PROFIBUS
Technical Overview

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Jeddah
September 25th , 2012

Agenda

Overview

DP & PA

Communication Technology

Networks & Segments

Integration Technology

What is a fieldbus?

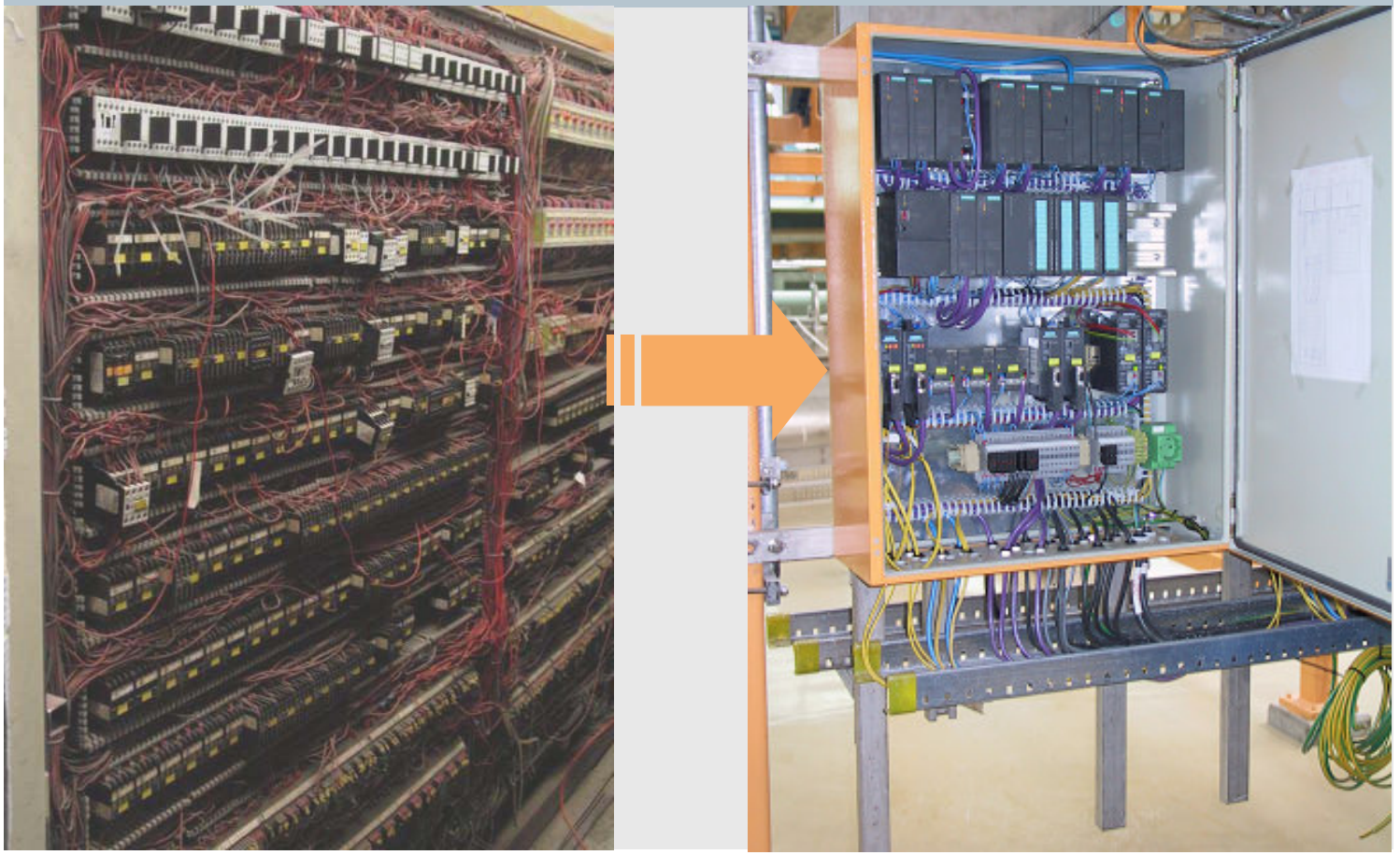
Digital Communication

Bi-directional

Multiple Devices on One Cable

The fieldbus network motivation

Save space, cost & effort !!!



What is PROFIBUS?

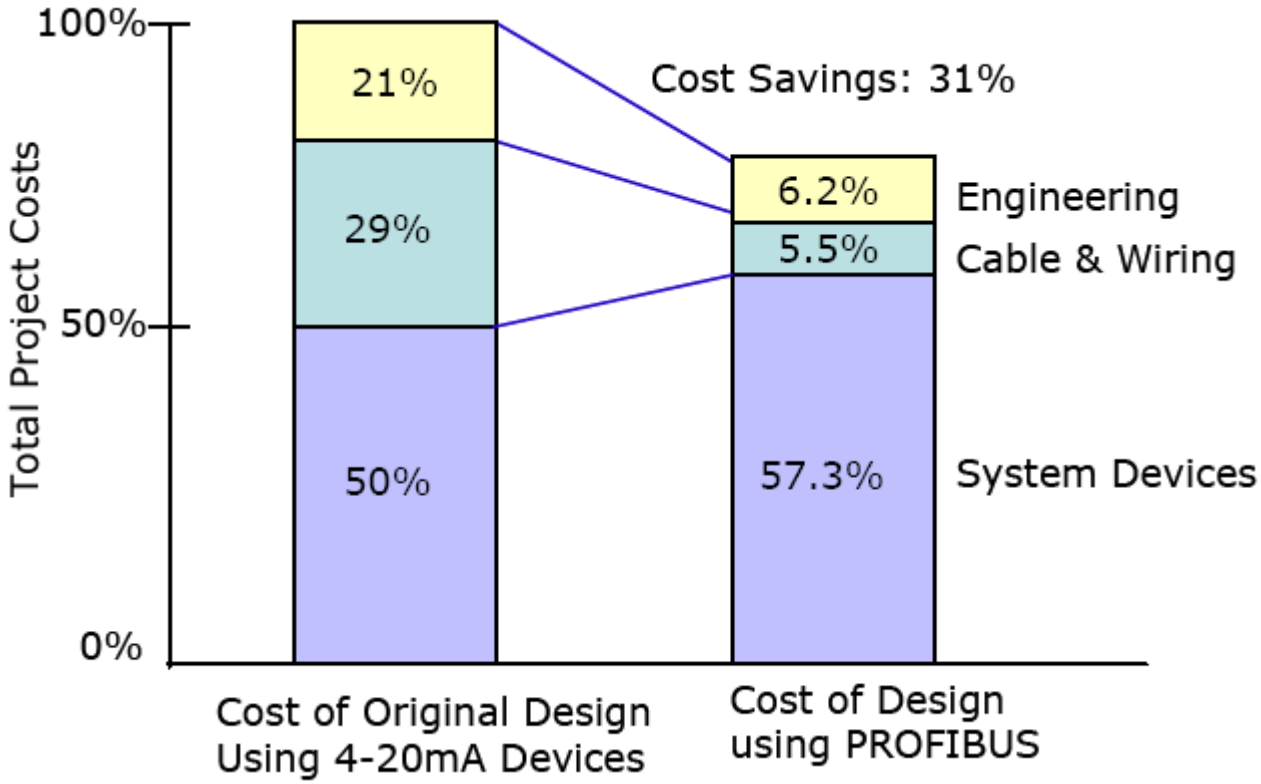
PROFIBUS is the open **Fieldbus Standard** for Automation of PROFIBUS International.

PROFIBUS covers all requirements of all branches of Automation Technology.

PROFIBUS ...

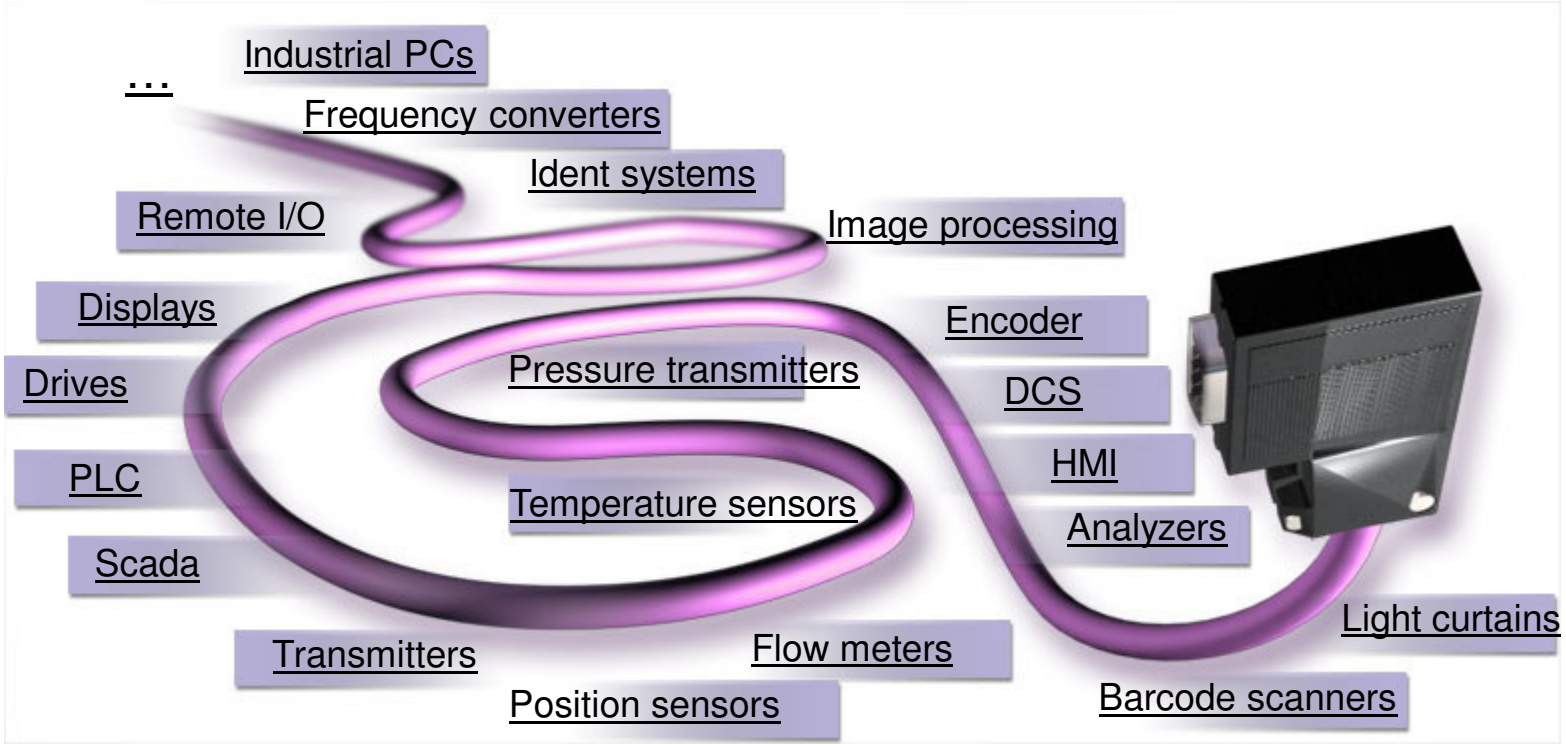
- Is a digital communication system optimized for automation tasks
- Covers both fast time-critical applications and complex communication tasks
- Supports numerous Application Profiles

