SIEMENS

Industrial Ethernet

**Industrial Ethernet / PROFINET
Industrial Ethernet**

System Manual

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Preface

Target group and motivation

The networking manual accompanies you through all phases of preparation and implementation of network projects. It provides you with an overview of the structure and configuration of Industrial Ethernet networks with the aid of SIMATIC NET.

On the one hand, the target groups are decision makers and planners; with this document, they can gain an overview of the technical principles, the SIMATIC NET product range and the most important practical applications. On the other hand, it provides configuration engineers and commissioning personnel with extensive information data to which they can refer when setting up their network systems.

Structure of the document

The book consists of several parts, structured as follows:

Table 1   Structure of the Networking Manual

Segment	Content and target group
Basics Chapters 1 to 3	The first chapters are intended for decision makers and planners. In Chapters 1 and 2, the basics of network communication technology, the special features of Industrial Ethernet and the essential characteristics of SIMATIC NET products are presented. Chapter 3 contains examples of the most common network topologies and use cases and describes the components required for them. The chapter is not only instructive; you can also use it as a practical starting point for planning your own systems.
SIMATIC NET product lines Chapters 4 to 8	These chapters are also intended for decision-makers and planners. These chapters introduce the product lines of SIMATIC NET. Here, you will find the main characteristics of the SCALANCE switches, security and wireless components - the emphasis being on their technical properties.
Passive components and accessories Chapter 9	This chapter is intended for planners, configuration engineers and commissioning engineers. You will gain an overview of passive components such as cables and plug-in connectors for connection to the product families described earlier. You will find comprehensive reference data as required during the planning and commissioning of a plant.

Orientation in the documentation

Apart from the System Manual you are currently reading, the following documentation is also available from SIMATIC NET on the topic of Network Manual:

- "Passive network components" system manual

  This system manual contains installation instructions for several of the most common components and guidelines for setting up networked automation plants in buildings.

- System manual "RCoax"

  This system manual contains both an explanation of the fundamental technical aspects as well as a description of the individual RCoax components and their functionality. Installation/commissioning and connection of RCoax components and their operating principle are explained. The possible applications of the various SIMATIC NET components are described.

- System manual - "Passive Network Components IWLAN"

  This system manual explains the entire IWLAN cabling that you require for your IWLAN application. For a flexible combination and installation of the individual IWLAN components both indoors and outdoors, a wide ranging selection of compatible coaxial accessories are available. The system manual also covers connecting cables as well as a variety of plug-in connectors, lightning protectors, a power splitter and an attenuator.

- Compact operating instructions
  These instructions contain wide-ranging descriptions of the components of the product, installation and setting up of SIMATIC NET devices as well as reference data and the relevant dimension drawings.

Operating Instructions and other documents

Despite every effort being made to provide a complete and thorough picture, this System manual cannot replace the Operating Instructions and reference documents of the individual devices and components. You will find the detailed documentation of the individual components on the Manual Collection DVD.

SIMATIC NET glossary

Explanations of the specialist terms used in this documentation can be found in the SIMATIC NET glossary.

You will find the SIMATIC NET glossary here:

- SIMATIC NET Manual Collection

  The DVD ships with certain SIMATIC NET products.

- On the Internet under the following entry ID:

50305045 (http://support.automation.siemens.com/WW/view/en/50305045)

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Basics of communication with Industrial Ethernet 1

1.1 Terminology

Industrial Ethernet

The term "Industrial Ethernet" covers a series of expansions to the Ethernet standard IEEE 802.3 with which communication suitable for an industrial environment is implemented. The main aims are as follows:

- Deterministic data transmission - guaranteed response times and data rates
- Safeguarding against component failure
- Network topologies adapted to a particular plant with the emphasis on linear (bus), redundant network structures.

The components must meet the following requirements:

- Equipment designed for industry, for example signaling contacts, protected cables and connectors
- Capability of withstanding extreme environmental conditions, for example extreme temperatures, vibration, dust, dampness, electromagnetic interference.

PROFINET

PROFINET is the name of the standard for Industrial Ethernet (IEC 61158/61784) developed and maintained by the PROFIBUS user organization.
PROFINET unites protocols and specifications with which Industrial Ethernet meets the requirements of industrial automation technology.

These include, for example:

- Real-time conditions
- Environment strongly affected by EMI
- Demanding requirements for safety, reliability and availability.

This world is in stark contrast to an office environment where high data throughput and large-area networking are the main objectives. Further differences between the two network types can be found in the numbers and heterogeneity of the nodes and their intermeshing.

SIMATIC NET

SIMATIC NET stands for a wide range of **network components** grouped under the motto "Totally Integrated Automation" to reflect the modern fully integrated implementation of automation solutions. PROFINET is the protocol used by SIMATIC NET components within the framework of Industrial Ethernet.

1.2 Industrial Ethernet

1.2.1 Basics of Industrial Ethernet

Properties of Industrial Ethernet

Industrial Ethernet is a powerful communication network complying with the international standard IEEE 802.3 (Ethernet) and was designed for the requirements in an industrial environment.

Ethernet was developed for the office environment and is subject to certain restrictions due to its origins. Industrial Ethernet therefore offers significant expansions of the Ethernet technology for the industrial environment:

- Protection of investment by connecting existing fieldbus systems

- Network components for use in a tough industrial environment

- Rugged and simple connection on-site

  - FastConnect cabling system with RJ-45 technology

  - Assembly of POF and PCF fiber-optic cable

- High transmission performance even with large numbers of nodes thanks to the end-to-end availability of components with 100 Mbps transmission rates complying with Fast Ethernet and 1000 Mbps with Gigabit Ethernet on all network components.

- Ethernet with real-time capability, even "hard real time"

- Integrated security concepts for protection against unauthorized access

- High availability of the networks thanks to redundant functionality, for example ring redundancy and redundant power supply

- Permanent monitoring of the network components with simple and effective signaling concept

- Almost unlimited communication performance with scalable performance available when necessary with switching technology.

- Networking of different areas of application such as office and production

- "Rapid Roaming" in Industrial Wireless LAN (IWLAN) for extremely fast handover of mobile nodes between different access points and therefore fast cyclic data communication (iPCF and iPCF-MC).

- Dual client for higher availability.

- Communication throughout the enterprise with the options of linking over WAN (Wide Area Network) such as ISDN or Internet

- Precise time stamping of events in the entire system with plant-wide timekeeping

Fast Ethernet

The Fast Ethernet standard IEEE 802.3u is an expansion of the existing standard (IEEE 802.3). Fast Ethernet is based essentially on the classic Ethernet standard for twisted pair cable.

Ethernet and Fast Ethernet have the following common features:

● the CSMA access method

● the glass fiber-optic cable used and category 5 twisted pair cables

Fast Ethernet includes the following expansions / modifications:

● Data transmission rate up to 100 Mbps

● Autosensing, automatic detection of the transmission rate

● Autonegotiation, automatic detection of the functionality of the interface of the partner

● Full duplex mode

● Auto polarity exchange, automatic adaptation of the polarity if the receive cable pair is incorrectly connected (RD+ and RD-swapped over)

● MDI/MDIX autocrossover, prevents malfunctions if transmit and receive cables are swapped over.

Gigabit Ethernet

Gigabit Ethernet is an expansion of the Ethernet specifications to increase the data transmission rate to 1000 Mbps, 1Gbps or 10 Gbps.
The relevant standards are as follows:

● IEEE 802.3z for transfer via glass fiber

● IEEE 802.3ab for electrical cable.

The increase in the transmission speed is achieved not only by adaptation of the protocol but also by using category "5e" or "6" twisted pair cables that are particularly immune to interference.

Differences compared with PROFINET

PROFINET expands Industrial Ethernet with the following additional properties:

● Transmission mode and real-time response:
It can be guaranteed that frames are transferred within a specified time.

● Deterministic; put simply:
The same conditions always lead to the same results and there are no undefined statuses.

See also

Transmission procedures and real-time response (Page 20)

Fault tolerance and redundancy (Page 29)

Access Methods (Page 30)

1.2.2 PROFINET

1.2.2.1 Basics of PROFINET

What is PROFINET?

PROFINET is the innovative and open Industrial Ethernet standard (IEC 61918, for PROFINET also IEC 61158/61784) for industrial automation.

PROFINET uses the existing IT standards and allows end-to-end communication from the field level to the management level as well as plant-wide engineering.

Aims of PROFINET

The aims of PROFINET are as follows:

- Open Ethernet standard for automation based on Industrial Ethernet.
  Industrial Ethernet and standard Ethernet components can be used together, however Industrial Ethernet devices are more rugged and therefore better suited to an industrial environment (temperature, noise immunity etc.).

- Use of TCP/IP and IT standards

- Automation of applications with real-time requirements

- Seamless integration of fieldbus systems

PROFINET communication

PROFINET communication is divided into non real time (NRT), real time (RT) and isochronous real time (IRT) communication, see section "Transmission procedures and real-time response (Page 20)".

PROFINET profiles

PROFINET transfers data transparently. The interpretation of the data is the responsibility of the user. The profiles are stipulations agreed by manufacturers and users relating to certain properties, performance characteristics and behavior of devices and systems.

- PROFIdrive

  The PROFIdrive profile (IEC 61800-7) defines the device behavior and the method of accessing internal device data for electric drives on PROFIBUS and PROFINET.

  The profile describes in detail how the communications functions direct data exchange, constant bus cycle time and isochronous real time should be used in drive applications. It also specifies all the device properties that influence the interface to a controller connected via PROFIBUS or PROFINET. These include the state machine (sequence control), the encoder interface, the standardization of values, the definition of standard frames, access to drive parameters etc.

  The PROFIdrive profile supports both central and distributed motion control concepts.

- PROFIsafe

  The PROFIsafe profile (IEC 61508 / EN 954-1) defines how the safety-related devices achieve fail-safe communication so that they can be used for safety-related applications.

  The profile is a software solution that is implemented as an additional layer (PROFIsafe layer) in the devices (e.g. operating system of the CPU). The safety-relevant data is included in the frame in addition to the standard data and forms the PROFIsafe frame. Existing solutions can be expanded without needing to change cabling.

  PROFIsafe prevents errors such as address corruption, loss, delay etc when transferring messages by consecutively numbering the PROFIsafe data, time monitoring, authenticity monitoring using passwords and optimized CRC protection.

- PROFIenergy

  With the PROFIenergy profile, individual consumers or entire production units can be turned off and on. This is coordinated centrally by a higher-level controller; networking is via PROFINET. During long pauses, this allows as much energy as possible to be saved. Plant sections that are turned off for a short time contribute to the uniform distribution of energy and optimum use of energy.
  It is also possible to read out measurement variables relating to consumption.

  PROFIenergy is defined so that the necessary function blocks can be included easily in existing automation solutions.

Implementation of PROFINET in SIMATIC

PROFINET is implemented in the SIMATIC products as follows:

- Communication between field devices is implemented in SIMATIC with **PROFINET IO**.

- Communication between the controllers as components in distributed systems is implemented in SIMATIC by **PROFINET CBA** (Component-Based Automation).

- Installation technology and network components are available under the **SIMATIC NET** brand name.

- For remote maintenance and network diagnostics, the tried and tested IT standards from the office world are used (e.g. SNMP = Simple Network Management Protocol for network parameter assignment and diagnostics).

Documentation of PROFINET on the Internet

Numerous publications on the topic of PROFINET can be found at the Internet address (http://www.profibus.com) of PROFIBUS International.

You will find further information on the Internet (http://www.siemens.com/profinet).

See also

1.2.2.2   PROFINET IO and PROFINET CBA

What is PROFINET IO?

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

With PROFINET IO, you create automation solutions in the same way as familiar from PROFIBUS DP.

Implementation of PROFINET IO is implemented by the PROFINET standard for programmable controllers (IEC 61158-x-10).

The STEP 7 engineering tool supports you when setting up and configuring an automation solution.

In STEP 7, you therefore have the same application view regardless of whether you are configuring PROFINET devices or PROFIBUS devices. The user program looks the same for PROFINET IO and PROFIBUS DP. The same function blocks and system status lists are used (were expanded for PN IO).

What is PROFINET CBA?

Within the framework of PROFINET, PROFINET CBA (Component-Based Automation) is an automation concept concentrating on the following aspects:

* Implementation of modular applications

* Machine-machine communication

With PROFINET CBA, you create a distributed automation solution based on off-the-shelf components and partial solutions. This concept meets the requirements for greater modularization in mechanical engineering and plant engineering with extensive distribution of intelligent processing.

With Component-Based Automation, you implement complete technological modules as standardized components that can be used in large plants.

You create the modular, intelligent components in PROFINET CBA in an engineering tool that may differ from device manufacturer to device manufacturer. Components made up of SIMATIC devices are created with STEP 7 and interconnect these with the SIMATIC iMAP tool.

Interaction between PROFINET IO and PROFINET CBA

PROFINET IO systems can be included in machine-machine communication with the aid of PROFINET CBA. From a PROFINET IO system, a PROFINET component is created, for example in STEP 7. With SIMATIC iMAP you can configure plants made up of several such components. The communications connections between the devices are simply configured graphically as interconnection lines.

The following figure shows a distributed automation solution with several components that communicate via PROFINET. The right-hand component contains IO devices and an IO controller on PROFINET IO.
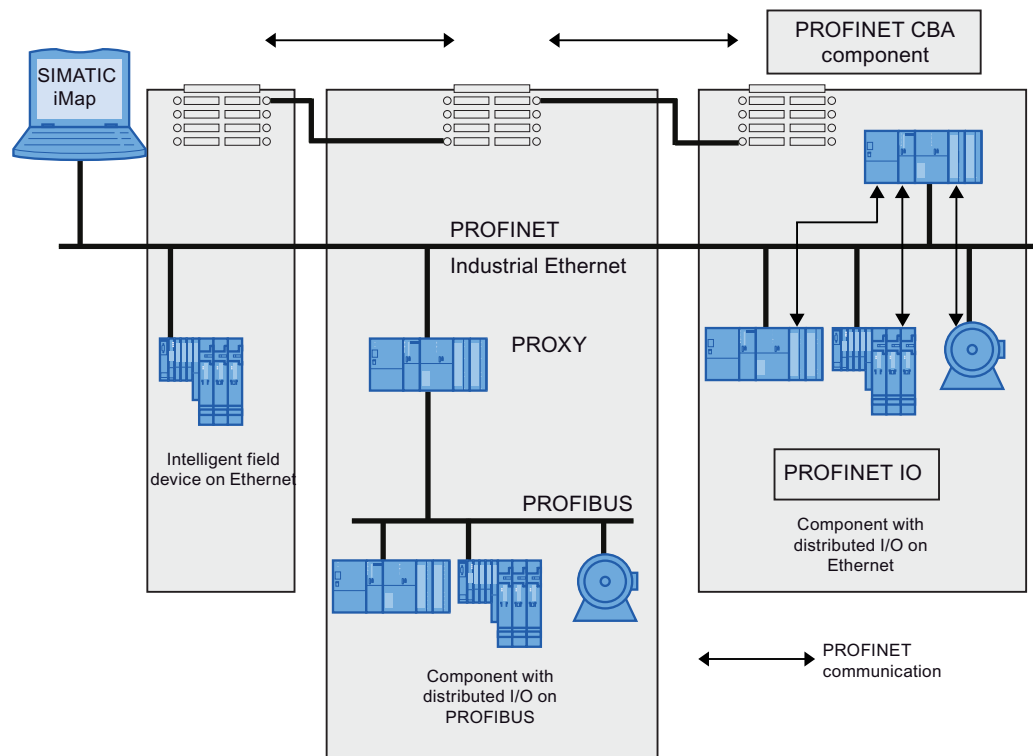
Figure 1-1   PROFINET CBA - modular concept

Distinction between PROFINET IO and PROFINET CBA

PROFINET IO and CBA are two different views of programmable controllers on Industrial Ethernet.
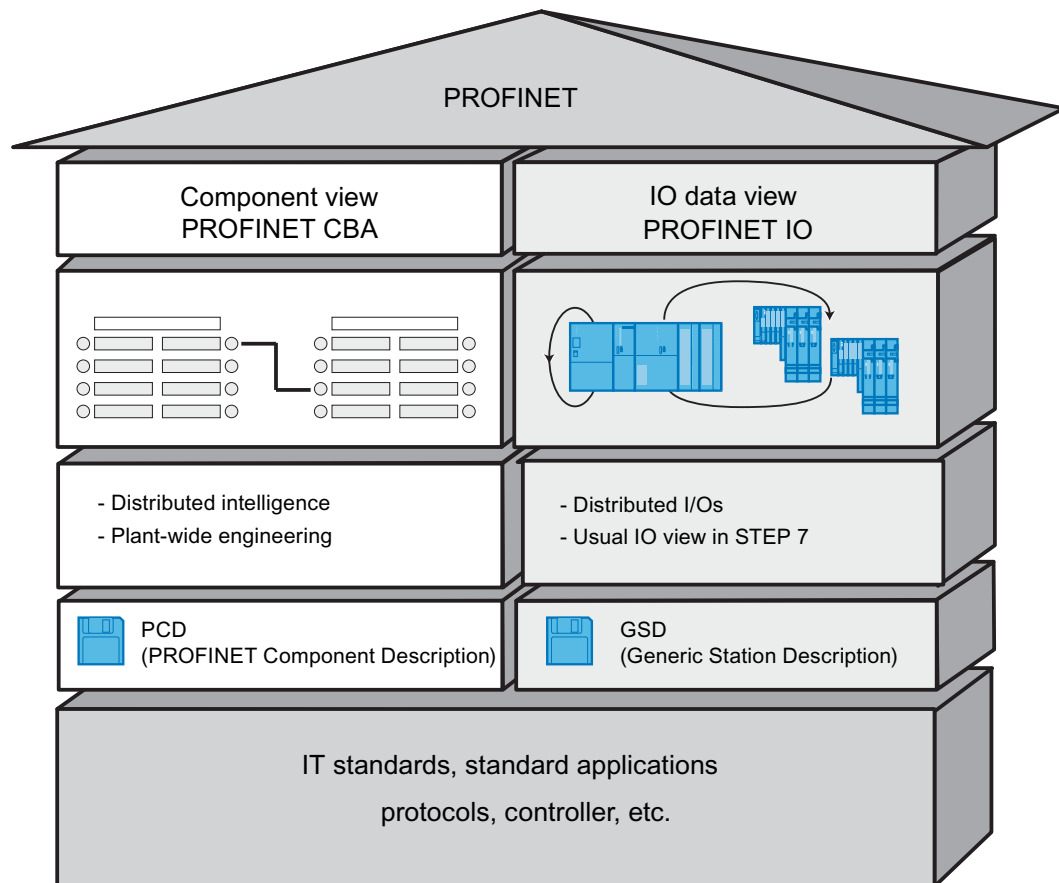
Figure 1-2   Distinction between PROFINET IO and PROFINET CBA

Component-Based Automation divides the entire plant into different functions. These functions are configured and programmed.

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

1.2.3   SIMATIC NET

SIMATIC NET in the automation world

SIMATIC NET is the product name for networks and network components. The network solutions of SIMATIC NET are an integral component of Totally Integrated Automation (TIA). With TIA, Siemens is the only manufacturer to provide a totally integrated basis for implementing customer-specific automation solutions.

The data can be exchanged between all levels - from the field level to the production management level right through to the enterprise management level.
The SIMATIC NET network components have uniform system interfaces and are coordinated with each other. In addition to the previous wired solutions, wireless communication is gaining ground in industry. SIMATIC NET provides products for enterprise-wide transmission of data over local area networks, intranet, Internet or wireless networks.
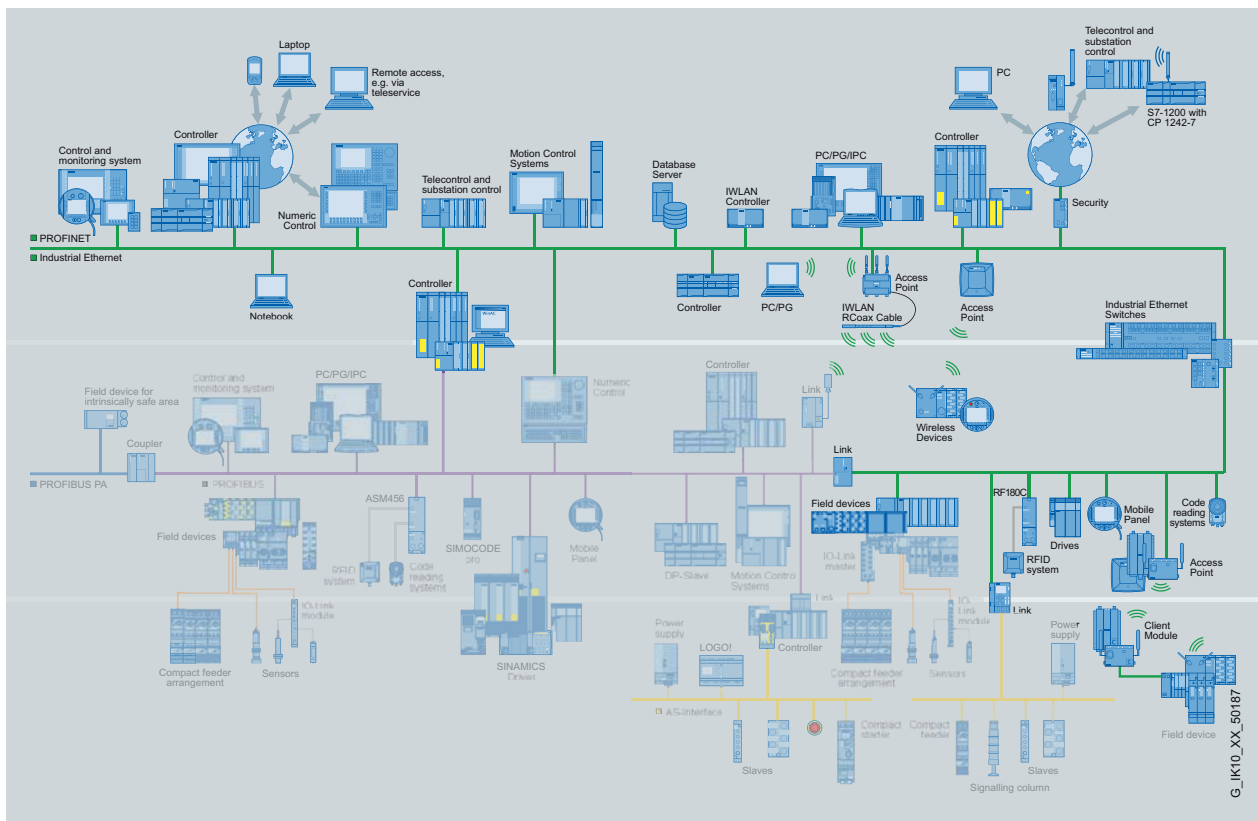
Figure 1-3   Industrial Ethernet and PROFINET in the SIMATIC NET environment

The distinguishing properties of SIMATIC NET include the following:

- Complete integration from the field level to the enterprise level,

- Coverage of the field area with Industrial Ethernet,

- Promotion of mobile communication,

- Integration of the IT technologies.

With these communication network options, SIMATIC products and intelligent devices can be combined locally according to your requirements. Flexibility and openness of the standards of SIMATIC communications networks make it possible to link different systems and to implement extensions.

Thanks to its scalable performance, SIMATIC NET allows the implementation of enterprise-wide communication – from the simplest device to the complex system. The SIMATIC NET components used with Industrial Ethernet are particularly powerful. The devices of the SCALANCE product family represent the latest and most advanced generation of active SIMATIC NET network components.

Technical requirements

Communications networks are a central component of modern automation solutions. Industrial networks have to fulfill special requirements, for example:

● Linking of automation systems, PCs as well as simple sensors, actuators and computers

● Robust against electromagnetic interference, mechanical stress and pollution

● Integration of existing systems and expandability

● IT communication to integrate modern information technology

● Simple cabling technology

● Flexible adaptation to the production requirements

● Availability of information at any location

● Correct transfer of information and at the right time

● Integrated diagnostics

● Deterministic - no undefined statuses

● Fast data exchange between parts of the plant

● Integrated security functions preventing unauthorized access

● Sale-safe standard communication over the same connection

Industrial networks belong to the LANs (Local Area Networks) and allow communication within a limited area.

1.2.4 Transmission procedures and real-time response

Overview
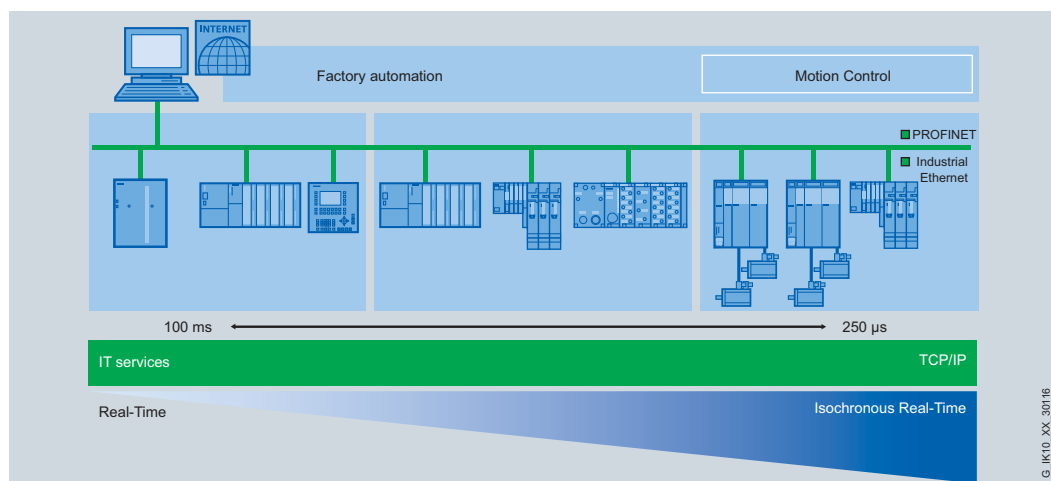
Non real-time communication (NRT communication)

The NRT communication is for communication that is not time-critical and corresponds to communication in Industrial Ethernet using the TCP/IP protocol family. Everything that is transferred using Industrial Ethernet can also be transferred via PROFINET, for example HTTP, TCP, UDP, SNMP, ARP.

Real-time communication (RT communication)

Real time means that a system processes external events within a specific time. If the reaction is predictable, this is known as a deterministic system.

A high data rate alone is no guarantee for real-time response, since delays are possible at "bottlenecks" in the network. Instead, the network protocol must ensure that time critical frames are given preferential treatment.

RT communication is suitable for transfer of alarms and cyclic data. Special switches must be used here. All SIMATIC NET switches are suitable for this. There is, however, not yet any need for particular communication planning in the form of a special configuration.

In RT communication the cyclic data are transferred between the IO controller and IO device, however, without the "best possible synchronicity".

Unsynchronized IO devices automatically exchange data using RT communication.

Isochronous real-time communication (IRT communication)

In PROFINET with IRT, communication over Ethernet is divided into individual cycles. Each cycle consists of two phases, an IRT channel reserved for extremely time-critical data, and an "open channel", within which RT and non-time critical frames can be sent.

This allows time-critical and uncritical data to be sent on the same connection. At the same time, however, a certain data rate (and therefore a transmission time) is reserved for the critical data and real-time capability can therefore be guaranteed.

Properties of isochronous real time

With the implementation of the data transfer procedure IRT in Ethernet controllers, the ERTEC ASICs (Enhanced Real-Time Ethernet Controller), update times of 250 µs and a jitter accuracy of the transmit clock of less than 1 µs can be achieved.

In PROFINET V2.3, the methods fast forwarding, dynamic frame packing and fragmentation were implemented. With these methods, update times of up to 31.25 µs can be reached.

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 reaction and update times in the range of a few milliseconds. Special switches must be used here. In SIMATIC NET, the suitable switches have "IRT" in their names.

1.3 Technologies of Industrial Ethernet

1.3.1 Communications media

Selection of media

Industrial Ethernet provides you with three different technologies to solve your automation task:

- Electrical cabling
- Fiber-optic cables
- Wireless/radio

Guide to selection

The following table shows with of the three communications media is best suited to which requirements:

	Twisted pair network	Fiber-optic network	Wireless linking
Suitability for high transmission rates	●	* 1)	*
Inter-building networking	--	●	*
EMC	*	●	●
Simple cable installation	●	*	
Range of cables for special use cases	Cables for indoors; trailing cable; marine cable, FastConnect cables	Cables for indoors and outdoors; trailing cable; halogen-free cable	--
The effect of failure of a network section	With a ring, no effect; with simple structures the network breaks down into two isolated subnetworks	With a ring, no effect; with simple structures the network breaks down into two isolated subnetworks	If there are overlapping wireless cells, the client roams to another AP
Maximum distance between two network nodes / access points	100 m	FE (100 Mbps) • 50 m POF • 100 m PCF • 5000 m multimode • Up to 200 km single mode GE (1000 Mbps) • 750 m multimode • 120 km single mode 10 GE (10000 Mbps) • 750 m multimode • 40 km single mode	Up to several kilometers depending on the environmental conditions, testing with www.siemens.de/snst
Preassembled cables	yes	yes	--
Redundant network structures	electrical ring or duplication of the infrastructure (bus, star, tree)	electrical ring or duplication of the infrastructure (bus, star, tree)	Dual client

● Suitable

* Suitable to some extent

-- Not suitable / not relevant

1) Longer distances possible

1.3.2 Active and passive network components

Active and passive network components

Industrial Ethernet networks are created using *active* and *passive* network components:

- Active network components are for example switches, access points, client modules, media converters and link modules.

- Passive network components are, for example, power cables and plug connectors.

The following tables contain a selection of network components for PROFINET/Industrial Ethernet.

Table 1- 1   Active network components for PROFINET/Industrial Ethernet

	Components	Remarks
Copper (electrical)	SCALANCE X switches	To interconnect nodes on Industrial Ethernet and to set up networks with more complex topologies
	PN/IO Link	Used to couple PROFINET to PROFIBUS
	SCALANCE S	"Security Module" to secure networks against unauthorized access
	Media and extender modules	To expand the functionality of SCALANCE X switches
Fiber-optic cable (optical)	SCALANCE X switches	see above
Radio (wireless)	SCALANCE W access point and client modules	Components for wireless transmission of Ethernet
	IWLAN/PB Link PN IO	For wireless coupling of Industrial Ethernet to PROFIBUS DP
	SCALANCE M	For the wireless linking of Industrial Ethernet-based programmable controllers on the UMTS/GSM mobile wireless network

Table 1- 2   Passive network components for PROFINET/Industrial Ethernet

Medium	Connectors	Cable type / transmission medium Standard
Copper (electrical)	RJ-45 cable connector ISO/IEC 61754-24 IE FC RJ-45 plug 90/145/180 M12 cable connector D-coded	Two-pair, symmetrical and shielded copper cable IEC 61158 IE FC TP standard cable GP 2x2 IE FC TP flexible cable GP 2x2 IE FC TP trailing cable GP 2x2 IE TP torsion cable GP 2x2 IE FC TP trailing cable 2x2 IE FC TP marine cable 2x2 IE FC TP FRNC cable GP 2x2
Fiber-optic cable (optical)	SC RJ plug ISO/IEC 61754-24	POF FO cable (Plastic Optical Fiber) ISO/IEC 60793-2-40
		PCF FO cable (Plastic Cladded Fiber) ISO/IEC 60793-2-30 PCF standard cable GP PCF trailing cable PCF trailing cable GP (for SC RJ plug)
	BFOC (Bayonet Fiber Optic Connector) ISO/IEC 60874-10 SC plug ISO/IEC 60874-14	Glass fiber cable - multimode fiber (62.5/125 µm) ISO/IEC 60793-2-10 Fiber-optic standard cable INDOOR fiber-optic indoor cable Flexible fiber-optic trailing cable SIENOPYR shipping duplex FO cable (for BFOC connectors)
		Glass fiber cable - multimode fiber (50/125 µm) ISO/IEC 60793-2-10 FO standard cable GP FO trailing cable FO trailing cable GP FO ground cable (for BFOC and SC connectors)
Radio (wireless)	N-Connect R-SMA SMA QMA	IEEE 802.11 IWLAN N-Connect/R-SMA male/male IWLAN N-Connect male/male IWLAN QMA/N-Connect male/female IWLAN R-SMA/SMA male/male

Note

Cable assembly

FastConnect cables can be assembled particularly fast and simply on site. This means that RJ-45 cabling technology, an existing standard, is also available in a version suitable for industry.

Product overview

You will find detailed overview of the available modules and accessories in the chapters 4 - 8.

Passive components for Industrial Ethernet and accessories

You will find an overview of the passive components and other accessories in chapter 9 Passive components and accessories (Page 263).

Passive components for IWLAN

You will find detailed overview of the passive components in the "Passive network components IWLAN" system manual.

See also

SCALANCE X switches and media converters (Page 99)

SCALANCE W components for Industrial Wireless LAN (Page 149)

SCALANCE M routers and modems (Page 184)

SCALANCE S security module (Page 197)

Communications processors for PCs (Page 217)

Communications processors for SIMATIC S7 (Page 225)

Compact switch module (Page 245)

Electrical networks (Page 264)

Optical networks (Page 304)

Power supply (Page 344)

Accessories (Page 214)

1.3.3 Management functions

SNMP

With the aid of Simple Network Management Protocol (SNMP), you can monitor and control the network elements (e.g. routers, servers, switches, printers, computers etc) from a central station. SNMP controls the communication between the monitored devices and the monitoring station.

SNMPv1 and SNMPv2c

In versions v1 and v2c, SNMP has no security mechanisms. Each user in the network can access data and also change parameter assignments using suitable software.

For the simple control of access rights without security aspects, community strings are used. The community string is transferred along with a query. If the community string is correct, the SNMP agent responds and sends the requested data. If the community string is not correct, the SNMP agent discards the query.

SNMP data packets are not encrypted and can easily be read by others. The monitoring is handled by "SNMP agents". SNMP agents are programs that execute on the devices to be monitored and send SNMP data packets to an SNMP manager. The data is described in a Management Information Base (MIB). The RFC 1213 document contains the definition of the MIB-2 important for SNMP.

SNMP v3

Compared with the previous versions SNMP v1 and SNMP v2c, SNMP v3 introduces a comprehensive security concept.

SNMP v3 supports

- Fully encrypted user authentication
- Encryption of the entire data traffic
- Access control of the MIB objects at the user/group level

Note

To further improve security, separate the administration network from the remaining network as a separate unit if this is possible.

DynDNS

Dynamic Domain Name Servers (DynDNS) allow applications to be reached on the Internet using a host name, for example myHost.org. Even if these applications do not have a fixed IP address and the host name is not registered. If, for example, you register a SCALANCE device for a DynDNS service, you can reach the device from the external network using a host name, for example SCALANCE.dyndns.org.

1.3.4 Power over Ethernet

Power supply via the Ethernet cable

In the IEEE 802.3af/at standard, the option of supplying devices with direct current was standardized. To achieve this, either the wire pairs of the network cable not used for data transfer are used or the supply voltage is modulated onto the data lines (phantom power).

The supply voltage and the load specified in the 802.3af standard differs from the 802.3at standard. The standards are abbreviated as PoE or PoE plus.

The following voltages or power are available:

Table 1- 3   PoE parameters

Characteristic	802.3af (also 802.3at type 1 or PoE)	802.3at type 2 (also PoE plus)
Power available on the powered device (PD)	12.95 W	25.50 W
Maximum power output of the power sourcing equipment (PSE)	15.40 W	34.20 W
Voltage range on the power sourcing equipment (PSE)	44.0-57.0 V	50.0-57.0 V
Voltage range on the end device (PD)	37.0-57.0 V	42.5-57.0 V
Maximum current flow	350 mA	600 mA per node
Maximum cable resistance	20 Ω (category 3)	12.5 Ω (category 5)
Power management	When the connection is first established, 3 power classes are negotiated	When the connection is first established, 4 power classes are negotiated or there is continuous negotiation in steps of 0.1 W
Reduction of the maximum operating temperature of the cable	None	5 °C for an active mode (2 pairs)
Supported cable types	CAT 3 and CAT 5	CAT 5, CAT 5e, CAT 6
Supported modes	Mode A (endspan), mode B (midspan)	Mode A (endspan), mode B (midspan)

Modes

- Mode A
  Phantom power via the data wires with

  - 10BASE-T

  - 100BASE-TX

  - 1000BASE-T

- Mode B
  Power supplied via the unused wires with

  - 10BASE-T

  - 100BASE-TX

  In both cases, a 4-pair Ethernet cable is required since the contacts 4-5 and 7-8 are used for power supply. All CAT 5 and CAT 5e cables meet these requirements.

Safety circuit to protect devices without PoE capability

To ensure that you do not damage any devices without PoE capability by using PoE or PoE plus, a safety circuit is defined:

- If the PSE identifies a resistance of 25 kΩ between the power wires, the end device is capable of PoE. The power is slowly increased by the PSE.

- If the PSE detects other resistance values, the power is not increased or it is turned off.

Classification of the power sourcing equipment (PSE)

- Endspan

  With endspan, the power is supplied via a switch that can reach a device over an Ethernet cable. The switch must be capable of PoE. The two modes can be used in parallel if the devices with PoE capability support this.

- Midspan

  Midspan is used when the switch is not PoE-compliant. The power is supplied by an additional device between the switch and end device. In this case, only data rates of 10/100 Mbps can be achieved because the power is supplied on redundant wires.

SIMATIC NET devices with PoE

Various devices of the SCALANCE W and SCALANCE X series are capable of PoE.

PoE according to 802.3af (also 802.3 type 1)

- X108PoE (PSE)

- X308-2M PoE, XR300 PoE (PSE)

- W7xx PRO and W7xx RR (PD)

PoE plus according to IEEE 802.3at type 2

- XR500 (PSE)

- W7xx RJ-45 and W700 M12 (PD)

1.3.5   Fault tolerance and redundancy

Overview

Fault-tolerant systems are designed to reduce production downtime. Availability can be enhanced, for example, by means of component redundancy. Communication systems are thus extended to automation systems.

Redundant systems in industrial Ethernet are characterized by the multiple (redundant) presence of important automation components. When a redundant component fails, processing of the program is not interrupted.

Redundancy is achieved by duplicating the part components such as CPU, network, CP, etc.

Monitoring and synchronization mechanisms ensure that if the active redundant connection path fails, the previously passive (redundant) connection path takes over the communication automatically. The connection itself remains established.

Redundant connection of several rings

The following graphic illustrates the principle of fault tolerance based on a network consisting of several optical (yellow) and electrical (yellow) rings. The interconnection of the rings is redundant.
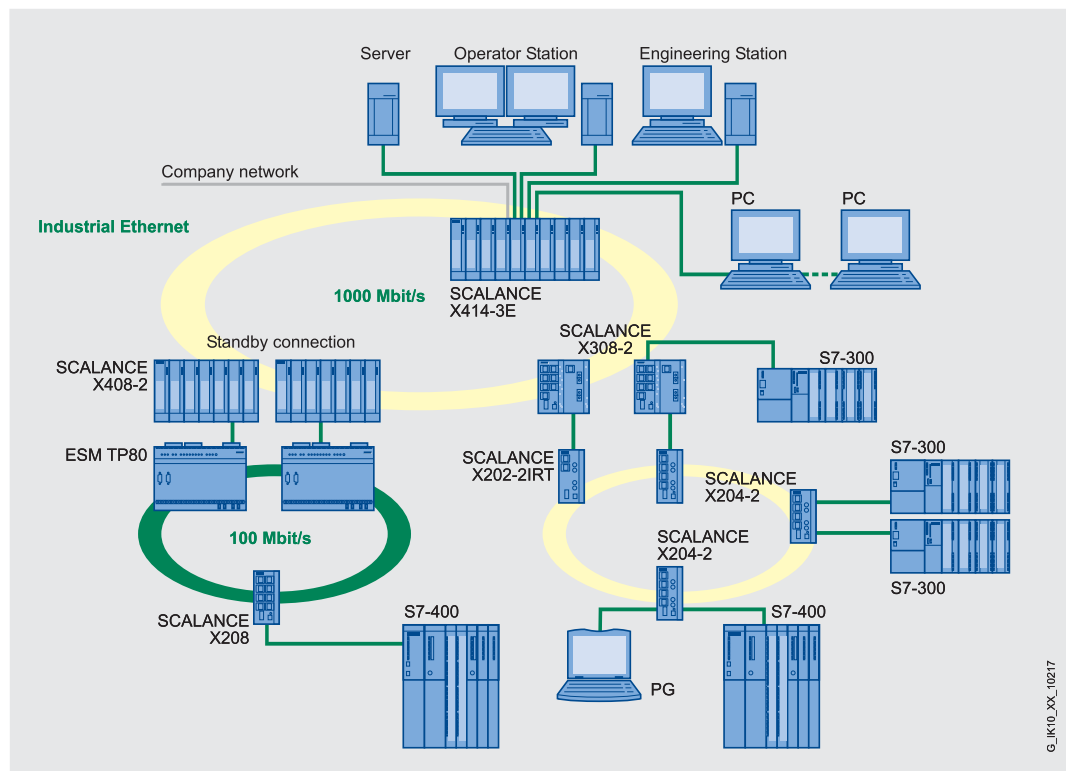
Figure 1-4   Optical and electric ring linked redundantly by SCALANCE X

The secondary rings (at the bottom) are connected redundantly with the main ring (at the top): Of the two connections, one is inactive and is only activated when the other fails.

1.3.6   Access Methods

Switching mechanisms

PROFINET is based consistently on Fast Ethernet at 100 Mbps and on switch mechanisms and has further developed this technology for real-time applications.

Compared with other methods this has the advantage that each node can send at any time since it always has a free point-to-point connection to the next switch. The connection is bidirectional. The nodes can send and receive in both directions at the same time (full duplex).

Switches in SIMATIC meet real-time requirements with PROFINET using two transmission techniques: "Store and Forward" and "Cut through".

Store and forward

With the transmission technique "Store and Forward", the switch stores the frames and then places them in a queue. The frames are now forwarded selectively to the port that has access to the addressed node.

If the device supports the international standard IEEE 802.1Q, the frames are sorted into different queues depending on their priority. The frames with the highest priority are processed first.

Advantage

With the "Store and Forward" transmission technique, the frames are checked for their correctness and validity. This prevents bad or damaged frames being distributed through the network.

Cut through

With the transmission technique "Cut Through", the entire frame is not stored temporarily in a buffer but is forwarded directly to the target port as soon as the first 6 bytes (destination address) have been read and the destination port has been identified.

The times that the data packet requires to pass through the switch are minimal and not dependent on the frame length. The data is only stored temporarily using the store and forward mechanism according to its priority when the section between the target part and the port of the next switch is in use.

With PROFINET switches, Cut Through is implemented by using ERTEC ASICs, for example in the SCALANCE IRT switches.

See also

Switches and switched LANs (Page 36)

1.3.7   Layer 3 functions

Introduction

The term layer 3 function effectively means routing. The term routing describes the specification of paths (routes) for communication between different networks. This decides how a data packet travels from subnet A to subnet B.

Devices with layer 3 functionality are also known as layer 3 switches. Layer 3 switches can operate both at OSI layer 2 (MAC address) or at OSI layer 3 (IP address).

A layer 3 switch can assign various subnets to its ports, e.g. subnet A and subnet B. This allows large networks to be divided into smaller subnets with their own address space. Reasons for dividing into subnets include, for example, the separation of the Ethernet network to reduce data traffic, the separation of sensitive areas from the main network and the division of the network into logical workgroups.

The data packets are forwarded either using the Cut Through or the Store and Forward technique.

Static routing

In static routing, the paths that a data packet can take are entered permanently (statically) in the routing table.

Dynamic routing

With dynamic routing, the paths that a data packet can take are identified dynamically between the routers involved, see also "Dynamic routing with OSPF".

Router redundancy with VRRP

With the aid of the Virtual Router Redundancy Protocol the failure of a router in a network can be countered. VRRP, for example, provides the option of setting up device redundancy for the default gateway of the end devices.

Several physical routers in a network segment are grouped together to form a logical group. A virtual MAC and IP address then apply for this area. One router of this group is made master. This master adopts the virtual MAC and IP address of the area. The other routers of this group are then backup routers. If the master fails, another router from the group takes over the virtual MAC and IP address and the tasks of the failed router. This means that the network area affected can continue to communicate with the outside world. The network segment can no longer be reached only after the failure of the last router in the group. Due to the backup router adopting the virtual MAC and IP address, no other actions are necessary for the other routers in the area of the segment. Routing tables or the ARP cache do not need to be updated. This minimizes the consequences of device failure.

Dynamic routing with OSPFv2

Open Short Path First is a routing protocol developed by the Internet Engineering Task Force (IETF). With OSPF, CIDR (Classless Inter-Domain Routing) and VLSM (Variable Length Subnet Mask) are also implemented.

The routers setup a, neighborhood database (LSDB = Link State DataBase). The neighborhood database is the heart of OSPF and contains information on the topology of the network.

To set up the neighborhood database, the router needs to learn its direct neighbor routers. To do this, the router sends out Hello packets following initialization. The neighbor routers exchange packets (LSA - Link State Advertisements) that describe the content of their database. When the exchange of information with the neighbor router is completed the neighborhood database of the neighbor routers is the same.

The neighborhood database is used to calculate routes based on the SPF algorithm (Shortest Path First). The algorithm creates a hierarchical tree structure (Shortest Path Tree) in which each destination with the shortest (loop-free) and lowest cost route is entered. The algorithm uses the costs of the path as a metric. What is used to calculate the costs is not defined. The costs can be, for example, the data rate of the connection or the reliability of the connection. The entries from the tree are adopted in the routing table. If several routes with the same costs exist for a destination, the data is transferred via different routes to achieve load distribution.

The routers continuously test the state of the connection between themselves by exchanging Hello packets. If a connection is disrupted, the router sends a message to its neighbor router. The neighbor router updates its database and sends the message to its neighbor router and so on until the modification has passed through the entire network.

To limit the size of the routing table, OSPF can divide a network (autonomous system) into hierarchical areas. Each area has its own neighborhood database and its own shortest path tree.

By dividing into areas, if there is change in the topology, the entire network is not loaded with messages so that OSPF manages with relatively low overheads.

If several neighbor routers can be reached in an area, the designated router (DR) and the backup designated router (BDR) are identified based on Hello packets. By identifying the designated router, the topology is simplified. The designated router then sends the message.

To send a frame from area 1 to area 2, the frame is first sent to the area border router (ABR) of area 1. The ABR connects its area to the backbone area. The ABR of area 1 sends the frame to the router in the backbone area that forwards the frame to the ABR of area 2. The backbone area (area 0) is used to distribute routing information about the reachability of areas between area border routers. A frame is sent to another AS via an Autonomous System Area Border Router (ASBR). On the ASBR, one interface is connected to another AS, for example an AS that uses the RIP routing protocol.

With OSPF, messages can be authenticated. Only trustworthy routers can take part in the routing with OSPF.

1.4   Network security

1.4.1   Basics

Security in automation technology

In principle, the security of every network with a connection to the outside world is at risk of being compromised. Attacks from the outside can take the form of widespread viruses or other malware, but may also involve sabotage or data espionage with an attacker deliberately attempting to take control of a network or to access relevant information.

The potential damage caused by such an attack (if it succeeds) is high and can involve not only serious production and machine downtimes but also a loss of customer confidence. Security of the networks should therefore always be given high priority, even more so today because island solutions are no longer practicable and automation networks normally also require access to the Internet.

1.4.2   Firewalls

"Gatekeeper" function

Put simply, a firewall is a device or a software application inserted between the network and the outside world as a "gatekeeper" to protect the network. The firewall represents the only access to the local area network from outside and the entire data traffic crossing the boundaries of the network is directed via the firewall. This means that the firewall can block unwanted and potentially dangerous access from the outside. Various techniques are available.

Packet filter

A packet filter inspects data packets entering or leaving the network, their sender and receiver addresses and the "port", or service, to which the data packet will be transferred. Such services might be E-mail, file transfer with FTP, database access, SSH for encrypted transfer etc.

Filter rules stored in the firewall now block the access to certain addresses or certain services. Firewalls can implement complex filter rules in which, for example, service "A" is available only for IP addresses "B" and "C" but is not allowed for other communications partners.

"Stateful Inspection"

"Stateful Inspection" goes a step further than the packet filter and takes into consideration the "context" within the communication in addition to the addresses and ports.

In concrete terms, this means, for example, that Web pages sent be an external server to an internal computer can only pass through the firewall if the internal computer has actually requested this page.

Such techniques are, for example, relevant for preventing "Denial of Service" attacks (DoS) in which an external intruder sends queries to the computer under attack from numerous computers at the same time in the hope of overloading and paralyzing the network. Since, however, the stateful inspection detects these illegitimate queries at the boundary of the local area network, local traffic continues unaffected by the DoS attacks.

"Network Address Translation" (NAT)

"Network Address Translation" ("NAT") is a function with which a router replaces the addresses of the local nodes involved in data traffic with its own IP address whenever the traffic goes beyond the network boundaries. Incoming replies are only assigned to the actual addressees with their IP addresses after passing the firewall.

This mechanism can be used for ergonomic reasons since to the outside only one single IP address is required for any number of local nodes.

It does, however, also provide a certain protection from attacks since only one single address is visible to the outside namely that of the firewall. A "naive" attack would always be aimed at the firewall directly and not at the local computers being protected behind it.

"Network Address Port Translation" (NAPT)

Compared with NAT, NAPT goes one step further. With NAPT, in addition to the IP addresses, the ports of the local nodes are also replaced. Incoming replies are then assigned back to the corresponding IP addresses and ports of the local nodes.

"Personal firewalls"

For professional applications, the firewalls normally used are separate devices. The alternative to these devices are "personal firewalls" in the form of software running on the target computers themselves.

Personal firewalls cannot, however, provide the same security as dedicated devices. Errors in the operating system or badly programmed or configured personal firewalls allow an attacker to avoid the "gatekeeper" filter function and to attack the target computer or target network despite the firewall.

1.4.3 "Virtual Private Networks" (VPNs)

The function of Virtual Private Networks

A VPN means that a public network is used to transfer private data by "embedding" the private communication in the traffic of the public network.

The nodes of the VPN have the impression that they are connected directly to each other. They are not aware of the intermediate steps inserted in the transmission via the public network. For this reason, the mechanisms are known as "tunneling" through the public network. Using VPNs, for example, two subnets at a considerable physical distance from each other can be connected so that the users can address them as one unit.

Security of VPNs

The term "private" relates primarily to the use of VPNs and not to the confidentiality of the data: VPNs are not automatically secure since the data traffic is not encrypted from the very beginning. If, however, suitable encryption techniques are used, communication via the VPN is practically safe from eavesdropping.

See also

Encryption and data security (Page 44)

1.4.4 Cell protection concept

Basics

With the cell protection concept, a plant network is divided into individual protected automation cells to ensure security for the automation systems; within these cells, all the devices can communicate securely with each other. In the sense of the cell protection concept, production units, for example, are worthy of protecting.

The following graphic illustrates this. A production cell is protected from unauthorized access from the remaining enterprise network by a SCALANCE S firewall.
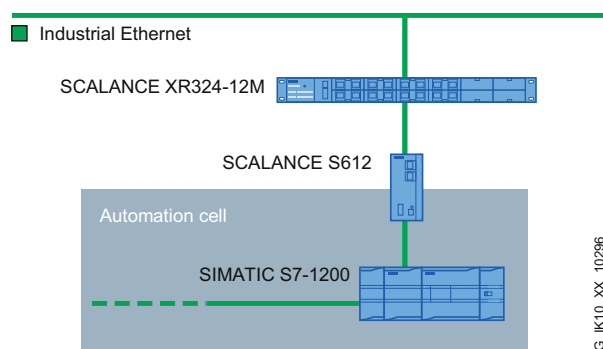
Figure 1-5   Cell protection concept

1.5 Switches and switched LANs

If a network needs to be divided into several (logical and physical) subunits, switches are used at the connection points of the network sections.

Switches are active components that can receive and send at several ports independently. There are equipped with intelligence that allows them to forward received messages only via the port connected to the segment in which the actual addressee is located. This can be connected directly to the port or via a further switch.

Since all direct connections are point-to-point and since the medium used allows full duplex communication, it is no longer possible for collisions to occur.

Switched connection paths: "Shared LANs" and "Switched LANs"

"Shared LANs" are networks on which a message being transmitted blocks the network for all other nodes; in other words, there can only be one sender at any one time. A wireless network is a simple example of such a shared LAN.

"Switched LANs" are set up using switches and are characterized by the connection paths for each data packet being switched based on the target address. Different data packets can be in transit in the network at the same time on different connection paths. The data packets only run through segments that lead to the recipient. All the SCALANCE X products belong to the products that operate according to the switching method and therefore create "switched LANs".

Functions of switches

Essentially, switches have the following functions:

- Connection of subnets
  Switches connect several collision domains. This allows extensive networks to be set up with numerous nodes and simplifies network expansion. The distances achieved depend on the fiber-optic interfaces used in the devices and the FOR fibers used. You will find information about the distances that can be covered in the section "Passive components and accessories (Page 263)".

- Containing load
  By filtering the data traffic based on the Ethernet (MAC) addresses, local data traffic remains local. The data is distributed to all ports/network nodes using the direct switching method. Only data intended for nodes in other sublets is switched from the input port to the appropriate output port of the switch. To make this possible, a table assigning Ethernet (MAC) addresses to output ports is created by the switch in a "teach-in" mode.

- Limitation of errors to the network segment affected
  By checking the validity of a data packet on the basis of the checksum which each data packet contains, the switch ensures that bad data packets are not transported further. Collisions in one network segment are not passed on to other segments.

Advantages of switched LANs

The advantages of such switched LANs are:

- Good performance (since the messages only block the sections of cable actually between the sender and receiver),

- Avoidance of data collisions because the sender does not block the entire network

- High availability particularly in topologies that include redundancy,

  If a connection path is blocked in a redundant topology (due to a cable break or component failure), switches can still redirect the messages over an alternative path and maintain communication. A network with a ring topology (see below) is a classic example of using switches in this way.

- Option of forming subnets and network segments,

- Simple rules for network configuration,

- Simple, expansion is possible without affecting the existing network.

Application example: Redundant ring

Using an IE switch as the redundancy manager in a ring with redundancy manager (Page 60) provides greater availability. If there is an interruption on the connection between these switches, the IE switch used as redundancy manager acts like a switch and in a very short time creates a line (bus) from the ring. As a result, a functional, end-to-end structure is restored.

1.6   Wireless LAN

1.6.1   What is wireless LAN?

WLAN

A wireless LAN or WLAN is a "Wireless Local Area Network"; in other words a network based on wireless covering a limited area. WLAN is based on the IEEE 802.11 standard.

IWLAN

The Industrial Wireless LAN (IWLAN) technology is a further development of WLAN for industrial applications. In contrast to WLAN, IWLAN provides predictable data traffic (deterministic) and defines response times for high-speed applications. This makes it possible to transfer process-critical data, for example alarms. By implementing a wireless solution, you can replace hard-wired connections that are subject to natural wear and tear, for example contact conductors. Use cases for wireless solutions such as overhead monorails, driverless transport systems or user-specific operator control and maintenance devices.

To protect data traffic, rugged and immune modules are used on the one hand and on the other hand the data is encrypted.

1.6.2   Differences between wireless LAN and wired networks

Cable as opposed to radio waves

The use of cables and wires for communication has certain advantages because this makes an exclusive medium available:

The transmission properties in a hard-wired network are defined and remain the same as long as the cable, routers or similar are not replaced. Since a wired network is limited in locality, it is possible to recognize at any time which nodes are connected to a LAN (Local Area Network) and which are not.

On the other hand, the effort and cost of cabling increases with the number of nodes and, at the same time, the potential for broken cables and other hardware faults. Finally, communication with freely moving nodes using wired methods is practicable only in exceptional situations. Wireless links also allow sections to be covered that would be problematic using cables, for example roads, water.

In these situations, wireless networks are an advantage. The advantage is in the mobility of the individual components and their flexible use.

"Wireless" as such is a limited resource. Due to its nature as a "shared medium" it is not possible to increase the capacity as would be possible, for example, by simply laying more cable. This means that with the increasing number of nodes, the effective data rate that can be reached by the individual nodes sinks.

Complexity of the RF field

Radio waves propagate through space are and deflected by obstacles or weakened when passing through. This means that an RF field with a complex structure is created that changes when the obstacles move. The area illuminated by one or more transmitters is not sharply defined. There is also no clear delineation of the RF field and the transmission characteristics of the individual nodes in the wireless network fluctuate depending on their position. Lastly, it is also practically impossible to detect a "silent listener" in a wireless network.

These properties need to be taken into account in terms of the reliability of the wireless link and the security of a network against eavesdropping and immunity to interference. Wireless networks are, however, just as reliable, secure and resilient as hard-wired networks if trained employees are deployed who are aware of the particular demands of a wireless network.

1.6.3 Preferred areas of application for WLANs

Preferred areas of application

In many environments, their special qualities make wireless networks the preferred, and in some cases only practical medium.

These include:

● Connection of mobile nodes both among themselves and with stationary nodes,

● Connection of mobile nodes with wired networks (Ethernet etc.),

● Contact with rotating nodes (cranes, carousels, ...),

● Connection of nodes with restricted mobility (monorail suspension tracks, high-bay storage racks, ...), as a replacement for slip contacts or trailing cables,

● Establishing wireless bridges between physically separate wired subnets (different buildings, across streets, over water, ...),

● Communication with nodes in inaccessible areas.

1.6.4 The standards of the "IEEE 802.11" series

Standardization of WLANs

IEEE

The acronym "IEEE" stands for the Institute of Electrical and Electronics Engineers, an organization that has taken on the task of developing, publishing and promoting electronic and electrotechnical standards and that can be compared in some ways with DIN.

The IEEE 802.11 group

Under the project number "802", a number of working groups were given the task of developing standards for setting up and operating networks. A known example is the "802.3" working group that is concerned with the standards for Ethernet connections.

The "802.11" working group concentrates on the specifications for wireless LAN, the IEEE 802.11 standard. The most important expansions of the standard are "802.11 a/h", "802.11 b/g" and "802.11n".

"802.11" standards

The following table provides an overview of the features of the individual standards.

	802.11 "a"/"h"	802.11 "b"	802.11 "g"	802.11 "n"
Frequency band	5 GHz	2.4 GHz	2.4 GHz	2.4 GHz + 5 GHz
Gross data rate	54 Mbps	11 Mbps	54 Mbps	600 Mbps
Modulation	OFDM	DSSS	OFDM	MIMO

Expansions of the 802.11 standard include the following:

- 802.11 "e": Introduces QoS to provide better support for real-time applications (VoIP, streaming),

- 802.11 "i": Replaces the no longer tenable WEP encryption mechanism with WPA or WPA2.

- 802.11 "p": Introduces WLAN technology for motor vehicles with which an interface for applications involving intelligent traffic systems is created.

1.6.5 IEEE 802.11n

The standard IEEE 802.11n is an expansion of the 802.11 standard and was approved in 2009.
Previous Standards worked either in the 2.4 GHz frequency band (IEEE 802.11g /b) or in the 5 GHz frequency band (IEEE 802.11a). IEEE 802.11n can operate in both frequency band. In the IEEE 802.11n standard, there are mechanisms implemented in PHY and MAC layers that increase the data throughput and improve the wireless coverage.

With SCALANCE W700 devices, a data throughput up to 450 Mbps (gross) is possible due to support of the following mechanisms. This maximum data throughput is possible only if the mechanisms are used at the same time.

MIMO antenna technology

MIMO (Multiple Input - Multiple Output) is based on an intelligent multiple antenna system. The transmitter and the receiver have several spatially separate antennas. The spatially separate antennas transmit the data streams at the same time. Up to four data streams are possible. The data streams are transmitted over spatially separate paths and return over different paths due to diffraction, refraction, fading and reflection (multipath propagation). The multipath propagation means that at the point of reception a complex, space- and time-dependent pattern results as a total signal made up of the individual signals sent. MIMO uses this unique pattern by detecting the spatial position of characteristic signals. Here, each spatial position is different from the neighboring position. By characterizing the individual senders, the recipient is capable of separating several signals from each other.
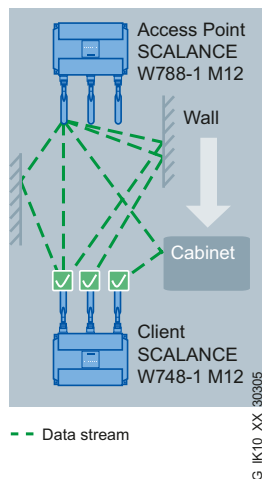
Maximum ratio combining (MRC)

In a multiple antenna system, the wireless signals are received by the individual antennas and combined to form one signal. The MRC method is used to combine the wireless signals. The MRC method weights the wireless signals according to their signal-to-noise ratio and combines the wireless signals to form one signal. The signal-to-noise ratio is improved and the error rate is reduced.

Spatial mutliplexing

With spatial multiplexing, the data to be transmitted can be distributed over several transmitting antennas according to specified rules. The devices currently use a maximum of three antennas. The data stream is therefore divided among three transmitting antennas. As a result different data streams are transferred at the same time over three transmission paths. This allows the data throughput to be greatly increased. The spatially differing data streams are known as spatial streams. The number of spatial streams specified for an IWLAN (Industrial WLAN) is a measure of the transmission rate. Per data stream, a maximum of 150 Mbps is transferred according to IEEE 802.11n. With four antennas and four data streams, this results in a maximum of 600 Mbps and with three antennas and three data streams 450 Mbps. Ideally the net data throughput is then somewhere higher than 200 Mbps which means a net transmission rate almost ten times higher than conventional WLAN standards.
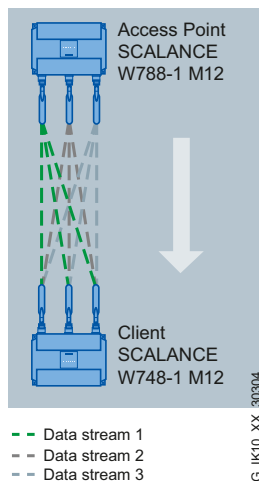
Channel bonding

With IEEE 802.11n, data can be transferred via two directly neighboring channels. The two 20 MHz channels are put together to form one channel with 40 MHz. This allows the channel bandwidth to be doubled and the data throughput to be increased.

To be able to use channel bonding, the recipient must support 40 MHz transmissions. If the recipient does not support 40 MHz transmissions, the band is automatically reduced to 20 MHz. This means that an IEEE 802.11n access point can communicate within the network with 802.11a/b/g/h and with 802.11n products.

Communication according to IEEE 802.11a /b/g/h standard

SCALANCE
W788-1PRO

2 x 20 MHz channels

SCALANCE
W746-1PRO

Maximum data rate: 54 Mbps

Communication according to IEEE 802.11n standard

SCALANCE
W788-1 M12

1 x 40 MHz channel

SCALANCE
W748-1 M12

Maximum data rate: 450 Mbps
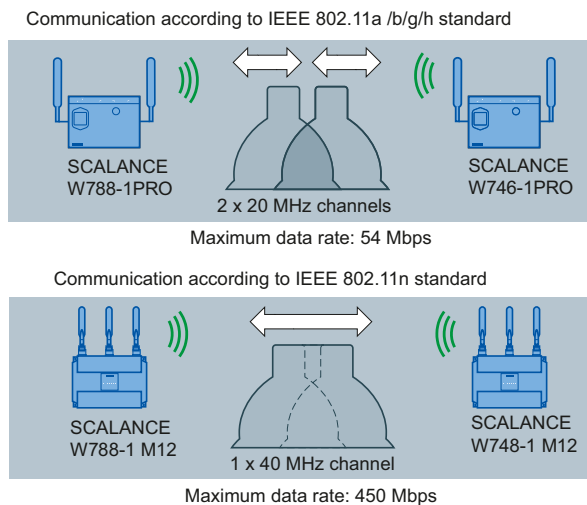
Frame aggregation

With IEEE 802.11n, it is possible to group together individual data packets to form a single larger packet; this is known as frame aggregation. There are two types of frame aggregation: Aggregated MAC Protocol Data Unit (A-MPDU) and Aggregated MAC Service Data Unit (A-MSDU).

The frame aggregation reduces the packet overheads. Frame aggregation can only be used if the individual data packets are intended for the same receiving station (client).

Accelerated guard interval

The guard interval prevents different transmissions being mixed together. In telecommunications, the guard interval is also as intersymbol interference (ISI).

The guard interval of IEEE 802.11a /b/g is 800 ns. IEEE 802.11n can use the reduced guard interval of 400 ns.

1.6.6   Encryption and data security

WPA2 and AES ("Advanced Encryption Standard")

WPA2 is recognized today as a standard and differs from WPA essentially in its encryption method: The weaknesses identified in WPA no longer exist in the AES method used in WPA2.

If a "sensible" passwords are selected that it are adequately long and cannot be guessed, messages encrypted with AES are considered proof against eavesdropping with the current state of the art (Spring 2007).

WPA ("Wi-Fi Protected Access")

WPA is the further development of WEP. Apart from technical modifications in the actual encryption algorithm, the protocol was also adapted:

- Passwords for network access (authentication) are stored on a central server ("RADIUS"),

- The key for frame transmission changes dynamically making statistical attacks more difficult,

- The MAC address is worked into the key (in other words, unique hardware identification) of the sender making it more difficult to falsify the sender of the message.

WEP ("Wired Equivalent Privacy")

WEP is the oldest and at the same time the least secure encryption method with which WLAN transmission is protected against unauthorized intruders according to the 802.11 standard.

With this method, a user password is used as a key from which a series of pseudo random numbers is generated. Each character of the frame to be transmitted is then encoded with next number of this series and decoded at the receiver.

Today, WEP is considered insufficiently secure.

EAP ("Extensible Authentication Protocol")

The acronym EAP covers a wide framework of different authentication mechanisms for network access. In other words, EAP is not an authentication method itself but describes the mechanism according to which the client and server can agree on a method.

1.6.7   Avoiding collisions in wireless networks

CSMA/CA with RTS/CTS

Ethernet uses the bus access method CSMA/CD. This acronym stands for Carrier Sense Multiple Access with Collision Detection. After the node that is ready to send has listened to the cable and recognized that it is free (Carrier Sense, CS), the data is sent.

The sending node can detect a collision (Collision Detection, CD) when other nodes are sending at the same time (Multiple Access, MA) based on a disrupted level and then back off.

This mechanism is used in just the same way in a wireless network apart from the fact that collisions are deliberately avoided (Collision Avoidance, CA) to avoid reducing the net data throughput unnecessarily. For this reason wireless LANs do not use the CSMA/CD method with which collisions can occur and be detected, but rather the CSMA/CA method (Carrier Sense Multiple Access with Collision Avoidance).

