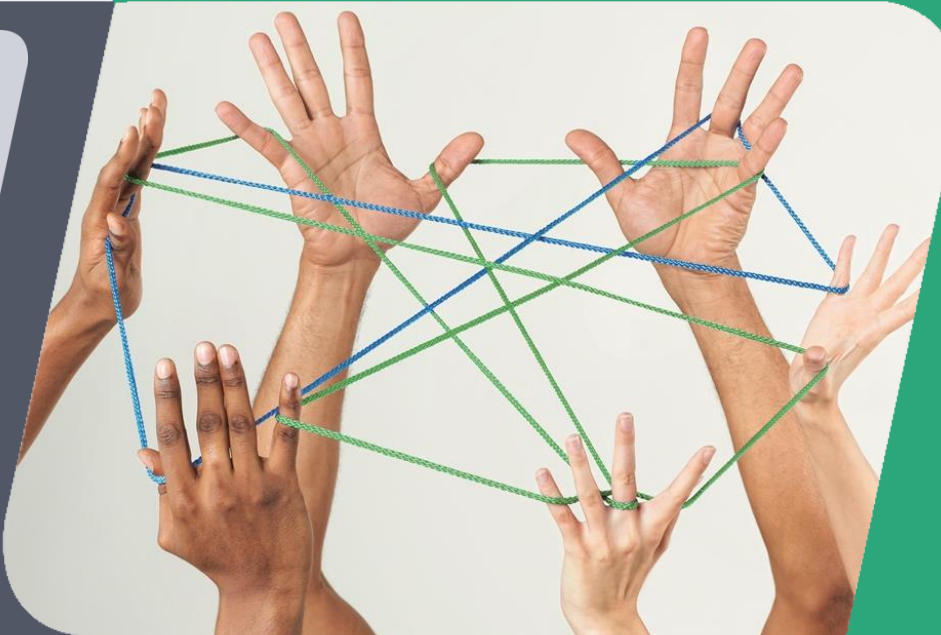




Basic Slide Set



Technology

PROFdrive
on PROFIBUS

PROFdrive
on PROFINET

Implementation

- **The PROFIdrive Basic Slide Set**
provides compact information on technology, operation, application and benefits of drive technology and PROFIdrive
- For easy handling, the slide set is structured in sections
[Click](#) to find the list of content

PROFIdrive at a glance

- PROFIdrive is the leading vendor-neutral, IEC-standardized Motion Control technology, developed and supported by PROFIBUS & PROFINET International.
- PROFIdrive interfaces different drives from different vendors with the plants or machines communication system
- PROFIdrive, by its own outstanding features and by using other PI technologies such as PROFIBUS, PROFINET, PROFIsafe and PROFIdenergy, provides best possible solutions to the demanding requirements of today's automation.
- The SlideSet PROFIdrive provides an overview of drive technology using PI technologies

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Drive technology

Introduction

Generals

Technical Progress

Device profiles PROFdrive und Encoder

Device Profiles

Profile PROFdrive

Profile Encoder

PROFIBUS (Fieldbus) as drive bus

PROFIBUS
Basics

PROFdrive
on PROFIBUS

PROFINET (Industrial Ethernet) as drive bus

PROFINET
Basics

PROFdrive on
PROFINET

Special applications and solutions

Drives and Safety

Drives and Energy Efficiency

Implementation

PROFdrive implementation
Community project

Organisation and Support

PROFIBUS & PROFINET
International (PI)

Case Studies

Drive technology (1)

Generals

Applications

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Drive Technology

- Drive technology is a fundamental requirement in both manufacturing and process automation
- Use cases range
 - from drives with fixed and variable speed such as for pumps, fans or compressors etc.,
 - to single-axis positioning controllers for applications such as for moving, setting and positioning,
 - to multi-axis interpolation for packaging, printing, or milling.
- Drives are extremely significant in terms of industrial energy saving tasks, because electrical drives account for almost 2/3 of industrial power demand.

No automation without drive technology

- Drive technology is a fundamental requirement for all automation tasks
- Tasks and requirements depend heavily on the particular application
- Applications include
 - **Drives with fixed and variable speed**
for pumps, fans, compressors, transport tasks etc.
 - **Single-axis controllers**
for moving, resetting or positioning etc.
 - **Multi-axis controllers**
for packaging, printing or milling etc.

Important facts

- Electric drive technology has passed through an significant innovation phase contributed to various progress in manufacturing and process industries.
- Electric drives are respnsible für up to 70 % of total industrial power consumption. Therefore, progess in drive technology includes remarkable savings in power consumption.
- Drives technology innovation is strongly related to innovation in communication technology such as Fieldbus and Ethernet.
- Innovation was also driven by the development of internationally-standardized, vendor-neutral „device profiles“ for drive devices.

Application „Pumps“



- Flexible process control due to fast, precise flow rate adjustment
- Safety-related shutdown in case of faults or maintenance
- Energy savings through highly efficient motors and speed-controlled drives
- High plant availability and service life

Application „Compressors and fans“



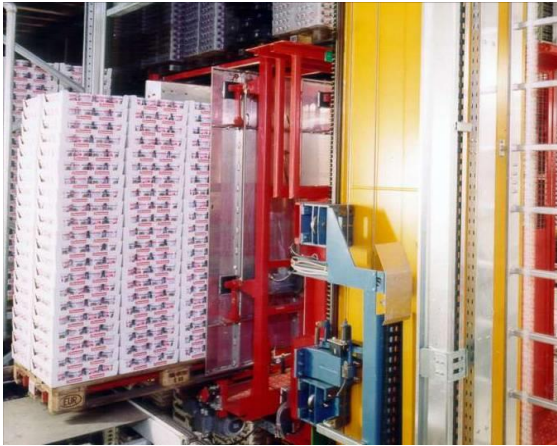
- Centralized control in distributed systems using fieldbus interfaces
- Easy maintenance through networking with centralized control units
- Energy saving potential through flexible motor speed presetting and control

Application „Conveying“



- Minimized downtimes through easy extensibility and fast device replacement
- Increased productivity during commissioning due to integrated safety functions
- Excellent availability due to high quality and comprehensive diagnostics for preventive maintenance

Application „Motion Control“



- Support of flexible machine concepts for fast realization of user-specific requirements
- Good scalability and flexibility of systems and plants
- Synchronized motion through clock-synchronous communication
- Fulfillment of increasing requirements for axis-number and short cycle times through PROFINET

„Wireless“ Applications

- As other field devices drives can be operated in wireless applications using industrial WLAN gateways.
- Applications include e.g.
 - Suspension tracks
 - Driverless transport systems
 - etc.



Drive technology (2)

Technical progress

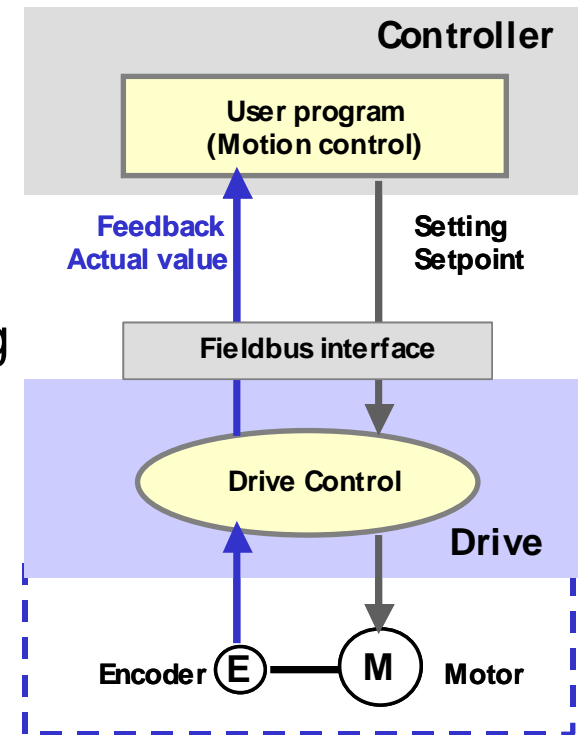
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Drive technology before the fieldbus era

- Drive technology was generally understood to mean a frequency converter or servo amplifier that controlled a motor according to a preset speed setpoint.
- The earliest drive systems used discrete analog interfaces with I/O terminals to transfer commands and signals.
- In the 1980s, serial interfaces such as RS422 and RS232 were introduced to connect a PC for parameter assignment or commissioning purposes.
- A second interface was used to connect the drive to a control system and a third interface was used to forward process variables to a downstream drive.

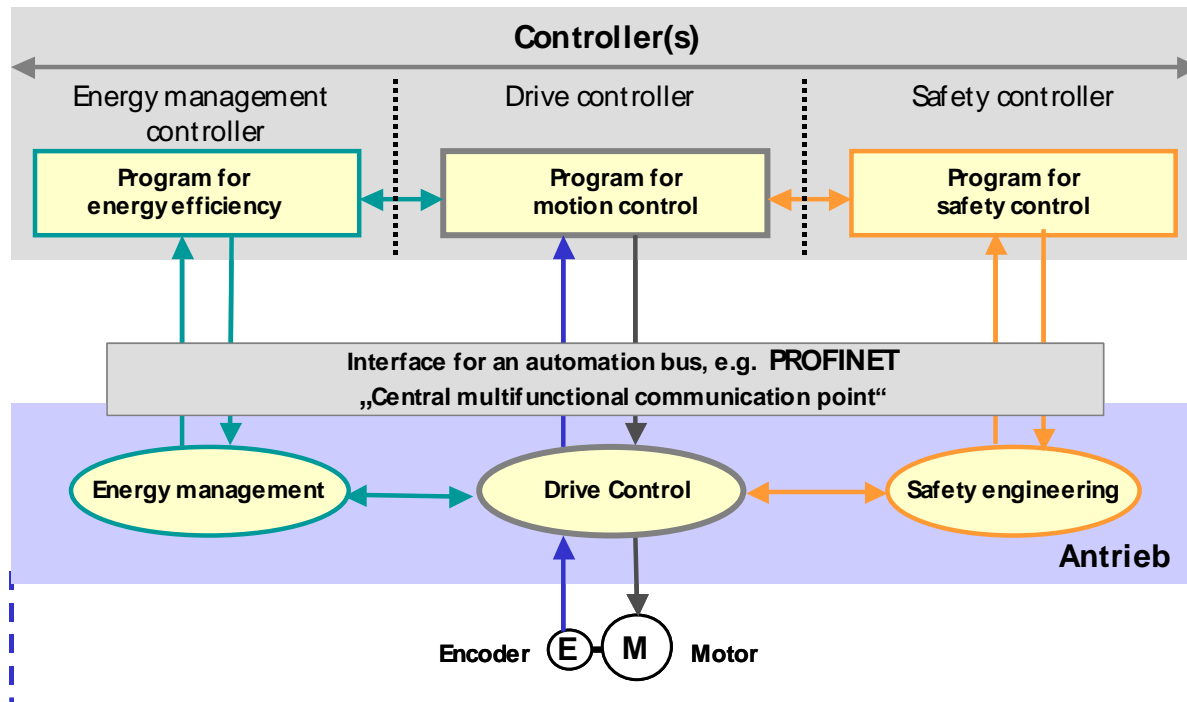
Drive technology during the fieldbus era

- The upcoming fieldbus technology was first seen on the interface with I/O signals to be read into the control system and output from there using cyclic communication.
- Later, cyclic communication has been added for parameter assignment and commissioning to replace the „second“ interface.
- With introduction of direct data exchange in PROFIBUS also the „third“ interface between drives was replaced with a single interface on the drive.
- Later on the transmission rate was increased from 1.5 to 12 Mbps and isochroneous communication and clock synchronization was added for motion control applications.



Drive technology in the Ethernet era

- In the Ethernet era, drive technology started to use industrial ethernet networks (such as PROFINET) and to combine with additional applications such as **safety engineering** and **energy management**.
- The drive is evolving into a platform for various drive-related functions.



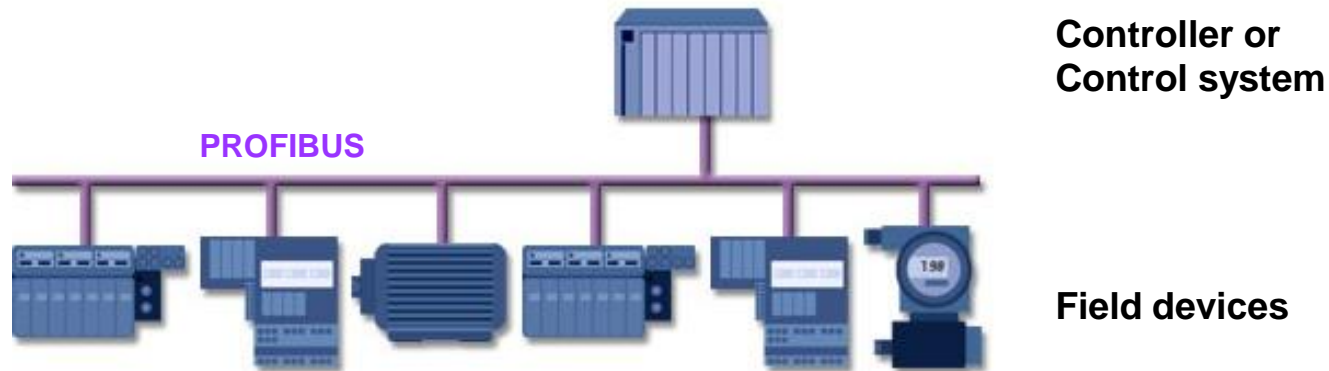
PROFIBUS

Basics
Application
PROFIBUS DP

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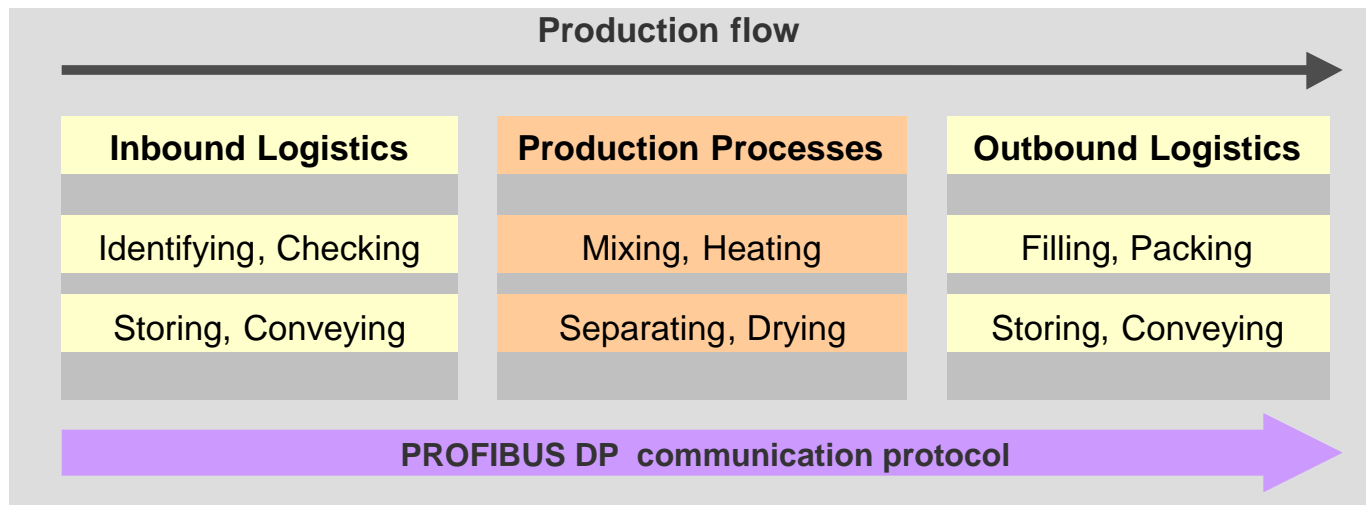
Fieldbus-based automation standard

- PROFIBUS is the fieldbus-based automation standard of PROFIBUS & PROFINET International (PI).
- PROFIBUS is a communication system that links controllers or control systems to decentralized field devices such as sensors, actuators or drives via a single cable.



