SIEMENS

SIMATIC

PROFINET
System Description

System Manual

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Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring to property damage only have no safety alert symbol. These notices shown below are graded according to the degree of danger.

Danger

indicates that death or severe personal injury **will** result if proper precautions are not taken.

Warning

indicates that death or severe personal injury **may** result if proper precautions are not taken.

Caution

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

Caution

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

Notice

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

Warning

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

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Preface

Purpose of the Manual

This document provides you with the basic information necessary to configure, set up and commission PROFINET.

It will also familiarize you with the methods and mechanisms with which you can identify and eliminate hardware and software problems.

Required Experience

General experience in the field of automation engineering is required to understand this manual.

Validity

This documentation is the basic documentation for all products from the PROFINET environment. The documentation of the individual PROFINET products is based on this documentation.

Recycling and Disposal

Due to the low levels of pollutants in the devices described in this documentation, they can be recycled. For environmentally-friendly recycling and disposal of your old devices, contact a company certified for disposal of electronic components.

Table of contents

Tables

1 Guide to the PROFINET Documentation

Overview

The schematic below provides you with an overview of the documentation on the topic of PROFINET.

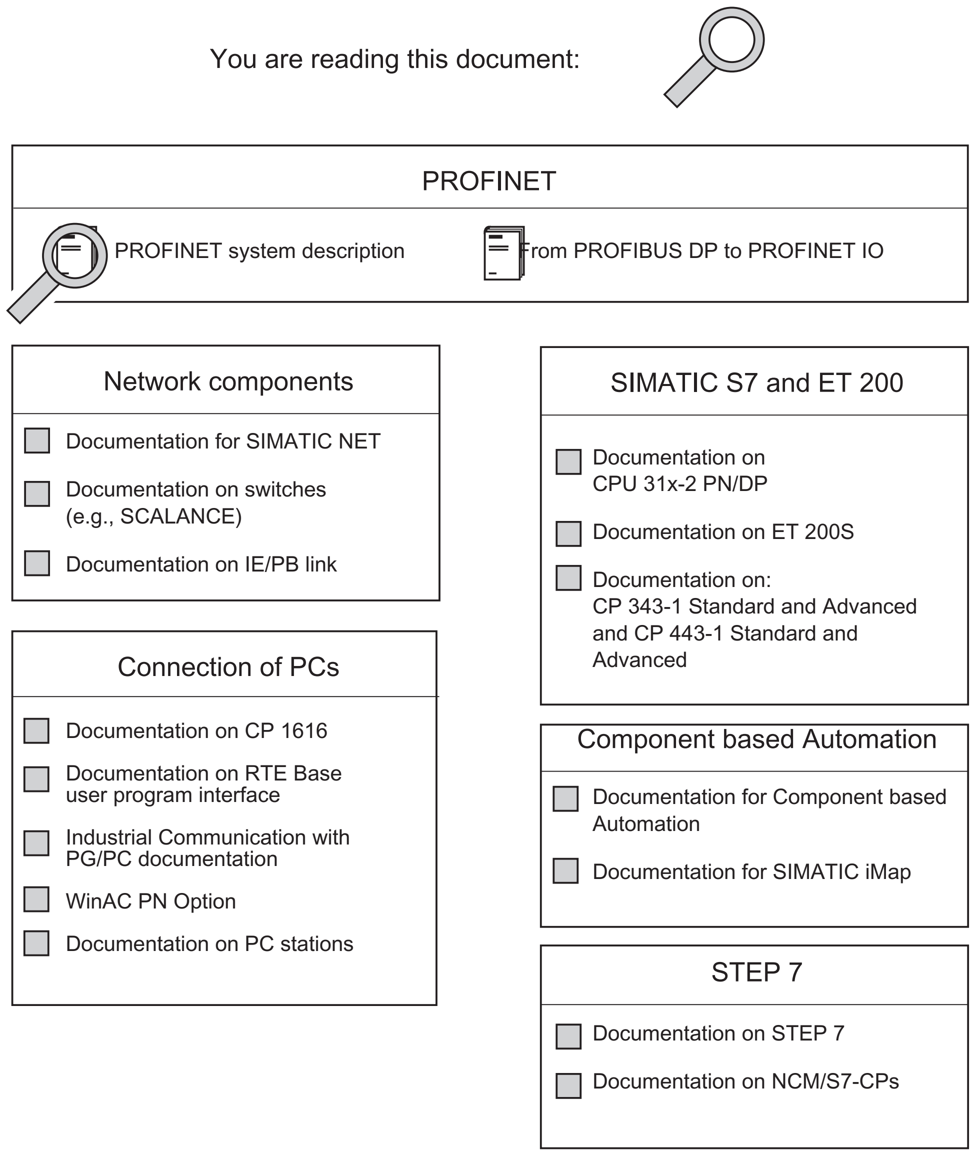


Figure 1-1 Overview of the Documentation

SIMATIC Manuals

At the Web address:

http://support.automation.siemens.com, you will find the latest versions of all the SIMATIC manuals. These can be downloaded free of charge.

1.1 Sources of Information on PROFINET

The following tables provide important reference sources with information that exceeds the scope of this manual.

General Information

Table 1-1 General Information on the Topic of PROFINET

Information	Source
General information on PROFINET	Internet: http://www2.automation.siemens.com/profinet
Standards and background knowledge on PROFINET and PROFIBUS	Internet: http://www.profibus.com
Basic terminology and basics of communication, communication functions, etc.	*Communication with SIMATIC* manual http://support.automation.siemens.com/WW/view/en/1254686
Active and passive network components, structure of networks, configuring and setting up communication networks	*Twisted Pair and Fiber-Optic Networks* manual http://support.automation.siemens.com/WW/view/en/8763736
Topology	*Twisted Pair and Fiber-Optic Network Installation Guideline PROFINET* from PROFIBUS International (can be found at: http://www.profibus.com)
Open communication connection over Industrial Ethernet	STEP 7 online help *S7-300, CPU 31xC and CPU 31x, Technical Specifications* manual http://support.automation.siemens.com/WW/view/en/12996906 *CP 443-1 Advanced for Industrial Ethernet* manual http://support.automation.siemens.com/WW/view/en/19308871 *SIMATIC NET IO Base User Programming Interface* programming manual http://support.automation.siemens.com/WW/view/en/19779901

Information	Source
Component based Automation PROFINET CBA	Internet: http://www.siemens.com/cba/ *Commissioning Component based Automation Systems* tutorial http://support.automation.siemens.com/WW/view/en/18403908 Getting Started *Getting Started with SIMATIC iMap* http://support.automation.siemens.com/WW/view/en/18403688 Manual *Configuring Plants with SIMATIC iMap* http://support.automation.siemens.com/WW/view/en/8131230

Special Topics

Table 1-2 Special Topics within the Framework of PROFINET

Information	Source
PROFINET IO and PROFIBUS DP • Differences and common features • From PROFIBUS DP to PROFINET IO • User programs • Diagnostics	*From PROFIBUS DP to PROFINET IO* programming manual http://support.automation.siemens.com/WW/view/en/19289930
New and modified blocks and system status lists	*From PROFIBUS DP to PROFINET IO* programming manual *http://support.automation.siemens.com/WW/view/en/19289930* *System Software for S7-300/400 System and Standard Functions* manual http://support.automation.siemens.com/WW/view/en/1214574 *STEP 7* online help
Commissioning an integrated PROFINET interface Commissioning PROFINET	*S7-300, CPU 31xC and CPU 31x Hardware and Installation* operating instructions http://support.automation.siemens.com/WW/view/en/13008499
CPU 317-2 PN/DP: Configuration of PROFINET X2 interface; configuration of an ET 200S as a PROFINET I/O device CPU443-1 Advanced: Configuration of the PROFINET interface with an IE/PB link and ET 200B	*PROFINET IO* Getting Started Collection http://support.automation.siemens.com/WW/view/en/19290251.
SNMP OPC server	Internet: http://www2.automation.siemens.com/net/html_76/produkte/040_snmp.htm
SNMP	Internet: http://www.profibus.com and http://www.snmp.org

Information	Source
SIMATIC iMap	*Component Based Automation Getting Started with SIMATIC iMap* http://support.automation.siemens.com/WW/view/en/8776710
Primary Setup Tool	Internet: http://support.automation.siemens.com/WW/view/en/19440762
Diagnostic data records	*From PROFIBUS DP to PROFINET IO* programming guide http://support.automation.siemens.com/WW/view/en/19289930

PROFINET overview 2

Chapter Content

The main topics covered in this chapter are as follows:

- Basics and basic terminology of PROFINET
- Interfacing PROFIBUS to PROFINET
- Basics of PROFINET IO
- Basics of Component Based Automation and
- Differences, common features and interaction of PROFINET IO and Component Based Automation (PROFINET CBA)

Read this chapter to familiarize yourself with PROFINET.

Details on Differences and Common Features of PROFINET IO and PROFIBUS DP

You will find this information in the *From PROFIBUS DP to PROFINET IO* programming manual.

2.1 Introduction

History of Industrial Ethernet

In 1976, Robert M. Metcalfe presented his idea for the "Ethernet" at the National Computer Conference. The term "Ethernet" was intended to remind us of the old idea of the ether that was supposed to envelop the earth and without which the propagation of electromagnetic waves was thought to be impossible. In much the same way as ether, the coaxial cable of the Ethernet was also a passive medium that transported the message of a transmitter to each connected node.

In 1985, the Ethernet was introduced into industry as Industrial Ethernet by Siemens AG under the name "SINEC H1". In contrast to conventional Ethernet, Industrial Ethernet has fixed mechanical connections and a solid aluminum shield.

In 1990, with a data transmission rate of 10 Mbps (Standard 10 Base-T) Ethernet established itself firmly in industry.

From 1995 onwards, the 100 Base-T standard established itself extremely quickly as Fast Ethernet. This allows data transmission rates of 100 Mbps.

What is PROFINET?

Within the framework of Totally Integrated Automation (TIA), PROFINET is the consistent further development of:

- PROFIBUS DP, the established fieldbus and
- Industrial Ethernet, the communication bus for the cell level.

The experience gained from both systems was and is being integrated in PROFINET.

PROFINET as an Ethernet-based automation standard from PROFIBUS International (PROFIBUS Nutzerorganisation e.V.) defines a vendor-independent communication and engineering model.

Aims and Advantages of PROFINET

The objectives of PROFINET are:

- Open standard for automation based on Industrial Ethernet:

  Industrial Ethernet and standard Ethernet components can be used together; however, Industrial Ethernet devices are more robust and therefore more suitable for an industrial environment (temperature, immunity to noise, etc.).
- Use of TCP/IP and IT standards
- Automation with real-time Ethernet
- Smooth integration of fieldbus systems

PROFINET specifies functions for implementing an integrated automation solution from network installation to web-based diagnostics. Due to its modular structure, PROFINET can be easily expanded in the future to include additional functions.

For you the user, this results in the following benefits:

- Flexibility due to the use of Ethernet and proven IT standards
- Savings in engineering and commissioning due to modularization
- Protected investment for PROFIBUS devices and applications
- Faster than today's special buses in motion control
- Large range of products available on the market

PROFINET Architecture

Among other things, PROFIBUS International has taken the following aspects into account in the PROFINET architecture:

- Communication between field devices, for example, I/O devices and drives

  Existing PROFIBUS architectures can be integrated. Thus, your investment in PROFIBUS devices and applications is ensured.
- Communication between controllers as components in distributed systems

  Technical modularization enables cost savings in engineering and maintenance.
- Installation system with standardized connectors and network components:

  This enables you to utilize the innovation potential of Ethernet and IT standards

Implementation of PROFINET by Siemens

We have implemented the aspects of the PROFINET architecture as follows:

- Communication between controllers and field devices is achieved with PROFINET IO.
- Communication between controllers as components in distributed systems is achieved with PROFINET CBA (Component based Automation)
- Cabling installations and network components are available from SIMATIC NET.
- For remote maintenance and network diagnostics, the proven IT standards from the office environment are used (for example, SNMP = Simple Network Management Protocol for network parameter assignment and diagnostics).

The Future of PROFINET

We will also implement the following aspects in future:

- Motion control applications have special requirements in terms of real-time communication, making isochrone communication necessary. PROFINET will standardize a totally integrated architecture for real-time communication that will also meet the highest demands of motion control.
- Safety-oriented features will complete the PROFINET architecture.

New developments and improvements made by Siemens in the near future will be easily integrated into existing networks with PROFINET - the open, Ethernet-based communication standard.

PROFINET ASICs

ASIC is the acronym for Application Specific Integrated Circuits.

PROFINET ASICs are components with a wide range of functions for the development of your own devices. They implement the requirements of the PROFINET standard in a circuit and allow extremely high packing densities and performance.

Because PROFINET is an open standard, SIMATIC NET offers PROFINET ASICs for the development of your old devices under the name ERTEC . For you, the benefits of ERTEC are as follows:

- Simple integration of switch functionality in devices
- Simple and cost-effective setup of bus structures
- Minimization of the communication load of devices

Documentation from PROFIBUS International on the Internet

You will find numerous documents about PROFINET on the PROFIBUS International web site at http://www.profibus.com.

You will also find further information on the Internet at:

http://www.siemens.com/profinet/.

2.2 Terminology in PROFINET and PROFIBUS

Definition: Devices in the PROFINET environment

Within the context of PROFINET, "device" is the generic term for:

- Automation systems (e.g. PLC, PC)
- Field devices (for example, PLC, PC, hydraulic devices, pneumatic devices)
- Active network components (e.g. switches, gateways, routers)
- PROFIBUS or other fieldbus systems

The main characteristics of a device is its integration into PROFINET communication by means of Ethernet or PROFIBUS.

The following device types are distinguished based on their attachment to the bus:

- PROFINET devices
- PROFIBUS devices

Definition: PROFINET devices

A PROFINET device always has at least one Industrial Ethernet port. A PROFINET device can also have a PROFIBUS port, that is, as master with proxy functionality.

Definition: PROFIBUS devices

A PROFIBUS device has at least one PROFIBUS link with an electric interface (RS485) or an optical interface (polymer optical fiber, POF).

A PROFIBUS device cannot take part directly in PROFINET communication, but must be implemented by means of PROFIBUS master with PROFINET link or Industrial Ethernet/PROFIBUS link (IE/PB Link) with proxy functionality.

Comparison of the terminology in PROFIBUS DP and PROFINET IO

The following schematic shows you the general names of the most important devices in PROFINET IO and PROFIBUS DP. The table below shows the designation of the various components in the PROFINET IO and PROFIBUS DP context.

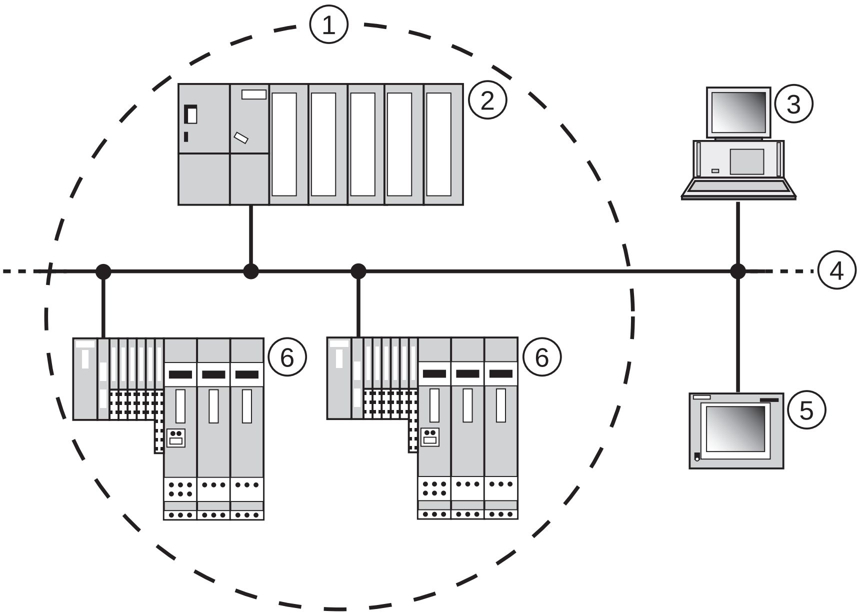


Figure 2-1 PROFINET and PROFIBUS devices

Number	PROFINET	PROFIBUS	Comment
①	IO system	DP master system	
②	IO controller	DP master	Device used to address the connected IO devices/DP slaves. That is: the IO controller/DP master exchanges input and output signals with field devices. The IO controller/DP master is often the controller on which the automation program runs.
③	IO supervisor	PG/PC Class 2 DP master	PG/PC/HMI device for commissioning and diagnostics
④	Industrial Ethernet	PROFIBUS	Network infrastructure
⑤	HMI (Human Machine Interface)	HMI	Device for operating and monitoring functions.
⑥	IO device	DP slave	Distributed field device assigned to one of the IO controllers/DP masters, for example, distributed I/O, valve terminal, frequency converter, and switches with integrated PROFINET IO functionality.

Slots and Submodules

A PROFINET IO device can have a modular structure similar to that of a DP slave. A PROFINET device consists of slots in which the modules/submodules are inserted. The modules/submodules have channels over which the process signals are read in or output.

The following graphic illustrates the situation.

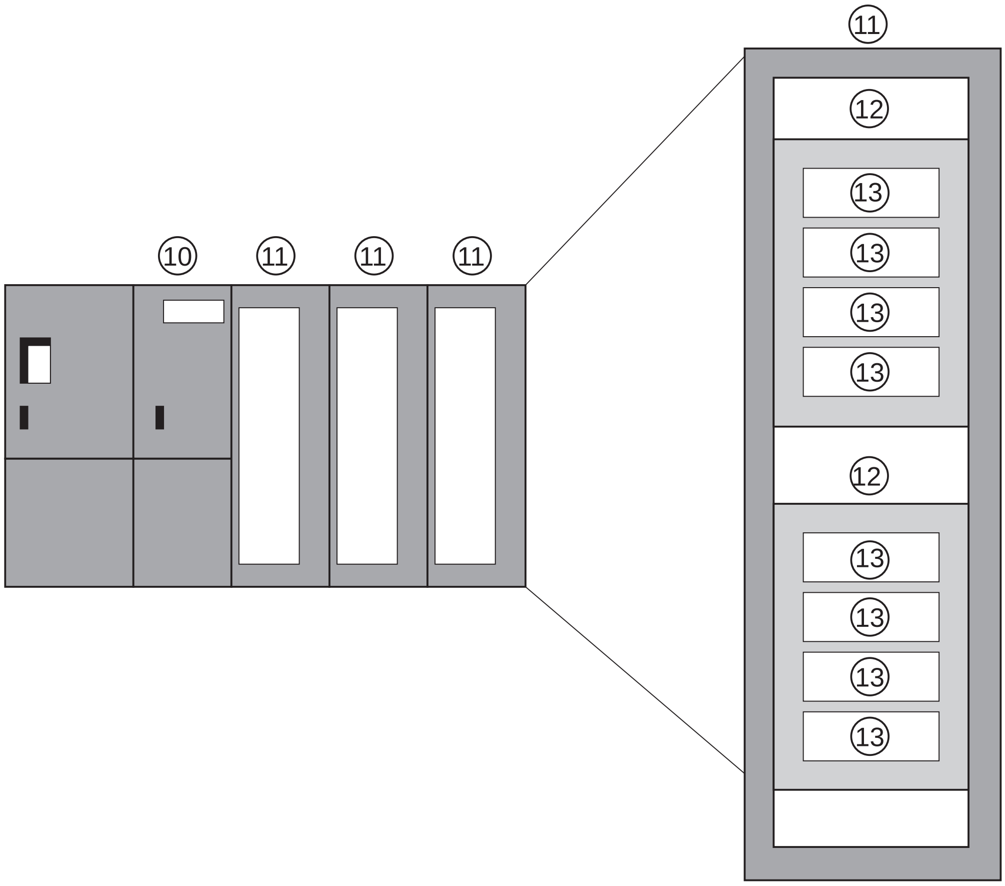


Figure 2-2 Module, Submodule, Slot, and Channel

Number	Description
⑩	Interface module
⑪	Slot with module/submodule
⑫	Submodule
⑬	Channel

A slot can be divided into submodule slots (subslots) that in turn contain submodules.

See also

Example of a PROFINET IO Application (Page 7-1)
Example of a PROFINET IO and PROFINET CBA Application (Page 7-2)

2.3 Integration of Fieldbuses in PROFINET

Field bus Integration

PROFINET allows you to integrate existing field bus systems (for example, PROFIBUS, ASI, etc.) into PROFINET via proxy. This allows you to set up mixed systems consisting of field bus and Ethernet-based subsystems. This makes a continuous technological transition to PROFINET possible.

Interconnection of PROFINET and PROFIBUS

You can connect PROFIBUS devices to the local PROFIBUS interface of a PROFINET device. This allows you to integrate existing PROFIBUS configurations in PROFINET.

The following figure shows the supported network types for PROFINET:

- Industrial Ethernet and
- PROFIBUS.