Cost Savings



Source: ARC White Paper "The Value Proposition of PROFIBUS in the Process Industries", April 2005

Application Coverage



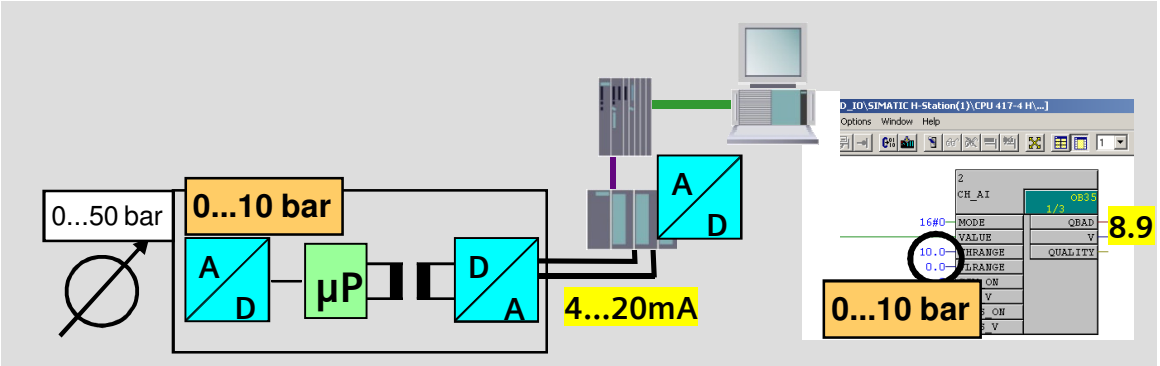
More than 2500 products available
from more than 200 manufacturers

High Availability

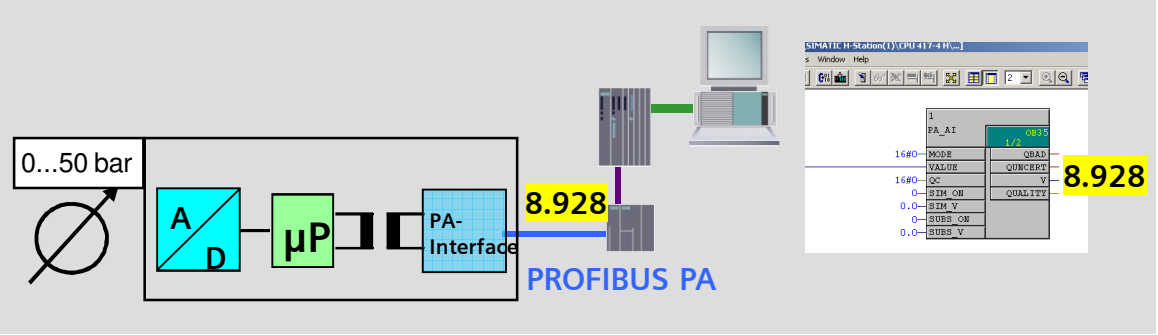
- Bus & device diagnostics
- Fault isolation
- Devices advertise their health
- Redundant controllers
- Redundant networks
- Ring topology

Better accuracy …

Conventional 4…20mA / 24VDC technology



PROFIBUS technology

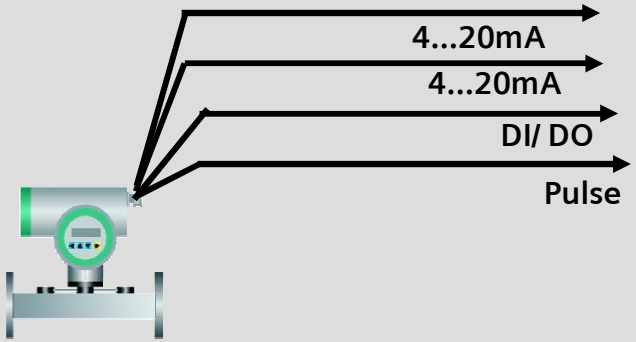


Turns into a dramatic increase of process control

- Less drift, faster conversion
- 32 bit resolution

Multi variable devices

Conventional 4…20mA technology



- conventional 4...20mA transmitters
  - Each signal on cable
- Logic in controller (total flow, direction)

PROFIBUS technology

- One single cable
  - Actual flow
  - Total flow (forward, reverse, reset)
  - Temperature

Less sensors, wiring, controller logic

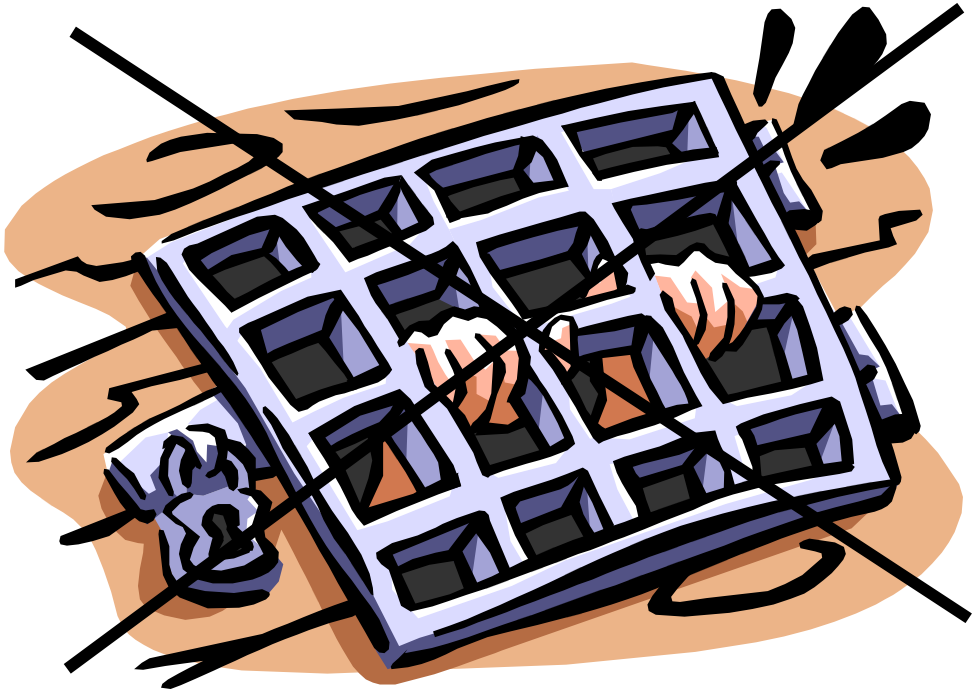
Quality Information

- Know if you can trust your Process Variable
- Diagnostics are instant and detailed
- Asset management information is automatically recorded and integrated
- Parameterisation can be easily repeated
- Devices can alert you of trouble before it happens

Open Technology

You are not locked into one vendor

PROFIBUS standard is maintained by PI



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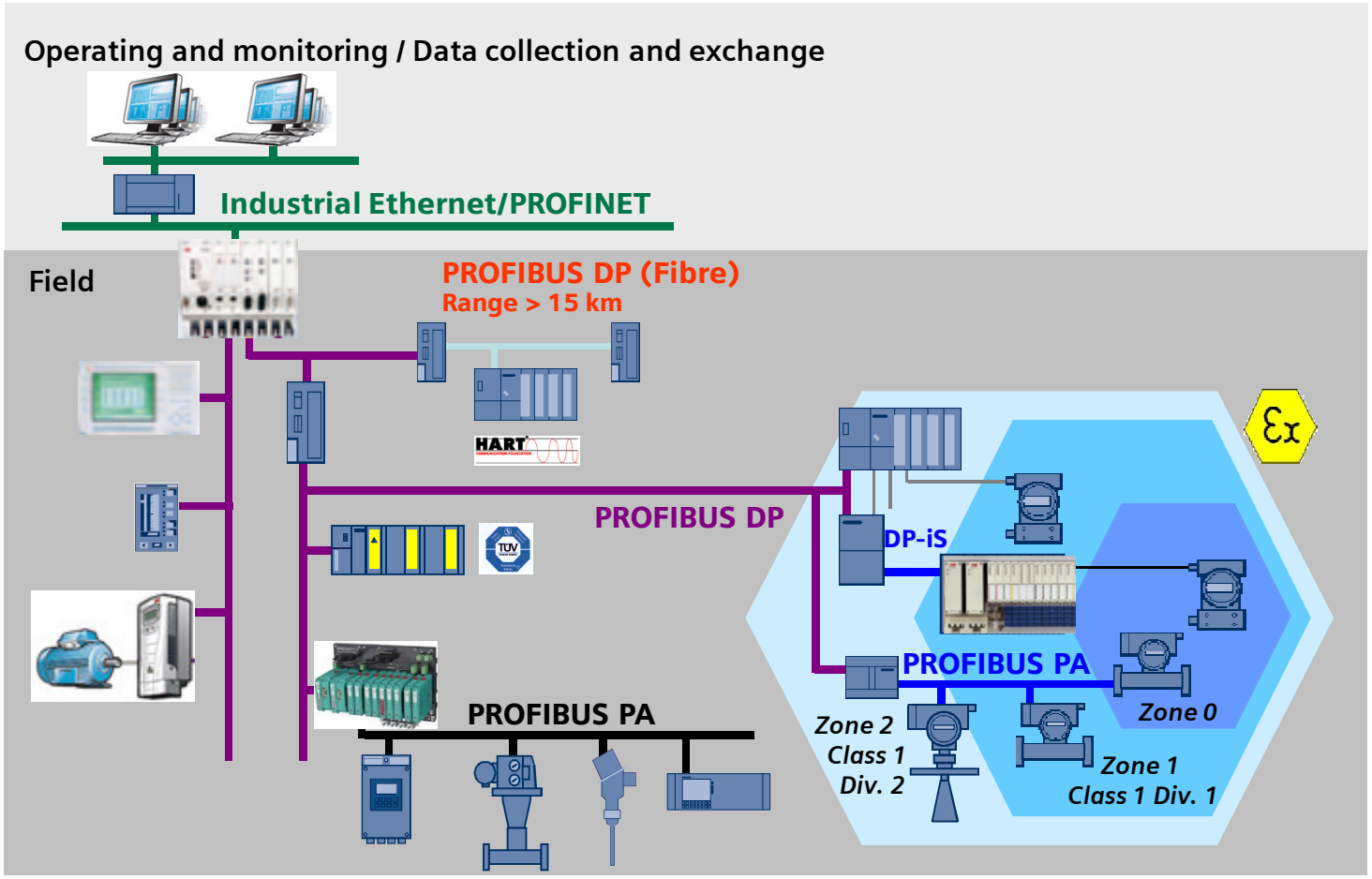
PROFIBUS DP & PA

