PROFINET in SIMATIC PCS 7 Guidelines and Blueprints

SIMATIC PCS 7 V9.1

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1 Introduction

1.1 Process Automation Requirements for the Fieldbus

Digitalization starts in the field

Scalability and availability are typical requirements of process automation. This also includes the increasing flexibility for future plant expansions with ever shorter commissioning and downtimes. In order to meet these classic requirements, digitization plays an increasingly important role. The basic approach of digitization is the integrated digital communication from the control level down to the sensor and actuator in the field.

Central process automation requirements for the fieldbus

- Scalable redundancy
- Flexible architecture
- High reliability and availability
- Ease of use
- Horizontal and vertical integration
- Investment protection

1.2 PROFINET as a Fieldbus

Why PROFINET?

When used as a fieldbus, PROFINET meets all the requirements of process automation, offers many advantages compared to PROFIBUS DP and, therefore, forms a future-proof platform for plants in the process industry.

As an open standard for fieldbus communication, PROFINET combines the advantages of the proven PROFIBUS DP fieldbus standard with those of the Industrial Ethernet network standard. This integrated communication forms the basis for horizontal and vertical integration and is thus the cornerstone for the implementation of digitalization.

Figure 1-1
**PROFINET in comparison to PROFIBUS DP**

Besides the prevailing simple line structures and rings via optical link modules (OLM) of PROFIBUS DP, PROFINET also supports ring, tree and star topologies with one or more IO controllers as a standard feature. This makes the network architecture more customizable to the plant and plant expansions can be implemented more easily.

PROFINET allows up to 1440 bytes of cyclic user data per device, in contrast to PROFIBUS DP, which only allows 244 bytes. These increasing data volumes are easily handled by PROFINET thanks to a higher transmission rate of 100 Mbps full duplex as compared to the maximum of 12 Mbps (typically 1.5 Mbps) in PROFIBUS DP. PROFINET also uses this bandwidth more efficiently.

With PROFINET, commissioning is also much faster and simpler than with PROFIBUS DP because only point-to-point connections exist and there is no need to take the entire bus in operation at once.

**Advantages**

- Quicker and easier device replacement
- Real-time and deterministic response
- IT standards, such as TCP/IP protocol, are supported
- Physical and/or logical segmentation of the plant
- High availability and flexibility for plant expansions
- Investment protection through integration of existing bus systems

### 1.3 PROFINET in SIMATIC PCS 7

As of SIMATIC PCS 7 Version 9.0, and with a variety of hardware and software innovations, the functionality of PROFINET has been significantly extended in PCS 7.

This documentation serves as a guide and describes the most important topics and functions when using PROFINET in SIMATIC PCS 7.

These include:

- Flexible and scalable availability with functionalities such as system connection, media redundancy, changes during operation, and more (see Section 2)
- Hardware required for using PROFINET in SIMATIC PCS 7 (Section 3)
- Blueprints – Recommended PROFINET network configurations as a planning template for different subsystems (see Section 4)
- Guidelines for using PROFINET in SIMATIC PCS 7 (Section 5)
- PROFINET Tools in the lifecycle overview (Section 6)
2 Overview of PROFINET Functionalities in SIMATIC PCS 7

This Section shows the different system connections and functions of PROFINET in SIMATIC PCS 7. It allows you to scale availability in a flexible manner. The following icons visually represent the PROFINET functions.

Table 2-1

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2.1 System Connections

2.1.1 Single PROFINET configuration S1

A Single PROFINET configuration S1 refers to the connection of an IO device via an interface module which only establishes an application link with one IO controller.

This means that the peripheral device is only connected to the standard automation system via a communication connection or, in the case of H-systems, unilaterally. The IO device fails if this communication connection gets interrupted or if the interface module fails.

S2-capable devices that have an interface module can also be connected to standard automation systems via a single PROFINET configuration S1.

Symbol used:

Example Configuration

AS 410 Single Station and ET 200SP HA with one interface module

Figure 2-1
2.1.2 Media Redundancy with MRP

Media redundancy is a function that ensures network and system availability. The Media Redundancy Protocol (MRP) enables the connection of devices based on ring topologies. If the transmission link in the ring is interrupted at one point, for example, due to a break in the ring cable or the failure of a node, the redundancy manager immediately activates the alternative communication path. The switchover lasts a maximum of 200 ms. The use of MRP is not affected by system redundancy (S1, S2 or R1) and it can be used with all three. You can find further information about MRP in Section 5.4.

Symbol used:

Example Configuration

AS 410 Single Station and ET 200SP HA with one interface module

Figure 2-2
2.1.3 System Redundancy S2

System redundancy S2 refers to the connection of an IO device via an interface module, which establishes one application relationship with each of both IO controllers in the H-system. This means that the peripheral device is connected to both IO controllers of the H-system via two communication connections. Several communication connections can be established using one physical cable to enable the IO device to be connected via one or two cables (see example configuration). If a communication connection is interrupted, all data and diagnostic functions are retained in the H-system. Communication connections are switched over without interruption. However, if the interface module fails, it causes the IO device to fail.

Symbol used:

Example Configuration

AS 410 Redundancy Station and ET 200SP HA with one interface module each; one with the connection via an open ring structure (left) and one with the connection via a switch in star structure (right).

Figure 2-3
2.1.4 Redundant PROFINET R1 Configuration

A redundant PROFINET R1 configuration refers to the connection of an IO device via two interface modules, whereby each one of them establishes one application relationship with one IO controller in the H-system. The advantage of having a redundant PROFINET R1 configuration is that the IO device uses two interface modules to communicate over two separate PROFINET networks (subnets).

In case of an interruption in the communication connection, an interface module failure or a subnet failure, all data and diagnostic functions are retained in the H-system. Communication connections are switched over without interruption. You can find further information on redundant PROFINET R1 configuration in Section 5.5.6.

Symbol used:

Example Configuration

AS 410 Redundancy Station and ET 200SP HA with two interface modules.

Figure 2-4

Note

The redundant PROFINET R1 configuration is also referred to as modular R1 system redundancy.
2.2 Configuration in Run – CiR

Configuration in Run (CiR) is a function that enables the system and configuration to be changed during operation. This includes adding and changing a PROFINET device, a module, or parameters. CiR allows to make these changes in the hardware configuration and to load them into the CPU without a CPU-STOP. This function is available to varying degrees for both standard automation systems and H-systems. Replacing hardware when replacement parts are needed is also possible without CiR.

For further information on CiR, refer to Section 5.1.

Symbol used:

2.3 High-Precision Timestamping

Accurate time stamping is a concept used for providing incoming events (e.g. signal changes in a distributed I/O) with a very precise timestamp (accuracy up to 1 ms). The time synchronization of the nodes is a basic prerequisite for timestamping.

The abbreviation of the term: Sequence of Events – SoE is used as a symbol.

Symbol used:

High-precision timestamping finds its application, for instance, in the event of a message overload in the system. If a large number of messages is generated within one second, it is only possible to identify the first message and therefore also its cause by means of the timestamp.

Note

When using high-accuracy timestamping (SoE) in R1 networks, different subnets must be configured and the networks must be physically separated.

Note

For more information about the quantity structures and structure rules, see the following FAQ:
"Which quantity frameworks and configuration guidelines apply for high-precision time stamping with an accuracy of 1 ms when using the ET 200SP HA and PROFINET?"

Note

Manual
"SIMATIC Process Control System PCS 7; High-precision timestamping When Using the ET 200SP HA"
2.4 PA Ready

For unlimited use in process automation, IO devices must support at least the following functionalities:

- System redundancy S2
- Media Redundancy Protocol (MRP)
- Configuration in Run (CiR)

Siemens uses the PA ready symbol to identify the IO devices which meet the requirements of process automation with regard to availability and changes during operation.

Symbol used:

Siemens, therefore, places similar requirements on both the PROFIBUS & PROFINET International (PI) and PROFINET IO devices in process automation. The PI subdivides IO devices into Conformance Classes (CC) depending on their range of functions: CC-A, CC-B and CC-C. There is also the CC-B (PA), an extension of the CC-B, which applies in particular to process automation. It contains the system redundancy requirement and optionally also MRP and Configuration in Run.

Less stringent requirements for PA ready apply if IO devices are connected to the end of a line or in a star topology:

**Modular terminals** (e.g. ET 200SP HA)
- System redundancy S2
- Configuration in Run (CiR)

**Compact terminals** (e.g. SIMOCODE)
- System redundancy S2
3 Hardware for Using PROFINET in SIMATIC PCS 7

In the SIMATIC product portfolio, Siemens provides all the necessary components for an effective use of all the advantages of PROFINET in SIMATIC PCS 7. The following section presents components, which are recommended and approved for PCS 7.

Figure 3-1
3.1 **AS 410 Automation System**

The AS 410 automation system provides the CPU 410-5H and CPU 410E IO controllers that are specifically designed for process automation. These are the only IO controllers that support all PROFINET functions (S1, S2, R1, CiR, and SoE) and, therefore, form the requirements for PROFINET in the PCS 7 environment (as of version V9.0) and the basis for future developments.

PROFINET IO devices can be connected to the AS 410 via single PROFINET configuration S1, system redundancy S2, and redundant PROFINET configurations R1. The AS 410 also supports the "Configuration in Run" and "High-precision timestamping (SoE)" functions.

Two versions of the CPU are available for the AS 410:
- CPU 410-5H – scalable performance for all applications
- CPU 410E – fixed quantity structure for applications with few process objects

An AS 410 with CPU 410-5H or CPU 410E can be configured as a standard high-availability or safety-oriented automation system, depending on your requirements.

Technically speaking, the CPU 410E program and system behave like those of a CPU 410-5H with limited quantity structures. The technical data of the CPU can be found in the manual.

**Advantages**

- A hardware platform for all application uses, application sizes and performance ranges
- Specially developed for process automation
- Conformal coating
- Extended temperature range (0 °C to +70 °C)
- PROFINET functions (S1, S2, R1, CiR, and SoE)
Communication

The CPU 410 has two PN/Ethernet interfaces with an integrated 2-port switch. Up to 250 IO devices can be connected per PROFINET interface. The CPU 410-5H has 8 KB and the CPU 410E has 1.5 KB for the I/O address range per PN interface.

The CPU also has a 12 Mbps PROFIBUS interface and allows up to 96 nodes to be connected. The distributed process I/O can be either linked directly with PROFINET, PROFIBUS DP or via a subordinate bus system, such as PROFIBUS PA.

**Note**

You can find further device-specific instructions for use in Section 5.6.2.

**Application example**

"Process automation with the SIMATIC PCS 7 CPU 410-5H controller"

**Manual**

"SIMATIC PCS 7 Process Control System CPU 410 Process Automation"
3.2 Distributed I/O

3.2.1 SIMATIC ET 200SP HA

The ET 200SP HA is the preferred choice as a distributed I/O in the case of a single PCS 7 system with PROFINET. It enables the integration of standard and fail-safe signal modules. Configuration variants with optional single (one) or redundant (two) interface modules enable connection via single PROFINET configuration S1, system redundancy S2 or redundant PROFINET R1 configurations.

Modular design

![Figure 3-2](image_url)

(1) BusAdapter
(2) Interface module
(3) I/O modules
(4) Terminal blocks without peripheral module
(5) Server module
(6) Carrier module for two interface modules
(7) Carrier modules with terminal blocks
Advantages

- Compact, modular design and up to 56 slots for I/O modules
- Connection via optical or electrical BusAdapter
- Possibility of IO redundancy through integrated MTA
- Formation of potential groups through terminal blocks
- Besides the standard modules (DI, DQ, AI, AQ), there are also the following module types:
  - Relay module (RQ)
  - Universal module (DI, DQ, Al)
  - Fail-safe modules (F-DI; F-DQ)
  - Modules for hazardous areas (DI, DQ, AI, AQ)
  - Modules with isolated channels (AI; AQ)
- Permanent wiring
- Release button to allow I/O modules to be replaced during operation
- Extension during operation

Communication

The ET 200SP HA is connected to the PROFINET fieldbus via BusAdapters, which are plugged onto the interface modules. This enables electrical connection via Industrial Ethernet or optical connection via fiber-optic cable. Both versions have an integrated 2-port switch.

When using an interface module, the connection can be established via single PROFINET configuration S1 or system redundancy S2. When using two interface modules, it is only possible to establish a connection via redundant PROFINET R1 configurations. In both cases, it is possible to connect with media redundancy (MRP).