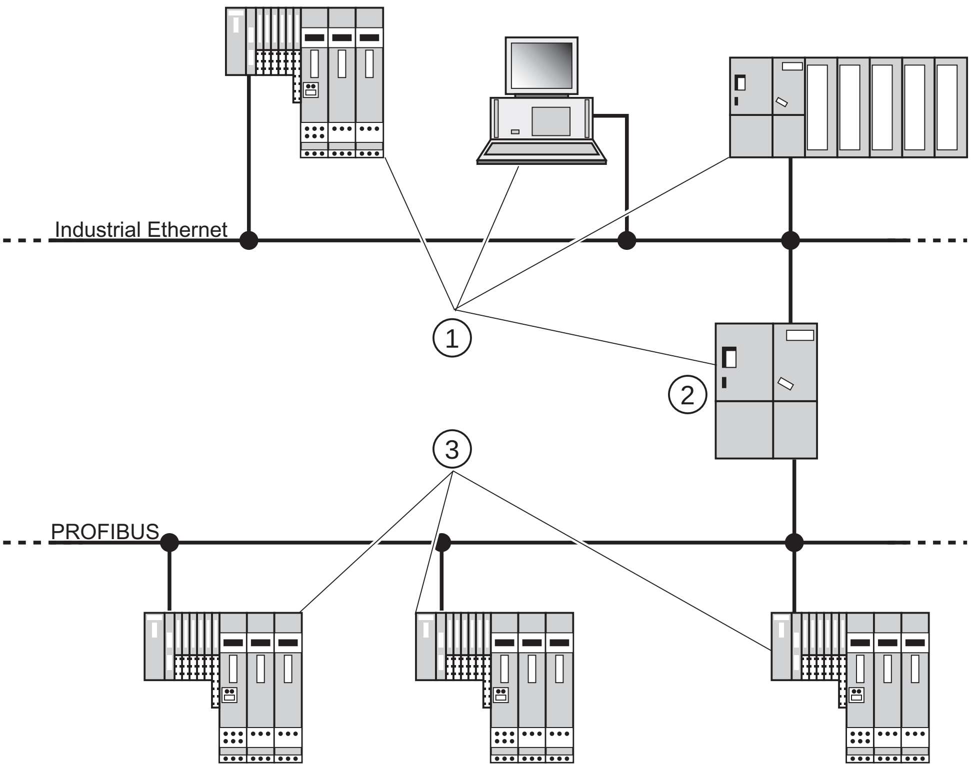


Figure 2-3 PROFINET Devices, PROFIBUS Devices, and Proxy

Number	Description
①	PROFINET devices
②	PROFINET device with proxy functionality (for more information, see below)
③	PROFIBUS devices

PROFINET device with proxy functionality = Substitute

The PROFINET device with proxy functionality is the substitute for a PROFIBUS device on Ethernet. The proxy functionality allows a PROFIBUS device to communicate not only with its master but also with all nodes on PROFINET.

You can integrate existing PROFIBUS systems in PROFINET communication, for example with the help of an IE/PB Link or a CPU 31x-2 PN/DP. The IE/PB Link then handles communication over PROFINET as a substitute for the PROFIBUS components.

In this way, you can connect both DPV0 and DPV1 slaves to PROFINET.

Further Information

For information on the differences and common features of PROFINET IO and PROFIBUS DP and for information on migrating from PROFIBUS DP to PROFIBUS I/O, refer to the *From PROFIBUS DP to PROFINET IO* programming manual.

2.4 PROFINET IO and PROFINET CBA

What is PROFINET IO?

Within the framework of PROFINET, PROFINET IO is a communication concept for the implementation of modular, distributed applications.

PROFINET IO allows you to create automation solutions familiar from PROFIBUS.

PROFINET IO is implemented by the PROFINET standard for the programmable controllers on the one hand, and on the other hand by the engineering tool STEP 7.

This means that you have the same application view in STEP 7 regardless of whether you configure PROFINET devices or PROFIBUS devices. Programming your user program is essentially the same for PROFINET IO and PROFIBUS DP if you use the expanded blocks and system status lists for PROFINET IO.

Reference

For more information on new and modified blocks, refer to the *From PROFIBUS DP to PROFINET IO* programming manual.

User Programs in PROFINET IO and PROFIBUS DP

A comparison of the most important differences and common features in PROFINET IO and PROFIBUS DP that are relevant for the creation of user programs can be found in the programming manual *From PROFIBUS DP to PROFINET IO.*

What is PROFINET CBA?

In the context of PROFINET, PROFINET CBA (Component-Based Automation) is an automation concept for:

- Implementation of modular applications with distributed intelligence
- Machine-to-machine communication

PROFINET CBA lets you create distributed automation solutions, based on default components and partial solutions. This concept satisfies demands for a higher degree of modularity in the field of mechanical and systems engineering by extensive distribution of intelligent processes.

Component-based Automation allows you to use complete technological modules as standardized components in large systems.

PROFINET CBA is implemented by:

- the PROFINET standard for programmable controllers and
- the SIMATIC iMAP engineering tool.

The components are created in an engineering tool that can differ from vendor to vendor. Components of SIMATIC devices are generated, for example, with STEP 7.

Interaction between PROFINET IO and PROFINET CBA

PROFINET CBA is used to integrate PROFINET IO systems in machine-to-machine communication. A PROFINET component is created from a PROFINET IO system in STEP 7, for example. With SIMATIC iMap, you can configure systems consisting of several such components. The communication connections between the devices are configured simply as interconnection lines.

The figure below illustrates a distributed automation solution with several components that communicate via PN. The component on the right contains a PN IO system.

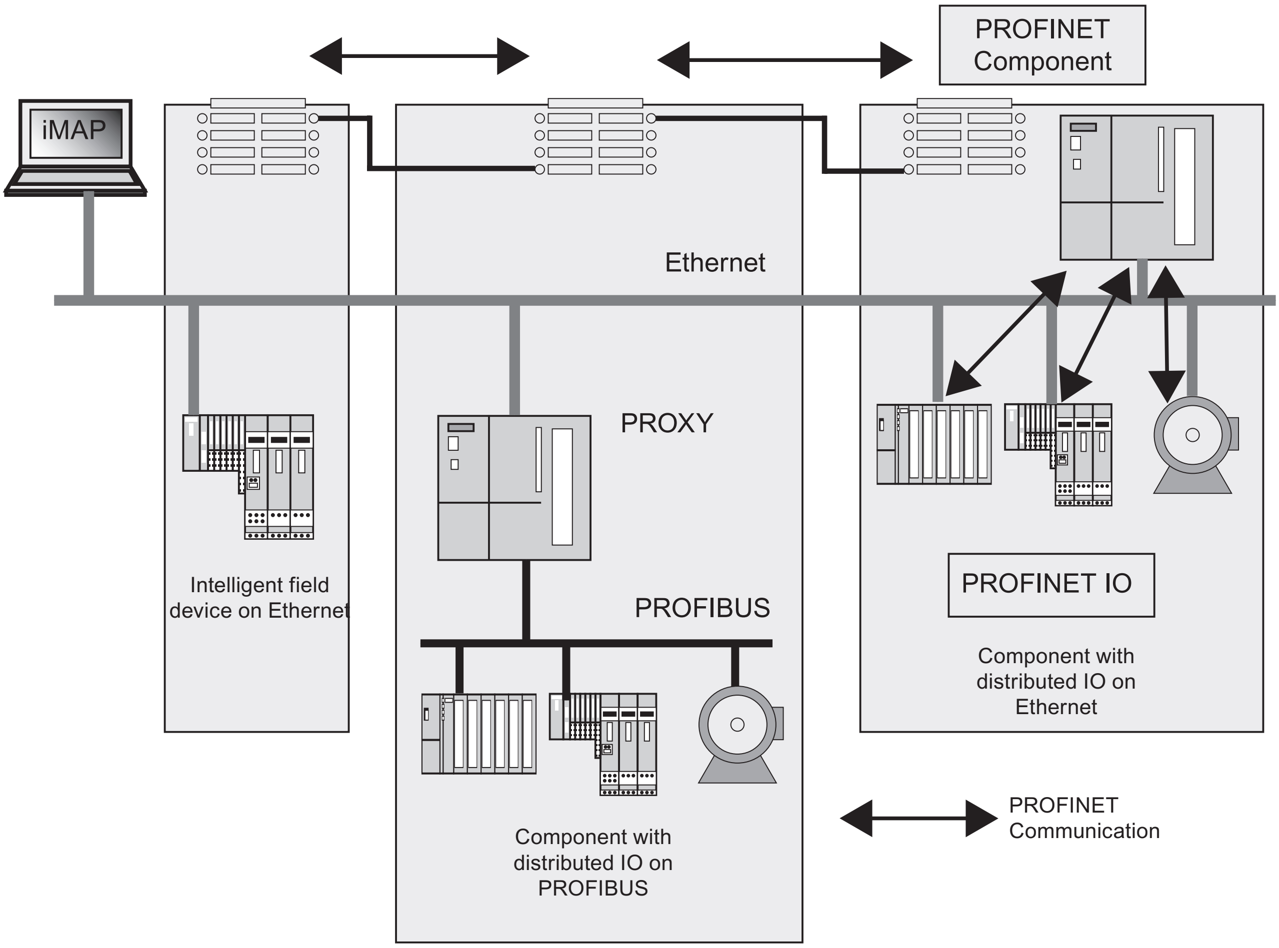


Figure 2-4 PN CBA - Modular Concept with Distributed Intelligence

Differentiation between PROFINET CBA and PROFINET IO

PROFINET IO and CBA are two different views of programmable controllers on Industrial Ethernet.

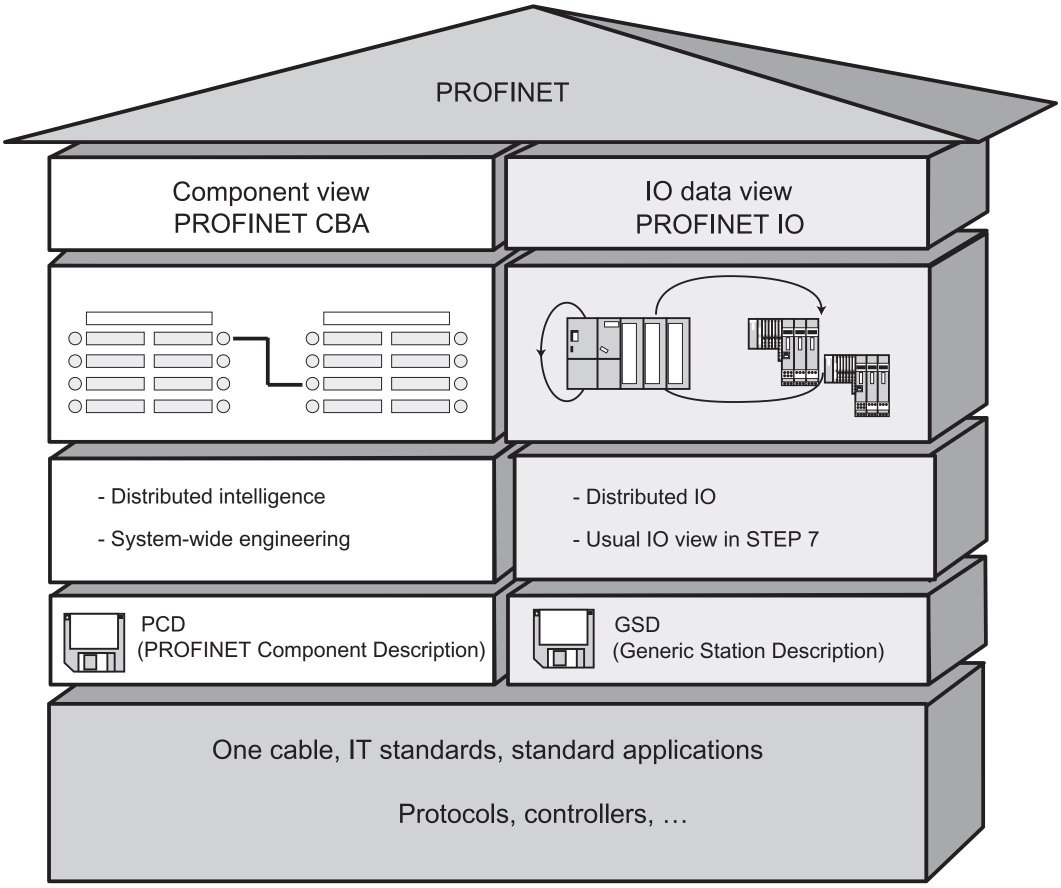


Figure 2-5 Differentiation between PROFINET CBA and PROFINET IO

Component Based Automation divides the entire system into various functions. These functions are configured and programmed.

PROFINET IO provides you with a picture of the plant that is very similar to the view obtained in PROFIBUS. You continue to configure and program the individual programmable controllers.

Controllers in PROFINET IO and PROFINET CBA

You can also use some PROFINET IO controllers for PROFINET CBA.

The following PROFINET devices can adopt the function of a **PROFINET CBA or IO controller**:

- Programmable controllers such as the S7-300 CPU 31x-2 PN/DP with firmware version V2.3 or higher
- CP 343-1 - starting with version 6GK7 343-1EX21-0XE0 and 6GK7 343-1GX21-0XE0, PROFINET I/O and PROFINET CBA communication services up to and including version V2.0 are supported
- CP 443-1 Advanced, firmware version V2.1 or higher

The following PROFINET devices can only adopt the function of a **PROFINET IO controller**:

- PCs connected to a CP with PROFINET IO capability (for example CP 1616) or via SOFTNET PN IO (for example, to CP 1612). With the CP 1616 and SOFTNET PN IO, the user program is executed in the CPU of the PC.
- SIMOTION device for particularly strict real-time requirements.

PROFINET devices can only adopt the function of a **PROFINET CBA controller**, for example PCs with a standard Ethernet interface and the WinLC software.

Proxy in PROFINET IO and PROFINET CBA

Proxies for PROFINET IO and proxies for PROFINET CBA are different.

In PROFINET IO, the proxy for PROFINET IO represents each connected PROFIBUS DP slave as a **PROFINET IO device** on PROFINET.

In PROFINET CBA, the proxy for PROFINET CBA represents each connected PROFIBUS DP slave as a **component** that can participate in PROFINET communication.

As a result, there are, for example, different IE/PB Links for PROFINET IO and PROFINET CBA. Currently, you can only use a CPU 317-2 DP/PN as a proxy for PROFINET CBA.

Connecting PROFIBUS Devices via an IE/PB Link

Remember that there is an available proxy functionality for both PROFINET I/O and PROFINET CBA. With the IE/PB Link, this means that you must use different devices depending on the system you are using.

Configuring and Integrating Components and Devices in PROFINET Communication

In Component Based Automation, you integrate the components in an component connection editor (for example, SIMATIC iMap). The components are described in a PCD file.

In PROFINET IO, you integrate the devices in an engineering system (for example STEP 7). The components are described in a GSD file.

Interaction of PROFINET CBA and PROFINET IO

PROFINET IO integrates field devices (IO devices) in PROFINET. The input and output data of the IO devices is processed in the user program. The IO devices with their IO controller themselves can, in turn, be part of a component in a distributed automation structure.

You configure communication between, for example, a CPU as IO controller and the IO devices assigned to it as PROFINET IO in much the same way as a PROFIBUS DP master system in STEP 7. You also create your user program in STEP 7. From the entire PN IO system, you create a component in STEP 7 (see Figure 2.4).

You then configure communication between the components conveniently in SIMATIC iMAP.

Update Time

During the update time, all IO devices in the IO system are supplied with new data from the IO controller (outputs), and all IO devices have their latest data sent to the IO controller (inputs).

Note

Update Times for Cyclic Data Exchange

STEP 7 determines the update time based on the existing hardware configuration and the resulting cyclic data emergence. During this time, a PROFINET IO device has exchanged its user data with the relevant IO controller.

The update time can be set for an entire bus segment of a controller or an individual IO device.

You can increase the update time manually in STEP 7.

If other cyclic PROFINET services (for example, cyclic services for PROFINET CBA) need to be taken into account in addition to PROFINET IO: In the Update time dialog in STEP 7 / HW Config, set an update time for the relevant devices to be reserved for PROFINET IO.

For more information, refer to the STEP 7 online help.

Details on the Possible Uses of the Individual Products

For more information, refer to the documentation of the particular product.

See also

Example of a PROFINET IO Application (Page 7-1)

Example of a PROFINET IO and PROFINET CBA Application (Page 7-33)

2.5 SIMATIC PC Stations

SIMATIC PC Station

A "PC station" is a PC with communication modules and software components within a SIMATIC automation solution.

PC Station as PROFINET IO Controller

By using suitable communication modules and software components you can operate a PC station as a PROFINET IO controller.

Your PC applications in the PC station can access the PROFINET IO controller in the following ways:

- As an OPC client over the PROFINET IO OPC server (OPC: Object Linking and Embedding (OLE) for Process Control)
- Directly over the PROFINET IO Base user interface

At any one time, PC applications can only use one of these access options.

Communication of a PC Station

Table 2-1 Communication

Functions	PROFINET IO OPC Server	IO Base Programming Interface
Reading and writing IO data	Yes	Yes
Reading and writing data records	Yes	Yes
Receiving and acknowledging interrupts	No	Yes

Components of a PC Station

The following schematic shows a PC station with the described components.

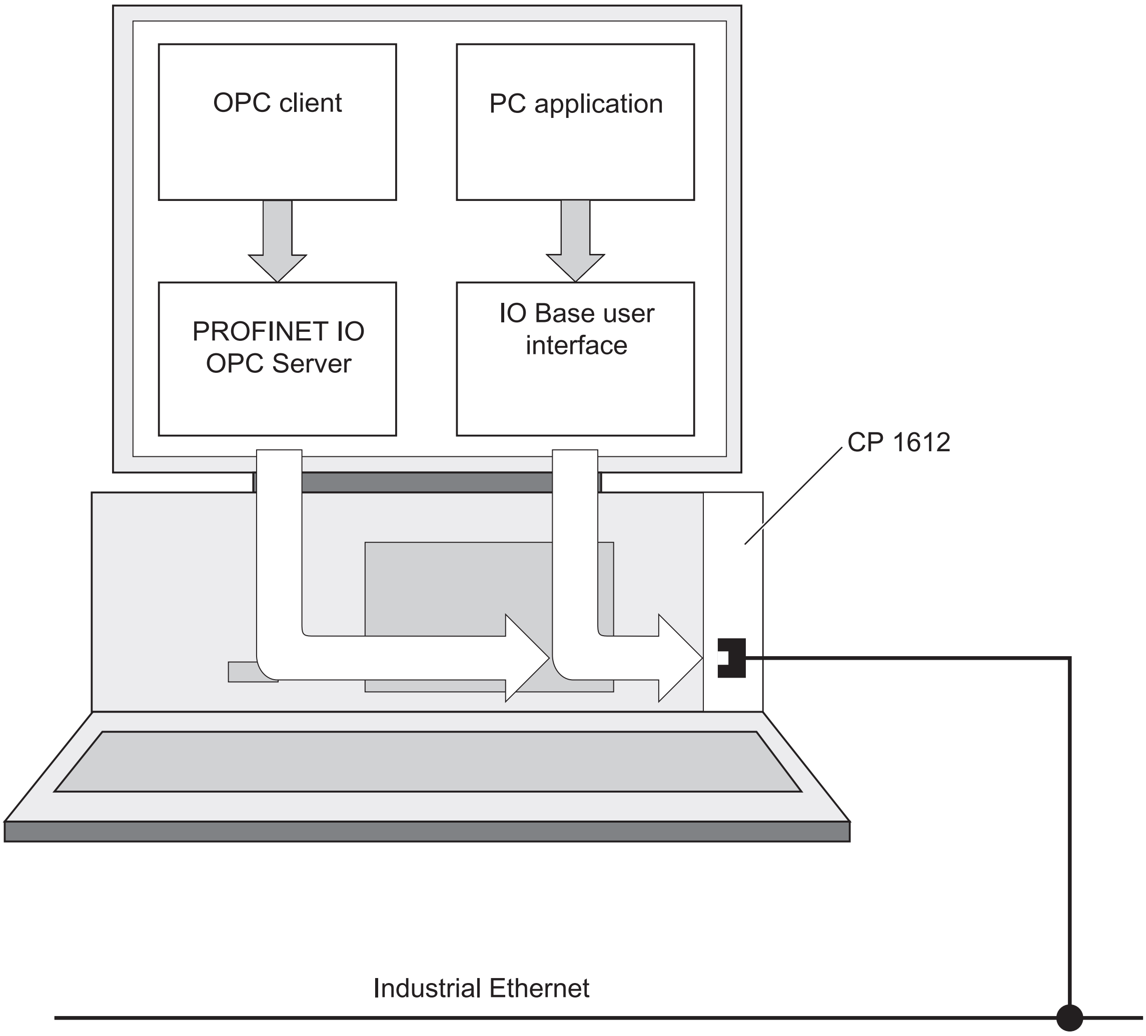


Figure 2-6 SIMATIC PC Station

See also

SIMATIC NCM PC (Page 5-5)

Setting Up PROFINET 3

Chapter Content

This chapter provides you with the background information on the structure of your communication network. In detail:

- An overview of the most important passive network components. These are network components (cables, connectors, etc.) that forward a signal without the option of influencing it directly.
- An overview of the most important active network components. These are network components (such as switches, routers, etc.) that actively influence a signal.
- Overview of the most common network structures (topologies).
- Guidelines on how to further improve the performance of your PROFINET.

