



PROFIBUS - The PROCESS FIELD BUS

PROFIBUS

Introduction

PROFIBUS PA

PROFISAFE

Central engineering
of Process Devices

Comparison analogue
versus Fieldbus

Device Diagnostics

Vendors and Products



The Plantwide, Worldwide Fieldbus

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PROFIBUS

The fieldbus for Totally Integrated Automation

PROFIBUS

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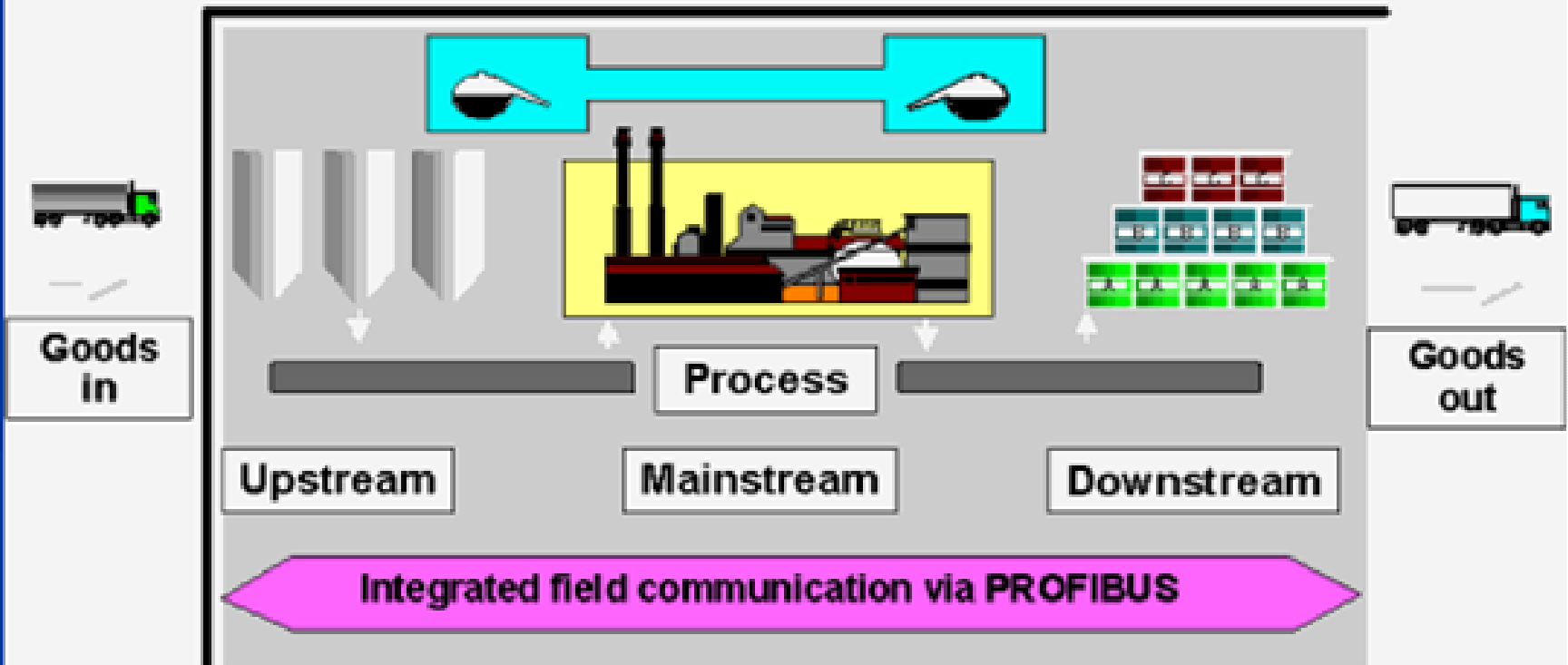
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PROFIBUS is the Process Fieldbus that allows total plant automation and is based upon one communication protocol.



PROFIBUS

One Protocol - Different Physical Layers

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	Physical layer	Application
PROFIBUS DP	Copper - RS485	for standard applications
PROFIBUS DP	Fibre Optic	fast, long distance, RFI immunity
PROFIBUS DP Intrinsically Safe	Copper - RS485	connects remote I/Os and DP/PA Links in hazardous areas with safe areas
PROFIBUS PA	Copper - MBP Manchester Coded Bus Powered	safe and hazardous areas, powers field devices, flexible topology, profiles provide interoperability and interchange-ability
PROFINET*	Ethernet	mapping of PROFIBUS protocol on Ethernet

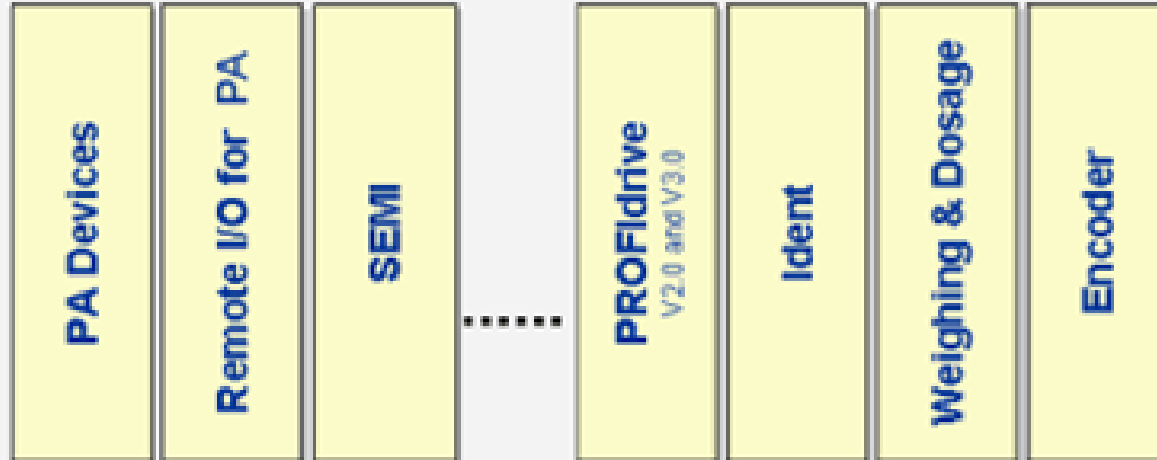
*Standardisation in progress



PROFIBUS Technologies

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Application Profiles II



Integration Technologies

System Profiles 1...x

Application Profiles I



Communication Technologies



Physical Layers



- Descriptions (GSD, EOD)
- Tools (DTM, Configurators)