Note
For the configuration of the ET 200SP HA, you need SIMATIC PCS 7 version 9.0 or higher.

Note
Additional device-specific notes for use can be found in Section 5.6.3.
Note **Application example**

"Configuring the ET 200SP HA in PCS 7 based on different configuration examples"


**Manual**

"SIMATIC ET 200SP HA ET 200SP HA Distributed I/O system"


Note Refer to Section 5.6.7 for additional information on the use of BusAdapters.
3.2.2  SIMATIC ET 200M

The ET 200M distributed I/O system enables the integration of standard and fail-safe signal modules.

Advantages

- Modular design and up to 12 modules per interface module
- Use of F modules (PROFIsafe)

Communication IM 153-4 PN HF

To connect the ET 200M to the fieldbus, there are interface modules for PROFIBUS DP or PROFINET. The interface module IM 153-4 PN HIGH FEATURE is used for connection via PROFINET. The IM153-4 PN STANDARD version is not approved for SIMATIC PCS 7.

The IM153-4 PN HF has a PN/Ethernet interface with integrated 2-port switch. When using this interface, the connection can be established via single PROFINET configuration S1 and system redundancy S2. It is also possible to connect with media redundancy (MRP).

Note

For an overview of approved modules, please refer to the manual "SIMATIC Process Control System PCS 7 Released modules"

Note

Manual
"SIMATIC Distributed I/O Device ET 200M"
3.3 Compact Field Unit

The Compact Field Unit (CFU) is a smart field distributor for process-oriented, distributed connection of digital I/O signals and PROFIBUS PA field devices to the PROFINET fieldbus. It allows for thorough decentralization and thereby allows a reduction in the number of classic control cabinets, a significant reduction in the number of cables and terminals, and savings in planning and documentation costs.

Communication

The CFU is connected to the PROFINET fieldbus via one BusAdapter. This enables electrical connection via Industrial Ethernet or optical connection via fiber-optic cable. Both versions have an integrated 2-port switch. This allows the connection to be established via single PROFINET configuration S1 or system redundancy S2. It is also possible to connect with media redundancy (MRP).

Note

Refer to Section 5.6.7 for additional information on the use of BusAdapters.

3.3.1 SIMATIC Compact Field Unit PA – CFU PA

The Compact Field Unit PA (CFU PA) is a field distributor for process-oriented, distributed connection of digital I/O signals and PROFIBUS PA field devices to the PROFINET fieldbus.

The CFU PA facilitates engineering and commissioning thanks to plug-and-produce. For instance, PROFIBUS PA field devices are addressed automatically and can then be detected (system-assisted) using standardized PROFIBUS PA profiles and integrated into the process control system.

Figure 3-4
3 Hardware for Using PROFINET in SIMATIC PCS 7

(1) BusAdapter
(2) Interface module
(3) Power supply
(4) Connections for reference potential (mass)
(5) Connections for freely configurable digital I/O channels
(6) Connections for each PROFIBUS PA field device

Advantages

- 8 fieldbus connections for each PROFIBUS PA field device
- 8 freely configurable channels (digital inputs/outputs for sensors or actuators)
- Frequency measurement and counter functionality
- Automatic addressing and use of PA profiles for PA field devices
- Optional commissioning with SIMATIC PDM
- Standardized diagnostics according to NAMUR recommendation NE107 for PA field devices
- Suitability for ATEX Zone 2
- Optional housing for installation in the field (IP66)
- Connection via optical or electrical BusAdapter

Note

A SIMATIC PCS 7 Version 9.0 or higher is required for the configuration of the Compact Field Unit.

When using PCS 7 V9.0 without the Service Pack, you will also need the Hardware Upgrade Package (HUP) for the SIMATIC Compact Field Unit.

This is available under the following link:

The HUP is already integrated from PCS 7 V9.0 SP1 and no additional time and effort is required.

Note

Manual
"SIMATIC Distributed I/O SIMATIC Compact Field Unit (CFU)"
3.3.2 SIMATIC Compact Field Unit DIQ – CFU DIQ

The Compact Field Unit DIQ (CFU DIQ) is a field distributor for the process-oriented, decentralized connection of digital I/O signals to the PROFINET fieldbus.

Figure 3-5

(1) BusAdapter
(2) Interface module
(3) Power supply
(4) Connections for reference potential (mass)
(5) Connections for freely configurable digital I/O channels

Advantages

- 16 freely configurable channels (digital inputs/outputs for sensors or actuators)
- Frequency measurement and counter functionality
- Optional commissioning with SIMATIC PDM
- Suitability for ATEX Zone 2
- Optional housing for installation in the field (IP66)
- Connection via optical or electrical BusAdapter

Note

To configure the DIQ Compact Field Unit, you need, at minimum, SIMATIC PCS 7 from version 9.0 SP2 and Update Collection 1.

Under the following link, you will find the latest software update for SIMATIC PCS 7 V9.0 SP2:

Note

Manual
"SIMATIC Distributed I/O SIMATIC Compact Field Unit (CFU)"
3.4 Recommended SCALANCE Switches

Selected SCALANCE switches are recommended for use in the process industry. The reason for this recommendation is that these are ready starting with FW V4.0 PA, and therefore support the S2 system redundancy functions, Configuration in Run and Media Redundancy Protocol (MRP). The recommended switches are thus suitable for unrestricted use in the process industry. Recommended switches include:

- XF204-2BA
- XC-200(ECC)
- XP-200(EEC)

The following table provides an overview of the properties of the switches.

Table 3-1

<table>
<thead>
<tr>
<th></th>
<th>SCALANCE XF204-2BA</th>
<th>SCALANCE XC-200(ECC)</th>
<th>SCALANCE XP-200(EEC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Figure</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>S1</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>S2</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>MRP</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>CiR</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Location of use</strong></td>
<td>Control cabinet</td>
<td>Control cabinet</td>
<td>Field</td>
</tr>
<tr>
<td><strong>IP degree of protection</strong></td>
<td>IP20</td>
<td>IP20</td>
<td>IP65</td>
</tr>
<tr>
<td><strong>ATEX Zone</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Interfaces</strong></td>
<td>Electrical / optical (BusAdapter)</td>
<td>Electrical / optical / SFP¹</td>
<td>Electrical</td>
</tr>
<tr>
<td><strong>Number of ports</strong></td>
<td>4 (2 BusAdapter)</td>
<td>Max. 24 RJ45 Max. 2 SFP</td>
<td>Max. 16 M12 (D-coded or X-coded)</td>
</tr>
<tr>
<td><strong>Temperature range</strong></td>
<td>-40 °C to +70 °C</td>
<td>-40°C to +70°C²</td>
<td>-40 °C to +70 °C</td>
</tr>
<tr>
<td><strong>Conformal coating</strong></td>
<td>✓</td>
<td>✓²</td>
<td>✓²</td>
</tr>
<tr>
<td><strong>NAMUR NE 21-compliant</strong></td>
<td>✓</td>
<td>✓²</td>
<td>✓²</td>
</tr>
</tbody>
</table>

1) SFP – Small Form-factor Pluggable
2) EEC versions.
3 Hardware for Using PROFINET in SIMATIC PCS 7

Note
XC-200 Manual
"Instruction manual"

XF-200BA Manual
"Instruction manual"

XP-200 Manual
"Instruction manual"

Configuration manuals: XC-200, XF-200BA, XP-200
"Web Based Management"
"Command Line Interface"

Note
Switches can only be integrated on one side as S1 devices in an R1 network structure. For information on the behavior of the switches in an R1 network structure, see Section 5.5.6.

Note
The functions S2 System Redundancy and Configuration in Run (CiR) are supported as of firmware version V4.0.

Note
Refer to Section 5.6.7 for additional information on the use of BusAdapters.
### 3.5 Service Bridge

The Service Bridge is a specially configured switch that allows dedicated temporary access from the system bus to the fieldbus for extended commissioning and diagnostic purposes, while ensuring the logical separation between the fieldbuses. The Service Bridge is based on SCALANCE XC-200 series switches (from FW V3), which are configured in a special manner. For security reasons, it is also recommended that a firewall, e.g. in the form of a SCALANCE SC, be provided between the system bus and the Service Bridge.

![Service Bridge diagram](image)

#### Procedure for configuring the Service Bridge

1. Download the prepared configuration file and instructions
2. Load the configuration file in the switch
3. Adjust the configuration individually for each plant according to instructions

**Use of the Service Bridge**

**Procedure for configuring the Service Bridge**

**Standard XC-200 switch**

1. Download the prepared configuration file and instructions
2. Load the configuration file in the switch
3. Adjust the configuration individually for each plant according to instructions

**Note**

You can find the application example for the Service Bridge and the prepared configuration files at the following link: [https://support.industry.siemens.com/cs/ww/en/view/109747975](https://support.industry.siemens.com/cs/ww/en/view/109747975)
Advantages

- Centralized access to the PROFINET networks with a secure separation of the networks
- Manual assignment of name and IP address
- Use of the scan and online features of the STEP 7 Topology Editor
- Use of commissioning tools (e.g. PRONETA)
- Extended network diagnostics (for example, SINEC NMS via separate network)
- Access to the web servers of PROFINET devices
- Installation of firmware updates

Note

The use of the Service Bridge is optional and not a requirement for using PROFINET.
3.6 Y switch (XF204-2BA DNA)

The SCALANCE XF204-2BA DNA, also called Y switch, enables S2 devices to be connected to R1 networks. The network separation of both R1 networks is maintained.

Figure 3-7

Advantages

- Integration of S2 devices in R1 networks
- Suitability for ATEX Zone 2
- No configuration necessary
- Transparent, i.e., no additional limitations on quantity structures, etc. by Y switch

Communication

The Y switch has two slots for one BusAdapter each. By default, the rear ports of the BusAdapter form the primary interface and the front ports form the secondary interface. The primary interface consists of two ports that are isolated from a network point of view, which connect to R1 networks. The secondary interface allows the connection of S2-capable devices with the optional use of media redundancy (MRP).
View from below

Figure 3-8

1. Secondary interface for the connection of S2-capable devices
2. Primary interface for connection to the R1 network

**Note**
The functionality of the Y-Link must not be confused with that of the Y link (PROFIBUS DP). Only S2-capable devices can be operated downstream from the Y switch.

**Note**
It is recommended to use the standard configuration for the ports of the R1 and S2 interfaces. Otherwise, resetting to factory settings could cause undesired reactions.

**Note**
When the Y switch is used, the subnets of the R1 network must be physically separated from each other. Furthermore, both subnets of the R1 network and the secondary S2 network must use the same IP address range.

**Note**
XF-200BA Manual
"Instruction manual"

**Note**
Refer to Section 5.6.7 for additional information on the use of BusAdapters.

**Note**
Further notes for the Y-Switch configuration can be found in Section 5.6.8.
3.7 Industrial Wireless LAN with PROFINET

As a radio system, wireless LAN (WLAN) is an "all-rounder" that is suitable for virtually any type of application involving local radio networks. This applies to any area, from household living rooms to offices or to industrial production halls. Although they share the same basis in technology, they have very different requirements.

Availability and reliability are vital especially in industrial environments. With industrial features in terms of hardware and software (iFeatures), even simple WLAN becomes a reliable Industrial Wireless LAN (IWLAN).

Customer benefits

PROFINET is intended for real-time communication in automation systems. Its application is not limited to wired networks, it can also be used in wireless networks. PROFINET via IWLAN has many advantages

- higher performance and improved diagnostics options
- flexible integration of stationary and mobile nodes
- significant cost savings - for the installation and operations
- safety applications with PROFINET are possible via a single medium, including wireless
- integration with Ethernet: Simple connection to the control and enterprise management level
- fast installation and startup thanks to reliable hardware components for wireless communication

Special considerations when using PROFINET

When operating IWLAN in the PROFINET environment, it must be ensured that the functions corresponding to the quantity structure and the update time are selected for the IWLAN devices. In addition, a good radio field must be ensured through radio field planning in order to provide sufficient security for dynamic effects.

PROFINET works with cyclic data exchange. A bus error occurs when three consecutive data packets (default setting) do not arrive.

