

## SIMATIC NET

### S7-CPs for Industrial Ethernet Configuring and Commissioning

Manual  
Part A - General Application

Preface, Contents

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## Classification of Safety-Related Notices

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:



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### **Danger**

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

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### **Warning**

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

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### **Caution**

with warning triangle indicates that minor personal injury can result if proper precautions are not taken.

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### **Caution**

without warning triangle indicates that damage to property can result if proper precautions are not taken.

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### **Notice**

indicates that an undesirable result or status can occur if the relevant notice is ignored.

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### **Note**

highlights important information on the product, using the product, or part of the documentation that is of particular importance and that will be of benefit to the user.

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## Safety Instructions Regarding your Product:

Before you use the product described here, read the safety instructions below thoroughly.

## Qualified Personnel

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

## Correct Usage of Hardware Products

Note the following



### Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Before you use the supplied sample programs or programs you have written yourself, make certain that no injury to persons nor damage to equipment can result in your plant or process.

EU Directive: Do not start up until you have established that the machine on which you intend to run this component complies with the directive 89/392/EEC.

---

## Correct Usage of Software Products

Note the following



### Warning

This software may only be used for the applications described in the catalog or the technical description, and only in connection with software products, devices, or components from other manufacturers which have been approved or recommended by Siemens.

Before you use the supplied sample programs or programs you have written yourself, make certain that no injury to persons nor damage to equipment can result in your plant or process.

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## Prior to Startup

Before putting the product into operation, note the following warning:

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### Caution

Prior to startup you must observe the instructions in the relevant documentation. For ordering data of the documentation please refer to the catalogs or contact your local SIEMENS representative.

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We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

Subject to technical change.

