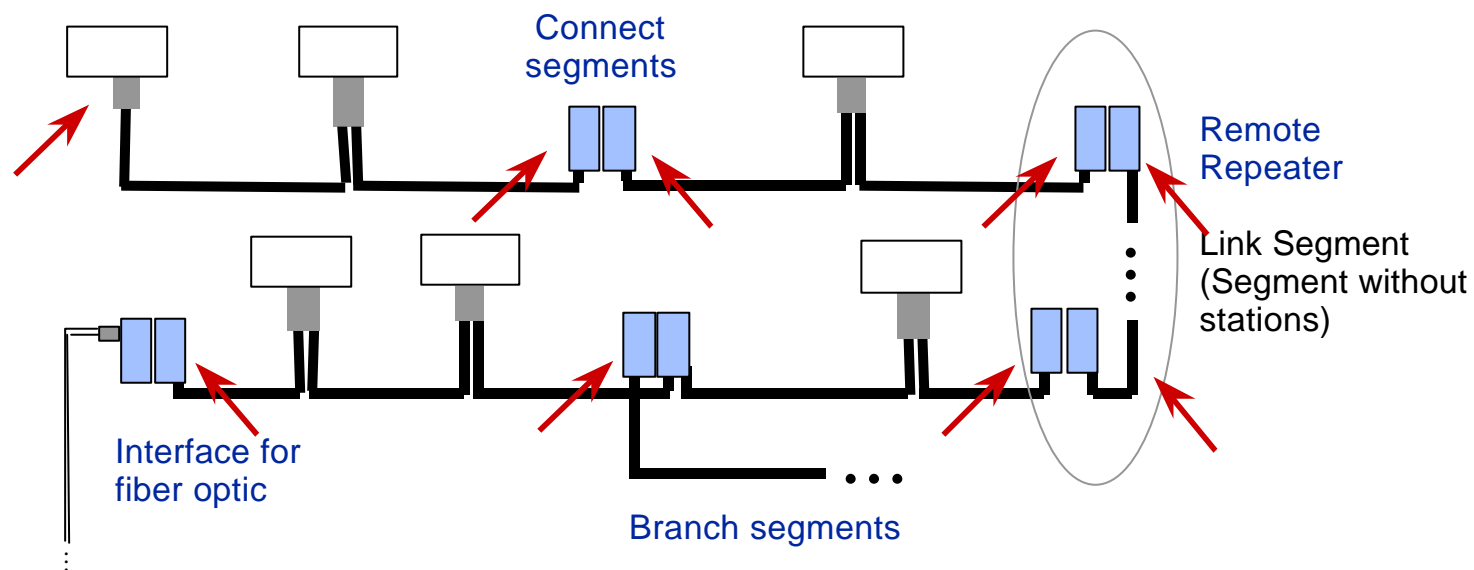
- ≡ **Segments are needed by**
 - 🌐 exceeding the length
 - 🌐 exceeding 32 devices (incl. Repeater/OLM)
- ≡ **Segments can be used for**
 - 🌐 building branch segments
 - 🌐 connecting up to 126 stations (Repeater/ OLM don't count)
- ≡ **Rules**
 - 🌐 one segment has a maximum of 32 devices (incl. Repeater)
 - 🌐 the first and the last segment can have 31 stations
 - 🌐 segments between have 30 stations as a maximum



PROFIBUS wiring



≡ segment structure with termination



Max. Number Repeater Cascading: 9

Termination "on"

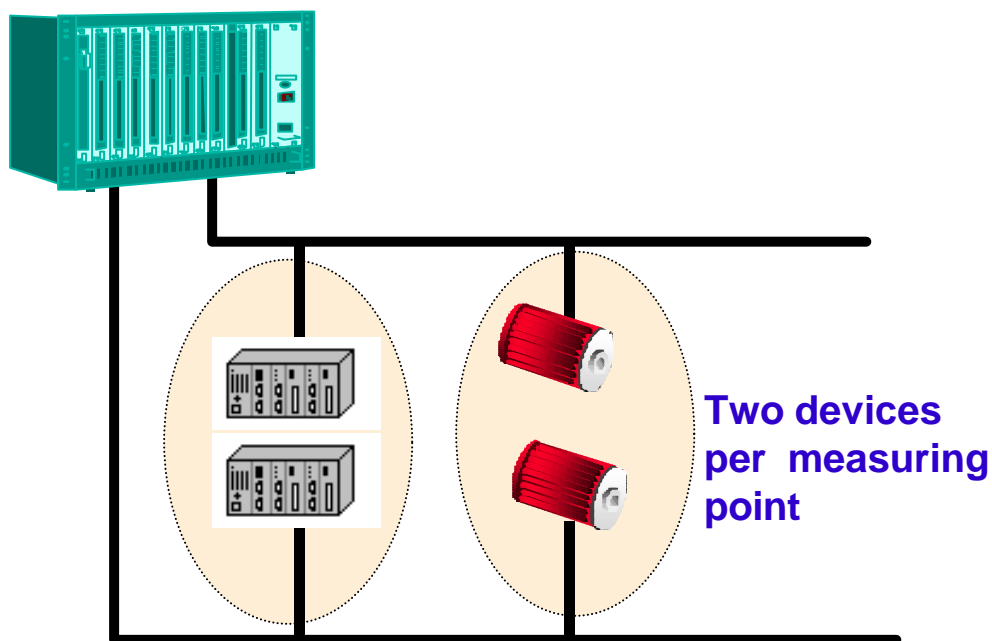


PROFIBUS wiring



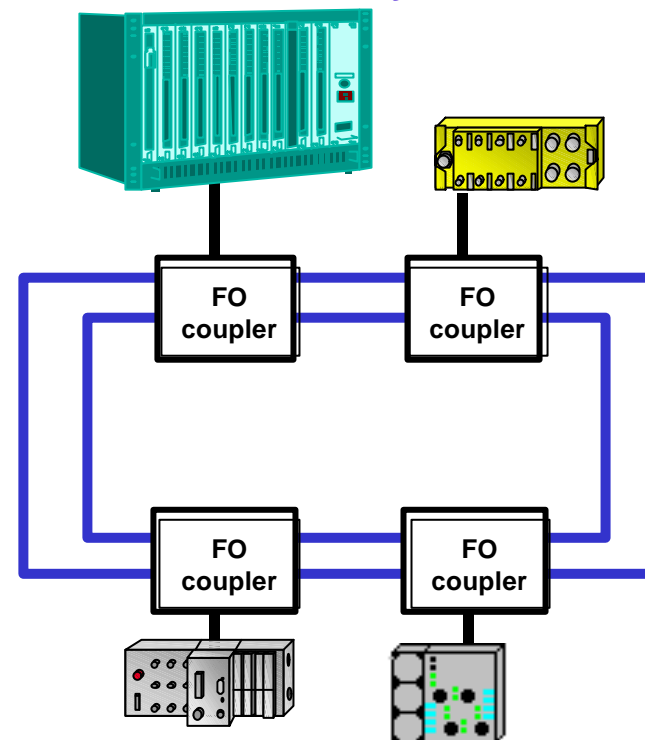
≡ Redundancy Improves System Reliability

System redundancy



Several interfaces enable redundant systems

Media redundancy



Fiber optic segments enable redundant wiring