Therefore, availability should be ensured by appropriate configuration and by the following criteria:

- Selection of a radio standard appropriate to the given environment
- Selection of a free radio channel
- Use of industry features if required
- Interference avoidance
- Selection of suitable antennas or antenna arrangements to ensure signal quality suitable for the application. The recommended signal strength for PROFINET is > -75dBm.
- Compliance with the update time in accordance with the hazard analysis

Note

Application example

"IWLAN: Setup of a Wireless LAN in the Industrial Environment"

3.7.1 SCALANCE W700 IEEE 802.11n

The high-performance models of the SCALANCE W700 IEEE 802.11n series offer reliability with their industrial design and features for industrial applications. They can be used in the control cabinet. Mounting on the wall and ceiling is possible, as well as use outdoors. Easy handling is guaranteed when configuring via Web Based Management or via central configuration and monitoring with SINEC NMS. Figure 3-9

Advantages
- Integration of IO devices in locations that are difficult to access or with moving nodes
- Connection of S2 devices
- Very robust housing
- EEC variants:
  - Conformal coating
  - Extended temperature range (-40°C to +70°C)

Communication

The SCALANCE IWLAN products themselves only support system redundancy S1. The PROFINET IO devices on an IWLAN client as, of firmware V6.5 or higher, can be S2 devices if IPCF is activated. A maximum of 8 IO devices are enabled behind an IWLAN client.

Note
You can find notes for use in the Blueprints in Section 5.5.7

Note
Additional notes for the configuration of IWLAN products can be found in Section 5.6.9.
3.8 IE/PB LINK

The IE/PB LINK is a Gateway between Industrial Ethernet and PROFIBUS. It enables the seamless integration of simple and fail-safe PROFIBUS devices into the PROFINET fieldbus. Here, the IE/PB LINK acts as a proxy, i.e. from the point of view of the IO controller, the integrated DP slaves are treated like IO devices with an Ethernet interface.

There are two variants of the IE/PB LINK:
- IE/PB LINK HA (Section 3.8.1)
- IE/PB LINK PN IO (Section 3.8.2)

You can use the LINK in the following operating modes:
- PROFINET IO proxy on the standard automation system
- PROFINET IO proxy on the H system (only with IE/PB LINK HA)
- Standard operation (Gateway)

You can define the operating mode in the configuration. For the "PROFINET IO proxy" operating mode, you must configure the LINK as a PROFINET IO device.
3.8.1 **IE/PB LINK HA**

The IE/PB LINK HA is a Gateway between Industrial Ethernet and PROFIBUS. It enables seamless integration of PROFIBUS devices in the PROFINET fieldbus. Here, the IE/PB LINK HA acts as a proxy, i.e. from the point of view of the IO controller, the integrated DP slaves are treated like IO devices with an Ethernet interface.

**Figure 3-10**

### Advantages

- Integration of a subordinate PROFIBUS network and access to all connected PROFIBUS nodes
- Cross-network programming device communication using S7 routing
- Use as router for data records for the parameterization of field devices via SIMATIC PDM by means of data record routing
- Connection via optical or electrical BusAdapter
- Conformal coating
- Extended temperature range (-40°C to +70°C)

### Communication

The IE/PB LINK HA has an internal PROFINET interface with integrated 2-port switch and a slot for the optional use of a BusAdapter. If a BusAdapter is inserted, the integrated PROFINET interface is automatically deactivated and the BusAdapter takes over the communication. BusAdapters enable electrical connection via Industrial Ethernet or optical connection via fiber-optic cable. Both versions have an integrated 2-port switch.

The IE/PB LINK is connected via single PROFINET configuration S1 or system redundancy S2. The connection with media redundancy (MRP) is also supported.
Note
The Configuration in Run functionality is only supported on the H-System and not on the standard automation system.

Note
Further device-specific instructions for use can be found in Section 5.6.4.

Note
Refer to Section 5.6.7 for additional information on the use of BusAdapters.

Note
Manual
“SIMATIC NET: Industrial Ethernet/PROFIBUS IE/PB LINK”

3.8.2 IE/PB LINK PN IO
The IE/PB LINK PN IO is a gateway between Industrial Ethernet and PROFIBUS. It enables seamless integration of PROFIBUS devices in the PROFINET fieldbus. The IE/PB LINK PN IO acts as a proxy: i.e. from the viewpoint of the IO controller, the integrated DP slaves are handled like IO devices with Ethernet interface.

Figure 3-11

Advantages
- Integration of a subordinate PROFIBUS network and access to all connected PROFIBUS nodes
- Cross-network programming device communication using S7 routing
- Use as router for data records for the parameterization of field devices via SIMATIC PDM by means of data record routing
- Connection via optical or electrical BusAdapter
Communication

The IE/PB LINK PN IO has an internal PROFINET interface with integrated 2-port switch and a slot for the optional use of a BusAdapter. If a BusAdapter is inserted, the integrated PROFINET interface is automatically deactivated and the BusAdapter takes over the communication. BusAdapters enable electrical connection via Industrial Ethernet or optical connection via fiber-optic cable. Both versions have an integrated 2-port switch.

The IE/PB LINK PN IO is connected via a single PROFINET configuration S1. Connection with media redundancy (MRP) is supported.

Note
Further device-specific instructions for use can be found in Section 5.6.5

Note
Refer to Section 5.6.7 for additional information on the use of BusAdapters.

Note
Manual
"SIMATIC NET: Industrial Ethernet / PROFIBUS IE/PB LINK
3.9 PN/PN Coupler

The PN/PN Coupler is used to connect two PROFINET subnets and to exchange data. That way, use data about input or output address areas or data records can be used. The maximum size of the transferable input and output data is 1440 bytes (1000 bytes when used with S2 system redundancy). Any allocation of input and output data is possible, e.g., 800 bytes of input data and 200 bytes of output data can be configured.

In the configuration, both sides of the PN/PN coupler are configured separately as individual IO devices in the respective subnet. The data exchange is realized via configured input/output modules, whereby the communication is independent of the IP addresses or the network structure behind the PN/PN Coupler.

This allows, for example, third-party systems to be integrated into an existing PROFINET network in the form of package units.

Figure 3-12

Figure 3-13
Advantages

- Cyclic communication
- Redundant power supply
- Electrical isolation between both PROFINET networks
- Device replacement without programming device
- Connection via optical or electrical BusAdapter

Communication

The PN/PN coupler is connected to the PROFINET fieldbus via a bus adapter on each side, which is plugged into each interface module. This enables an electrical connection via Industrial Ethernet or an optical one via fiber-optic glass cables. Both versions have an integrated 2-port switch.

This supports the connection via a single PROFINET configuration S1 or system redundancy S2 (as of firmware V4.2). Redundant connection with media redundancy (MRP) is also possible.

Note

Manual
"SIMATIC Bus Couplers PN/PN Coupler"
4 Blueprints – Recommended PROFINET Network Configurations

4.1 Introduction

Blueprints – background

PROFINET recognizes line, ring, tree and star topologies as well as multi-controller networks and thus offers countless possibilities to network the devices of a system. By performing a one-to-one transformation of existing systems based on PROFIBUS DP into PROFINET you will not exploit the advantages of PROFINET, neither functionally nor in terms of costs.

In order to reduce planning effort and to eliminate possible sources of error, provided network configurations are tested with Blueprints. These are tailored to typical system configurations of process automation and are recommended as prepared solution approaches or standard blocks for planning PROFINET networks.

The following figure shows how blueprints are used as adaptable templates for planning plant sections.

Figure 4-1

Advantages for users

- Recommended and tested PROFINET network configurations
- Standard blocks for easy planning of the PROFINET network
- Scalable from entry level to high-end
- Directly recognizable availability
Approach

The PROFINET Blueprints show prepared standard solutions for the connection of PROFINET devices to a (fail-safe) automation system. In order to make these standard blocks optimally available for planning, they are structured according to the automation system extension and the type of system connection. Section 4.2 includes an overview of the blueprint configuration.

Since each system places individual requirements on availability and segmentation, and these are not always covered by a single blueprint, it is possible to combine the network structures shown in the blueprints. Section 4.6 contains an example of a system based on blueprints.

The following questions help you choose a suitable blueprint:

- What are your requirements for availability?
- Standard or high-availability automation system?
- How many devices are to be integrated?
- Is a physical or logical segmentation necessary?
4.2 Overview of Blueprints

Figure 4-2
4.3 Blueprints – Standard Automation System

The main distinguishing feature of PROFINET network configurations in a standard automation system is the number of devices. The blueprints are designed in such a way that only one PROFINET interface of the CPU is used. This way, the topologies can also be configured with the second interface of the CPU, whereby the same quantity structures can be implemented in parallel.

All devices that support the single PROFINET configuration S1 can be used in the following configurations. If using in the MRP ring, all nodes of the ring must also support MRP. The distributed ET 200SP HA I/O devices are used as examples in the blueprints.
4.3.1 Entry

Requirements for the fieldbus

- Up to 50 devices
- Avoid single point of failure in the network
- Avoid additional hardware for the network infrastructure
- No segmentation prescribed

Network topology

Figure 4-3

Explanation

The cheapest and simplest variant among the Blueprints consists of one CPU with up to 49 devices. The maximum number of devices is limited by the MRP ring, which may contain a maximum of 50 nodes. No additional infrastructure components, such as switches, are required if using the 2-port switches integrated in the nodes. In the topology shown above, an optional switch is also provided as an access point for the integration of the Service Bridge, as otherwise no free ports are available.

Advantages

- No additional hardware required (without Service Bridge access)
- No single point of failure in the network
- Optional integration of the Service Bridge (with additional switch)
4.3.2 Standard

Requirements for the fieldbus

- Up to 100 devices
- Avoid single point of failure in the network
- Logical segmentation

Network topology

Figure 4-4

Explanation

This blueprint serves as a template for standard automation systems with 50 to 100 devices. The number of devices is achieved by having two MRP rings with logical segmentation, whereby each ring is connected to the ports of the same CPU interface via a switch. The MRP limit of 50 nodes per ring applies.

It is recommended to install the first switches with the CPU in the control cabinet. This ensures protection of this route and a reduction of error probability at this single point of failure.

One of the unassigned ports in the switches can be used as access for the Service Bridge.

Advantages

- Logical segmentation into two networks
- Access for Service Bridge
4.3.3 **High-End**

**Requirements for the fieldbus**
- 100 to 250 devices
- Avoid single point of failure in the network
- Logical segmentation

**Network topology**

Figure 4-5

**Explanation**

This blueprint serves as a template for standard automation systems with more than 100 devices. An MRP ring is constructed as a backbone consisting of a CPU and a series of switches. The devices are connected in separate logical segments starting from the switches in the backbone.

With further switches connected in star configuration, the installation of MRP rings is intended for the connection of devices. Alternatively, it is also possible to connect devices in star configuration.

In this topology, MRP rings limit the quantity structure because they support a maximum of 50 nodes. Even the PROFINET interface of the CPU limits the quantity structure, as it supports a maximum of 250 devices.

**Advantages**
- Logical segmentation into "n" networks
- Access for Service Bridge
4.4 Blueprints – H-System with System Redundancy S2

The following PROFINET network configurations consist of a high-availability automation system and up to 250 devices connected to a PROFINET interface of the CPU 410. If both interfaces are used, it can achieve quantity structures of up to 500 devices. The devices used must support connection via system redundancy S2. If you want to integrate a device that only supports the single PROFINET configuration S1, you have to keep in mind that there are some limitations – see Section 5.5.5. The distributed ET 200SP HA I/O devices are used as examples in the blueprints.
4.4.1 Entry

Requirements for the fieldbus

- Avoid additional hardware for the network infrastructure
- Avoid single point of failure in the network
- No segmentation prescribed

Network topology

Figure 4-6

Explanation

The cheapest and simplest variant of the blueprints for a high-availability automation system is one H-system and up to 250 PROFINET devices, which are integrated in a line between the two IO Controllers. This variant of the connection is also called an open ring structure.

Connecting the open ports to an MRP ring would not provide any advantages in this case, but rather limit the number of devices to 48 (50–2 IO controllers) instead of 250 devices and delay the switchover time in case of error due to a reconfiguration of the MRP ring. The MRP ring also leads to an increased configuration effort (potential sources of error) because the MRP domain would have to be configured and the watchdog times adjusted.

The CPU has an unassigned port at the beginning and at the end of the line to provide access for the Service Bridge. This blueprint does not require additional components for the network structure design, however no logical segmentation is intended.

Advantages

- No additional hardware required
- No single point of failure in the network
- Access for Service Bridge
4.4.2 Standard

Requirements for the fieldbus
- Avoid single point of failure in the network
- Logical segmentation

Network topology
Figure 4-7

Explanation
When compared to the entry variant, this blueprint assigns switches for the logical segmentation of the network. Together with the H-system, the switches form an open ring, from which the devices are connected via MRP rings or star structures. As opposed to the high-end variant, this blueprint leads to single point of failures due to the switches that connect the segments to the open ring.