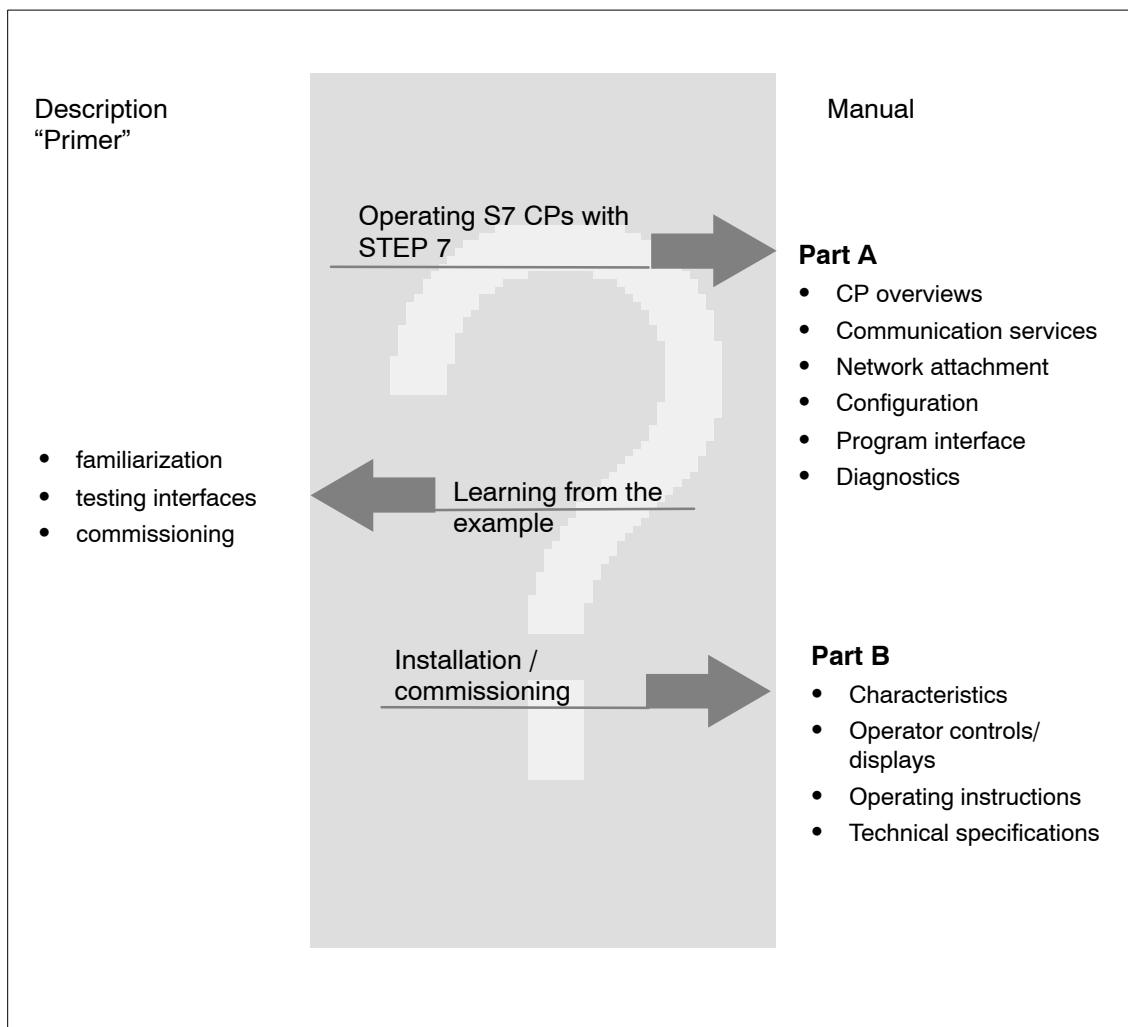
G79000-G8976-C182-08

## This manual...

... supports you when commissioning your SIMATIC NET CP modules in an S7 station.

... supports you so that your applications can communicate successfully and efficiently over the SIMATIC NET CPs.

... in tandem with the “Primer” description, provides you with all the information you require to implement your communications tasks:



These two descriptions of your S7 CPs and NCM S7 are both on the SIMATIC NET Manual Collection and on the paper version that can be ordered separately.



The examples described in “Primer” can also be found in the project folder for sample programs after you have installed STEP 7.

## Audience

This manual is intended for personnel responsible for installing and programming STEP 7 programs and for service personnel.

## Scope of this Manual

This manual applies to version V5.x and higher of the NCM S7 configuration software and to version V5.x and higher of the STEP 7 software.

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### Notice

If functions are described that require higher versions, this is indicated by an additional icon.



**New in this version**

Apart from various adaptations to the currently available devices, the following topics are also included:

- Additional information in the block description
  - New blocks for user programs of the CP 443-1:
    - FC53 AG\_SSEND
    - FC63 AG\_SRECV

With CPs of the S7-400, that support PROFINET communication in conjunction with CPUs as of version 5.1, data can be transmitted at a higher transmission rate using the FCs AG\_SSEND and AG\_SRECV.

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### Note

You should also check the History for this manual in Appendix F.

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### Notice

Please note that the availability of new functions depends on the device type you are using. You can check which functions your module supports in the description in the Properties dialog in STEP 7 and in the catalog in HW Config.

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## The Documentation in the “S7-CPs / NCM S7” Documentation Package and on the Internet

You can order this manual along with other documents in a manual package:

Order no. - German: 6GK7080-0AA01 8AA0  
 Order no. - English: 6GK7080-0AA01 8BA0

The following table provides you with an overview of the content and the addresses for downloading from the Web.