3.1 Passive network components

3.1.1 Wired Networks

Data Transmission Rate and Cables

For PROFINET, you require a data transmission rate of 100 Mbps (Fast Ethernet) full duplex. For the data transmission, you can choose between:

- Electrical cables with a twisted copper cable (100 Base, twisted pair, 4-wire, 100 Base-T).

  The transmission characteristics of this cable must meet the requirements of CAT 5 (see glossary).

  The maximum length of the connection between the end device and network component or between two network components (for example switch ports) must not exceed 100 m.
- Optical cables (100 base-FX, fiber-optic, 50/125 µm, 62.5/125 µm).

  The transmission medium is a multimode fiber-optic cable or a monomode fiber-optic cable with fibers made of quartz or plastic.

  The maximum length of the connection between the end device and network component or between two network components (for example switch ports) must not exceed 3,000 m for multimode fiber-optic cables and 26 km for monomode fiber-optic cables.

Notice

Connectors for quartz fiber-optic cables should only be assembled by trained personnel using suitable tools (refer to the IK PI catalog). When assembled correctly, these provide very low coupling attenuation and this value can be reproduced even after they have been inserted and removed many times.

Simple Assembly of Twisted-Pair Cables On-site

When setting up your PROFINET system, you can cut the AWG 22 twisted pair cable on-site to the length required, strip it with the *Fast Connect Stripping Tool* (stripping tool for Industrial Ethernet), and fit *Industrial Ethernet FastConnect RJ-45 Plugs* using the insulation displacement technique. For more information about assembly, refer to the *Assembly Instructions for SIMATIC NET Industrial Ethernet* product information.

Notice

A maximum of 6 plug/jack pairs are permitted per connection. For cabinet feed-through, for example, you need 2 plug/jack pairs.

Fast Ethernet

Fast Ethernet describes the standard with which data is transmitted at 100 Mbps. This transmission technology uses the 100 Base-T standard.

Industrial Ethernet

Industrial Ethernet (formerly SINEC H1) is a technology that allows data to be transmitted free of interference in an industrial environment.

Due to the openness of PROFINET, you can use standard Ethernet components. We recommend, however, that you install PROFINET as Industrial Ethernet.

Further Information

For more information, refer to the SIMATIC NET manual *SCLANCE W788-1PRO (Access Point) SCALANCE W788-2PRO (Dual Access Point)*.

For more information, refer to the SIMATIC NET manual *Twisted-Pair and Fiber-Optic Networks*.

You should also read the *PROFINET Installation Guideline* from PROFIBUS International.

3.2 Active Network Components

3.2.1 Active Network Components

Switch

PROFIBUS is based on a bus topology. Communication nodes are connected to the bus by a passive cable.

In contrast, Industrial Ethernet is made up of point-to-point links: Each communication node is connected directly to one other communication node.

If a communication node needs to be connected to several other communication nodes, this communication node is connected to the port of an active network component, such as a switch. Other communications nodes (including switches) can then be connected to the other ports of the switch. The connection between a communication node and the switch remains a point-to-point link.

The task of a switch is therefore to regenerate and distribute received signals. The switch "learns" the Ethernet address(es) of a connected PROFINET device or other switches and forwards only the signals intended for the connected PROFINET device or connected switch.

The SCALANCE X device family includes switches, for example, with 4 electric ports and 2 optical ports for mounting onto a DIN rail in a control cabinet.

With STEP 7, you can configure, address, and perform diagnostics on switches in the SCALANCE X device family as a PROFINET IO device.

Note

IP Address Assignment

When assigning IP addresses to the switches, you can also use the Primary Setup Tool (PST) as an alternative to STEP 7.

Protection against Unauthorized Access

Connection of industrial networks to the Intranet and Internet requires solutions for protection against internal and external threats.

The new SIMATIC NET Industrial Security components of the SCALANCE S product family offer optimal defense mechanisms against attacks, espionage, manipulation, and incorrect access on all network levels.

They have numerous features such as encryption, authentication, and access control for up to 64 channels for setting up a virtual private network (VPN), easy integration of existing networks with no configuration required, and an integrated firewall.

The modules contain a configuration plug for configuration data that you insert in the replacement device in the event of a fault. Because the data are automatically accepted by the new device, there is no need for an IO supervisor/PC for programming if a replacement becomes necessary. On the PC side, a security client helps you set up secure communication.

In addition, a configuration tool that generates the certificate for each VPN is integrated in the software.

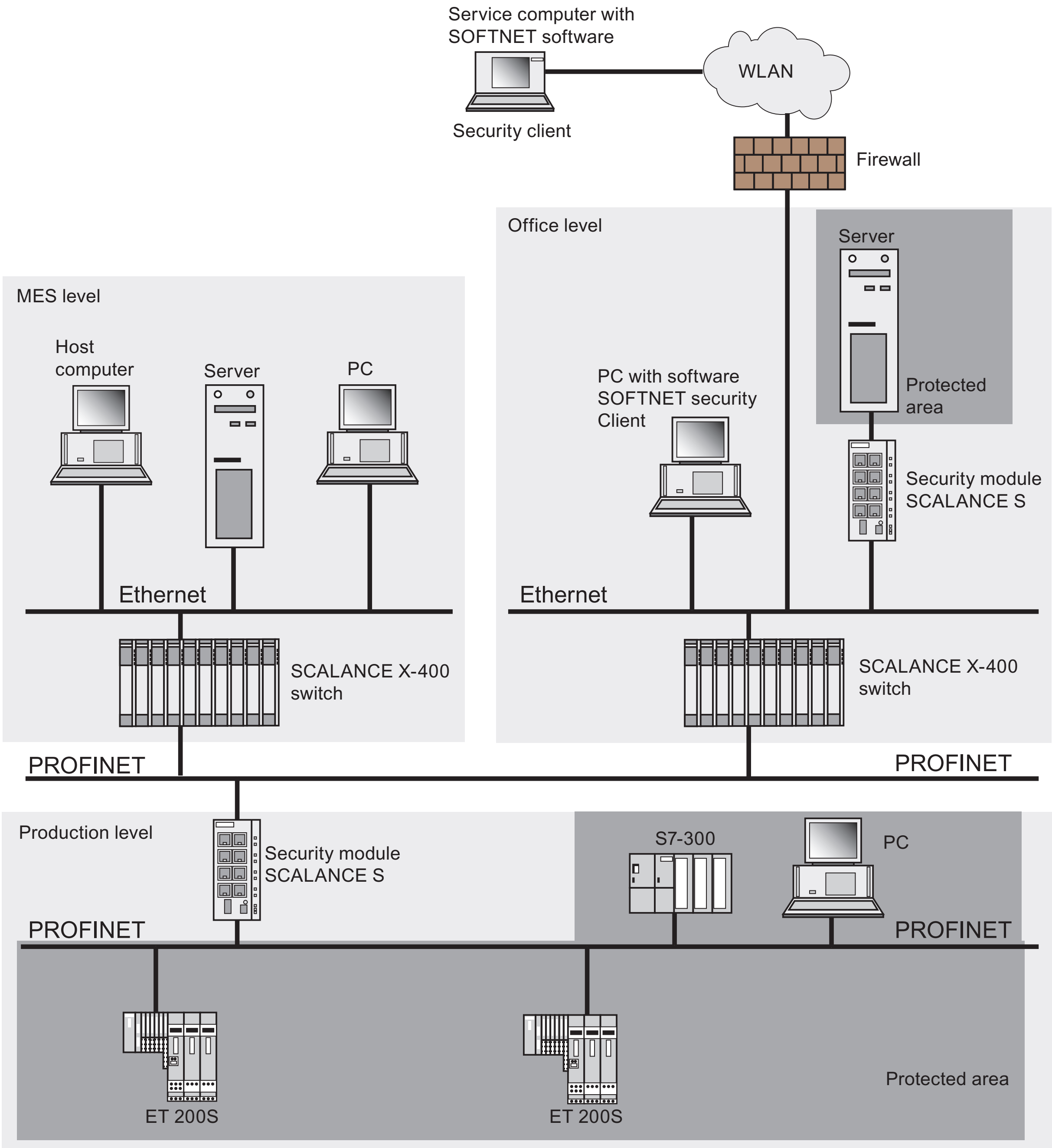


Figure 3-1 Network Setup with the SCALANCE S Security Module

Integrated Switch

If a PROFINET device has more than one PROFINET port, a switch is already integrated in the PROFINET device. This allows you to set up PROFINET devices with two PROFINET ports in a linear structure.

PROFINET devices with an integrated switch include, for example, the CP 1616 and the CP 443-1 Advanced. Both devices each have 4 PROFINET ports).

Hub (Repeater)

Under no circumstances use hubs, but only switches.

In contrast to a switch, a hub sets itself to the lowest speed at the ports and forwards the signals to all connected devices. Moreover, a hub is not capable of giving priority to signals. This results in a high network load on Industrial Ethernet. Data can only be transmitted free of collisions when certain constraints are applied.

Router

A router works similar to switch. With a router, however, it is also possible to specify which communications nodes can communicate over the router and which cannot. Communication nodes on different sides of a router can only communicate with each other if you have explicitly enabled communication between them via the router.

The high degree of communication traffic in an office Ethernet could impair communication in Industrial Ethernet. The router prevents this and limits network load.

If, for example, you want to access manufacturing data directly from SAP, connect your Industrial Ethernet in the factory with the Ethernet in your office area over a router.

A router represents the boundary of a subnet.

Further Information

For more information, refer to the SIMATIC NET manual *Twisted-Pair and Fiber-Optic Networks* and the manuals of the individual devices.

See also

Topology (Page 3-8)

3.2.2 Wireless Networks

Wireless Networks, Applications

With PROFINET, you can also set up wireless networks with Industrial Wireless Local Area Network (Industrial WLAN) technology. We recommend that you use the SCALANCE W device line and the corresponding communication processors (CP, e.g., CP 7515 wireless card) for this purpose.

Application Examples

- Local access to service and maintenance schedules
- Communication with mobile subscribers (e.g. mobile controllers and devices), high bay storage and retrieval devices, conveyor lines, production belts, translation stages, and rotating machines
- Wireless coupling of communication segments for fast commissioning or cost-effective networking where routing of wires is extremely expensive (e.g. public streets, railroad lines, etc.)

What Is Industrial Wireless LAN?

In addition to data communication in accordance with IEEE 802.11, SIMATIC NET Industrial Wireless LAN provides a number of extremely useful enhancements (I-features) for the industrial customer. The following features make IWLAN especially well suited for more advanced industrial applications requiring reliable wireless communication:

- Automatic roaming when the connection to Industrial Ethernet is interrupted (Rapid Roaming)
- Cost savings due to the use of a single wireless network for secure operation of a process with both process-critical data (such as an alarm message) and non-critical communication (such as service and diagnostics)
- Cost-effective connection to devices in remote environments that are difficult to access

Objectives and Advantages of Industrial Wireless LAN

Wireless data transmission achieves the following objectives:

- Seamless integration of devices in the existing bus system via the wireless interface
- Mobile implementation of devices for various production-related tasks
- Flexible configuration of devices enabling quick setup according to customer requirements
- Continuous availability of subscribers within the entire network

Data Transmission Rate

In Industrial Wireless LAN, gross data transmission rates of 11 Mbps or 54 Mbps without full duplex are permitted. SCALANCE W provides the option of encrypted data transmission.

Range

With SCALANCE W (access points), wireless networks with ranges of up to 30 m indoors (approximately 100 m outdoors) can be set up. Multiple access points can be installed to create large wireless networks in which mobile subscribers are transferred seamlessly from one access point to another (roaming).

As an alternative to a wireless network, point-to-point connections of Industrial Ethernet segments can be set up over large distances (several hundred meters). In this case, the range and characteristics of the wireless hop are determined by the antennas used.

Note

Range

The range can be considerably less, depending on spatial factors, the wireless standard used, the data rate, and the antennas on the send and receive side.

Update time in STEP 7

If you set up PROFINET with Industrial Wireless LAN, you may have to increase the update time for the wireless devices. The performance of the IWLAN interface is lower than that of a wired data network.

You will find the parameter in STEP 7/HW Config in the object properties of the PROFINET IO system.

Configuring and Setting Parameters for SCALANCE W

You configure and set parameters using the Web interface. To assign an IP address, you require either the Primary Setup Tool (PST) or STEP 7.

Further Information

For more information about the SCALANCE W Industrial Wireless LAN component, refer to the *SCLANCE W788-1PRO (Access Point) SCALANCE W788-2PRO (Dual Access Point)* manual at: http://support.automation.siemens.com/WW/view/en/19384623

For general information, refer to the SIMATIC NET manual *Twisted-Pair and Fiber-Optic Networks* at: http://support.automation.siemens.com/WW/view/en/8763736

You should also read the *PROFINET Installation Guideline* from PROFIBUS International, which can be found at: http://www.profibus.com.

You will find the Primary Setup tool on the Internet at the address: http://support.automation.siemens.com/WW/view/en/14929629

3.3 Topology

Below, you will find an overview of various options open to you when setting up a PROFINET network.

Star

If you connect communication nodes to a switch, you automatically create a star network topology.

If a single PROFINET device fails, in contrast to other structures, this does not automatically lead to failure of the entire network. Only the failure of a switch leads to failure of a section of the communication network.

Tree

If you interconnect several star structures, you obtain a tree network topology.

Ring

If you want to increase availability, you should use a ring structure. You achieve this by connecting the two open ends of a network to a single switch that you then operate as the redundancy manager. If there is a break in the network, the redundancy manager ensures that the data is redirected over an intact network connection.

Caution

Reconfiguration Time

Is there is a break on a cable, the redundancy manager takes up to 300 ms to reconfigure the network so that the data can be redirected. During this time, the IO controller cannot reach the IO devices in this network. This means that a station failure interrupt followed by a station return interrupt is triggered.

Bus

All the communication nodes are connected in series as a bus.

If a link element (for example a switch) fails, communication downstream of the failed link element is no longer possible. The network is then divided into 2 subsegments.

In PROFINET, the bus structure is implemented by switches that are already integrated in the PROFINET devices. As a result, the bus structure in PROFINET is simply a special form of a tree/star structure.

Bus network structures require the least cabling effort.

Subnetwork

All the devices connected by switches are located in the same network, called the subnet. All the devices in a subnet can communicate directly with each other.

All devices in the same subnet have the same subnet mask.

A subnet is physically restricted by a router.

Notice

If devices need to communicate beyond the limits of a subnet, you must program the router so that it allows this communication to take place.

Network

A network is a larger communication system that allows data exchange between a large number of nodes.

All the subnets together form a network.

Further Information

For more information, refer to the SIMATIC NET manual *Twisted-Pair and Fiber-Optic Networks*.

You should also read the *PROFINET Installation Guideline* from PROFIBUS e.v (http://www.profibus.com).

You will find basic information in the *Communication with SIMATIC* manual.

3.4 Examples of Topology

Examples of Topology

The following example shows various topologies combined.

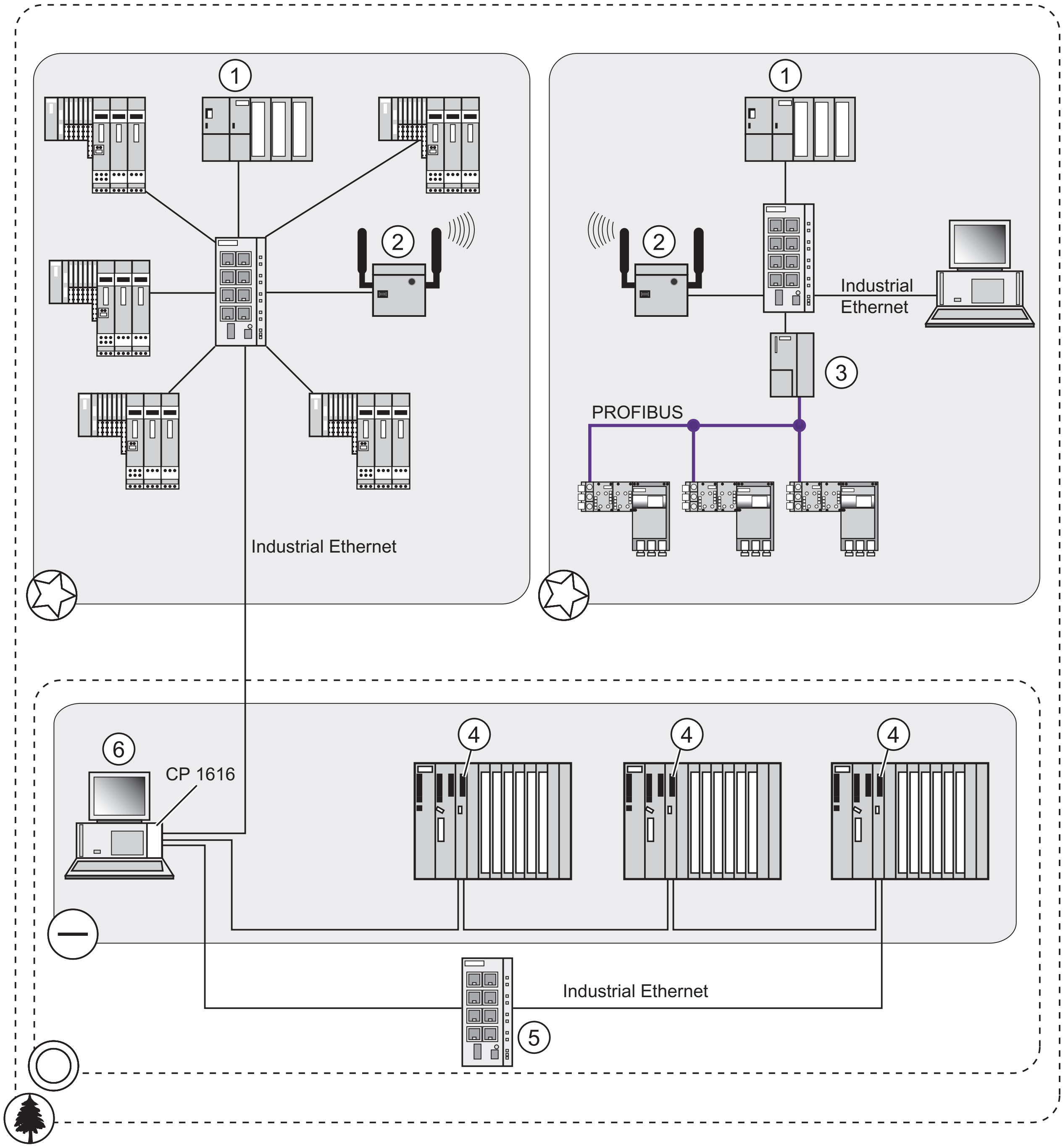
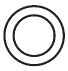


Figure 3-2 Combined Topology

Number/ Symbol	Meaning
①	S7-300 as IO controller
②	Industrial WLAN with SCALANCE W; wireless connections
③	IE/PB Link
④	CP 443-1 Advanced in an S7-400; the CP has an integrated switch so that you can connect it to other PROFINET devices to implement a bus topology.
⑤	Redundancy manager
⑥	PC with CP 1616; the CP 1616 has an integrated switch so that you can connect it to up to 4 PROFINET devices.
	Star topology
	Bus topology
	The open ends of the bus topology are closed by a redundancy manager to form a ring topology
	The combination of different topologies results in a tree topology.

3.5 Guidelines for Optimizing PROFINET

PROFINET optimize

PROFINET allows you to set up communication with both high-performance and a high degree of integration.

By keeping to the following guidelines, you can improve performance even further.

1. Connect a router or a SCALANCE S between the office network and PROFINET system. With the router, you can specify precisely who can access your PROFINET system.
2. Set up your PROFINET system, where possible, as a star (for example: in a switching cubicle).
3. Keep the "nesting" depth of the switches as low as possible. This increases clarity in your PROFINET system.
4. Connect your IO supervisor close to the communication partner (for example: PG and communication partner connected to the same switch).