Instead of physically listening in on the channel, a communications protocol is used that reserves the channel for a specific time. Before sending, a node checks whether or not the medium is free.

In this so-called RTS/CTS method, the node wishing to transmit sends a short test signal ("Ready To Send" - RTS). The actual transmission begins after the recipient has replied to this with "Clear To Send" (CTS). If a collision occurs, the retransmission follows after a pause not selected at random but according to priority. With this strategy, communication remains deterministic.

1.6.8 Structure of an IWLAN

Basic structure of a WLAN

WLANs do not have a physical topology like traditional wired networks. There are no "buses", "rings" or "stars". Instead wireless networks are divided into cells.
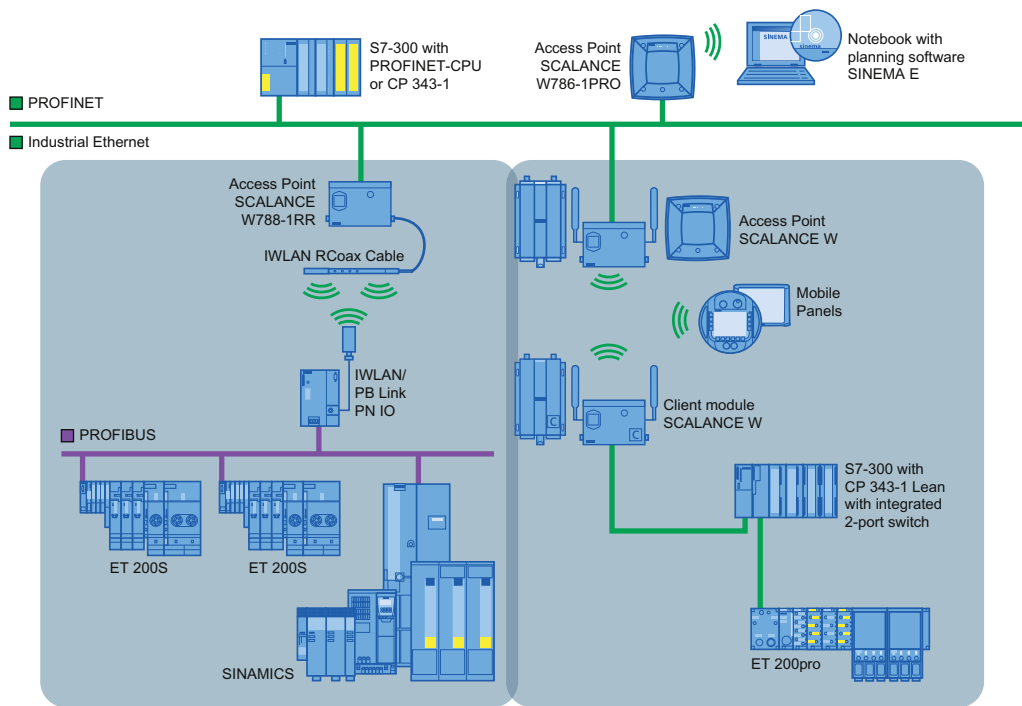
Figure 1-6   Simple WLAN structure with two access points/wireless cells, RCoax cable and IWLAN/PB Link PN IO gateway

Here, access points take over the role of switches. End nodes are connected to the network by activating "clients". Larger networks can be achieved by setting up several wireless cells each under the control of an access point. The connection between individual cells is also via access points.

The access points function as their own wireless cells between which mobile nodes can move. ("Roaming")

Shared medium instead of switched medium

Wireless networks operate on the shared medium principle, in other words, only one node can send at any one time. As the number of nodes increases, the effective achievable data rate for individual nodes sinks.

1.6.9   Network structures

1.6.9.1   Infrastructure mode

In infrastructure mode, communication is handled via an access point. The nodes (clients) need to log on with the access point and transmit on the channel specified by the access point. The access point can manage the access rights of the clients and assign time slices to them for communication so that real-time and deterministic communication is assured.

In the simplest case there is a group of clients in the wireless range of the access point. Such a network is also known as a standalone network.
If the wireless range of an access point is not adequate either because the range is too short or too few clients can be served, the network can be divided into several wireless cells. All clients within the wireless cell are within the range of a central access point (AP). The other clients only ever communicate with their access point and not directly with other clients. By connecting external antennas, the range and coverage can be adapted to the application. This means, for example that omnidirectional antennas in closed rooms can achieve distances between 30 m and 100 m.

Standalone networks

Coordination by an access point:

This configuration does not require a server and the SCALANCE W access point does not have a connection to a wired Ethernet. In this case, a central access point functions like a switch receiving the frames from the individual nodes (clients) and forwarding them.
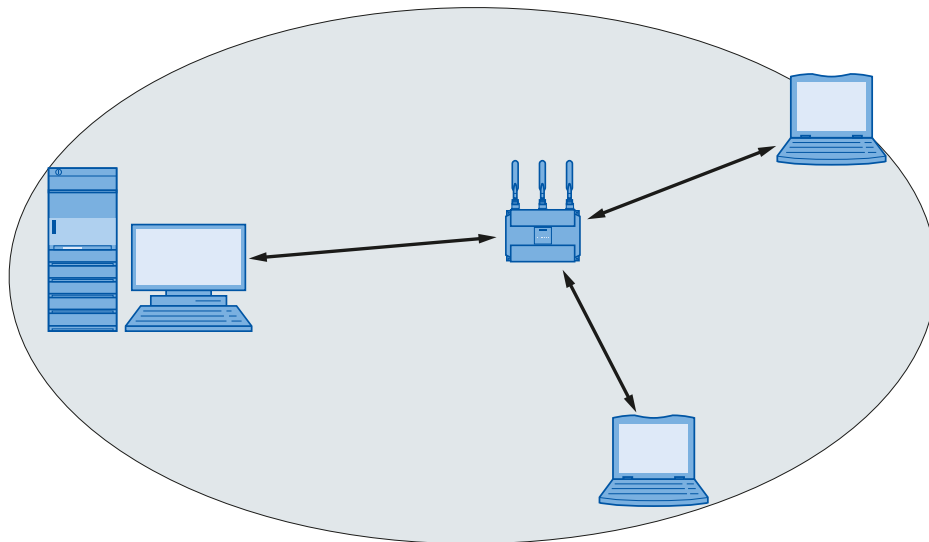
Controller-based network structure

The IWLAN controller SCALANCE WLC711 allows central management of up to 64 controller-based access points. The IWLAN controller automatically recognizes new access points, establishes the connection to them and manages and coordinates both access points and clients. Due to the layer 3 architecture, access points are also managed that are located in various layer 2 subnets. This function allows wireless expansion of an existing Ethernet network without changes being necessary to the existing network structure.

With the IWLAN controller, the IWLAN Wireless infrastructure can be divided into logical, service-based networks (Virtual Network Services). Different services, security requirements and access criteria can be managed reliably and different user groups, for example administrators, commissioning engineers or visitors can use the entire wireless network.

Various applications such as Voice-over-IP (VoIP), video and Internet access can use the same infrastructure.
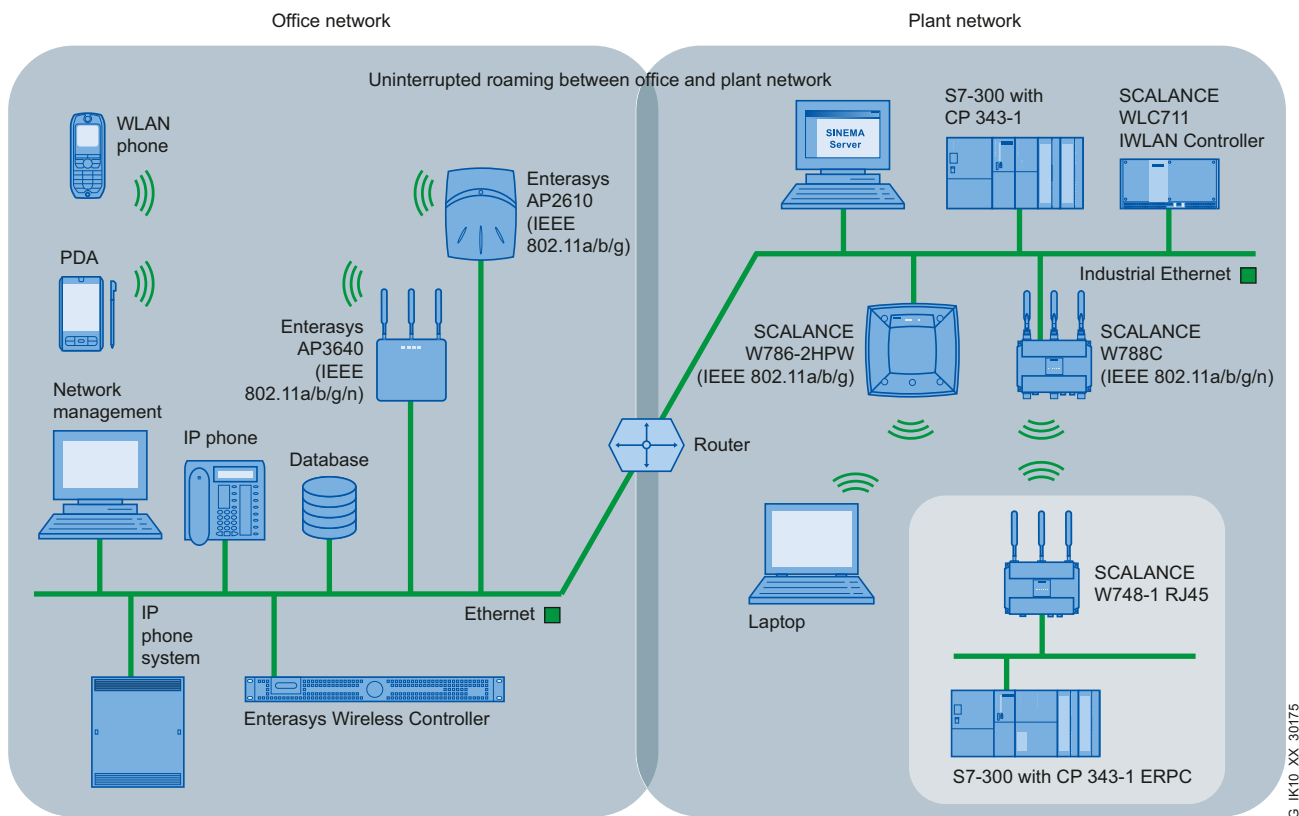
Figure 1-7   Enterprise-wide WLAN based on Enterasys Wireless Controller and SCALANCE WLC IWLAN controller

Redundant operation of two SCALANCE WLC711 devices increases the availability of the wireless network. With the IWLAN controller, only the controller-based access points of the SCALANCE W78xC series can be used.

Apart from central management and configuration of the wireless network, the IWLAN controller WLC711 also allows logging of errors, monitoring of the wireless network and documentation of network statistics.

Multichannel configuration

If neighboring SCALANCE W access points use the same frequency channel, this can lead to longer response times due to any collisions that may occur. If the configuration shown in the figure is implemented as a single-channel system, computers A and B cannot communicate at the same time with the SCALANCE W access points in their cells.

If neighboring SCALANCE W access points are set up for different frequencies, this leads to a considerable improvement in performance. As a result, neighboring cells each have their own medium available and the delays resulting from time-offset transmission no longer occur.

The channel spacing should be as large as possible; a practical value is 25 MHz. Even in a multichannel configuration, all SCALANCE W access points can be configured with the same network name.
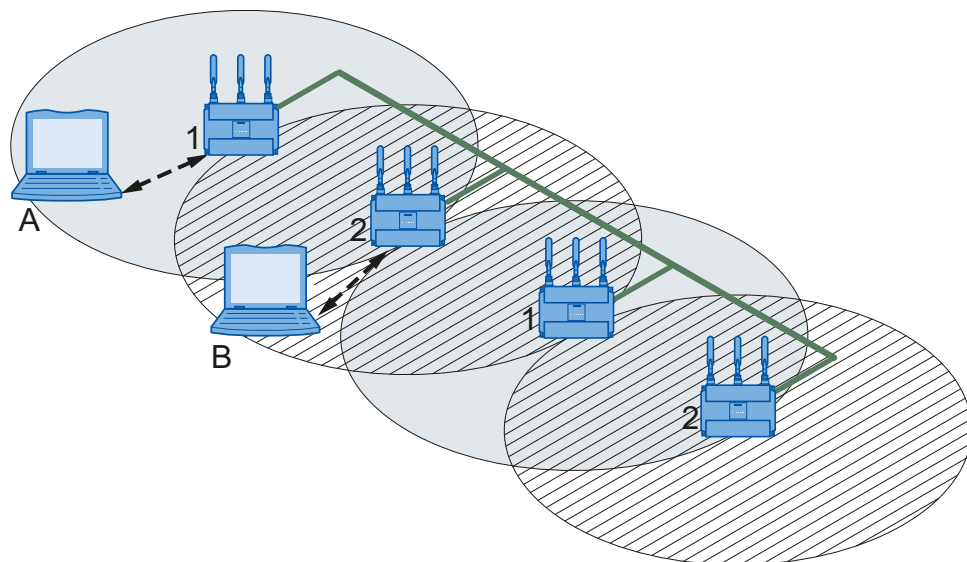
Figure 1-8   Multichannel configuration on channels 1 and 7 with four SCALANCE W access points

Wireless Distribution System (WDS)

WDS allows direct connections between SCALANCE W access points and or between SCALANCE W and other WDS-compliant devices. These are used to create a wireless backbone or to connect an individual SCALANCE W to a network that cannot be connected directly to the cable infrastructure due to its location.
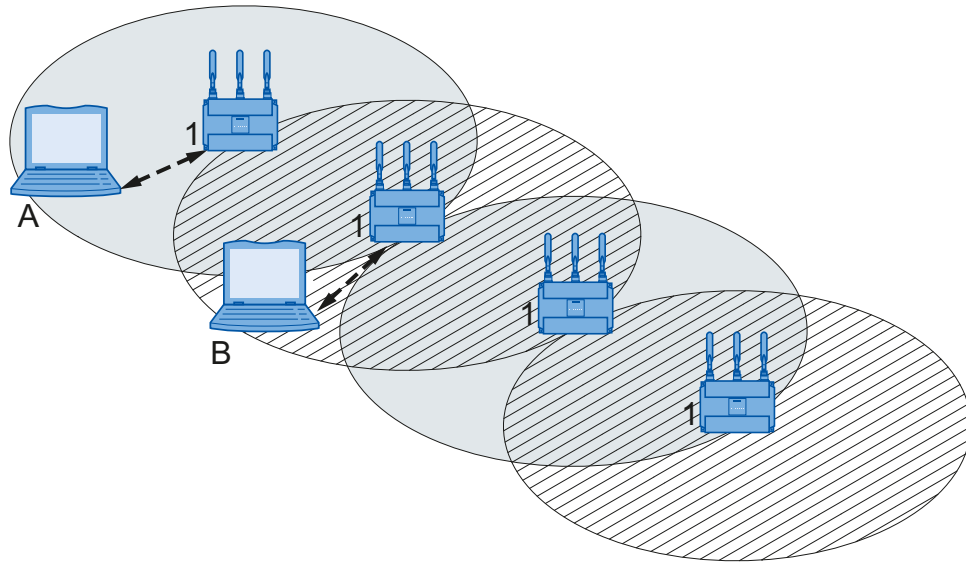
Figure 1-9   Implementation of WDS with four SCALANCE W access points

Redundant Wireless LAN (RWLAN)

RWLAN allows a redundant, wireless connection between two SCALANCE W access points with at least two WLAN interfaces. This is used to set up a redundant wireless backbone that cannot be implemented as a wired network due to its location but nevertheless has high demands in terms of availability.
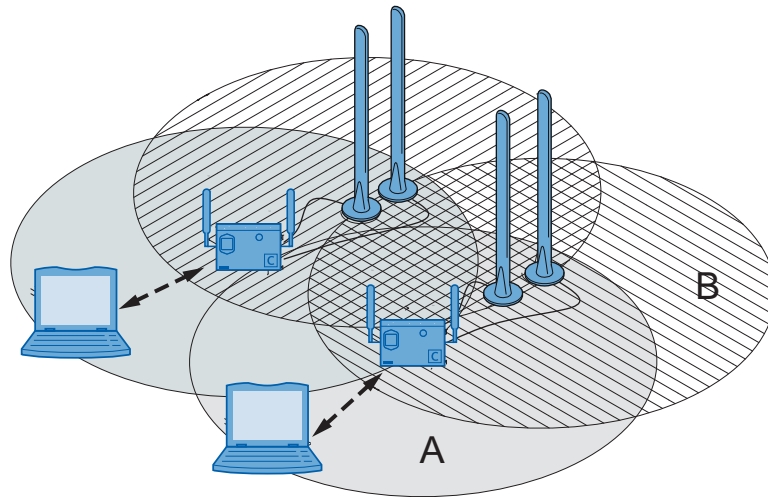
Roaming

Clients moving between wireless cells: "Roaming"

To allow mobile nodes to be able to roam seamlessly from one access point to the next, the individual wireless cells must overlap. This is transparent for the application. The access points need to be interconnected via Industrial Ethernet or a wireless distribution system (WDS).
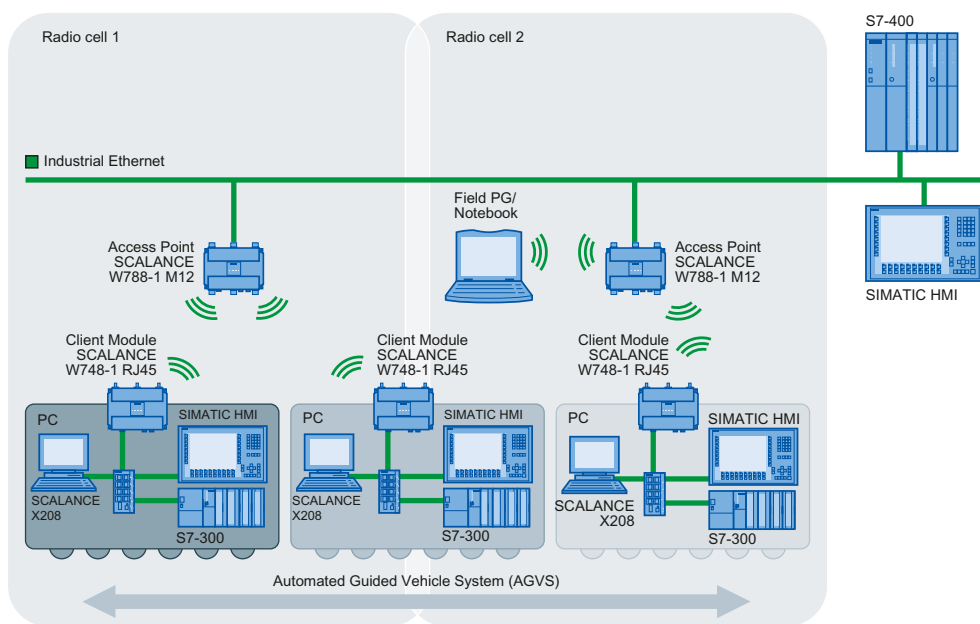
The figure above shows how a moving node (in this case an automated guided vehicle system) is handed over between two wireless cells: The client module runs regular scans of the wireless signals on all the channels stipulated by the standard being used. The client module then connects to the access point with the channel on which it finds the best reception. If the limit between wireless cell 1 and wireless cell 2 is reached, the connection to the access point of wireless cell 1 is terminated. From this time on, the access point of wireless cell 2 is responsible for the client module.

The time required for the change (handover time) is in the order of 100 ms. A significant reduction in handover times can be achieved with Rapid Roaming using the iPCF method ("industrial Point Coordination Function"). Both the access point and client must support Rapid roaming, for example SCALANCE W788-1RR and W788-2RR.

1.6.9.2 Ad hoc networks

Ad hoc networks

In ad hoc mode, nodes communicate with each other directly (connection 4) without involving an access point. The nodes access common resources (files or even devices, for example printers) of the server (connections 1 to 3 in the figure). This is, of course, only possible if the nodes are located within the wireless range of the server or are within each other's wireless range. Ad hoc networks can only be operated with the 802.11 "b" standard.
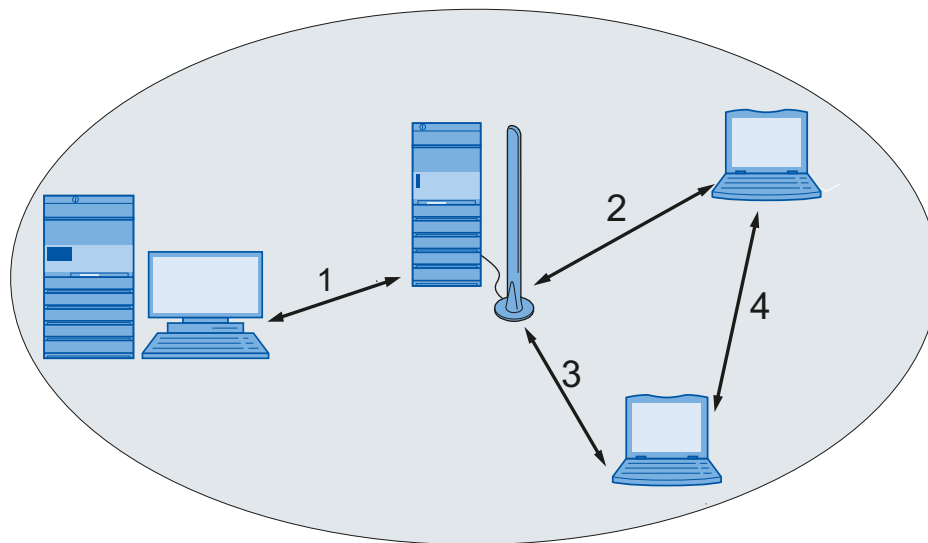
As an alternative, wireless networks can be configured in "infrastructure mode".

1.6.10   Other wireless technologies

Industrial Wireless Control

Industrial wireless control is the connection of widely distributed process stations to one or more central control systems. Various wireless methods are used for the communication required for monitoring and control. This makes service possible on installations without fixed telephone lines. An Internet access is also not necessary for the installation.

* GPRS

  The General Packet Radio Service (GPRS) is a mobile wireless technology for packet-switched data transmission via GSM networks (Global system for mobile communications). The GSM wireless channels are divided into eight time slots. One time slot represents one transmission channel.
  Packet-switched data transmission means that in contrast to line-switched data transmission (as with GSM), no transmission channel is reserved permanently. The sender divides the message into individual packets with additional information (packet sequence, recipient address). With the aid of the GPRS system, the packets are forwarded through various time slots of the network. This makes it possible to use free capacity. A GPRS session can also use several time slots at the same time. The recipient then puts together the packets in the correct order. GPRS allows data exchange without connection establishment and billing only according to the transferred amount of data. Packet switching is made possible by IP technology. GPRS is used mainly for access in IP-based networks, for example the Internet.

* EGPRS

  The Enhanced General Packet Radio Service (EGPRS) is an expansion of GPRS and is also known as Enhanced Data Rates for GSM Evolution (EDGE). EGPRS uses a different modulation technique (8-PSK) from GPRS that is more efficient. This means that a data rate up to four times faster can be achieved with EGPRS.

* UMTS

  UMTS is the acronym for Universal Mobile Telecommunications System and is also known as a mobile wireless standard of the third generation (3G). The maximum transmission rate is 384 kbps.

WirelessHART

HART (Highway Addressable Remote Transducer) is the wireless connection of field devices in process automation for advanced diagnostics.

WirelessHART also uses the ISM frequency band (2.4 GHz and with maximum of 250 kbps) and automatically establishes meshed networks. The span of the network is greater than the nominal wireless range of an individual node. The network organizes itself by having all the connection information evaluated by a network manager. With this information, redundant paths are made available automatically that can bridge the failure of individual nodes. The main focus during the development of WirelessHART was simple commissioning and maintenance of the self-organizing networks so that configuration involved only minimum effort. The main area of application of WirelessHART is in the regular transmission of small, non time critical-amounts of data at long intervals over relatively long distances. Thanks to the low energy consumption, battery working lives of several years are achieved.

Network structures and network configuration

2

2.1 Network structures

2.1.1 Network topologies

Network topologies are oriented according to the requirements of the equipment to be networked. The most common topologies include bus, star and ring structures. In practice, plants usually consist of mixed structures. These can be implemented both with electrical cables as well as with optical cables (fiber-optic cables).

Glass fiber-optic cables are used for long distances. For short distances, plastic fiber-optic cables such as Polymer Optic Fiber (POF) or plastic covered glass fibers such as Polymer Cladded Fiber (PCF) can be used.

2.1.2 Linear structure

Linear bus

The linear bus is the simplest network structure. It is characterized by a network backbone to which the individual nodes are connected directly or over a branch (only one node is permitted per branch).

- The advantage of the linear bus topology is its simple setup and low hardware investment. It is suitable, for example, for networking of rigidly linked machines over a wide area as found in assembly lines.

- The disadvantages of bus topologies are that the resources are not put to optimum use and that there is no redundancy: A break on the cable at any point cannot be bridged. Connecting the ends of the linear bus, on the other hand, creates a ring with which these disadvantages can be avoided.
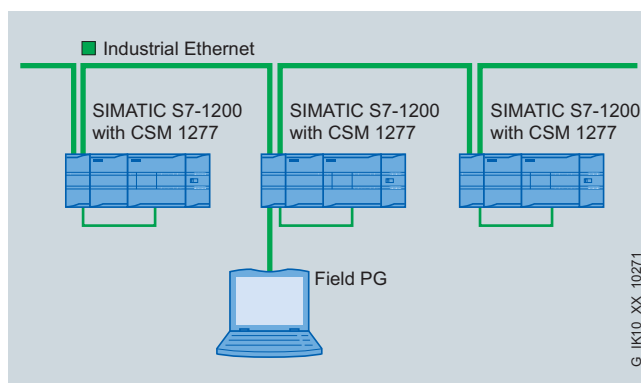
Figure 2-1   Linear bus network topology based on the example of Industrial Ethernet

A further restriction for networks with a linear bus structure is the physical arrangement of the network nodes. Depending on their position, the backbone may need take long detours which may, in turn, lead to problems with frame delay times. In a linear network topology, the network components such as switches typically have only one or few connection points for network nodes. Linear bus structures can also be created with devices with two integrated network interfaces.

Setup

The bus structure can be implemented with SCALANCE X switches. Any TP ports can be used to cascade and form a linear bus. The number of SCALANCE X switches that can be cascaded depends on the response times of the applications operating over this linear bus.

- Electrical cables

  There may be a maximum distance of 100 m between two of these devices.

- Optical cables

  At 100 Mbps, the maximum distance between 2 devices can be as follows:

  – Multimode, glass, up to max. 5 km

  – LD: Single mode, glass up to max. 26 km

  – LH+: Single mode, glass up to max. 70 km

  At 1 Gbps, the maximum distance between 2 devices can be as follows:

  – Multimode, glass, up to max. 750 m

  – LD: Single mode, glass up to max. 10 km

  – LH: Single mode, glass up to max. 40 km

  – LH+: Single mode, glass up to max. 70 km

  – ELH: Single mode, glass up to max. 120 km

See also

SCALANCE X100 unmanaged (Page 110)

2.1.3 Star structure

"Star"

The difference between the star topology and linear bus topology is that one switch functions as the central node from which the spokes branch off to the individual nodes. The individual nodes of the network therefore have separate point-to-point links with the active network component (i.e. with the switch).

The immediate effect is that the messages only run via the spokes between sender and recipient, in other words network performance improves significantly because several nodes can communicate at the same time.

In practice, these may be a mixture of fiber-optic and twisted-pair cables depending on what is required of the individual links. Typical applications are Ethernet office networking or the networking of production cells in manufacturing with Industrial Ethernet.
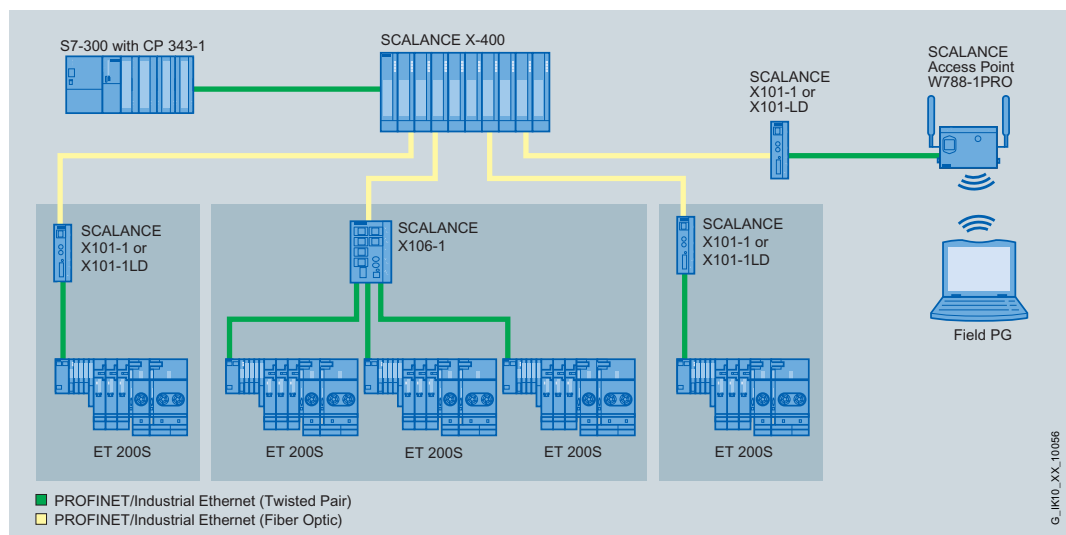
Figure 2-2   Star topology based on the example of Industrial Ethernet with a gateway to Industrial Wireless LAN

- The use of a switch optimizes data throughput in the network. Messages are transferred only on the star segments between sender and recipient and the segments of the other nodes remain unaffected by them. If a node fails, the communication between the other network nodes remains intact.

- Compared with ring or linear bus structures, however, the investment in cabling increases considerably due to the long distances back to the star center.

Typical use cases for star networks are switching cubicles, individual machines or manufacturing cells.

Examples of simple star structures
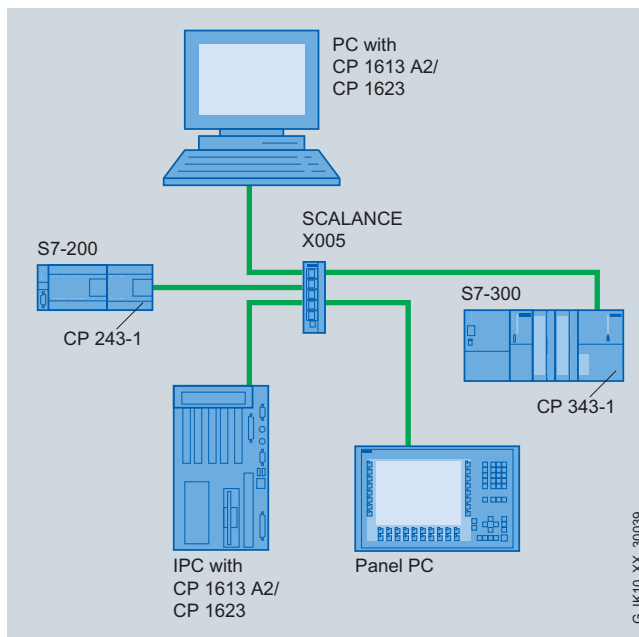
Figure 2-3   Star structure with SCALANCE X005

The number and technology of the connections to the end nodes (electrical/optical) depends on the number of relevant ports on the switch: In the example above, the SCALANCE X005 can support five 10/100 Mbps cables with RJ-45 connectors and no fiber-optic connections.

With an FC TP standard cable, the end nodes can be located up to 100 m from the switch.
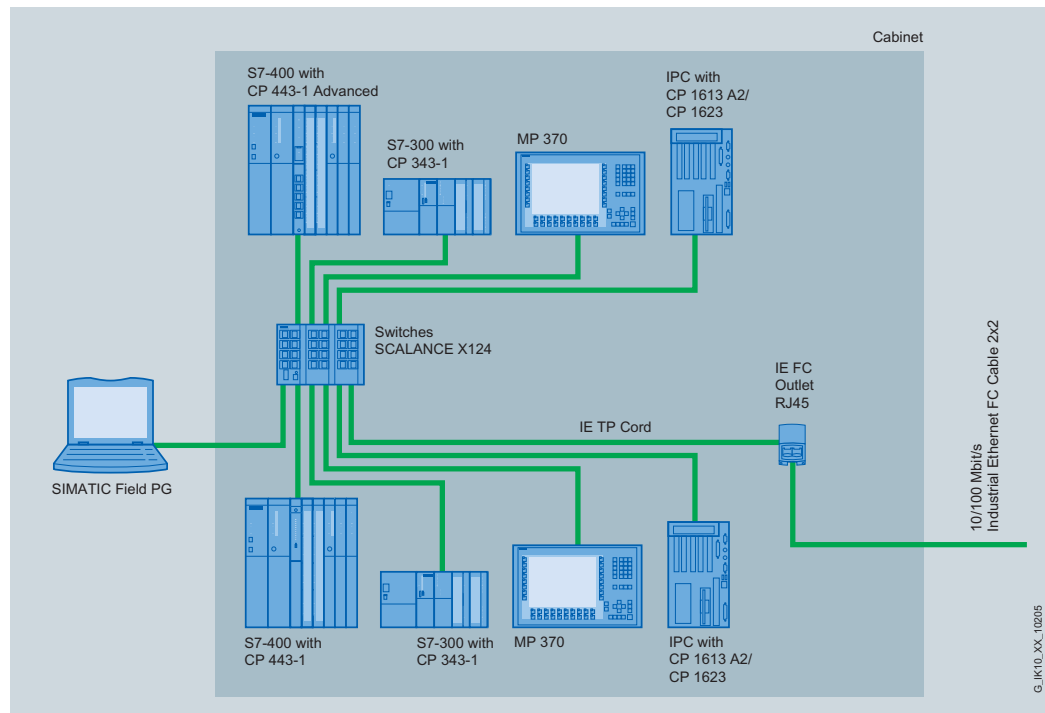
Figure 2-4   Star network structure with SCALANCE X124

More complex network structures can be set up by using switches with a higher number of ports. (In the example above, a SCALANCE X124 with 24 electrical ports.) In terms of the numbers of nodes and the physical span of the network, this is practicable only up to a certain limit.

If more extensive networks need to be configured, it is advisable to use more switches and the extra subnets that result.

See also

SCALANCE X005 (Page 106)

SCALANCE X100 unmanaged (Page 110)

2.1.4   Ring structure

"Ring"

If the ends of a bus are connected via an additional connection, this results in a ring structure. The switches connected together in a ring do not need to be interconnected only with FO cables or only electrical cables. A mixed electrical-optical ring is also permitted.

A special redundancy mechanism ensures that the ring structure remains a logical bus in normal situations and prevents frames from circulating. If a section of the ring fails, the mechanism quickly makes a substitute path available in the ring: The message now travels the long way round via the intact network section instead of over the direct interrupted path and reaches its recipient via this detour. The network does not break down into two segments.
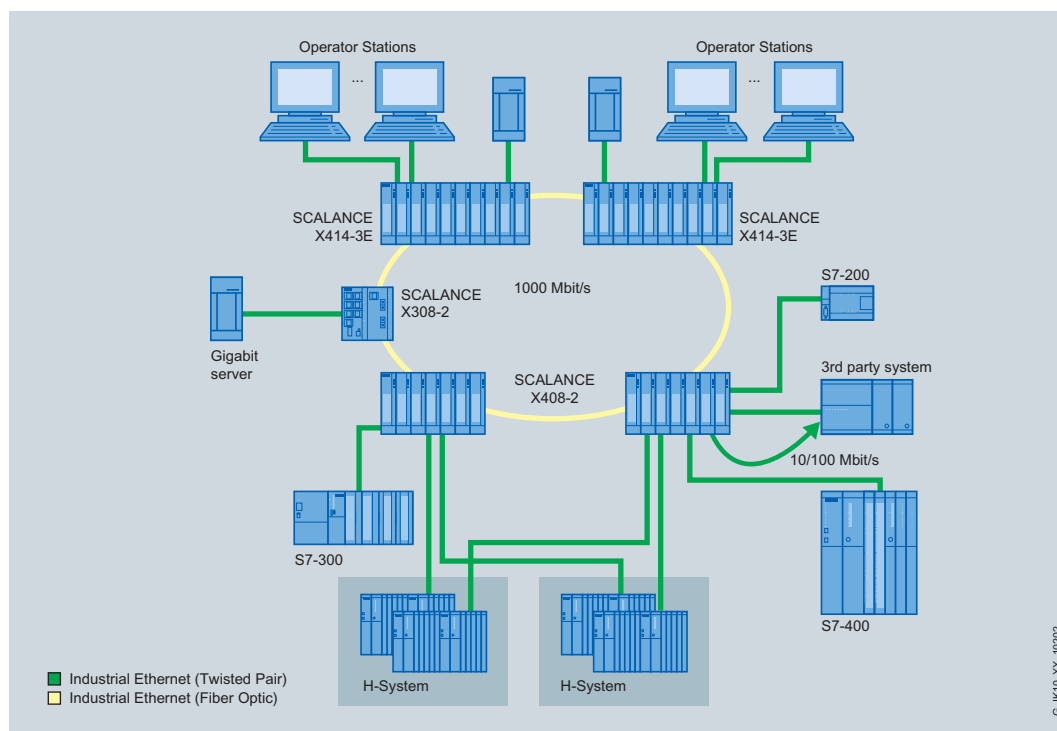
Figure 2-5   Ring topology based on the example of Industrial Ethernet with glass fiber-optic cables

● The effects of a network component being disrupted are restricted to the failed component and to the end devices connected to it. If a ring section is interrupted, for example by a cable break, communication continues without any disruption.

The reconfiguration time is faster here than in the office world and meets the requirements of the automation world.

Example: Structure of a redundant network with SCALANCE X switches

With the aid of a redundancy manager (RM), the two ends of a bus can be closed to form a redundant ring. All the media converters SCALANCE X100/200/300/400 and X500 devices can be used in this ring. The role of the RM can be handled by the SCALANCE X200/X300/400 and X500 devices.

The RM monitors the line connected to it, if there is an interruption, it closes the ring and restores a functioning bus configuration. A maximum of 50 of the SCALANCE X devices mentioned above are permitted in an optical ring. Here, a reconfiguration time of less than 0.3 seconds is achieved. The RM mode on the SCALANCE X devices is configured in the software. The maximum length of the fiber-optic cable between two devices is 3000 m for multimode fiber and 200 km for single mode fiber. This means that a maximum of 150 km (multimode) can be achieved for the entire optical ring consisting of 50 switches.
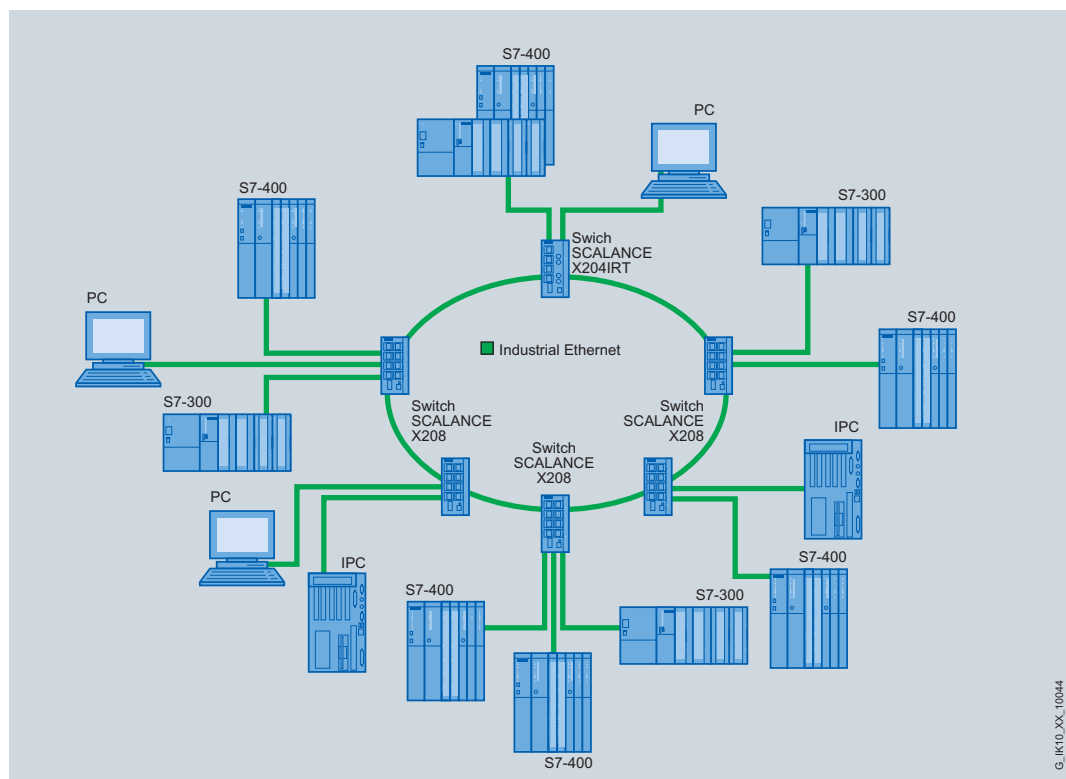
Figure 2-6   SCALANCE X: Configuration with high-speed redundancy in the electrical ring

See also

Network topologies (Page 55)

SCALANCE X500 (Page 142)

2.1.5 Redundant linking of network segments with electrical and FO components

General

SCALANCE X switches support not only ring redundancy within a ring but also redundant linking of several rings or open network segments (linear bus). In the redundant link, two rings are connected together over two Ethernet connections. This is achieved by configuring a master/slave device pair in one ring so that the devices monitor each other and, in the event of a fault, redirect the data traffic from the normally used master Ethernet connection to the substitute (slave) Ethernet connection.

Standby redundancy
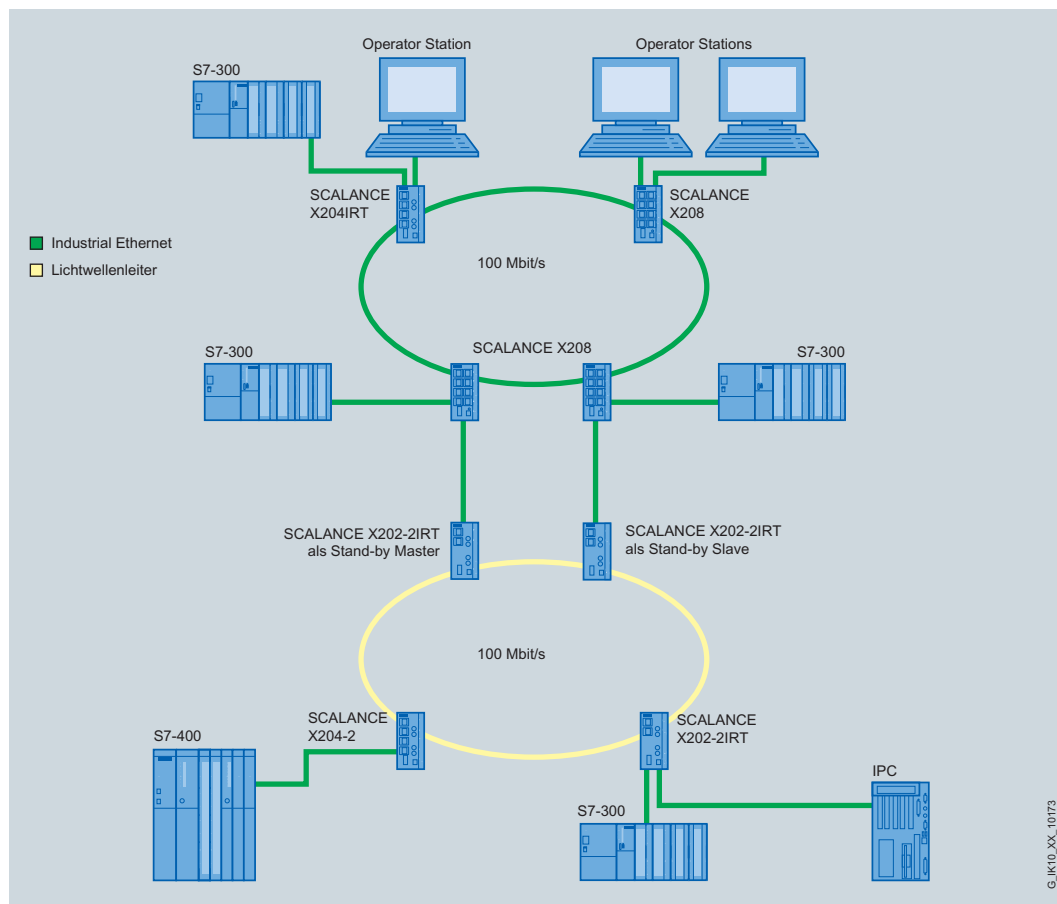
Figure 2-7   Example of redundant linking of two SCALANCE X-200 IRT rings

For a redundant link as shown in the figure, two devices must be configured as standby redundancy switches within a network segment. Here, network segments are rings with a redundancy manager (RM, in the example, the SCALANCE X202-2IRT switches). Instead of rings, network segments might also be linear.

The two X202 devices connected in the configuration exchange data frames with each other to synchronize their operating statuses (one device is master and the other slave). If there are no problems, only the link from the master to the other network segment is active. If this link fails (for example due to a link-down or a device failure), the slave activates its link as long as the problem persists.

See also

SCALANCE X200/X200 IRT (Page 118)

SCALANCE X300 (Page 125)

SCALANCE X400 (Page 134)

2.1.6 VLAN

Virtual Local Area Network

VLANs are virtual network segments in a physical network that are assigned to the nodes during configuration. In contrast to the physical network, a VLAN is not spatially restricted. This allows nodes to be put together in logical groups according to their function (VLAN groups). VLANs can be set up without modifying the physical network.

SCALANCE X and SCALANCE W support port-based VLAN. For the parameter assignment of the VLANs, a VLAN ID is assigned to the individual ports of a SCALANCE device. Multicast and broadcast frames are possible only within the boundaries created by the logical network structure; in other words, between ports with the same VLAN ID.

This segmentation not only reduces network load because broadcasts can be limited to a practical number of end systems. VLANs also increase the security of a network since no node can listen in any longer on the data traffic of other nodes unless they are a member of this VLAN.

To identify which packet belongs to which VLAN, the Ethernet frame is expanded by 4 bytes (VLAN tagging). This expansion includes not only the VLAN ID but also priority information.

2.2 Media redundancy

2.2.1 Options of media redundancy

There are various options available to increase the network availability of an Industrial Ethernet network with optical or electrical linear bus topologies:

- Mesh networks
- Parallel connection of transmission paths
- Closing a linear bus topology to form a ring topology

2.2.2 Media redundancy in ring topologies

Structure of a ring topology

Nodes in a ring topology can be external switches and/or the integrated switches of communications modules.

To set up a ring topology with media redundancy, you bring together the two free ends of a linear bus topology in one device. Closing the linear bus topology to form a ring is achieved with two ports (ring ports) of a device in the ring. This device is the redundancy manager. All other devices in the ring are redundancy clients.
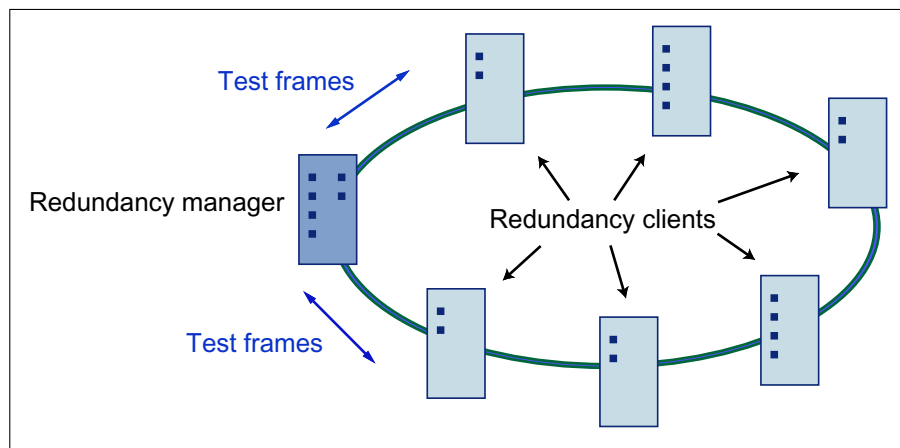
Figure 2-8   Devices in a ring topology with media redundancy

The two ring ports of a device are the ports that establish the connection to its two neighboring devices in the ring topology. The ring ports are selected and set in the configuration of the relevant device. In STEP 7 and on the S7 Ethernet CP modules themselves, the ring ports are indicated by an "R" after the port number.

Note

Before physically closing the ring, download the configuration of your STEP 7 project to the individual devices.

How media redundancy works in a ring topology

When using media redundancy, the data paths between the individual devices are reconfigured if the ring is interrupted at one point. Following reconfiguration of the topology, the devices can once again be reached in the resulting new topology.

In the redundancy manager, the 2 ring ports are disconnected from each other if the network is uninterrupted. This prevents circulating data frames. In terms of data transmission, the ring topology is a linear bus topology. The redundancy manager monitors the ring topology. It does this by sending test frames both from ring port 1 and ring port 2. The test frames run round the ring in both directions until they arrive at the other ring port of the redundancy manager.

An interruption of the ring can be caused by loss of the connection between two devices or by failure of a device in the ring.

If the test frames of the redundancy manager no longer arrive at the other ring port, the redundancy manager connects its two ring ports. This substitute path once again restores a functioning connection between all remaining devices in the form of a linear bus topology.

The time between the ring interruption and restoration of a functional linear topology is known as the reconfiguration time.

If the redundancy manager fails, the ring becomes a functional linear bus.

Media redundancy methods

The following media redundancy methods are supported by SIMATIC NET products:

- HSR (High Speed Redundancy)

  Reconfiguration time: 0.3 seconds

- MRP (Media Redundancy Protocol)

  Reconfiguration time: 0.2 seconds

The mechanisms of these methods are similar. With both methods, up to 50 devices can participate in the ring. HSR and MRP cannot be used in the ring at the same time.

If you want to introduce media redundancy in a ring topology in your STEP 7 project, select MRP.

2.2.3   MRP

The "MRP" method conforms to the Media Redundancy Protocol (MRP) specified in the following standard:
IEC 62439-2 Output 1.0 (2010-02) Industrial communication networks - High availability automation networks Part 2: Media Redundancy Protocol (MRP)

The reconfiguration time after an interruption of the ring is a maximum of 0.2 seconds.

Requirements

Requirements for problem-free operation with the MRP media redundancy protocol are as follows:

- MRP is supported in ring topologies with up to 50 devices. Exceeding this number of devices can lead to a loss of data traffic.

- The ring in which you want to use MRP may only consist of devices that support this function.

  These include, for example, some of the Industrial Ethernet SCALANCE X switches, some of the communications processors (CPs) for SIMATIC S7 and PG/PC or non-Siemens devices that support this function.

- All devices must be interconnected via their ring ports.

- "MRP" must be activated on all devices in the ring (see "MRP configuration in PROFINET IO").

- The connection settings (transmission medium / duplex) must be set to full duplex and at least 100 Mbps for all ring ports. Otherwise there may be a loss of data traffic.

  To do this, set all the ports involved in the ring to "Automatic settings" in the "Options" tab of the properties dialog during STEP 7 configuration.

Topology

The following schematic shows a possible topology for devices in a ring with MRP.

1:	S7-400 with CP 443-1 Advanced	6:	HMI station
2:	SCALANCE X206-1 switch	7:	Engineering station
3:	PC with CP 1616	8:	ET 200S
4, 5:	S7-300 with CP 343-1 Advanced	9:	ET 200M
		10:	ET 200pro
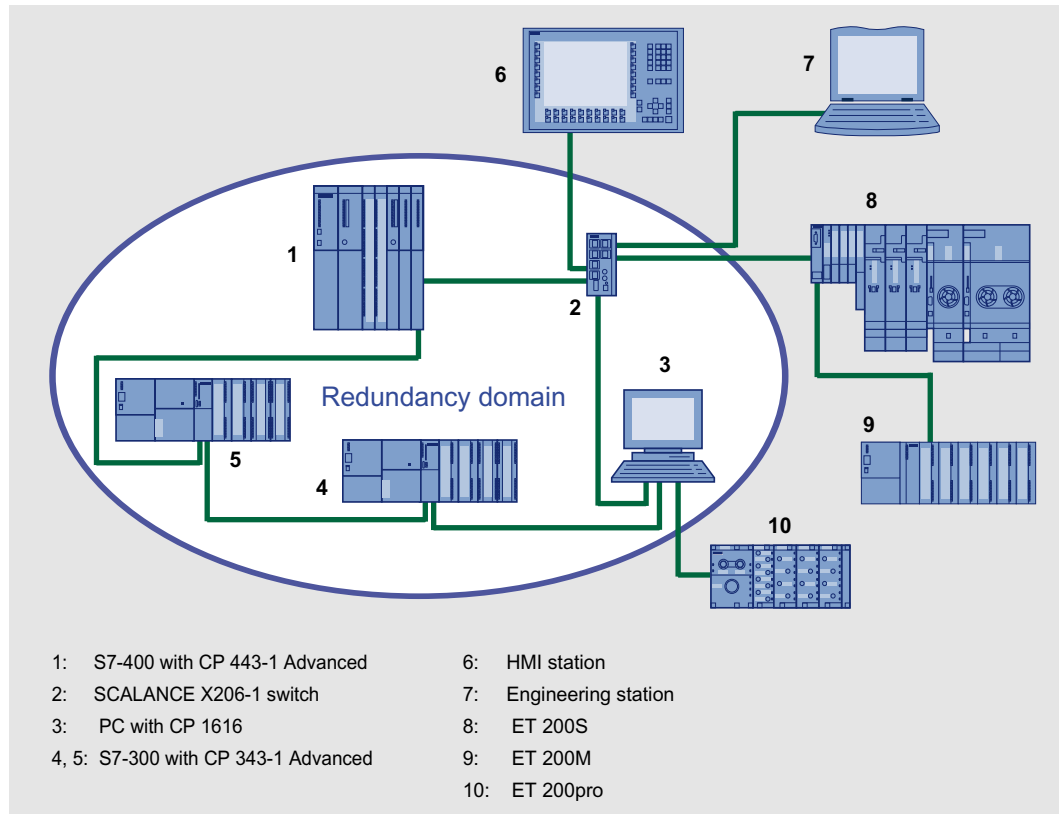
Figure 2-9   Example of a ring topology with the MRP media redundancy protocol

The following rules apply to a ring topology with media redundancy using MRP:

● All the devices connected within the ring topology are members of the same redundancy domain.

● One device in the ring is acting as redundancy manager.

● All other devices in the ring are redundancy clients.

Non MRP-compliant devices can be connected to the ring via a SCALANCE X switch or via a PC with a CP 1616.

Prioritized startup

If you configure MRP in a ring, you cannot use the "prioritized startup" function in PROFINET applications on the devices involved.

If you want to use the "prioritized startup" function, then disable MRP in the configuration.

In the STEP 7 configuration, set the role to "Not a node in the ring".

2.2.4　MRPD

MRPD - Media Redundancy with Planned Duplication

The MRPD procedure is specified in IEC 61158 Parts 5 and 6 type 10 "PROFINET". It allows bumpless redundant linking of devices.

The cyclic IRT frames are duplicated and the PROFINET devices connected to the ring send their data in both directions. The devices receive this data at both ring ports and this reduces the reconfiguration time of the ring. As with MRP, a redundancy manager prevents circulating data frames.

Requirements

- Devices with ERTEC hardware support.
  - SCALANCE X-200IRT as of firmware version 5.0
- STEP 7 as of version V5.5 SP1

2.2.5　HSR

HSR - High Speed Redundancy

HSR is the name of a redundancy method for networks with a ring topology. The switches are interconnected via ring ports. One of the switches is configured as the redundancy manager (RM). The other switches are redundancy clients. Using test frames, the redundancy manager checks the ring to make sure it is not interrupted. The redundancy manager sends test frames via both ring ports and checks that they are received at the other ring port. The redundancy clients forward the test frames.

If the test frames of the RM no longer arrive at the other ring port due to an interruption, the RM switches through its two ring ports and informs the redundancy clients of the change immediately.

Standby redundancy

Standby redundancy is a method with which several rings each of which is protected by high-speed redundancy can be linked together redundantly. In the ring, a master/slave device pair is configured and these monitor each other via their ring ports. If a fault occurs, the data traffic is redirected from one Ethernet connection (standby port of the master or standby server) to another Ethernet connection (standby port of the slave)

Requirements

- HSR is supported in ring topologies with up to 50 devices. Exceeding this number of devices can lead to a loss of data traffic.

- The following devices support HSR:

  - SCALANCE X400, SCALANCE X300, SCALANCE X200

- All devices must be interconnected via their ring ports.

2.2.6 RNA / PRP

Redundant Network Access (RNA)

In Siemens Industry, RNA stands for devices and software that support the PRP redundancy protocol. Suitable devices have "RNA" appended to their names.

A device with RNA capability is used to connect devices not capable of redundancy to redundant networks. This makes the use of PRP possible for end devices even if the device itself does not have PRP capability. Devices with RNA capability are located in two independent networks with the same MAC and IP address.

Parallel Redundancy Protocol (PRP)

The basis of the PRP redundancy method (IEC 62439-3) is the transmission of the frames via two different networks. PRP is only possible when two end devices are connected via two independent networks (LAN A and LAN B). Each of these end devices is represented in both networks with the same MAC and IP address. The two networks can be made up of standard components and only one of the two end components needs to be capable of RNA, for example SCALANCE X204RNA.

At the sender end, the SCALANCE X204RNA duplicates the frame coming from the sender. The frame is then sent on LAN A and LAN B.

At the receiving end, the SCALANCE X204RNA forwards the first frame to arrive to the addressee. The second frame is discarded. This achieves N-1 redundancy without reconfiguration (= bumpless switchover).

If there is a disruption, only one frame arrives at the SCALANCE X204RNA. This means that at least one of the two frames sent simultaneously arrives unless both networks are disrupted. This means that there is no reconfiguration time of the network.

2.2.7 STP / RSTP / MSTP

Spanning Tree Protocol (STP)

STP (IEEE 802.1D standard) is the method with which loops are prevented in redundant network structures.

With this method, it is not end devices that know the path from the sender or recipient, but rather the switches. The switches continuously exchange configuration frames with each other known as BPDUs (Bridge Protocol Data Unit). Due to the MAC addresses of the packets passing through, the switches get to know the topology of the network independently. The network is considered to be a tree.

Sequence

After initialization of the switches, a root bridge is selected. Each switch has an ID that it passes on to the group. The switch with the lowest bridge ID becomes the root bridge.

All other paths are decided by this root bridge. The other switches select one of their ports as a root port in the direction of the root bridge. This selection is also made using BPDUs that the root bridge sends to the switches. The port of switch that receives the BPDU of the root bridge first adopts the status of root port.

The designated ports are selected from the remaining ports connected to another switch. This is also done by sending BPDUs. This time the switches send frames to the connected partners. The port via which the frame reaches the recipient quickest becomes the designated port.
The other port is deactivated. If there is a disruption or device failure, the network needs to be reconfigured. The devices start to negotiate new paths only when the interruption occurs. This can take up to 30 seconds.

Rapid Spanning Tree Protocol (RSTP)

RSTP (IEEE 802.1D-2004 standard) is a further development of STP. RSTP differs from STP essentially in that the devices are already collecting information about alternative routes during normal operation and do not need to gather this information after a disruption has occurred. This allows the reconfiguration time for an RSTP-controlled network to be reduced to less than 1 second.

This was achieved by the following functions:

*   Edge ports

    A port that is defined as an edge port is activated immediately after connection establishment. If a BPDU is received at an edge port, the port loses its role as edge port and takes part in RSTP again. If no further BPDU is received after a certain time has elapsed (3 x hello time), the port returns to the edge port status.

*   Point-to-point (direct communication between two neighboring devices)

    By directly linking the devices, a status change (reconfiguration of the ports) can be made without any delays.

- Alternative port (substitute for the root port)

  A substitute for the root port is configured. If the connection to the root bridge is lost, the device can establish a connection over the alternate port without any delay due to reconfiguration.

- Reaction to events

  A Rapid Spanning Tree reacts to events, such as a connection abort, without delay. There is no waiting for timers as in spanning tree.

- Counter for maximum number of bridge hops

  The number of bridge hops a package is allowed to make before it automatically becomes invalid.

In principle, therefore with rapid spanning tree, alternatives for many parameters are preconfigured and certain properties of the network structure taken into account to reduce the reconfiguration time.

Multiple Spanning Tree Protocol (MSTP)

MSTP is a further development of RSTP. MSTP is defined in the IEEE 802.1s standard, subsequently IEEE 802.1Q.

Among other things, it provides the option of operating several RSTP instances or VLAN groups within different virtual networks (VLAN - Virtual Local Area Network) so that; for example; paths that would block the simple Rapid Spanning Tree Protocol for data traffic globally can be available within individual VLANs.

2.2.8 Link aggregation

Link aggregation

With link aggregation, several parallel physical connections with the same transmission speed are grouped together to form a logical connection with a higher transmission rate. This method based on IEEE 802.3ad is also known as port trunking or channel bundling.

Link aggregation works only with full duplex connections with the same transmission rate in point-to-point mode. This achieves multiplication of the bandwidth or transmission rate. If part of the connection fails, the data traffic is handled via the remaining parts of the connection.

To control and monitor, the Link Aggregation Control Layer (LACL) and the Link Aggregation Control Protocol (LACP) are used.

Examples of applications

<div style="text-align: right; font-size: 2em;">3</div>

3.1 Optimization of a power screwdriver control

Task

Handheld compressed air screwdrivers are used in the final assembly of motor vehicles and they can be supplied via mobile stations on overhead monorails. These units need to be replaced by new, motor-driven screwdriver stations and the customer would like to do away with the previously necessary sliding contacts that were always subject to wear and tear.

Solution
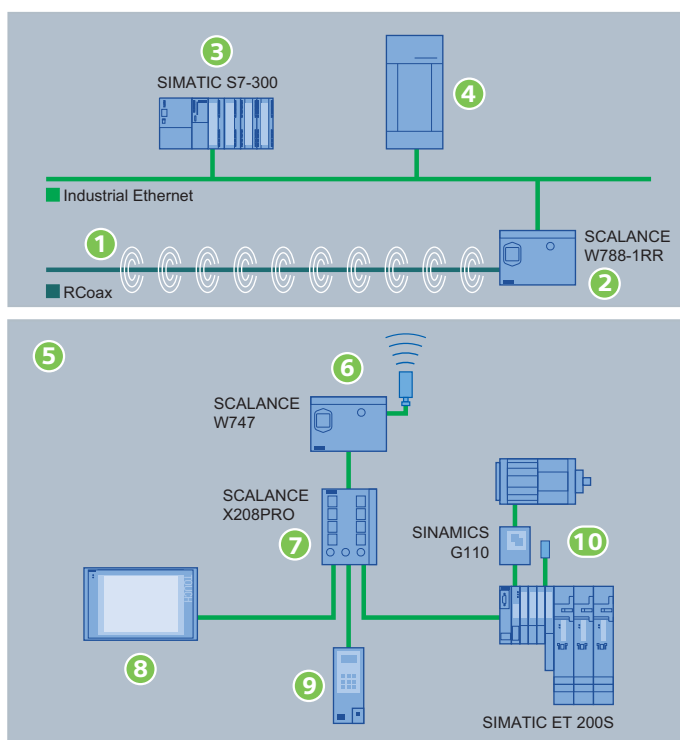
The new solution is based on Industrial Wireless LAN. To allow wireless data communication, an RCoax cable ① is laid along the path of the screwdriver stations. The RCoax cable is connected to the antenna output of a SCALANCE W788-1RR ② access point. This means that there is a defined RF field available around the RCoax cable. Via the Ethernet interface of the access point, there is a connection to the plant controller ③ and the server of the assembly line ④.

⑤ The communications partner on the screwdriver stations is a SCALANCE W747 ⑥ client module.

⑦ The data exchange with all components of the mobile station is handled by a SCALANCE X208PRO switch. The station is controlled via a panel PC ⑧ and the screwdriver controller ⑨.

⑩ The new screwdriver stations are moved by a geared motor connected via the distributed I/O.

Benefits

- Low investment costs thanks to fewer screwdriver stations.

- Reduction of maintenance costs and downtimes with reliable wireless and therefore non-wearing data transmission to mobile communications partners.

- Shorter downtimes if a fault occurs thanks to the C-PLUG (configuration plug) in the SCALANCE devices. Devices can be replaced without a programming device and without specialist personnel.

- Higher productivity and process reliability because all data of the plant controller (for example workpiece IDs, screwdriver data and assembly information) is also available directly on the screwdriver stations. Other applications for quality control are also easy to integrate.

- The SCALANCE devices used in the "RR" version are particularly rugged (for example degree of protection IP65) and are designed specifically for use in industry.

3.2   Process automation in hazardous areas

Task

The aim was to allow mobile access to the process data of the entire plant in a hazardous area (production of polyoxymethylene thermoplastic). Extremely complicated constraints had to be taken into account when interfacing to the existing PCS 7 plant. The wireless network had to work in an industrial building made of reinforced concrete with unspecified fittings over seven floors. Added to this, were the chemical load and the high temperature differences resulting from the production process.