Title	Content / Web Addresses
Configuring and Commissioning S7-CPs for Industrial Ethernet Manual	<p>This is available on the Web at:</p> <p>General section:  <a href="http://support.automation.siemens.com/WW/view/en/8777865">http://support.automation.siemens.com/WW/view/en/8777865</a></p> <p>Device descriptions:</p> <ul style="list-style-type: none"> <li>• CP 343-1 Lean (CX00): *)  <a href="http://support.automation.siemens.com/WW/view/en/19308657">http://support.automation.siemens.com/WW/view/en/19308657</a></li> <li>• CP 343-1 Lean (CX10):  <a href="http://support.automation.siemens.com/WW/view/en/23643456">http://support.automation.siemens.com/WW/view/en/23643456</a></li> <li>• CP 343-1 (EX21): *)  <a href="http://support.automation.siemens.com/WW/view/en/22259495">http://support.automation.siemens.com/WW/view/en/22259495</a></li> <li>• CP 343-1 (EX30):  <a href="http://support.automation.siemens.com/WW/view/en/24485272">http://support.automation.siemens.com/WW/view/en/24485272</a></li> <li>• CP 343-1 Advanced:  <a href="http://support.automation.siemens.com/WW/view/en/20736149">http://support.automation.siemens.com/WW/view/en/20736149</a></li> <li>• CP 343-1 (EX20/EX11): *)  <a href="http://support.automation.siemens.com/WW/view/en/8777308">http://support.automation.siemens.com/WW/view/en/8777308</a></li> <li>• CP 343-1 PN: *)  <a href="http://support.automation.siemens.com/WW/view/en/8776538">http://support.automation.siemens.com/WW/view/en/8776538</a></li> <li>• CP 343-1 IT: *)  <a href="http://support.automation.siemens.com/WW/view/en/8776544">http://support.automation.siemens.com/WW/view/en/8776544</a></li> <li>• CP 443-1 (EX11):  <a href="http://support.automation.siemens.com/WW/view/en/8776219">http://support.automation.siemens.com/WW/view/en/8776219</a></li> <li>• CP 443-1 (EX20):  <a href="http://support.automation.siemens.com/WW/view/en/26417141">http://support.automation.siemens.com/WW/view/en/26417141</a></li> <li>• CP 443-1 IT: *)  <a href="http://support.automation.siemens.com/WW/view/en/8776322">http://support.automation.siemens.com/WW/view/en/8776322</a></li> <li>• CP 443-1 Advanced (EX40):  <a href="http://support.automation.siemens.com/WW/view/en/9308871">http://support.automation.siemens.com/WW/view/en/9308871</a></li> <li>• CP 443-1 Advanced (EX41):  <a href="http://support.automation.siemens.com/WW/view/en/23643789">http://support.automation.siemens.com/WW/view/en/23643789</a></li> <li>• IE/PB Link: *)  <a href="http://support.automation.siemens.com/WW/view/en/7851748">http://support.automation.siemens.com/WW/view/en/7851748</a></li> <li>• IE/PB Link PN IO:  <a href="http://support.automation.siemens.com/WW/view/en/9299692">http://support.automation.siemens.com/WW/view/en/9299692</a></li> <li>• IWLAN/PB Link PN IO:  <a href="http://support.automation.siemens.com/WW/view/en/21379908">http://support.automation.siemens.com/WW/view/en/21379908</a></li> </ul>

Title	Content / Web Addresses
NCM S7 for SIMATIC NET S7-CPs Primer	This is available on the Web at: <a href="http://support.automation.siemens.com/WW/view/en/1172503">http://support.automation.siemens.com/WW/view/en/1172503</a>
Information Technology in SIMATIC S7 with CPs for S7-300 and S7-400 Manual	This manual serves as instructions and as a reference for working with the CP functions of Internet technology. This is available on the Web at: <a href="http://support.automation.siemens.com/WW/view/en/1172744">http://support.automation.siemens.com/WW/view/en/1172744</a>
Commissioning PC Stations Manual and Quick Start	The manual supports you and helps you to make efficient use of communications with your PC applications in conjunction with the SIMATIC NET modules. It shows you how to configure PC modules and the steps required in project engineering with NCM S7.
Commissioning PC Stations Manual and Quick Start	This is available on the Web at: <a href="http://support.automation.siemens.com/WW/view/en/13542666">http://support.automation.siemens.com/WW/view/en/13542666</a>
Configuring and Commissioning S7-CPs for PROFIBUS Manual	You will find the Web addresses of the current documents of this manual at the address shown below for the Version History.
NCM S7 for PROFIBUS/FMS	This is available on the Web at: <a href="http://support.automation.siemens.com/WW/view/en/1158418">http://support.automation.siemens.com/WW/view/en/1158418</a>