- Master Conformance Classes
- Interfaces (Comm-FB, FDT, etc.)
- Constraints



PROFIBUS

Fundamental properties

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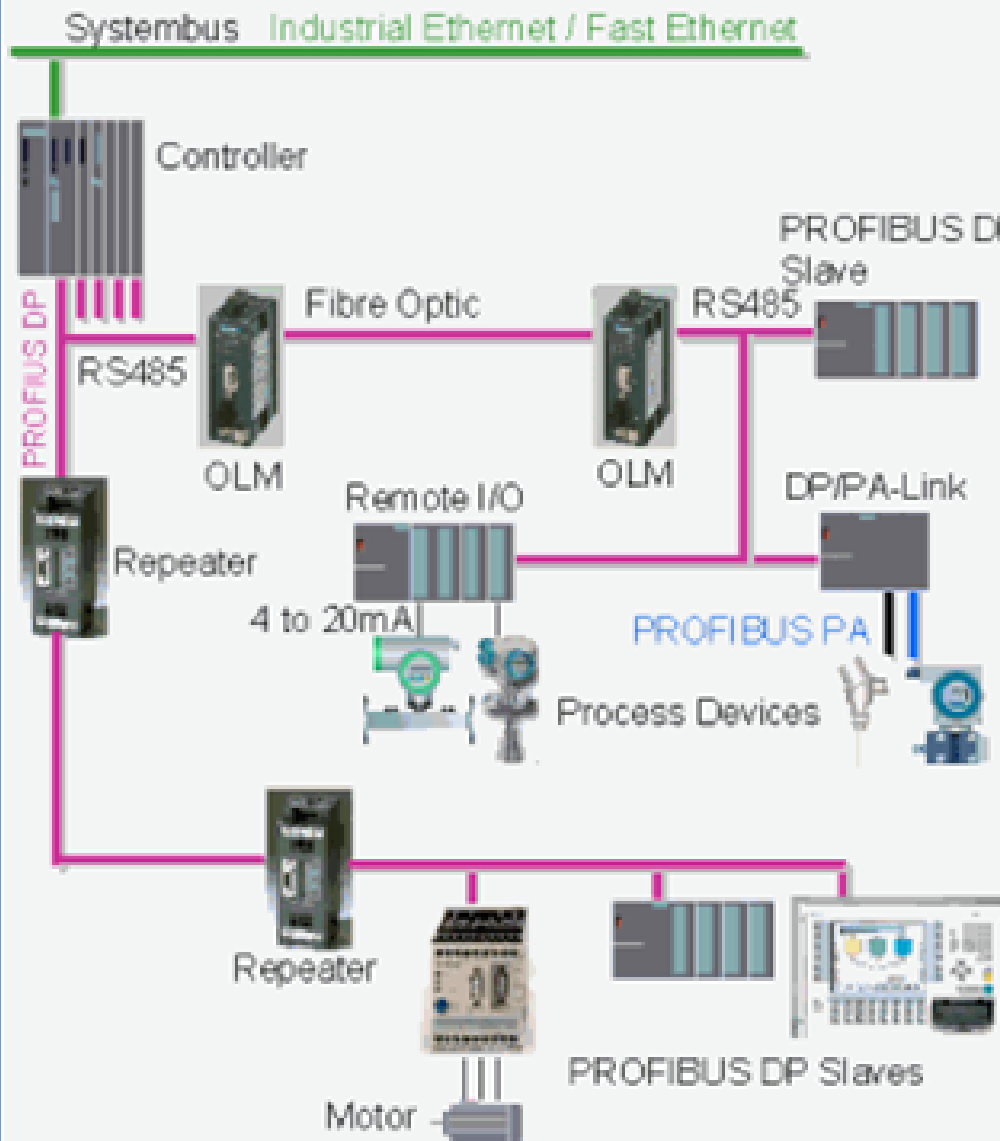
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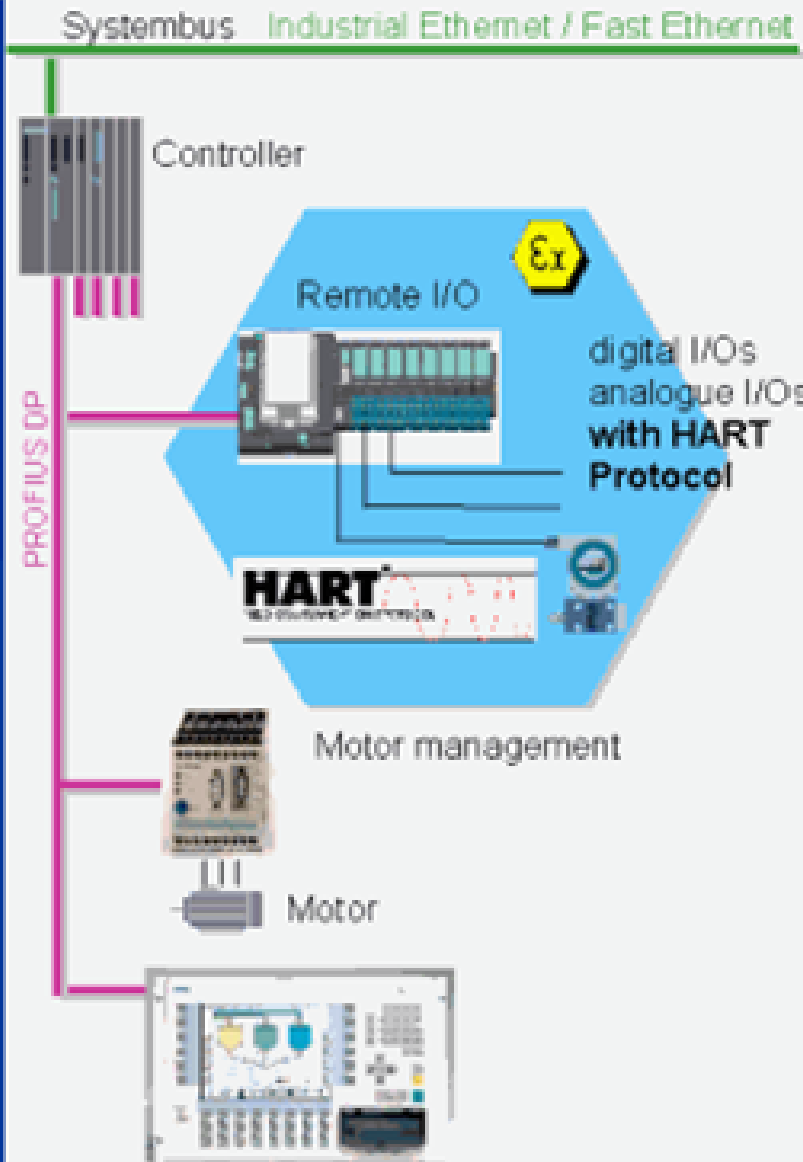
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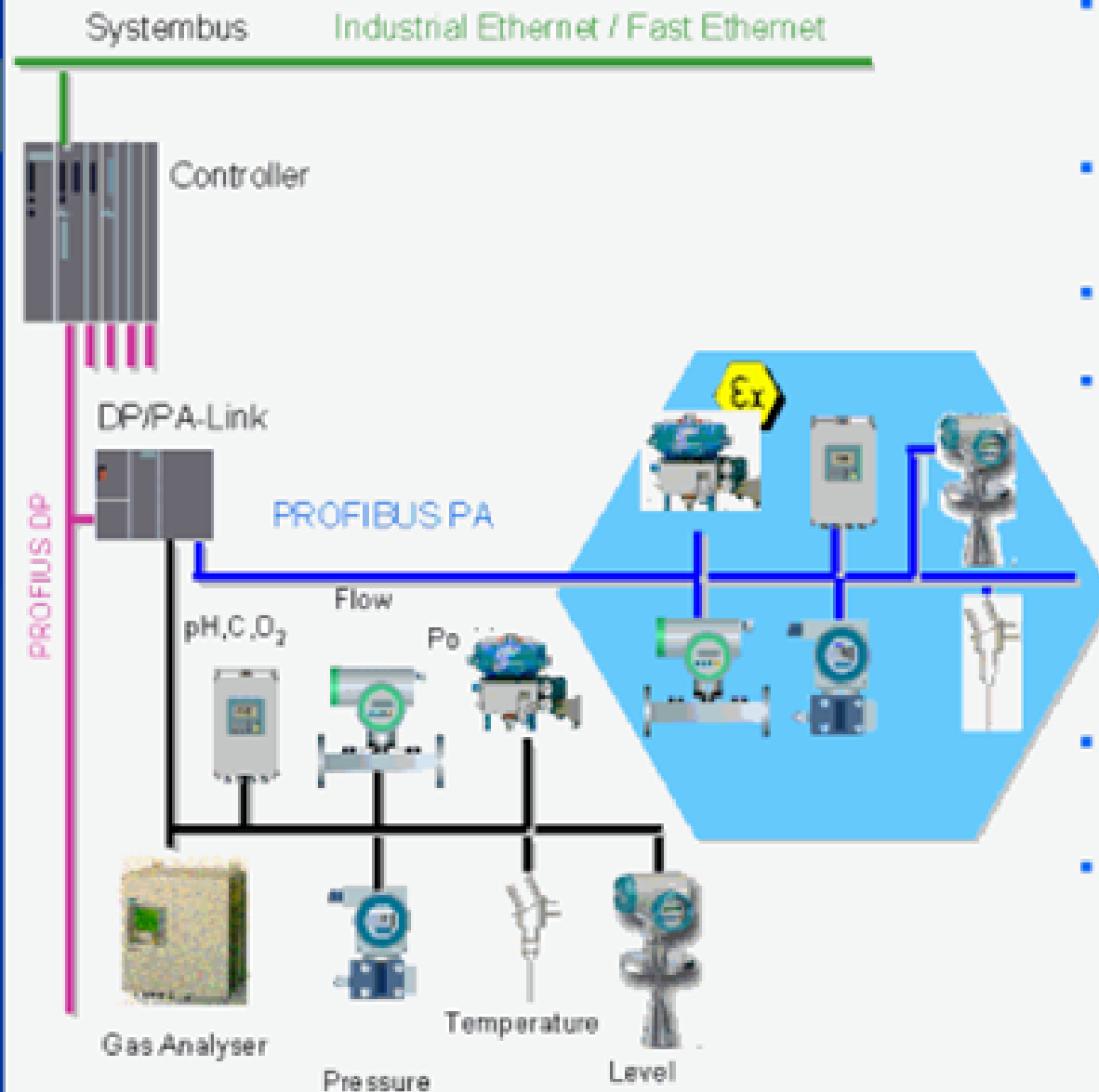
Vendors and Products



