

PROFINET Technology



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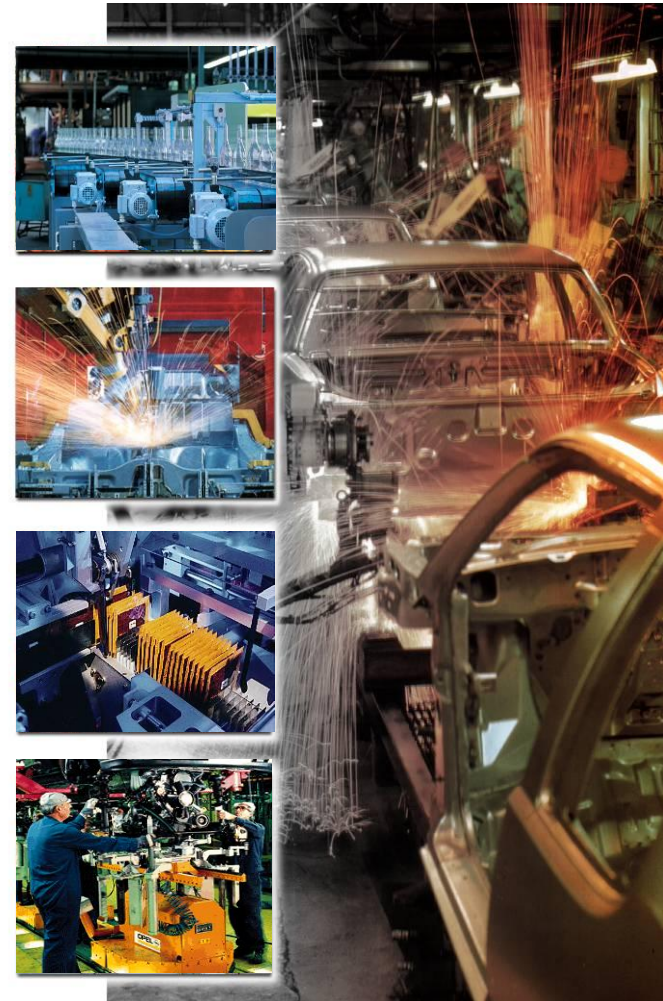
FEB 13, 2013

Trend away from central control structures to distributed local units

Use of Ethernet in all levels of automation

Increase in use of open IT standards in automation

IT and automation world are growing together



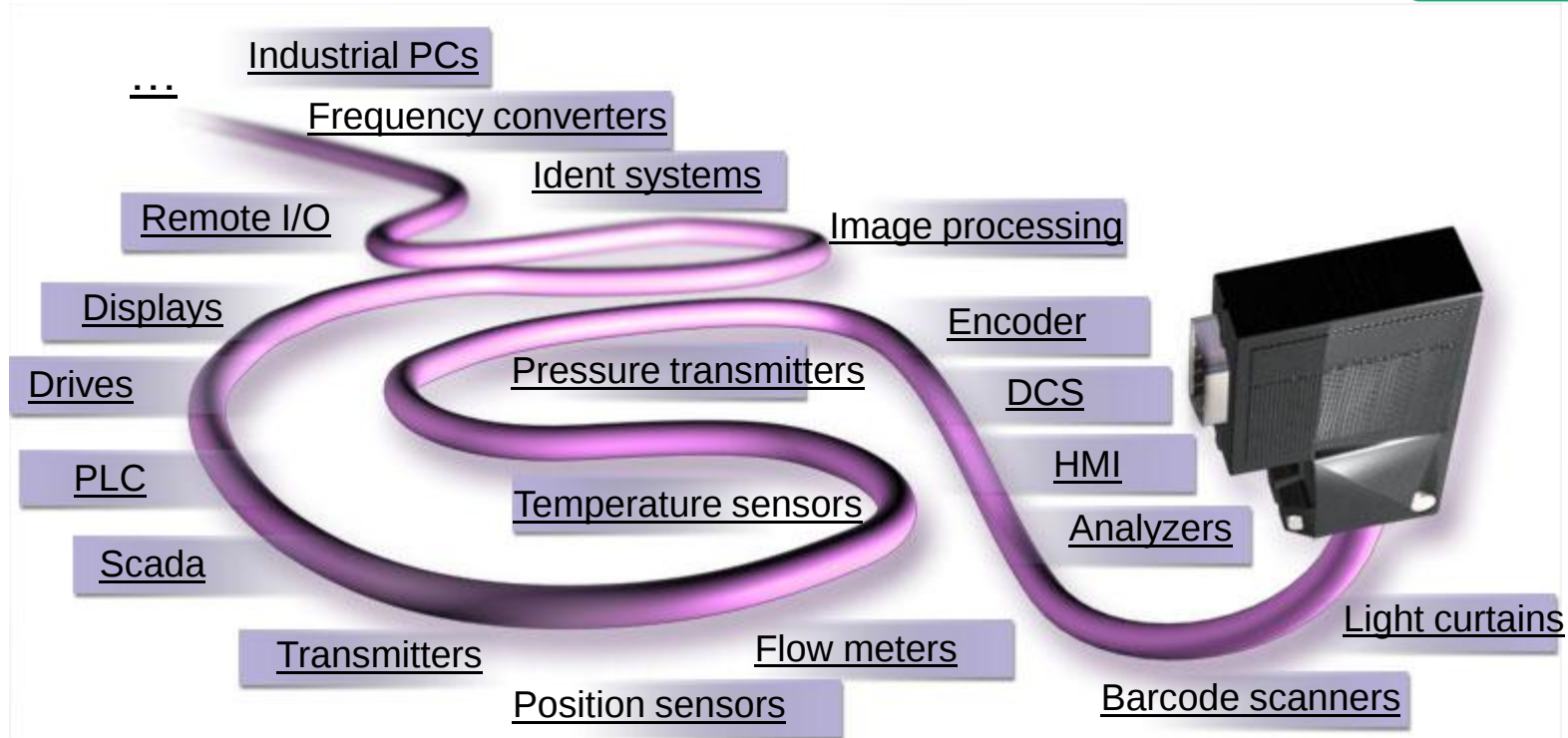
PROFIBUS?

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



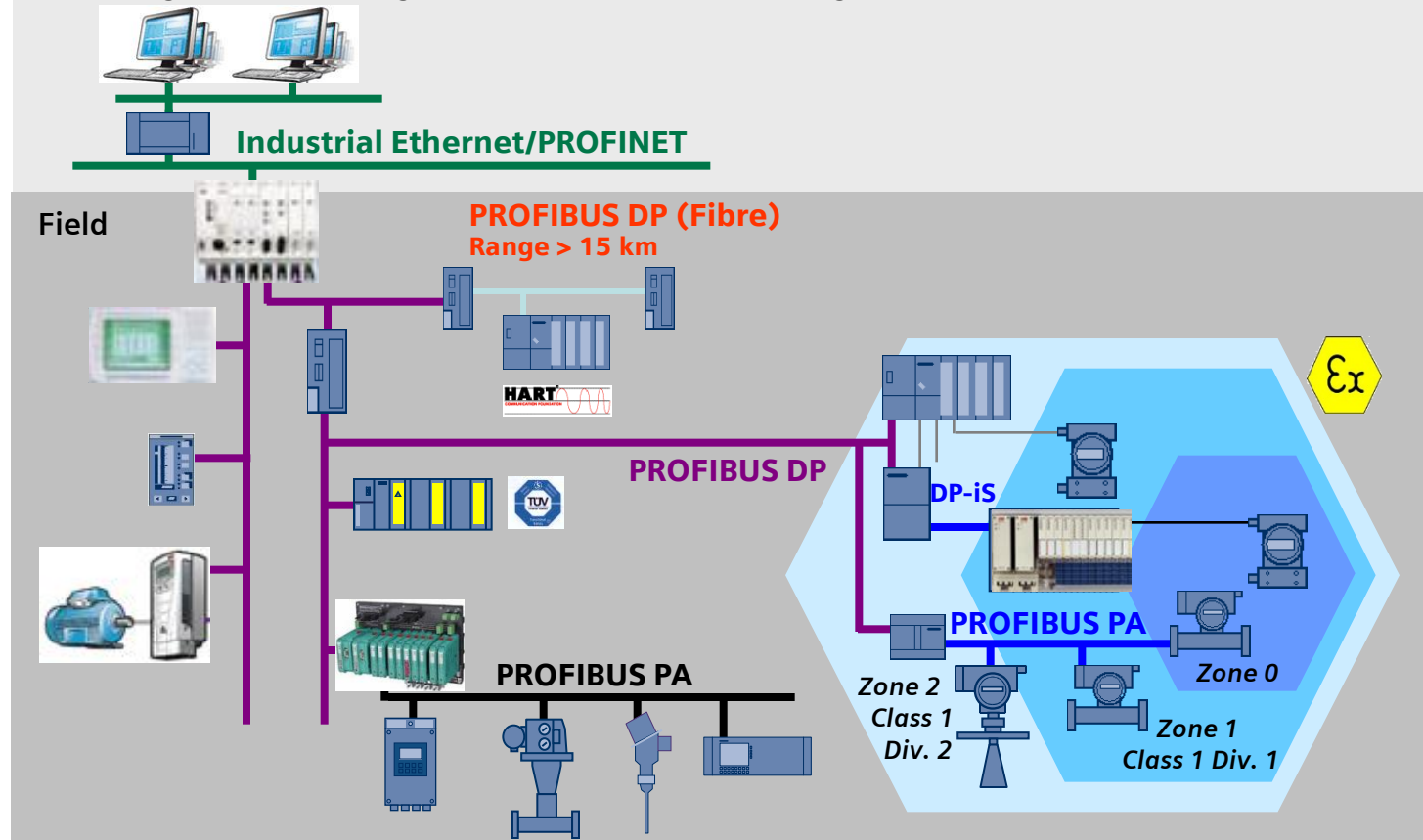
More than 2500 products available
from more than 200 manufacturers

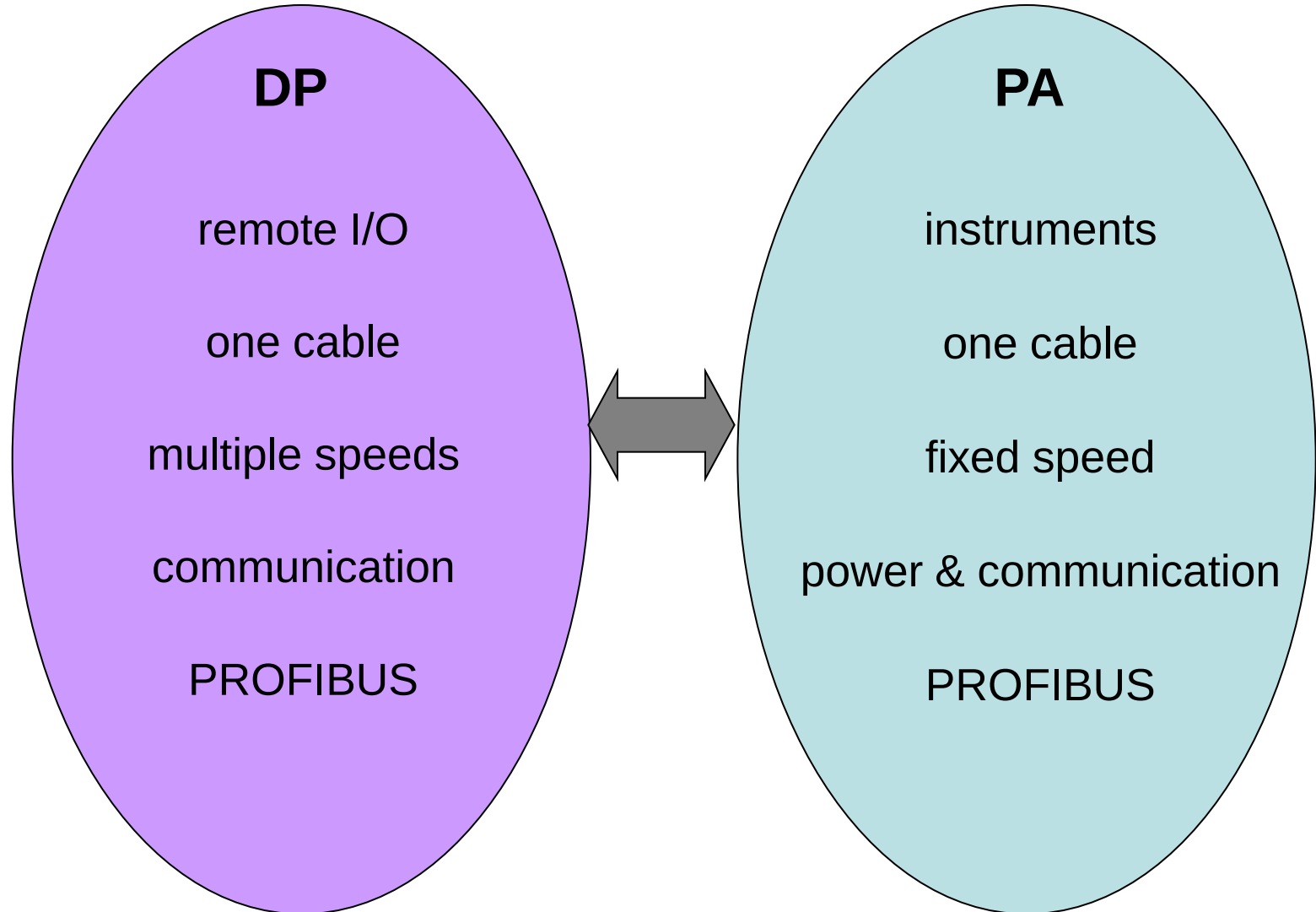
User-friendly search functions

Continuous updates by member companies

PROFIBUS Architecture

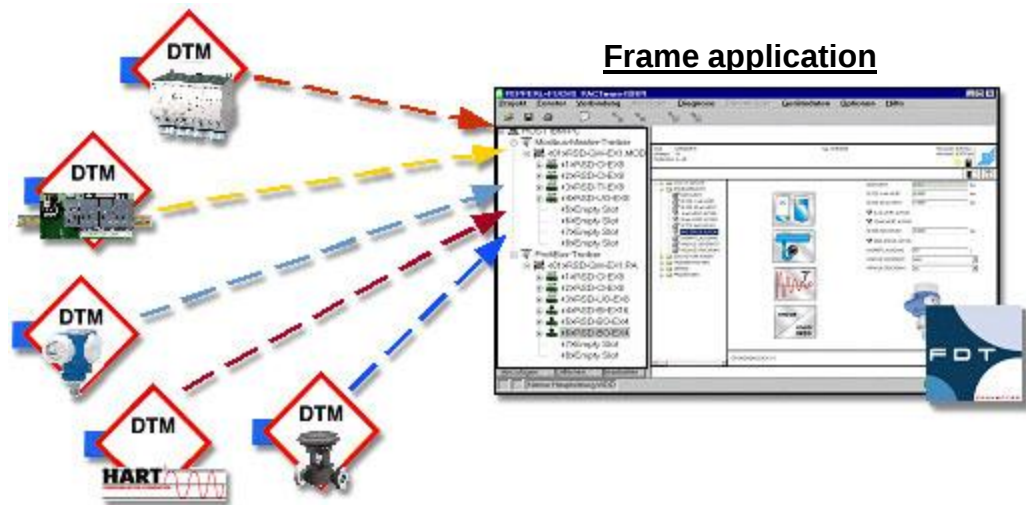
Operating and monitoring / Data collection and exchange