\*) Document is not part of the manual package

### CP Documentation in the Manual Collection (Order no. A5E00069051)



The SIMATIC NET Manual Collection ships with each S7-CP. This DVD is updated at regular intervals; this means that the DVD contains the latest device manuals and descriptions available at the time the DVD was written.

### Version History/Current Downloads for the SIMATIC NET S7-CPs

In the “Version History/Current Downloads for the SIMATIC NET S7-CPs”, you will find information on all previously available CPs for SIMATIC S7 (Ind. Ethernet, PROFIBUS and IE/PB Link).

You will find the latest release of these documents at:

<http://support.automation.siemens.com/WW/view/en/9836605>



## Information on the Current Block Versions (FCs/FBs)

Please use the latest block versions for new user programs. You will find information on the current block versions and can download the blocks from the Internet at:

<http://support.automation.siemens.com/WW/view/en/8797900>

If you require replacements, please follow the instructions in the device-specific Part B of this manual.

## SIMATIC NET Quick Start CD: Samples covering all aspects of communication



The Quick Start CD that can be ordered separately is a treasure-trove of sample programs and configurations.

You can order this directly over the Internet at:

<http://support.automation.siemens.com/WW/view/en/21827955>

## Additional Information on SIMATIC S7 and STEP 7

The additional documentation on the basic software STEP 7 of the SIMATIC programmable controllers is included in electronic format in your STEP 7 installation.

You will also find information on SIMATIC programmable controllers on the Quick Start CD and from the Customer Support Online services at:

<http://www.siemens.com/simatic-net> General information

or

<http://www.ad.siemens.com/csi/net> Product information and downloads

## Symbols Used in this Manual



Unless indicated otherwise, the functions described in this manual assume the use of STEP 7. This symbol is used to indicate functions that require a specific version of STEP 7 or higher, for example Version V5.2.



This symbol appears in the margin to draw your attention to useful tips.



This symbol indicates recommended documentation.



HLP

Where you see this symbol, you should also refer to additional information in the basic help system of STEP 7.



This symbol indicates where detailed context-sensitive help is available. You can display these help texts with the F1 key or by clicking on the “Help” button in the relevant dialog.

## Conventions

References to other manuals and documentation are indicated by numbers in slashes /.../. These numbers refer to the titles of manuals listed in the References section of the Appendix.

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# 1 Communication via Ethernet CPs in S7 Stations

The Ethernet CP for SIMATIC S7 provides a series of communications services for different tasks.

This chapter explains the following:

- The types of communication possible with the Ethernet CP on Industrial Ethernet
- The tasks handled by the Ethernet CP for the various services
- How to create the conditions for your communications requirements



You will find further information in the following sources:

- When installing the Ethernet CP, please refer to the instructions in the manual /2/ supplied with the Ethernet CP. This also contains further information about the performance of the Ethernet CP .
- For the functions and use of the STEP 7 configuration software, some of which is used to configure the CP (such as hardware configuration), please refer to /6/.
- For using, structuring and handling Industrial Ethernet, you will find detailed information in /10/.
- For a general introduction to local area networks with TCP/IP refer to /12/ and /13/.

## 1.1 Industrial Ethernet

### Definition

Within the open, heterogeneous SIMATIC NET communication system, Industrial Ethernet is the network for the management and cell level. Physically, Industrial Ethernet is an electrical network that uses a shielded coaxial cable or twisted pair or an optical network with fiber-optic cables.