Example of an optimized PROFINET: Topology

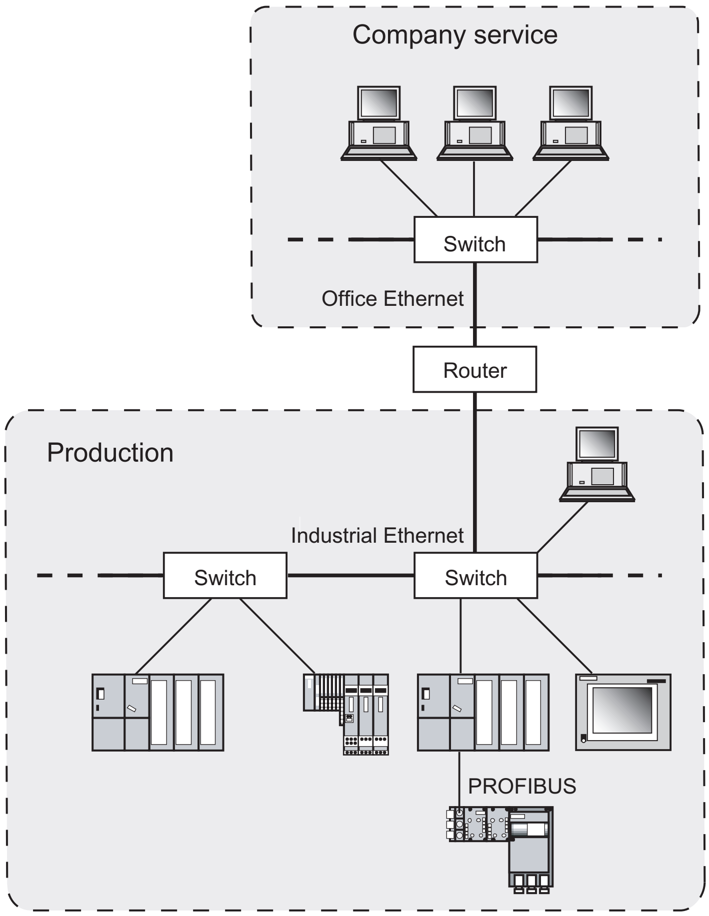


Figure 3-3 Optimized PROFINET Topology

Protection by Extra Low Voltage

Caution

Modules with PROFINET interfaces must only be operated in LANs in which all connected network components are supplied with SELV/PELV power supplies or integrated power supplies that afford compatible protection.

If you connect modules with PROFINET interfaces to a WAN (for example the Internet), the data transfer point (router, modem, or similar) must ensure this protection.

SITOP power supplies from Siemens, for example, provide this protection.

For more information, refer to the EN 60950-1 (2001) standard.

Commissioning

You will find information on commissioning in the *S7-300, CPU 31xC and CPU 31x Hardware and Installation* operating instructions.

4 PROFINET Data Exchange and Communication

Requirements

In this chapter, it is assumed that you are familiar with the terminology from the previous chapters.

Chapter Content

This chapter explains the following:

- Basic Terminology of Communication and
- Options for Real-time Communication

4.1 Basic Communication Terminology

PROFINET communication

PROFINET communication is over Industrial Ethernet. The following transmission types are supported:

- Acyclic transmission of engineering data and time-critical data (for example parameters and configuration data, diagnostic data, alarms, etc.)
- Cyclic transmission of user data (e.g., process values, etc.).

Transparent Data Access

Access to process data from different levels of the factory is supported by PROFINET communication. By using Industrial Ethernet, standard mechanisms of communication and information technology such as OPC, XML, COM/DCOM can now be used along with standard protocols such as UDP/TCP/IP in automation engineering. This makes transparent access from the office world of the enterprise management directly to the data of the automation systems at the control level and production level possible.

Management level

Control level

Production level

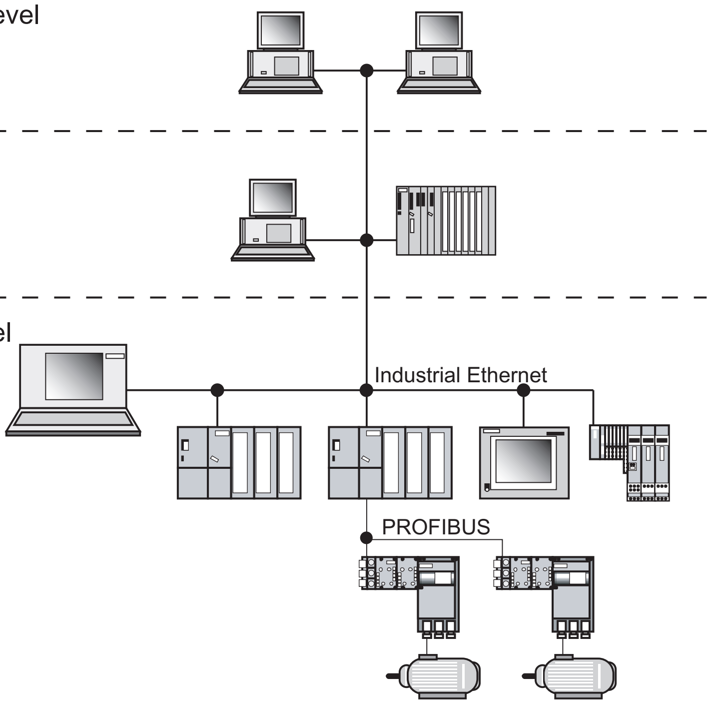


Figure 4-1 Access to Process Data

What are TCP/IP, COM/DCOM, OPC and XML?

You will find explanations of these terms in the glossary.

You will find detailed information in the *Introduction to the OPC Server for SIMATIC NET* manual.

4.2 Communication in Real Time

Real-Time Communication

Industrial communication in which supervisors take part in communication involves runtimes during communication that are too long for production automation. When communicating time-critical IO user data, PROFINET therefore uses its own real-time channel, rather than TCP/IP.

Branch-specific Requirements for Communication

PROFINET is used in the widest possible range of branches, for example in:

- Production plants
- Assembly plants
- Automobile industry plants
- Plants in the food, beverages and tobacco industry
- Packing plants
- and many others

Each branch has different requirements in terms of communication and its performance.

Application-Dependent Requirements for Communication

The environment in which PROFINET is used also influences the requirements for communication and its performance:

- Process automation
- Factory automation
- Motion control applications

Definition: Real Time (RT) and Determinism

Real time means that a system processes external events within a defined time.

Determinism means that a system reacts in a predictable (deterministic) manner.

In industrial networks, both these requirements are important. PROFINET meets these requirements. PROFINET is implemented as a deterministic real-time network as follows:

- Transmission of time-critical data takes place at guaranteed time intervals.

  To achieve this, PROFINET provides an optimized communication channel for real-time communication : Real Time (RT).
- An exact prediction of the time at which the data transfer takes place is possible.
- Problem-free communication using other standard protocols is guaranteed within the same network.

Definition: Isochronous Real-Time Communication, IRT

Isochronous real-time communication (PROFINET V3) is a transmission method in which a portion of the transmission time is reserved for cyclic (deterministic) data transmission. Thus, the communication cycle is split into a deterministic portion and an open portion. In the deterministic channel, cyclic IRT frames are transported, whereas the TCP/IP and RT frames are transported in the open channel. In this way, both types of data transmission exist together without interfering with each other.

When this transmission method is implemented in ERTEC-ASICs (Enhanced Real-Time Ethernet Controller), cycle times of less than 1 ms and jitter accuracy of less than 1 μs are achieved.

Application for IRT

IRT is used in areas with particularly stringent requirements for response times that cannot be exceeded. This is the case, for example, for motion control applications, which require response and update times in the range of a few milliseconds.

Real Time and TCP/IP

RT/IRT and TCP/IP communication take place in parallel and at the same time on the same cable.

5 PROFINET IO System Engineering

Requirements

In this chapter, it is assumed that you are familiar with the terminology from the previous chapters.

Chapter Content

This chapter provides you with information on PROFINET IO in greater depth. Here, you will learn the following:

- The basic sequence of the entire engineering
- The significance of device names and IP addresses and how you can assign them
- What diagnostic options are available

Details on Differences and Common Features of PROFINET IO and PROFIBUS DP

You will find this information in the *From PROFIBUS DP to PROFINET IO* programming manual.

5.1 Engineering

Basic Steps from Planning to Operating a Plant

Setting up and operating an automation system with STEP 7 or NCM PC involves the following basic steps:

1. Plan the system

   The system planner specifies the following:

   – Which functions are necessary?

   – Which programmable controllers and field devices will be used?

2. Configure the system with STEP 7 or NCM PC

   The system configuration engineer creates the project by:

   – Opening an existing project or creating a new project?

   – When necessary: Importing new PROFINET IO devices into the hardware catalog using GSD files?

   – Inserting PROFINET IO devices in the project Inserting

   – Networking devices in the network view

   – Assigning names to the devices

   – Creating the user program

   – Checking the configuration

   – Documenting the project and archiving.

3. Commissioning and Testing

   The commissioning engineer performs the following tasks:

   – Commissioning individual devices

   – Downloading project data to the devices of the system

     The device name is then assigned to a real device with a MAC address.

   – When necessary: Configuring and/or reediting the user program in STEP 7.

   – Testing the system

4. Operating the plant.

   The plant user performs the following tasks:

   – Monitoring and manipulating process data online (vertical integration)

   – Running diagnostics on the plant

   – Operator control and monitoring

5. Performing maintenance and modifications.

Integration using a GSD file

Just as in PROFIBUS, you can integrate a PROFINET device in STEP 7 using a device description. The properties of a PROFINET device are described in a GSD file (General Station Description) that contains all the information required for configuration.

In PROFINET IO, the GSD file is in XML format. The structure of the GSD file complies with ISO 15745, the worldwide standard for device descriptions.

GSD import, Engineering and Data Exchange

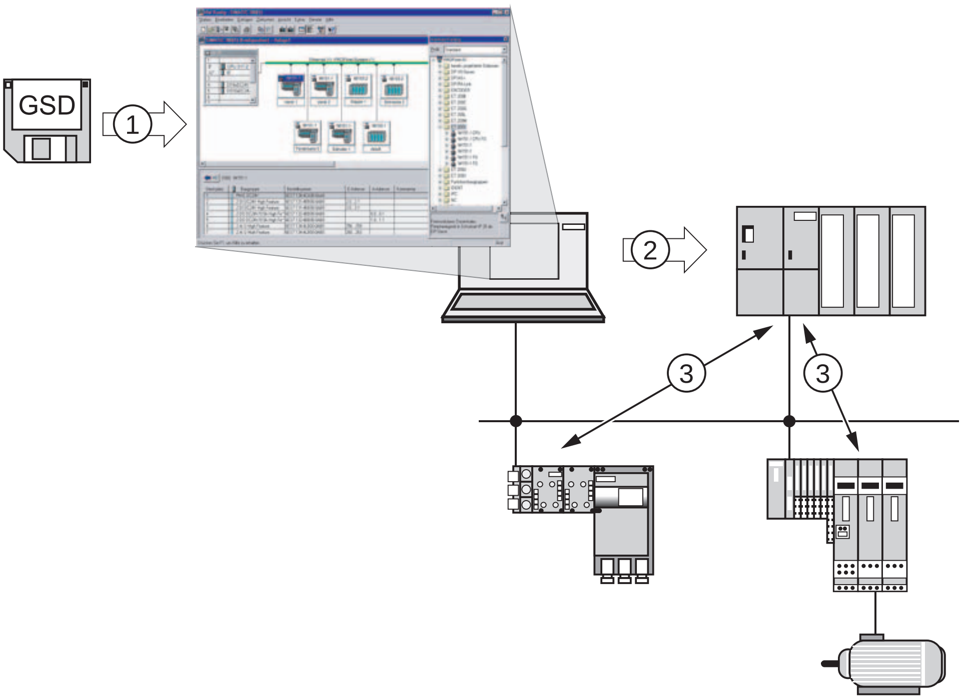


Figure 5-1 From GSD Import to Data Exchange

Number	Description
①	The device description is imported into the engineering system as a GSD file.
②	You configure and program in the engineering system (for example STEP 7). Following this, the configuration and user programs are transferred to the IO controller.
③	After you have assigned device names to the IO devices, the data exchange between the IO controller and the assigned IO devices is handled automatically.

Downloading the User Program from the IO Supervisor/PC to the Target System

To download the user program via Industrial Ethernet from the IO supervisor to the target system, even via routers, STEP 7 uses TCP/IP. Thus, you must set the Ethernet interface as the interface on your IO supervisor.

You can also still download the user program to the target system via MPI and PROFIBUS.

Support by STEP 7

STEP 7 supports you from planning to operating a plant as follows:

- Data management of PROFINET devices in the hardware catalog.
- Networking of devices in the network view (Netpro) and / or in HW Config
- (Configuration view in STEP 7)

  In the network view, you can attach devices to a PROFIBUS or Industrial Ethernet subnet and address the relevant addresses.
- Configure the PROFINET CPs in STEP 7. Remember that under some circumstances, you must configure, program, and run diagnostics with CPs differently from the integrated interface of a CPU. For more information, refer to the relevant manual.
- Monitoring and modifying variables online
- You can access the process data online at any time. You can either use a variable table or integrate HMI devices such as ProTool/Pro RT or WinCC flexible in your system or use OPC-based client programs.
- Diagnostics on PROFINET IO devices

  The current status of the PROFINET devices is displayed in a separate diagnostics window. With an online-offline comparison, you can determine whether or not it is necessary to download programs and/or a configuration to the automation systems.
- Presentation of the project in a hierarchical tree structure

  All parts of the system are represented in a clearly identifiable way that allows convenient navigation and other management functions in the project.
- Support in creating system documentation

  STEP 7 automatically creates a comprehensive documentation of the configured system including all devices and their attachments.
- Checking the configuration

  STEP 7 automatically checks
  - whether you have kept to the configuration limits dictated by the hardware and
  - whether the configuration is consistent and free of errors.
- Querying online data of the devices.

  With the online device analysis, you can query the online data of individual devices for test and diagnostic purposes.
- Diagnostics of the switches

Diagnostics can be performed on the SCALANCE X200 and SCALANCE X400 series switches as a PROFINET IO device

Commissioning a PROFINET Interface for a CPU

You will find detailed information in the *S7-300, CPU 31xC and CPU 31x Hardware and Installation* operating instructions.

CPU communication

In PROFINET IO, you configure and program the communication between the I/O controllers as normal as an S7 connection or as a Send/Receive connection.

Detailed Information on CPU Communication

You will find a detailed information on this topic in the *Communication with SIMATIC* manual and in the reference manual *System Software for S7-300/400 System and Standard Functions*.

See also

Communication in Real Time (Page 4-3)

SIMATIC NCM PC (Page 5-5)

5.2 SIMATIC NCM PC

SIMATIC NCM PC Configuration Tool

SIMATIC NCM PC is a version of STEP 7 tailored to PC configuration. For PC stations, it offers the full range of functions of STEP 7.

SIMATIC NCM PC is the central tool with which you configure the communication services for your PC station. The configuration data generated with this tool must be downloaded to the PC station or exported. This makes the PC station ready for communication.

SIMATIC NCM PC and STEP 7 are compatible with each other

- You can open and edit projects you have created with SIMATIC NCM PC at any time in STEP 7/SIMATIC Manager. There, you will find the additional functions for programming and configuring the S7 stations.
- You can open projects you have created with STEP 7/SIMATIC Manager at any time in SIMATIC NCM PC. You can edit the existing PC stations and create new PC stations. You can configure the communication connections for these PC stations to the existing S7 stations.

NCM PC can use STEP 7 project data

The restrictions in SIMATIC NCM PC relate to the configurable station types. You can only configure and program S7 stations in STEP 7.

The station types that can only be configured in STEP 7 are, however, available for connection configuration as target stations after importing the project into SIMATIC NCM PC.

The OPC server can also use the symbol files created for the S7 stations. You make the relevant settings when you configure the OPC server.

A project that has been further edited in SIMATIC NCM PC can be opened again in STEP 7 and edited at any time.

STEP 7 provides additional functions for test and diagnostic purposes.

Functions

To configure and engineer a PC station, use the following functions:

- Create and configure components of the PC station
- Configure the communication properties of the SIMATIC NET OPC server
- Configure connections
- Adopt the symbols from the SIMATIC S7 configuration
- Configure DP and PROFINET operation
- Set network parameters for operating PROFIBUS and Industrial Ethernet
- Download configuration data to the PC stations
- Store configuration and project engineering data in a file
- Monitor the communication with connected S7 stations using NCM Diagnostics

See also

SIMATIC PC Stations (Page 2-14)

5.3 Address assignment

5.3.1 Addresses

Addresses

All PROFINET devices are based on the TCP/IP protocol and therefore require an IP address to operate on Ethernet.

To simplify project engineering, you are requested to assign an IP address only once: When configuring the IO controller in STEP 7/HW Config.

Here, STEP 7 opens a dialog in which you can select the IP address and the Ethernet subnet. If the network is isolated, you can accept the IP address and subnet mask proposed by STEP 7. If the network is part of an existing Ethernet company network, obtain the information from your network administrator.

The IP addresses of the IO devices are generated by STEP 7 and assigned to the IO devices when the CPU starts up. The IP addresses of the IO devices always have the same subnet mask as the IO controller and are assigned in ascending order starting from the IP address of the IO controller. The IP address can be changed manually, if necessary.

Device Name

Before an IO device can be addressed by an IO controller, it must have a device name, as the IP address is permanently assigned to the device name. In PROFINET, this method was selected because it is simpler to work with names than with complex IP addresses.

The assignment of a device name for a concrete IO device can be compared with setting the PROFIBUS address of a DP slave.

When it ships, an IO device does not have a device name. An IO device can only be addressed by an IO controller, for example, for the transfer of project engineering data (including the IP address) during startup or for user data exchange in cyclic operation, after it has been assigned a device name with the IO supervisor/PC.

Alternatively, the device name can be written in the programming device directly to the MMC (for the ET200S/PN IO device).

Structured Device Names

You can structure the device names according to DNS conventions. The Domain Name System (DNS) is a distributed database that manages the namespace on the Internet. To structure the names, you use the period (".").

...<Subdomain-Name>.<Domain-Name>.<Top-Level-Domain-Name>

Device number

Apart from the device name, STEP 7 also assigns a device number beginning with "1" when an IO device is inserted.

With this device number, you can identify an IO device in the user program (for example SFC71 "LOG_GEO"). In contrast to the device number, the device name is not visible in the user program.

5.3.2 IP and MAC Address

Definition: MAC address

Each PROFINET device is assigned a worldwide unique device identifier in the factory. This 6-byte long device identifier is the MAC address.

The MAC address is divided up as follows:

- 3 bytes vendor identifier and
- 3 bytes device identifier (consecutive number).

The MAC address is normally printed on the front of the device.
Example: 08-00-06-6B-80-C0

IP address

To allow a PROFINET device to be addressed as a node on Industrial Ethernet, this device also requires an IP address that is unique within the network. The IP address is made up of 4 decimal numbers with a range of values from 0 through 255. The decimal numbers are separated by a period.

The IP address is made up of

- The address of the (subnet) network and
- The address of the node (generally called the host or network node).

Definition: Subnet Mask

The bits set in the subnet mask decides the part of the IP address that contains the address of the subnet/network.

In general:

- The network address is obtained by an AND operation on the IP address and subnet mask.
- The node address is obtained by an AND NOT operation on the IP address and subnet mask.

Example of the Subnet Mask

Subnet mask: 255.255.0.0 (decimal) = 11111111.11111111.00000000.00000000 (binary)

IP Address: 140.80.0.2

Meaning: The first 2 bytes of the IP address decide the subnet - in other words 140.80. The last two bytes address the node - in other words 0.2.

IP Address Assignment

You assign the IP address with vendor-specific software, for example STEP 7. You can also assign the IP address for network components using the Primary Setup Tool (PST). You can download the Primary Setup Tool from the Internet free of charge. Go to: http://support.automation.siemens.com/WW/view/en/19440762. Here, you will also find a list of devices for which the PST is approved.

IP Address Assignment when Replacing an IO Controller or IO Device

The memory card (MMC) of programmable controllers (PLC) contains the following:

- On the IO controller: Device name and IP address
- On the IO device: Device name

The C-Plug in CPs, IE/PB links, PN IO, and in switches (e.g., in the SCALANCEX series) contains the device name.

If you remove the memory card / C-Plug from a PROFINET controller and insert it in a different PROFINET device, you transfer the device-specific information and the IP address to the device.

If an IO device must be completely replaced due to a device or submodule defect, the IO controller automatically assigns parameters and configures the new device or submodule. Following this, cyclic exchange of user data is restarted.

The MMC card / C-Plug allows module exchange without an IO supervisor when a fault occurs in a PROFINET device. You can also transfer the device data from the PC/IO supervisor directly to the MMC card (e.g., for the ET200S/PN IO device).

Default Router

A default router is used when data have to be forwarded via TCP/IP to a partner located outside the subnet.

In the STEP 7 properties dialog Properties Ethernet Interface > Parameters > Gateway, the default router is called *Router*. STEP 7 assigns the local IP address to the default router.

5.3.3 Assigning Device Name and IP Address

Assigning an IP Address and Subnet Mask for an IO Controller the First Time

There are four possibilities:

1. If your PROFINET device has an MPI or PROFIBUS DP interface, connect your IO supervisor directly to the PROFINET device via the MPI or PROFIBUS DP interface. From STEP 7, you assign an IP address to the device (actually assigned when the hardware configuration is downloaded).
2. If your PROFINET device is equipped for a memory card (MMC), insert the MMC in your IO supervisor and store the hardware configuration along with the configured IP address on the MMC. Then insert the MMC in the PROFINET device. When you insert the MMC, the PROFINET device automatically adopts the IP address.
3. Connect your IO supervisor to the PROFINET interface of a PROFINET device and download the hardware configuration along with the configured IP address to the PROFINET device. You can do this is STEP 7.
4. Connect your IO supervisor to the same subnet to which the relevant PROFINET device is connected. Download the hardware configuration and the configured IP address to the PROFINET device via the subnet. You can do this is STEP 7.

Commissioning a PROFINET Interface

You will find more information on commissioning a PROFINET interface in the *S7-300, CPU 31xC and CPU 31x Hardware and Installation* operating instructions.