FDT/FDI/EDDL

- is a vendor-independent, open interface specification (not a "tool")
- serves as the interface for the open connection of field devices of different manufacturers to tools and control systems using DTM, EDDL
- defines the interaction between the DTMs and an FDT frame application in the engineering system



Data Rate vs Segment Length

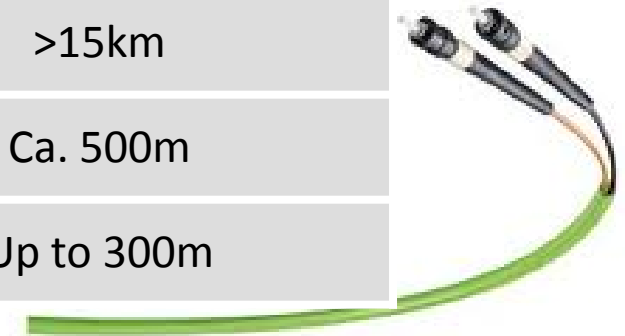
Transmission Rate (kbps)	Max Segment length (m)
9.6; 19.2 ; 45.45 ; 93.75	1200
187.5	1000
500	400
1500	200
3000; 6000; 12000	100



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 Top 5 Faults*

1. Termination
2. Power Lines
3. Cabling Rules
4. Configuration Faults
5. Damaged or non-certified interfaces

*Based on over 300 field studies carried out by PROCENTEC

A uniform network structure

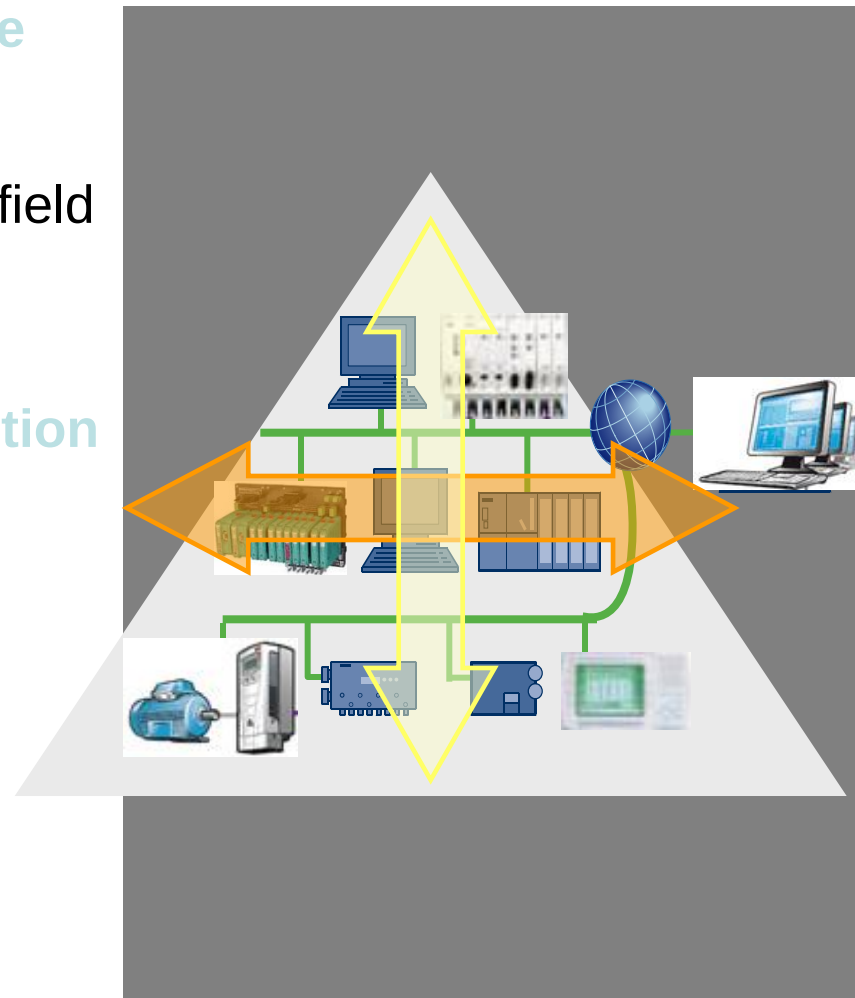
- Reduce the interfaces
- Plant wide Engineering
- Continuity through to the field level

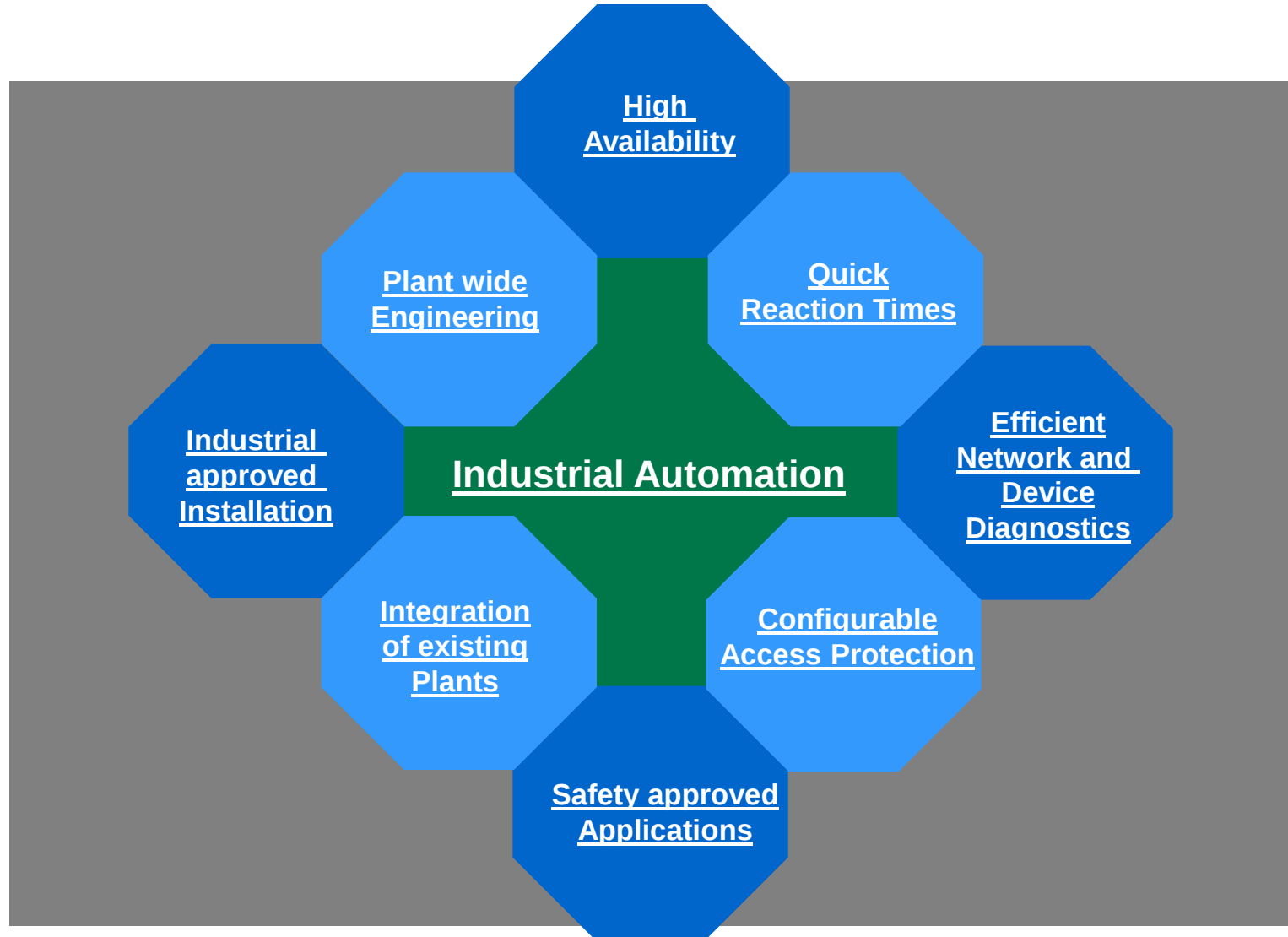
Use the advantages of IT-technology in the production area

- Remote Access
- Web services
- Software updates

Improvements relative to today's systems

- High performance
- Unlimited quantities
- Simple handling







PROFINET is the open Industrial Ethernet standard from PROFIBUS & PROFINET International (PI)

PROFINET is based on Industrial Ethernet

PROFINET utilizes TCP/IP and IT-Standards

PROFINET is Real-Time Ethernet

PROFINET allows seamless integration of fieldbus systems

PROFIBUS & PROFINET International (PI)

25 Regional
Associations
(RPA)

35 PI Competence
Center (PICC)

8 PI Test
Laboratories (PITL)

More than 1,400 members world wide

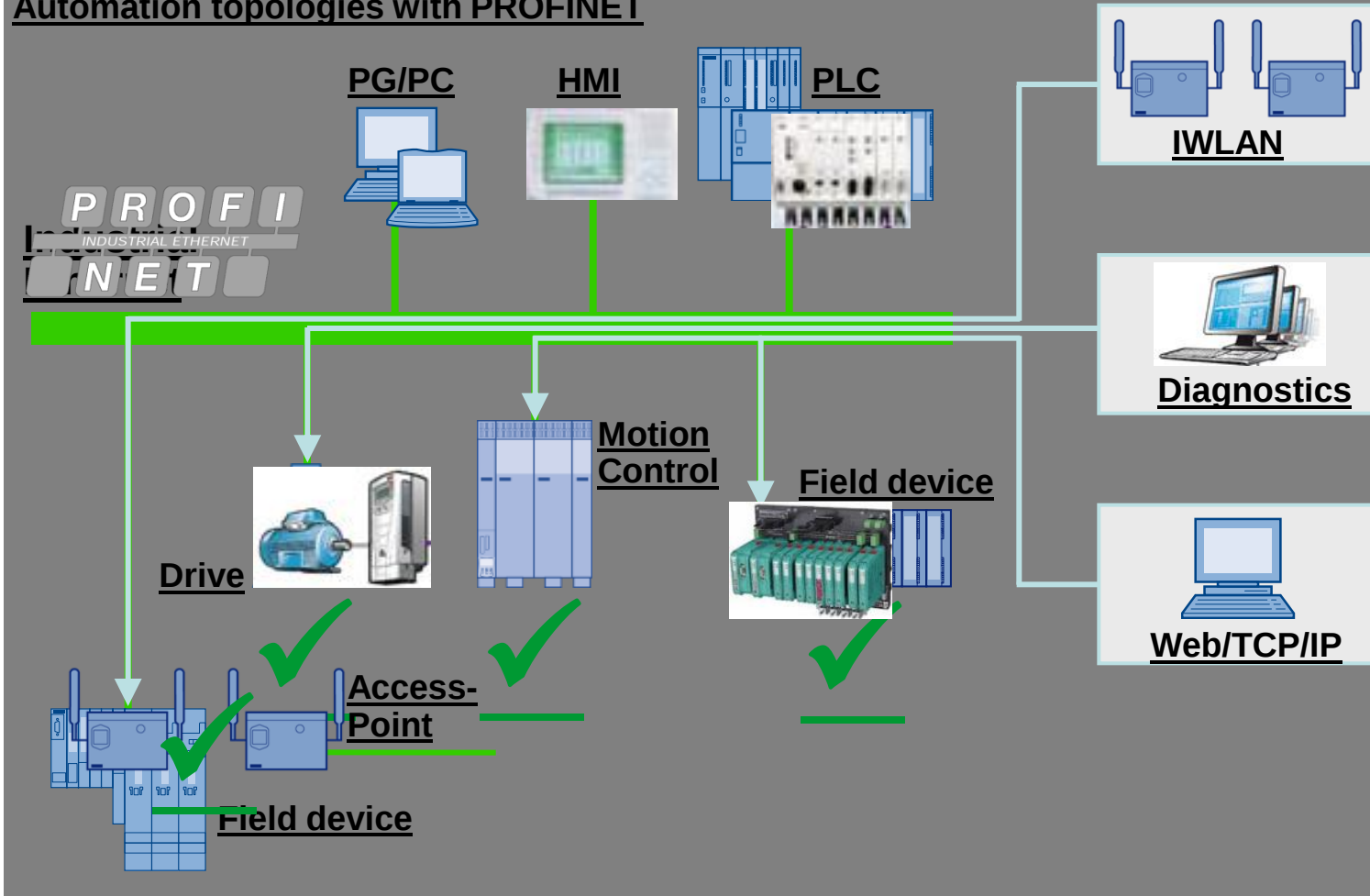
The architecture is being devised by

- 12 working groups
- with 140 employees
- from 60 companies



PROFINET – from the world's largest fieldbus organization

Automation topologies with PROFINET



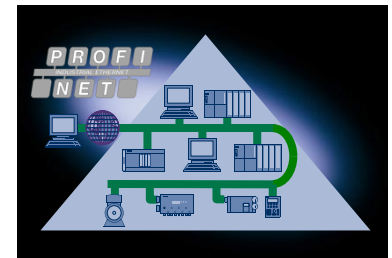
With PROFINET –
use one bus for all your tasks!!