Advantages
- Logical segmentation into "n" networks
- Access for Service Bridge
4.4.3 High-End

Requirements for the fieldbus
- No single point of failure in the network
- Logical segmentation

Network topology
Figure 4-8

Explanation
The switches in this blueprint are used for the logical segmentation of the network. Together with the H-system, the switches form an open ring, from which the devices are connected via MRP rings. In order to avoid a single point of failure, two switches are used per MRP ring.

Advantages
- Logical segmentation into "n" networks
- No single point of failure in the network
- Access for Service Bridge
4.5 Blueprints – H-System with Redundant PROFINET R1 Configuration

The following PROFINET network configurations consist of a high-availability automation system with two separate networks. This allows the connection of up to 250 R1 devices per interface or, in combination with the connection of devices via system redundancy S2, also up to 250 devices.

To operate the devices directly on the two networks, they must support redundant PROFINET R1 configurations. Devices with system redundancy S2 can be integrated into the R1 network by means of a Y switch. In order to use the Service Bridge, an access port is required in both subnets of the R1 network. The distributed ET 200SP HA I/O devices are used as examples in the blueprints.

4.5.1 Standard

Requirements for the fieldbus

- Highest possible availability when connecting the distributed I/O devices
- Avoid single point of failure in the network
- Avoid additional hardware for the network infrastructure
- No segmentation prescribed

Network topology

The following section shows two variants for this blueprint. The first variant (Figure 4-9) for the exclusive use of R1 devices, and the second variant (Figure 4-10) for the additional integration of devices with system redundancy S2 via a Y switch (SCALANCE XF204-2BA DNA).
Explanation

This Blueprint shows the standard variant for connecting R1 devices to a high-availability automation system.

From the CPUs of the H system onwards, the R1 devices are connected via two separate line structures. In order to increase availability, we recommend reverse cabling (as shown in the blueprint). With reverse cabling, all devices remain available if a device is removed. It is technically possible to have a configuration with two MRP rings instead of the lines, but this is not provided in this blueprint because it would require increased engineering effort (possible sources of error), lead to a slower switchover time and restrict the number of devices in the ring to 50. The second variant is designed with a Y switch downstream from two XF204-2BA switches, which enables connection of devices that only support system redundancy S2. The unused ports of the CPU can be used for the Service Bridge to access both subnets of the R1 network.

Advantages

- No additional hardware required (in a purely R1 network)
- No single point of failure (except Y switch)
- Access points for Service Bridge
4.5.2 High-End

Requirements for the fieldbus

- Highest possible availability when connecting the distributed I/O devices
- Avoid single point of failure in the network
- Logical segmentation

Network topology

Figure 4-11

Explanation

This Blueprint shows a variant for integrating R1 devices into a high-availability automation system with simultaneous logical segmentation in "n" networks.

A line consisting of switches is established for each CPU. These linearly arranged switches act as a backbone for the logical segmentation of the system.

When setting up two MRP rings as a backbone (dashed line), the following points must be observed:

- The MRP ring leads to increased configuration effort, since the MRP domain must be configured and the watchdog times must be adapted.
- In the event of an error, the increased watchdog time for the IO devices is added to the switchover time of the H-System.

On the other hand, there is only a minimal increase in availability due to the MRP ring. The advantages of this MRP solution are minimized by the issues addressed above.

The network downstream from the switches is divided into three segments. A segment consisting of just R1 capable devices is connected to the switches of the backbone MRP ring via two simple lines. The two other segments show the possibility of integrating S2-capable devices with a Y switch into the R1 network. In this case, MRP rings are installed downstream from the Y switch to allow the S2 devices to be connected. The backbone MRP rings have ports in the switches that enable the Service Bridge to access both subnets of the R1 network.
Advantages

- Logical segmentation into "n" networks
- No single point of failure (except Y switch)
- Access points for Service Bridge
4.6 Example Configuration

PROFINET allows several automation systems to be operated in a shared network. It allows I/O devices to be assigned flexibly and reduces wiring effort when the I/O devices are removed.

The following system configuration shows a multi-controller installation with a standard system and an H-system, in which devices are integrated via single PROFINET configuration S1, system redundancy S2 and redundant PROFINET R1 configurations. Both automation systems have local peripherals, which are built in separate PROFINET subnets for spatial and safety reasons.

Furthermore, a shared PROFINET subnet is provided for a remote field level by assigning the IO devices to the respective automation systems.

You can find further example configurations without additional explanation in Section 7.2.
Figure 4-12

Central Control Room

Field

Engineering Station
Operator Station

Terminal / Plant Bus (example)

CPU 410-5H
Service Bridge (SB)

Security Module
SCALANCE SC

CPU 410-5H, red.

PROFINET – electrical, redundant

PROFINET – optical, redundant

MCC Room

SIMOCODE SIMACOS

IE/FP LINK HA

PROFIBUS DP

Field devices are... or... according corresponding controller

CFU PA

XC-200ESC

ET 200SP

SB

Access for service Bridge

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PROFINET in SIMATIC PCS 7 Guidelines and Blueprints
Entry ID: 72887082, V2.4, 07/2021 55
**Explaination**

1. The local PROFINET subnet of the standard AS 410 is modelled on the blueprint from Section 4.3.2. The first logical segment is an MRP ring consisting of distributed I/O devices and an IE/PB link with subordinate PROFIBUS DP network. The second logical segment is used for the connection of a Motion Control Cabinet (MCC). The path between the switch near the CPU and switch in the MCC area is done optically through fiber-optic cables. In this case, it is optionally possible to build an MRP ring. The SINAMICS frequency inverter and SIMOCODE motor management systems in the MCC area are connected to the switch in star configuration. Thanks to this star-shaped connection topology, it is possible to switch off individual devices for maintenance purposes without affecting the rest.

2. The local PROFINET subnet of the H system corresponds to the blueprint in Section 4.5.1 and is used for connecting distributed I/O devices of type ET 200SP HA via redundant PROFINET R1 configuration.

3. The communication between the central control room and the field is provided by two mutually separated optical MRP rings. The standard AS 410 and a CPU of the H-System communicate together via an MRP ring. The second MRP ring is only used by the second CPU of the H system. This means that two separate networks are available for the connection of R1 devices in the field.

4. In practice, the transition from the two separate R1 subnets to a shared subnet is achieved with a Y switch (XF204-2BA DNA). Behind the Y-switch, devices can be connected via a single PROFINET configuration S1 to the standard AS 410 or via system redundancy S2 to the H-system.

5. Connection of a distributed I/O device of type ET 200SP HA via redundant PROFINET R1 configuration.

6. A large MRP ring made up of switches is built in the field to network all the system sections.

7. Point-to-point connection of Compact Field Units (CFU) for the integration of PROFIBUS PA devices and digital sensors/actuators.

8. A further part of the plant consisting of CFUs and two switches is constructed as an MRP ring and connected to the main MRP ring in the field via a line.
5 Guide

5.1 Configuration in Run – CiR/H-CiR

Configuration in Run (CiR) is a function that enables the system and configuration (e.g., the addition or modification of hardware) to be changed during operation without causing a system shutdown. This function is available to varying degrees for both standard automation systems and H-systems. Replacing hardware when replacement parts are needed is also possible without CiR.

A requirement for the function "Configuration in Run" (CiR) at PROFINET is the deployment of the CPU 410 as of FW V8.2 and PCS 7 as of V9.0.

Configuration in Run in a standard automation system (CiR)

When CiR is used in a standard automation system, the process execution of the loading process is paused for a brief time interval (CiR synchronization time). The process inputs and outputs retain their last value during this time. When using the CPU 410, the maximum CiR synchronization time is 60ms.

Configuration in Run in a high-availability automation system (H-CiR)

Besides the modifications that are possible in a standard automation system, it is also possible to modify some CPU parameters in a high-availability automation system.

Sequence of an H-CiR process:

- Modify the Hardware Configuration offline
- When loading:
  - Stop standby CPU
  - Upload new Hardware Configuration to the standby CPU
  - Switch over to the CPU with modified configuration
  - Update the second CPU
- The system works redundantly again

Note: The H-CiR loading process must run with the H-CiR Wizard.
5.1.1 CiR/H-CiR Options

The changes that are possible as a CiR/H-CiR operation depend on whether the (changed) IO device has CiR functionality. Several changes can be made within a CiR/H-CiR process. It is recommended to always perform changes simultaneously on one string.

The following table gives an overview:

<table>
<thead>
<tr>
<th>CiR/ H-CiR operation</th>
<th>IO Device without CiR</th>
<th>IO Device with CiR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add Device</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Remove device</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Add submodule</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Remove submodule</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Reassign submodule parameters</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Interface parameters (e.g. enable/disable ports, topology configuration)</td>
<td>✗</td>
<td>✓</td>
</tr>
</tbody>
</table>

Note: IO devices (S1) configured on one side of the H-System lose the connection during the H-CiR process. This behavior is independent of whether the IO devices are CiR-capable or not. Furthermore, it is not recommended to operate S1 devices unilaterally on the H system. Exceptions are switches in an R1 network, which can only be connected unilaterally. (see Section 5.5.6)

Besides the changes that are possible as a CiR operation on the standard automation system, it is also possible to add and remove IO controllers and IO systems in H systems as an H-CiR operation.

Note: For further information on the various possibilities of CiR, such as the changeable CPU parameters in H-CiR, refer to the manual: "SIMATIC PCS 7 Process Control System CPU 410 Process Automation" [https://support.industry.siemens.com/cs/ww/en/view/109748473](https://support.industry.siemens.com/cs/ww/en/view/109748473)

Note: It is recommended that the "CiR capability" of the system is checked before each CiR operation or Save and Compile. This way, you can still reject the changes.

Note: Before making any changes in the HW Config, it is recommended to archive the project. This allows you to restore the old project even if the CiR/H-CiR loading capability is lost after saving.
Note

In addition, observe the documentation of the devices (or modules) used; in some cases, there may be specific features or restrictions for CiR.

5.1.2 Notes on CiR/H-CiR

Representation in HW Config

CiR-capable IO devices are color-coded in the HW Config.

Figure 5-1

Adding or removing IO devices

No CiR objects are required in PROFINET for adding IO devices as a CiR/H-CiR operation.

Whether an IO device can be added or removed is independent of whether the device itself supports CiR or not. It should be noted that the neighboring devices must support CiR if the interface parameters are to be adjusted during a CiR/H-CiR operation.

Interface parameter assignment includes the enabling or disabling of ports as well as the modification of the configured topology. If one of these steps is necessary for addition or removal, the neighboring devices or the neighboring device at the end of a line must support CiR as a requirement.

Figure 5-2
Note

For more information about Configuration in Run with configured topology, please refer to the following FAQ:
"What do you have to consider for non-CiR-compatible IO devices in conjunction with PROFINET and configured topology?"

Note

The re-parameterization of the internal PN interface of the CPU 410 is only possible with H-systems as H-CiR process.

Address ranges in Configuration in Run

In the case of CiR/H-CiR with PROFINET, no CiR objects are needed and thus no address spaces have to be reserved.

If IO devices or submodules are to be added and removed during a CiR/H-CiR operation, care must be taken so that logical addresses and device numbers are not used more than once during a CiR/H-CiR operation. As an example, when removing an IO device with EB245 (input byte), no other IO device with EB245 may be added in the same step. This can be prevented by first adding the new IO device or submodule in the configuration phase and then deleting the IO device or submodule you wish to remove.

Note

If multiHART or HART variables are not used, the address spaces for the corresponding HART subvariables must still be reserved.

Update time in Configuration in Run

To set the update time of IO devices, HW Config has three modes: "automatic", "fixed update time", and "fixed factor". When using Configuration in Run, it is recommended to set the update time of all non CiR-capable devices to a fixed value.

The reason is that during automatic configuration, HW Config configures the update time based on the devices present in the IO system. The addition or removal of IO devices can lead to a change in the update times (of the factor), which is only possible as interface parameters in form of a CiR/H-CiR operation with CiR-compatible devices.

In this case, it is possible to restore CiR consistency by undoing changes to the update time of the non-CiR-capable devices concerned.

CAUTION

If a CiR operation is performed on CiR-capable IO devices, the update time following this CiR operation must be at least 1 ms.
Neighborhood detection - LLDP mode

The Link Layer Discovery Protocol (LLDP) is a manufacturer-independent protocol used for the exchange of information between neighboring devices. It serves for various tasks, including the recognition of the network topology.

