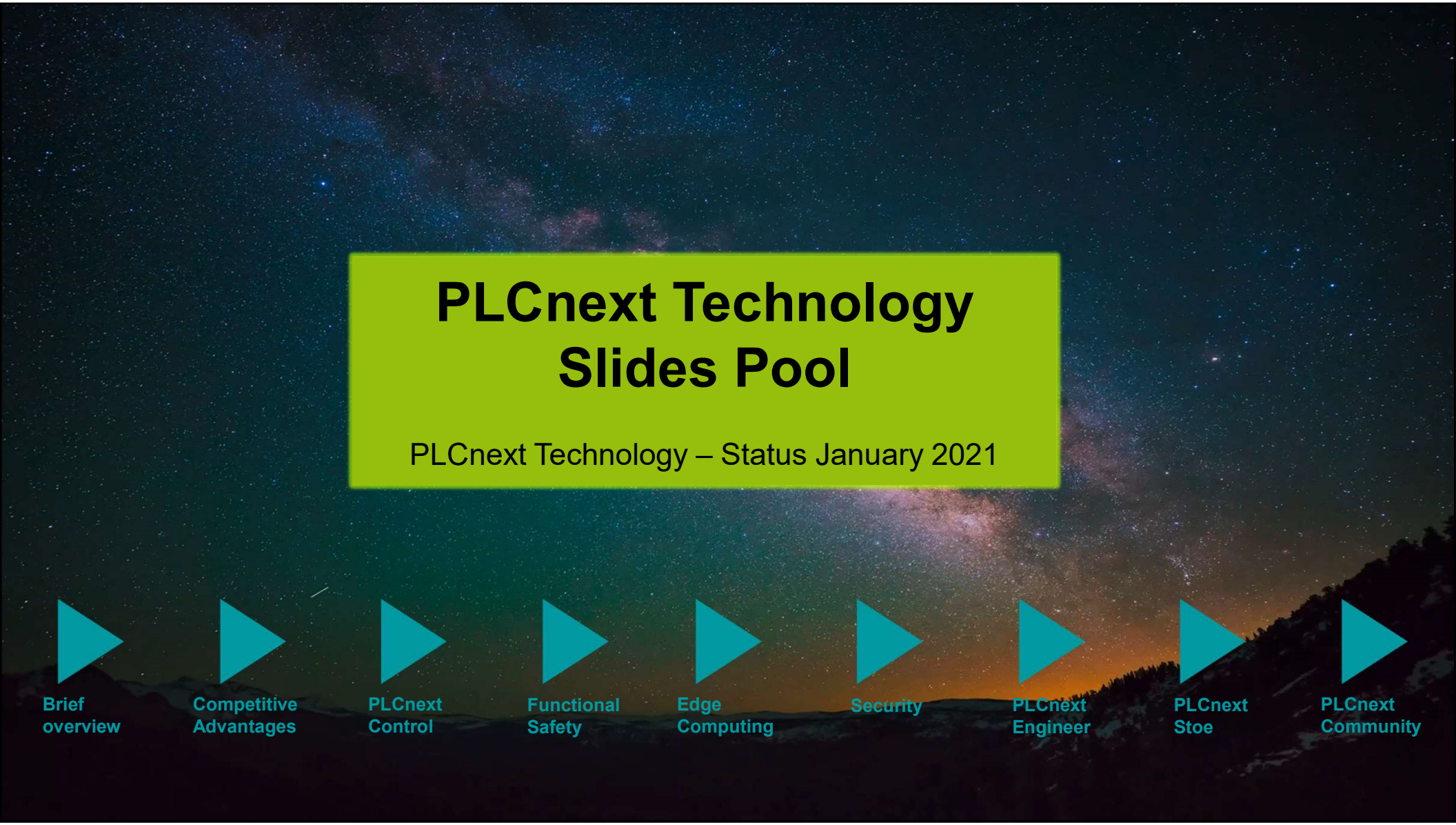
PLCnext Technology
Slides Pool
PLCnext Technology – Status January 2021
Brief overview
Competitive Advantages
PLCnext Control
Functional Safety
Edge Computing
Security
PLCnext Engineer
PLCnext Stoe
PLCnext Community

PLCnext Technology Ecosystem

PLCnext Technology

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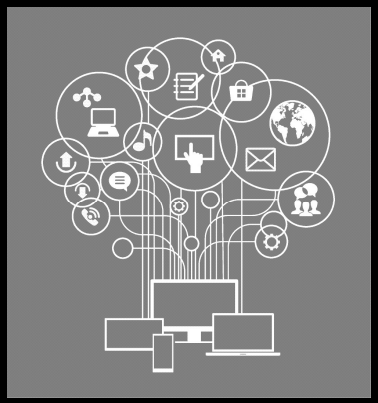
PLCnext Technology Ecosystem

Motivation

INDUSTRIAL
INTERNET
OF THINGS



Our solution for a
rapidly changing world

PLCnext Technology
Designed by PHOENIX CONTACT

The open ecosystem for
limitless automation

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PLCnext Technology

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PLCnext Technology open ecosystem

The open ecosystem for
limitless automation

PLCnext Technology

Designed by PHOENIX CONTACT

PLCnext Control

PLCnext Engineer

PLCnext Store

PLCnext Community

Open Control Platform

Devices in various performance classes including PLCnext Runtime System and accessories

Engineering Software

Engineering tool for commissioning, configuring and programming PLCnext Control

Software Store

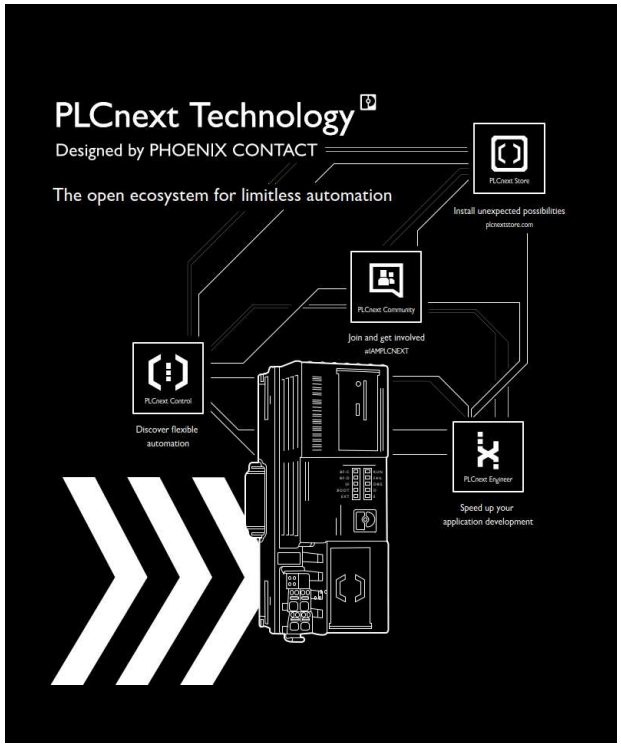
Apps for functional extension of PLCnext Control and PLCnext Engineer

Collaboration & Resources

We offer our community Information, support and helpful resources, including FAQs, forums, tutorials, and a GitHub presence

PLCnext Technology Ecosystem

PLCnext Technology



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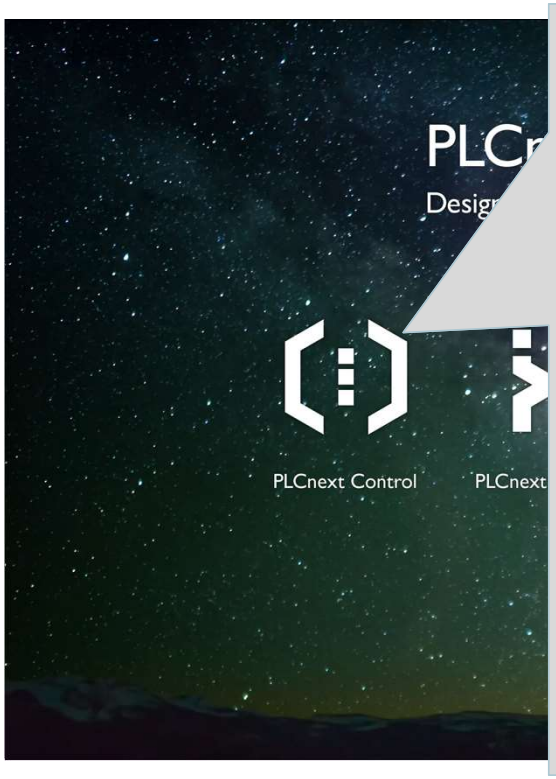
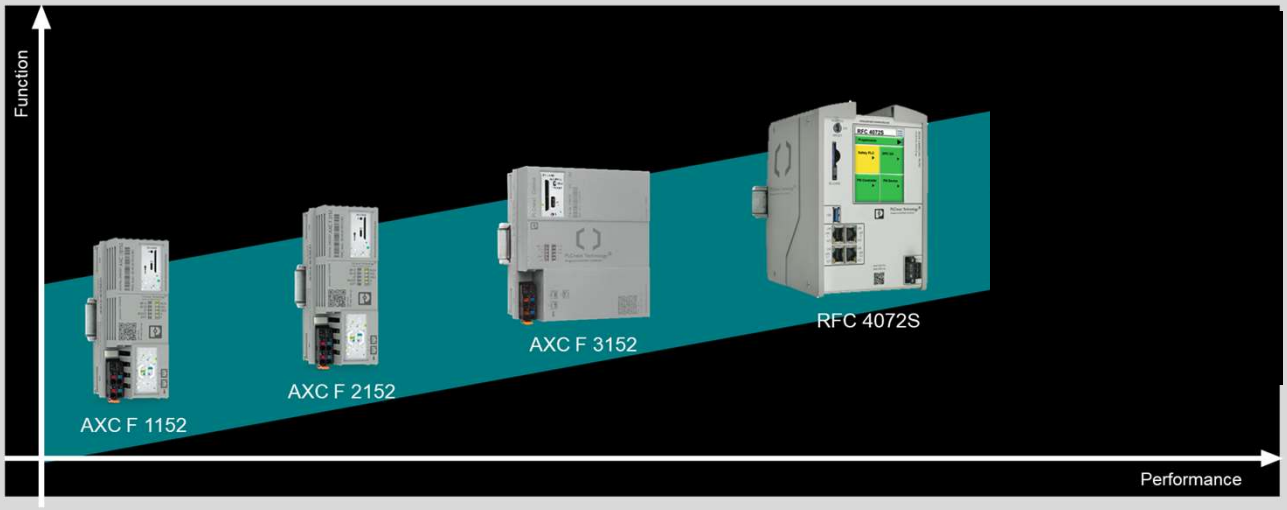
PLCnext Ecosystem

PLCnext Technology





Open Control Platform

PLCs in various performance classes including
PLCnext Runtime System and accessories for PLCnext Technology

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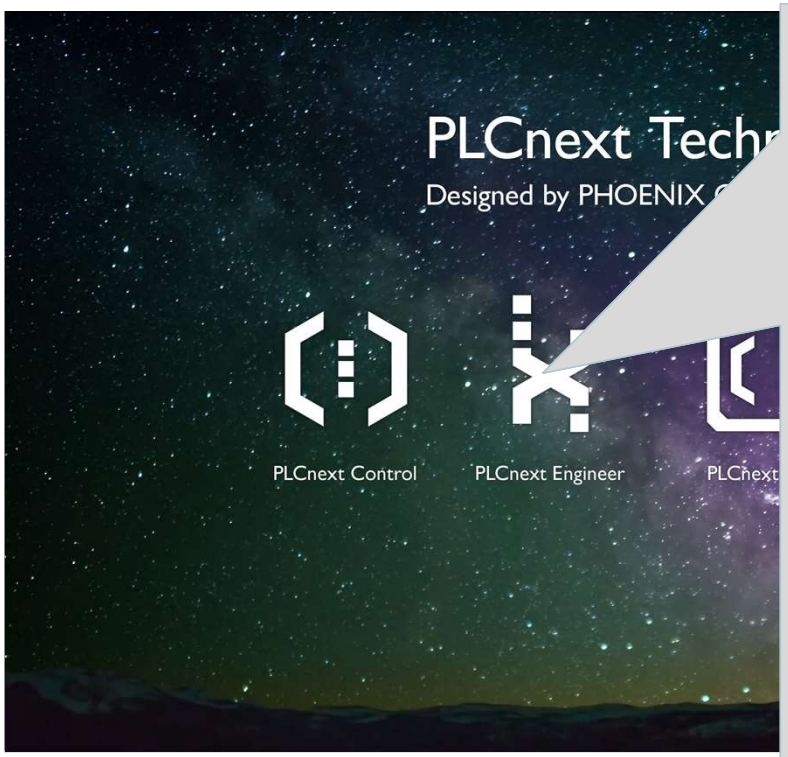
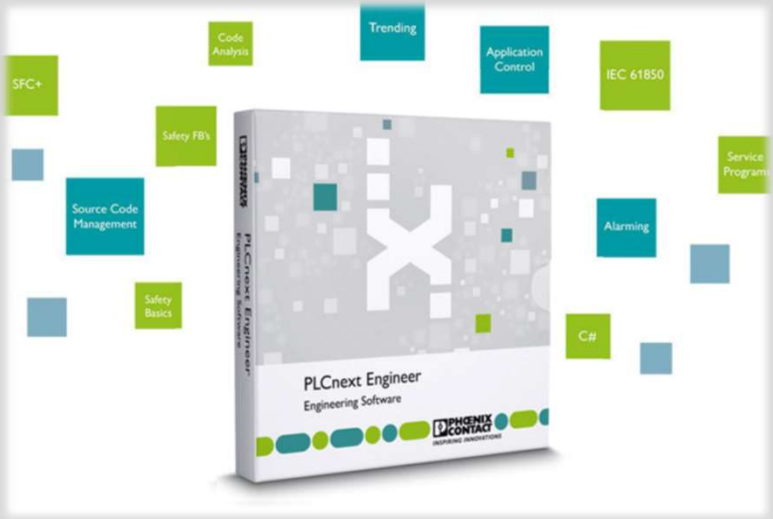
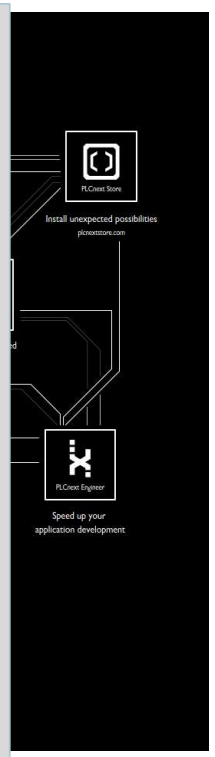
PLCnext Ecosystem

PLCnext Technology







Engineering Software

Engineering tool for commissioning, configuring, and programming PLCnext Controls

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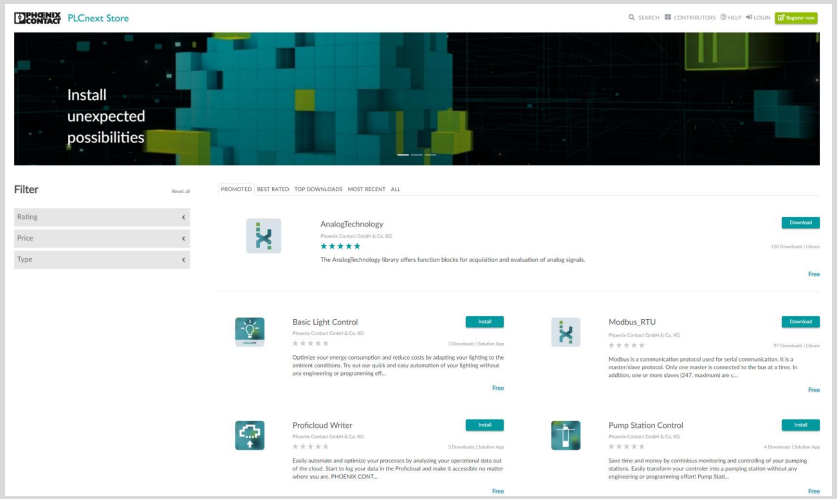
PLCnext Ecosystem

PLCnext Technology



Software Store for Automation

Apps for functional extension of
PLCnext Control and PLCnext Engineer

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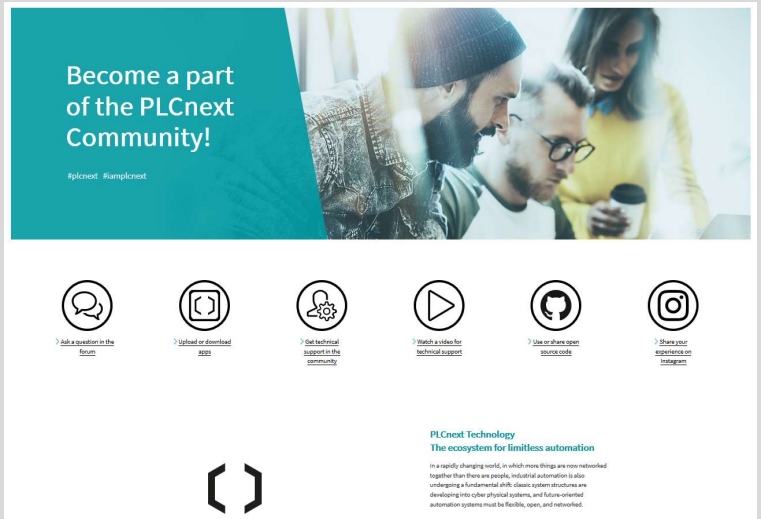
PLCnext Ecosystem

PLCnext Technology



User Collaboration & Resources

Information, support, and helpful resources about PLCnext Technology including FAQs, forums, tutorials and a GitHub presence

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PLCnext Technology

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enhanced freedom

Flexible integration of open source software and apps

enhanced development

Connected coworking

enhanced convenience

Using your favorite programming tool

enhanced connectivity

Open interfaces and cloud integration

enhanced performance

Real-time execution across different programming languages

PLCnext Technology

The reliability and robustness
of the classical PLC world

enhances

with the openness and flexibility
of Smart Devices.

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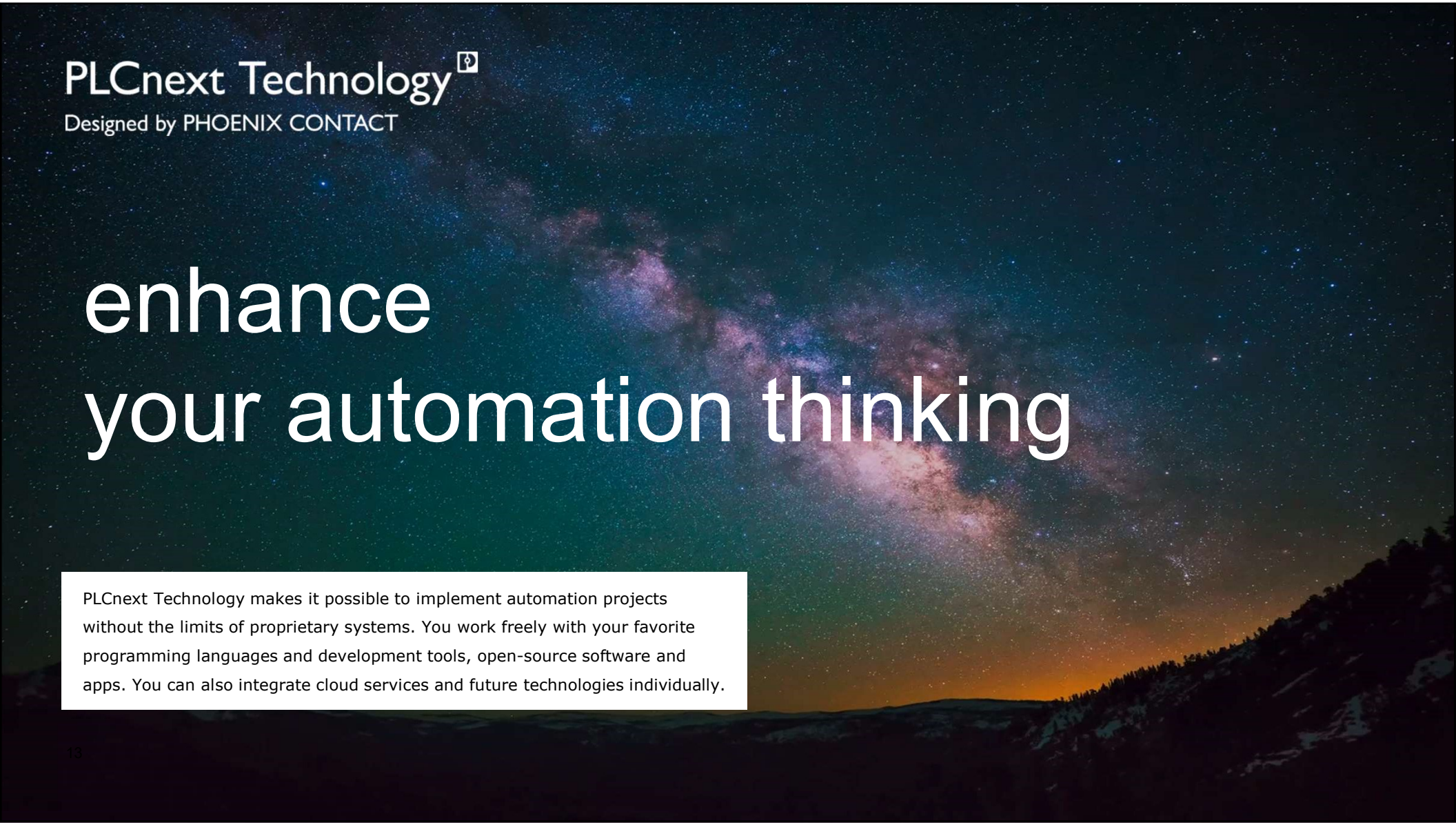
PLCnext Technology
Designed by PHOENIX CONTACT
enhance
your automation thinking
PLCnext Technology makes it possible to implement automation projects without the limits of proprietary systems. You work freely with your favorite programming languages and development tools, open-source software and apps. You can also integrate cloud services and future technologies individually.

PLCnext Technology

Designed by PHOENIX CONTACT

enhanced connectivity

Open interfaces and cloud integration

PLCnext Technology enables the integration of current and future interfaces and protocols for open communication in highly networked automation systems. Implement new IoT-based business models through edge computing and/or direct connection to cloud-based services and databases.

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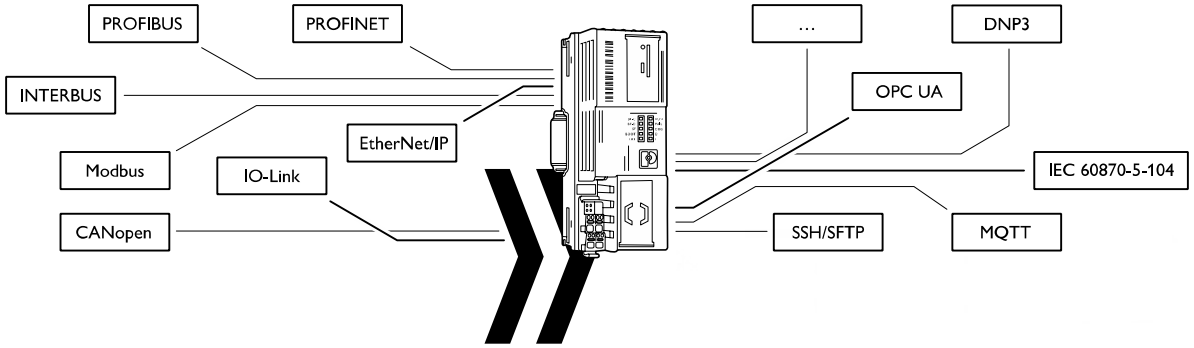
Future-proof Connectivity



PLCnext Technology enables the integration of current and future interfaces and protocols for open communication in highly networked automation systems.

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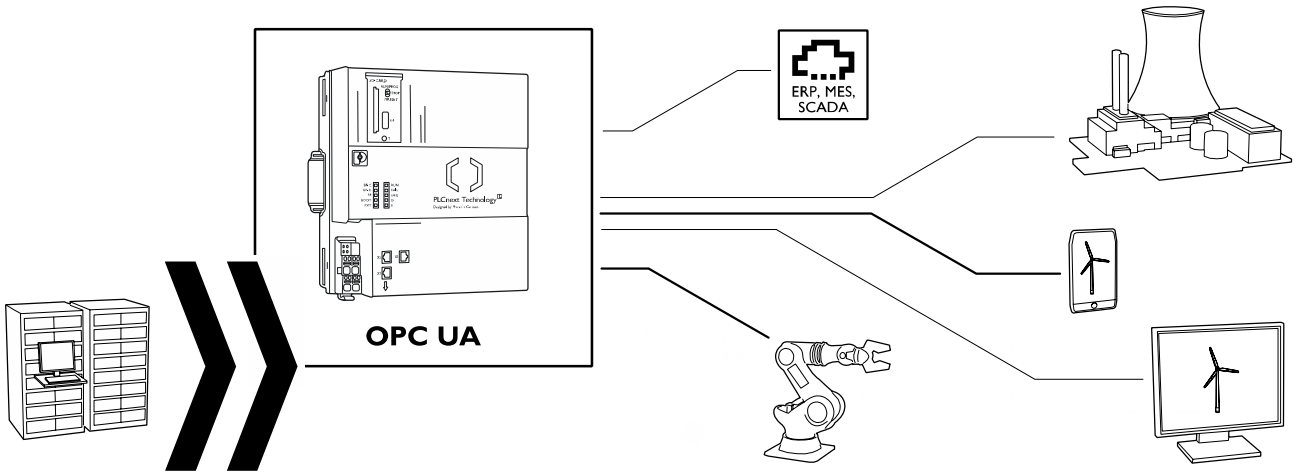
Integrated OPC UA Server



Data Access, Alarms and Conditions, Programs, Historical Access, Global Discovery Server

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PROFICLOUD, Public Cloud, Private Cloud – any Cloud!

Implement new IoT-based business models through direct connection to cloud-based services and databases.

Benefit from the seamless integration of Phoenix Contact´s PROFICLOUD and a cloud-agnostic strategy where the PLCnext Store delivers cloud connectors for every cloud. PLCnext Technology supports any customer cloud implementation – public, private, hybrid - including AWS, IBM, Azure, Alibaba, and MindSphere.

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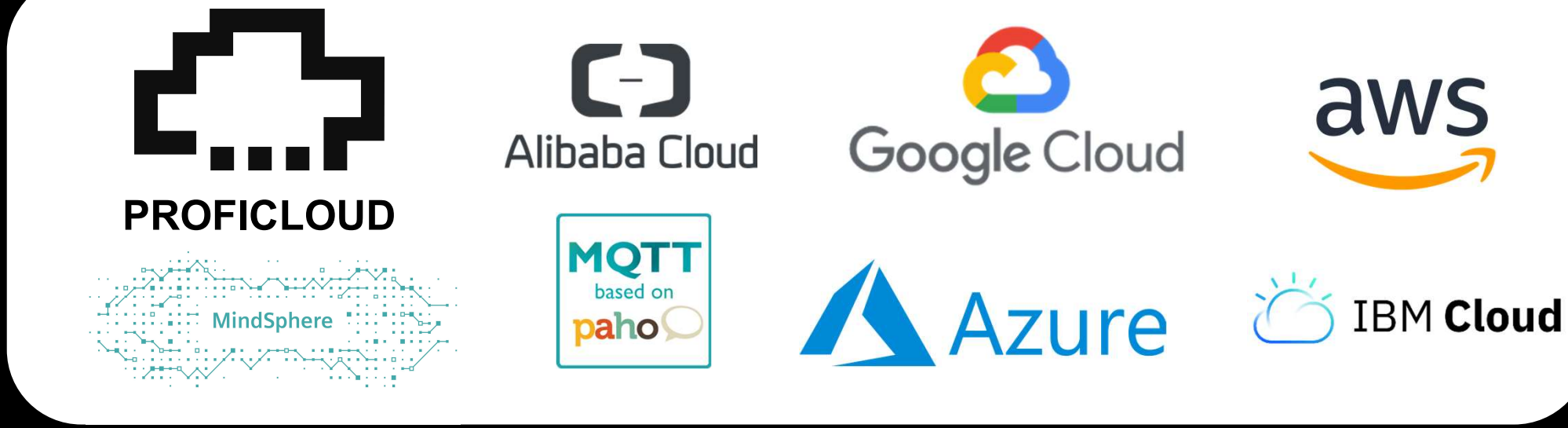
Cloud Strategy for Intelligent Networking

Proficloud, Public Cloud, Private Cloud, any Cloud

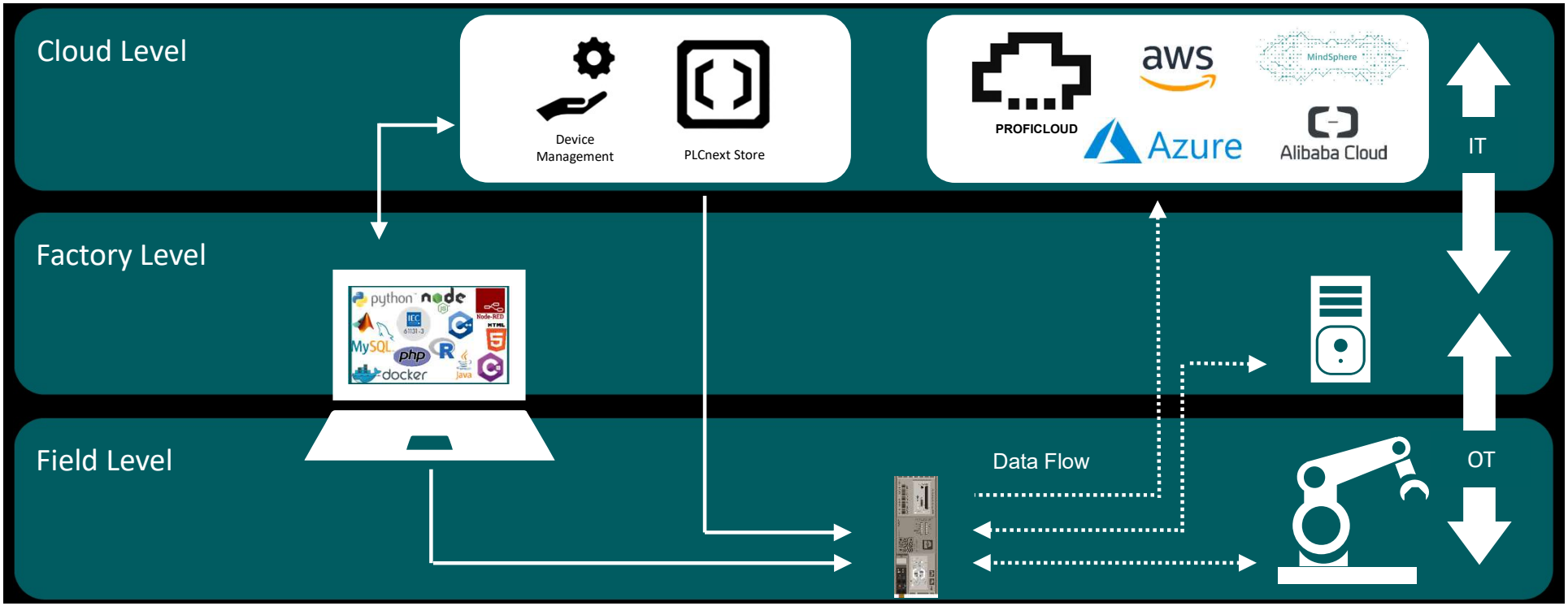


Implement new IoT-based business models through direct connection to cloud-based services and databases. With the cloud agnostic strategy, a cloud connector to any cloud can be downloaded via PLCnext Store and a fully integrated Proficloud connectivity, PLCnext Technology provides full support for any cloud strategy - public, private, hybrid - including AWS, IBM, Azure, Alibaba and MindSphere.

