

PROFINET The leading communication system

Proven and future-oriented











- 1 Market & Applications
- 2 **PROFINET overview**
- 3 10 Reasons for PROFINET
- 4 Industrie 4.0 and PROFINET







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PROFINET fits in all markets





Oil & Gas & Energy Industries Power Generation

Chemical and Medial Industries

Mines und Metal

Food & Beverage

Process Automation



Factory Automation

Printing Machinery Machines for Wood, **Ceramics and Glass** Production Plastics Packaging Wind Turbines....

Motion Control





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The development of PROFINET is very encouraging. In 2016, a record 3.6 million PROFINET devices were put on the market. This brought the total number to 16.4 million at the end of 2016, which represents an increase of 28% over the previous year.









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Communication requirements



Your requirements

- Uniform, safe and secure networks without any network transitions
- Uniformity and reliability based on accepted standards
- Plant-wide, uniform engineering
- Access, service and maintenance from anywhere
- Detailed diagnostics
- Reduced costs for engineering, commissioning and live operation



Plant-wide communication



PROFINET is switched Ethernet



PROFINET basics

- Standard Ethernet IEEE802.3
- Switching technology IEEE802.1Q
- Wireless LAN IEEE 802.11
- Bluetooth IEEE 802.15.1
- Flexible network topologies
- Switch integration into the devices
- Physical Port-to-Port communication (Copper 100m, FO up to 80 km)
- PROFINET and Standard-Ethernet devices mixed in one network

PROFINET is "switched Ethernet" (no need for repeater)



Switches connected into a line

→ The topology follows the production process

PROFINET is switch integration



→ Reduced network costs



PROFINET is Standard Ethernet and more



PROFINET basics

- Simultaneous sending/receiving
- Usually 100MBit between Controller/Devices
- More than 64 kbyte cyclic input and output data per Device possible, typical 20 – 1440 Byte
- Acyclic data volume almost unlimited
- Logical controller-2-device communication
- IT communications parallel to real-time communications
- Easy use and integration of standard Ethernet applications

PROFINET uses full duplex communication



→ More applications on one cable

Separate channels for IO data and TCP/IP



→ No extra network for TCP/IP needed



PROFINET communication channels





• Communication Jitter <1µsec



Operating Mode RT





PROFINET RT

- Cycle time down to 1ms
- Suitable for over 80% of all automation applications
- Different non-synchronous cycles
- Application, data transmission and field devices have their own processing cycles



Operating Mode IRT





PROFINET IRT

- For motion control applications and synchronous IOs
- Cycle time down to 31,25µs with performance upgrade
- Application, data transmission and device cycle are synchronous with jitter accuracy <1µs</p>
- Deterministic data & internet protocol at the same time





Black channel principle

- F-messages between F-host (safety control) and its F-device are transported as payload in PROFINET frames
- Guarantees functional safety of the complete path including backplane systems
- Additional safety measures of the F-messages
 - Consecutive numbering of F-messages ("Sign-of-life")
 - Time expectation with acknowledgment ('Watchdog")
 - An identifier between sender and receiver ("F-address")
 - Data integrity check ("F-CRC = cyclic redundancy check")

The Black Channel Approach







Media Redundancy Protocol (MRP) Concept

- In normal operation the ring topology is reduced to a line
- One ring port of the MRP manager is blocked
- In case of failure the blocked ring port of the MRP manager change to forwarding
- The network reconfigures in short time
- The ring topology is reduced to a line again
- Automanager for redundant MRP manager
- MRP performance
 - 200 ms reconfiguration time
 - Max. 50 nodes in the ring





PROFINET – offers the required uniformity

PROFINET core functionality

- Real-time communication with simultaneously TCP/IP
- IT communication, access to the automation from anywhere in the world
- Standard and failsafe communications over the same transmission path
- Proven and certified security standards (firewall, VPN)
- Media Redundancy and System Redundancy
- Standardized wireless technology with no restrictions compared to normal cabling (safety, security)









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10 Reasons for PROFINET



User Friendly

Flexible Installation

Best Diagnostics

Safety Integrated

Synchronicity for Motion integrated

High Availability

Secure IT-integration

Energy Efficiency

IO-Link integration

Huge Organisation and Support



#1 Flexible Topology and Media



Plant orientated topology

- The topology follows the plant structure
- Line structure through integration of switch ports in devices
- Tree and star topologies for plant orientated configurations
- Redundant rings with reconfiguration in real time
- Wireless (WLAN, BLUETOOTH), copper or fiber optics transmission where you need it
- Easy combination of different topologies