Industrial Ethernet is defined by the international standard IEEE 802.3 (see /10/).

### All-Round Communication in the Industrial Sector

Industrial Ethernet is integrated in the SIMATIC NET concept that allows comprehensive networking of the management, cell and field levels in conjunction with PROFINET / PROFIBUS and the AS-interface (AS-i).

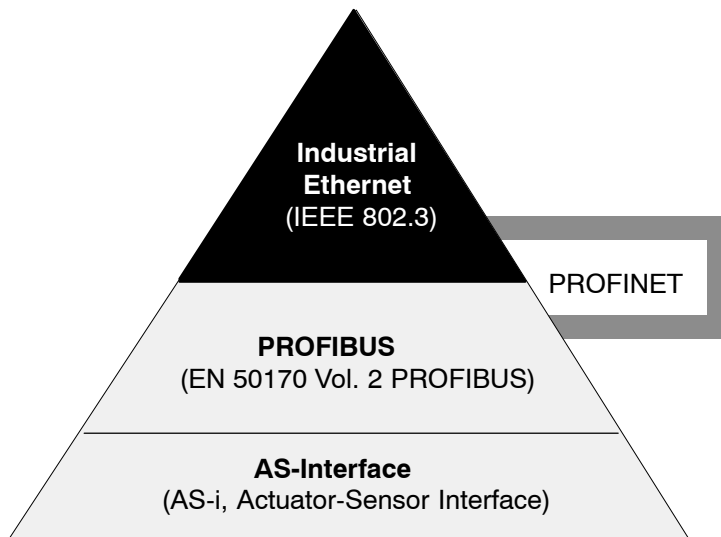


Figure 1-1 Industrial Ethernet in the SIMATIC NET Concept

### Network Access

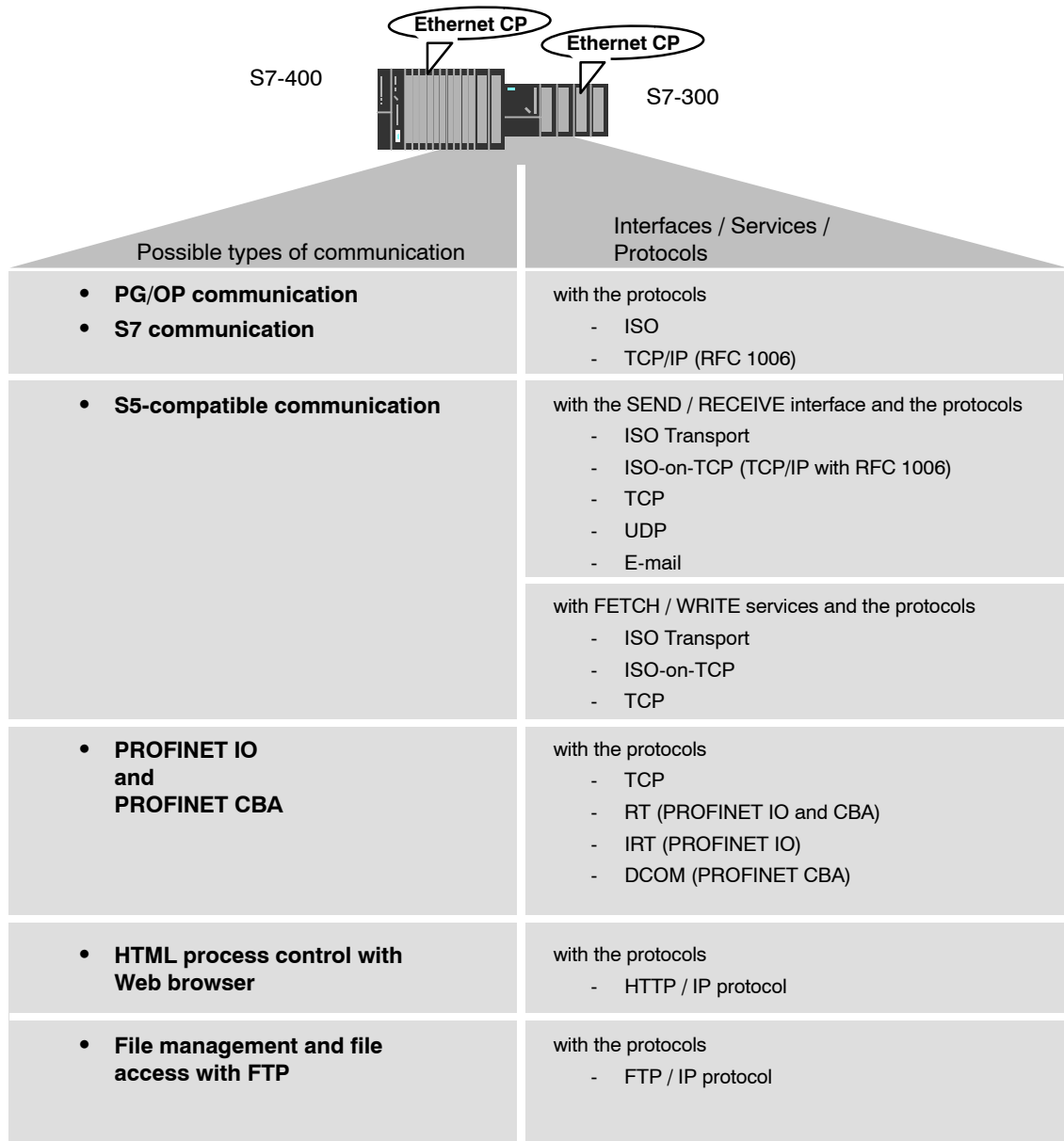
Industrial Ethernet is accessed using the CSMA/CD (Carrier Sense Multiple Access with Collision Detection) network access technique specified in IEEE 802.3.