PLCnext Technology
Designed by PHOENIX CONTACT

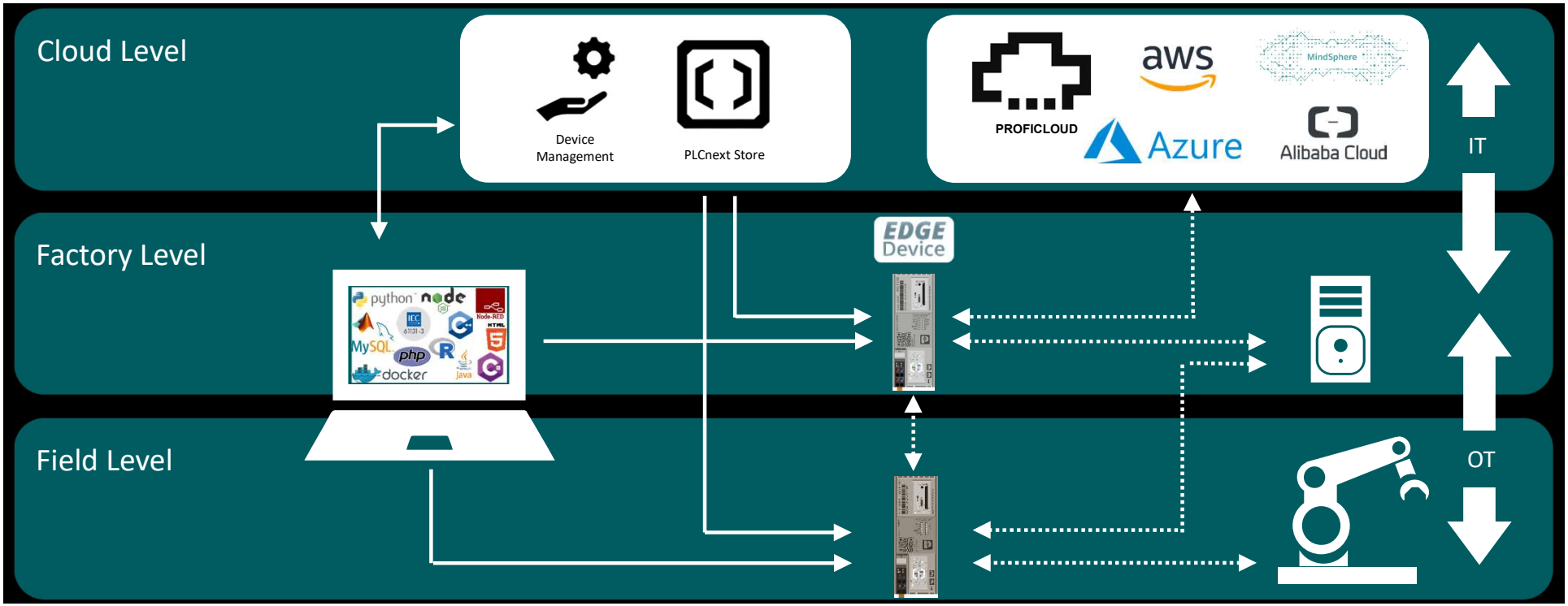
enhanced connectivity – Edge Device or PLC connecting all Levels

PLCnext Control as PLC



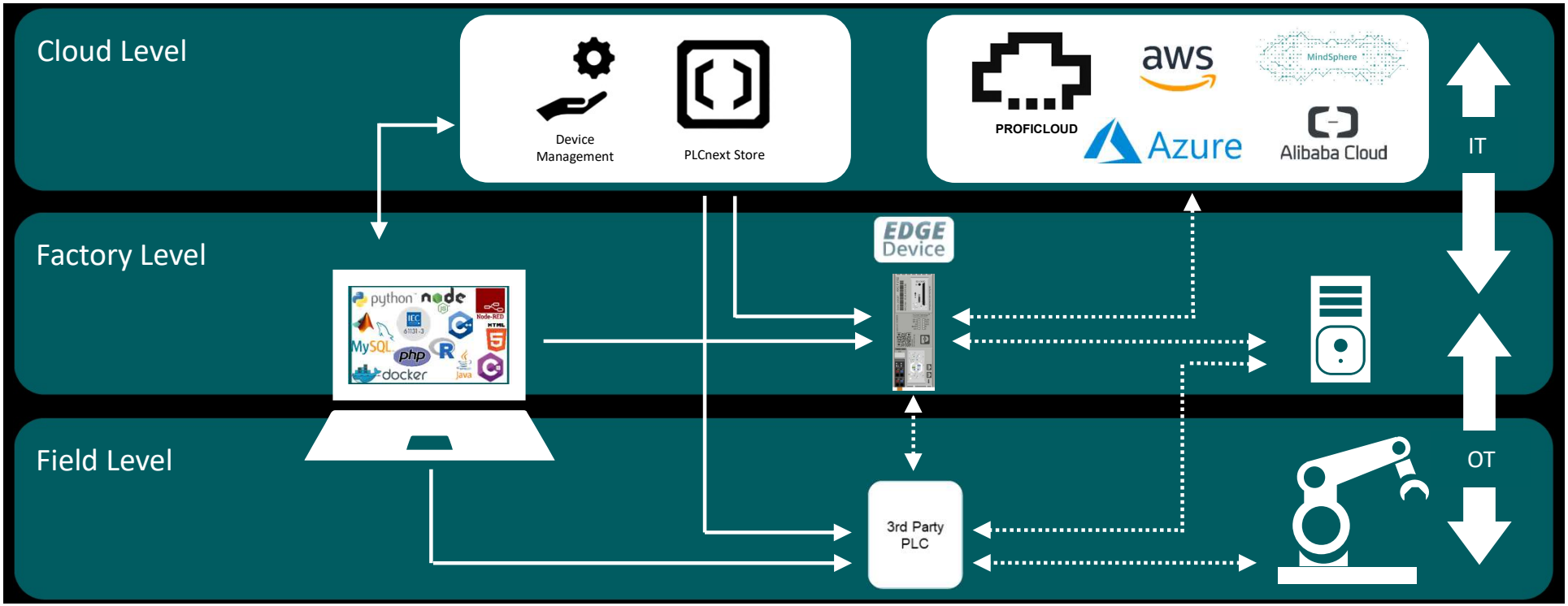
enhanced connectivity – Edge Device or PLC connecting all Levels

PLCnext Control as PLC and Edge Device



enhanced connectivity – Edge Device or PLC connecting all Levels

PLCnext Control as Edge Device

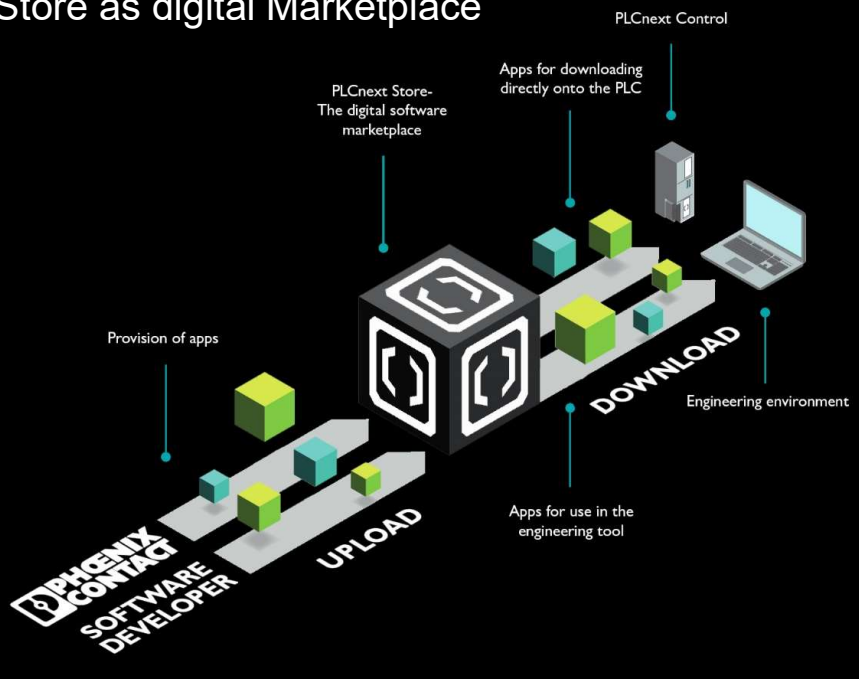



enhanced
freedom
Flexible integration of
open source software and apps
PLCnext Technology
Designed by PHOENIX CONTACT
PLCnext Technology enables any desired combination of independently created program parts and complete applications. The use of open-source software and apps, e.g. from our PLCnext Store, improves the efficiency of your development processes. They sky is the limit when it comes to future expansions.

enhanced freedom

Limitless Adaption Capability

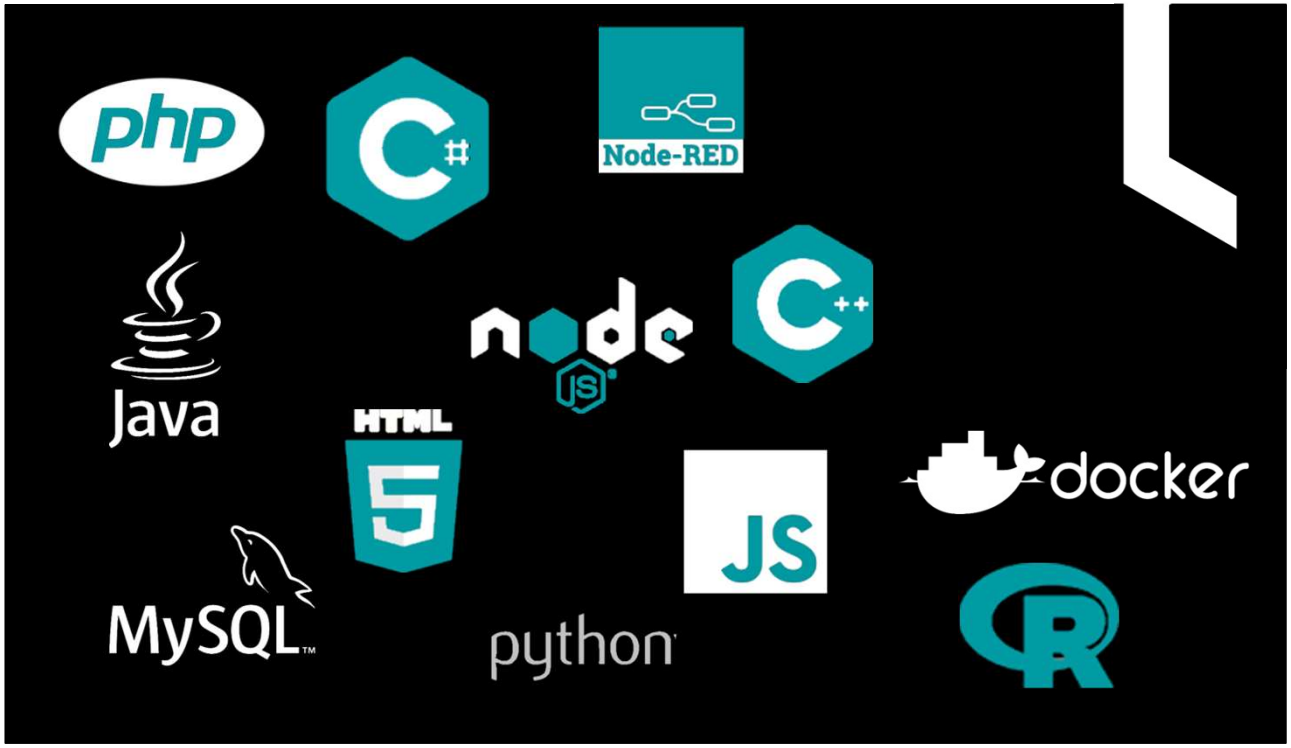
PLCnext Store as digital Marketplace



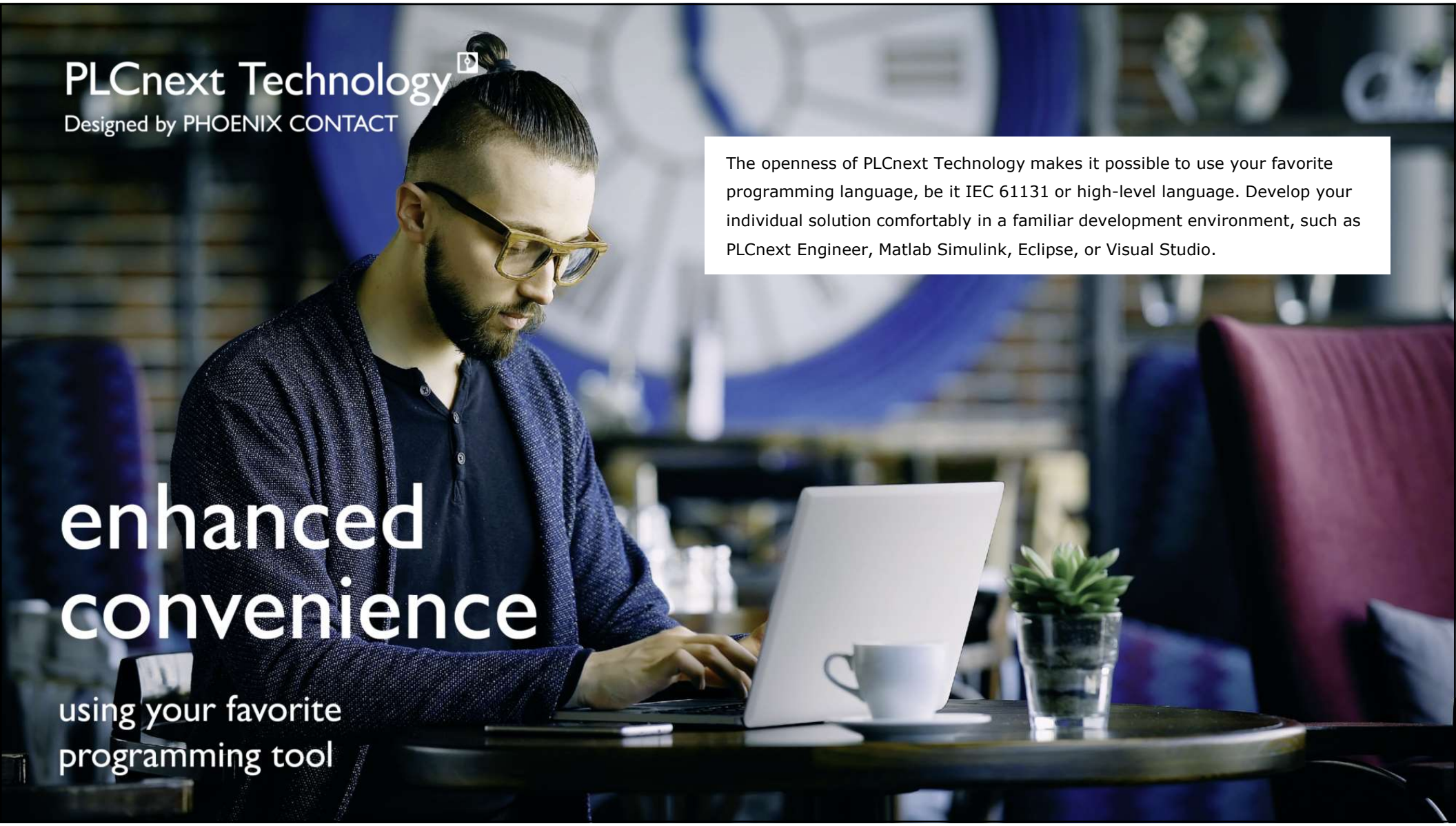
Open-Source Software

enhanced freedom

Limitless Adaption Capability



PLCnext Technology enables any desired combination of independently created program parts and complete applications. The use of open-source software and apps improves the efficiency of your development processes.

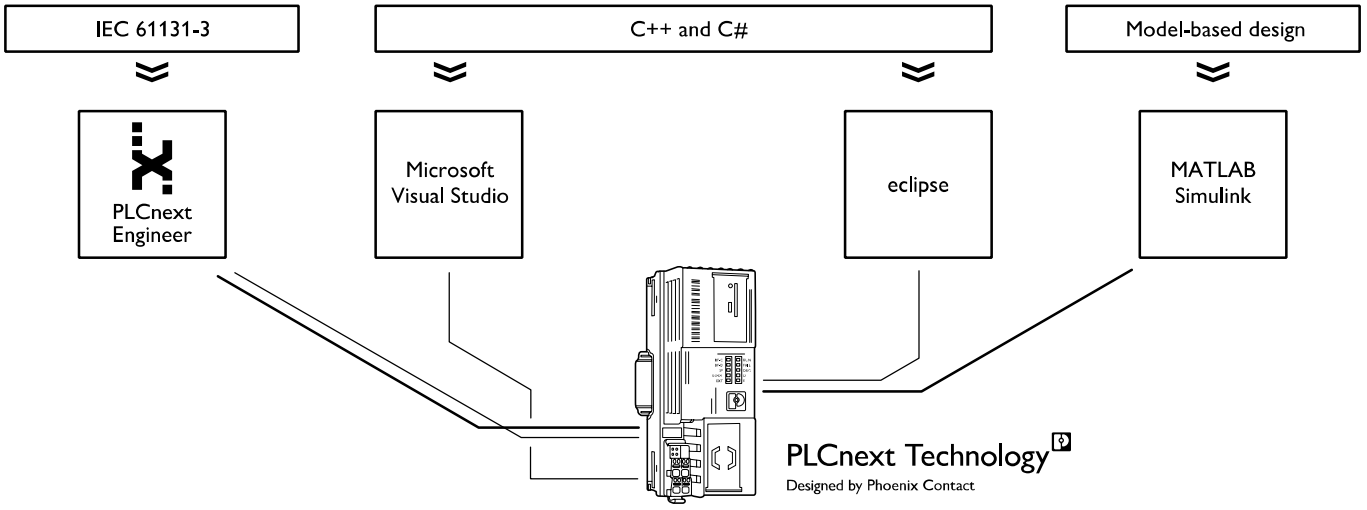


The openness of PLCnext Technology makes it possible to use your favorite programming language, be it IEC 61131 or high-level language. Develop your individual solution comfortably in a familiar development environment, such as PLCnext Engineer, Matlab Simulink, Eclipse, or Visual Studio.

enhanced convenience

Engineering and Application Development

PLCnext Technology
Designed by Phoenix Contact

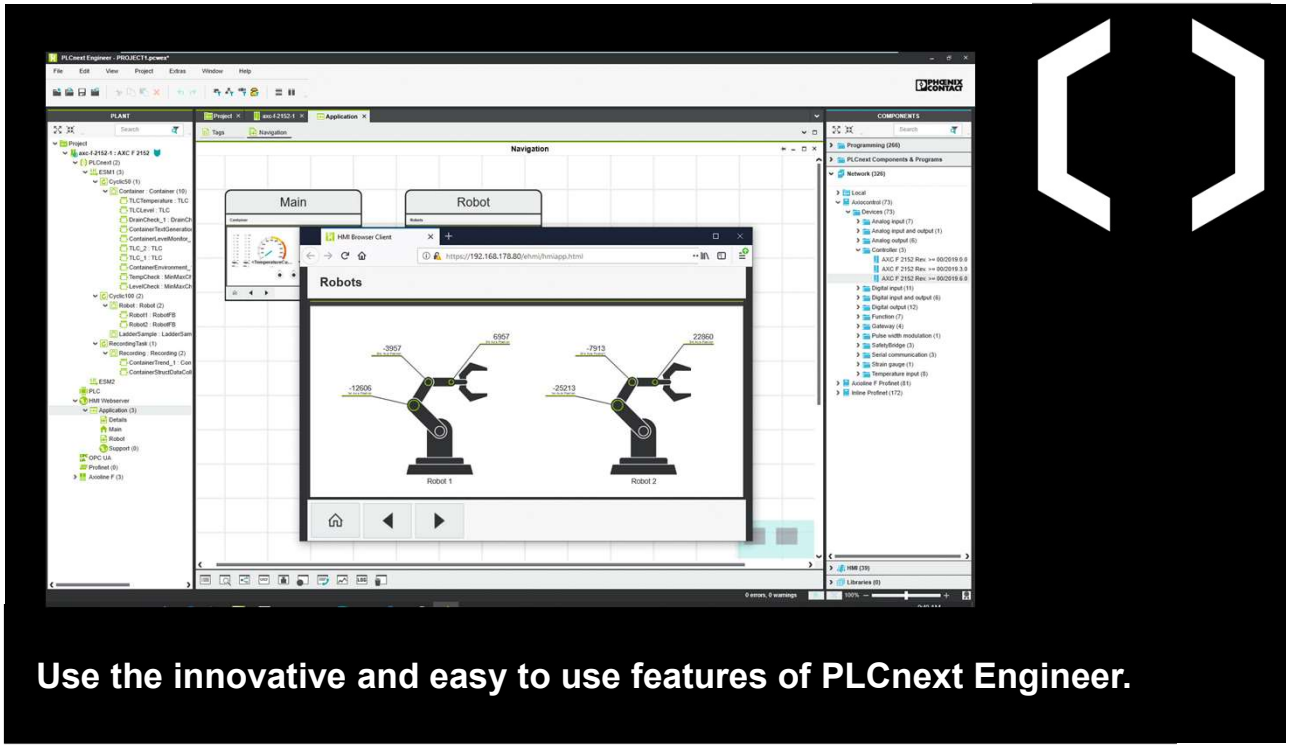


With PLCnext Technology, several developers from different generations, with different skill sets and expertise can work on one controller program, in parallel and yet independently, using different programming languages.

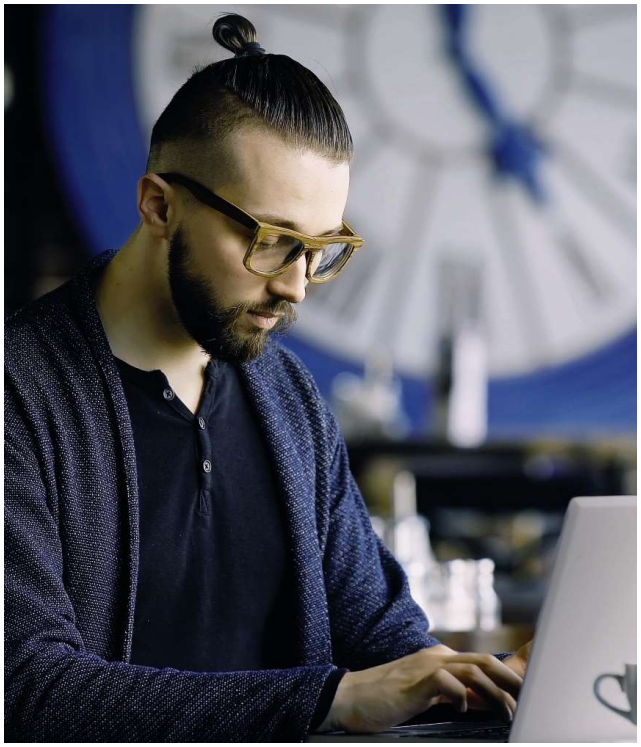
PHOENIX CONTACT
INSPIRING INNOVATIONS

enhanced convenience

IEC 61131-3 Programming with PLCnext Engineer



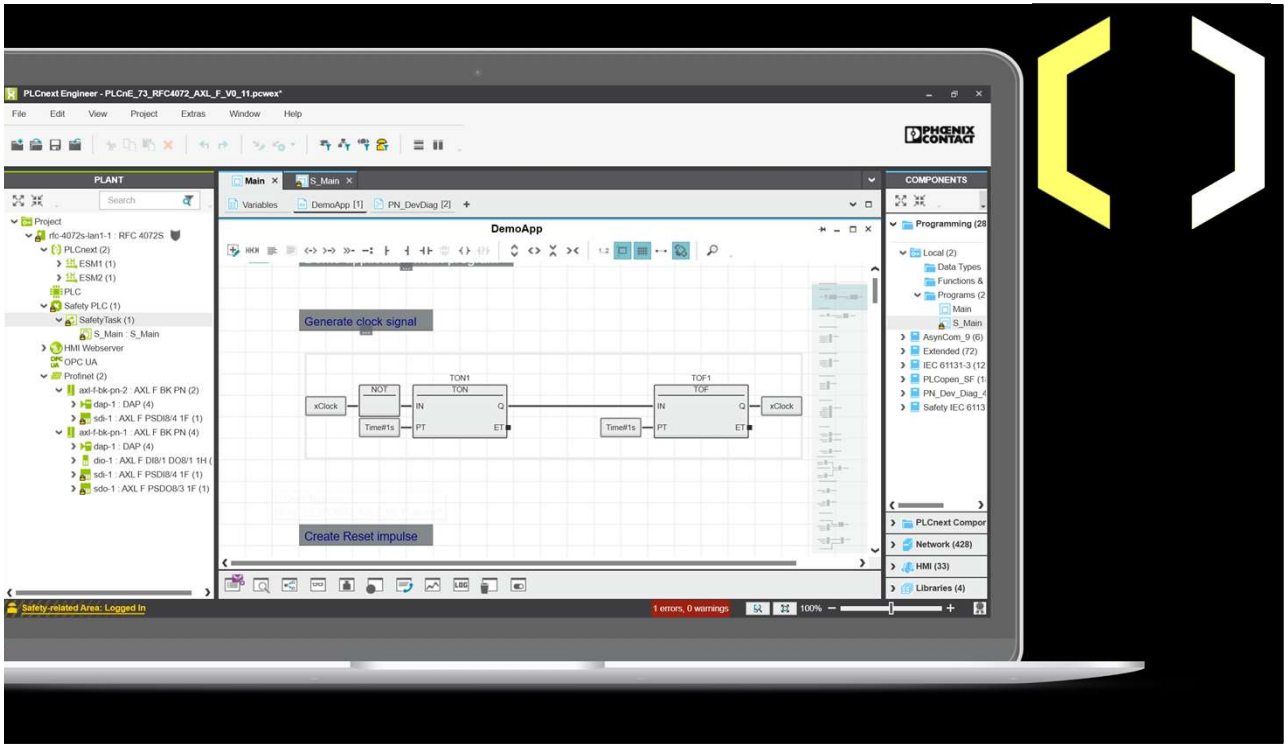
Use the innovative and easy to use features of PLCnext Engineer.

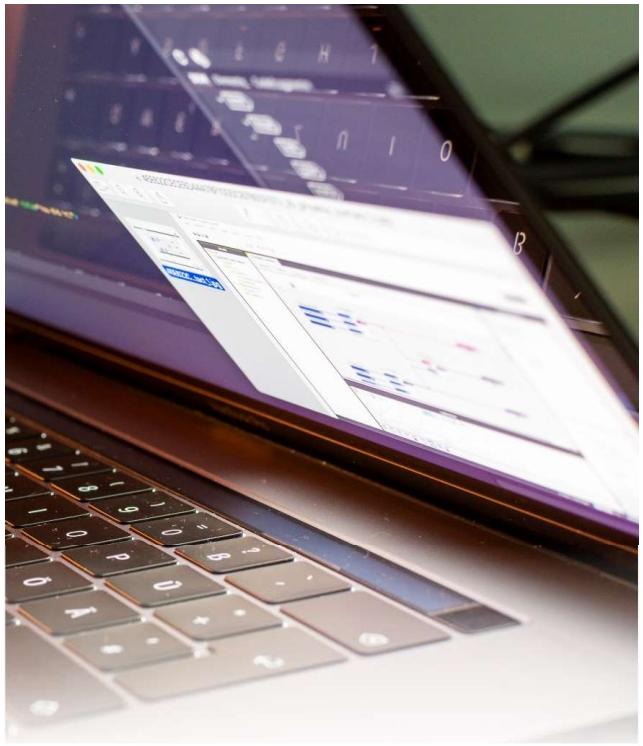


PLCnext Technology
Designed by PHOENIX CONTACT

Standard and safety programming in one engineering software

PLCnext Engineer





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PLCnext Technology
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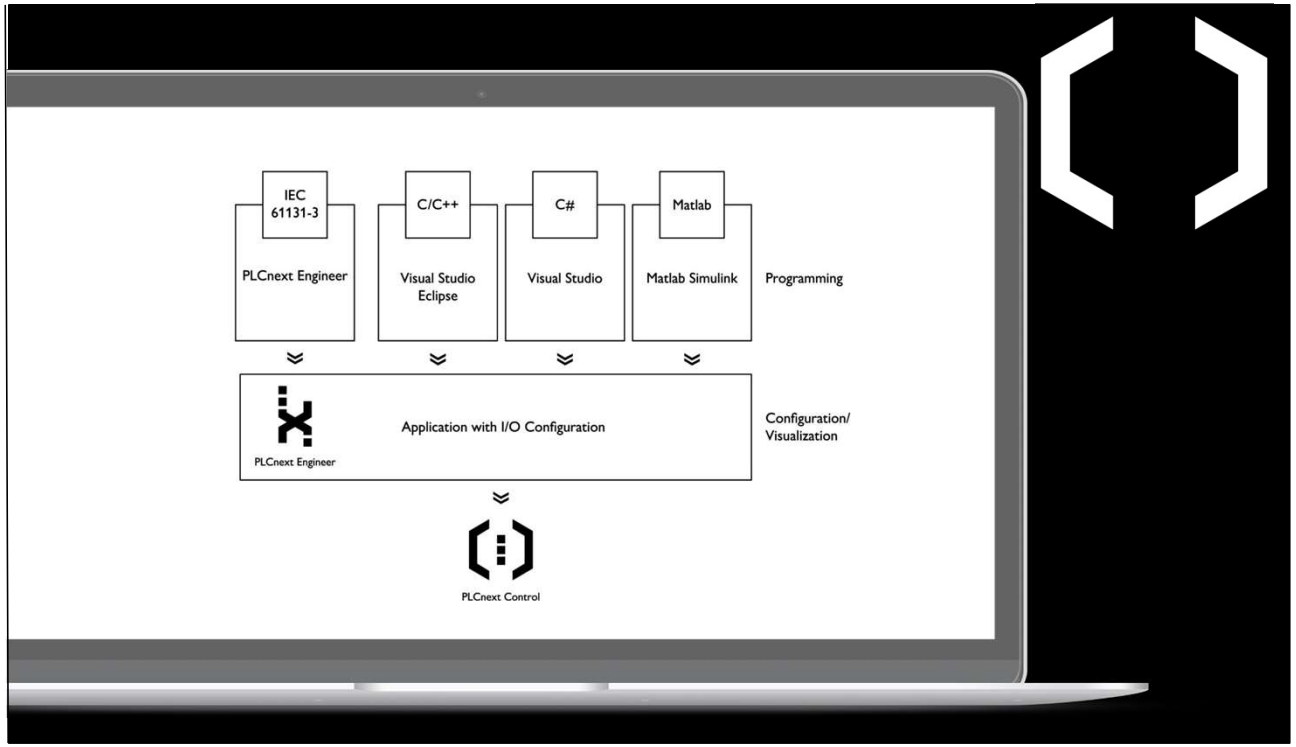
PLCnext Engineer



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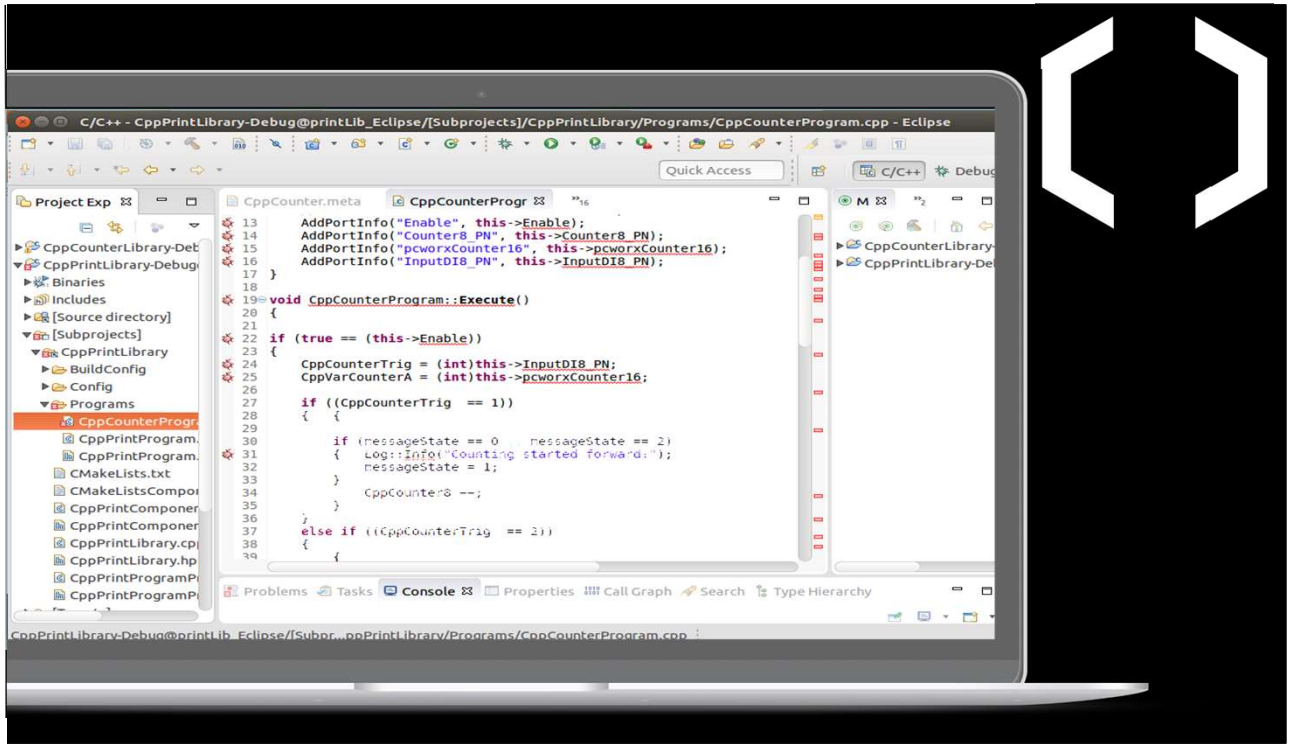
enhanced convenience

Programming – C/C++



eclipse

- C/C++ acc. to standard
- Easy interface to the PLCnext Runtime System
- Support of remote debugging
- Use the tool you are familiar with

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PLCnext Technology
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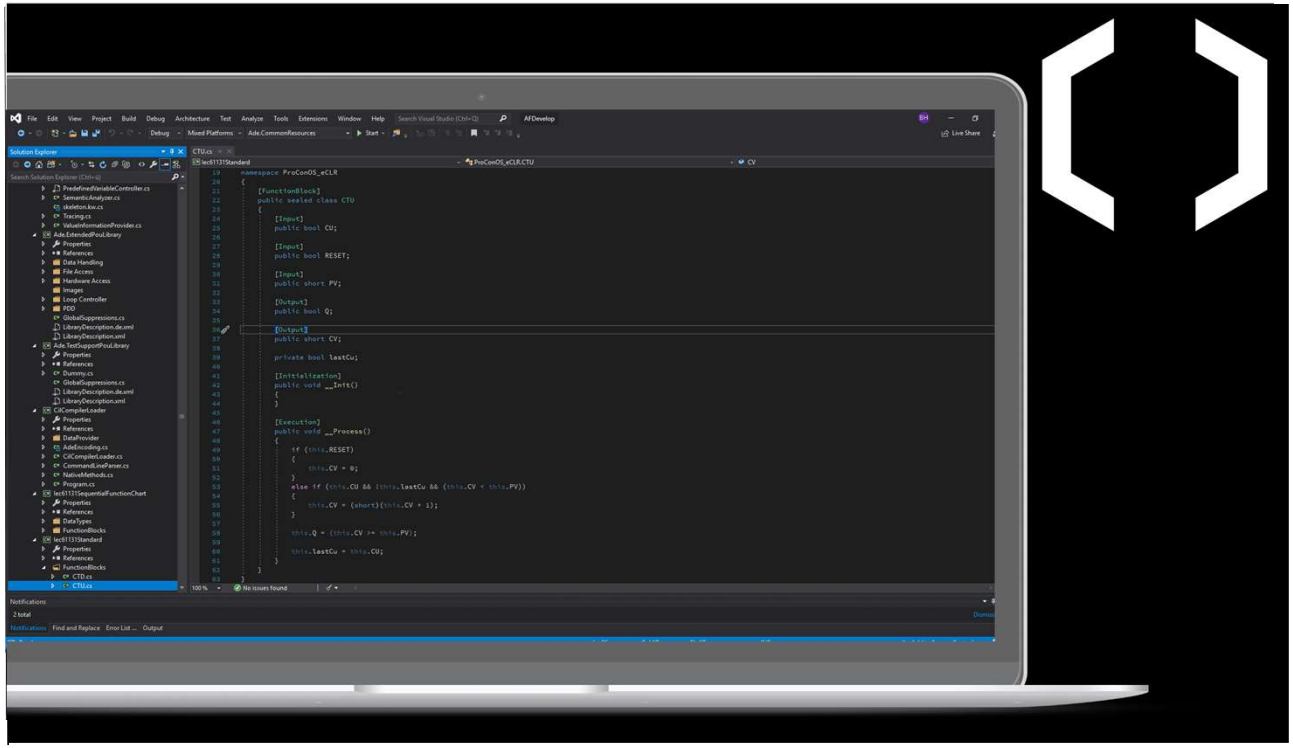
Programming – C/C++



Visual Studio

- Development and integration of function blocks with C#
- Dedicated plug-in for Visual Studio.
- Execute C# function blocks in real-time with the eCLR runtime system.