Communication Technology

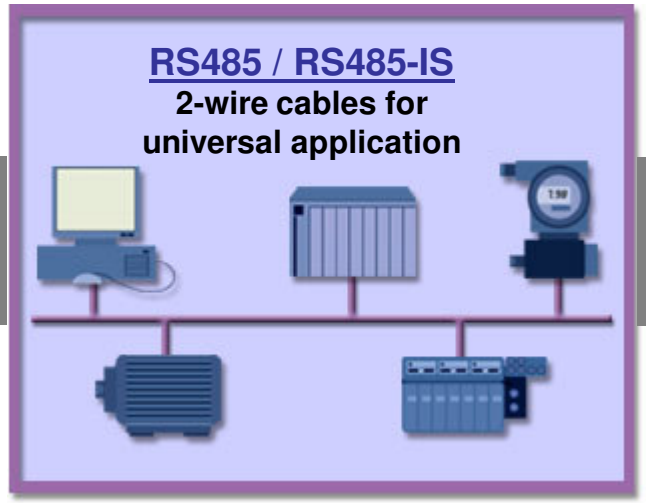
Networks & Segments

Integration Technology

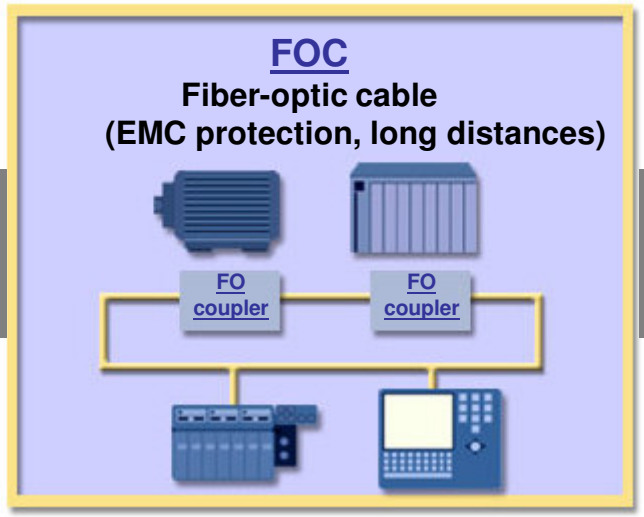
PROFIBUS Architecture



PROFIBUS DP



Most common installation



Ring redundancy
Long distance
EMC protection

PROFIBUS DP – Typical Devices

PROFIBUS DP - copper

	RS485
Data Transmission	Digital; differential signals (RS485); NRZ
Transmission Rate	9.6 to 12000 kbps
Cable	Twisted, shielded two-wire cable
Remote power supply	Possible with additional cores
Ignition Protection Type	Possible for EX
Topology	Line, tree, star with termination
Number of nodes	Up to 32 per segment. Max 126 per network
Number of repeaters	Max 9 (with signal refreshing)

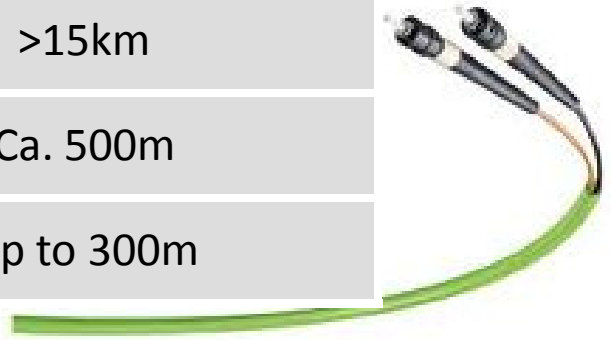
Data Rate vs Segment Length

Transmission Rate (kbps)	Max Segment length (m)
9.6; 19.2 ; 45.45 ; 93.75	1200
187.5	1000
500	400
1500	200
3000; 6000; 12000	100

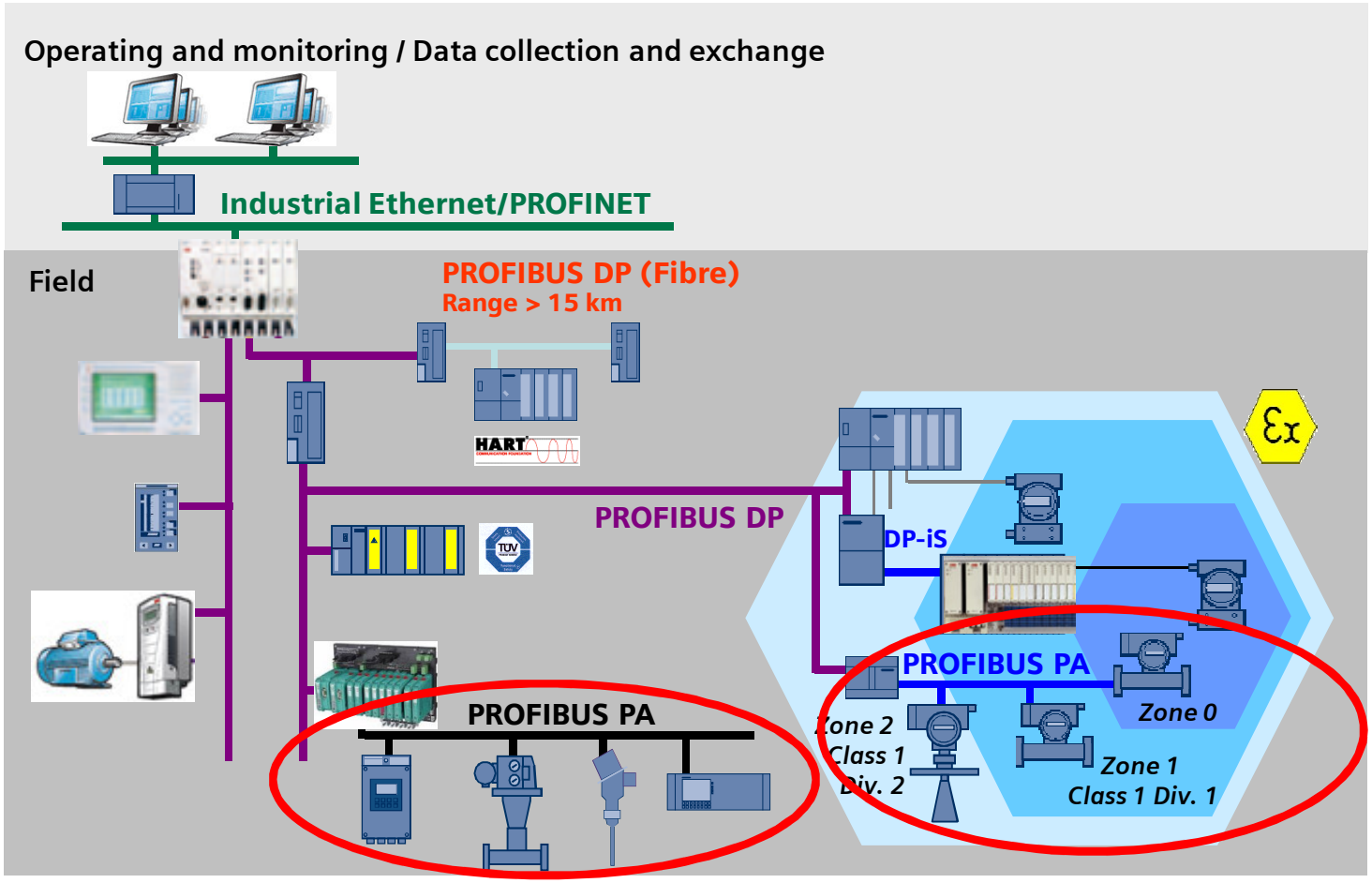
Values apply to cable type A

PROFIBUS Fibre – Segment Length

Fibre Type	Transmission Range
Multi-mode glass	2-3km
Single-mode glass	>15km
HCS	Ca. 500m
Plastic FibreHCS	Up to 300m



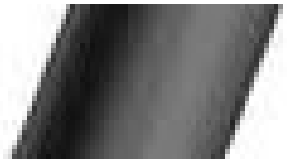
PROFIBUS PA


Operating and monitoring / Data collection and exchange
Industrial Ethernet/PROFINET
Field
PROFIBUS DP (Fibre)
Range > 15 km
HART
PROFIBUS DP
DP-iS
PROFIBUS PA
PROFIBUS PA
Ex
Zone 2
Class 1
Div. 2
Zone 0
Zone 1
Class 1 Div. 1

PA Typical Devices

PROFIBUS PA – Segment Length

Type	Transmission Rate (kbps)	Max Segment length (m)
PA	31.25	1900



In reality – it depends on the devices you have & the coupler you use!

Make sure that you have **min. 9V** at the end of the cable!