Benefits and added value for customers

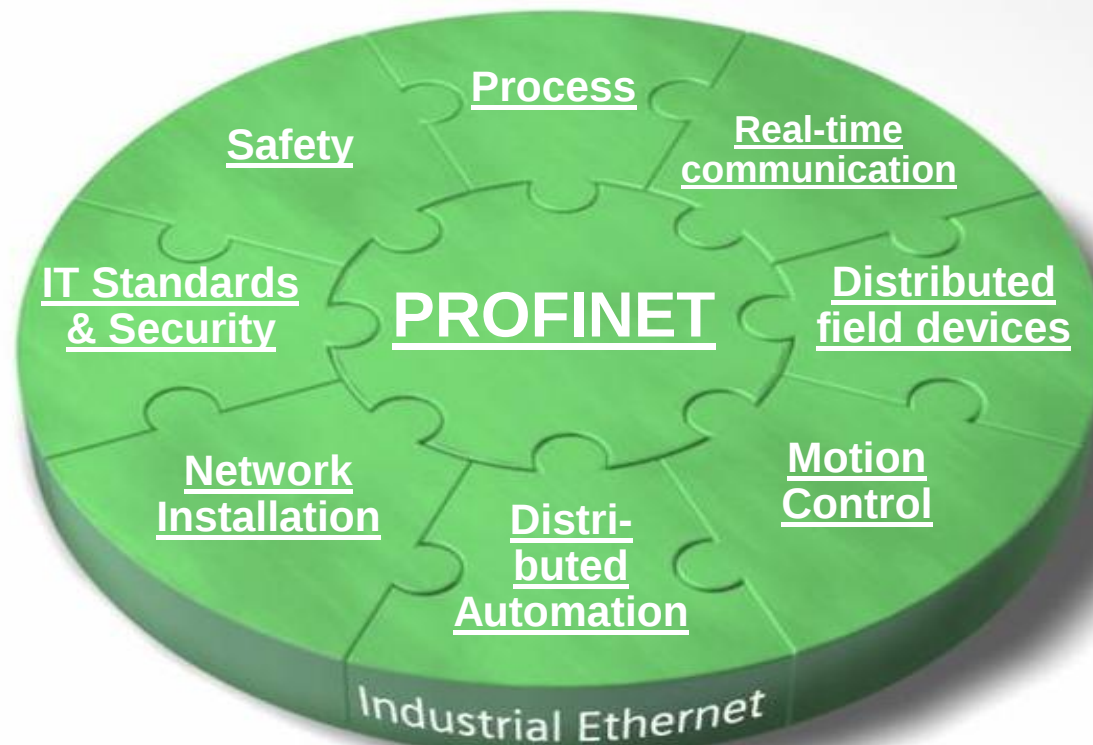
Connect any automation device to any point

All automation applications run via just one cable;
Real-time and TCP/IP

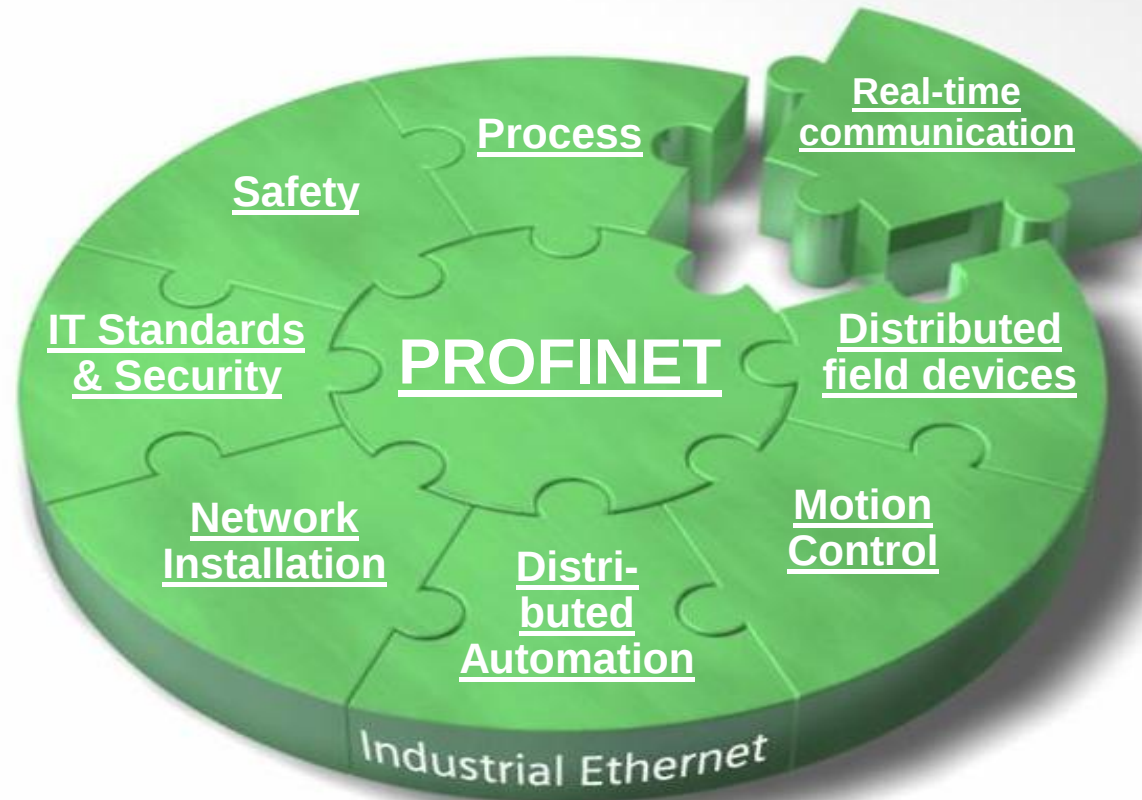
Standard and failsafe automation
via one cable; if need be,
also wireless with Industrial WLAN



Flexibility and cost reduction
for engineering, installation and maintenance



PROFINET – the comprehensive Industrial Ethernet Standard



Uniform communication and quick reaction times

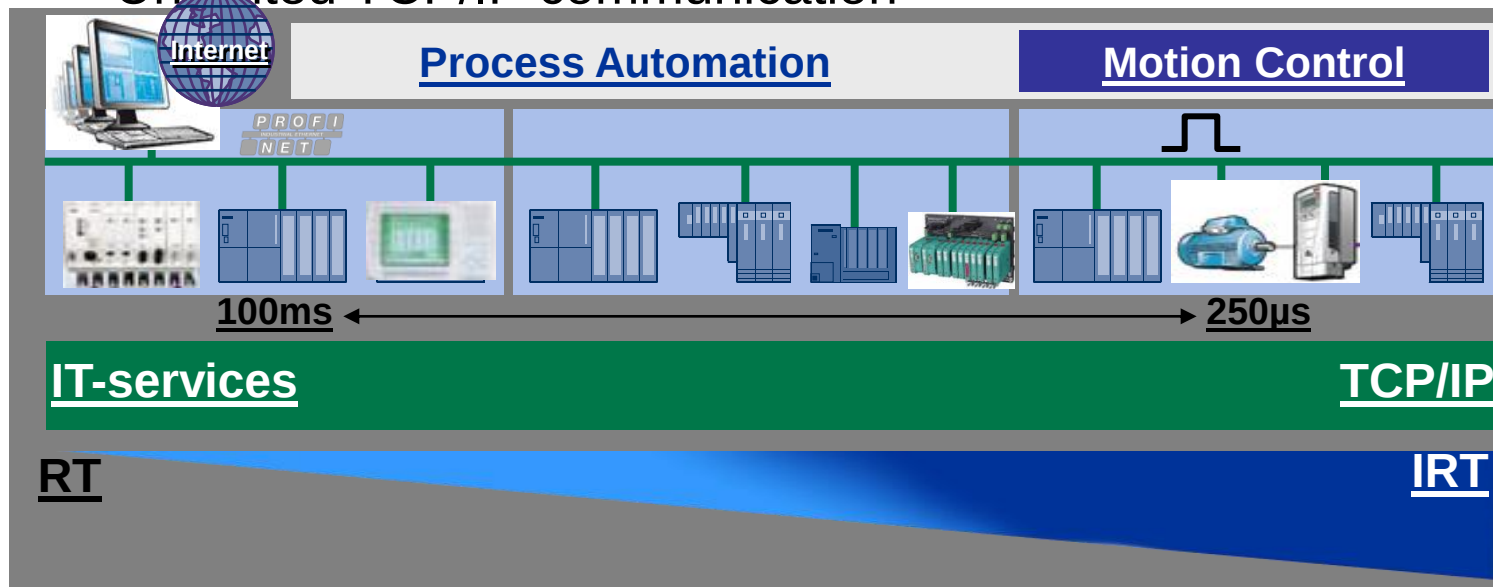
Simultaneous real-time and IT-service on one cable

Scalable real-time communication from non-critical time applications up to high performance applications

Real-Time (RT)

Isochronous Real-Time (IRT)

Unlimited TCP/IP communication



Standardized telegram format according to IEEE 802.3
Ether type according to IEEE for PROFINET real-time telegrams

0x0800: IP telegram

0x8892: PROFINET real-time telegram

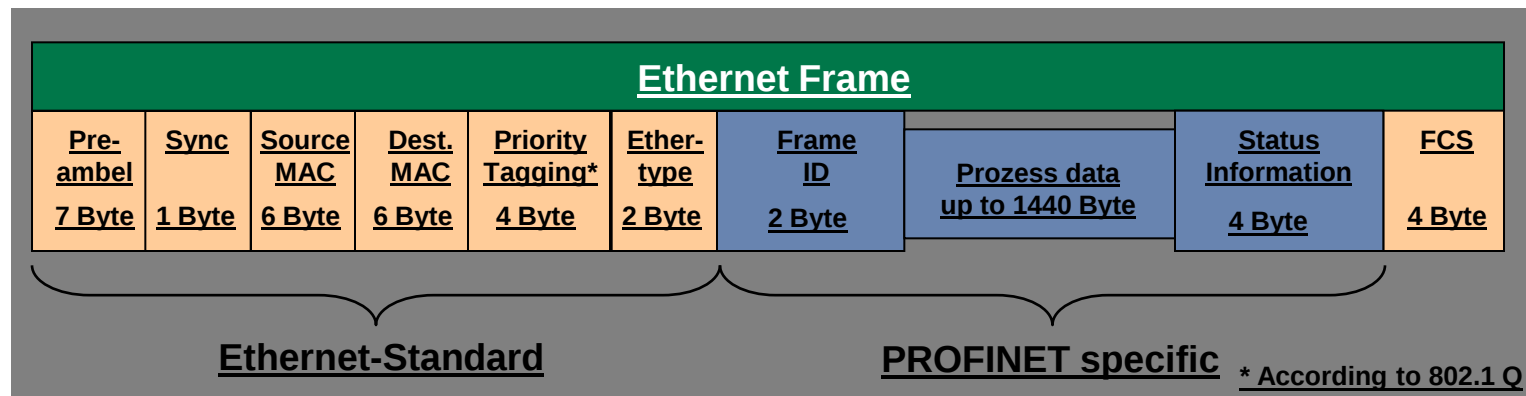
Allocation of the received data via the Frame-ID

Cyclical transmission (process values)

Event triggered transmission (alarms and events)

Status information

Device and data status (e.g. Run, Stop, Error)

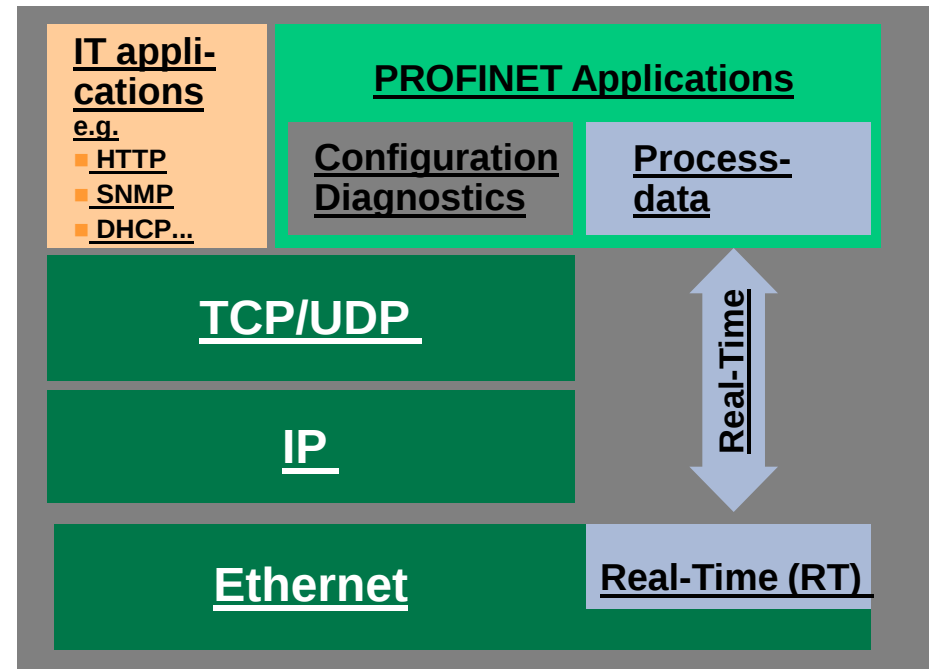


Use of standard components, e.g. Switches

Same performance class as today's fieldbus systems (e.g. PROFIBUS)

Typical application is factory automation

High Performance by minimizing the stack processing time



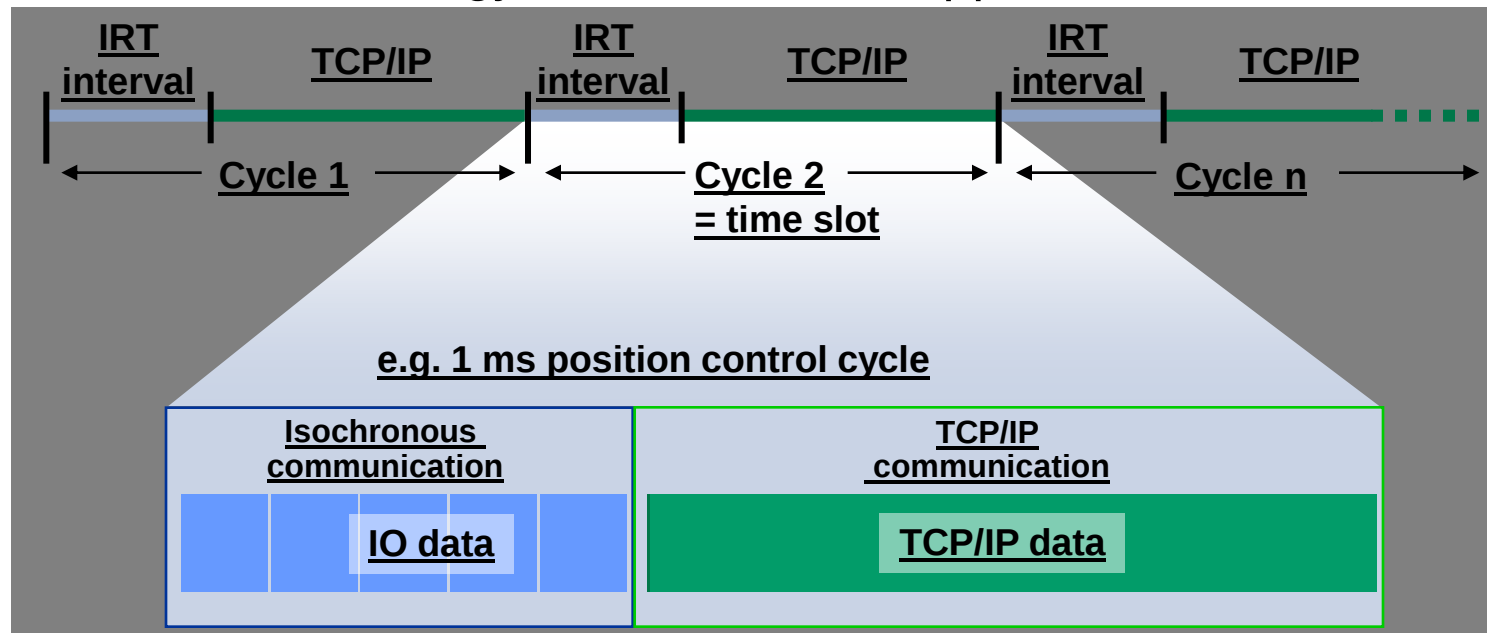
Hardware support for the allocation of time slots
for real-time message frames