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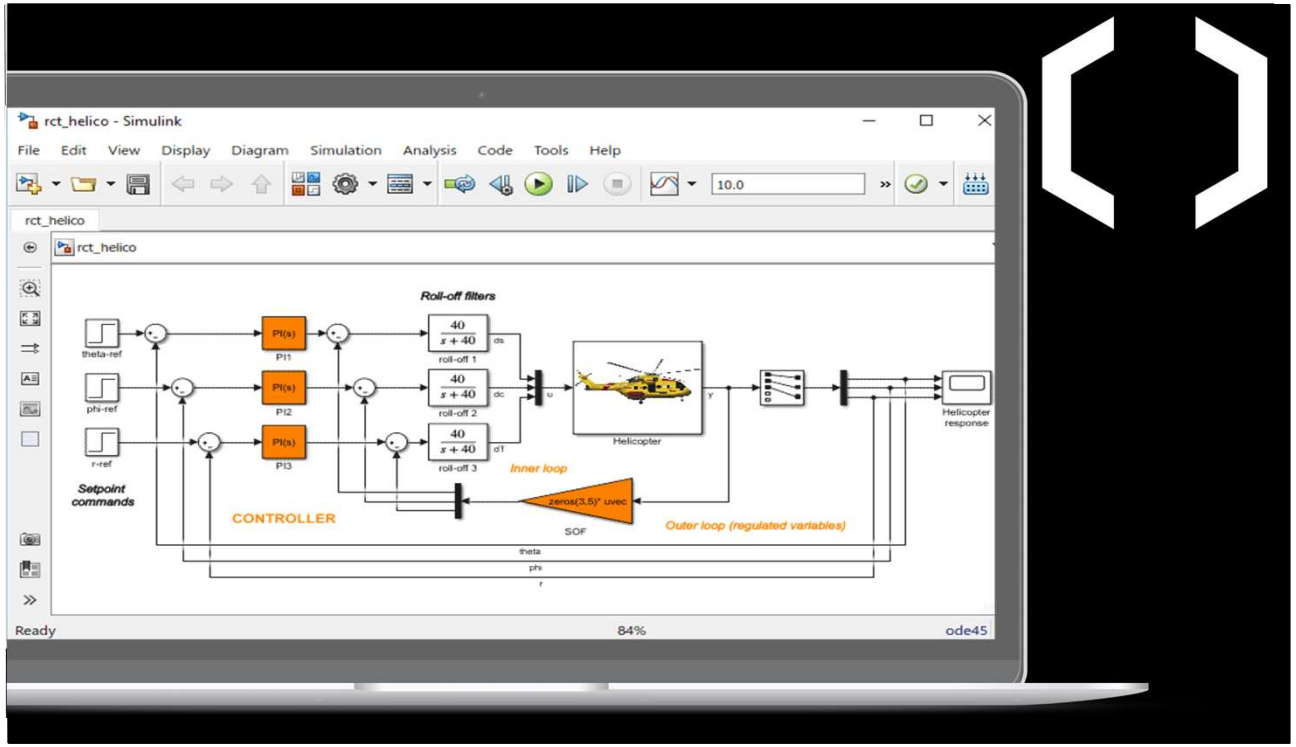
MATLAB Simulink



Seamless integration of model-based design & development with MATLAB Simulink.

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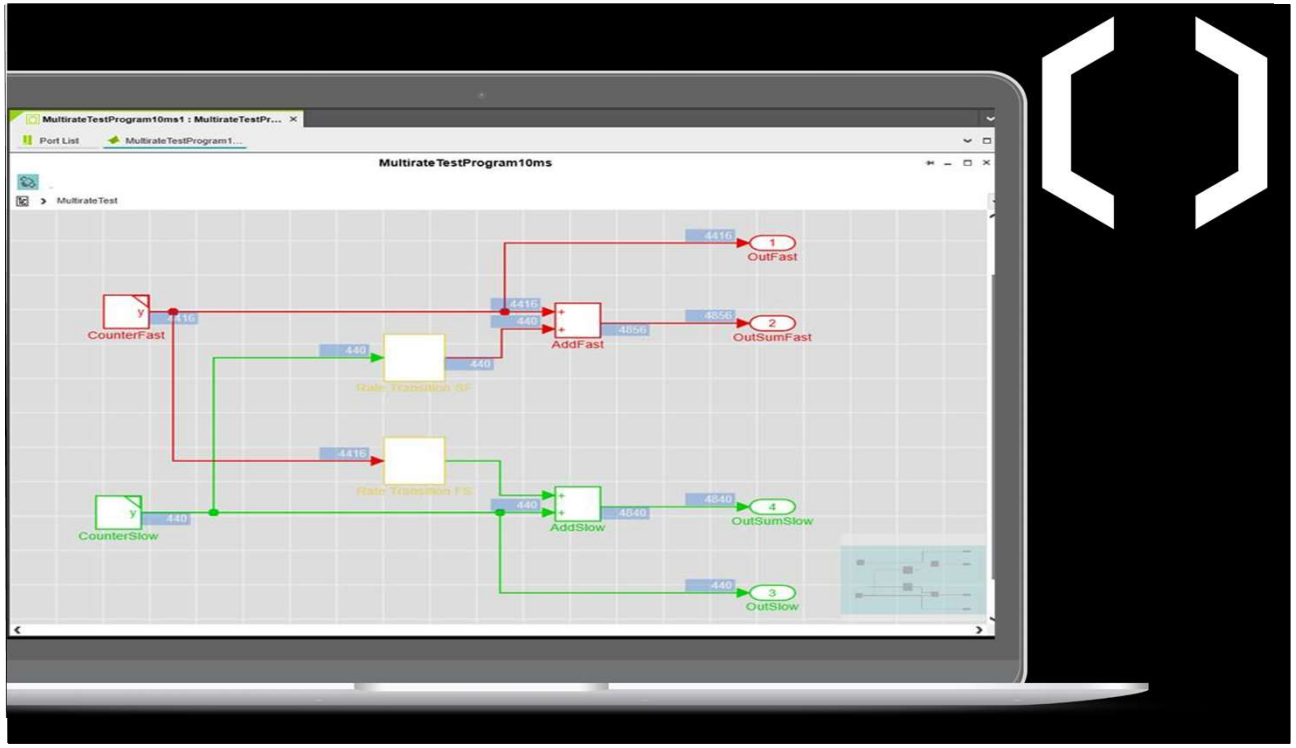
MATLAB Simulink & PLCnext Engineer



Seamless integration of model-based design & development with MATLAB Simulink and PLCnext Engineer.

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INSPIRING INNOVATIONS

With PLCnext Technology, several developers from different generations can work on one controller program independently of each other using different programming languages. Thus, you can develop complex applications quickly using the advantages of the classic PLC world and the openness and flexibility of PLCnext Technology.

PLCnext Technology
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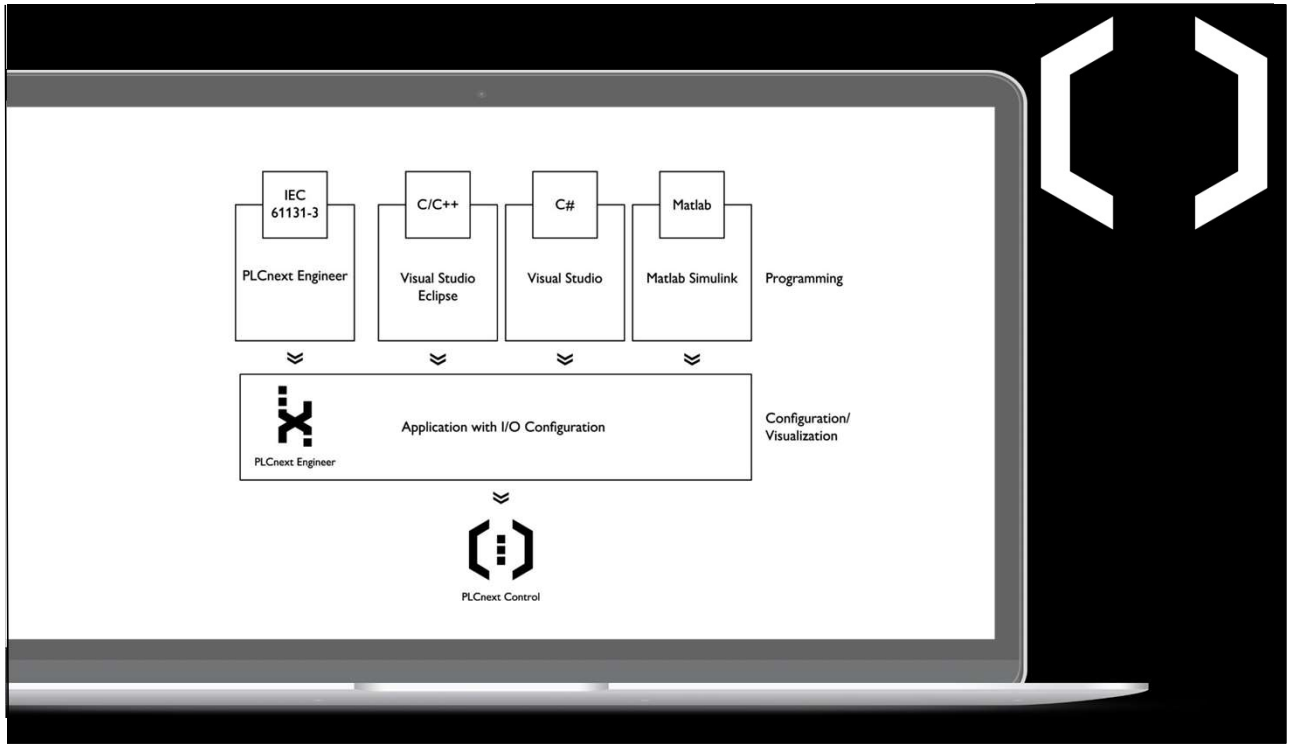
PLCnext Engineer



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enhanced development

PLCnext Technology
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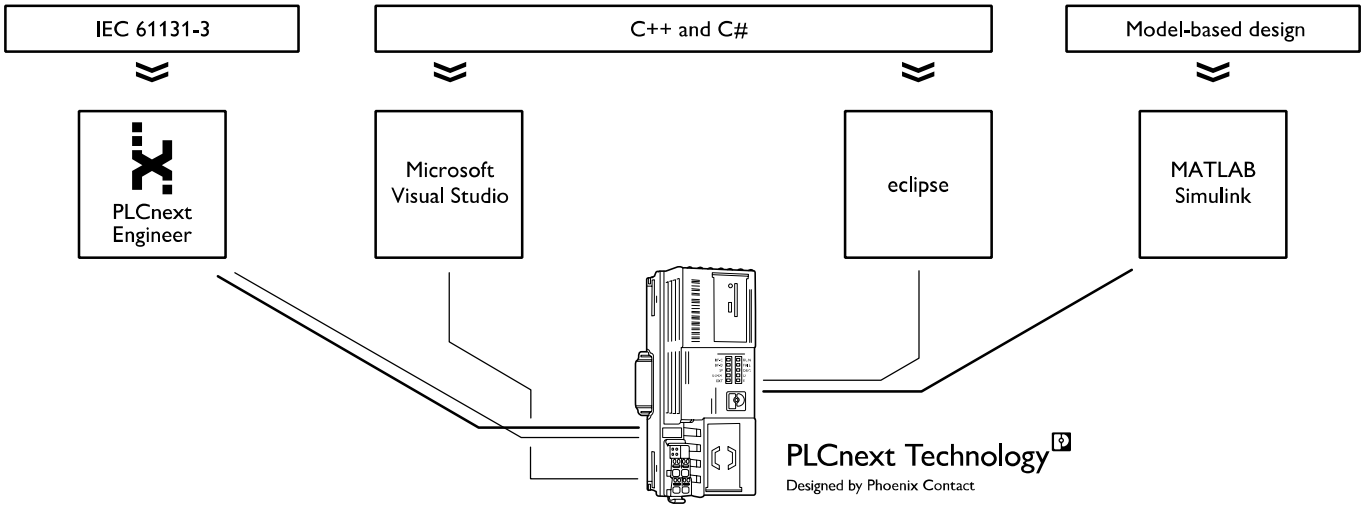
Engineering and Application Development



With PLCnext Technology, several developers from different generations, with different skill sets and expertise can work on one controller program, in parallel and yet independently, using different programming languages.

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PLCnext Technology
Designed by PHOENIX CONTACT
Combine program sequences in different languages into tasks as desired. The task-handling of the PLCnext Technology (patent applied for) lets program routines of different origin run like a classical IEC-61131-PLC-code – Your high-level language programs become automatically deterministic. The platform ensures consistent data exchange and synchronous execution of the program code.
enhanced performance
Real-time execution across different programming languages

PLCnext Technology
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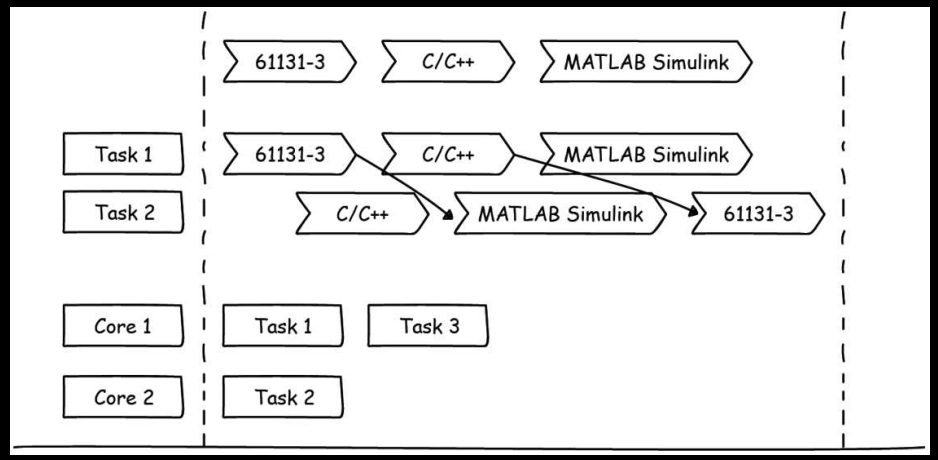
enhanced performance – PLC-typical Real-time Performance

Execution & Synchronization Manager



The patent-applied-for task handling of PLCnext Technology lets program routines of different origin run like classical IEC 61131 PLC code. Your high-level language programs become automatically deterministic.

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PLCnext Technology
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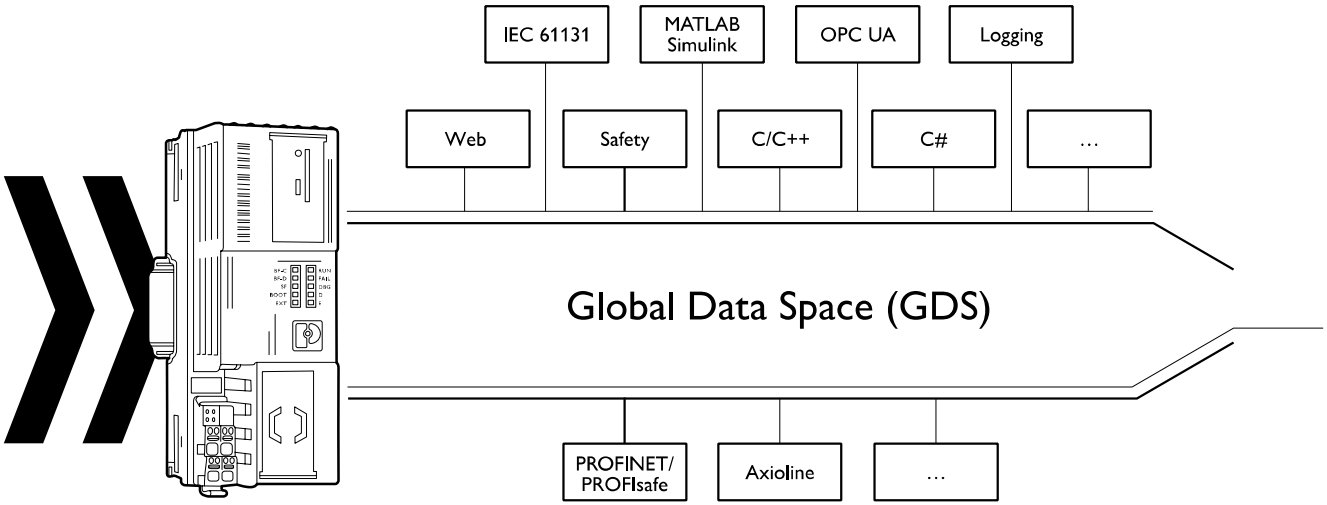
enhanced performance – Data Consistency

Global Data Space



Fast and consistent data exchange between user programs, fieldbuses, and system programs. Access via Data Logger, HMI, and OPC UA. Security aspects for user management.

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PLCnext Technology Architecture

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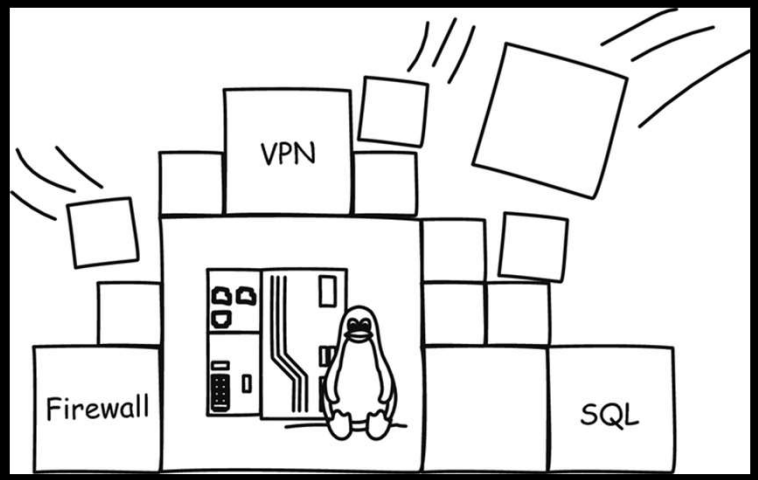
Flexibility of Linux plus the Reliability of a PLC



PLCnext Technology is based on Linux…

- Open source Linux Packages

…but as performant as a “classic” PLC!

- Easy task management
- Precise synchronization
- Cycle-consistent data exchange
- No Linux knowledge needed

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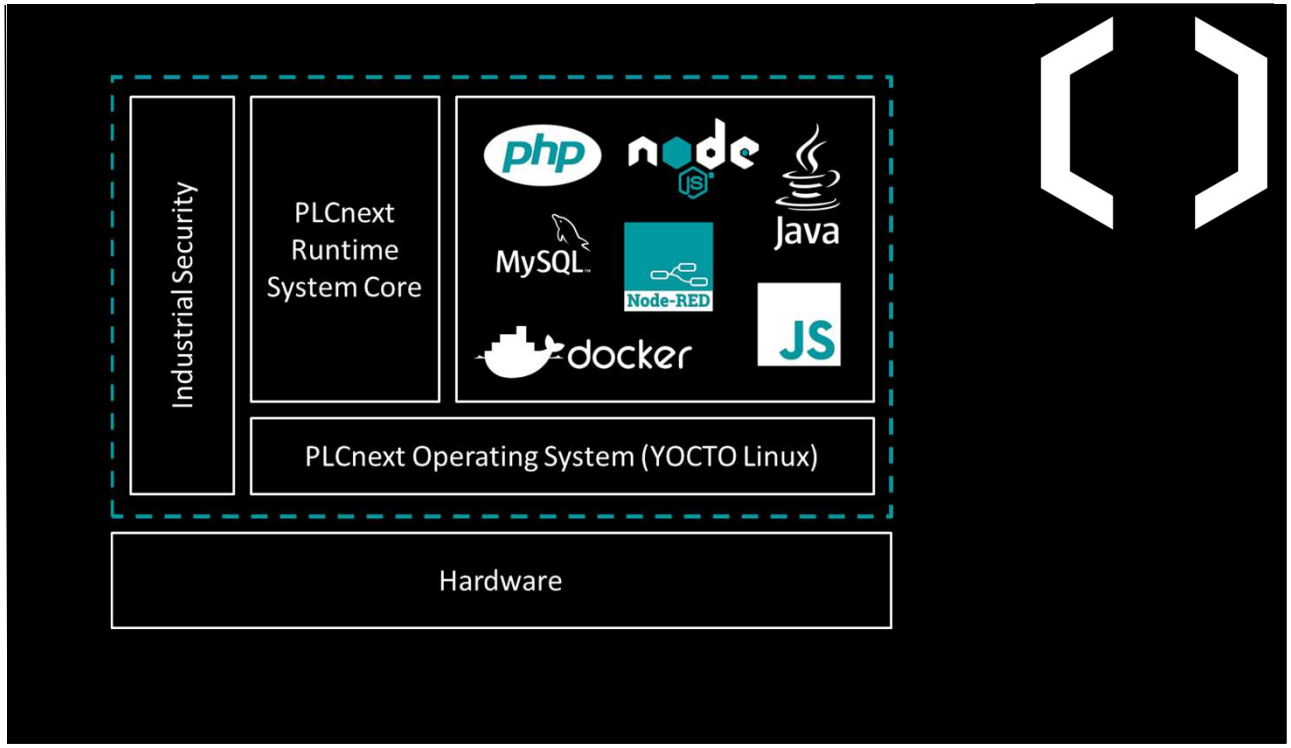
PLCnext Runtime System



- Reduced deployment time through the integration of source software
- Connectivity, security & real-time capability are already implemented
- Future-proof, flexible and secure thanks to continuous updates
- Integration of IEC61131-3, high-level languages and open source software possible
- Apps from PLCnext Store easy to implement

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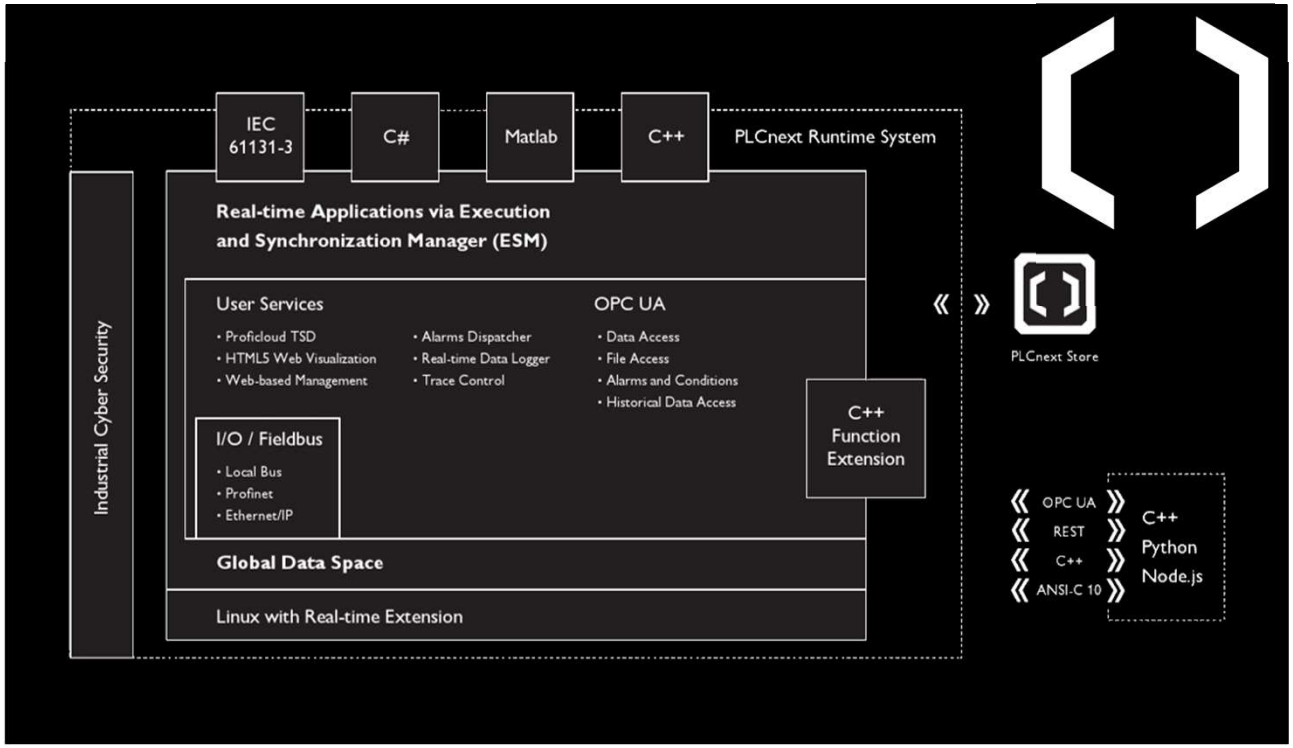
PLCnext Runtime System Architecture



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PLCnext Runtime System Architecture

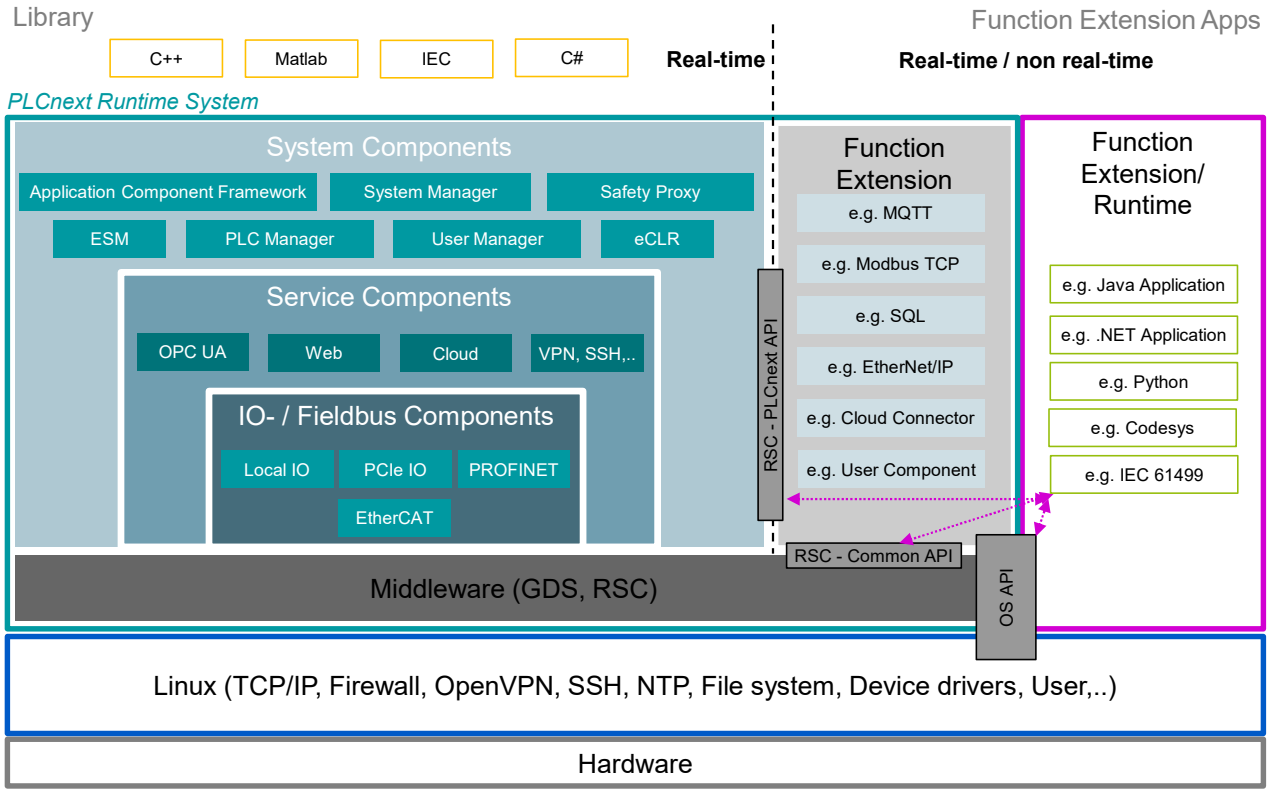
PLCnext Runtime System Core Components

System Components	Service Components

• Execution and Synchronization Manager (ESM)
• System Manager
• PLC Manager
• Device Interface
• User Manager
• Diagnostic Logger
• eCLR
• Application Component Framework
• Safety Proxy
• Event Manager
• …
	• OPC UA Server
	• PROFICLOUD Gateway
	• Web-based Management
	• PLCnext Engineer HMI
	• Data logger
	• Device HMI
	• Accessible via OS
	  • DHCP, DCP
	  • SFTP,VPN
	  • SSH, NTP
	  • Trace Controller