Solution
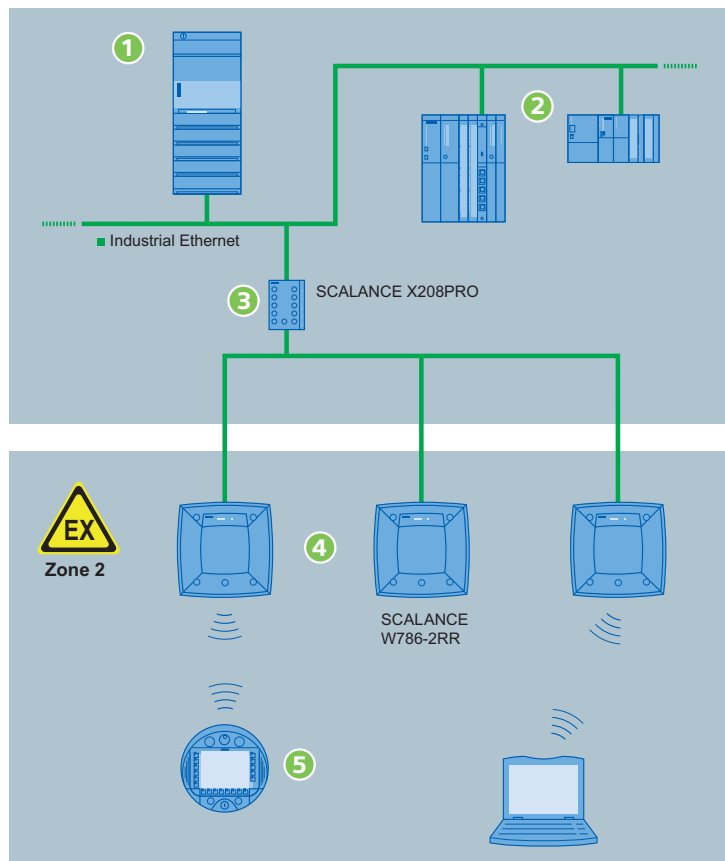
① All the SIMATIC S7-400 and SIMATIC S7-300 controllers involved in the production process are connected to the SIMATIC PCS 7 server via Industrial Ethernet.

③ A SCALANCE X208PRO controls data exchange with the access points.

④ In the hazardous area, several SCALANCE W786-2RR access points ensure stable illumination of the RF field. This device type was selected because it meets all the requirements reliably: The degree of protection IP65 in conjunction with an extended temperature range of -40 to +70 °C and the high mechanical stability providing resistance to vibration and shock ensure high availability of the entire system.

Note the information on the use of modules in hazardous area zone 2. You will find information on this including a list of approved SIMATIC modules on the Internet at: 13702947 (http://support.automation.siemens.com/WW/view/en/13702947)
Search keys: Explosion protection, Ex modules

⑤ With mobile operator stations, all the information relating to the entire plant can be called up anywhere and at any time.

Benefits

- A modular structure and scalability make any necessary expansions simpler.

- Price advantage because industrial components from SIMATIC NET meet users' requirements without them having to take any additional measures.

- Simple integration in the PCS 7 system and simple configuration of the SCALANCE components used thanks to Web-based management.

3.3 Automation of gantry cranes

Task

Two gantry cranes are used in a cold rolling mill to handle the steel coils. Fully automated and fail-safe control of these cranes is required because damage to the steel coils puts up costs considerably. The intention was to minimize maintenance effort and to reduce operating costs. The fail-safe monitoring of the 14 entrances and exits of the 16,000 m² storage area was also required.

Solution

The following graphic shows the components of the crane control ② and the interfacing of the production control system ① and the access monitoring for the open air storage area ③.
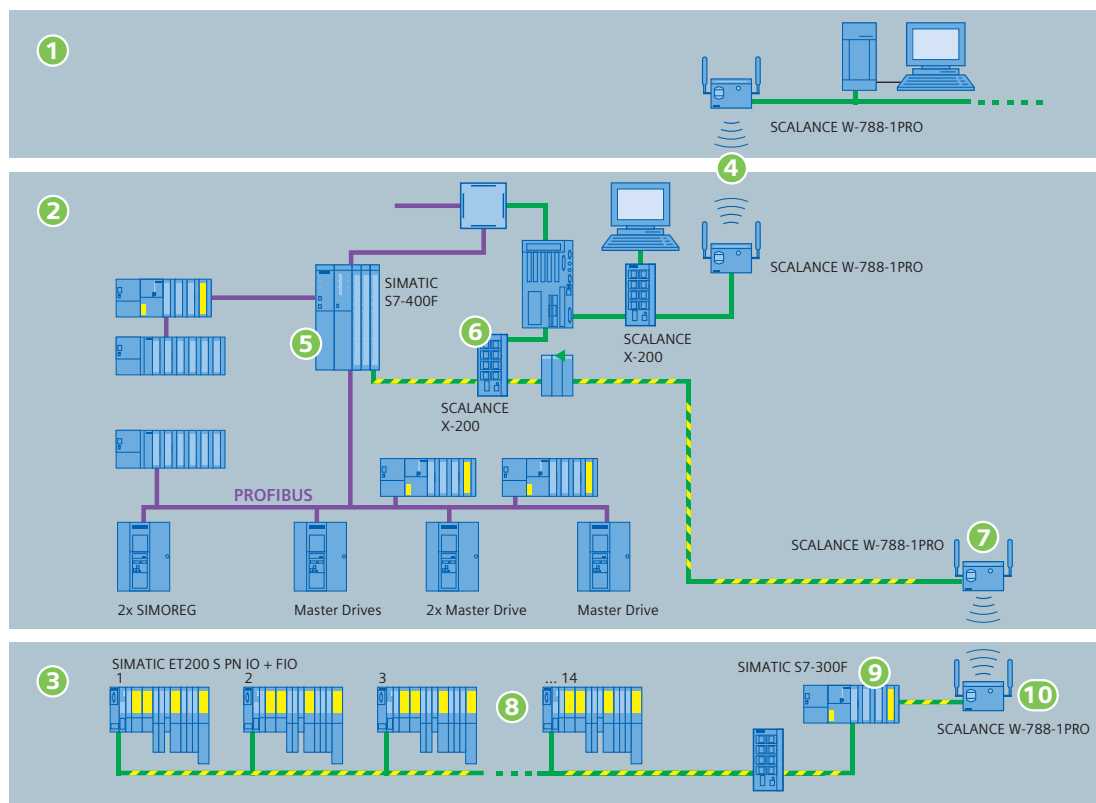
Figure 3-1   Schematic representation of the crane control

④ Data exchange between the production control system and the gantry crane is via two SCALANCE W788-1PRO access points. The use of wireless communication means that no trailing cables are required between the stationary and mobile station.

⑤ A SIMATIC S7-400F controls all crane movements (lifting, lowering, grasping, travel).

⑥ For the communication between the production control system and an access point ⑦, a SCALANCE X-200 is used. With this switch, safety-oriented data for the access monitoring is exchanged via PROFIsafe.

⑧ Each entrance/exit is monitored by an ET 200S PN IO.

A SIMATIC S7-300F processes all the data of the access monitoring and can, when necessary, stop the movement of the crane via the connected access point ⑩.

Benefits

- By using Industrial Wireless LAN, no cables need to be laid for communication.
- SCALANCE W788-1PRO access points are designed to be suitable for industry and are therefore capable of withstanding the mechanical load caused by shock and vibration when used on the crane bridges. The devices with degree of protection IP65 can be used without problems in areas subject to dampness and spray water.
- Lower operating costs thanks to maintenance-free components.
- With PROFINET and the PROFIsafe profile, safety-oriented data can also be transferred with no additional effort.

3.4 Controlling material transportation with SCALANCE components

Task

Transportation vehicles in a building need to be controlled using wireless. These vehicles move steel pipes with a weight of several tons. One important aspect was easy scalability if additional vehicles are used. Another requirement was the reliable accessibility of the vehicles in all areas of the building and high mechanical stability of the devices used on the vehicles in particular with regard to vibration.

Solution

The following graphic shows the topology of the implemented solution and the interfacing to the existing IT structure:
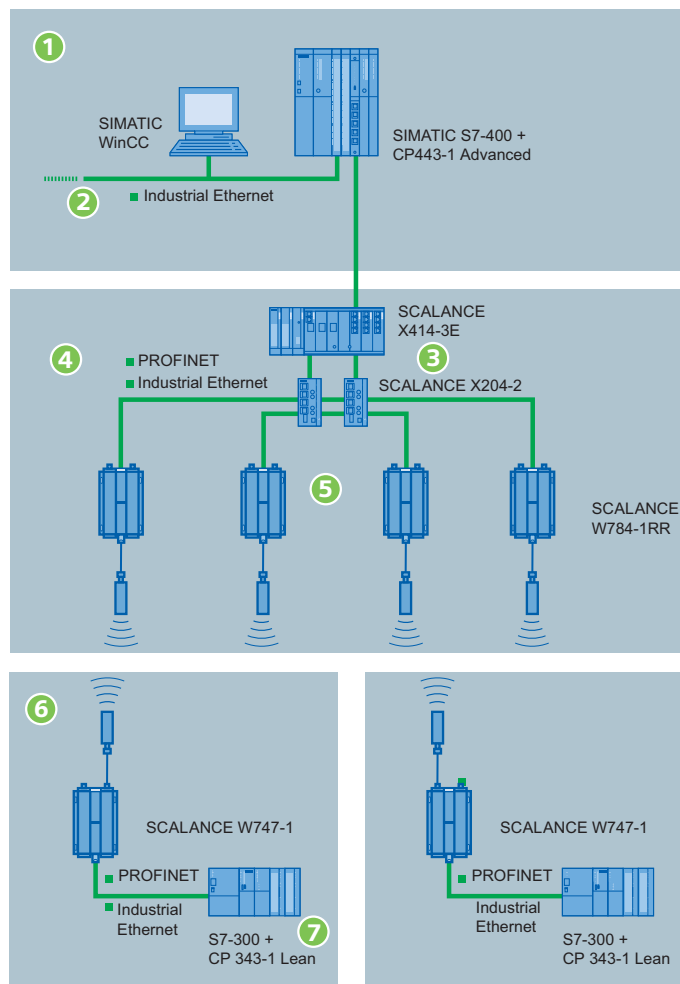
① The plant is controlled via a WinCC system that accepts user input and displays feedback from the individual system components.

② Here, controllers from other operational areas are also connected to allow synchronization of the transportation vehicles with other steps in production.

③ The data from the central controller is forwarded to the access points via Industrial Ethernet switches SCALANCE X414-3E and SCALANCE X204-2.

④ Industrial Wireless LAN is used for the wireless communication with the vehicles. In the production plant, several SCALANCE W784-1RR access points ⑤ ensure a full-coverage IWLAN RF field. iPCF can be used with these devices. This minimizes the handover times when the vehicle moves from one wireless cell to another.

⑥ To allow this, each vehicle is equipped with a SCALANCE W747-1 client module. The control information received via wireless is forwarded via the Ethernet interface of the W747-1 client to a SIMATIC S7-300 controller. There, data traffic is handled by a CP 343-1 Lean ⑦.

Benefits

The selected solution has the following advantages for the users:

- Wireless LAN suitable for industry that meets all the requirements in terms of reliability and mechanical stability.

- Maximum availability even when changing wireless cells thanks to iPCF.

- Simple integration in a WinCC system.

- Optimization of the IWLAN installation thanks to the SINEMA E software.

- Maintenance-free and problem-free scalability.

3.5 Crane carriage control for a high-bay warehouse

Task

An existing SIMATIC S5 controller of a case picking high-bay warehouse system needs to be modernized. The customer also hopes to reduce plant costs by using modern and future-proof components.

Solution
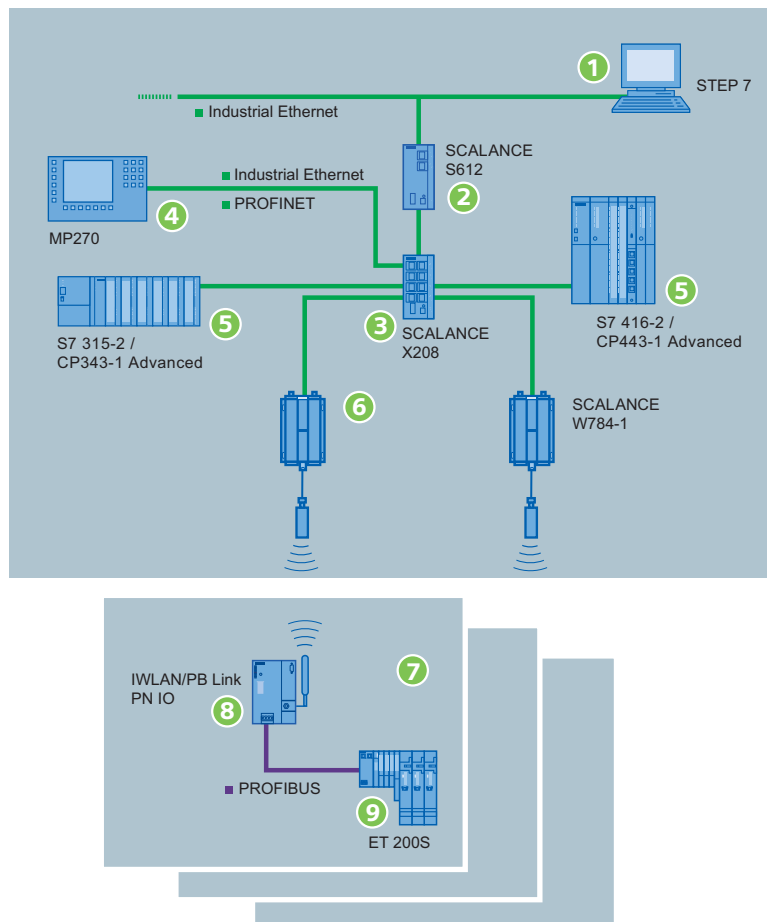
① The controller of the high-bay warehouse can be reached via the factory network and it will also be configured via this path.

② To protect against unauthorized access, the entire crane system is protected by a SCALANCE S612.

③ Starting with a SCALANCE X208, the individual components form a star topology that includes not only four multi-panels MP270 as operator control and monitoring systems ④ but also the controllers for the crane carriage ⑤.

⑥ IWLAN was selected for the communication between the stationary parts of the system and the mobile crane carriage. This meant that the previously required cable festoons were no longer necessary. Broken cables and the associated maintenance effort would therefore no longer be a problem. Two SCALANCE W784-1 access points ensure reliable wireless coverage in the area in which the crane carriage moves.

⑦ Each crane carriage is equipped with an IWLAN Link ⑧ that converts wireless control signals for PROFIBUS and forwards them to the ET 200S ⑨ on each crane carriage. In conjunction with absolute value encoders, this achieves precise movement and positioning of the crane carriage.

Benefits

- Reliable and high-speed communication with PROFINET IO and Industrial Wireless LAN.
- Protection of investment by using IWLAN/PB Links. The existing PROFIBUS I/O can continue to be used unchanged.
- By integrating the absolute value encoders in the distributed ET 200S, additional cabling is unnecessary.
- Absence of maintenance and operational safety thanks to wireless transmission between the stationary part of the system and the crane carriage.
- Although remote access to the system via the factory network is possible, a SCALANCE S612 protects against unauthorized access.
- If requirements change, the system can be easily expanded or adapted.

3.6 Connecting a PROFIBUS network to a PROFINET installation

Task

In a brickworks, raw bricks are transported to the drying kiln by a reciprocating conveyor ①. The functions of the reciprocating conveyor are controlled by an S7-300. The movements of the reciprocating conveyor are synchronized with the production process in the stationary parts of the works with which the conveyor communicates via a wireless PROFIBUS modem ②. The doors of the drying kiln open automatically when the conveyor arrives and close again automatically. The stationary part of the works also has a wireless PROFIBUS modem ③ and the ET 200 I/O ④ and operator control stations ⑤ required for production.

This solution alone eliminates numerous problems that occurred previously with the trailing cables but nevertheless there were occasional short interruptions in communication. The reason was that the transmission speed of the wireless PROFIBUS communication was not fast enough for this situation.

Solution

The new solution consists of Industrial Wireless LAN and PROFINET IO. This combines a high data rate in the wireless communication with a communications concept for modular distributed applications based on Ethernet.

⑥ The CPU 315-2 PN/DP used on the conveyor has a PROFINET interface to connect distributed field devices. For the wireless communication, a SCALANCE W744-1PRO ⑦ is connected as a client module.

⑧ In the stationary part of the works, an IWLAN/PB Link PN IO allows unchanged use of the ET 200M modules.

⑨ A SCALANCE W788-1PRO is used as the access point and the operator control stations ⑩ can access the entire system via its Ethernet interface.

Benefits

- High data throughput and high reliability in communication with the reciprocating conveyor without trailing cables or sliding contacts.

- Transparent network with wireless PROFINET/PROFIBUS gateway.

- When necessary, a PC with a WLAN interface can be used for diagnostics and for process visualization.

- Lower operating costs and reduction of downtimes with maintenance-free IWLAN technology, higher productivity.

- Protection of investment by an IWLAN/PB Link. The existing ET 200 M controllers can continue to be used unchanged.

3.7 Redundant coupled rings with a connection to an office network

Task

In a production plant, two ring topologies need to be interconnected reliably. Faults or the failure of a connecting cable should not have any influence on the data traffic. Data must also be exchanged with the office network of the plant.

Solution
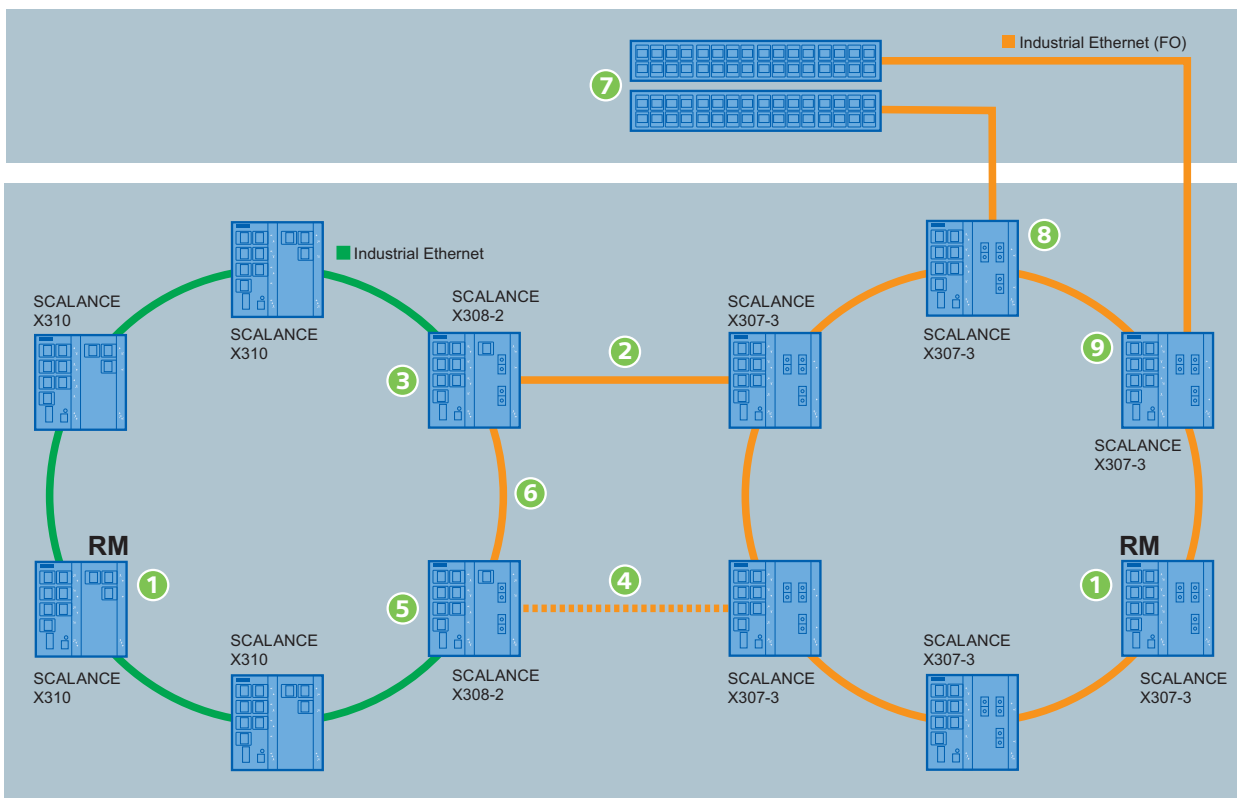
The production network consists of two redundant rings. One switch ① in each of the ring topologies is configured as the redundancy manager (RM) but this does not forward any frames if the transmission path is intact. This means that data traffic is interrupted at the redundancy manager. If a section of the ring fails, the redundancy manager closes the connection between its ring ports. As a result, all the devices in the ring remain accessible for data traffic.

Due to the high requirements for reliability, the coupling of the two rings is also redundant. In regular operation, the data traffic between the two rings is via cable ②, the device ③ adopts the function of standby master. In this situation, cable ④ does not transfer any data because the standby slave ⑤ is controlled accordingly by the standby master.

If the standby master ③ recognizes that the connection via cable ② is faulty or interrupted, it activates cable ④ for data exchange via the standby slave ⑤. The cable ⑥ serves as the connection between the standby master ③ and the standby slave ⑤. It is a normal network segment that simply provides the additional function of the standby link.

All cables are designed for gigabit Ethernet because there is an extremely high volume of data to be transferred. Either copper cable or fiber-optic cable can be used without problems because there are for example SCALANCE X-300 components with gigabit ports for all possible media.

Due to the redundant operation in the two rings of the plant network, Spanning Tree/RSTP cannot be used because an IE switch cannot use both mechanisms at the same time. If Spanning Tree/RSTP is necessary in the office network, passive listening must be activated for devices ⑧ and ⑨. They then forward (R)STP configuration frames transparently even when (R)STP is disabled for them. This behavior does not conform with the IEEE 802.1d standard but allows the connection of network segments with media redundancy and those that use Spanning Tree/RSTP.

Benefits

- Extremely high reliability thanks to media redundancy and the redundant coupling of ring topologies.

- High data throughput thanks to gigabit technology.

- Freedom of choice in terms of the transmission medium; depending on specific requirements either twisted-pair cables or fiber-optic cables can be used.

- Connection to networks with activated Spanning Tree/RSTP by using passive listening.

3.8 Data protection during mobile communication

Task

In an assembly plant, access to field devices and the control technology should only be possible for authorized personnel for commissioning, maintenance and service. Due to the size of the plant, network access should also be possible for mobile nodes. In this case in particular, reliable protection of the automation cells against unauthorized access, manipulation and espionage is necessary.

Solution
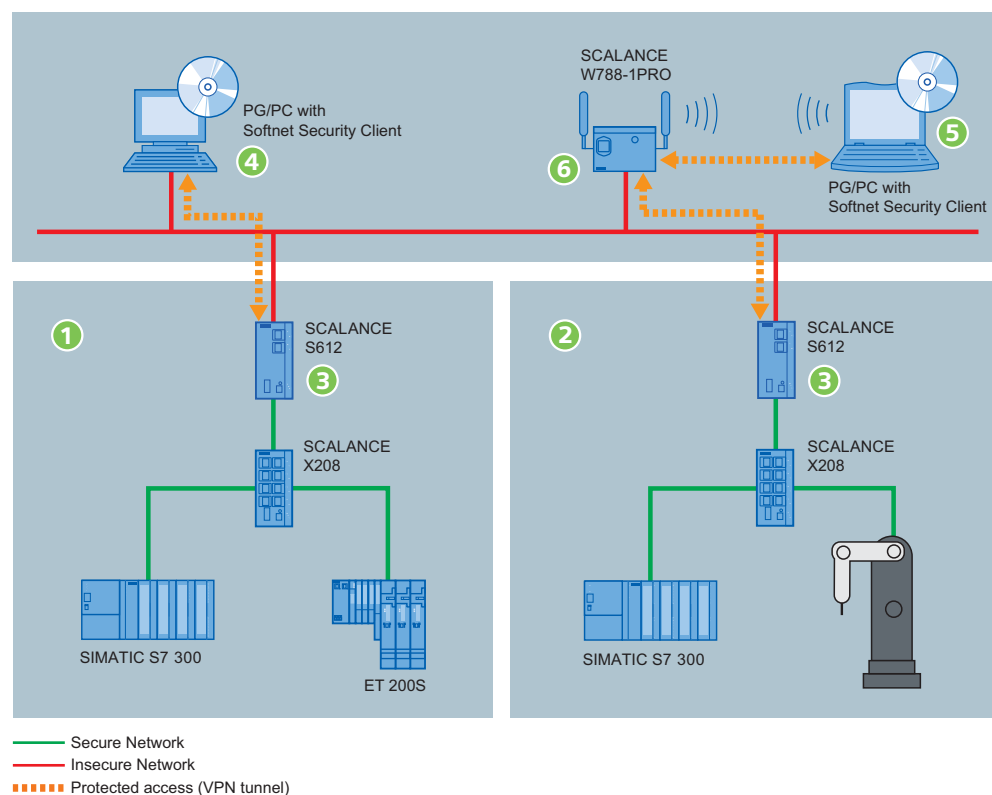
Within the automation cells ① and ②, devices can be used without their own security functionality. The entire data exchange with these devices is via a SCALANCE S612 ③ that, among other things, provides the function of a firewall. The protection also extends to layer 2 frames if the SCALANCE S612 is not operating as a router.

④ Devices in public networks can also communicate with the automation cells if they use the SOFTNET Security Client software. This means that the PC/PG is automatically configured so that it can establish a secure IPsec tunnel in the VPN (Virtual Private Network) to one or more SCALANCE S612 modules. As a result, STEP 7 can be used to access devices in an automation cell protected by a SCALANCE S612 via a secure tunnel. This cell protection concept allows the use of effective security structures even for access by external devices.

⑤ This protected access is also possible from mobile PCs/PGs that communicate by wireless with an access point ⑥. In the assembly plant, several SCALANCE W788-1PROs ensure full wireless coverage. Roaming (moving from one wireless cell to another) has no influence on the security mechanisms.

Benefits

- Reliable protection of the plant against unauthorized access, manipulation and espionage.

- Mobile devices can access the automation cells from any location in the plant which means that the number of stationary nodes for diagnostics and service can be greatly reduced.

- The security mechanisms of the SCALANCE S612 and the SOFTNET Security Client are easy to configure and do not require specialist knowledge.

- No modifications or adaptations of the existing network structure or the applications used are necessary. Internal network nodes are found without configuration.

3.9 Protection of the production network when networking with the office network

Task

In a car bodywork plant, the company network includes both the office network, the data processing center and the automation cells. The integration of all company areas allows continuity from the enterprise to the field level. This means that process data such as numbers produced, manufacturing number and type names are available throughout the company. Apart from this, fully integrated diagnostics can be created for field devices and network components. This continuity does, however, involve certain risks. There is a danger of unauthorized access from the office network to the automation cells and the influence of one automation cell on another. The network needs to be structured so that these weak points are eliminated. The configuration should also be simple to create since personnel without special training in security will be involved in commissioning and service.

Solution
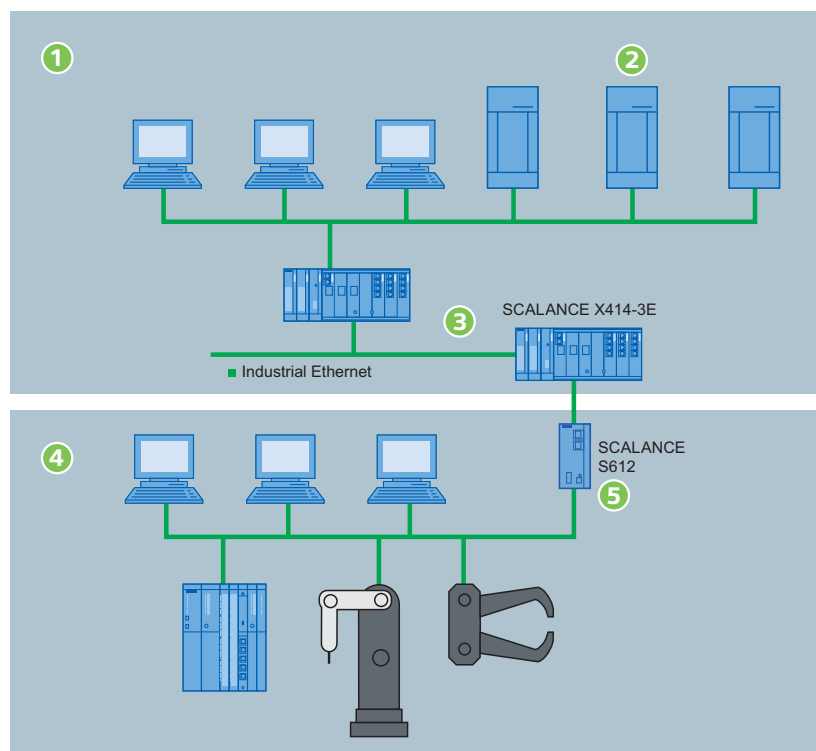
The office network includes a Syslog server ② that also logs unauthorized access attempts and overload situations.

③ Switches of the type SCALANCE X414-3E are responsible for handling the data traffic. With their gigabit ports, these devices are not only suitable for a high data throughput, they also provide wide-ranging configuration options for parameters relevant to security. Using the access control function, for example, individual ports can be blocked for unknown nodes.

④ Each automation cell includes several components that are connected to the network (controllers, robots, field devices). A SCALANCE S602 ⑤ acting as a firewall filters the data packets and allows communications connections according to the firewall rules. Criteria for the filtering might be the IP address, the MAC address or the communications protocol. There is also an option for limiting overload. The logging functionality allows access monitoring and logs attacks and attempted access to allow preventive measures to be taken. Syslog information such as process data is automatically sent to the Syslog server. To allow effective protection of the automation cells, an IP address conversion is necessary and for this the SCALANCE S602 uses the NAT and NAPT methods.

These measures implement a comprehensive cell protection concept for the individual production areas. The production network is protected effectively and reliably from unauthorized access from the office network and the office network is also protected from any influence from the production network.

Benefits

- Effective protection from mutual influence between production and office network.
- Protecting the plant from unauthorized attacks and communication overload by using SCALANCE S602.
- Continuous monitoring of access to the production network.
- Cost saving by saving on public IP addresses.
- Simple maintenance and diagnostics, since all protected cells can be set up identically.

3.10 Gigabit network in the pharmaceuticals industry

Task

An existing network needs to be replaced by a new future-proof network. The aim was not only to increase the bandwidth (gigabit), but to provide ideal conditions for PROFINET. The intention was to use only open communications standards and there was very little time for the implementation.

Solution
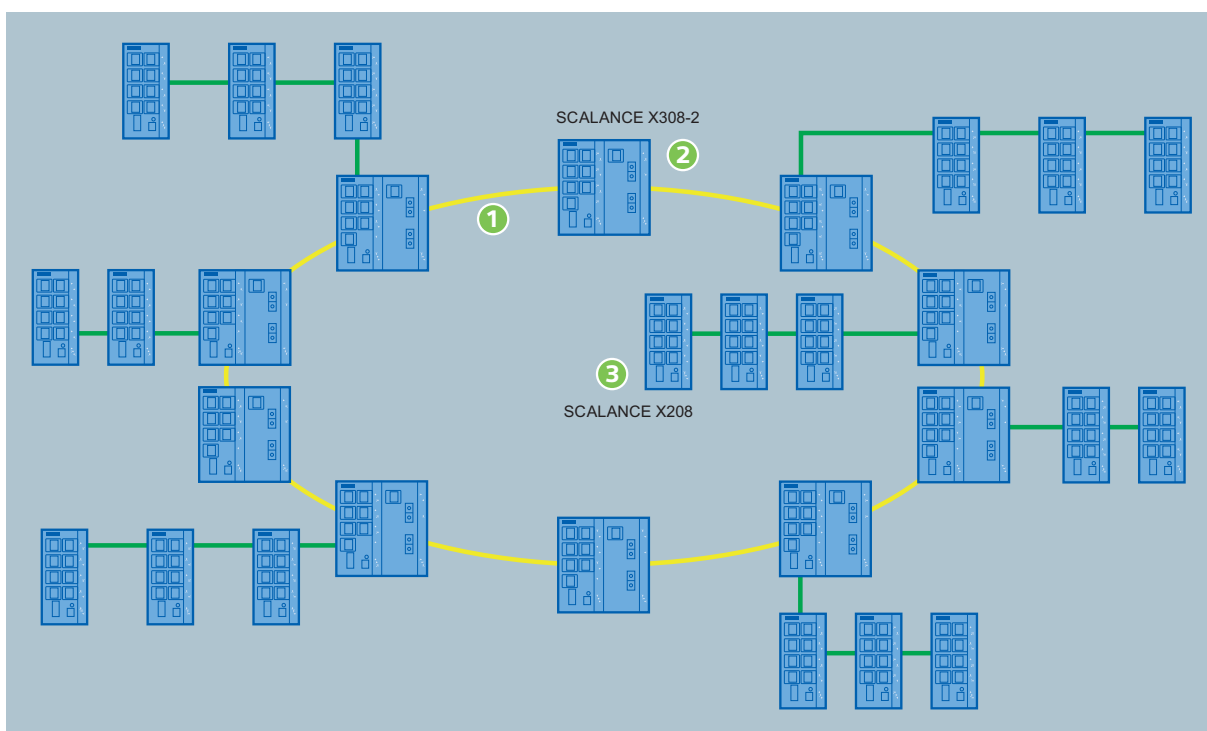
① A redundant glass fiber-optic ring was selected as the backbone. The total length of this cable is approximately 2 km.

② The ring topology was set up with SCALANCE X308-2 devices. This device has three gigabit ports (2 x fiber-optic, 1 x RJ-45) as well as comprehensive management functions. The gigabit ports are used for a high-speed connection between the switches. One SCALANCE X308-2 is configured as the redundancy manager and this prevents frames from circulating if the transmission path is intact. If the transmission path is interrupted, this closes the connection between its ring ports and restores a connection between all the components.

③ The second level linear bus structures are made up of SCALANCE X208 devices. These devices also have a compact housing suitable for industry that is, for example, equipped with securing collars for the RJ-45 jacks. In conjunction with the FastConnect connectors used, this achieves a high degree of mechanical stability within the network.

Benefits

- Ideal configurability and simple diagnostics of the SCALANCE X devices.

- More bandwidth due to the gigabit backbone.

- Future-proof and suitable for straightforward expansion due to the use of PROFINET.

3.11 Communications components for extreme climatic conditions

Task

A mobile loading crane in a harbor needs to be supplied with data from a logistics center. The devices used must be able to stand up to extreme environmental conditions (salt water spray, strong vibration caused by the movement of the crane).

Solution
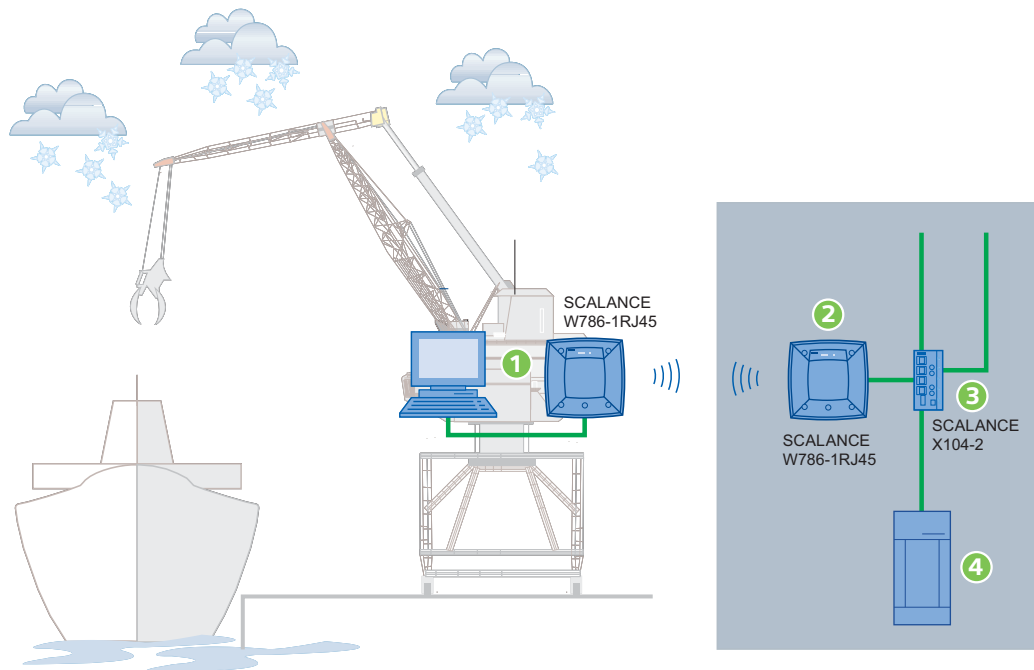
The communication between the crane and the logistics center is handled via Industrial Wireless LAN. The advantage of wireless data transmission is that neither sliding contacts nor trailing cables are necessary. Taking into account the environmental conditions, this represents a considerable saving in costs.

① The loading crane is equipped with a SCALANCE W786-1RJ-45 and a PC for displaying and entering data. The SCALANCE W786-1RJ-45 fitted to the outside of the crane is particularly suitable for this application due to its resistance to ultraviolet light and salt water. The device is configured as a client. Thanks to the antennas integrated in the housing, external antennas and the associated cabling are unnecessary.

② A SCALANCE W786-1RJ-45 is also mounted on a building of the logistics center and acts as the access point.

③ The integration of the access point in the company network is achieved with a SCALANCE X104-2. Among other things, this switch provides two interfaces for fiber-optic cables that can also be used for networks with a large span. This means that the server of the logistics center ④ can be accessed although it is several hundred meters away from the loading station.

Benefits

- High availability thanks to maintenance-free components for data transmission.
- Unrestricted suitability of the implemented solution for the difficult environmental conditions.
- Simple integration in the existing company network.
- Access to logistics data regardless of location.

SCALANCE network components

<div style="text-align: right; font-size: 2em;">4</div>

4.1 Product families

The name SCALANCE stands for SIMATIC NET network components for simple setup, management and operation of Industrial Ethernet LANs. The product families are as follows:

- **SCALANCE X** is the product family of Industrial Ethernet switches. Switches are active network components that distribute data to specific addressees, control network traffic and ensure that the load on network connections is optimally distributed.
SCALANCE X switches are available in a wide range of variants with electrical and/or optical ports, and in some cases with special functionalities to meet strict real-time requirements.

- **SCALANCE W** is the family of components and accessories for wireless local area networks ("WLANs"). The use of access points, clients and accessories allows the connection of mobile nodes and the establishment of networks in exacting environments. SCALANCE W components are distinguished by their ruggedness, security and reliability. Wireless transmission can be implemented using conventional antennas, directional antennas or over short distances with leaky feeder cables (RCoax cable).

- **SCALANCE S** security modules protect automation networks from unauthorized access and unnecessary communication load. Both eavesdropping and attacks by outsiders are prevented reliably. Even if there are disturbances in the external network, data traffic in the automation cell remains unaffected. Communication is protected regardless of the application protocol used.

- **SCALANCE M** Devices are used as UMTS, EGPRS (GPRS with Edge) and GPRS routers for wireless IP communication of Industrial Ethernet-based programmable controllers via UMTS / GSM mobile wireless networks. With UMTS, high transmission speeds are achieved. An integrated firewall provides wide-ranging security functions. Some models can be used both as a VPN server and as a VPN client (IPsec).

Note

For further information on support when selecting Industrial Ethernet switches and when configuring the module variants, the SIMATIC NET Selection Tool is available.

Online version: http://www.siemens.com/snst
Offline version: http://www.siemens.com/snst-download

4.2 Common properties of all SCALANCE devices

Properties shared by all SCALANCE devices

All SCALANCE devices have the following properties. If there are exceptions, this will be pointed out in the description of the relevant device.

Autocrossover function

All SCALANCE devices have an integrated MDI/MDIX autocrossover function on their electrical ports making it possible to use straight-through cables. This prevents malfunctions resulting from mismatching send and receive wires. This makes installation much easier for the user.

Autonegotiation

All SCALANCE devices also have the autonegotiation function. Autonegotiation means the automatic detection of the functionality of the port at the opposite end. Using autonegotiation, repeaters or end devices can detect the functionality available on the interface of a partner device allowing automatic configuration of different types of device. With autonegotiation, two components connected to a link segment can exchange parameters and set themselves to match the supported communication functionality.

The SCALANCE devices are therefore plug-and-play devices that require no settings when they are put into operation.

Please note the following:

- that devices that do not support autonegotiation need to be permanently set to half duplex.

- that the port speed and duplex mode must be set identically on the connection partners otherwise frames may be lost.

Fault mask

On all SCALANCE devices with a button on the front panel, it is possible to set a specific configuration as the desired status (good status). Deviations from this setting occurring during operation are treated as errors.

Monitored error statuses include, for example, the status of the power supply or link to a communications partner down, to which the SCALANCE device reacts with a fault LED and by opening the signaling contact.

Avoiding the formation of loops

The typical configuration of a network with the SCALANCE products is a tree structure. The direct connection of two ports on the switch or accidental connection over several switches causes an illegal loop. Such a loop can lead to network overload and network failures.

When configuring the network with SCALANCE X300, X400 and X500, meshing is possible since, in this case, the Rapid Spanning Tree algorithm can eliminate loops. At the same time, RSTP increases the availability of the network. If one connection fails, the redundant connection is activated.

Cable length at the electrical ports

A maximum of two IE-TP cords or IE-TP-XP cords with a total length of max. 10 m can be used between two adjacent SCALANCE devices with IE TP ports.

With the IE FC cables and IE FC RJ-45 plug, an overall cable length of a maximum of 100 m is permitted between two devices depending on the cable type.

Table 4- 1   Maximum runs with twisted-pair cables

Cabling structure	Cable type	Max. length	Max. total of the patch cables (TP cord)
In one piece (without IE TP cords)	IE FC standard cable GP	100 m	-
	IE FC flexible cable GP	85 m	
	IE FC torsion cable GP	55 m	
	IE FC trailing cable GP	85 m	
	IE FC trailing cable	85 m	
	IE FC marine cable	85 m	
	IE FC FRNC cable GP	85 m	
	IE FC food cable	85 m	
	IE FC festoon cable GP	85 m	
Structured (with IE-TP cords and IE FC outlet RJ-45 or IE FC RJ-45 modular outlet)	IE FC standard cable GP	90 m	10 m
	IE FC flexible cable GP	75 m	
	IE FC torsion cable GP	45 m	
	IE FC trailing cable GP	75 m	
	IE FC trailing cable	75 m	
	IE FC marine cable	75 m	
	IE FC FRNC cable GP	75 m	
	IE FC food cable	75 m	
	IE FC festoon cable GP	75 m	

Note on Installation

When installing the devices, read the instructions in the operating instructions of the relevant device. With a few exceptions, the devices are suitable for wall mounting, DIN rail mounting and mounting on the S7 standard rail. In individual cases, it is possible to install using a mounted adapter.

4.3   Web Based Management for configuring networks

Configuration over a Web interface

All SCALANCE devices that have management functions can be configured using "Web Based Management" (WBM).

The devices have an integrated Web server that can be accessed by the configuration engineer with a browser via every Ethernet connection. The server then provides a series of Web pages. On these Web pages, the configuration engineer can make all important settings and can also run diagnostics and report functions.
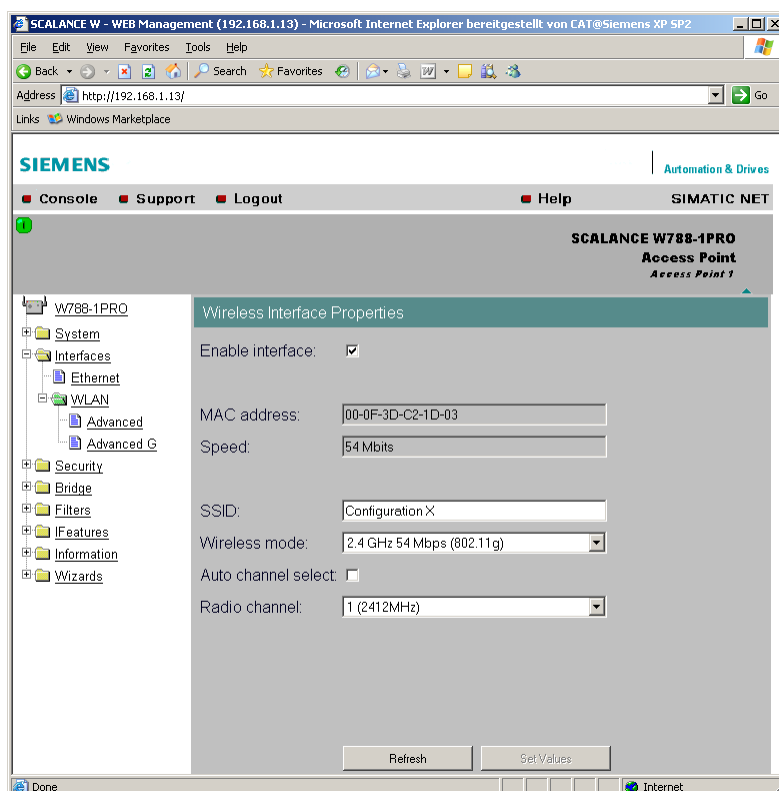
Figure 4-1   Web Based Management based on the example of configuring a W788 access point

Advantages

● Access is possible from any PC with a Web browser installed on it and with an Ethernet connection to the target device. With SCALANCE W devices, this connection can also be over a wireless network.

● The installation of special software is not necessary and no specialist knowledge is required to navigate through and work with WBM.

● Access is password protected.

For more detailed information on the functions of the WBM, refer to the compact operating instructions of the individual devices and in the configuration manual.

4.4 SCALANCE X switches and media converters

4.4.1 Type designations and properties

Overview of the performance classes of the SCALANCE X devices

In the overview graphic below, you can see which performance classes are covered by the various SCALANCE X devices.
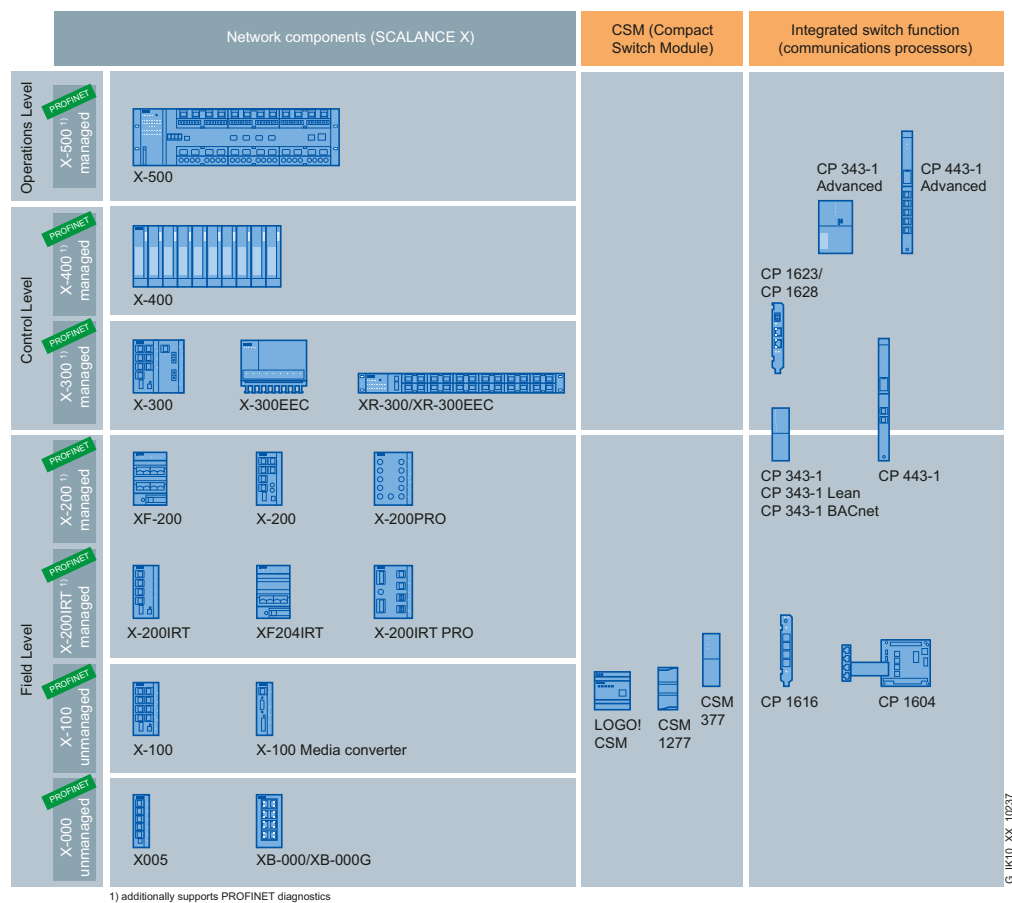
Figure 4-2   Overview of IE switches

Type designations and properties

Identify the SCALANCE X devices based on their type key. The design and basic characteristics can be identified based on the following type key.


```
X ▨ ▨▨▨ ▨▨▨-▨▨
```

EEC Expanded temperature range
PoE Power over Ethernet
TS   Transport System

[-]   Device without module slots
M   Modular device
PRO Degree of protection IP65

Interface

Number of optical ports or
 number of module slots in modular devices

Number of electrical ports or
 total number of ports in modular devices

Product line
0 ⎫ Unmanaged switch
1 ⎭
2 ⎫
3 ⎪
4 ⎬ Managed switch
5 ⎭

[-] Compact housing
R   Rack device
F   Flat housing
B   Plastic box housing

Figure 4-3   Type key SCALANCE X

Interfaces of devices without optical ports:

Interface	Property
LF	RJ-45 port electrical for 10 Mbps
FE	RJ-45 port electrical for 10/100 Mbps.
GE	RJ-45 port electrical for 10/100/1000 Mbps.
RNA	Ethernet port with RNA capability
[-]	RJ-45 electrical for 10/100 Mbps or 10/100/1000 Mbps.

Interfaces of devices with optical ports:

Interface	Property
LF	BFOC port 10 Mbps multimode FO cable (up to max. 5 km)
AUI	AUI port 10 Mbps Industrial Ethernet plug-in cable 727-1 (AUI drop cable) (up to max. 0.05 km)
FE	SC port 100 Mbps multimode FO cable (up to max. 5 km).
LD FE	SC port 100 Mbps single mode FO cable (up to max. 26 km).
POF	SC port with 100 Mbps plastic optical fiber, POF (up to max. 0.05 km)
P	POF/PCF SC RJ ports 100 Mbps
[-]	SC port 1000 Mbps multimode FO cable (up to max. 750 m).
LD	SC port 1000 Mbps single mode FO cable (up to max. 10 km).
LH	SC port 1000 Mbps single mode FO cable (up to max. 40 km).
LH+	SC port 1000 Mbps single mode FO cable (up to max. 70 km).
ELH	SC port 1000 Mbps single mode FO cable (up to max. 120 km).

Management functions

The SCALANCE X200, SCALANCE X300, SCALANCE X400 and SCALANCE X500 devices are equipped with management functions. These devices are also known as "managed switches". The managed devices provide numerous configuration and diagnostics functions that make the operation of an Industrial Ethernet network much more convenient. The SCALANCE X100, SCALANCE XB000 and SCALANCE X005 devices have no management functions. These "unmanaged switches" are therefore less expensive.

SCALANCE X modular switches

To achieve the greatest possible flexibility in terms of interfaces, the use of the modular devices SCALANCE XR324-12M, SCALANCE X308-2M, SCALANCE X414-3E, SCALANCE X408-2 and SCALANCE XR-552-12M is recommended. By making use of media modules, these provide the maximum possible variability.

Electrical and optical interfaces

SCALANCE X devices can be used as switches in both optical and electrical Industrial Ethernet networks. Each performance class therefore includes devices with varying numbers of electrical and optical interfaces. The optical interfaces also include versions specially designed to cover long distances. These are available in devices that have LD, LH, LH+ or ELH in the device designation.

Fault-tolerance due to redundancy

The SCALANCE X200, X300, X400 and X500 switches have functions that allow the setup and management of redundant networks in a ring topology. These networks can handle the failure of individual nodes or cable sections and "divert" the data traffic so that the network remains available.

IRT for strict real-time requirements

Devices with the IRT suffix (Isochronous Real Time) are particularly suitable for applications in which a data transmission must be guaranteed at fixed intervals. To allow this, all devices in an Industrial Ethernet have the same timebase. The messages of the preferred nodes are transmitted together at previously configured times. Frames of other nodes are held back by the IRT switches and sent later.

SCALANCE X100 media converters

The media converters of the SCALANCE X-100 line are particularly suitable for applications in which two Industrial Ethernet networks implemented with different media need to be linked. These have only two interfaces and therefore fit into an extremely narrow casing. They can also be used in a redundant ring.

The media converters have electrical and optical interfaces to link optical networks with electrical networks and to link existing network segments or individual end devices via 10BaseFL, AUI drop cable, etc.

Devices for special environmental conditions

Some switches are available with special constructions that allow them to be used in special environments.

These include the version of the housing in IP65 with M12 connectors. This version has the suffix PRO in the type designation.

Switches with the EEC suffix have an extended temperature range in which they can be used and they are also suitable for gaseous atmospheres.

Notes on installation

When installing the devices, read the instructions in the compact operating instructions of particular device. With a few exceptions, the devices are suitable for wall mounting, DIN rail mounting and mounting on the S7 standard rail. In individual cases, it is possible to install using a mounted adapter.

Devices with the suffix R are either suitable as desktop devices or for mounting in a 19" rack. To do this mount the appropriate mounting aids as described in the compact operating instructions.

4.4.2   Functions of SCALANCE X devices

Introduction

This section describes certain functions of SCALANCE X devices. For further information on all the functions, refer to the compact operating instructions of the devices or the configuration manual.

Signaling contact

The signaling contact is connected to a 2-pin plug-in terminal block. The signaling contact (optical relay contact) is a floating switch with which error/fault states can be signaled by breaking the contact.

The following errors/faults are signaled by the signaling contact:

● The failure of a link on one of the two monitored ports.

● The failure of one of the two redundant power supplies.

The connection or disconnection of a communication node on an unmonitored port does not lead to an error message.

The signaling contact remains activated until the error/fault is eliminated or until the current status is applied as the new desired status using the button or by Web Based Management.

When the device is turned off, the signaling contact is always activated (open).

Support of virtual networks (VLAN)

There is no physical difference between a virtual network (VLAN) and a normal LAN. The particular feature of a VLAN is that devices can be assigned to a device group during configuration. Several of these device groups use a network infrastructure that exists only once physically. Several "virtual networks" result on the one physical network. Data exchange and even the transmission of broadcasts takes place only within a VLAN.

You can configure VLANs on the device or using GVRP frames.

MAC address list

If this function is activated for a port, the device only forwards frames received at this port if their source address exists in the address table.

SCALANCE devices log the information about which MAC address can be reached over which port in a learning table. Entries in this list are deleted automatically when there is no further data transfer for the corresponding MAC addresses. The time after which addresses are deleted if there is no data traffic is set in the 'Aging Time' parameter.

The learning table indicates the Ethernet interface on which a MAC address can be reached.

The MAC address list can be based on the port or MAC addresses.

Network access protection complying with the standard IEEE 802.1X

Ports can be configured for end devices that support authentication according to IEEE 802.1X. The authentication is via a RADIUS server.

IGMP Snooping and IGMP Querier

IGMP (Internet Group Message Protocol, RFC 2236) is a protocol for the group management of IP multicasts.
The group management is on a central device, for example a switch. With IGM Snooping, the switch (IGM querier) queries the multicast group membership of its connected devices. The switch notes the outgoing interfaces on which devices are located that want to receive certain multicast IP packets. The switch enters the devices in a list (MAC filter table). When a switch receives a multicast, the message is forwarded only to the members of the multicast group. The multicast data traffic is therefore filtered and the load on the network limited.

Bundling network links for redundancy and higher bandwidth

Link aggregation according to IEEE 802.3ad allows several links between neighboring devices to be bundled to achieve higher bandwidths, see section Link aggregation (Page 72).

Topology support (LLDP)

The topology is identified using LLDP (Link Layer Discovery Protocol). The devices exchange LLDP frames with each other. The information is stored and can be represented graphically by network management software. In the default setting, LLDP is enabled for all ports; in other words, LLDP frames are sent and received on all ports.

Using the GARP VLAN Registration Protocol (GVRP)

Whether or not a port belongs to a VLAN is set dynamically using GVRP frames.

Forwarding of multicast frames with GMRP (Generic Multicast Protocol)

GMRP is a mechanism for efficient forwarding of multicast frames. With a GARP Information Declaration (GID), a node registers with the IE switch as recipient for a multicast address. The IE switch sends this registration to its ports. As a result, this address is also known to other IE switches and they send multicast frames for this address only to ports that have received a registration for this address.

Fast redundancy in the ring

The following redundancy methods are possible:

- MRP in the ring with a maximum reconfiguration time of 200 ms, see section MRP (Page 67)

- HSR with a maximum reconfiguration time of 300 ms, see section HSR (Page 69)

- MRPD (IE switches with IRT) with 250 µs reconfiguration time, see section MRPD (Page 69)

- Standby redundancy, see section HSR (Page 69)

Limiting the transfer rate of incoming and outgoing data

To limit the transfer load, the maximum number of data packets per second can be specified for the individual ports.

The limit values can apply to the following category of frames:

● Broadcast: Special form of multicast.

● Multicast: A device sends a single data packet to several recipients

● Unicast: A device sends the data packets to one recipient

4.4.3 SCALANCE X005

4.4.3.1 Description

Figure 4-4   SCALANCE X005

The SCALANCE X005 switch allows the cost-effective installation of small Industrial Ethernet linear bus or star structures with switching functionality.

The SCALANCE X005 has five RJ-45 jacks for connection of end devices or other network segments.

To keep the size of the switch as small as possible while including a large number of TP interfaces, a redundant power supply and signaling contact were not implemented.

4.4.3.2 Functions

The switch does not support any redundancy functions and cannot be used in redundant networks. An exception is between two devices capable of RNA. If the connecting network line is not subject to other redundancy methods, the device does not need to capable of redundancy or RNA.

The SCALANCE X005TS (transportation systems) is suitable for railway and road traffic due to its specification according to EN 50155 and e1/E1.

4.4.3.3 Interfaces

Main statement

Table 4- 2

Name	SCALANCE X005	SCALANCE X005TS
Transmission rate	10 / 100 Mbps	10 / 100 Mbps
Interfaces	5 x RJ-45 ports	5 x RJ-45 ports
Power supply	1	1
Signaling contact	--	--

Order numbers

X005	Industrial Ethernet switch for 10/100 Mbps; with five 10/100 Mbps RJ-45 ports for establishing small star and bus structures	**6GK5 005-0BA00-1AA3**
X005TS	Industrial Ethernet switch with extended temperature range and approvals for use in railway and road traffic	**6GK5 005-0BA00-1CA3**

4.4.4 SCALANCE XB000

4.4.4.1 Description

Figure 4-5   SCALANCE XB000

The unmanaged Industrial Ethernet switches of the SCALANCE XB000 line allow small electrical and optical star or bus structures to be set up with switching functionality in machines or plant sections. Depending on the version, the switches have 5 to 8 RJ-45 jacks for connection of end devices or other network segments. Here, a connection can be implemented by an optical interface.

With SCALANCE XB000, there are variants that support gigabit Ethernet. These devices have the suffix G in the device designation.

4.4.4.2 Characteristics

- Data rates of 10/100 and, depending on the specific device, 1000 Mbps (half/full duplex) are supported.
- Diagnostics LED

4.4.4.3 Interfaces

Table 4- 3

IE Switch	Twisted pair		Fiber-optic cables				
	RJ-45 jacks 10 / 100 Mbps	RJ-45 jacks 10 / 100 / 1000 Mbps	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Max. segment length / km	Multim ode	Single mode
XB004-1	4	-	1	-	4* / 5**	●	-
XB004-1LD	4	-	1	-	26	-	●
XB005	5	-	-	-	-	-	-
XB008	8	-	-	-	-	-	-
XB004-1G	-	4	-	1	0.75	●	-
XB004-1LDG	-	4	-	1	10	-	●
XB005G	-	5	-	-	-	-	-
XB008G	-	8	-	-	-	-	-

● Suitable / available or according to the specified standard.
* at 50 µm core diameter of the FO cable
** at 62.5 µm core diameter of the FO cable

Order numbers

XB004-1	4 x 10/100 Mbps RJ-45 ports electrical, 1x 100 Mbps SC port optical (multimode, glass), up to max. 5 km	6GK5 004-1BD00-1AB2
XB004-1LD	4 x 10/100 Mbps RJ-45 ports electrical, 1x 100 Mbps SC port optical (single mode, glass), up to max. 26 km	6GK5 004-1BF00-1AB2
XB005	5 x 10/100 Mbps RJ-45 ports electrical	6GK5 005-0BA00-1AB2
XB008	8 x 10/100 Mbps RJ-45 ports electrical	6GK5 008-0BA00-1AB2
XB004-1G	4 x 10/100/1000 Mbps RJ-45 ports electrical, 1 x 1000 Mbps SC port optical (multimode, glass), up to max. 0.75 km	6GK5 004-1GL00-1AB2
XB004-1LDG	4 x 10/100/1000 Mbps RJ-45 ports electrical, 1 x 1000 Mbps SC port optical (single mode, glass), up to max. 10 km	6GK5 004-1GM00-1AB2
XB005G	5 x 10/100/1000 Mbps RJ-45 ports electrical	6GK5 005-0GA00-1AB2
XB008G	8 x 10/100/1000 Mbps RJ-45 ports electrical	6GK5 008-0GA00-1AB2

4.4.5 SCALANCE X100 unmanaged

4.4.5.1 Description

Figure 4-6   SCALANCE X100 unmanaged switches

The unmanaged Industrial Ethernet switches of the SCALANCE X100 line allow cost-effective establishment of Industrial Ethernet with 10/100 Mbps bus or star structures with switching functionality. They are particularly suitable for factory floor applications and have a rugged metal housing for space-saving installation in cabinets, on DIN rails, S7-300 standard rails or for wall mounting.

The node or network connectors are rugged, suitable for industry and have electrical or optical interfaces depending on the model. Plug-in connectors complying with PROFINET provide additional strain and bending relief by locking into the housing.

4.4.5.2   Characteristics

The individual devices have the characteristics shown in the following table:

	X104-2 X106-1 X108 X112-2 X116 X124	X108PoE
Modular system design		
Gigabit Ethernet		
PoE Power over Ethernet		●
Diagnostics LED	●	●
Redundant Power supply	●	●
Signaling contact	●	●
On-site display (Set button)	●	●
C-PLUG slot		

● Suitable/available or according to the specified standard.

Additional information on the SCALANCE X108PoE:

Over and above the pure Ethernet functionality, ports 1 and 2 can also be used to supply power to Power-over-Ethernet end devices, for example SCALANCE-W, in compliance with 802.3af. The two ports providing PoE are supplied from the same power source. This means that they are electrically interconnected. They are however isolated from ground, from the ports that do not provide PoE and from the power connector (24 V). Their use is therefore subject to the conditions listed in IEEE 802.3af for Environment A. The ports that do not provide PoE are all isolated from each other. Ports 3 to 8 do not have the PoE function.

Note

Ethernet devices without PoE functionality can also be connected to ports 1 and 2. A voltage is applied only after the SCALANCE X108 PoE has detected a PoE end device complying with the standard at the port.

4.4.5.3 Interfaces

Table 4- 4

IE Switch	Twisted pair			Fiber-optic cables				
	RJ-45 jacks 10 / 100 Mbps	RJ-45 jacks 10 / 100 / 1000 Mbps	RJ-45 jacks 10 / 100 / 1000 Mbps with PoE	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Max. segment length / km	Multimode	Single mode
X104-2	4	-	-	2 (BFOC)	-	4* / 5**	●	-
X106-1	6	-	-	1 (BFOC)	-	4* / 5**	●	-
X108	8	-	-	-	-	-	-	-
X108PoE	6	-	2	-	-	-	-	-
X112-2	12	-	-	2 (BFOC)	-	4* / 5**	●	-
X116	16	-	-	-	-	-	-	-
X124	24	-	-	-	-	-	-	-

⦿ Suitable / available or according to the specified standard.
* at 50 µm core diameter of the FO cable
** at 62.5 µm core diameter of the FO cable

Order numbers

X104-2	4 x 10/100 Mbps RJ-45 ports, electrical, 2 x BFOC ports, optical (multimode, glass), up to max. 5 km	6GK5 104-2BB00-2AA3
X106-1	6 x 10/100 Mbps RJ-45 ports, electrical, 1 x BFOC port, optical (multimode, glass), up to max. 5 km	6GK5106-1BB00-2AA3
X108	8 x 10/100 Mbps RJ-45 ports, electrical	6GK5 108-0BA00-2AA3
X108PoE	6 x 10/100 Mbps RJ-45 ports, electrical 2 x 10/100 Mbps RJ-45 PoE ports, electrical	6GK5 108-0PA00-2AA3
X112-2	12 x 10/100 Mbps RJ-45 ports, electrical, 2 x BFOC ports, optical (multimode, glass), up to max. 5 km	6GK5 112-2BB00-2AA3
X116	16 x 10/100 Mbps RJ-45 ports, electrical	6GK5 116-0BA00-2AA3
X124	24 x 10/100 Mbps RJ-45 ports, electrical	6GK5 124-0BA00-2AA3

4.4.6 SCALANCE X100 media converters

4.4.6.1 Description

Figure 4-7   SCALANCE X101 media converters

Media converters are used to link two Industrial Ethernet networks. They are ideally suited for the conversion of various transmission media in Industrial Ethernet networks with transmission rates from 10/100 Mbps in bus, star and ring structures.

Individual end devices or network segments located at a distance from the main network can be connected via the optical link of the SCALANCE X100 media converters. It is also possible to integrate an optical link into a redundant ring and to install the SCALANCE X100 media converters in a standby link.

The major advantage of the converters is their compact construction and cost-effective design. The media converters are designed for installation in a cabinet.

4.4.6.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	X101-1 X101-1LD X101-1POF X101-1FL X101-1AUI
Modular system design	
Gigabit Ethernet	
PoE Power over Ethernet	
Diagnostics LED	●
Redundant power supply	●
Signaling contact	●
On-site display (Set button)	●
C-PLUG slot	

● Suitable/available or according to the specified standard.

Functions

All devices have the following function:

● Ring redundancy without RM functionality

4.4.6.3 Interfaces

Table 4- 5

IE Switch	Twisted pair	Fiber-optic cables						
	RJ-45 jacks 10 / 100 Mbps	Optical connectors 10 Mbps	Optical connectors 100 Mbps	Max. segment length / km	FO multimode	FO single mode	POF	AUI
X101-1	1	-	1 (BFOC)	4* / 5**	●	-	-	-
X101-1LD	1	-	1 (BFOC)	26	-	●	-	-
X101-1POF	1	-	1 (SC RJ)	0.05	-	-	●	-
X101-1FL	-	1 (BFOC)	-	3	●	-	-	-
X101-1AUI	1	1 (AUI)	-	0.05	-			●

● Suitable / available or according to the specified standard.
* at 50 μm core diameter of the FO cable
** at 62.5 μm core diameter of the FO cable

Order numbers

X101-1	1 X 10/100 Mbps RJ-45 port; 1 X 100 Mbps multimode BFOC	6GK5 101-1BB00-2AA3
X101-1LD	1 X 10/100 Mbps RJ-45 port; 1 X 100 Mbps single mode BFOC	6GK5 101-1BC00-2AA3
X101-1POF	1 X 10/100 Mbps RJ-45 port;1 X 100 Mbps POF SC RJ	6GK5 101-1BH00-2AA3
X101-1FL	1 X 10/100 Mbps RJ-45 port; 1 X 10 Mbps multimode BFOC	6GK5 101-1BY00-2AA3
X101-1AUI	1 X 10/100 Mbps RJ-45 port; 1 X 10 Mbps AUI segment port	6GK5 101-1BX00-2AA3

4.4.6.4 Application examples

Network connection and media transition

The unmanaged media converters of the SCALANCE X100 product line allow the cost-effective connection of network segments or nodes with different transmission media (optical/electrical) within Industrial Ethernet linear bus, star and ring structures. They are designed for installation in a switching cubicle.