Sequence of the Assignment of Device Name and Address for an IO Device

The following schematic illustrates the sequence when assigning the device name and address.

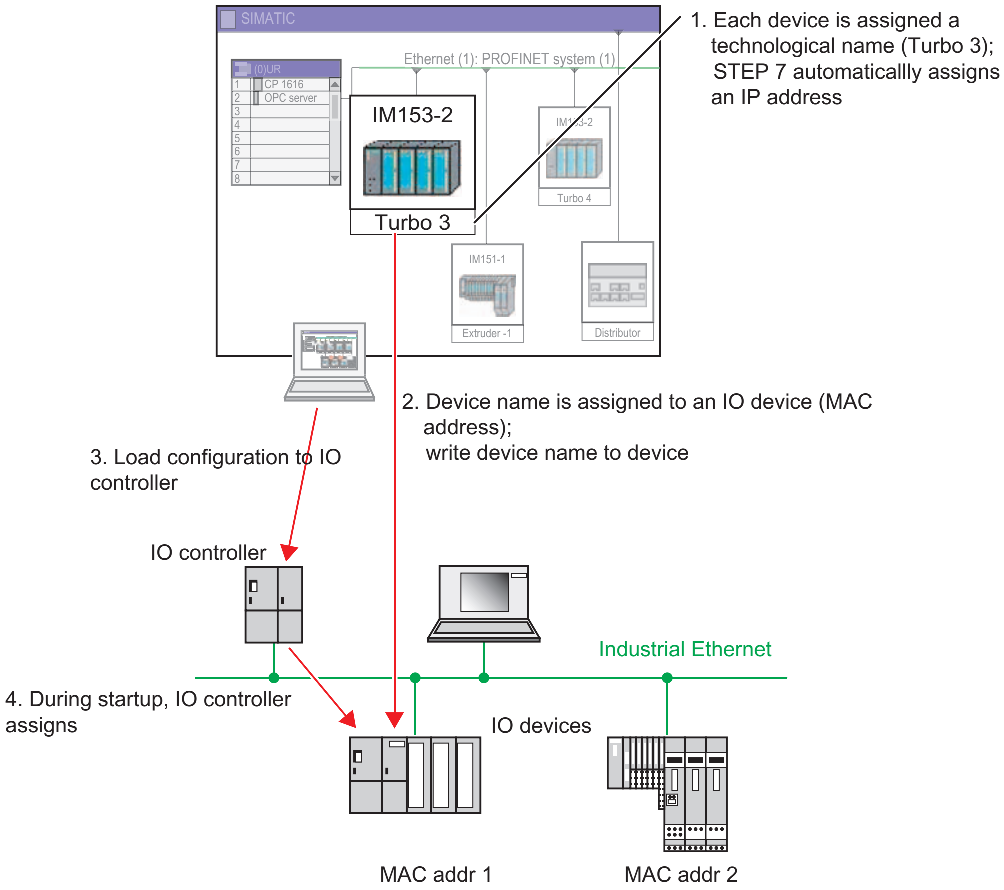


Figure 5-2 Principles: Assigning Device Name and Address

In STEP 7, a device name is assigned for each IO device and its MAC address. You can change the the name and IP address manually.

You have two basic options for downloading configured data to the PROFINET device:

1. Offline with MMC:

Place the configured data (device name: e.g., Turbo 3) for the device in the MMC in the IO supervisor. The STEP 7 "Save device name to memory card" function helps you do this. Then insert the MMC in the PROFINET device. The device automatically assumes its configured device name.

2. Online with IO Supervisor:

Connect the IO supervisor directly to the IO device via the PROFINET interface. Download the configured data (device name, e.g., Turbo 3) from STEP 7 to the PROFINET device.

The IO controller recognizes the IO device by its device name and automatically assigns the configured IP address to it.

See also

IP and MAC Address (Page 5-8)

5.4 Diagnostics in PROFINET IO

Content of the Section

This section explains the following:

- How the diagnostic mechanism works in PROFINET IO
- How STEP 7/NCM PC supports you
- How to evaluate diagnostic messages in the user program
- How to run diagnostic checks on the network infrastructure
- Which diagnostic information you can obtain from the LEDs of a PROFINET interface

Summary of diagnostics

With diagnostics, you can either

- react to an error (event-related diagnostics, the evaluation of interrupts) or
- check the current status of your automation system (status-related diagnostics).

Just as PROFIBUS DP, PROFINET IO also offers you various options. The table below lists the most important options with which you can access diagnostic information.

Table 5-1 Summary of diagnostics

Diagnostic Capability	Benefits	You will find the information in the section...
Online diagnostics with an IO supervisor/PC/HMI device	This allows you to evaluate the current status of your automation system.	Support by STEP 7/NCM PC
Reading out systems status lists (SSL)	You can narrow down an error with the SSLs	Evaluation of Diagnostics in the User Program
Reading out diagnostic data records	You can obtain detailed information on the type and source of an error from the diagnostic data records.	Evaluation of Diagnostics in the User Program
Reporting system error	Diagnostic information is displayed as messages on the HMI device	Support by STEP 7/NCM PC
SNMP	With this protocol, you can run diagnostic checks on the network infrastructure	Network Infrastructure Diagnostics (SNMP)
LEDs of a PROFINET interface	Based on the LEDs, you can see whether problem-free communication is possible and whether data is being sent or received	Diagnostics with LEDs

5.4.1 Basics of Diagnostics in PROFINET IO

Totally Integrated Diagnostics Concept

PROFINET IO supports you with a totally integrated diagnostics concept comparable with that of PROFIBUS DP. Below, we will explain the basics of the concept.

Concept

Each individual or several errors occurring simultaneously are transferred from the IO device to the IO controller.

If you require the full status of the IO device including any pending errors, you can also read the status directly from the IO device.

Diagnostics Levels

You can evaluate diagnostic information at different levels.

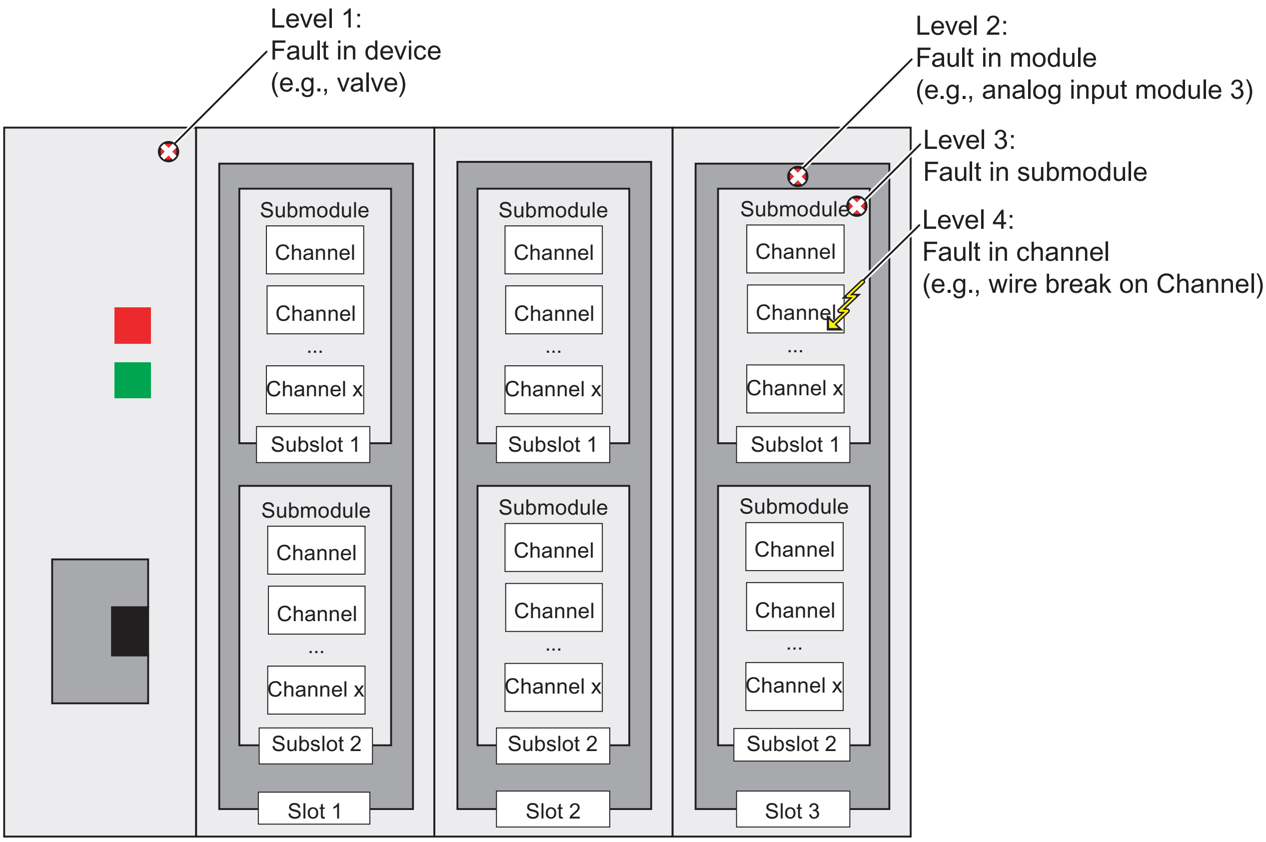


Figure 5-3 PROFINET IO Diagnostics Levels

Access to the Status of an IO Device with a Programming Device or an Operator Control and Monitoring Device

If you are connected to Industrial Ethernet via a programming device with STEP 7 or an operator control and monitoring device, you can also call up diagnostic information online. This is illustrated by the following graphic.

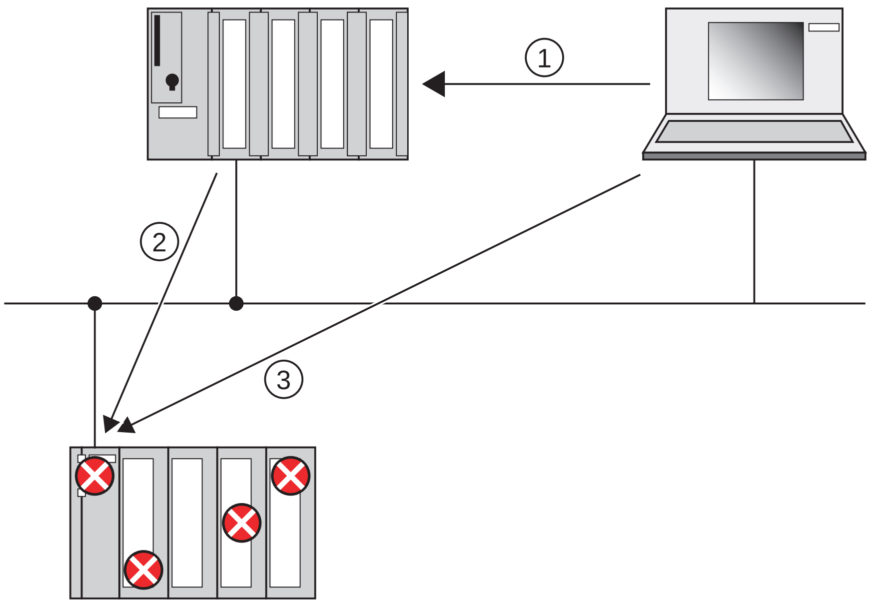


Figure 5-4 PROFINET IO Diagnostics with STEP 7 or Operator Control and Monitoring Device

Number	Description
①	Online diagnostics in STEP 7 or operator control and monitoring device: The programming device/operator control and monitoring device (IO supervisor/HMI) requests the station status of the IO device.
②	Following the request from the IO supervisor/HMI, the IO controller automatically reads the entire station status asynchronously directly from the IO device and stores the read diagnostic information in system status lists on the IO controller. The IO supervisor/HMI then accesses these system status lists.
③	Online diagnostics in STEP 7 or operator control and monitoring device: The IO supervisor/HMI can also read the station status directly from the IO device without the IO controller being involved. This is only possible if the IO supervisor/HMI is connected directly to Industrial Ethernet. This means that you can access diagnostic information during the commissioning phase or during service even if the IO controller is not operational.

Information on Diagnostics in PROFINET IO

You will find further information in the *From PROFIBUS DP to PROFINET IO* programming manual.

5.4.2 Support by STEP 7/NCM PC

Diagnostics in STEP 7/NCM PC

The following schematic illustrates the paths leading to diagnostics in STEP 7.

For diagnostics with NCM PC, the devices must support the Simple Network Management Protocol (SNMP). The diagnostic steps are applicable accordingly for NCM PC as in STEP 7.

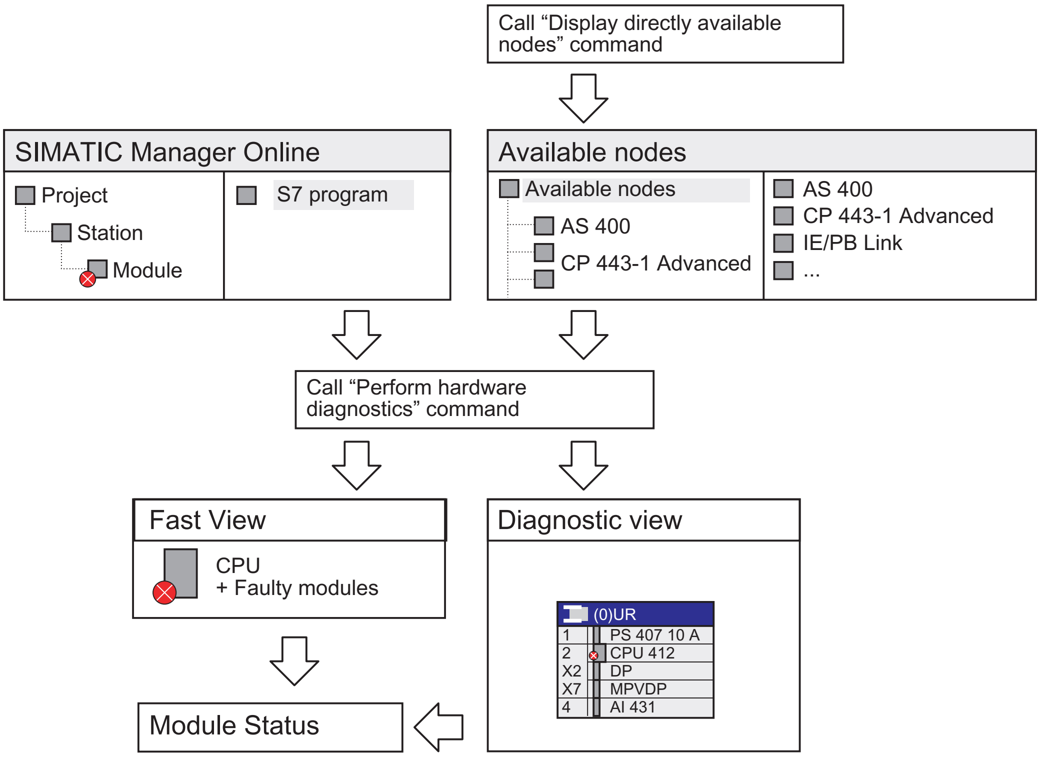


Figure 5-5 Diagnostics in STEP 7

HW Config Online

With the online view in HW Config, you can obtain an overview of the current status of your system in STEP 7. Here, you also have the project engineering information available (for example unconfigured modules). To use these functions in STEP 7/HW Config select the menu command **Station > Open Online**. The following graphic is an example of the station view.

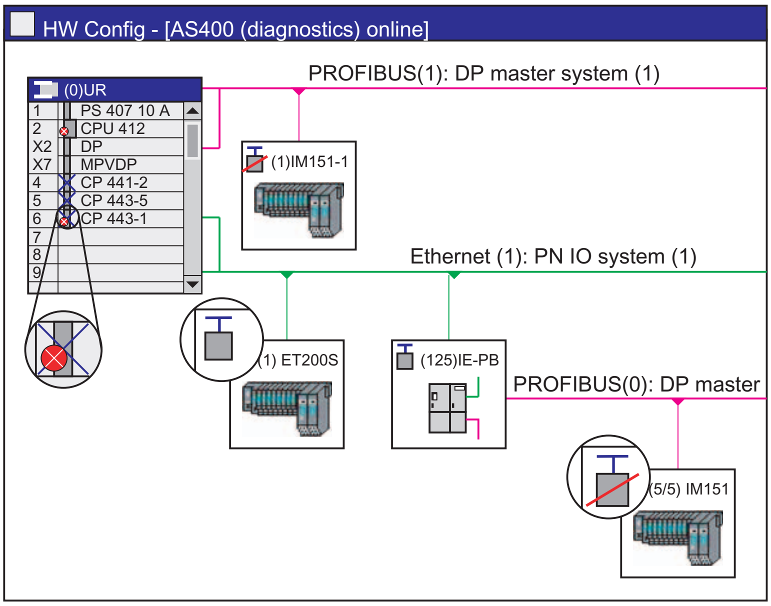


Figure 5-6 Online view In STEP 7

"Report System Error"

Starting with Service Pack 2 (SP2) of STEP 7 V5.3, the "Report system error" function is also supported in PROFINET IO (this function was previously supported only in PROFIBUS DP).

The STEP 7 "Report system error" function provides a convenient way to display diagnostic information provided by the component in the form of a message.

STEP 7 automatically generates the necessary blocks and message texts. The user only needs to download the generated blocks to the CPU and transfer the texts to connected HMI devices.

Information on Configuring "Report System Error"

You can find detailed information on the concept and configuration of "Report system error" in the Version V5.4, Service Pack 2 or higher of the STEP 7 help.

Available nodes Displaying

In the SIMATIC Manager, you can use the menu command Display > Available Nodes to display a list of the PROFINET devices.

Note

The interface of the IO supervisor/PC must be set to Ethernet in STEP 7/NCM PC. Otherwise, no connection can be established.

Diagnostics View and Fast View

In STEP 7, you can display an overview of modules causing problems. To do so, invoke the following menu command in SIMATIC Manager: PLC > Diagnostics/Settings > Hardware Diagnostics.

In the settings in STEP 7, you can select whether the fast view or the diagnostics view is displayed as default.

In the fast view, the IO controller (CP or CPU) and the modules causing problems are displayed.

In the diagnostics view, all modules are displayed.

Module Status

Detailed diagnostic information is displayed in the module status window. You can see the following information in this window:

- Device status (OK, faulty, failed)
- Device name (for example, valve_1)
- Device type (for example, ET200S)
- Plant designation and location identifier (for example, press line 1, cubicle 4.1. A)
- Fault location (slot, module, submodule,channel)
- Channel error type (for example, wire break)
- Remedy with troubleshooting (with some modules)

STEP 7 NCM

NCM integrated in STEP 7, provides comprehensive diagnostic options for the various types of communication in PROFINET.

You can start NCM diagnostics from the Start > SIMATIC > STEP 7 > NCM S7 menu or in the properties dialog of a CP.

5.4.3 Examples of Diagnostic Mechanisms

Communications Processors and Switches

The following schematic illustrates important basics of diagnostics with communications processors and switches.

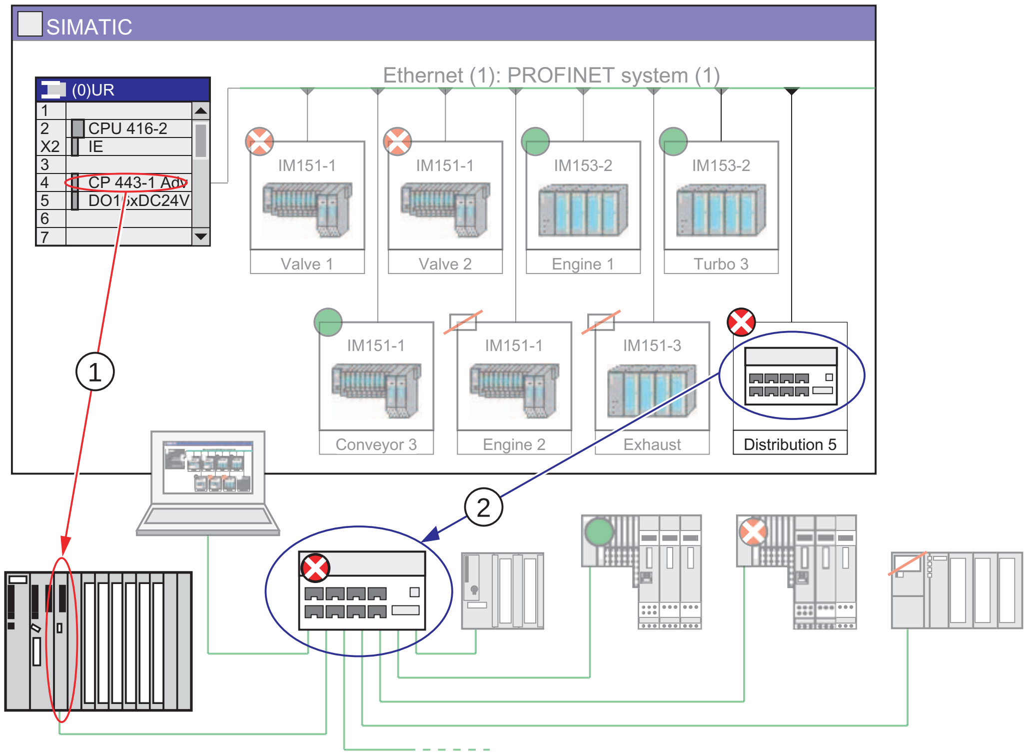


Figure 5-7 Communications Processors and Switches

Number	Meaning
①	Diagnostic checks for a communications processor (CP)
②	Diagnostic checks for a switch

Communications Processor

A communications processor provides diagnostics in STEP 7 identical to that of the PROFINET interface of a CPU. This applies to all communications processors used as the PROFINET interface in a PC (number ①, Figure 5-7).