IO Components	**Middleware**

• Fieldbus Manager
  • PROFINET Controller
  • PROFINET Device
  • Axioline
  • …
	• Global Data Space (GDS)
	• Remote Service Calls (RSC)
	• Commons Layer (Common Classes)



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IEC 62443: IT-Security for Industrial Automation Control Systems

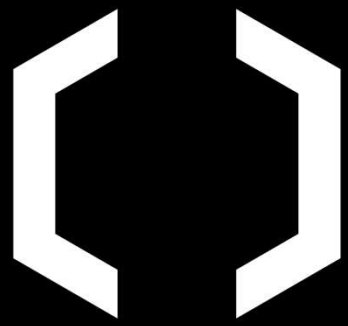
Authentication
- User accounts
- Authentication of credentials
- Authorization

Integrity
- Principle of least privilege
- Defense in depth
- Network segmentation

Security by Design

Confidentiality
- Use of secure protocols
- Secure remote maintenance
- Cryptography
- Protection of expertise

Availability
- Monitoring and attack detection
- Tamper protection



IEC 62443

Industrial Automation Basis Standard

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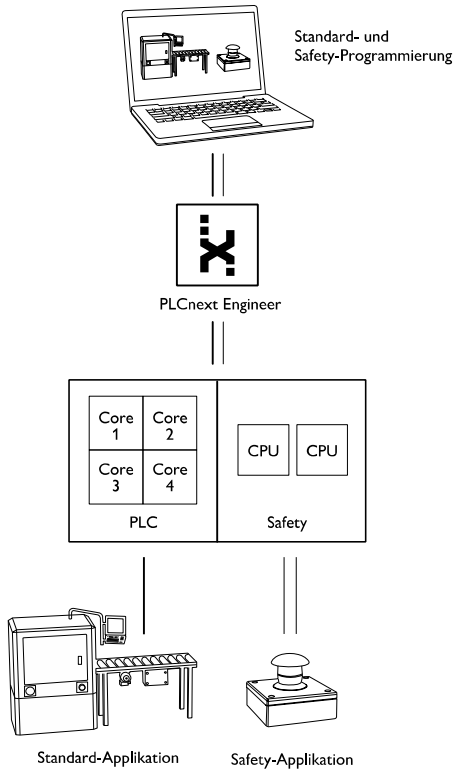
Functional Safety Integration



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PLCnext Technology Architecture – Competitive Advantages

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PLCnext Conceptual Advantages vs. Competitor Solutions

Contents

- Considerations on basic architectural concepts, features comparison & evaluation
- Argumentation guideline for pre-sales customer conversation in terms of openness and integration aspects

Symbols explanation


Proprietary IEC runtime environment


Deterministic real-time capability


Consistent process data exchange

EVALUATION SCALE

✓ Available / implemented / possible
o Partly available / implementation-specific
x Not available / implemented / possible

EVALUATION CRITERIA

- Open programming tools
- Open application & network interfaces
- Open source & apps integration
- Real-time HLL programs can use OS API
- Future-proof through modular extensibility
- Integrated real-time capability
- Cloud connectivity integrated
- Security integrated

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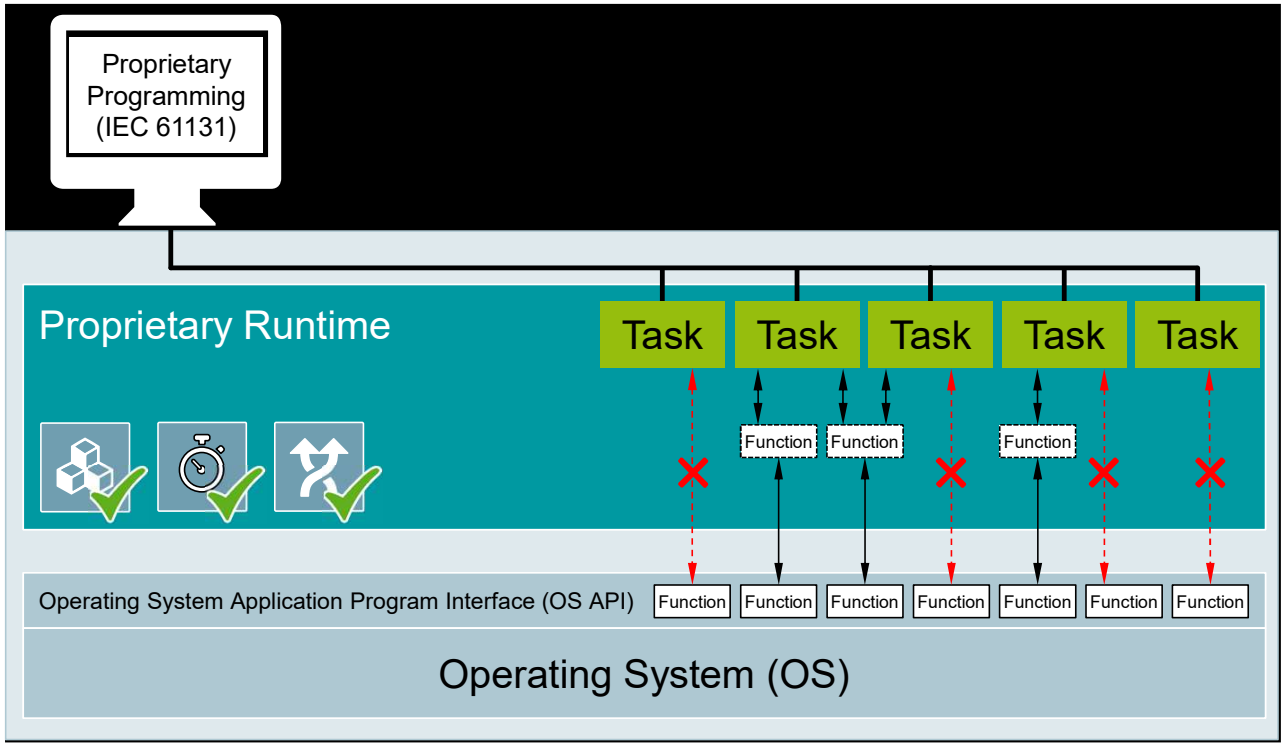
Classical PLC Architecture



- Only IEC 61131 programming
- High vendor dependency
- No possibility to use HLL programs
- No or limited OS API access

x Open programming tools
x Open application & network interfaces
x Open source & apps integration
x Real-time HLL programs can use OS API
x Future-proof through modular extensibility
✓ Integrated real-time capability
○ Cloud connectivity integrated
○ Security integrated

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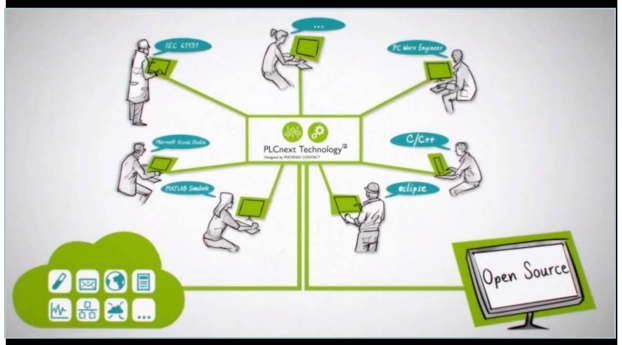
Digital Transformation ➔ Changing Market Requirements

Competitors promote various “open” solutions approaches – with major drawbacks

- Proprietary solutions keep single-vendor dependencies
- “Open” systems tend to neglect classical PLC benefits like real-time and data consistency aspects

Basic architectural approaches on the market

- **A**: Modified Classical PLC Architecture
- **B**: Open Linux-based Architecture
- **C**: Dual System Approach with Hypervisor
- **D**: PLCnext Technology



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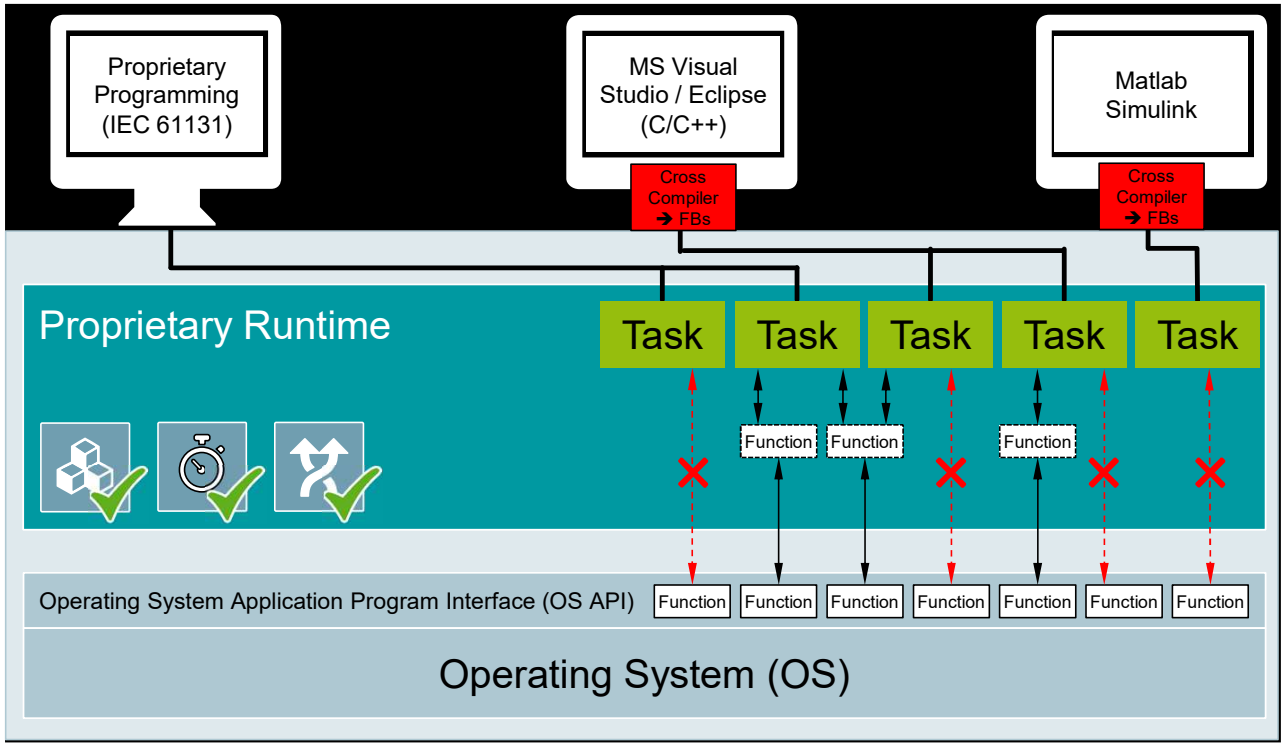
A: Modified Classical PLC Architecture



- Proprietary development packages
- HLL cross compilation → proprietary runtime → function blocks in IEC 61131
- High vendor dependency

EVALUATION

- ✓ Open programming tools
- o Open application & network interfaces
- x Open source & apps integration
- x Real-time HLL programs can use OS API
- o Future-proof through modular extensibility
- ✓ Integrated real-time capability
- o Cloud connectivity integrated
- o Security integrated

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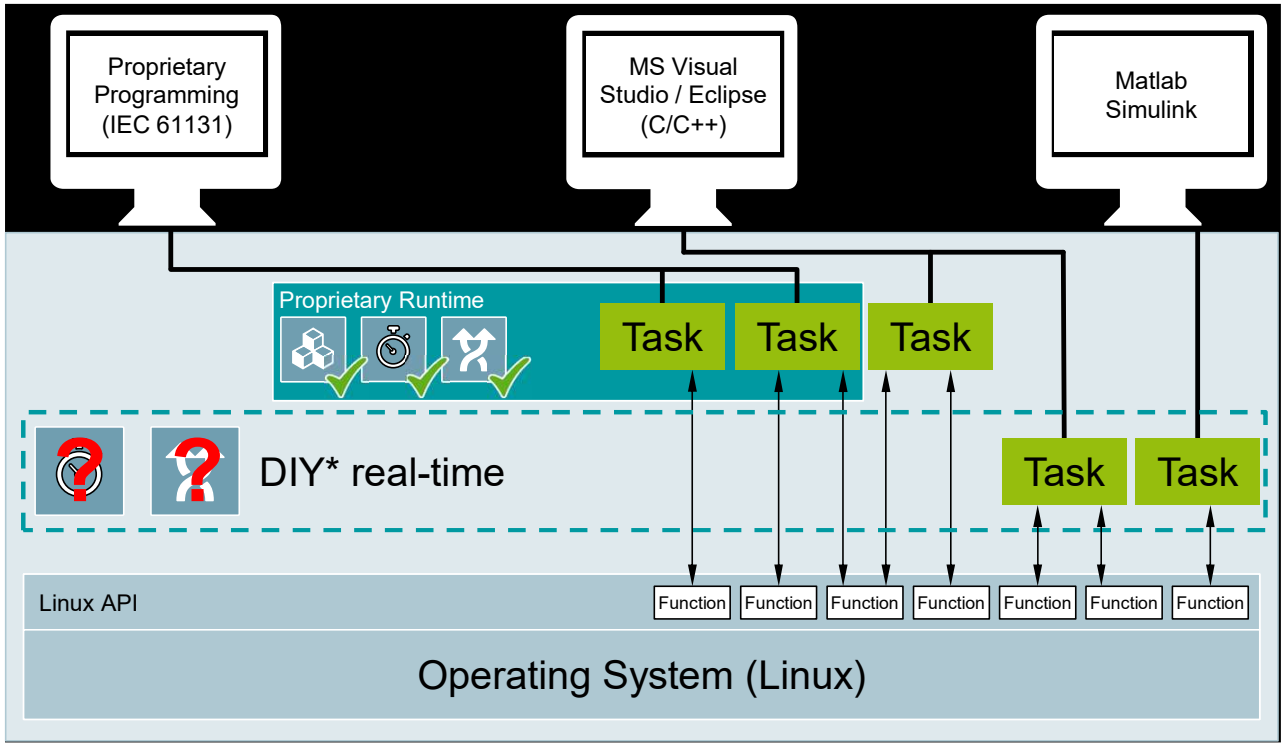
B: Open Linux-based Architecture



- No specific vendor dependency
- High additional programming effort and expert knowledge needed to solve real-time automation applications

EVALUATION

- ✓ Open programming tools
- ✓ Open application & network interfaces
- ✓ Open source & apps integration
- o Real-time HLL programs can use OS API
- ✓ Future-proof through modular extensibility
- x Integrated real-time capability
- o Cloud connectivity integrated
- o Security integrated

* DIY = Do It Yourself

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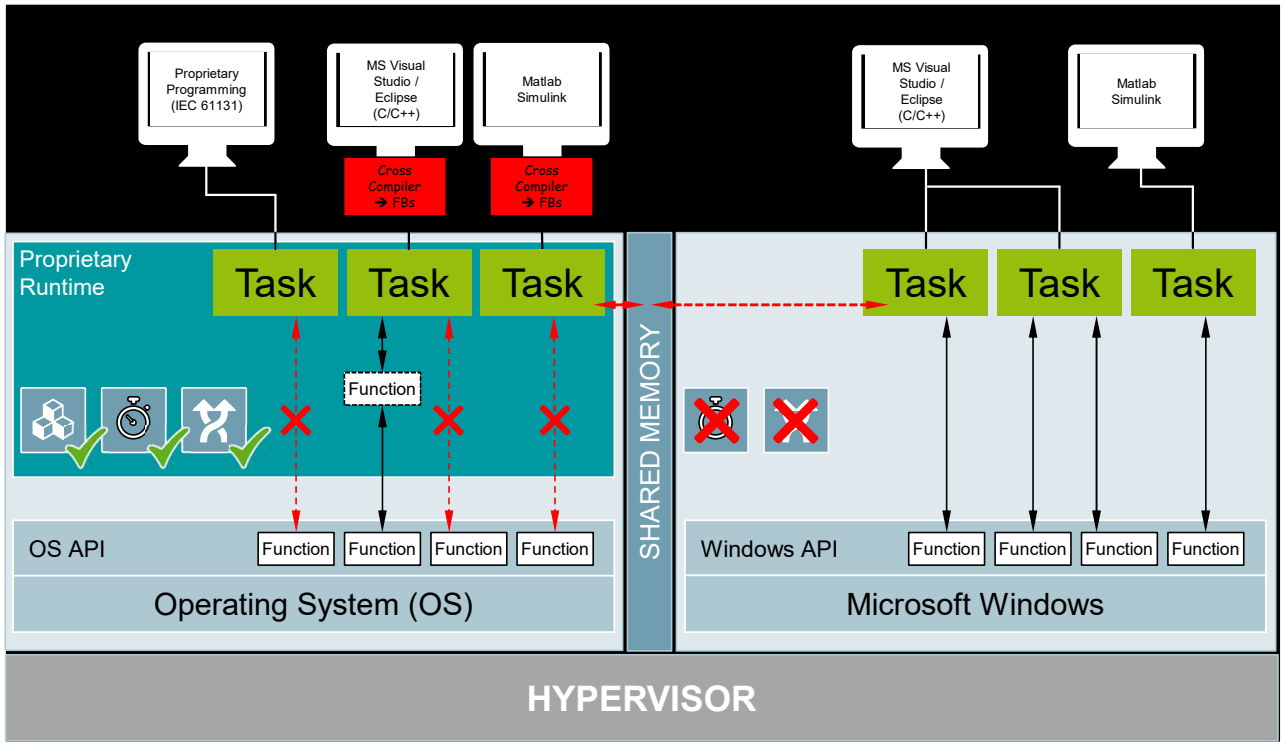
C: Dual System Approach with Hypervisor



- Costly high-performance HW needed
- Real-time for IEC 61131 and cross-compiled HLL (function blocks) only
- No OS API access HLLs in real-time ➔ e.g. no EtherCAT integration etc.

EVALUATION

- ✓ Open programming tools
- ✓ Open application & network interfaces
- ✓ Open source & apps integration
- x Real-time HLL programs can use OS API
- o Future-proof through modular extensibility
- ✓ Integrated real-time capability
- ✓ Cloud connectivity integrated
- ✓ Security integrated

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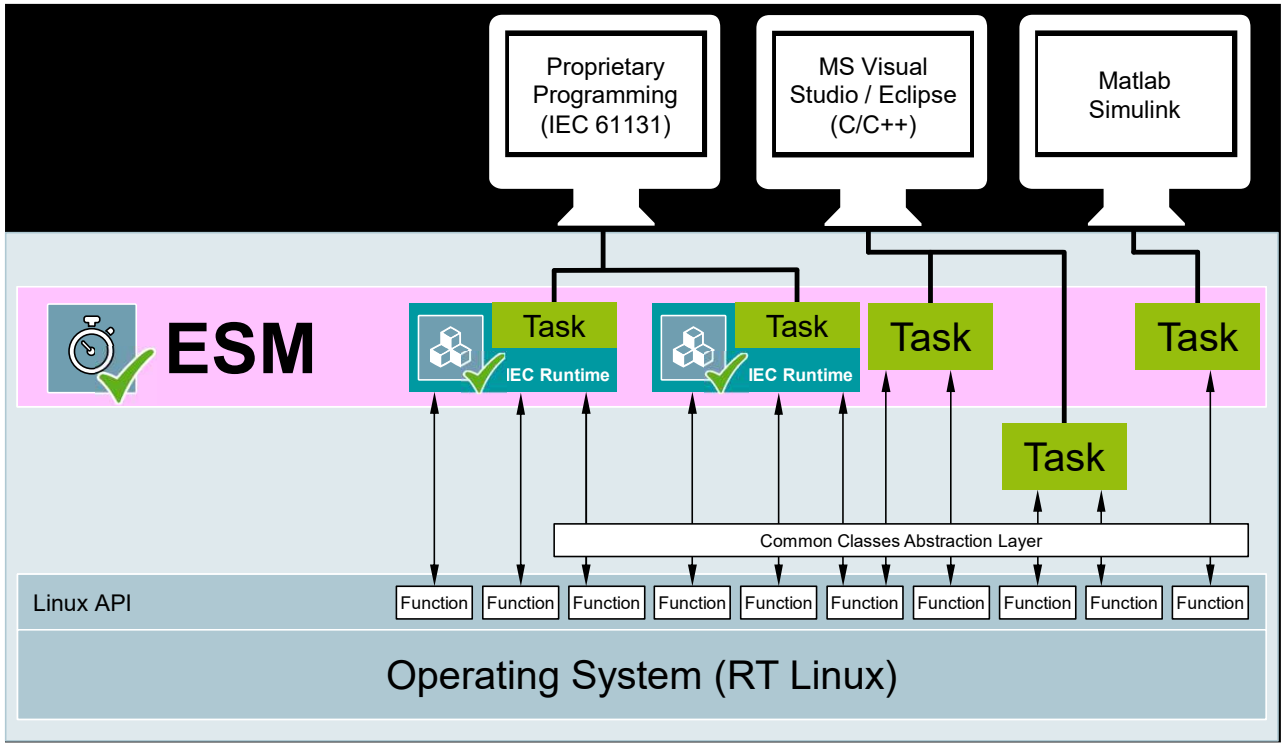
D: PLCnext Technology Architecture Advantages – ESM



ESM
Execution & Synchronization Manager

- Real-time scheduler for all Linux tasks
  - Separated from IEC 61131 runtime – no mutual dependencies
- Tasks can run inside or outside the real-time context
- Open source and HLL programs are based on Linux
  - Unlimited access to Linux API – directly or via Common Classes
- HLL or Simulink applications possible, also combined with IEC 61131 programs
- No need for in-depth Linux knowledge to implement PLC-like real-time
- Easy configuration via PLCnext Engineer or XML files

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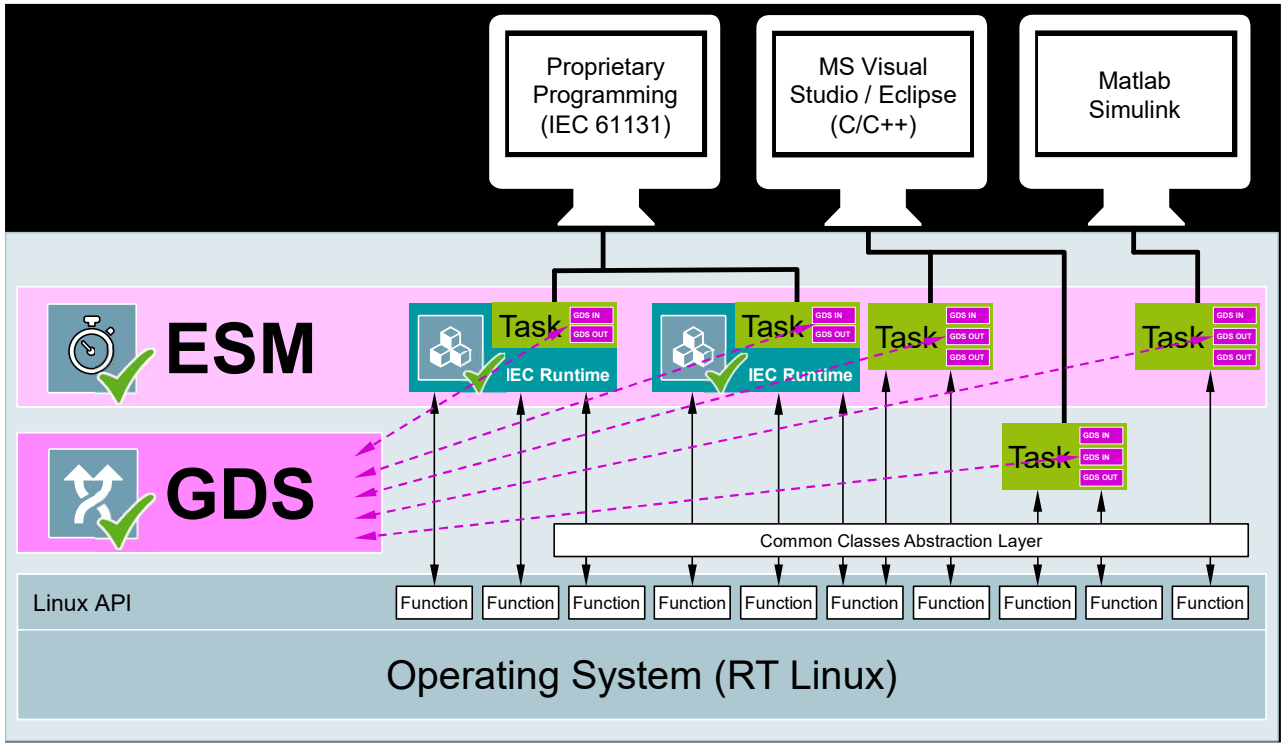
D: PLCnext Technology Architecture Advantages – GDS



GDS
Global Data Space

- Intelligent shared memory
- Port-based process data exchange among tasks via intelligent automatic buffer generation
- No programming effort for consistent and task-synchronous process data exchange (e.g. semaphores, resource blocking, …)
- No need for in-depth Linux knowledge
- Easy configuration via PLCnext Engineer or XML files

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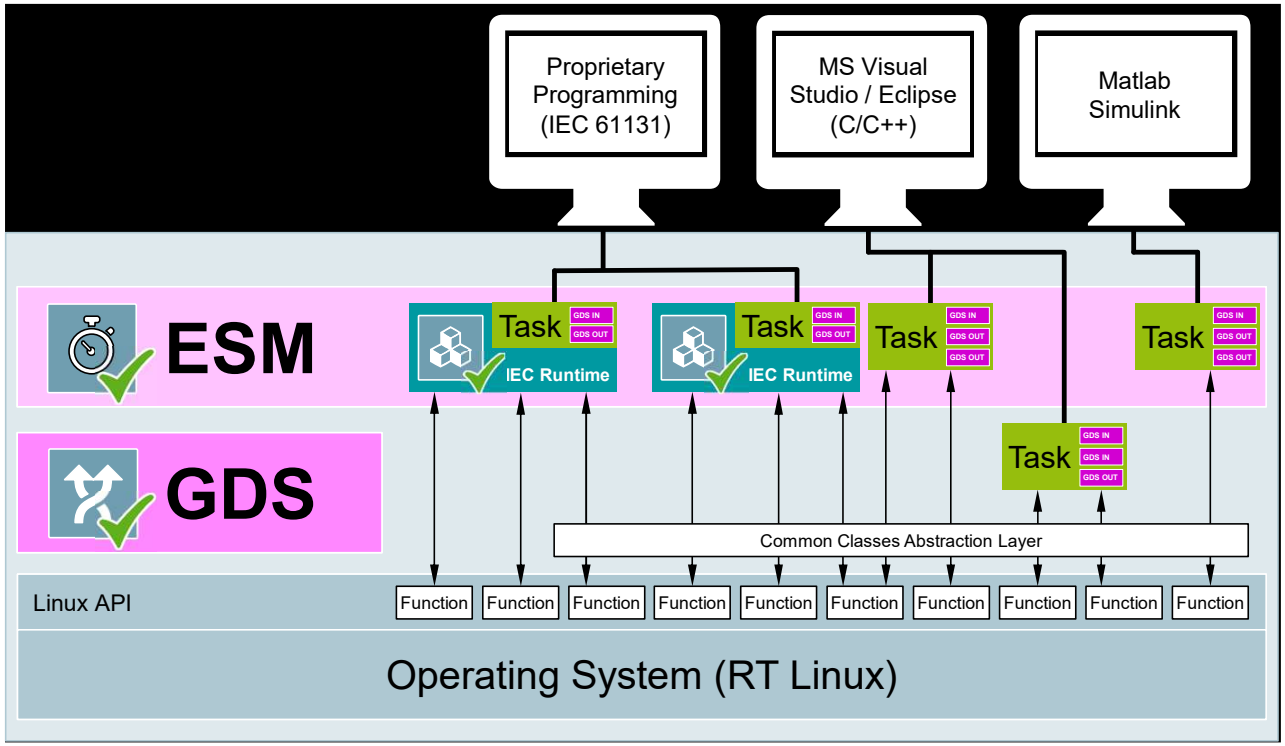
D: PLCnext Technology Architecture Advantages – Summary



- No vendor dependency
- Combined use of IEC 61131, HLL, and model-based programs
- Built-in real-time and data consistency for IEC 61131, HLL, and Matlab
- Unlimited OS API access

EVALUATION

- ✓ Open programming tools
- ✓ Open application & network interfaces
- ✓ Open source & apps integration
- ✓ Real-time HLL programs can use OS API
- ✓ Future-proof through modular extensibility
- ✓ Integrated real-time capability
- ✓ Cloud connectivity integrated
- ✓ Security integrated

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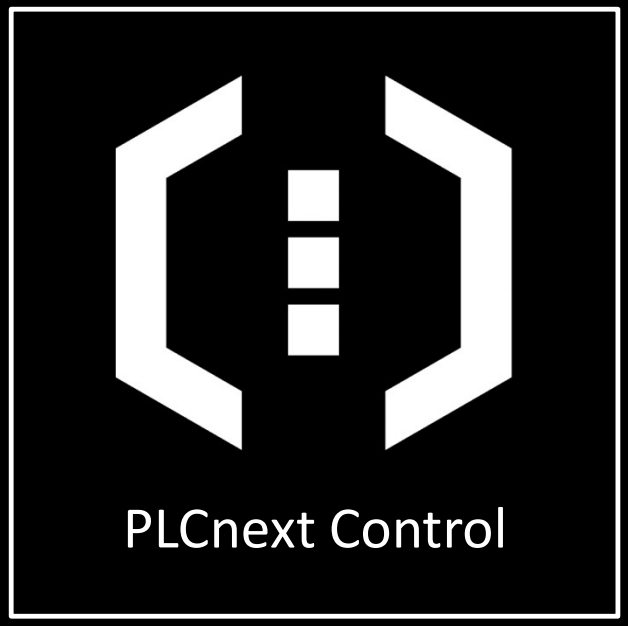
Open control platform for flexible automation



Discover flexible
automation

PLCnext Ecosystem – PLCnext Control

PLCnext Control

PLCnext Technology
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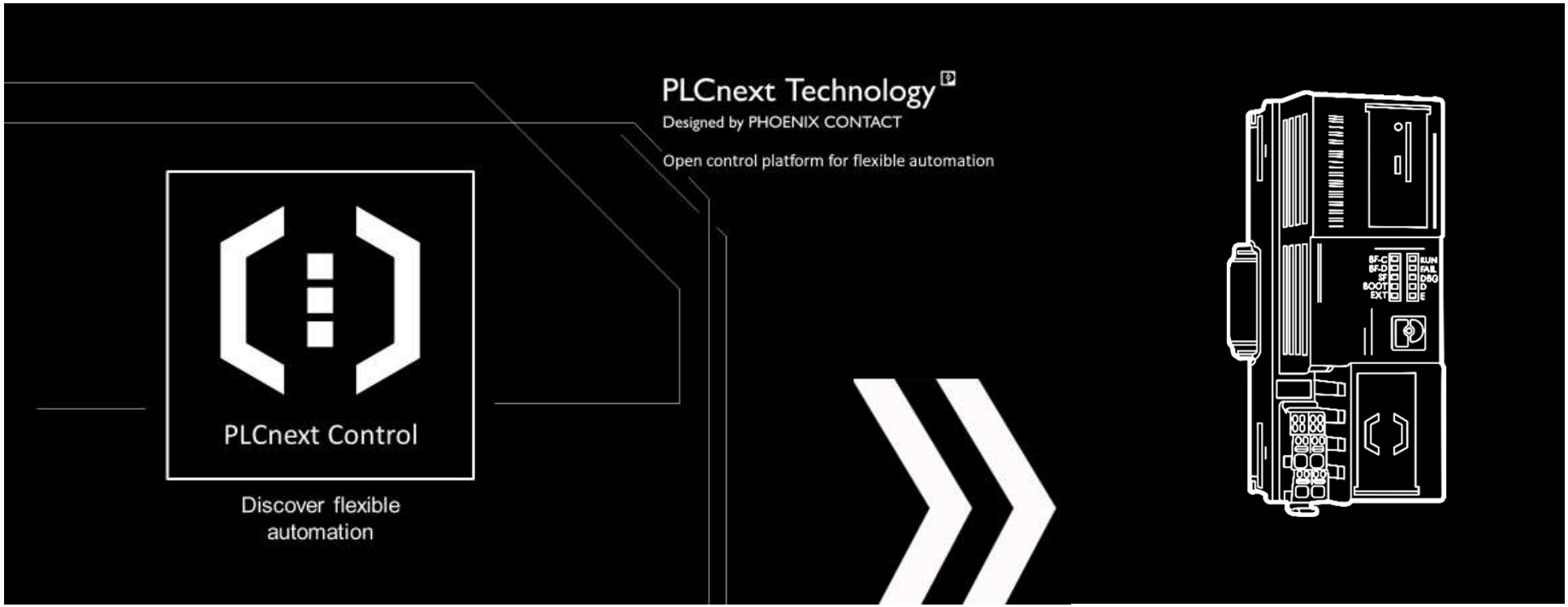