Individual end devices or network segments located at a distance from the main network can be connected via the optical link of the SCALANCE X100 media converters. It is also possible to integrate an optical link into a redundant ring and to install the SCALANCE X100 media converters in a standby link.
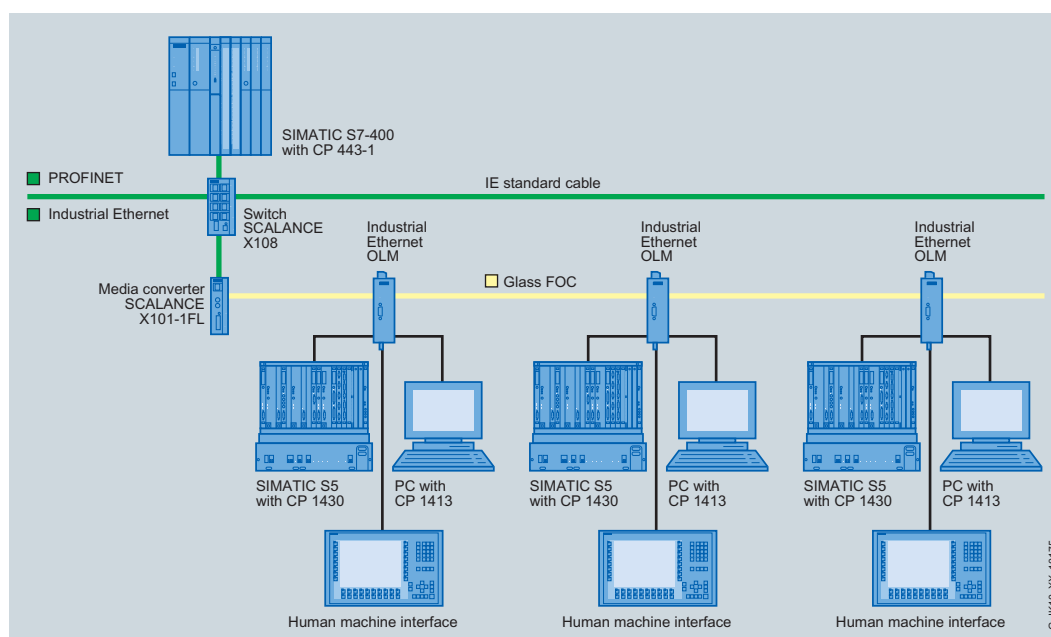
Figure 4-8   Example of using the X101-1FL media converter: Connection of an optical network segment to copper Industrial Ethernet
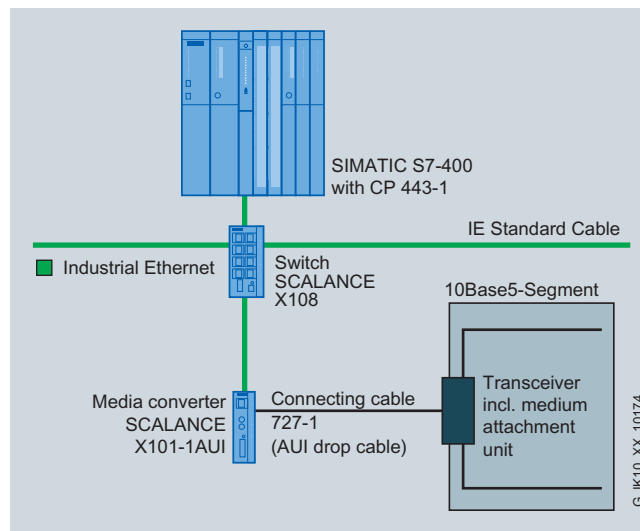
Figure 4-9   Example of using the X101-1AUI media converter: Connection of existing network
                 segments to IE networks

Cascading (series connection) two media converters

In this mode, two media converters are connected in series via their FO ports. This mode is, for example, useful when two electrical Industrial Ethernet networks located at some distance from each other need to be linked together.

4.4.7 SCALANCE X200/X200 IRT

4.4.7.1 Description

Overview

Figure 4-10   SCALANCE X200 managed switches

Figure 4-11   SCALANCE XF200

Figure 4-12   SCALANCE X 20x IRT PRO

Figure 4-13   SCALANCE X204 RNA

SCALANCE X200 Industrial Ethernet switches allow the cost-effective installation of 10/100 Mbps Industrial Ethernet linear (bus), star and ring structures with switching functionality, where availability of the network or remote diagnostics options are required. The devices have IP30 protection and are designed for installation in a cabinet. With IP65, the SCALANCE X208PRO is intended for installation outside a cabinet. The SCALANCE X202-2P IRT PRO and SCALANCE X204 IRT PRO devices have IP67 protection.

SCALANCE X200 switches vary in terms of the functions they provide and the number and type of electrical and optical IE interfaces.

The SCALANCE X200IRT switches form a special class by using the "cut through" switching mechanism, the optimum solution to meet the real-time requirements of PROFINET. SCALANCE X200IRT switches allow the installation of isochronous mode real-time Industrial Ethernet linear bus and star structures with switching functionality. The special requirements for automation solutions in terms of linear topology, hard real time and unrestricted IT openness are incorporated in one technology.

The only difference between the devices of the SCALANCE XF200 product line and the SCALANCE X200 product is the flatter construction.

4.4.7.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	X204-2 X204-2TS X204-2LD X206-1 X206-1LD X208 X208PRO X212-2 X212-2LD X216 X224 XF204 XF204-2 XF206-1 XF208	X200-4P IRT X201-3P IRT X201-3P IRT PRO X202-2IRT X202-2P IRT X202-2P IRT PRO X204IRT X204IRT PRO XF204IRT	XF204 XF204-2 XF206-1 XF208	X204RNA X204RNA EEC
Diagnostics LED	●	●	●	●
Redundant Power supply	●	●	●	●
Signaling contact	●	●	●	●
On-site display (Set button)	●	●	●	●
C-PLUG slot	●	●	●	●

● Suitable/available or according to the specified standard.

Functions

All devices have the following functions:

- Configuration with the Primary Setup Tool (PST) V3 or higher;
  It is only possible to assign the IP address with the Primary Setup Tool if the SCALANCE X-200 can be reached via Ethernet.

- Configuration of the IP address with DHCP

- Configuration with STEP 7 V 5.3 plus SP 1

- Web-based Management

- Command Line Interface

- Configuration with STEP 7

- SNMP

- SNTP

Apart from the X208PRO, the devices have the following functions:

- PROFINET diagnostics

- Topology support (LLDP)

- Ring redundancy including RM functionality

- Passive Listening

The devices with the suffix IRT have the following extra functions:

- Standby redundancy

- IRT capability

- Fast learning

The devices with the suffix RNA have the following extra functions:

- RNA (PRP)

4.4.7.3 Interfaces

Table 4- 6

IE Switch	Twisted pair		Fiber-optic cables					
	RJ-45 jacks 10 / 100 Mbps	M12 10 / 100 Mbps	Optical connectors 100 Mbps	Optical connectors 1000 Mbps	Max. segment length / km	FO multim ode	FO single mode	POF PCF
X204-2	4	-	2 (BFOC)	-	4* / 5**	●	-	-
X204-2TS	4	-	2 (BFOC)	-	4* / 5**	●	-	-
X204-2LD	4	-	2 (BFOC)	-	26	-	●	-
X206-1	6	-	1 (BFOC)	-	4* / 5**	●	-	-
X206-1LD	6	-	1 (BFOC)	-	26	-	●	-
X208	8	-	-	-	-	-	-	-
X208PRO	-	8	-	-	-	-	-	-
X212-2	12	-	2 (BFOC)	-	4* / 5**	●	-	-
X212-2LD	12	-	2 (BFOC)	-	26	-	●	-
X216	16	-	-	-	-	-	-	-
X224	16	-	-	-	-	-	-	-
XF204	4	-	-	-	-	-	-	-
XF204-2	7	-	2 (BFOC)	-	4* / 5**	●	-	-
XF206-1	6	-	1 (BFOC)	-	4* / 5**	●	-	-
XF208	8	-	-	-	-	-	-	-
X200-4P IRT	-	-	4 (SC RJ)	-	0,05 / 0,100 ****	-	-	●
X201-3P IRT	1	-	3 (SC RJ)	-	0,05 / 0,100 ****	-	-	●
X201-3P IRT PRO	1	-	3 (SC-RJ / push-pull plug PRO)	-	0,05 / 0,100 ****	-	-	●
X202-2IRT	2	-	2 (BFOC)	-	4* / 5**	●	-	-
X202-2P IRT	-	2	2 (SC RJ)	-	0,05 / 0,100 ****	_	-	●

IE Switch	Twisted pair		Fiber-optic cables					
	RJ-45 jacks 10 / 100 Mbps	M12 10 / 100 Mbps	Optical connectors 100 Mbps	Optical connectors 1000 Mbps	Max. segment length / km	FO multim ode	FO single mode	POF PCF
X202-2P IRT PRO	2 (IE RJ-45 plug PRO)	-	2 (SC-RJ / push-pull plug PRO	-	0,05 / 0,100 ****	-	-	●
X204IRT	4	-	-	-	-	-	-	-
X204IRT PRO	4 (IE RJ-45 plug PRO)	-	-	-	-	-	-	-
X204RNA	2 x 2 2 x ports and 2 x PRP ports	-	-	-	-	-	-	-
X204RNA EEC	2 x 2 2 RJ-45 (ports) and 2 x RJ-45 or 2 x SFP modules (PRP ports)	-	2 (Duplex LC)	-	3 (SFP991-1)	●	-	-
		-	2 (Duplex LC)	-	26 (SFP991-1LD) 70 (SFP991-1LH+)	-	●	-

● Suitable / available or according to the specified standard.
* at 50 µm core diameter of the FO cable
** at 62.5 µm core diameter of the FO cable
*** with POF fiber-optic cables 1 - 50 m and PCF fiber-optic cables 1 - 100 m

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Note

TP connectors of SCALANCE X204RNA EEC

2 x RJ-45 for connecting two end devices / network structures without PRP-1 capability and optionally 2 x RJ-45 or 2 x SFP modules for connecting network structures capable of PRP. If an SFP module is inserted, the corresponding RJ-45 jack is disabled.

Example: If SFP module "PRP A" is inserted, the TP Interface "PRP A" has no function

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Note

SCALANCE X200RNA

The networks LAN A and/or LAN B can have PROFINET or IRT functionality. These cannot, however, be transferred via the SCALANCE X200RNA because PRP does not support this. PRP functionality is not impaired by using PROFINET or IRT components in the LAN A and LAN B networks.

Order numbers

X204-2	with four 10/100 Mbps RJ-45 ports and two FO ports 6GK5 204-2BB10-2AA3	**6GK5 204-2BB10-2AA3**
X204-2TS	with four 10/100 Mbps RJ-45 ports and two FO ports with extended temperature range and approval EN 50155 for rolling stock applications	**6GK5 204-2BB10-2CA2**
X204-2LD	with four 10/100 Mbps RJ-45 ports and two FO ports Long Distance	**6GK5 204-2BC10-2AA3**
X206-1	with six 10/100 Mbps RJ-45 ports and one FO port	**6GK5 206-1BB10-2AA3**
X206-1LD	with six 10/100 Mbps RJ-45 ports and one FO port Long Distance	**6GK5 206-1BC10-2AA3**
X208	with eight 10/100 Mbps RJ-45 ports	**6GK5 208-0BA10-2AA3**
X208PRO	with eight 10/100 Mbps M12 ports, incl. eleven M12 dust caps, degree of protection IP65,	**6GK5 208-0HA00-2AA6**
X212-2	with 12 10/100 Mbps RJ-45 ports and two FO ports	**6GK5 212-2BB00-2AA3**
X212-2LD	with 12 10/100 Mbps RJ-45 ports and two FO ports with six 10/100 Mbps RJ-45 ports and one FO port Long Distance	**6GK5 212-2BC00-2AA3**
X216	with 16 10/100 Mbps RJ-45 ports	**6GK5 216-0BA00-2AA3**
X224	with 24 10/100 Mbps RJ-45 ports	**6GK5 224-0BA00-2AA3**
XF204	4 x 10/100 Mbps RJ-45 ports electrical	**6GK5 204-0BA00-2AF2**
XF204-2	4 x 10/100 Mbps RJ-45 ports electrical; 2 x 100 Mbps BFOC ports; optical (multimode, glass), up to max. 5 km	**6GK5 204-2BC00-2AF2**
XF206-1	6 x 10/100 Mbps RJ-45 ports electrical, 1x 100 Mbps BFOC port optical (multimode, glass), up to max. 5 km	**6GK5 206-1BC00-2AF2**
XF208	8 x 10/100 Mbps RJ-45 ports electrical	**6GK5 208-0BA00-2AF2**
X200-4P IRT	4 x 100 Mbps POF/PCF SC RJ ports	**6GK5 200-4AH00-2BA3**
X201-3P IRT	1 x 10/100 Mbps RJ-45 port, 3 x 100 Mbps POF/PCF SC RJ ports	**6GK5 201-3BH00-2BA3**
X201-3P IRT PRO	1 x 10/100 Mbps RJ-45 port, 3 x 100 Mbps POF/PCF SC RJ ports	6GK5 201-3BH00-2BA3
X202-2IRT	2 x 10/100 Mbps RJ-45 ports, 2 x 100 Mbps multimode BFOC ports	**6GK5 202-2BB00-2BA3**
X202-2P IRT	2 x 10/100 Mbps RJ-45 ports, 2 x 100 Mbps POF/PCF SC RJ ports	**6GK5 202-2BH00-2BA3**
X202-2P IRT PRO	2 x 10/100 Mbps RJ-45 push-pull ports, 2 x 100 Mbps POF/PCF SC RJ push-pull ports	**6GK5 202-2JR00-2BA6**
X204IRT	4 x 10/100 Mbps RJ-45 ports	**6GK5 204-0BA00-2BA3**
X204IRT PRO	4 x 10/100 Mbps RJ-45 push-pull ports	**6GK5 204-0JA00-2BA6**
X204RNA	with four 10/100 Mbps RJ-45 ports	**6GK5204-0BA00-2MB2**
X204RNA EEC	with four 10/100 Mbps RJ-45 ports, of which 2 combo ports	**6GK5204-0BS00-2NA3**

4.4.8   SCALANCE X300

4.4.8.1   Description

Figure 4-14   SCALANCE X300

Figure 4-15   SCALANCE XR324-12M

The managed switches SCALANCE X300 from SIMATIC NET are intended for use in high-speed plant networks.

With the HSR redundancy function and standby coupling of rings, high network availability can be achieved. If there is an interruption on the connection between these switches, the SCALANCE X300 IE switch used as redundancy manager acts like a switch and in a very short time creates a linear bus from the ring with redundancy manager. As a result, a functional, end-to-end structure is restored.

Support of IT standards such as VLAN, RSTP, IGMP, and GARP makes seamless integration of automation networks in existing office networks possible.

The IE Switches SCALANCE X300 and XR300 are designed for use in switching cubicles and cabinets. The X300 models have a rugged metal housing with degree of protection IP30 for installation on a DIN rail, on a S7-300 standard rail or for wall mounting. The XR300 models are intended for mounting in a 19" rack.

All devices have a C-PLUG for backing up the configuration data and a signaling contact. They are suitable for use of a redundant power supply.

4.4.8.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	X310FE X306-1LD FE X320-1FE X320-3LD FE	X310X X307-3 X307-3LD X308-2 X308-2LD X308-2LH X308-2LH+ X308-2 X302-7EEC X307-2EEC	X308-2M XR324-12M XR324-4M EEC	X308-2M PoE
Modular system design			●	●
Gigabit Ethernet		●	●	●
PoE Power over Ethernet				●
Diagnostics LED	●	●	●	●
Redundant Power supply	●	●	●	●
On-site display (Set button)	●	●	●	●
C-PLUG slot	●	●	●	●

● Suitable/available or according to the specified standard.

Functions

All devices have the following functions:

- PROFINET diagnostics
- SNMP / SNMP-supported diagnostics
- Topology support (LLDP)
- Command Line Interface
- Web-based Management
- Configuration with STEP 7
- Ring redundancy including RM functionality
- Standby redundancy
- VLAN (Virtual Local Area Network)
- GVRP (Generic VLAN Registration Protocol)
- STP/RSTP (Spanning Tree Protocol/Rapid Spanning Tree Protocol)
- Passive Listening
- IGMP Snooping/Querier (Internet Group Management Protocol)
- GMRP(Generic Multicast Protocol)
- Broadcast/multicast/unicast limiter
- Broadcast blocking
- Access Control List (ACL)
- IEEE 802.1x (Radius)
- Link aggregation

4.4.8.3   Interfaces

Table 4- 7

IE Switch	Twisted pair			Fiber-optic cables				
	RJ-45 connectors 10 / 100 Mbps	RJ-45 connectors 10 / 100 / 1000 Mbps	RJ-45 connectors 10 / 100 / 1000 Mbps with PoE	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Max. segment length / km	Multim ode	Single mode
X304-2FE	4	-	-	2 (SC)	-	5	●	-
X306-1LD FE	6	-	-	1 (SC)	-	26	-	●
X307-3	7	-	-	-	3 (SC)	0.75	●	-
X307-3LD	7	-	-	-	3 (SC)	10	-	●
X308-2	7	1	-	-	2 (SC)	0.75	●	-
X308-2LD	7	1	-	-	2 (SC)	10	-	●
X308-2LH	7	1	-	-	2 (SC)	40	-	●
X308-2LH+	7	1	-	-	2 (SC)	70	-	●
X310	7	3	-	-	-	-	-	●
X310FE	10	-	-	-	-	-	-	-
X320-1FE	20	-	-	1	-	4** / 5***	●	-
X320-3LD FE	20	-	-	1	2 (SC)	5 / 26	●	●
X308-2M	-	4 and *	-	*	*	*	*	*
X308-2M TS	-	4 and *	-	*	*	*	*	*
XR324-12M	-	*	-	-	*	*	*	*
X308-2M PoE	-	-	4	*	*	*	*	*
XR324-4M PoE	-	8 and *	8	*	*	*	*	*
X302-7 EEC	-	2	-	7	-	4** / 5***	●	-
X307-2 EEC	5	2	-	2	-	4** / 5***	●	-

● Suitable / exists or according to specified standard.
* 2 x100/1000 Mbps slots for 2 port media modules, electrical or optical.
** with a core diameter of 50 µm
*** with a core diameter of 62.5 µm

Order numbers

X304-2FE	2 x 100 Mbps SC ports, optical (single mode, glass), up to max. 26 km 4 x 10/100 Mbps RJ-45 ports, electrical	6GK5 304-2BD00-2AA3
X306-1LD FE	1 x 100 Mbps SC port, optical (single mode, glass), up to max. 26 km 6 x 10/100 Mbps RJ-45 ports, electrical	6GK5 306-1BF00-2AA3
X307-3	3 x 1000 Mbps SC ports, optical (multimode, glass), up to max. 750 m 7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 307-3BL00-2AA3
X307-3LD	3 x 1000 Mbps SC ports, optical (single mode, glass), up to max. 10 km 7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 307-3BM00-2AA3
X308-2	2 x 1000 Mbps SC ports, optical (multimode, glass), up to max. 750 m 1 x 10/100/1000 Mbps RJ-45 port, electrical,7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 308-2FL00-2AA3
X308-2LD	2 x 1000 Mbps SC ports, optical (single mode, glass), up to max. 10 km 1 x 10/100/1000 Mbps RJ-45 port, electrical, 7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 308-2FM00-2AA3
X308-2LH	2 x 1000 Mbps SC ports, optical (single mode, glass), up to max. 40 km 1 x 10/100/1000 Mbps RJ-45 port, electrical, 7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 308-2FN00-2AA3
X308-2LH+	2 x 1000 Mbps SC ports, optical (single mode, glass), up to max. 70 km 1 x 10/100/1000 Mbps RJ-45 port, electrical, 7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 308-2FP00-2AA3
X310	3 x 10/100/1000 Mbps RJ-45 ports, electrical 7 x 10/100 Mbps RJ-45 ports, electrical	6GK5 310-0FA00-2AA3
X310FE	10 x 10/100 Mbps RJ-45 ports, electrical	6GK5 310-0BA00-2AA3
X320-1FE	1 x 100 Mbps SC port, optical (multimode, glass), up to max. 5 km 20 x 10/100 Mbps RJ-45 ports, electrical	6GK5 320-1BD00-2AA3
X320-3LD FE	1 x 100 Mbps SC port, optical (multimode, glass), up to max. 5 km 2 x 100 Mbps SC port, optical (single mode, glass), up to max. 26 km 20 x 10/100 Mbps RJ-45 ports, electrical	6GK5 320-3BF00-2AA3
X308-2M	4 x 10/100//1000 Mbps RJ-45 ports, electrical 2 x 10/100/1000 Mbps slots for 2 port media modules, electrical or optical	6GK5 308-2GG00-2AA2
X308-2M TS	4 x 10/100//1000 Mbps RJ-45 ports, electrical 2 x 10/100/1000 Mbps slots for 2 port media modules, electrical or optical, with extended temperature range and EN 50155 approval for railway applications	6GK5 308-2GG00-2CA2
X308-2M PoE	4 x 10/100//1000 Mbps RJ-45 ports with PoE, electrical; 2 x 10/100/1000 Mbps slots for 2 port media modules, electrical or optical	6GK5 308-2QG00-2AA2

XR324-12M	Fully modular 19" Industrial Ethernet switches for setting up electrical and/or optical Industrial Ethernet networks; all ports can be fitted optionally with optical or electrical 2-port media modules); 12 x 10/100/1000 Mbps slots for 2-port media modules, electrical or optical	
	24 VDC power supply	
	Data cable outlet front	**6GK5 324-0GG00-1AR2**
	Data cable outlet at rear	**6GK5 324-0GG00-1HR2**
	Power supply 110 to 230 VAC	
	Data cable outlet front	**6GK5 324-0GG00-3AR2**
	Data cable outlet at rear	**6GK5 324-0GG00-3HR2**
XR324-4M PoE	Partially modular 19" Industrial Ethernet switches for setting up electrical and optical Industrial Ethernet networks; eight ports with PoE capability, can be fitted optionally with optical or electrical 2-port media modules 16 x 10/100/1000 Mbps RJ-45 ports, of which eight support PoE; 4 x 10/100/1000 Mbps slots for 2-port media modules, electrical or optical	
	24 VDC power supply	
	Data cable outlet front	**6GK5 324-4QG00-1AR2**
	Data cable outlet at rear	**6GK5 324-4QG00-1HR2**
	Power supply 110 to 230 VAC	
	Data cable outlet front	**6GK5 324-4QG00-3AR2**
	Data cable outlet at rear	**6GK5 324-4QG00-3HR2**
X302-7 EEC	2 x 10/100/1000 Mbps RJ-45 ports, electrical; 7 x 100 Mbps LC ports, optical (multimode, glass) up to max. 5 km EN 50155 approval for railway stock applications	
	Power supply 110 to 230 VAC	
	1 power supply unit	**6GK5 302-7GD00-1EA3**
	2 power supply units	**6GK5 302-7GD00-2EA3**
	1 x power supply unit with conformal coating	**6GK5 302-7GD00-1GA3**
	2 x power supply unit with conformal coating	**6GK5 302-7GD00-2GA3**
	Power supply 110 to 230 VAC	
	1 power supply unit	**6GK5 302-7GD00-3EA3**
	2 power supply units	**6GK5 302-7GD00-4EA3**
	1 x power supply unit with conformal coating	**6GK5 302-7GD00-3GA3**
	2 x power supply unit with conformal coating	**6GK5 302-7GD00-4GA3**

X307-2 EEC	2 x 10/100/1000 Mbps RJ-45 ports, electrical; 7 x 100 Mbps LC ports, optical (multimode, glass) up to max. 5 km EN 50155 approval for railway stock applications	
	Power supply 110 to 230 VAC	
	1 power supply unit	**6GK5 307-2FD00-1EA3**
	2 power supply units	**6GK5 307-2FD00-2EA3**
	1 x power supply unit with conformal coating	**6GK5 307-2FD00-1GA3**
	2 x power supply unit with conformal coating	**6GK5 307-2FD00-2GA3**
	Power supply 110 to 230 VAC	
	1 power supply unit	**6GK5 307-2FD00-3EA3**
	2 power supply units	**6GK5 307-2FD00-4EA3**
	1 x power supply unit with conformal coating	**6GK5 307-2FD00-3GA3**
	2 x power supply unit with conformal coating	**6GK5 307-2FD00-4GA3**

4.4.8.4   Media modules and SFP transceivers

Media modules

The use of media modules in partially and fully modular variants of the SCALANCE X300 switches allows the expansion of networks by subsequently plugging in additional media modules in unused media module slots and allows a changeover of the cabling technology (the example change from copper to fiber-optic or from multimode to single mode fiber-optic cable).

Media module	Twisted pair		Fiber-optic cables				
	RJ-45 jacks 10 / 100 Mbps	RJ-45 jacks 10 / 100 / 1000 Mbps	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Max. segment length / km	Multimode	Single mode
MM991-2	-	-	2 (ST)	-	4* / 5**	●	-
MM991-2LD	-	-	2 (ST)	-	26	-	●
MM991-2	-	-	2 (SC)	-	4* / 5**	●	-
MM991-2LD	-	-	2 (SC)	-	26	-	●
MM991-2LH+	-	-	2 (SC)	-	70	-	●
MM992-2CUC	-	2	-	-	-	-	-
MM992-2CU	-	2	-	-	-	-	-
MM992-2SFP	-	2	-	-	-	-	-
MM992-2	-	-	-	2 (SC)	0.75	●	-
MM992-2LD	-	-	-	2 (SC)	10	-	●
MM992-2LH	-	-	-	2 (SC)	40	-	●
MM992-2LH+	-	-	-	2 (SC)	70	-	●
MM992-2ELH	-	-	-	2 (SC)	120	-	●

● Suitable / exists or according to specified standard.
* with a core diameter of 50 µm
** with a core diameter of 62.5 µm

SFP transceiver

The SFP transceiver (Small Form-factor Pluggable) can be used only in conjunction with the SFP media module MM992-2SFP.

SFP transceiver	Twisted pair		Fiber-optic cables				
	RJ-45 jacks 10 / 100 Mbps	RJ-45 jacks 10 / 100 / 1000 Mbps	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Max. segment length / km	Multimode	Single mode
SFP991-1	-	-	1 (LC)	-	4* / 5**	●	-
SFP991-1LD	-	-	1 (LC)	-	26	-	●
SFP991-1LH+	-	-	1 (LC)	-	70	-	●
SFP992-1	-	-	-	1 (LC)	0.75	●	-
SFP992-1LD	-	-	-	1 (LC)	10	-	●
SFP992-1LH	-	-	-	1 (LC)	40	-	●
SFP992-1LH+	-	-	-	1 (LC)	70	-	●
SFP992-1ELH	-	-	-	1 (LC)	120	-	●

● Suitable / exists or according to specified standard.
* with a core diameter of 50 µm
** with a core diameter of 62.5 µm

4.4.9 SCALANCE X400

4.4.9.1 Description

Figure 4-16   SCALANCE X400

The SCALANCE X400 product line includes modular Industrial Ethernet switches that can be expanded with various media modules, some also with extender modules. 10/100/1000 Mbps technology is supported for different transmission media (twisted pair, fiber-optic) and increased port requirements. The main areas of application are high-performance plant networks (control level). Due to its partly modular structure, the X400 product line is designed to meet future demands and can be adapted to meet the requirements of a particular task.

Area of application

SCALANCE X400 products allow switched networks to be set up at the control level. In this area, there are not only high demands on the availability of the network and requirements for wide-ranging diagnostics, but also for large numbers of ports, high transmission rates and the support of fiber-optic and twisted pair transmission media. SCALANCE X400 products have degree of protection IP20 for installation in cabinets.

SCALANCE X408-2

● Control rooms with low device density

● Hubs in the plant bus for applications with low device density

● High-speed backbone including fast media redundancy for process control systems

● In the high-speed backbone for linking gigabit network structures

SCALANCE X414-3E

● Control rooms with high device density

● Hubs in the plant bus for applications with high device density

● High-speed backbone including fast media redundancy for process control systems

● SCALANCE X414-3E equipped with layer 3 for IP routing (static, dynamic, redundant)

● A further eight nodes can be connected on the right of the basic device using extender modules.

SCALANCE network components

4.4 SCALANCE X switches and media converters

4.4.9.2   Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	X408-2	X414-3E
Modular system design	●	●
Gigabit Ethernet	●	●
PoE Power over Ethernet	-	-
Redundant Power supply	●	●
Signaling contact	●	●
On-site display (Set button)	●	●
Console port (1 x RS-232)	●	●
8 floating inputs for acquisition of digital status information	-	●
Out-band port for on-site parameter assignment	-	●
C-PLUG slot	●	●

Functions

All devices have the following functions

- PROFINET diagnostics
- Topology support (LLDP)
- Command Line Interface / Telnet
- Web-based Management
- Configuration with STEP 7
- SNMP
- Ring redundancy including RM functionality
- Standby redundancy
- VLAN (Virtual Local Area Network)
- GVRP (Generic VLAN Registration Protocol)
- STP/RSTP (Spanning Tree Protocol/Rapid Spanning Tree Protocol)
- Passive Listening
- IGMP Snooping/Querier (Internet Group Management Protocol)
- GMRP(Generic Multicast Protocol)
- Broadcast/multicast/unicast limiter
- Broadcast blocking
- DHCP Option 82 (Dynamic Host Configuration Protocol)
- Access Control List (MAC)
- IEEE 802.1x (Radius)
- Link aggregation

X414-3E also supports the following layer 3 functions:

- Static IP routing
- RIPv2 (dynamic routing)
- OSPFv2 (dynamic routing)
- VRRP, router redundancy (Virtual Router Redundancy Protocol)

4.4.9.3   Interfaces

The SCALANCE X400 devices have the following integrated interfaces. The total number and the type of interface vary depending on the type and number of media modules used. The properties of the media modules are covered separately.

	SCALANCE X408-2	SCALANCE X414-3E
24 VDC power supply	2 (redundant)	2 (redundant)
Signaling contact	1	1
Transmission speeds	10/100/1000 Mbps via RJ-45	10/100/1000 Mbps via RJ-45
Console port	1 x RS-232	1 x RS-232
Out-band port for on-site parameter assignment		1 x RJ-45
RJ-45 ports	4	12
Universal slots for optical fast or gigabit media modules with 2 ports	2	-
Slots for optical Fast Ethernet media modules with 2 ports	-	2
Floating inputs for acquisition of digital status information	-	8
Connector for extender modules (4 further media modules or 8 x RJ-45)	-	1
Maximum number of network interfaces	12	24

Order numbers

X408-2	Modular Industrial Ethernet switches with integrated RJ-45 ports for setting up electrical and/or optical IE networks; 4 x 10/100/1000 Mbps and 4 x 10/100 Mbps RJ-45 ports; 2 x gigabit/Fast Ethernet media module slots	6GK5 408-2FD00-2AA2
X414-3E	Modular Industrial Ethernet switches with integrated RJ-45 ports for setting up electrical and/or optical IE networks; 2 x 10/100/1000 Mbps and 12 x 10/100 Mbps RJ-45 ports; 1 x gigabit Ethernet and 2 x Fast Ethernet media module slots; 1 x extender interface	6GK5 414-3FC00-2AA2

4.4.9.4 Media modules

Media modules

The Industrial Ethernet SCALANCE X400 devices can be equipped with media modules to allow FO cables to be used. Media modules are available both for multimode FO cables and for single mode FO cables. They can be added or changed during operation. SCALANCE X414-3E supports two optical gigabit Ethernet ports and up to four extra optical Fast Ethernet ports.

An inserted media module for gigabit Ethernet converts the two gigabit Ethernet twisted-pair ports to optical, the onboard ports are disabled. Media modules can be added or replaced during operation

Media module	Fiber-optic cables					
	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Max. segment length / km	Multimode	Single mode	Wavelength
MM491-2	2 (BFOC)	-	4* / 5**	●	-	1310 nm
MM491-2LD	2 (BFOC)	-	26	-	●	1310 nm
MM491-2LH+	2 (SC)	-	70	-	●	1550 nm
MM492-2	-	2 (SC)	0.75	●	-	850 nm
MM492-2LD	-	2 (SC)	10	-	●	1310 nm
MM492-2LH	-	2 (SC)	40	-	●	1550 nm
MM492-2LH+	-	2 (SC)	70	-	●	1550 nm
MM492-2ELH	-	2 (SC)	120	-	●	1550 nm

● Suitable / exists or according to specified standard.
* with a core diameter of 50 µm
** with a core diameter of 62.5 µm

Options for inserting media modules

Media modules can be inserted in the following slots:

Media module	In device	Slot
MM491-2	SCALANCE X414-3E	6, 7
	SCALANCE X408	5, 6
	EM496-4	12 - 15
MM491-2LD	SCALANCE X414-3E	6, 7
	SCALANCE X408	5, 6
	EM496-4	12 - 15
MM491-2LH+	SCALANCE X414-3E	6, 7
	SCALANCE X408	5, 6
	EM496-4	12 - 15
MM492-2	SCALANCE X414-3E	5
	SCALANCE X408	5, 6
MM492-2LD	SCALANCE X414-3E	5
	SCALANCE X408	5, 6
MM492-2LH	SCALANCE X414-3E	5
	SCALANCE X408	5, 6
MM492-2LH+	SCALANCE X414-3E	5
	SCALANCE X408	5, 6
MM492-2ELH	SCALANCE X414-3E	5
	SCALANCE X408	5, 6

4.4.9.5   Extender modules

Overview of the extender modules

The SCALANCE X414-3E has an expansion interface on the right-hand side of the device. An optional extender module can be attached to this interface.

The SCALANCE X408-2 cannot be extended with an extender module.

The following extender module variants are available:

- EM495-8:
  This has 8 twisted-pair 10/100 Mbps ports (RJ-45 jacks). This allows the twelve onboard Fast Ethernet twisted-pair ports of the SCALANCE X414-3E to be extended to a total of 20 ports.
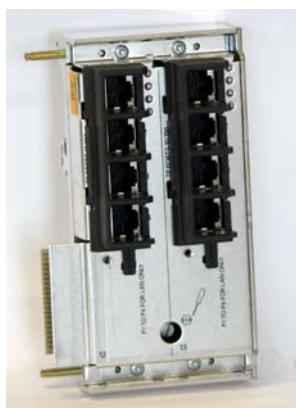
Figure 4-17   Twisted pair extender EM495-8

The twisted pair extenders can also be installed during operation. No media module is required for data transfer with this extender module.

For slots 12 and 13 of the twisted pair extender EM495-8, you can use the cover that can also be used on slots 9 to 11 on the basic device. Two CV490 4x100 covers are supplied with the twisted pair extender.

- EM496-4:
  This has 4 media module slots for the Fast Ethernet media modules MM491-2 and MM491-2LD so that the SCALANCE X414-3E can be extended by up to 8 optical Fast Ethernet ports (100 Mbps).

Figure 4-18   Empty media module extender EM496-4 without protective caps for the media module terminal strips and without cover

Installation of the media module extender and removal or insertion of the media modules is possible during operation. You require at least one media module for data transfer over this extender module.

Mixed operation in slots 12 through 15 with MM491-2 and MM491-2LD modules is possible. The media module plug connectors are protected by protective caps.

Four CV490 2x100 covers are supplied with the twisted media module extender EM496-4. The media module plug connectors are also protected from damage by protective caps.

4.4.10   SCALANCE X500

4.4.10.1   Description

Figure 4-19   SCALANCE XR500

The SCALANCE XR500 switches are ideal for use in industrial networks and for integrating the industrial network into an existing enterprise network. From the controller level to the management level, the switch handles the networking both of plant sections as well as distributed field devices and ensures high plant availability with wide-ranging diagnostics options and high transmission speeds. Due to the scalability of the basic device and the optionally available layer 3 functions, the network can be set up specifically for each particular application and adapted and expanded at any time.

The SCALANCE XR500 switches are suitable for setting up electrical and optical Industrial Ethernet bus, star or ring structures with four integrated SFP+ slots for optional plugging of SFP+ transceivers (10 Gbps) or SFP transceivers (1000 Mbps) and up to 12 media module slots that can be used optionally for electrical and/or optical 4-port media modules. With transmission rates up to 10 Gbps, the switches can be used as Industrial Ethernet backbone switches and as hubs in the plant bus (redundant connection possible).

The use of media modules or SFP+/SFP allows the following:

● The expansion of networks later by plugging in additional media modules in unused media module slots

● Replacing the cabling technology, for example converting from copper to FO cable or from multimode to single mode FO cable

● Changing the transmission rate, for example from 1000 Mbps to 10 Gbps

4.4.10.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	XR552-12M XR528-5M
Modular system design	●
Gigabit Ethernet	●
10 gigabit Ethernet	●
PoE Power over Ethernet	●
Diagnostics LED	●
Redundant Power supply	●
On-site display (Set button)	●
C-PLUG slot	●

● Suitable/available or according to the specified standard.

Functions

All devices have the following functions:

- PROFINET diagnostics
- SNMP / SNMP-supported diagnostics
- Topology support (LLDP)
- Command Line Interface
- Web-based Management
- Configuration with STEP 7
- Ring redundancy including RM functionality
- Standby redundancy
- IRT capability
- VLAN (Virtual Local Area Network)
- GVRP (Generic VLAN Registration Protocol)
- STP/RSTP (Spanning Tree Protocol/Rapid Spanning Tree Protocol)
- Passive Listening
- IGMP Snooping/Querier (Internet Group Management Protocol)
- GMRP(Generic Multicast Protocol)
- Broadcast/multicast/unicast limiter
- Broadcast blocking
- Access Control List (ACL)
- IEEE 802.1x (Radius)
- Link aggregation
- Static IP routing
- RIPv2 (dynamic routing)
- OSPFv2 (dynamic routing)
- VRRP, router redundancy (Virtual Router Redundancy Protocol)

4.4.10.3 Interfaces

Table 4- 8

IE Switch	Number of slots for media modules	Number of slots for SFP+	Number of ports	Modular ports via module slots
XR552-12M	12	4	52	48
XR528-6M	6	4	28	24

Order numbers

XR552-12M	4 x integrated 1/10 Gbps SFP+ slots for SFP or SFP+ transceivers; 12 x 10/100/1000 Mbps slots for 4-port media modules, electrical or optical	
	Data cable outlet front	**6GK5 552-0AA00-2AR2**
	Data cable outlet at rear	**6GK5 552-0AA00-2HR2**
XR528-6M	SFP+ slots for SFP or SFP+ transceivers 6 x 10/100/1000 Mbps slots for 4-port media modules, electrical or optical	
	Data cable outlet front	**6GK5 528-0AA00-2AR2**
	Data cable outlet at rear	**6GK5 528-0AA00-2HR2**

Media modules

The use of media modules in the SCALANCE X-500 IE switches allows the expansion of networks by subsequently plugging in additional media modules in unused media module slots and allows a changeover of the cabling technology (for example change from copper to fiber-optic or from multimode to single mode fiber-optic cable).

Media module	Twisted pair	Fiber-optic cables					
	RJ-45 jacks 10 / 100 / 1000 Mbps	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Fiber-optic ports 10 000 Mbps	Max. segment length / km	Multimode	Single mode
MM992-4	-	-	4 (SC)	-	4* / 5**	●	-
MM992-4CU	4	-	-	-	-	-	-
MM992-4CUC	4 [1]	-	-	-	-	-	-
MM992-4LD	-	-	4 (SC)	-	10	-	●
MM992-4PoEC	4 [1]	-	-	-	-	-	-
MM992-4PoE	4	-	-	-	-	-	-
MM992-4SFP	-	4 (LC)[2]	4 (LC)[2]	4 (LC)[2]		●	●
MM991-4	-	-	4 (SC)	-	4* / 5**	●	-
MM991-4LD	-	-	4 (SC)		10	-	●

● Suitable / available or according to the specified standard.
* at 50 μm core diameter
** at 62.5 μm core diameter
[1] securing collars
[2] the SFP slot module MM992-4FP can accommodate a total of maximum 4 x 1-port SFP modules

SFP transceiver

The SFP transceiver (Small Form-factor Pluggable) can be used only in conjunction with the SFP media module MM992-4SFP.

Media modules	Fiber-optic cables					
	Fiber-optic ports 100 Mbps	Fiber-optic ports 1000 Mbps	Fiber-optic ports 10 000 Mbps	Max. segment length / km	Multimode	Single mode
SFP991-1 [1]	1 (LC)	-	-	4* / 5**	●	-
SFP991-1LD [1]	1 (LC)	-	-	26	-	●
SFP991-1LH [1]	1 (LC)	-	-	26	-	●
SFP992-1 [1][2]	-	1 (LC)	-	0.75	●	-
SFP992-1LD [1][2]	-	1 (LC)	-	10	-	●
SFP992-1LH [1][2]	-	1 (LC)	-	40	-	●
SFP992-1LH+ [1][2]	-	1 (LC)	-	70	-	●
SFP992-1ELH [1][2]		1 (LC)	-	120	-	●
SFP993-1 [2]	-	-	1 (LC)	0.3	●	-
SFP993-1LD [2]		-	1 (LC)	10	-	●
SFP993-1L [2]	-	-	1 (LC)	40	-	●

● Suitable / available or according to the specified standard.
* at 50 µm core diameter
** at 62.5 µm core diameter
[1] can only be plugged in along with SFP slot module MM992-4SFP
[2] can only be plugged into integrated XR-500 SFPplus slots

Optional external power supply units

Optional external power supply units are available to supply power to the switches of the SCALANCE X-500 series. You can create a redundant power supply by installing two power supply units for one switch in the rack.

Figure 4-20   SCALANCE X-500 power supply unit

Connectors

Type	Power	Input voltage	Output voltage
PS598-1	300 W	100 to 240 VAC	24 VDC

Note

Two connectors for the 24 VDC output voltage

The PS598-1 has two connectors with the output voltage 24 VDC. Note that you can only use one connector on the front or the connector on the rear of the PS598-1. You cannot operate the device with the connectors on the front and rear at the same time.

Note

Requirement for connecting at the rear

Note that the connector on the rear of the PS598-1 can only be used if the power supply is mounted on the SCALANCE XR-500M.

Note

Replacing the filter mat

To replace the filter mat, use the material Viledon P 15/150 G2 EN 779. The dimensions of the filter mat are 38 x 135 x 8 mm (H x W x D).

4.5 SCALANCE W components for Industrial Wireless LAN

4.5.1 SCALANCE W devices

Introduction

The SCALANCE W products can be subjected to fluctuations in the extended temperature range without coming into contact with dust or water. Rugged housing and construction protecting from shock and vibration allow use in a harsh industrial environment. Accessories such as antennas, power supply units and cabling are also part of this concept and manufactured to be suitable for industry. Power and data are transferred by Power-over-Ethernet on one cable saving investment and maintenance costs. The C-PLUG (configuration plug) exchangeable medium stores engineering and configuration data allowing a module to be replaced quickly and without specially trained personnel. This minimizes downtimes and saves training costs

To protect against unauthorized access, the products provide modern standard mechanisms for user identification (authentication) and encryption of data, but at the same time can also be easily integrated into existing security concepts.

With the international standard IEEE 802.11n, wireless communication via IWLAN has become even more rugged. The greatest advantage is the use of multipath propagation (Multiple Input, Multiple Output (MIMO)). This allows devices to use several antennas at the same time. This achieves a higher data rate and at the same time reduces susceptibility to disruptions in areas with many reflections.

- Access points

  Access points are the central base stations for infrastructure networks. They coordinate and control the wireless traffic within a wireless cell. If there are two or more access points in a wireless network, in other words, same wireless network name (SSID), the client module can move between the wireless cells formed by the individual access points (roaming). The wireless connection is retained during roaming. This technique is used when the required wireless coverage is greater than the distance that can be covered by a single access point. All access points can also be configured so that they are restricted to client functionality

- Client modules
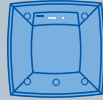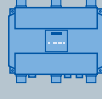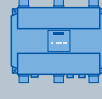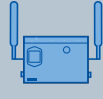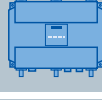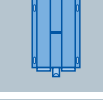
  The client modules of the SCALANCE W product line are used as gateways from wireless to wired network segments (bridge function). Normally, they communicate with an access point (infrastructure network).

- IWLAN controller

  The IWLAN controller SCALANCE W product line manages and coordinates controller-based access points.

Overview of the performance classes of the SCALANCE W devices devices

In the overview graphic below, you can see which performance classes are covered by the various SCALANCE W devices.

		Industrial Wireless LAN acc. to IEEE 802.11		Industrial Wireless LAN incl. iFeatures	
		Access Points	Client Modules	Access Points	Client Modules
For outdoors	802.11a/b/g + 802.11n	W786 RJ45 / W786 SFP		W786-2RR	
For indoors		W788 M12	W748 M12	W788-1RR / W788-2RR	W747-1RR
For cabinet		W788 RJ45	W748 RJ45	W784-1RR	W747-1
	802.11a/b/g	W784-1	W744-1 / W746-1		IWLAN / PB Link PN IO

Figure 4-21   Overview of the SCALANCE W network components

Example of a topology
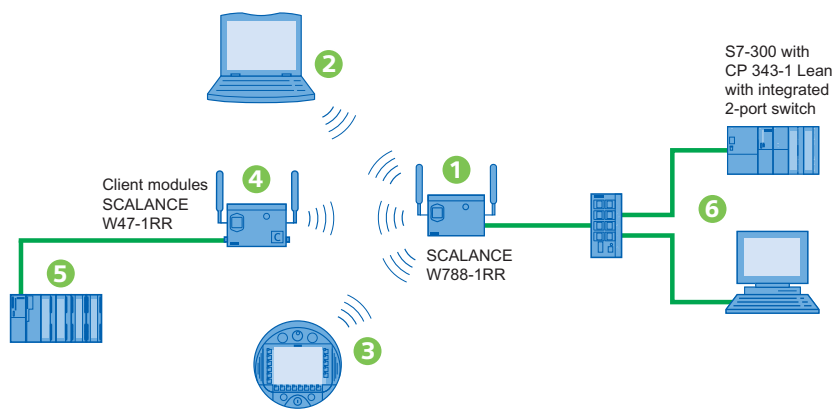
Figure 4-22   Example of an infrastructure network:
A SCALANCE W788-1RR ① adopts the function of the access point. Mobile nodes such as PC/PG with IWLAN card ②, IWLAN control panels ③ or WLAN clients ④ and their nodes ⑤ can communicate with each other or exchange data with stationary nodes ⑥.

Note

You will find more information on the configuration parameters of the particular SCALANCE W device in the online help systems of Web Based Management.

4.5.2 Type designations

Identify the SCALANCE W devices based on their type key. The design and basic characteristics can be identified based on the following type key

Type designations for SCALANCE W devices according to IEEE 802.11n

RJ-45 **Ethernet copper cable**
SFP **Ethernet fiber-optic cable**
M12 **M12 slot**

[-] Connection options for external antennas
IA internal antennas

Number of WLAN interfaces

[-] Devices for use without IWLAN controller
C Devices for use with an IWLAN controller

6 Metal housing and plastic cover
8 Metal housing

4 Client
8 Access point

Type designations for SCALANCE W devices according to IEEE 802.11a/b/g

W7⬜⬜-⬜⬜⬜

[-] **Devices without Rapid Roaming**
RR **Devices with Rapid Roaming**

[-] **Degree of protection IP30**
PRO **Degree of protection IP65**

Number of WLAN interfaces

[Access point]
  4 **For installation in a cabinet or for integration in device or for integration in devices**
  8 **For installation without cabinet indoors**
  6 **For outdoor environments with demanding climatic requirements**
[Client]
  4 **For installation in a cabinet**
  6 **or for integration in devices**
  7 **Interface with iPCF capability**

4 **Client**
8 **Access point**

4.5.3   Functions of WLAN devices

Introduction

This section describes certain functions of SCALANCE W devices. For further information on all the functions, refer to the operating instructions of the individual devices or the configuration manual.

Authentication and encryption

Authentication and encryption protect a network from unauthorized access. This is achieved by an exchange of keys or certificates between client and server. There are various methods that are explained in detail in the SCALANCE W700 configuration manual and in the section "Encryption and data security (Page 44)".

Support of IEEE 802.11n

With SCALANCE W700 devices that support IEEE 802.11n, a data throughput up to 450 Mbps (gross) is possible, see section "IEEE 802.11n (Page 40)". These devices also support the following functions:

- Frame aggregation
- Accelerated guard interval
- Channel bonding

SCALANCE W devices as bridges

A bridge is a network component that connects two networks. A bridge is not dependent on the protocol; management of the data packages is based on the physical address of the network nodes, MAC address. The SCALANCE W provides bridge functionality for handling data exchange between wired and wireless Ethernet.

- **Learning Table**

  SCALANCE W devices log the information about which MAC address can be reached over which port in a learning table.

- **NAPT: Network Address Port Translation**

  With Network Address Port Translation (NAPT) or Port Address Translation (PAT), several internal source IP addresses are translated into the same external source IP address. This function is only available on clients in client mode.

Special functions for industrial applications

The following functions are used especially in an industrial environment:

- **IPCF: Industrial Point Coordination Function**

  IPCF is the functional expansion of the IEEE 802.11 standard for applications requiring real time and a deterministic response (predictable reply times). This allows Rapid Roaming of mobile nodes from one RF field to the next. Wireless and secure PROFINET IO communication is also supported with the SIMATIC Mobile Panel 277F IWLAN.

- **IPCF-MC: IPCF Management Channel**

  The IPCF Management Channel, IPCF MC, is a further development of iPCF. This mode should be used when IWLAN nodes that also support iPCF MC are moving freely in the RF field. In particular when using omnidirectional antennas, when deterministic data needs to be exchanged.

- **iQoS: industrial Quality of Service**

  iQoS (industrial Quality of Service) is a method with which a specified transfer capacity is reserved for necessary clients. This method is used in areas in which predefined response times need to be guaranteed.

- **Dual client**

  In the dual client technique, devices connect to a wireless network not through a WLAN client as normal but through two client devices. These two devices handle different functions. The active client handles the normal data traffic with the access point as it would without the second client connected.
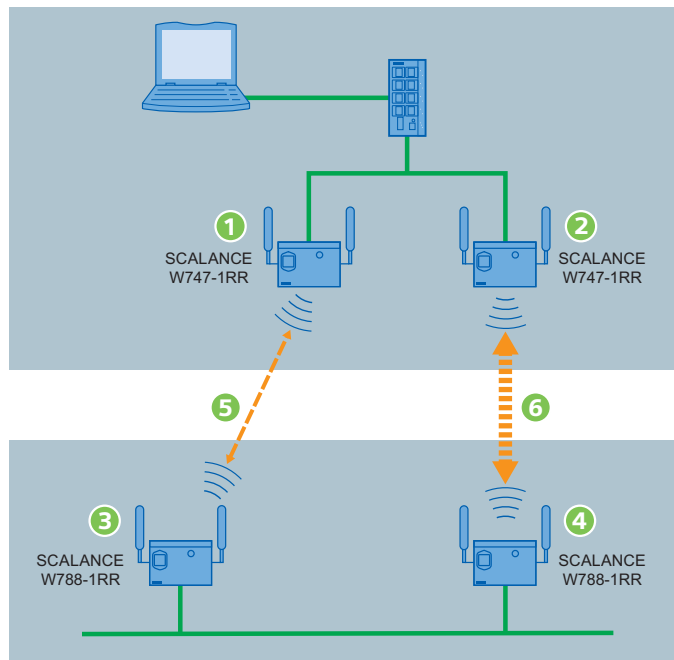
Figure 4-23   Clients ① and ② are used in the mode shown as dual clients. There is an active connection ⑥ between the client ② and access point ④. Data is exchanged via this. There is also a connection ⑤ between client ① and access point ③. Here, this is a standby connection without data exchange.

The second client known as the standby client scans the RF field permanently for alternative access points and always establishes a connection to the access point providing the best transmission quality. There is, however, no data transfer. The standby client also receives information on the quality of the connection between the active client and access point at regular intervals.

As soon as the connection quality of the standby client to the connected access point is better than the quality of the connection between the active client and access point, there is a switchover within a few milliseconds and the previous standby client takes over the data transfer. The previously active client now takes on the role of standby client and scans the RF field for access points.

For each dual client connection, there must therefore be two client devices interconnected over Ethernet. The two clients do not necessarily need to be of the same type.

4.5.4 SCALANCE W784

4.5.4.1 Description

Figure 4-24   SCALANCE W784 Access Point

The access points of the SCALANCE W784 product line are intended for installation in cabinets. These device types can also be operated as client modules. As an alternative, the client modules of the SCALANCE W740 series are also available for this mode.

Due to its compact and space-saving design, the SCALANCE W784 device line is particularly suitable for applications in which IWLAN is used in the cabinet or needs to be integrated in a device or machine.

SCALANCE W784 access points have an IP30 aluminum housing to provide protection against mechanical and electromagnetic influences.

In conjunction with the SCALANCE W740 client modules with degree of protection IP30, infrastructures can be set up in which large temperature differences or protection from dust and water are less important.

SCALANCE W784 Access Points are produced in two variants:

- SCALANCE W784-1

- SCALANCE W784-1RR with an integrated wireless card and a wireless interface capable of iPCF.

The SCALANCE W784-1RR access point with rapid roaming, just like the SCALANCE W-788 product line, provides an expanded range of functions such as iPCF mode. This allows applications with real-time requirements and deterministic response times to be implemented for wireless networks even during roaming. This means that wireless PROFINET IO is supported.

4.5.4.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

Functionality	W784-1 W784-1RR [2]
PoE Power over Ethernet (IEEE 802.3at Type 1, previously IEEE 802.3af)	●
Redundant power supply	●
Digital input / digital output	
C-PLUG slot	●
IP degree of protection	IP30
Operating temperature minimum [°C]	-20
Operating temperature maximum [°C]	+60
Resistant to condensation	
Resistant to salt water spray	
Use in EX Zone 2 [1]	●
IEEE 802.11 a/b/g/h	●
Number of supported IP nodes	8
Number of supported MAC nodes	Several

● Suitable / available or according to the specified standard.

   [1] Note installation instructions.

   [2] The device type W784-1RR is intended for the iPCF mode

Functions

All devices have the following functions:

- Support of forced roaming
- SSH / HTTPS / admin password
- WEP / WPA / WPA2
- IEEE 802.11i, Hidden SSID
- IEEE 802.1X (RADIUS)
- EAP-TLS, EAP-TTLS, PEAP
- NAT / NAPT
- iQoS: industrial Quality of Service
- IEEE 802.11e (QoS/WMM)
- STP / RSTP (IEEE 802.1d/w)
- WDS (Wireless Distribution System)
- Operation possible as IWLAN client
- VLANs (Multi-SSID)
- PROFINET IO diagnostics
- SNMP
- Syslog

W784-1RR also has the following functions:

- Dual client
- iHOP
- iPCF

4.5.4.3   Interfaces

Table 4- 9

Functionality	W784-1 W784-1RR
Number of wireless interfaces	1
Connectors for external antennas	2 (R-SMA connector female)
Ethernet port	RJ-45

Order numbers

W784-1	Ethernet interface RJ-45, 2 external antennas	6GK5784-1AA30-2AA0 6GK5784-1AA30-2AB0 [1]
W784-1RR	Ethernet interface RJ-45, 2 external antennas, Rapid Roaming	6GK5784-1AA30-6AA0 6GK5784-1AA30-6AB0 [1]

[1]   US variant

4.5.5 SCALANCE W786

4.5.5.1 Description

Figure 4-25   SCALANCE W786 Access Point

SCALANCE W786 products are intended for applications with demanding climatic requirements for installation outdoors and/or in areas open to the public.
Areas of application include, for example harbors, public spaces or public transport. The functions correspond to the IEEE 802.11a/b/g/h and IEEE 802.11n standards.

The access points are designed for ruggedness. No parts that can be damaged are led out of the devices. The SCALANCE W786 devices have a housing that is resistant to impact and shock and tensile compression.

SCALANCE W786 access points according to IEEE 802.11a/b/g/h

The SCALANCE W786-1PRO/ -2PRO/ -3PRO devices are access points with the same construction with 1 - 3 wireless interfaces and standardized electrical RJ-45 or fiber-optic cable connectors. Thanks to the fiber-optic cable connectors, links strongly affected by interference can be bridged using multimode cables up to 3000 m long.

With SCALANCE W786-3PRO, two wireless interfaces allow communication between the access points. The third wireless interface establishes the RF field for the nodes, for example a driverless transport system. With this concept, it is possible to implement meshed networks.

The SCALANCE W786-1RR and -2RR access points are equipped with an RJ-45 Ethernet interface and are intended for iPCF mode.

SCALANCE W786 access points according to IEEE 802.11n

The SCALANCE W786-1 RJ-45 device type is equipped with a wireless card, SCALANCE W786-2 RJ-45 with two wireless cards. There are two variants of the SCALANCE W786-2 RJ-45 access point. For use indoors equipped with six internal antennas, for outdoors with six external antennas.

The SCALANCE W786-2HPW is an access point suitable only for operation with a Siemens HiPath Wireless Controller.

The SCALANCE W786-2 SFP access point has class of protection IP20. Two wireless cards are integrated in the device.

4.5.5.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	W786-1PRO W786-2PRO W786-3PRO W786-1RR [2] W786-2RR [2] W786-2HPW [3]	W786-1 RJ-45 W786-2 RJ-45 W786-2IA RJ-45	W786-2 SFP
PoE (Power-over-Ethernet) IEEE 802.3at Type 1, previously IEEE 802.3af.	●	●	
Redundant power supply	●	●	●
Digital input / digital output	●	●	●
C-PLUG slot	●	●	●
IP degree of protection	IP65	IP65	IP20
Operating temperature minimum [°C]	-40	-40	-40
Operating temperature maximum [°C]	+70	+60	+60
Resistant to condensation	●	●	●
Resistant to salt water spray	●	●	●
UV resistant	●	●	●
Use in EX Zone 2 [1]	●		●
IEEE 802.11a/b/g/h	●	●	●
IEEE 802.11n		●	●

● Suitable / available or according to the specified standard.

   [1] Note the installation instructions

   [2] The device types W786-1RR / -2RR are intended for the iPCF mode.

[3]   The device type W786-2HPW is intended for use without a C-PLUG.

Functions

All devices have the following functions:
- SSH / HTTPS / admin password
- WEP / WPA / WPA2
- IEEE 802.11i, Hidden SSID
- IEEE 802.1x (RADIUS)
- EAP-TLS, EAP-TTLS, PEAP
- IEEE 802.11e (QoS/WMM)
- STP / RSTP (IEEE 802.1d/w)
- WDS (Wireless Distribution System)
- Operation possible as IWLAN client
- VLANs (Multi-SSID)
- PROFINET IO diagnostics
- SNMPv1/v2/v3
- Syslog

Apart from W786-2HPW, the devices have the following functions:
- Support of forced roaming
- Wireless redundancy between access points
- Operation as IWLAN client

W786-xRR and W786-xPRO also have the following functions:
- NAT / NAPT
- iQoS: industrial Quality of Service

W786-1RR and W786-2RR also have the following functions:
- Dual client
- iHOP
- iPCF

W786-2 RR also has the following function:
- iPCF-MC

4.5.5.3   Interfaces

Table 4- 10

	W786-1PRO W786-2PRO W786-3PRO W786-1RR [1] W786-2RR [1] W786-2HPW	W786-1 RJ-45 W786-2 RJ-45 W786-2IA RJ-45 [2]	W786-2 SFP
Number of wireless interfaces	1 – 3	1 – 2	2
Connectors for external antennas	2 – 6	3 – 6	6
Ethernet port	RJ-45 / BFOC	RJ-45	SFP

[1]   W786-1RR and W786-2RR are equipped with an RJ-45 Ethernet interface.

[2] W786-2IA RJ-45 is equipped for internal use with 6 internal antennas.

Order numbers

W786-1PRO	Ethernet interface RJ-45, 1 internal antenna	6GK5786-1BA60-2AA0 6GK5786-1BA60-2AB0 [1]
W786-1PRO	Ethernet interface RJ-45, 1 external antenna	6GK5786-1AA60-2AA0 6GK5786-1AA60-2AB0 [1]
W786-1PRO	1 ST duplex multimode FO cable, 1 internal antenna	6GK5786-1BB60-2AA0 6GK5786-1BB60-2AB0 [1]
W786-1PRO	1 ST duplex multimode FO cable, 1 external antenna	6GK5786-1AB60-2AA0 6GK5786-1AB60-2AB0 [1]
W786-2PRO	Ethernet interface RJ-45, 2 internal antennas	6GK5786-2BA60-2AA0 6GK5786-2BA60-2AB0 [1]
W786-2PRO	Ethernet interface RJ-45, 2 external antennas	6GK5786-2AA60-2AA0 6GK5786-2AA60-2AB0 [1]
W786-2PRO	1 ST duplex multimode FO cable, 2 internal antennas	6GK5786-2BB60-2AA0 6GK5786-2BB60-2AB0 [1]
W786-2PRO	1 ST duplex multimode FO cable, 2 external antennas	6GK5786-2AB60-2AA0 6GK5786-2AB60-2AB0 [1]
W786-3PRO	Ethernet interface RJ-45, 3 external antennas	6GK5786-3AA60-2AA0 6GK5786-3AA60-2AB0 [1]
W786-3PRO	1 ST duplex multimode FO cable, 3 external antennas	6GK5786-3AB60-2AA0 6GK5786-3AB60-2AB0 [1]
W786-1RR	Ethernet interface RJ-45, 2 internal antennas	6GK5786-2BA60-6AA0 6GK5786-2BA60-6AB0 [1]
W786-2RR	Ethernet interface RJ-45, 2 external antennas	6GK5786-2AA60-6AA0 6GK5786-2AA60-6AB0 [1]
W786-2HPW [2]	Ethernet interface RJ-45, 2 internal antennas	6GK5786-2BA60-1CA0
W786-2HPW [2]	Ethernet interface RJ-45, 2 external antennas	6GK5786-2AA60-1CA0
W786-2HPW [2]	1 ST duplex multimode FO cable, 2 internal antennas	6GK5786-2BB60-1CA0
W786-2HPW [2]	1 ST duplex multimode FO cable, 2 external antennas	6GK5786-2AB60-1CA0
W786-1 RJ-45	Ethernet interface RJ-45, 3 external antennas	6GK5786-1FC00-0AA0 6GK5786-1FC00-0AB0 [1]
W786-2 RJ-45	Ethernet interface RJ-45, 6 external antennas	6GK5786-2FC00-0AA0 6GK5786-2FC00-0AB0 [1]
W786-2IA RJ-45	Ethernet interface RJ-45, 6 internal antennas	6GK5786-2HC00-0AA0 6GK5786-2HC00-0AB0 [1]
W786-2 SFP	SFP slot, 6 external antennas	6GK5786-2FE00-0AA0

[1] US variant
[2] The device types of the W786-2HPW do not currently have a US variant on the market.

4.5.6 SCALANCE W788-x M12/ -x RJ-45 and client modules

4.5.6.1 Description

Description

Figure 4-26   SCALANCE W788 M12 access point

The access points W788x M12/-x RJ-45 and the client modules W748 M12/RJ-45 support the IEEE 802.11n standard. These devices are intended for setting up Industrial Wireless LAN (IWLAN) wireless networks for 2.4 GHz or 5 GHz.

The standard supports data rates up to 450 Mbps. The high data rate is achieved among other things by using channel bonding and by 3 x 3 MIMO technology (Multiple Input, Multiple Output), see section IEEE 802.11n (Page 40). To achieve this, the devices use three data streams to send and receive wireless signals at the same time.

The access points SCALANCE W788-x M12 and the client modules SCALANCE W748 M12 can be installed in areas with suitable wireless conditions indoors outside a cabinet. The IP65 housing and the connectors can withstand high loads caused by shock and vibration since all connectors are screwed or locked in position. To achieve optimum illumination for special applications, the supplied antennas can be replaced.

The access points SCALANCE W788-x RJ-45 and the client module SCALANCE W748 RJ-45 are particularly suited for applications in which the access point needs to be installed in a cabinet. The rugged aluminum housing of the SCALANCE W788 RJ-45 devices with degree of protection IP30 provides protection from mechanical and electromagnetic load and is a cost-effective alternative for use indoors.

4.5.6.2   Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	Access points		Client modules	
	W788-1 M12 W788-2 M12	W788-1 RJ-45 W788-2 RJ-45	W748-1 M12	W748-1 RJ-45
PoE (Power-over-Ethernet) IEEE 802.3at Type 1, previously IEEE 802.3af.	●	●	●	●
Redundant power supply	●	●	●	●
Digital input / digital output	-	●	-	●
C-PLUG slot	●	●	●	●
IP degree of protection	IP65	IP30	IP65	IP30
Operating temperature minimum [°C]	-20	-20	-20	-20
Operating temperature maximum [°C]	+60	+60	+60	+60
Resistant to condensation	-	-	-	-
Resistant to salt water spray	-	-	-	-
UV resistant	-	-	-	-
Use in EX Zone 2 [1]	-	-	-	-
IEEE 802.11a/b/g/h	●	●	●	●
IEEE 802.11n MIMO (input x output streams)	3 x 3	3 x 3	3 x 3	3 x 3

● Suitable / available or according to the specified standard.

