



Figures
PROFINET
PROFenergy
IO-Link

Bernd Lieberth
Secretary RPA-SEA

Figures
PROFINET
PROFenergy
IO-Link

PROFIBUS & PROFINET International (PI)

25 Regional
Associations
(RPA)

36 PI Competence
Center (PICC)

10 PI Test
Laboratories (PITL)

More than 1,400 members world wide

■ The architecture is being devised by

- 12 work groups
- With 140 employees
- from 60 companies



PROFINET[®]



PROFIBUS[®]

PROFINET – from the world's largest fieldbus organization

Figures
PROFINET
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IO-Link



PI worldwide:

27 Regional PI Associations (RPA)

PI Technical Support:

40 PI Competence Centers (PICC)
18 PI Training Centers (PITC)
10 PI Test Laboratories (PITL)

Figures

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Organization logo
South East Asia



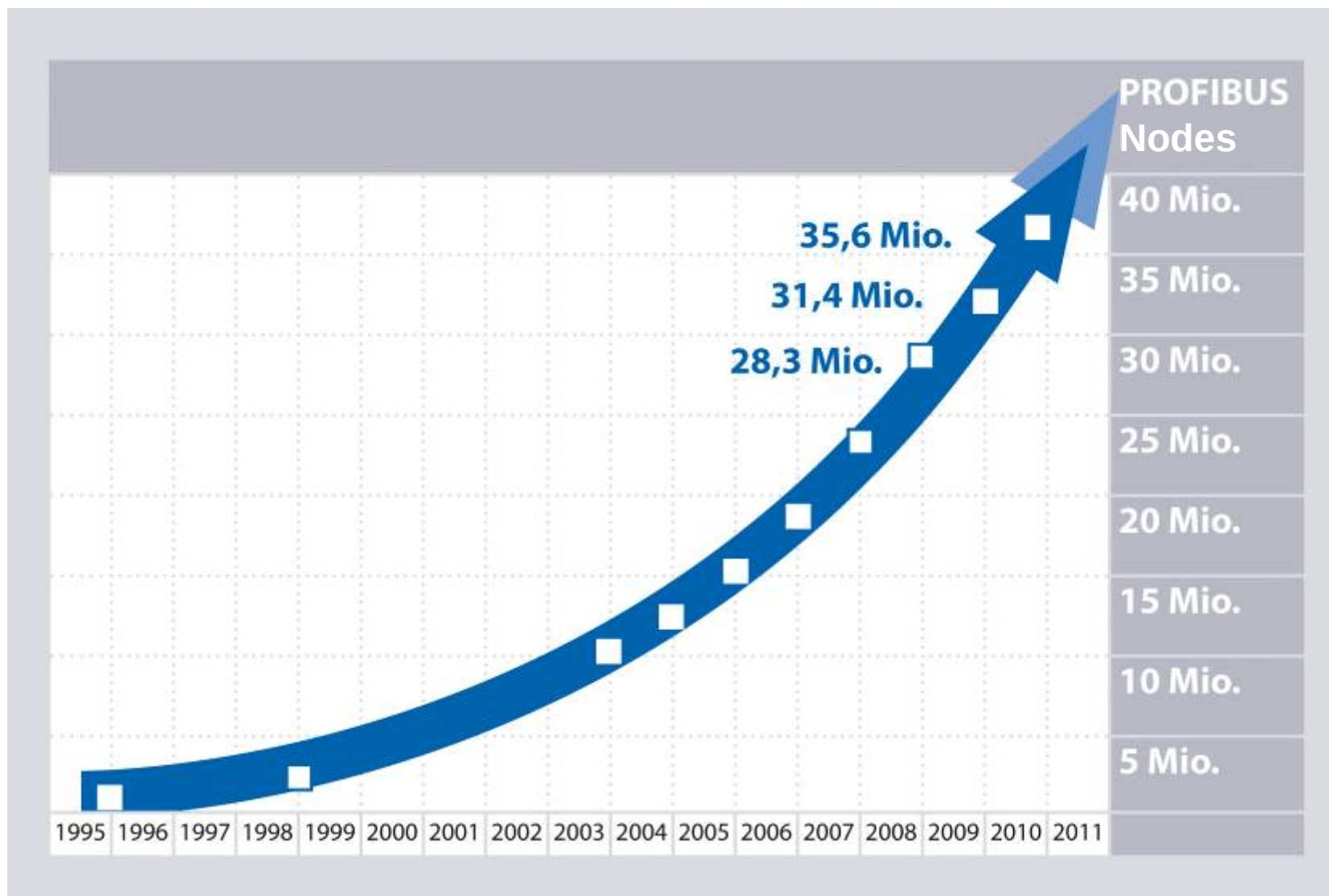
Technology logo

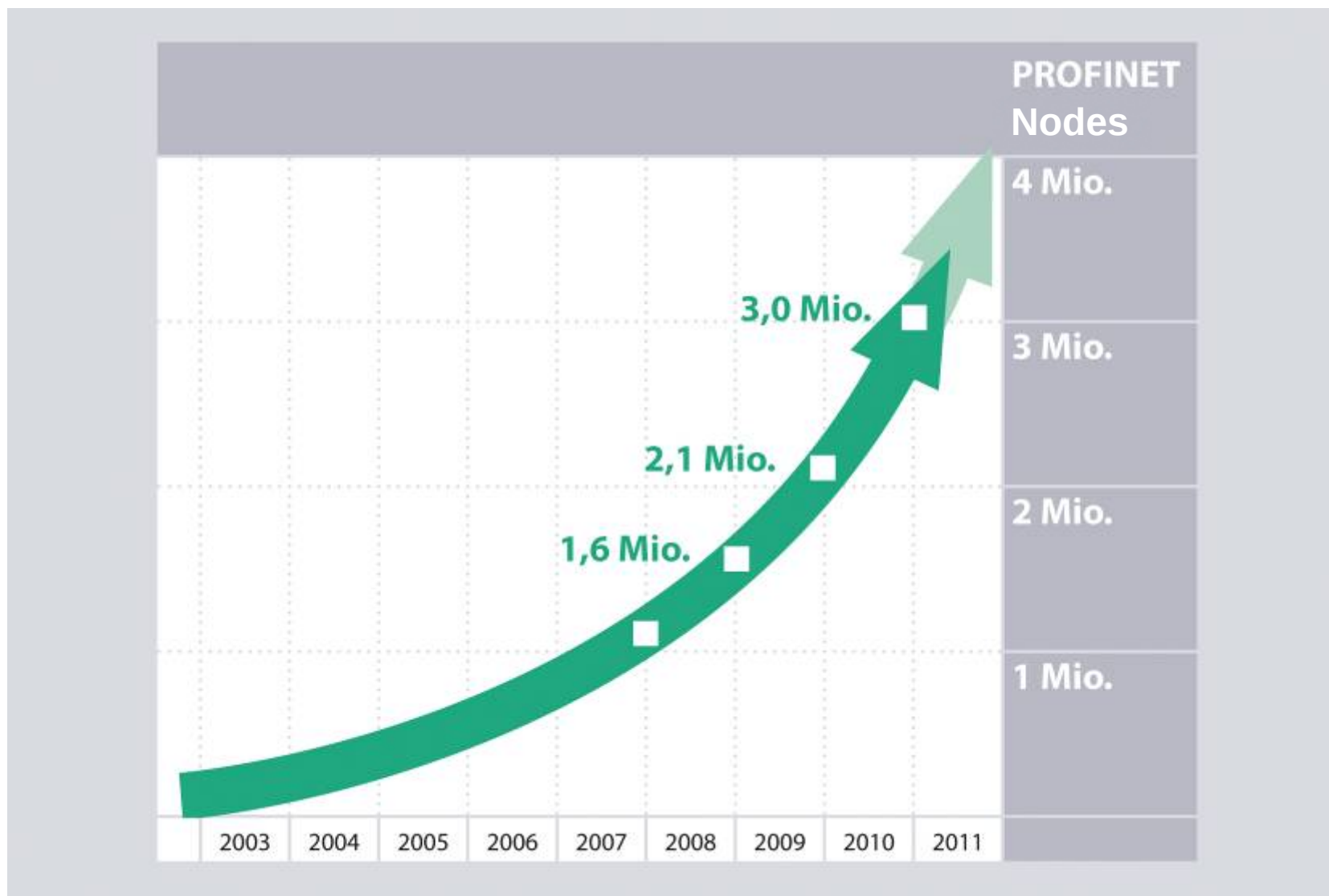


Profile logo



Installed nodes World wide, new counting





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2007: Every **15th** device sold with
PI technology (PB/PN) is PROFINET

2008: Every **12th** device sold with
PI technology (PB/PN) is PROFINET

2009: Every **7th** device sold with
PI technology (PB/PN) is PROFINET

2010: More than every **6th** device sold with
PI technology (PB/PN) is PROFINET



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Factory Automation



Motion Control



Process Automation



PROFINET

- Worldwide established in Factory Automation and Motion Control
- Already used in Process Automation for In-/Outbound
- Standardization activities for primary processes finalized

One system for all applications

What does process automation mean?