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PLCnext Ecosystem – PLCnext Control

PLCnext Control Portfolio Overview

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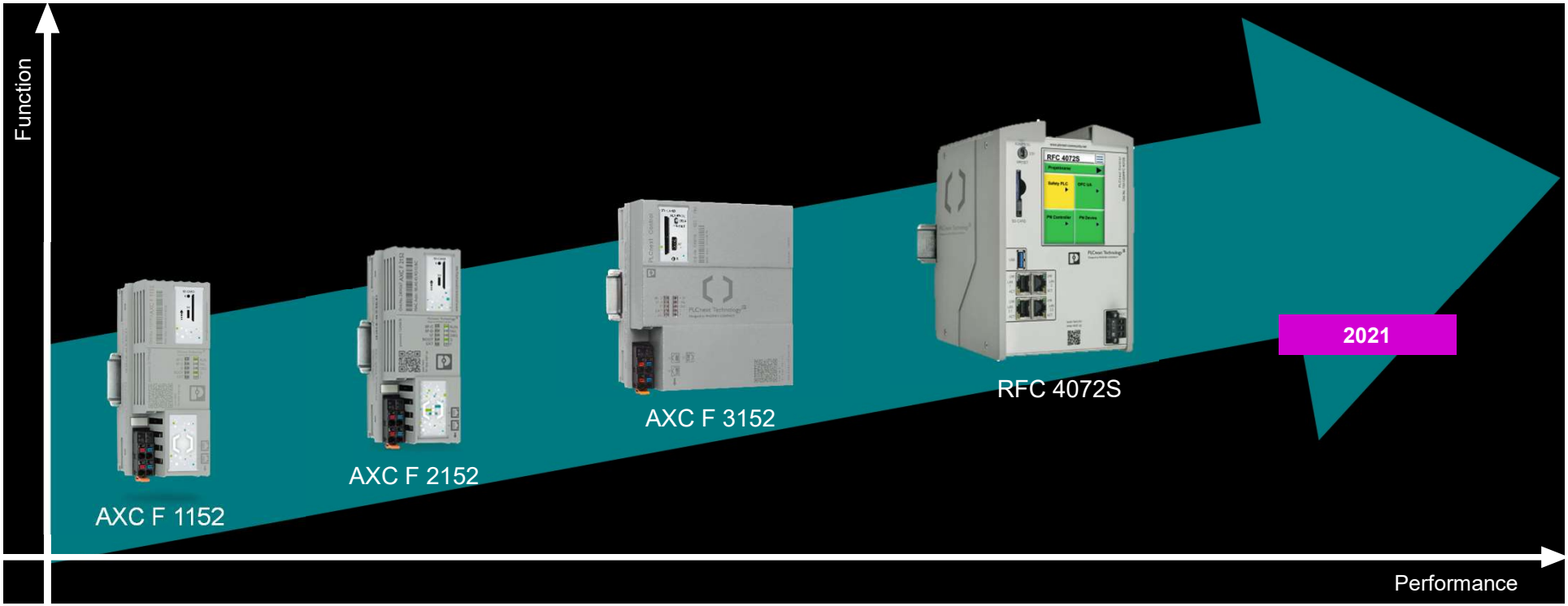

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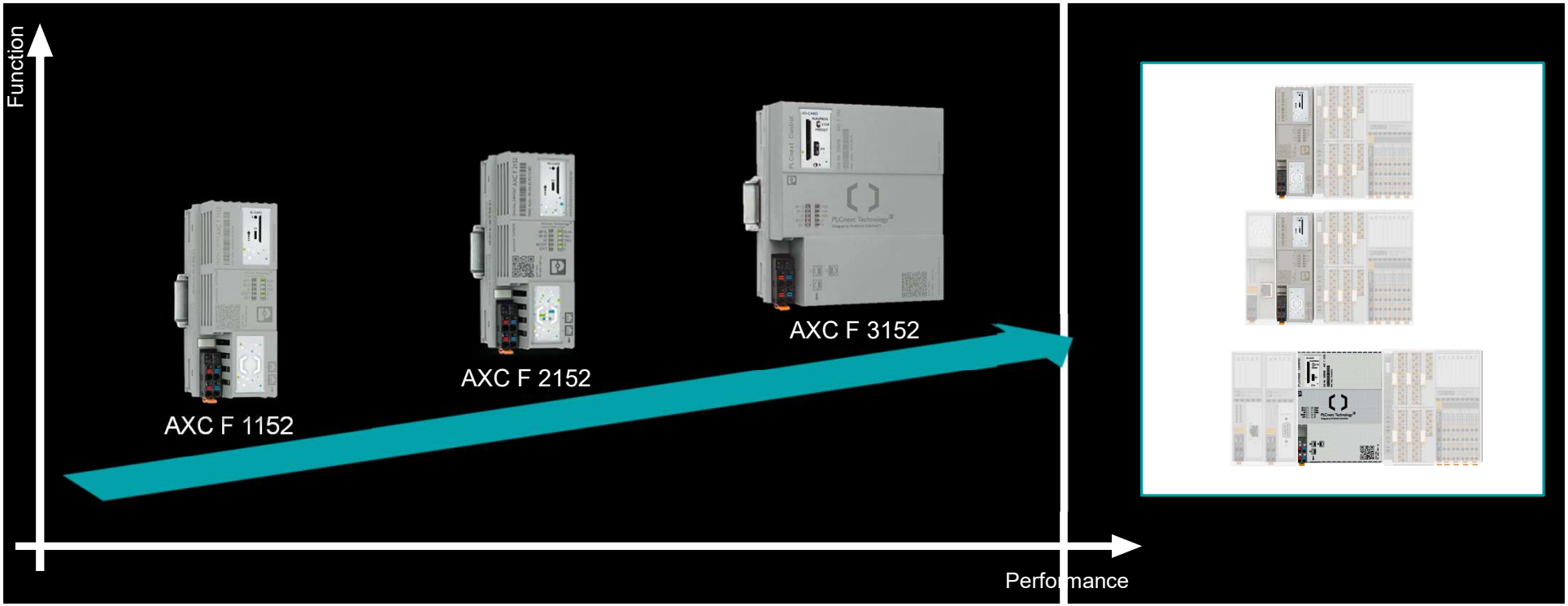
PLCnext Control for flexible automation with modular hardware platform



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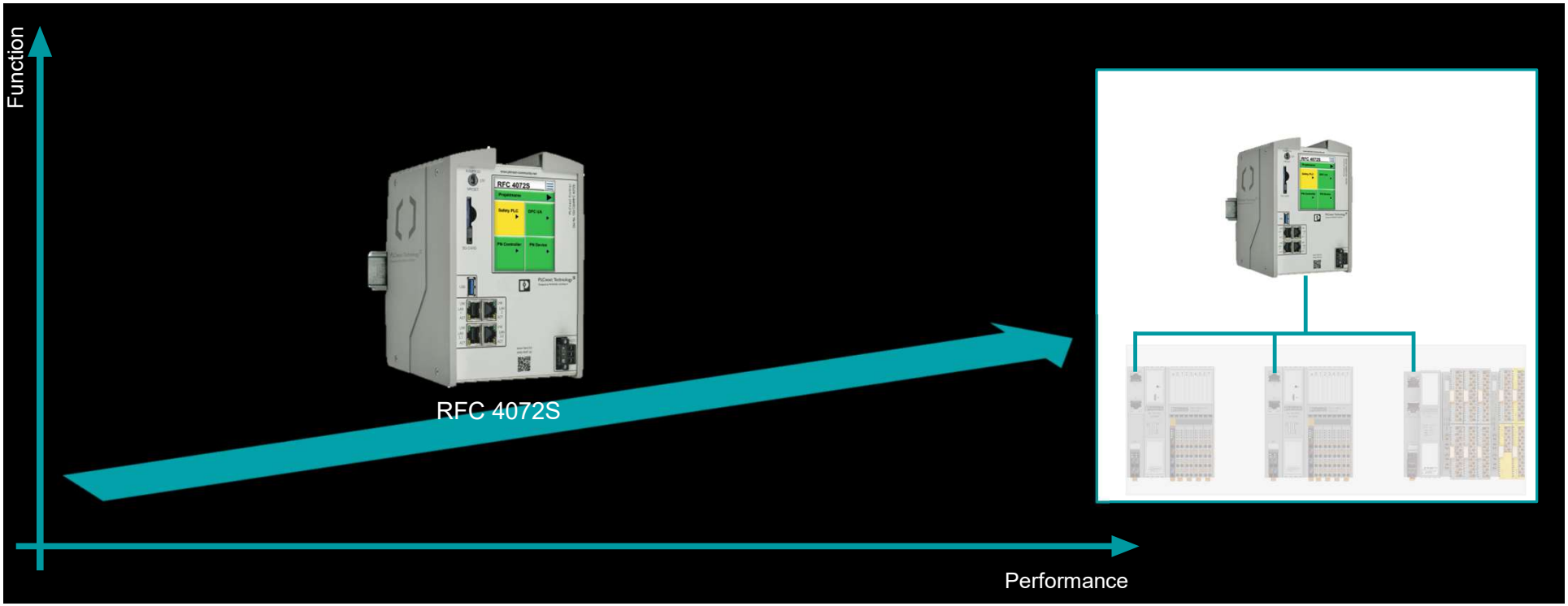
PLCnext Control for centralized applications with decentralized IOs



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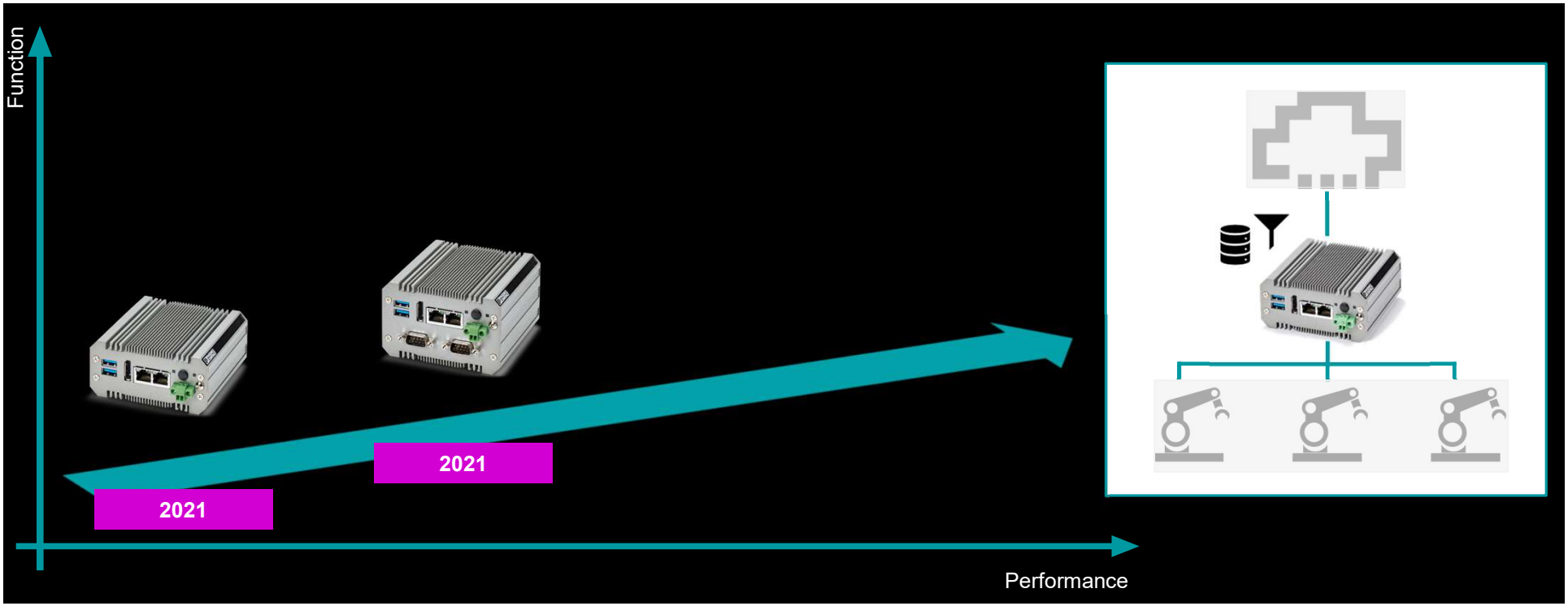
PLCnext Control for Edge Computing



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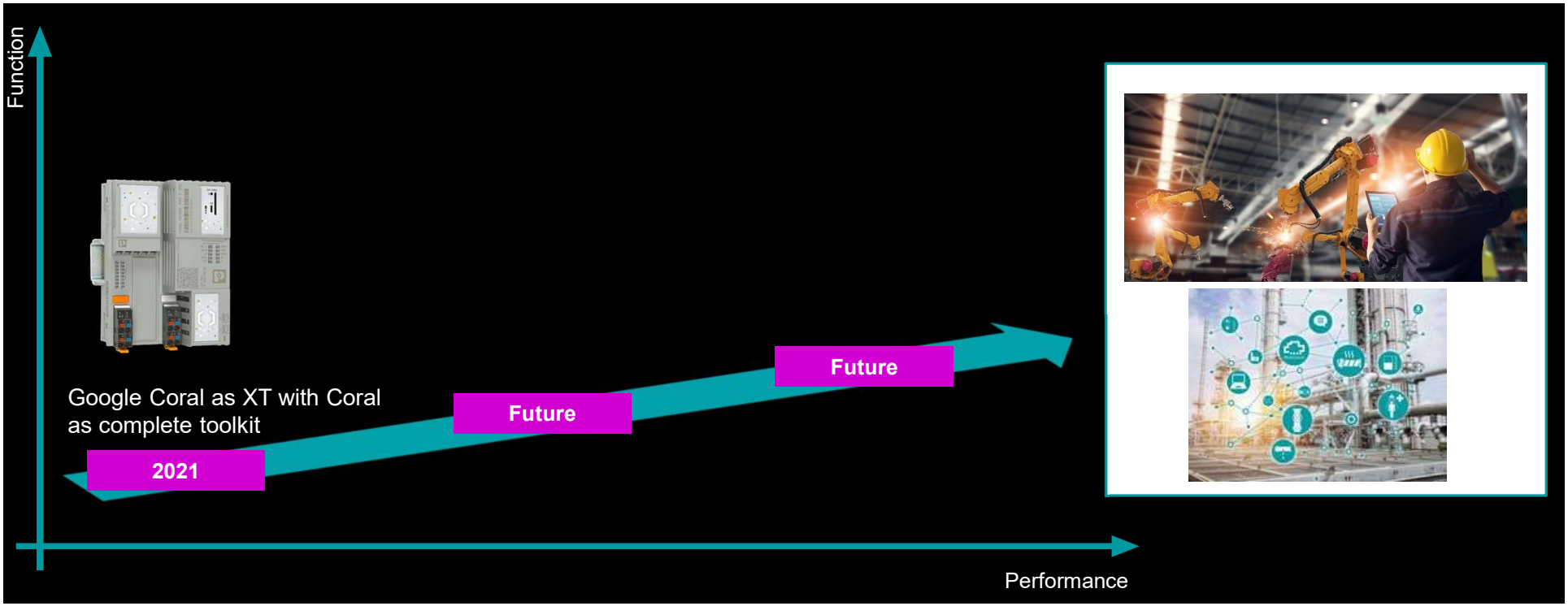
PLCnext Control for intelligent applications with Artificial Intelligence



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PLCnext Controls Performance Benchmark

RFC 4072S

4362

Intel i5 – 6300U dual core

AXC F 3152

811

Intel E3930 1,3GHz dual core
Basic list price ~ 1599 EUR

~ 2.7 times faster than AXC F 2152

AXC F 2152

300

Cyclone 5 Cortex-A9 800 MHz dual core (Comparable with AXC 3050)
Basic list price 599 EUR

AXC F 1152

150

Cyclone 5 Cortex-A9 800 MHz single core (Comparable with ILC 390)
Basic list price 399 EUR

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PLCnext Control

PLCnext Control AXC F 1152

Core	Working memory	Temperature
ARM Cortex-A9 (800 MHz)	512 Mbytes RAM	-25°C-60°C

# control tasks (IEC 61131)	Min. cycle time (IEC 61131)	Security
8	5 ms	TPM integrated

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Entry Level – PLCnext Control AXC F 1152

- Cyclone 5 with ARM Cortex-A9 CPU 1 x 800 MHz
- Number Control-Tasks (IEC 61131): 8
- Min. cycle time (IEC 61131): 5 ms
- Profinet Controller & Device with 16 ARs
- 512 Mbytes RAM
- SD Flash card slot
- 1 x ETH-MAC interface (2 x 10/100 Mbit) switched
- Real-time clock
- Supports INLINE and AXIOLINE I/O modules
- Trusted platform module (TPM) for security
- Temperature range: -25°C up to +60°C

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PLCnext Control

PLCnext Control AXC F 2152

Core	Working memory	Temperature
ARM Cortex-A9 (2x 800 MHz)	512 Mbytes RAM	-25°C-60°C

# control tasks (IEC 61131)	Min. cycle time (IEC 61131)	Security
32	1 ms	TPM integrated

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Proven Standard – PLCnext Control AXC F 2152

- Cyclone 5 with ARM Cortex-A9 CPU 2 x 800 MHz
- 512 Mbytes RAM
- SD Flash card slot
- 1 x ETH-MAC interface (2 x 10/100 Mbit) switched
- Micro-USB type C
- Real-time clock
- Supports INLINE and AXIOLINE I/O modules
- Left side extension capability
- Trusted platform module (TPM) for security
- Temperature range: -25°C up to +60°C

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Feature Set Differences – AXC F 1152 vs. AXC F 2152

Feature	AXC F 1152	AXC F 2152
CPU	Cyclone 5 with ARM Cortex-A9 1 x 800 MHz	Cyclone 5 with ARM Cortex-A9 2 x 800 MHz
Approvals	UL, CE	UL, CE, Marine, ATEX
Max. number of control tasks	8 (1 x 8)	32 (2 x 16)
PLCnext extension support (left-hand side)	No	Yes
PROFINET Features	Controller & Device with max. 16 ARs	Controller & Device with max. 64 ARs
Min. task cycle time	5 ms	1 ms

PLCnext Control

PLCnext Control AXC F 3152

Core	Working memory	Temperature
Intel ATOM x5-E3930 dual-core	2 GB DDR4 dual-channel RAM	-25°C-60°C

# control tasks (IEC 61131)	Min. cycle time (IEC 61131)	Security
32	500 µs	TPM integrated

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More Performance – PLCnext Control AXC F 3152

- Intel ATOM x5-E3930 dual-core CPU (2 x 1,3 GHz)
- 2 GB DDR4 dual-channel RAM
- 3 independent ETH-MAC interfaces (3 x 1 Gbit)
- Supports 2 PLCnext Control extensions (internal PCIe bridge)
- Supports INLINE and AXIOLINE I/O modules
- Integrated uninterruptible power supply (UPS) for targeted application shutdown
- SD card slot
- Diagnostic LEDs
- Real-time clock
- Temperature range: -25°C up to 60°C
  - Optional fan to increase service life

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More Performance – PLCnext Control AXC F 3152

- Based on PLCnext Technology
  - Linux operating system
  - Supports high-level programming languages
  - PROFICLOUD Connection
- PROFINET Controller (up to 128 devices) + Device
- OPC UA
  - Easy integration of other fieldbus protocols (Linux OS)
- Prepared for TSN
- Trusted platform module (TPM) for security
- Approvals
  - UL (Hazloc), CUL, IEC Ex, ATEX
  - DNV/GL, LR, BV, ABS, …

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PLCnext Control RFC 4072S

Core

Intel i5 6300U 2 x 2,4 GHz processor

Working memory

4 GB DDR 4 dual channel RAM

Temperature

0°C up to 55°C with fan

control tasks (IEC 61131)

32

Min. cycle time (IEC 61131)

500 µs

Security

TPM integrated

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PLCnext Control RFC 4072S

- Intel i5 6300U 2 x 2,4 GHz processor
- 4 GB DDR 4 dual channel RAM
- Profisafe integrated (up to 300 F-Devices)
- Operation Mode Switch
- Touch display
- SD Flash card slot
- 3 ETH-MAC interfaces
  (2 x 1 Gbit, 1 x 100 Mbit switched)
- Real-time clock
- Trusted platform module (TPM) for security
- Temperature range: 0°C up to 55°C with fan

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PLCnext Technology – New Starterkit

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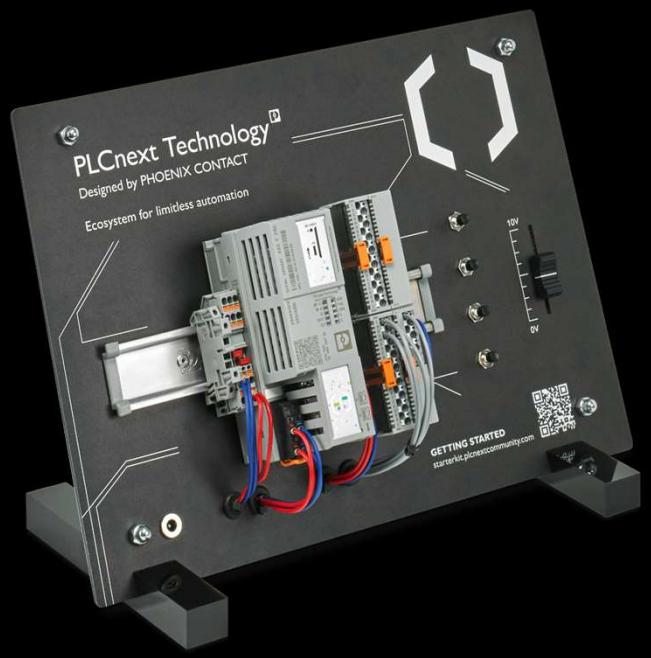
Start now and become a part of PLCnext Technology



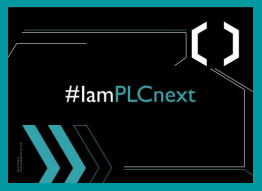
Getting started

Online

Hardware

PLCnext Control &
Axioline Smart Element

starterkit.plcnextcommunity.com



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Countless possibilities in hardware variance

PLCnext Control

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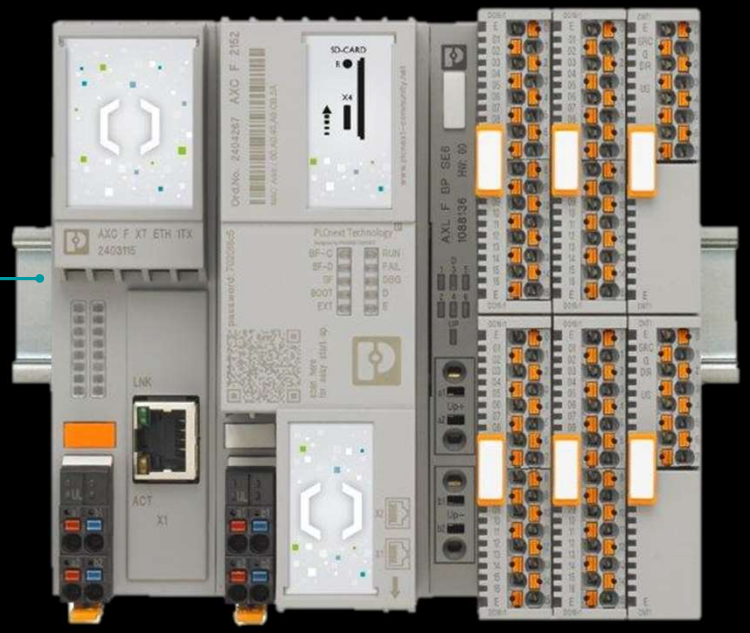
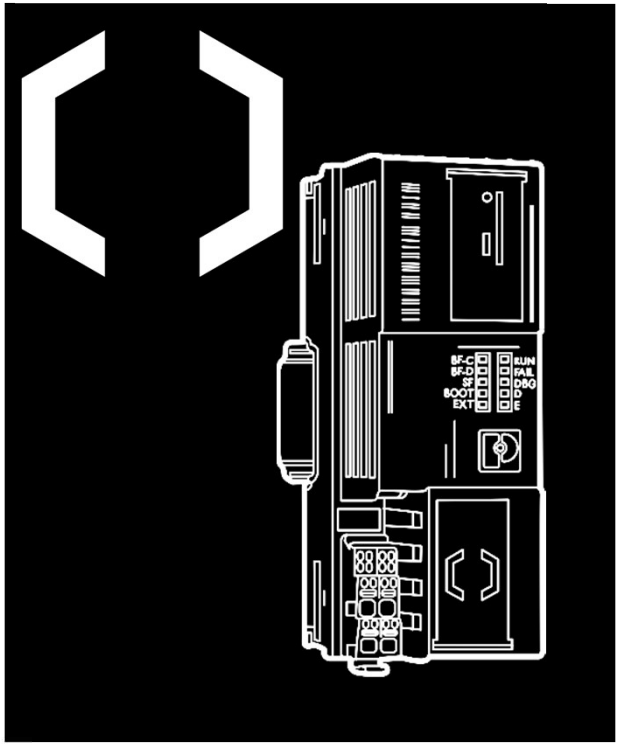
new

PLCnext Control Extension

Control functionality can be easily extended with left-handed modules





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PLCnext Ecosystem – PLCnext Control

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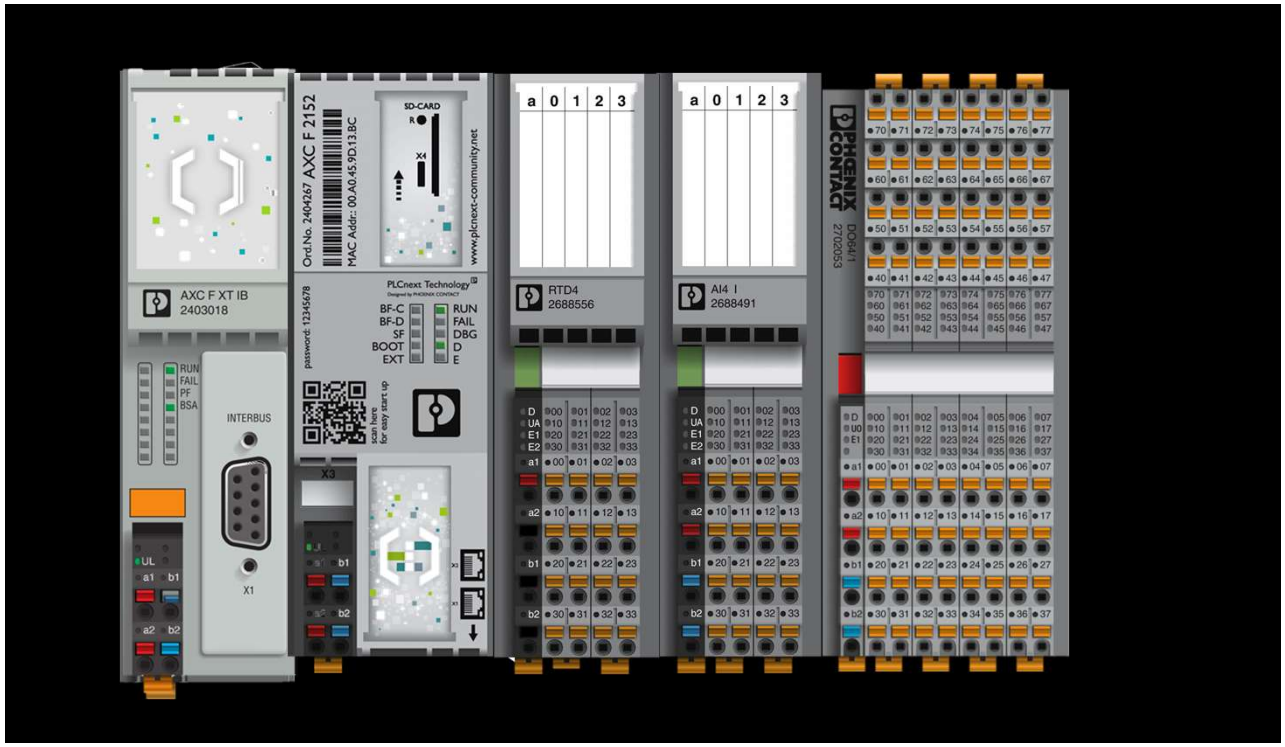
Left-hand side extension possibilities



- Modular expandability of the controller through left-sided expansion modules on the PCI express interface via a corresponding bus socket
- Unlimited expansion possibilities

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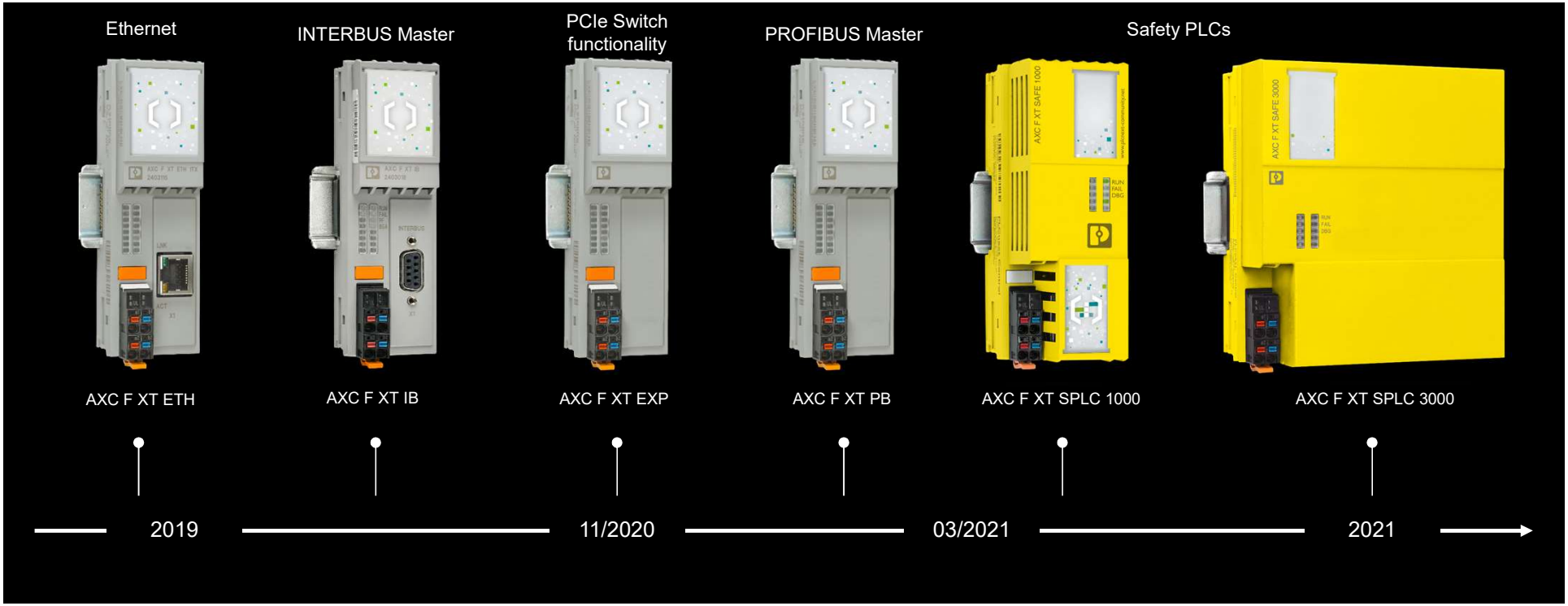
Portfolio PLCnext Control Extensions