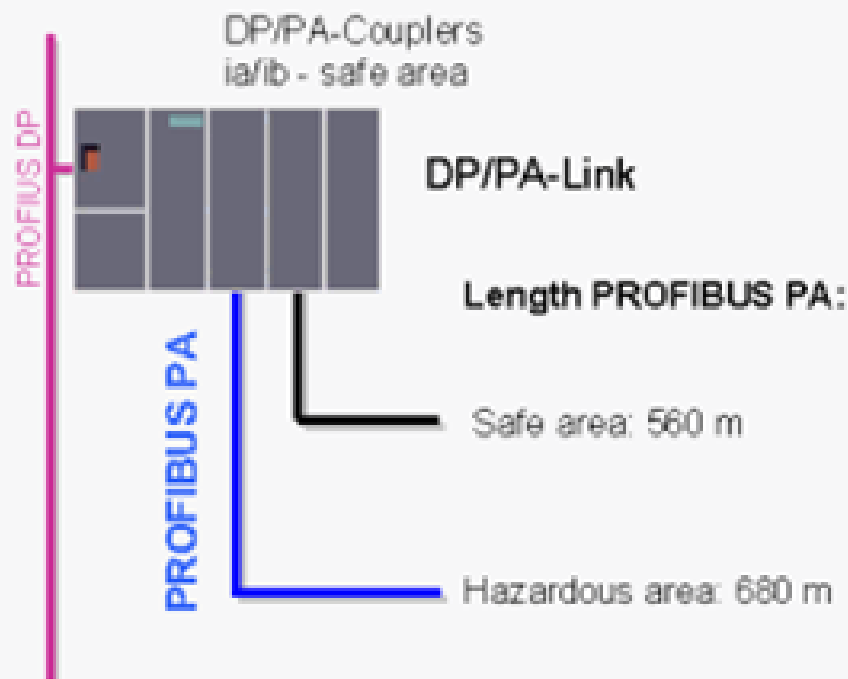
- Speed of PROFIBUS DP is adjustable up to 12Mbit/s
- Each PROFIBUS DP allows up to 123 slaves
- The DP/PA-Link is one DP-Slave with up to 30 process devices (PA-Slaves) per link
- Each PROFIBUS DP segment with RS485 allows connection of 31 slaves
- RS485 segments are cascaded using repeaters
- Length of one RS485 segment is 200m @ 1.5Mbit/s
- Fibre optic and RS485 segments are connected using Optical Link Modules (OLM)
- Fibre optic segments can have a length up to 2.8km.
- Fibre optic segments can be cascaded using OLMs
- Fibre optic buses can have a ring structure



- Remote I/Os, MCCs and local operation are integrated for automation via PROFIBUS
- PROFIBUS talks the HART Protocol.
 - existing Process Devices can be integrated in central engineering
 - protection of past investment!!
- Motor Control Centre (MCC)
- Local operation



- The DP/PA-Link connects the fast PROFIBUS DP (up to 12 Mbit/s) and PROFIBUS PA (31.25 kbit/s)
- Each DP/PA-Link can connect up to 5 PROFIBUS PA using DP/PA-Couplers
- DP/PA-Couplers for safe and hazardous areas can be mixed
- DP/PA-Couplers are compact devices providing the following functions:
 - swap physical layer from RS485 to MBP
 - galvanic isolation
 - separation of safe and hazardous areas
 - provide current for the bus
- Up to 31 process devices can be connected to each DP/PA-Link
- The maximum is to connect more than 3600 Process Devices to one PROFIBUS DP



- The DP/PA-Couplers provide the available voltage
- The minimum voltage for a PROFIBUS PA device is 9V
- The typical impedance of the bus cable for PROFIBUS PA is 44 Ω / km
- Calculation of the bus length is based upon Ohm's law
- Assumption:
The DP/PA-Coupler provides it's maximum current.
This allows to add more field devices at a later date
- The maximum length of PROFIBUS PA includes the total length of all drops

The maximum length of a PROFIBUS PA is 1900 m. Following design rules for real plants the total length of a PROFIBUS PA is 560 m in safe areas and up to 680 m in hazardous areas.

PROFIBUS PA

How many devices can be connected??

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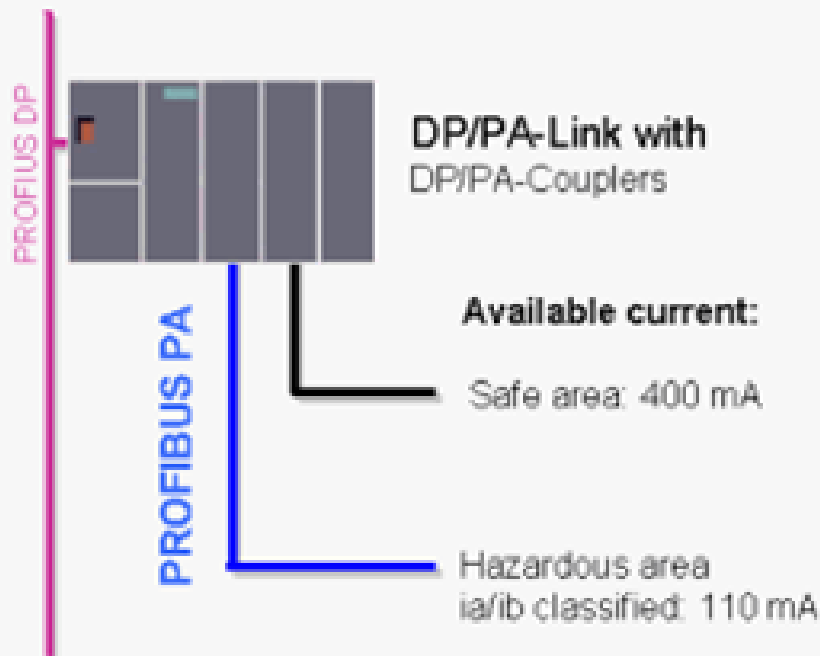
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- The available current for the field devices is provided by the DP/PA-Couplers
- Typical current consumption of process devices:

Bus powered:	12 mA
Devices with separate power supply:	10 mA
- Design guide:
Total current consumption of all devices connected to PROFIBUS PA must not exceed the available current provided by the DP/PA-Coupler.
- Example: $110 / 12 \text{ mA} = 9.17$ bus powered devices

Up to 9 bus powered devices within hazardous areas can be connected to one DP/PA-Coupler.

Up to 31 devices within safe areas can be connected to one DP/PA-Coupler.



PROFIBUS PA

The barrier concept



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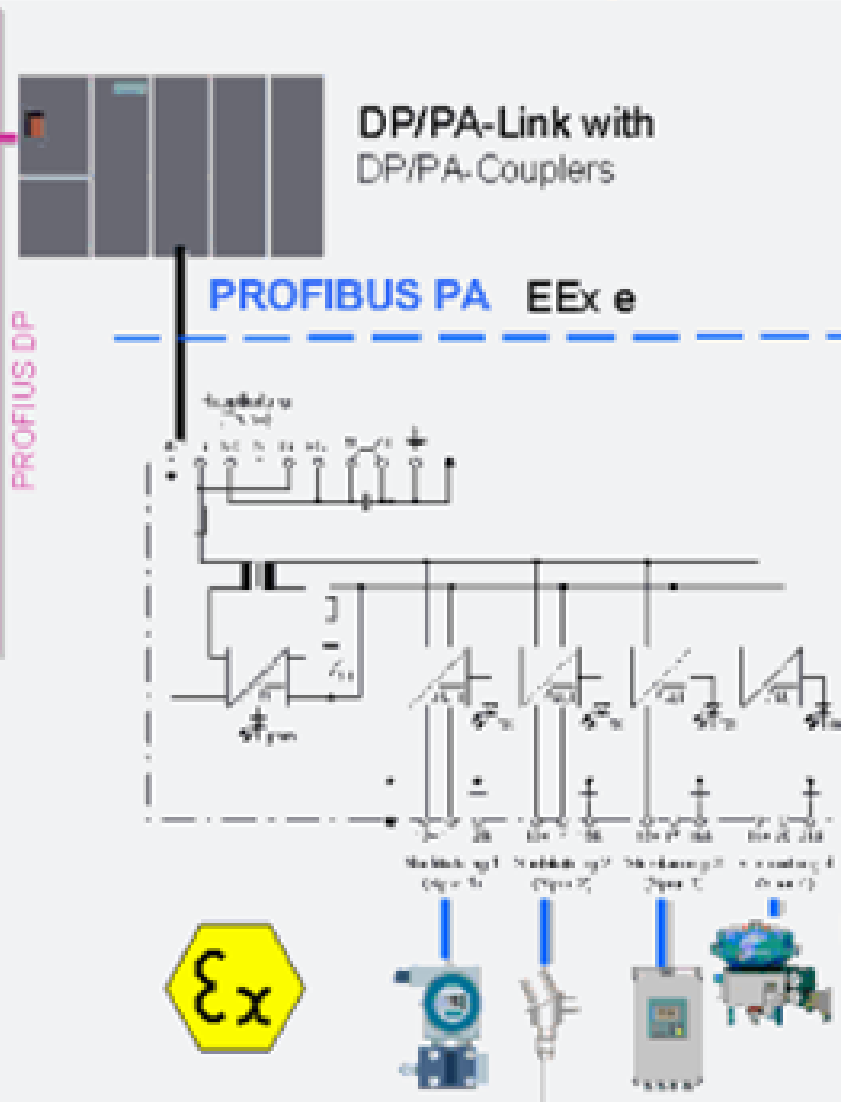
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- The barrier concept allows to connect up to 31 process devices to one high current backbone PROFIBUS PA
- Backbone PROFIBUS PA is connected to barriers in hazardous areas via EEx e
- Barriers produce intrinsically safe PROFIBUS PA segments
- Process devices can be connected to PROFIBUS PA segments point to point
- Short circuit in one segment does not interfere with other segments
- Barriers can be cascaded
- Barriers can replace junction boxes
- Length of PROFIBUS PA is reduced