PROFIBUS PA – Spur Line Length

Number of devices on segment	Max **single** spur length (m)
1-12	120
13-14	90
16-18	60
19-24	30

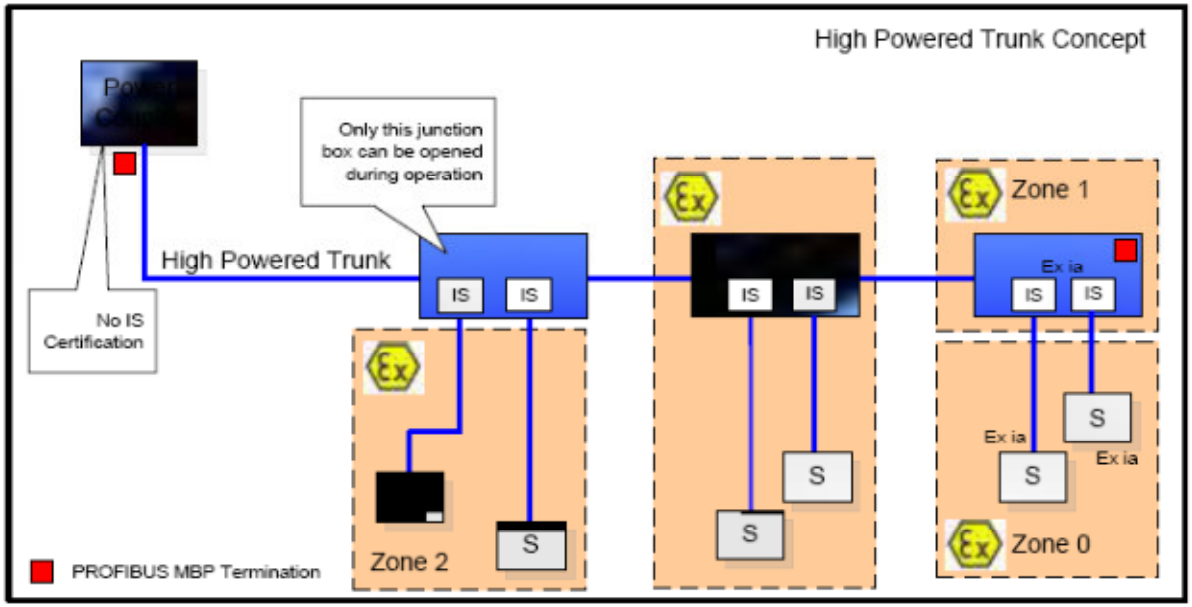
Intrinsically Safe Design for PA

Entity

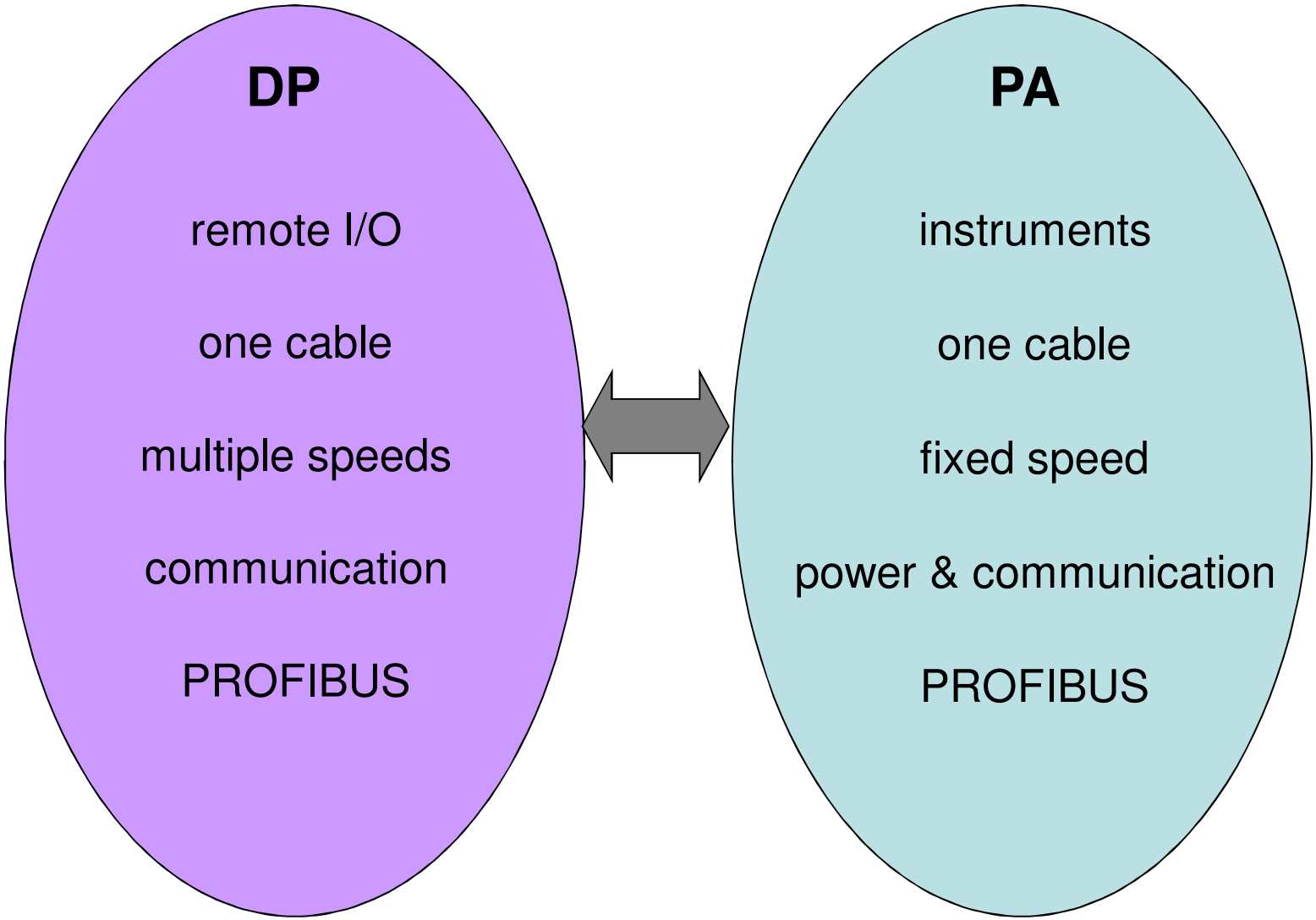
FISCO

High-Powered Trunk

DART



DP and PA


DP
remote I/O
one cable
multiple speeds
communication
PROFIBUS
PA
instruments
one cable
fixed speed
power & communication
PROFIBUS

Agenda

Overview

PROFIBUS DP & PA

Communication Technology

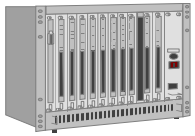
Networks & Segments

Integration Technology

PROFIBUS Devices

Class 1 Master: Traditional Master (PLC, DCS)

- Traditional Central Controller
- I/O Data Exchange
- Sets the bus speed
- Read Diagnostics
- Configure I/O
- Manage token transfer between other masters

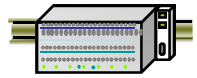


Class 2 Master – Engineering Station (SIMATIC PDM)

- Configuration Device
- Diagnostic or commissioning tool
- Change address
- Read I/O but does not have write-access to the slave

Slave:

- Passive device
- Only responds to a master request
- Input or output device



Communication Protocols

Master-Slave protocol

Master controls all communications

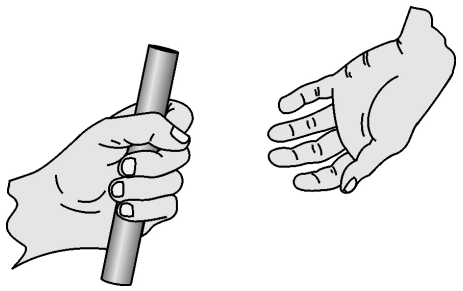
Slave only speaks when spoken to

Token Ring protocol

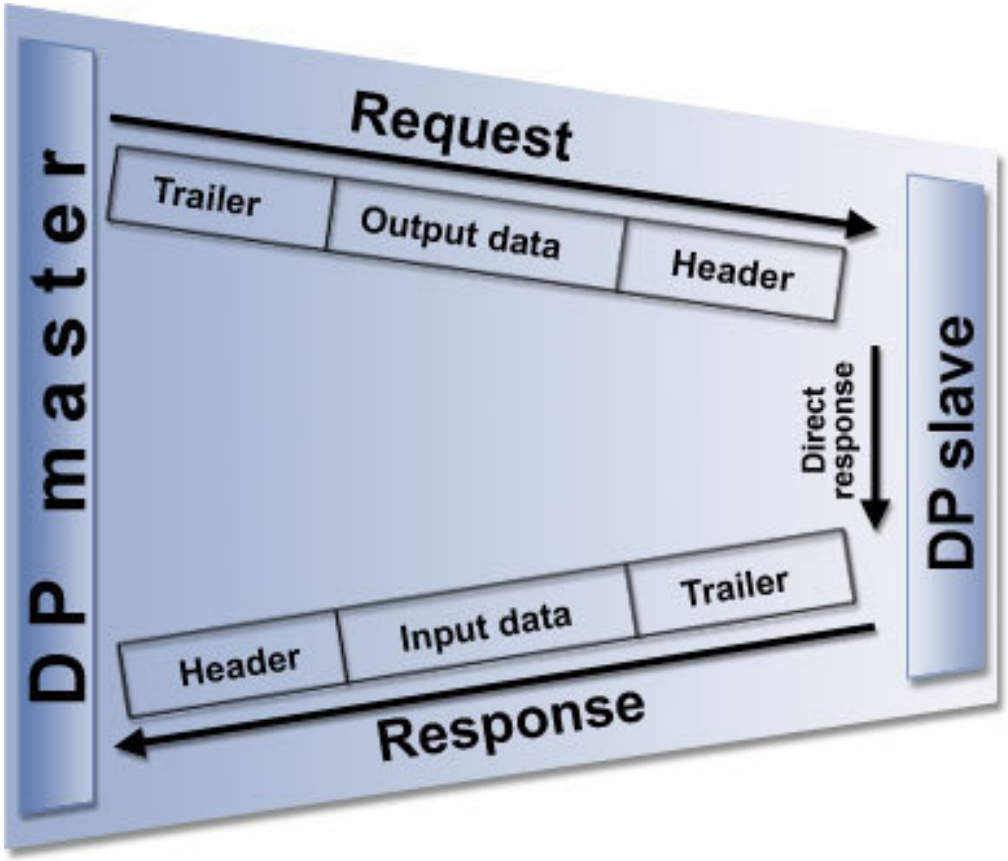
A 'Token' is passed from device to device