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- 
- Slow change of process signals
(Cycle times ~ 100ms)
 - Systems are running continuously,
24 hours/day and 365 days/year
 - Complex actuators and sensors
 - Huge quantities with
up to 100,000 I/O signals
 - Very long lifecycles of process plants

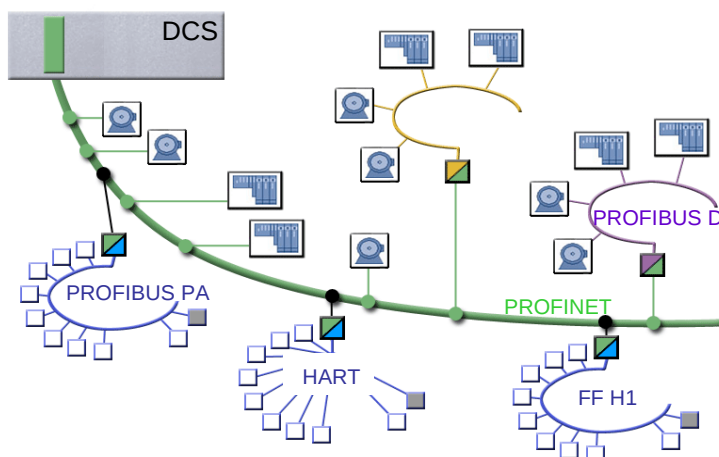
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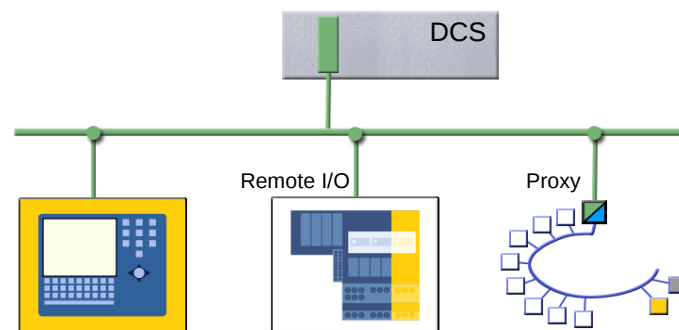
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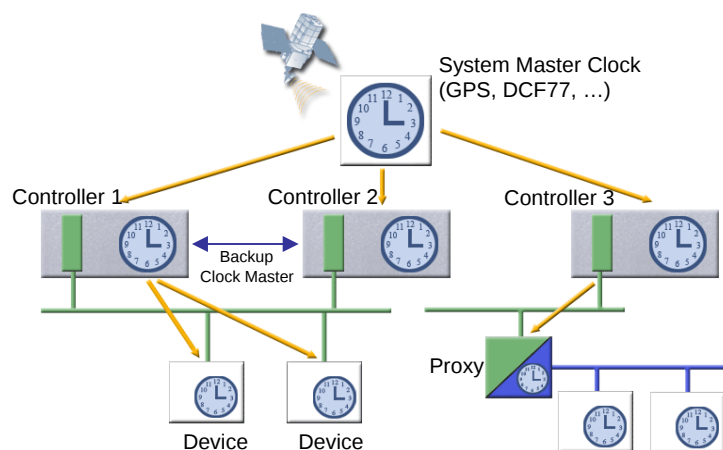
Fieldbus Integration



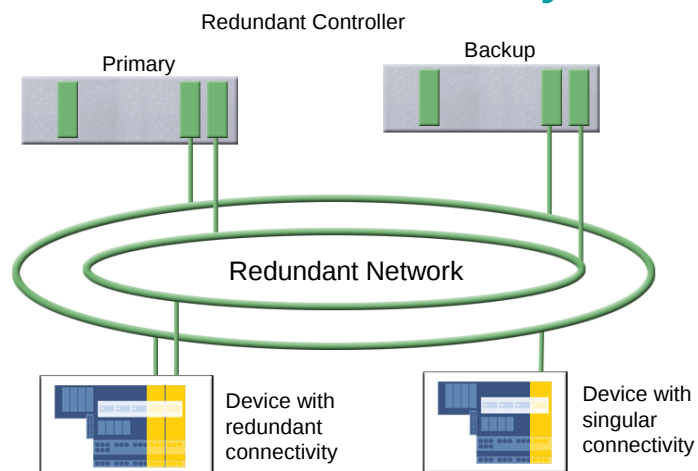
Configuration in Run (CiR)



Time sync / stamping



Scalable Redundancy



Schedule for PROFINET in PA

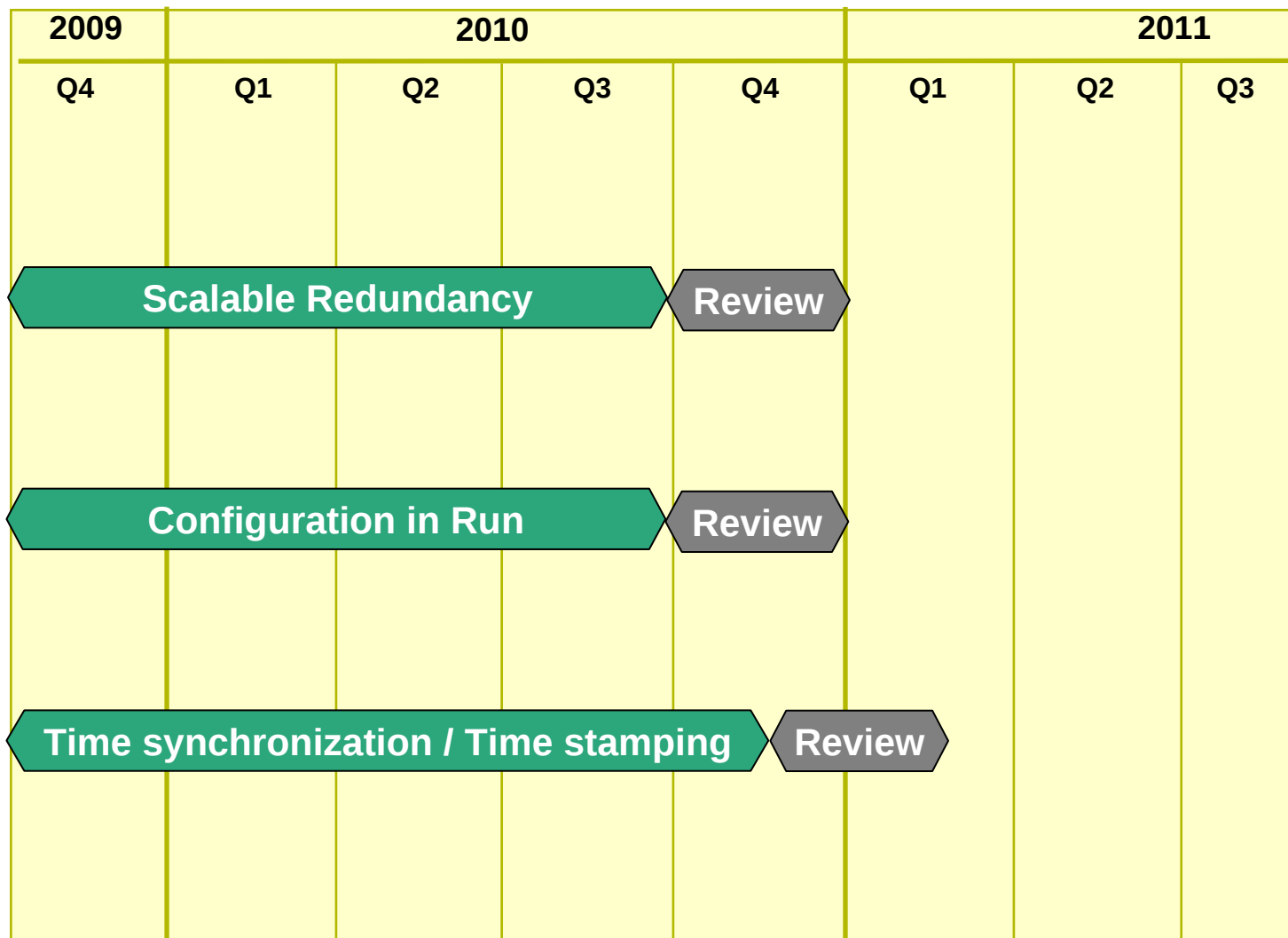
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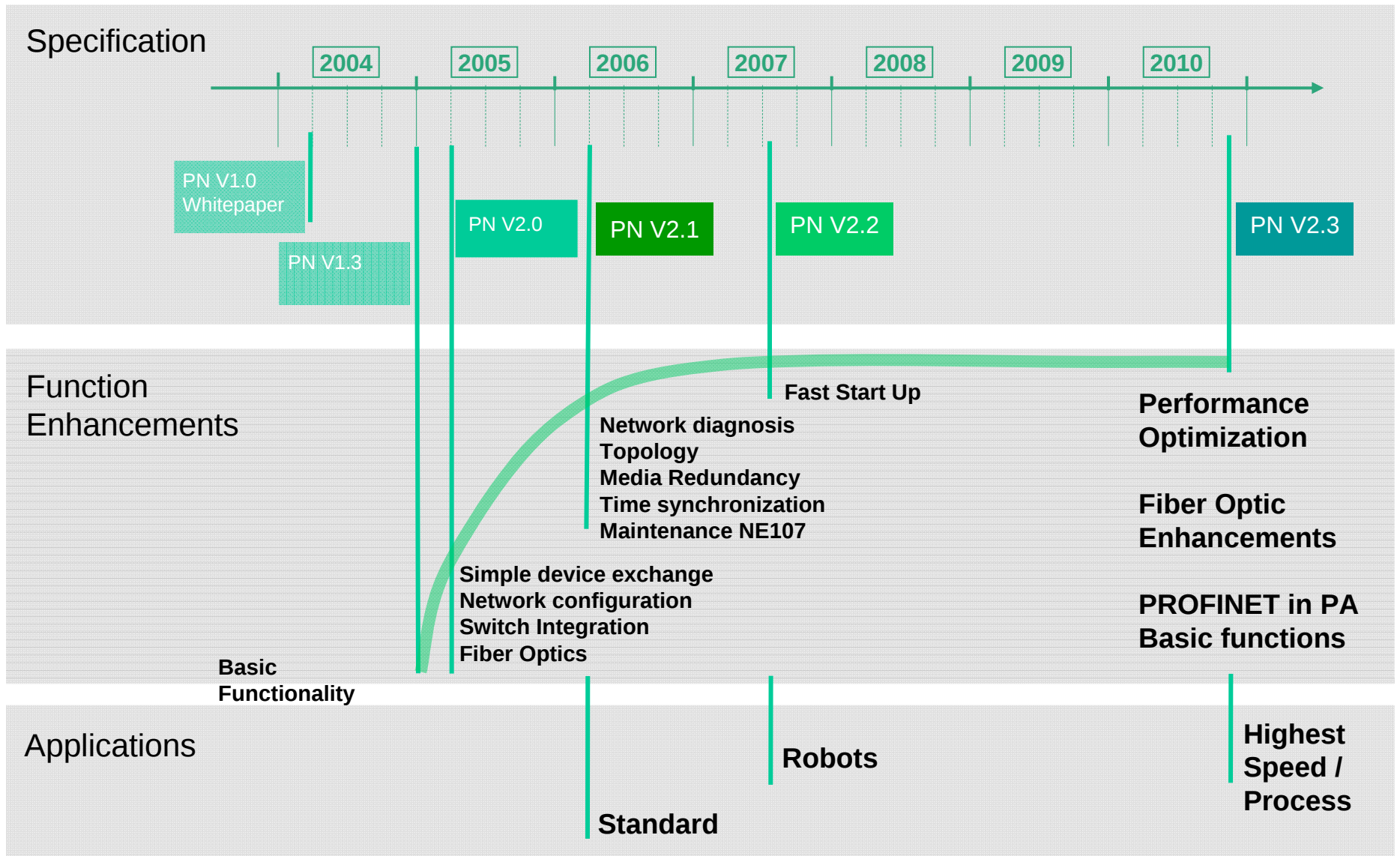
IO-Link