PROFIBUS PA intrinsically safe



PROFIBUS PA und FISCO

Plug & Play in hazardous areas

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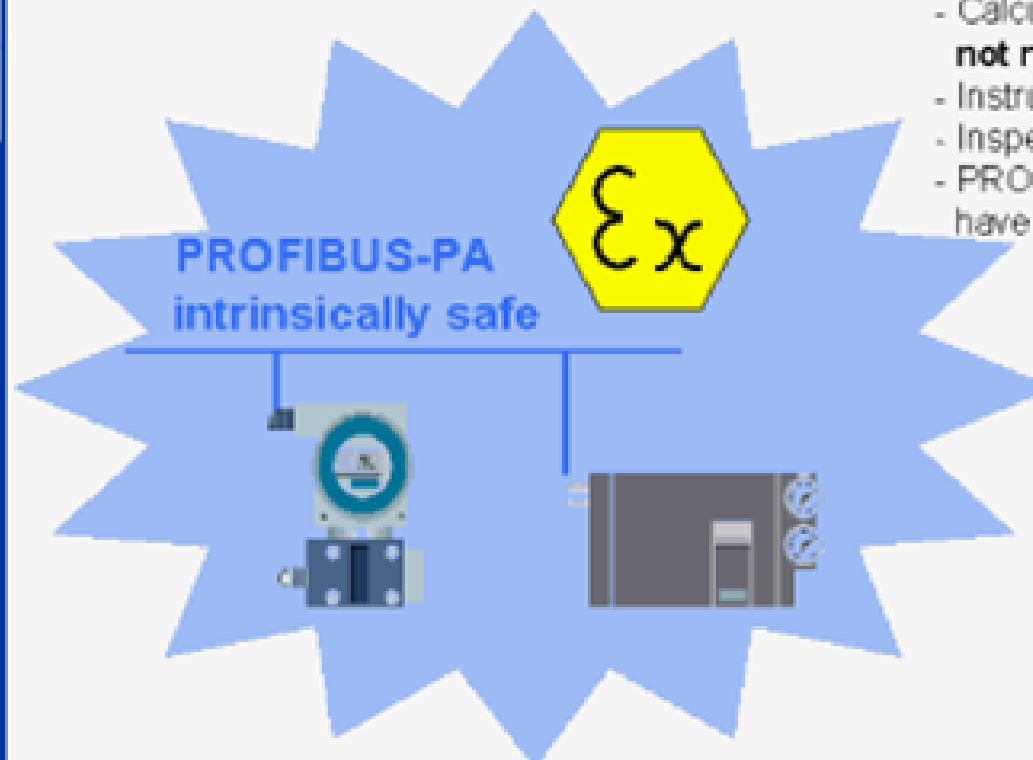
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Device Diagnostics

Vendors and Products

- FISCO
Fieldbus Intrinsicly Safe Concept
Model of an intrinsically safe fieldbus
- FISCO is a prerequisite for an intrinsically safe fieldbus
- PROFIBUS PA conforms to FISCO
- PTB approves conformance to FISCO
- Provided all products used for a PROFIBUS PA segment conform to FISCO then:
 - Calculation of inductivity and capacity is **not necessary**
 - Instruments can be added at a later time
 - Inspection of the segment is not needed
 - PROFIBUS PA is intrinsically safe after devices have been changed



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PROFIBUS PA

Topology and installation

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Introduction

PROFIBUS PA

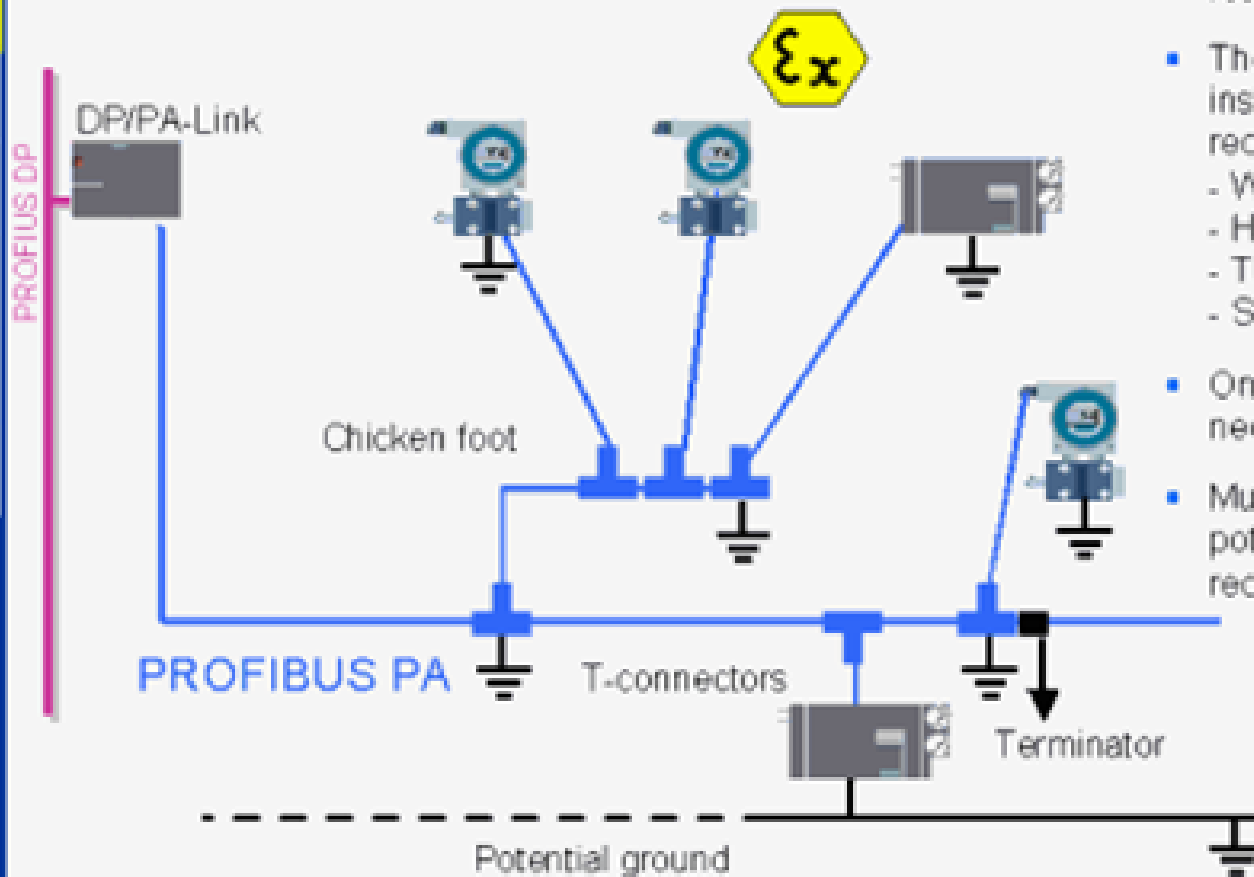
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Device Diagnostics

Vendors and Products



- Maximum length of drops is 30 m
This includes drops off chicken foot
- The use of professional installation equipment is strongly recommended, i.e. from
 - WEIDMÜLLER, or
 - HIRSCHMANN, or
 - TURCK, or
 - SIEMENS, etc.
- One common potential ground is necessary
- Multiple connections to this potential ground is strongly recommended