   [1] Note installation instructions

Functions

All devices have the following functions:

- SSH / HTTPS / admin password
- WEP / WPA / WPA2
- IEEE 802.11i, Hidden SSID
- IEEE 802.1x (RADIUS)
- EAP-TLS, EAP-TTLS, PEAP
- PROFINET IO diagnostics
- SNMP
- Syslog

The access points also have the following functions:

- Support of forced roaming
- IEEE 802.11e (QoS/WMM)
- STP / RSTP (IEEE 802.1d/w)
- WDS (Wireless Distribution System)
- Operation possible as IWLAN client
- VLANs (Multi-SSID)

4.5.6.3 Interfaces

Table 4- 11

Functionality	W788-1 M12 W748-1 M12 [1]	W788-2 M12	W788-1 RJ45 W748-1 RJ45 [1]	W788-2 RJ-45
WLAN interface	1	2	1	2
Connectors for internal antennas	-	-	6	-
Connectors for external antennas	3 (N-Connect female)	6 (N-Connect female)	3 (R-SMA connector female)	6 (R-SMA connector female)
Ethernet port	M12	M12	RJ-45	RJ-45
Version for network components or end devices	1 (x-coded)	1	1	1
Connectors for power supply	1	1	1	1
Design of the electrical connections for the power supply	M12 interface (4-pin, A-coded), PoE		4-pin screw terminal incl. PoE	

[1] The Ethernet interfaces correspond to the specific type designation of the assigned client module.

SCALANCE network components

4.5 SCALANCE W components for Industrial Wireless LAN

Order numbers

Access points		
W788-1 M12 [2]	Ethernet interface M12, 3 external antennas	6GK5 788-1GD00-0AA0 6GK5 788-1GD00-0AB0 [1]
W788-2 M12 [3]	Ethernet interface M12, 6 external antennas	6GK5 788-2GD00-0AA0 6GK5 788-2GD00-0AB0 [1]
W788-1 RJ-45 [2]	Ethernet interface RJ-45, 3 external antennas	6GK5 788-1FC00-0AA0 6GK5 788-1FC00-0AB0 [1]
W788-2 RJ-45 [3]	Ethernet interface RJ-45, 6 external antennas	6GK5 788-2FC00-0AA0 6GK5 788-2FC00-0AB0 [1]
Client modules		
W748-1 M12	Ethernet interface M12	6GK5 748-1GD00-0AA0 6GK5 748-1GD00-0AB0 [1]
W748-1 RJ-45	Ethernet interface RJ-45, 3 external antennas	6GK5 748-1FC00-0AA0 6GK5 748-1FC00-0AB0 [1]

[1] US variant
[2] One integrated wireless card
[3] Two integrated wireless cards

4.5.7 SCALANCE W788-xPRO/ -xRR and client modules

4.5.7.1 Description

Figure 4-27   SCALANCE W788-1PRO access point

The SCALANCE W788 access points have a rugged metal housing and are designed for demanding mechanical requirements in industrial applications without installation in cabinets. These can be installed indoors at locations suitable for wireless. The housing and the connectors can withstand high loads caused by shock and vibration since all connectors are screwed or locked in position. To achieve optimum illumination for special applications, the supplied antennas can be replaced.

The W788-2PRO and W788-2RR access points with two wireless interfaces have two separate wireless modules. The wireless modules operate as two separate devices. This allows cost-effective solutions to be implemented, for example where one wireless interface is used for wireless connection of a distant production facility and the second wireless interface provides an RF field within the vicinity of the access point.

Within the RF field, local nodes can log in and move freely. Two separate wireless modules also provide the option of having redundant RF fields to achieve a high degree of operating reliability.

The client modules are designed for use indoors and outdoors in industrial applications and for cost-effective integration in an cabinet. They provide a reliable wireless link that can be transferred quickly from one access point to the next (roaming). This allows processes to be monitored and production losses due to machine stoppages to be avoided. Industrial Wireless LAN (IWLAN) can also be used in manufacturing automation for time-critical applications (PROFINET IO) or for safety-related signals (PROFIsafe).

The client modules W746-1PRO and W747-1RR are designed to manage the wireless links of up to eight connected devices with an Industrial Ethernet connector with degree of protection IP65.

SCALANCE W access points and clients with the extension "RR" in the device name also have a wireless interface with iPCF capability.

4.5.7.2   Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

	Access points		Client modules
	W788-1PRO [2] W788-2PRO	W788-1RR W788-2RR	W744-1PRO W746-1PRO W747-1RR [2]
PoE (Power-over-Ethernet) IEEE 802.3at Type 1, previously IEEE 802.3af.	●	●	●
Redundant power supply	●	●	●
Digital input / digital output			
C-PLUG slot	●	●	●
IP degree of protection	IP65	IP65	IP65
Operating temperature minimum [°C]	-20	-20	-20
Operating temperature maximum [°C]	+60	+60	+60
Resistant to condensation	●	●	●
Resistant to salt water spray			
UV resistant			
Use in EX Zone 2 [1] [3]	●	●	●
IEEE 802.11a/b/g/h	●	●	●
IEEE 802.11n			

● Suitable / available or according to the specified standard.

[1] Note the installation instructions

[2] The client module W747-1RR is not for use in Ex zone 2.

Functions

All devices have the following functions:

- SSH / HTTPS / admin password
- WEP / WPA / WPA2
- IEEE 802.11i, Hidden SSID
- IEEE 802.1x (RADIUS)
- NAT / NAPT
- EAP-TLS, EAP-TTLS, PEAP
- VLANs (Multi-SSID)
- SNMP
- Syslog

The access points also have the following functions:

- Support of forced roaming
- Operation possible as IWLAN client
- WDS (Wireless Distribution System)
- IEEE 802.11e (QoS/WMM)
- STP / RSTP (IEEE 802.1d/w)

The access points W788-xRR and the client module W747-1RR also have the following functions:

- iPCF
- iPCF-MC
- iHOP
- iQoS
- Dual client

4.5.7.3 Interfaces

Table 4- 12

	W788-1PRO W788-2PRO	W788-1RR [1] W788-2RR [1]	W744-1PRO W746-1PRO W747-1RR [1]
Number of wireless interfaces	1 - 2	1 - 2	1
Connectors for external antennas	2 - 4	2 - 4	2
Ethernet port	RJ-45	RJ-45	RJ-45

[1] Has a wireless interface with iPCF capability.

Order numbers

Access points		
W788-1PRO	Ethernet interface RJ-45, 2 external antennas	**6GK5 788-1AA60-2AA0** **6GK5 788-1AA60-2AB0** [1]
W788-2PRO	Ethernet interface RJ-45, 4 external antennas	**6GK5 788-2AA60-2AA0** **6GK5 788-2AA60-2AB0** [1]
W788-1RR	Ethernet interface RJ-45, 2 external antennas	**6GK5 788-1AA60-6AA0** **6GK5 788-1AA60-6AB0** [1]
W788-2RR	Ethernet interface RJ-45, 4 external antennas	**6GK5 788-2AA60-6AA0** **6GK5 788-2AA60-6AB0** [1]
Client modules		
W744-1PRO [1]	Ethernet interface RJ-45, 2 external antennas	**6GK5 744-1AA60-2AA0** **6GK5 744-1AA60-2AB0** [1]
W746-1PRO	Ethernet interface RJ-45, 2 external antennas	**6GK5 746-1AA60-4AA0** **6GK5 746-1AA60-4AB0** [1]
W747-1RR	Ethernet interface RJ-45, 2 external antennas	**6GK5 747-1AA60-6AA0** **6GK5 747-1AA60-6AB0** [1]

[1]   US variant

4.5.8 SCALANCE WLC711, W788C and W786C

4.5.8.1 Description

Figure 4-28   SCALANCE WLC711

The IWLAN controller SCALANCE WLC711 manages wireless networks as the central station. The controller provides support during commissioning, diagnostics and access control as well as the security settings of the wireless networks and firmware updates of the access points. This reduces the effort and costs for commissioning and operation of larger IWLAN installations. Only controller-based access points can be used with the controller.

Redundant operation of two IWLAN controllers increases the availability of the communications network.

The device with degree of protection IP 20 is licensed for the connection of up to 16 controller-based access points of the SCALANCE W78xC product line, of the SCALANCE W786-2HPW according to IEEE 802.11n and IEEE 802.11a/ b/ g.

With licensing, this function can be expanded to 32 access points in standard mode. New access points are detected automatically.

The SCALANCE IWLAN controller WLC711 also supports:

- Up to 64 access points in redundant mode with two IWLAN controllers.
- Up to 512 WLAN clients
- Up to 8 logical, service-based networks (Virtual Network Services)

Controller-based access points SCALANCE W788C and W786C

The SCALANCE W788C-2 RJ-45 device with degree of protection IP30 is designed like all other controller access points for setting up Industrial Wireless LAN (IWLAN) wireless networks in the 2.4 GHz or 5 GHz frequency band. The rugged aluminum housing is resistant to both shock and vibration and provides protection from mechanical and electromagnetic load in an industrial environment. It is installed either in a cabinet, on the wall, on an S7 standard rail or on a 35 mm DIN rail.

SCALANCE W788C-2 RJ-45 is a cost-effective alternative for use indoors with less harsh environmental influences.

The controller access point SCALANCE W788C- 2 M12 with degree of protection IP65 is designed for indoor use and has similar characteristics to the SCALANCE W788C-2 RJ-45 but with a somewhat more rugged construction.

The controller access points SCALANCE W786C-2IA RJ-45 and SCALANCE W786C-2 RJ-45 are equipped with a strong plastic housing (Plexiglas type). The devices with degree of protection IP65 are designed to be resistant to shock and vibration and to meet demanding mechanical and climatic requirements. This means that they are particularly suitable for applications where they are installed outdoors and/or in areas open to the public.

All controller access points must be operated only with the IWLAN controller WLC711.

4.5.8.2 Features and functions

Characteristics

The individual devices have the characteristics shown in the following table:

Functionality	W788C-2 RJ-45	W788C-2 M12	W786C-2IA RJ-45	W786C-2 RJ-45
PoE (Power-over-Ethernet) IEEE 802.3at Type 1, previously IEEE 802.3af.	●	●	●	●
Redundant power supply	●	●	●	●
Digital input / digital output	●			
C-PLUG slot				●
IP degree of protection	IP30	IP65	IP65	IP65
Operating temperature minimum [°C]	-20	-20	-40	-40
Operating temperature maximum [°C]	+60	+60	+60	+60
Resistant to condensation	●		●	●
Resistant to salt water spray			●	●
UV resistant			●	●
Use in EX Zone 2 [1]				
IEEE 802.11 a/b/g/h	●	●	●	●
IEEE 802.11n MIMO	●	●	●	●
Operation with IWLAN controller	●	●	●	●
Operation with Enterasys WLAN controller	●	●	●	●

● Suitable / available or according to the specified standard.

[1] Note installation instructions

Functions

All devices have the following functions:

- SSH / HTTPS / admin password
- WEP / WPA / WPA2
- IEEE 802.11i, Hidden SSID
- IEEE 802.1x (RADIUS)
- EAP-TLS, EAP-TTLS, PEAP
- WDS (Wireless Distribution System)
- SNMP
- Syslog

The controller-based access points of the SCALANCE W78xC have the following additional functions:

- IEEE 802.11e (QoS/WMM)
- PROFINET IO diagnostics
- STP / RSTP (IEEE 802.1d/w)
- VLANs (Multi-SSID)

The WLC controller also has the following functions:

- Integrated VLAN-VNS
- Auto detection of new access points
- Dynamic Radio Management
- VoIP QoS Mapping (DSCP/TCP to WMM)
- VoIP roaming between IP subnets
- VoIP roaming between several IWLAN controllers

4.5.8.3 Interfaces

Table 4- 13

	WLAN interface	Antenna connection		Ethernet interface 10 / 100 /1000 Mbps	Power supply connector
		external	Internal		
WLC711	-	-	-	2 (RJ-45)	2-pin screw terminal
W788C-2 M12	2	6 (N-Connect female)	-	1 (M12)	4-pin screw terminal including PoE or 4- to 8-pin PoE
W788C-2 RJ-45	2	6 (R-SMA connector female)	-	1 (RJ-45)	
W786C-2IA RJ-45	2	-	6	1 (RJ-45)	2-pin male connector (24 VDC) or optional power supply adapter (4-pin 24 VDC or 3-pin 110 - 230 VAC)
W786C-2 RJ-45	2	6 (R-SMA connector female)		1 (RJ-45)	

Order numbers

WLC711	Ethernet interface RJ-45	6GK5 711-0XC00-1AA0 6GK5 711-0XC00-1AB0 [1] 6GK5 711-0XC00-1AD0 [2]
W788C-2 RJ-45	Ethernet interface RJ-45, 6 external antennas	6GK5 788-2FC00-1AA0 [3]
W788C-2 M12	Ethernet interface M12, 6 external antennas	6GK5 788-2GD00-1AA0 [3]
W786C-2IA RJ-45	Ethernet interface RJ-45, 6 internal antennas	6GK5 786-2HC00-1AA0 [3]
W786C-2 RJ-45	Ethernet interface RJ-45, 6 external antennas with R-SMA female connector	6GK5 786-2FC00-1AA0 [3]

[1] US wireless approval
[2] Wireless approval for Japan
[3] Two permanently installed wireless cards

4.5.9 Antennas

4.5.9.1 How it works

How antennas work

The task of an antenna is to convert electrical current into electromagnetic waves and vice versa. A basic distinction is made between separate and integrated antennas. Detached antennas increase the reliability of wireless links by optimizing the transmit and receive conditions. The connection between access point and client is via a cable. The antennas operated directly on the device allow compact, low-maintenance installation.

The antennas can communicate in the 2.4 GHz and 5 GHz frequency bands or in both frequency bands.

Two further related properties are important for any antenna:

- **Radiation characteristics**
  The radiation characteristics describe the directionality of an antenna. There are three options:

  – **Omnidirectional**
  Radiation is uniform in all directions of a spatial plane (horizontal or vertical, depending on the position of the antenna).

  – **Directional**
  Radiation is predominantly in one direction in which the electromagnetic waves are transmitted with higher intensity. In the other spatial areas, the field strength is correspondingly weaker.

  – **RCoax cable**
  an RCoax cable in which the inner conductor is separated from the outer conductor by a dielectric. The outer conductor is interrupted by slits at regular intervals. At these points, a high-frequency signal in the cable is also emitted into the environment of the cable or a high-frequency signal in the environment of the cable is received on the cable. This means that there is a defined RF field along the cable.
  RCoax cables are used when an RF field is required along fixed paths, for example in a railway tunnel or on overhead monorails.

- **Antenna gain**
  The antenna gain is the characteristic value for the directionality of an antenna. This parameter is obtained by comparing the maximum radiated power of the antenna with the power of an isotropic radiator. The antenna gain G is calculated in dBi according to the following formula:

  G = 10 * log (max. power density antenna / max. power density of an isotropic radiator)

Antennas with multiple connectors: Dual or MIMO antennas according to IEEE 802.11n

Dual antennas are antennas with two connectors. These are integrated in an antenna housing as two individual antennas offset by 90° from each other. Due to the two different polarization planes, these antennas can be used to transmit two data streams at the same time. Depending on the alignment of the polarization planes, these antennas are known as dual slant (turned through +/-45°) or vertical-horizontal.

MIMO antennas are antennas with three connectors. They contain three individual radiators combined in one antenna housing and operating either in different polarization planes (0°, +/-45°) or with a suitable clearance between them. The MIMO antennas can transmit three data streams simultaneously making use of multipath propagation.
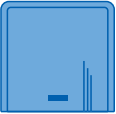
Transmitting multiple data streams increases the data throughput while at the same time making data transfer more reliable.

4.5.9.2 Product overview

Table 4- 14

Device Type	Horizontal radiation angle/ characteristics	Antenna gain 2.4 GHz / dBi	Antenna gain 5 GHz / dBi	Direct mounting	Mounted away from the device	Degree of protection
Antennas for SCALANCE W-700 according to IEEE 802.11n						
1 connector						
ANT795-4MA	360°	3	5	●	-	IP30
ANT795-4MC	360°	3	5	●	-	IP65
ANT795-4MD	360°	3	5	●	-	IP65
ANT795-6DC	75° [2)] 55° [3)]	9	9	-	●	IP67

SCALANCE network components

4.5 SCALANCE W components for Industrial Wireless LAN

Device Type	Horizontal radiation angle/ characteristics	Antenna gain 2.4 GHz / dBi	Antenna gain 5 GHz / dBi	Direct mounting	Mounted away from the device	Degree of protection
2 connectors (dual)						
ANT793-6DG	70° [3]	-	9	-	●	IP67
ANT793-8DJ	17° [3]	-	18	-	●	IP67
ANT793-8DK	9° [3]	-	23	-	●	IP67
3 connectors (MIMO)						
ANT795-6MT	360°	4	6	-	●	IP65
ANT793-6DT	65° [3]	-	8	-	●	IP67

Device Type	Horizontal radiation angle/ characteristics	Antenna gain 2.4 GHz / dBi	Antenna gain 5 GHz / dBi	Direct mounting	Mounted away from the device	Degree of protection
Antennas for SCALANCE W-700 according to IEEE 802.11n and IEEE 802.11a/ b/ g (1 connector)						
ANT792-6MN	360°	6	-	-	●	IP65
ANT793-6MN	360°	-	5	-	●	IP65
ANT792-8DN	35°	14	-	-	●	IP23
ANT795-6MN	360°	6	3.4 - 3.7 GHz: 7 5 GHz: 8	-	●	IP65 [1]

Device Type	Horizontal radiation angle/ characteristics	Antenna gain 2.4 GHz / dBi	Antenna gain 5 GHz / dBi	Direct mounting	Mounted away from the device	Degree of protection
Antenna only for SCALANCE W-700 according to IEEE 802.11a/ b/ g (1 connector)						
ANT795-4MR	360°	3	5	●	-	IP65
ANT795-4MS	360°	4	5.2 GHz: 5 5.8 GHz: 4.5	●	-	IP30
ANT795-6DN	2.4 GHz: 75° 5 GHz: 55°	9	9	-	●	IP55
ANT793-8DN	18°	-	18.5	-	●	IP65

Device Type	Horizontal radiation angle/ characteristics	Antenna gain 2.4 GHz / dBi	Antenna gain 5 GHz / dBi	Direct mounting	Mounted away from the device	Degree of protection
RCoax antennas for SCALANCE W-700 IWLAN Rcoax cable according to IEEE 802.11n and IEEE 802.11a/ b/ g						
ANT792-4DN	90° [2]	4	-	-	●	IP65
ANT793-4MN	360° [3]	-	6	-	●	IP65
RCoax cable	-	-	-	-	●	IP65

[1] degree of protection IP20 when using the mounting adapter.
[2] In the frequency band 2.4 GHz
[3] In the frequency band 5 GHz

4.5.9.3   Area of application

Radiating cable IWLAN RCoax cable

In environments that make the use of wireless difficult, or when the node only moves along predefined rails, it is sometimes preferable to replace the omnidirectional antennas with an RCoax radiating cable. The radiating cable is a special antenna in the form of a thick, flexible cable that produces an RF field with high intensity but only over a very limited range. As long as it can be guaranteed that the communication partner moves in an area close to the RCoax cable, the radiating cable provides a reliable RF field and an excellent connection to the nodes.

● Reliable coverage in difficult wireless areas, for example cranes,

● high-bay loader units, production lines, tunnels or overhead monorails

● Generation of a cone-shaped limited RF field

● Low interference or mutual disturbance due to low transmit power

● Cost saving due to direct substitution of sliding contacts and trailing cables

● Highly flexible application

Order numbers

Antennas with omnidirectional characteristics		
ANT795-4MA [1]	Antenna gain incl. connector 4 dB, for 2.4 GHz / 5 GHz, IP30 rotatable, with extra joint, R-SMA male, pack of: 1 antenna	6GK5 795-4MA00-0AA3
ANT795-4MC [1]	Antenna gain incl. connector 4 dB, for 2.4 GHz / 5 GHz, IP65 (-20° to +65 °C), straight connector, N-Connect male, pack of : 1 antenna	6GK5 795-4MC00-0AA3
ANT795-4MD [1]	Antenna gain incl. connector 4 dB, for 2.4 GHz / 5 GHz, IP65 (-20 to +65 °C), connector at fixed 90° angle, N-Connect male, pack of : 1 antenna	6GK5 795-4MD00-0AA3
ANT795-4MR [1]	Antenna gain incl. connector 4 dB, for 2.4 GHz/ 5 GHz, IP65 (-20y° to +65 C), pack of: 1 antenna	6GK5 795-4MR00-0AA6
ANT795-4MS [1]	Antenna gain incl. connector 4 dB, for 2.4 GHz / 5 GHz, IP30 rotatable, with extra joint, R-SMA male, pack of: 2 antennas	6GK5 795-4MS00-0AA6
ANT792-6MN [2]	Antenna gain incl. N-Connect connector male 6 dB, for 2.4 GHz, IP65 (-40 to +80 C), with terminating resistor 1 x TI795-1R; incl. mounting fittings	6GK5 792-6MN00-0AA6
ANT793-6MN [2]	Antenna gain incl. N-Connect connector male 5 dB, for 5 GHz, IP65 (-45 to +70 C), with terminating resistor 1 x TI795-1R; incl. mounting fittings	6GK5 793-6MN00-0AA6
ANT795-6MN [3]	Antenna gain incl. connector 6/ 8 dB, for 2.4 GHz/ 5 GHz, IP65 (- 40 to + 80 °C), with terminating resistor 1 x TI795-1R	6GK5 795-6MN10-0AA6
ANT795-6MN Mounting tool	Mounting aid for installing the ANT795-6MN below a roof, including installation fittings.	6GK5 795-6MN01-0AA6
ANT795-6MT [3]	MIMO antenna with 3 QMA sockets, antenna gain 6 dB, for 2.4 GHz / 5 GHz, IP65 (- 40 to + 80 °C), incl. mounting bracket	6GK5 795-6MT00-0AA0

Antennas with directivity		
ANT795-6DC [2)	Wide-angle antenna with slight directivity; antenna gain incl. N-Connect male connector 9/ 9 dB, for 2.4 GHz / 5 GHz, IP67 (- 40 to + 80 °C)	6GK5 795-6DC00-0AA0
ANT793-6DG [2)	Dual-slant wide-angled antenna with slight directivity; antenna gain incl. 2 N-Connect male connectors 9 dB, for 5 GHz, IP67 (-40 to +80 °C)	6GK5 793-6DG00-0AA0
ANT793-6DT [2)	MIMO antenna with 3 QMA sockets; wide-angle antenna with slight directivity; antenna gain 9 dB, for 5 GHz, IP67 (- 40 to + 85 °C)	6GK5 793-6DT00-0AA0
ANT795-6DN [2)	Wide-angle antenna with slight directivity; antenna gain incl. N-Connect male connector 9/ 9 dB, for 2.4 GHz / 5 GHz, IP55 (- 40 to + 80 °C); with terminating resistor 1 x TI795-1R	6GK5 795-6DN00-0AA6
ANT792-8DN [2)	Antenna with strong directivity; antenna gain incl. N-Connect male connector 14 dB, for 2.4 GHz, IP23 (- 40 to + 80 °C); with terminating resistor 1 x TI795-1R	6GK5 792-8DN00-0AA6
ANT793-8DN [2)	Antenna with strong directivity; antenna gain incl. N-Connect male connector 19 dB, for 5 GHz, IP65 (- 45 to + 70 °C); with terminating resistor 1 x TI795-1R	6GK5 793-8DN00-0AA6
ANT793-8DJ [2)	Vertical-horizontal polarized antenna with strong directivity; antenna gain incl. 2 N-Connect male connector 18 dB, for 5 GHz, IP67 (- 45 to + 70 °C)	6GK5 793-8DJ00-0AA0
ANT793-8DK [2)	Vertical-horizontal polarized antenna with strong directivity; antenna gain incl. 2 N-Connect male connector 23 dB, for 5 GHz, IP67 (- 45 to + 70 °C)	6GK5 793-8DK00-0AA0
Antennas for RCoax systems		
ANT792-4DN	RCoax helical antenna circular, polarized for RCoax systems; Connector N-Connect female; antenna gain at 2.4 GHz 1 dB, IP65	6GK5 792-4DN00-0AA6
ANT793-4MN	RCoax λ 5/ 8 vertically polarized for RCoax systems; connector N-Connect female; Antenna gain at 5.2 GHz/ 5.7 GHZ 6/ 5 dB; IP65	6GK5 793-4MN00-0AA6
IWLAN accessories		
RCoax cable	IWLAN RCoax cable for 2.4 GHz Radiating cable for difficult wireless areas as a special antenna for SCALANCE W access points in the expanded temperature range of -40 °C to +85 °C; sold by the meter, minimum order 20 m	6XV1 875-2A
RCoax cable	IWLAN RCoax cable for 5 GHz Radiating cable for difficult wireless areas as a special antenna for SCALANCE W access points in the expanded temperature range of -40 °C to +85 °C; sold by the meter, minimum order 20 m	6XV1 875-2D

[1) Mounting directly on SCALANCE W
[2)Wall or mast mounting
[3)Roof mounting

4.6 SCALANCE M routers and modems

4.6.1 SCALANCE M devices

Areas of application for SCALANCE M and components of GPRS

The widespread availability of GPRS (General Packet Radio Service) and advantageous volume tariffs allow wireless connection of stations to a control center in many countries without users needing to set up their own wireless network. The stations can be either stationary or mobile.

The online wireless connection is permanently available and provides properties similar to those of a dedicated line. Data changes can be transferred immediately and station or connection failures are detected and localized in a very short time.

The following systems can be controlled and monitored with the SCALANCE M devices:

- Sewage works, water treatment
- Oil and gas supply
- District heating networks
- Energy distributors
- Pumping stations
- Traffic control technology
- Building
- Wind energy and photovoltaic systems
- Machines
- Electronic advertising boards
- Weather stations
- Lighthouses and buoys

GPRS / UMTS for complex stations with increased security requirements

GPRS is a packet-switching mobile communications service based on GSM channels. With its high transmission speed, GPRS allows fast communication and is suitable above all for mobile Internet access.

Note: GSM stands for 'Global System for Mobile communication' and is the name of the worldwide standard for mobile communication.

In networked stations, the EGPRS router MD741-1 (enhanced GPRS) is used that represents the combination of a fast GPRS VPN router with greater data security (IPsec protocol) and firewall. In these stations, other devices connected to the MD741-1 can also be reached via Industrial Ethernet from a master station for diagnostics and parameter assignment.

For higher data rates, instead of the EGPRS router MD741-1, the UMTS router SCALANCE M875 can also be used to make use of the UMTS mobile wireless network.

A control center PC must be reachable constantly from the GPRS network. To achieve this, it is connected directly to the GPRS provider via a dedicated line or permanently to the Internet, for example using DSL. A SCALANCE S612 or SCALANCE S623 security module takes over the firewall function in the control center and represents the partner for the VPN connections of the GPRS stations.

The VPN configuration is performed with the SIMATIC NET "Security Configuration Tool" and allows configuration without special IT experience.

The IP address of the master station should ideally be fixed, those of the stations can be assigned dynamically.
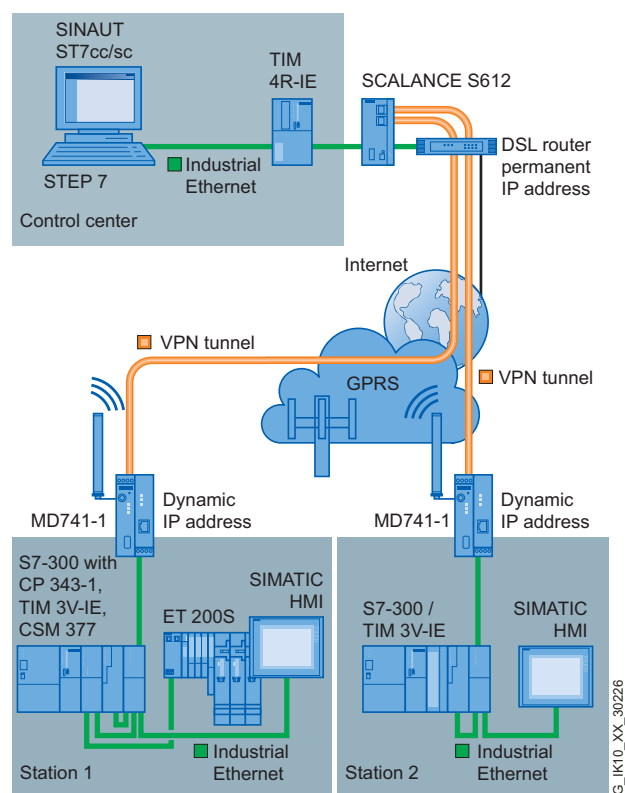
Figure 4-29   Example of a topology for the telecontrol network: Industrial Remote Communication

4.6.2 SCALANCE M873 and M875

4.6.2.1 Description

SCALANCE M873

Figure 4-30   SCALANCE M873

The SCALANCE M873 and M785 are designed as UMTS, EGPRS (GPRS with Edge) and GPRS routers for wireless IP communication of Industrial Ethernet-based programmable controllers via UMTS / GSM mobile wireless networks. SCALANCE M873 and M875 have a high transmission rate using UMTS. Both devices are equipped with integrated security functions including a firewall.

SCALANCE M875 can also be used as a VPN server and client (IPsec).

SCALANCE M875

Figure 4-31   SCALANCE M875

SCALANCE M873 and M875 have a rugged plastic housing and are designed for mounting on a DIN rail. The devices are equipped with an RJ-45 interface for Industrial Ethernet, diagnostics LEDs for the modem status, the field strength and connection control, DI/DO channels, an SMA antenna connector for the GSM/UMTS antenna and a SET service button. The 4-pin screw terminal is for connection to the 24 VDC power supply. In addition to this, a 4-pin screw terminal is integrated for a digital input and output. .

The following properties distinguish the SCALANCE M873 and M875 routers:

● Low investment and operating costs for monitoring and controlling telecontrol substations connected by wireless

● Reduction of traveling costs or telephone costs thanks to remote programming and remote diagnostics using UMTS.

● High security thanks to the integrated firewall

● M875 can also be used as a VPN server and client (IPsec).

● The use of the existing UMTS /GSM infrastructure of mobile wireless providers

● Simple planning and commissioning of telecontrol substations without the user needing special wireless knowledge.
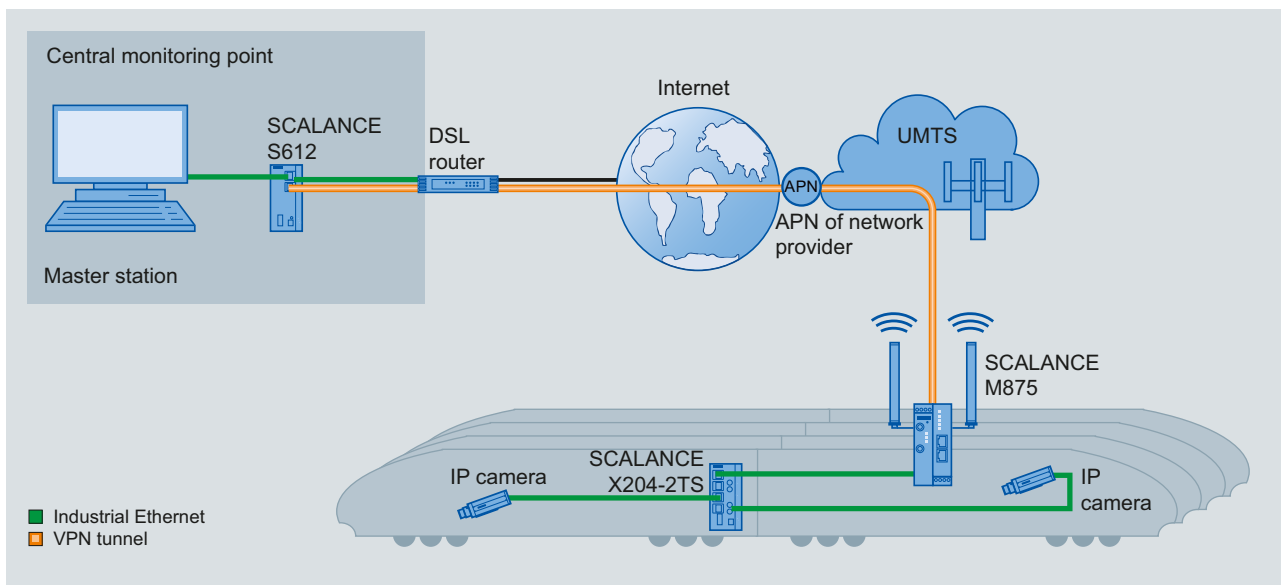
Figure 4-32   Example of a topology for use of the UMTS router M875 to improve passenger safety

4.6.2.2 Features and functions

Characteristics of the SCALANCE M873 router

- 1 RJ-45 port with 10 / 100 Mbps
- 1 SMA antenna connector
- Support of UMTS with HSDPA (downlink: at 3.6 Mbps, uplink: 384 kbps).
- Integrated firewall function

Characteristics of the SCALANCE M875 router

- 1 RJ-45 port with 10 / 100 Mbps
- 1 SMA antenna connector
- Support of UMTS with HSDPA and HSUPA (downlink: 14.4 Mbps, uplink: 384 kbps).
- Integrated firewall function including use as VPN server and client (IPsec)

Functions of the SCALANCE M873 and M875 routers

The SCALANCE M873 and M875 routers have the following functions:

- Triband UMTS with the frequency bands 850 / 1900 / 2100 MHz
- Quadband GSM with the frequency bands 850 / 900 / 1800 / 1900 MHz
- Without a UMTS network, there is an automatic changeover to EGPRS (multislot class 12) or GPRS mode.
- The automatic establishment and keeping open of the IP-based online connection to the Internet.
- The linking of distributed, IP-based networks using UMTS/GSM mobile wireless networks
- Bidirectional, IP-based data communication with the telecontrol control center, for example ST7cc or ST7sc, WinCC or PCS 7.
- Integrated security functions including firewall
- The data exchange between telecontrol stations (inter-station communication) via a TIM communications module in the master station.
- Secure data communication with the SINAUT ST7 stations, including communication via mobile wireless provider networks that do not provide public and fixed IP addresses for the modem.
- Automatic and user-defined sending of SMS messages

Project engineering

- Convenient configuration of all network and firewall parameters of the router via a Web browser

Security

- Router for data transfer via public networks with NAT functionality (NAT traversal)

- Suitable VPN termination of the control center using SCALANCE S

- A firewall for protection against unauthorized access The dynamic packet filter examines data packets based on their source and destination addresses (stateful packet inspection) and blocks undesirable data traffic (anti-spoofing).

Diagnostics and upkeep

- Status of connection establishment and an existing connection displayed by front panel LEDs and via a Web browser

Requirements for using the SCALANCE M873 UMTS router

- The SIM card of a UMTS network operator with HSDPA support or alternatively a SIM card of a GSM network operator with EGPRS or GPRS support.

Requirements for using the SCALANCE M875 UMTS router

- The SIM card of a UMTS network operator with HSPA support (HSUPA and HSDPA) or a SIM card of a GSM network operator with EGPRS or GPRS support.

Note

For further technical details, refer to the operating instructions of the relevant SCALANCE M78x router.

Order numbers

M873 [1]	UMTS routers for wireless IP communication of Industrial Ethernet-based programmable controllers via UMTS/GSM mobile wireless networks; EGPRS multislot class 12	6GK5 873-0AA10-1AA2
M875 [1]	UMTS routers for wireless IP communication of Industrial Ethernet-based programmable controllers via UMTS/GSM mobile wireless networks; EGPRS multislot class 12	6GK5 875-0AA10-1AA2

[1] Please note the wireless approvals of the individual countries: http://www.siemens.com/funkzulassungen

4.6.3   SINAUT MD741-1

4.6.3.1   Description

Figure 4-33   EGPRS router SINAUT MD741-1

The EGPRS router SINAUT MD741-1 was developed as a component of the SINAUT ST7 system for SINAUT data transmission via EGPRS but can also be used independently of this system. Due to its design and its electrical properties, the EGPRS router is particularly suitable for use in an industrial environment. Fast and worldwide remote programming as well as maintenance of the nodes is possible via the EGPRS interface.

The EGPRS router SINAUT MD741-1 has a rugged plastic housing and is designed for mounting on a DIN rail. The device is equipped with an RJ-45 interface for Industrial Ethernet, diagnostics LEDs for the modem status, the field strength and connection control, an SMA antenna connector for the GSM/EGPRS antenna and a SET service button. The 4-pin screw terminal is for connection to the 24 VDC power supply.

The EGPRS router SINAUT MD741-1 is suitable to meet the following requirements:

- monitoring and control of lower-level telecontrol stations connected by wireless with low investment and operating costs.

- reduction of traveling costs or telephone charges thanks to remote programming and remote diagnostics via GPRS

- convenient diagnostics via terminal clients with short download times thanks to the higher speed of EGPRS

- high requirements in terms of security thanks to IPsec-based VPN functionality and firewall

- control and monitoring via the GPRS infrastructure of the network operator with cost-effective machine-to-machine standard contracts thanks to the VPN integration

- simple planning and commissioning of low-level stations without the user needing specialist wireless knowledge.

The quadband technology allows worldwide use of the EGPRS router SINAUT MD741-1 taking into account the specific national approvals.
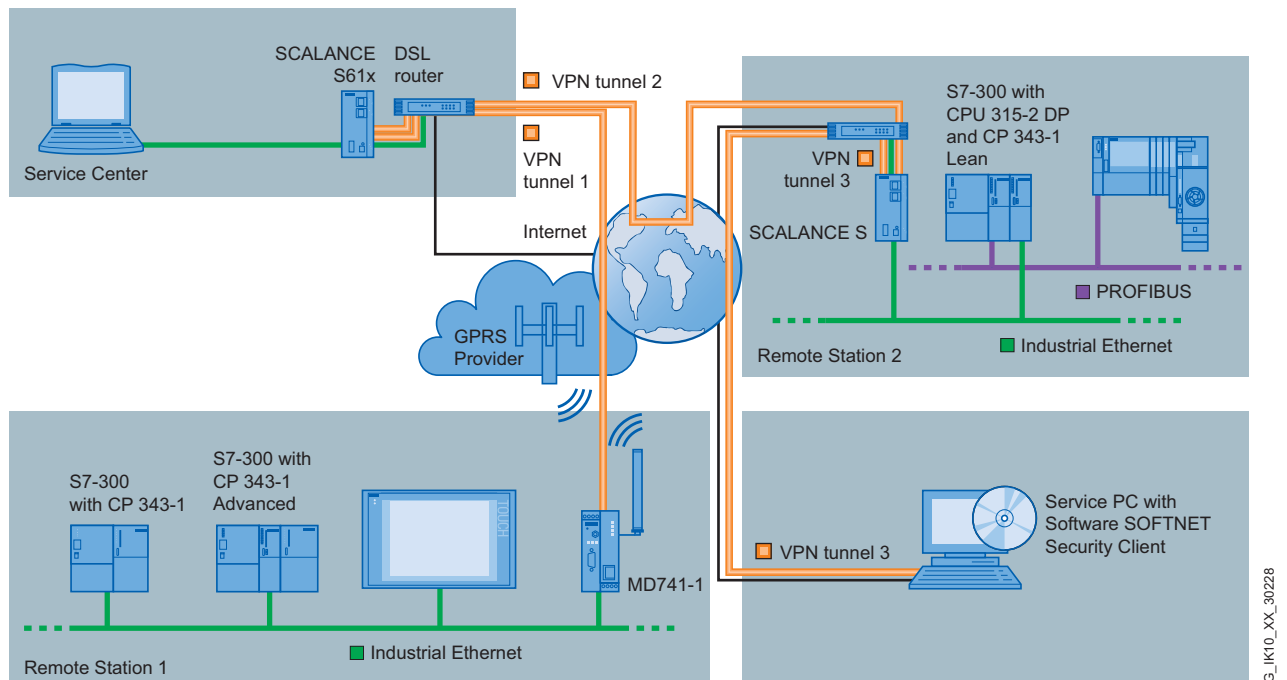
Figure 4-34   Example of topology for using the EGPRS router SINAUT MD741-1

4.6.3.2 Features and functions

The EGPRS router SINAUT MD741-1 has the following characteristics and functions:

- EGPRS (GPRS with Edge) and GPRS router for wireless IP communication of Industrial Ethernet-based programmable controllers via GSM mobile wireless networks

- Four times the transmission speed due to EGPRS

- Integrated security functions with firewall and VPN (IPsec)

- Quadband GSM with the frequency bands 850 / 900 / 1800 / 1900 MHz

- Fast communication with EGPRS multislot class 12 in EGPRS networks

- Without EGPRS network, automatic switchover to GPRS mode

- Automatic establishment and retention of IP-based online connection to Internet

- Bidirectional, IP-based data communication with the telecontrol control center, for example ST7cc or ST7sc

- Data exchange between telecontrol stations (inter-station communication) via a TIM communications module in the master station

- Integrated security functions with firewall and VPN (IPsec)

- Secure data communication with the SINAUT ST7 stations also via GSM networks that do not provide public and fixed IP addresses for the router.

Project engineering

- Parameter assignment of the router using a Web browser

Security

- A VPN router for secure data transfer via public networks (IPsec protocol, 3DES data encryption, AES encryption, and NAT traversal).

- Suitable VPN termination of the control center using SCALANCE S612 or S623 (available as of April 2012)

- A firewall for protection against unauthorized access The dynamic packet filter examines data packets based on their source and destination addresses (stateful packet inspection) and blocks undesirable data traffic (anti-spoofing).

Diagnostics and upkeep

- Status of the connection establishment and an existing connection by front panel LEDs

Requirements for the use of the EGPRS router SINAUT MD741-1

- The SIM card of a network operator that supports EGPRS.

Note

For further technical details, refer to the operating instructions of the relevant SCALANCE M78x router.

Order numbers

SINAUT MD741-1 [1] EGPRS router	For wireless IP communication of Industrial Ethernet-based automation systems via GSM mobile wireless networks. Integrated firewall, VPN router (IPsec), quadband GSM and EGPRS multislot class 12.	6NH9 741-1AA00

[1] Please note the wireless approvals of the individual countries: http://www.siemens.com/funkzulassungen

4.6.4   SINAUT MD720-3

4.6.4.1   Description

Figure 4-35   GSM/GPRS modem SINAUT MD720-3

The GSM/GPRS modem SINAUT MD720-3 is used for the telecontrol system SINAUT ST7 for data transmission over dial-up connections (CSD service) and the telecontrol system SINAUT MICRO for data transmission via GPRS. It is used to set up systems for monitoring and controlling simple telecontrol stations. This device also allows energy-saving concepts in systems and the connection of mobile nodes with central monitoring/control of rail-guided vehicles, special vehicles, local public transport, complex machines, and shipping in inland waters and coastal areas. Using a GSM dial-up connection (CSD service), remote programming and maintenance of the SIMATIC S7-200 is possible.

The GSM/GPRS modem SINAUT MD720-3 has a rugged plastic housing and is designed for mounting on a DIN rail. The device is equipped with an RS-232 interface, diagnostics LEDs for the modem status, the field strength and connection control, an SMA antenna connector for the GSM/EGPRS antenna and a SET service button. The 4-pin screw terminal is for connection to the 24 VDC power supply.

Example of a topology

IP-based communication via GPRS/DSL with the MSC protocol
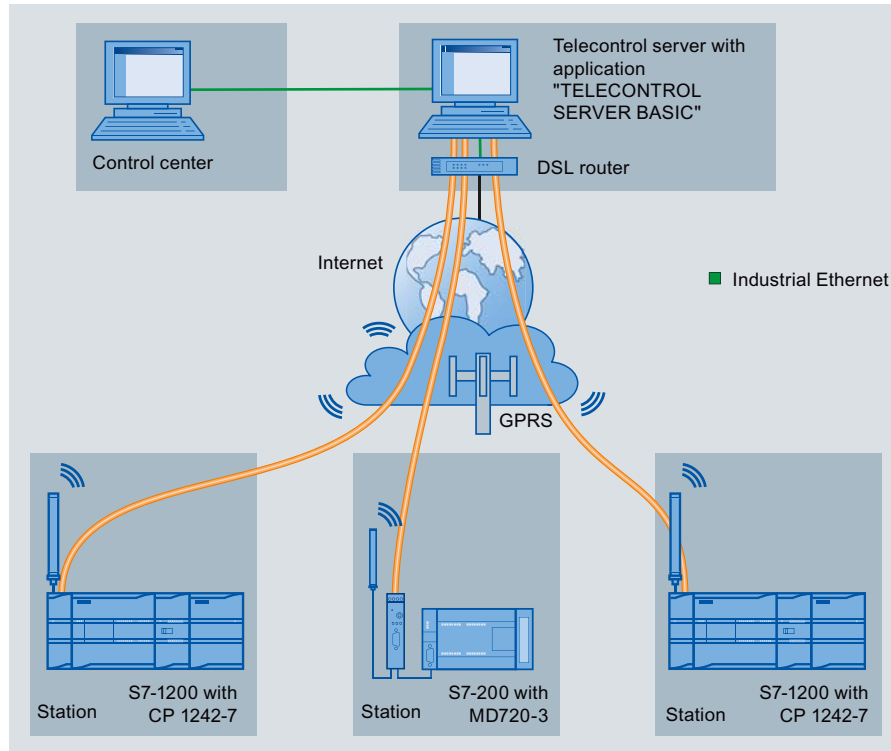
4.6.4.2 Features and functions

The GSM/GPRS modem SINAUT MD720-3 has the following characteristics and functions:

- Quadband GSM (850 / 900 / 1800 / 1900 MHz)

- GPRS multislot class 10 (gross: 13.4-27 kbps upload, 40-54 kbps download).

- Automatic establishment and retention of IP-based online connection to Internet via GPRS

- IP-based data exchange with PC-based application SINAUT MICRO SC (router and OPC server)

- Data exchange with other MD720-3 modems via the routing of SINAUT MICRO SC

- Changeover between GPRS and CSD (modem mode) possible during operation

- CSD and GPRS connection controllable with AT commands

- Sending of SMS messages and faxes (via SMS) using GSM services

- Secure access to data of the S7-200, also via mobile wireless provider networks that do not provide any public or fixed IP addresses for the modem.

Project engineering

- Parameter assignment using PLC blocks with the Micro/Win programming tool for S7-200 (blocks ship with SINAUT MICRO SC)

- AT command interface

Security

- Enabling of up to 3 call numbers for incoming GSM connections (CLIP function) for teleservice

- User name and password for GSM connection

- Unrestricted client and server operation even in protected GPRS networks with private IP addresses of the mobile wireless provider

- Encrypted data traffic between modem, Internet and SINAUT MICRO SC

Diagnostics / upkeep

- Status of the connection establishment and an existing connection by front panel LEDs

- Reading out the configuration data via the RS-232 interface

- Status of the connection to the modem and PLC can be monitored in SINAUT MICRO SC

- Direct additional access via GSM (modem mode) for teleservice (remote programming, remote diagnostics)

Order numbers

SINAUT MD720-3 [1] **GSM/GPRS modem**	Mobile wireless modem with RS-232 interface; for the GSM services CSD, GPRS, SMS; quadband GSM, AT command interface. Automatic GPRS connection establishment; including gender changer for RS-232/PPI adapter	6NH9720-3AA00

[1] Please note the wireless approvals of the individual countries: http://www.siemens.com/simatic-net/ik-info

4.7 SCALANCE S security module

4.7.1 SCALANCE S

Areas of application of SCALANCE S

The SCALANCE S security modules protect nodes connected to the protected network with a combination of different security measures. SCALANCE S602, SCALANCE S612 and SCALANCE S623 have different protective functions. With all SCALANCE S devices, individual devices or even entire automation cells can be integrated into the protected area.

With the security modules of the SCALANCE S product line, all devices of an Ethernet network can be protected from unauthorized access. SCALANCE S612 or SCALANCE S623 also protect data transfer between devices or network segments (e.g. automation cells) from data manipulation and espionage and can be used for secure remote access via the Internet.

The security modules can be operated not only in bridge mode but also in router mode. This means that the security modules are used directly at IP subnet boundaries.

Secure remote access via the Internet is possible with the GPRS router MD741-1 or with the UMTS router SCALANCE M875.

SCALANCE S is optimized for use in an automation or industrial environment. It meets the specific requirements of automation engineering, for example easy upgrading of existing systems, simple installation and minimum downtimes if a fault occurs.

Advantages of the cell protection concept:

- Protection from data espionage and data manipulation
- Protection against overload of the communications system
- Protection from external influences
- Protection from addressing errors
- Secure remote access via Internet

- Changes to or adaptation of the existing network structure are not necessary.
- Changes to or adaptation of the existing applications or network nodes are not necessary.

Figure 4-36   SCALANCE S product family

The range of devices is expanded by the SOFTNET Security Client. This is a software application that allows secure access to automation systems protected by SCALANCE S.
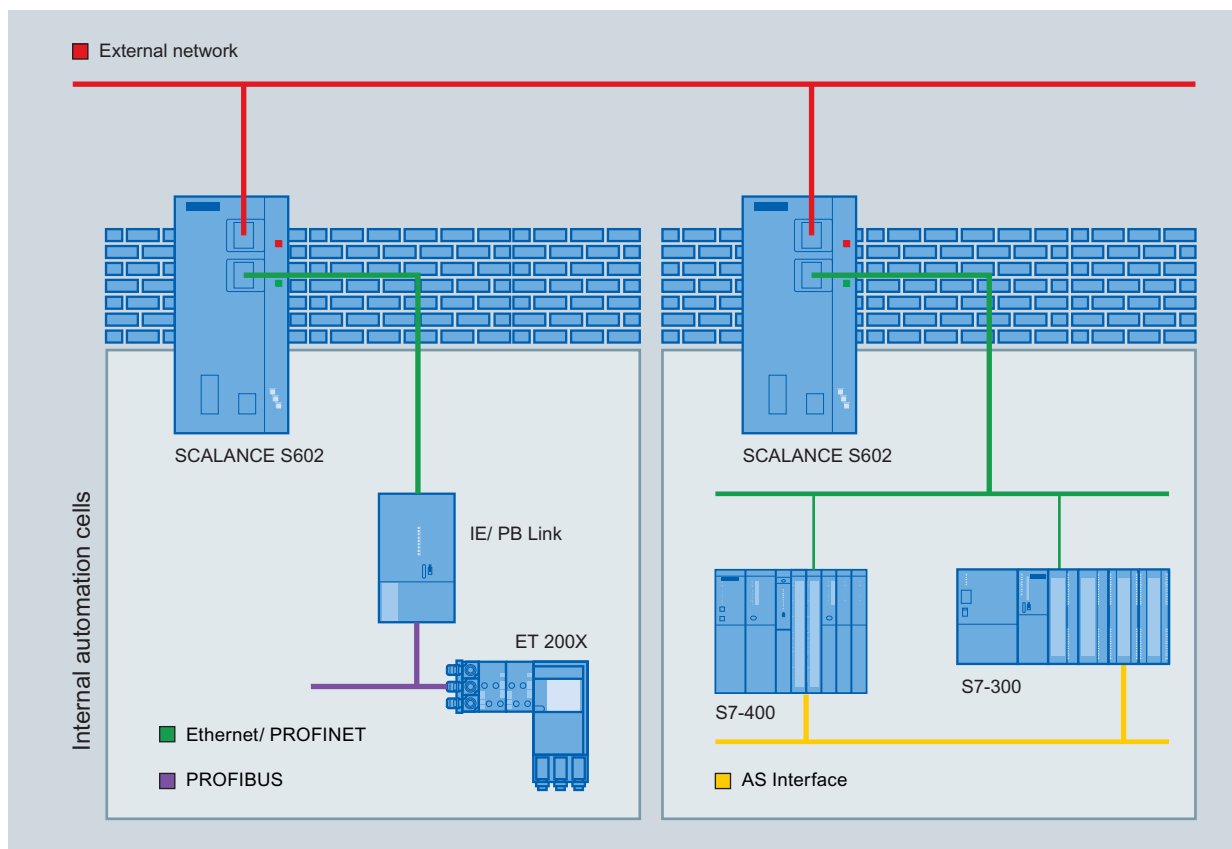
Figure 4-37   Example of a topology: Setting up a system with SCALANCE S602

4.7.2 Functions of SCALANCE S devices

With the security modules of the SCALANCE S product line, all devices of an Ethernet network can be protected from unauthorized access. The essential characteristic of all SCALANCE S devices is that individual devices as well as entire automation cells can be integrated flexibly.

Internal and external network nodes

SCALANCE S602, S612 and S623 modules divide networks into two areas:

- Internal network: Protected areas with the "internal nodes"

   Internal nodes are the nodes protected by a SCALANCE S device.

- External network: Unprotected areas with the "external nodes".

   External nodes are all the nodes located outside the protected areas.

The internal network is considered to be secure (trustworthy). Connect an internal network segment to the external network segments only over a SCALANCE S device.

There must be no other paths connecting the internal and external networks.

Configuration and administration

A CD ships with the SCALANCE S containing not only the manual but also the 'Security Configuration Tool'.

The Security Configuration Tool is designed for the following tasks:

- For configuration of the SCALANCE S security modules.

- For configuration of the SOFTNET Security Client for SCALANCE S612 and S623,

- For test and diagnostics functions and status displays.

To operate the SCALANCE S modules, you need to download a configuration created with the Security Configuration Tool. The configuration of a SCALANCE S module involves the IP parameters and the configuration of the firewall rules. With the SCALANCE S612 and S623 devices, it is also possible, when necessary, to configure IPsec tunnels; for a SCALANCE S602 router mode can be configured.

Firewall

The firewall functionality of SCALANCE S security modules protects the internal network from influences or disturbances from external networks. This means that; depending on the configuration, only certain specified communication relations between the network nodes from the internal network and network nodes of the external networks are allowed.

All network nodes located in the internal network segment of a SCALANCE S security module are protected by its firewall.

The firewall functionality can be configured for the following protocol levels:

- IP firewall incl. stateful inspection

- Firewall for Ethernet "non-IP" frames according to IEEE 802.3; (layer 2 frames)

The stateful inspection firewall (also known as Stateful Packet Filter or Dynamic Packet Filter) is a firewall technology that operates both on the network and at the application layer. The IP packets are accepted on the network layer, inspected according to their state by an analysis module and compared with a status table.

For the communication partner, a firewall with stateful inspection appears as a direct connection that only allows communication according to the rules.

Firewall rules are the rules for data traffic in the following directions:

● From the internal to the external network and vice versa,

● from the internal network into an IPsec tunnel and vice versa (SCALANCE S612 and S623 only).

SCALANCE S in routing mode

If SCALANCE S modules are operated in routing mode, they separate the internal network from the external network based on the analysis of the IP addresses. The internal network separated by SCALANCE S602 therefore becomes a separate subnet.

The following options are available:

● Routing - configured in standard mode and advanced mode.

Packets intended for an existing IP address in the subnet (internal or external) are forwarded. The firewall rules for the direction of transmission also apply.

For this mode, you must also configure an IP address for the internal subnet.

Note

In contrast to the bridge mode of the SCALANCE S security modules, VLAN tags are lost in routing mode.

● NAT / NAPT routing - configured in advanced mode.

In this mode, the IP addresses are also converted. The IP addresses of the devices in the internal subnet are translated to external IP addresses and are therefore "invisible" in the external network.

SCALANCE S as DHCP server

A DHCP server assigns an IP address to each client throughout the network. DHCP (Dynamic Host Configuration Protocol) in conjunction with a suitable server, allows the dynamic assignment of an IP address and other configuration parameters to computers within the network.

SCALANCE S security modules can be operated in the internal network as DHCP servers. This allows IP addresses to be assigned automatically to the devices connected to the internal network.

The IP addresses are assigned either dynamically from a defined range of addresses or a specific device is assigned a specific IP address according to the definition.

Testing, diagnostics, logging and Syslog

For testing and monitoring, the Security Configuration Tool (SCT) has diagnostics and logging functions.

- Diagnostics functions
  In online mode various system and status functions can be used for diagnostics.

- Logging functions
  The system and security events are logged. The events are logged in the buffer areas of the security module (local logging) or of a server (network Syslog). You select the events to be logged in the log settings for the relevant security module.

IPsec tunnel (SCALANCE S612 and S623)

The expansion or supplement to IP is IPsec or Internet Protocol Security, a layer 3 tunneling protocol.

This protocol is supported by the SCALANCE S612 and S623 modules.

In the internal networks protected by the SCALANCE S612 and S623, the IPsec tunnel provides the nodes with a secure data connection through the unsecured external network to other internal networks protected by the SCALANCE S612 and S623.

The encryption of the data transmission with VPN (IPsec) provides the following:

- Protection from espionage, confidentiality: The data exchanged is safe from eavesdropping.

- Protection from manipulation, integrity: The data exchanged is safe from corruption/counterfeiting.

- Authenticity: Only authorized nodes can establish a tunnel.

Using the Security Configuration Tool, the SCALANCE S612 and S623 modules as well as the SOFTNET Security Client modules integrated in an internal network can be put together in groups in the configuration to form the VPN (Virtual Private Network).

IPsec tunnels are established automatically between all SCALANCE S612, SCALANCE S623 modules and SOFTNET Security Client modules that belong to the same group. All internal nodes of these SCALANCE S612 or S623 modules can communicate with each other securely via this tunnel.

Tunneling also includes Ethernet frames according to the IEEE standard 802.3 (layer 2 frames). Both IP and non-IP frames are transmitted through the IPsec tunnel.

4.7.3 SCALANCE S602/S612/S623

4.7.3.1 Description

The SCALANCE S devices have rugged metal housings with degree of protection IP30. The devices are designed so that they can be mounted on a 35 mm DIN rail or an S7-300 standard rail. Direct wall mounting for different mounting positions is also possible. Due to the S7-300 housing dimensions, the devices are ideally suited for integration in automation solutions with S7-300 components.

Configuration and engineering data is stored in internal non-volatile memory on the SCALANCE S modules. A C-PLUG can be used for storage. The compartment for the C-PLUG is below a screw cover on the back of the device. If a SCALANCE S module needs to be replaced, the stored data can be transferred simply to the new device.

SCALANCE S602

Figure 4-38   SCALANCE S602

The SCALANCE S602 device provides flexible protection without complicated handling with a combination of different security measures:

- Data espionage
- Unauthorized access

SCALANCE S612

Figure 4-39   SCALANCE S612

The security functions of the SCALANCE S612 module provide flexible protection without system repercussions are protocol independent (as of layer 2 according to IEEE 802.3) and do not involve complicated handling to protect against the following: :

● Data espionage

● Data manipulation

● Unauthorized access

SCALANCE S623

Figure 4-40   SCALANCE S623

The SCALANCE S623 module has an RJ-45 **DMZ port** for secure connection, for example of remote maintenance routers, laptops or an additional network. DMZ "Demilitarized Zone" is a network with access options controlled by security mechanisms. The interface is marked **yellow** and in the following graphic is protected from the red and green port by a firewall. VPNs can be terminated using this.
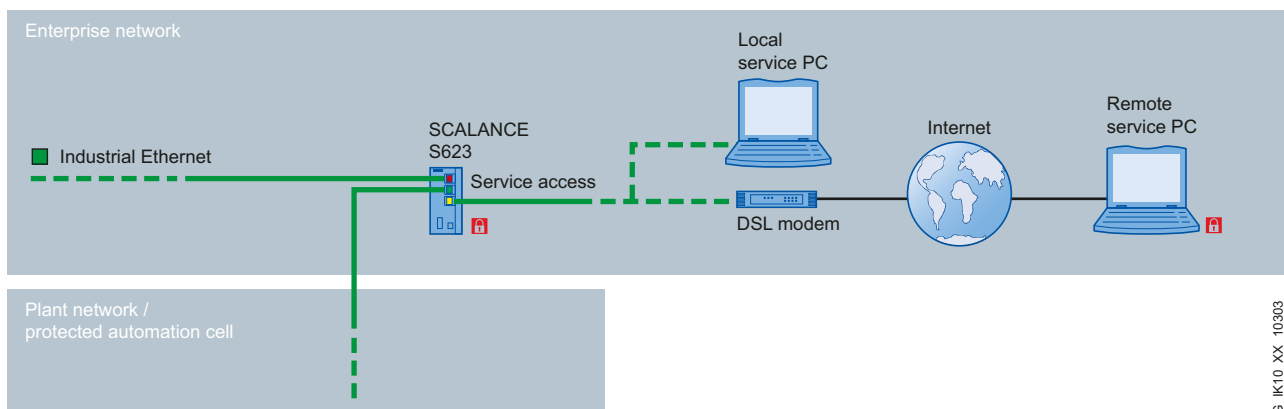
Figure 4-41   Local service PC: Internet access via the DMZ interface of the SCALANCE S623

4.7.3.2   Features and functions

The following table shows an overview of the essential characteristics and functions of the SCALANCE S modules.

Functionality	S602	S612	S623
10 / 100 / 1000 Mbps ports	●	●	●
DMZ port			●
C-PLUG slot	●	●	●
Firewall	●	●	●
NAT/NAPT router	●	●	●
DHCP server	●	●	●
SysLog	●	●	●
IPsec tunnel (VPN, Virtual Private Network)		●	●
Softnet Security Client		●	●

● Suitable / available or according to the specified standard.

4.7.3.3   Interfaces

The SCALANCE S modules have the following connectors or interfaces:

Connectors / interfaces	
Attachment of end devices or network components over twisted pair	10 / 100 / 1000 Mbps (half/full duplex)
SCALANCE S602 and S612	2 x RJ-45 jacks with MDI-X assignment
SCALANCE S623	3 x RJ-45 jacks with MDI-X assignment
Connector for power supply	1 x 4-pin plug-in terminal block
Connector for signaling contact	1 x 2-pin plug-in terminal block
Electrical data	
Supply voltage	Supply 24 VDC (18 to 32 VDC) • Implemented redundantly • Safety extra-low voltage (SELV)

The two Industrial Ethernet connectors, port 1 and port 2 are handled differently by SCALANCE S modules. For this reason, these interfaces must not be confused when connecting to the communications network.

- **Port 1: External network**

  Upper RJ-45 jack. Marked **red**, this interface is for the unprotected network area.

- **Port 2: Internal network**

  Lower or with the SCALANCE S623 module, the **middle** RJ-45 jack. Marked **green**, this interface is intended for the network area protected by SCALANCE S.

  Note

  If these marked ports are swapped over, the devices lose their protective function.

Order numbers

S602	Protects network segments from unauthorized access using a Stateful Inspection firewall; • at 10 / 100 Mbps	
		6GK5 602-0BA00-2AA3
	• at 10 / 100 / 1000 Mbps	**6GK5 602-0BA10-2AA3**
S612	Protects network segments from unauthorized access using a Stateful Inspection firewall; • at 10 / 100 Mbps Protection of up to 32 devices, up to 64 VPN tunnels simultaneously	**6GK5 612-0BA00-2AA3**
	• at 10 / 100 / 1000 Mbps Protection of up to 128 devices, up to 128 VPN tunnels simultaneously	**6GK5 612-0BA10-2AA3**
S623	Protects network segments from unauthorized access using a Stateful Inspection firewall; • at 10 / 100 / 1000 Mbps Protection of up to 128 devices, up to 128 VPN tunnels simultaneously Expanded temperature range (from -40 °C to +60 °C)	6GK5 623-0BA10-2AA3

4.7.4 SOFTNET Security Client

Description

The SOFTNET Security Client is a software application that serves as an integral component of the Industrial Security concept for the protection of programmable controllers. This ensures security during data exchange between programmable controllers and complete automation systems or automation cells.

- The SOFTNET Security Client application is available as a VPN client for programming devices, PCs and notebooks in an industrial environment. The application allows secure client access via LANs or even via WANs to automation systems protected by devices with SCALANCE S functionality. For example for remote maintenance via the Internet.

- Protection of the data transfer from incorrect operator input, eavesdropping/espionage and manipulation.
  Communication is only possible between authenticated and authorized devices.

- The SOFTNET Security Client uses tried-and-tested IPsec mechanisms for establishing and operating Virtual Private Networks (VPNs).

- Fully integrated intuitive configuration without specialist security knowledge.

- A common configuration tool with a common database for SCALANCE S modules and the SOFTNET Security Client.

  - Automatic generation of certificates by the Security Configuration Tool.

  - Automatic identification of the nodes of the internal network and detection of the SCALANCE S modules in the external network.

Principle of application

The SOFTNET Security Client PC software provides VPN services on the PG or notebook. This allows secure IP-based access from a PC/PG to automation systems in subnets protected by SCALANCE S612 or SCALANCE S623.

Details

- Easy handling thanks to minimum configuration.

- No special IT security experience is necessary.

- Changes to or adaptation of the existing network structure are not necessary.

- Automatic generation of certificates by the configuration tool.

- Little configuration effort due to automatic identification of the nodes of the internal network and detection of other security modules in the external network.

Benefits

- Secure access by programming devices or notebooks to entire automation cells/systems.

- Simple use of mobile PCs.

- Protection of the data transfer from espionage and manipulation using certified standards.

- Devices that can be classified as non-secure can be included in the secure data traffic.

Area of application - access over VPN

With the SOFTNET Security Client, a PC/PG is configured automatically so that it can establish IPsec tunnels to one or more SCALANCE S modules.

Thanks to communication via these IPsec tunnels, it is possible to access devices or networks securely that are located in an internal network protected by SCALANCE S using PG/PC applications such as NCM (Network and Communication Management) Diagnostics or with STEP 7.

Note

Remember that you can only use the SOFTNET Security Client in groups with modules in active bridge mode.

Automatic communication over VPN

For your application, it is important that the SOFTNET Security Client automatically detects access to the IP address of a VPN node. The nodes are addressed in this way using the IP address as if they were located in the local subnet to which the programming device/PC with this application is connected.

How it works

The SOFTNET Security Client reads in the configuration created by the Security Configuration Tool and obtains the required information on the certificates to be imported from the relevant file. The root certificate and the private keys are imported and stored on the local PG/PC. Following this, security settings are made based on the data from the configuration so that applications can access IP addresses downstream from the SCALANCE S modules.

If a learning mode for the internal nodes or programmable controllers is enabled, the configuration module first sets a security policy for the secure access to the SCALANCE S modules. The SOFTNET Security Client then addresses the SCALANCE S modules to obtain the IP addresses of the internal nodes. The SOFTNET Security Client registers these IP addresses in special filter lists of the security policy. Following this, applications such as STEP 7 can communicate with the programmable controllers over VPN.

Order numbers

The SOFTNET Security Client software for establishing secure IP-based VPN connections from PG/PC to network segments protected by SCALANCE S is available for the following Windows operating systems.