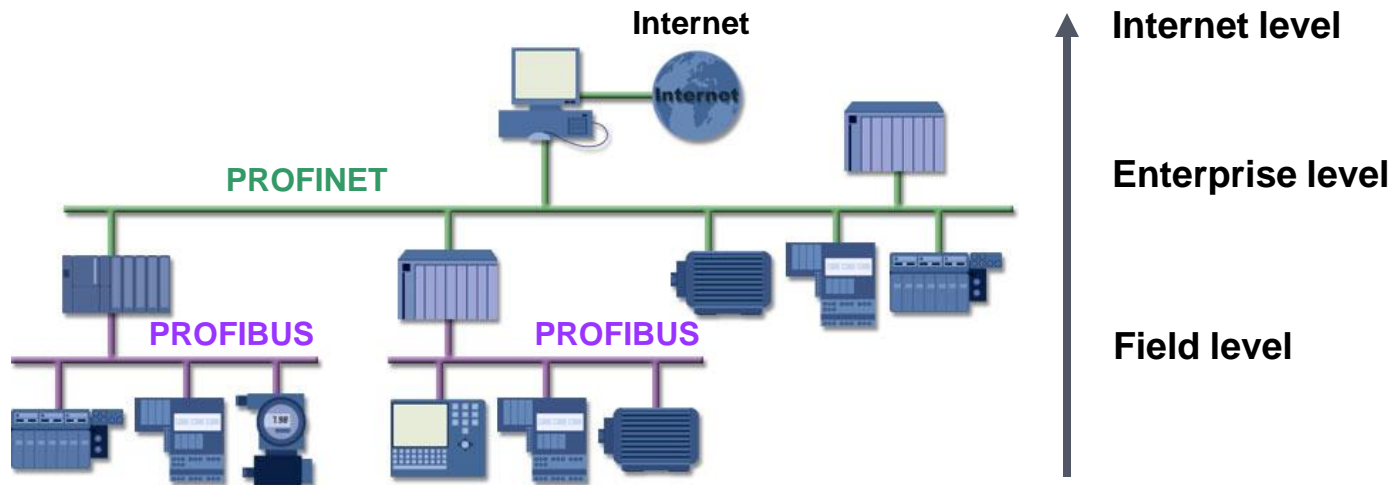
One single protocol

- PROFIBUS supports factory and process automation as well as drive applications with the same consistent communication protocol named PROFIBUS DP.
- This enables mixed (hybrid) applications, where continuously running processes, e.g. mixing or drying, are combined with discrete functions such as identifying, conveying or packing.



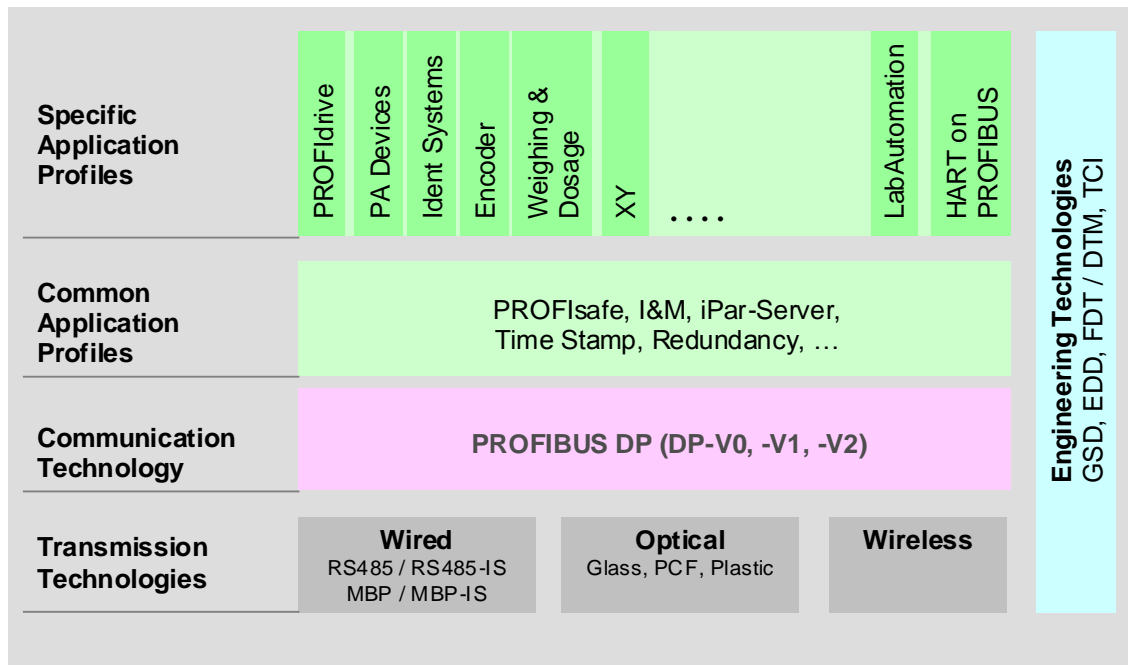
Part of a multi-level network

- PROFIBUS enables consistent data exchange with higher-ranking communication systems.
- PROFIBUS is part of the communication network between field level and enterprise level, or even going up to the internet.



A modular structured system

- PROFIBUS consists of different functional modules which are arranged according to their functionalities: Transmission, Communication, Application and Engineering/Integration.



Dedicated solutions for various industry sectors

- A PROFIBUS solution for a certain industry sector is implemented by combining suitable modules

Market Segment	Process Automation Ex / non-Ex areas	Factory Automation	Motion Control	Safety Application
PROFIBUS Solution (Common term)	PROFIBUS PA	PROFIBUS DP	PROFIdrive	Safety
Application Profile	PA Devices (and others)	e.g. Ident Systems	PROFIdrive	PROFIsafe
Communication Technology	PROFIBUS DP	PROFIBUS DP	PROFIBUS DP	PROFIBUS DP
Transmission Technology	MBP / MBP-IS RS 485 / 485-IS	RS 485	RS 485	RS 485 MBP-IS

Key applications in different industries

Factory automation

- Vehicle manufacture
- Bottling plants
- Warehousing systems
- Switchgear
- Hollow glass production



Process automation

- Chemical industry
- Petrochemical industry
- Paper and textile industry
- Foodstuffs
- Power stations
- Sewage plants



Drive technology

- Machine tools
- Packaging machines
- Pressing plants
- Paper production



Safety applications

- Vehicle assembly
- Machine tool building



PROFIdrive on PROFIBUS

Basics

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PROFIdrive at a glance

- PROFIdrive is the modular device profile for drive devices developed by PROFIBUS & PROFINET International (PI).
- PROFIdrive has already enabled fieldbus-based drive solutions from the 1990s on using PROFIBUS DP as communication system.
- To meet the increasing user requirements, PROFIdrive has been continuously developed further by a PI working group with participants from different device manufacturers.
- Since 2005 PROFIdrive can also be used on Ethernet-based PROFINET communication (see special section).

PROFdrive Milestones

- 1991 Start of profile work
- 1997 Profile version 2.0

- 2002 Profile version 3.1 for use on PROFIBUS DP-V2
- 2005 Use also possible on PROFINET
- 2005 Use also possible in safety applications

- 2007 International standardization in IEC 61800-7

Further development steps please see in section “PROFdrive on PROFINET”

Solution for Motion Control

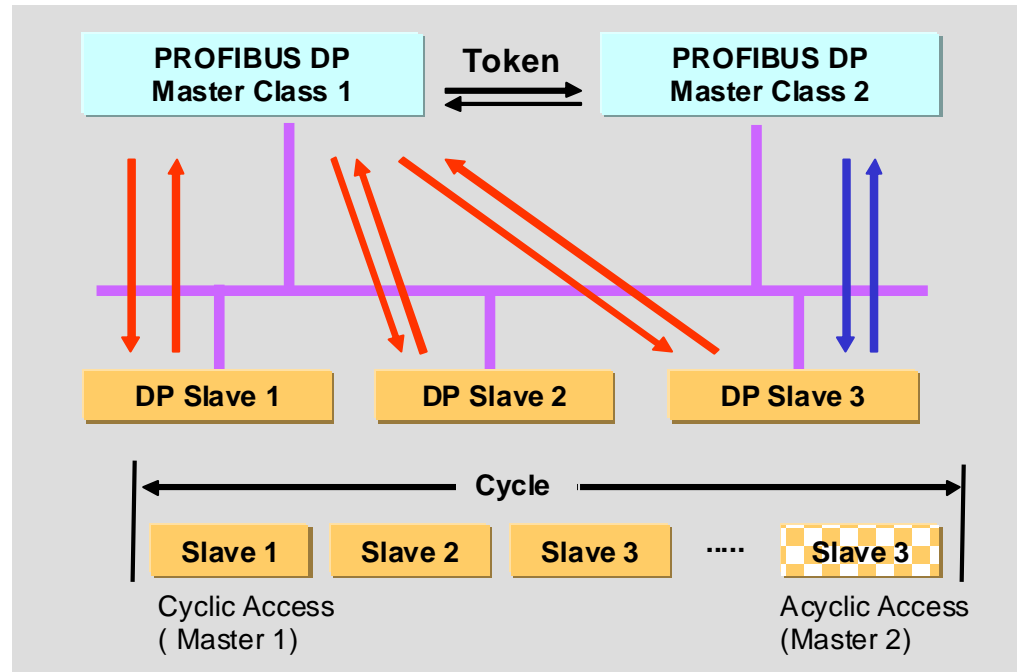
- PROFIdrive together with RS 485 transmission and PROFIBUS DP communication technology forms the PROFIBUS-Solution “Motion Control”.

Market Segment	Process Automation Ex / non-Ex areas	Factory Automation	Motion Control	Safety Application
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Application Profile	PA Devices (and others)	e.g. Ident Systems	PROFIdrive	PROFIsafe
Communication Technology	PROFIBUS DP	PROFIBUS DP	PROFIBUS DP	PROFIBUS DP
Transmission Technology	MBP / MBP-IS RS 485 / 485-IS	RS 485	RS 485	RS 485 MBP-IS

PROFIBUS DP (Decentralized Periphery)

PROFIBUS uses a single, open communication protocol (PROFIBUS DP, **D**ecentralized **P**eriphery) for all applications.

- PROFIBUS DP uses the “Master-Slave“ model: One device (master) controls one or more other devices (slaves).
- PROFIBUS DP uses the “Token Passing“ model: The “token“ is transmitted across the network; the station in possession of the token controls the access to the network.



Three versions of PROFIBUS DP

■ DP-V0

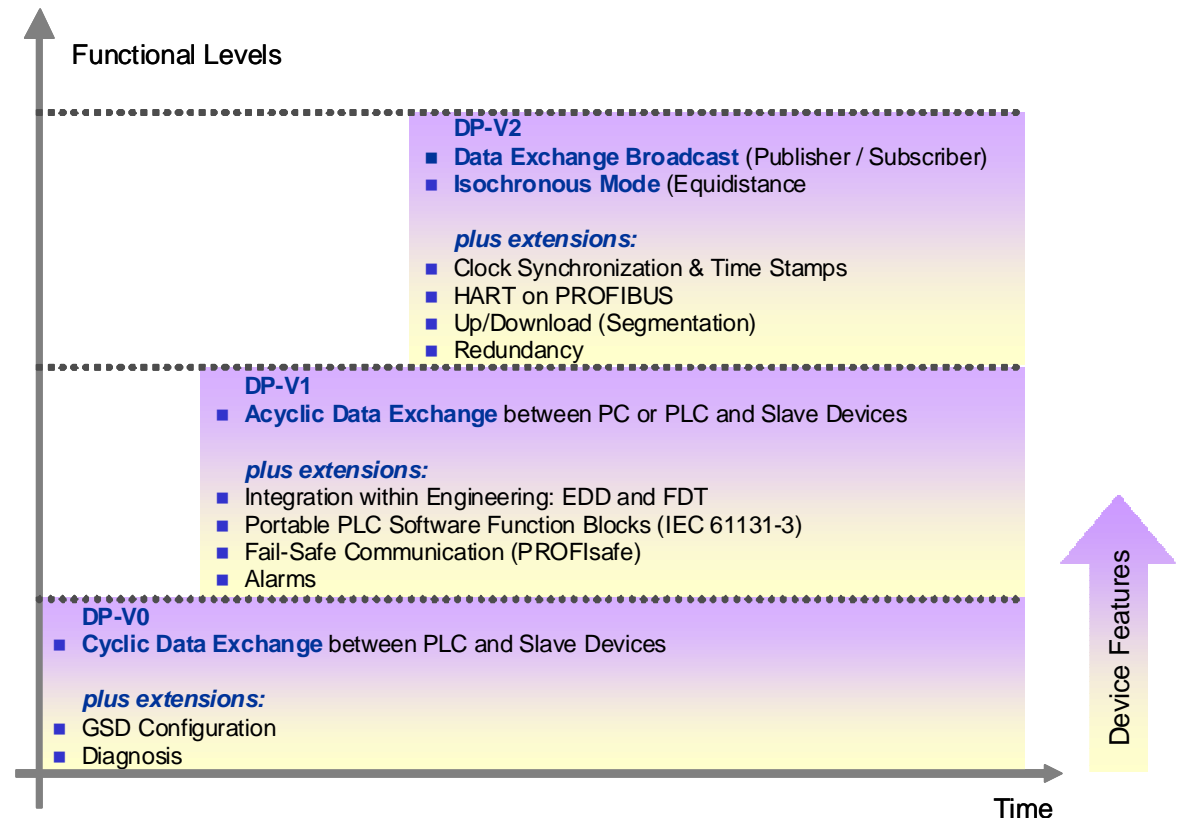
Overall command structure, cyclic data exchange

■ DP-V1

Extension by acyclic data exchange et al.