PROFIBUS und PROFISAFE

The failsafe Process Field Bus

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Introduction

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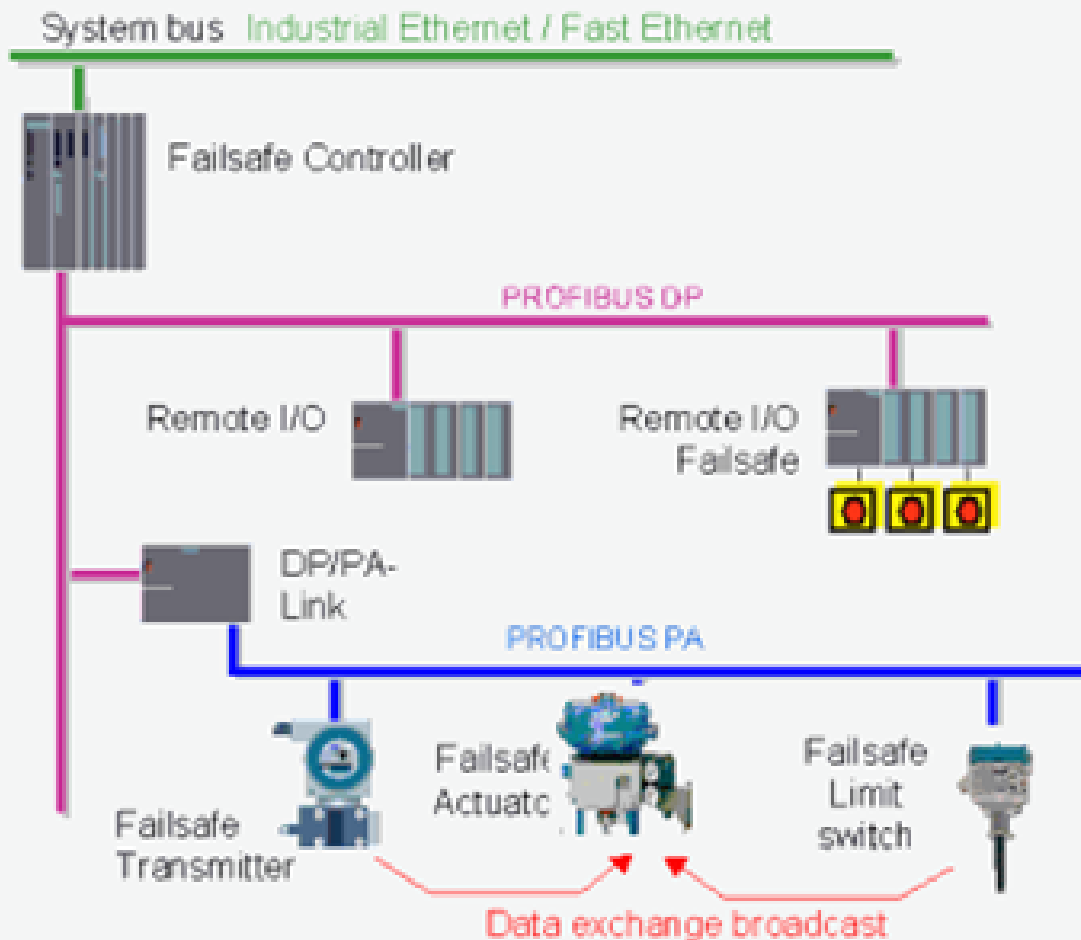
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- Failsafe communication to IEC61508 via PROFIBUS
- Coexistence of standard and failsafe communication
- Failsafe controllers and failsafe remote I/Os providing SIL 1 to SIL3
- Coexistence of standard and failsafe applications in one controller
- Redundant architecture for high availability possible
- TÜV certified
- Prototypes for PROFIBUS PA under development



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PROFISAFE

Possible failures and remedies

- PROFIBUS Introduction
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- Central engineering of Process Devices
- Comparison analogue versus Fieldbus
- Device Diagnostics
- Vendors and Products

Remedy \ Failure type	Consecutive Number	Time Out with Receipt	Codename for Sender and Receiver	Data Consistency Check
Repetition	X			
Deletion	X	X		
Insertion	X	X	X	
Re-sequencing	X			
Data Corruption				X
Delay		X		
Masquerade (standard message mimics failsafe)		X	X	X
FIFO failure within Router		X		

PROFISafe enables failsafe communication between failsafe applications using the standard PROFIBUS protocol

Central and open engineering of Process Devices

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PROFIBUS PA

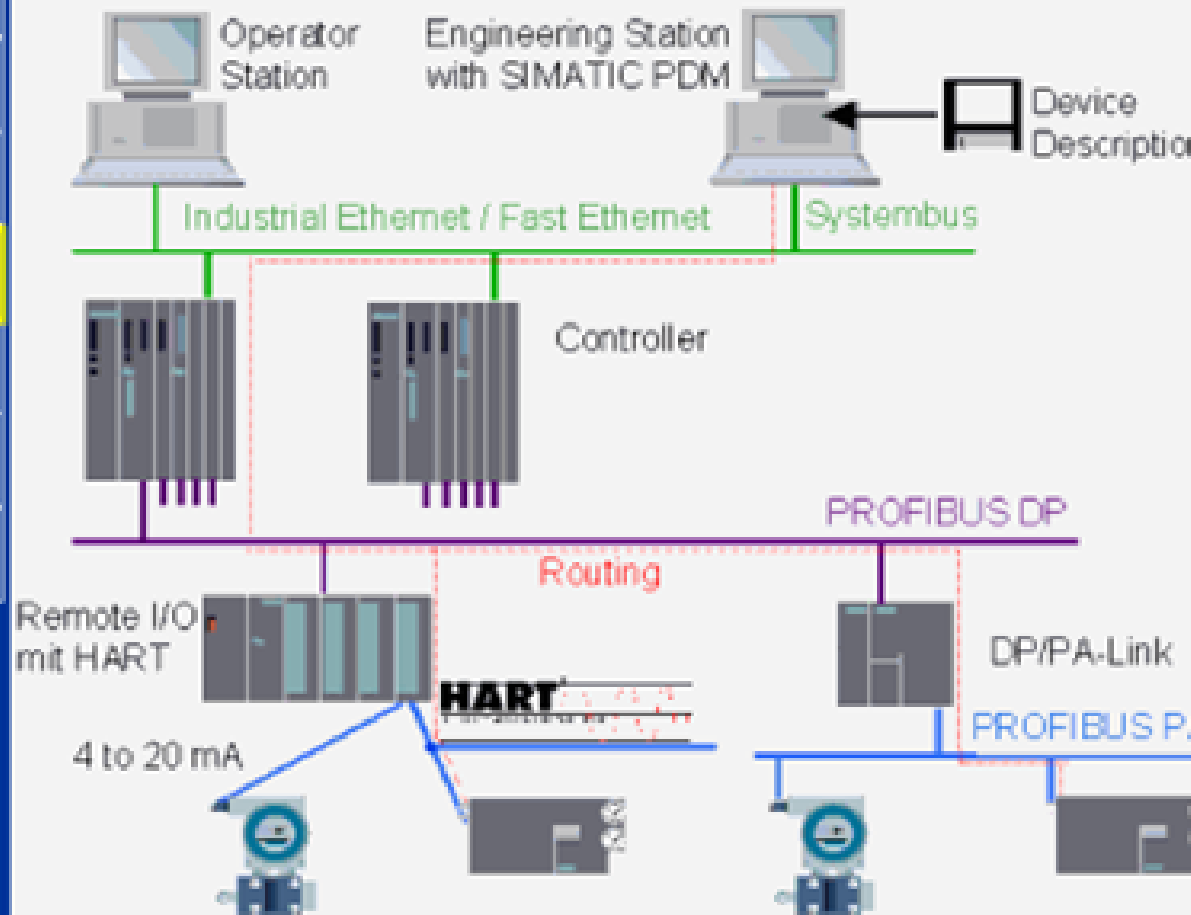
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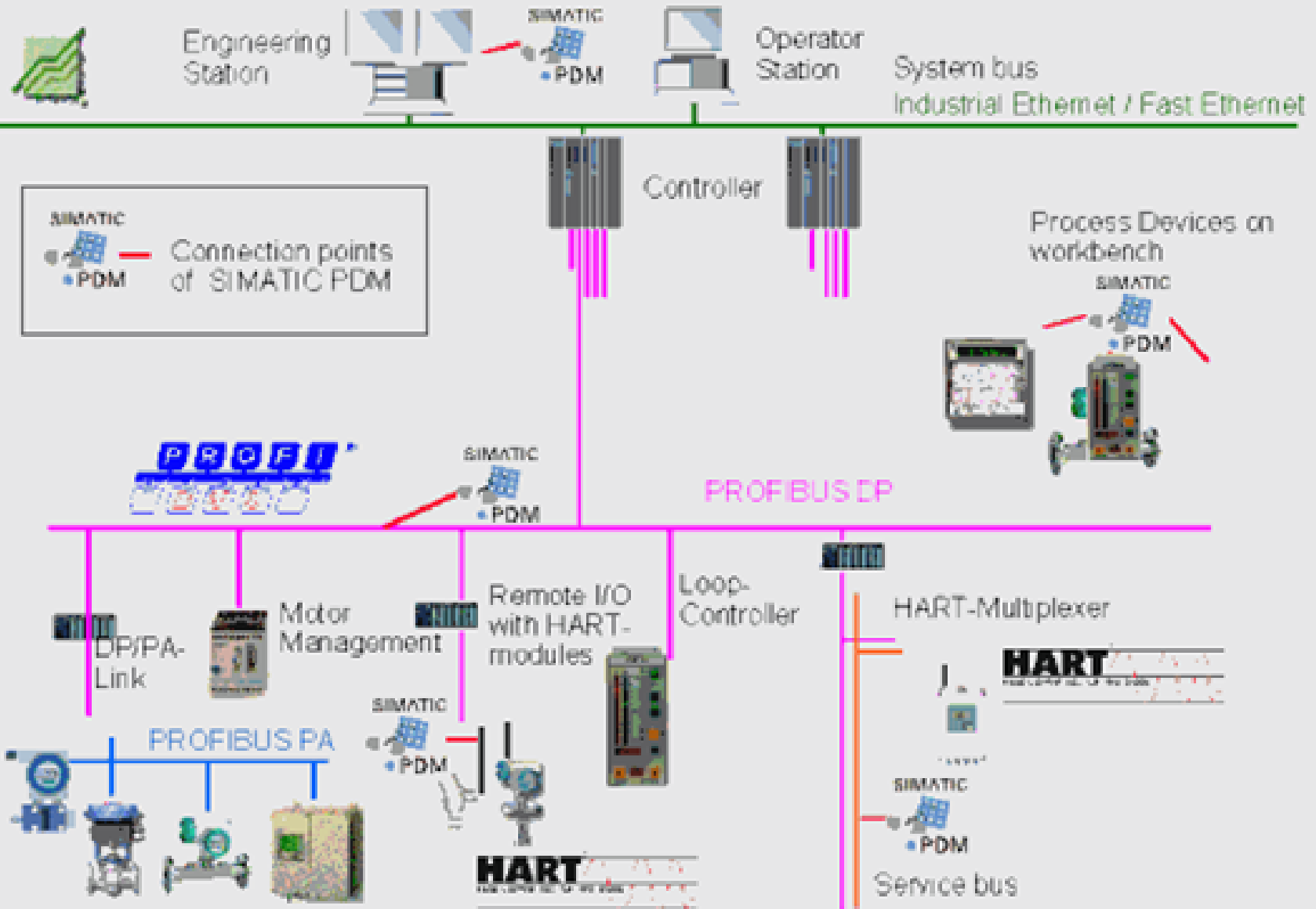
- Routing function enables communication between central Engineering Station and Process Devices
- SIMATIC PDM is tool for Asset Management, i.e.
 - configuration of Process Devices
 - Diagnostic and Maintenance
 - Loop check
 - Manager of central data base for Process Devices
- Integration of Process Devices is via Device Descriptions (EDD)
- SIMATIC PDM is open for all manufacturers