If you have the 'Token', you can speak

If you do not have the 'Token' you cannot speak



Communication Technology: Request/Response



- The Master controls the bus access – slaves are passive.
- Slaves respond to a request packet from the master.
- Each slave can support up to 244 bytes of input and output cyclic data

Two Types of communications

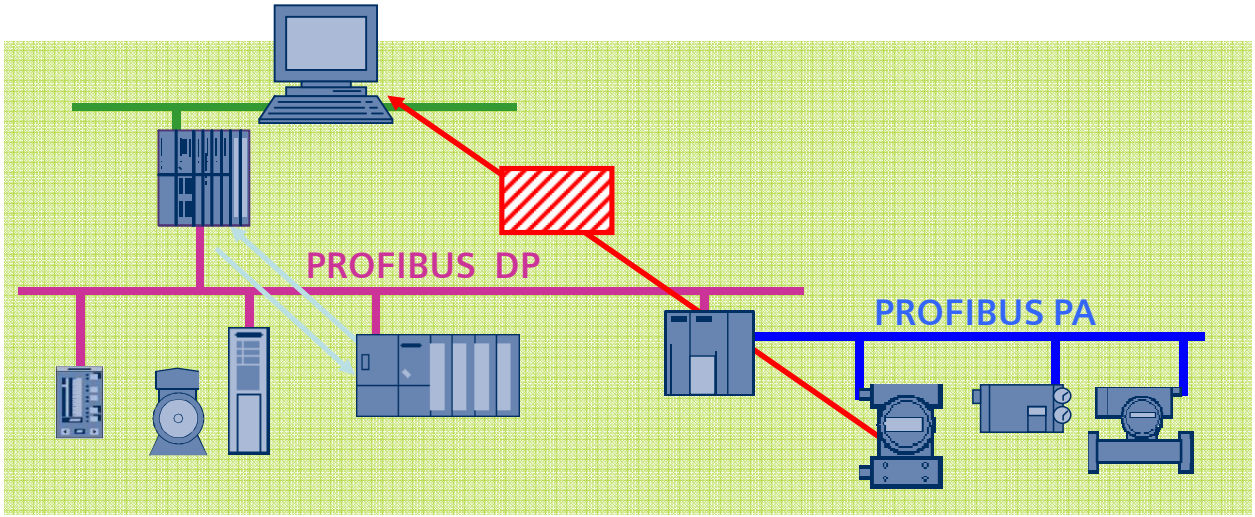
Cyclic Messages:

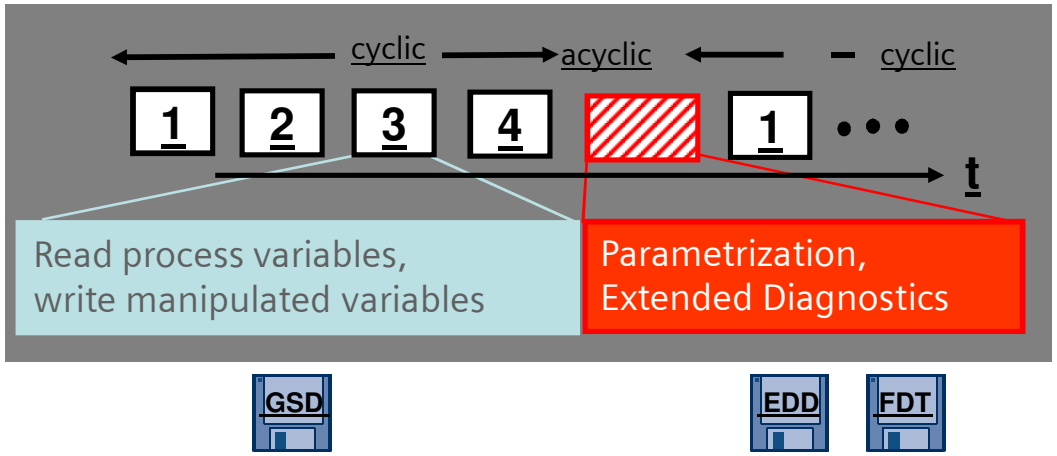
- Communications to every slave every cycle
- You know when communications will occur
- Used for Data exchange

Acyclic Messages:

- Communications to one slave at end of each cycle
- Dialog can take multiple cycles to complete
- You do not know when communications will occur
- Used for configuration data

Cyclic and Acyclic





What is a fieldbus?

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Networks & Segments

One PROFIBUS network can be made up of many segments…

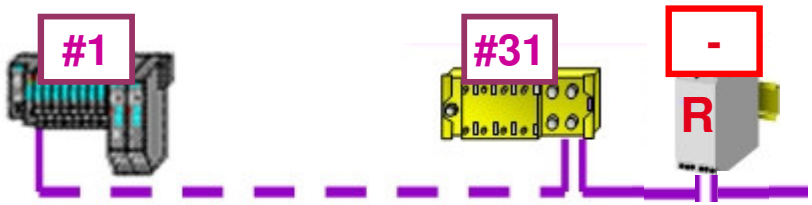
A segment **must** follow the rules of RS-485 for segment quality.

A network **must** follow the rules of PROFIBUS.

A network can use different media: fibre, RS-485, PA, wireless…

You can have many networks in one automation system.