■ DP-V2

Further extension by time stamp, clock synchronization et al.
Typically used in drive and motion control



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Device Profiles

Generals

Digital Interface

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Uniform properties and behavior

- Device Profiles describe specific device properties that have been jointly specified by device manufacturers for uniform implementation into their devices.
- Devices with the same device profile will – irrespective of the manufacturer – exhibit the same behavior on a bus system
- Users benefit result from a larger device selection and greater ease of device replacement, commissioning and diagnostics
- Device profiles not only define data-exchange but also specify the meaning of drive-specific data and parameters.
Therefore, program sections of a PLC can remain unchanged when used with different devices that feature the same profile

A different view to device profiles

- Viewed in a different way, a device profile establishes a „cross-vendor digital interface“ for communication between the automation system and the devices.
- This is performed by explicit specifications regarding functionality and parameters of the respective devices or device classes.
- The importance of such interfaces is increasing with respect to the enormous data quantities that are being exchanged as the degree of automation advances.

Device Profiles

„PROFIdrive“ and

„Encoder“

Profile PROFIdrive
Application Classes
Interface functions

Profile Encoder

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PROFdrive at a glance

- PROFdrive is the modular device profile of PROFIBUS & PROFINET International (PI) for drive devices
- PROFdrive has already enabled fieldbus-based drive solutions from the 1990s on using PROFIBUS DP as communication system
- To meet the increasing user requirements, PROFdrive has been continuously developed further by a PI working group with participants from different device manufacturers
- PROFdrive can be used with Fieldbus-based PROFIBUS as well as with Ethernet-based PROFINET communication

Milestones

- 1991 Start of profile work
- 1997 Profile version 2.0

- 2002 Profile version 3.1 for use with PROFIBUS DP-V2
- 2005 Use also possible with **PROFINET**
- 2005 Use also possible in safety applications

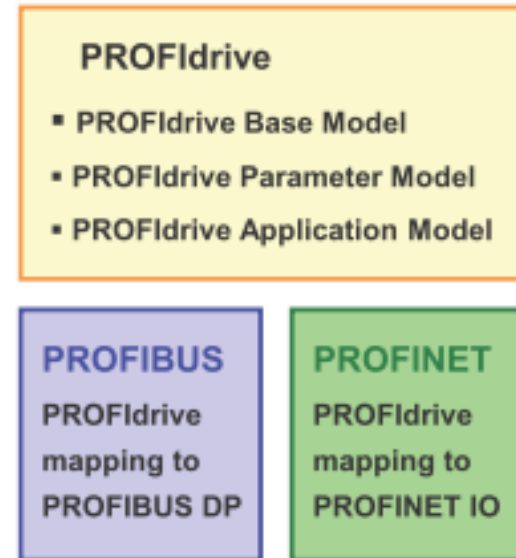
- 2007 International standardization in IEC 61800-7
- 2009 Option for energy management through joint use of PROFInergy application profile

- 2011 **Community Project** for joint further development and free of charge PROFIdrive source code

PROFdrive structure

- The basic specifications of the PROFdrive standard include
 - Base model definition
 - Parameter model definition
 - Application model definition
 - Mapping to PROFIBUS
 - Mapping to PROFINET

- The major part of the profile (yellow box) describes functions that are independent of the communication system. This part remains unchanged when PROFdrive is used on PROFIBUS or PROFINET.



Application Classes (AK1 - AK 6)

- PROFIdrive spans all of the extremely diverse applications of drive technology.
- To avoid unneeded load in case of simple applications, PROFIdrive is structured into six application classes (AK 1 to 6).
- A drive device can span one or more device classes depending on market segment and implementation.
- In all application classes, except class 1, the technology functions are distributed between the controller and drives.
- **The Application Classes** are assigned to (see next slide)
 - Non-isochronous or isochronous operation (second line from above)
 - Converters or drives (third line from above)
 - Proportion of automation functions within the drive (vertical position)

Application classes

- Application classes allow flexible and cost efficient design of drive devices

Performance features of PROFIdrive application classes (AK1 - AK6)			
		Non-isochronous operation	Isochronous operation
		Converters <u>without</u> servo motor	Drives <u>with</u> servo motor
<p style="text-align: center;">Automation proportion in the drive</p> <p style="text-align: center;">↑</p> <p style="text-align: center;">High</p>	<p>Same as AK 1, but with distribution of automation among several drives</p> <p style="text-align: right;">AK 2</p>	<p>Closed-loop drive control with open-loop single-axis positioning control</p> <p style="text-align: right;">AK 3</p>	<p>Same as AK 4/5, except for decentralized automation, e.g., for clocked processes and electronic shaft</p> <p style="text-align: right;">AK 6</p>
	<p>Standard drive with closed-loop speed control</p> <p style="text-align: right;">AK 1</p>		<p>Servo drive with isochronous closed-loop speed and position control with central motion control</p> <p style="text-align: right;">AK 4/5</p>
	<p>Applications</p> <p>Pumps, fans, compressors Conveyor belts, elevators, etc.</p>	<p>Single-axis positioning Simple handling of caps Paper machines</p>	<p>Machine tools, robots Paper machines Packaging machines</p>

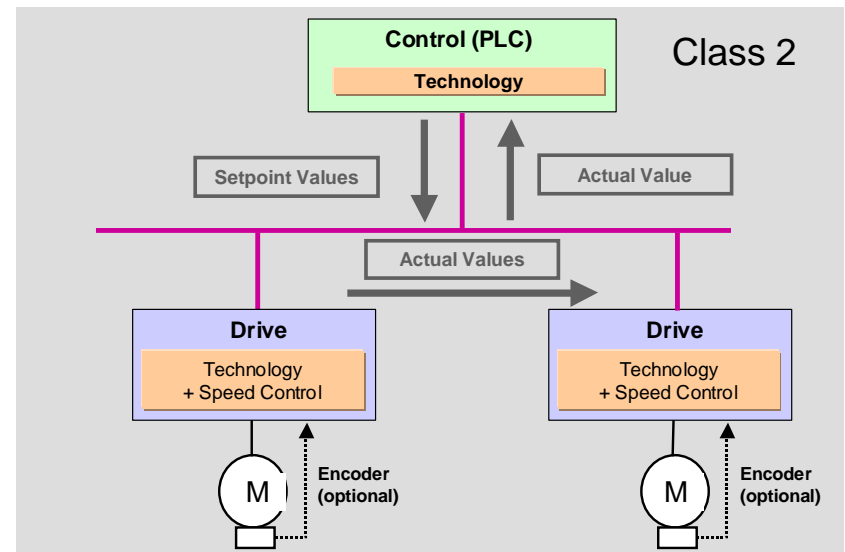
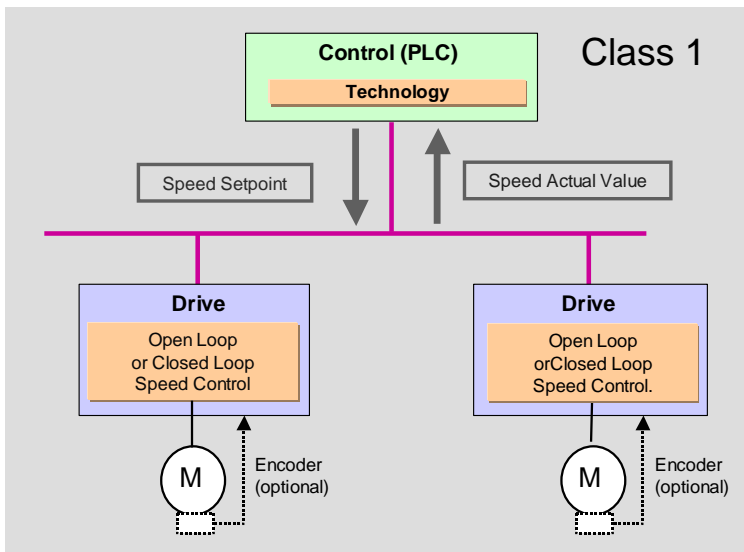
Application classes

■ Application class 1

Standard drives with open/closed-loop speed ctr. (pumps, compress. ..)

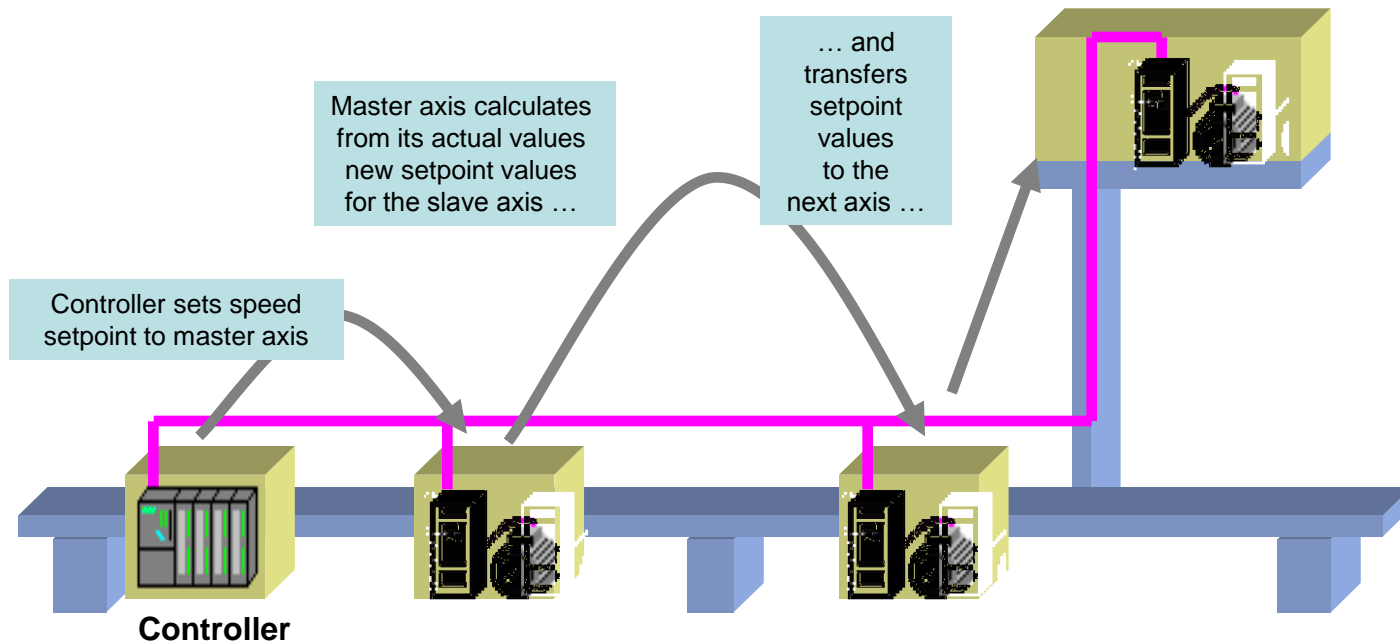
■ Application class 2

As class 1, but with technology functions in the drives for e.g. closed-loop pressure or flow control and for distribution of functions among controller and multiple drives.



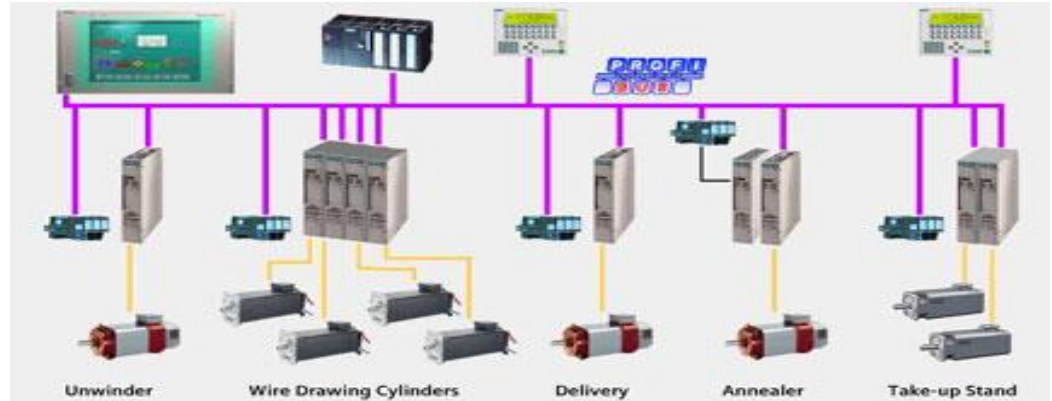
Application class 2 (example)

- Drive-to-drive communication for e.g. generating a setpoint cascade



Application class 2 (example)

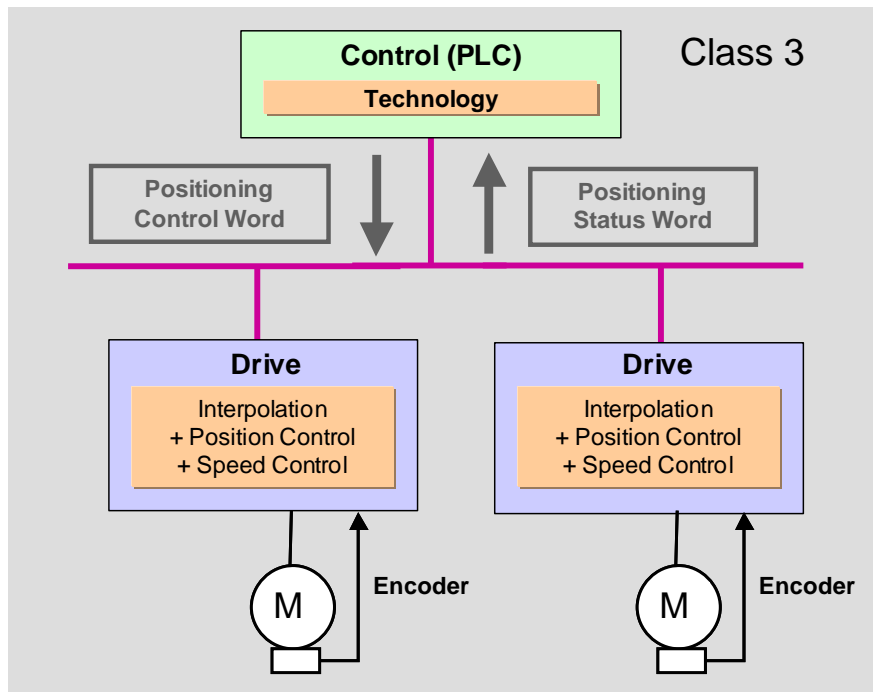
- A single bus system for
 - Operating and monitoring
 - Process data for visualization and diagnostics
 - Set point cascade for numerous drives



Application classes

■ Application class 3

Drives with closed-loop drive and position control e.g. for twisting bottle caps on and off. The drive acts as autonomous single axis positioning drive.