SIMATIC PDM

Connection points - integrated and stand-alone

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PROFIBUS and SIMATIC PDM - Process Device Manager



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Vendors and Products

Parameter	Wert	Hebel	Status
SITRANS P			
↳ Identifikation			
↳ Reibschleifent			
TAC	100%		geladen
Dev. PROFIBUS	Local/Remote 1		geladen
Modell	simatic 3000		geladen
↳ Reset			
Hersteller	Siemens		geladen
Modellname	3000-00-P		geladen
Modell-Typ	7ED-001-0AC1-0000-000		geladen
Modell-Produktname	7ED-001-001-000		geladen
Produkt-Modell	7ED-001-001		geladen
Produkt-Modellname	1		geladen
Modellname	1		geladen
Geräte-Typ	3000-00-000		geladen
Geräte-Modellname	0000		geladen
↳ Übergang			
Einheit	mm/00		geladen
↳ Modifikation			
Modifikation (Datei)			
[Datei] [Datei] [Datei]			
Ausgangswert			
013.26 mmH2O			
[Progress bar]			
Eingangswert			
123.456 mmH2O			
789.012 mmH2O			
Ausgangswert [0]			
[Buttons]			

- SIMATIC PDM is suitable for all PROFIBUS and HART Devices
- Uniform Human Machine Interface for Process Devices from different manufacturers
- SIMATIC PDM can access all parameters of all Process Devices
- SIMATIC PDM can perform all methods of Process Devices
 - calibration
 - reset
 - display
- SIMATIC PDM provides ease of use



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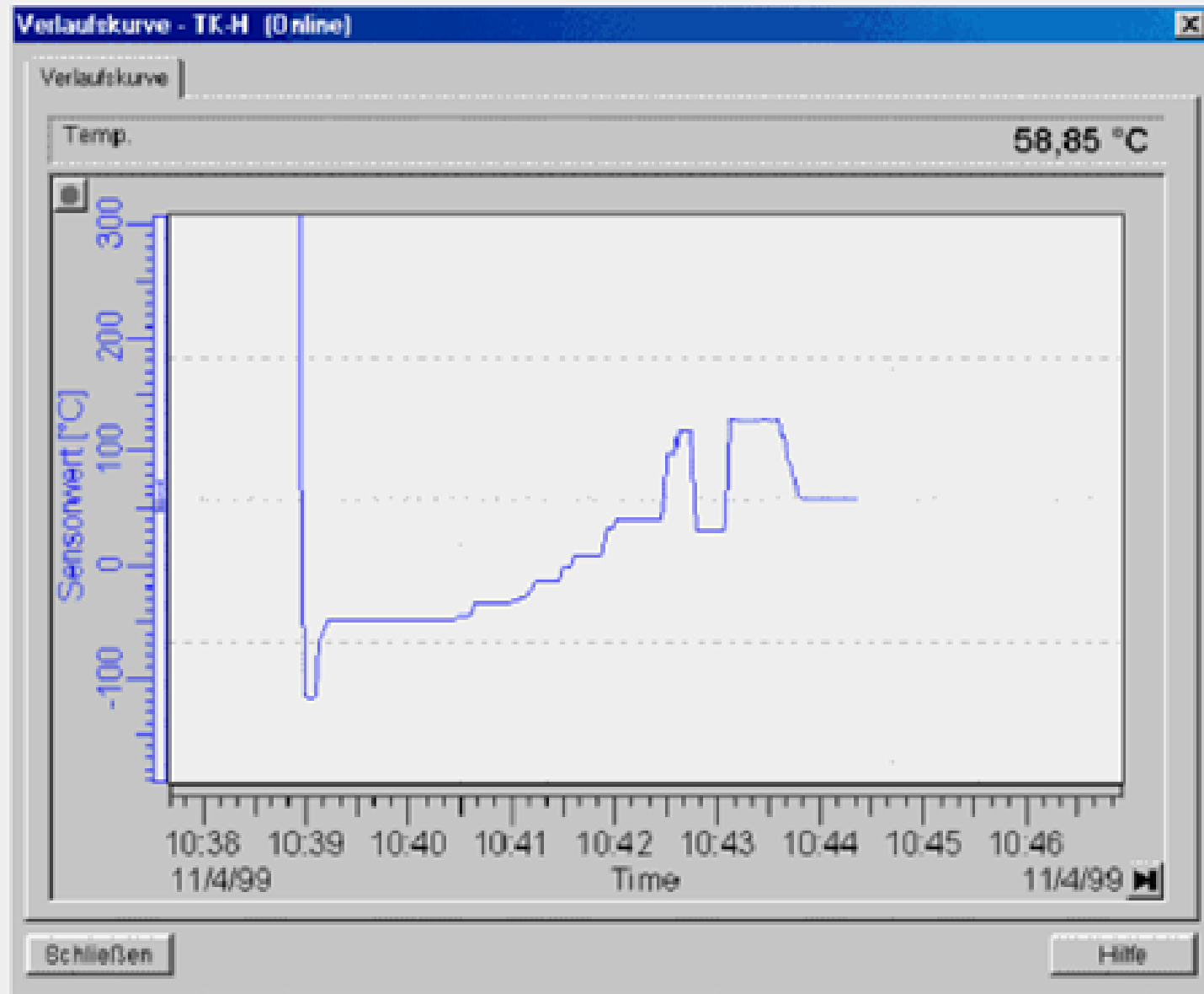
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- SIMATIC PDM provides a graphic for process variables and characteristics



SIMATIC PDM Integrated devices

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HART-Gerätecatalog: 742 Einträge (432 Geräte)

- ⊖ Aktoren
 - ⊖ Elektro-pneumatisch
 - ⊖ SAMSON AG
 - ⊖ SIEMENS
 - ⊖ HCF
 - ⊖ ACCUTECH (ID: 0x005e)
 - ⊖ ANDERSON (ID: 0x005a)
 - ⊖ APPARATEBAU_HUNDSBACH (ID: 0x0071)
 - ⊖ BAILEY_FISCHER_AND_PORTER (ID: 0x0012)
 - ⊖ BESTA (ID: 0x0066)
 - ⊖ BOPP_AND_REUTHER_HEINRICHS (ID: 0x006c)
 - ⊖ BROOKS_INSTRUMENT (ID: 0x000a)
 - ⊖ BURKERT (ID: 0x0076)
 - ⊖ DELTA (ID: 0x000e)
 - ⊖ DMC (ID: 0x0074)
 - ⊖ DRAEGER (ID: 0x0052)
 - ⊖ DREXELBROOK (ID: 0x004e)
 - ⊖ DYNISCO (ID: 0x0072)
 - ⊖ ECKARDT (ID: 0x003f)

Buttons: OK, Abbrechen, Hilfe, Katalog-Import ...