- 1 single license for one installation,

- runtime software (German/English),

- configuration tool (German/English)

- The electronic manual on CD-ROM is available in the following languages:

  - German

  - English

  - French

  - Spanish

  - Italian

SOFTNET Security Client Edition 2008	For Microsoft Windows XP Professional, 32-bit, incl. SP1, SP2 and SP3	**6GK1 704-1VW02-0AA0**
SOFTNET Security Client V3	For Microsoft Windows 7 Professional, Ultimate and XP Professional, 32-bit, incl. SP3	**6GK1 704-1VW03-0AA0**
SOFTNET Security Client V4	For Microsoft Windows 7 Professional, Ultimate, 32/64-bit	**6GK1 704-1VW04-0AA0**

4.8 Network management software

4.8.1 SINEMA server

Introduction

SINEMA Server monitors the programmable controllers and wireless devices connected to LANs or WLANs as well as the infrastructure components such as Industrial Ethernet switches or access points of industrial WLANs. With the "autodiscovery" function of SINEMA Server, not only the controllers and infrastructure components but also their parameters are automatically detected if they are relevant for the network. Based on this information the software then calculates the network topology and statistics. This information is displayed in the Web interface of SINEMA Server. When necessary, more detailed information can also be queried in additional diagnostics displays.

SINEMA Server queries the data of the Ethernet nodes cyclically during operation and signals network alarms. Changes to the network, errors and availability data are logged and stored in a database. This information is then available. Using reporting functions that can be restricted to certain periods, the network can be documented and analyzed.

Note

You will find more detailed information on SINEMA Server under SINEMA (http://www.siemens.com/sinema)

Features and functions

- HTTPS Web access with user authentication.
- Remote monitoring of network operation, network errors, network security and network access.
- Management of the network and effective monitoring of the detected network devices.
- Several users can access the same information at the same time regardless of their location in the network.
- Reporting functions for creating and displaying reports
- Support of standard SNMP traps.
- Creation of new users and user groups
- User roles for different network management activities. Based on these roles, different views of the Web interface can also be defined in SINEMA Server and can be assigned to different users and user groups.
- E-mail client function and an OPC server for forwarding network data and alarms to other users or systems.
- Export function for archiving project and configuration data.
- Function for importing configuration data.

4.8.2 Primary Setup Tool

Description

With the Primary Setup Tool (PST), an address assignment (for example an IP address) is made via the network for unconfigured SIMATIC NET network components, Ethernet CPs and gateways. This is only possible if the SIMATIC NET devices have a default ETHERNET (MAC) address and can be reached online in the network. The nodes must also support the DCP protocol. The PST uses a filter view to allow a clear presentation of modules and devices.

Note

The Primary Setup Tool supports only SIMATIC NET Ethernet network components with management functionality (Web-based Management and/or SNMP). With these components, you also have the option of calling Web-based Management for diagnostics and configuration.

Functions

Depending on the properties of the addressed components and interfaces, the following functions are available in the PST:

● Basic functions:

– Browsing for devices with an Ethernet interface

– Calling up Web Based Management

– Downloading configurations to the components

– Using functions via the DOS command line

● Configuration for Ind. Ethernet / PROFINET

– Settings for IP addresses

● Configuration for PROFIBUS (for devices with Ethernet and PROFIBUS interfaces)

– Setting the PROFIBUS address

– PROFIBUS bus parameters

The PST provides these functions via a user-friendly user interface.

Requirements

● The devices have a preset ETHERNET (MAC) address or an IP address and can be reached on the network online.

● PROFIBUS interfaces can also be configured using PST only for modules that also have a reachable Ethernet interface in the network in addition to the PROFIBUS interface.

Supported operating systems

The Primary Setup Tool can be installed and executed under the following operating systems:

- 32-bit operating systems
  - Windows XP Professional SP2 and SP3
  - Windows 7 Professional / Ultimate
- 64-bit operating systems
  - Windows 7 Professional / Ultimate SP1
  - Windows Server 2008 Standard Server R2

It is possible to set addresses for the following SIMATIC NET network components using PST:

- ELS TP40 M
- SCALANCE W700
- SCALANCE X200
- SCALANCE X300
- SCALANCE X400
- SCALANCE XR-500M

It is possible to set addresses for the following Ethernet CPs using PST:

- CP 343-1
- CP 343-1 Lean
- CP 343-1 Advanced
- CP343-1 ERPC
- CP 343-1 BACnet
- CP 443-1
- CP 443-1 Advanced

It is possible to set addresses for the following SIMATIC NET gateways using PST:

- IE/PB Link
- IE/PB Link PN IO
- IWLAN/PB Link

DCP protocol and DLC protocol

The Primary Setup Tool uses the protocols DCP (**D**iscovery and basic **C**onfiguration **P**rotocol) and DLC (**D**ata **L**ink **C**ontrol) for communication with the modules. The DLC protocol is necessary for devices with older firmware versions.

This includes the following devices:

● CP 443-1 (6GK7 443-1EX10 and 6GK7 443-1EX11)

Note

The DLC protocol is not supported in 64-bit operating systems. The DLC protocol is not available either in the setup or during operation of the Primary Setup Tool.

Note

Depending of the operating system you are using, remember the following if you want to use the DLC protocol:

● Windows 7 Professional / Ultimate
The DLC protocol is not included in Windows, but it can be installed and enabled during installation of the PST.
Hardware requirements at least: Clock frequency 1 GHz / 1 GB RAM / screen resolution 1024 x 768 / color quality 16 bit

● Windows XP Professional
The DLC protocol is not included in Windows, but it can be installed and enabled during installation of the PST.
Hardware requirements at least: Clock frequency 600 MHz / 512 MB RAM / screen resolution 1024 x 768 / color quality 16 bit

Note

You will find more detailed information on the Primary Setup Tool and on downloading the software at 19440762 (http://support.automation.siemens.com/WW/view/en/19440762).

4.9   Accessories

4.9.1   C-PLUG Configuration Memory

Description

The C-PLUG is an exchangeable medium for storage of the configuration and project engineering data of the basic device. This means that the configuration data remains available if the basic device is replaced. It is therefore used when the replacement of network components or communications modules needs to be quick if a fault occurs without needing to configure a replacement and without needing specialist personnel. Downtimes of network segments and connected Industrial Ethernet nodes can therefore be minimized if a fault occurs.

It can be used in all SIMATIC NET products with a C-PLUG slot.

Design

The C-PLUG has degree of protection IP20. With IP65 components, the protection is retained because the C-PLUG is installed inside the protected housing.

Power is supplied by the host device. The C-PLUG retains all data when the power is turned off.

Function

If an empty CPLUG (as supplied) is inserted in a SIMATIC NET component, the device automatically backs up the configuration data during startup. Changes to the configuration during operation are also saved on the C-PLUG without any additional operator intervention being necessary.

When an unconfigured device starts up, it automatically adopts the configuration data of an inserted C-PLUG assuming the data was written by a compatible device type.

The C-PLUG can also be used to store application data such as documentation or Web pages.

Diagnostics

Incorrect use of the C-PLUG, such as inserting a C-PLUG containing the configuration of a different device group or general malfunctions of the C-PLUG are indicated by diagnostics mechanisms of the host device (LEDs, PROFINET, SNMP, Web based Management, etc.).

Order number

C-PLUG	Exchangeable medium for simple replacement of devices if faults occur, can be used in SIMATIC NET products with a C-PLUG slot.	6GK1 900-0AB00

Communications processors for PCs

<div style="text-align: right; font-size: 3em;">5</div>

Area of application

Communications processors for PCs/PGs allow you to establish a connection to industrial Ethernet with a PC/PG or a SIMATIC Microbox PC (PCI-104 interface). There are two categories of communications processors for PCs/PGs:

● Communications processors with their own microprocessor.
  This relieves the PC/PG CPU. This frees up computing power on the PC for other applications, for example HMI (ISO and TCP/IP transport on board).

● Communications processors without their own microprocessor.
  These communications processors are less expensive than the communications processors that have their own microprocessor. If there is, however, heavy load on the PC microprocessor, it is possible that the protocol stack does not receive a time slice and this leads to the connection being terminated. When using communications processors with their own microprocessor, this does not occur.

Example of a topology
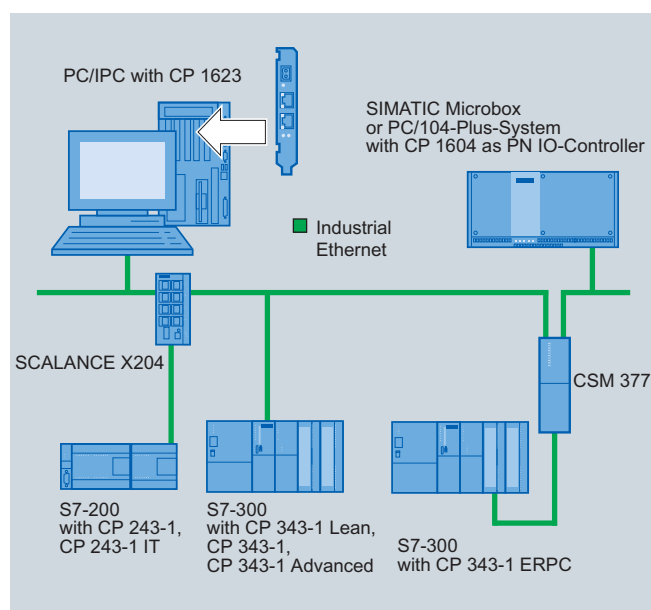
Figure 5-1   Connecting communications processors for PCs/PGs to Industrial Ethernet based on the example of a linear bus topology

Device variants

Functionality	CP 1604	CP 1616	CP 1612 A2	CP 1613 A2	CP 1623	CP 1628 [1]
Interfaces						
→ PCI		●	●	●		
→ PCI Express					●	●
→ PCI-104	●					
Connectors						
→ RJ-45	4	4	1	1	2	2
Configurable connections	128	128	64	120	120	120
Gigabit Ethernet			●		●	●
Integrated switch	●	●			●	●
PN IO	●	●	●			

● Suitable / available or according to the specified standard.

5.1 CP 1604

Description
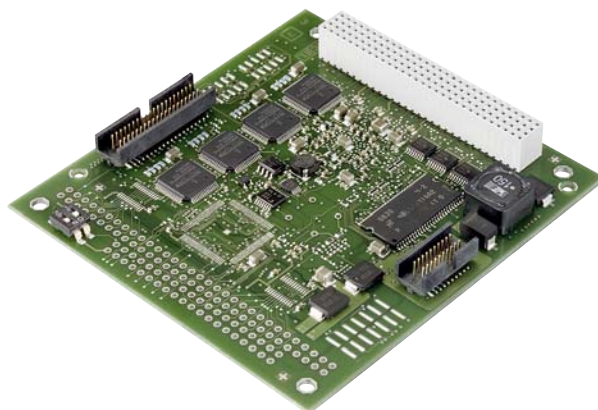
Figure 5-2   CP 1604

- PCI-104 card with its own microprocessor Ethernet real-time ASIC ERTEC 400 with which PNIO communication is also possible.
- Four RJ-45 ports for Industrial Ethernet for connecting twisted-pair cables.
- Integrated 4-port real-time switch for 10/100 Mbps.
- Optional: External 12 - 24 VDC power supply to allow operation of switches when the PC/PG is turned off (using "power supply for CP 1604").

Characteristics and functions of the CP 1604

- Up to 128 connections can be configured at one time.
- Data rates 10/100 Mbps (half/full duplex) are supported.
- Autocrossover and autonegotiation
- IRT (Isochronous Real Time)
- Network management and diagnostics over SNMP
- Supported protocols

ISO	TCP/UDP	PN	MRP	OPC	PG/OP	S7/S5	IT
	●	●	●				

● Suitable / available or according to the specified standard.

Order numbers

CP 1604	PCI 104 card (32-bit) with ASIC ERTEC 400 for connection of PCI/104 systems to a PROFINET IO with 4-port real-time switch (RJ-45); including IO-Base software for PROFINET IO controller and NCM PC; 1 single license for one installation, runtime software, software and electronic manual on CD-ROM, class A, for Microsoft Windows XP Professional (32-bit) and Windows 7; other operating systems using the Development Kit DK-16xx PN IO	**6GK1 160-4AA00**
	Languages: German / English	

CP 1616

Description

Figure 5-3   CP 1616

- PCI module for connecting PCs and SIMATIC PG/PC to PROFINET IO (universal keyed 3.3 V and 5 V; 33 MHz/66 MHz; 32-bit, can operate with 64-bit PCI-X systems)
- Four RJ-45 ports for Industrial Ethernet for connecting twisted-pair cables.
- Integrated 4-port real-time switch for 10/100 Mbps
- Optional: External 6 - 9 VDC power supply to allow operation of switches when the PC/PG is turned off.

Features and functions

- Up to 128 connections can be configured at one time.
- Data rates 10/100 Mbps (half/full duplex) are supported.
- Autosensing, autocrossover and autonegotiation
- IRT (Isochronous Real Time)
- Network management and diagnostics over SNMP
- Supported protocols

ISO	TCP/UDP	PN	MRP	OPC	PG/OP	S7/S5	IT
	●	●	●				

● Suitable / available or according to the specified standard.

Order numbers

CP 1616	PCI/104 card (32-bit; 3.3 / 5 V universal keyed) with ASIC ERTEC 400 for connecting PCs to PROFINET IO with 4-port real-time switch (RJ-45); including IO-Base software for PROFINET IO controller and NCM PC; 1 single license for one installation, runtime software, software and electronic handbook on CD-ROM, class A, for Microsoft Windows XP Professional (32-bit) and Windows 7; other operating systems using the Development Kit DK-16xx PN IO	6GK1 161-6AA01
	Languages: German / English	

5.2   CP 1612 A2

Description

Figure 5-4   CP 1612 A2

- PCI card without its own microprocessor.
- RJ-45 connector for Industrial Ethernet for connecting a twisted-pair cable.

Features and functions

- Up to 64 connections can be configured at one time.
- Data rates 10/100/1000 Mbps (half/full duplex) are supported.
- Autonegotiation
- Supported protocols

ISO	TCP/UDP	PN	MRP	OPC	PG/OP	S7/S5	IT
●	●	●		●	●	●	●

● Suitable / available or according to the specified standard.

Order numbers

CP 1612 A2	PCI card (32-bit; 33 / 66 MHz, 3.3 / 5 V universal keyed) for connection to Industrial Ethernet (10 / 100 / 1000 Mbps) with RJ-45 connector; including driver for Microsoft Windows XP Professional (32-bit), Service Pack 2 / 3, 2003 R2 Server SP2, Vista Business / Ultimate SP1 and Windows 2008 Server	6GK1 161-2AA01
	Languages: German / English	

5.3 CP 1613 A2

Description

Figure 5-5   CP 1613 A2

- PCI card with its own microprocessor
- RJ-45 connector for Industrial Ethernet for connecting a twisted-pair cable.

Features and functions

- Up to 120 connections can be configured at one time.
- Data rates 10/100/1000 Mbps (half/full duplex) are supported.
- Autonegotiation
- Time-of-day synchronization
- SNMP-supported diagnostics
- Supported protocols

ISO	TCP/UDP	PN	MRP	OPC	PG/OP	S7/S5	IT
●	●			●	●	●	●

● Suitable / available or according to the specified standard.

Order numbers

| CP 1613 A2 | PCI card (32-bit; 33 / 66 MHz, 3.3 / 5 V universal keyed) for connection to Industrial Ethernet (10 / 100 Mbps) with RJ-45 connector via HARDNET-IE S7 /S7-1613 and S7 REDCONNECT; Support of operating systems according to the SIMATIC NET software | 6GK1 161-3AA01 |

5.4   CP 1623

Description

Figure 5-6   CP 1623

- PCI Express card with its own microprocessor.
- Two RJ-45 jacks for Industrial Ethernet for connecting twisted-pair cables.
- Can be used as a 2-port switch, both RJ-45 connectors lead to the integrated switch.
- Optional: External 12 - 24 VDC power supply to allow operation of switches when the PC/PG is turned off.

Features and functions

- Up to 120 connections can be configured at one time.
- Data rates 10/100/1000 Mbps (half/full duplex) are supported.
- Autocrossover and autonegotiation
- Time-of-day synchronization
- SNMP-supported diagnostics
- Supported protocols

ISO	TCP/UDP	PN	MRP	OPC	PG/OP	S7/S5	IT
●	●			●	●	●	●

● Suitable / available or according to the specified standard.

Order numbers

CP 1623	PCI Express x1 card for connection to Industrial Ethernet (10 / 100 / 1000 Mbps), with 2-port switch (RJ-45) via HARDNET-IE S7 /S7-1613 and S7 REDCONNECT; Support of operating systems according to the SIMATIC NET software	6GK1 162-3AA00

5.5 CP 1628

Description

Figure 5-7   CP 1628

- PCI Express card with its own microprocessor.
- Two RJ-45 jacks for Industrial Ethernet for connecting twisted-pair cables.
- Can be used as a 2-port switch, both RJ-45 connectors lead to the integrated switch.
- Optional: External 12 - 24 VDC power supply to allow operation of switches when the PC/PG is turned off.

Characteristics and functions of the CP 1623

- Up to 120 connections can be configured at one time.
- Data rates 10/100/1000 Mbps (half/full duplex) are supported.
- Autocrossover and autonegotiation
- Time-of-day synchronization
- SNMP-supported diagnostics
- Security mechanisms
- Supported protocols

ISO	TCP/UDP	PN	MRP	OPC	PG/OP	S7/S5	IT
●	●			●	●	●	●

● Suitable / available or according to the specified standard.

Order numbers

CP 1628	PCI Express x1 card for connection to Industrial Ethernet (110 / 100 / 1000 Mbps), with 2-port switch (RJ-45) and integrated security (firewall, VPN) via HARDNET-IE S7 and S7 REDCONNECT; Support of operating systems according to the SIMATIC NET software	6GK1 162-8AA00 [1]

Communications processors for SIMATIC S7 6

Description

For each SIMATIC S7 system, there are communications processors (CPs) that provide a connection to Industrial Ethernet. This means that S7 controllers can exchange data with other network nodes via Industrial Ethernet. These network nodes may be other S7 controllers or PGs/PCs. This is only possible if these are equipped with an Ethernet card and STEP 7 or STEP 7 Micro / WIN 32. This allows remote programming and diagnostics from a PG/PC. With the communications processors that support PROFINET, PNIO-compliant field devices can be addressed directly.

SIPLUS

For applications in harsh environmental conditions, in aggressive environments or in extreme temperature ranges, the standard properties of an individual device or system are often inadequate. Due to deployment in such locations, there may be restrictions to the functionality or operational reliability and even total failure of a system.

The product types designed to meet such requirements are identified by 'SIPLUS' being appended to the name. The products are certified according to EN 60721-3C4, -3S4, -3B2 as well as ISA S71.04-G1, -G2, -G3 and -GX.

The modules are designed for use in humidity of up to 100%, condensation and salty atmospheres due to conformal coating. These properties also protect the products from dendrite formation and micro corrosion.

Based on the industrial automation system SIMATIC S7-300, two upgraded SIPLUS versions are available.

● For an expanded temperature range of -25 °C to +60 °C and some devices up to +70 °C.

● Unusual environmental load (conformal coating) and electronic equipment on rolling stock conforming with EN 50155.

Note

SIPLUS

You will find more detailed information and the technical documentation on SIPLUS in the portal of Siemens AG: http://www.siemens.de/siplus-extreme

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Device types of the SIMATIC S7 CPs (communications processors)

The following graphic shows the various device types and the corresponding categories of the **SIMATIC S7** product line.

SIMATIC S7: CP	Ethernet	GPRS
SIMATIC S7-200	CP 243-1	
SIMATIC S7-300	CP 343-1 Lean SIPLUS CP 343-1 Lean CP 343-1 SIPLUS CP 343-1 CP 343-1 Advanced SIPLUS CP 343-1 Advanced CP 343-1 ERPC	
SIMATIC S7-400	CP 443-1 SIPLUS CP 443-1 CP 443-1 Advanced	
SIMATIC S7-1200		CP 1242-7 (GRPS)
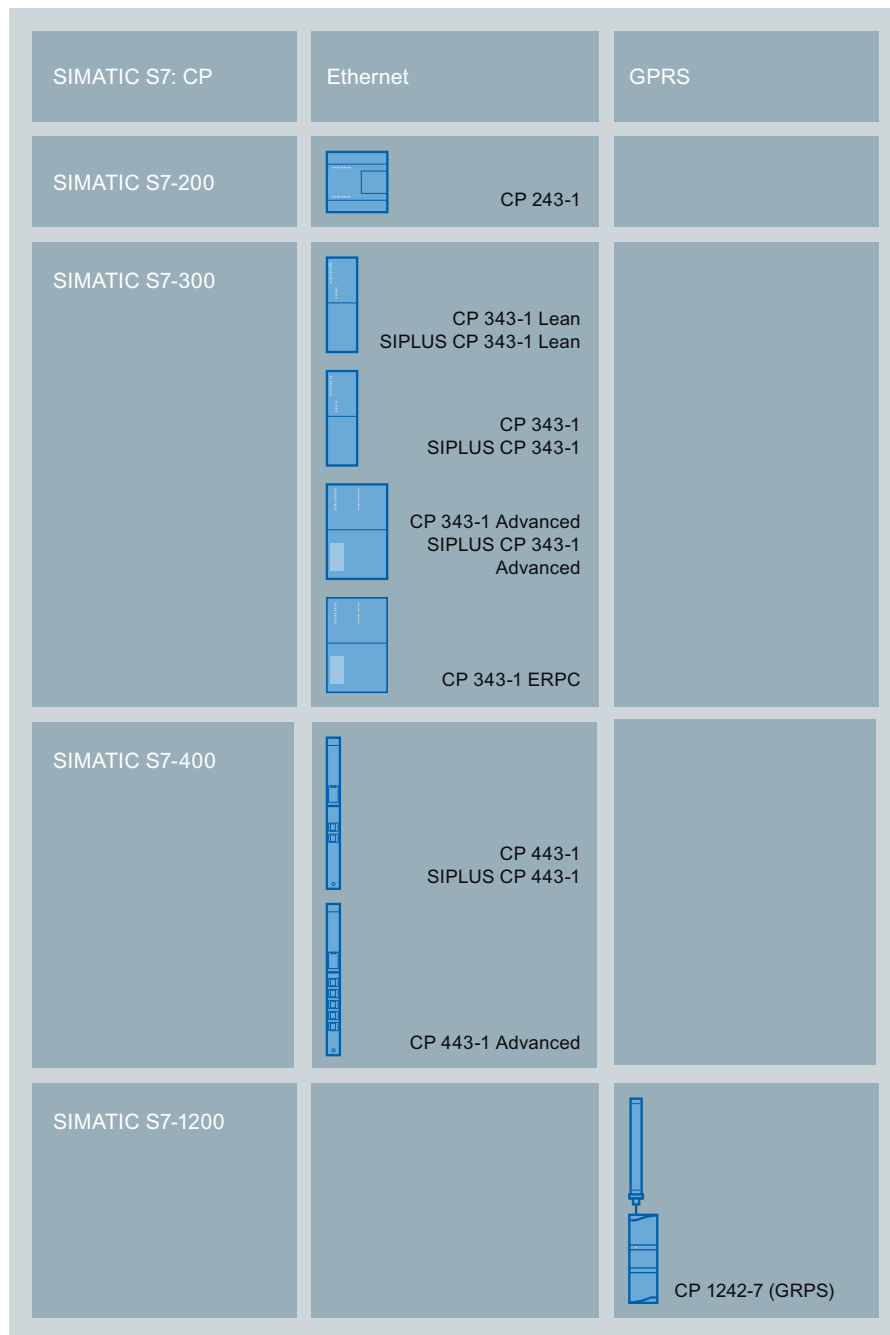
Figure 6-1   SIMATIC S7: CP - communications processors

Example of a topology
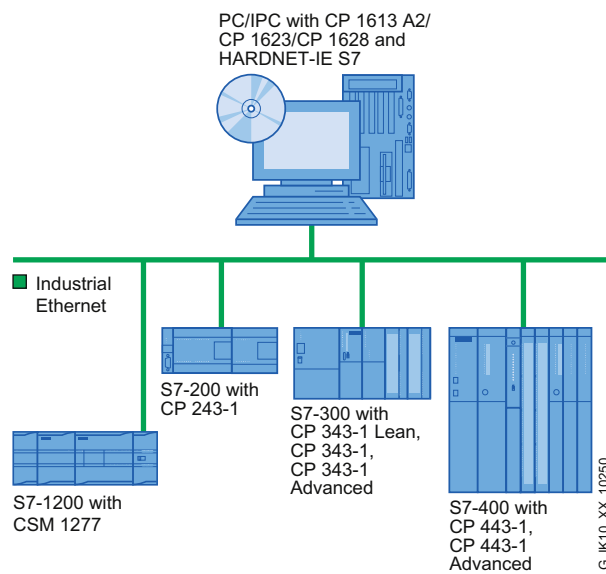
Figure 6-2   Connecting S7 systems to Industrial Ethernet based on the example of a linear bus topology.

6.1   Communications processors for SIMATIC S7-200

Description

Figure 6-3   CP 243-1

- Rugged plastic housing with IP20 protection for installation on a DIN rail or for wall mounting.
- Connection to S7-200 components via the backplane bus.
- External 24 VDC power supply.
- 2-pin terminal block for power supply
- One RJ-45 jack for Industrial Ethernet for connecting twisted-pair cables.

Features and functions

- Up to 8 connections can be configured.

- Data rates 10 / 100 Mbps (half/full duplex) are supported along with the autocrossing function.

- A module can be replaced without a programming device because the project engineering data of the CP is stored on the S7-200 CPU.

- Diagnostics LED

- 8 MB flash memory with file system

- File exchange with other computers using FTP.

- Integrated HTTP server for a maximum of four connections that allows write and read access to process and status data of the S7-200 system. This means, for example, that system diagnostics is possible via a Web browser.

- Integrated SMTP client for event-driven sending of e-mails. Up to 32 e-mails can be configured and these can also contain variables. The current value of such a variable is queried as soon as the program of the S7-200 CPU triggers the sending of the corresponding e-mail.

- Supported protocols and technologies:

PROFINET			ISO	TCP/UDP	MRP	IT	IP-R	FTP	PG/OP	S7
IO-C	IO-D	CBA								
						●		●	●	●

● Suitable / available or according to the specified standard.

Order numbers

CP 243-1	For connecting SIMATIC S7-200 to Industrial Ethernet; for S7 communication, PG communication, e-mail and WWW server; incl. electronic manual on CD-ROM in the languages: German, English, French, Italian, Spanish	6GK7 243-1EX01-0XE0

6.2   Communications processors for SIMATIC S7-300

Description

Figure 6-4   SIMATIC S7-300: CP 343-1 Lean and CP 343-1 Advanced

The communications processors of the category SIMATIC S7-300 are equipped with the following:

- Rugged plastic housings for mounting on S7-300 standard rails.
- Connections to S7-300 components via a backplane bus.
- External 24 VDC power supply.
- 2-pin terminal blocks for power supply.

Characteristics and functions of all devices

The communications processors of this category support the following protocols and technologies:

Functionality	CP 343-1 Lean SIPLUS CP 343-1 Lean	CP 343-1 SIPLUS CP 343-1	CP 343-1 Advanced SIPLUS CP 343-1 Advanced
PROFINET			
→ IO controller		●	●
→ IO device	●	●	●
→ CBA			●
ISO		●	●
TCP/UDP	●	●	●
MRP	●	●	●
IT			●
IP-R			●
FTP			●
PG/OP	●	●	●
S7/S5	●	●	●

● Suitable / available or according to the specified standard.

Functionality	CP 343-1 ERPC
TCP/UDP	●
FMS	
PG/OP	●
S7/S5	●

● Suitable / available or according to the specified standard.

CP 343-1 Lean / SIPLUS 343-1 Lean

The CP 343-1 Lean and the SIPLUS 343-1 Lean are designed for connection of a SIMATIC S7-300 system to Industrial Ethernet networks also as a PROFINET IO device.

The communications processors support

- PG/OP communication
- S7 communication
- Open communication (SEND/ RECEIVE)
- PROFINET communication

The device has the following characteristics and functions:

- A PROFINET interface with two RJ-45 connectors,
- 10 /100 Mbps, full / half duplex with the functionality for autosensing and autocrossover via an integrated 2-port switch.

- The communications services operate over the following interfaces:
  - Open communication (TCP/IP, UDP), multicast for UDP
  - Inter-network PG/OP communication with S7 routing.
  - S7 communication (server)
  - PROFINET IO device
- Media redundancy (MRP):
  - Within an Ethernet network with a ring topology, the communications processor supports the media redundancy protocol MRP
- Diagnostics and network management:
  - Extensive diagnostics functions of all modules of the rack
  - Integration in network management systems by supporting SNMP V1
- Configuration of all functions with STEP 7 as of V5.4 or STEP 7 Professional V11.
- Module replacement without PG by storing the configuration data on the CPU.
- Connector for connecting SIMATIC S7-300 systems to Industrial Ethernet, except for SINUMERIK.
  - Two RJ-45 interfaces for 10 / 100 Mbps full and half duplex connection including autosensing for automatic switchover and the autocrossover function.
  - Integrated 2-port real-time ERTEC switch
  - Multiprotocol operation with TCP and UDP transport protocol and PROFINET IO
  - Keepalive function
- Communications services:
  - Open communication (TCP/IP and UDP)
  - PG/OP communication
  - S7 communication (server)
  - PROFINET IO device
- Multicast for UDP
- Full remote programming and initialization are possible via Industrial Ethernet.
- IT communication incl. Web functionality.
- Integration in network management systems using SNMP.
- The data is configured in STEP 7.
- Inter-network PG/OP communication with S7 routing.
- Diagnostics options in STEP 7 and via a Web browser.
- SIPLUS CP 343-1 Lean

  The SIPLUS CP 343-1 Lean is intended for use under extreme environmental conditions. One variant of the SIPLUS CP 343-1 Lean for harsh environmental conditions is designed for ambient temperatures from -25 °C to +60 °C.

CP 343-1 / SIPLUS CP 343-1

The CP 343-1 and the SIPLUS CP 343-1 have the following characteristics and functions:

- A PROFINET interface with two RJ-45 connectors.

- 10 /100 Mbps, full / half duplex with the functionality for autosensing and autocrossover via an integrated 2-port switch.

- With access protection with the ACL (Access Control List), CP 343-1 communication can be restricted to partners with specific IP addresses.

- For the PROFINET interface, you can specify how the IP configuration (IP address, subnet mask and gateway address) is obtained.

- PROFINET IO controller or PROFINET IO device

- Communications services:

   – Open communication with TCP/IP, UDP, multicast for UDP and ISO.

   – Inter-network PG/OP communication with S7 routing.

   – S7 communication (client, server, multiplexing)

- Media redundancy (MRP):

   – Within an Ethernet network with a ring topology, the CP 343-1 supports the media redundancy protocol MRP.

- Diagnostics and network management:

   – Extensive diagnostics functions of all modules in the rack.

   – Integration in network management systems by support of SNMP V1.

- Security mechanisms:

   Access protection with a configurable IP-ACL (IP Access Control List).

- Configuration of all functions with STEP 7 as of V5.4 or STEP 7 Professional V11.

- Module replacement without PG by storing the configuration data on the CPU.

- SIPLUS CP 343-1

   The SIPLUS CP 343-1 module is intended for environmental loads at ambient temperatures of 0°C to +60°C. One variant of the SIPLUS CP 343-1 is designed for harsh environmental conditions at ambient temperatures from -25 °C to +70 °C.

CP 343-1 Advanced / SIPLUS CP 343-1 Advanced

The CP 343-1 Advanced and the SIPLUS CP 343-1 Advanced have the same range of functions as the CP 343-1 / SIPLUS CP 343-1. They also have the following additional characteristics and functions:

- Two separate interfaces (integrated network separation)

   – Gigabit interface

   – PROFINET interfaces:
   CBA, IO controller and IO device with the real-time properties RT and IRT.

- 30 MB of flash memory with a file system for user-defined HTML pages and 30 MB of RAM for buffering dynamic data.

- File exchange with other computers using FTP.

- An integrated HTTP server that allows write and read access to process and status data of the S7-300 system. System diagnostics is therefore possible via a secure Web browser.

- An integrated ESMTP client for secure, event-dependent sending of e-mails that can also contain tags. The current value of such a variable is queried when the program of the S7-300 CPU triggers the sending of the corresponding e-mail.

- A C-PLUG for storing the configuration data ships with the product.

- CP 343-1 Advanced with security function: Security of the system against unauthorized access by

  - Central access protection for any devices within an automation cell, for example by secure authentication of the network nodes.

  - Secure remote access via Internet thanks to data encryption (VPN)

  - Data integrity check

  - Traceability with data logging based on standard IT mechanisms (Syslog)

- SIPLUS CP 343-1 Advanced

  The SIPLUS CP 343-1 Advanced module is intended for harsh environmental loads at ambient temperatures of 0°C to +60°C.

CP 343-1 ERPC (Enterprise Connect)

The CP 343-1 ERPC communications processor (Enterprise Connect) is designed to connect a SIMATIC S7-300 system to Industrial Ethernet networks.

The CP supports the following:

- PG/OP communication

- S7 communication

- Open communication (SEND/ RECEIVE)

- ERPC communication

- Direct interfacing with database applications such as ORACLE, MySQL, MS-SQL, DB2. This allows controllers to be supplied with data or jobs directly from databases of manufacturing execution systems (MES) or the enterprise resource planning level (ERP).

Note

Database connection of the SIMATIC S7-300 to various database systems for vertical integration is supported by a firmware expansion from the ILS-Technology company that must be ordered separately.

- A C-PLUG for storing the configuration data ships with the product.

- Optimum support of upkeep with:

  – Web-based diagnostics

  – Remote programming via LAN/WAN

  – Monitoring using the network management tool (SNMP)

  – Module replacement without PG using the C-PLUG exchangeable medium

- Access protection with a configurable IP-ACL (IP Access Control List)

The CP 343-1 ERPC communications processor allows subsequent connection to SIMATIC S7 systems within Industrial Ethernet.

Order numbers

CP 343-1 Lean	To connect SIMATIC S7-300 to Industrial Ethernet using TCP/IP and UDP multicast. S7 communication, open communication (SEND/RECEIVE), FETCH/WRITE, PROFINET IO device, MRP, integrated 2-port switch ERTEC, wide-ranging diagnostics options, module replacement without PG, SNMP, initialization via LAN; incl. electronic manual on CD-ROM.	6GK7 343-1CX10-0XE0
SIPLUS CP 343-1 Lean	For an extended temperature range and harsh environmental loads. To connect SIMATIC S7-300 to Industrial Ethernet using TCP/IP and UDP multicast. S7 communication, open communication (SEND/RECEIVE), FETCH/WRITE, PROFINET IO device, integrated 2-port switch ERTEC, wide-ranging diagnostics options, module replacement without PG, SNMP, initialization via LAN; incl. electronic manual on CD-ROM. **Ambient temperature from 0 °C to +60 °C**	6AG1 343-1CX10-4XE0
	Ambient temperature from -25 °C to +60 °C	6AG1 343-1CX10-2XE0
CP 343-1	For connecting SIMATIC S7-300 in Industrial Ethernet via ISO and TCP/IP; PROFINET IO controller or PROFINET IO device, MRP, integrated 2-port switch ERTEC. S7 communication, open communication (SEND/RECEIVE), FETCH/WRITE, with and without RFC 1006, multicast, DHCP, time-of-day synchronization of CPU with SIMATIC mode and NTP, diagnostics, SNMP, access protection using IP access list, initialization via LAN 10/100 Mbps; incl. electronic manual on DVD.	6GK7 343-1EX30-0XE0
SIPLUS CP 343-1	For an extended temperature range and harsh environmental loads. For connecting SIMATIC S7-300 in Industrial Ethernet using ISO and TCP/IP, PROFINET IO controller or PROFINET IO device. S7 communication, open communication (SEND/RECEIVE), FETCH/WRITE, with and without RFC 1006, multicast, DHCP, time-of-day synchronization of CPU with SIMATIC mode and NTP, diagnostics, SNMP, access protection using IP access list, initialization via LAN 10/100 Mbps; incl. electronic manual on DVD. **Ambient temperature from 0 °C to +60 °C**	6AG1 343-1EX30-4XE0
	Ambient temperature from -25 °C to +70 °C	6AG1 343-1EX30-7XE0

CP 343-1 Advanced	For connecting SIMATIC S7-300 in Industrial Ethernet. 1 x 10 / 100 / 1000 Mbps; 2 x 10 / 100 Mbps (IE SWITCH); RJ-45 ports; TCP; UDP; ISO; PROFINET IO controller and IO device, S7 communication (client and server). Open communication (SEND/RECEIVE); S7 routing; IP configuration using DHCP/block; advanced Web diagnostics; time-of-day synchronization; IP access control list; IP routing; FTP; e-mail; PROFINET CBA; C-PLUG. **Without security function.**	6GK7 343-1GX30-0XE0
	With security function, firewall, VPN and PROFIenergy (controller and device).	6GK7 343-1GX31-0XE0
SIPLUS CP 343-1 Advanced	For connecting SIMATIC S7-300 in Industrial Ethernet. 1 x 10/100/1000 Mbps; 2 x 10/100 Mbps (IE SWITCH); RJ-45 ports; TCP; UDP; ISO; PROFINET IO controller and IO device, S7 communication (client and server). Open communication (SEND/RECEIVE); S7 routing; IP configuration using DHCP/block; advanced Web diagnostics; time-of-day synchronization; IP access control list; IP routing; FTP; e-mail; PROFINET CBA; C-PLUG. **Ambient temperature from 0 °C to +60 °C**	6AG1 343-1GX30-4XE0
CP 343-1 ERPC (Enterprise Connect)	For connecting SIMATIC S7-300 in Industrial Ethernet and to support the database connection of the SIMATIC S7-300 to various databases, TCP/UDP. S7 communication, open communication (SEND/RECEIVE), with and without RFC 1006; multicast; Web server, time-of-day synchronization of the CPU with SIMATIC mode and NTP, access protection using IP access list, SNMP, DHCP, initialization via LAN 10/100/1000 Mbps, incl. electronic manual on DVD. A C-PLUG ships with the product.	6GK7 343-1FX00-0XE0

6.3   Communications processors for SIMATIC S7-400

Description

Figure 6-5   SIMATIC S7-400: CP443-1 and CP 443-1 Advanced

The communications processors of the category SIMATIC S7-400 are equipped with the following:

● Rugged plastic housings for mounting in S7-400 racks.

● Connections to S7-400 components via the backplane bus.

Features and functions

The communications processors of this category support the following protocols and technologies:

Functionality	CP 443-1 SIPLUS CP 443-1	CP 443-1 Advanced SIPLUS CP 443-1 Advanced
PROFINET		
→ IO controller	●	●
→ IO device	-	-
→ CBA	-	●
ISO	●	●
TCP/UDP	●	●
MRP	●	●
IT [1]	●	●
IP-R [2]	-	●
FTP	-	●
PG/OP	●	●
S7/S5	●	●

● Suitable / available or according to the specified standard.

1) IT stands for Web server, e-mail, FTP

2) IP-R stands for routing between the interfaces

CP 443-1 / SIPLUS CP 443-1

The CP 443-1 and the SIPLUS CP 443-1 are designed to connect a SIMATIC S7-400 system to Industrial Ethernet networks.

The communications processors support:

- PG/OP communication

- S7 communication

- Open communication (SEND/ RECEIVE)

- PROFINET communication

- IT communication

The communications processors are also suitable for redundant S7 communication in SIMATIC H systems and for applications for the functional safety of the communications technology, for example PROFIsafe in conjunction with an S7-400 F-CPU.

The additional characteristics and functions are as follows:

- A PROFINET interface with two RJ-45 connectors. Connection is via an IE FC RJ-45 plug 180 with 180° cable outlet or via a standard patch cable.

- Diagnostics LEDs for displaying the operational and communication status.

- 10 /100 Mbps, full / half duplex with the functionality for autosensing and autocrossover via an integrated 2-port switch.

- Simple installation, the CP 443-1 is installed in the rack of the SIMATIC S7-400 and connected to the other modules via the backplane bus. There are no slot rules.

- In conjunction with the interface module IM 460/461, the CP 443-1 can also be operated in an expansion rack (ER).

- Fanless operation of the communications processor.

- The communications services operate over the following interfaces:

  - Open communication (TCP/IP and UDP), multicast for UDP incl. routing between the two interfaces.

  - Inter-network PG/OP communication with S7 routing.

  - S7 communication (client, server, multiplexing) incl. routing between the two interfaces.

  - S7-H communication for SIMATIC S7-400 H systems

  - PROFINET IO controller with real-time properties due to RT and IRT

  - The IP address is assigned using DHCP, a simple PC tool or a program block, for example for HMI.

- Media redundancy (MRP):

  - Within an Ethernet network with a ring topology, the communications processor supports the media redundancy protocol MRP

- Diagnostics and network management:

  - Extensive diagnostics functions of all modules of the rack

  - Integration in network management systems by supporting SNMP V1/V3

- A wide range of diagnostics options with LEDs, in STEP 7 and Web-based diagnostics units incl. monitoring by IT network management tools (SNMP V1 MIB II)

- Security mechanisms:

  - Access protection with a configurable IP-ACL (IP Access Control List)

- Configuration of all functions with STEP 7 as of V5.4

- Configuration with STEP 7 Professional V11.

- Module replacement without PG by storing all data on the CPU.

- SIPLUS CP 443-1

- The SIPLUS CP 443-1 module is intended for environmental loads at ambient temperatures of 0°C to +60°C.

CP 443-1 Advanced / SIPLUS CP 443-1 Advanced

The CP 443-1 Advanced and the SIPLUS CP 443-1 Advanced are designed for connection of a SIMATIC S7-400 system to Industrial Ethernet networks also as a PROFINET IO controller or in SIMATIC H systems.

The additional characteristics and functions are as follows:

- PROFINET communication

  - In addition to PROFINET IO communication, PROFINET CBA (Component-Based Automation) is also available here.

  - This makes communication between technological modules (distributed intelligence) possible.

  - Users can choose between cyclic and acyclic communication.
    This form of communication is suitable both for non time-critical as well as time-critical applications.

- Configurable keepalive function

- Two separate interfaces (integrated network separation):

  - Gigabit interface with an RJ-45 connector for 10 / 100 / 1000 Mbps full / half duplex with the autosensing functionality.

  - PROFINET interface with four RJ-45 connectors for 10 / 100 Mbps full / half duplex incl. autosensing and autocrossover functionality via an integrated 4-port switch.

- 30 MB of flash memory with a file system for user-defined HTML pages and 30 MB of RAM for buffering dynamic data.

- File exchange with other computers using FTP.

- Integrated HTTP server that allows write and read access to process and status data of the S7-400 system. This means, for example, that system diagnostics is possible via a secure Web browser.

- Integrated ESMTP client for reliable event-driven sending of e-mails that can also include variables. The current value of such a variable is queried when the program of the S7-400 CPU triggers the sending of the corresponding e-mail.

- A C-PLUG for storing the configuration data ships with the product.

- CP 443-1 Advanced with security function: Security of the system against unauthorized access by

  - Central access protection for any devices within an automation cell, for example by secure authentication of the network nodes.

  - Secure remote access via Internet thanks to data encryption (VPN)

  - Data integrity check

  - Traceability with data logging based on standard IT mechanisms (Syslog)

- SIPLUS CP 443-1 Advanced

  The SIPLUS CP 443-1 module is intended for environmental loads at ambient temperatures of 0°C to +60°C.

Order numbers

CP 443-1	For connecting SIMATIC S7-400 to Industrial Ethernet using TCP/IP, ISO and UDP; PROFINET IO controller, MRP, integrated real-time switch ERTEC with two ports and two RJ-45 interfaces. S7 communication, open communication (SEND/RECEIVE) incl. FETCH/WRITE, with or without RFC 1006, DHCP, SNMP V2, diagnostics, multicast, access protection with IP access control list, initialization via LAN 10/100 Mbps; incl. electronic manual on DVD.	**6GK7 443-1EX30-0XE0**
SIPLUS CP 443-1	For connecting SIMATIC S7-400 to Industrial Ethernet using TCP/IP, ISO and UDP; PROFINET IO controller, MRP, integrated real-time switch ERTEC with two ports and two RJ-45 interfaces. S7 communication, open communication (SEND/RECEIVE) incl. FETCH/WRITE, with or without RFC 1006, DHCP, SNMP V2, diagnostics, multicast, access protection with IP access control list, initialization via LAN 10/100 Mbps; incl. electronic manual on DVD. **Ambient temperature from 0 °C to +60 °C** (For harsh environmental load.)	**6AG1 443-1EX20-4XE0**
CP 443-1 Advanced	For connecting the SIMATIC S7-400 CPU to Industrial Ethernet: 1 x 10 / 100 / 1000 Mbps, 4 x 10 / 100 Mbps (IE switch). RJ-45 ports, ISO, TCP, UDP, PROFINET IO controller, S7 communication; open communication (SEND/RECEIVE). S7 routing, IP configuration using DHCP/block. Access protection with IP access control list; time-of-day synchronization, advanced Web diagnostics; fast startup, PROFIenergy support; IP routing; FTP, Web server, e-mail, PROFINET CBA. **Without security function.**	**6GK7 443-1GX30-0XE0**
	With security function: Firewall and VPN.	**6GK7 443-1GX31-0XE0**
SIPLUS CP 443-1 Advanced	For connecting the SIMATIC S7-400 CPU to Industrial Ethernet: 1 x 10 / 100 / 1000 Mbps, 4 x 10 / 100 Mbps (IE switch). RJ-45 ports, ISO, TCP, UDP, PROFINET IO controller, S7 communication; open communication (SEND/RECEIVE). S7 routing, IP configuration using DHCP/block. Access protection with IP access control list; time-of-day synchronization, advanced Web diagnostics; fast startup, PROFIenergy support; IP routing; FTP, Web server, e-mail, PROFINET CBA **Ambient temperature from 0 °C to +60 °C** (For harsh environmental load.)	**6AG1 443-1GX20-4XE0**

6.4 Communications processors for SIMATIC S7-1200

Description
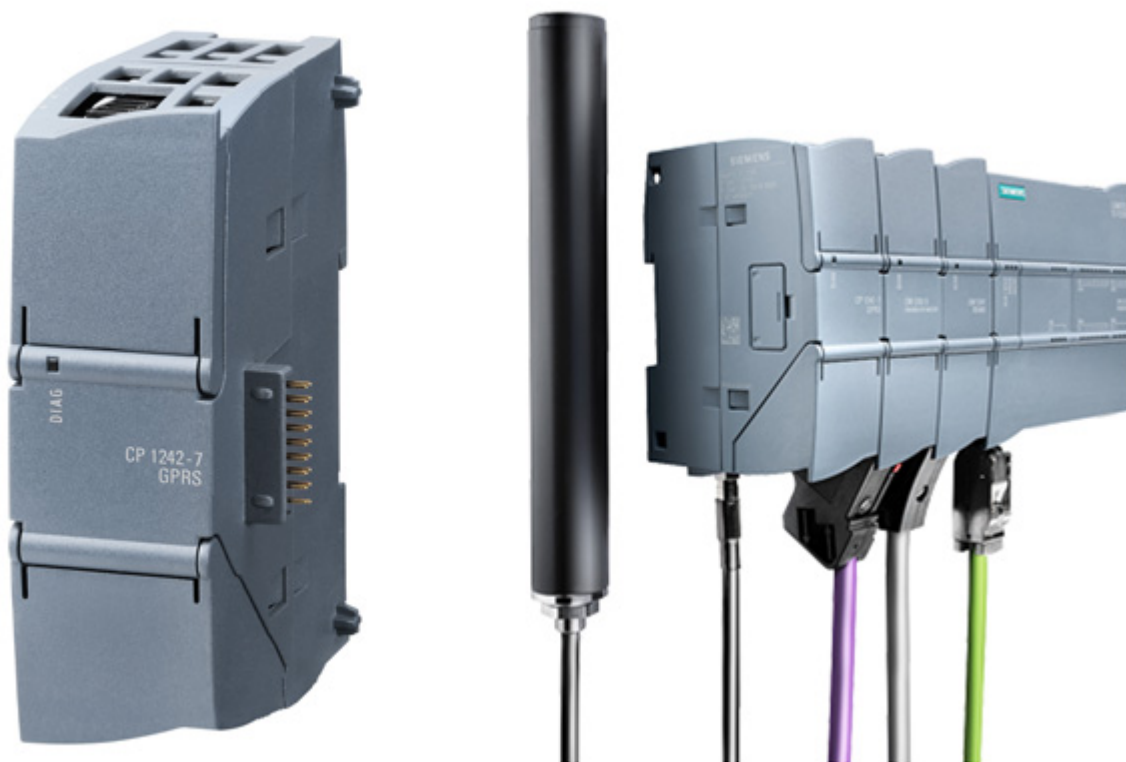
Figure 6-6   SIMATIC S7-1200: CP 1242-7 (GPRS) and communication with S7-1200

The communications processor also has a rugged and compact plastic housing. The elements for connecting and the diagnostics are protected by front covers and easily accessible. The connecting terminals can be removed, installation is on a SIMATIC S7-1200 standard rail.

The CP 1242-7 is connected to the left system bus interface of the S7-1200. The external 24 VDC power supply is via a 3-pin plug-in terminal strip on the top of the module. The SMA antenna connector for GSM/GPRS antenna and the SIM card slot are on the underside of the module protected by the lower front cover.

The communications processors CP 1242-7 is used to connect a SIMATIC S7-1200 system to the GSM/GPRS mobile wireless network that is available worldwide.

Features and functions

- Worldwide, wireless data exchange between S7-1200 controllers and/or between S7-1200 controllers and control centers with an Internet connection.

- Communication based on the mobile wireless service GPRS (General Packet Radio Service) with data transmission speeds of up to 86 kbps on the downlink, the received channel, and up to 43 kbps on the uplink, the transmit channel.

- GPRS mode with fixed IP addresses and dynamic IP addresses with the usual mobile phone contract types.

- Time-of-day synchronization based on NTP (Network Time Protocol)

- Connection establishment is "on demand" with a phone call or SMS.

- Sending and receiving SMS messages

- Clearly recognizable LED signals for fast and simple diagnostics

- Compact housing suitable for industry in the S7-1200 design for mounting on a standard rail

- Fast commissioning thanks to simple configuration with STEP 7

In conjunction with the "Telecontrol Server Basic" software, the CP 1242-7 forms a wireless communications system:

- Connection of up to 5000 telecontrol stations to a control center via the OPC interface, the standard interface for access to process data (Openness, Productivity & Collaboration).

- Buffering of data in the substations if there are connection failures.

- The central status monitoring of the substations.

- Special services from providers for fixed IP addresses are not necessary.

- Teleservice access to the substations is made with STEP 7 via Internet.

Order numbers

CP 1242-7 (GPRS)	Communications processor for connecting SIMATIC S7-1200 to GSM/GPRS mobile wireless networks	6GK7 242-7KX30-0XE0 [1]

[1] Note the national approvals in: http://www.siemens.com/funkzulassungen

Compact switch module

<div style="text-align: right; font-size: 3em;">7</div>

Description

The Compact Switch Modules are industrial Ethernet switches with a compact, modular design for use in the immediate vicinity of the SIMATIC S7 CPUs. Using a CSM, the Ethernet interface of a SIMATIC S7 CPU can be multiplied. This means that simultaneous communication with operator control and programming devices, other controllers or office networks is possible.

With a CSM and the SIMATIC S7 controller, simple, low-cost automation networks can be implemented.

Example of a topology
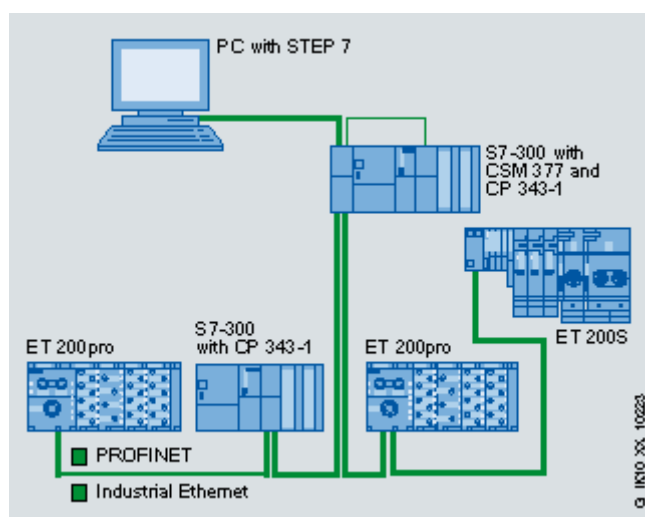
Device variants

Currently, there are four device types of the Compact Switch Module available. These differ in terms of their construction and the installation options:

- The CSM 377 unmanaged meets the requirements of rugged SIMATIC S7-300 technology and is installed on an S7-300 standard rail. The module is designed according to the standards EN 61000-6-2:2001 and EN 61000-6-4:2001.

- The CSM 1277 unmanaged meets the technical and industrial requirements of the new SIMATIC generation S7-1200. The CSM 1277 is installed on an S7-1200 standard rail. The module conforms with the standards EN 61000-6-2 and EN 61000-6-4.

- The SIPLUS NET CSM 1277 is an unmanaged switch for unusual environmental conditions. The module complies with the standards EN 60721-3-3, class 3B2, EN 60721-3-3, class 3C4 incl. salt mist and ISA –S71.04, the immunity test levels G1, G2, G3 and GX.

- LOGO! With four RJ-45 ports, CSM is intended for external access or connection to Industrial Ethernet networks. With the LOGO! With a CSM, an Ethernet interface of the SIMATIC LOGO! can be multiplied. This means that simultaneous communication with operator control and programming devices, other controllers or office environments is possible.

    It is installed on a standard rail.

    Two product variants are available:

    – LOGO! CSM 12/24 for operation with direct current at a voltage of 12 and 24 V.

    – LOGO! CSM 230 for operation with AC voltage of 110 and 230 V.

7.1 CSM 377

Description

Figure 7-1   CSM 377 unmanaged

Unmanaged switch for connection of a SIMATIC S7-300 with integrated PROFINET interface or with an Industrial Ethernet CP or ET 200M to an Industrial Ethernet network with an electrical, bus, tree or star structure.

As an unmanaged switch, the CSM 377 is intended for integration of small machines in existing automation networks or for stand-alone operation of the machines.

● Rugged plastic housing with degree of protection IP20.

● Simple installation; the CSM 377 switch module is installed on an S7-300 standard rail. It has no connection to the backplane bus of the S7-300 or ET 200M and muss therefore be plugged in either at the start (first module to the left of the CPU) or at the end (last module at the extreme right) of the S7-300 station. The connection to the CPU of the S7-300 is either via an Industrial Ethernet cable or an Industrial Ethernet twisted pair cord.

● Rugged node connectors suitable for industry with four PROFINET-compliant RJ-45 plug-in connectors for twisted pair cables that provide tensile and bending relief due to a locking mechanism on the casing.

● Cost-effective solution for the implementation of small, local Ethernet networks.

Features and functions

The CSM 377 unmanaged switch has the following characteristics and functions of SIMATIC S7-300 technology:

- Data rates of 10 / 100 Mbps (half / full duplex)

- 4 x RJ-45 ports for connection to Industrial Ethernet (securing collars) on the front.

- 1x 2-pin plug-in terminal block for connecting the external supply voltage of 24 VDC.

- LEDs for diagnostics and status display of the Industrial Ethernet ports.

- 10 / 100 BaseTX

- Automatic detection of the data rate with autosensing and autocrossover functions for connection of IE FC cables using an IE FC RJ-45 plug from 180 to 100 m.

- There are three further Industrial Ethernet interfaces (TP ports) for connection of additional Ethernet nodes, for example HMI panels or ET 200s.

- The CSM 377 does not require a fan or backup battery.

- The module can be replaced without a PG.

Order numbers

CSM 377	Unmanaged switch for connection of a SIMATIC S7-300, ET 200M and up to three further nodes to Industrial Ethernet. 10/ 100 Mbps, 4 x RJ-45 ports, external power supply 24 VDC, LED diagnostics, S7-300 module including electronic device manual on CD-ROM.	6GK7 377-1AA00-0AA0

7.2 CSM 1277

Description

Figure 7-2   CSM 1277 unmanaged

The Compact Switch Module CSM 1277 is an "unmanaged switch" for connection of a SIMATIC S7-1200 module to an Industrial Ethernet network with a bus, tree or star structure.

With the CSM 1277, the Ethernet interfaces on a SIMATIC S7-1200 module can be multiplied for the additional connection of up to three programming devices, control elements and other Ethernet nodes. This means that simultaneous communication with operator control and programming devices, other controllers or office networks is possible.

With the CSM 1277 and the controller of SIMATIC S7-1200 systems, simple automation networks can be implemented at low cost.

- Rugged plastic housing with degree of protection IP20

- Simple, space-saving installation on the SIMATIC S7-1200 standard rail.

- Cost-effective solution for the implementation of small, local Ethernet networks.

- Straightforward connection via RJ-45 standard connectors.

- Simple and fast status display via LEDs on the device.

- The use of straight-through connecting cables is possible due to the integrated autocrossover function.

Features and functions

The following section describes the characteristics and functions of the two product variants CSM 1277 unmanaged and SIPLUS NET CSM 1277.

CSM 1277 unmanaged

- Data rates of 10 / 100 Mbps (half/full duplex) are supported.

- 3-pin plug-in terminal strip for connection of the external 24 VDC power supply on the top of the device.

- 4 RJ-45 jacks for twisted-pair cables

- Diagnostics display and status display of the individual industrial Ethernet ports using LEDs.

- Automatic data rate detection with autosensing and autocrossover function.

- Multiplication of the Ethernet interfaces of the SIMATIC S7-1200 systems.

- The module can be replaced without a PG.

- Fanless operation and low-maintenance design

With the Compact Switch Module CSM 1277, various network topologies can be implemented:

- Set up of a small local Industrial Ethernet network with three further nodes.

- Connection of the SIMATIC S7-1200 in a bus structure:

  At least one RJ-45 connector of the SIMATIC S7-1200 remains free, for example to connect a programming device (PG).

- Connection of the SIMATIC S7-1200 to a higher-level network with a tree or star structure:

  At least two RJ-45 connectors of the SIMATIC S7-1200 remain free, for example to connect a PG/OP.

SIPLUS NET CSM 1277

The technical concept of the Compact Switch Module SIPLUS NET CSM corresponds to the functions and characteristics of the CSM 1277 unmanaged. The SIPLUS NET 1277 module is intended for unusual environmental loads at ambient temperatures of 0°C to +55°C.

Note

SIPLUS

The SIPLUS extreme products are based on the Siemens standard industrial products.

You will find more detailed information and the technical documentation on SIPLUS in the portal of Siemens AG: http://www.siemens.de/siplus-extreme

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Order numbers

CSM 1277	Unmanaged switch for connection of a SIMATIC S7-1200 and up to three further nodes to Industrial Ethernet at 10 / 100 Mbps, 4 x RJ-45 ports. External power supply 24 VDC, LED diagnostics, S7-1200 module including an electronic manual on CD-ROM.	**6GK7 277-1AA10-0AA0**
SIPLUS NET CSM 1277	For an extended temperature range and unusual environmental loads. Unmanaged switch for connection of a SIPLUS S7-1200, up to three further nodes on Industrial Ethernet at 10 / 100 Mbps, 4 x RJ-45 ports. External power supply 24 VDC, LED diagnostics, S7-1200 module including an electronic manual on CD-ROM. **Ambient temperature from 0 °C to +55 °C** (For unusual environmental loads.)	**6AG1 277-1AA00-4AA0**

7.3 LOGO! CSM

Description

Figure 7-3   LOGO! CSM 12/24 and LOGO! CSM 230

With the Compact Switch Modules **LOGO! CSM 230** and **LOGO! CSM 12/24**, the logic system modules of the LOGO! product series can be expanded with additional Ethernet interfaces. This allows Ethernet networks to be expanded flexibly in electrical bus, tree or star structures.

The design of the logic modules has been adapted to the LOGO! series to allow simple and space-saving installation. The "unmanaged switches" can either connect two logic modules together or provide connectors for additional components such as operator control and monitoring devices, displays or programming devices (PGs).

- Industrial design of the new LOGO! generation
- Space-saving, optimized for connection to LOGO! System modules
- Cost-effective solution for the implementation of small, local Ethernet networks

Features and functions

The LOGO! switch modules have the following characteristics and functions. CSM unmanaged consisting of:

● 4-port unmanaged switch

● Straightforward connection with 4 RJ-45 standard connectors

● 1 Ethernet port on the front of the module for direct diagnostics access in the cabinet.

● 2 product variants for the voltage ranges 12 / 24 VDC or 230 VAC/VDC

● Power supply via terminal strip connectors

● Diagnostics LEDs

● Connection of a LOGO! module and up to 3 further nodes to an Industrial Ethernet network at 10 / 100 Mbps in electrical bus, tree or star structures.

● Stand-alone use for networking different Ethernet devices

Order numbers

LOGO! CSM 230	4-port Compact Switch Module for LOGO!, 230 VAC / VDC	6GK7177-1FA10-0AA0
LOGO! CSM 12/24	4-port Compact Switch Module for LOGO!, 12 / 24 VDC	6GK7177-1MA10-0AA0

Gateways

<div style="text-align: right; font-size: 3em;">8</div>

Description

Gateways allow the connection of Industrial Ethernet networks and other networks that differ in terms of the transmission media and the handling of data traffic. This makes data exchange possible with devices that cannot be connected directly to Industrial Ethernet.

Example of a topology
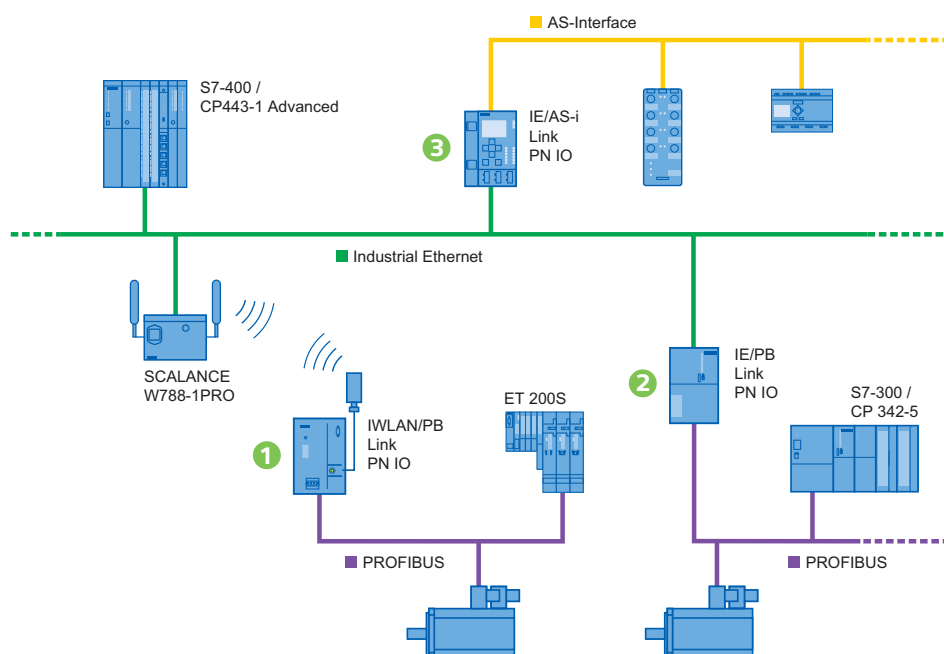
Figure 8-1   ① Connection between IWLAN and PROFIBUS via the IWLAN/ PB Link
                     ② Connection between Industrial Ethernet and PROFIBUS via the IE/ PB Link PN IO
                     ③ Connection between Industrial Ethernet and AS-interface via the IE/ AS-i Link PN IO
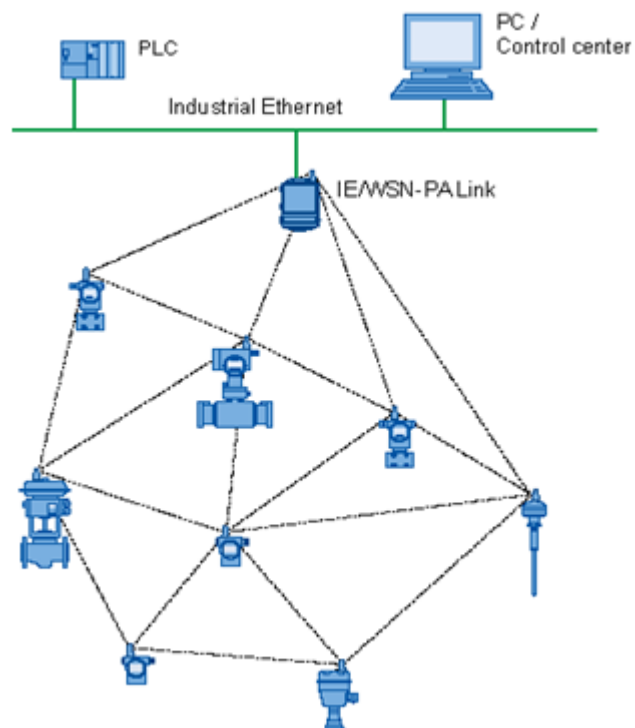
Figure 8-2   Use of the IE/WSN-PA Link as gateway between a WirelessHART network abbreviated
              to WSN (Wireless Sensor Network) and a hard-wired network.

Device variants
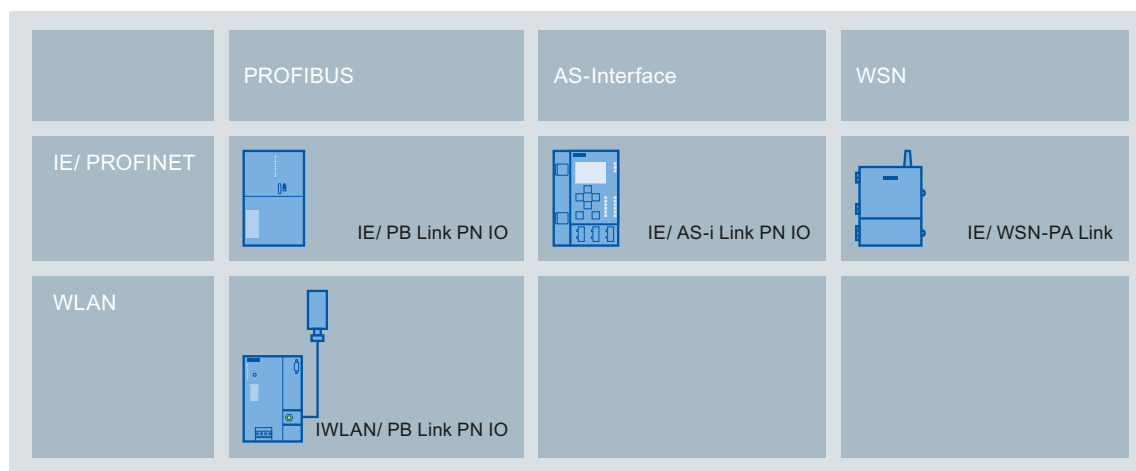
Figure 8-3   Gateways

IE/PB Link PN IO

The IE / PB Link PN IO is a gateway between Industrial Ethernet and PROFIBUS. This device can also be used as a PROFINET IO proxy. This means that PROFIBUS DP slaves are treated as IO devices with an Ethernet interface.