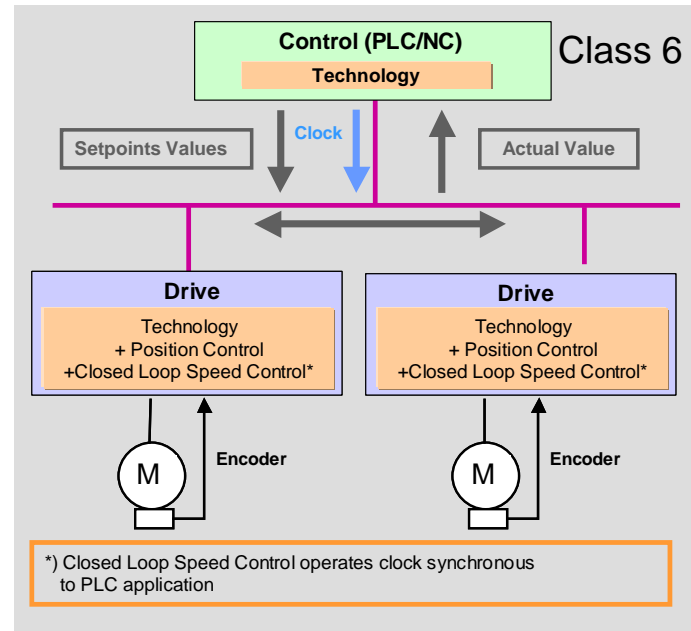
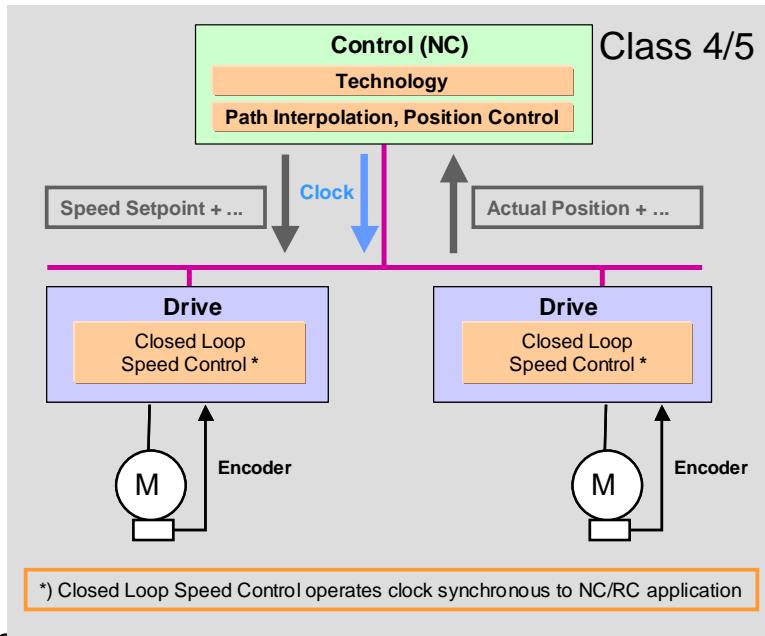
Application classes

■ Application class 4/5

Servo drives with central motion control in multiple axes, e.g. for machine tools or robots with closed-loop speed control in the drive and closed-loop motion control in the controller with clock-synchronization

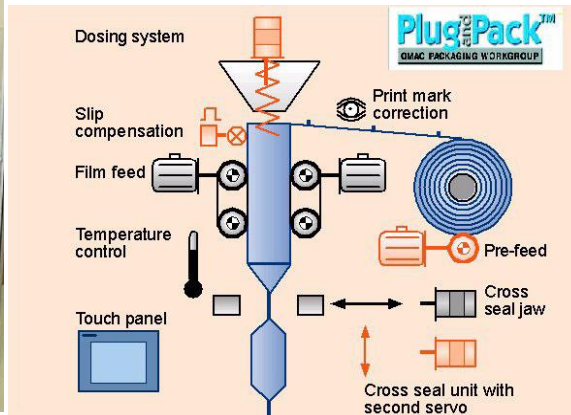
■ Application class 6

Servo drives for decentralized automation, e.g. for electronic shafts or clocked machines with synchronized master and slave drives



Application class 4 (example)

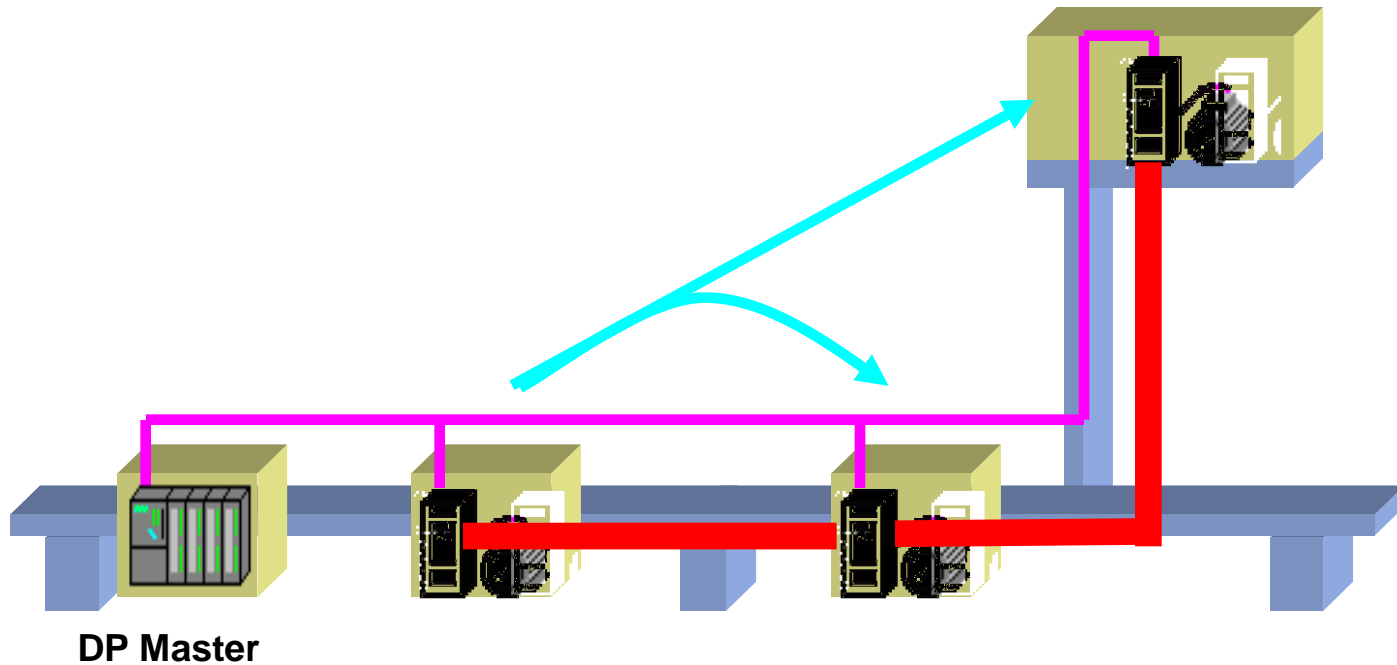
- Central motion control system with decentralized servo drives



Machine with isochronous drives

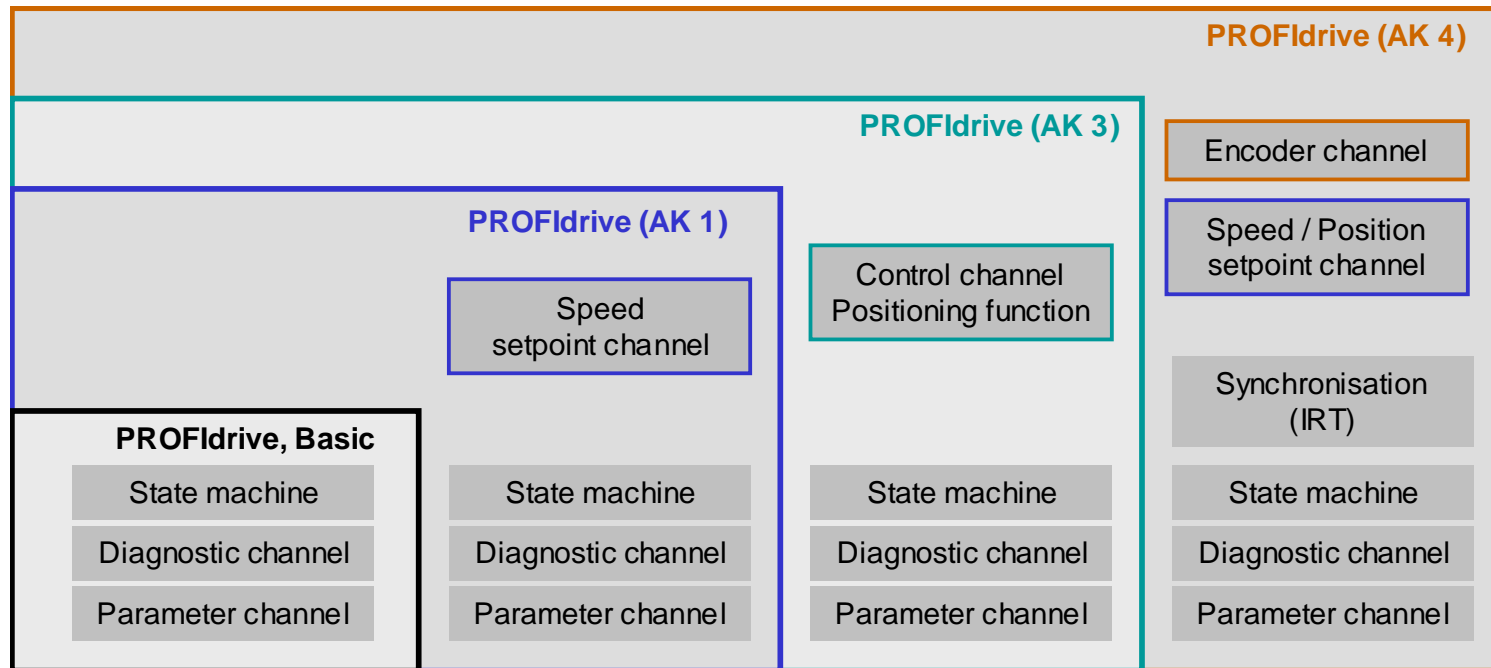
Electronic gear

Application class 6 (example)



Modular interface functions

- The realization of particular application classes requires implementation of the corresponding interface functions
- The interface functions have a modular structure



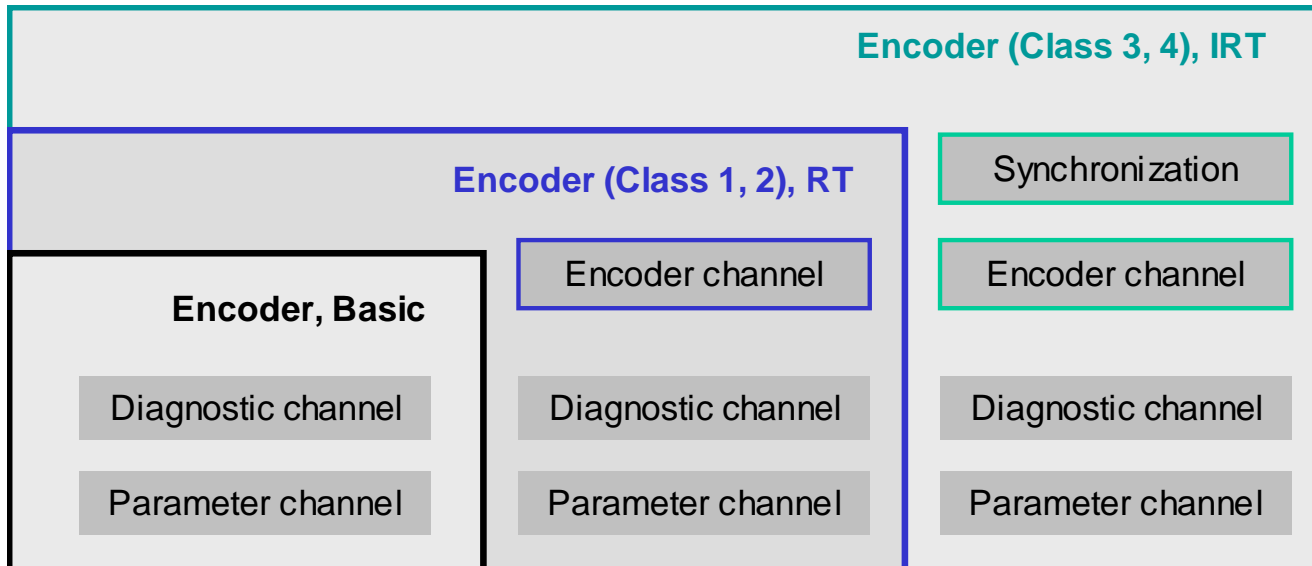
Harmonization

- **PROFdrive** ensures vendor-neutral and interoperable drive devices by using a consistent drive interface
 - State machine
 - Application classes
 - Telegrams for data transfer
 - Diagnostic routines
- **PROFdrive** ensures protection of investment through
 - Identical interface (from application view) to PROFIBUS and PROFINET
 - Vendor-neutral device functionality
 - Internationally standardized specification



Definition

- The **Encoder** device profile defines a uniform interface comprising application-specific classes
 - Classes 1 and 2 include simpler encoders without isochronous position or speed signals to the controller
 - Classes 3 and 4 include isochronous encoders that provide a PROFIdrive encoder channel and can also be used with standard motion controllers or fast digital control loops



PROFINET

Industrial Ethernet (Basics)

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Ethernet

- Ethernet technology specifies protocols and hardware for wired data networks to exchange data packets between devices
- Transmission rates range from 10 Mbps, 100 Mbps (Fast Ethernet) to 1000 Mbps (Gigabit Ethernet) and 10 Gbps.
- Specification comprises definitions for cable types, connectors, packet formats and other transmission formats.
- Ethernet conforms to IEEE 802.3 and comprises layer 1 and part of layer 2 in the OSI model.
- Ethernet often serves as base for network protocols like TCP/IP that operate in higher layers.