Switch

If a switch (for example, SCALANCE X 200/400) supports PROFINET IO and is integrated in the configuration like a field device, you can run diagnostics on this switch like a field device in STEP 7 (number ①, Figure 5-7).

Some switches (for example SCALANCE X 200/400) also provide the option of Web-based diagnostics.

Sequence with a Wire Break

The following schematic illustrates how diagnostic information is exchanged if a wire break occurs. Problems on cables are handled in the same way as problems in devices.

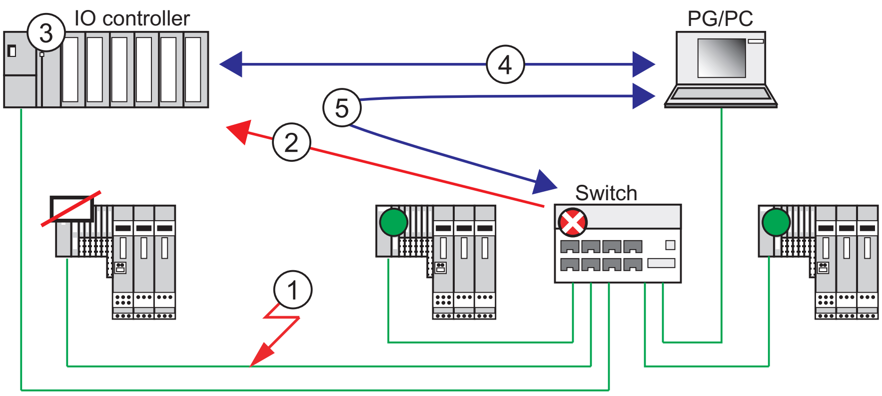


Figure 5-8 Sequence with a Wire Break

Number	Description
①	The cable between an IO device and a switch is interrupted.
②	The switch generates an interrupt on the IO controller along with the information on the port involved.
③	The IO controller detects the failure of the IO device and at the same time the diagnostic interrupt from the switch. The module status data is updated on the IO controller and an error OB is called.
④	STEP 7 (on the PG/PC) reads the module status data from the IO controller. When the module status data are read out from STEP 7, the IO device (ET200S) is indicated as having failed and the switch is marked as faulty. If you check the system status online, for example, in STEP 7/HW Config, you can see that there is a problem on the cable.
⑤	STEP 7 can also read detailed information directly from the switch.

Whatever the situation, a station failure is indicated in such a scenario. If diagnostics cannot be performed on the switch, this is the only information provided.

Diagnostics in the User Program

The evaluation of diagnostic information using SFBs/SFCs in the user program is similar to that in PROFIBUS DP.

In PROFINET IO, there is a vendor-independent structure for data records with diagnostic information. Diagnostic information is generated only for channels causing problems. With PROFINET, there are two basic ways of obtaining diagnostic information.

1. Evaluating the Diagnostic Status

If you would like to find out the current status of your automation system, read the system status lists (SSLs), which provide an overall view of the available IO subsystems. You can use the SSLs to locate faulty stations within an IO subsystem.
You can use partial lists to narrow the fault down to one module/submodule.
With SFB52 (Read data record), you can read various diagnostic data records directly from the module causing problems and obtain detailed information on the problem.

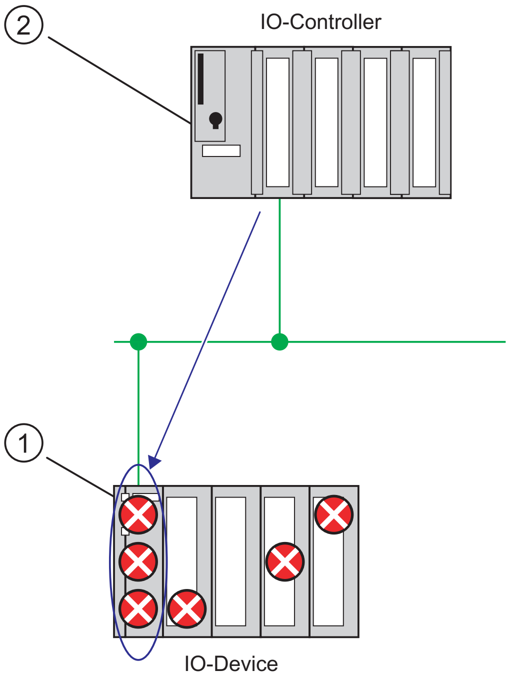


Figure 5-9 Example: Evaluating diagnostic interrupts with SFB52

Number	Description
①	All individual errors are collected in one data record on the head module.
②	In your user program, SFB52 reads the entire station status asynchronously directly from the IO device.

2. Evaluation of Interrupts

If an error/interrupt occurs, an error organization block (error OB) is called automatically. Based on the OB number and start information, you already have information on the cause of the problem and location. You can obtain detailed information on the event that caused the problem in this error OB the using SFB54 (Read additional interrupt information).

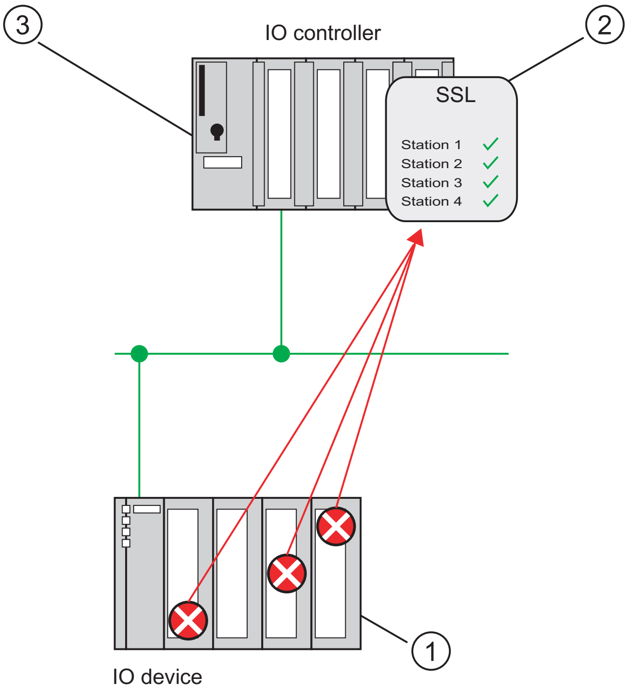


Figure 5-10 Diagnostics with OB82 and SFB54

Number	Description
①	Each error is sent to the IO controller individually as channel diagnostic information in the form of an interrupt.
②	On the IO controller, the module status data is updated automatically and the error OB (OB82) is started.
③	In your user program in the error OB (OB82), SFB54 reads the error synchronously from the IO controller without addressing the I/O device.

Diagnostic Data Records (Records in PROFINET IO)

There are two different types of diagnostic data records:

1. Channel diagnostic data records

   Channel diagnostic data records are displayed when there is an error on a channel or when the channel has triggered an interrupt. If there is no error, a diagnostic data record with a length of 0 is returned.

   A maximum of 400 channel errors can be displayed at one time.

2. Vendor-specific diagnostic data records

   The structure and size of the vendor-specific diagnostic data records differ from vendor to vendor. This information is entered in the GSD file of a device. The GSD file is supplied by the vendor of a device.

List of Diagnostic Data Records

You will find information in the *From PROFIBUS DP to PROFINET IO* programming manual.

Comparison of Diagnostics between PROFINET IO and PROFIBUS DP

You will find information in the *From PROFIBUS DP to PROFINET IO* programming manual.

You will find information on SFBs and OBs in the STEP 7 online help and in the manual *System Software for S7-300/400 System and Standard Functions.*

5.4.5 Diagnostics using LEDs

Status and Error Indicators: PROFINET devices

Note

The RX and TX LEDs can be combined in one LED, for example, on CPU 317-2 PN/DP or CP 343-1. The LED on this device is located, for example, behind the front cover.

LED	LED status			Description of the status
	Not lit	Flashes	Lit	
LINK	–	–	X	The Ethernet connection between the PROFINET interface X2 of your PROFINET device and a communication partner is up (for example, a switch).
	–	X	–	Only with an IO device: The user activated flashing from STEP 7.
	X	–	–	The Ethernet connection between the PROFINET interface of the PROFINET device and the communication partner is down.
RX	–	–	X (flickers)	At the current time, data are being received from a communication partner on Ethernet via PROFINET interface of the PROFINET device.
	X	–	–	No data are currently received via the PROFINET interface.
TX	–	–	X (flickers)	Data are currently sent to a communication partner on Ethernet via the PROFINET interface of the PROFINET device.
	X	–	–	No data are currently transmitted via the PROFINET interface.
BF2 or BUSF	–	–	X	Error on the PROFINET interface, communication no longer possible (for example, with a CPU as IO controller, when the connection to the switch is down) To correct or avoid error: See the table below
	–	X	–	Error on the PROFINET interface (for example, due to station failure of one or more IO devices) To correct or avoid error: See the table below
	X	–	–	No error at the PROFINET interface

Corrective Measures for Errors on the PROFINET Interface:

- BF2/ BUSF LED is lit

Table 5-2 BF2/ BUSF LED is lit

Possible Problem	Reaction based on the example of a CPU	Possible Remedies
• Bus problem (no physical connection to a subnet/switch) • Wrong transmission speed • Full duplex mode not set	Call of OB 86 (when CPU is in RUN mode). CPU switches to STOP if OB 86 is not loaded.	• Check the bus cable for a short-circuit or break. • Check that the module is connected to a switch and not to a hub. • Check that data are being transmitted at 100 Mbps and in full duplex mode. • Analyze the diagnostic data. Edit the configuration.

- BUSF LED is flashing on an IO controller

Table 5-3 BF2/ BUSF LED flashes on a PROFINET IO controller

Possible Problem	Reaction based on the example of a CPU	Possible Remedies
• Failure of a connected IO device • At least one of the assigned IO devices cannot be addressed • Bad engineering configuration	Call of OB 86 (when CPU is in RUN mode). CPU switches to STOP if OB 86 is not loaded.	• Check that the Ethernet cable is connected to the module or whether the bus is interrupted. • Wait until the CPU has completed its startup. If the LED does not stop flashing, check the IO devices or evaluate its diagnostic information. • Verify that the configured device name matches its actually assigned name.

- BUSF LED is flashing on an IO device

Table 5-4 BF2/ BUSF LED flashes on a PROFINET IO device

Possible Problem	Possible Remedies
• Bus communication via PROFINET is interrupted. • The IP address is incorrect. • Bad engineering configuration • Bad parameter assignment • IO controller does not exist/turned off, but Ethernet connection established. • Bad or no device name • • The watchdog has elapsed.	• Check that the Ethernet cable is correctly connected. • Check whether the Ethernet cable to the controller is interrupted. • Check the configuration and parameter assignment. • On the IO device: Switch on the IO controller. • Check whether the expected configuration matches the actual configuration. • Check the physical communication connection for interruption

Tip: Identification of the PROFINET device in the cubicle

When they are first commissioned, PROFINET IO devices must be assigned a device name. In STEP 7/HW Config, you can make the LINK LED of a PROFINET IO device you are naming flash usingPLC > Ethernet > Assign Device Name. This allows you, for example, to identify the PROFINET IO device uniquely among several identical devices in a cubicle.

5.4.6 Network Diagnostics (SNMP)

Network Diagnostics

SNMP (Simple Network Management Protocol) is the standardized protocol for diagnostics of the Ethernet network infrastructure and for assignment of parameters to it.

Within the office area and in automation engineering, devices of a wide range of vendors support SNMP on Ethernet.

Applications based on SNMP can be operated on the same network at the same time as applications with PROFINET.

The range of functions supported differs depending on the device type. A switch, for example, has more functions than a CP 1616.

Uses of SNMP

SNMP can be used as follows:

- By the IT administration of users of machines and plants to monitor their Industrial Ethernet network using standard network management systems.
- By users to integrate network diagnostics in a central HMI/SCADA system.
- By the IT administration to monitor primarily the office network but also in many cases the automation network using standard network management systems (for example, HP Openview).
- By automation engineers (plant operators) to integrate network diagnostics in a central HMI/SCADA system using the SNMP OPC server.

Software for SNMP

As an open standard, you can use any systems or software solutions for diagnostics based on SNMP in PROFINET.

The SNMP OPC server, for example, supports SNMP.

Application Examples for SNMP

- Network administrator of IT sets parameters for switches / routers during commissioning and service
  - using vendor-specific network management software.
- Network administrator of IT runs overview and detailed diagnostics during operation using the network management system
  - using vendor-specific network management software.
- Plant operator runs diagnostics during operation
  - using an HMI/SCADA system. The SNMP OPC server is required for this.

Further Information

At "http://www.profibus.com", you will find information on SNMP in the Network Management standardization group.

At "http://www.snmp.org", you will find further details on SNMP.

At "http://www.siemens.com/snmp-opc-server", you will find further information on the SNMP OPC server.

PROFINET CBA - Engineering 6

Chapter Content

This chapter provides you with information on PROFINET CBA (Component based Automation) in greater depth. Here, you will learn the following:

- The basic sequence of the entire engineering
- The meaning of PROFINET components and technological functions
- What devices PROFINET components consist of
- What diagnostic options are available

6.1 Engineering with SIMATIC IMap

Engineering Concept of SIMATIC IMap

PROFINET offers you a standardized device and vendor-independent engineering interface in SIMATIC iMap. This allows you to integrate devices and components of different manufacturers simply in one plant via PROFINET.

SIMATIC iMap allows you to bring together distributed automation applications in a graphical format so that they can be displayed for the entire facility. All necessary PROFINET components are available to you in a uniform representation in a library.

The communication connections between the devices do not need to be programmed, but can be configured graphically as interconnection lines.

SIMATIC iMap can download the contents of the PROFINET components and the associated interconnections to devices in the plant. During commissioning and while the facility is in operation, you can use SIMATIC iMap to scan the process and the diagnostic data of the devices as well as to modify parameters and project data for testing purposes.

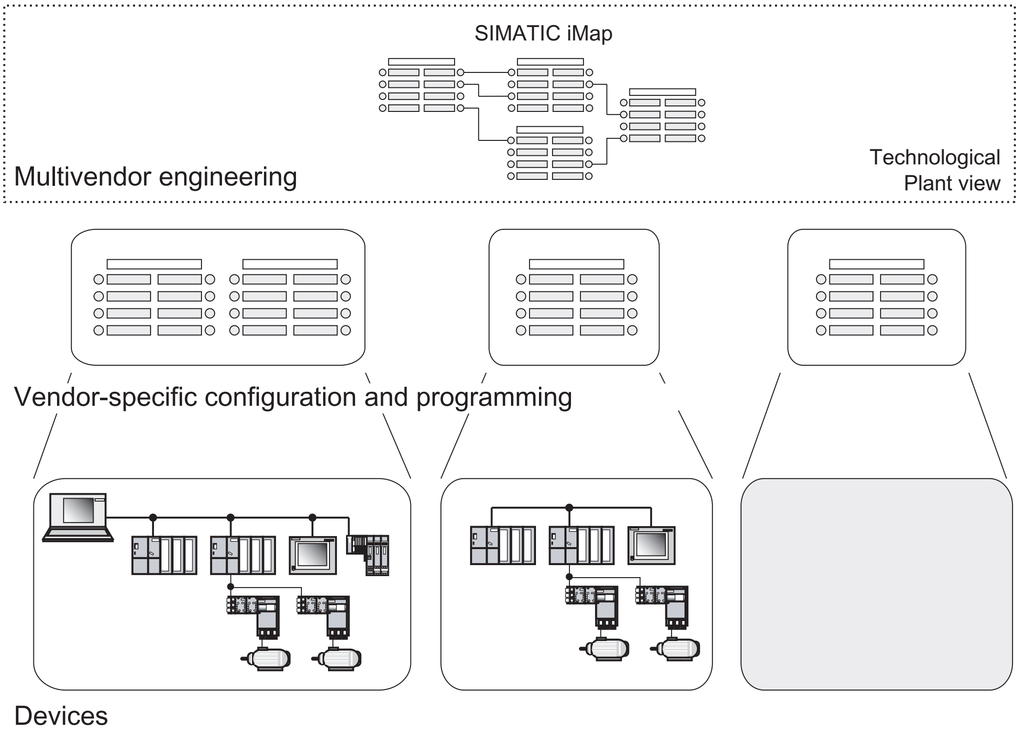


Figure 6-1 SIMATIC iMap Engineering Concept

Vendor- and Device-independent Engineering Concept

To interface with vendor-specific configuration and programming tools, SIMATIC iMap provides the following functions:

- Software for the integration of PROFINET components that contain SIMATIC automation systems and that were programmed in STEP 7.
- Access to vendor-specific tools for configuration and diagnostics of devices.

Basic Steps from Planning to Operating a Plant

Setting up and operating a system with SIMATIC iMap involves the following basic steps:

1. Planning the system

   The system planner specifies the following:

   – Which functions are necessary
   – Which automation systems and field devices will be used.
   – Which functions can be put together into reusable technological modules.
   – Which technological interfaces are necessary, how the PROFINET components interact, and which variables are used for diagnostics and visualization.

2. Creating PROFINET components

   The system and mechanical engineer creates PROFINET components with the vendor-specific configuration and programming tool (for SIMATIC automation systems: STEP 7. The engineer must:

   – Configure and make the parameter settings for the hardware
   – Create technological interface descriptions
   – Create user programs
   – Test technological modules
   – Create PROFINET components (XML file and corresponding database)
   – Optional: Import PROFINET components into a SIMATIC iMap library

3. Configuring the system in SIMATIC iMap

   The configuration engineer creates a project in SIMATIC iMap by performing the following steps:

   – Opening an existing library or creating a new library
   – When necessary: Importing new PROFINET components into the library
   – Inserting PROFINET components into the project
   – Networking devices in the network view
   – Assigning addresses to the devices: address and/or PROFIBUS address (this step depends on the device)
   – Interconnecting technological functions in the plant view
   – Changing properties of devices and functions
   – Checking the configuration
   – Documenting the project and archiving.

4. Commissioning and Testing

   The commissioning engineer performs the following tasks:

   – Commissioning individual devices
   – Downloading project data to the devices of the system
   – When necessary: Revising devices and technological functions in the vendor-specific engineering system
   – Testing the system
   – Creating symbol files for access via OPC

5. Operating the plant.

   The plant user performs the following tasks:

   – Monitoring and manipulating process data online (vertical integration)
   – Running diagnostics on the plant
   – Operator control and monitoring
   – Performing maintenance and modifications.

PROFINET Component Description (PCD)

In your engineering system (for example, STEP 7), you generate a component. The description of the component (PROFINET Component Description) is stored by the engineering system as an XML file. You can import this XML file into SIMATIC iMap and interconnect it with other components.

Support by SIMATIC IMap

SIMATIC iMap supports you from planning to operating a plant as follows:

- Data management of own and predefined PROFINET components in libraries

  PROFINET components that you have created or predefined can be managed in libraries whose content you yourself decide on.
- Interconnecting technological functions in the plant view

  In the plant view, you can place technological functions graphically, interconnect them, and query/modify their properties.
- Networking devices in the network view

  In the network view, you can attach devices to a PROFIBUS or Industrial Ethernet subnet and address the relevant addresses.
- Monitoring and modifying variables online

  You can access the process data online at any time. You can either use a variable table, integrate HMI devices such as WinCC flexible in your system, or use OPC-based client programs.
- Diagnostics of PROFINET devices and technological functions

  The current status of the PROFINET devices and technological functions is displayed continuously in a separate diagnostics window. With an online-offline comparison, you can check whether or not a download of the programs and/or the interconnections is necessary.
- Presentation of the project in a hierarchical tree structure

  All parts of the system are represented in a clearly identifiable way that allows convenient navigation and other management functions in the project.
- Automatic creation of plant documentation

  SIMATIC iMAP automatically creates full documentation of the configured plant including all devices, technological functions and their attachments as well as the graphic representation of the networking and interconnections.
- Checking the configuration

  You can check the configuration in SIMATIC iMap even before you generate the project based on the device-specific performance data.
- Querying online data of the devices

  With the online device analysis, you can query the online data of individual devices for test and diagnostic purposes.
- Versioning of PROFINET components

Assigning the IP Address

You must assign the IP address with vendor-specific software. How to assign an IP address, for example, with STEP 7, is explained in the section below.

CPU communication

With PROFINET CBA, communication between the CPUs as components is either cyclic or acyclic.

See also

IP and MAC Address (Page 5-8)

6.2 Component Concept

Overview

Mechanical, electrical, and electronic parts of automation systems handle certain technological functions in the automation system or the manufacturing process.