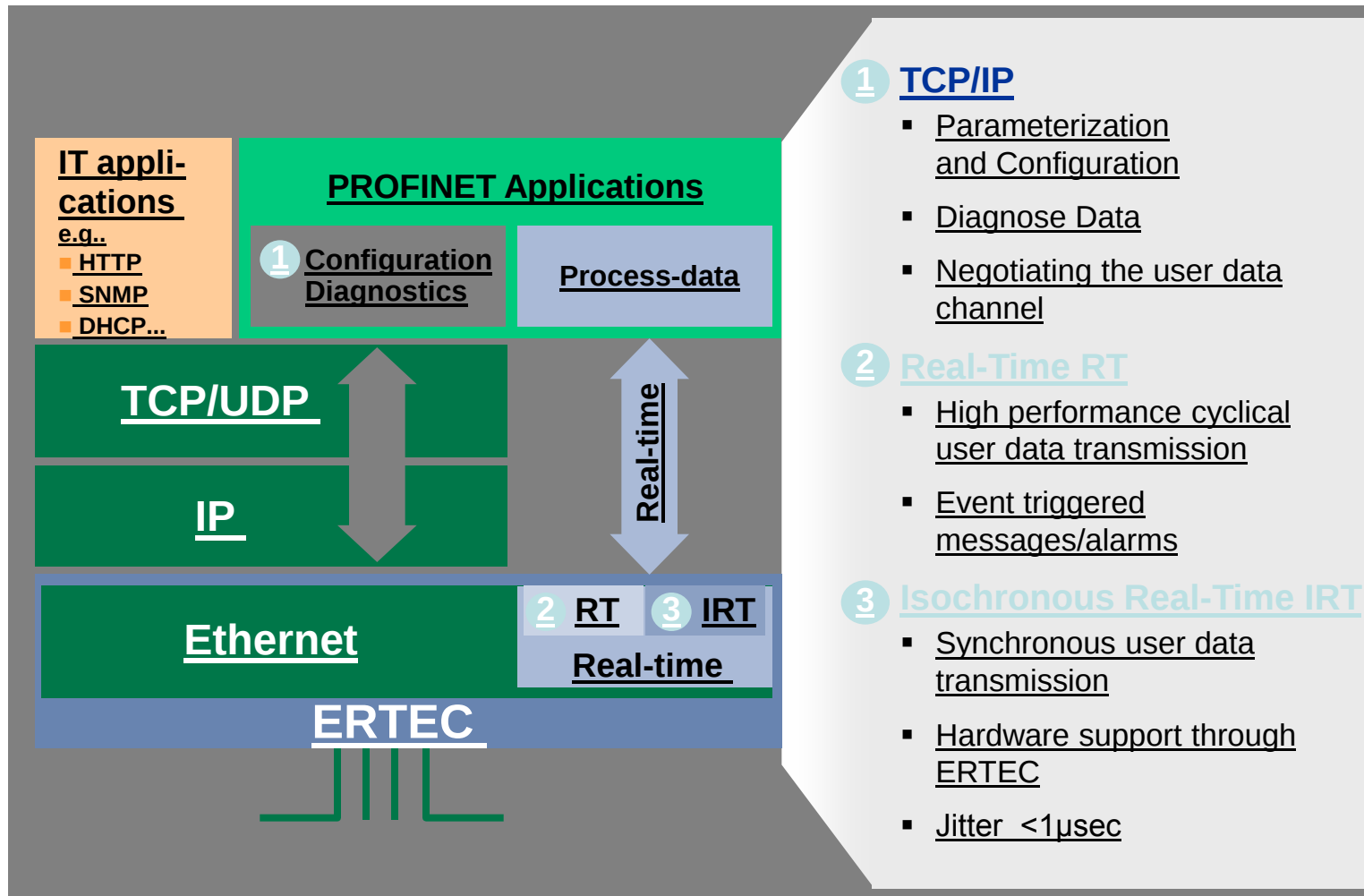
No influence on real-time characteristics by
TCP/IP or broadcast/multicast communication

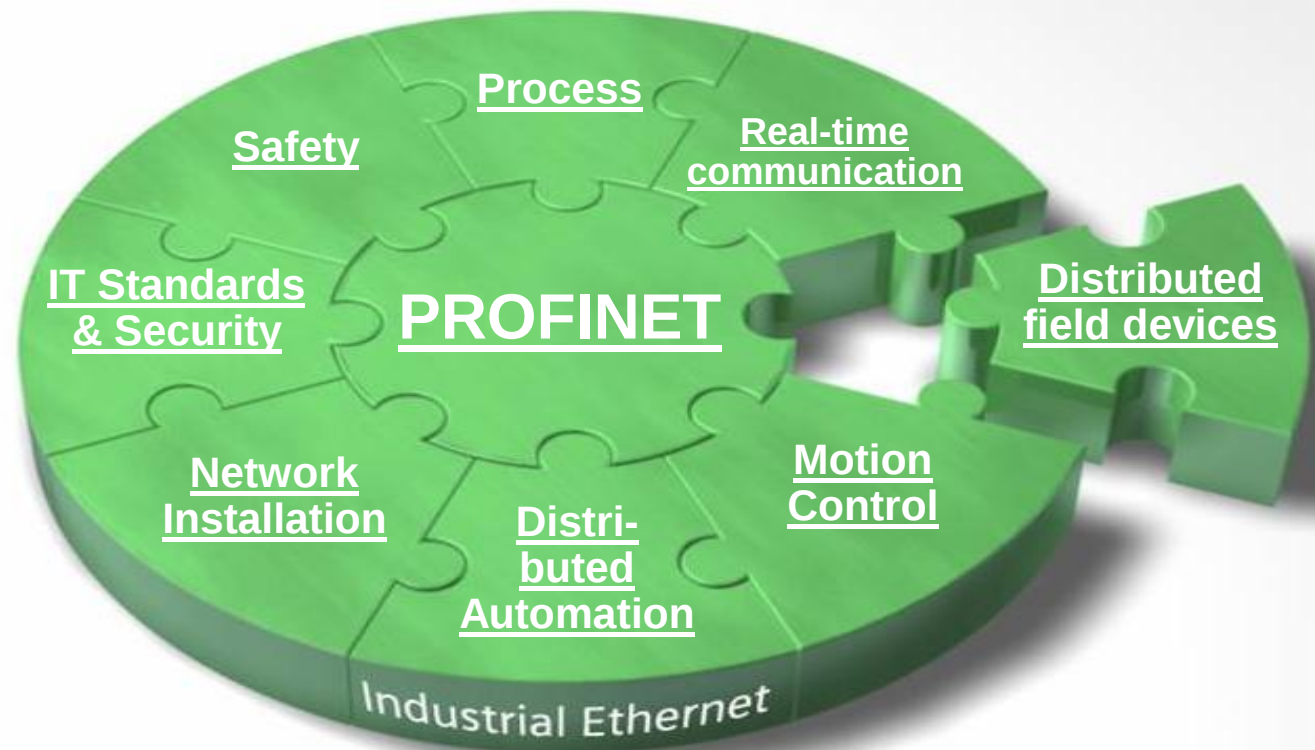
High level of performance, even in the case of
cascaded switches

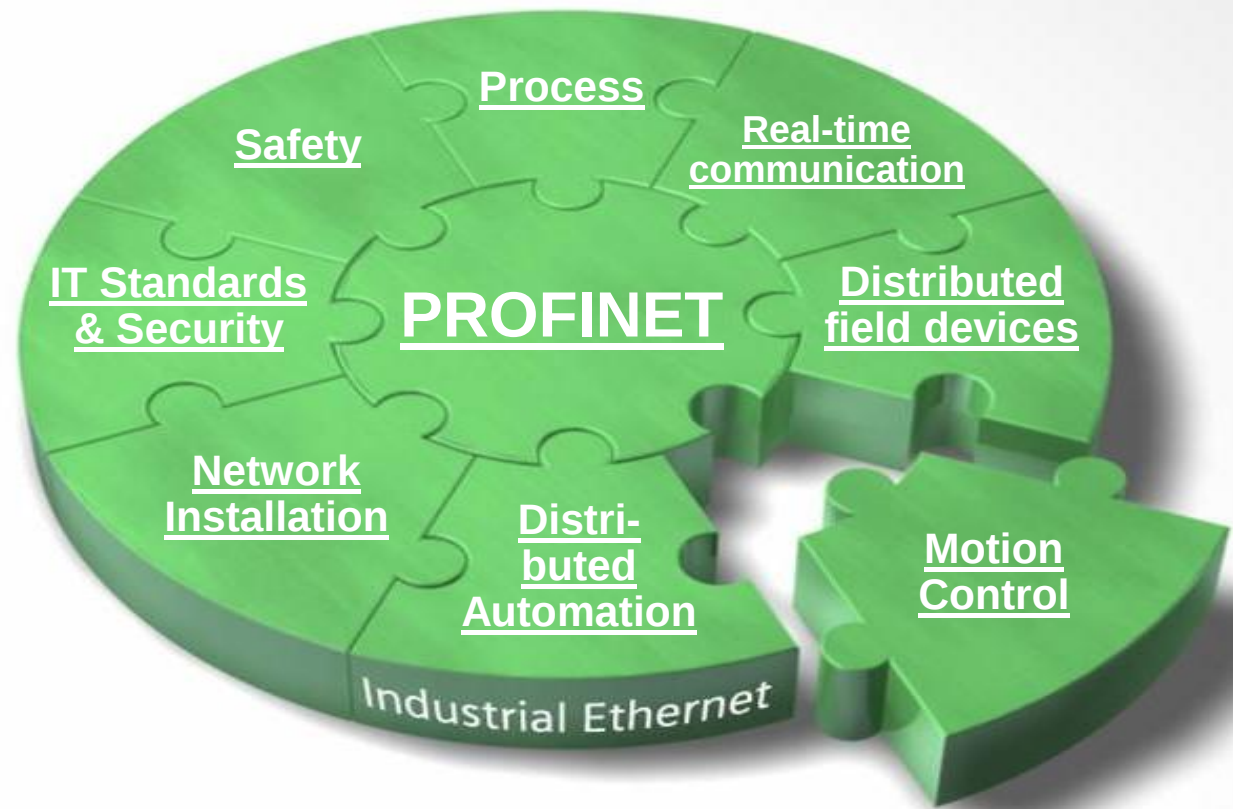
Accurately timed data transmission

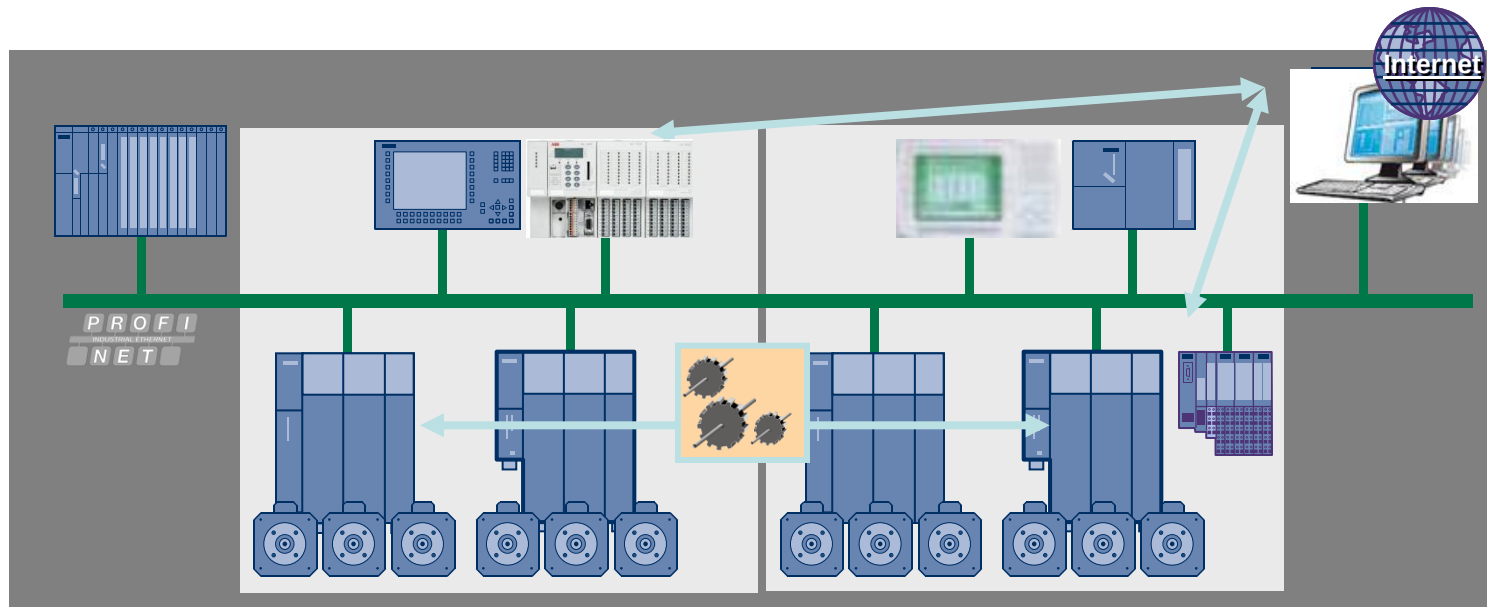
Basic technology for isochronous applications











Synchronization of drives over the bus system between controller and drives

Closing of the controlled system via bus system
(constant dead time)