IWLAN/PB Link PN IO

IWLAN/PB Link PN IO is a link between Industrial Wireless LAN and PROFIBUS. The wireless interface supports Rapid Roaming and is therefore also suitable for industrial use with real-time requirements. An omnidirectional antenna, directional antenna or helical antenna (in conjunction with RCoax cables) suitable for the application can be connected to the R-SMA socket. With an IWLAN/PB Link, PROFIBUS IO can also be made usable for mobile applications.

IE/AS-i Link PN IO

The IE/AS-i Link PN IO is a gateway between a PROFINET / Industrial Ethernet (PROFINET IO device) and an AS-Interface. This device allows transparent data access to the AS-interface from Industrial Ethernet.

IE/WSN-PA Link

The IE/ WSN-PA Link is a gateway that connects WirelessHART wireless networks with Ethernet. An IE/WSN-PA Link allows a self-organizing WirelessHART network to be set up and manages the security functions and connectivity. This link is the entry point for data sent by WirelessHART sensors. This data is made available to other systems via an Ethernet interface.

On the wireless side, the IE/ WSN-PA Link supports the WirelessHART standard (HART V 7.1) and on the Ethernet side communication with TCP/IP.

8.1 IE/PB Link PN IO

Design

- Compact synthetic housing with degree of protection IP20 for mounting on an S7-300 standard rail.

- A 9-pin D-sub socket for connection to PROFIBUS.

- An RJ-45 jack for connection to Industrial Ethernet.

- 24 VDC power supply via 2-pin terminal strip.

- Optional use of the C-PLUG memory medium (does not ship with the product) for storage of device parameters. This makes fast device replacement possible if there is a fault.

Features and functions

- Ethernet transmission rate 10/100 Mbps full/half duplex, autosensing.

- Data transmission rate PROFIBUS 9.6 kbps to 12 Mbps incl. 45.45 kbps for PROFIBUS PA.

- By using the PROFINET IO proxy function, existing PROFIBUS devices can continue to be used in a PROFINET environment. PROFIBUS DP slaves are connected to the PROFINET IO controller with real-time properties.

- SNMP diagnostics and integration in the network management systems of the PROFIBUS devices via the IE/PB Link PN IO.

8.2 IWLAN/PB Link PN IO

Design

- Compact synthetic housing with degree of protection IP20 for installation on a DIN rail.

- A 9-pin D-sub socket for connection to PROFIBUS.

- R-SMA socket for connecting antennas.

- 24 VDC power supply via 4-pin terminal strip. As an option, redundant power supply via the decoupled inputs is also possible.

- Optional use of the C-PLUG memory medium (does not ship with the product) for storage of device parameters. This makes fast device replacement possible if there is a fault.

Features and functions

- Support of the wireless standards IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, IEEE 802.11h with data transmission rates up to 54 Mbps at 2.4 GHz or 5 GHz.

- Data transmission rate PROFIBUS 9.6 kbps to 12 Mbps incl. 45.45 kbps for PROFIBUS PA.

- By using the PROFINET IO proxy function, existing PROFIBUS devices can continue to be used in a PROFINET environment. PROFIBUS DP slaves are connected to the PROFINET IO controller with real-time properties.

- The IWLAN/PB Link PN IO supports iPCF (industrial Point Coordination Function). This mechanism allows reduced handover times of significantly less than 50 ms when changing from one wireless cell to another.

- Communication with PROFIBUS automation systems in mobile applications, for example driverless transport systems, high-bay conveyor systems or overhead monorails.

8.3   IE/AS-i Link PN IO

Design

- Compact synthetic housing with degree of protection IP20 for installation on a DIN rail.
- Full graphics display and control buttons on the front of the housing for commissioning the entire lower-level AS-i line and diagnostics on site.
- Two switched Ethernet ports (RJ-45 jacks).
- Power supply via the AS-interface cable or as an option, 24 VDC via screw terminals.
- Optional use of the C-PLUG memory medium (does not ship with the product) for storage of device parameters. This makes fast device replacement possible if there is a fault.

Features and functions

- Ethernet transmission rate 10/100 Mbps, autosensing.
- AS-Interface bus cycle time 5 ms with 31 slaves, 10 ms with 62 slaves.
- Use as single and double AS-interface master for the connection of 62 AS-interface slaves and integrated analog monitoring.
- Integrated Web server via which configuration with Web-based Management is also possible.
- Integrated short-circuit to ground monitoring for the AS-interface cable.

8.4 IE/WSN-PA Link

Design

- Rugged metal housing with degree of protection IP65 for wall or mast mounting indoors and outdoors
- two RJ-45 jacks for connection to Industrial Ethernet and Modbus TCP/IP
- one RS-485 interface (2-pin terminal strip) for connection to Modbus RTU
- 24 VDC power supply via 3-pin terminal strip
- Antenna variants:
    - Integrated, non-detachable antenna
    - one N-Connect socket for connection of external antennas.

Features and functions

- Support of the wireless standard IEEE 802.15.4 and the Wireless HART standard HART V7.1
- Up to 100 WirelessHART devices can be operated in the WirelessHART network with a maximum latency time of 10 seconds (with the maximum configuration).
- Ethernet transmission rate 10/100 Mbps, autosensing
- System integration can be achieved with: TCP/IP via an HTTPS browser, OPC server, Modbus TCP/IP over Ethernet or via the Modbus RTU over a serial connection.
- THE IE/WSN-PA Link sets up a meshed wireless sensor network on the wireless side via which the wireless measuring transducers communicate with the IE/WSN-PA Link. The data of the wireless field devices is buffered on the IE/WSN-PA Link and transferred to the connected systems via Ethernet.
- The configuration of the IE/WSN-PA Link is via Web user interfaces generated by the IE/WSN-PA Link. Device statuses and measured values can also be displayed using this Web user interface.

8.5 Order numbers for gateways

Order numbers

IE/PB Link PN IO	Gateway between Industrial Ethernet and PROFIBUS with PROFINET IO functionality, TCP/IP, S7 routing and data record routing. 10/100 Mbps Fast Ethernet, 9.6 to 12 Mbps PROFIBUS including electronic manual on CD-ROM in the following languages: German, English, French, Spanish and Italian.	6GK1 411-5AB00
IWLAN/PB Link PN IO	Functionality and S7 routing according to IEEE 802.11 B/G/A. Transmission frequencies: 2.4/ 5 GHz up to 54 Mbps 9.6 kbps to 12 Mbps PROFIBUS. ● National approvals for operation outside the USA	6GK1 417-5AB00
	● National approvals for operation in the USA	6GK1 417-5AB01
IE/AS-i Link PN IO	Gateway between PROFINET / Industrial Ethernet and AS-Interface with degree of protection IP20. Including plug-in screw connectors COMBICON for connecting an AS-Interface cable, with double masters, two AS-Interface cables, and an optional power supply of 24 V. According to the AS-Interface specification 3.0. Dimensions (width x height x depth): 90 mm x 132 mm x 88.5 mm ● Single master with display	6GK1 411-2AB10
	● Double master with display	6GK1 411-2AB20
IE/WSN-PA Link	Gateway between WirelessHART and Industrial Ethernet. Transmission frequency: 2.4 GHz ● With integrated antenna	6GK1 411-6CA40-0AA0
	● N-connector for connection of external antennas	6GK1 411-6CA40-0BA0

Note

You will find the current approvals in the portal of Siemens AG under:
http://support.automation.siemens.com/WW/view/en/46374734

Passive components and accessories

<div style="text-align: right; font-size: 2em">9</div>

9.1 Contacts for special cables and special lengths

Contacts for special cables and special lengths

For special cables and special lengths of the individual cable types please contact:

Jürgen Hertlein
SIEMENS I IA SC CI PRM 4
E-mail: juergen.hertlein@siemens.com
Tel.: + 49 (911) 750-4465
Telefax: + 49 (911) 750-9991

9.2 Electrical networks

9.2.1 Electrical cables

The following electrical Industrial Ethernet cables are available for different topologies, requirements or areas of application.

Note

You will find detailed information and technical specifications on the products in the system manual "Passive network components".

Cable	Cable type	Characteristics	Area of application
TP cord	IE TP cord 2x2 IE TP XP cord 2x2 IE TP cord 4x2 IE TP XP cord 4x2	Patch cable, preassembled with RJ-45 connectors	For connection of nodes to network components within a cabinet, up to 10 m cable length
Fast Connect		FC installation cables Insulation-piercing technique Sold by the meter	For direct connection between node and network component, used for structured cabling, fast and simple attachment to FC contacts
IE FC TP 2x2 4-wire cable for Fast Ethernet networks	IE FC TP standard cable GP		Standard bus cable with solid wires and special design for self-assembly; 4 solid wires twisted into a star quad
	IE FC TP flexible cable GP		Flexible bus cable for special situations with occasional movement; 4 wires (stranded) twisted into a star quad
	IE FC TP FRNC cable GP		Flexible, halogen-free cable for use in buildings (FRNC= Flame Retardant Non Corrosive); 4 wires (stranded) twisted into a star quad for occasional movement
	IE FC TP trailing cable GP IE FC TP trailing cable		Highly flexible bus cable for special uses involving constant movement in a drag chain, for example with permanently moving machine parts; 4 wires (stranded) twisted into a star quad
	IE FC festoon cable GP		Flexible cable for special use with constant movement in a cable festoon, for example in cranes; 4 wires (stranded) twisted into a star quad
	IE FC TP food cable		Flexible cable specially for use in the food and beverages industry; 4 wires (stranded) twisted into a star quad

Cable	Cable type	Characteristics	Area of application
	IE FC TP marine cable GP		Bus cable specially for use on ships; 4 wires (stranded) twisted into a star quad, halogen-free, certified for shipbuilding
	IE FC TP torsion cable		Highly flexible bus cable specially for use with constant movement, for example when using robots; 4 wires (stranded)
IE FC TP 4x2 8-wire cable for gigabit Ethernet networks	IE FC TP standard cable (22 AWG)		For setting up Industrial Ethernet networks up to 100 m in conjunction with the IE FC Modular Outlet and the TP cords
	IE FC TP standard cable GP (24 AWG)		For direct connection up to 60 m without patching with IE FC RJ-45 Plug 4x2
IE connecting cable	IE connecting cable M12-180/M12-180	Preassembled cable with two 4-pin M12 plugs	Connecting cable with two 4-pin M12 plugs (D-coded) for connection of Industrial Ethernet nodes with degree of protection IP65/IP67
	Power connecting cable M12-180/M12-180		Connecting cable with one 4-pin M12 plug (A-coded) and one 4-pin M12 socket (A-coded) for 24 V power supply
	IE connecting cable M12-180/IE FC RJ-45 Plug	Preassembled cable with one 4-pin M12 plug and one IE FC RJ-45 Plug	Connecting cable with one 4-pin M12 plug (D-coded) and one IE FC RJ-45 connector with 145° cable outlet. The connecting cable is used to connect Industrial Ethernet nodes
IE hybrid cable	IE hybrid cable 2x2	Hybrid cable for simultaneous transfer of data (10/100 Mbps) and power (24 V/400 mA); insulation piercing technique sold by the meter	Industrial and office environment; for IE FC RJ-45 modular outlet and access point SCALANCE W with IP67 hybrid connector
Power	Energy cable 2 x 0.75	Energy cable, sold by the meter	For connecting a signaling contact or 24 VDC power supply
	Energy cable 5 x 1.5		

9.2.2   General

FastConnect (FC) twisted pair (TP)

For structured cabling within a factory, the FC TP cabling system is ideal. Using the FastConnect (FC) assembly system for Industrial Ethernet, structured cabling from the office environment has been further developed for use in the factories.

FC cables can be assembled quickly and simply on site. This means that RJ-45 cabling technology, an existing standard, is also available in a version suitable for industry and making such cabling possible in an industrial environment.

With the IE RJ-45 plug and FC cables, runs of up to 100 m cable length are possible without patching.

Twisted pair (TP) cord

The TP cord is used to connect end devices to the Industrial Ethernet FC cabling system. It is intended for use in cabinets and is used mainly as patch cables. TP cord is also known as patch cable.

The maximum total length of the TP cord in a point-to-point link is 10 m.

Standards

The EN 50173 standard describes the structured cabling of office buildings. IEC 24702 describes the structured building networking of an industrial building. The general description of networking an automated plant within an industrial building can be found in IEC 61918. The the profile-specific networking rules for PROFINET can be found in IEC 61784-5-3.

Structured cabling

Structured cabling describes the cabling of building complexes for information technology purposes regardless of the applications used. A building is divided into the following areas:

- Primary area: Interconnection of buildings of a campus

- Secondary area: Interconnection between floors of a building

- Tertiary area: Information technology connectors for the end devices of a floor

TP Cords can be used as patch cables between devices and on patch panels.

The structured cabling that can be implemented with the Industrial Ethernet FC system corresponds to tertiary cabling according to the ISO/IEC 11801, IEC 24702 and EN 50173 standards.
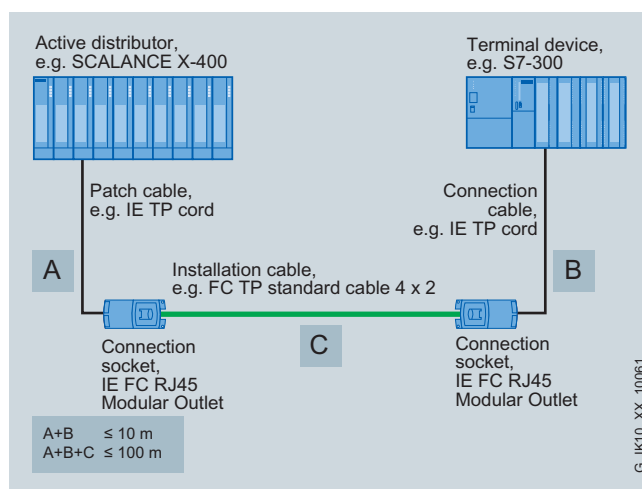
Figure 9-1   Structured cabling

Table 9- 1   Cables for structured cabling to EN 50173

Use	SIMATIC NET cable	Maximum length
Patch cable	IE TP cord	A+C max. 10 m
Tertiary cable	IE FC standard cable GP	B max. 90 m
	IE FC flexible cable GP	B max. 75 m
	IE FC torsion cable GP	B max. 45 m
	IE FC trailing cable GP	B max. 75 m
	IE FC trailing cable	B max. 75 m
	IE FC marine cable	B max. 75 m
	IE FC TP FRNC cable GP	B max. 75 m
	IE FC food cable	B max. 75 m
	IE FC festoon cable GP	B max. 75 m
	IE hybrid cable	B max. 75 m

100BASE-TX

The twisted pair interfaces of the SCALANCE products correspond to the standard IEEE 802.3u: 100BASE TX. Depending on the variant, the devices have one or more RJ-45 jacks or M12 sockets.

Maximum lengths of twisted pair cables

The twisted pair cables to be used between two neighboring devices must not exceed the following maximum lengths:

Cabling structure	Cable type	Max. length	Max. total of the patch cables (TP cord)
In one piece They are used without patch cables.	IE FC standard cable GP	100 m	
	IE FC flexible cable GP	85 m	
	IE FC torsion cable GP	55 m	
	IE FC trailing cable GP	85 m	
	IE FC trailing cable	85 m	
	IE FC marine cable	85 m	
	IE FC TP FRNC cable GP	85 m	
Structured The set up is with patch cables and and IE FC outlet RJ-45 or IE FC RJ-45 modular outlet.	IE FC standard cable GP	90 m	10 m
	IE FC flexible cable GP	75 m	10 m
	IE FC torsion cable GP	45 m	10 m
	IE FC trailing cable GP	75 m	10 m
	IE FC trailing cable	75 m	10 m
	IE FC marine cable	75 m	10 m
	IE FC TP FRNC cable GP	75 m	10 m
In one piece, including D-sub plugs.	ITP standard 2 x 2	100 m	

See also

Appendix (Page 359)

9.2.3   IE FC TP cable

The FastConnect (FC) twisted-pair (TP) cables are shielded cables with a symmetrical radial design and 100 ohms characteristic impedance.

The combination of twisted cores, foil screen and braided shield makes the FC cables especially suitable for installation in industrial environments subject to electromagnetic interference. When installed, the design also ensures a high degree of stability of electrical and mechanical data.

Using the IE FC stripping tool, the outer jacket and shield of the FC TP cables can be stripped to correct lengths in a single action.

All FC TP cables are UL-listed products and suitable for use in the USA and Canada. Cables with this certification have the letters GP (General Purpose) in their names.

IE FC TP cable 2x2

The 4-wire FC TP cables are suitable for a transmission rate of 10 / 100 Mbps. The 4 wires are twisted into a star quad.

Cable cross-section

Figure 9-2   IE FC TP CABLE 2X2

The IE FC TP standard cable and the IE FC TP food cable have solid wires, the other cables have stranded wires.

Note

You will find information about PROFINET conformity for the electrical cable types of the IE FC cable 2x2 in the PROFINET Installation Guide. This document can be downloaded from the portal www.profibus.com/downloads.

IE FC TP cable 4x2

To operate 1 gigabit Ethernet networks, 8-wire FC TP cables are required. The 8-wire FC TP cables are category 6 (CAT6) according to the international cabling standards ISO/IEC 11801 and EN 50173.

The 8-wire FC TP cable can also be operated at lower data rates, for example 100 Mbps.

Cable cross-section
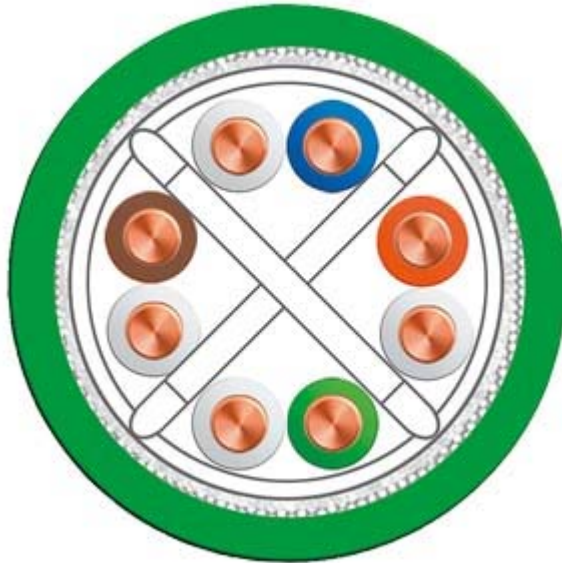
Figure 9-3   IE FC TP 4x2 22 AWG
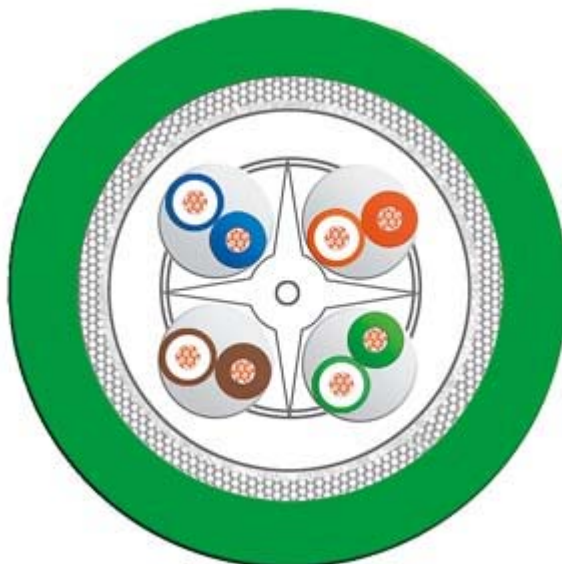
Figure 9-4   IE FC TP 4x2 27 AWG

9.2.3.1 IE FC TP standard cable GP 2x2

Description

The IE FC TP standard cable GP is the standard cable for Fast Ethernet. The cable with solid copper wires (22 AWG) is intended for permanent, fixed installation.

Features and functions

Cable type [1]	IE FC TP standard cable GP 2x2 (PROFINET type A)
Areas of application	Universal application
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	100 m
• with IE FC outlet RJ-45	90 m
Cable type (standard code)	2YY (ST) CY 2x2x0.64/1.5-100 GN
Jacket	PVC Ø (6.5 ± 0.2) mm, green
Permitted ambient conditions	
Operating temperature	-40 ℃ to +75 ℃
Transportation/storage temperature	-40 ℃ to +75 ℃
Installation temperature	-20 ℃ to +60 ℃
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1]   Electrical characteristics at 20 °C, tests according to DIN 47 250 Part 4 or DIN VDE 0472

Order numbers

IE TP standard cable GP 2x2 (PROFINET type B)	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug PROFINET-compliant; with UL approval.	6XV1 840-2AH10

9.2.3.2   IE FC TP flexible cable GP 2x2

Description

The IE FC flexible cable GP 2x2 with its flexible wires is suitable for applications in which occasional movement is required.

Features and functions

Cable type [1]	IE FC TP flexible cable GP 2x2 (PROFINET type B)
Areas of application	Occasional movement
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	2YY (ST) CY 2x2x0.75/1.5-100LI GN
Jacket	PVC Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	–25 ºC to +75 ºC
Transportation/storage temperature	-25 ℃ to +75 ℃
Installation temperature	-10 ℃ to +60 ℃
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1]   Electrical properties at 20 °C, tested to DIN 0472

Order numbers

IE FC TP flexible cable GP 2x2 (PROFINET type B)	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug for occasional movement; PROFINET-compliant; with UL approval;	6XV1 870-2B

9.2.3.3   IE FC TP torsion cable 2x2

Description

In contrast to IE FC TP Standard Cable 2x2 with the IE FC TP torsion cable 2x2, the wires are stranded copper. In conjunction with the special combination of braid shield, fleece foil shield, and the sheath material of polyurethane (PUR), the cable achieves a torsional strength of ±180° and highly constant electrical characteristics. The cable has been tested for 5,000,000 torsion movements on 1 m cable length (±180°).

The cable is suitable for networking moving plant parts, such as robots. The cable is not suitable for festoons.

Features and functions

Cable type [1]	IE FC TP torsion cable GP 2x2 (PROFINET type C)
Areas of application	Constant motion when used with robots
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	55 m
• with IE FC outlet RJ-45	45 m
Cable type (standard code)	2YY (ST) CY 2x2x0.75/1.5-100 LI GN
Jacket	PVC Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	-40 ºC to +80 ºC
Transportation/storage temperature	-40 ºC to +80 ºC
Installation temperature	-20 ºC to +60 ºC
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1]   Electrical properties at 20 °C, tested to DIN 0472

Order numbers

IE FC TP torsion cable GP 2x2 (PROFINET type C) [3]	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug for use with robots; PROFINET-compliant; with UL approval;	6XV1 870-2F

9.2.3.4 IE FC TP trailing cable 2x2

Description

In contrast to the IE FC TP standard cable 2x2, with the IE FC TP trailing cable 2x2, the wires are stranded copper. In conjunction with the special combination of braid shield, fleece foil shield, and the sheath material of polyurethane (PUR), the cable achieves a bending radius of 100 mm and highly constant electrical characteristics. The cable is designed for 4,000,000 bending cycles with a bending radius of 100 mm, a speed of 4 m/s and an acceleration of 4m/s^2.

Features and functions

Cable type [1]	IE FC TP trailing cable 2x2 (PROFINET type C)
Areas of application	Use in drag chains
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	2YH (ST) C11Y 2 x 2 x 0.75/1.5-100 LI GN VZN FRNC
Jacket	PUR Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	-40 ºC to +75 ºC
Transportation/storage temperature	-40 ºC to +75 ºC
Installation temperature	-20 ºC to +60 ºC
Resistance to fire	Flame retardant to IEC 60332-1-2
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

[1] Electrical properties at 20 °C, tested to DIN 0472

Order number

IE FC TP trailing cable 2x2 (PROFINET type C)	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug 180/90 for use in drag chains; PROFINET-compliant; with UL approval	6XV1 840-3AH10

9.2.3.5 IE FC TP trailing cable GP 2x2

Description

In contrast to the IE FC TP standard cable 2x2, with the IE FC TP trailing cable GP 2x2, the wires are stranded copper. The cable is designed for 3,000,000 bending cycles with a bending radius of 100 mm, a speed of 4 m/s and an acceleration of 4m/s^2.

Features and functions

Cable type [1]	IE FC TP trailing cable GP 2x2 (PROFINET type C)
Areas of application	Use in drag chains
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	2YY (ST) CY 2x2x0.75/1.5-100 LI GN
Jacket	PVC Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	-25 °C to +75 °C
Transportation/storage temperature	-25 ºC to +75 ºC
Installation temperature	-10 ºC to +60 ºC
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1] Electrical properties at 20 °C, tested to DIN 0472

Order number

IE FC TP trailing cable 2x2 (PROFINET type C)	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug for use with drag chains; PROFINET-compliant; with UL approval;	6XV1 870-2D

9.2.3.6 IE FC TP FRNC cable GP 2x2

Description

The halogen-free IE FC TP FRNC cable is suitable for installation in areas in which special fire prevention conditions prevail, for example in buildings open to the public.

The jacket is FRNC (Flame Retardant Non Corrosive): FRNC materials are halogen-free, flame-retardant or self extinguishing and do not release any aggressive gases or acids when burned.

Features and functions

Cable type [1]	IE TP FRNC cable GP2x2 (PROFINET type B)
Areas of application	Occasional movement
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	02YS (ST) C11Y 1 x 4 x 0.75/1.5-100LI GN VZN FRNC
Jacket	FRNC Ø (6.5 ± 0.2) mm, green
Permitted ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transportation/storage temperature	-45 ºC to +75 ºC
Installation temperature	0 ºC to +50 ºC
Resistance to fire	Flame retardant IEC 60332-3-22 Category A/F
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

[1] Electrical characteristics at 20 °C, tests according to DIN 47 250 Part 4 or DIN VDE 0472

Order numbers

IE TP FRNC cable GP 2x2 (PROFINET type B)	4-wire, shielded, halogen-free TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug for occasional movement. PROFINET-compliant, with UL approval.	6XV1 871-2F

9.2.3.7   IE FC festoon cable GP 2x2

Description

The IE FC festoon cable GP 2x2 with its stranded wires and a PUR outer jacket is specifically designed for festoon applications on cranes.

Features and functions

Cable type [1]	IE FC festoon cable GP 2x2 (PROFINET type B)
Areas of application	Use in festoons
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	2YY(ST)CY 2X2X0.75/1.5 LI GN
Jacket	FRNC Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	-40 ºC to +75 ºC
Transportation/storage temperature	-50 ºC to +75 ºC
Installation temperature	-20 ºC to +60 ºC
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

Order numbers

IE FC TP festoon cable GP 2x2 (PROFINET type C)	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/IE FC RJ-45 plug 180/90 for food, beverages and tobacco industry; PROFINET-compliant; sold in meters; maximum length available 1000 m, minimum length available 20 m	6XV1 871-2L
IE FC TP festoon cable GP 2x2 (PROFINET type B)	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug 180/90 for use in festoon applications; PROFINET-compliant; with UL approval	6XV1 871-2S

9.2.3.8   IE FC TP food cable 2x2

Description

The IE FC TP food cable 2x2 with its PE outer jacket and stranded wires is specifically designed for use in the food, beverages and tobacco industry.

Features and functions

Cable type [1]	IE FC TP food cable 2x2 (PROFINET type C)
Areas of application	Food, beverages and tobacco industry
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	2YH(ST)C2Y 2X2X0.75/1.5-100 LI
Jacket	PUR Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	-40 ºC to +75 ºC
Transportation/storage temperature	-50 ºC to +75 ºC
Installation temperature	-20 ºC to +60 ºC
Resistance to fire	Flammable
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

[1]   Electrical properties at 20 °C, tested to DIN 0472

Order numbers

IE FC TP food cable GP 2x2 (PROFINET type B))	4-wire, shielded TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug 180/90 for use in festoon applications; PROFINET-compliant; with UL approval	6XV1 871-2S

9.2.3.9 IE FC TP marine cable 2x2 GP

Description

The halogen-free IE FC TP marine cable has a the following shipbuilding certifications:

- American Bureau of Shipping Europe Ltd. (ABS)
- Bureau Veritas (BV)
- Det Norske Veritas (DNV)
- Germanischer Lloyd (GL)
- Lloyds Register of Shipping (LRS)

The jacket is FRNC (Flame Retardant Non Corrosive): FRNC materials are halogen-free, flame-retardant or self extinguishing and do not release any aggressive gases or acids when burned.

Features and functions

Cable type [1]	IE FC TP marine cable 2x2 (PROFINET type B)
Areas of application	Marine and offshore use
Cable specification	Cat 5e
Maximum cable length	
• with IE FC RJ-45 plug	85 m
• with IE FC outlet RJ-45	75 m
Cable type (standard code)	L-9YH (ST) CH 2 x 2 x 0.34/1.5-100 GN VZN FRNC
Jacket	FRNC Ø (6.5 ± 0.2) mm
Permitted ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transportation/storage temperature	-40 ºC to +70 ºC
Installation temperature	0 ºC to +50 ºC
Resistance to fire	Flame retardant IEC 60332-3-22 Category A/F
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

[1] Electrical properties at 20 °C, tested to DIN 0472

Order number

IE FC TP marine cable 2x2 (PROFINET type B) [2]	4-wire, shielded, halogen-free TP installation cable for connection to IE FC outlet RJ-45/ IE FC RJ-45 plug 180/90, certified for shipbuilding;	6XV1 840-4AH10

9.2.3.10   IE FC TP flexible cable GP 4x2

Description

The IE FC flexible cable GP 4x2 with its flexible wires is suitable for applications in which occasional movement is required. The cable has the FC design and can be stripped with the IE FC stripping tool. This allows the IE FC RJ-45 4x2 plug-in connector to be connected to the IE FC flexible cable GP 4x2.

Features and functions

Cable type [1]	IE FC standard cable GP 4x2 (22 AWG)
Areas of application	Occasional movement
Cable specification	Cat 6
Maximum cable length	
• with IE FC RJ-45 plug	55 m
Cable type (standard code)	LI02YSH (ST) CY 4x2x0.22/1.1-100 GN
Jacket	PVC Ø (8 ± 0.2) mm; green
Permitted ambient conditions	
Operating temperature	-40 ºC to +80 ºC
Transportation/storage temperature	-40 ºC to +80 ºC
Installation temperature	–40 C to +80 ºC
Resistance to fire	Flame retardant to IEC 60332-3-24 (Category C)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1]   Electrical properties at 20 °C, tested to DIN 0472

Order numbers

IE FC TP flexible cable GP 4x2	8-wire shielded TP installation cable for universal application; with UL approval.	6XV1 878-2B

9.2.3.11   IE FC TP Standard Cable GP 4x2

Description

The IE FC TP standard cable GP 4x2 is available in two variants.

- IE FC TP standard cable 4x2 (22 AWG)

  The cable is used to set up Industrial Ethernet networks up to 100 m.

- IE FC TP cable 4x2 (24 AWG)

  The cable is used for direct connection up to 90 m without patch cables.

Features and functions

Cable type [1]	IE FC standard cable GP 4x2 (22 AWG)	IE FC standard cable GP 4x2 (24 AWG)
Areas of application	Universal application	Universal application
Cable specification	Cat 6	Cat 6
Maximum cable length		
• with IE FC RJ-45 plug	-	55 m
• with IE FC outlet RJ-45	90 m + 10 m patch cable	-
Cable type (standard code)	2YH (ST) C 4x2x0.64/1.25-100 GN 4x2xAWG22	2YH (ST) CY 4x2x0.5/1.0-100 GN
Jacket	PVC Ø (9.6 ± 0.3) mm; green	PVC Ø (8 ± 0.2 mm; green
Permitted ambient conditions		
Operating temperature	-40 ºC to +80 ℃	-40 ºC to +80 ℃
Transportation/storage temperature	-40 ℃ to +80 ℃	-40 ℃ to +80 ℃
Installation temperature	-40 ℃ to +80 °C	-40 ℃ to +80 °C
Resistance to fire	Flame retardant to IEC 60332-1	Flame retardant to IEC 60332-3-24 (Category C)
Resistance to oil	Conditionally resistant	Conditionally resistant
UV resistance	resistant	resistant
Product characteristics		
Halogen-free	no	no
Silicone-free	yes	yes

[1]   Electrical properties at 20 °C, tested to DIN 0472

Order numbers

IE FC TP Standard Cable GP 4x2	8-wire shielded TP installation cable for universal application; with UL approval.	
	• 22 AWG	6XV1 870-2E
	• 24 AWG	6XV1 878-2A

9.2.4   IE connecting cable M12

Description

The IE connecting cable M12 is an assembled connecting cable for connecting Industrial Ethernet nodes. As the connecting cable, the IE FC TP trailing cable GP is used. Due to the 4-wire IE FC TP trailing cable GP that is used, the connecting cable is suitable for drag chains. The IE connecting cable M12 is suitable for drag chains for 3,000,000 bending cycles at a bending radius of 100 mm, a speed of 4 m/s and an acceleration of 4 m/s².

The IE connecting cable M12 is available in the following variants:

• IE connecting cable M12-180/M12-180

  Connecting cable with two 4-pin M12 plugs (D-coded) for connection of Industrial Ethernet nodes with degree of protection IP65/IP67, e.g. SIMATIC ET 200, SCALANCE X208PRO and SIMATIC RF systems.

• IE connecting cable M12-180/IE FC RJ-45-145

  Connecting cable with one 4-pin M12 plug (D-coded) and one IE FC RJ-45 connector. The connecting cable is used to connect Industrial Ethernet nodes, for example SIMATIC ET 200, SCALANCE X208PRO and SIMOTION.

Features and functions

Cable type [1]	IE connecting cable M12
Areas of application	For connecting Industrial Ethernet nodes
Cable specification	Cat 5e
Maximum cable length	
• with two M12 plugs	1 m
• with M12 plugs and RJ-45 plugs	10 m
Cable type (standard code)	2YY (ST) CY 2x2x0.75/1.5-100 LI GN
Jacket	PVC $\varnothing$ (6.5 ± 0.2) mm, green
Permitted ambient conditions	
Operating temperature	-25 ℃ to +75 ℃
Transportation/storage temperature	25 ℃ to +75 ℃
Installation temperature	25 ℃ to +75 ℃
Resistance to fire	Flame retardant to UL 1685 (CSA FT 4)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1] Electrical properties at 20 °C, tested to DIN 0472

Order numbers

IE connecting cable M12-180/M12-180	preassembled IE FC TP trailing cable GP, with 2 x M12 plugs (D coded)	
	• 0.3 m	6XV1 870-8AE30
	• 0.5 m	6XV1 870-8AE50
	• 1.0 m	6XV1 870-8AH10
	• 1.5 m	6XV1 870-8AH15
	• 2.0 m	6XV1 870-8AH20
	• 3.0 m	6XV1 870-8AH30
	• 5.0 m	6XV1 870-8AH50
	• 10.0 m	6XV1 870-8AN10
	• 15.0 m	6XV1 870-8AN15

IE connecting cable **M12-180/IE FC RJ-45 Plug-145**	preassembled IE FC TP trailing cable GP, with 1 x M12 plugs (D coded) and 1 x IE FC RJ-45 plug	
	• 2.0 m	**6XV1 871-5TH20**
	• 3.0 m	**6XV1 871-5TH30**
	• 5.0 m	**6XV1 871-5TH50**
	• 10.0 m	**6XV1 871-5TN10**
	• 15.0 m	**6XV1 871-5TN15**

9.2.5   IE Hybrid Cable

Description

The IE hybrid cable 2x2 + 4x0.34 in conjunction with the IE FC RJ-45 modular outlet is the ideal solution when a device such as SCALANCE W needs to be supplied with its operating voltage and data at the same time.

The cable contains the following:

● 2x2 wires according to Cat 5e for data transfer

● 2x2 wires each with a wire diameter of 0.76 mm for transferring power

The power is transferred via the cable according to the Power over Ethernet standard (PoE).

The hybrid cable is halogen-free for universal application in an industrial and office environment. The cable is UV-resistant according to UL 1581 Sec. 1200.

The maximum cable length between the IE FC RJ-45 modular outlet and the SCALANCE W access point is 80 m with an additional 6 m of patch cable for the IE FC RJ-45 modular outlet. For connection to the SCALANCE W, an IP67 hybrid plug-in connector is recommended.

Cable cross-section

Features and functions

Cable type [1)]	IE hybrid cable 2x2 + 4x0.34
Areas of application	Industrial and office environment; for IE FC RJ-45 modular outlet and SCALANCE W access point with IP67 hybrid plug-in connector
Cable specification	Cat 5e (data wires) 22 AWG (power wires)
Maximum cable length	
• with IE FC RJ-45 modular outlet	80 m
• IP67 hybrid connector	
Cable type (standard code)	L-9YH(ST)CH 2X2X0.34/1.5-100 GN VZN FRNC
Jacket	PVC Ø (6.5 ± 0.2) mm; green
Permitted ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transportation/storage temperature	-25 ºC to +70 ºC
Installation temperature	-25 ºC to +70 ºC
Free of halogens	yes
Resistance to fire	Flame retardant to IEC 60332-3-24 (Category C)
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

Order numbers

IE Hybrid Cable 2x2 + 4x0.34	Flexible cable; 4 x Cu Cat 5e, shielded (22 AWG) and 4 x CU (0.34 mm² per wire) for IE FC RJ-45 modular outlet with power insert and hybrid plug-in connector IP67.	**6XV1 870-2J**

9.2.6 IE TP cord

9.2.6.1 Introduction to TP cord

The TP cords are used inside buildings for distances up to 10 m. TP cord is also known as patch cable. A maximum of 10 m of TP cord can be used between two devices. With structured cabling using two TP cords, this length is the maximum for both patch cables together.

Compared with the IE FC TP cables, the TP cords are thinner and more flexible. Standardized RJ-45 plugs are used as the connectors.

- The TP cords 2x2 are suitable for a transmission rate of 10/100 Mbps.
- The TP cords 4x2 are suitable for a transmission rate of 10/100/1000 Mbps.

The 2 wires are twisted into a pair (PIMF). Each pair of wires is shielded by a plastic laminated aluminum foil with an external contact surface. All the pairs making up the cable are surrounded by a braided shield of tinplated copper braid with coverage of approximately 88 %. The outer sheath is PVC.

IE TP cord and IE TP XP cord

The TP cords are available as straight-through cables with the name **"IE TP Cord"** and as crossover cables with the name **"IE TP XP Cord"**.

To distinguish straight-through and crossover cables, the RJ-45 plugs are color-coded.

- not crossed over: RJ-45 plug, green at both ends
- crossed over: RJ-45 plug, red at both ends

9.2.6.2 IE TP cord 2x2

Description

The TP cord 2x2 is available as a preassembled cable in the following variants:

- **IE TP cord RJ-45/RJ-45 and IE TP XP cord RJ-45/RJ-45**

  with two RJ-45 plugs.

Features and functions

Cable type [1]	IE TP (XP) cord 2x2
Areas of application	Cabling between an end device and a network component
Cable specification	Cat 5e
maximum cable length [2]	
• with IE FC outlet RJ-45	10 m
• Device with RJ45 connector	10 m
Cable type (standard code)	LI 02YSCY 2x2x0.15/0.98 PIMF ICCS GN
Jacket	PVC Ø (5.8 ± 0.2) mm; green
Environmental conditions	
Operating temperature	-40 ºC to +70 ℃
Transportation/storage temperature	-40 ºC to +70 ℃
Installation temperature	-40 ºC to +70 ℃
Resistance to fire	Flame retardant to IEC 60332-1
Resistance to oil	Conditionally resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1] Electrical properties at 20 °C, tested to DIN 0472

[2] With structured cabling using two TP cords, this length is the maximum for both patch cables together

Order numbers

IE TP cord RJ-45/RJ-45	Preassembled TP installation cable 2x2 with two RJ-45 plugs.	
	• 0.5 m	6XV1850-2GE50
	• 1 m	6XV1850-2GH10
	• 2 m	6XV1850-2GH20
	• 6 m	6XV1850-2GH60
	• 10 m	6XV1850-2GN10
IE TP XP cord RJ-45/RJ-45	Preassembled crossover TP installation cable 2x2 with two RJ-45 plugs.	
	• 0.5 m	6XV1850-2HE50
	• 1 m	6XV1850-2HH10
	• 2 m	6XV1850-2HH20
	• 6 m	6XV1850-2HH60
	• 10 m	6XV1850-2HN10

9.2.6.3   IE TP cord 4x2

Description

The patch cable is required for gigabit Ethernet networks. The IE TP cord RJ-45/RJ-45 4x2 is available as a preassembled cable with two RJ-45 plugs. With XP, the send and receive lines are crossed over.

Features and functions

Cable type [1]	IE TP cord RJ-45/RJ-45 4x2
Areas of application	Cabling between an end device and a network component
Cable specification	Cat 6
maximum cable length [2]	
• with IE FC outlet RJ-45	10 m
• IE device with D-sub connector	10 m
• Device with RJ45 connector	10 m
Cable type (standard code)	LI 02YSCH 4x2x0.15 PIMF GN FRNC
Jacket	FRNC Ø (6.2 ± 0.3) mm; green
Permitted ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transportation/storage temperature	-25 ºC to +70 ºC
Installation temperature	-25 ºC to +70 ºC
Resistance to fire	Flame retardant to IEC 60332-1
Resistance to oil	Conditionally resistant
Product characteristics	
Halogen-free	yes
Silicone-free	yes

[1]   Electrical properties at 20 °C, tested to DIN 0472

[1]   With structured cabling using two TP cords, this length is the maximum for both patch cables together

Order numbers

IE TP cord RJ-45/RJ-45	Preassembled TP installation cable 4x2 with two RJ-45 plugs.	
	• 0.5 m	**6XV1 870-3QE50**
	• 1 m	**6XV1 870-3QH10**
	• 2 m	**6XV1 870-3QH20**
	• 6 m	**6XV1 870-3QH60**
	• 10 m	**6XV1 870-3QN10**
IE TP XP cord RJ-45/RJ-45	Preassembled, TP crossover installation cable 4x2 with two RJ-45 plugs.	
	• 0.5 m	**6XV1 870-3RH50**
	• 1 m	**6XV1 870-3RH50**
	• 2 m	**6XV1 870-3RH50**
	• 6 m	**6XV1 870-3RH50**
	• 10 m	**6XV1 870-3RH50**

9.2.7   Plugs

9.2.7.1   IE FC RJ-45 plugs 2x2

Description

The IE FC RJ-45 plugs 2x2 are compact and rugged plug-in connectors. The connectors have a robust metal casing suitable for industry that provides protection from interference for the data communication. The connectors comply with the standards EN 50173 (RJ-45) and ISO/ IEC 11801

The IE FC RJ-45 plugs 2x2 are used to install 4-wire IE FC TP cables in the field.

The connector allows point-to-point connections (10/100 Mbps) to be implemented for Industrial Ethernet between two end devices/network components up to 100 m without patch cables.

The IE FC RJ-45 plugs 2x2 are available in three versions:

- With 180° (straight) cable outlet
  Due to its design, the IE FC RJ-45 plug 180 can be used both with devices with single jacks and with devices with multiple jacks (blocks). The connector is particularly suitable for connecting IE FC TP cables to SIMATIC NET modules and SCALANCE devices.

- With 90° (angled) cable outlet

  The connector is particularly suitable for connecting IE FC TP cables to ET200 or PN/PN links.

  Figure 9-5   IE FC RJ-45 PLUG 902X2

- With 145° (angled) cable outlet

  The connector is intended for connecting IE FC TP cables to SIMOTION and SINAMICS modules.

Features and functions

Connection type	IE FC RJ-45 plug 180 (2x2)	IE FC RJ-45 plug 90 (2x2)	IE FC RJ-45 plug 145 (2x2)
Cabling specification	Cat5	Cat5	Cat5
Standards, approvals			
• RoHS conformity	yes	yes	yes
• UL approval	yes	yes	yes
Transmission speed			
Industrial Ethernet	10 / 100 Mbps	10 / 100 Mbps	10 / 100 Mbps
Interfaces			
Number of electrical connectors for IE FC TP cables	4	4	4
version IE FC TP	Integrated insulation-piercing contacts for 4-wire IE FC TP cables	Integrated insulation-piercing contacts for 4-wire IE FC TP cables	Integrated insulation-piercing contacts for 4-wire IE FC TP cables
Version for network components or end devices	RJ-45 plug	RJ-45 plug	RJ-45 plug
Design			
Cable outlet	180°	90°	145°
Housing material	Metal	Metal	Metal
Permitted ambient conditions			
Operating temperature	-20 ºC to +70 ºC	-20 ºC to +70 ºC	-20 ºC to +70 ºC
Transportation/storage temperature	-40 ºC to +80 ºC	-40 ºC to +80 ºC	-40 ºC to +80 ºC
IP degree of protection	IP20	IP20	IP20
Product property			
Silicone-free	yes	yes	yes

Order numbers

IE FC RJ-45 plug 180	RJ-45 cable connector for Industrial Ethernet with rugged metal casing and integrated insulation piercing contacts for connection of the 4-wire IE FC TP cables. With 180° cable outlet.	
	1 pack of 1	6GK1 901-1BB10-2AA0
	1 pack of 10	6GK1 901-1BB10-2AB0
	1 pack of 50	6GK1 901-1BB10-2AE0
IE FC RJ-45 plug 90	RJ-45 cable connector for Industrial Ethernet with rugged metal casing and integrated insulation piercing contacts for connection of the 4-wire IE FC TP cables. With 90° cable outlet.	
	1 pack of 1	6GK1 901-1BB20-2AA0
	1 pack of 10	6GK1 901-1BB20-2AB0
	1 pack of 50	6GK1 901-1BB20-2AE0
IE FC RJ-45 plug 145	RJ-45 cable connector for Industrial Ethernet with rugged metal casing and integrated insulation piercing contacts for connection of the 4-wire IE FC TP cables. With 145° cable outlet.	
	1 pack of 1	6GK1 901-1BB30-0AA0
	1 pack of 10	6GK1 901-1BB30-0AB0
	1 pack of 50	6GK1 901-1BB30-0AE0

9.2.7.2   IE FC RJ-45 plug 4x2

Description

The IE FC RJ-45 plugs 4x2 have a robust metal casing suitable for industry that provides protection from interference for the data communication. The connectors comply with the standards EN 50173 (RJ-45) and ISO/ IEC 11801

The IE FC RJ-45 plugs 4x2 are used to install 8-wire IE FC TP cables in the field.

The connector allows point-to-point connections (10 / 100 / 1000 Mbps) to be implemented for Industrial Ethernet between two end devices/network components up to 90 m without patch cables.

Features and functions

Connection type	IE FC RJ-45 plug 180 (4x2)
Cabling specification	Cat6
Standards, approvals	
• RoHS conformity	yes
• UL approval	yes
Transmission speed	
Industrial Ethernet	10/100/1000 Mbps
Interfaces	
Number of electrical connectors for IE FC TP cables	8
version IE FC TP	Integrated insulation-piercing contacts for 8-wire IE FC TP cables
Version for network components or end devices	RJ-45 plug
Design	
Cable outlet	180°
Housing material	Metal
Permitted ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transport/storage temperature	-40 ºC to +70 ºC
IP degree of protection	IP20
Product property	
Silicone-free	yes

Order numbers

IE FC RJ-45 plug 180	RJ-45 plug for Industrial Ethernet with rugged metal casing and integrated insulation piercing contacts for connection of the 8-wire IE FC TP cables.	
	1 pack of 1	**6GK1 901-1BB11-2AA0**
	1 pack of 10	**6GK1 901-1BB11-2AB0**
	1 pack of 50	**6GK1 901-1BB11-2AE0**

9.2.7.3   IE FC RJ-45 plug PRO (push-pull)

Description

The connector with the push-pull device connection can be used in conjunction with end devices and network components with degree of protection IP65/67 in plants without cabinets.

The IE FC RJ-45 plug PRO is used to install 4-wire IE FC TP cable in the field.

Figure 9-6   IE FC RJ-45 plug PRO

The push-pull mechanism allows simple plugging and pulling of the plug-in connector IE FC RJ-45 plug PRO to SCALANCE X-200IRT PRO, ET 200pro and SIMATIC RF systems. The mechanism also increases the bending and tensile strength of the plug-in connector and protects the RJ-45 jack of the device from mechanical strain in an industrial environment.

In contrast to the plug-in connector IE FC RJ-45 plug PRO (push-pull), assembly of the electrical connector with the IE RJ-45 plug PRO is not FastConnect.

Figure 9-7   IE RJ-45 plug PRO

Features and functions

Connection type	IE RJ-45 plug PRO (push pull)	IE FC RJ-45 plug PRO (push-pull)
Cabling specification	Cat 5e	Cat 5e
• Standards, approvals		
• RoHS conformity	yes	yes
• UL approval	no	no
Transmission speed		
Industrial Ethernet	10 / 100 Mbps	10 / 100 Mbps
Interfaces		
Number of electrical connectors for IE FC TP cables	4	4
version IE FC TP	Integrated insulation-piercing contacts for 4-wire IE FC TP cables	Integrated insulation-piercing contacts for 4-wire IE FC TP cables
Version for network components or end devices	RJ-45 plug (push-pull device connector)	RJ-45 plug (push-pull device connector)
Design		
Cable outlet	180°	180°
Housing material	Plastic	Plastic
Permitted ambient conditions		
Operating temperature	-40 ºC to +70 ºC	-40 ºC to +70 ºC
Transportation/storage temperature	-40 ºC to +70 ºC	-40 ºC to +70 ºC
Chemical resistance to water	resistant	resistant
IP degree of protection	IP65/67	IP65/67
Product property		
Silicone-free	yes	yes

Order numbers

IE RJ-45 plug PRO (push pull)	RJ-45 cable connector with push-pull device connection with rugged plastic casing and integrated insulation piercing contacts for connection of Industrial Ethernet installation cables. With 180° cable outlet for SCALANCE X-200IRT PRO switches, ET 200pro and SIMATIC RF systems with an Industrial Ethernet interface	
	1 pack of 1	**6GK1 901-1BB10-6AA0**
IE FC RJ-45 plug PRO (push pull)	RJ-45 cable connector with push-pull device connection with rugged plastic casing and integrated insulation piercing contacts for connection of the IE FC TP cables. With 180° cable outlet.	
	1 pack of 1	**6GK1 901-1BB20-6AA0**

9.2.7.4   IP 67 hybrid cable connector

General

The IP67 hybrid plug-in connector is used to connect SCALANCE W700 to Industrial Ethernet. In conjunction with the IE hybrid cable 2x2 + 4x0.34 and the IE FC RJ-45 modular outlet with power insert, the supply voltage can also be transferred to the target device along with the data. Connection of a voltage is possible with Power over Ethernet (PoE). The IP67 hybrid plug-in connector ships with the SCALANCE W700.

Features and functions

Connection type	IP 67 hybrid cable connector
Cabling specification	Cat 5
Transmission speed	
Industrial Ethernet	10 / 100 Mbps
Interfaces	
Number of electrical connectors for hybrid cables	1
version IE FC TP	integrated insulation-piercing contacts for 4-wire TP FC installation cables
Cable outlet	180°
Housing material	Plastic
Permitted ambient conditions	
Ambient temperature	-40 ℃ to + 70℃
IP degree of protection	IP67

Order numbers

IP 67 hybrid cable connector	Plug-in connector for connecting SCALANCE W700 to Industrial Ethernet and Power over Ethernet (PoE), with assembly instructions.	
	Can be ordered directly from:	
	HARTING Deutschland GmbH & Co KG Postfach 24-51 D-32381 Minden, Germany Tel. +49 571-8896-0 Fax. +49 571-8896-354	
	E-mail: de.sales@HARTING.com	
	Internet: http://www.HARTING.com	
	1 pack of 1	**09 45 125 1300.00**

9.2.7.5 IE FC M12 plug PRO 2x2

Description

The plug-in connector IE FC M12 plug PRO 2x2 can be used in conjunction with end devices and network components with degree of protection IP65/67 in systems without cabinets.

The connector is a 4-pin M12 plug with which you can connect industrial Ethernet devices with M12 Fast Ethernet sockets via a 4-wire IE FC TP cable to a Fast Ethernet network, for example SCALANCE X208 PRO, IM 154-4 PN and SIMATIC RF systems.

With IE FC cable 2x2 and IE M12 plug PRO 2x2, an overall cable length of up to 100 m is permitted between two devices depending on the cable type.

Figure 9-8   IE FC M12 plug PRO

Features and functions

Connection type	IE FC M12 plug PRO 2x2
Cabling specification	Cat5
Standards, approvals	
• RoHS conformity	yes
• UL approval	yes
Transmission speed	
Industrial Ethernet	10 / 100 Mbps
Interfaces	
Number of electrical connectors for IE FC TP cables	Integrated insulation-piercing contacts for 4-wire IE FC TP cables
Version for network components or end devices	M12 plug (D-coded)
Design	
Cable outlet	180°
Housing material	Metal
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 85 ℃
Transportation/storage temperature	- 40 ℃ to + 85 ℃
IP degree of protection	IP 65/67
Product property	
Silicone-free	yes

Order numbers

IE FC M12 plug PRO 2x2	M12 plug-in connector 4-pin, D-coded, for fitting to 4-wire IE FC TP cables with rugged metal casing and FastConnect technology; 180° cable outlet.	
	1 pack of 1	**6GK1 901-0DB20-6AA0**
	1 pack of 8	**6GK1 901-0DB20-6AA8**

9.2.7.6 IE FC M12 Plug PRO 4x2

Description

The IE M12 plug PRO is a 4-pin, D-coded M12 plug with degree of protection IP67. The plug is particularly suitable for use with devices with the relevant degree of protection such as the SCALANCE X208PRO. The plug can be fitted to cables with an outer diameter of 6 mm to 8 mm. The plug is suitable for assembling IE FC cables with transmission rates of up to 100 Mbps. This allows the IE FastConnect stripping tool to be used. By using the insulation piercing technique, assembly is simple and fast and requires no additional special tools.

With IE FC cable 2 x 2 and IE M12 plug PRO, an overall cable length of up to 100 m is permitted between two devices depending on the cable type.

Figure 9-9   IE FC M12 plug PRO 4 x 2

Features and functions

Connection type	IE FC M12 Plug PRO 4x2
Cabling specification	Cat6
Standards, approvals	
• RoHS conformity	yes
• UL approval	no
Transmission speed	
Industrial Ethernet	10 / 100 / 1000 Mbps
Interfaces	
Number of electrical connectors for IE FC TP cables	Integrated insulation-piercing contacts for 8-wire IE FC TP cables
Version for network components or end devices	M12 plug (X-coded)
Design	
Cable outlet	180°
Housing material	Metal
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 85 ℃
Transportation/storage temperature	- 40 ℃ to + 85 ℃
IP degree of protection	IP 65/67
Product property	
Silicone-free	yes

Order numbers

IE FC M12 Plug PRO 4x2	M12 plug-in connector 8-pin, X-coded, for fitting to 8-wire cables with rugged metal casing and FastConnect technology; 180° cable outlet	
	1 pack of 1	**6GK1901-0DB30-6AA0**
	1 pack of 8	**6GK1901-0DB30-6AA8**

9.2.8   Outlets

9.2.8.1   IE FC RJ-45 modular outlet

Description

The rugged metal casing allows the IE FC modular outlet to be connected to a DIN rail.
Direct mounting on a wall is also possible.

Figure 9-10   IE FC RJ-45 modular outlet - base module

There is an industrial Ethernet FC RJ-45 modular outlet base module with three
exchangeable inserts:

* Insert 2 FE: Base module with insert for two Fast Ethernet connections for connection of
  two 10/100 Mbps end devices/network components

Figure 9-11   Modular outlet, 2 x LAN

* Insert 1 GE: Base module with insert for a gigabit Ethernet connection for connection of a
  10/100/1000 Mbps end device/network component

Figure 9-12   Modular outlet insert 1GE

* Outlet power insert: Base module with insert for connecting a power supply and a 10/100
  Mbps end device/network component.

Figure 9-13   Modular outlet, power insert

By changing the insert, a 100 Mbps double connection can be upgraded to a gigabit connection. This is only possible if the wiring was done with the IE FC standard cable GP 4x2. In this case, only the insert 2FE needs to be replaced with an insert of the type 1GE.

To supply distributed nodes with power and data, the IE FC RJ-45 modular outlet with the power insert is connected to the IE hybrid cable 2x2 + 4x0.34. A maximum distance of 80 m can be bridged between the outlet and the IP67 hybrid plug-in connector. The connection between the outlet and end device can be established with a patch cable with the maximum length of 6 m.

Features and functions

Connection type	IE FC RJ-45 modular outlet insert 2FE	IE FC RJ-45 modular outlet insert 1GE	IE FC RJ-45 modular outlet power insert
Cabling specification	Cat 5e	Cat 6	Cat 5e
Standards, approvals			
• RoHS conformity	yes	yes	yes
• UL approval	yes	yes	yes
Transmission speed			
Industrial Ethernet	10 / 100 Mbps	10 / 100 /1000 Mbps/	10 / 100 Mbps
Interfaces			
Number of electrical connectors for IE FC TP cables	8	8	8
version IE FC TP	integrated insulation-piercing contacts for 8-wire TP FC installation cables	integrated insulation-piercing contacts for 8-wire TP FC installation cables	integrated insulation-piercing contacts for 8-wire TP FC installation cables
Version for network components or end devices	RJ-45 plug	RJ-45 plug	RJ-45 plug 24 VDC terminal (2-pin)
Design			
Cable outlet	180 °	180 °	180 °
Housing material	Metal	Metal	Metal
Permitted ambient conditions			
Operating temperature	–20 ºC to +70 ºC	–20 ºC to +70 ºC	–20 ºC to +70 ºC
Transportation/storage temperature	-40 °C to +80 °C	-40 °C to +80 °C	-40 °C to +80 °C
IP degree of protection	IP40	IP40	IP40

Order numbers

IE FC RJ-45 modular outlet (base module)	IE FC RJ-45 modular outlet base module for industrial Ethernet with an interface for an exchangeable insert	
	1 pack of 1	6GK1901-1BE00-0AA0
IE FC RJ-45 modular outlet insert 2FE	IE FC RJ-45 modular outlet base module with insert; 2 x RJ-45 for 2 x 100 Mbps interface	
	1 pack of 1	6GK1 901-1BE00-0AA1
IE FC RJ-45 modular outlet insert 1GE	IE FC RJ-45 modular outlet base module with insert; 1 x RJ-45 for 1 x 1000 Mbps interface	
	1 pack of 1	6GK1 901-1BE00-0AA2
IE FC RJ-45 modular outlet power insert	IE FC RJ-45 modular outlet base module with insert; 1 x RJ-45 for 1 x 100 Mbps interface and 1 x 24 VDC	
	1 pack of 1	6GK1 901-1BE00-0AA3
Insert 2 FE	Insert for IE FC RJ-45 modular outlet base module; 2 x RJ-45 for 2 x 100 Mbps interface	
	1 pack of 4	6GK1901-1BK00-0AA1
Insert 1 GE	Insert for IE FC RJ-45 modular outlet base module; 2 x RJ-45 for 2 x 100 Mbps interface	
	1 pack of 4	6GK1901-1BK00-0AA2

9.2.8.2   IE FC outlet RJ-45

Description

The IE FC outlet RJ-45 is used for the transition from the rugged IE FC cables used in an industrial environment to the preassembled TP cord cables with an RJ-45 jack.

The IE FC outlet RJ-45 has a rugged metal casing and corresponds to category 5 of the international cabling standards ISO/IEC 11801 and EN 50173. The IE FC outlet RJ-45 is suitable both for installation on a DIN rail and for wall mounting.

The IE FC outlet RJ-45 can also be mounted behind a metal plate with a cutout, for example a switching cubicle.

By arranging several IE FC outlet RJ-45 devices one after the other, it is possible to set up a patch panel with any connector density.

Figure 9-14   Industrial Ethernet FC outlet RJ-45 (opened)

Features and functions

Connection type	IE FC outlet RJ-45
Cabling specification	Cat 5
Standards, approvals	
• RoHS conformity	yes
• UL approval	yes
Transmission speed	
Industrial Ethernet	10 / 100 Mbps
Interfaces	
Number of electrical connectors for IE FC TP cables	4
version IE FC TP	integrated insulation-piercing contacts for 4-wire FC TP installation cables
Version for network components or end devices	RJ-45 plug
Design	
Cable outlet	180°
Housing material	Metal
Permitted ambient conditions	
Operating temperature	-25 ºC to +70 ºC
Transportation/storage temperature	-40 °C to +70 °C
IP degree of protection	IP20

Order numbers

IE FC outlet RJ-45	IE FC outlet RJ 45 for connection of Industrial Ethernet FC TP-cables and TP cords	
	1 pack of 1	**6GK1 901-1FC00-0AA0**

9.3 Optical networks

9.3.1 Optical transmission technology

Fiber-optic cables (FO cables)

On fiber-optic cables (FO) data is transmitted by modulating electromagnetic waves in the range of visible and invisible light.

The materials used are highquality plastic and glass fibers

Only the fiber-optic cables intended for SIMATIC NET for Industrial Ethernet are described below. The various FO cable types allow solutions for connecting the components with each other adapted to the operating and environmental conditions.

The following fiber-optic cables are available for industrial Ethernet:

- Glass FO cables
- PCF FO cables (Polymer Cladded Fiber)
- POF FO cables (Polymer Optical Fiber)

Compared with electrical cables, fiber-optic cables have the following advantages:

Advantages

- Electrical isolation of nodes and segments
- No grounding problems,
- No shield currents,
- Transmission path immune to external electromagnetic noise,
- No lightning protection required,
- No noise emission along the transmission path,
- Light weight,
- Depending on the fiber type, cables several kilometers long can be used even at higher transmission rates.
- The transmission rate does not affect the maximum permitted cable length
- The meter markers printed on the cable make it easier to identify the length. (Serve as orientation; accuracy ±5 %.)

Point-to-point link

Fiber-optic technology only allows the implementation of point-to-point links; in other words, one transmitter is connected to only one receiver. The transmission path between two nodes requires two fibers (one for each transmission direction). With the optical components for Industrial Ethernet, bus, star and ring structures can be implemented.

9.3.2　　　Optical cables

The following fiber-optic cables (FO cable) are available for different topologies, requirements or areas of application.

Cable	Cable type	Characteristics	Area of application
Fast Connect FO cable		Glass fiber, sold by the meter or pre-assembled with 4 BFOC or SC connectors	Laying in indoor and outdoor areas
	FO standard cable GP (50/125)		Rugged standard cable for universal applications
	FO ground cable (50/125)		Longitudinally and laterally watertight cable for use outdoors; with non-metallic rodent protection; underground installation possible
	FO trailing cable GP (50/125) FO trailing cable (50/125)		Cable for use in drag chains
	SIENOPYR duplex fiberoptic marine cable (62.5/125)		halogen-free, can be walked on, flame retardant and shipbuilding approved cable for installation on ships and offshore facilities
Plastic FO cables		Plastic fiber-optic cable, sold by the meter or preassembled (PCF FO cable) with 4 SC RJ plugs	Laying in indoor and outdoor areas
	POF Standard Cable GP 980/1000		POF standard FO cable for permanent installation indoors up to 50 m with PVC jacket
	POF Trailing Cable 980/1000		POF fiber-optic trailing cable for moving applications (e.g. drag chain) up to 50 m with rugged PUR jacket
	PCF standard cable GP 200/230		PCF standard FO cable for permanent installation indoors and outdoors up to 100 m with rugged PVC jacket
	PCF trailing cable 200/230		PCF fiber-optic trailing cable high mechanical strain indoors and outdoors up to 100 m with rugged PUR jacket
	PCF trailing cable GP 200/230		PCF fiber-optic trailing cable for low mechanical strain indoors and outdoors up to 100 m with PVC jacket

9.3.3 Glass FO cables

9.3.3.1 FOC links

Standard Fast Ethernet

The switches equipped with interfaces for 100BASE-FX comply with the standard IEEE 802.3u. They operate at a wavelength of 1300 nm.

Multimode glass fibers of the type 50/125 µm are suitable for the connection.

Switches or media modules equipped with an optical interface for single mode glass fibers of the type 10/125 µm have the supplement LD in their names (Long Distance).

The length of an insertable FOC link is decided by:

● The fiber type multimode/ single mode

● The FO cable attenuation at the wavelength used

● The bandwidth distance product of the fiber-optic cable

Requirements of multimode glass fiber-optic cables

Table 9- 2   Max. length of a link with multimode FO cables between two switches:

Fiber-optic cable type	FO power loss at 1300 nm	Bandwidth distance product	Max. length
50/125 µm	<= 0.7 dB/km	>= 1200 MHz * km	3,000 m

Requirements of single mode glass fiber-optic cables

Single mode glass fiber-optic cables between two switches with suitable interfaces must meet the following requirements in terms of power loss and the bandwidth distance product:

Table 9- 3   Max. length of a link with single mode FO cables between two suitable equipped switches:

Fiber-optic cable type	FO power loss at 1300 nm	Bandwidth distance product	Max. length
10/125 µm	<=0.5 dB/km	No info	26,000 m

SIMATIC NET multimode glass fiber-optic cables

The SIMATIC NET product range for Industrial Ethernet includes various types of multimode glass fiberoptic cables with 50/125 μm fibers (see "Passive components for optical networks").

- FO Standard Cable
- FO Ground Cable
- FO Trailing Cable
- FO Trailing Cable GP
- SIENOPYR duplex marine fiberoptic cable

When connecting SIMATIC NET Industrial Ethernet switches using SIMATIC NET multimode glass fiberoptic cables, distances of 0 to 3000 m are permitted between two adjacent components.

Note

Single mode glass fiberoptic cables with fiber type 10/125 are available in customized lengths. You will find contacts in the "Support and training" section of this manual.

Standard 1 Gbps Ethernet

In Gbps Ethernet, a distinction is made in much the same way as in Fast Ethernet between two versions both of which are described in the IEEE 802.3z standard.

1000BASE-SX is the name of the version for multimode glass fiber. A wavelength of 850 nm is used. Due to their properties, the same 50/125 μm fiber from the SIMATIC NET product range can be used as for 100BASE-FX. The range between two points is 750 m. As long as this range is not exceeded, it is possible to upgrade from 100 Mbps Ethernet to 1 Gbps Ethernet over existing installed cable of this type without needing to install new cables.