Users

- 100 % investment protection (seamless complement for PROFIBUS)
- Cost reduction by ONE plantwide communication system
- Network management / diagnosis with standard Ethernet-Tools
- Higher performance
- Larger quantities
- New scalable and highly available architectures

Vendors

- Focus on ONE plantwide communication system
- Flexibility in device development (enhancements optional)

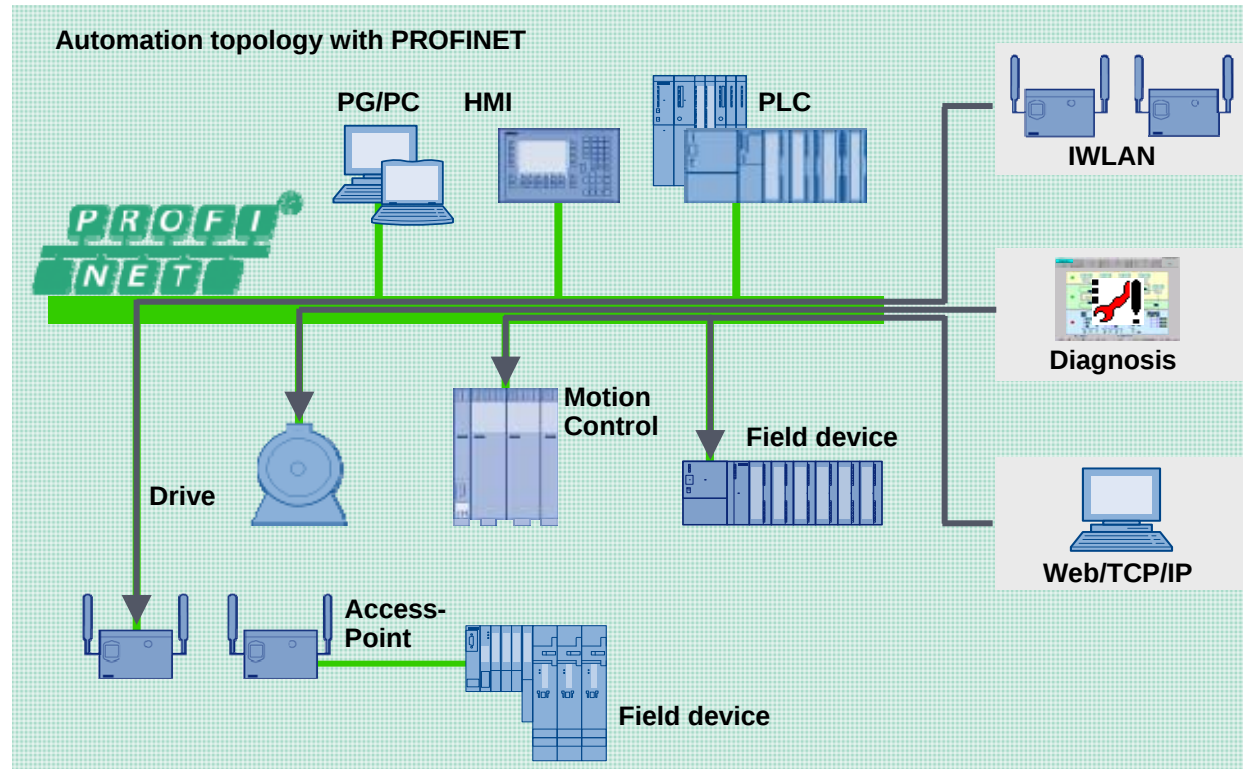


Fieldbus:

- Dedicated connections for different tasks

PROFINET:

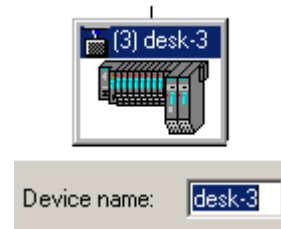
- Open Communication
 - TCP/IP
- Engineering/Operation
 - PC
 - HMI
- Control
 - PLC/PLC
 - IO Communication
 - Motion



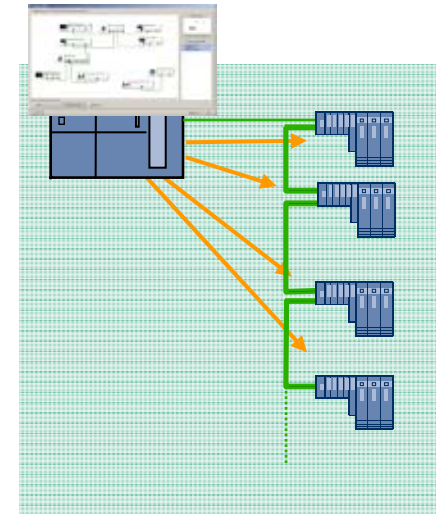
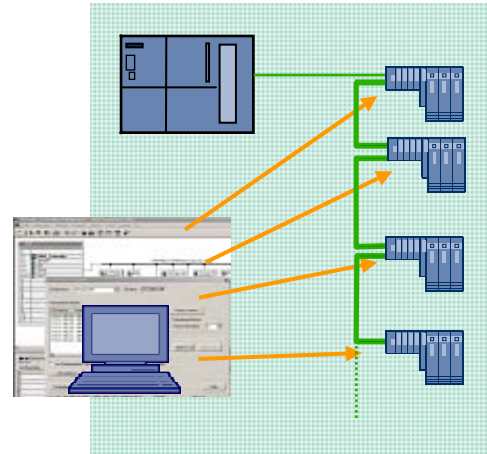
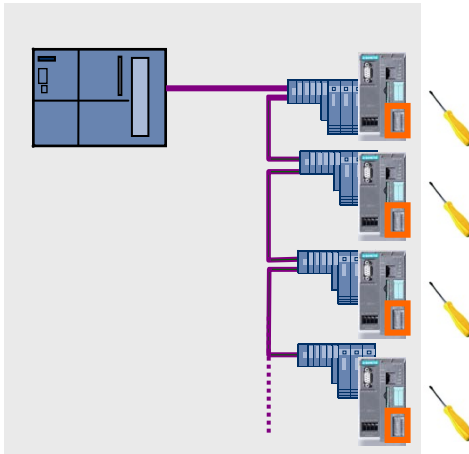
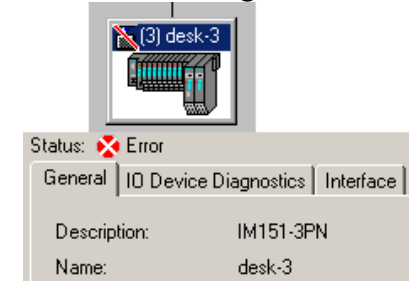
Names instead of numbers

- Meaningful names for each station
- Assignment name = IP Address by engineering station / user

Offline-Engineering



Online-Diagnosis



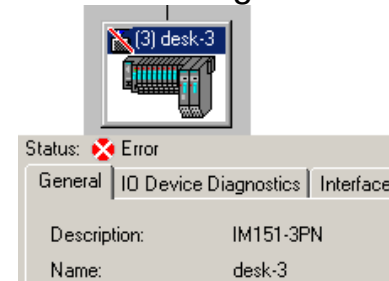
Names instead of numbers

- Meaningful names for the stations
- Assignment Name = IP Address by ES / user

Offline-Engineering



Online-Diagnosis



Continuous naming of connections

- Common Look & Feel
- Network diagnosis

Device chassis



X1 P2

[3] desk-3	
Slot	Module
0	desk-3
X1	PN-IO
X1	Port 1
X1	Port 2
1	PM-E DC24/48

Online-Diagnosis

Status: Error	
General	IO Device Diagnostics
Communication Diagnostics:	
Name	Error
Port 2 (X1 P2)	Wrong partner port

As well as ...