When using Configuration in Run, it is important to draw a line between two different standards: LLDP mode V2.2 and V2.3.

When using CiR, it is recommended to force the V2.2 LLDP mode. This setting is located in the properties of the CPU’s PROFINET interface – see Figure 5-3.

**CAUTION** When using CiR, it is recommended to force the V2.2 LLDP mode.

The reason is that the CPU 410 and newer IO devices support both modes and that HW Config automatically determines the mode from the configured devices by default. Version V2.3 is used if all IO devices support it. If an IO device does not support this mode, version V2.2 is used. For Configuration in Run, this is especially important if only IO devices with V2.3 support are to be configured. In such case, even the CPU uses version V2.3. If you had to add an IO device that only supports LLDP mode V2.2, the CPU would change the LLDP mode to V2.2 and the system would lose its CiR capability. The same applies to a scenario in which all IO devices with V2.2 are removed from a mixed IO system.
The LLDP mode defined via HW Config can be displayed using the menu command "PROFINET IO LLDP mode…", accessible from the shortcut menu of the PROFINET IO system.

Figure 5-4

S1 Devices on the H System

It is not recommended to operate S1 devices with cyclic IO data on an H system. The reason is that S1 devices can only establish one application relationship with a CPU of the H system. If the CPU stops, the connection to the IO device is interrupted and the H system is not supplied with current data any longer. In Configuration in Run, it means that unilaterally configured IO devices (S1) on the H system support only limited changes during operation (H-CIR), regardless of whether they are CIR-capable or not.

Note

Switches can only be integrated on one side as S1 devices in an R1 network structure. In the H-CIR process, they behave as follows:

- The switching functionality is retained, i.e., the connection to IO devices behind the switches remains available without restriction.
- This causes a failure and rebuilding of the application relationship between the switch and the CPU. No diagnostic data is available in the H system when the assigned CPU is stopped.
- The interface parameters can be changed.
ET 200SP HA

When connecting the ET 200SP HA via single PROFINET configuration S1 or system redundancy S2, Configuration in Run is supported with up to 1000 byte user data. If connected as an R1 device, the entire quantity structure of 1440 bytes is available.

SINEC NMS & SINEMA Server

The network management software SINEC NMS and SINEMA Server offers the possibility to save a reference topology of the network as a target state. This reference topology is used in online mode as a basis for monitoring the network and allows it to detect deviations from the target state.

If changes are made to the network topology, (e.g., IO devices are added or removed) the reference topology in SINEC NMS or SINEMA Server must then be updated.
5.2 Topology Configuration – Replace Device without Exchangeable Medium

Requirement

The requirement that the device replacement must be able to be carried out by an electrician in case of error, means that automatic initialization is required for PROFINET IO devices. Without automatic initialization, the initialization would have to be done with the Engineering Station/programming device (ES/PG) if a device is replaced.

Here are two possibilities for automatic device initiation:

- Topology configuration
- Use of the PROFINET BusAdapter or other storage media (e.g. C-plug), which save the device name locally

Topology configuration is recommended for SIMATIC PCS 7.

Benefits of topology configuration

- Automatic commissioning
- Replace device without exchangeable medium
- Topology comparison between target and actual topology to ensure correct cabling
- Source data for SINETPLAN

5.2.1 Possibilities for Topology Configuration

Automatic commissioning

Thanks to automatic commissioning, the devices do not have to be initialized individually. Rather, the IO controller undertakes the initialization for the entire IO system.

The IP address and device names are assigned without requiring a removable medium (e.g. Micro Memory Card) with a saved device name or a programming device (PG). The topology of the IO system, which is configured offline and then loaded into the IO controller, forms the basis for automatic commissioning. By comparing the loaded target topology and the actual topology determined via LLDP, the IO controller can identify the IO devices without names and assign the configured names and IP addresses accordingly. This reduces time requirements and also the number of possible sources of error during commissioning.

Note

As a requirement for automatic commissioning, the IO controller and the IO devices must support the PROFINET functionality "Replace device without exchangeable medium".

Note

The port interconnection of the real system must match the topology configuration. An incorrect name could be assigned if errors occur.
CAUTION  As a requirement for automatic commissioning, the devices and BusAdapter must be reset to factory settings and have no name assigned.

Replace device without exchangeable medium

If the topology is configured and the function "Replace device without exchangeable medium" is enabled in HW Config, it is possible to perform automatic commissioning and replace a device without storage medium. For device replacement, it is sufficient to replace the defective hardware with a replacement device of the same type, which has been reset to factory settings. When this is done, the device receives its name and IP address automatically by the IO controller, with no intervention by the user.

The advantage of device replacement based on topology configuration is that it also covers the defect of the explicit storage media or BusAdapters on which the device name is stored.

CAUTION  Requirement: in order to replace the device without a removable medium, the replacement device and BusAdapter must be first reset to factory settings and have no name assigned. This must be taken into account during stockkeeping.

Reading-In the Actual Topology

If the automatic commissioning function is not to be used (e.g. because not all devices are yet present during commissioning), it is possible to scan the existing actual topology and save it as the target topology after successful commissioning. Scanning and saving the actual topology is performed in the Topology Editor via the tab "Offline/Online comparison". To do this, the ES must be connected to the PN network. This connection can be established via the Service Bridge (see Section 3.5).

It is then possible to exploit the advantages of device replacement without a swappable medium by reloading the station (STOP may be required).
Topology comparison between target and actual topology

The Topology Editor makes it possible to compare the configured target topology with the actual topology determined online. The online view of the “Graphic view” tab is shown in Figure 5-5 as an example. Their accessibility or status is indicated by color highlighting.

Figure 5-5

Source data for SINETPLAN

If the topology is configured in HW Config, it can be used as the basis for the network planning software SINETPLAN (Siemens Network Planner) without the need for topology configuration in SINETPLAN. The following data is imported from SINETPLAN:

- Configured devices
- Network topology
- Real-time data flows between the devices

You can find further information on SINETPLAN in Section 6.1.1.

FAQ

“How do you prepare STEP 7 for the export of topology data/flows for SINETPLAN?”

5.2.2 Notes on Topology Configuration

Creating the topology

HW Config provides three options for topology configuration:

- Configuration with the port properties in HW Config
- Tabular interconnection with the Topology Editor
- Graphical interconnection with the Topology Editor (recommended)

Note

Switches must be configured as IO devices for topology planning.

Note

Topology configuration is only possible within a project, i.e. the stations on a shared PROFINET network must be within the same project.

Use of the Service Bridge

When the Service Bridge is used, the scan feature of the topology and the target/actual comparison can be run from the ES, which is located in the system bus.

In addition to the PROFINET devices, the scan also detects the nodes on the system bus and the Service Bridge. The list of existing devices is thus larger than the list of configured devices. Unknown devices are displayed in color on an orange background.

Nevertheless it is still possible to apply the actual topology scanned to the target topology.

Note

The corresponding PROFINET segments must be enabled on the Service Bridge.

R1 network

In the case of an R1 network structure, it must be noted that the graphic view refers to two separate subnets when scanning the topology or during the target/actual comparison.

When the Service Bridge is used, access to both subnets can be enabled simultaneously, so that the scan finds all devices.

If the ES is connected directly to the PROFINET network without using the Service Bridge, the scan must be performed in both subnets, otherwise only the devices in the corresponding segment are found. Devices behind a Y switch are visible in both scans. Devices on the system bus are not found. If the ES is connected downstream from the Y switch, all devices in the PROFINET network are found during the scan.
5.3  Operational Reliability

5.3.1  General Measures

To increase the operational reliability of the PROFINET networks in PCS 7 systems, the following measures are recommended:

**General information**

- Protect the infrastructure against unauthorized access (e.g. lock the control cabinet/rooms)
- Measure/test the cable before connecting it (wiring, shield connection)
- Do not lay the cables next to each other (isolate the outgoing and return lines spatially)
- Topology configuration so that devices receive their configuration automatically after a factory reset
- If possible, protect internal interfaces of the CPU 410 from external connections. This is done by activating the "Enable additional protection for the interface" function in the properties of the interface of the CPU.

| CAUTION | Devices with PROFIsafe communication must be protected against unauthorized access, i.e. only within a cell with access protection. |

**Switches**

- Deactivate SET/RESET switch
- Use the HTTPS protocol for accessing the Web Based Management (disable HTTP access)
- Change the default password for the Web/CLI access to the switches
- Use of the "Loop Detection" function
- Disable write access to SNMP variables

**All PN devices**

- Disable unused ports and lock with Hardlock if necessary

**Commissioning**

- Before physically connecting the ring, it must be already configured.

**Note**  You can find further measures for increasing operational reliability in the manual: "SIMATIC Process Control System PCS 7 Compendium Part F – Industrial Security"  

**Note**  Please also note the security guideline for PROFIBUS & PROFINET International (PI): 
https://www.profibus.com/download/profinet-security-guideline/
5.3.2 **Loop Detection**

Loop detection is a function of the SCALANCE switches, which serves for detecting loops in the network and limiting their effects. A loop is an error in the network configuration that occurs when a network cable connects two ports on the same switch, or when several connections that are not managed by a protocol (e.g. MRP) exist between two switches.

Broadcast packets sent through loops can lead to a broadcast storm within seconds, thus overloading the network.

Loop detection allows these negative effects of a loop to be limited to a specific area in the network. This function can be configured in the SCALANCE switches, e.g. via Web Based Management (WBM).

**Functionality and configuration**

The loop detection function detects existing loops in the network by sending special test frames. If the telegrams sent by a switch return to the same switch, a loop exists.

Loop detection works with three different port modes, which are configured in the WBM of SCALANCE switches:

- **Sender** – sends loop detection (LD) telegrams
- **Forwarder** – (default setting) forwards the LD telegrams
- **Blocked** – stops forwarding LD telegrams

![Loop Detection Diagram](image-url)
This allows two types of loops to be detected and treated with different responses (disable port/no response):

- Local Loop – LD telegram is detected at a different port
- Remote Loop – LD telegram is detected on the same port

It is recommended to block the respective ports in response to a loop detection. Note, however, that the port must be enabled again via the WBM. An automatic reactivation of the port is not implemented.

Figure 5-7

Note

Loop detection cannot be activated with the ring ports of a switch.

As a rule of thumb, the switches in the network (from "bottom to top") should use increasingly larger thresholds for the number of detected LD telegrams. With this control, the local switches react first and switch off the specific port before the higher level switch disconnects the entire cell.
Examples using the blueprints

In general, it is recommended to configure the Service Bridge as a loop detection sender. This way, the effects of loops can be mutually protected at the various network levels.

The blueprints in the following section present various application scenarios for loop detection.

1. High-end blueprint of a standard automation system

In this blueprint, the loops in the secondary ring pose a danger, which could spread throughout the system via the backbone. Rings with loops are detected and isolated through active loop detection at the branches.

Figure 5-8
2. High-end blueprint of an H system with system redundancy S2

In this blueprint, loops in the linked rings pose a danger, which could spread throughout the system via the backbone line. Rings with loops are detected and isolated through active loop detection in the coupling paths.

Figure 5-9
3. Blueprints of an H system with a redundant PROFINET R1 configuration

In this blueprint, a danger exists due to loops in subordinate S2 segments/rings, which could spread throughout the system. Segments/rings with loops are detected and isolated through active loop detection in the coupling paths.

Figure 5-10
5.4 Media Redundancy with MRP

The Media Redundancy Protocol (MRP) enables the connection of devices based on ring topologies. The use of ring topologies with MRP is independent of the system redundancy (S1, S2 or R1).

In order to set up an MRP ring, all ring nodes (e.g. IO controllers) must support MRP, but please note that MRP only allows a maximum of 50 nodes per ring.

MRP defines 3 roles: MRP Manager (MRM), MRP Client (MRC), and MRP Manager Auto (MRA). In an MRP ring, there may be only one MRP Manager. The remaining nodes must be configured as MRP Clients. If the role of MRP Manager Auto is configured multiple times within a ring, an MRP Manager Auto takes over the role MRP Manager and the others fall into the role of MRP Client.

The MRP Manager is responsible for constantly checking the ring connection. If the ring is functional, the MRP Manager blocks a port, opens the ring connection and provides a loop-free communication. If the transmission path fails, the MRP Manager activates the blocked port and provides another communication path. Subsequently, the ring participants have to relearn their communication channels. The maximum reconfiguration time is 200 ms.