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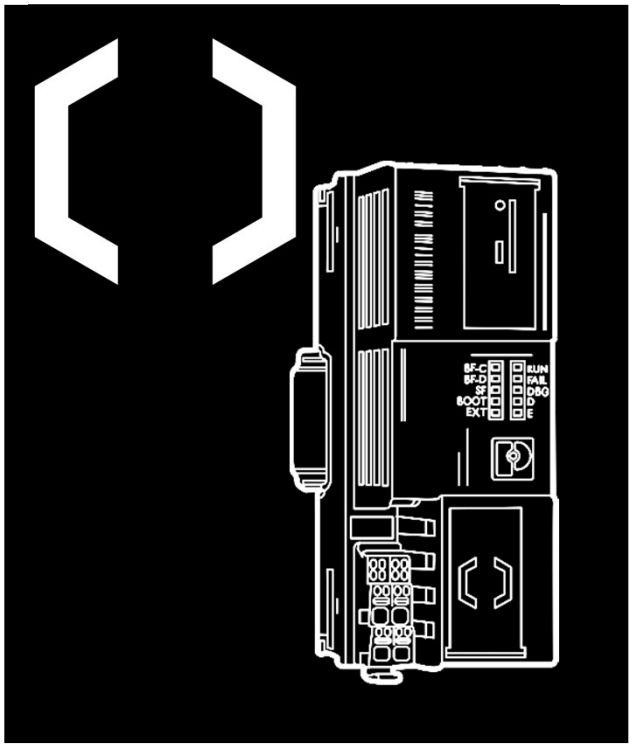
PLCnext Extension AXC F XT ETH

- Additional 1Gbit MAC interface
- Temperature range: -25°C up to 60°C
- Profinet Control capability
- Security due to separated interfaces
- Modularity and Flexibility
- Approvals
- UL (Hazloc), CUL
- DNV/GL, LR, BV, ABS, …
- IEC Ex, ATEX



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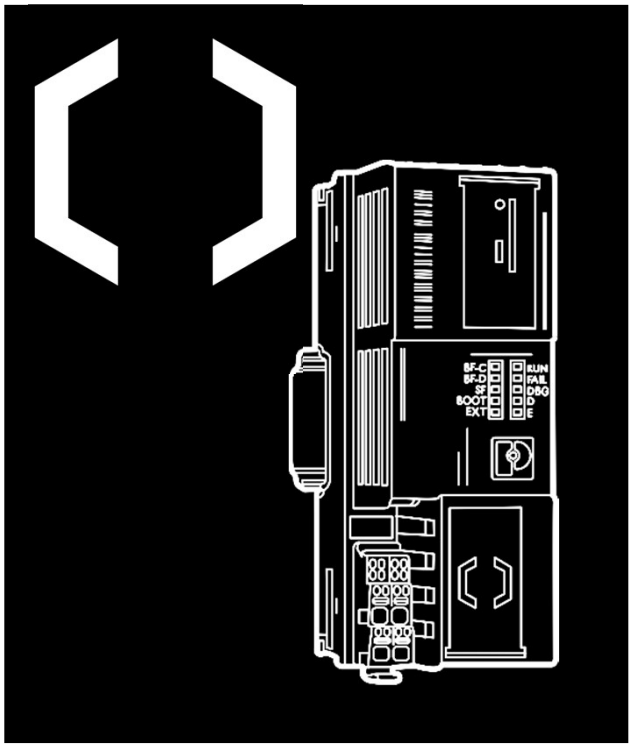
PLCnext Extension AXC F XT IB

- Additional INTERBUS Master
- Up to 512 Devices, up to 255 Remote Devices
- Up to 126 PCP Devices
- Up to 16 Remote Bus Level
- 4096 Bit Process data
- 500kBit und 2 Mbit
- Ideal for Retrofit applications
- Approvals
  - UL (Hazloc), CUL, IEC Ex, ATEX
  - DNV/GL, LR, BV, ABS, …
- Temperature range: -25°C up to 60°C



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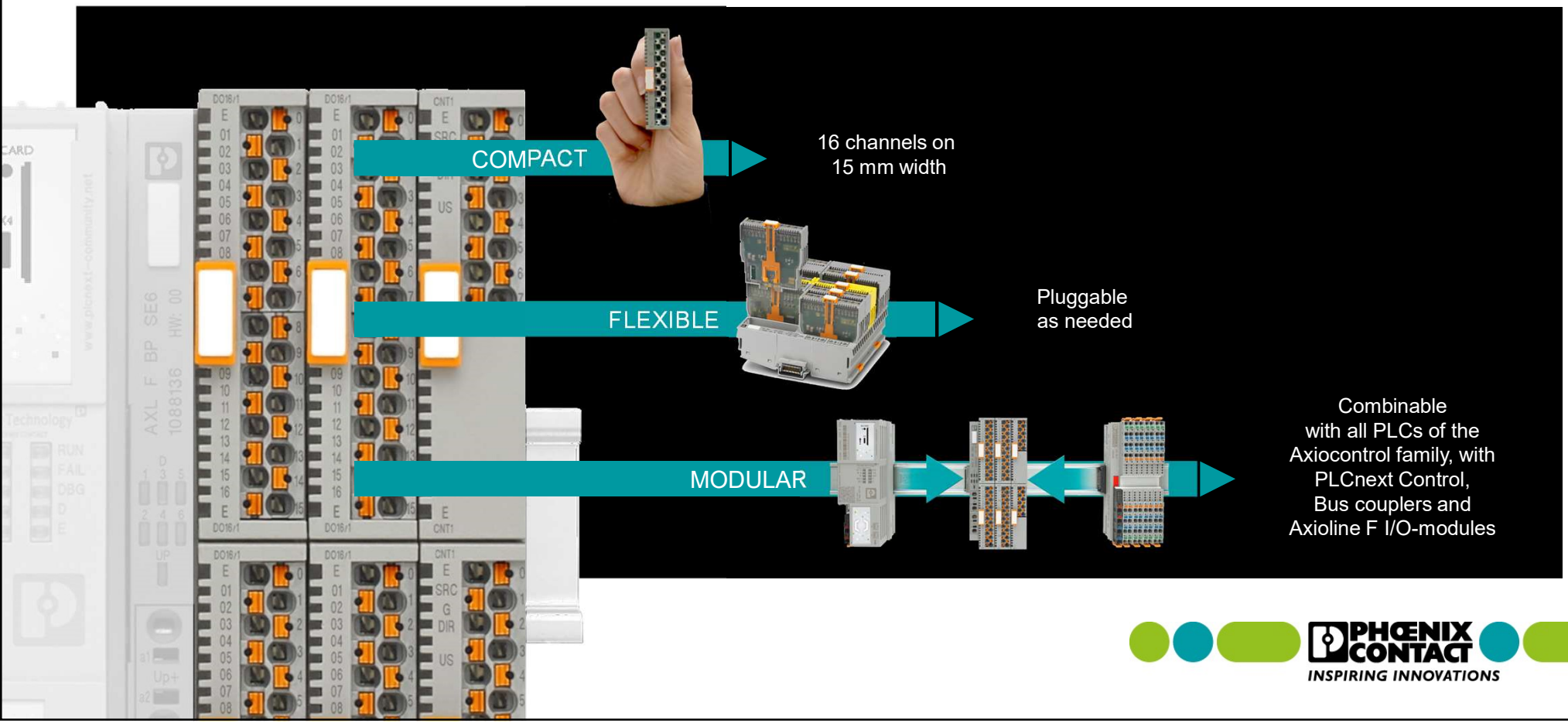
PLCnext Ecosystem – PLCnext Control - IO

Axioline Smart Elements



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Axioline Smart Elements

Automate smart and economically

Ready for automation

All necessary functionalities
incl. Safety and IO-Link

DI	SDI	AI	IO-Link	INC
DO	SDO	AO	RS485	CNT

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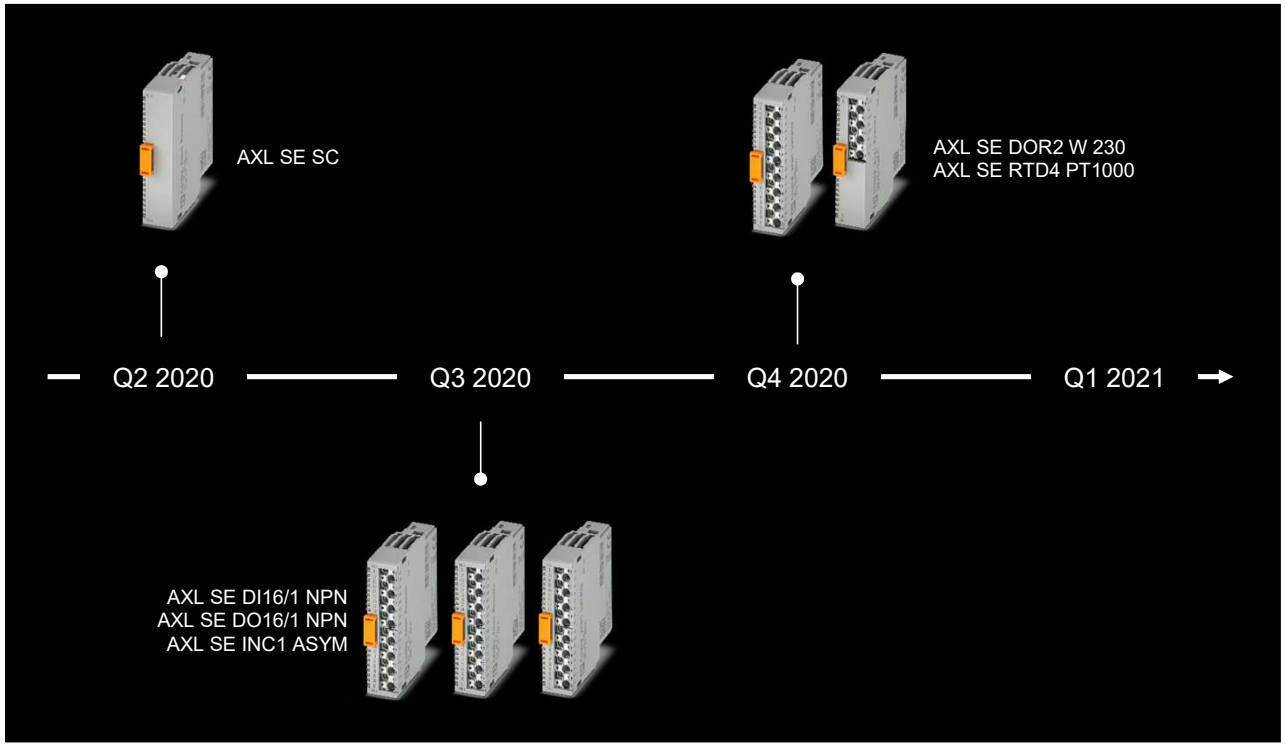
Axioline Smart Elements

More to come



Check regularly for latest information on new products and management updates.

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PLCnext & Axioline Smart Elements

Modular automation system

- Scalable automation system for simple to complex assignments
- Large selection of modules according to the modular system principle
- Optimal complement to PLCnext Control
- All components are part of the COMPLETE line system

PLCnext Technology
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COMPLETE line

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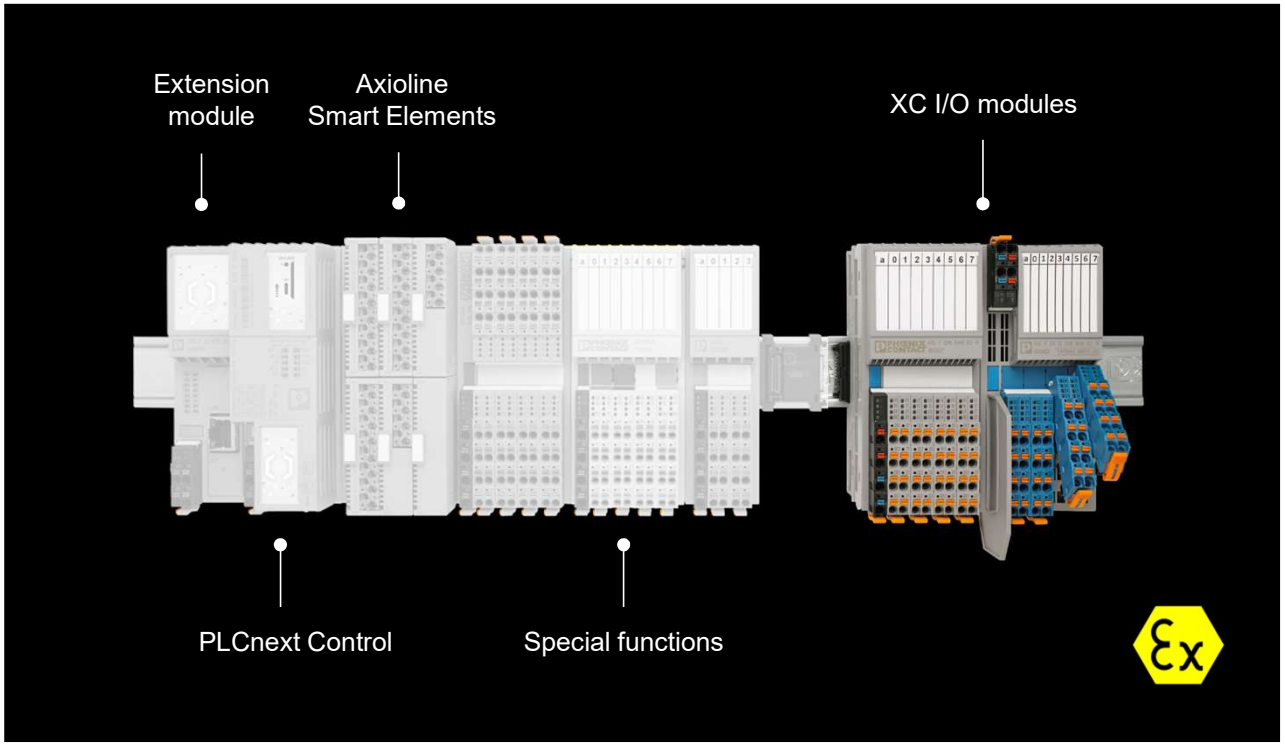
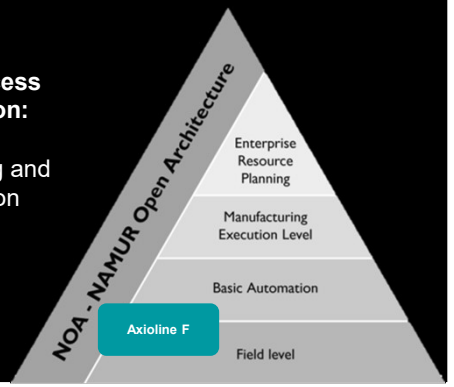
I/O solutions for process industry

Axioline F – Monitoring and Optimization



- Extreme condition temperature range
- IECEX/ATEX zone 2 certification
- Intrinsically safe
- HART communication
- NAMUR functionality

Side process automation:
Focus on monitoring and optimization



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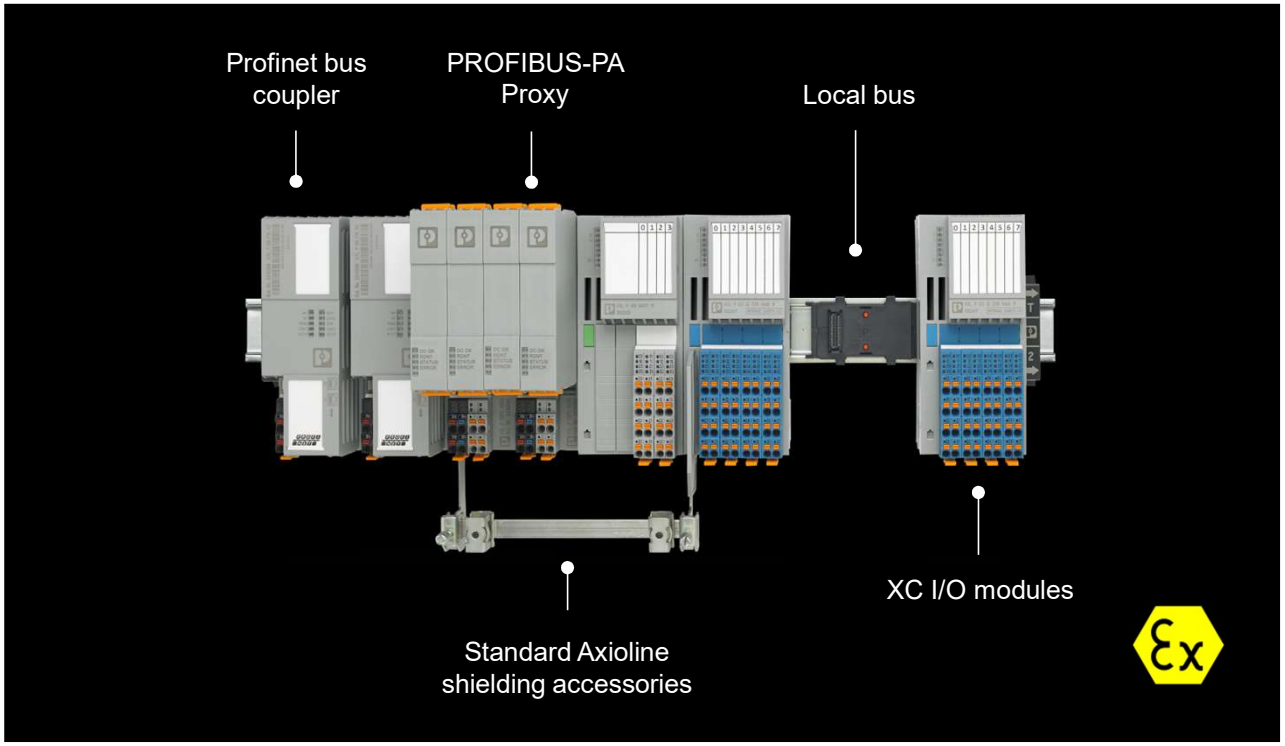
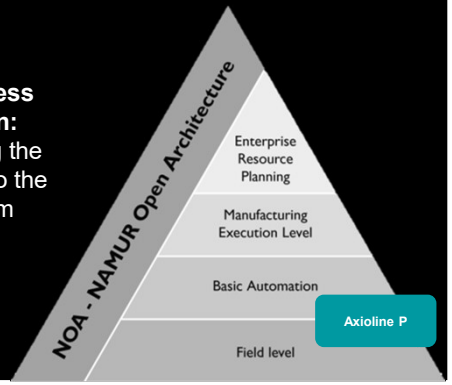
I/O solutions for process industry

Axioline P – high availability with hot-swap



- PROFINET S2 redundancy
- Hot-swap
- Installation in zone 2
- Connection to zone 0/1
- HART communication
- NAMUR functionality

Core process automation: Connecting the field level to the control room



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Overview – Axioline IP20 I/O systems

Axioline Smart Elements

- Flexible, modular and space saving I/O concept
- Machine building
- Field-level communication IO-Link

Axioline F XC

- Wide temperature range, process-relevant approvals
- Hybrid applications, process applications
- Field-level communication HART COMMUNICATION PROTOCOL

General requirements
Factory automation

Specific requirements
Process industry

Axioline F

- Robust and fast I/O solution, wide I/O portfolio
- Ship building, energy applications
- Field-level communication IO-Link

Axioline P

- Hot swap, PROFINET redundancy
- Process applications
- Field-level communication HART COMMUNICATION PROTOCOL

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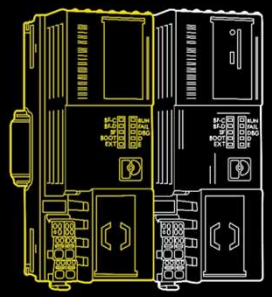
PLCnext Technology
Designed by PHOENIX CONTACT
Functional Safety Integration

The open ecosystem for limitless automation

Safety

with PLCnext Control



PLCnext Control

Discover flexible automation

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PLCnext Control Extension SPLC 1000

PLCnext Extension AXC F XT SPLC 1000

Core	# of Profisafe devices	Temperature
2 x Cortex M4	32	-25°C - 60°C

Width	Approvals	C Functions
45mm	UL, CUL, etc	Reloadable

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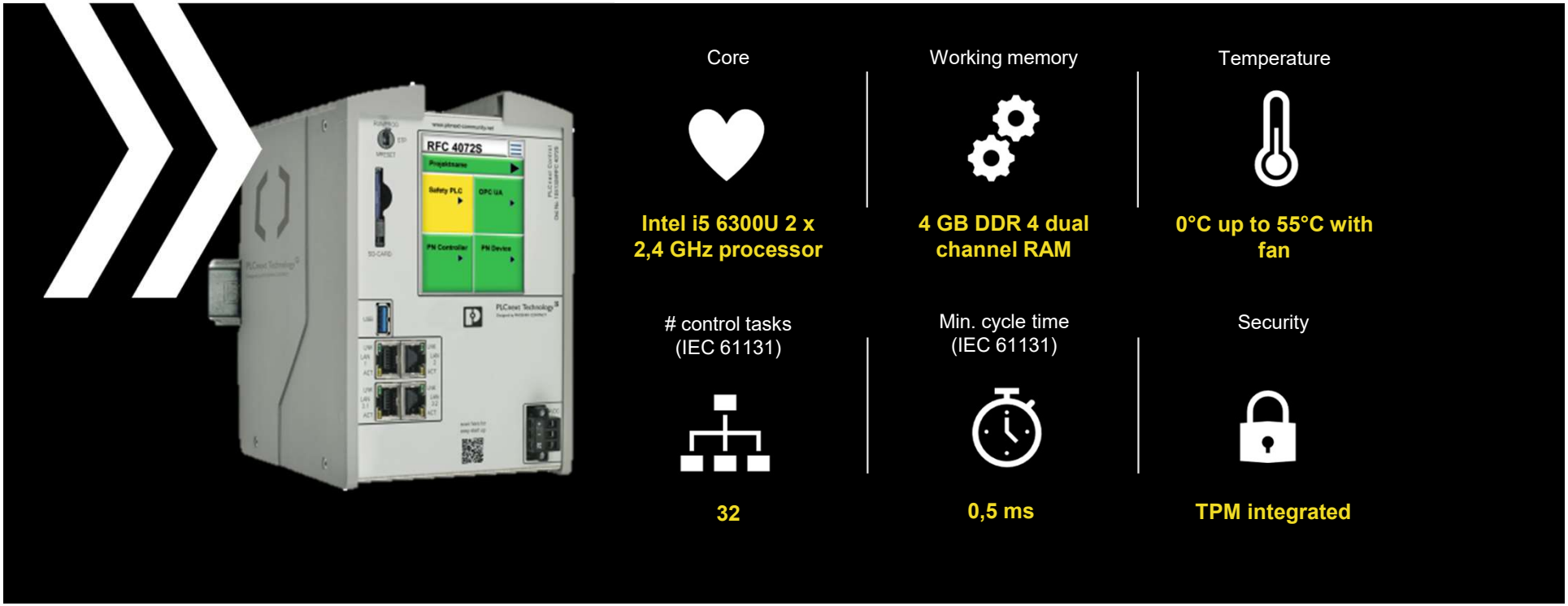
PLCnext Control RFC 4072S



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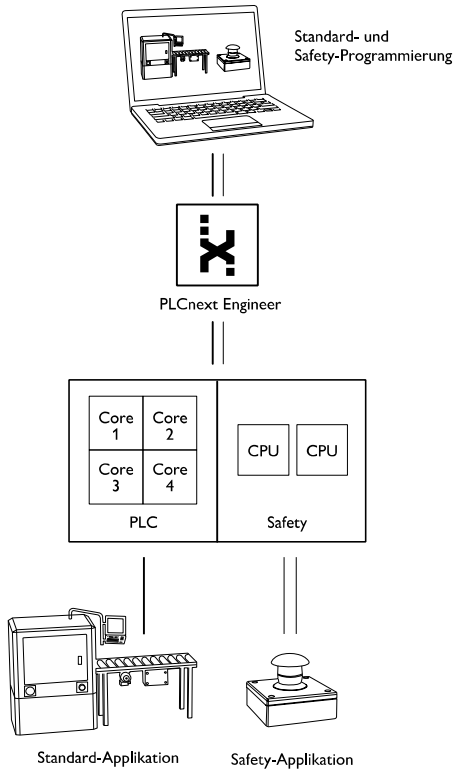
Functional Safety Integration



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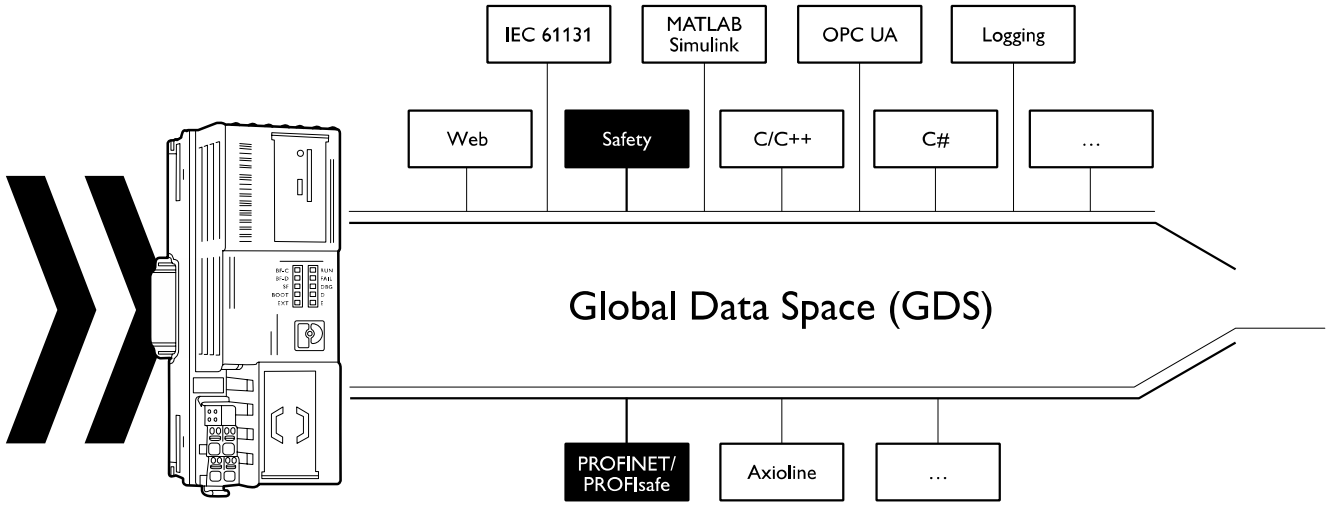
Safety integrated

PROFIsafe



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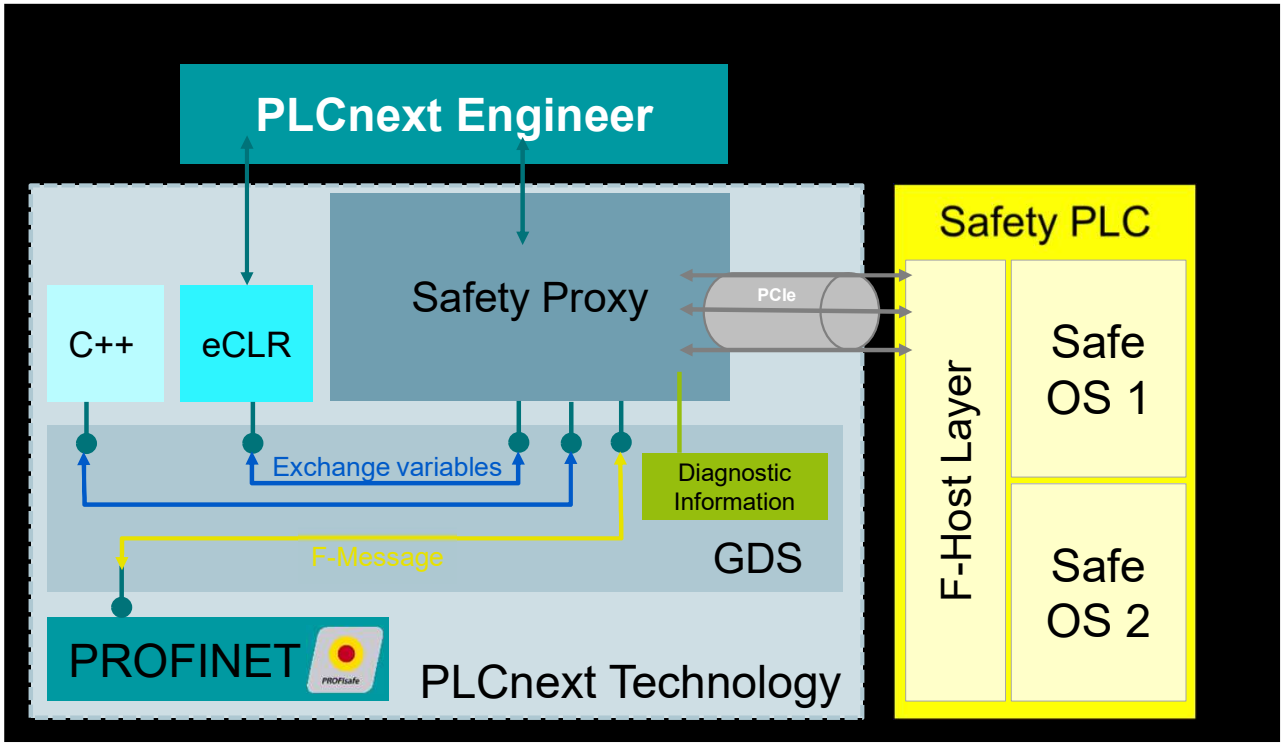
Safety integrated



- Safety integrated (programming, hardware configuration)
- Consistent usability
- SIL 3
- Separate Safety PLC
  - 2 different cores

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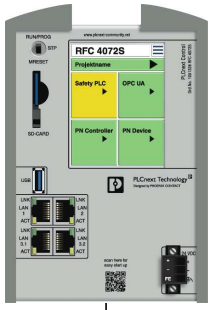
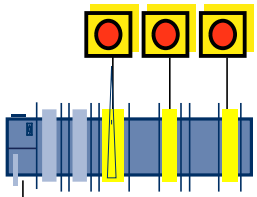
RFC 4072S
(F-Host)