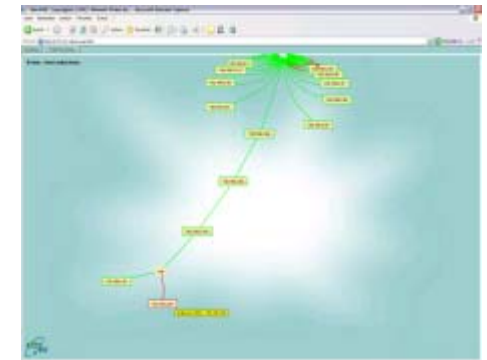
- Reliable, well-understood diagnosis of the channel
- Assured Alarms

Date/Time arrived	ID	Message text
01/13/2009 03:47:30.354 PM	76	PN device 1 on PN system 100 Slot: 3: Mo Name: PN02-IM151-3PN Module: 4DI DC24V HF I/O address: I3
01/13/2009 03:46:07.480 PM	75	PN device 1 on PN system 100 Slot: 2: Shc Name: PN02-IM151-3PN Module: 2DO DC24V/0,5A HF I/O address: O2
01/13/2009 10:38:55.512 AM	75	PN device 1 on PN system 100 Slot: 2: Shc Name: PN02-IM151-3PN Module: 2DO DC24V/0,5A HF I/O address: O2

... usage of standard Ethernet diagnostics ...

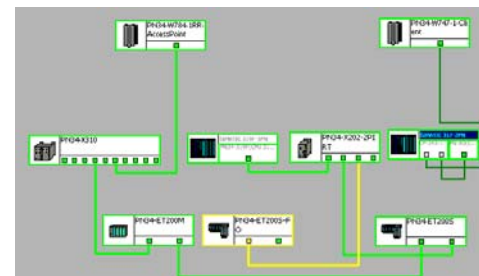
- Proven mechanisms like SNMP
- Access from any location

Port	Statistical value	Current
Port 1 (X1 P1)	Dropped received packets - no resources	0
Port 1 (X1 P1)	Bad received packets	0
Port 1 (X1 P1)	Received octets	103326816
Port 1 (X1 P1)	Dropped send packets - no resources	0
Port 1 (X1 P1)	Bad send packets - transmit collisions	0
Port 1 (X1 P1)	Send octets	102490566
Port 2 (X1 P2)	Dropped received packets - no resources	0
Port 2 (X1 P2)	Bad received packets	0
Port 2 (X1 P2)	Received octets	127463239
Port 2 (X1 P2)	Dropped send packets - no resources	0
Port 2 (X1 P2)	Bad send packets - transmit collisions	0
Port 2 (X1 P2)	Send octets	128327936



... and, on top of that

- Simple fault location via topology views
- Simple access via web
- Maintenance



Module	Name	Order number	I Address	Q Address	Comment
PS 307 5A0	PS 307 5A0	6ES7 307-1EA00-0AA0	0	0	
DI 16xDC24V/0.5A	DI 16xDC24V/0.5A	6ES7 321-1BH02-0AA0	0	0	
DO 16xDC24V/0.5A	DO 16xDC24V/0.5A	6ES7 322-1BH02-0AA0	0	0	

GSD-Description

- XML based
 - Test tools
- Architecture
 - all languages
 - all variants
 - in one file
- Well-understood procedures

Device + GSD



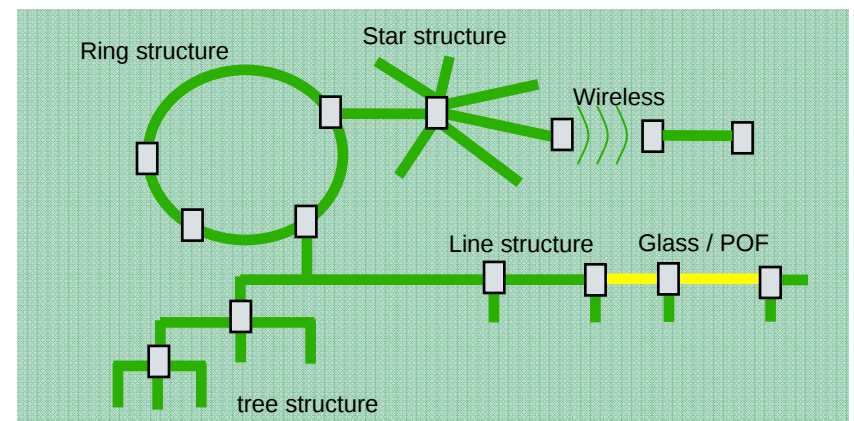
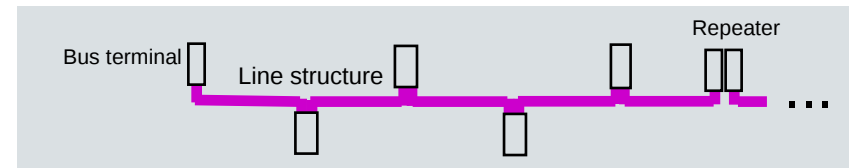
Description format

```
<ModuleList>
  <ModuleItem ID="ID_Mod_01"
    <ModuleInfo>
      <Name TextId="TOK_TextId"
        <InfoText TextId="TOK_Info"
          <HardwareRelease Value="1.0"
            <SoftwareRelease Value="1.0"
          </SoftwareRelease>
        </HardwareRelease>
      </InfoText>
      </Name>
    </ModuleInfo>
  </ModuleItem>
</ModuleList>
<VirtualSubmoduleList>
```

Cabling

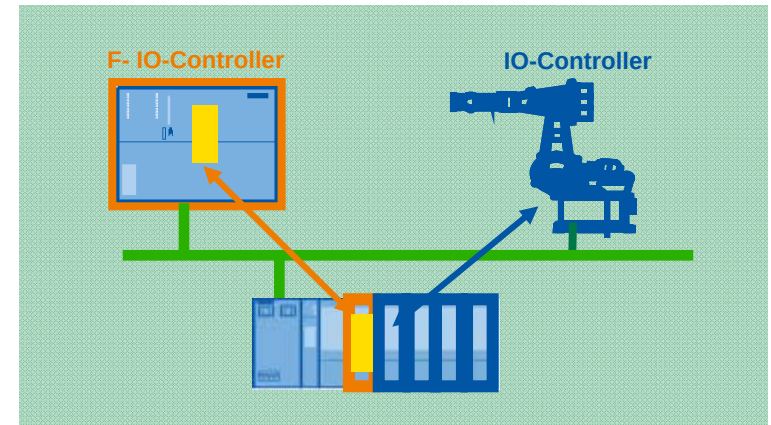
- Specification of the cables and connectors
- Installation / planning guidelines
- Flexible topologies

...



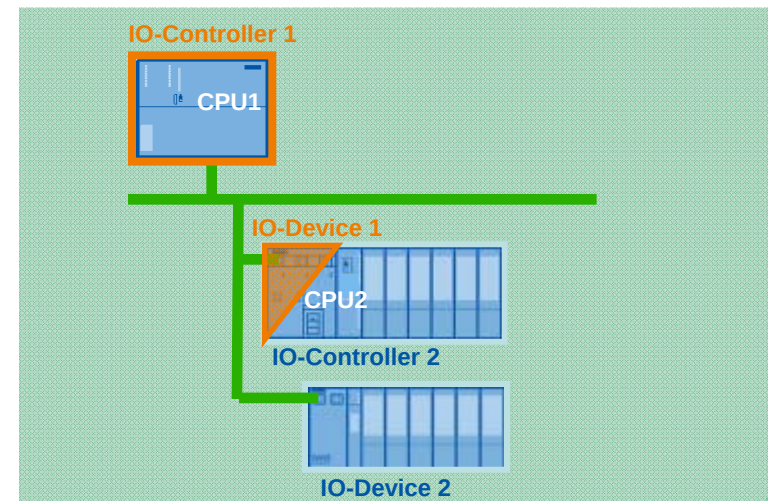
Shared Device

- Access from different controllers to one device
- Flexible assignment of modules to different controllers
- e. g. for the assignment of an F-PLC



I-Device

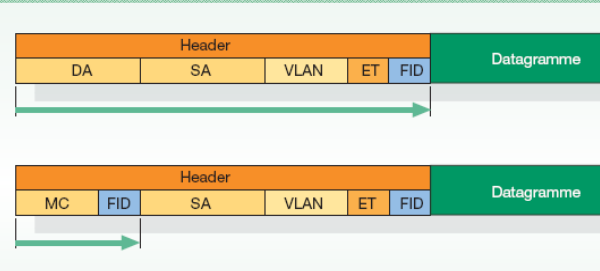
- An IO-controller can also operate as an IO-Device
- With IO-Controller function on the same interface