Short and deterministic cycle times/response times of up to 250µs, jitter < 1µs

Interoperability thanks to PROFIdrive, the application profile for drives on PROFIBUS and PROFINET

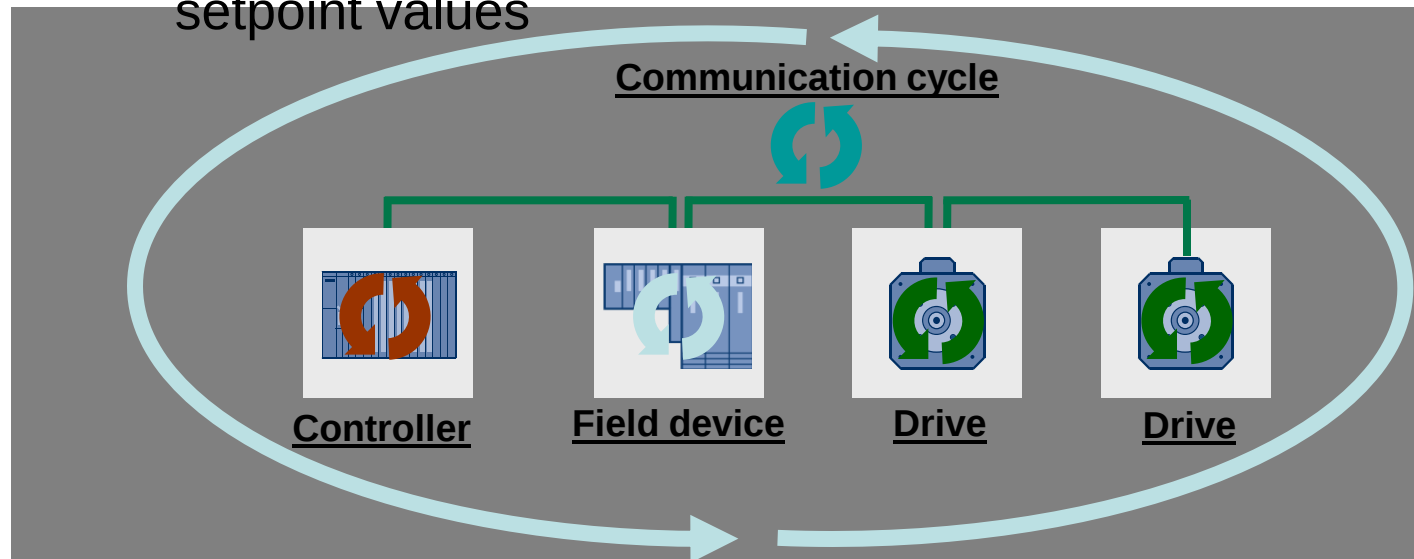
TCP/IP for engineering, diagnostics and HMI integration

Synchronization of the control cycles to the bus cycle

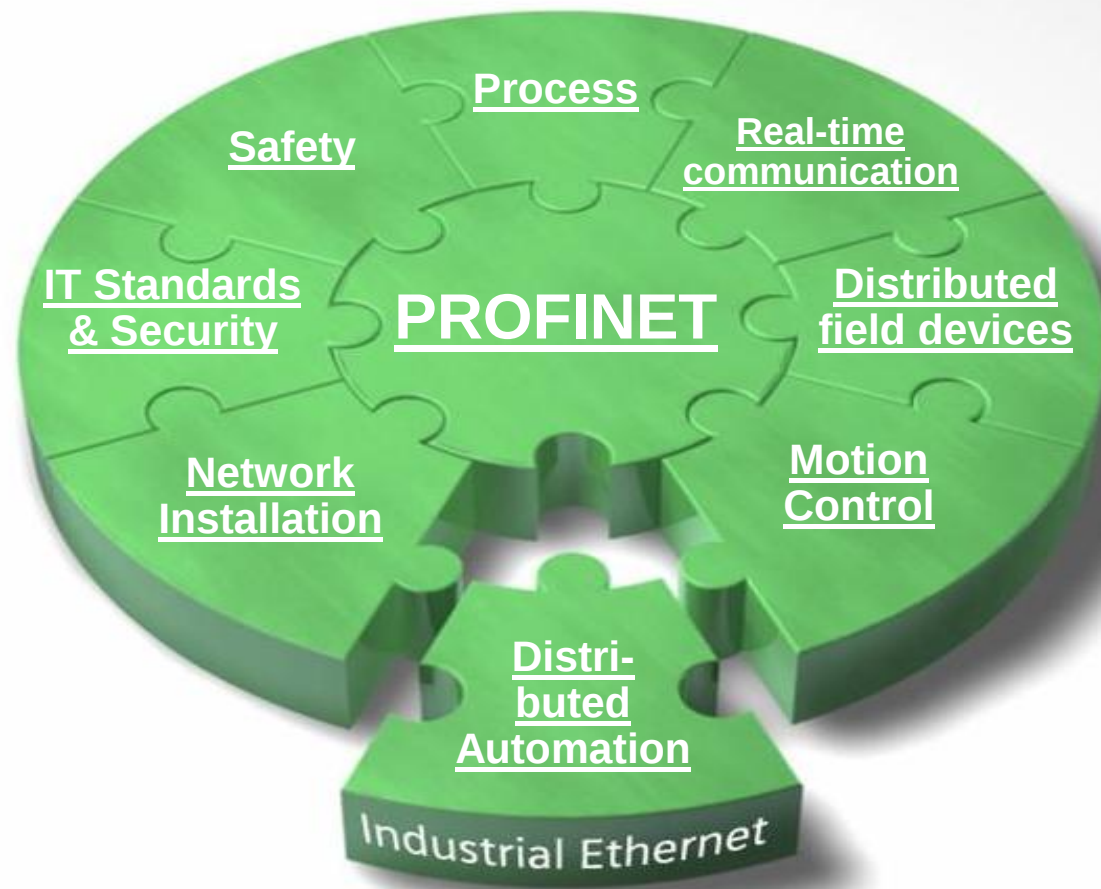
Closing of the control loops via the bus

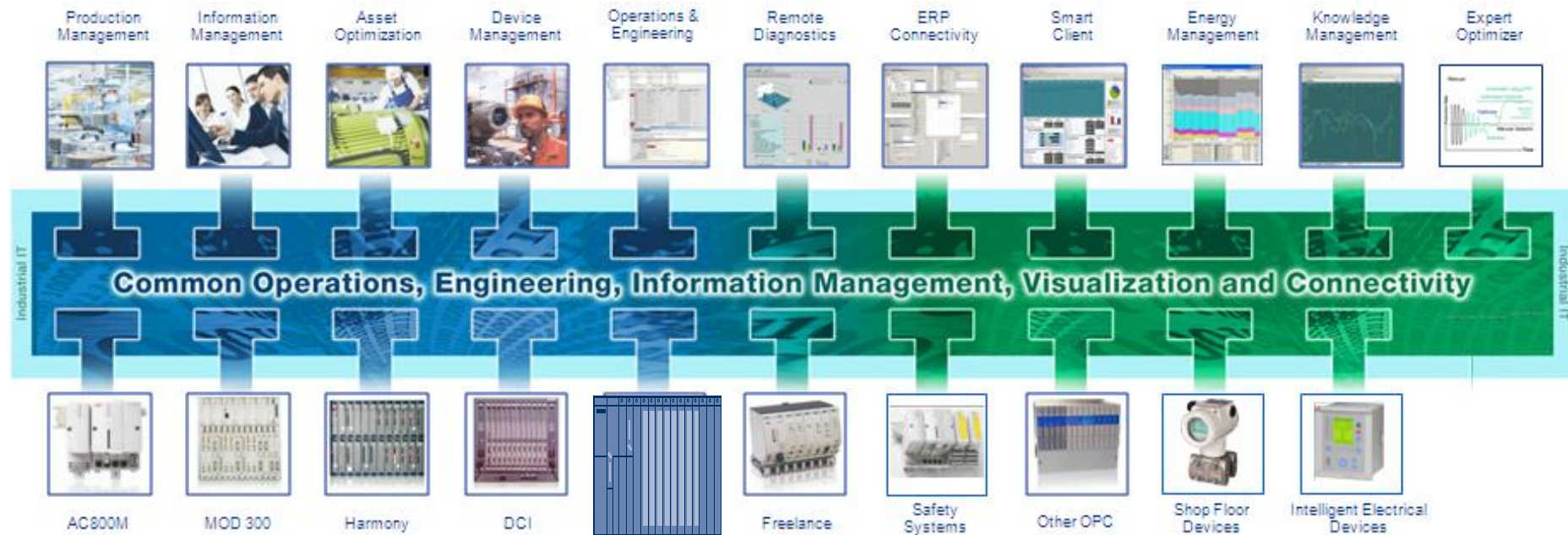
Isochronous synchronous acquisition of the actual position values

Isochronous synchronous activation of the setpoint values

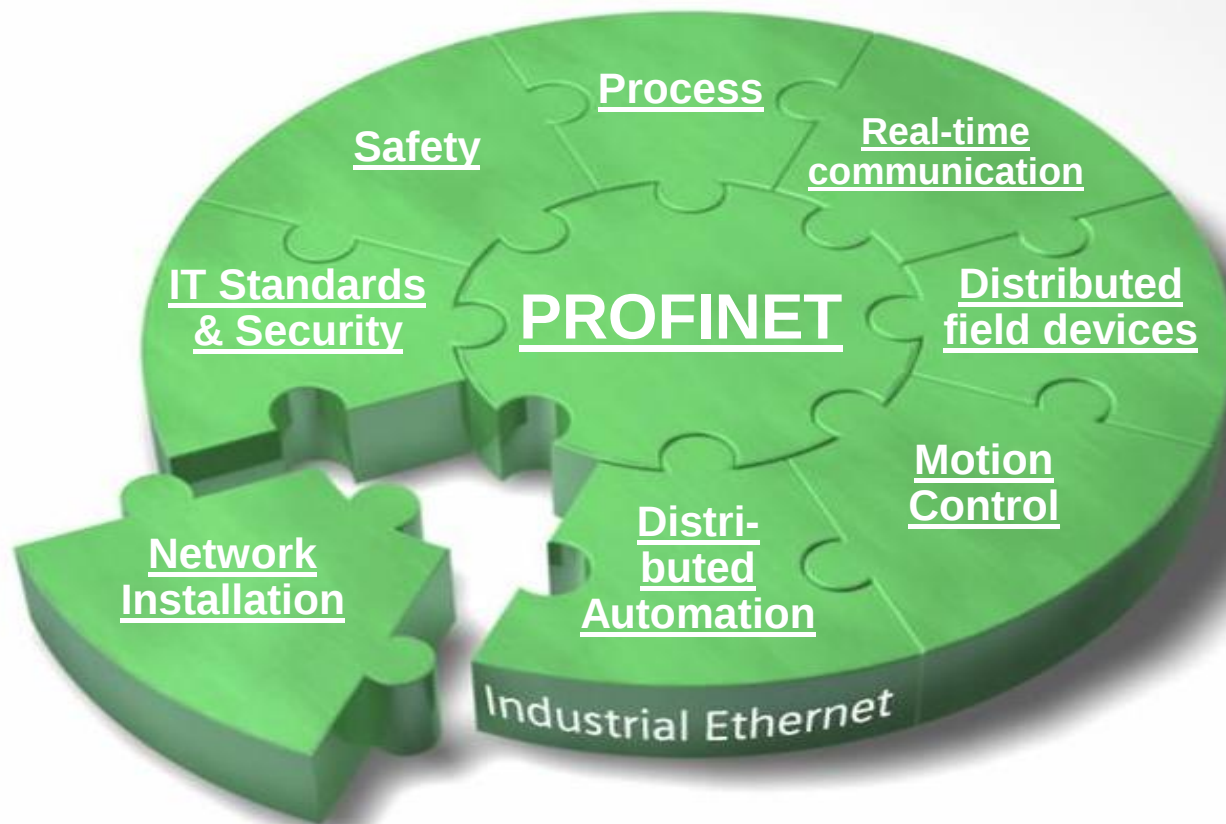


Perfect for distributed motion control tasks such as line shaft, synchronism, ... multi-axis applications





Data that comes from various sources can be accessed by multiple applications without separate interfaces!



PROFINET utilizes 100 Mbit/s Switched Ethernet

PROFINET utilizes Industrial Ethernet components based on the well-known IEEE standards

The Industrial Ethernet components supplement or expand the standard with special properties and features in order to fulfill the increased demands on industrial communication

Ethernet for industrial data communication since 1985



Thanks to PROFINET, Industrial Ethernet is penetrating even the field level!