Industrial Ethernet

- Industrial Ethernet is a term for all efforts to strengthen the Ethernet standard for use in industrial environments
 - Switches for industrial application; mounting rail systems
 - EMC interference immunity
 - protection against dust and splashing water
 - Increased availability

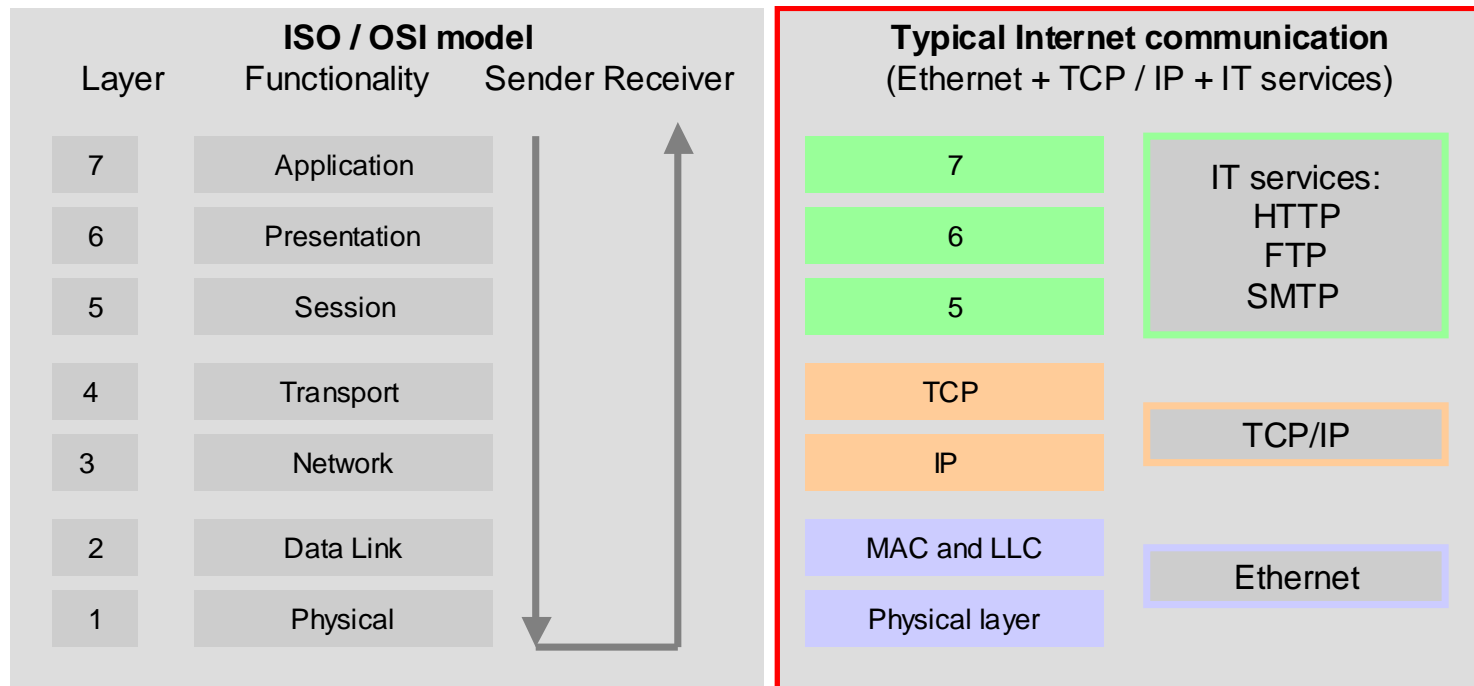
- Highly important are
 - Short and extremely short cycle times, simultaneously with high level of determinism and synchronous behavior
 - Powerful diagnostic mechanism

IEEE 802.3

- Standards for Ethernet were developed in the responsibility of Working Group 802.3 of IEEE. Since that time, Ethernet became the synonym for all specifications by it.
- Ethernet is standardized in IEEE 802.3 and builds on IEEE 802.1 (Internet Working) and IEEE 802.2 (Logical Link Control, LLC).
- IEEE802.3 comprises a number of different technologies for which individual standards are included.

Internet communication in the ISO/OSI model

- The ISO/OSI model divides the overall communication function into 7 logical layers; each layer takes a portion of this function
- Each layer uses its internal processes to generate a layer-specific output which serves as input for the next higher layer



**PROFIdrive
on PROFINET**

PROFINET

**PROFINET
as „Drive Bus“**

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PROFINET Basics

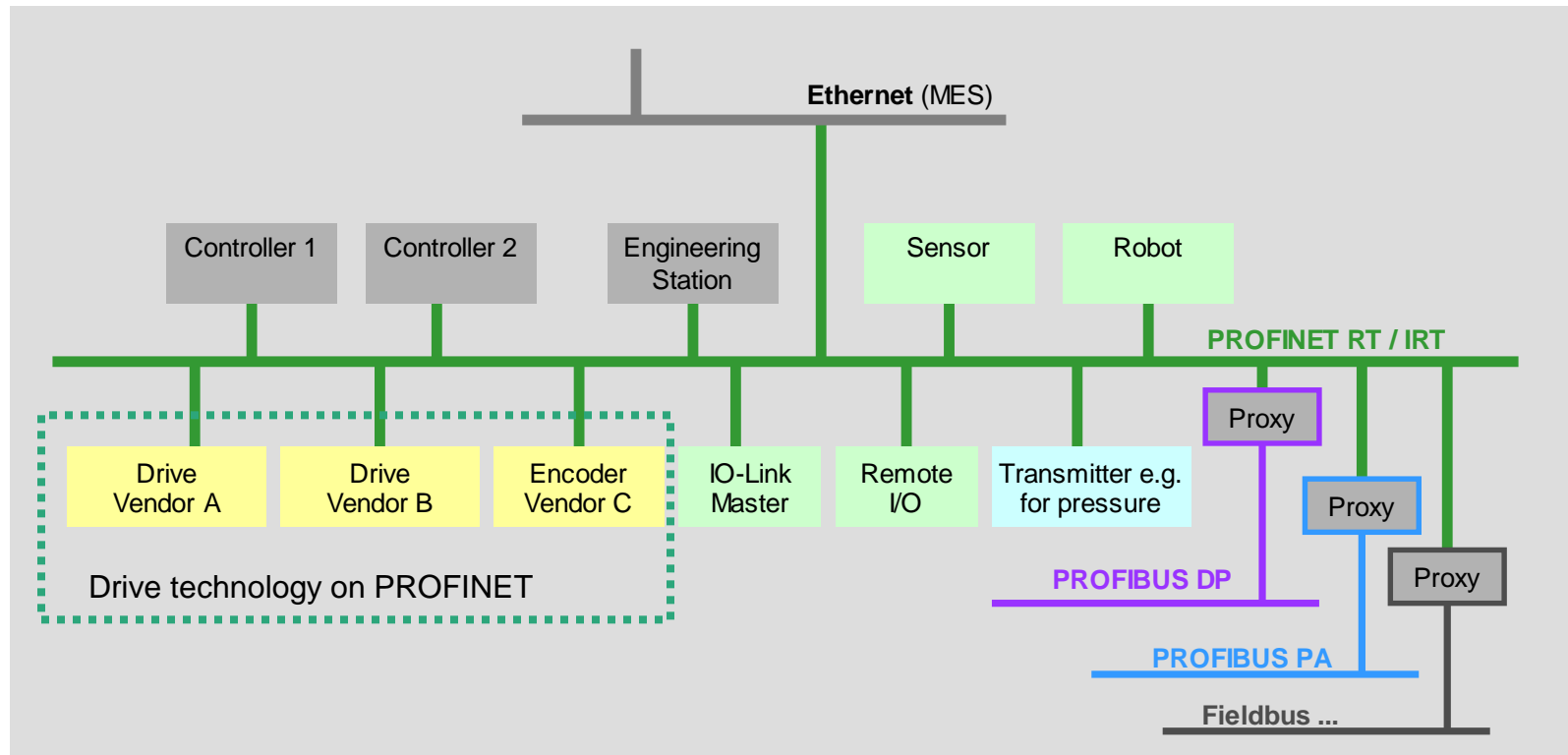
- PROFINET has become the leading Industrial Ethernet Standard in the market. It is supported by many product vendors, thus ensuring long-term availability and investment protection.
- PROFINET uses the same Ethernet as offices and IT departments but with enhanced capabilities to meet the far tougher conditions encountered in industrial applications.
- As standard technology that in the automotive industry, widely spread in machine building, and well-proven in the food and packaging and logistics industries, PROFINET has found its way into all application areas including drives and motion.

PROFINET Basics ctd.

- PROFINET is the Industrial Ethernet solution of PROFIBUS & PROFINET International (PI).
- PROFINET builds on the wide experience of PI gained over decades with PROFIBUS in the industrial fieldbus environment
- PROFINET realizes fast vertical and horizontal data exchange at all levels and thus is the basis for efficient machine and plant automation including integration into the corporate level
- PROFINET is standardized in IEC 61158
- PROFINET is a high-performance “Drive bus” when operated together with drive devices using the PROFIdrive device profile

PROFINET for all industrial applications

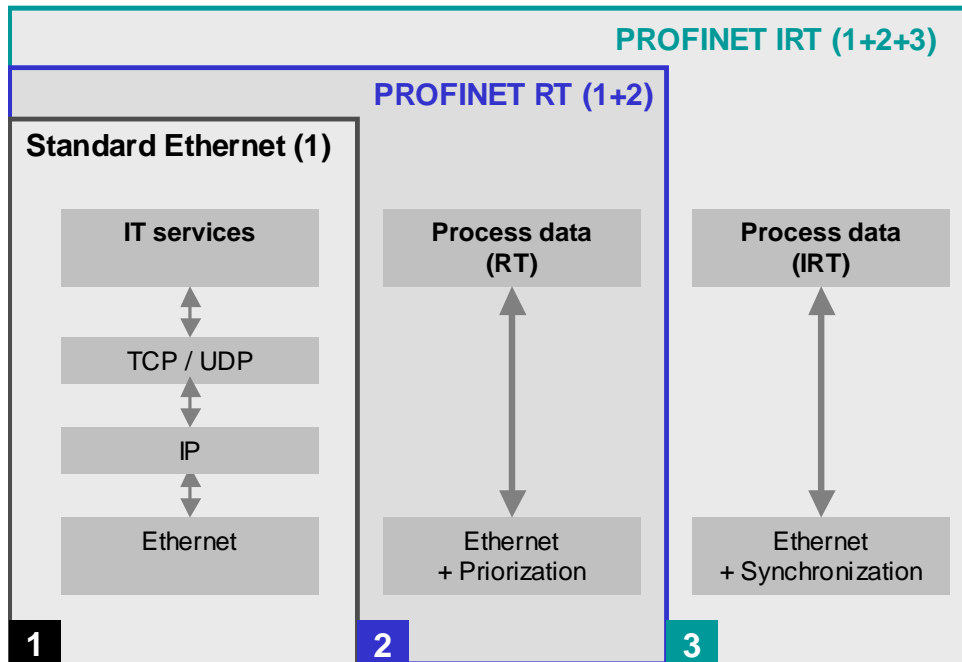
- PROFINET integrates all automation functions and levels of a plant **including drives** in one single approach



PROFINET cycle times are scalable

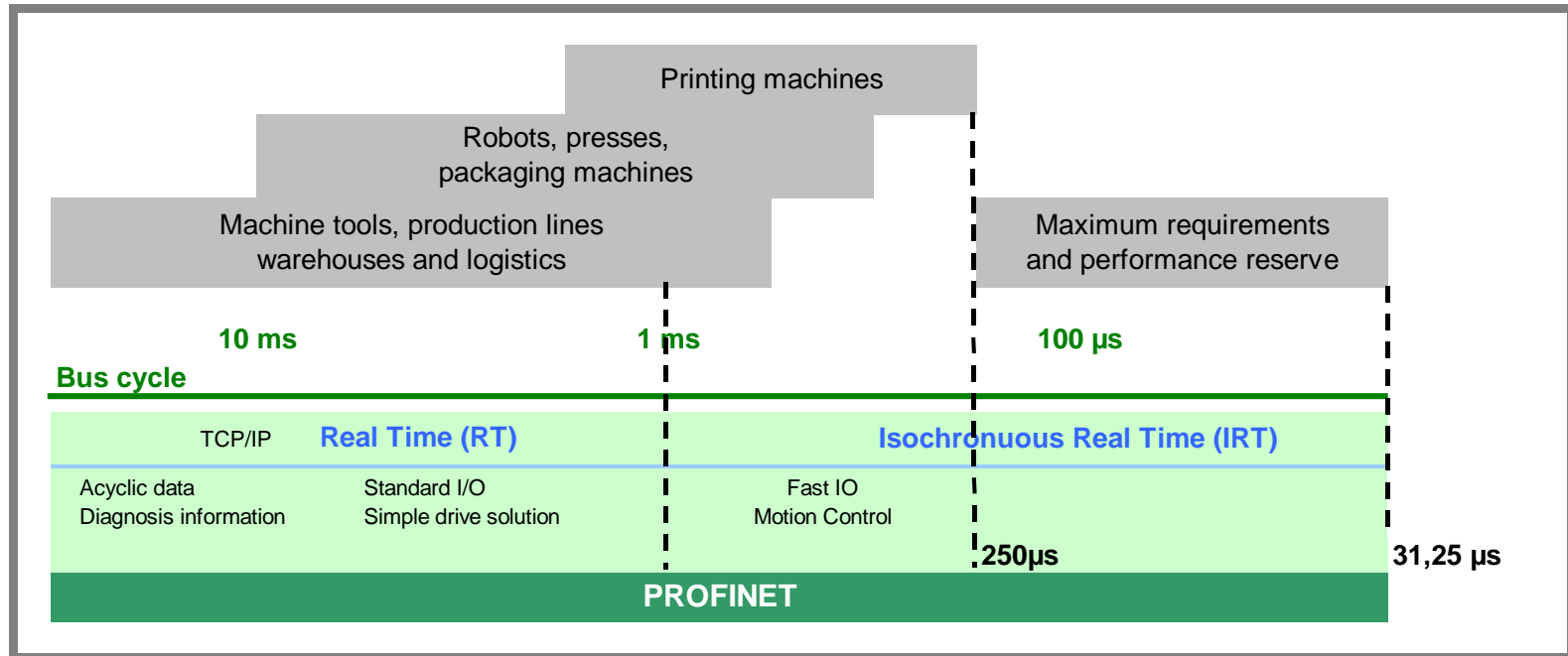
PROFINET supports

- fast communication of I/O data with a high level of determinism (Real Time RT and Isochronous Real Time IRT)
- and - at the same time and on the same cable - standard TCP/IP communication for use of all IT services and Web tools