- Reduction of forwarding time
(6..3 μ s $\rightarrow$ 1,2 μ s)

→ Fast Forwarding “FF”

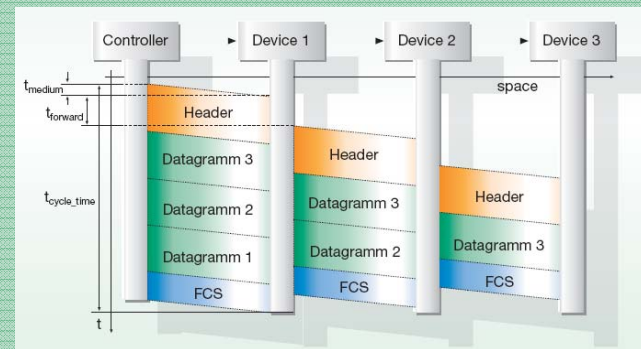
- Early forwarding decision taken during switching



- Reduced telegram overhead
- Usage of the ‘slip stream’ effect

→ Dynamic Frame Packing “DFP”

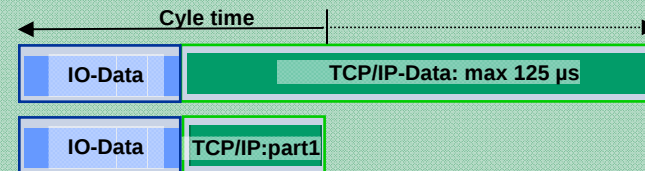
- One frame for several stations
- Frame gets shorter at each station



- Cycle time 250 μ s $\rightarrow$ 31,25 μ s

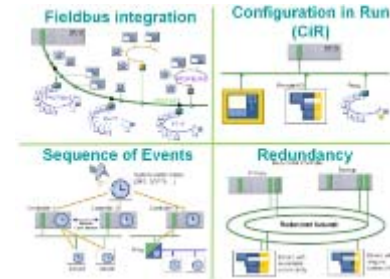
→ Fragmentation

- Splitting of long TCP/IP-frames into smaller parts during forwarding



Basic services for PROFINET in PA

- Redundancy
- Time stamping
- Configuration in Run



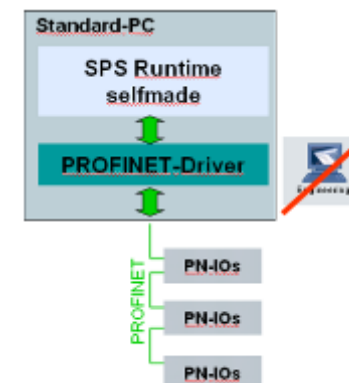
Fiber Optic Enhancements

- Reading the attenuation value



Auto-config

- Simplified read of device and network parameters
- Startup without ES
 - ➔ simple PC applications



....

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PROFINET Tester

- <http://www.profibus.com/nc/downloads/downloads/profinet-io-tester/display/>
- can be used for preparing certification

GSD Checker

- <http://www.profibus.com/nc/downloads/downloads/profinet-xml-viewer-v22/display/>
- verifies if a GSD complies with the specification

Wireshark

- <http://www.profibus.com/nc/downloads/downloads/ethereal-wireshark/display/>
- well-known network protocol analyzer
- easy readout of PROFINET telegrams

**Free downloads on PI website
to support the efficient development
of PROFINET interfaces**



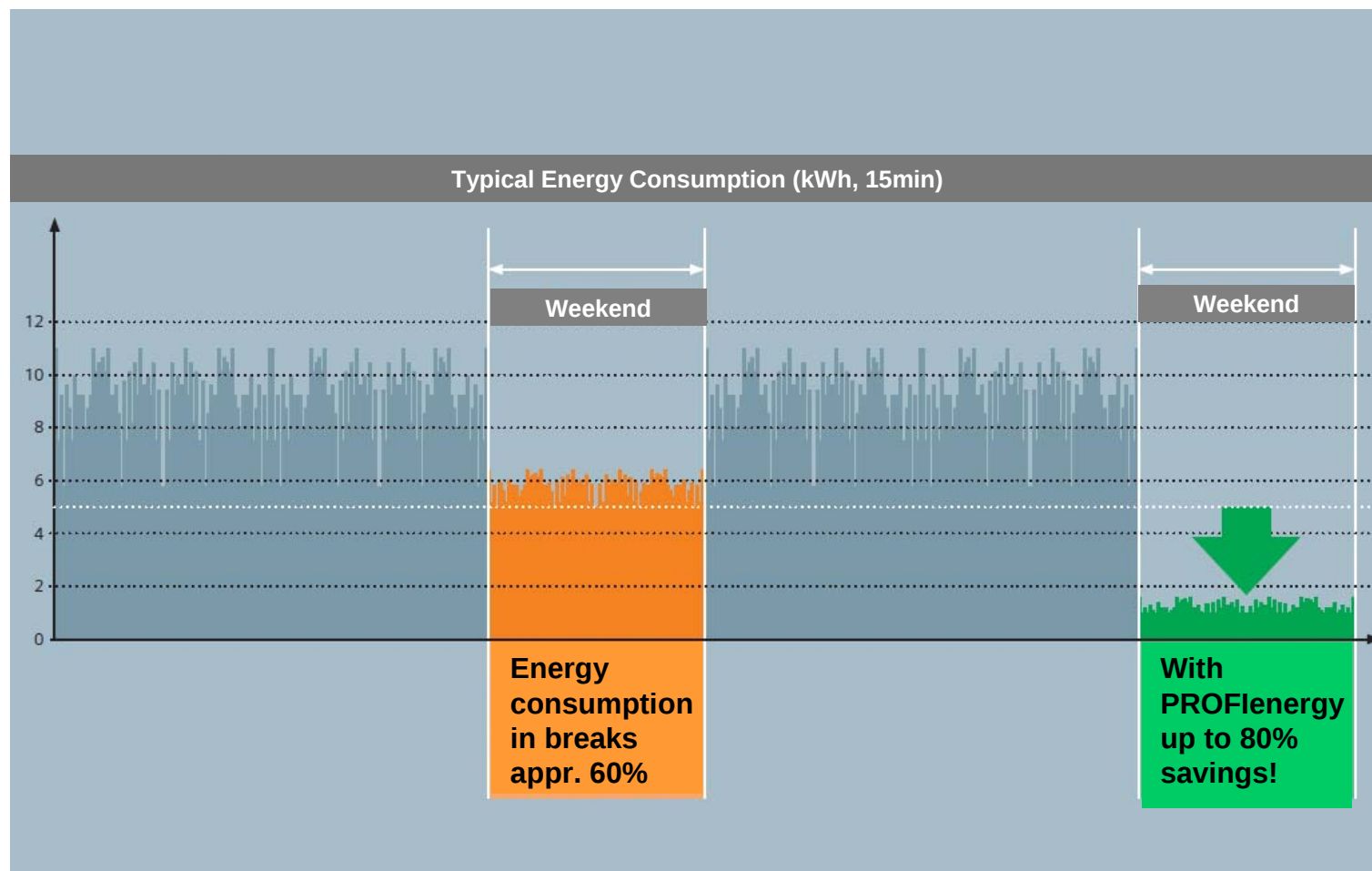
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Energy consumption during breaks appr. 60%!

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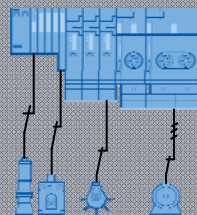
Controller



- ☐ Knows the switching response of the devices
- ☐ Coordinates switch-on and off sequences



Conveyer

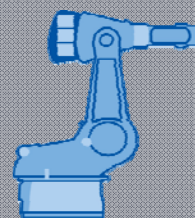


- ☐ Switch-off time = 1 min
- ☐ Switch-on time = 1 min
- ☐ Minimum hold time = 2 min
- ☐ Minimum pause time thus = 4 min

Conditions:

- Conveyor must be switched off 2 minutes after the robot, and switched on 2 minutes before the robot
- Start of pause: 12:00
- End of pause: 12:45

Robot



- ☐ Switch-off time = 3 min
- ☐ Switch-on time = 5 min
- ☐ Minimum hold time = 2 min
- ☐ Minimum pause time thus = 10 min