Emergency Stop

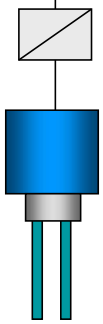


Safety I/Os

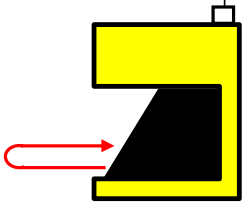
Standard I/Os

Standard and safety devices in common ethernet network

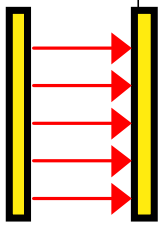
DP/PA



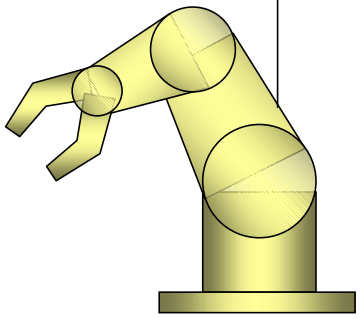
Limit switch



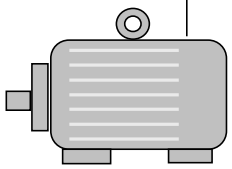
Sick
Safety
Scanner



Light curtain



Kuka Robot



E Motors

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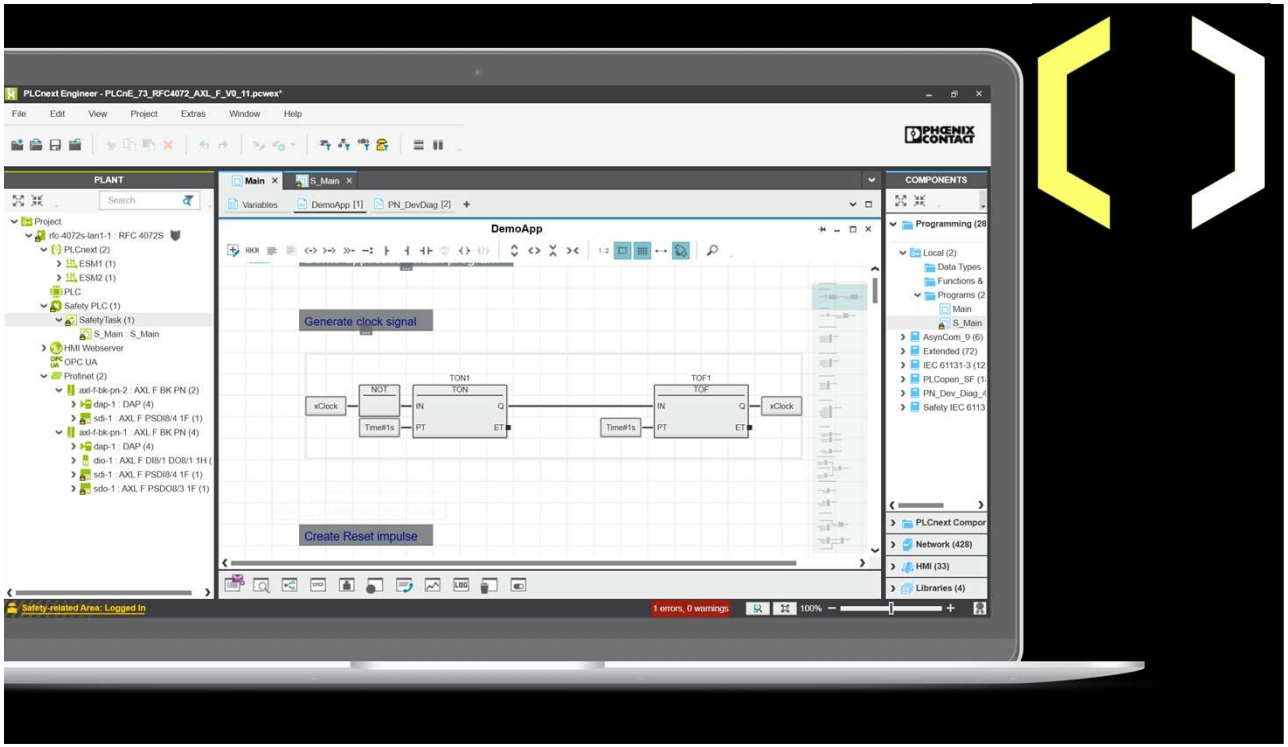
Standard and safety programming in one engineering software

PLCnext Engineer



Fully integrated Safety programming

- TÜV Rheinland certified according to IEC 61508
- Editor with common behavior as known from standard FBD or LD editors
- Low Variability Language support
- Networkt granular CRC checksums
- PROFIsafe Support

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Standard and safety programming in one engineering software

PLCnext Engineer

Fully integrated Safety programming

- Individual safety functions can be protected by a verification function
- Background signal path analysis
- Background safe semantic analysis
- Diversely-redundant code generator

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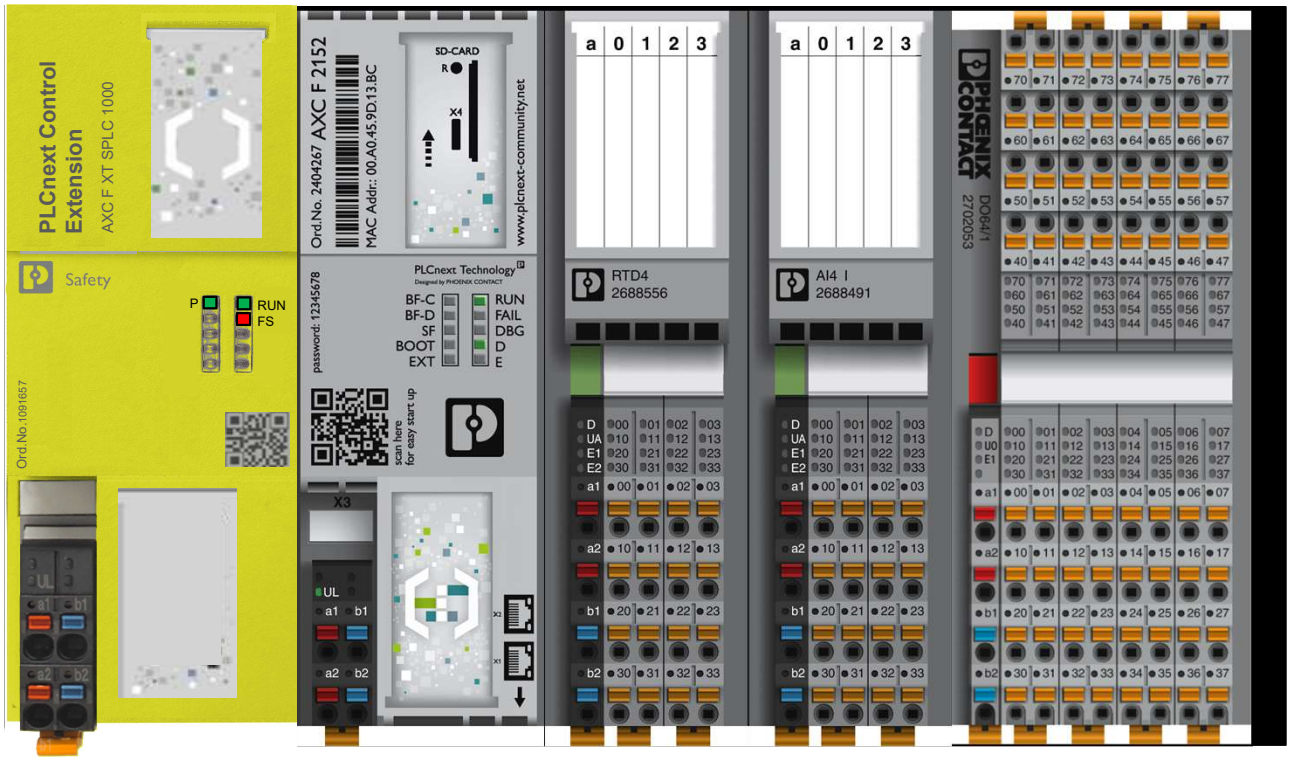
AXC F XT SPLC 1000 – Low-Scale Modular Safe PLC



- Decentralized Small Safe PLC
- Left-hand side connectable to PLCnext Controls
- Supported Safety Protocols:
  - PROFIsafe V2.61 (32 instances)
- Connectable to higher-layer SPLC
  - as F-Device
  - via new OPC UA Safety Protocol

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PLCnext Safety / SafetyBridge Categorization

PLCnext Technology
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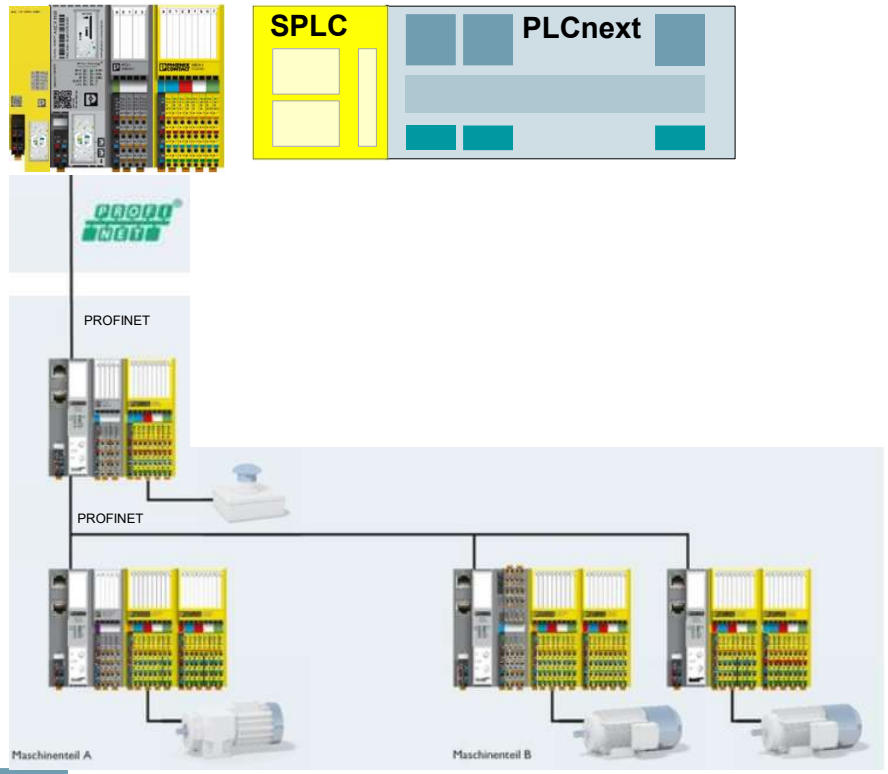
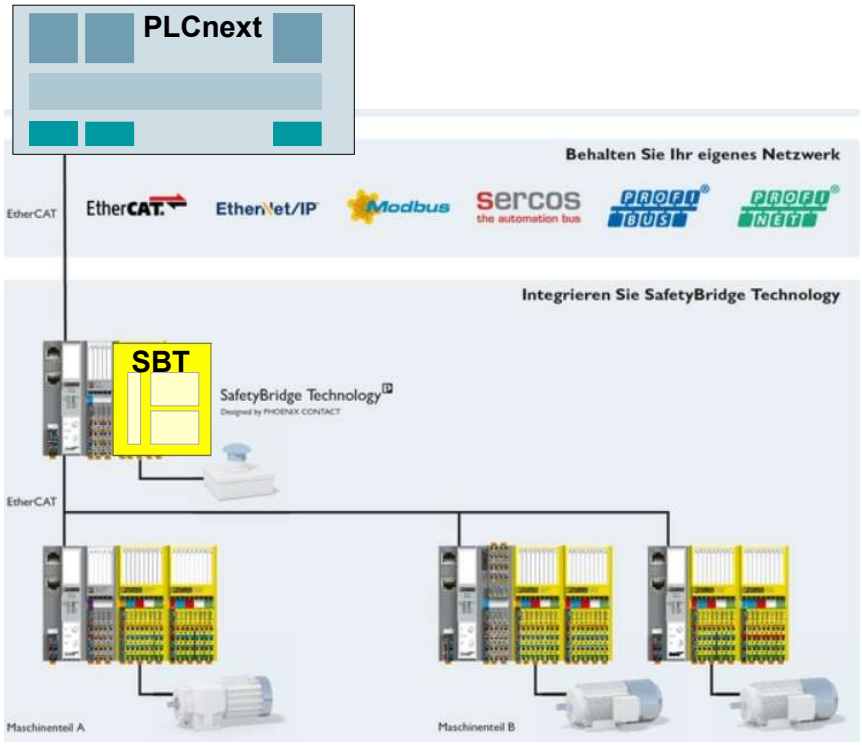
PLCnext Safety



SafetyBridge Technology



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PLCnext Technology
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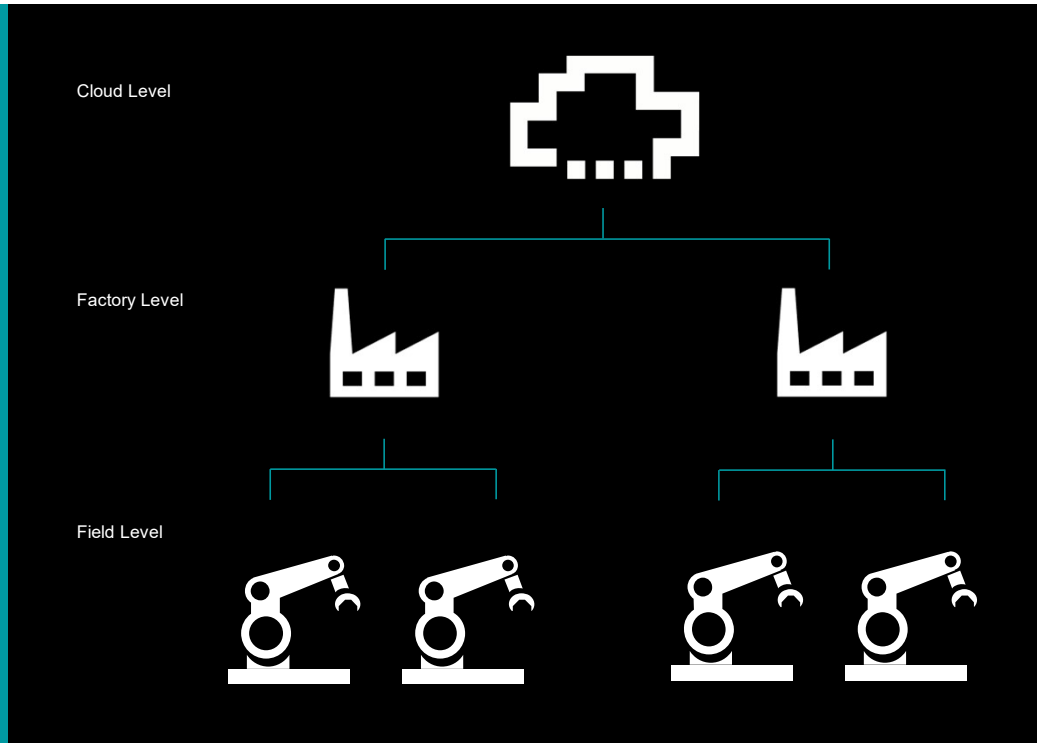
PLCnext Control for
Edge Computing

PLCnext Ecosystem – PLCnext Control

Edge Computing

- Cloud computing has revolutionized how people store and use their data, but…
- Latency, bandwidth, security or a lack of offline access can be problematic
- To solve this problem, users need robust, secure and intelligent on-premise infrastructure for edge computing
- When data is physically located closer to the user who connect to it, information can be shared quickly, securely and without latency



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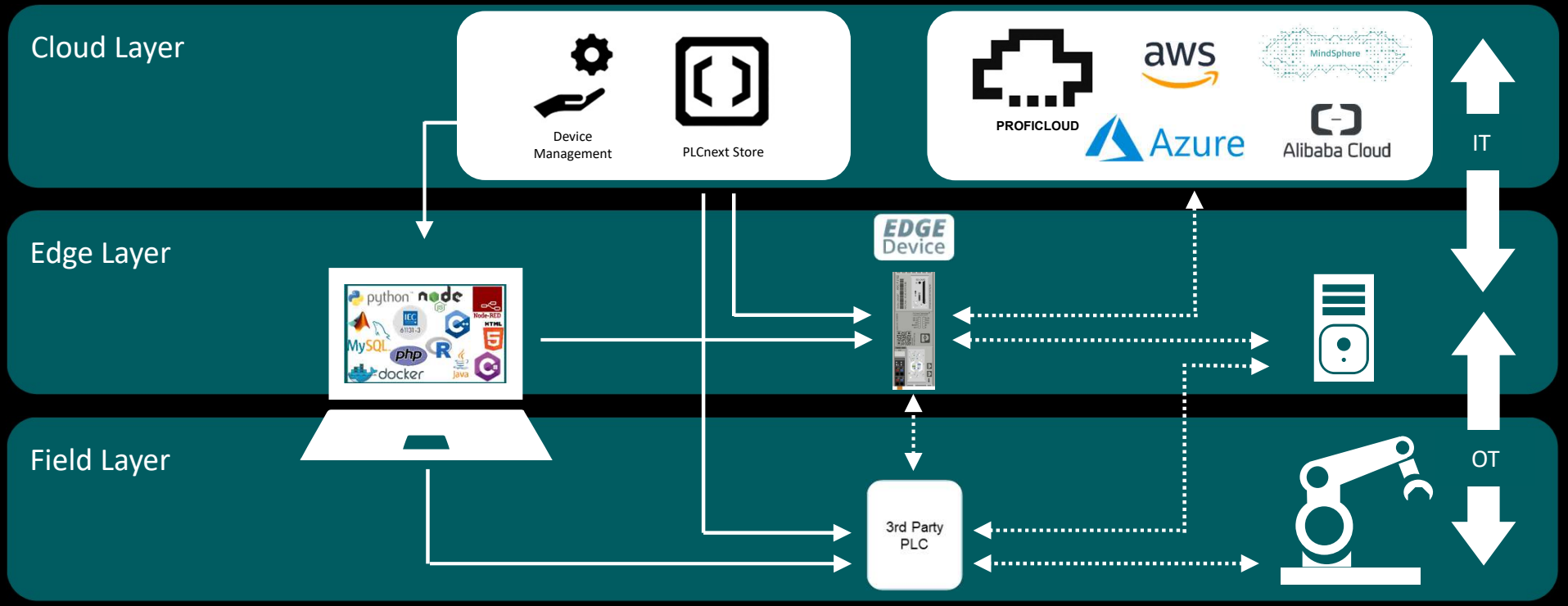
PLCnext Control for Edge Computing



Application Example

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PLCnext Technology
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Security by design
acc. to IEC 62443

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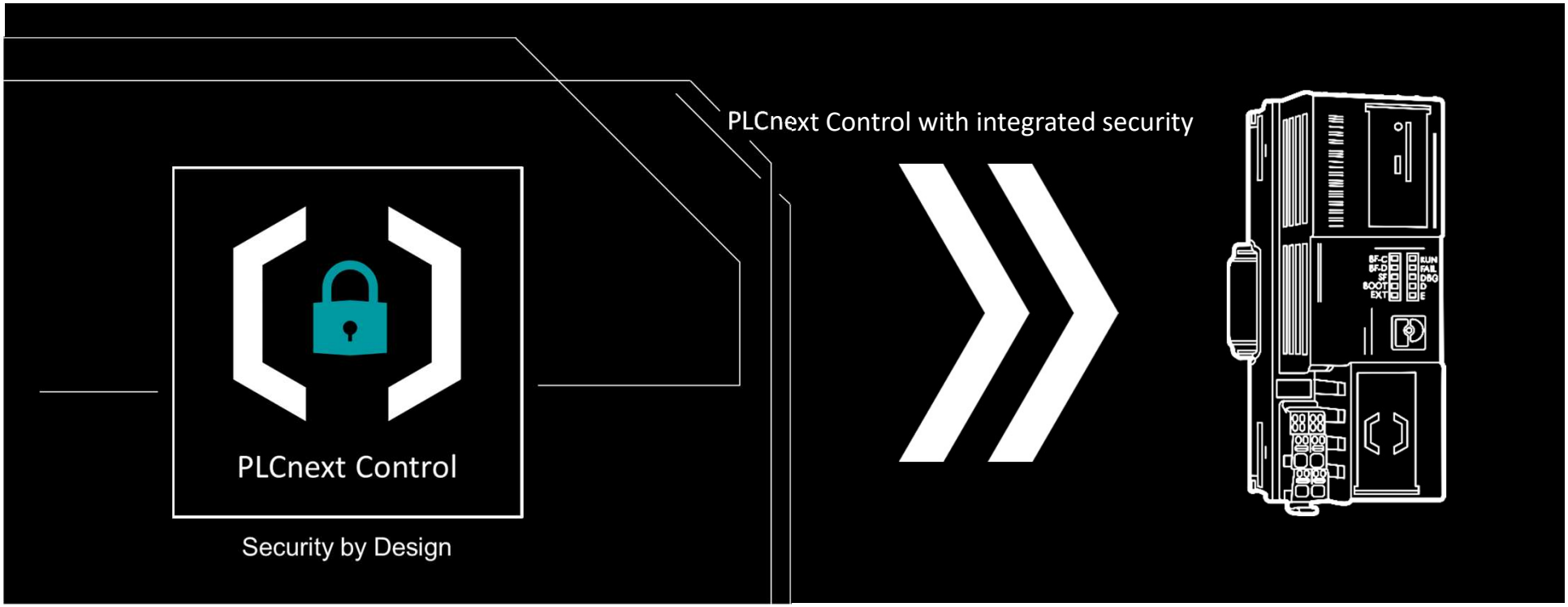
PLCnext Ecosystem – PLCnext Control

PLCnext Control according to the standard IEC 62443



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Effects of Security Incidents on Production Facilities

Plant downtime

Due to security problems, production has to be stopped for hours or days. What are the costs of such a production downtime?

Loss of know-how

A competitor can access your sensitive data (design, engineering,…). Can you quantify the damage economically?

Data loss

Suddenly all data is lost. What would be the cost of reconstructing this data?

Standing

What happens if your reputation for the reliability and security of your company's data is compromised by your partners?

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Applicable Security Laws and Standards

Brief Overview of the Most Important Laws & Standards

Security Laws (What must be done?)

Bundesministerium des Innern

Version 2.0 in preparation

IT Security Act (2015)

Asset owner of critical infrastructures must establish and certificate an **ISMS** (**I**nformation **S**ecurity **M**anagement **S**ystem) as well as fulfill a set of minimum technical requirements

EU Cybersecurity Act (3/2019)

A comprehensive set of regulations, technical requirements, standards and procedures for certification or conformity assessment of products

Recommendations (What should be done?)

Bundesamt für Sicherheit in der Informationstechnik

BSI IT Basic Protection Catalogs
(asset owner / device manufacturer)

Basic Security Standards (How to implement?)

IEC

IEC 62443 Security for industrial automation
(asset owner / device manufacturer)

ISO

ISO/IEC 2700X Information Technology
(asset owner)

Applicable Security Laws and Standards

Sector-specific Security Standards

Standard	Target Group	Main Purpose	Geographical / Industry Focus	Certification possible?
BDEW	Device manufacturers / system integrators	Security requirements for suppliers	D, A, CH Energy & water sectors	No
WIB	Device manufacturers / system integrators	Device manufacturer certification	Oil & Gas sector	Yes
ISO/IEC 27019	Asset owners / plant operators	IT security for control systems	Energy sector	Yes
NIST 800-82	Asset owners / plant operators	Technical security recommendations	USA	No
NERC CIP	Asset owners / plant operators	Increasing reliability of energy supply infrastructure	USA, Canada	Yes
IEC 62443	Device manufacturers / system integrators / plant operators	Requirements for secure products, secure solutions, and secure operation	General industry sector	Yes

Applicable Security Laws and Standards

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IEC 62443: IT-Security for Industrial Automation Control Systems

Authentication
- User accounts
- Authentication of credentials
- Authorization

Integrity
- Principle of least privilege
- Defense in depth
- Network segmentation

PLCnext Control

Security by Design

Confidentiality
- Use of secure protocols
- Secure remote maintenance
- Cryptography
- Protection of expertise

Availability
- Monitoring and attack detection
- Tamper protection

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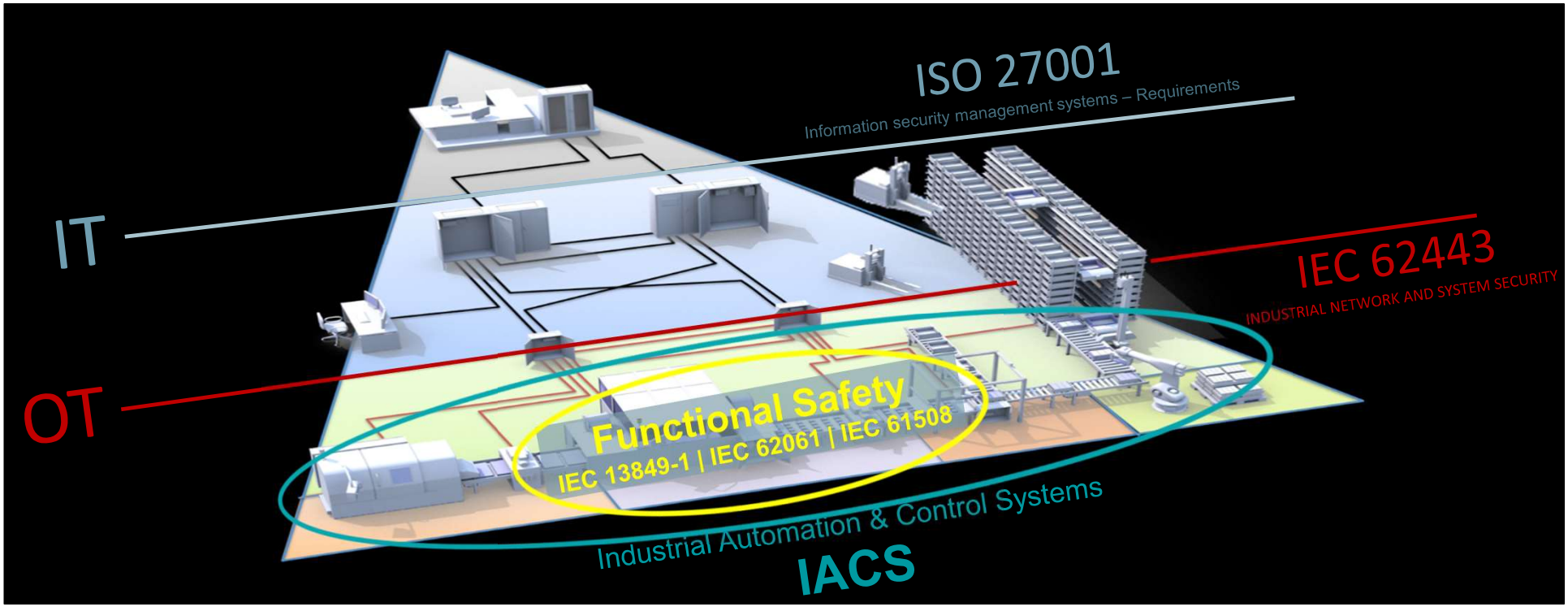
Terminology, Roles, and Tasks in Security Processes

The “Automation Pyramid”

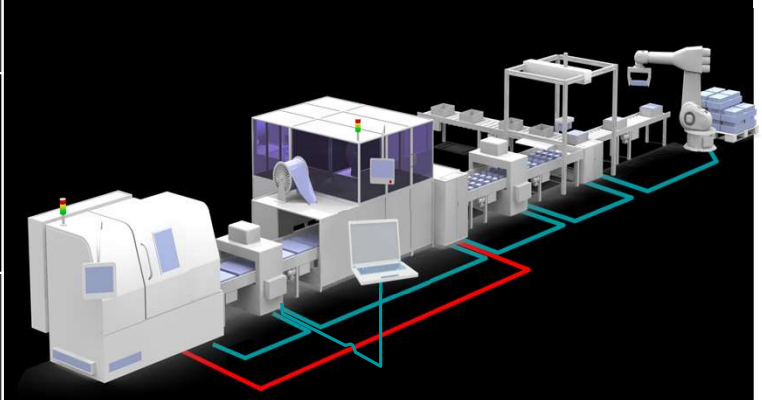


Terminology, Roles, and Tasks in Security Processes

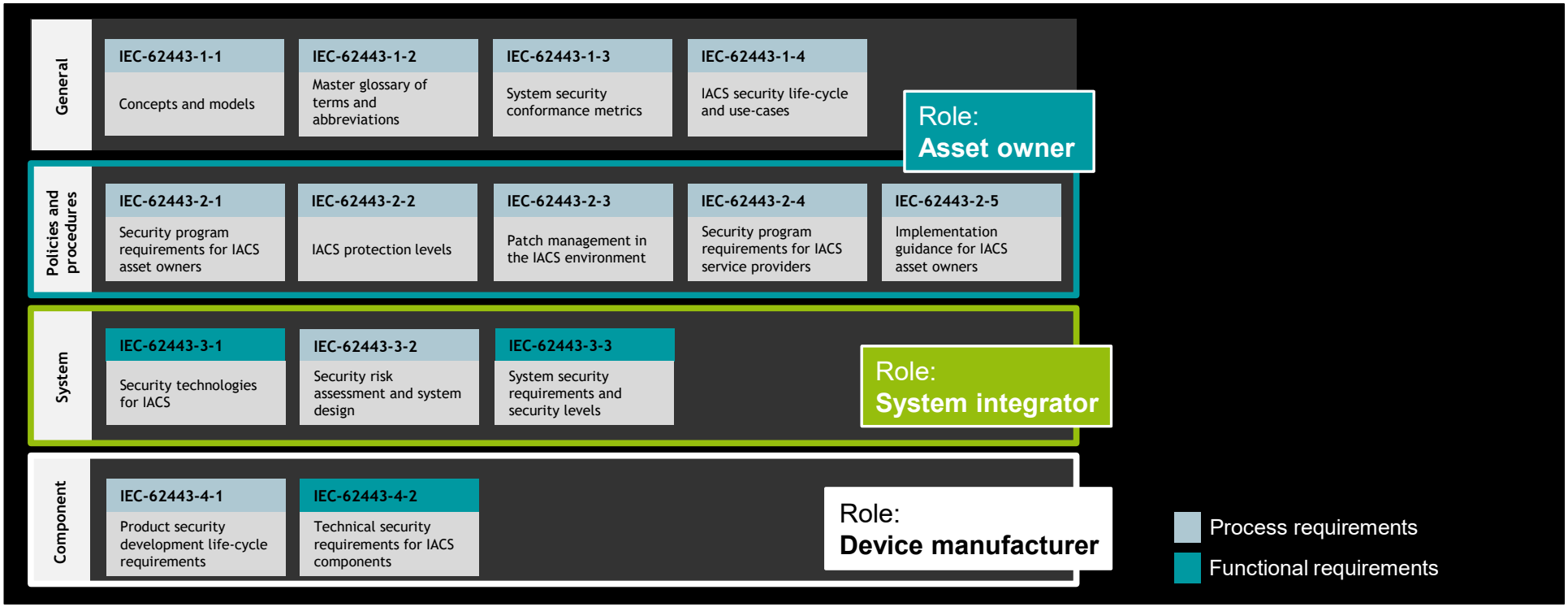
Basic Roles & Purposes of the IEC 62443 Standard

Role	Focus	Interest
Asset owner / plant operator	Operation & maintenance of automation solutions	Secure operation
System integrator / Machine builder	Design & commissioning of automation solutions	Secure solution
Device manufacturer	Design & management of components for automation solutions	Secure devices

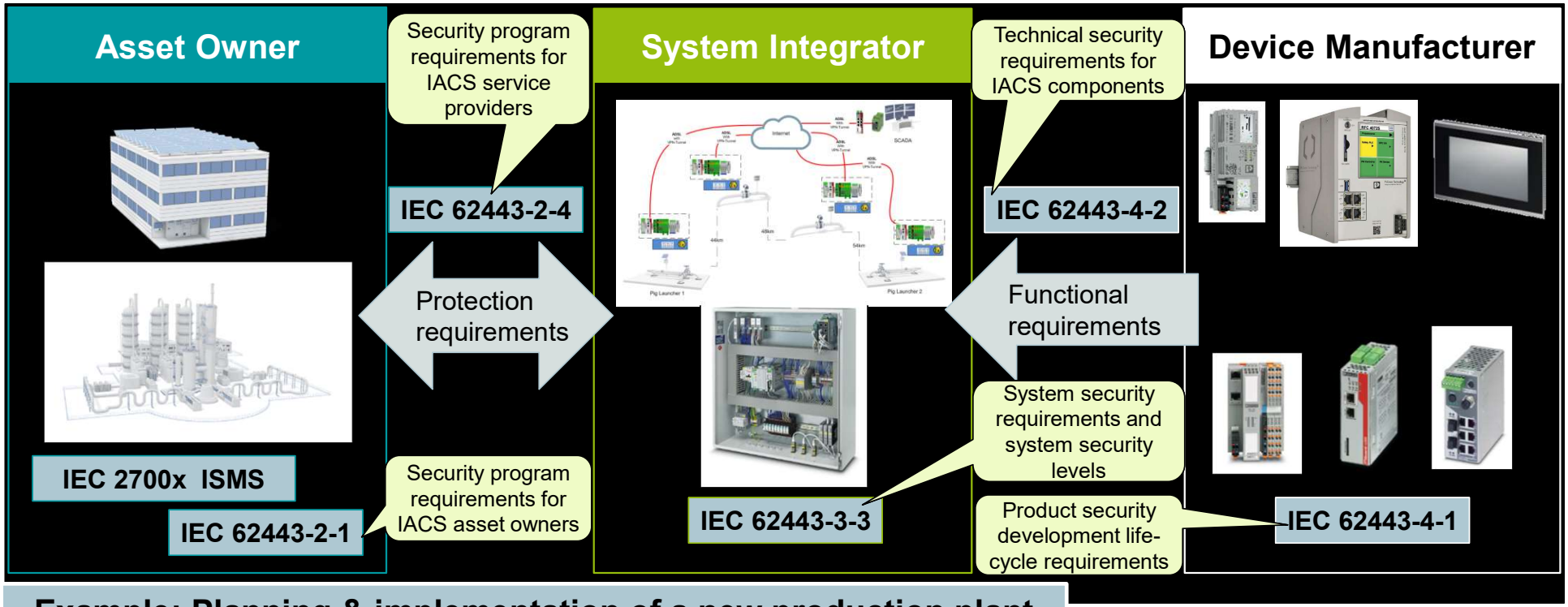
Companies can check their automation technology for potential weaknesses and develop protective measures