PROFINET cycle time range and drive use cases

- The cycle time of PROFINET ranges from TCP/IP to IRT down to 31,25 μ s. It covers all drive applications including motion control and additionally provides a performance reserve



PROFINET scalable performance classes

- PROFINET performance is scalable by subdividing its functions into three Conformance Classes (CC) and a number of options

	Conformance classes			Options (for all CCs)
	CC-A	CC-B	CC-C	
Cyclic data exchange, Real-Time (RT)				
Acyclic data exchange, Non-Real-Time via standard TCP/UDP				
Access to IT services via standard TCP/UDP				
Reading out of identification information of devices (I&M function)				
Diagnosis of device states (tiered alarm model)				
Same device model as for PROFIBUS DP facilitates technology switch				
Model for integrating PROFIBUS and other fieldbuses				
Diagnostics for monitoring and maintenance of network components				
Topology detection for simple device replacement, etc.				
Topology display for easy plant documentation				
Isochronous real-time communication (IRT)				
Further optimized IRT communication for the most stringent requirements				
Use of PROFIdrive profile for drive technology and motion control				
Use of PROFIsafe profile for safety-related communication				
Use of PROFInergy profile for energy efficiency optimization				
Access by multiple controllers to one device input (shared input)				
Distribution of device functions to various controllers (shared devices)				
Access to devices without plant shutdown (Configuration in Run)				
Time stamping for alarms and status messages				
Redundancy mechanisms for high plant availability				
Extended I&M functions (see item 4)				
Industrial Wireless communication via WLAN and Bluetooth				
Call-up of a specific engineering tool (of a device)				

Application areas of conformance classes of PROFINET			
Building automation, process automation			
Drive technology, machine control			
Isochronous applications, motion control			

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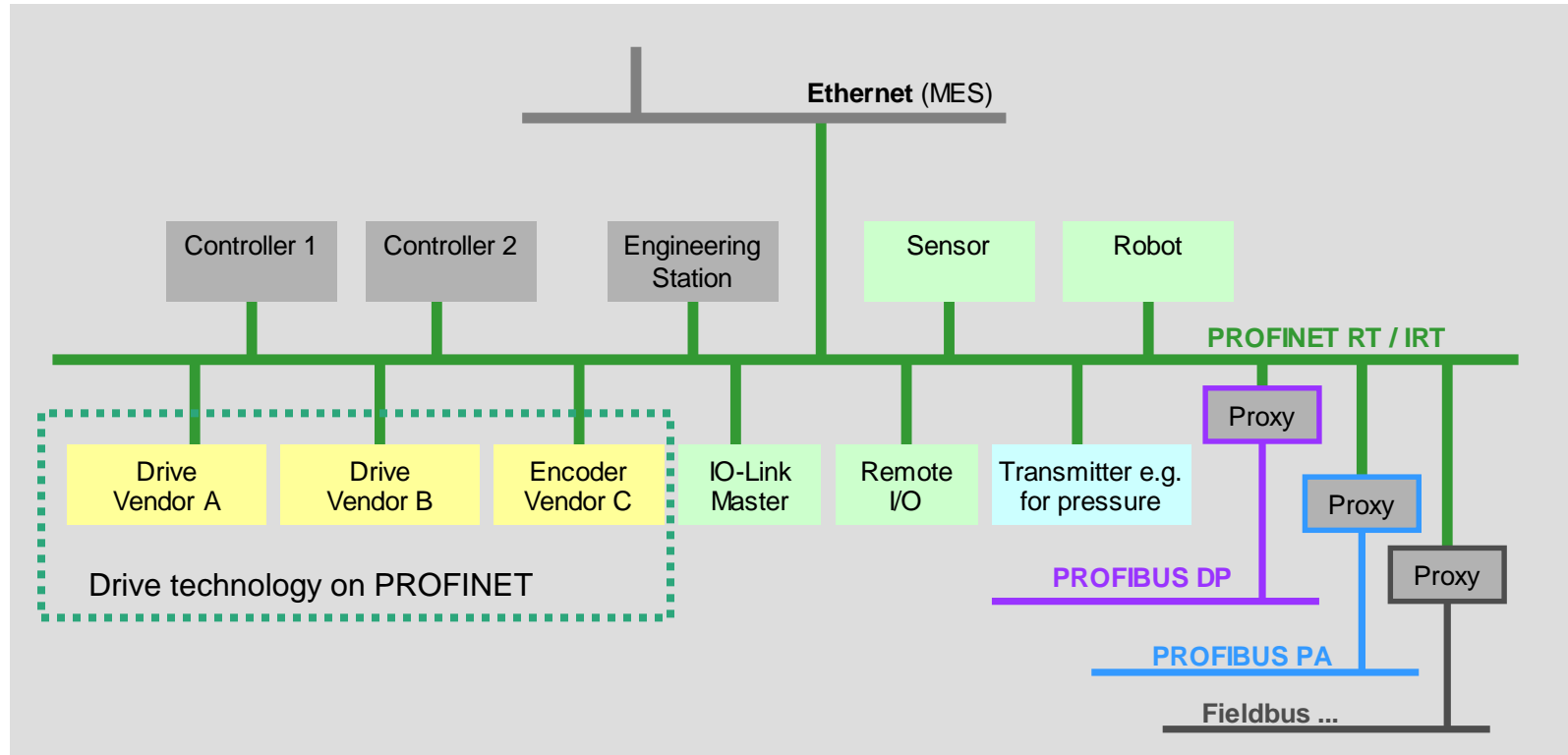
PROFINET expands to drive application

- Ethernet, in its „Industrial Ethernet“ version, has been long accepted in industry for
 - networking of controllers and visualization stations and
 - integrating instrumentation and controls into higher corporate levels
- In the field level of drives and transmitters, however, fieldbus-based technology is still used.
- But times are changing:
Industrial Ethernet-based solutions get increasingly attention in the drive world with PROFINET in the leading position.
Main benefits are much higher performance and the integrated approach of the plant-wide communication infrastructure.

PROFIdrive on PROFINET

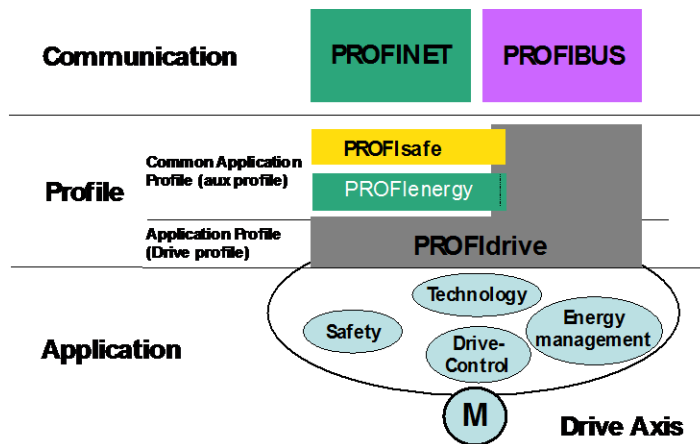
- In combination with PROFINET, PROFIdrive becomes a high-performance, ethernet-based technology for comprehensive drive solutions
- Conversely, in combination with PROFIdrive, PROFINET becomes a drive bus for the most stringent requirements that is without any limitation suitable for all other automation tasks.

PROFINET for all automation tasks including drives



PROFdrive profile on both PROFIBUS and PROFINET

- The PROFdrive device profile (beginning from version 4.0 of 2005) can be used with PROFINET without any reprogramming of the application.
- This meets the machine building industry’s demand for an easy and low-cost way of operating devices on both communication systems



PROFIdrive profile on both PROFIBUS and PROFINET

- The dual use of PROFIdrive is possible because the architecture of PROFIdrive strictly separates between
 - communication system and
 - communication-independent functions (primarily the application)

- The figure shows the correspondences
 - P-Device and Supervisors are terms from the object model of PROFIdrive

PROFIdrive	PROFIBUS	PROFINET
PROFIdrive Controller	PROFIBUS DP Master Class 1	PROFINET Controller
PROFIdrive P-Device	PROFIBUS DP Slave	PROFINET Device
PROFIdrive Supervisor	PROFIBUS DP Master Class 2	PROFINET Supervisor

Benefits - More flexibility

- The openness of PROFINET provides an integrated and uniform automation network in machines and plants and allows to connect standard Ethernet devices
- The topology options (line, star, tree, ring) offer complete freedom for new plants or adapting to existing structures
- PROFINET is 100% Ethernet and supports TCP/IP and thus the use of all Web technologies
- In addition to drives with PROFIdrive, other devices with PROFINET interfaces (e.g. transmitters) can be operated on the same network

Benefits - More Performance

- The scalable cycle times of PROFINET open the way to all drive and motion control applications thereby increasing the productivity of plants and machines
- With version 2.3 PROFINET provides cycle times down to 31,35 μs with exact deterministic behavior and without any limitation to the TCP/IP communication
- PROFINET communication is deterministic with a jitter $< 1 \mu\text{s}$ and thus ensures maximum precision of the executed functions
- PROFINET provides best possible availability through its media redundancy via integrated interfaces or external switches

Benefits - More efficiency

- PROFINET requires only one cable for transmission of both machine data and simultaneous IT communication
- PROFINET does not require time-consuming entry of IP addresses- Addressing is automatically done.
- High machine availability is achieved by powerful device and network diagnostics and the use of switches in field devices
- A replaced device is automatically assigned the name of its predecessor; no engineering tool is required for that
- With PROFlenergy individual loads or whole production units can be selectivity switches off during idle times

Drives and Safety

PROFIdrive on PROFIsafe

Safety channel

Multi-profile Drive

Safety communication model

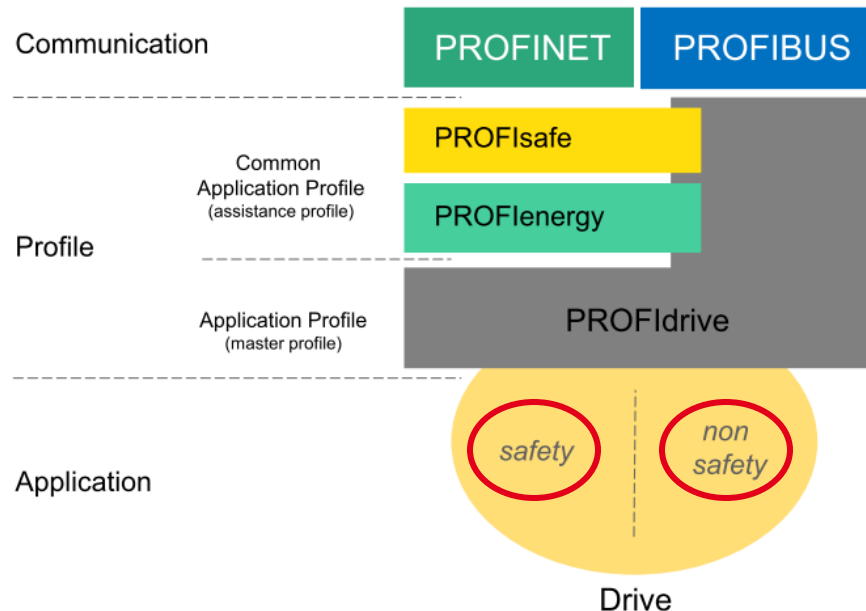
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Safety channel

- Today, drives will be increasingly equipped with autonomous functional safety (Drive-based safety)
- Drive-based functions must be handled by safety control systems (Safety PLC) as part of the automation
- For these application requirements PROFIdrive has specified a safety channel „PROFIdrive on PROFIsafe“
- **„PROFIdrive on PROFIsafe“** describes the interaction of autonomous safety functions with a safety control system and defines possible safety functions and its general behaviour.

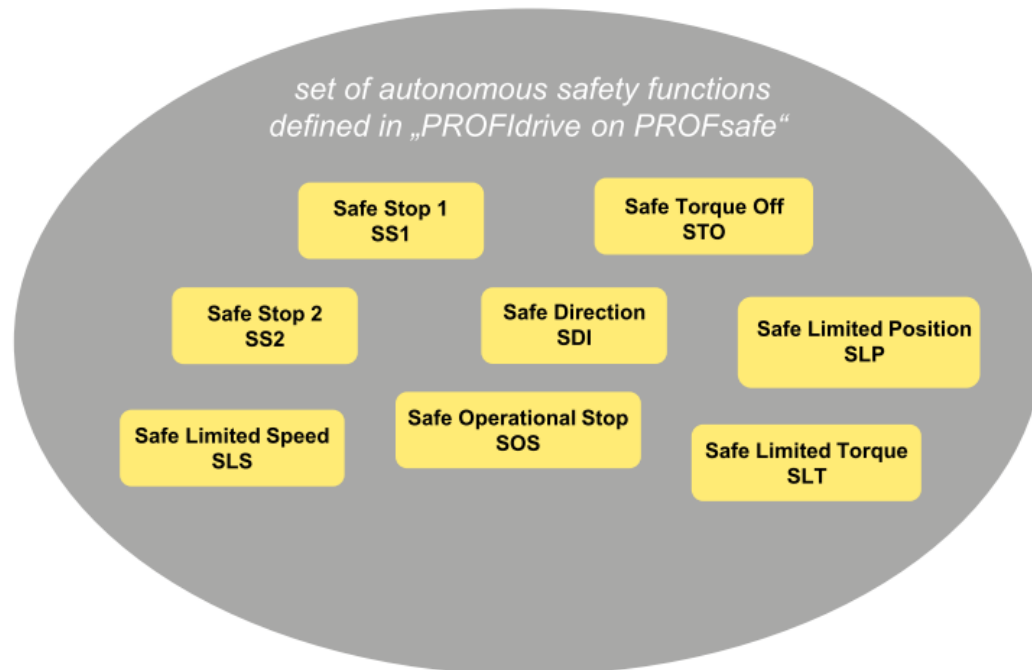
Multi-profile Drive

- A “Multi-profile drive“ device is equipped with, besides PROFIdrive, additional profiles such as PROFIsafe and/or PROFIenergy.
- In case of using e.g. PROFIsafe it provides a safety and a non-safety communication channel.