Example: Coordination And Commands

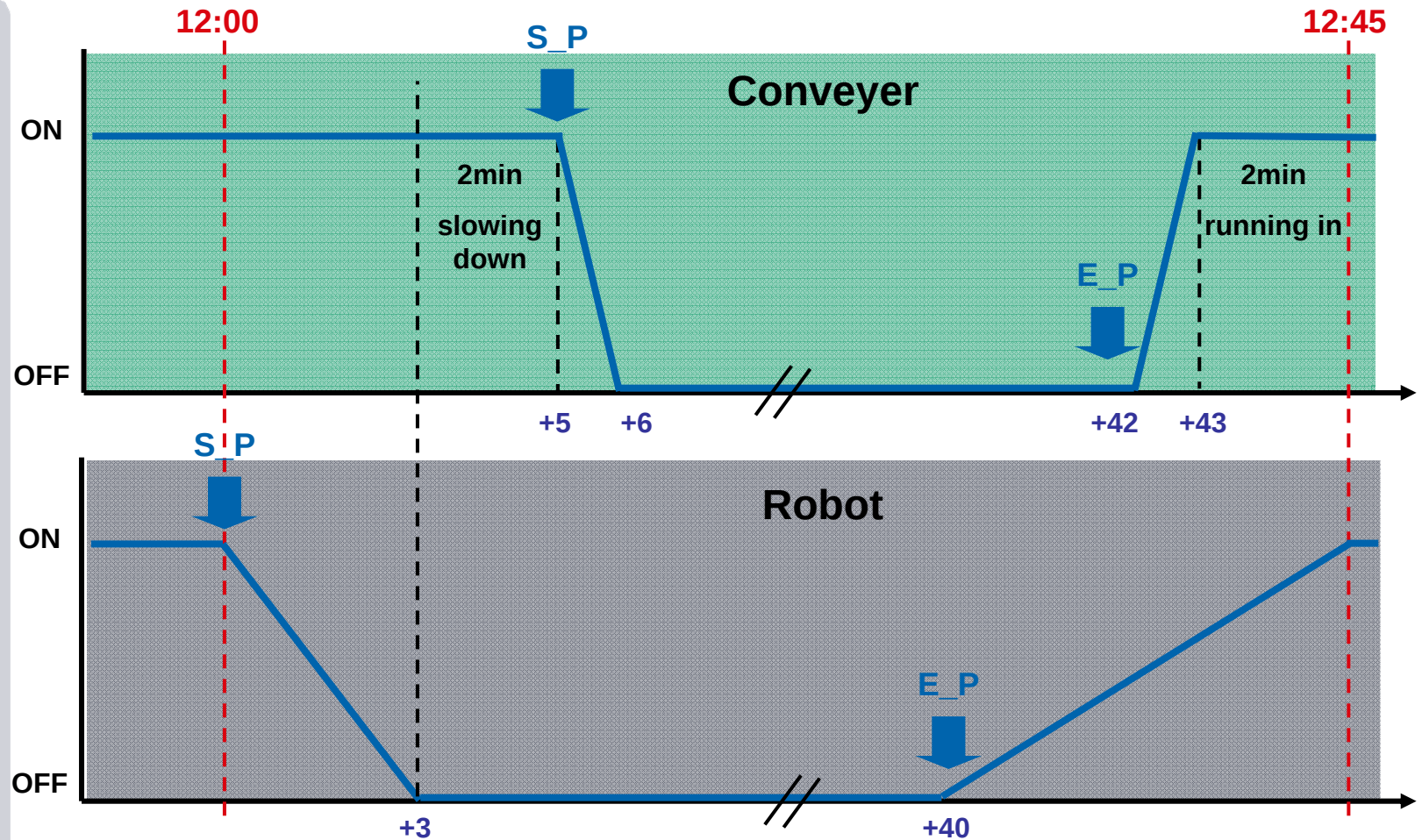
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PROFenergy also permits coordination of dependencies.

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IO-Link

- **Competitive advantage ...**
 - ... through marketing of low-energy machines
- **Investment safeguarding ...**
 - ... through simple expansion of existing programs
- **Low programming requirements ...**
 - ... through reloadable function blocks
- **Fast commencement ...**
 - ... through integration into known product families and use of existing mechanisms
- **Free choice of manufacturer and devices ...**
 - ... through manufacturer independent standard
- **Environmental protection ...**
 - ... through lowering energy consumption and CO₂ emissions



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**Inquiry of
users**

**Definition of Use
Cases and
requirements
by PN Marketing
Working Group**

**Definition
of a
Profile**

**Implemen-
tation
device
manufac-
turers**

**Use in
projects**

- First products available, further implementations running
- NEW: Certification established, First certificates issued
Test scope: Energy saving/measuring functions
- New: PROFlenergy live demo