## 1.2 SIMATIC S7 Communication with S7 Ethernet CPs

### 1.2.1 Possible Types of Communication

The Ethernet CP for SIMATIC S7 supports the following types of communication depending on the CP type:



- **PG/OP communication**

PG/OP communication is used to download programs and configuration data, to run tests and diagnostic functions, and to control and monitor a plant from OPs.

- **S7 communication**

S7 communication forms a simple and efficient interface between SIMATIC S7 stations and PGs/PCs using communication function blocks.

- **S5-compatible communication with SEND/RECEIVE interface**

Depending on the CP type, the SEND/RECEIVE interface allows program-controlled communication on a configured connection from a SIMATIC S7 PLC to another SIMATIC S7 PLC, to a SIMATIC S5 PLC, to PCs/PGs, and to any other station.

Depending on the CP type, the following communications services are available on the SEND/RECEIVE interface:

- ISO Transport  
optimized for top performance at the self-contained manufacturing level
- TCP/IP for internetwork communication with  
ISO-on-TCP connections (RFC 1006), TCP connections and  
UDP datagram service (including broadcast / multicast).
- sending E-mails  
The controller is capable of sending messages triggered by process events (refer to the IT-CP manual for details /5/).

- **S5-compatible communication with FETCH/WRITE services (server)**

The FETCH/WRITE services (server) allow direct access to the system memory areas on the SIMATIC S7 CPU from SIMATIC S5, SIMATIC PC stations, or from devices of other ranges.

Depending on the CP type, the following communications services are available for FETCH/WRITE access:

- ISO Transport  
optimized for top performance at the self-contained manufacturing level
- TCP/IP for internetwork communication with  
ISO-on-TCP connections (RFC 1006), TCP connections.

- **PROFINET IO**

PROFINET is a standard of the PROFIBUS Users organization defining a heterogeneous communications and engineering model.