Networks & Segments

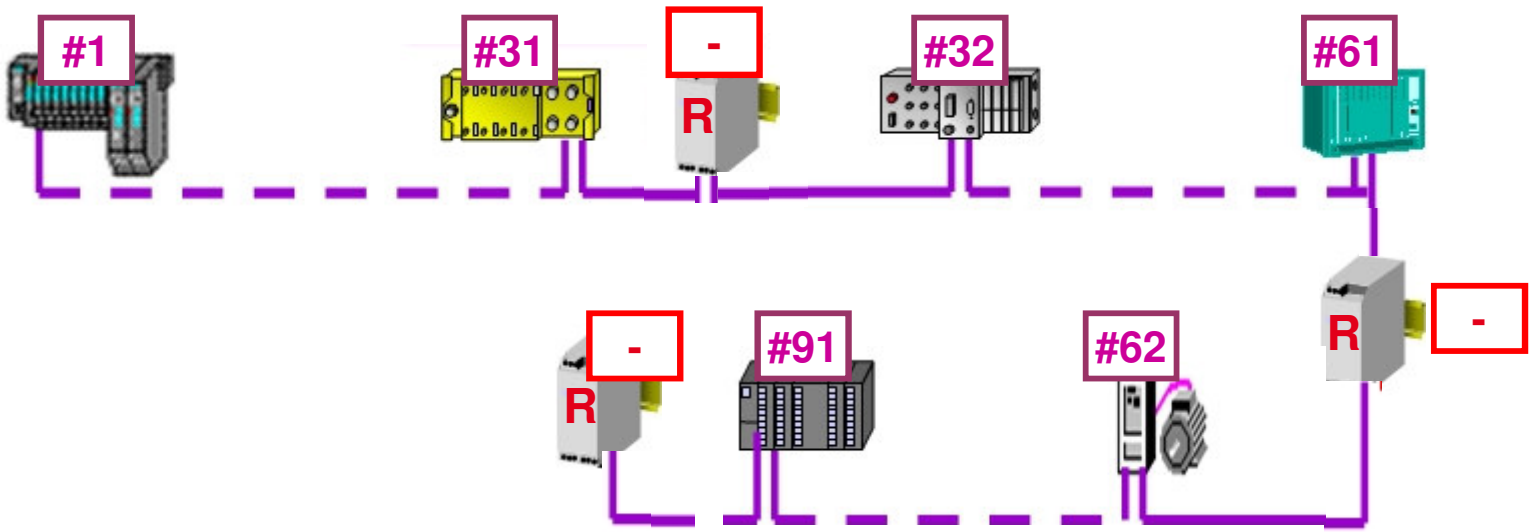


31 addressable devices

32 bus loads

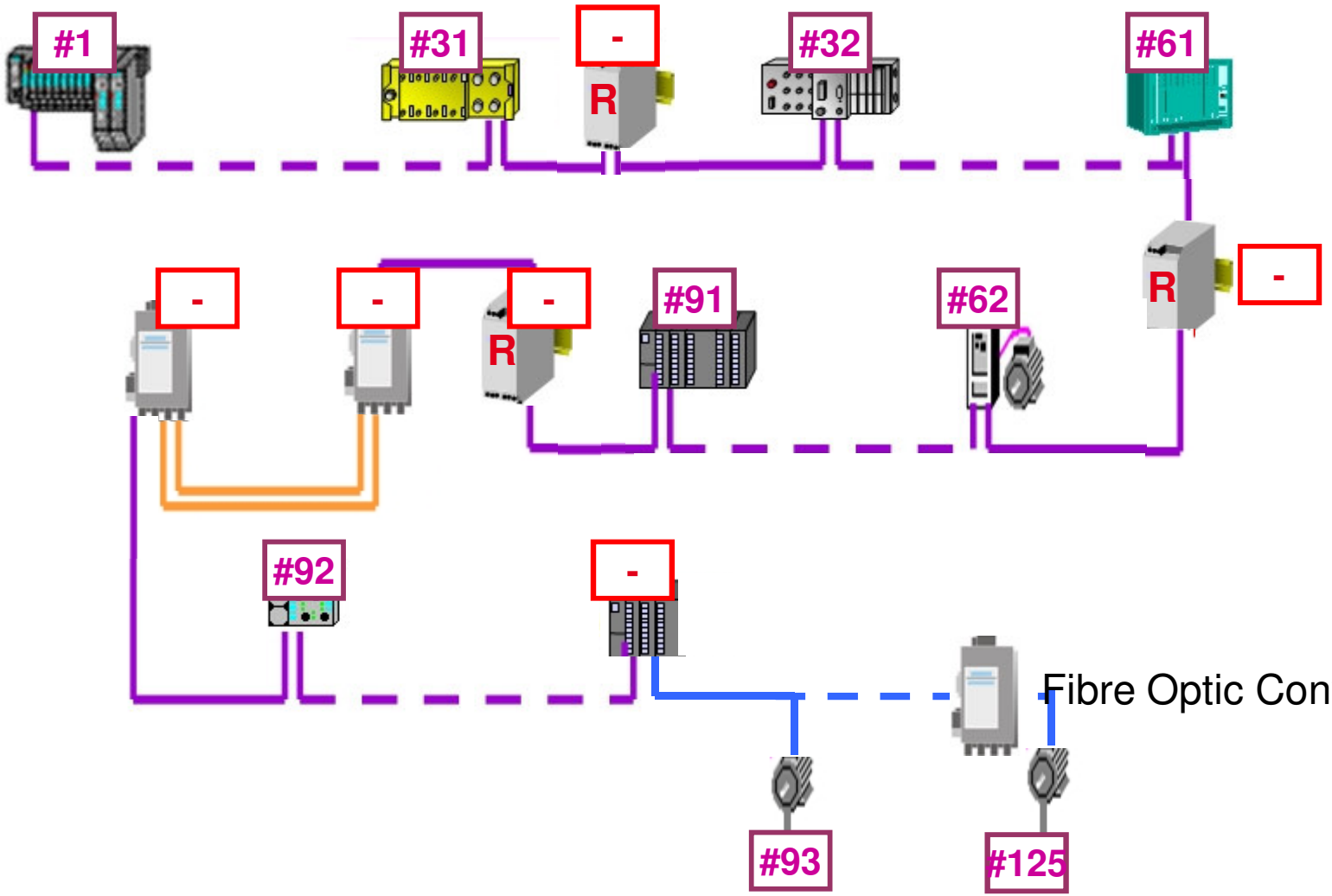
Repeater

Networks & Segments

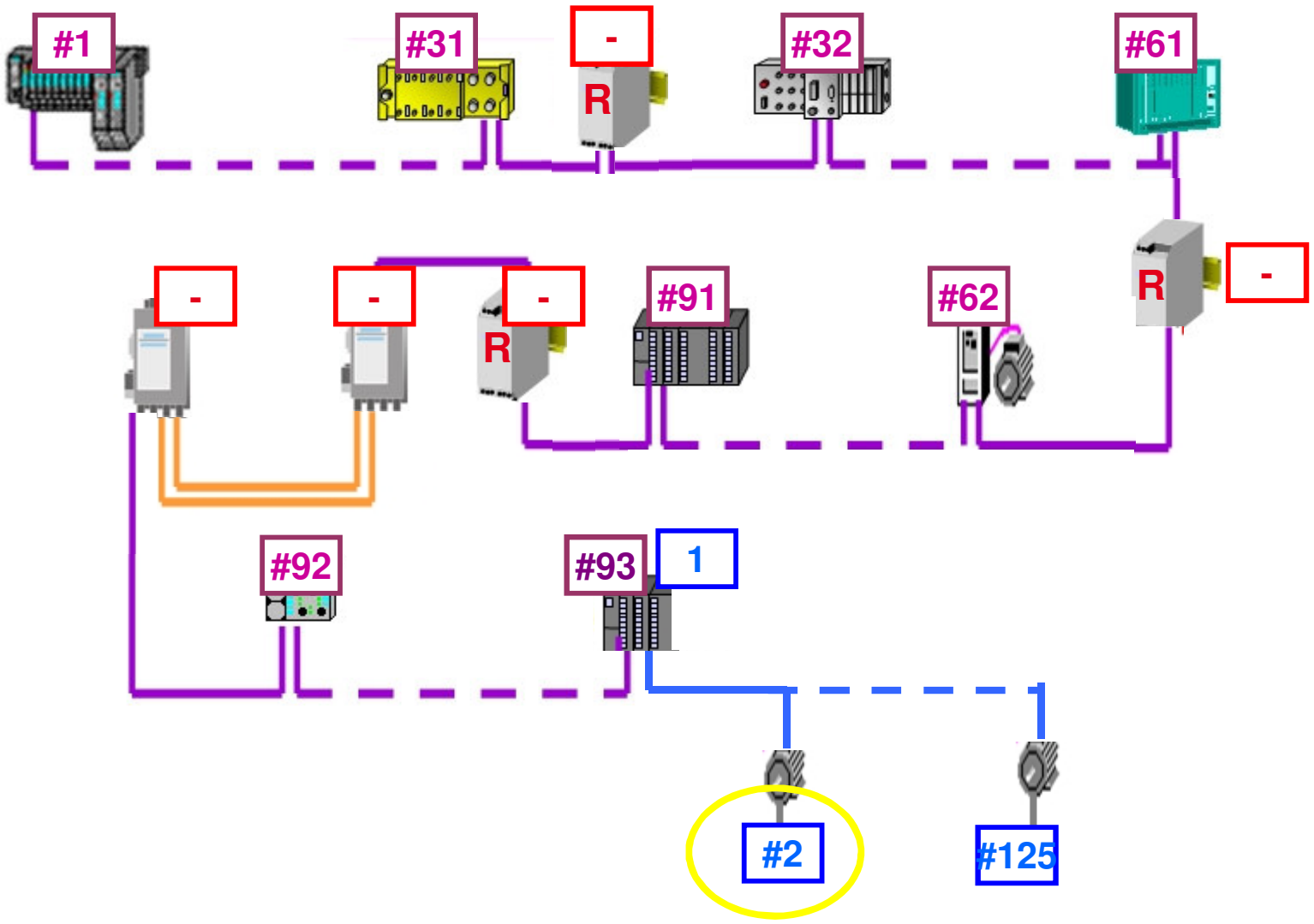


30 addressable devices
+
2 repeaters

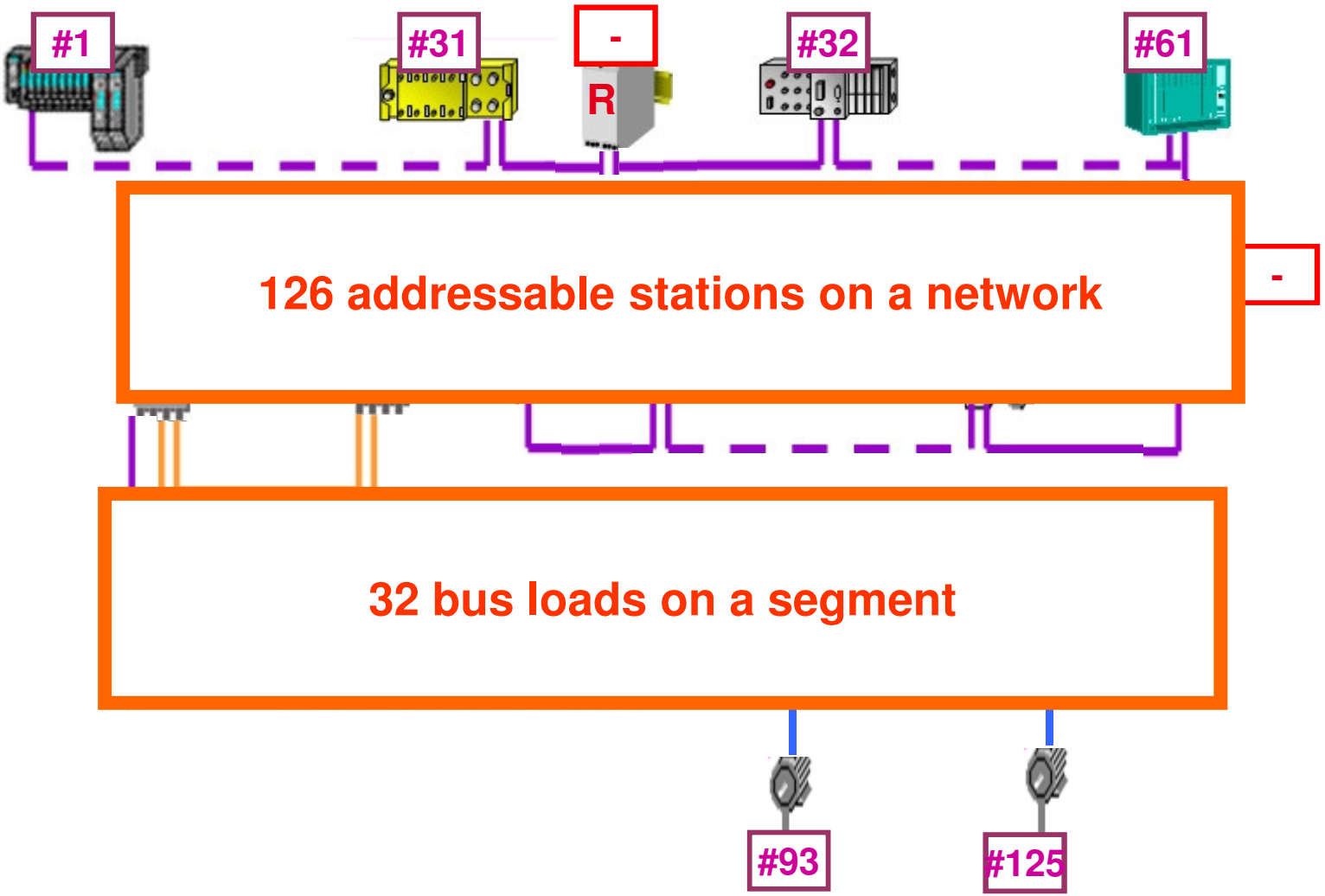
Networks & Segments



Networks & Segments



Networks & Segments



Network Rule 1: Addresses

Address	Purpose
0	Master (Class 2)
1	Master (Class 1)
2..125	Slave
126	Address for Software Address Setting
127	Broadcast/Multicast

- Most configuration tools block address 0 and 126 for slaves
- Address 126 is default “factory setting” address for slaves with no hardware address configuration
- Address 127 is broadcast/multicast address (sync or freeze)

Maximum 124 slaves per network!