PROFlenergy

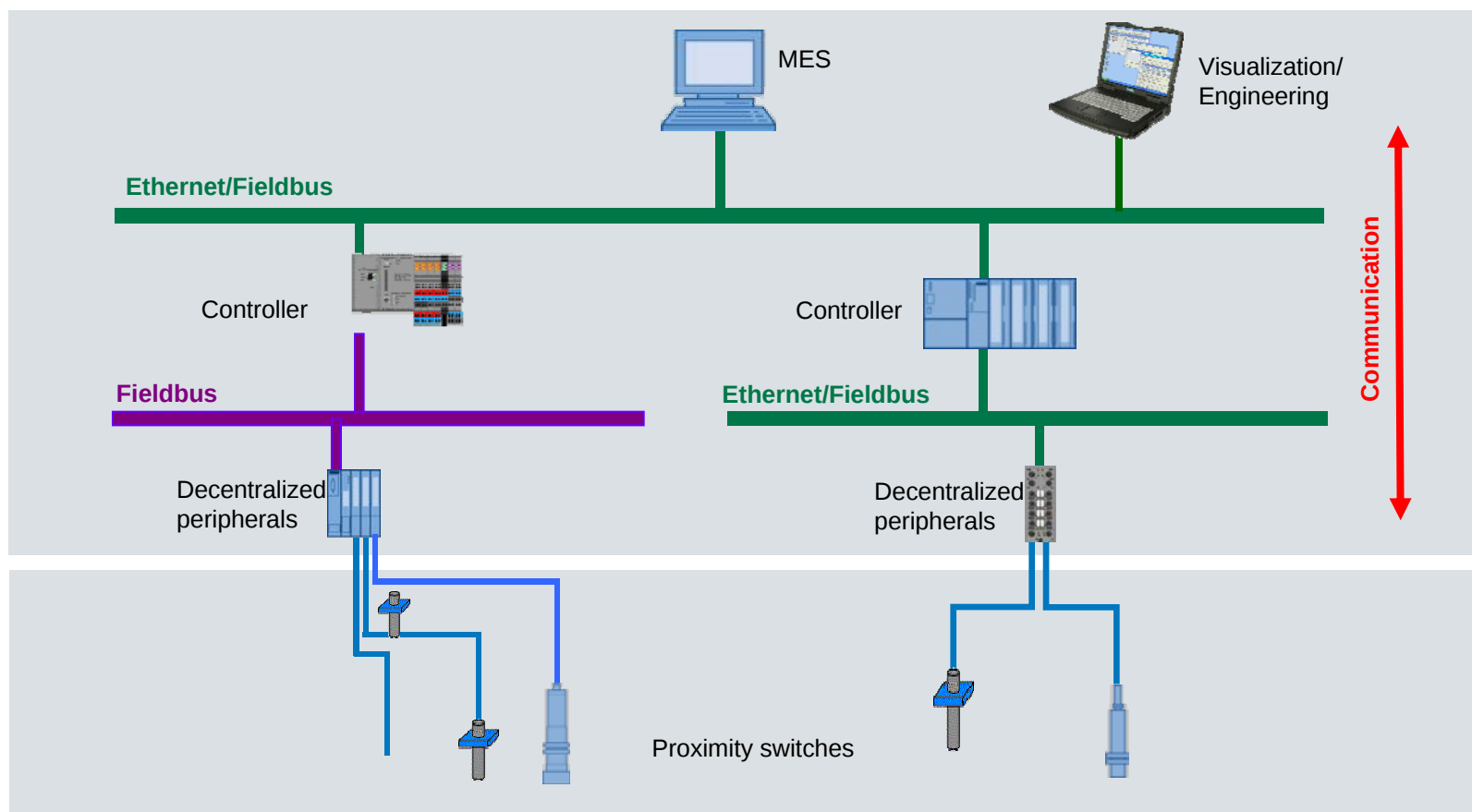
✓ IO-Link goes IEC



Current automation structure

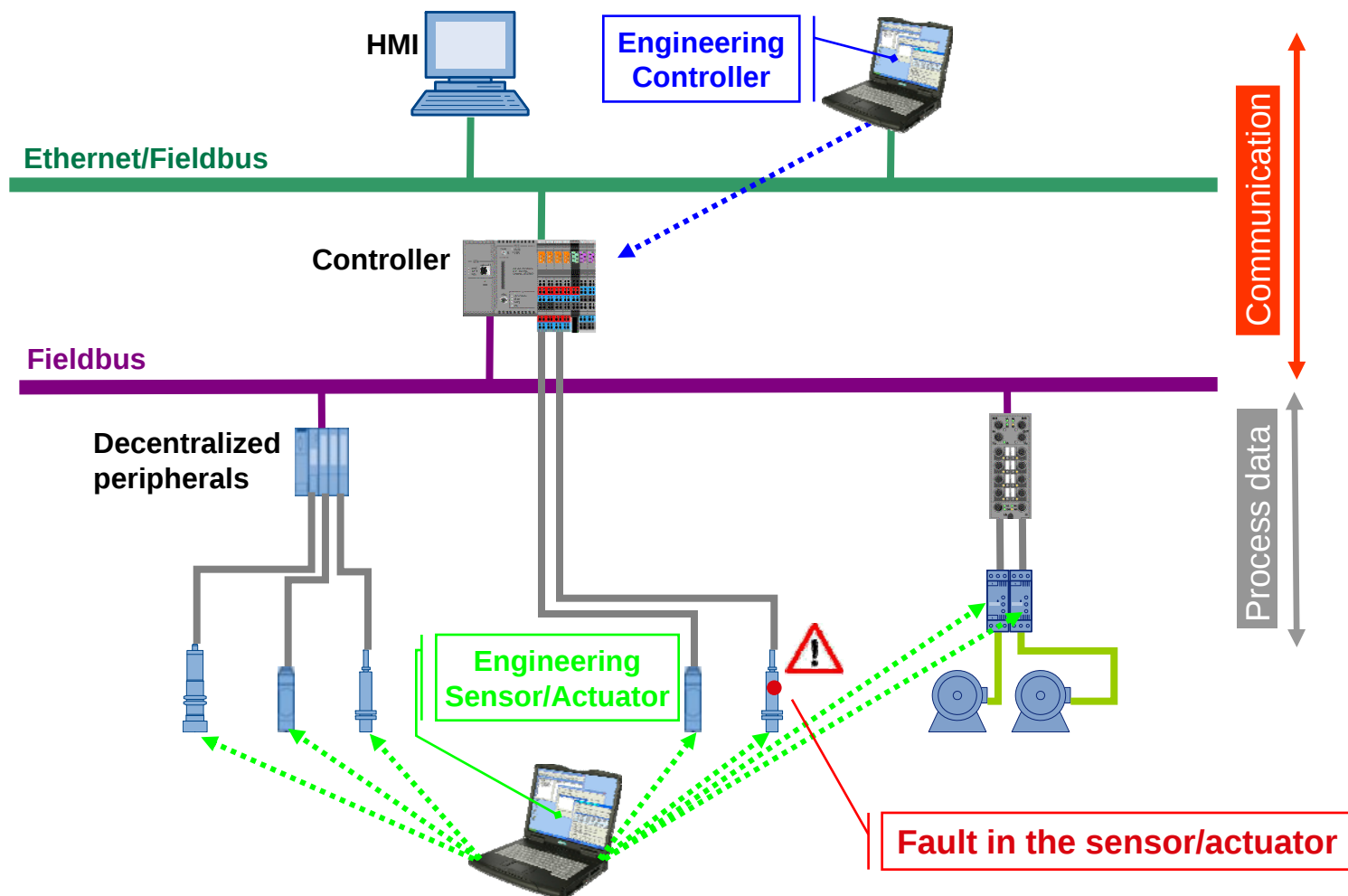
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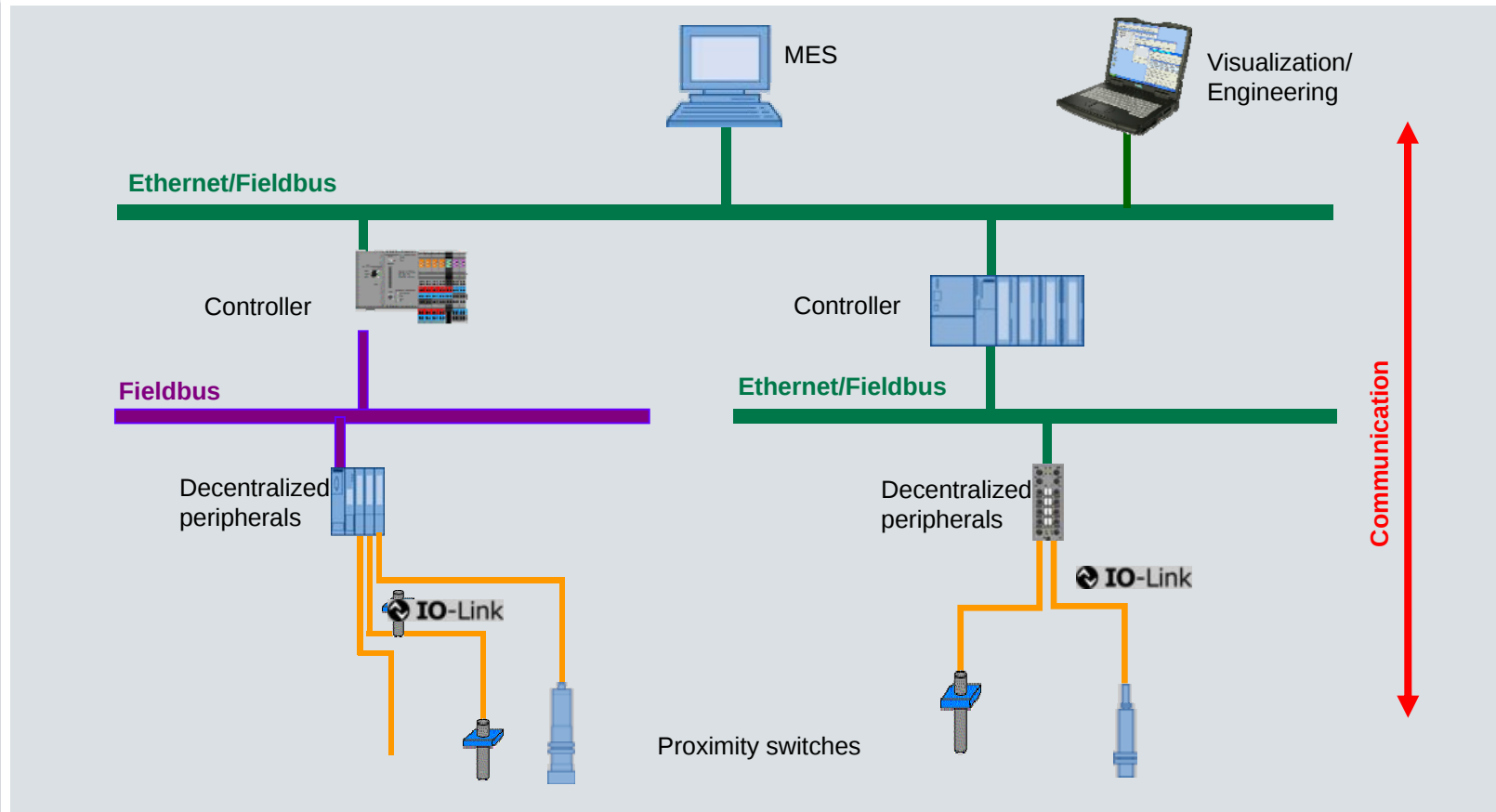


Existing network topologies only reach the I/O level

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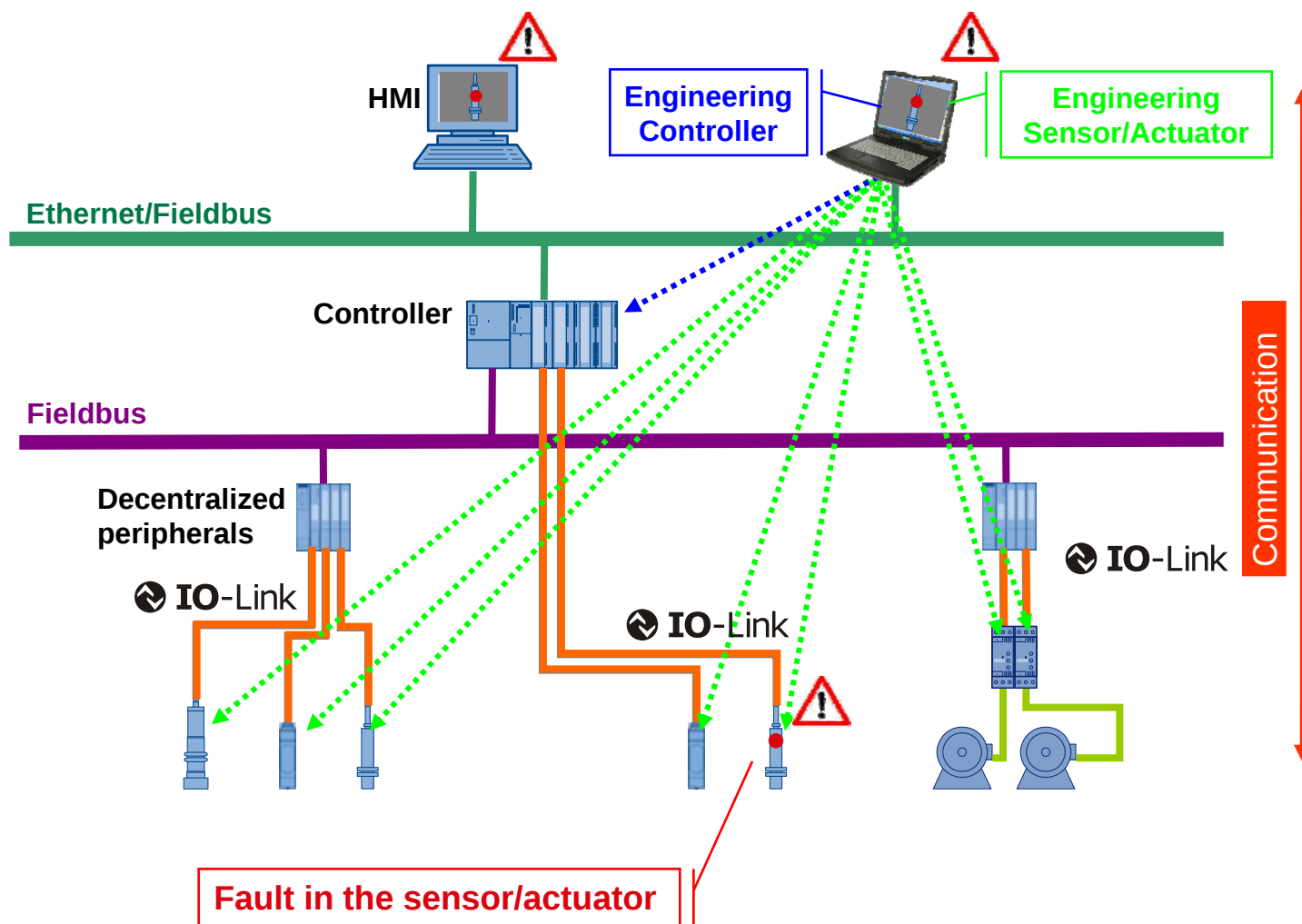