Due to the maximum reconfiguration time of 200 ms, the watchdog time must be set to at least 200 ms for all nodes in the ring and devices downstream from the ring. Otherwise, the CPU may detect the failure of IO devices by mistake during reconfiguration.

Note

It is recommended to configure only one node as MRP Manager or MRP Manager Auto in the ring.

CAUTION

The Hardware Configuration must be loaded before physically connecting the ring. Otherwise, a loop could form, which would lead to undesirable reactions in the network.
Diagnostic interrupts

When configuring an MRP ring, it is recommended to select the "Diagnostic interrupts" checkbox in the MRP Manager's media redundancy settings. The diagnostic interrupt option is a requirement, so that a message is generated in the operator station when the ring is interrupted.

Figure 5-12

Furthermore, the option "OB 82 / IO Fault Task – call at communications interrupt" option must be activated in the settings of the PROFINET interface of the CPU. If the option is deactivated, only one diagnostic buffer entry is generated in the CPU in case of diagnostic interrupts.

Figure 5-13

CAUTION

If one of the above described options, "Diagnostic interrupt" or "OB 82/IO Fault Task – call at communications interrupt", is deactivated, no message is generated in the operator station when the MRP ring is interrupted.
5.5 Using Blueprints

5.5.1 Multi-Controller Networks

PROFINET allows several IO controllers to operate in a shared network. For PROFINET in SIMATIC PCS 7A, we recommend a maximum of four automation systems per PROFINET segment.

The following figure shows an example configuration with two standard automation systems. In addition to the possibility of setting up separate PROFINET networks (see (1) and (2)), a shared PROFINET network is also set up for the field area (see (3)). In this shared network, both IO controllers have access to their assigned IO devices.

Figure 5-14

For complete topology configuration of a multi-control network, all IO controllers must be within the same project.

5.5.2 Segmentation

By segmenting the system, it is possible to increase system availability, reduce the network load, and create a clearer assignment. When using the AS 410 automation system and PROFINET, networks can be segmented physically or logically.

Physical segmentation

The AS 410 has two internal PROFINET interfaces, which enable you to set up two physically separate segments. Up to 250 IO devices can be integrated per interface/segment. It is not possible to use the CP 443-1 for more PROFINET segments. If a system segmentation is required in more than two system sections, it is recommended to also implement logical segmentation.

Logical segmentation

By using switches, it is possible to divide the system into any number of logical segments. This division is possible irrespective of the system connection (S1, S2 or R1). It is recommended to arrange the switches responsible for the segmentation close to the CPU.
In the logical segmentation of the H system networks, it is possible to set up MRP rings instead of lines for the connection of switches.

Disadvantages:
- In case of error, the reconfiguration process of the MRP ring is slower than the switchover time of the H system.
- The MRP ring leads to increased configuration effort since the MRP domain would have to be configured and the watchdog times adjusted.

5.5.3 Update Time

The update time is the time interval in which IO devices/IO controllers are cyclically supplied with new data. PROFINET offers the option to individually configure the update time for each IO device.

To set the update time of IO devices, HW Config has three modes: "automatic", "fixed update time", and "fixed factor".

When the default "automatic" setting is enabled, HW Config automatically calculates an optimized (i.e., quickest possible) update time.

This can be adjusted manually by selecting the "fixed update time" or "fixed factor" mode.

When selecting the update time, the following factors should be considered:
- Process requirements
- Number of PROFINET IO devices
- Quantity of configured user data

In order to keep the network load as low as possible, it is also recommended to select the update time for each IO device as follows:
- As short as necessary.
- As long as possible.

Note

The update time of IO devices without cyclic IO data is automatically 128 ms and usually does not need to be changed.
Watchdog Time

The watchdog time is calculated from the product of "Update time" and "Number of accepted update cycles with missing IO data". The IO device should be identified as failed if this time elapses with no IO data.

The watchdog time must be adjusted depending on the network architecture, e.g. ring (see Section 5.4) or network with a large line depth. Line depth is the number of devices (switches/IO devices with integrated switches) that a telegram must pass through on its way between IO device and IO controller.

At an update time of 2 ms and a watchdog time of 6 ms (default setting), the line depth can include up to approx. 50 IO devices. A higher update time or an adjustment to the watchdog time allows for greater line depth. When using HW Config to perform automatic calculation of the update time, the line depth is used in the calculation and the watchdog time does not have to be adjusted manually.

5.5.4 Cyclic Network Load

The cyclic network load generated should be taken into consideration right from the planning phase of the system. PROFIBUS & PROFINET International (PI) recommends the following limit values for the network load of cyclic real-time communication in the PROFINET Installation Guidelines:

- < 20 % – no handling required.
- 20 to 50 % – a review of the planned network load is recommended.
- > 50 % – measures have to be taken to reduce the network load.

Note

Download "PROFINET Installation Guidelines"
https://www.profibus.com/download/profinet-installation-guidelines/

HW Config automatically calculates the cycle times for small PROFINET networks if they are fully configured within a project. It is not necessary to check the network load again.

If a shared network is used by several automation systems that are configured in different subprojects or if there is a high Non Realtime Traffic (NRT), for instance, due to webcams, the network load must be checked.

The network load calculation can be performed, for instance, with SINETPLAN (Section 6.1.1).

Measures to reduce the network load

In principle, the update time of the IO devices should be checked first. It is recommended to set an update time speed that reflects what is needed for the process to complete.

If the network load is still too high after the update time has been increased, the topology can be optimized, e.g. by segmenting the system.
5.5.5 S1 Devices on the H System

It is not recommended to operate S1 devices on an H-system. The reason is that S1 devices can only establish one application relationship with a CPU of the H system. If this CPU stops, the connection to the IO device is interrupted and no more current data is available in the H-System. The S1 devices are not available on both CPUs of the H system – even through MRP or the Y switch.
5.5.6 R1 Networks

Physical configuration
When establishing an R1 network structure, it is recommended to establish physically separate networks for the two subnets. This has the advantage that in the event of a network fault (e.g. due to a loop), the other network remains available for communication. As for the cabling, we recommend reverse cabling, as shown in the following figure. Dual cabling ensures that all other nodes remain available in the event of a failure or station replacement.

Figure 5-16

IP addresses
When configuring the IP addresses of R1 networks, the following notes must be observed:

- In a purely R1 configuration without a Y switch and without embedded S2 devices, the two subnets can be in the same IP address ranges or in different ones.
- In a mixed configuration (R1 and S2 devices), the two subnets must be in the same IP address range. A common PROFINET IO system is configured in the HW Config.

CAUTION | Device names and IP address must be unique within a network.
Switches in an R1 network

Switches in an R1 network structure have only one connection to a CPU due to the network separation. They can, therefore, only be integrated as S1 devices on one side. This is independent of whether or not they support S2 system redundancy. Figure 5-17 shows an example configuration with two XF204-2BA switches in an R1 network structure (1 and 2) and a Y switch (XF204-2BA DNA) (3).

Figure 5-17

(1) Switch in R1 network with connection to the CPU in rack 0
Can only be configured as an S1 device on one side.

(2) Switch in R1 network with connection to the CPU in rack 1
Can only be configured as an S1 device on one side.

(3) Y switch with connection to both CPUs (rack 0 and rack 1)
Can be configured as an S2 device for redundant operation.

When configuring an S2-capable switch within an R1 network structure, the following must be observed if a common PROFINET IO system is configured in the HW Config (e.g., in a configuration with a Y switch):

By default, an S2-capable IO device is automatically configured for redundant operation during configuration on the PROFINET network of a high-availability automation system (i.e., the IO device is assigned to both CPUs). Since switches in an R1 network structure only have one connection to a CPU due to the network separation, the assignment must be adjusted in this case.

If the assignment is not adjusted, the switch is recognized as failed by the CPU that is not connected and a corresponding bus error and alarm is generated.

The assignment to the CPUs is configured in the properties of the switch in the "Redundancy" tab (1) by enabling or disabling the checkboxes (2). Figure 5-18 shows the configuration of an XC208 switch assigned only to the CPU in Rack 1.
In the H-CiR process, switches in an R1 network structure behave as follows:

- The switching functionality is retained, i.e., the connection to IO devices behind the switches remains available without restriction.

- This causes a failure of the application relationship between the switch and the CPU, thus leading to a device failure and returns after a hot restart of the CPU. No switch diagnostic data is available in the H system during the failure.

- The interface parameters can be changed.
5.5.7 **Industrial Wireless LAN**

IWLAN can be used in the PROFINET environment. For reliable operation, please observe the notes in Section 3.7, especially the use of iFeatures, possible response times, and the provision of free channels for the applications. The IWLAN products of the SCALANCE W700 IEEE 802.11n only support the system redundancy S1 itself. The IO devices behind an IPCF client can be connected via S2 system redundancy. For this, it is mandatory that the SCALANCE W700 products have firmware V6.5.0 or higher.

**Note**

Further notes for the configuration of the IWLAN products can be found in Section 5.6.9.

Three example configurations for IWLAN in high-availability automation systems are presented below. The use of IWLAN in the standard automation system is also possible.

**H-System with simple system redundancy – standard**

The following figure shows how two devices (S2 devices) can be connected to an H system using IWLAN.

Figure 5-19

![Image of H-System with simple system redundancy](image)

Two separate IWLAN networks (two SSIDs) are set up using two separate IWLAN access points (IWLAN AP). The separate networks are identified by the different SSIDs. An IWLAN client is connected to each of the WLAN networks. In this example, there is an S2 device under each of the IWLAN clients. The IWLAN AP does not support MRP and must, therefore, be integrated remotely.
H-System with redundant PROFINET configuration R1 – Standard

The following figure shows how an R1 device can be connected via IWLAN.

In this case, two separate IWLAN networks are established. This ensures the network separation of the two R1 networks.

In this case, the IWLAN AP and clients, as well as the switches shown, can only be connected as S1 devices.
H-System with redundant PROFINET configuration R1 – High End

The following figure shows how several S2 devices can be connected to an R1 network structure using IWLAN.

Figure 5-21

In this case, the IWLAN network is established by an IWLAN AP behind an XF204-2BA DNA (Y switch). A switch is used behind the IWLAN client, via which the S2 devices are connected by means of an MRP ring.
5.6 Device-Specific Notes

5.6.1 Function overview of PROFINET devices

You can find an overview of the PROFINET devices and PROFINET functions relevant to SIMATIC PCS 7 in the following FAQ on the Industry Online Support portal:


5.6.2 AS 410

Firmware version

For the use of PROFINET, firmware V8.2 or higher is recommended. The following PROFINET functions are only available with FW V8.2 and higher:

- Redundant PROFINET R1 configurations
- Configuration in Run in standard systems (CiR)
- Configuration in Run in H systems (H-CiR)
- High-precision timestamping (SoE)

The firmware can be updated by performing a firmware update.

Note

Instructions


Download


Redundant PROFINET R1 Configuration

To connect PROFINET IO devices via redundant PROFINET R1 configurations, you need an additional license, which is transferred to the CPU in the System Expansion Card (SEC).

The required license "PCS 7 CPU 410 EXPANSION PACK (PN RED)" can be ordered in two variants:

- License on USB stick: 6ES7653-2CX01-0XE0
- License via Online software delivery (download): 6ES7653-2CX01-0XK0

Note

Application example

"Process automation with the SIMATIC PCS 7 CPU 410-5H controller"


Manual

"SIMATIC PCS 7 Process Control System CPU 410 Process Automation"

5.6.3 ET 200SP HA

Carrier module
The interface of the ET 200SP HA consists of the IM 155–6 PN HA interface module together with the carrier module and the BusAdapter. The interface serves for communication between the CPU and the connected ET 200SP HA I/O modules via PROFINET.

Different carrier modules are required depending on the system connection – this must be taken into account during the planning phase.

The following two variants exist:
- Carrier module for an IM 155-6 PN HA – for single PROFINET configuration S1 or system redundancy S2
- Carrier module for two IM 155-6 PN HA - for redundant PROFINET R1 configuration

Configuration in Run
When connecting the ET 200SP HA via single PROFINET configuration S1 or system redundancy S2, Configuration in Run is supported with up to 1000 byte user data. If connected as an R1 device, the entire quantity structure of 1440 bytes is available.

IO redundancy
When using the terminal blocks for IO redundancy (TB45), care must be taken so that the L+ supply voltage terminals are separated from each other. The supply voltage must be connected to both terminals.

Furthermore, only terminal blocks for individual I/O modules or only terminal blocks for IO redundancy may be used within a potential group.