Network Rule 2: Number of Devices

- Maximum 126 addressable nodes on a network
- Maximum 124 slaves on a network
- Maximum 32 bus loads per RS485/MBP segment
  - includes devices without addresses
- Devices that generate new segments
  Repeaters
  Fiber Optic Couplers
  DP/PA Couplers

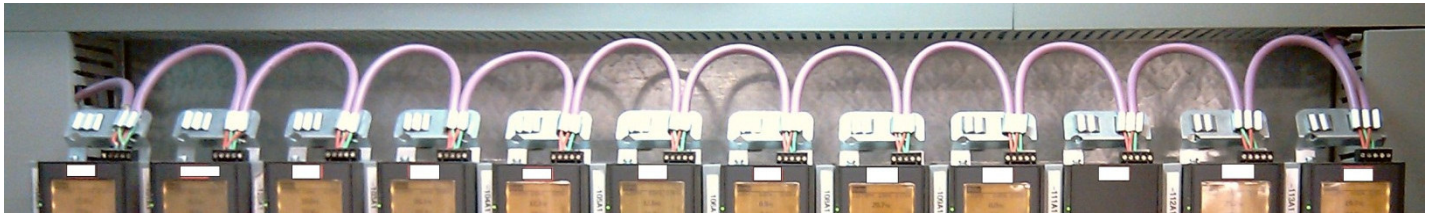
Save a place on every segment for a bus analyzer/configuration tool!

Network Rule 3: Segment Lengths

PROFIBUS DP (copper)

Max segment length depends on speed

Must have minimum 1m cable between devices (1.5M++)



PROFIBUS DP (fibre)

Max segment length depends on fibre type

PROFIBUS PA

Max segment length is fixed at 1900m

Check that you have min. 9V at segment end

Network Rule 4: Terminate

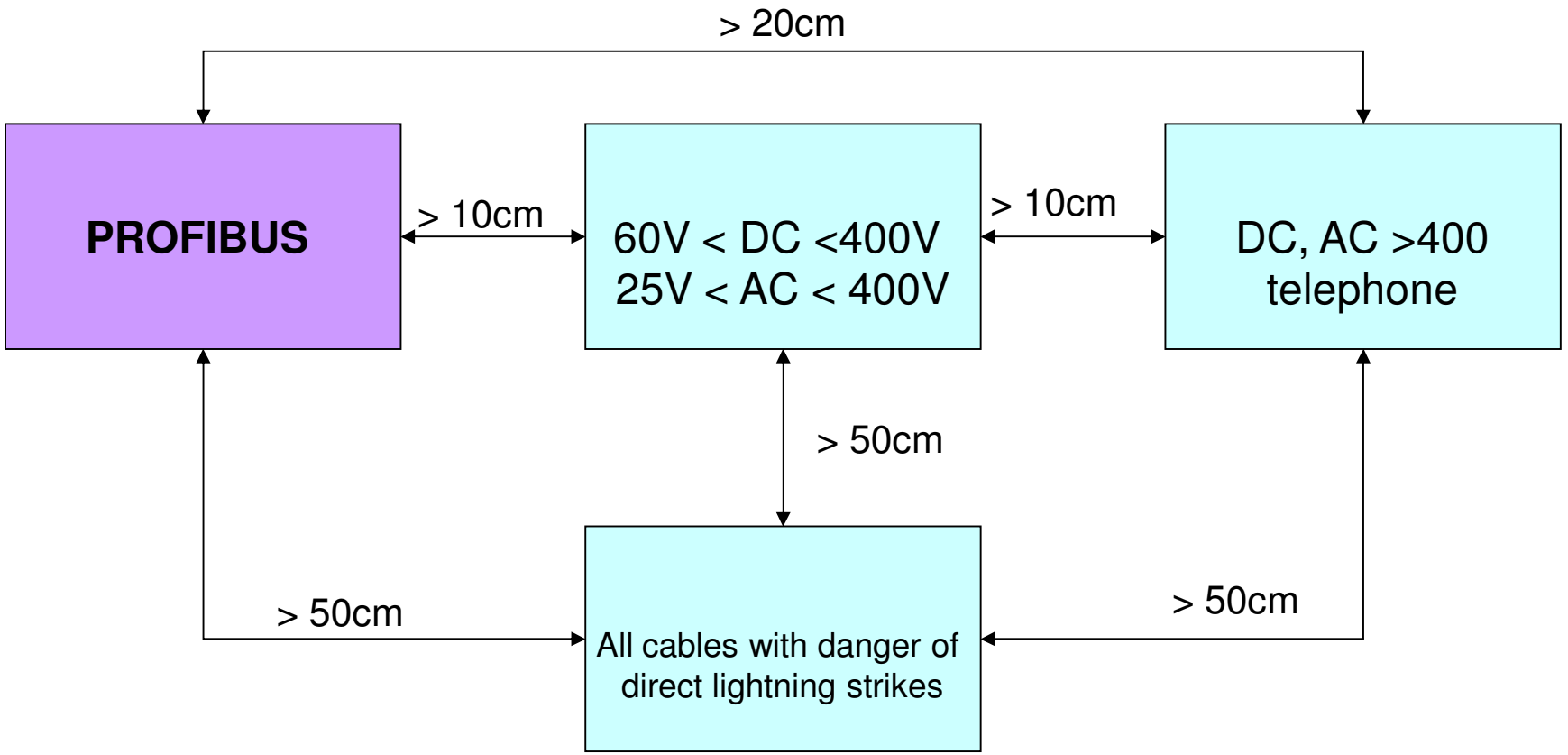
Each network segment must start & end with termination

Terminator can be built into network connector or device

Terminator can be separate powered terminator

Incorrect termination is the **number one installation error**!

Network Rule 5: Cable Spacing



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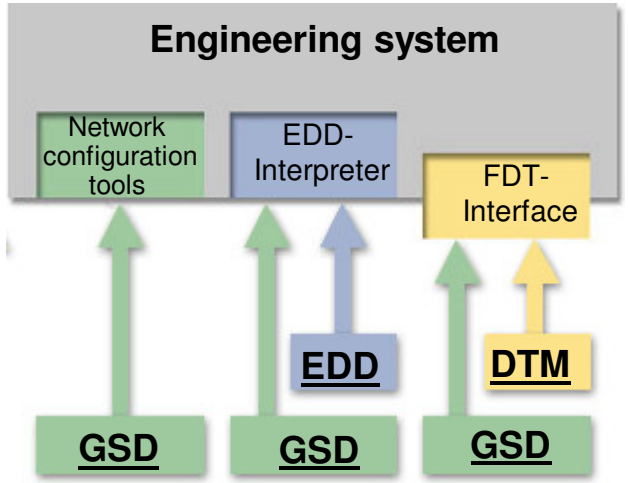
PROFIBUS Integration Technologies

PROFIBUS offers three application-orientated graded technologies for device integration

GSD technology

EDD technology

FDT/DTM technology



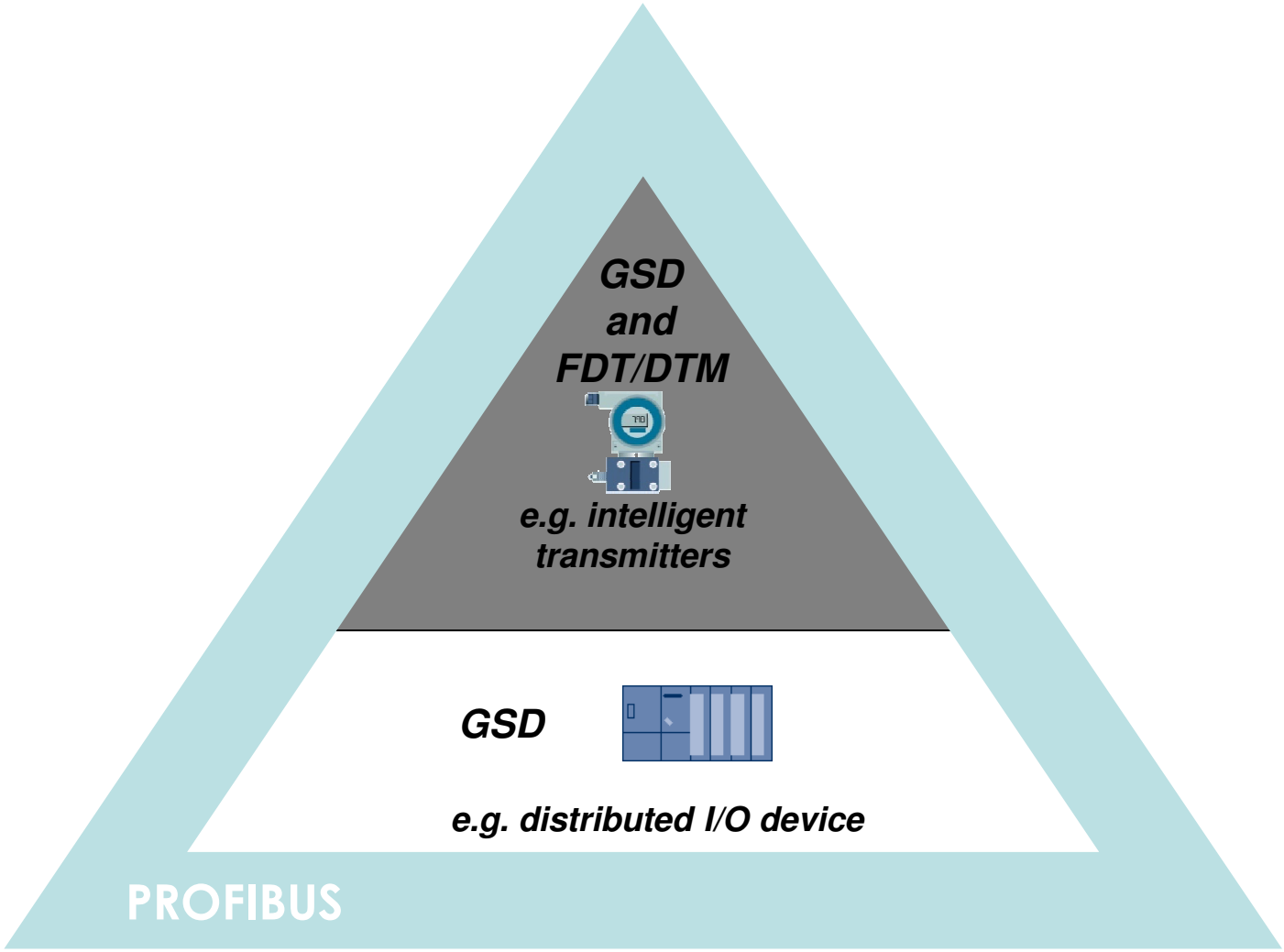
GSD

- Mandatory basic description for each PROFIBUS device
- Integration in the master and exchange of measured values and manipulated variables

EDD and FDT/DTM

- Used in addition to GSD (optional)
- Exchange of additional information with the master for e.g. diagnostics or asset management