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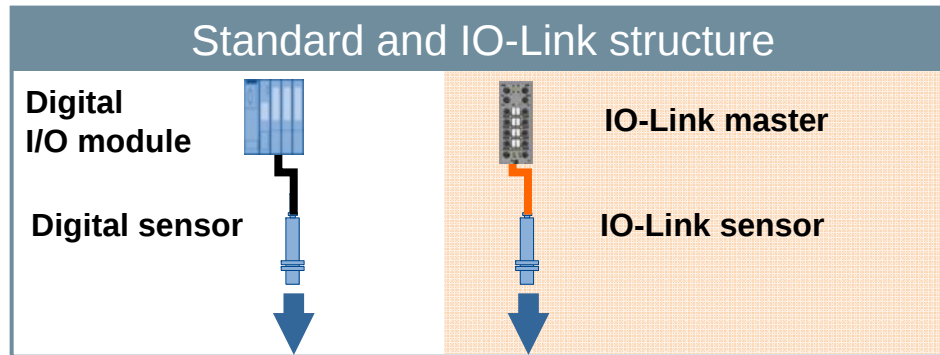
With IO-Link, the ability to communicate extends over the entire automation environment

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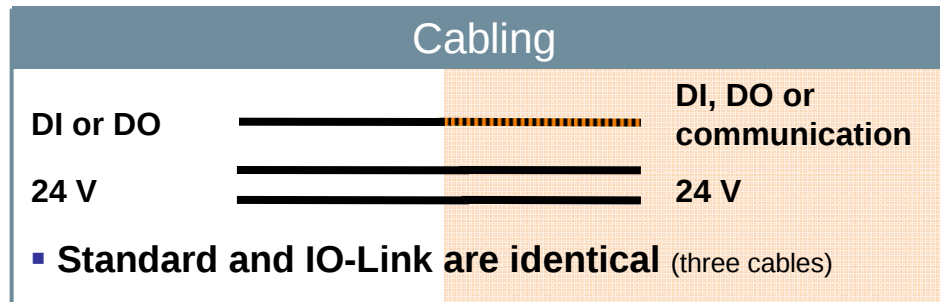


**Diagnosis and configuration of sensors and actuators
in runtime operation**

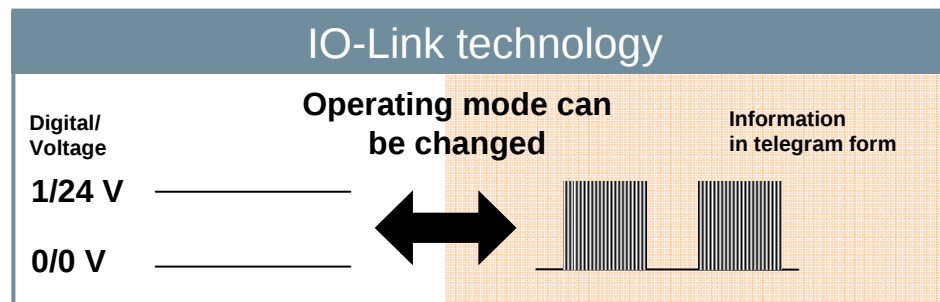
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- ### Point-to-point
- 1-to-1 assignment of master to device
 - No bus address
 - Simple data assignment, as there is no bus structure



- ### Advantages
- Capable of connection to sensors
 - Standard unshielded cabling
 - The master supports a variety of operating modes
 - No excessive variant types
 - Standard UART protocol, implemented without special components

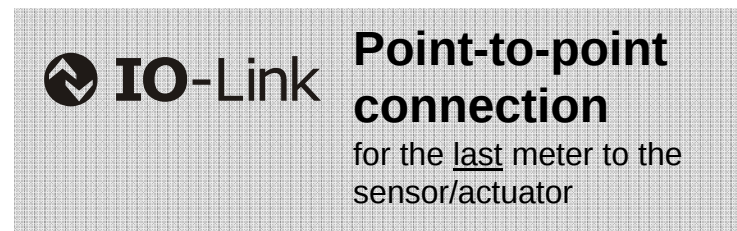
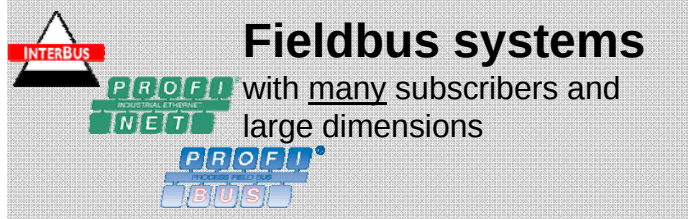
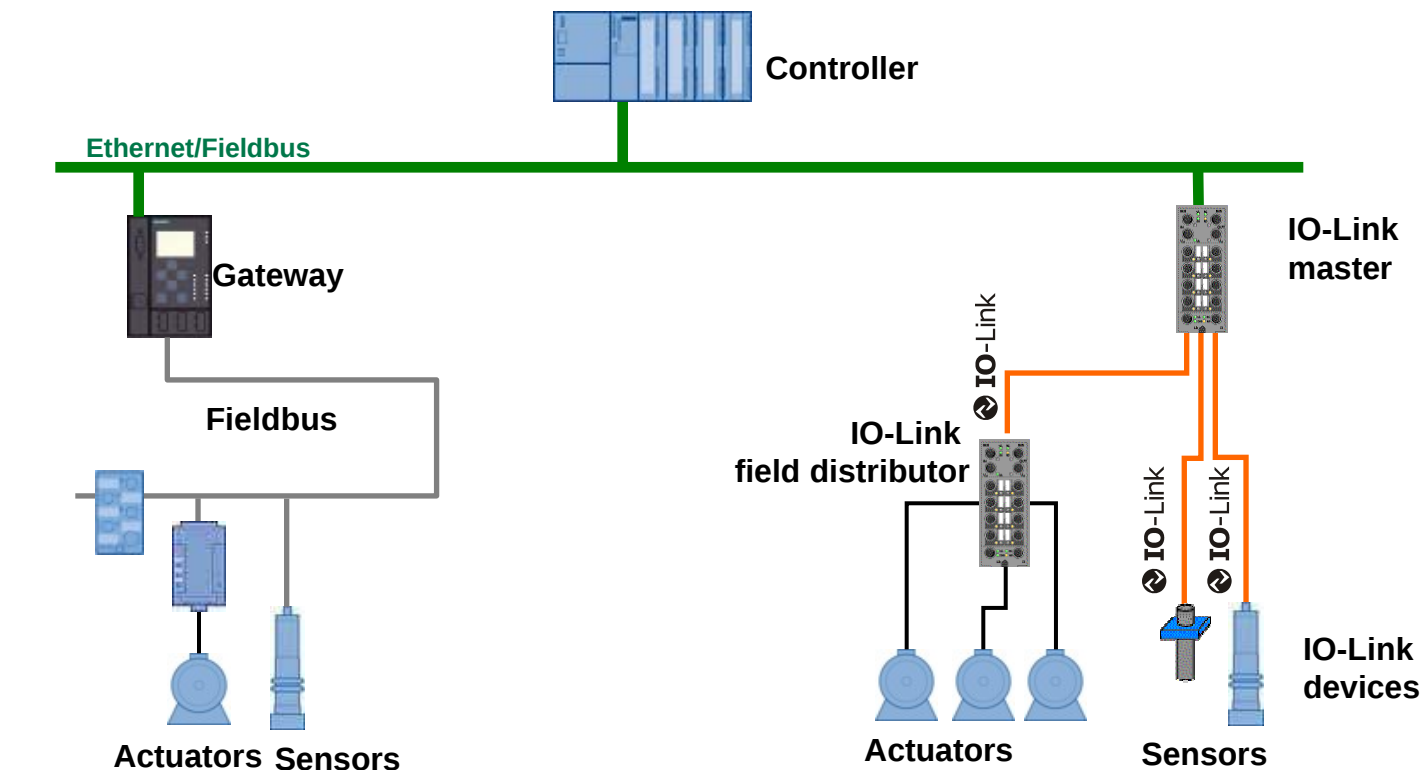


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IO-Link makes communication transparent up to the sensor/actuator

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■ New member companies from all sectors

- service
- chip vendors
- master/device vendors
- software development

■ Increasing share of international companies

■ Currently:
more than 50 members

IO-Link



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■ IEC Standardization

- IO-Link standardization application accepted within IEC by vote
- Publication as IEC 61131-9 (Comittee Draft)



■ Specification supplemented upwards compatible, now V1.1

- Optimization of performance for large data quantities
- Saving of device parameters for easy device swapping without tool
- Improved diagnosis

- Target:
To guarantee world-wide availability, interoperability and stability of IO-Link products and services
- Measures: specification and implementation of
 - test specifications
 - test systems
 - measures for quality assurance
- Foundation of IO-Link competence centers
 - Processes and structures defined (Quality of Services)
 - Two competence centers already established:
MESCO and TMG TE



Thank you for your attention!

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- Bernd Lieberth
- Secretary
- PROFIBUS Association South East Asia

- Phone: +65 9150 2977

- E-Mail: southeastasia@profibus.com
- E-Mail: Bernd.Lieberth@siemens.com

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