Note
For further information about wiring rules, refer to the manual:
"SIMATIC ET 200SP HA ET 200SP HA Distributed I/O system"
5.6.4 IE/PB LINK HA

The IE/PB LINK HA allows for the connection of up to 125 PROFIBUS slaves and up to 64 PROFIBUS slaves as S2 devices. It must be ensured that only compact slaves (e.g., drives) are supported with SIMATIC PCS 7. This means that the connection of modular slaves (e.g., an ET 200M) via the IE/PB- LINK HA is not possible. To integrate modular PROFIBUS slaves into the system, you can use the internal interface of the CPU. S7 routing and data record routing are supported via the IE/PB LINK HA.

The IE/PB LINK HA supports the S2 system redundancy, as well as Configuration in Run (PROFINET and PROFIBUS side).

**Note**
The Configuration in Run functionality is only supported on the H-System and not on the standard automation system.

**Note**
The addressing of DP or PA slaves downstream from the IE/PB link PN IO is not possible.

**Media redundancy – MRP**

The PROFIBUS devices downstream from the IE/PB link are visible to the CPU as PROFINET devices. Therefore, the watchdog time of the IE/PB link and that of all PROFIBUS devices must be adjusted to over 200 ms when using MRP.

5.6.5 IE/PB LINK PN IO

The IE/PB LINK PN IO enables the connection of up to 64 PROFIBUS slaves. It must be ensured that only compact slaves (e.g., drives) are supported with SIMATIC PCS 7. This means that the connection of modular slaves (e.g., an ET 200M), via the IE/PB LINK PN IO is not possible. To integrate modular PROFIBUS slaves into the system, you can use the internal interface of the CPU. S7 routing and data record routing are supported via the IE/PB LINK PN IO. The S2 system redundancy and Configuration in Run functionalities (PROFINET and PROFIBUS side) are not supported.

**Note**
The addressing of DP or PA slaves downstream from the IE/PB link PN IO is not possible.

**Media redundancy – MRP**

The PROFIBUS devices downstream from the IE/PB link are visible to the CPU as PROFINET devices. Therefore, the watchdog time of the IE/PB link and that of all PROFIBUS devices must be adjusted to over 200 ms when using MRP.
5.6.6 Switches

The recommended SCALANCE switches XC-200, XP-200, and XF204-2BA (see Section 3.4) log occurring events in a log table. This can be called up via Web Based Management and contains entries, such as change of the connection status of a port with the associated timestamp.

In order to facilitate the traceability of the timestamp in the case of a diagnostic event, it is recommended to set the system time of the switches.

The system time of the switches can be set manually or synchronized, for example via the SIMATIC or NTP method.

For the switches in the PROFINET fieldbus, synchronization via the SIMATIC method is optimal, since the CPU supports this procedure as a time master. If the CPU is active in the fieldbus as the SIMATIC time master, only the synchronization in the switch must be enabled as SIMATIC Time Client via the WBM. Figure 5-22 shows the procedure for activating time synchronization via the SIMATIC procedure using the example of an XC-200 switch.

![Figure 5-22](image)

5.6.7 BusAdapter

The bus adapters for PROFINET IO allow you to freely select the connection technology for the device. For the interface modules, multiple variants of the BusAdapters are available.

Examples:
- BusAdapter with standard RJ45 plug (BA 2xRJ45)
- BusAdapter with Fast Connect connector for direct connection of the bus cable (BA 2×FC)
- BusAdapter with connector for fiber-optic cable (BA 2xLC)
- BusAdapter with one standard RJ45 plug and one plug for fiber-optic cable (BA LC/RJ45)
- Bus adapter with a Fast Connect plug for direct connection of the bus cable and a plug for fiber-optic cable (BA LC/FC)
- BusAdapter with standard RJ45 plug for distances up to 1000m (BA 2xRJ45VD HA)
The BusAdapter BA 2xRJ45VD HA offers the possibility to enable distances up to max. 500m (at 100Mbit/s) with ethernet conform cables.

A 2-wire transmission function (Variable Distance) can be used to establish Ethernet connections even over non-Ethernet-compliant cables (e.g., PROFIBUS FC standard cable; > 100 m, up to max. 1000 m). The bridgeable distance depends on the line quality. This means that PROFIBUS FC standard cables that have already been laid can be used for PROFINET. When upgrading existing systems, the existing infrastructure can, therefore, be used. This can be considered for lines that are difficult to install.

When used, it must be ensured that a BA 2xRJ45VD HA bus adapter is installed at both ends of the cable.

Figure 5-23

Note
The ET 200SP HA and the CFU only support 100Mbit/s when using the BusAdapter BA 2xRJ45VD HA. This must be taken into account when planning the maximum cable lengths and the type of cable used.

Note
For further information about BusAdapters, refer to the manual:
"SIMATIC Distributed I/O devices BusAdapter for Distributed I/O"

Note
Further information about the bus adapter BA 2xRJ45VD HA can be found in the manual:
"SIMATIC: Network components SIMATIC BusAdapter"
5.6.8 Configuration of the Y Switch (XF 204-2BA DNA)

When configuring the Y-Switch, no separate PROFINET system is mapped in HW Config. This means that no direct assignment is visible in HW Config as to which IO devices are physically installed behind which Y switch. However, the Y-Switch and the IO devices behind it can be placed graphically accordingly:

Figure 5-24

In topology configuration, the arrangement of the devices is visible in the graphical view of the topology editor.
5.6.9 Configuration of SCALANCE W Components

Topology configuration

The IWLAN AP and clients can be configured as IO devices. The advantage is that the topology can be configured up to the IWLAN AP and behind the IWLAN client. This is necessary for the automatic device exchange of the IO devices behind the IWLAN client. The IWLAN route or an assignment of clients to an AP cannot be configured in the topology editor.

Here is an example of this type of configuration

Figure 5-25

Configuration in HW Config

To connect S2 devices behind an IWLAN client, the client and the IWLAN AP must have firmware V6.5 or higher. The PCS 7 catalog does not contain this firmware; therefore, the older firmware version of the devices must be configured.

The IWLAN devices can only be configured as S1 devices.

Configuration of the IWLAN AP & Clients

The IWLAN configuration must be done via the Web-Based Management, Command Line Interface or SINEC NMS. There is no possibility for this in HW Config. In case of replacement, it is recommended to equip the corresponding IWLAN components with a C-Plug on which the configuration is saved. This ensures easy device replacement by removing the C-Plug from the defective device and inserting it into a new device.

Points to consider include the following:
- Activation of iPCF is necessary for real-time communication (PROFINET).
- "Layer 2 Tunnel" must be activated on the IWLAN client.
- Maximum 8 IO devices behind one IWLAN client.
- The minimum recommended update time of IO devices behind an IWLAN Client is 32ms; these times have to be adjusted depending on the application.

Note

For more information on configuration, see the application example "IWLAN: Setup of a Wireless LAN in the Industrial Environment"
5.7 Setting the PG/PC Interface

By setting the PG/PC interface, you define which access point the applications (STEP 7, WinCC, etc.) use for network access.

The following table provides an overview of the interface types used in the PCS 7 environment and their applications:

Table 5-2

<table>
<thead>
<tr>
<th>Setting the PG/PC Interface</th>
<th>Function</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC internal (local)</td>
<td>Automatic selection of the access point based on the</td>
<td>• Loading of stations and automation systems</td>
</tr>
<tr>
<td>(Recommended setting in the</td>
<td>interfaces configured in the component configurator</td>
<td></td>
</tr>
<tr>
<td>PCS 7 environment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCP/IP or RFC1006</td>
<td>Use of the TCP/IP protocol for access via the set</td>
<td>• Online mode of the topology editor (^1)</td>
</tr>
<tr>
<td></td>
<td>interface (IP-addresses-based)</td>
<td>• Loading an automation system via the &quot;Show</td>
</tr>
<tr>
<td></td>
<td></td>
<td>accessible nodes&quot; function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Using the &quot;Edit Ethernet nodes...&quot; function</td>
</tr>
<tr>
<td>ISO</td>
<td>Use of the ISO protocol for access via the set</td>
<td>• Loading an automation system without an IP</td>
</tr>
<tr>
<td></td>
<td>interface (MAC-addresses-based)</td>
<td>address via the &quot;Show accessible nodes&quot; function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Using the &quot;Edit Ethernet nodes...&quot; function</td>
</tr>
</tbody>
</table>

1) When using the Service Bridge, the separate network adapter must be used to access the PROFINET networks.
In principle, no additional tools are required when using PROFINET. However, different tools are available for PROFINET in all phases of the project life cycle as an aid for special cases or support purposes. The following section presents the relevant tools based on the typical lifecycle phase for their application. It is also possible to use them in other phases.

Figure 6-1
6.1 Planning

6.1.1 SINETPLAN (Siemens Network Planner)

SINETPLAN (Siemens Network Planner) is a tool for calculating the network load, which can already be implemented during the planning phase. SINETPLAN enables predictive planning through a simple network load calculation. Critical locations, where a network load check is recommended or necessary, are highlighted in color depending on the data throughput.

It is necessary to calculate/check the network load, especially for complex networks consisting of several projects and existing NRT (Non Realtime) communication (for instance, from video systems). HW Config automatically calculates the cycle times for networks if they are fully configured within a project. There is no need to use additional tools for the network load calculation.

Advantages

- Online scan function
- Import the topology and real-time data flows from STEP 7 or PCS 7 projects
- Port-by-port simulation
- Identification of areas with critical network load
- Reporting function

Note

**Manual**
"SINETPLAN Siemens Network Planner"

**FAQ**
"How do you prepare STEP 7 for the export of topology data/flows for SINETPLAN?"

Note

**Download**
"SINETPLAN Trial Version"
6.2 Commissioning

Various tools with different ranges of functions are available for commissioning. The following table compares the tools.

Table 6-1

<table>
<thead>
<tr>
<th>Product Functions</th>
<th>SIMATIC PCS 7</th>
<th>SINEC PNI Basic</th>
<th>PRONETA Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent of the set PG/PC interface</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Assign IP address</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Assign PROFINET device names</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Topology</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>IO Test (without IO controller)</td>
<td>✗</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>Firmware update of SCALANCE products</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Enabling SNMP</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Changing passwords for SCALANCE products</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
</tr>
</tbody>
</table>

6.2.1 SIMATIC PCS 7

All the required functions for commissioning a PROFINET network are integrated in SIMATIC PCS 7. In SIMATIC PCS 7, it is possible to assign device names and IP addresses manually or automatically via the automatic commissioning feature.

Functions

- Browse network for reachable devices via "Show accessible nodes"
- Manual assignment of device names and IP addresses via "Edit Ethernet nodes..."
- Reading in the actual topology with the topology editor
- Topology comparison between target and actual topology using the Topology Editor
6.2.2 SINEC PNI Basic

SINEC PNI (Primary Network Initialization) Basic is a free tool for initializing Siemens network components; one of its uses is for assigning device names and IP addresses. A password change can be performed for several devices (including SCALANCE products) at the same time. A firmware upgrade of SCALANCE and RUGGEDCOM products is also possible.

SINEC PNI is independent of other configuration tools (i.e., SIMATIC PCS 7) and can be installed and used on all standard Windows PCs.

Functions

- Browse network for accessible devices
- Assign device names and IP addresses
- Restoring to factory settings
- Launch Web Based Management
- Initial password change (SCALANCE & RUGGEDCOM)
- Firmware upgrade (e.g., for the SCALANCE product families)
- Download and upload of configuration for SCALANCE products and others
- Download and upload of files needed to diagnose problems (e.g., for SCALANCE)

Advantages

- Simple operation
- Does not need STEP 7 or PCS 7 to be installed
- Available free of charge

Note

Download and manual
"SINEC PNI Basic"
6.2.3 PRONETA Basic

PRONETA Basic is a free tool that simplifies the commissioning of PROFINET systems. Just like SINEC PN I Basic, PRONETA Basic does not depend on other configuration tools and can be used on all standard Windows PCs.

In contrast to SINEC PN I Basic, PRONETA offers a graphical user interface with a convenient topology overview and additional functions, such as the I/O test.

Figure 6-2

Functions

- Online topology overview
- Assign device names and IP addresses
- I/O test, e.g. when performing a loop check
- Topology comparison with topology imported from STEP 7/PCS 7 or reference topology saved in PRONETA

Advantages

- Graphical user interface
- Does not need STEP 7 or PCS 7 to be installed
- Does not need to be installed
- Available free of charge

Note

Download and manual "PRONETA"
### Note
When assigning device names, the PROFINET naming conventions must be observed. PRONETA does not test whether the naming conventions have been observed. Characters that are not in line with the naming conventions are replaced by others.