All the parts of automation systems belonging to a technological function and the corresponding control program form an independent technological module. If this technological module meets the communication requirements of the PROFINET specification, it is possible to create a PROFINET component from it in an engineering system.

Example Transport

The definitions made above can be seen in the following graphic based on an example called "transport":

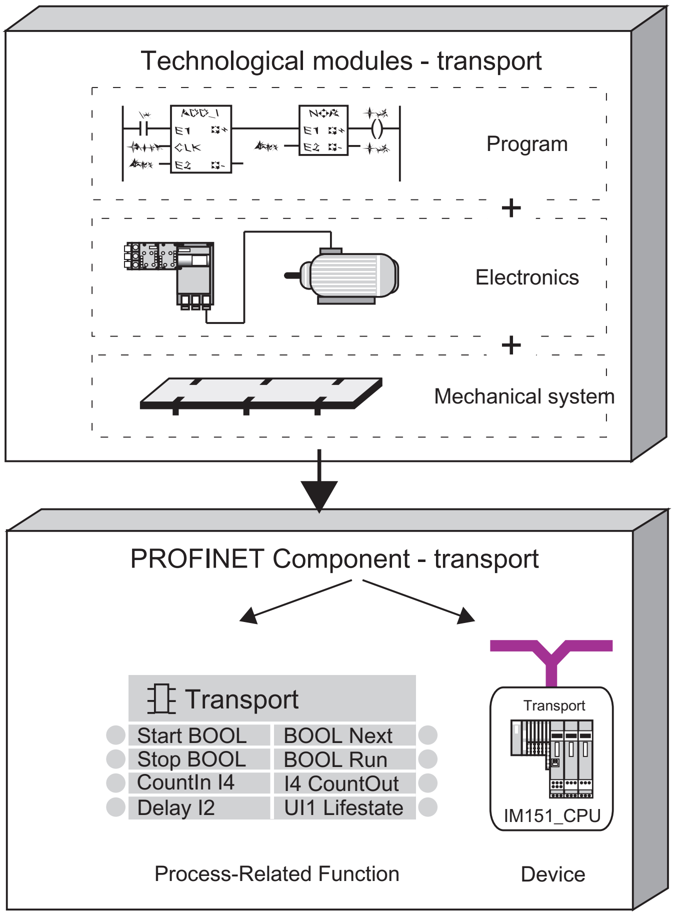


Figure 6-2 From Technological Module to PROFINET Component

PROFINET Component

A PROFINET component includes the entire data of the hardware configuration, the parameters of the modules, and the corresponding user program. The PROFINET component is made up as follows:

- Technological Function

  The (optional) technological (software) function includes the interface to other PROFINET components in the form of interconnectable inputs and outputs.

- Device

  The device is the representation of the physical programmable controller or field device including the I/O, sensors and actuators, mechanical parts, and the device firmware.

Libraries and Instances

You can store PROFINET components in a library in SIMATIC iMap and use them again. If you reuse PROFINET components, you simply need to adapt them to the new situation (create instances).

How are PROFINET components created?

You configure and program the programmable controller or field device of the PROFINET component with the configuration and programming tool of the device vendor (for example, STEP 7).

From the configuration of the programmable controller and its user program, you then create a PROFINET component, for example with a menu command. The functionality of the device with the application-specific programs is encapsulated. From the outside, only the technological interfaces (component interface) are accessible. These are required for the interaction within the machine or plant, diagnostics, visualization, and vertical integration.

The technological interfaces of the PROFINET components are described in XML (Extended Markup Language) and stored in an XML file. This is created, for example in STEP 7 with the PROFINET Interface Editor. XML allows information to be represented in a cross-platform and vendor-independent format. The structure of the XML file is specified in the PROFINET engineering model.

The device-dependent information on the hardware configuration and, if required, the user program can be included in the PROFINET component.

Properties of PROFINET Components

- Modularization and reusability

  The concept of the PROFINET components allows extensive modularization of automation systems. PROFINET components can be reused as often as required in different automation solutions.

- Totally integrated communication by supporting the PROFINET specification

  Regardless of their internal functionality, each PROFINET component presents a uniform interface for communication with other components via Industrial Ethernet or PROFIBUS. The PROFINET specification describes the open communication interface for PROFINET-compliant devices.

- Vendor-independent engineering

  The technological functions of individual devices are programmed in the vendor-specific engineering tools. For the plantwide interconnection of technological functions, however, vendor-independent engineering tools, for example SIMATIC iMap, are used. This allows products from different vendors to be integrated in PROFINET communication. Vendors of field devices and programmable controllers must simply extend their programming and configuration tools to interface with the device-independent engineering tool.

Programmable and Fixed Functionality

The application-specific functionality of an intelligent device is determined by the user program that can be downloaded to the device. Simpler devices such as drives or field devices do not have their own user program. The functionality of these devices is integrated in their firmware. A distinction is made between PROFINET components

- with programmable functionality

  The component includes its own user program that can be downloaded to the device from SIMATIC iMap.
- with fixed functionality

  The component does not have its own user program (for example standard DP slaves).

6.3 Diagnostics in PROFINET CBA

Diagnostics in SIMATIC iMap

In SIMATIC iMap, diagnostic information on process variables and problems in the technological functions, the devices, and interconnections are displayed in three tabs in the diagnostics window.

Further Information on Diagnostics with SIMATIC iMap

For further information, open the online help of SIMATIC iMap.

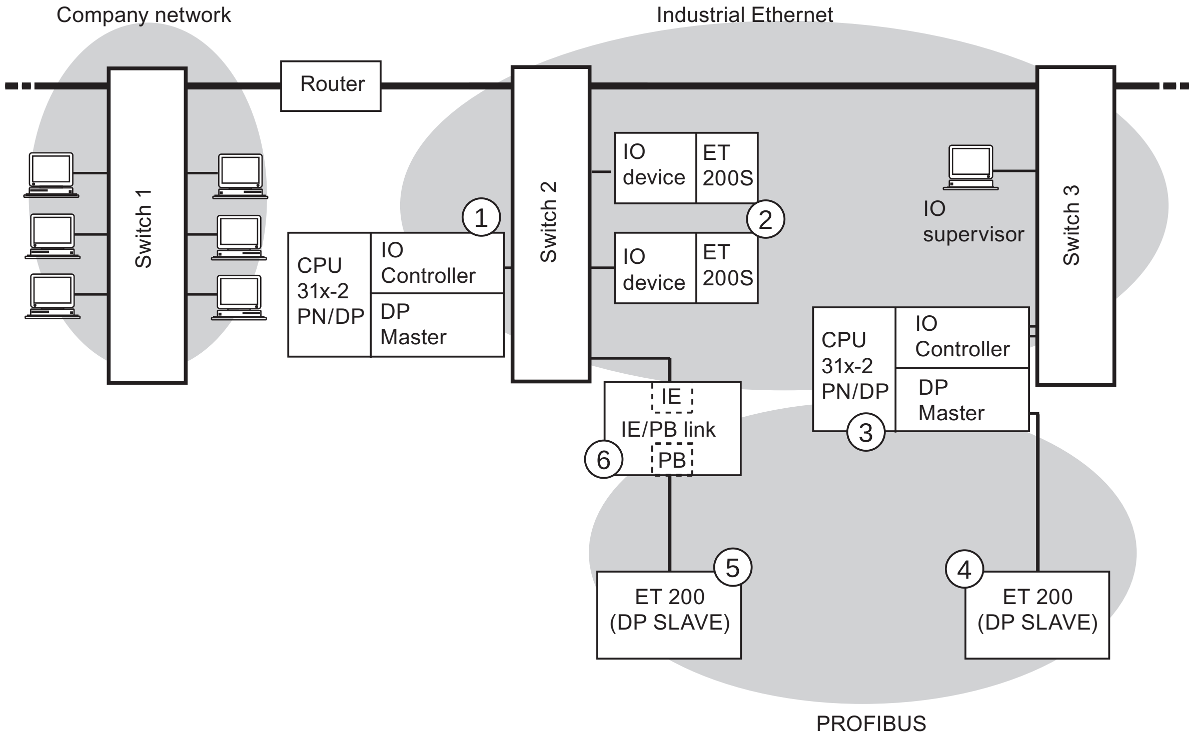
You will find an application example illustrating diagnostics in the Component based Automation manual *Getting Started with SIMATIC IMap* in the chapter Step 9: Diagnostics.

PROFINET - Application Examples 7

7.1 Example of a PROFINET IO Application

Extended Functions of PROFINET IO

The following graphic shows the new functions of PROFINET IO



The graphic displays	Examples of connection paths
The connection of company network and field level	From PCs in your company network, you can access devices at the field level Example: • PC - Switch 1 - Router - Switch 2 - CPU 31x-2 PN/DP ①.
The connection between the automation system and field level	You can, of course, also access one of the other areas in Industrial Ethernet from an IO supervisor at the field level. Example: • IO supervisor - Switch 3 - Switch 2 - ET 200S IO device ②.

The graphic displays	Examples of connection paths
The IO controller of the CPU 31x-2 PN/DP ① controls devices on Industrial Ethernet and on PROFIBUS **directly**	At this point, you see the extended IO feature between the IO controller and IO device(s) on Industrial Ethernet: • The CPU 31x-2 PN/DP ① is the IO controller for one of the ET 200S ② IO devices. • The CPU 31x-2 PN/DP ① is also the IO controller for the ET 200 (DP slave) ① via the IE/PB Link ①.
A CPU can be both IO controller and DP master	Here, you can see that a CPU can be both IO controller for an IO device as well as DP master for a DP slave: • The CPU 31x-2 PN/DP ③ is the IO controller for the other ET 200S ② IO device. CPU 31x-2 PN/DP ③ - Switch 3 - Switch 2 - ET 200S ② • The CPU 31x-2 PN/DP ③ is the DP master for a DP slave ④. The DP slave ④ is assigned locally to the CPU ③ and is not visible on Industrial Ethernet.

Requirements

- CPUs as of Firmware 2.3.0 (for example CPU 315-2 PN/DP)
- STEP 7, as of Version 5.3 + Service Pack 1

Reference

You will find information on the topic of PROFINET in the following sources:

- in the *From PROFIBUS DP to PROFINET IO* programming manual. This manual also lists the new PROFINET blocks and system status lists.

7.2 Example of a PROFINET IO and PROFINET CBA Application

In the following example, we will show you how flexible PROFINET is.

Configuration in SIMATIC iMap

The graphic shows a possible configuration of components in SIMATIC iMap.

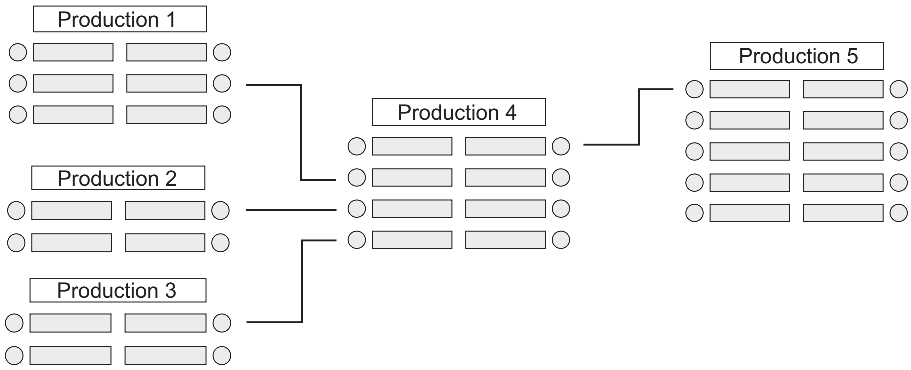


Figure 7-1 Example - Configuration in SIMATIC iMap

Real Technical Interconnection

Technically, these components can be set up, put together, and interconnected completely differently as illustrated in the following graphic.

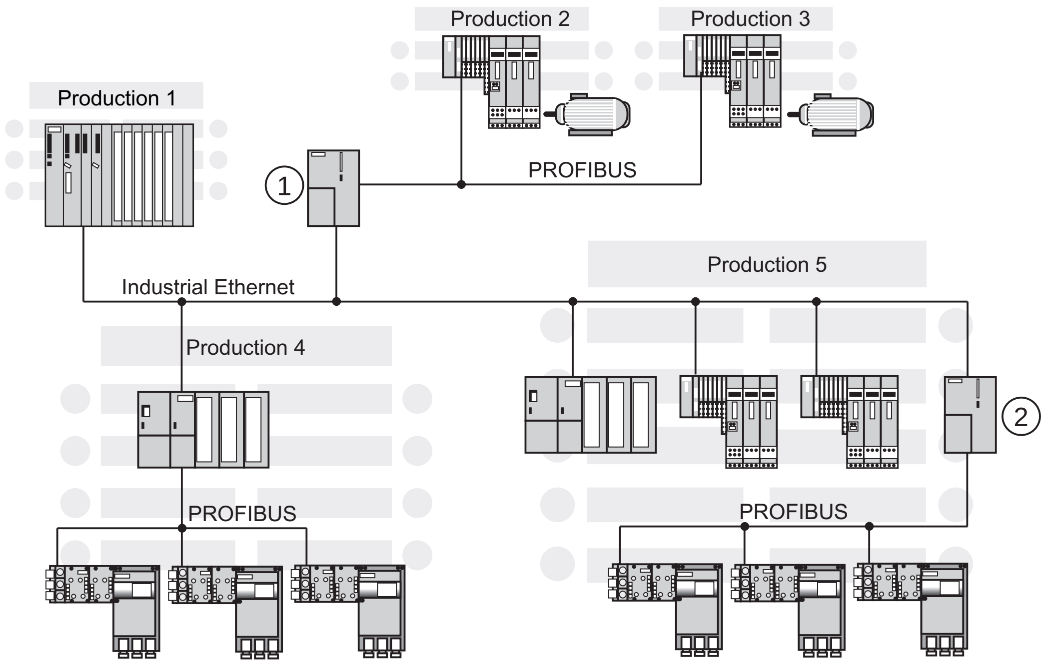


Figure 7-2 Example - Implementation

Number	Description
①	IE/PB link for PROFINET CBA
②	IE/PB link for PROFINET IO

Component "Production 1"

This component consists of a PROFINET controller with central I/O.

For example, S7-400 with CP 441-1 Advanced

Components "Production 2" and "Production 3"

Each of these components consists of one intelligent PROFIBUS device. Both devices are connected to PROFINET via an IE/PB Link

For example ET 200S CPU

The **IE/PB Link** ① for Component Based Automation in this case as a PROFINET device with proxy functionality is the proxy for the PROFIBUS nodes. The IE/PB Link ① represents each connected PROFIBUS DP slave as a separate component on PROFINET.

Component "Production 4"

This component consists of a PROFINET controller as a PROFIBUS DP master to which distributed PROFIBUS DP slaves are connected. The PROFIBUS and the DP slaves are not visible in SIMATIC iMap.

For example CPU 317-2 PN/DP or PC with PROFIBUS CP and software WinLC

PROFINET IO Component "Production 5"

The largest component in the system consists of a PROFINET IO controller (for example CPU 317-2 PN/DP) and the PROFINET IO devices assigned to it. The PROFINET IO devices are connected directly to Industrial Ethernet. Additional PROFIBUS devices are also connected via an IE/PB Link.

The **IE/PB Link** ② for PROFINET IO in this case as a PROFINET device with proxy functionality is the proxy for the connected PROFIBUS nodes. The IE/PB Link ② represents each connected PROFIBUS DP slave as a PROFINET IO device on PROFINET.

Communication between PROFINET IO controllers and PROFIBUS devices is fully transparent.

Summary: IE/PB Link for Component based Automation and IE/PB Link for PROFINET

Remember the differences between the IE/PB Link for CBA and the IE/PB Link for PROFINET IO.

In Component based Automation, the IE/PB Link for CBA ① represents each connected PROFIBUS DP slave as a component on PROFINET.

In PROFINET IO, the IE/PB Link for PROFINET IO ② represents each connected PROFIBUS DP slave as a PROFINET IO device on PROFINET.

Advantages of CBA and SIMATIC iMap as a Plantwide Engineering System

In SIMATIC iMap, you connect the various components simply and conveniently throughout the entire plant. You no longer need to know

- whether the real device is connected to Industrial Ethernet of PROFIBUS
- whether and how communication is configured
- whether central I/O or field devices are involved.

See also

Terminology in PROFINET and PROFIBUS (Page 2-4)

Appendix 8

8.1 Technical Support, contact partners and training

8.1.1 Support & Service

Technical Support

You can reach the Technical Support for all A&D products

- Via the Support Request web form

http://www.siemens.de/automation/support-request

- Phone: +49 (0) 180 5050 222
- Fax: +49 (0) 180 5050 223

Additional information about our Technical Support can be found on the Internet pages

http://www.siemens.de/automation/service

Service & Support on the Internet

In addition to our documentation service, you can also access our complete knowledge base online on the Internet.

http://www.siemens.com/automation/service&support

There you can find:

- The Newsletter, which provides the latest information on your products
- The right documents for you via our Search function in Service & Support
- A forum, in which users and specialists from around the world share their experience and knowledge
- Your local service partner for Automation & Drives in our contact database
- Information about local service, repairs, and spare parts. You can find much more information under "Services."

8.1.2 Contact partner

If you have any unanswered questions about the products in this manual, consult your Siemens contact at your local agencies and branch offices.

http://www.automation.siemens.com/partner/

8.1.3 Training

Training center

We provide courses to help you get started with the *PROFINET System Description* manual and the SIMATIC S7 automation system. Please contact your local Training Center or the Central Training Center in

D-90327 Nuremberg. Phone: +49 (911) 895-3200

Internet: http://www.sitrain.com

Glossary

10 Base-T/F

Ethernet standard that allows transmission of 10 Mbps.

100 Base-T/F

Ethernet standard that allows transmission of up to 100 Mbps.

1000 Base-T/F

Ethernet standard that allows transmission of up to 1000 Mbps.

Application

→ *User program*

Application

An application is a program that runs directly on the MS-DOS / Windows operating system. Applications on the PG include, for example, the STEP 5 basic package, GRAPH 5 and others.

ASIC

→ *PROFINET ASIC*

CAT 3

Twisted-pair cable does not always the same thing. Several versions are specified in the Ethernet standard.

There are several categories, however only CAT 3 and CAT 5 are relevant for networks. The two types of cable differ in the maximum permitted frequency and the values for attenuation (weakening of the signal over a certain distance).

CAT 3 is a twisted-pair cable for Ethernet with 10 Base-T.

CAT 5 is a twisted-pair cable for Fast Ethernet with 100 Base-T.

CAT 5

→ *CAT 3*

Category 3

→ *CAT 3*

Category 5

→ *CAT 3*

Coaxial Cable

A coaxial cable, also known as "coax", is a metallic cabling system used in high-frequency transmission, for example, as the antenna cable for radios and televisions as well as in modern networks in which high data transmission rates are required. In a coaxial cable, an inner conductor is surrounded by an outer tube-like conductor. The two conductors are separated by a dielectric layer. In contrast to other cables, this design provides a high degree of immunity to and low emission of electromagnetic interference.

COM

Component Object Model - Specification of Microsoft for Windows objects, based on OLE.

Automation systems are mapped on objects in PROFINET CBA. An object consists of interfaces and properties. Using these interfaces and properties, two objects can communicate.

The basis for mapping the automation systems is the Component Object Model (COM). COM is a programming model from Microsoft that converts the interfaces and properties into software so that objects can communicate with each other via interfaces and properties.

COM

→ *DCOM*

Communication processor

Communications processors are modules for point-to-point and bus links.

Component-based automation

→ *PROFINET CBA*

Consistent data

Data which are related in their contents and not to be separated are referred to as consistent data.

For example, the values of analog modules must always be handled as a whole, that is, the value of an analog module must not be corrupted as a result of read access at two different points of time.

CP

→ *Communication processor*

CPU

Central processing unit = CPU of the S7 automation system with a control and arithmetic unit, memory, operating system, and interface for programming device.

CPU

→ *CPU*

DCOM

→ *COM*

DCOM

Distributed COM - an extension of the COM standard - is a higher-level protocol based on TCP/IP. DCOM forms the common language spoken by all devices and can be used to initiate communication between object-based applications. Devices in PROFINET CBA exchange non time-critical data using DCOM, such as process data, diagnostic data, parameter assignments etc.

DCOM technology is supported by PROFINET Version V1.0 and higher.

The PNO provides its users with a portable DCOM protocol stack customized for PROFINET. This eliminates dependency on Microsoft and its further developments in this technology while at the same time ensuring compatibility with Microsoft products.

Default Router

A default router is used when data have to be forwarded via TCP/IP to a partner located outside the subnet.

In the STEP 7 properties dialog Properties Ethernet Interface > Parameters > Gateway, the default router is called *Router*. STEP 7 assigns the local IP address to the default router.

Determinism

→ *Real Time*

Device

Within the context of PROFINET, "device" is the generic term for:

- Automation systems (e.g. PLC, PC)
- Field devices (for example, PLC, PC, hydraulic devices, pneumatic devices)
- Active network components (e.g. switches, gateways, routers)
- PROFIBUS or other fieldbus systems

The main characteristics of a device is its integration into PROFINET communication by means of Ethernet or PROFIBUS.