Plant with different topologies



#2 User Friendly - Fast Commissioning



- Diagnostics and topology recognition
 - Online scan of connected devices
 - Automatic assignment of IP address and device name
 - Transparency in the network topology by comparing planned topology to real topology
 - Comparison of module configuration (modules, serial no. , firmware,...)
 - Simulation of network loads caused by data traffic
 - Automatic device and network documentation





#3 Device Diagnostics and Asset Information

- Flexible Device diagnostics down to a channel
 - Guaranteed alarm mechanism with 4 priority levels (Fault, Maintenance required, Maintenance demanded, Advice)
 - Alarm text specified by PI or by the device supplier in the GSDML file
 - Signaling of data validity
- Asset information
 - I&M (Identification & Maintenance)
 - Hardware, firmware version
 - Article, serial number







- Integration in network management tools via SNMP
 - MIB 2 for device information and port based statistics
 - Neighborhood information through LLDP MIPs
- Error localization with topology views and port based information via PROFINET
 - Topology neighborhood information
 - Port statistics, port media information, cable length

Online scan und verification of existing plants









- Meets the highest safety categories Safety Integrity Level 3 / PL e / Cat. 4
- Fully integrated and scalable safety functions
 - In engineering, controller, drives and IO-systems
 - Uniform diagnostics, device parameterization and uniform user interface
 - One controller for standard and failsafe applications
 - One network for standard and failsafe automation with flexible topologies and wireless communication
 - Reduce the number of types and parts





#5 Scalable Redundancy

IEC



Highly available & cost efficient

- With the Media Redundancy Protocol and managed ring architectures
- Standardized in IEC 62439-2
- Less costs, because of less required components
- System Redundancy
 - By primary and backup mechanism in PROFINET controllers
 - With single or double network interfaces in PROFINET Device
 - Dynamic Reconfiguration allows changes during plant operation





#6 Motion Control



Modular machine concepts increase flexibility & customer orientation



Configuration Address assignment at a later point in time Commissioning / operation Flexible address – Automatic adjustment via the controller address



#6 PROFIdrive profile



PROFIdrive

- The PROFIdrive application profile offers users an interoperable application interface
- Provides the possibility to operate drive devices of various manufacturers with one control application
- Allowed that a drive from one vendor can be exchanged with one from another vendor without costly changes to the software
- The PROFIdrive profile also offers an interoperable interface for the control of safety functions
- Reference implementations available for free





#7 IT-Integration One System for All



IT-Integration

- PROFINET supports well known network structuring using Routers and Bridges
- Using standard IT mechanism for easy access to production
- Integration of Web servers in PROFINET devices
- Direct access to diagnostic information using standard Web browser
- Individually adaptable maintenance concepts thanks to user-defined Web pages





#7 IT-Integration and security



Defense-in-Depth

- PROFINET Networks and applications can be protected using the defense-in-depth approach according to IEC 62443 (cybersecurity for industrial installations
- PROFINET Security Guideline contains important recommendations and best practices

Security Test

- Security Level 1 test is an integral part of the PN certification, PN devices are tested for high robustness against network faults
- Certified PN products are robust against every netload and stay always in a definite state





#8 Good points for PROFlenergy



PROFlenergy

- Measure the consumption in the devices
- Cost savings through omission of external hardware
- Energy saving even in short pauses thanks to granular switching
- High system reliability through coordinated switching
- Investment safeguarding through integration into existing standards











Knowing the consumption is the first step







IO-Link

- Standardized uniform interface for sensors and actuators
- IO-Link communication
 - Excellent integration into PROFINET
 - Consistent communication between sensors/actuators and the controller
 - Consistent diagnostic information down to the sensor/actuator level
 - Automatic parameter reassignment for device replacement during operation



Architecture with IO-Link



#10 Huge Organization and Support

- Worldwide organized
- Defining technology by specifications and white papers
- Know-How Transfer by trainings and implementation seminars
- Test specification and device certification
- Guidelines for installation, security, profiles,...
- For more information see PI website
- http://www.profibus.com/











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Industrie 4.0 requires a powerful communication system







Ethernet based network for Industrie 4.0



PROFINET

- Future proof due to use of IEEE-standards
- Parallel operation of variant protocols PROFINET, OPC UA, TCP/IP, HTTP,...

OPC UA

- Open standard for communication concepts within Industrie 4.0
- Vendor & platform independent
- ... offers as an addition to PROFINET a comfortable interface to 3rd party devices
- Future base for vertical and horizontal communication





Focused on the future since 25 years