The “PROFINET Installation Guide“ supplements the standards for structured building cabling to meet the special requirements of the industrial sector

Network operators:

Simple rules for network installation

No network specialist knowledge required for the installation of PROFINET

Device manufacturer:

Definition of accurate information for the device development

Mechanical and electrical features of interfaces



PROFINET

Guideline

Installation Guideline PROFINET
Part 2: Network Components

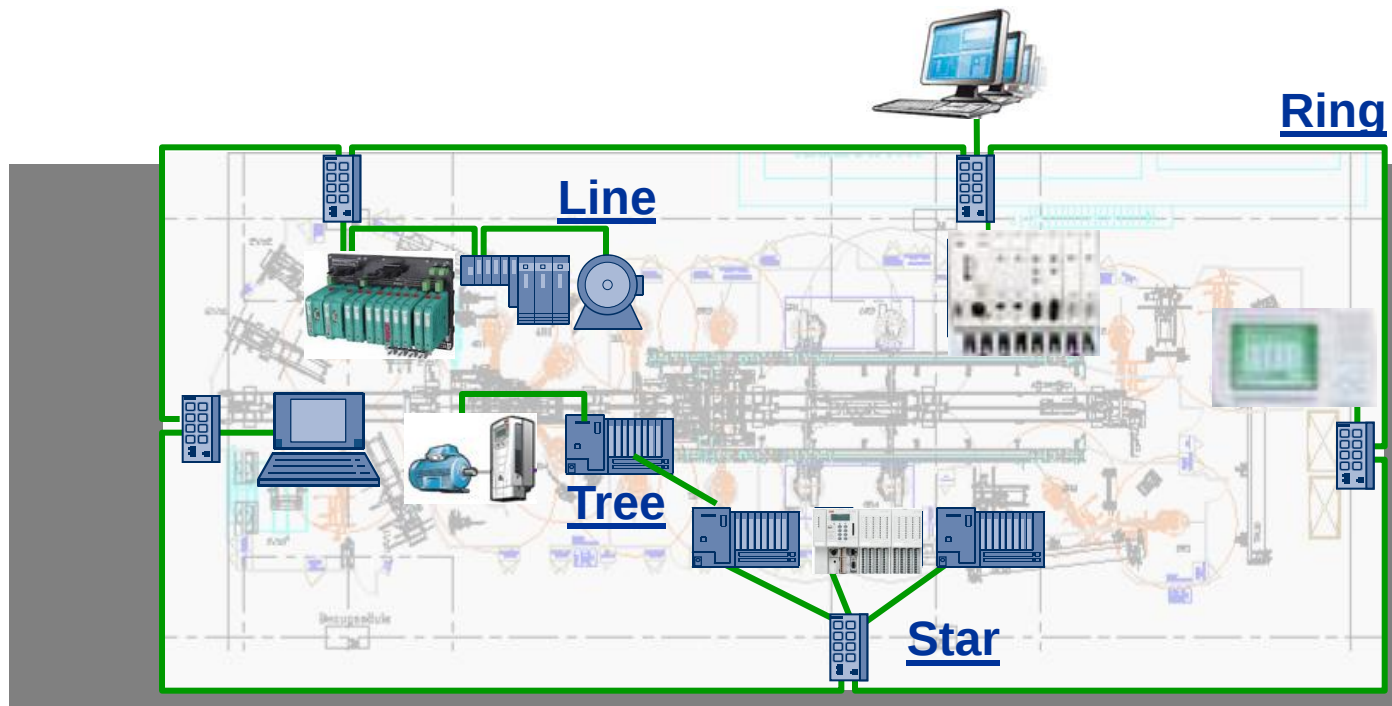
Version 1.01
February 2004

Order No: 2.252 p2

All topologies can be used

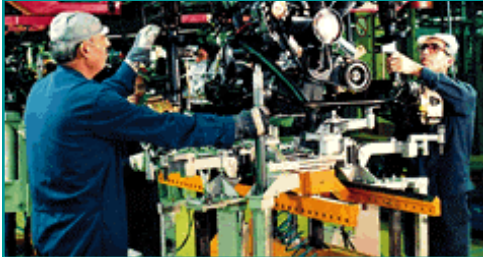
Ring structure guarantees high availability

Line minimizes the cabling overheads



Optimized network structures for cost savings in all applications

Differences between industrial network and office network

	<u>Industry</u>	<u>Office</u>
		
Location	Rough environment	Air-conditioned offices
Installation	Plant commissioning personnel	Network specialists
Topology	Plant-specific	Star
Availability	Network downtimes < 300 ms	Second to minute range accepted
Device density	Low, switches with few ports	High, switches with a large number of ports
Network monitoring	Part of plant monitoring	By specially-trained person(s)

Transmission technology based on copper compliant with 8802-3

Cables

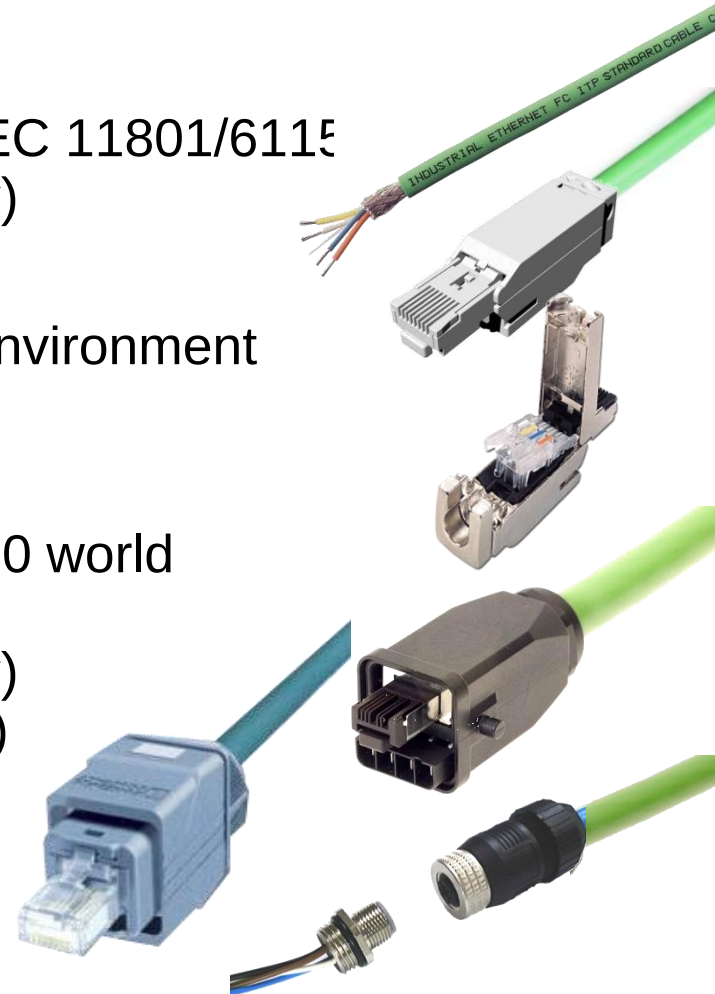
Twisted Pair compliant with IEC 11801/6115
Hybrid version (data + energy)

Connector IP20

RJ45 design from the office environment
Can be assembled in the field

Connector IP65

Compatible design for the IP20 world
Push pull design for data
Hybrid version (data + energy)
M12 circular connector (4-pin)
Can be assembled in the field



Transmission technology based on fiber optics compliant with 8802-3

Cables

Plastik fiber optic (POF*/PCF*)

Glass fiber optic cables compliant with
IEC 60793, 60794

Connector IP 20

SC RJ Push/ Pull connectors for POF, PC
and Glass fiber optic

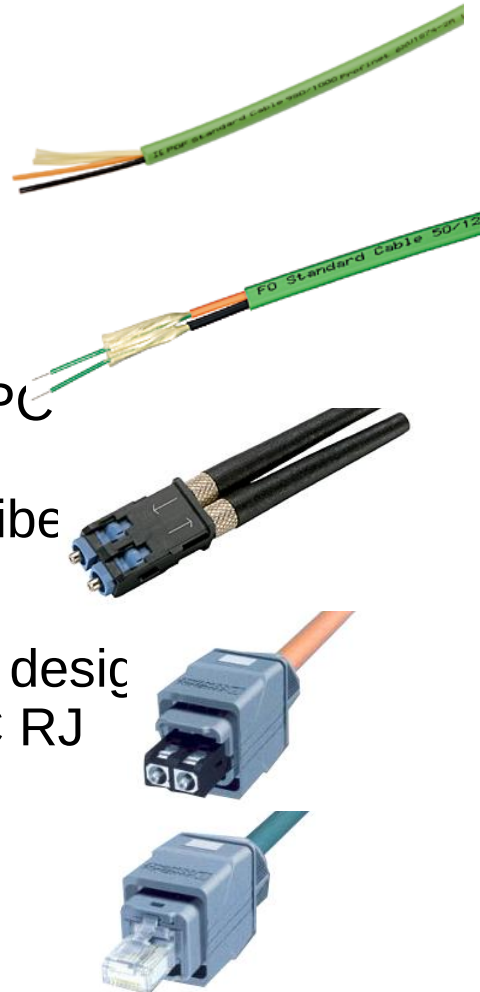
SC Push Pull/ST connectors for Glass fiber

Connector IP 65/67

Design of connector compatible to IP20 design
Push/ Pull connector with integrated SC RJ
connector

* POF = Plastic Optical Fiber

* PCF = Polymer Cladded Fiber

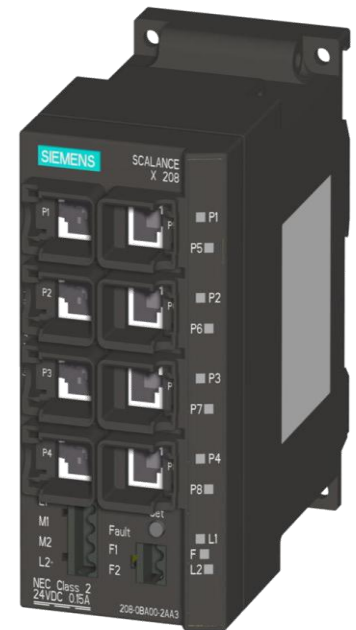


Extensive line of Industrial Ethernet switches
(type of medium, type of protection,
functionality)

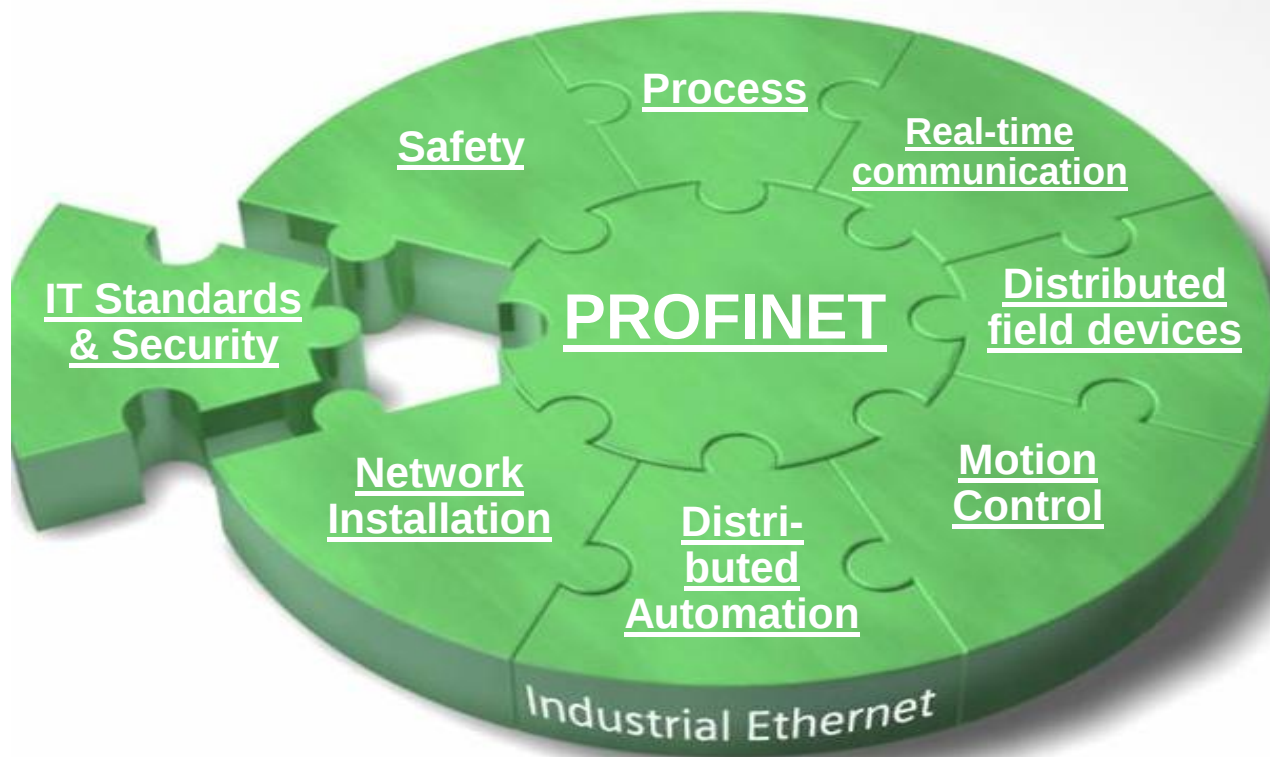
Easy configuration and diagnosis

Comprehensive diagnostic functions
via PROFINET, SNMP, Web

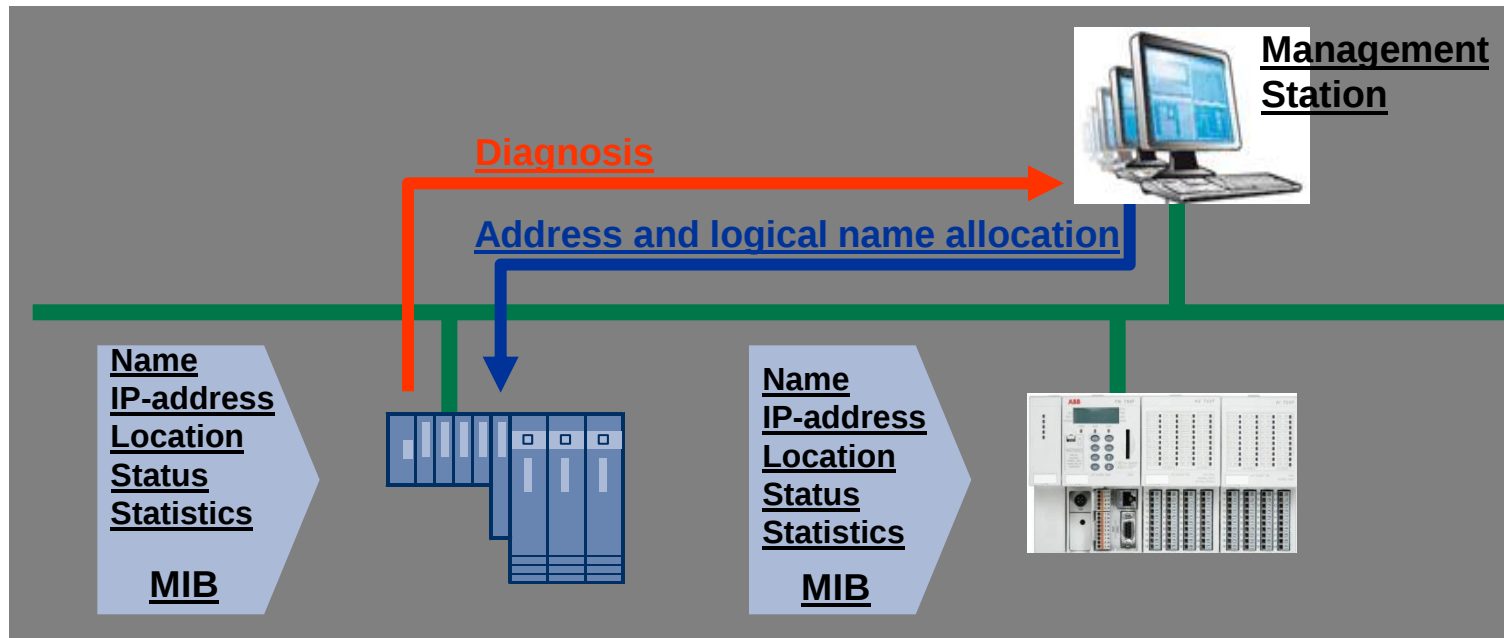
Optimum support of
PROFINET real-time services
RT and IRT