Device Engineering



GSD file

General Station Description

Describes all cyclic data and protocol information for use by the class 1 master

Contains:

- Unique device identification number
- Supported baud rates
- Supported message length
- Number of bytes of input/output data
- Meaning of diagnostic messages
- Options which are available for modular devices

Controller
CLASS 1 MASTER

EDD (Electronic Device Description)

Vendor-independent description of device

Describes all acyclic data (configuration information) which is used by the class 2 master

Describes:

- Configuration parameters
- Parameters interactions
- Where parameters are located
- Simple procedures

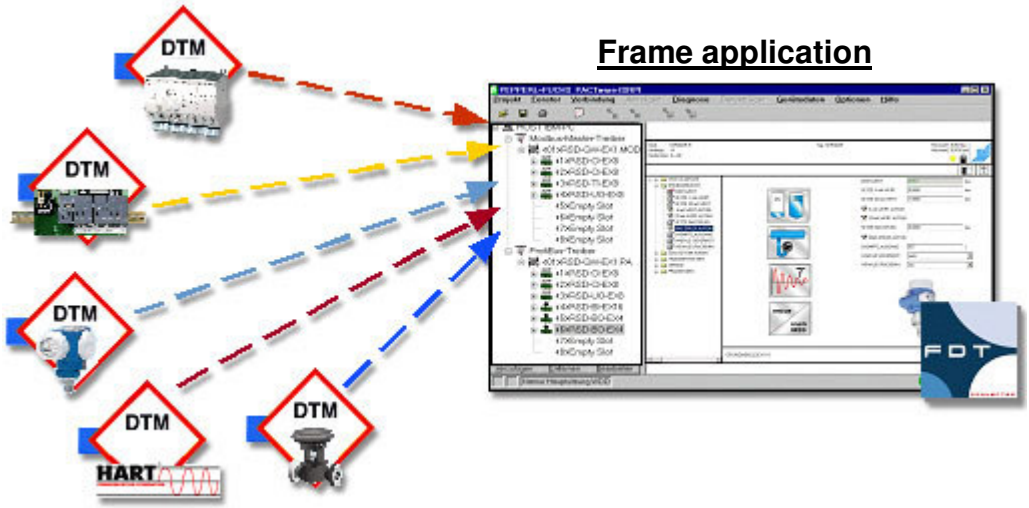
ENGINEERING STATION (CLASS 2 MASTER)

FDT (Field Device Tool)

BSS-

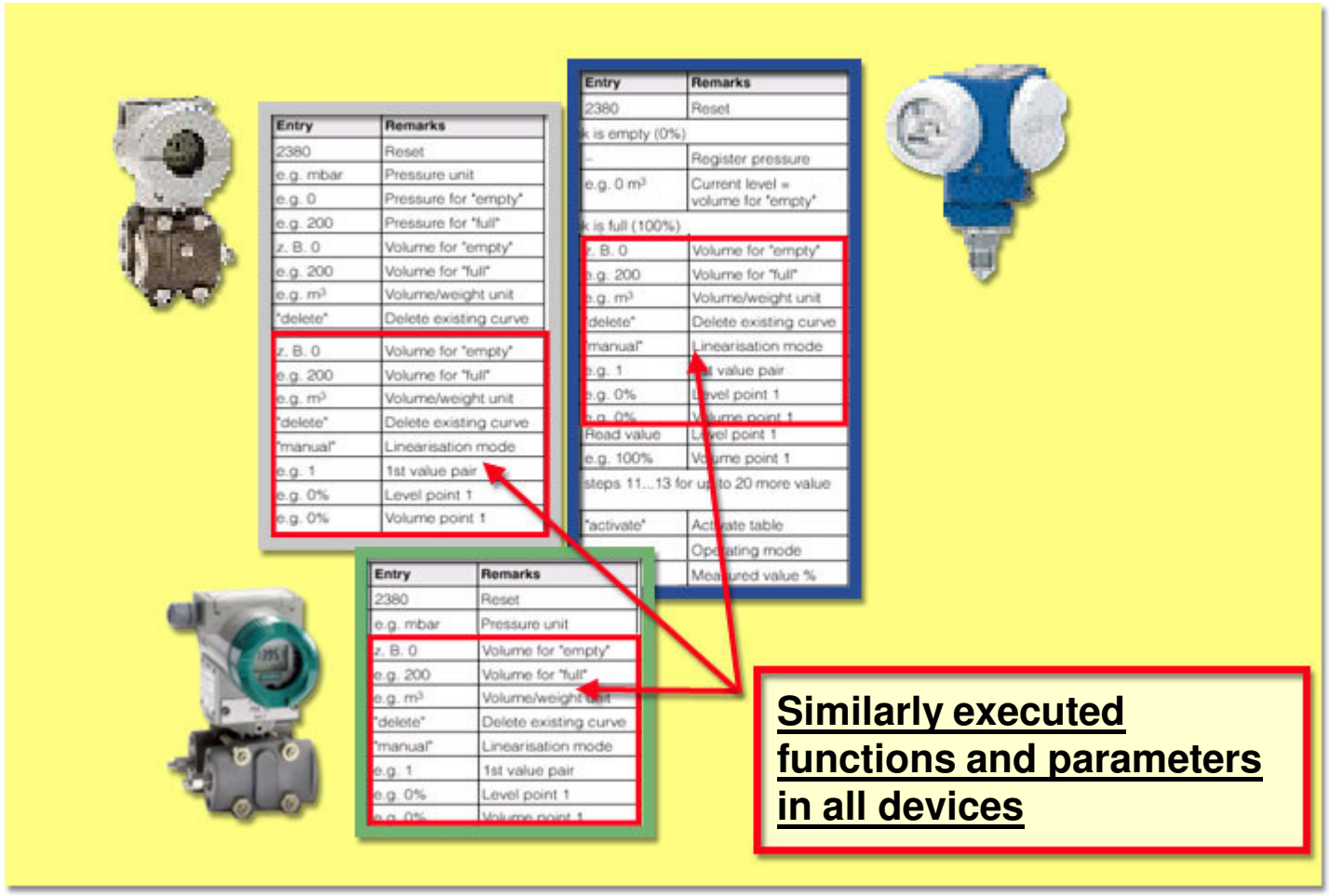
FDT

- vendor-independent, open interface specification
- serves as the interface for the open connection of field devices of different manufacturers to tools and control systems using DTM
- defines the interaction between the DTMs and an FDT frame application in the engineering system

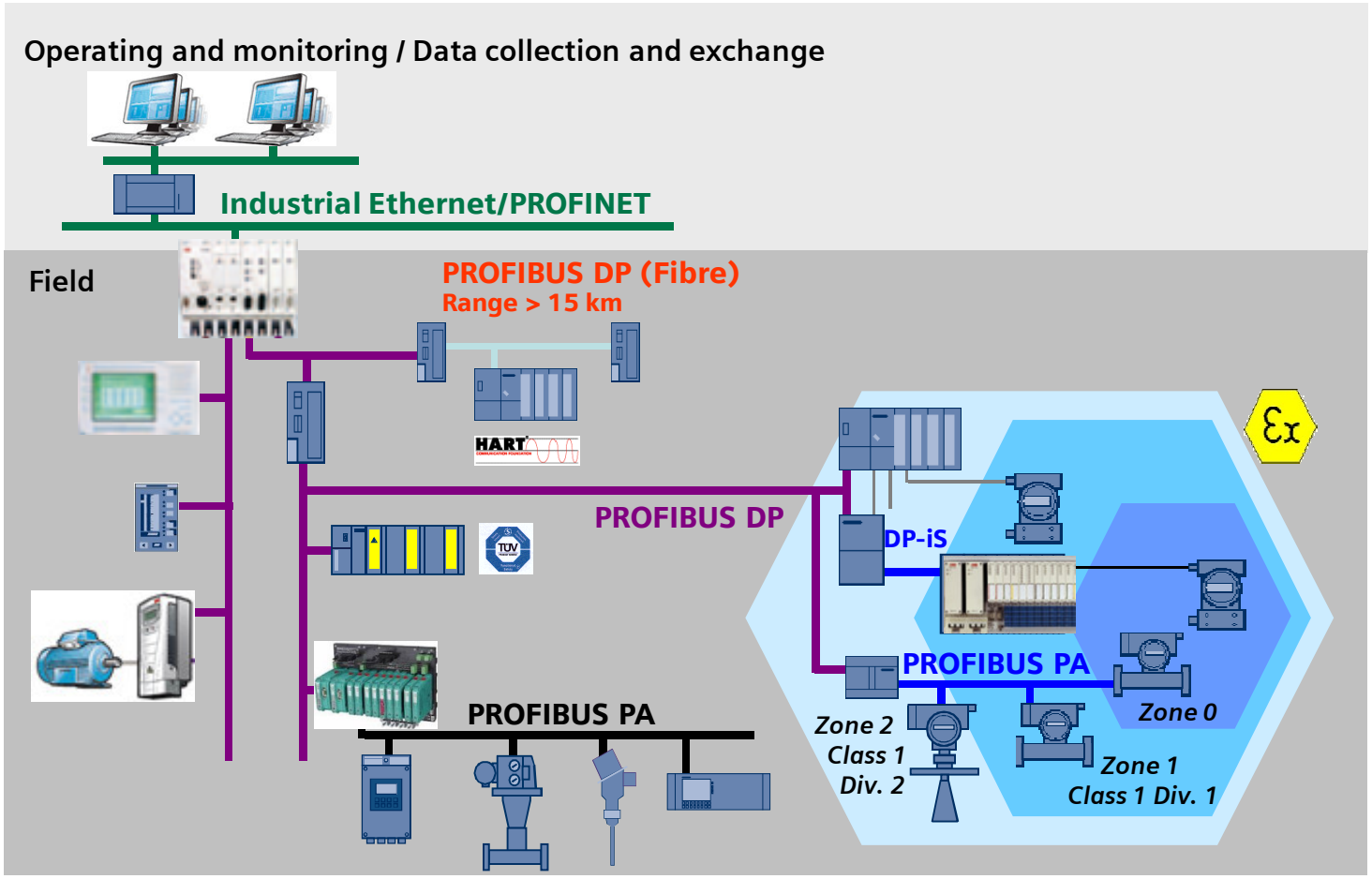


Interoperability Due to Profiles

Vendor-independent device interchangability



PROFIBUS Architecture



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