The version for single mode glass fibers is 1000BASE-LX. A wavelength of 1300 nm is used here. A single mode glass fiber-optic cable 10/125 μm may be up to 10,000 m long.

In terms of the FO link length that can be included, the dependencies are basically the same as for 100 Mbps Ethernet.

Table 9- 4   Maximum link length with multimode glass fiber-optic cables with 1 Gbps Ethernet:

Fiber-optic cable type	FO power loss	Bandwidth distance product	Max. length
50/125 μm Multimode	≤ 2.7 dB/km at 850 nm	≥ 600 MHz * km	750 m
9/125 μm Single mode	≤ 0.5 dB/km at 1310 nm		10,000 m
	≤ 0.28 dB/km at 1550 nm		

9.3.3.2 SM FO robust cable GP (4E9/125)

Description

The 4-fiber single mode (SM) FO robust cable can be used to bridge distances of more than 3 km.

The SM FO robust cable GP can be used to set up optical networks with devices that have an LC (Lucent Connector) interface, for example SCALANCE X devices.

To connect to the LC interface, the SM FO robust cable GP is cemented to the SM FO LC duplex plug.

Features and functions

Cable type		SM FO robust cable GP (4E9/125)
Areas of application		Cable for use indoors and outdoors and for direct installation underground
Version of the preassembled FO cable		• BFOC plug • SC plug • LC duplex plug
Cable type (standard code)		AT-V(ZN)H(ZN)BH 2G50/125
Standards, approvals		
• RoHS conformity		yes
• UL approval		yes
Mechanical data		
Number of fibers		4
Fiber material		Single mode fiber 9/125 µm, OS2
Maximum tensile load		1000 N
Optical data		
Attenuation	805 nm	-
	1300 nm	≤ 0.5 dB/km
	1550 nm	≤ 0.5 dB/km
Permitted ambient conditions		
Operating temperature		-40 ºC to +70 ºC
Transportation/storage temperature		-40 ºC to +70 ºC
Installation temperature		-20 °C to +60 °C
Resistance to fire		Flame retardant to IEC 60332-1-24
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Halogen-free		yes
Silicone-free		yes
Rodent protection		yes
Cable length	100BaseFX	26 000 m
	1000BaseLX	2000 m

Order numbers

SM FO robust cable GP (4E9/125)[1]	Cable for outdoors; rodent protection, splittable, without connectors, sold by the meter	6XV1 843-2R

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.3 MM FO robust cable GP (2G50/125)

Description

The 2-fiber multimode (MM) FO robust cable can be used to bridge distances up to 3 km.

The MM FO robust cable GP can be used to set up optical networks with devices that have an LC (Lucent Connector) interface, for example SCALANCE X devices.

To connect to the LC interface, the MM FO robust cable GP is cemented to the MM FO LC duplex plug.

Features and functions

Cable type		MM FO robust cable GP (2G50/125)
Areas of application		Universal cable for use indoors and outdoors and for direct installation underground
Version of the preassembled FO cable		• BFOC plug • SC plug • LC duplex plug
Cable type (standard code)		AT-V(ZN)H(ZN)BH 2G50/125
Standards, approvals		
• RoHS conformity		yes
• UL approval		yes
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 50/125/245 µm, OM 2
Maximum tensile load		1000 N
Optical data		
Attenuation	805 nm	≤ 2.7 dB/km
	1300 nm	≤ 1 dB/km
Bandwidth length product	805 nm	600 GHz *m
	1300 nm	1200 GHz *m

Cable type		MM FO robust cable GP (2G50/125)
Permitted ambient conditions		
Operating temperature		-40 ºC to +85 ºC
Transportation/storage temperature		-40 ºC to +85 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame retardant to IEC 60332-1-24
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Halogen-free		yes
Silicone-free		yes
Rodent protection		yes
Cable length	100BaseFX	5000 m
	1000BaseSX	750 m
	1000BaseLX	2000 m

Order numbers

MM FO robust cable GP (2G50/125)[1]	Cable for indoors and outdoors; rodent protection, splittable, without connectors, sold by the meter	6XV1 873-2R

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.4   FO Standard Cable GP 50/125 µm

Description

The FO standard cable contains 2 multimode graded fibers of type 50/125 µm. The FO standard cable GP is the universal cable for use indoors and outdoors. The standard cable is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

The FO standard cable GP is available in fixed lengths, preassembled with four BFOC plugs or 4 SC plugs.

Features and functions

Cable type	FO standard cable GP 50/125
Areas of application	Universal cable for use indoors and outdoors
Cable type (standard code)	AT-W(ZN)YY 2x1G50/125
Version of the preassembled FO cable	• BFOC plug • SC plug

Cable type		FO standard cable GP 50/125
Standards, approvals		
• RoHS conformity		yes
• UL approval		yes
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 50/125 µm, OM2
Maximum tensile load		500 N
Optical data		
Attenuation	805 nm	≤ 2.7 dB/km
	1300 nm	≤ 0.7 dB/km
Bandwidth length product	805 nm	600 GHz *m
	1300 nm	1200 GHz *m
Permitted ambient conditions		
Operating temperature		-25 ºC to +80 ºC
Transportation/storage temperature		-25 ºC to +80 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame-retardant to IEC 60332 -1-2 and IEC 60332 -3-22 (Cat A)
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Silicone-free		yes
Halogen-free		no
Rodent protection		no
Cable length	100BaseFX	5000 m
	1000BaseSX	750 m
	1000BaseLX	2000 m

Order numbers

FO standard cable GP 50/125 [1]	Outdoor cable with rodent protection, splittable, without connectors, sold by the meter	6XV1 873–2A
FO standard cable GP 50/125	Preassembled FO cable with 2x2 BFOC connectors.	
	• 100 m	6XV1 873-3AT10
	• 200 m	6XV1 873-3AT20
	• 300 m	6XV1 873-3AT30
FO standard cable GP 50/125	Preassembled FO cable with 2x2 SC plugs.	
	• 100 m	6XV1 873-6AT10
	• 200 m	6XV1 873-6AT20
	• 300 m	6XV1 873-6AT30

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables

9.3.3.5 FO Ground Cable 50/125 µm

Description

The FO ground cable contains 2 multimode graded fibers of type 50/125 µm. The FO ground cable is a standard cable for laying directly in the ground, in pipes, cable channels or on cable racks, also suitable for cable ladders.

The FO ground cable is available in fixed lengths, preassembled with four BFOC plugs or 4 SC plugs.

Features and functions

Cable type		FO ground cable 50/125
Areas of application		Outdoors and for direct installation underground
Version of the preassembled FO cable		• BFOC plug • SC plug
Cable type (standard code)		AT-WQ(ZN)Y(ZN)B2Y 2G 50/125
Standards, approvals		
• RoHS conformity		yes
• UL approval		no
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 50/125 µm, OM2
Maximum tensile load		800 N
Optical data		
Attenuation	805 nm	≤ 2.7 dB/km
	1300 nm	≤ 0.7 dB/km
Bandwidth length product	805 nm	600 GHz *m
	1300 nm	1200 GHz *m
Permitted ambient conditions		
Operating temperature		-40 ºC to +75 ºC
Transportation/storage temperature		-40 ºC to +75 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flammable
Resistance to oil		resistant
UV resistance		resistant
Product characteristics		
Silicone-free		yes
Halogen-free		no
Rodent protection		yes
Cable length	100BaseFX	5000 m
	1000BaseSX	750 m
	1000BaseLX	2000 m

Order numbers

FO ground cable 50/125 [1]	Standard cable; UL approval; splittable, without connectors, sold by the meter	6XV1 873–2G
FO ground cable 50/125	Preassembled FO cable with 2x2 BFOC connectors.	
	• 0.5 m	6XV1 873-3AH05
	• 1 m	6XV1 873-3AH10
	• 2 m	6XV1 873-3AH20
	• 3 m	6XV1 873-3AH30
	• 5 m	6XV1 873-3AH50
	• 10 m	6XV1 873-3AN10
	• 15 m	6XV1 873-3AN15
	• 20 m	6XV1 873-3AN20
	• 30 m	6XV1 873-3AN30
	• 40 m	6XV1 873-3AN40
	• 50 m	6XV1 873-3AN50
	• 80 m	6XV1 873-3AN80
	• 100 m	6XV1 873-3AT10
	• 150 m	6XV1 873-3AT15
	• 200 m	6XV1 873-3AT20
	• 300 m	6XV1 873-3AT30
FO ground cable 50/125	Preassembled FO cable with 2x2 SC plugs	
	• 0.5 m	6XV1 873-6AH05
	• 1 m	6XV1 873-6AH10
	• 2 m	6XV1 873-6AH20
	• 3 m	6XV1 873-6AH30
	• 5 m	6XV1 873-6AH50
	• 10 m	6XV1 873-6AN10
	• 15 m	6XV1 873-6AN15
	• 20 m	6XV1 873-6AN20
	• 30 m	6XV1 873-6AN30
	• 40 m	6XV1 873-6AN40
	• 50 m	6XV1 873-6AN50
	• 80 m	6XV1 873-6AN80
	• 100 m	6XV1 873-6AT10
	• 150 m	6XV1 873-6AT15

| | • 200 m | **6XV1 873-6AT20** |
| | • 300 m | **6XV1 873-6AT30** |

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables

9.3.3.6   FO trailing cable 50/125 µm

Description

The FO trailing cable contains 2 multimode graded fibers of type 50/125 µm.

The FO trailing cable is available in the following variants:

- FO trailing cable (standard)
  Cable for high mechanical strain, PUR outer jacket, without UL approval.

- FO trailing cable GP (general purpose)
  Cable for low mechanical strain, PVC outer jacket, with UL approval

The FO trailing cable is available in fixed lengths, preassembled with four BFOC plugs or 4 SC plugs.

Features and functions

Cable type		FO trailing cable 50/125	FO trailing cable GP 50/125
Areas of application		Use in drag chains	Use in drag chains
Version of the preassembled FO cable		• BFOC plug • SC plug	• BFOC plug • SC plug
Cable type (standard code)		AT-W(ZN)Y(ZN)11Y 2G50/125	50/125 2G AT-W(ZN)Y(ZN)Y
Standards, approvals			
• RoHS conformity		yes	yes
• UL approval		no	yes
Mechanical data			
Number of fibers		2	2
Fiber material		Multimode graded-index fiber 50/125 µm, OM2	Multimode graded-index fiber 50/125 µm, OM2
Number of bending cycles		5 000 000	3 500 000
Maximum tensile load		800 N	800 N
Optical data			
Attenuation	805 nm	≤ 2.7 dB/km	≤ 2.7 dB/km
	1300 nm	≤ 0.7 dB/km	≤ 0.7 dB/km
Bandwidth length product	805 nm	600 GHz *m	600 GHz *m
	1300 nm	1200 GHz *m	1200 GHz *m

Cable type		FO trailing cable 50/125	FO trailing cable GP 50/125
Permitted ambient conditions			
Operating temperature		-40 ºC to +80 ºC	-25 ºC to +80 ºC
Transportation/storage temperature		-40 ºC to +80 ºC	-25 ºC to +80 ºC
Installation temperature		-5 ºC to +50 ºC	-5 ºC to +50 ºC
Resistance to fire		Flammable	Flame-retardant to IEC 60332 -1-2 and IEC 60332 -3-22 (Cat A)
Resistance to oil		Conditionally resistant	Conditionally resistant
UV resistance		resistant	resistant
Product characteristics			
Halogen-free		no	no
Silicone-free		yes	yes
Rodent protection		no	no
Cable length	100BaseFX	5000 m	5000 m
	1000BaseSX	750 m	750 m
	1000BaseLX	2000 m	2000 m

Order numbers

FO trailing cable 50/125[1]	Trailing cable, splittable, without connectors, sold by the meter	6XV1 873-2C
FO trailing cable 50/125	Preassembled FO cable with 2x2 BFOC connectors	
	• 3 m	6XV1 873-3CH30
	• 5 m	6XV1 873-3CH50
	• 10 m	6XV1 873-3CN10
	• 20 m	6XV1 873-3CN20
	• 50 m	6XV1 873-3CN50
	• 100 m	6XV1 873-3CT10
FO trailing cable 50/125	Preassembled FO cable with 2x2 SC plugs	
	• 3 m	6XV1 873-6CH30
	• 5 m	6XV1 873-6CH50
	• 10 m	6XV1 873-6CN10
	• 20 m	6XV1 873-6CN20
	• 50 m	6XV1 873-6CN50
	• 100 m	6XV1 873-6CT10
FO trailing cable GP 50/125[1]	Trailing cable, UL approval, splittable, without connectors, sold by the meter, minimum length available 20 m, maximum 1000 m	6XV1873–2D

FO trailing cable GP 50/125	Preassembled FO cable with 2x2 BFOC connectors	
	• 3 m	**6XV1 873-3DH30**
	• 5 m	**6XV1 873-3DH50**
	• 10 m	**6XV1 873-3DN10**
	• 20 m	**6XV1 873-3DN20**
	• 50 m	**6XV1 873-3DN50**
	• 100 m	**6XV1 873-3DT10**
FO trailing cable GP 50/125	Preassembled FO cable with 2x2 SC plugs	
	• 3 m	**6XV1 873-6DH30**
	• 5 m	**6XV1 873-6DH50**
	• 10 m	**6XV1 873-6DN10**
	• 20 m	**6XV1 873-6DN20**
	• 50 m	**6XV1 873-6DN50**
	• 100 m	**6XV1 873-6DT10**

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables

9.3.3.7 FO FRNC Cable 50/125

Description

The FO FRNC Cable with two 50/125 μm fibers is halogen-free and flame retardant and is suitable for fixed installation in buildings. With this cable design, little smoke that is free of halogens is produced in the case of fire therefore reducing secondary damage significantly.

The cable is splittable and therefore suitable for direct fitting of connectors.

Features and functions

Cable type		FO FRNC Cable 50/125
Areas of application		Halogen-free cable for fixed installation indoors and outdoors
Version of the preassembled FO cable		• BFOC plug • SC plug
Cable type (standard code)		AT-W(ZN)HH 2G50/125 UV
Standards, approvals		
• RoHS conformity		yes
• UL approval		yes
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 50/125 µm, OM2
Maximum tensile load		500 N
Optical data		
Attenuation	805 nm	≤ 2.7 dB/km
	1300 nm	≤ 0.7 dB/km
Bandwidth length product	805 nm	600 GHz *m
	1300 nm	1200 GHz *m
Permitted ambient conditions		
Operating temperature		-40 ºC to +70 ºC
Transportation/storage temperature		-40 ºC to +70 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame-retardant to IEC 60332 -1-2 and IEC 60332 -3-22 (Cat A)
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Halogen-free		no
Silicone-free		yes
Rodent protection		yes
Cable length	100BaseFX	5000 m
	1000BaseSX	750 m
	1000BaseLX	2000 m

Order numbers

FO FRNC Cable 50/125	Halogen-free cable, splittable, for fixed installation, without connectors, sold by the meter	6XV1 873-2B

9.3.3.8   FC FO glass fiber-optic cable 62.5/200/230 µm

Description

Thanks to the fiber construction (62.5/200/230), it is possible to work with the FastConnect FO fibers like traditional PCF fibers (Polymer Cladded Fiber). This means that users have the advantages of glass FO cables (longer distances, resistant to temperature) and the advantages of PCF cables when fitting connectors.

With the FastConnect cables, glass FO runs of up to 3 km (100 Mbps Industrial Ethernet, PROFIBUS) can be set up and the cable assembled on site. A complete link, can be made up of up to 3 subsegments (2 splices) (average coupling loss of a splice approx. 2.5 dB). The combination of already installed, traditional 62.5/125 µm multimode glass FO runs with the new FastConnect FO cables is also possible.

The user can now assemble glass FO cable runs of the correct length for each specific application easily and on site. Repairing installed FastConnect FO links is therefore simple and can be performed without special service personnel (this does not apply to already installed cables - it applies only when FastConnect FO cables and connectors were used).

The following cable types are available:

- FO FC standard cable GP 62.5/200/230
- FO FC trailing cable 62.5/200/230.

Features and functions

Cable type		Fiber-optic standard cable	
Areas of application		Cable for use indoors and outdoors	Flexible cable for installation in drag chains indoors and outdoors
Version of the preassembled FO cable		• BFOC plug	• BFOC plug
Cable type (standard code)		AT-V(ZN)YY 2X1 G 62.5/125	AT-W11Y(ZN)11Y 2 G 62.5/125
Standards, approvals			
• RoHS conformity		yes	
• UL approval		no	
Mechanical data			
Number of fibers		2	2
Fiber material		Multimode graded-index fiber 62.5/125 µm, OM 2	Multimode graded-index fiber 62.5/125 µm, OM 2
Maximum tensile load		1500 N	1000 N
Bending cycles		--	100,000
Optical data			
Attenuation	805 nm	≤ 3.1 dB/km	≤ 3.1 dB/km
	1300 nm	≤ 0.8 dB/km	≤ 0.8 dB/km
Bandwidth length product	805 nm	200 GHz *m	200 GHz *m
	1300 nm	600 GHz *m	600 GHz *m

Cable type	Fiber-optic standard cable	
Permitted ambient conditions		
Operating temperature	-20 ºC to +60 ºC	-25 ºC to +60 ºC
Transportation/storage temperature	-25 ºC to +70 ºC	-25 ºC to +70 ºC
Installation temperature	-5 ºC to +50 ºC	-30 ºC to +60 ºC
Resistance to fire	Flame-retardant acc. to IEC 60332 -1-2 and IEC 60332 -3-22 (Cat. A)	acc. to IEC 60332-1, flammable
Resistance to oil	not resistant	
UV resistance	resistant	resistant
Product characteristics		
Halogen-free	no	yes
Silicone-free	no	yes
Rodent protection	yes	no
maximum cable length	100BaseFX	4000 m	4000 m
	1000BaseSX	350 m	350 m
	1000BaseLX	500 m	500 m

Order numbers

Fiber-optic standard cable [1]	Standard cable; can be walked on; splittable; without connectors, sold by the meter,	**6XV1 820-5AH10**
Fiber-optic standard cable	Preassembled FO cable with 2x2 BFOC connectors	
	• 1 m	**6XV1 820-5BH10**
	• 2 m	**6XV1 820-5BH20**
	• 3 m	**6XV1 820-5BH30**
	• 4 m	**6XV1 820-5BH40**
	• 5 m	**6XV1 820-5BH50**
	• 10 m	**6XV1 820-5BN10**
	• 15 m	**6XV1 820-5BN15**
	• 20 m	**6XV1 820-5BN20**
	• 30 m	**6XV1 820-5BN30**
	• 40 m	**6XV1 820-5BN40**
	• 50 m	**6XV1 820-5BN50**
	• 55 m	**6XV1 820-5BN55**
	• 60 m	**6XV1 820-5BN60**
	• 65 m	**6XV1 820-5BN65**
	• 70 m	**6XV1 820-5BN70**
	• 75 m	**6XV1 820-5BN75**
	• 80 m	**6XV1 820-5BN80**
	• 100 m	**6XV1 820-5BT10**
	• 120 m	**6XV1 820-5BT12**
	• 130 m	**6XV1 820-5BT13**
	• 150 m	**6XV1 820-5BT15**
	• 200 m	**6XV1 820-5BT20**
	• 250 m	**6XV1 820-5BT25**
	• 300 m	**6XV1 820-5BT30**

Flexible fiber-optic trailing cable [1]	Multimode cable; flame retardant, splittable, without connectors, sold by the meter	6XV1 820-6AH10
Flexible fiber-optic trailing cable	preassembled with 2x2 BFOC connectors	
	• 1 m	6XV1 820-6BH10
	• 2 m	6XV1 820-6BH20
	• 3 m	6XV1 820-6BH30
	• 5 m	6XV1 820-6BH50
	• 10 m	6XV1 820-6BN10
	• 15 m	6XV1 820-6BN15
	• 20 m	6XV1 820-6BN20
	• 25 m	6XV1 820-6BN25
	• 50 m	6XV1 820-6BN50

[1]   Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.9   INDOOR FO indoor cable 62.5/125 µm

Description

The INDOOR fiberoptic cable is intended for use indoors in areas protected from the weather, for example in factories and in building automation.

The indoor cable is suitable for connecting optical interfaces operating in the wavelength range around 850 nm and 1300 nm.

Can be supplied in fixed lengths, preassembled with four BFOC connectors.

Features and functions

Cable type	MM FO robust cable GP (2G50/125)
Areas of application	Non-crush, halogen-free and extremely flame-retardant cable for use indoors
Version of the preassembled FO cable	• BFOC plug
Cable type (standard code)	I-V(ZN)HH 2x1 G 62.5/125
Standards, approvals	
• RoHS conformity	yes
• UL approval	no
Mechanical data	
Number of fibers	2
Fiber material	Multimode graded-index fiber 62.5/125 µm, OM 2
Maximum tensile load	1000 N

Cable type		MM FO robust cable GP (2G50/125)
Optical data		
Attenuation	805 nm	≤ 3.1 dB/km
	1300 nm	≤ 0.8 dB/km
Bandwidth length product	805 nm	200 GHz *m
	1300 nm	600 GHz *m
Permitted ambient conditions		
Operating temperature		-40 ºC to +70 ºC
Transportation/storage temperature		-40 ºC to +70 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame-retardant acc. to IEC 60332-1-2 , IEC 60332-3-22 (Cat. A) and DIN VDE 0472 Part 804, test type B
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Halogen-free		yes
Silicone-free		yes
Rodent protection		no
Cable length	100BaseFX	4000 m
	1000BaseSX	350 m
	1000BaseLX	550 m

Order numbers

INDOOR fiber-optic indoor cable[1]	Cable for indoors; flame retardant, splittable, without connectors, sold by the meter	6XV1 820-7AH10
INDOOR fiber-optic indoor cable	preassembled with 2x2 BFOC connectors	
	• 0.5 m	6XV1 820-7BH05
	• 1 m	6XV1 820-7BH10
	• 2 m	6XV1 820-7BH20
	• 3 m	6XV1 820-7BH30
	• 5 m	6XV1 820-7BH50
	• 10 m	6XV1 820-7BN10
	• 15 m	6XV1 820-7BN15
	• 20 m	6XV1 820-7BN20
	• 25 m	6XV1 820-7BN25
	• 50 m	6XV1 820-7BN50
	• 75 m	6XV1 820-7BN75
	• 100 m	6XV1 820-7BT10

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.10 Flexible FO trailing cable (62.5/125 µm)

Description

The flexible fiberoptic trailing cable was developed for applications in which the cable must be flexible enough to move, for example when attached to moving machine parts (drag chains).

The cable is mechanically designed for 100,000 bending cycles through ±90° (at the specified minimum bending radius). The trailing cable can be used both indoors and outdoors.

The trailing cable is available in fixed lengths, preassembled with four BFOC connectors.

Features and functions

Cable type		Flexible fiber-optic trailing cable
Areas of application		Flexible cable for installation in drag chains indoors and outdoors
Version of the preassembled FO cable		• BFOC plug
Cable type (standard code)		AT-W11Y(ZN)11Y 2 G 62.5/125
Standards, approvals		
• RoHS conformity		yes
• UL approval		no
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 62.5/125 µm, OM 2
Maximum tensile load		1000 N
Bending cycles		100,000
Optical data		
Attenuation	805 nm	≤ 3.1 dB/km
	1300 nm	≤ 0.8 dB/km
Bandwidth length product	805 nm	200 GHz *m
	1300 nm	600 GHz *m
Permitted ambient conditions		
Operating temperature		-25 ºC to +60 ºC
Transportation/storage temperature		-25 ºC to +70 ºC
Installation temperature		-30 ºC to +60 ºC
Resistance to fire		acc. to IEC 60332-1, flammable
Resistance to oil		
UV resistance		resistant

Cable type		Flexible fiber-optic trailing cable
Product characteristics		
Halogen-free		yes
Silicone-free		yes
Rodent protection		no
Cable length	100BaseFX	4000 m
	1000BaseSX	350 m
	1000BaseLX	550 m

Order numbers

Flexible fiber-optic trailing cable [1]	Cable for indoors; flame retardant, splittable, without connectors, sold by the meter	6XV1 820-6AH10
INDOOR fiber-optic indoor cable	preassembled with 2x2 BFOC connectors	
	• 1 m	6XV1 820-6BH10
	• 2 m	6XV1 820-6BH20
	• 3 m	6XV1 820-6BH30
	• 5 m	6XV1 820-6BH50
	• 10 m	6XV1 820-6BN10
	• 15 m	6XV1 820-6BN15
	• 20 m	6XV1 820-6BN20
	• 25 m	6XV1 820-6BN25
	• 50 m	6XV1 820-6BN50

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.11   SIENOPYR Duplex FiberOptic Marine Cable 62.5/125 µm

Description

The SIENOPYR Duplex FiberOptic Marine Cable has 2 multimode graded-index fibers 62.5/125 µm. The cable also has 2 multiwire, rubber-insulated copper wires with 1 mm² cross section. The SIENOPYR duplex fiberoptic marine cable is intended for fixed installation on ships and offshore facilities in all enclosed spaces and on open decks. The cable is not, however, suitable for permanent installation in water.

The halogen-free cable is certified for shipbuilding by the following organizations:

- Lloyds Register of Shipping
- Germanischer Lloyd
- Registro Staliano Navale
- Bureau Veritas

Features and functions

Cable type	SIENOPYR duplex fiber-optic marine cable	
Areas of application	Fixed installation on ships and offshore facilities in all enclosed spaces and on free decks	
Version of the preassembled FO cable	• BFOC plug	
Cable type (standard code)	MI-VHH 2G 62.5/125 3.1B200 + 0.8F600 + 2x1Cu 300V	
Standards, approvals		
• RoHS conformity	yes	
• UL approval	no	
• Shipbuilding approval	yes	
Mechanical data		
Number of fibers	2	
Fiber material	Multimode graded-index fiber 62.5/125 µm, OM 2	
Maximum tensile load	250 N	
Bending cycles	100,000	
Optical data		
Attenuation	805 nm	≤ 3.1 dB/km
	1300 nm	≤ 0.8 dB/km
Bandwidth length product	805 nm	200 GHz * km
	1300 nm	600 GHz * km
Permitted ambient conditions		
Operating temperature	-40 ºC to +80 ºC	
Transportation/storage temperature	-40 ºC to +80 ºC	
Installation temperature	-10 ºC to +50 ºC	
Environmental conditions for operation	At ambient temperatures of -10 °C, the cables must not be subjected to any motions beyond the normal vibration and oscillation on ships.	
Resistance to fire	Flame retardant acc. to IEC 60332-3 (Cat. A)	
Resistance to oil	not resistant	
UV resistance	resistant	
Product characteristics		
Halogen-free	yes	
Silicone-free	yes	
Rodent protection	no	

Order numbers

SIENOPYR duplex fiber-optic marine cable [1]	Glass SIENOPYR fiber-optic marine cable, sold in meters, without connectors	6XV1 830-0NH10

[1]   Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.12   FC FO standard cable GP 62.5/200/230 μm

Description

The FC fiberoptic standard cable GP contains two multimode graded fibers of type 62.5/200/230 μm. Thanks to the fiber construction (62.5/200/230), the cable can be cut etc. like normal PCF fibers (Polymer Cladded Fiber). This means that users have the advantages of glass FO cables (longer distances, resistant to temperature) and the advantages of PCF cables when fitting connectors.

With the FC cables, glass FO runs of up to 3 km (100 Mbps Industrial Ethernet, PROFIBUS) can be set up and the cable assembled on site. The combination of already installed, traditional 62.5/125 μm multimode glass FO runs with the new FastConnect FO cables is also possible.

Features and functions

Cable type		FC FO standard cable GP
Areas of application		Cable for fixed installation in cable channels and pipes
Version of the preassembled FO cable		• FC FO BFOC connectors • FC FO SC connectors
Cable type (standard code)		AT-V(ZN)YY 2GK 62.5/200/230
Standards, approvals		
• RoHS conformity		yes
• UL approval		no
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 62.5/200/230 μm
Maximum tensile load		100 N
Optical data		
Attenuation	805 nm	≤ 3.2 dB/km
	1300 nm	≤ 0.9 dB/km
Bandwidth length product	805 nm	200 GHz *m
	1300 nm	500 GHz *m

Cable type		FC FO standard cable GP
Permitted ambient conditions		
Operating temperature		-40 °C to +85 °C
Transportation/storage temperature		-40 °C to +85 °C
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame-retardant acc. to IEC 60332 -1-2 and IEC 60332 -3-22 (Cat. A)
Resistance to oil		Conditionally resistant to mineral oils and fats
UV resistance		Resistant
Product characteristics		
Halogen-free		no
Silicone-free		yes
Rodent protection		no
Cable length	100BaseFX	3000 m
	1000BaseSX	350 m
	1000BaseLX	550 m

Order numbers

FC FO standard cable GP[1]	FC FO standard cable for fixed installation indoors with PVC jacket	6XV1 847-2A

[1]   Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.3.13   FC FO trailing cable 62.5/200/230 μm

Description

The FC fiberoptic trailing cable is the universal cable for use in drag chains indoors and outdoors. The FC fiberoptic trailing cable contains two multimode graded fibers of type 62.5/200/230 μm. The outer jacket with the outer diameter 8.8 ± 0.5 mm is made of TPE-U (polyurethane).

Features and functions

Cable type	FC fiber-optic trailing cable
Areas of application	Cable for high mechanical load for use in drag chains indoors and outdoors
Version of the preassembled FO cable	• FC FO BFOC connectors • FC FO SC connectors
Cable type (standard code)	AT-V(ZN)Y(ZN)11Y 2GK 62.5/200/230

Cable type		FC fiber-optic trailing cable
Standards, approvals		
• RoHS conformity		yes
• UL approval		no
Mechanical data		
Number of fibers		2
Fiber material		Multimode graded-index fiber 62.5/200/230 µm
Maximum tensile load		800 N
Bending cycles		5 000.000
Optical data		
Attenuation	805 nm	≤ 3.2 dB/km
	1300 nm	≤ 0.9 dB/km
Bandwidth length product	805 nm	200 GHz *m
	1300 nm	500 GHz *m
Permitted ambient conditions		
Operating temperature		-25 ºC to +70 ºC
Transportation/storage temperature		-30 ºC to +75 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame retardant to IEC 60332-1-2
Resistance to oil		resistant
UV resistance		resistant
Product characteristics		
Halogen-free		no
Silicone-free		yes
Rodent protection		no
Cable length	100BaseFX	4000 m
	1000BaseSX	350 m
	1000BaseLX	550 m

Order numbers

FC fiber-optic trailing cable [1]	Trailing cable, splittable, without connectors, sold by the meter	6XV1 847-2C

[1] Special tools and trained personnel are required to assemble glass fiber-optic cables.

9.3.4　Plastic fiber-optic cables

9.3.4.1　Overview

The plastic fiber-optic cable is available with PCF fibers (Polymer Cladded Fiber) and POF fibers (Plastic Optical Fiber).

Properties

Plastic fibers have several properties that differ from those of glass fibers. For example, the maximum possible cable length is shorter with glass fibers due to the higher attenuation and the bandwidth is smaller. Plastic fibers require far less effort to assemble on site compared with glass fibers.

The use of plastic fibers is particularly attractive when networking islands for example with the ET 200. In this case, small distances up to a maximum of 50 m can be covered with the plastic fibers.

9.3.4.2　POF Standard Cable GP 980/1000

Description

The Plastic Optical Fiber (POF) standard cable GP consists of two plastic fibers with a rugged polyamide inner jacket. The inner jacket is surrounded by Kevlar strengthening elements and a green PVC outer jacket. The POF standard cable GP can be assembled on site. The cable is fitted with SC RJ connectors for devices with an integrated optical interface.

Devices with an integrated optical interface include, for example SCALANCE X200-4P IRT, SCALANCE X201-3P IRT, SCALANCE X202-2P IRT, SCALANCE X101-1POF, ET 200S.

Features and functions

Cable type	POF Standard Cable GP 980/1000
Areas of application	Fixed installation indoors
Version of the preassembled FO cable	• SC RJ plug • SC RJ POF Plug Pro
Cable type (standard code)	I-V4Y(ZN)Y 2P 980/1000
Standards, approvals	
• RoHS conformity	yes
• UL approval	yes

Cable type		POF Standard Cable GP 980/1000
Mechanical data		
Number of fibers		2
Fiber material		POF FO cable fiber 980/1000 µm
Maximum tensile load		100 N
Optical data		
Attenuation	650 nm	≤ 160 dB/km
Bandwidth length product	650 nm	1 GHz *m
Permitted ambient conditions		
Operating temperature		-25 ºC to +60 ºC
Transportation/storage temperature		-25 ºC to +70 ºC
Installation temperature		-30 ºC to +60 ºC
Resistance to fire		Flame retardant to IEC 60332-1-2
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Halogen-free		no
Silicone-free		yes
Rodent protection		no
Cable length for Industrial Ethernet		≤ 50 m

Order numbers

POF Standard Cable GP 980/1000	Standard cable; without connectors, UL approval, sold by the meter	6XV1 874-2A

9.3.4.3   POF Trailing Cable 980/1000

Description

The Plastic Optical Fiber (POF) trailing cable consists of two plastic fibers with a rugged polyamide inner jacket. The inner jacket is surrounded by Kevlar strengthening elements and a green PUR outer jacket. The POF trailing cable can be assembled on site.

Devices with an integrated optical interface include, for example SCALANCE X200-4P IRT, SCALANCE X201-3P IRT, SCALANCE X202-2P IRT, SCALANCE X101-1POF, ET 200S

Features and functions

Cable type	POF trailing cable
Areas of application	For moving applications (e.g. drag chains)
Version of the preassembled FO cable	• SC RJ plug • SC RJ POF Plug Pro
Cable type (standard code)	I-V4Y(ZN)11Y 2P 980/1000 FLEX UL
Standards, approvals	
• RoHS conformity	yes
• UL approval	yes
Mechanical data	
Number of fibers	2
Fiber material	POF FO cable fiber 980/1000 µm
Maximum tensile load	100 N
Bending cycles	5 000 000
Optical data	
Attenuation 650 nm	≤ 180 dB/km
Bandwidth length product 650 nm	1 GHz *m
Permitted ambient conditions	
Operating temperature	-20 ºC to +70 ºC
Transportation/storage temperature	-40 ºC to +80 ºC
Installation temperature	-5 ºC to +50 ºC
Resistance to fire	Flame retardant to IEC 60332-1-2
Resistance to oil	resistant
UV resistance	resistant
Product characteristics	
Free of halogens	no
Rodent protection	no
Silicone-free	yes
Cable length for Industrial Ethernet	≤ 50 m

Order numbers

POF trailing cable	Trailing cable; with poly-optic fiber; without connectors, sold by the meter	6XV1 874-2B

9.3.4.4 PCF standard cable GP 200/230

Description

The PCF standard cable GP consists of two PCF fibers. The fibers are surrounded by aramid strengthening elements and a green PVC outer jacket. The cable is intended for fixed installation indoors and outdoors with cable lengths up to 100 m.

The PCF standard cable GP 200/230 is available in meters and is suitable for fitting connectors directly.

Features and functions

Cable type		PCF standard cable GP 200/230
Areas of application		Fixes installation indoors and outdoors
Version of the preassembled FO cable		• SC RJ plug • SC RJ PCF Plug Pro
Cable type (standard code)		AT-V(ZN)YY 2K 200/230
Standards, approvals		
• RoHS conformity		yes
• UL approval		yes
Mechanical data		
Number of fibers		2
Fiber material		Graded-index 200/230 µm
Maximum tensile load		100 N
Optical data		
Attenuation	650 nm	≤10 dB/km
	660 nm	≤10 dB/km
Bandwidth length product	650 nm	17 GHz *m
Permitted ambient conditions		
Operating temperature		-40 ºC to +90 ºC
Transportation/storage temperature		-40 ºC to +90 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame-retardant acc. to IEC 60332 -1-2 and IEC 60332 -3-22 (Cat. A)
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Halogen-free		no
Silicone-free		yes
Rodent protection		no
Cable length for Industrial Ethernet		≤ 100 m

Order numbers

PCF standard cable GP 200/230	Standard cable; UL approval; without connectors, sold by the meter	6XV1 861-2A

9.3.4.5 PCF trailing cable 200/230

Description

The PCF trailing cable 200/230 consists of two PCF fibers. The fibers are surrounded by aramid strengthening elements and a green PUR outer jacket. The cable is intended for moving applications such as drag chains indoors and outdoors with cable lengths up to 100 m. The recommended wavelength is 660 nm.

The PCF Trailing Cable is available in meters and is suitable for fitting connectors directly.

Features and functions

Cable type		PCF trailing cable 200/230
Areas of application		Cable for high mechanical load and moving applications, for example drag chains
Version of the preassembled FO cable		• SC RJ plug • SC RJ PCF Plug Pro
Cable type (standard code)		AT-V(ZN)Y(ZN)11Y 2K200/230
Standards, approvals		
• RoHS conformity		yes
• UL approval		no
Mechanical data		
Number of fibers		2
Fiber material		Graded-index 200/230 µm
Maximum tensile load		800 N
Bending cycles		5 000 000
Optical data		
Attenuation	650 nm	≤10 dB/km
	660 nm	≤10 dB/km
Bandwidth length product	650 nm	17 GHz *m

Cable type	PCF trailing cable 200/230
Permitted ambient conditions	
Operating temperature	-25 ºC to +75 ºC
Transportation/storage temperature	-30 ºC to +75 ºC
Installation temperature	-5 ºC to +50 ºC
Resistance to fire	Flame retardant
Resistance to oil	resistant
UV resistance	resistant
Product characteristics	
Free of halogens	no
Rodent protection	no
Silicone-free	yes
Cable length for Industrial Ethernet	≤ 100 m

Order numbers

PCF trailing cable 200/230	PCF fiber-optic cable with plastic cladding, without connectors, sold by the meter	6XV1 861-2C

9.3.4.6   PCF trailing cable GP 200/230

Description

The PCF trailing cable GP 200/230 is a rugged round cable with a green PVC outer jacket and Kevlar strengthening elements and two glass fibers with a rugged PVC inner jacket. The cable is intended for moving applications such as drag chains indoors and outdoors with cable lengths up to 100 m. The recommended wavelength is 660 nm.

Features and functions

Cable type	PCF trailing cable GP 200/230
Areas of application	Cable for high mechanical load and moving applications, for example drag chains.
Version of the preassembled FO cable	• SC RJ plug • SC RJ PCF Plug Pro
Cable type (standard code)	AT-V(ZN)Y(ZN)Y 2K200/230
Standards, approvals	
• RoHS conformity	yes
• UL approval	yes

Cable type		PCF trailing cable GP 200/230
Mechanical data		
Number of fibers		2
Fiber material		Graded-index 200/230 μm
Maximum tensile load		800 N
Bending cycles		5,000,000
Optical data		
Attenuation	650 nm	≤10 dB/km
	660 nm	≤10 dB/km
Bandwidth length product	650 nm	17 GHz * km
Permitted ambient conditions		
Operating temperature		-25 ºC to +75 ºC
Transportation/storage temperature		-30 ºC to +75 ºC
Installation temperature		-5 ºC to +50 ºC
Resistance to fire		Flame retardant
Resistance to oil		Conditionally resistant
UV resistance		resistant
Product characteristics		
Free of halogens		no
Rodent protection		no
Silicone-free		yes
Cable length for Industrial Ethernet		≤ 100 m

Order numbers

PCF trailing cable 200/230	PCF fiber-optic cable with plastic cladding, without connectors	6XV1 861-2D

9.3.5 Plugs

9.3.5.1 BFOC plug

Description

The BFOC connector is used to assemble glass fiber-optic cables with the following fiber type.

- Glass fiber-optic cable 50/125 μm

- Glass fiber-optic cable 62.5/125 μm

Special tools and trained personnel are required to assemble glass fiber-optic cables.

Features and functions

Connection type	BFOC plug
Standards, approvals	
• RoHS conformity	yes
• UL approval	no
Transmission speed	
Industrial Ethernet	100 / 1000 Mbps
Interfaces	
Number of optical connectors for POF fiber-optic cables	1
Version for optical interface	BFOC plug
Version for network components or end devices	no
Design	
Cable outlet	180°
Housing material	Metal and plastic
IP degree of protection	IP20
Product property	
Silicone-free	yes

Order numbers

Multimode FO BFOC connector set	Connector set for on-site assembly of FO standard cables (50/125/1400), FO ground cable (50/125/1400), flexible FO trailing cable, INDOOR FO cable (62.5/125/900)	
	1 pack of 20	**6GK1 901-0DA20-0AA0**

9.3.5.2 Single mode FO LC plug

Description

The SM FO LC plug is used to assemble SM FO robust cable GP. The connector is used to connect to Ethernet/PROFINET devices with an integrated optical single mode interface, for example SCALANCE XR-300EEC, SCALANCE XR-300, SCALANCE X308-2M.
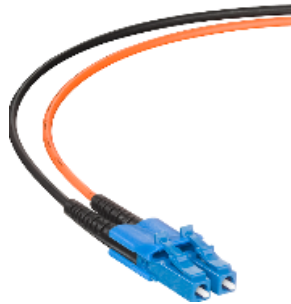
Features and functions

Connection type	**SM FO LC plug**
Standards, approvals	
• RoHS conformity	yes
• UL approval	no
Transmission speed	
Industrial Ethernet	100 / 1000 Mbps
Interfaces	
Number of optical connectors for glass fiber-optic cables	2
Version for optical interface	Duplex plug (push-pull device connector)
Version for network components or end devices	no
Design	
Cable outlet	180°
Housing material	Plastic
IP degree of protection	IP20
Product property	
Silicone-free	yes

Order numbers

SM FO LC plug	LC duplex plug for SM FO robust cable GP (4E9/125)	
	1 pack of 10	**6GK1901-0SB10-2AB0**

9.3.5.3   Multimode FO LC plug

Description

The MM FO LC plug is used to assemble MM FO robust cable GP. Numerous SCALANCE products support the Lucent Connector (LC) interface , e.g. X308-2M, XR-300 and X-300EEC.

Features and functions

Connection type	MM FO LC plug
Standards, approvals	
● RoHS conformity	yes
● UL approval	no
Transmission speed	
Industrial Ethernet	100 / 1000 Mbps
Interfaces	
Number of optical connectors for glass fiber-optic cables	2
Version for optical interface	Duplex plug (push-pull device connector)
Version for network components or end devices	no
Design	
Cable outlet	180°
Housing material	Plastic
IP degree of protection	IP20
Product property	
Silicone-free	yes

Order numbers

MM FO LC plug	LC duplex plug for MM FO robust cable GP (2G50/125)	
	1 pack of 10	**6GK1 901-0RB10-2AB0**

9.3.5.4 FO FC SC plug

Description

The FO FC SC plug is used to assemble FO FC glass fiber-optic cables. A case is available for on-site cable assembly. The case contains the tools required for cable assembly.

Features and functions

Connection type	FO FC SC plug
Standards, approvals	
• RoHS conformity	yes
• UL approval	no
Transmission speed	
Industrial Ethernet	100 / 1000 Mbps
Interfaces	
Number of optical connectors for POF fiber-optic cables	1
Version for optical interface	SC plug
Version for network components or end devices	yes, FC
Design	
Cable outlet	180°
Housing material	Metal and plastic
IP degree of protection	IP20
Product property	
Silicone-free	yes

Order numbers

FC FO SC plug	Screw connector for on-site fitting to FC cable	
	1 pack of 10 duplex plug + cleaning cloths	6GK1900-1LB00-0AC0
FC FO Termination Kit	Cable assembly case for on-site assembly of FC plugs and FC glass fiber-optic cables	6GK1900-1GL00-0AA0

9.3.5.5   FO FC BFOC plug

Description

The FO FC BFOC plug is used to assemble FO FC glass fiber-optic cables. A case is available for on-site cable assembly. The case contains the tools required for cable assembly.

Features and functions

Connection type	FC FO BFOC plug
Standards, approvals	
● RoHS conformity	yes
● UL approval	no
Transmission speed	
Industrial Ethernet	100 / 1000 Mbps
Interfaces	
Number of optical connectors for POF fiber-optic cables	1
Version for optical interface	BFOC plug
Version for network components or end devices	yes, FC
Design	
Cable outlet	180°
Housing material	Metal and plastic
IP degree of protection	IP20
Product property	
Silicone-free	yes

Order numbers

FC FO BFOC plug	Screw connector for on-site fitting to FC fiber-optic cables	
	1 pack of 10 duplex plug + cleaning cloths	6GK1900-1GB00-0AC0
FC FO Termination Kit	Cable assembly case for on-site assembly of FC plugs and FC glass fiber-optic cables	6GK1900-1GL00-0AA0

9.3.5.6   SC RJ plug

Description

The SC RJ plug is used to assemble POF and PCF fiber-optic cables.

The SC RJ plug is available in two versions:

● SC RJ POF plug
   For assembling POF fiber-optic cables. The maximum cable length between two
   Industrial Ethernet devices is 50 m.

● SC RJ PCF plug
   For assembling PCF fiber-optic cables. The maximum cable length between two
   Industrial Ethernet devices is 100 m.

A case is available for on-site cable assembly. The case contains the tools required for cable
assembly.

Features and functions

Connection type	SC RJ POF plug
	SC RJ PCF plug
Standards, approvals	
● RoHS conformity	yes
● UL approval	no
Transmission speed	
Industrial Ethernet	100 Mbps
Interfaces	
Number of optical connectors for POF fiber-optic cables	1
Version for optical interface	SC RJ plug (push-pull device connector)
Version for network components or end devices	no
Design	
Cable outlet	180°
Housing material	Plastic
IP degree of protection	IP65/67
Product property	
Silicone-free	yes

Order numbers

IE SC RJ POF Plug	Screw connector for on-site fitting to POF fiber-optic cable	
	1 pack of 20	**6GK1900-0MB00-0AC0**
Termination Kit SC RJ POF plug	Assembly case for on-site assembly of SC RJ POF plugs; consisting of stripping tool, Kevlar scissors, SC RJ polishing plate, grinding and polishing paper, grinding and polishing base, microscope	**6GK1900-0ML00-0AA0**
IE SC RJ PCF Plug	Screw connector for on-site fitting to PCF fiber-optic cable	
	1 pack of 10	**6GK1900-0NB00-0AC0**
Termination Kit SC RJ PCF plug	Assembly case for on-site assembly of SC RJ plugs; consisting of stripping tool, buffer stripping tool, Kevlar scissors, fiber breaking tool, microscope	**6GK1 900-0NL00-0AA0**

9.3.5.7   IE SC RJ Plug Pro

Description

The SC RJ plug Pro is a plug that can be assembled in the field for push-pull device connection with a high degree of protection.

The SC RJ Plug Pro is available in two versions:

- SC RJ POF Plug Pro
  For assembling POF fiber-optic cables. The maximum cable length between two Industrial Ethernet devices is 50 m.

- SC RJ PCF Plug Pro
  For assembling PCF fiber-optic cables. The maximum cable length between two Industrial Ethernet devices is 100 m.

Features and functions

Connection type	SC RJ POF Plug Pro
	SC RJ PCF Plug Pro
Standards, approvals	
• RoHS conformity	yes
• UL approval	no
Transmission speed	
Industrial Ethernet	100 Mbps
Interfaces	
Number of optical connectors for POF fiber-optic cables	1
Version for optical interface	SC RJ plug (push-pull device connector)
Version for network components or end devices	no
Design	
Cable outlet	180°
Housing material	Plastic
IP degree of protection	IP65/67
Product property	
Silicone-free	yes

Order numbers

IE SC RJ POF Plug PRO	Connector for on-site fitting to POF FO cable	
	1 pack of 1	**6GK1900-0MB00-6AA0**
IE SC RJ PCF Plug PRO	Connector for on-site fitting to PCF FO cable	
	1 pack of 1	**6GK1900-0NB00-6AA0**

9.4 Power supply

Different types of cables are required for the power supply in Industrial Ethernet.

The power cables are used for devices with degree of protection IP65/67 to connect the signaling contact or 24 V supply of the SCALANCE X and SCALANCE W components (energy cable 2 x 0.75) and to supply power (energy cable 5 x 1.5 for the ET 200).

Preassembled power cables are also available to supply power for the ET 200 in different lengths (M12 power connecting cable).

9.4.1 Power cable

9.4.1.1 Energy cable 2 x 0.75

Description

Rugged cable suitable for trailing with 2 copper wires for connecting the signaling contact and 24 VDC power supply to SCALANCE X and SCALANCE W components.

The energy cable 2x1.5 is assembled with the following M12 plug-in connectors:

- Signaling contact M12 cable connector
  For connection to SCALANCE X208Pro for signaling contact

- Power M12 cable connector
  for connection to SCALANCE X208Pro and SCALANCE W700 for the 24 VDC power supply.

Features and functions

Cable type [1]	Energy cable 2x1.5
Areas of application	Connector for signaling contact and power supply
Cable type (standard code)	2YY (ST) CY 2x2x0.64/1.5-100 GN
Jacket	PVC Ø (7.4 ± 0.3) mm, gray
Electrical data	
Operating voltage (rms value)	600 V
Continuous current of the power wires	6 A
Permitted ambient conditions	
Operating temperature	-20 ºC to +80 ºC
Transportation/storage temperature	-20 ºC to +80 ºC
Installation temperature	-20 ºC to +80 ºC
Resistance to fire	Flame retardant to IEC 60332-1-2
Resistance to oil	Conditionally resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1] Electrical characteristics at 20 °C, tests according to DIN 47 250 Part 4 or DIN VDE 0472

Order numbers

Energy cable 2x1.5	2-wire energy cable (2 x 0.75 mm^2) for connection to M12 plug-in connector.	6XV1 812-8A

9.4.1.2 Energy cable 5 x 1.5

Description

The energy cable 5x1.5 is used to connect the 24 V power supply for ET 200 modules via 7/8" plug-in connectors.

The power supply concept of the ET 200 involves power being supplied by a central power supply unit and being looped through from device to device. The load and device supply are over separate circuits. The devices have a 7/8" male connector on the input side and a socket on the output side.

The energy cable 5x1.5 is available in meters for assembly in the field and also in various lengths of assembled 7/8" plug-in cable with degree of protection IP65.

7/8" plug-in cable has a 5-pin 7/8" plug-in connector with pin insert at one end and a 5-pin 7/8" plug-in connector with socket insert at the other end.

Features and functions

Cable type [1]	Energy cable 5x1.5
Areas of application	Power supply of ET 200 modules with 7/8" power port
Cable type (standard code)	L-Y11Y-Z 5x1x1.5 GR
Jacket	PUR Ø (10.5 ± 0.3) mm, gray
Electrical data	
Operating voltage (rms value)	600 V
Continuous current of the power wires	16 A
Permitted ambient conditions	
Operating temperature	-40 ºC to +80 ºC
Transportation/storage temperature	-40 ºC to +80 ºC
Installation temperature	-40 ºC to +80 ºC
Resistance to fire	Flame retardant to IEC 60332-1-2
Resistance to oil	resistant
UV resistance	resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1] Electrical characteristics at 20 °C, tests according to DIN 47 250 Part 4 or DIN VDE 0472

Order numbers

Energy cable 5x1.5	5-wire energy cable (5 x 1.5 mm^2) for connection to 7/8" plug-in connector	6XV1 830-8AH10
7/8" CONNECTING CABLE	Preassembled energy cable 5x1.5 with two 5-pin 7/8" plugs/sockets. Maximum cable length 50 m	
	• 0.3 m	6XV1 822-5BE30
	• 0.5 m	6XV1 822-5B E50
	• 1.0 m	6XV1 822-5B H10
	• 1.5 m	6XV1 822-5B H15
	• 2.0 m	6XV1 822-5B H20
	• 3.0 m	6Xv1 822-5B H30
	• 5.0 m	6XV1 822-5B H50
	• 10 m	6XV1 822-5B N10
	• 15 m	6XV1 822-5B DN15

9.4.2 Power connecting cable M12-180/M12-180

Description

The Power connecting cable M12 is an assembled connecting cable for the 24 V power supply of the ET 200.

The Power connecting cable M12 has a 4-pin M12 male connector at one end and a 4-pin M12 female connector at the other. The M12 male connector and the M12 female connector are A-coded and have a straight cable outlet.

Features and functions

Cable type [1]	Power connecting cable M12-180/M12-180
Areas of application	Connection of the 24 V power supply to ET 200eco PN with degree of protection IP65/67
Cable type (standard code)	LI9YH-Y 4x0.75
Jacket	PVC Ø (5.7 ± 0.2) mm, gray
Electrical data	
Operating voltage (rms value)	300 V
Continuous current of the power wires	-
Permitted ambient conditions	
Operating temperature	-25 °C to +80 °C For moving applications, the maximum operating temperature range of -5 °C to +80 °C must be adhered to.
Transportation/storage temperature	-25 ºC to +80 ºC
Installation temperature	-5 ºC to +80 ºC
Resistance to fire	Flame retardant to UL 758 (CSA FT 1)
Resistance to oil	Conditionally resistant
UV resistance	not resistant
Product characteristics	
Halogen-free	no
Silicone-free	yes

[1] Electrical characteristics at 20 °C, tests according to DIN 47 250 Part 4 or DIN VDE 0472

Order numbers

Power connecting cable M12-180/M12-180	Flexible 4-wire power plug-in cable, assembled with an A-coded 4-pin M12 male connector and an A-coded, 4-pin M12 female connector for supply of the ET 200 with 24 VDC.	
	• 0.3 m	6XV1 801-5DE30
	• 0.5 m	6XV1 801-5D E50
	• 1.0 m	6XV1 801-5D H10
	• 1.5 m	6XV1 801-5D H15
	• 2.0 m	6XV1 801-5D H20
	• 3.0 m	6Xv1 801-5D H30
	• 5.0 m	6XV1 801-5D H50
	• 10 m	6XV1 801-5D N10
	• 15 m	6XV1 801-5D DN15

9.4.3 Cable connectors

9.4.3.1 Power Plug Pro

Description

The IE power plug PRO is 5-pin power connector that can be fitted in the field for on-site assembly. the plug-in connector is used for the 2 x 24 V power supply for SCALANCE X-200IRT PRO switches and the SIMATIC ET 200 pro. The energy cable 5x1.5 is assembled with the plug-in connector.

The silicone-free design allows it to be used in the automobile industry, for example in paint spraying lines.

Features and functions

Connection type	IE power plug PRO
Standards, approvals	
• UL approval	yes
• RoHS conformity	yes
Interfaces	
Number of electrical connectors for network components / end devices	1
Version for network components or end devices	Power contacts (push-pull casing)
Feed-out to cable	integrated spring contacts for 5-wire power cables
Cable outlet	180°
Housing material	Plastic
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 70 ℃
Transport/storage temperature	- 40 ℃ to + 70 ℃
IP degree of protection	IP 65/67
Silicone-free	yes

Order numbers

IE power plug PRO	5-pin power plug-in connector for on-site assembly with push-pull device connection	
	1 pack of 1	6GK1 907-0AB10-6AA0

9.4.3.2   7/8" plug-in connector

Description

The 7/8" plug-in connector is 5-pin plug-in connector that can be fitted in the field for on-site assembly. The plug-in connector is used for the power supply of PROFIBUS nodes (e.g. SIMATIC ET 200) with IP65 protection. The energy cable 5x1.5 is assembled with the plug-in connector.

The 7/8" plug-in connector is available in the following versions.

● Pin insert
   For feeding in the supply voltage

● Socket insert
   For looping through the supply voltage

Features and functions

Connection type	7/8" plug-in connector
Standards, approvals	
● UL approval	no
● RoHS conformity	yes
Interfaces	
Number of electrical connectors for network components / end devices	1
Version for network components or end devices	7/8" plug (socket insert or pin insert)
Feed-out to cables	Screw terminal
Cable outlet	180°
Housing material	Plastic
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 70℃
Transport/storage temperature	- 40 ℃ to + 80 ℃
IP degree of protection	IP 65/67
Silicone-free	yes

Order numbers

7/8" plug-in connector	Plug-in connector with axial cable outlet for field assembly for ET 200, 5-pin, metal casing.	
	Pin insert 1 pack of 5	**6GK1905-0FA00**
	Socket insert 1 pack of 5	**6GK1905-0FA00**

9.4.3.3   Power M12 plug Pro

Description

The Power M12 plug PRO is a 4-pin A-coded M12 power plug-in connector for energy cable 2x0.75.

The Power M12 plug PRO is suitable for connection to power supply PS791-1PRO for 24 VDC power supply.

Features and functions

Connection type	Power M12 plug PRO
Standards, approvals	
• UL approval	no
• RoHS conformity	yes
Interfaces	
Number of electrical connectors for network components / end devices	1
Version for network components or end devices	M12 connector plug (pin insert, A-coded, 4-pin)
Feed-out to cable	integrated screw contacts for 2-wire power cables
Cable outlet	180°
Housing material	Plastic

Connection type	Power M12 plug PRO
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 70 ℃
Transport/storage temperature	- 40 ℃ to + 80 ℃
IP degree of protection	IP 65/67
Silicone-free	yes

Order numbers

Power M12 plug PRO	Plug-in connector for connection to power supply PS791-1 PRO; 4-pin, A-coded, with assembly instructions.	
	1 pack of 3	**6GK1 907-0DB10-6AA3**

9.4.4 Power supply

9.4.4.1 Power supply PS791-1PRO

Description

The power supply PS791-1PRO is an AC/DC power supply unit for input voltages from 90 to 265 VAC for all SCALANCE products. The rugged metal housing provides protection against water and dust to IP65.

The PS791-1PRO power supply unit can be mounted in the following ways:

- directly on the SCALANCE W700 devices and SCALANCE X200 devices
- Wall
- S7-300 standard rail
- DIN rail

To connect the M12 socket X2 with the SCALANCE products W788 and W744 and the SCALANCE X208PRO, the M12 power cord supplied with the products can be used. As an alternative, a user-assembled cable can also be used.

Overview

	Power supply PS791-1PRO
Interfaces	AC Power 3+PE Cable Connector for 100-240 V AC power supply
	Power M12 Plug PRO or power cord M12 for 24 VDC output power
	On/off switch
Electrical data	
Input voltage	90 V to 265 V AC at 47 Hz to 63 Hz
Output voltage	24 V DC, +-7%, 0.42 A
Output power	10 W
Network disruption	Bridging min. 20 ms at 230 V AC
Perm. ambient conditions	
• Operating temperature	• -20 ℃ to 60 ℃
• Transport/storage temperature	• -40 ℃ to +85 ℃
Relative humidity	100%
Standards, approvals, degree of protection	
Approvals	EMC: EN 55022 Class B, EN 61000-4;
	UL 1950, EN 60950;
Degree of protection	IP65

Order numbers

Power supply PS791-1PRO	AC/DC power supply unit for input voltages from 90 to 265 VAC for numerous SCALANCE products with degree of protection IP65	6GK5791-1PS00-0AA6
AC Power 3+PE cable connector	Connecting socket for connecting the PS791-1PRO power supply unit to an AC power supply	
	1 pack of 5	6GK1 907-0FC10-0AA5

9.4.4.2   Power M12 cable connector PRO

Description

The Power M12 cable connector PRO is a 4-pin M12 power connecting socket that can be fitted in the field. The connecting socket is used for the 24 VDC power supply of the SCALANCE X208PRO or SCALANCE W788-xPRO devices

Features and functions

Connection type	Power M12 cable connector PRO
Standards, approvals	
• UL approval	no
• RoHS conformity	yes
Interfaces	
Number of electrical connectors for network components / end devices	1
Version for network components or end devices	M12 male connector (socket insert, A-coded, 4-pin)
Cable outlet	180°
Housing material	Plastic
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 70 ℃
Transport/storage temperature	- 40 ℃ to + 80 ℃
IP degree of protection	IP 65/67
Silicone-free	yes

Order numbers

Power M12 cable connector PRO	Connecting socket for connecting SCALANCE W700 for 24 VDC power supply; 4-pin, A-coded, with assembly instructions.	
	1 pack of 3	**6GK1 907-0DC10-6AA3**

9.4.4.3   7/8" Power T-Trap PRO

Description

The plug-in connector consists of two 7/8" socket inserts and one 7/8" pin insert, in each case 5-pin.

The 7/8" Power T-Trap PRO is used for supplying power and distributing power to ET200pro modules.

Features and functions

Connection type	7/8" Power T-Trap PRO
Standards, approvals	
• UL approval	no
• RoHS conformity	yes
Interfaces	
Number of electrical connectors for network components / end devices	3
Version for network components or end devices	7/8" plug-in connector (2 x socket insert 1 x pin insert)
Cable outlet	180°
Housing material	Metal
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 70℃
Transport/storage temperature	- 40 ℃ to + 80 ℃
IP degree of protection	IP 65/67
Silicone-free	yes

Order numbers

7/8" Power T-Trap PRO	Power T-piece for ET 200 with two 7/8" socket inserts and one 7/8" pin insert	
	Pin insert 1 pack of 5	6GK1 905-0FC00

9.4.4.4 Signaling contact M12 cable connector PRO

Description

The signaling contact M12 cable connector PRO is a 5-pin M12 cable connector that is B-coded for the signaling contact. The component has degree of protection IP65 and is used with the SCALANCE X208PRO.

Features and functions

Connection type	Signaling contact M12 cable connector PRO
Standards, approvals	
• UL approval	no
• RoHS conformity	yes
Interfaces	
Number of electrical connectors for network components / end devices	1
Version for network components or end devices	M12 connecting plug (socket insert, B-coded, 4-pin)
Cable outlet	180°
Housing material	Plastic
Permitted ambient conditions	
Operating temperature	- 40 ℃ to + 70℃
Transport/storage temperature	- 40 ℃ to + 80 ℃
IP degree of protection	IP 65/67
Silicone-free	yes

Order numbers

Signaling contact M12 cable connector PRO	Connecting socket for connecting SCALANCE X208PRO for signaling contact; 5-pin, B-coded with assembly instructions	
	1 pack of 3	6GK1908-0DC10-6AA3

Validity of the information

> **Note**
>
> Please note that the data provided here is only intended to give you general information.
>
> Our products are in constant development and the specifications and reference data may change in the course of this development. Despite all our efforts, it is possible that individual items of information in this networking manual are out of date.
>
> You will find the continuously updated data in the compact operating instructions of the individual devices.

Appendix

A

A.1   Overview of the standards relevant for network installation

Introduction

This section provides with a basic overview of the standards generally relevant for installation of networks in buildings and those particularly relevant for Industrial Ethernet.

Note

This section can only include basic information available at the time of going to print.

Fort more detailed and up-to-date guidelines, contact the PROFIBUS user organization e.V.

The PROFIBUS user organization

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Standards for general-purpose cable communications networks in an office environment

Standard	Area of application
ISO/IEC 11801	International standard for network planning in office buildings
EN50173	European standard for network planning in office buildings; adopted as national standard

Due to the use of Ethernet in automation engineering, the existing standards needed to be expanded to include the industrial sector.

Standards for general purpose cable communications networks in an industrial environment

Standard	Area of application
ISO/IEC 24702	International standard for planning general-purpose networks in industrial buildings
EN50173-2 EN50173-3	European standard for network planning in industrial buildings; adopted as national standard

For industrial applications, expanded standards are necessary that describe the constraints for these applications

Cabling standards for industrial networks and their scope

Standard	Area of application	Scope
IEC 61918	International standard for communications networks in industrial automation systems; relevant for various fieldbuses, common aspects of planning, installation, operation[1]	Describes the network structure and general requirements in and between automation cells
IEC61784-5-x	International series of standards for special requirements in industrial networks such as PROFINET / PROFIBUS, supplementing IEC 61918	Describes specific requirements of the communication profile

[1] Fieldbus-specific aspects are described in separate, ancillary standards

The "PROFINET Cabling and Interconnection Technology" guideline

Among other things, the PROFIBUS User Organization has produced the "PROFINET Cabling and Interconnection Technology" guideline that served as input for IEC 61918 and IEC 61784 and that also references these standards.

It describes the technical benchmark values for cables and connectors (both electrical and optical) for PROFINET networks. These are intended to help new manufacturers to produce PROFINET-compliant products.

The guideline can be downloaded in English from the URL:

`http://www.profibus.com/pall/meta/downloads/article/00327/`

A.2 Content of the standards

Content of the IEC 24702 and EN50173-3 standards

The standards for general purpose building networking of buildings used for industrial purposes describe:

- The structure of the building network,
- The requirements for cables (fibre-optic, electrical),
- The requirements for connectors (fibre-optic, electrical),
- Limit values for installed links.

IEC 24702 references IEC11801.

Technical aspects of installation described in IEC 14763 (EN50174).

Content of the IEC 61918 and IEC61784 standards

the standards for automation networks include a general section describing the following points:

- Design of the network (network structure, grounding, equipotential bonding),
- Planning and installation,
- Requirements of components (table connectors, cables, grounding, ...)
- Acceptance of an installation,
- Maintenance and service.

IEC 61918 contains general requirements common to all fieldbuses (PROFINET, PB, Interbus,…).

Fieldbus-specific aspects/requirements that differ from the general section described in profile-specific standards, for example in *IEC61784-5-3* for PROFIBUS, PROFIBUS PA and PROFINET; IEC61784-5-6 for Interbus.

A.3   Application of the standards

Application of the EN standards 50173/50174

Standard	Project phase	Tasks
EN50173-1	Planning of cabling	Topology, cables, connection technology, limit values for transmission links
EN50174-1 EN50174-2 EN50174-3	Planning phase	Management of the cabling, safety requirements, laying of cables, equipotential bonding)
EN50174-1 EN50174-2 EN50174-3	Implementation phase	
EN501714-1	Operational phase	Quality assurance, management of the cabling, repair and maintenance

Description of the fieldbus-specific characteristics in IEC 61784

This standard references IEC 61918.

Standard	Fieldbus
IEC 61784-5-2	ControlNet, EtherNet/IP
IEC 61784-5-3	PROFIBUS, PROFINET
IEC 61784-5-6	Interbus
IEC 61784-5-10	Vnet/IP (Yokogawa)
IEC 61784-5-11	TCnet (Toshiba)

General-purpose cabling systems: EN 50173/EN 50174

Standard	Contents
EN50173-1	Part 1: General requirements
EN50173-2	Part 2: Office environment
EN50173-3	Part 3: Industrial area
EN50173-4	Part 4: Domestic environment
EN50174-5	Part 5: Computer centers

Installation of communication cabling: EN 50174

Standard	Contents
EN50174-1	Part 1 Specification and quality assurance
EN50174-2	Part 2 Installation planning and practices in buildings
EN50174-3	Part 3 Installation planning and practices outdoors

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