The following device types are distinguished based on their attachment to the bus:

- PROFINET devices
- PROFIBUS devices

Device

→ *PROFINET Device*

→ *PROFIBUS node*

Device Name

Before an IO device can be addressed by an IO controller, it must have a device name, as the IP address is permanently assigned to the device name. In PROFINET, this method was selected because it is simpler to work with names than with complex IP addresses.

The assignment of a device name for a concrete IO device can be compared with setting the PROFIBUS address of a DP slave.

When it ships, an IO device does not have a device name. An IO device can only be addressed by an IO controller, for example, for the transfer of project engineering data (including the IP address) during startup or for user data exchange in cyclic operation, after it has been assigned a device name with the IO supervisor/PC.

Alternatively, the device name can be written in the programming device directly to the MMC (for the ET200S/PN IO device).

Diagnostics

→ *System diagnostics*

ERTEC

Because PROFINET is an open standard, SIMATIC NET offers PROFINET ASICs for the development of your old devices under the name ERTEC . ASIC is the acronym for Application Specific Integrated Circuits. PROFINET ASICs are components with a wide range of functions for the development of your own devices. They implement the requirements of the PROFINET standard in a circuit and allow extremely high packing densities and performance.

For you, the benefits of ERTEC are as follows:

- Simple integration of switch functionality in devices
- Simple and cost-effective setup of bus structures
- Minimization of the communication load of devices

Fast Ethernet

Fast Ethernet describes the standard with which data is transmitted at 100 Mbps. This transmission technology uses the 100 Base-T standard.

→ *100 Base-T/F*

FB

→ *Function block*

FC

→ *Function*

Function

According to IEC 1131-3, a function (FC) is a code block without static data. A function allows transfer of parameters in user program. Functions are therefore suitable for programming frequently occurring complex functions, e.g. calculations.

Function block

According to IEC 1131-3, a function block (FB) is a code block with static data. An FB allows the user program to pass parameters. Function blocks are therefore suitable for programming frequently occurring complex functions, e.g. controls, mode selections.

GSD file

The properties of a PROFINET device are described in a GSD file (General Station Description) that contains all the information required for configuration.

Just as in PROFIBUS, you can integrate a PROFINET device in STEP 7 using a GSD file.

In PROFINET IO, the GSD file is in XML format. The structure of the GSD file complies with ISO 15734, the worldwide standard for device descriptions.

In PROFIBUS, the GSD file is in ASCII format.

Hub

→ *Switch*

Hub

In contrast to a switch, a hub sets itself to the lowest speed at the ports and forwards the signals to all connected devices. A hub is also not capable of giving priority to signals. This would lead to a high communication load on Industrial Ethernet.

Industrial Ethernet

→ *100 Base-T/F*

Industrial Ethernet (formerly SINEC H1) is a technology that allows data to be transmitted free of interference in an industrial environment.

Due to the openness of PROFINET, you can use standard Ethernet components. We recommend, however, that you install PROFINET as Industrial Ethernet.

Industrial Wireless LAN

In addition to data communication in accordance with IEEE 802.11, SIMATIC NET Industrial Wireless LAN provides a number of extremely useful enhancements (I-features) for the industrial customer. The following features make IWLAN especially well suited for more advanced industrial applications requiring reliable wireless communication:

- Automatic roaming when the connection to Industrial Ethernet is interrupted (Rapid Roaming)
- Cost savings due to the use of a single wireless network for secure operation of a process with both process-critical data (such as an alarm message) and non-critical communication (such as service and diagnostics)
- Cost-effective connection to devices in remote environments that are difficult to access

Interface, MPI

→ *MPI*

Interface, MPI-capable

→ *MPI*

IO controller

→ *PROFINET IO Controller*

→ *PROFINET IO Device*

→ *PROFINET IO Supervisor*

→ *PROFINET IO System*

IO device

→ *PROFINET IO Controller*

→ *PROFINET IO Device*

→ *PROFINET IO Supervisor*

→ *PROFINET IO System*

IO supervisor

→ *PROFINET IO Controller*

→ *PROFINET IO Device*

→ *PROFINET IO Supervisor*

→ *PROFINET IO System*

IO system

→ *PROFINET IO Supervisor*

→ *PROFINET IO System*

IP Address

To allow a PROFINET device to be addressed as a node on Industrial Ethernet, this device also requires an IP address that is unique within the network. The IP address is made up of 4 decimal numbers with a range of values from 0 through 255. The decimal numbers are separated by a period.

The IP address is made up of

- The address of the (subnet) network and
- The address of the node (generally called the host or network node).

Isochronous Real Time

Isochronous real-time communication (PROFINET V3) is a transmission method in which a portion of the transmission time is reserved for cyclic (deterministic) data transmission. Thus, the communication cycle is split into a deterministic portion and an open portion. In the deterministic channel, cyclic IRT frames are transported, whereas the TCP/IP and RT frames are transported in the open channel. In this way, both types of data transmission exist together without interfering with each other.

When this transmission method is implemented in ERTEC-ASICs (Enhanced Real-Time Ethernet Controller), cycle times of less than 1 ms and jitter accuracy of less than 1 µs are achieved.

LAN

→ *Industrial Wireless LAN*

Local area network to which several computers are connected within an enterprise. The LAN therefore has a limited geographical span and is solely available to a company or institution.

MAC address

Each PROFINET device is assigned a worldwide unique device identifier in the factory. This 6-byte long device identifier is the MAC address.

The MAC address is divided up as follows:

- 3 bytes vendor identifier and
- 3 bytes device identifier (consecutive number).

The MAC address is normally printed on the front of the device.
Example: 08-00-06-6B-80-C0

Master

→ *Slave*

When a master is in possession of the token, it can send data to other nodes and request data from other nodes (= active node).

MPI

The multipoint interface (MPI) is the programming device interface of SIMATIC S7. It enables multiple-node operation (PGs, text-based displays, OPs) on one or several PLCs. Each node is identified by a unique address (MPI address).

MPI address

→ *MPI*

NCM PC

→ *SIMATIC NCM PC*

Network

A network is a larger communication system that allows data exchange between a large number of nodes.

All the subnets together form a network.

Network

A network consists of one or more interconnected subnets with any number of nodes. Several networks can exist alongside each other.

OB

→ *Organization blocks*

OLE

Object Linking and Embedding - Central architectural principle of Windows. OLE is a Microsoft technology that enables linking of objects and data exchange between programs.

OPC

→ *OPC client*

→ *OPC server*

OLE for Process Control - Industrial standard that allows vendor-independent access to industrial communication networks, defined on the basis of OLE.

OPC (OLE for Process Control) refers to a standard interface for communication in automation engineering. With OPC, you can access OLE (Object Linking and Embedding). OLE is the component model of Microsoft. Components are the software objects or applications that make their functionality available to other applications.

Communication via the OPC interface is based on COM/DCOM. In this case, the object is the process image.

The OPC interface was designed as an industry standard by leading automation companies with the support of the Microsoft Corporation. Previously, applications that access process data were restricted to the access mechanisms of the communications network of one manufacturer. Now, the standardized OPC interface provides a uniform method of accessing the communication networks of any vendor. For example, for a user implementing operator control and monitoring software.

OPC client

→ *OPC*

→ *OPC server*

An OPC client is a user program that accesses process data via the OPC interface. Access to the process data is made possible by the OPC server.

OPC server

→ *OPC*

→ *OPC client*

The OPC server provides the OPC client with a wide range of functions with which it can communicate via industrial networks.

You will find more detailed information in the *Industrial Communication with PG/PC* manual.

Operating system

→ *CPU*

The CPU OS organizes all functions and processes of the CPU which are not associated to a specific control task.

Organization blocks

Organization blocks (OBs) form the interface between CPU operating system and the user program. The sequence for user program execution is determined in the organization blocks.

PC station

→ *SIMATIC PC Station*

PCD

The PROFINET component description is the description of the components you have generated in your engineering system (for example, STEP 7). The PCD is an XML file that you can import into SIMATIC iMap so that you can configure the PROFINET CBA communication.

PG

→ *Programming device*

PLC

→ *Programmable Logic Controller*

→ *CPU*

Programmable controllers (PLCs) are electronic controllers whose function is saved as a program in the control unit. Therefore, the configuration and wiring of the unit does not dependend on the PLC function. A programmable logic controller has the structure of a computer; it consists of a CPU with memory, input/output modules and an internal bus system. The I/O and the programming language are oriented to control engineering needs.

PNO

→ *PROFIBUS International*

Process-Related Function

→ *PROFINET Component*

PROFIBUS

Process Field Bus - European fieldbus standard.

→ *PROFIBUS DP*

→ *PROFIBUS International*

PROFIBUS Device

→ *Device*

PROFIBUS DP

→ *PROFIBUS*

→ *PROFIBUS International*

A PROFIBUS with the DP protocol that complies with EN 500170. DP stands for distributed peripheral I/O (fast, real-time, cyclic data exchange). From the perspective of the user program, the distributed I/O is addressed in exactly the same way as the central I/O.

PROFIBUS International

Technical committee that defines and further develops the PROFIBUS and PROFINET standard.

Also known as the PROFIBUS User Organization (PNO).

Home page http://www.profibus.com

PROFINET

→ *PROFIBUS International*

Within the framework of Totally Integrated Automation (TIA), PROFINET is the consistent further development of:

- PROFIBUS DP, the established fieldbus and
- Industrial Ethernet, the communication bus for the cell level.

The experience gained from both systems was and is being integrated in PROFINET.

PROFINET as an Ethernet-based automation standard from PROFIBUS International (PROFIBUS Nutzerorganisation e.V.) defines a vendor-independent communication and engineering model.

PROFINET ASIC

ASIC is the acronym for Application Specific Integrated Circuits.

PROFINET ASICs are components with a wide range of functions for the development of your own devices. They implement the requirements of the PROFINET standard in a circuit and allow extremely high packing densities and performance.

Because PROFINET is an open standard, SIMATIC NET offers PROFINET ASICs for the development of your old devices under the name ERTEC . For you, the benefits of ERTEC are as follows:

- Simple integration of switch functionality in devices
- Simple and cost-effective setup of bus structures
- Minimization of the communication load of devices

PROFINET CBA

In the context of PROFINET, PROFINET CBA (Component-based Automation) is an automation concept for:

- Implementation of modular applications with distributed intelligence
- Machine-to-machine communication

PROFINET CBA lets you create distributed automation solutions, based on default components and partial solutions. This concept satisfies demands for a higher degree of modularity in the field of mechanical and systems engineering by extensive distribution of intelligent processes.

Component-based Automation allows you to use complete technological modules as standardized components in large systems.

PROFINET CBA is implemented by:

- the PROFINET standard for programmable controllers and
- the SIMATIC iMAP engineering tool.

The components are created in an engineering tool that can differ from vendor to vendor. Components of SIMATIC devices are generated, for example, with STEP 7.

The components are created in an engineering tool that can differ from vendor to vendor. Components of SIMATIC devices are generated, for example, with STEP 7.

PROFINET Component

A PROFINET component includes the entire data of the hardware configuration, the parameters of the modules, and the corresponding user program. The PROFINET component is made up as follows:

- Technological Function

  The (optional) technological (software) function includes the interface to other PROFINET components in the form of interconnectable inputs and outputs.

- Device

  The device is the representation of the physical programmable controller or field device including the I/O, sensors and actuators, mechanical parts, and the device firmware.

PROFINET Component Description

→ *PCD*

PROFINET IO

Within the framework of PROFINET, PROFINET IO is a communication concept for the implementation of modular, distributed applications.

PROFINET IO allows you to create automation solutions familiar from PROFIBUS.

PROFINET IO is implemented by the PROFINET standard for the programmable controllers on the one hand, and on the other hand by the engineering tool STEP 7.

This means that you have the same application view in STEP 7 regardless of whether you configure PROFINET devices or PROFIBUS devices. Programming your user program is essentially the same for PROFINET IO and PROFIBUS DP if you use the expanded blocks and system status lists for PROFINET IO.

PROFINET IO Controller

Device via which the connected IO devices are addressed. This means that the IO controller exchanges input and output signals with assigned field devices. The IO controller is often the controller on which the automation program runs.

→ *PROFINET IO Device*

→ *PROFINET IO Supervisor*

→ *PROFINET IO System*

PROFINET IO Device

→ *PROFINET IO Controller*

Distributed field device assigned to one of the IO controllers (for example, remote I/O, valve terminal, frequency converter, switches)

→ *PROFINET IO Supervisor*

→ *PROFINET IO System*

PROFINET IO Supervisor

→ *PROFINET IO Controller*

→ *PROFINET IO Device*

→ *PROFINET IO System*

PG/PC or HMI device for commissioning and diagnostics.

PROFINET IO System

→ *PROFINET IO Controller*

→ *PROFINET IO Device*

PROFINET IO controller with assigned PROFINET IO devices.

PROFINET node

→ *Device*

Programmable Logic Controller

→ *CPU*

Programming device

Basically speaking, PGs are compact and portable PCs which are suitable for industrial applications. Their distinguishing feature is the special hardware and software for SIMATIC programmable logic controllers.

Proxy

→ *PROFINET Device*

→ *PROFINET node*

The PROFINET device with proxy functionality is the substitute for a PROFIBUS device on Ethernet. The proxy functionality allows a PROFIBUS device to communicate not only with its master but also with all nodes on PROFINET.

You can integrate existing PROFIBUS systems in PROFINET communication, for example with the help of an IE/PB Link or a CPU 31x-2 PN/DP. The IE/PB Link then handles communication over PROFINET as a substitute for the PROFIBUS components.

In this way, you can connect both DPV0 and DPV1 slaves to PROFINET.

Proxy functionality

→ *Proxy*

Real Time

Real time means that a system processes external events within a defined time.

Determinism means that a system reacts in a predictable (deterministic) manner.

In industrial networks, both these requirements are important. PROFINET meets these requirements. PROFINET is implemented as a deterministic real-time network as follows:

- Transmission of time-critical data takes place at guaranteed time intervals.

  To achieve this, PROFINET provides an optimized communication channel for real-time communication : Real Time (RT).
- An exact prediction of the time at which the data transfer takes place is possible.
- Problem-free communication using other standard protocols is guaranteed within the same network.

→ *Real Time*

→ *Isochronous Real Time*

Repeater

→ *Hub*

Router

→ *Switch*

A router works in a way similar to a switch. With a router, however, it is also possible to specify which communications nodes can communicate via the router and which cannot. Communication nodes on different sides of a router can only communicate with each other if you have explicitly enabled communication between the two nodes via the router.

RT

→ *Real Time*

SELV/PELV

Term indicating circuits with safety extra-low voltage.

SITOP power supplies from Siemens, for example, provide this protection.

For more detailed information, refer to the EN 60950-1 (2001) standard.

SFB

→ *System function block*

SFC

→ *System Function*

Signal module

Signal modules (SM) form the interface between the process and the PLC. There are digital input and output modules (input/output module, digital) and analog input and output modules (input/output module, analog).

SIMATIC

Name of products and systems for industrial automation from Siemens AG.

SIMATIC iMap

Engineering tool for configuration, commissioning, and monitoring of modular distributed automation systems. It is based on the PROFINET standard.

SIMATIC NCM PC

SIMATIC NCM PC is a version of STEP 7 tailored to PC configuration. For PC stations, it offers the full range of functions of STEP 7.

SIMATIC NCM PC is the central tool with which you configure the communication services for your PC station. The configuration data generated with this tool must be downloaded to the PC station or exported. This makes the PC station ready for communication.

SIMATIC NET

Siemens business area for industrial communication, networks, and network components.

SIMATIC PC Station

A "PC station" is a PC with communication modules and software components within a SIMATIC automation solution.

Slave

→ *Master*

A slave can only exchange data after being requested to by the master.

SNMP

SNMP (Simple Network Management Protocol) is the standardized protocol for diagnostics of the Ethernet network infrastructure and for assignment of parameters to it.

Within the office area and in automation engineering, devices of a wide range of vendors support SNMP on Ethernet.

Applications based on SNMP can be operated on the same network at the same time as applications with PROFINET.

The range of functions supported differs depending on the device type. A switch, for example, has more functions than a CP 1616.

STEP 7

Engineering system. Contains programming software for the creation of user programs for SIMATIC S7 controllers.

Subnet mask

The bits set in the subnet mask decides the part of the IP address that contains the address of the subnet/network.

In general:

- The network address is obtained by an AND operation on the IP address and subnet mask.
- The node address is obtained by an AND NOT operation on the IP address and subnet mask.

Subnetwork

All the devices connected by switches are located in the same network, called the subnet. All the devices in a subnet can communicate directly with each other.

All devices in the same subnet have the same subnet mask.

A subnet is physically restricted by a router.

Notice

If devices need to communicate beyond the limits of a subnet, you must program the router so that it allows this communication to take place.

Substitute

→ *Proxy*

Switch

PROFIBUS is based on a bus topology. Communication nodes are connected to the bus by a passive cable.

In contrast, Industrial Ethernet is made up of point-to-point links: Each communication node is connected directly to one other communication node.

If a communication node needs to be connected to several other communication nodes, this communication node is connected to the port of an active network component, such as a switch. Other communications nodes (including switches) can then be connected to the other ports of the switch. The connection between a communication node and the switch remains a point-to-point link.

The task of a switch is therefore to regenerate and distribute received signals. The switch "learns" the Ethernet address(es) of a connected PROFINET device or other switches and forwards only the signals intended for the connected PROFINET device or connected switch.

The SCALANCE X device family includes switches, for example, with 4 electric ports and 2 optical ports for mounting onto a DIN rail in a control cabinet.

With STEP 7, you can configure, address, and perform diagnostics on switches in the SCALANCE X device family as a PROFINET IO device.

Note

IP Address Assignment

When assigning IP addresses to the switches, you can also use the Primary Setup Tool (PST) as an alternative to STEP 7.

System diagnostics

System diagnostics refers to the detection, evaluation, and signaling of errors that occur within the PLC, for example programming errors or module failures. System errors can be indicated by LEDs or in STEP 7.

System function

A system function (SFC) is a function integrated in the operating system of the CPU that can be called when necessary in the STEP 7 user program.

System function block

A system function block (SFB) is a function block integrated in the operating system of the CPU that can be called when necessary in the STEP 7 user program.

System status list

The system status list contains data that describe the current status of an S7-300 or S7-400. You can always use this list to obtain an overview of:

- The configuration of the S7-300
- the current CPU configuration and configurable signal modules
- the current status and processes in the CPU and in configurable signal modules.

TCP/IP

The Ethernet is simply a transport system for data in the way that a highway is a transport system for people and goods. The actual data transport is handled by protocols in the same way that cars and trucks transport people and goods on the highway.

The two basic protocols TCP (Transmission Control Protocol) and Internet Protocol (IP), combined into TCP/IP, handle the following tasks:

1. On the sender, the data is encapsulated in packets.
2. The packets are transported via Ethernet to the correct recipient.
3. At the receiver, the data packets are reassembled in the correct order.
4. Bad packets are sent repeatedly until they are received correctly.

Most higher-level protocols use TCP/IP to handle the tasks. This is how, for example, the Hyper Text Transfer Protocol (HTTP) transfers documents on the World Wide Web (WWW) that are written in Hyper Text Markup Language (HTML). Without this technology, you would not be able to view Web sites in your Internet browser.

Token

Allows access to the bus for a limited time.

Topology

Structure of a network. Common structures include:

- Bus topology
- Ring topology
- Star topology
- Tree topology

Twisted Pair

Fast Ethernet via twisted-pair cables is based on the IEEE 802.3u standard (100 Base-TX). The transmission medium is a 2x2 wire, twisted and shielded cable with a characteristic impedance of 100 ohms (AWG 22). The transmission characteristics of this cable must meet the requirements of category 5 (see glossary).

The maximum length of the connection between end device and network component must not exceed 100 m. The ports are implemented according to the 100 Base-TX standard with the RJ-45 connector system.

Update Time

During the update time, all IO devices in the IO system are supplied with new data from the IO controller (outputs), and all IO devices have their latest data sent to the IO controller (inputs).

Note

Update Times for Cyclic Data Exchange

STEP 7 determines the update time based on the existing hardware configuration and the resulting cyclic data emergence. During this time, a PROFINET IO device has exchanged its user data with the relevant IO controller.

The update time can be set for an entire bus segment of a controller or an individual IO device.

You can increase the update time manually in STEP 7.

If other cyclic PROFINET services (for example, cyclic services for PROFINET CBA) need to be taken into account in addition to PROFINET IO: In the Update time dialog in STEP 7 / HW Config, set an update time for the relevant devices to be reserved for PROFINET IO.

For more information, refer to the STEP 7 online help.

User program

In SIMATIC, a distinction is made between the operating system of the CPU and user programs. The user program contains all instructions and declarations, as well as signal processing data that can be controlled by the plant or the process. It is assigned to a programmable module (for example CPU or FM) and can be structured in smaller units (blocks).

→ *Operating system*

→ *STEP 7*

WAN

A network with a span beyond that of a local area network allowing, for example, intercontinental operation. Legal rights do not belong to the user but to the provider of the transmission networks.

Wireless LAN

→ *Industrial Wireless LAN*

XML

XML (Extensible Markup Language) is an easily understood and easily learnt data description language. Information is exchanged with the aid of legible XML documents. These contain continuous text with added structuring information.

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