Beschreibung: _____

Bestellnummer: _____

- SIMATIC PDM includes libraries for nearly all Process Devices that communicate PROFIBUS, HART

- Library of HART Communication Foundation (HCF) is included in standard scope of supply of SIMATIC PDM



Conventional Instrumentation via 4 to 20 mA - The Information Gap

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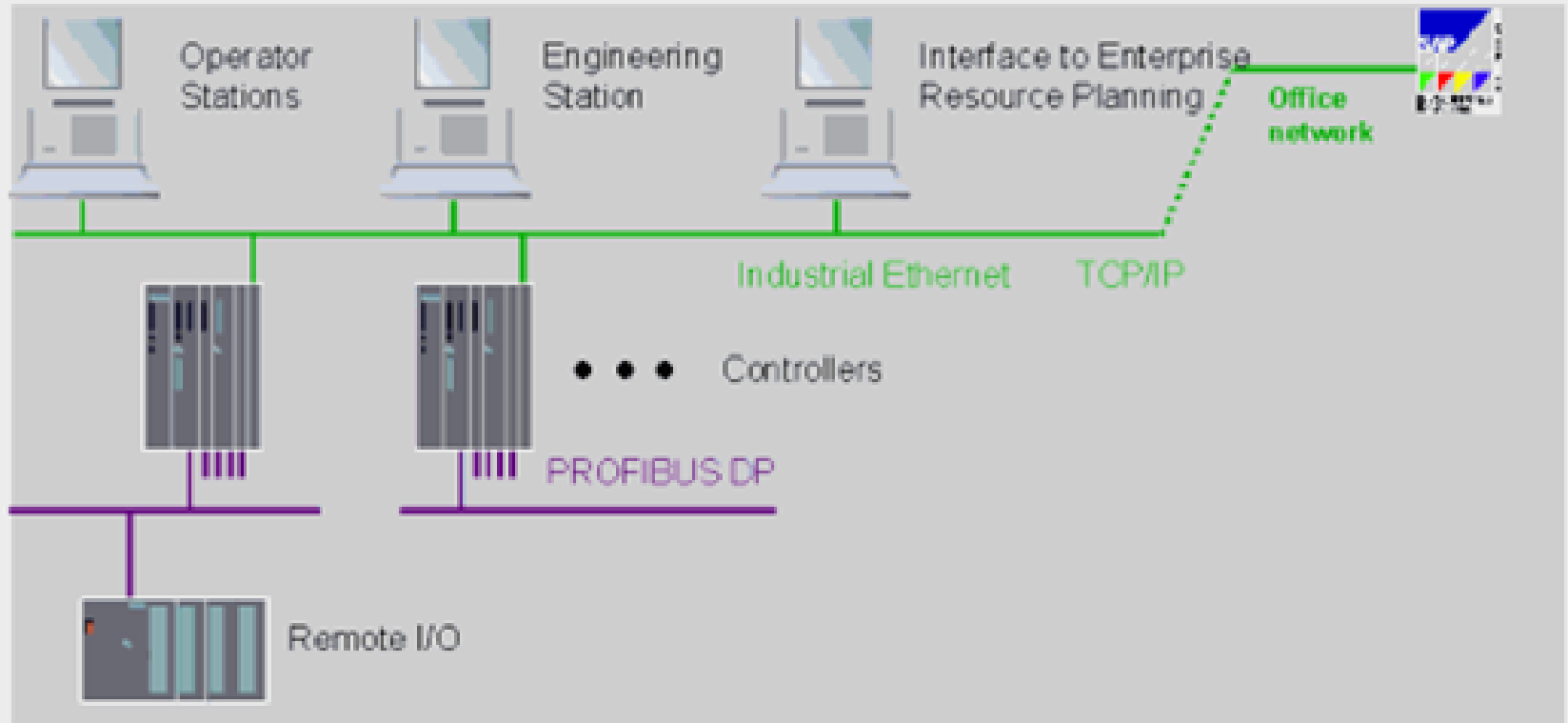
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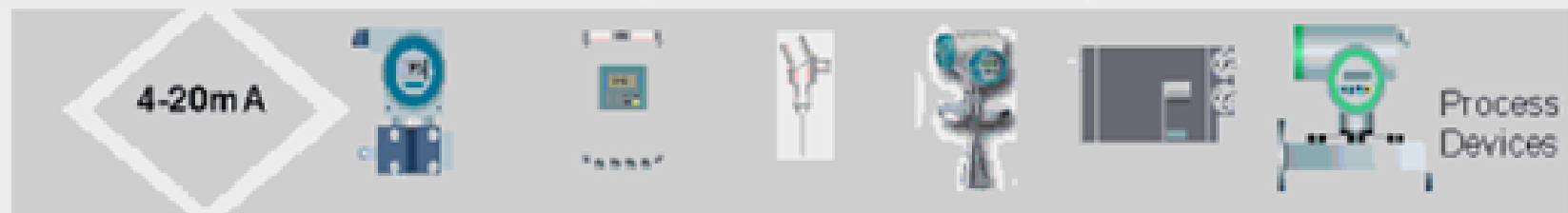
Comparison analogue
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Device Diagnostics

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Information Gap between field and Control System





PROFIBUS PA closes the Information Gap between field and Control System

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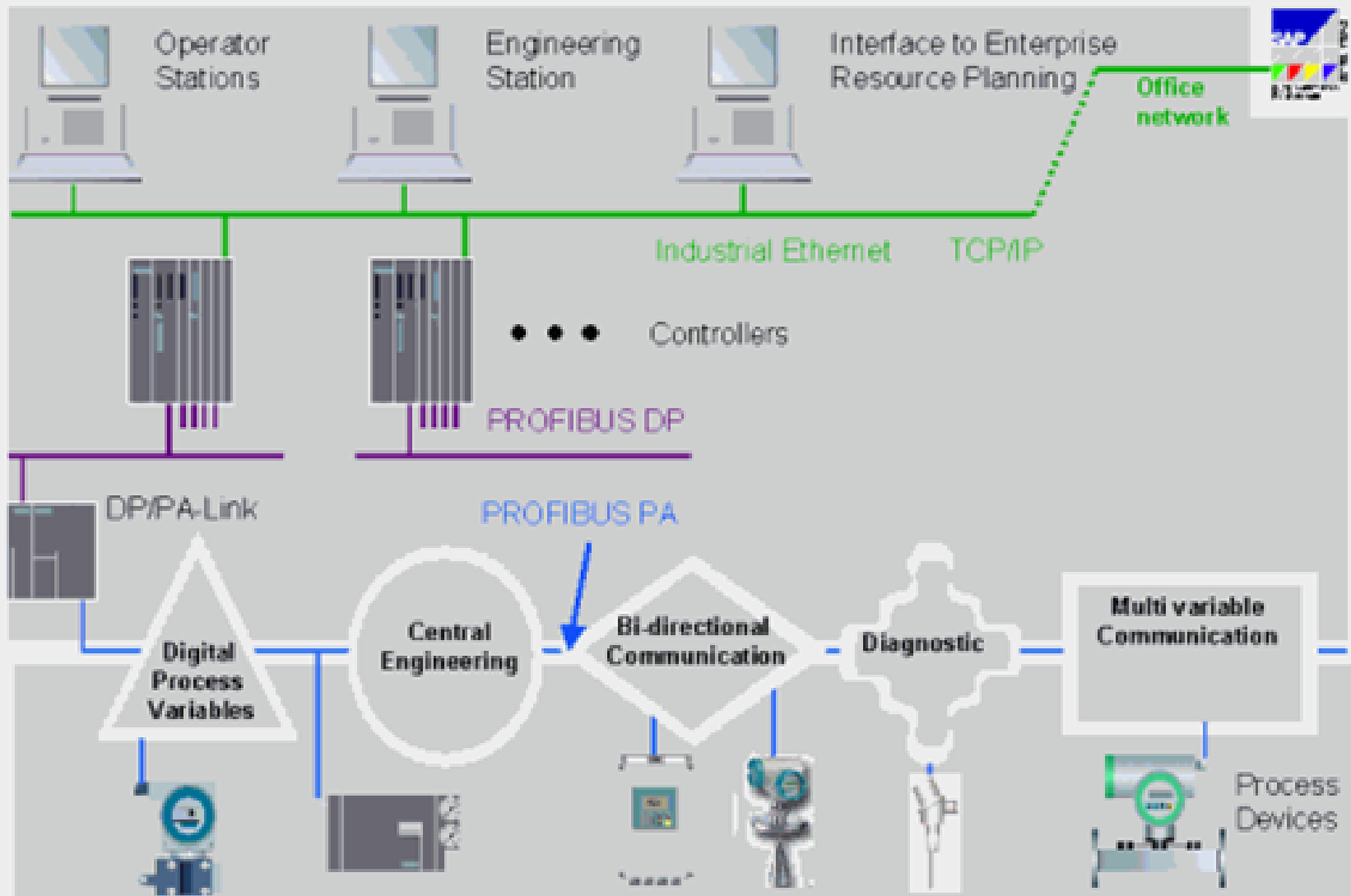
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Diagnostic sensor failure, device failure, overload PROFIBUS PA versus 4 to 20 mA