Autonomous Safety functions of Drives

- „PROFdrive on PROFIsafe“ defines a non-exhaustive list of possible drive-based safety functions (IEC 81800-5-2)
- The list can be expanded with vendor-specific functions
- The implementation of the drive based safety functions is in the responsibility of the drive manufacturers



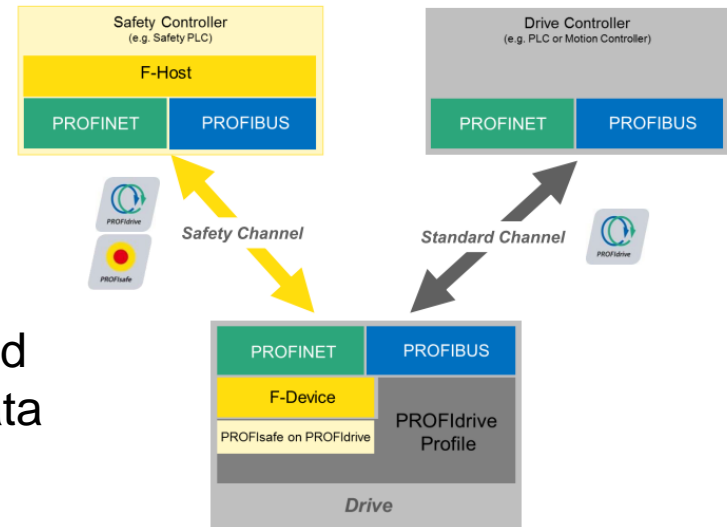
PROFIdrive Safety Communication Model

■ PROFIdrive Safety Channel

- Standard communication format according to PROFIsafe spec.
- F-Host/F-Device layer according to PROFIsafe specification

■ PROFIdrive Safety Telegram

- PROFIdrive telegrams for drive-based safety specified as F-Input/Output data
- Telegrams are linked to a subslot within the drive object analogue to PROFIdrive standard telegrams
- The drive safety process is controlled via “Safety Control Word” and “Safety Status Word”.



**Drives and
Energy efficiency**

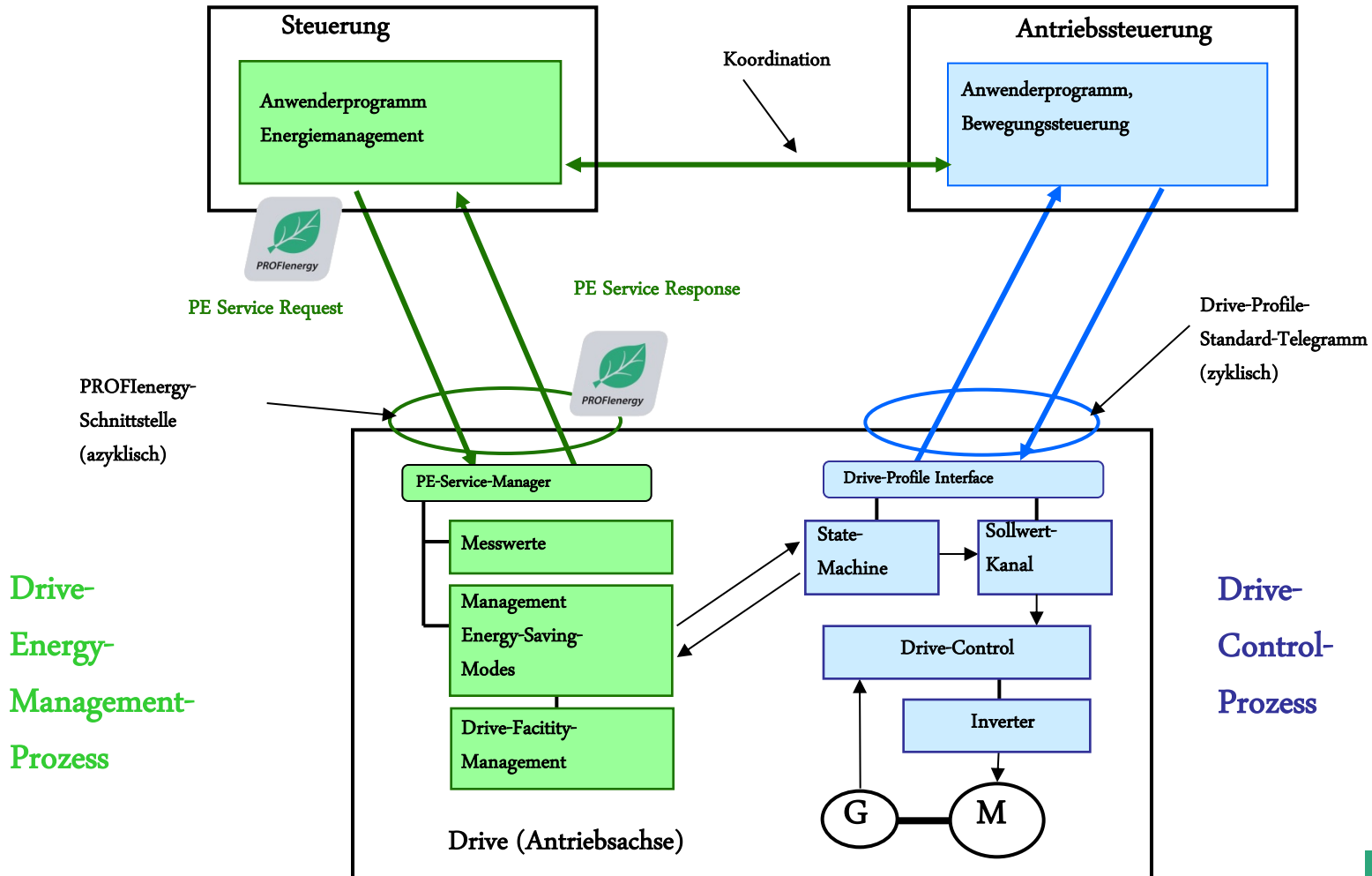
PROFenergy

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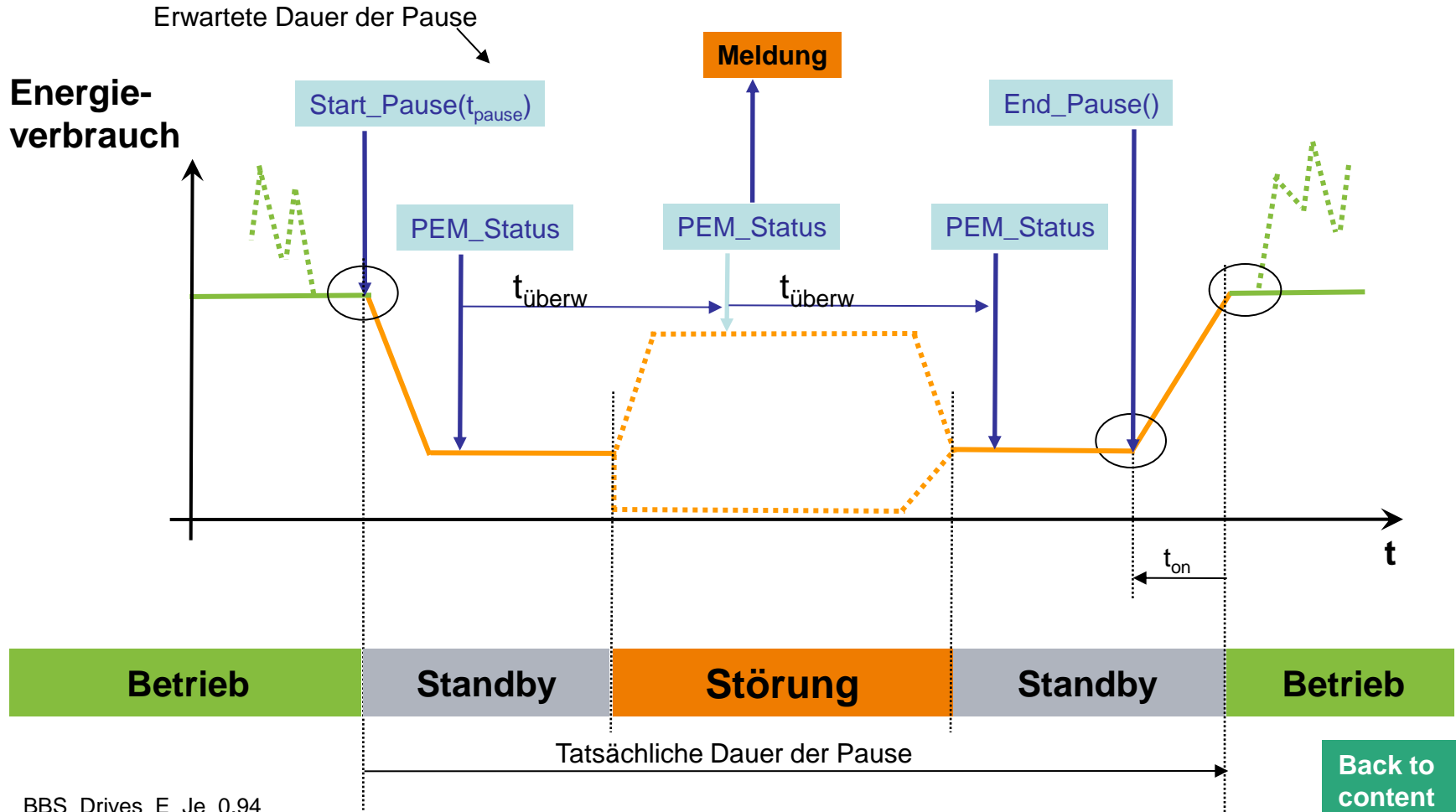
PROFenergy application profile

- PROFenergy is a profile of the Real Time PROFINET protocol and an enabler for intelligent energy management
- PROFenergy implements energy saving concepts by placing energy consuming devices (robots, conveyors, ...) into „sleep“ mode during equipment idle times
- The profile requires firmware in vendor supplied devices to enable responding to PROFenergy commands and status requests
- Energy savings up to 30% have been calculated in typical cases
- PROFenergy can be used on drives together with PROFdrive

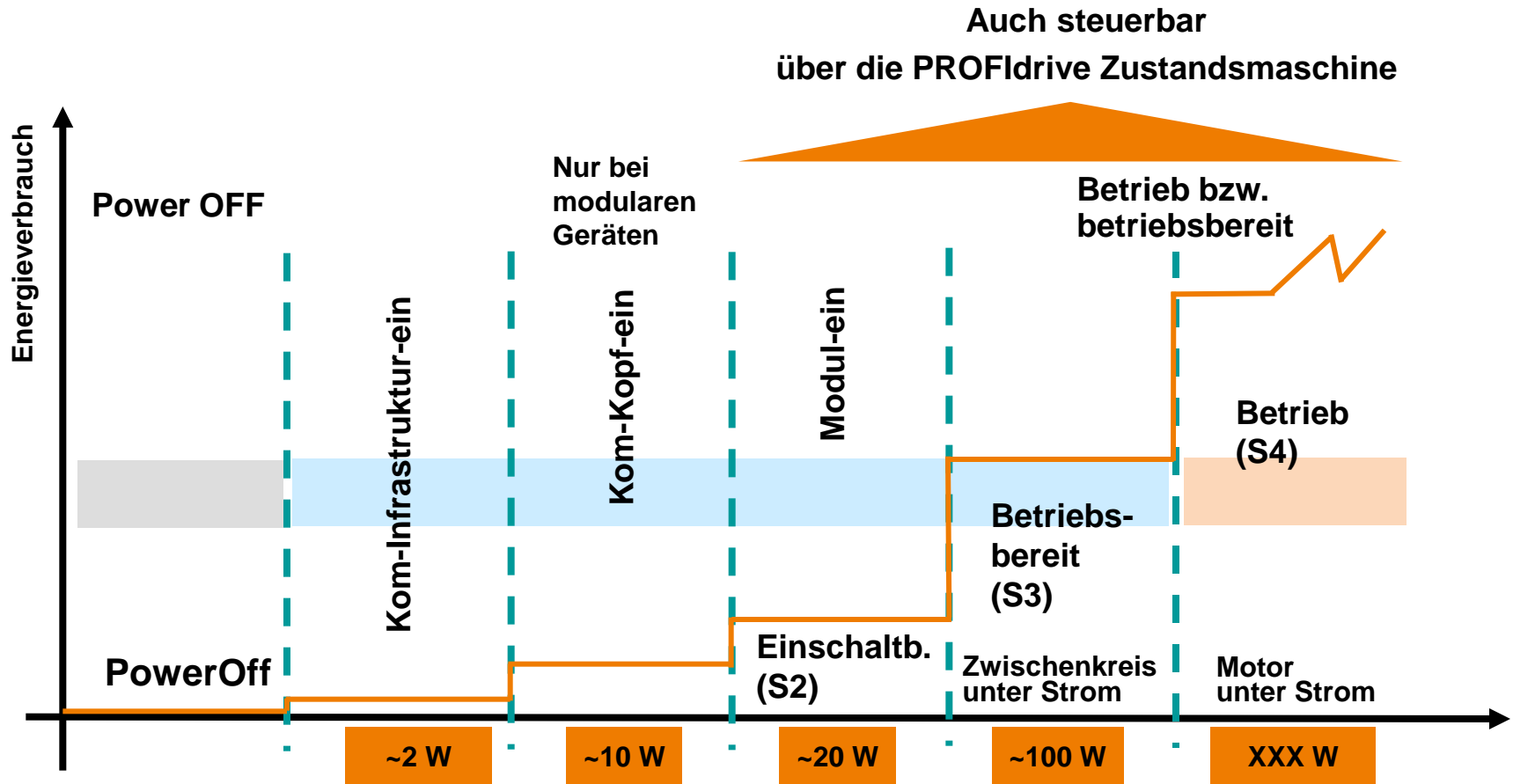
Realization of PROFenergy in a drive



PROFenergy cycle



Energy steps of drive devices



Conclusion

- PROFIenergy supports energy saving concepts in drive technology
 - Raise of additional potentials by optimized stand-by management
 - Existing stand-by solutions can be simplified

- Easy to handle interface
 - Device and vendor independent
 - Process dependencies are solved on-site
 - Hierarchical structures are supported

- Sustainable
 - Easy to expand for additional use cases and requirements
 - „Advanced“ communication features already integrated

Implementation

Concepts
Alternatives
Reference
implementation

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Different implementation concepts

- Implementation method depends on
 - Design and performance scope of the device
 - Expected production quantities
 - Business model (Time to market etc.)