**FAQ**
PROFINET name conventions

### Note
For the I/O test, it is imperative that the IO device does not communicate with any IO controller.
6.3 Operation

6.3.1 SINEC NMS

The SINEC NMS software is a network management system for monitoring and managing industrial networks. It enables the user to fully visualize and monitor networks. Using SNMP with simultaneous diagnostics via SIMATIC and PROFINET mechanisms, many aspects of plant and network diagnostics can be mapped in a single tool.

The SINEC NMS distributed approach enables network infrastructure expansion at any time.

The following figure shows an example configuration. In this case, the SINEC NMS Operation 1 monitors the system bus and terminal bus. The SINEC NMS Operation 2 monitors the fieldbus. Several fieldbuses can be connected via a Service Bridge.

The SINEC NMS Control collects the data of the individual operation.

Figure 6-3
Features of SINEC NMS

- SINEC NMS detects all devices in the network. This provides a constantly updated overview of all installed components including all essential properties in the network.
- The plant Topology is automatically read out, depicted and monitored for changes.
- Diagnostic data is collected from all network nodes and stored centrally. The overall state of the network is displayed via a central dashboard.
- Statistics can be displayed and evaluated over any period of time. In this way it is also easy to analyze historical events.
- Configurable test patterns enable essential network properties to be repeatedly checked and documented.
- A large number of interfaces (e.g., HTTPS, OPC UA) enable network and diagnostic data to be displayed and further processed in higher-level systems.
- Policy-based configuration of various network radio functions.
- Mass Operation for firmware update for single or multiple SCALANCE components.
- Central management of roles and permissions for the entire system.

Note

Download
"SINEC NMS V1.0 Software (incl. 21 days trial license) Download"

Manual
"SIMATIC NET: Network management SINEC NMS"

Application example
"Getting Started: Use and Understanding of SINEC NMS"
6.3.2 **SINEMA Server**

SINEMA Server is a tool for 24/7 monitoring of Industrial Ethernet and PROFINET networks during operation. SINEMA allows networks to be automatically exported, documented, individually structured for each plant and visualized. Furthermore, the SINEMA Server sends alerts and analyzes errors and changes in the network.

The use of SINEMA Server requires permanent access to the PROFINET fieldbus. For security reasons it is therefore recommended not to run it directly on the system bus, but rather to connect it via a separate Service Bridge.

![Image of SINEMA Server diagram]

**Functions**

- Inventory and documentation of all network nodes
- Topological representation of the network
- Read out status information
- Evaluation and display of diagnostic states
- Display of statistics for any time period
- Validation of network parameters
- Configuration of devices via CLI (Command Line Interface) / firmware management
Advantages

- Continuously updated documentation at a central location and avoidance of additional archives
- Fast, easy check of network status over extended time periods
- Firmware update of network components from a central location

Note

Download
"SINEMA Server Trial Version"

Manual
"SIMATIC NET: Network management SINEMA Server"

Application example
"GettingStarted: Understanding and Using SINEMA Server V14"
6.4 Maintenance and Diagnostics

6.4.1 Bus Analyzer (BANY)

The Bus Analyzer (BANY) product helps you to analyze Ethernet/PROFINET network traffic. BANY consists of a combination of the BANY Scope software and its BANY Agent hardware. The BANY Scope software is included with the hardware.

Figure 6-5

The BANY Agent is integrated reaction-free in the network via the integrated TAP (Test Access Point) or via an external TAP. In general, it is recommended to install it directly after the CPU, so that the entire communication of this IO controller can be detected at this point.

A TAP is a passive network component, which transmits all telegrams transparently in a de-energized state. For the purpose of the analysis, TAP also reflects all network traffic without packet loss or delays. This network traffic can be either analyzed live with BANY Scope live or after it has been logged. BANY Scope enables you to determine, show and evaluate all the important PROFINET parameters. BANY Scope automatically interprets the bus traffic and generates, for instance, a live list containing all nodes and diagrams with PROFINET KPIs (cycle time, jitter, port load, etc.). It is also possible to use the data traffic to perform an analysis with Wireshark (Section 6.4.2).

Functions

- PROFINET live list
- PROFINET KPIs (cycle time, jitter, port load, etc.)
- Online analysis of network quality
- Telegram/frame generator (e.g. stress tests)
- Online value tracking
- Online real-time analysis of telegrams
- Telegram capture
Advantages

- Higher transparency for PROFINET communication
- No additional cabling for data communication analysis
- Network quality measurement and stress test as components of network validation

Note

Download and manual
“BANY Agent and BANY Scope”

6.4.2 Wireshark

Wireshark is a free program that serves for analyzing data traffic on a protocol level. To perform an analysis, you must first log the data traffic in the network with a TAP, such as Bus Analyzer Agent (Section 6.4.1). The combination of BANY and Wireshark enables you, for instance, to perform an online analysis of the telegrams.

Advantages

- Standard network analysis tool
- Analyze the data traffic on a protocol level
- Free of charge

Note

Download
“Wireshark”
https://www.wireshark.org/
7 Appendix

7.1 Comparison of PROFINET and PROFIBUS

The table below compares PROFIBUS and PROFINET.

Table 7-1

<table>
<thead>
<tr>
<th></th>
<th>PROFIBUS DP</th>
<th>PROFINET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data channels</td>
<td>One channel between master and slave</td>
<td>Multiple channels between IO controller and IO devices</td>
</tr>
<tr>
<td>Data per device</td>
<td>244 bytes Input/Output</td>
<td>1440 bytes Input/Output</td>
</tr>
<tr>
<td>Data per controller</td>
<td>8 KB</td>
<td>8 KB</td>
</tr>
<tr>
<td>(interface)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of nodes</td>
<td>Maximum 125 slaves per interface</td>
<td>Maximum 250 IO devices per interface (AS 410)</td>
</tr>
<tr>
<td></td>
<td>Maximum 31 slaves per segment</td>
<td>Unlimited number of IO devices in the network</td>
</tr>
<tr>
<td>Cable length</td>
<td>&gt;1000 m (depending on transmission rate)</td>
<td>Electrical: Maximum 100 m&lt;sup&gt;1)&lt;/sup&gt; FOC: Some km</td>
</tr>
<tr>
<td>Addressing the nodes</td>
<td>Manually via DIP switch or telegram</td>
<td>Automatic assignment by IO controller, alternatively manual</td>
</tr>
<tr>
<td>Transmission rate</td>
<td>Maximum 12 Mbps (typically 1.5 Mbps) (half duplex)</td>
<td>100 Mbps (full duplex)</td>
</tr>
<tr>
<td>Topology</td>
<td>Standard: Line Tree and ring topologies are supported</td>
<td>Flexible topologies are supported: Line, star, tree, ring individually and in combination</td>
</tr>
</tbody>
</table>

<sup>1)</sup> Longer distances are possible when using the BusAdapter BA 2xRJ45VD HA.
7 Appendix

7.2 Additional Example Configurations

The following section shows several mixed system configurations based on the blueprints. You can find an example configuration with a description in Section 4.6.

7.2.1 Two Standard Automation Systems with Single PROFINET configuration S1 and MRP

Figure 7-1

![Diagram of two standard automation systems with single PROFINET configuration S1 and MRP](image-url)
7 Appendix

7.2.2 Three Standard Automation Systems with Single PROFINET configuration S1 – Automation Systems In MRP Ring

Figure 7-2

Local Periphery (Centralized)

Central Control Room

Terminals / Plant Bus (exemplary)

Industrial Ethernet

PROFINET, electrical

SoE not considered

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7.2.3 Three Standard Automation Systems with Single PROFINET configuration S1 – Separate Optical MRP Ring

Figure 7-3

Local Periphery (Centralized)

Central Control Room

- Engineering Station Operator Station
- Industrial Ethernet

Terminal / Plant Bus (exemplary)

- CPU 110-SH
- Security Module SCALANCE SC
- Service Bridge (SB)

PROFINET, electrical
PROFINET, optical

SoE not considered
7.2.4 Two H Systems with System Redundancy S2

Figure 7-4

Local Periphery (Centralized)

Central Control Room

Terminal/Plant Bus (exemplary)

Engineering Station
Operator Station

Industrial Ethernet

Centralized Control System

Security Module SCALANCE SC

Service Bridge (SB)

CPS 410-5H, rec.

Remote Periphery (Decentralized)

Field

Remark: All devices have to support System Redundancy S2
SoE not considered; 1 Not all SINAMICS products supporting S2
7.2.5 Three H Systems with System Redundancy S2

Figure 7-5

Local Periphery (Centralized)

Central Control Room

Terminal / Plant Bus (exemplary)

Engineering Station
Operator Station

Industrial Ethernet

PROFINET, electrical

Security Module
SCALANCE SC
Service Bridge (SB)

CPU 410-5H, red.

XC-200EEG

XF204-2BA

MRP

MRP

MRP

Star

Star

Remark: All devices have to support System Redundancy
SoE not considered

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7.2.6 Three H Systems with Redundant PROFINET R1 Configuration

Figure 7-6

Local Periphery (Centralized)
7.2.7 Two H Systems with Redundant PROFINET R1 Configuration and System Redundancy S2

Figure 7-7

**Local Periphery (Centralized)**

**Central Control Room**

**Remote Periphery (Decentralized)**

**Field**

**Remark:** All devices have to support at minimum System Redundancy S2
*SuE: not considered; *Not all SIMATIC products supporting S2

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7 Appendix

7.2.8 Standard Automation System with Single PROFINET configuration S1 and H System with System Redundancy S2

Figure 7-8

Local Periphery (Centralized)

Central Control Room

Remote Periphery (Decentralized)

Field

Field devices are  or  according corresponding controller

Remark: Devices assigned on the redundant CPU410 have to support at minimum System Redundancy S2. ScE not considered.

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7.3 Service and support

Industry Online Support
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Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:
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Please send queries to Technical Support via Web form:
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mall.industry.siemens.com

7.5 Links and literature

Table 7-2

<table>
<thead>
<tr>
<th>No.</th>
<th>Subject</th>
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<tbody>
<tr>
<td>1.</td>
<td>Siemens Industry Online Support</td>
</tr>
<tr>
<td>3.</td>
<td>SIMATIC PCS 7 Overview (links to FAQ, manuals, compendium, forum, application examples and multimedia)</td>
</tr>
<tr>
<td>6.</td>
<td>Web version of PROFIBUS &amp; PROFINET International (PI)</td>
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7 Appendix

7.6 Change documentation

Table 7-3

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
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<tr>
<td>V1.0</td>
<td>10/2013</td>
<td>First version</td>
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<tr>
<td>V1.1</td>
<td>10/2014</td>
<td>Supplemented with PCS 7 V8.1 notes, MRP-supporting switches added in Section 2.2.2</td>
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<tr>
<td>V1.2</td>
<td>09/2015</td>
<td>Layout editing, additional notes added, VLAN section added</td>
</tr>
<tr>
<td>V1.3</td>
<td>01/2017</td>
<td>Updated for PCS 7 V8.2, enhanced with screenshots</td>
</tr>
<tr>
<td>V2.0</td>
<td>06/2017</td>
<td>Brand new edition for SIMATIC PCS 7 V9.0</td>
</tr>
<tr>
<td>V2.1</td>
<td>09/2017</td>
<td>Enhanced with hints, updated and added links to manuals, application examples, and FAQ</td>
</tr>
<tr>
<td>V2.2</td>
<td>10/2017</td>
<td>Enhanced with notes</td>
</tr>
<tr>
<td>V2.3</td>
<td>06/2018</td>
<td>Updated:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- New features for SIMATIC PCS 7 V9.0 SP2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- SCALANCE XC-200, XP-200, and XF204-2BA firmware V4.0 with S2 system redundancy and Configuration in Run (CiR)</td>
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<td>V2.4</td>
<td>07/2021</td>
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<td>- Removed note for LC bus adapters for Scalance XF204-2BA</td>
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<td>- IE/PB Link HA included</td>
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<td>- SINEC NMS included</td>
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<td></td>
<td>- SINEC PNI included and Primary Setup Tool removed</td>
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<tr>
<td></td>
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<td>- VD bus adapter included</td>
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<td>- IWLAN included</td>
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- New features for SIMATIC PCS 7 V9.0 SP2
- SCALANCE XC-200, XP-200, and XF204-2BA firmware V4.0 with S2 system redundancy and Configuration in Run (CiR)