Integrated PROFINET system solution, incl.
network infrastructure



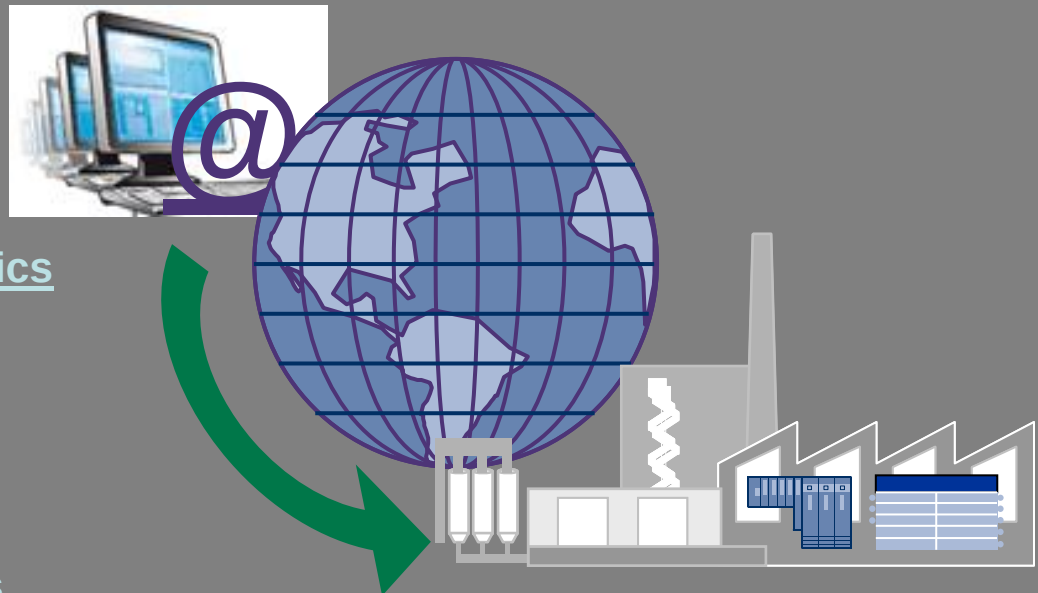
- Manual address allocation via PROFINET DCP
(Discovery Configuration Protocol)
- Automatic address allocation via DHCP
(Dynamic Host Configuration Protocol)
- Network diagnosis via the established IT-
standard SNMP
(Simple Network Management Protocol)



Access to the information of the automation world

Independent of any engineering tool
Possible with any standard browser
Independent of location

- Remote diagnostics
- FAQs
- Documentation
- Process optimization
- Software updates



PROFINET specifies the contents and the structure of

Web pages and the access to this data

Standardized PROFINET device information

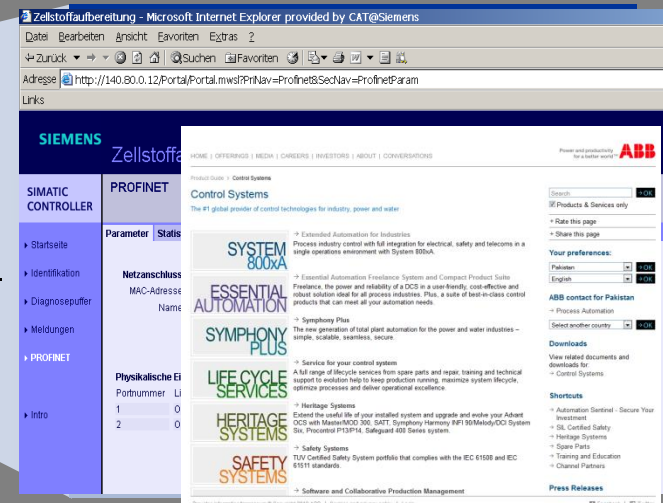
e.g. device name, status, statistics

Additional vendor specific device information

e.g. Extended Automation diagnostics



Data within
HTML pages
and via Applets



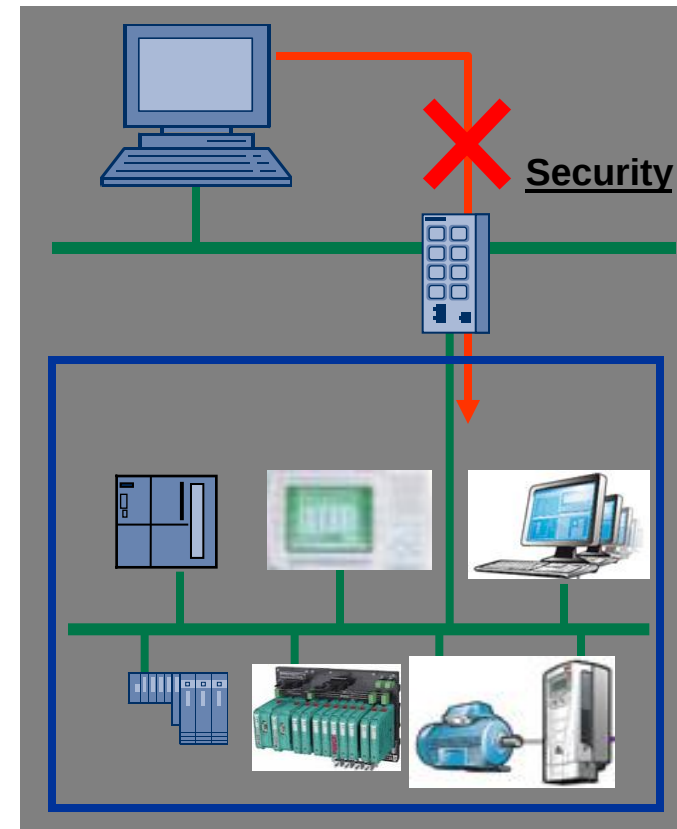
Security against

- Wrong address allocations
- Unauthorized access
- Spying
- Manipulation

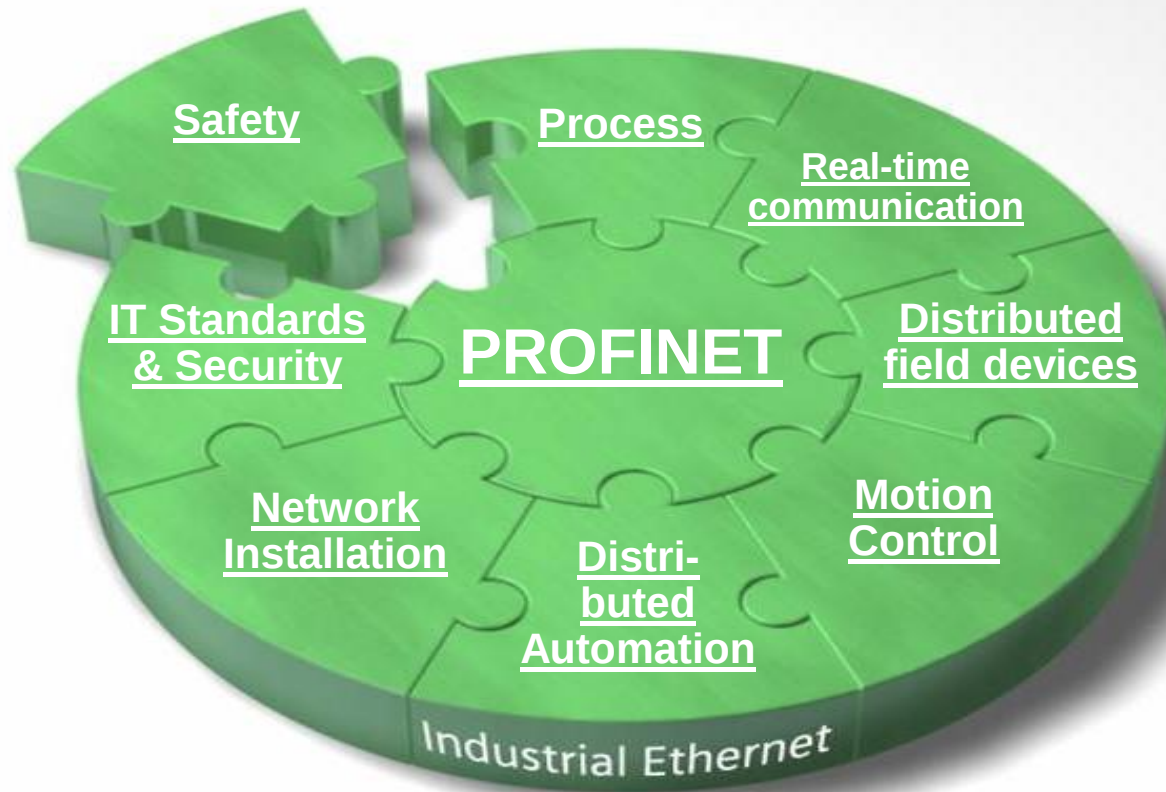
Security solution is scalable and free of repercussions

No specialist knowledge needed

Effective and certified security standards

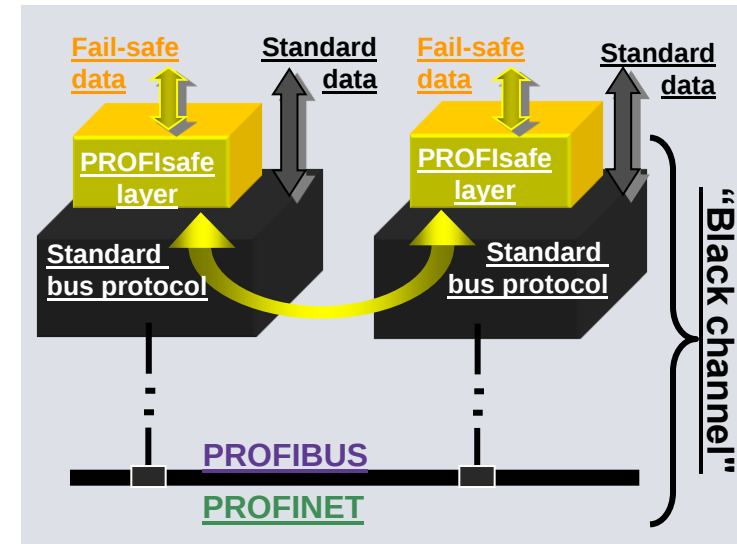


Plant security against operating errors, manipulation and spying based on security standards

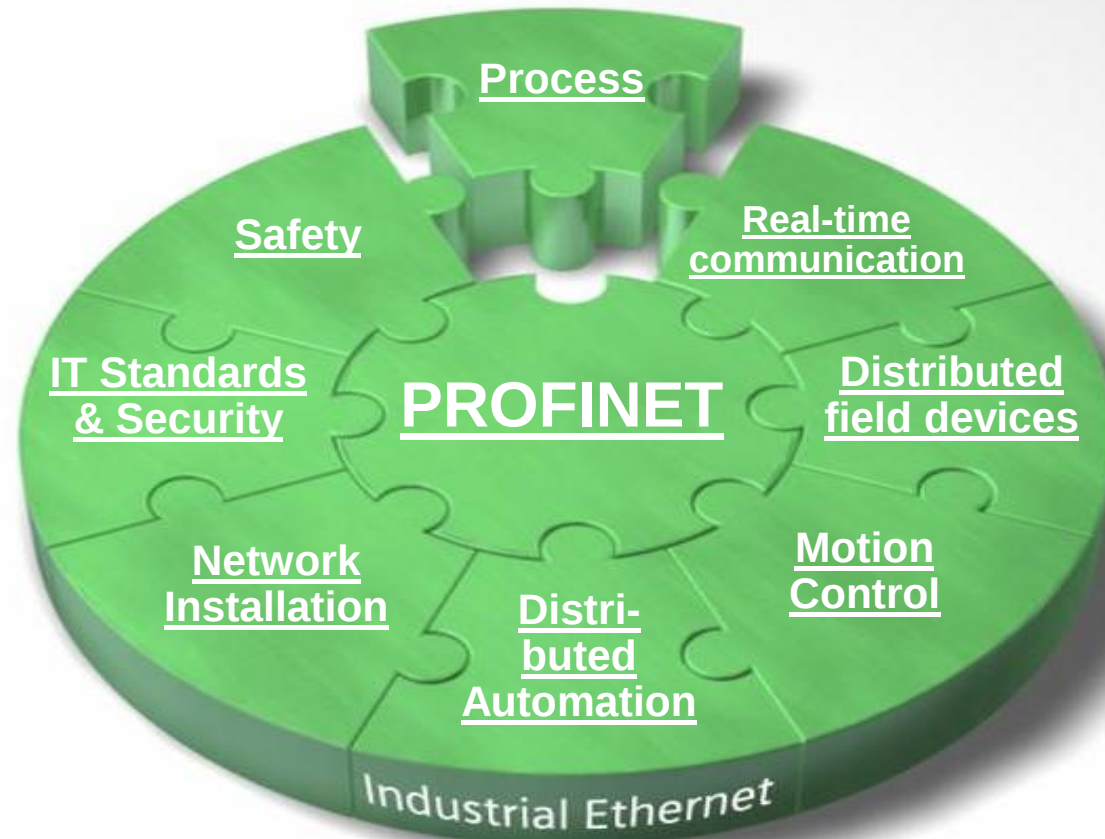


Fail-safe communication via PROFIsafe

- Technology can be used for open standard buses
- PROFIBUS and PROFINET
- "Wireless" technology can be used
- Specified by PROFIBUS International
- Can be used for
 - Up to Category 4 to EN 954-1
 - Up to SIL3 to IEC/EN 61508
- Available since 1999
- Used in over 40,000 systems with more than 410,000 PROFIsafe nodes



First open Ethernet Standard with available safety solution



PROFINET is the solution for all requirements
in automation

PROFINET - The Industrial Ethernet Standard for Automation

— Data — I/O — Motion — Safety — Process

A sole supplier for our customers

PROFIBUS - the world's leading fieldbus

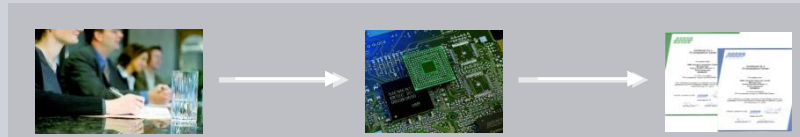
PROFINET- the innovative and comprehensive
Industrial Ethernet Standard

PROFINET strategy

**is to set the trend for the use of Ethernet
in all levels of industrial automation**

PROFINET Technology

Integration of PROFINET interface in devices



The easy way to
PROFINET

Agenda

Development
Phases

Implementation

Certification

Operators

Support

... for device manufactures

- Support in all phases of th development
- Different implementation possibilities
- Quality by certification