- Implementation alternatives
 - Development in-house or by a service provider
 - Use of ready-made modules or a customized design
 - Fixed design (Asic) or reconfigurable (FPGA)

- Member companies of PI offer a comprehensive range of hard- and software and services to support device manufacturers.

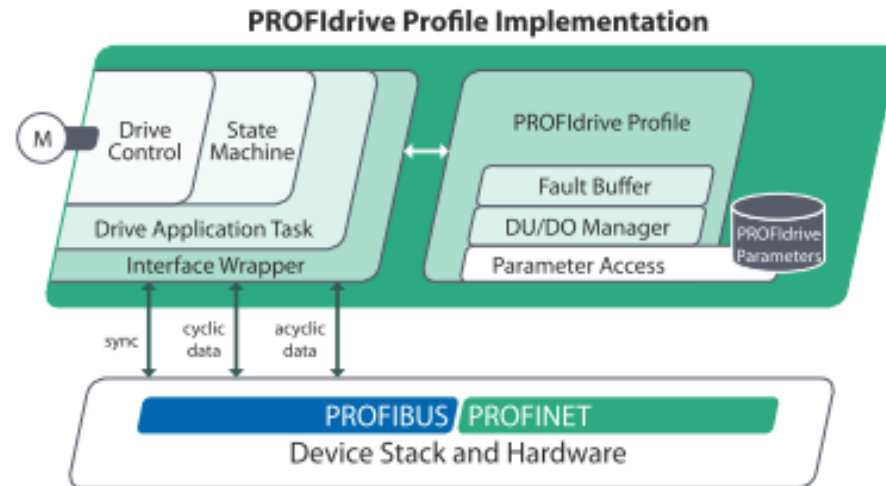
- The Community project „Reference implementation of PROFIdrive profile“ provides a very cost- and time-effective and solution.

Choice of technologies

- Use of an **external protocol converter** via a serial interface of the device in case of the implementation is either infeasible or undesirable.
- **Ready-to-install communication modules** provide implementation in the device with minimum in-house work. The entire protocol runs on the module; the in-house work is reduced to connecting the module to the device electronics.
- For compact devices with large production numbers an in-house development using a **single-chip interface with standard Ethernet controller** is appropriate
 - ASICs (ERTEC, TPS 1., ...)
 - FPGA-technology (Field Programmable Gate Array)

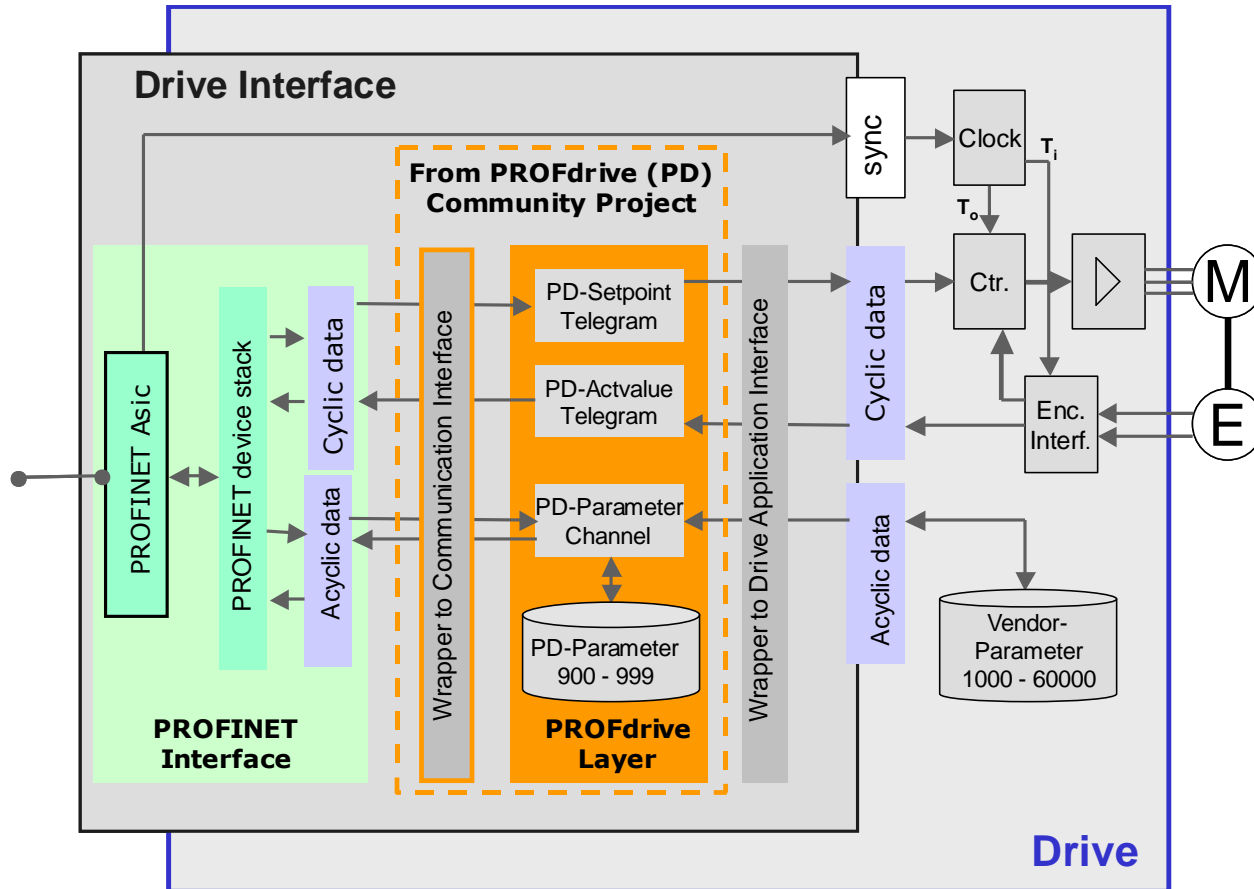
Community project (www.industrialnetworx.com/profidrive-profile)

- The Community project „Reference Implementation of PROFIdrive profile“ provides an extremely cost- and time-efficient solution.
- The community supports drive device manufacturers by providing the source code of a standard implementation of PROFIdrive free of charge. The community further supports source code implementation up to device certification.
- This development represents a de facto standard reference implementation in drive technology



- For details see: www.industrialnetworx.com/profidrive-profile

Contribution of the community project to the drive interface



PROFIBUS & PROFINET International (PI)

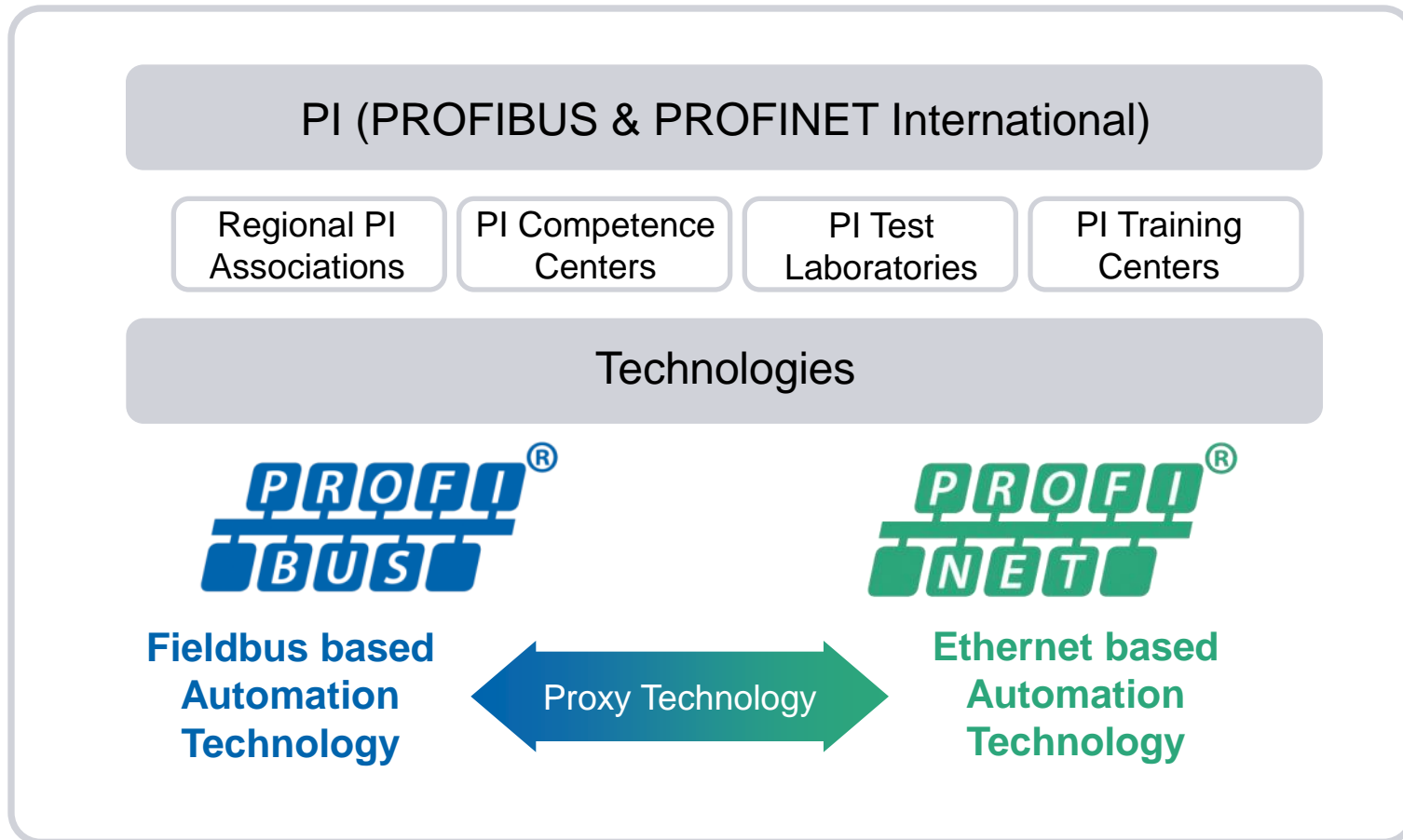
**Two technologies
Global support
Benefits from
membership**

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Leader in industrial communication

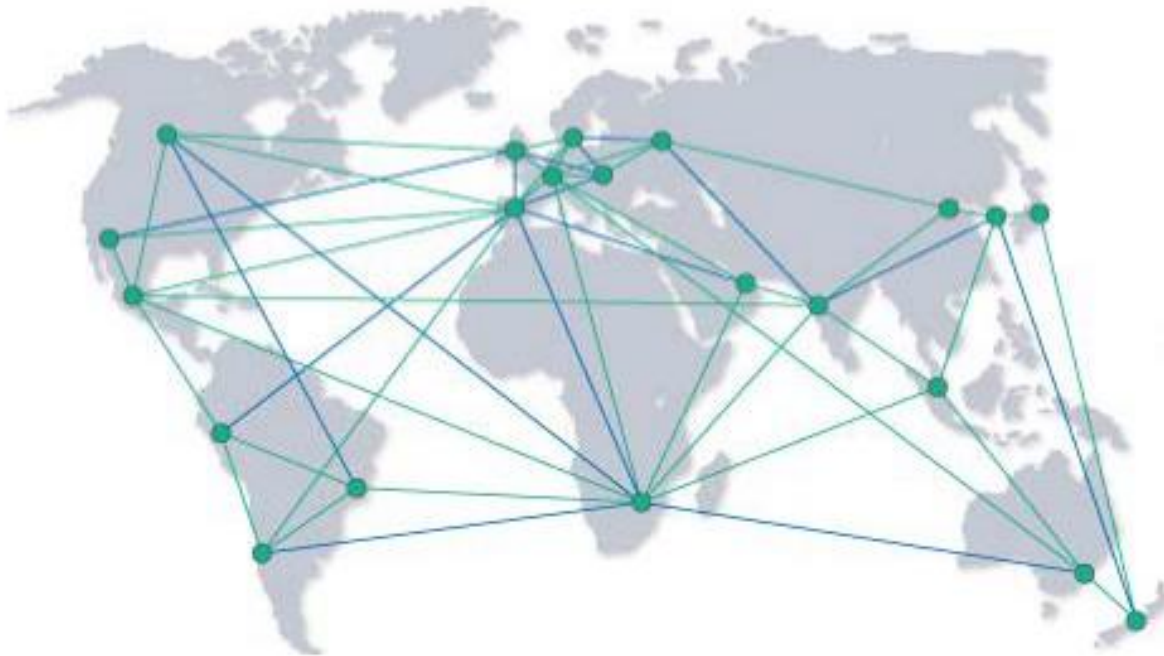
- PROFIBUS & PROFINET International (PI) is the most influential interest group in the field of industrial communication.
- PI's industrial networking solutions are based on two technologies: Fieldbus-based PROFIBUS and Ethernet-based PROFINET.
- PI hosts a large number of active Working Groups which are responsible for developing, standardizing and maintaining PROFIBUS and PROFINET.
- PI heads a global network of vendors, end users, developers, and System Integrators having a common interest in promoting , supporting and using PROFIBUS and PROFINET.

Two technologies in one organisation



Global engagement

- PI provides significant regional engagement and support thanks to its representatives and institutions in numerous countries.



User support worldwide

- **Regional representatives (27)**
are contact persons for local member support.
- **Competence centers (50)**
provide consulting and support for all technical issues.
- **Training centers (27)**
share their technical know how and practical experience with manufactureres and users.
- **Test Labs (11)**
are experienced partners for easy and cost-effective certufication of devices.

All figures as of year 2013.

Benefits from membership

- Members profit from the unique network and the profound experience of over 1400 member companies of PI.
- Members have access to all technical documentation and can participate in developing future technologies and solutions.
- Members will get an ideal basis to achieve significant competitive advantages.