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- Sensor failure
- Device failure
- Overload



- Online Diagnose provides instant information regarding nature of failure
- Failure can be cured immediately

- Failure can only be identified if signal is outside 4 to 20mA
- Local inspection of measuring point is necessary
- Elimination of failure is delayed

Recognition of irregular operating conditions PROFIBUS PA versus 4 to 20 mA

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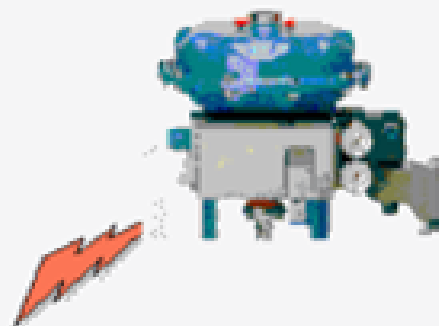
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Vendors and Products

SIPART PS2
Valve positioner



- Loss of instrument air
- Ambient temperature outside specification

PROFIBUS DP
DP/PA-Link
PROFIBUS PA

- Online diagnostic of PROFIBUS PA recognises immediately irregular operating conditions
- Problem can be cured immediately



- Irregular operating conditions will not be identified

PROFIBUS DP
Remote I/O
4 to 20 mA

Process device requires maintenance PROFIBUS PA versus 4 to 20 mA

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- Valve travel
- Position of hard stops
- Travel time, open/close
- Operating hours of valve exceed alarm limit in positioner

Valve positioner can monitor itself, the actuator and the valve regarding maintenance required

- Online diagnostic of PROFIBUS PA provides instant information that maintenance is required by Process Device
- Maintenance can be performed as and when it suits operation
- Maintenance depends on status of Process Device



- Process Device can not require maintenance



SIMATIC PCS7 and PROFIBUS

Diagnostic display of Process Devices in OS

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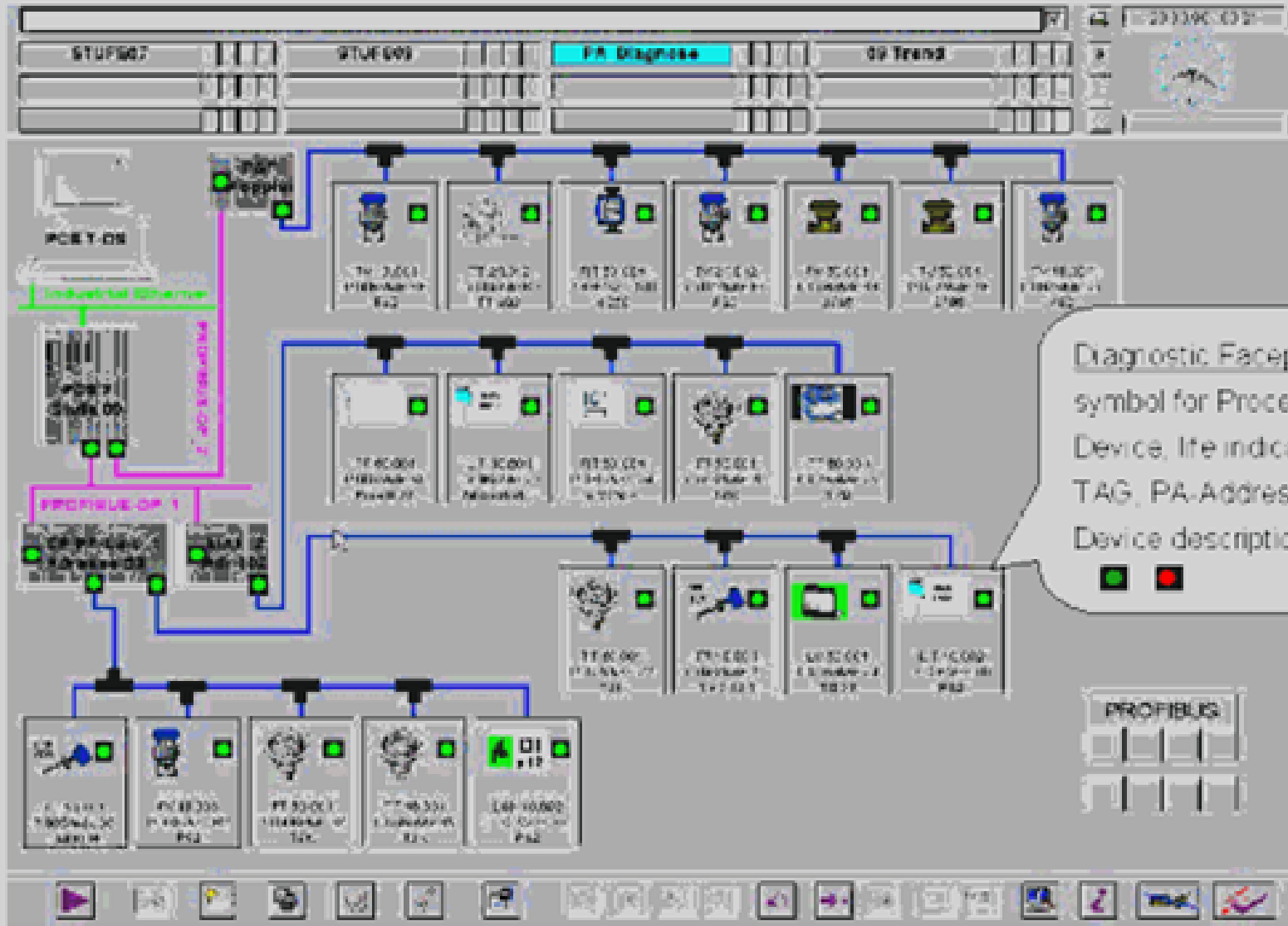
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Diagnostic Faceplate incl. symbol for Process Device, Life indication TAG, PA-Address, Device description



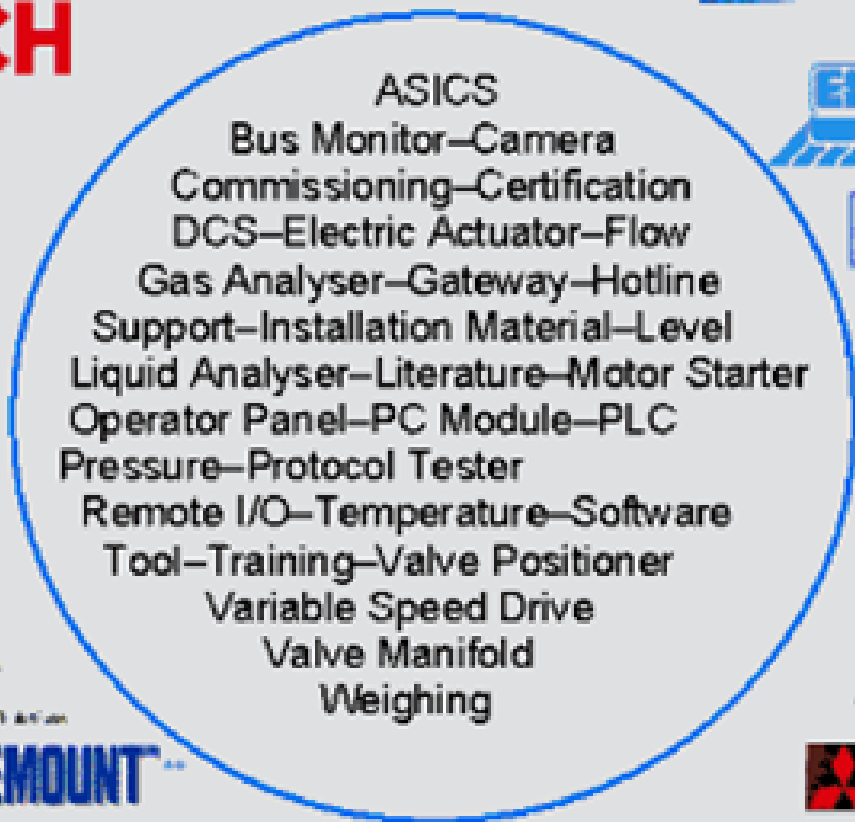


PROFIBUS Vendors and products

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Hartmann & Braun



- more than 1000 companies are member of PROFIBUS International
- more than 2000 products for PROFIBUS are available

Reference: <http://www.profibus.com>

* Random list
 ** Not a member of PI