IEC 62443 Structure and Systematics



Role Distribution in a Value-added Chain according to IEC 62443



Example: Planning & implementation of a new production plant

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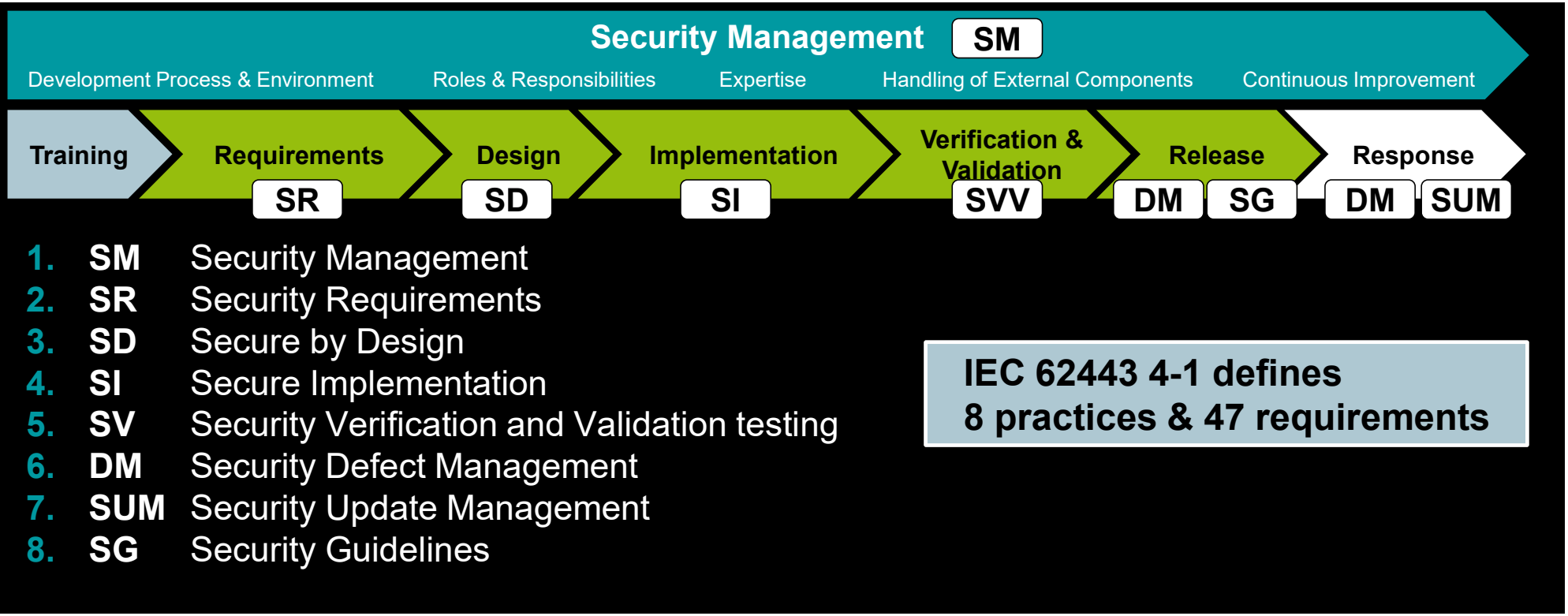
IEC 62443-4-1: Product Development & Lifecycle



1. **SM** Security Management
2. **SR** Security Requirements
3. **SD** Secure by Design
4. **SI** Secure Implementation
5. **SV** Security Verification and Validation testing
6. **DM** Security Defect Management
7. **SUM** Security Update Management
8. **SG** Security Guidelines

IEC 62443 4-1 defines
8 practices & 47 requirements

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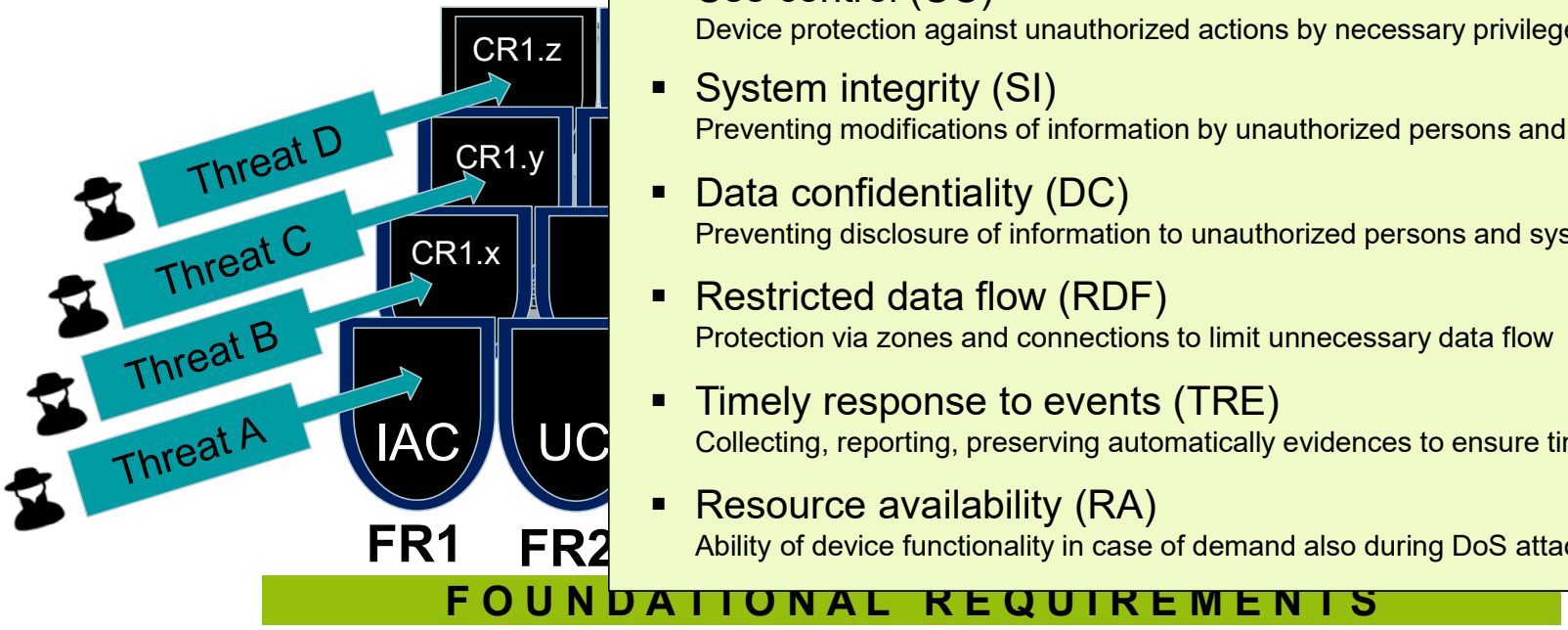
Secure Product Development

IEC 62443-4-2: Functi



Foundational Requirements

- Identification and authentication control (IAC)
  Device protection by verifying the identity of any user before enabling communication
- Use control (UC)
  Device protection against unauthorized actions by necessary privileges before performing
- System integrity (SI)
  Preventing modifications of information by unauthorized persons and systems
- Data confidentiality (DC)
  Preventing disclosure of information to unauthorized persons and systems
- Restricted data flow (RDF)
  Protection via zones and connections to limit unnecessary data flow
- Timely response to events (TRE)
  Collecting, reporting, preserving automatically evidences to ensure timely corrective actions
- Resource availability (RA)
  Ability of device functionality in case of demand also during DoS attacks

FR: Foundational Requirements
CR: Component Requirements **w, x, y, z** => acc. to SL feature table in **IEC 62443 4-2 Appendix B**

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IEC 62443-3-3: Security Level Def

Functional requirements				
Attacker capabilities				
Security Level	**Means**	**Resources**		
SL - 0	no protection requirements			
SL - 1	casual or coincidental manipulatio			
SL - 2	simple	low		
SL - 3	sophisticated	moderate	IACS specific	moderate
SL - 4	sophisticated	extended	IACS specific	high

Protection against the abilities of…

SL-1
…any Internet user

SL-2
… interested individuals and companies with generic security knowledge

SL-3
… experts and companies that develop and deploy effective, yet cost-oriented attack scenarios with clear goals

SL-4
… governmental organizations which focus on achieving the specifically selected target at almost any price

IEC 62443-3-3: Security Level Definitions

CRs und REs	SL-1	SL-2	SL-3	SL-4
CR 1.1 Human user identification and authentication	✓	✓	✓	✓
RE (1) Unique identification and authentication		✓	✓	✓
RE (2) Multifactor authentication for all interfaces			✓	✓
CR 1.2 Software process and device identification and authentication	✓	✓	✓	✓
RE (1) Unique identification and authentication			✓	✓

CR: Component Requirements

RE: Requirement Enhancements

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PLCnext Technology Security Basic Design

- Configurable Linux using Yocto build system
- OS components: Bootloader, Syslog-ng, SSH, Open SSL, Firewall nf-tables, Role Based Access Control (RBAC), Preemptive Real-time Patch (OSADL), …..
- Hardware design with TPM to store manufacturers roots of trust
- Communication: HTTPS, VPN, NTP/SNTP, OPC UA, …..
- Overlay File system with capabilities and supporting of SD Cards
- Security Patches supported via second Partition with rollback capability

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PLCnext Technology
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PLCnext Technology Security Basic Design

- Roots of trust via TPM usage; processes during production and delivery
- Certificate management via trust store for manufacturer, system integrator and asset owner
- NGINX web server supporting HTTPS
- Web Based Management as central entry point for configuration
- Firewall with management of different levels for chains and rules
- VPN configuration supports IPSec and OpenVPN
- TLS 1.2 secured communication
- User Manager supporting roles, permissions and credentials

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PLCnext Technology
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Security Features PLCnext 2021.0 LTS summary

Security by Design

- Security Architecture: Configurable Linux based on Yocto Build System
- Hardware design with: TPM -> IEEE 802.1 AR (Secure Device Identity)
- Network segmentation for Zones and Conduits management AXC F XT ETH 1TX Extensio module integrated in the firewall
- Integrity check during boot process
- Secure Communication: TLS, SFTP, VPN, HTTPS, …..
- User Management with enhanced complexity rules and central AD (LDAP)
- Linux nftables Firewall with netload limiter
- VPN IPSec IKEv1/2 Strongswan and Open VPN file configuration
- SYSLOG for security message management and central storage on server
- OPC UA security signed & encrypted with certificate management via GDS
- SD card activation / deactivation / (encryption 2021.3)
- Device and Patch Management (OPC UA 2021.6)

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Secure Product Development

Product Security Incident Response Team

PSIRT – Public Website

PLCnext Technology Security by Design

PLCnext Technology
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Phoenix Contact 360 Grad Security concept

- Secure Development processes according IEC 62443-4-1
- Security certified products according IEC 62443-4-2
- Security certified Services according IEC 62443-2-4
- Blueprints and customer specific solutions certified according IEC 62443-3-3
- Product Security Incident Response Team
  Market Vulnerabilities scans and publishing updates and advisories

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Security nach IEC 62443

Cyber Security

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD Product Service

CERTIFICATE

No. Q4B 029429 0008 Rev. 00

Holder of Certificate: PHOENIX CONTACT GmbH & Co. KG
Flachsmarktstr. 8
32825 Blomberg
GERMANY

Certification Mark:

Scope of Certificate: ICS Security Service Provider

The Certification Body of TÜV SÜD Product Service GmbH certifies that the company mentioned above has established and is maintaining a management system which meets the requirements of the listed standards. The results are documented in a report. See also notes overleaf.

Report No.: 19CR11S007

Valid until: 2022-03-17

Date, 2019-03-18

Andreas Bärwolff

Page 1 of 2
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TÜV®

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Security nach IEC 62443

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PHOENIX CONTACT
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Security Certifications

Certifications according to IEC 62443

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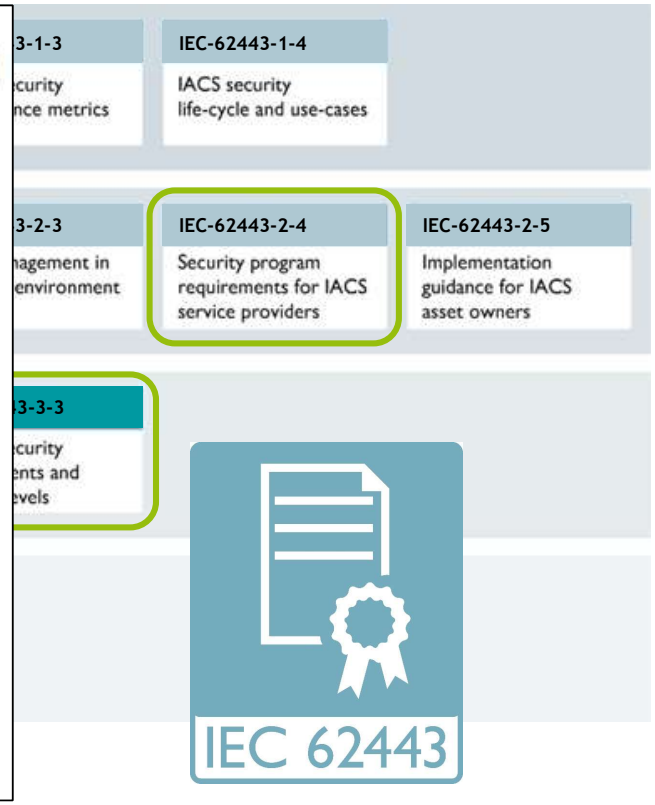
Date, 2019-03-18 (Andreas Bärwald)



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32825 Blomberg
GERMANY

Factory(ies): PHOENIX CONTACT Electronics GmbH
Industry Management and Automation
Business Unit Control Systems
Dringenauer Strasse 30, 31812 Bad Pyrmont, GERMANY

PHOENIX CONTACT Software GmbH
Langenbruch 6, 32657 Lemgo, GERMANY

Certification Mark:

Scope of Certificate: Secure Product Development Lifecycle

Applied Standard(s): IEC 62443-4-1:2018
PPP 15002A:2018 *(IEC 62443-4-1 Full Process Profile)*

The Certification Body of TÜV SÜD Product Service GmbH certifies that the company mentioned above has established and is maintaining a management system which meets the requirements of the listed standards. The results are documented in a report. See also notes overleaf.

Report No.: 18CR01S007

Valid until: 2021-07-29

Date, 2018-08-01 (Andreas Bärwald)

Page 1 of 1
TÜV SÜD Product Service GmbH · Certification Body · Ridlerstraße 65 · 80339 Munich · Germany

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IEC 62443-2-4 – ICS-Security Service Provider Certificate

As an ICS service provider we are offering

- Security services
- Design and commissioning of an automation system for acceptance as system integrator

ICS = Industrial Control System

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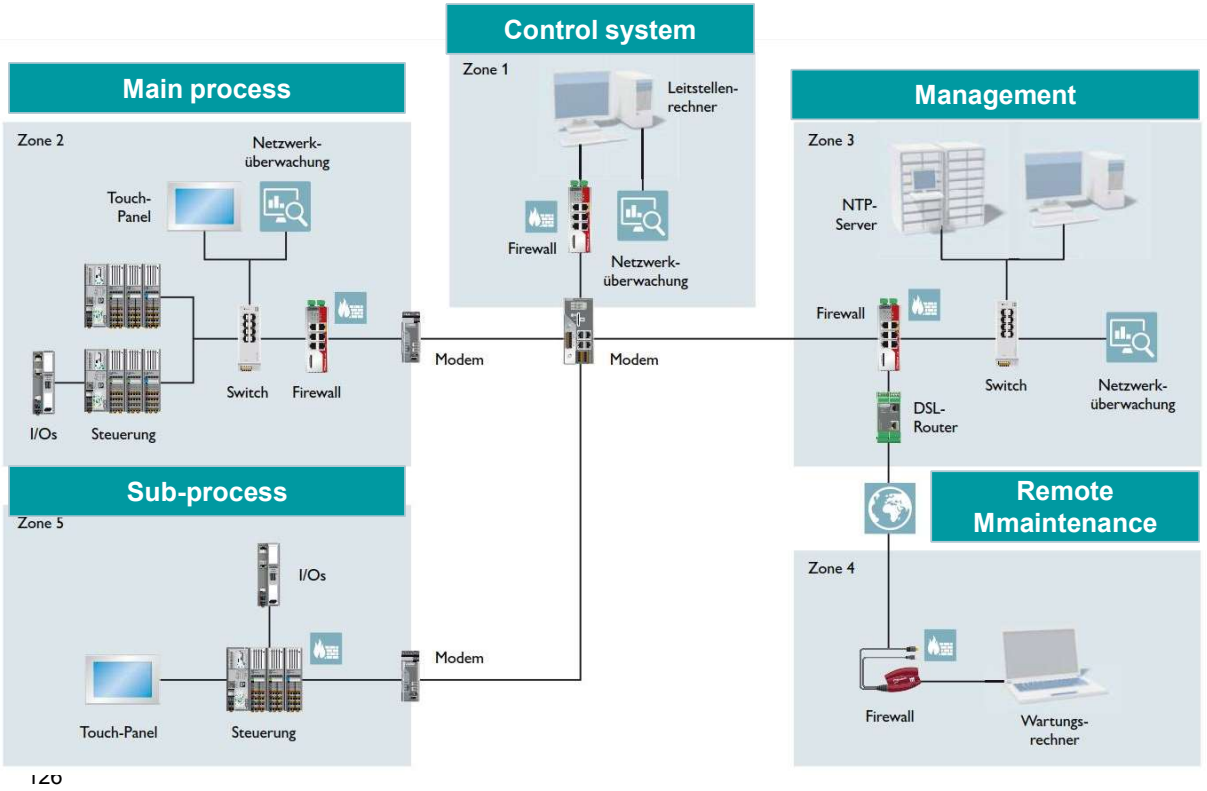
Security Context: Security Blueprint Certification



Security Context:

- describes the environment
- describes the operating conditions
- defines the data criticality
- defines the zones and communication relationships
- assumptions the environment must fulfill.
- threat evaluation and priorities

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Ecosystem & PLCnext Store

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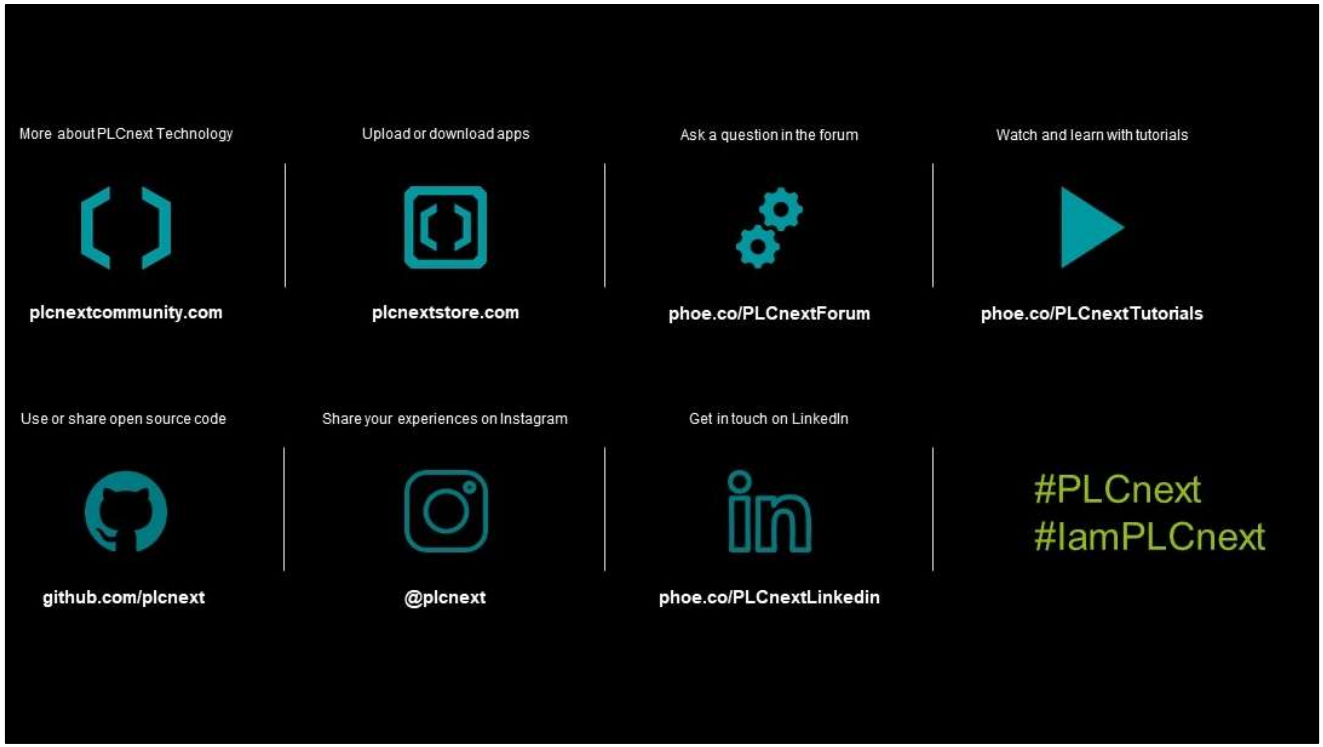
PLCnext Community – Global Exchange & Collaboration



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Join and get involved

PLCnext Community

More about PLCnext Technology

plcnextcommunity.com

Upload or download apps

plcnextstore.com

Ask a question in the forum

phoe.co/PLCnextForum

Use or share open source code

github.com/plcnext

Get in touch on LinkedIn

phoe.co/PLCnextLinkedin

#PLCnext
#IamPLCnext

Join and get involved
#IamPLCnext

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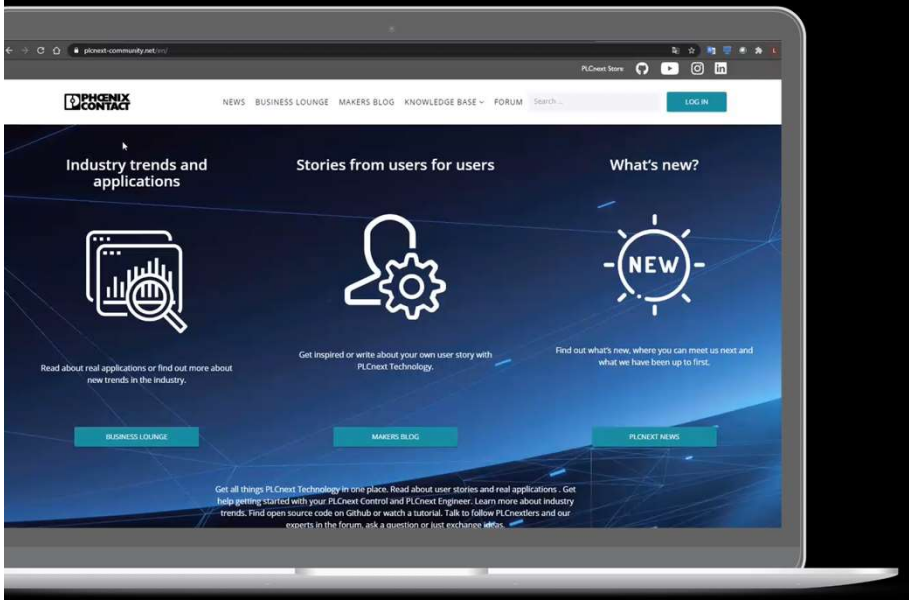
PLCnext Technology

PLCnext Community website



The PLCnext Community website offers information, support and helpful resources:

- Forum
- FAQ
- Infocener
- MakersBlog
- Business Lounge

plcnext-community.net

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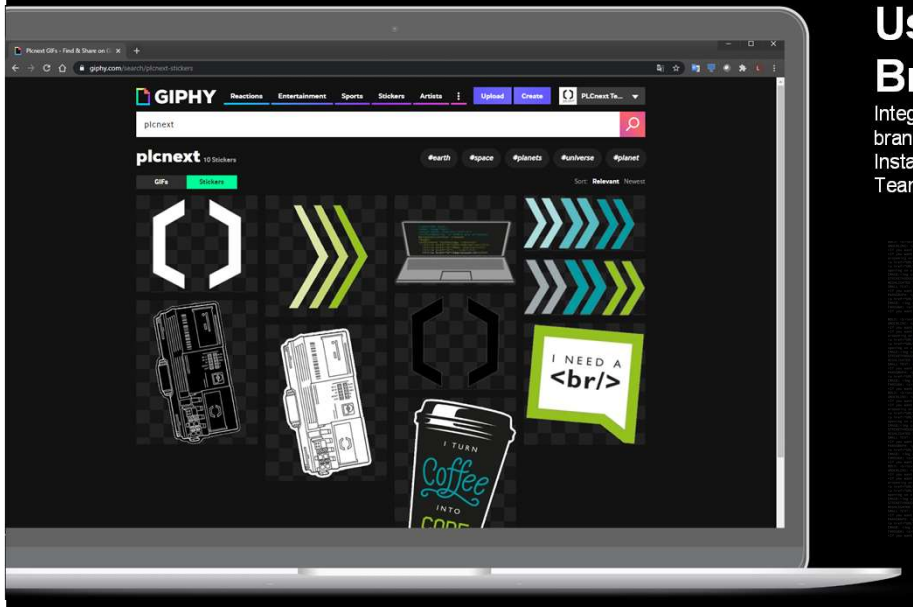
Join and get involved

PLCnext Community



Use GIPHY Brand Channel

Integration of PLCnext Technology branded Gifs and Stickers eg. On Instagram, Facebook, Snapchat, or Teams

Join Live Q&As

eg. on Instagram

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PLCnext Ecosystem – PLCnext Community

Benefit from Crowd Knowledge

Specialists develop ideas and software solutions

Exchange of know-how with the aim of jointly advancing further developments. Profit from the ideas developed by others

Speed up your application developement or earn money with your developements

Market leadership requires speed

We need to make use of Crowed Knowledge

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SPS 2019

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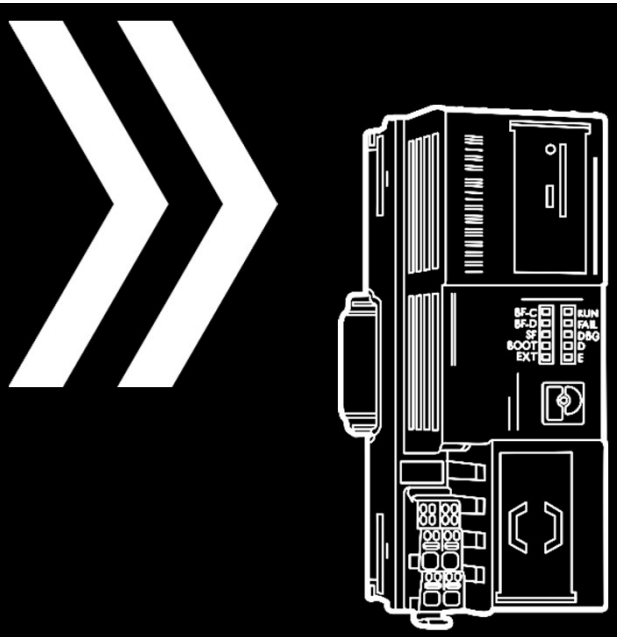
Made with PLCnext Technology: Demonstration der Use Cases

Gutshof Rethmar

BASF Schwarzheide & TU Dresden

Schweizer Bundesbahnen (SBB)

Kraftwerk Huntorf



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Made with PLCnext Technology

Craft beer brewery Hanover

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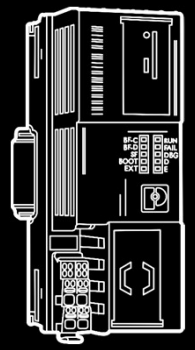

- Fast porting
- Modular expandability
- Creative Community

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Made with PLCnext Technology

TU Dresden und BASF

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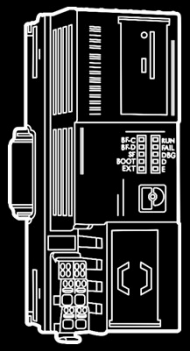
Combining programming languages

TECHNISCHE UNIVERSITÄT DRESDEN

BASF
We create chemistry



- High level language integration
- Integration of Matlab Simulink models
- NOA compliant solution

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Schweitzerische Bundesbahnen

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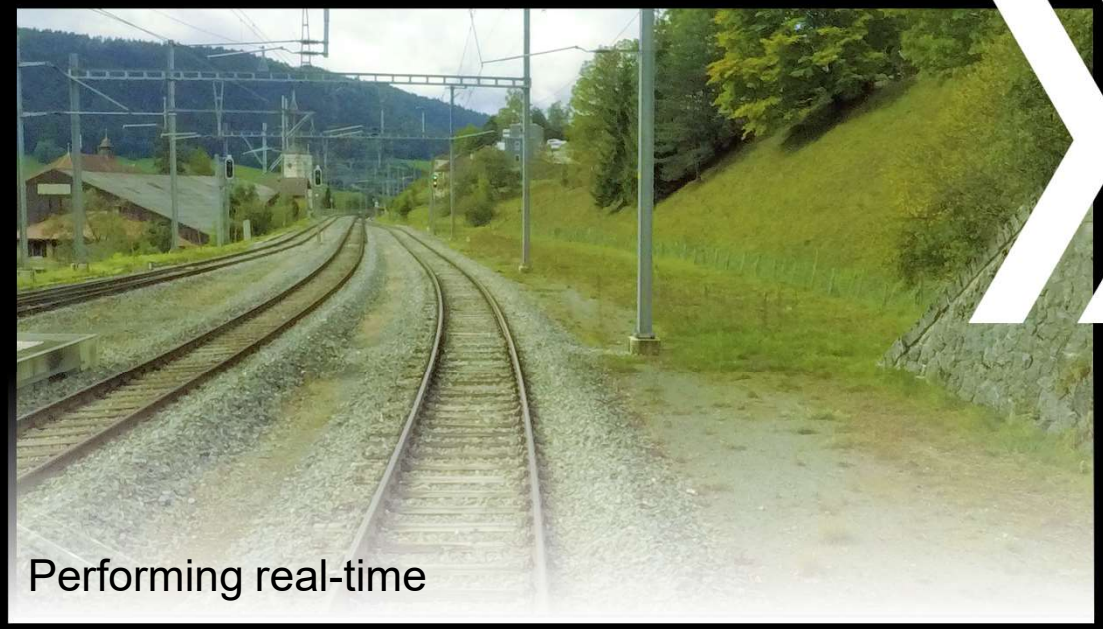
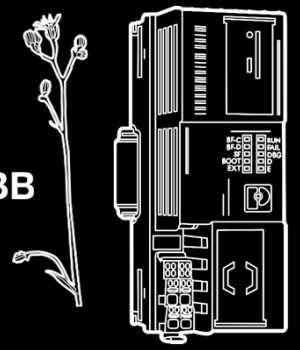


SBB



- Real-time performance
- Cloud connection
- Connection to existing IT infrastructures

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Power station Huntdorf

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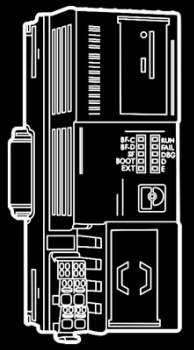

- Extension of existing plants
- Data security
- Futureproof

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What else is worth mentioning …

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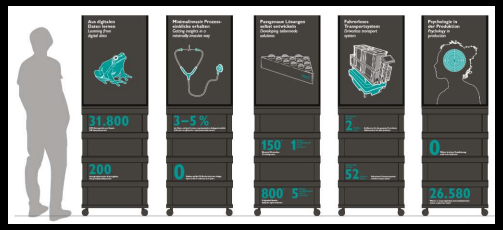
Visitors can experience PLCnext: We live and think digitalization

PLCnext Factory –
PLCnext Technology becomes a tangible experience

VISION:
In a rapidly changing world, we have to rethink our production processes every day. Digitalization is the key to this. Every day, we move borders, are flexible and open to new ways of working together. So are our products.

Tour for visitors with 5 stations on digitization topics



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