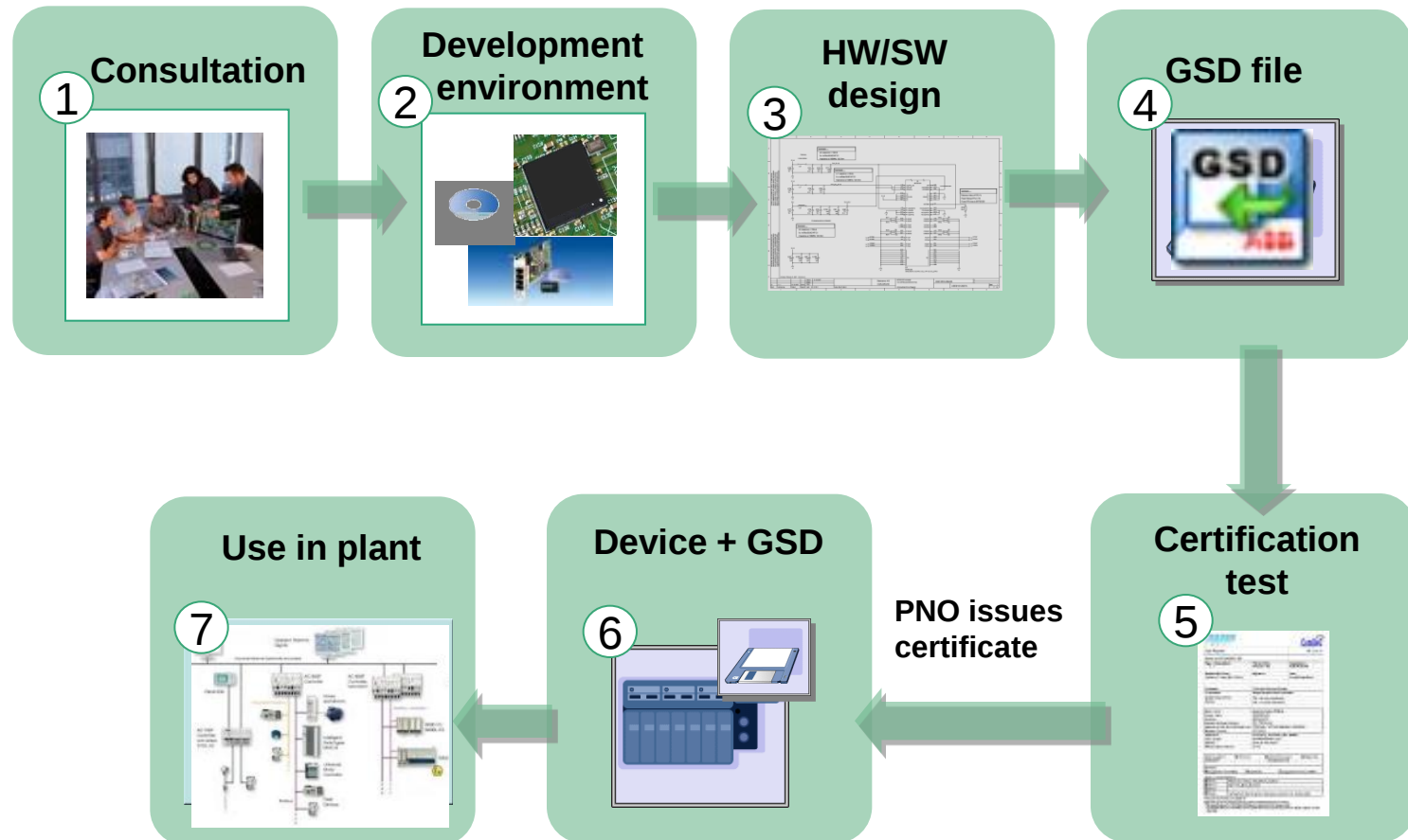
... for operators

- Training
- Support
- Worldwide



easy to implement

... the view of the device manufacturer



Agenda

Development
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Support

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Development
Phases

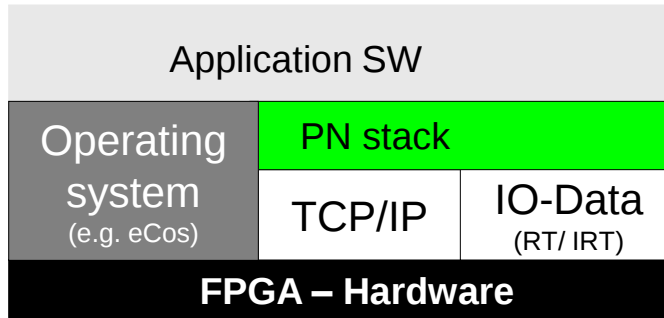
Implementation

Certification

Operators

Support

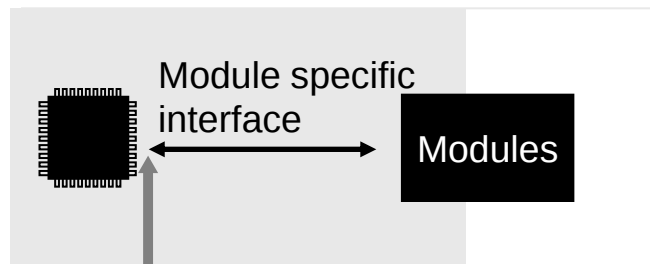
FPGA



Standard Microcontroller

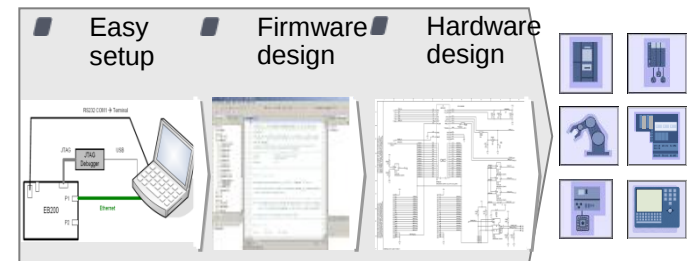


Modules and Boards



Driver SW from module manufacturer

ASIC and Development Kits



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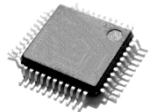
Support

FPGA



- Flexible setup of functionality
- CPU integration
- Ethernet hardware switch
- Easy updates during development phase

Standard Microcontroller



- Cost effective
- MII and/or PHY on Chip
- No integrated hardware switch
- Software switch solution possible
- Only one Ethernet port on Chip

Modules and Boards



- Short development cycles
- Easier device certification with pre-certified modules
- High degree of flexibility
- Low development risk

ASIC and Development Kits



- Support of applications with high-performance
- Integrated hardware switch
- Support of all Conformance Classes
- PROFINET functionality in hardware

Agenda

Development
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Support

Performance & Functionalities



FPGA

Conformance
Class A

Conformance
Class B

Conformance
Class C*



**Standard
Microcontroller**



Modules



ASIC/ Dev. Kits
(Own Device Development)

*CC-C: Synchronization with IRT requires special HW support
(e.g. ERTEC 200, ERTEC 400, TPS-1 and netX)

PROFINET Technology

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Support

- **The classification into conformance classes allows:**
 - Easy choice of components with required properties by the end user/system integrator
 - Secured functional scope in the device class
 - Basis for certification
- **There are three Conformance Classes defined**
 - Class A
 - Class B
 - Class C

Agenda

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Support

■ Class C:

- Highest deterministic data transfer
- Certified devices and network components
- Topmost performance

■ Class B:

- Certified devices and network components
- Topology determination and upload
- Comfortable Diagnostics, redundancy

■ Class A:

- Standard Ethernet Network components
- Certified Devices and Controller

■ Application Class:	non isochronous	non isochronous	Non iso. + isochronous
■ Communication Class:	TCP/IP, RT	TCP/IP, RT	TCP/IP, RT, IRT
■ Redundancy:	RedClass 1 optional	RedClass 1 mandatory RedClass 2 optional	RedClass 1, 2, 3 mandatory

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Protocols

Defined way to transfer data within a network

TCP (Transmission Control Protocol)

UDP (User Datagram Protocol)

DHCP (Dynamic host config. Protocol)

SNMP (simple network mgmt protocol)

LLDP (Link Layer Discovery Protocol)

MRP (Media Redundancy Protocol)

...

Profiles

A Profile is a special and optional add-on, tunneling data by using the standard protocol

PROFenergy

PROFIsafe

Functions

A function is an optional configurable change of the device behavior

Fast Start Up (FSU)

Ident. & Maint. (I&M)

The PROFINET Technology has a core functionality. Additionally there are optional expandable protocols, profiles or functions (modular communication technology)

Agenda

Development Phases

Implementation

Certification

Operators

Support



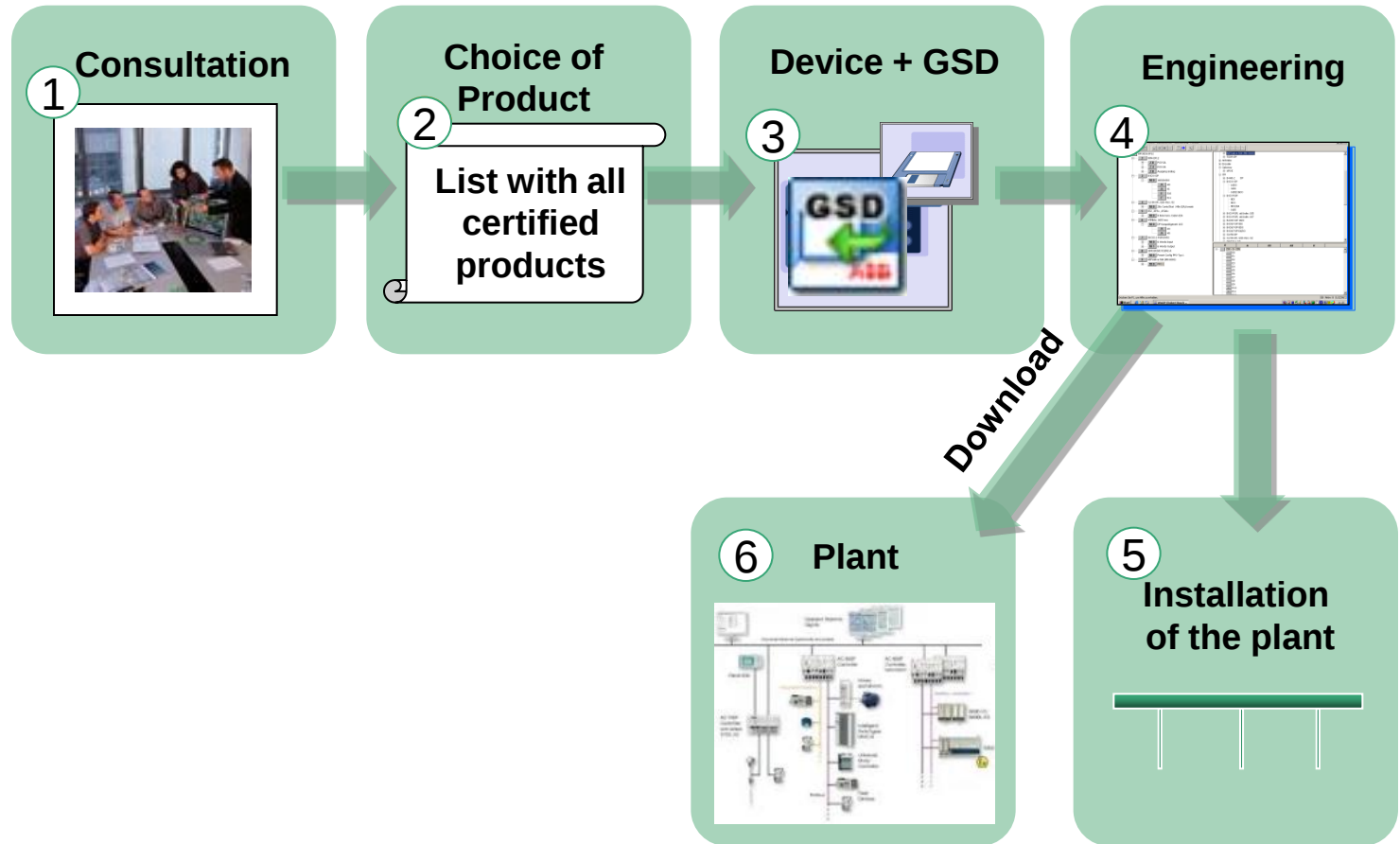
- Certification according to proven system by accredited test laboratories
- Certification as a prerequisite for market introduction of PROFINET products
- Complete testing scenario with uniform testing range and uniform testing system
 - Test for compliance with specification
 - Test for interoperability with other PROFINET devices

AnfData ComDeC itm

Certification is mandatory for PROFINET

PIC Phoenix Testlab

... the view of the plant operator



Agenda

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Support

Goal: To establish a worldwide standardized training program for:

- Certified PROFINET Engineer
- Certified PROFINET Installer
- Certified PROFIsafe Designer

Stipulations:

- Uniform learning target
- Required learning aids
- Standardized examination catalogue
- Guidelines for Training Centers
- Accreditation procedure for the Training Centers

Agenda

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Support

Hardware - Software - Consulting - Implementation

- Trainings and consulting of the PROFINET Competence Centers
- Implementation of PROFINET-Stacks incl. porting and configuration
- Hardware and/or software development
- Project Management
- Error analysis
- Certification
- And more...



and others...

Agenda

Development
Phases

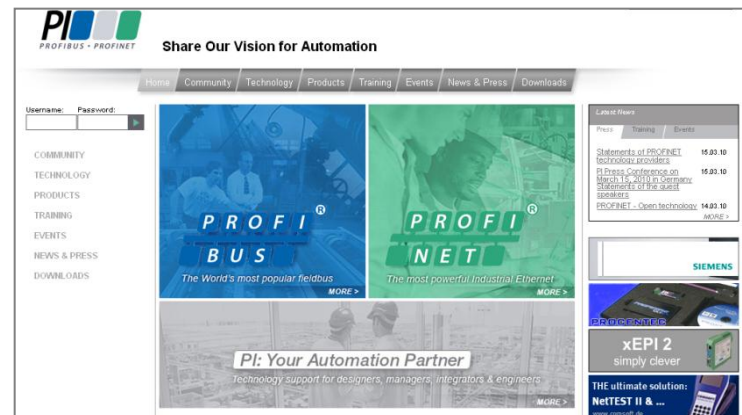
Implementation

Certification

Operators

Support

- PROFINET Technology Flyer
- PROFINET System Description
- Book: “Industrial Communication with PROFINET”
- www.profinet.com
 - downloads
 - trainings



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<http://www.abb.com/recorders>
<http://www.abb.com/knowledgestore>

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Power and productivity
for a better world™





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