- PROFINET IO Controller  
The S7-CPs that support the PROFINET IO controller mode allow direct access to IO devices over Industrial Ethernet.
- PROFINET IO device

With the S7-CPs that support the PROFINET IO device mode, you can operate S7 stations as “intelligent” PROFINET IO devices on Industrial Ethernet.

For more detailed information on PROFINET CBA, refer to /20/ and /21/

For PROFINET IO communication, TCP connections are used to assign parameters and RT (real time) or IRT (isochronous real time) for cyclic IO data traffic.

- **PROFINET CBA**

- PROFINET CBA

An S7 station equipped with a CP capable of PROFINET CBA can be interconnected as a PROFINET CBA component in SIMATIC iMap.

For more detailed information on PROFINET CBA, refer to /19/

In PROFINET CBA, interconnections are used with acyclic and cyclic transmission.

- **HTML process control**

With the CPs with IT functionality, you use the supplied functions and HTML pages to query important system data using a Web browser (refer to the IT-CP manual for more information /5/).

- **File management and file access with FTP**

The CPs with IT functionality (S7-400 / S7-300) provide additional functions for FTP services.

You can use your S7 station both as an FTP client and as an FTP server (refer to the manual of the IT-CP /5/).

- S7 Station as FTP Client



You can transfer data blocks from or to a file server.

- S7 Station as FTP Server

Another station, for example, a PC transfers data blocks to or from the S7 station the file system on the CP with IT functionality.

## 1.2.2 The communication Services of the Ethernet CPs

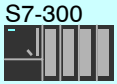





Depending on the module type, the S7-CPs support the following communications options:

Automation system		Supported functions					
		PG/OP	S7	S5-compatible	PROFINET		IT
	Module				CBA	IO	
S7/C7-300 	CP 343-1 Lean	●	● 4)	●	-	● 1)	-
	CP 343-1	●	●	●	●	● 3)	-
	CP 343-1 Advanced	●	●	●	●	● 2)	●
S7-400/ S7-400H 	CP 443-1	●	●	●	-	● 2)	-
	CP 443-1 IT	●	●	●	-		●
	CP 443-1 Advanced	●	●	●	●	● 2)	●

- 1) PROFINET IO device
- 2) PROFINET IO controller
- 3) PROFINET IO device or PROFINET IO controller
- 4) Server only

### Possibilities for Communication between Device Types

The possible communication available with the types of communication listed above is shown in the following table:

	 S7-300	 S7-400	 S5-115 to -155U/H	 PC station
 S7-300	S7 communication SEND/RECEIVE PROFINET CBA PROFINET IO	S7 communication SEND/RECEIVE PROFINET CBA PROFINET IO <sup>2)</sup>	SEND/RECEIVE FETCH/WRITE	PG/OP communication <sup>1)</sup> S7 communication <sup>1)</sup> SEND/RECEIVE FETCH/WRITE HTML process monitoring PROFINET CBA PROFINET IO FTP services
 S7-400	S7 communication SEND/RECEIVE PROFINET CBA PROFINET IO <sup>2)</sup>	S7 communication SEND/RECEIVE PROFINET CBA FTP services	SEND/RECEIVE FETCH/WRITE	PG/OP communication <sup>1)</sup> S7 communication <sup>1)</sup> SEND/RECEIVE FETCH/WRITE PROFINET CBA PROFINET IO HTML process monitoring FTP services

1) PC only as client

2) S7-400 as PROFINET IO controller and S7-300 as PROFINET IO device or controller

### 1.2.3 Operation Using a Configured or Programmed Database

#### Configuration and Diagnostics

To connect and configure the Ethernet CP, you require the STEP 7 configuration software and the SIMATIC NET NCM S7 option.

NCM S7 is installed as a STEP 7 option automatically and is therefore integrated in STEP 7.

NCM S7 for Industrial Ethernet also provides a wide range of diagnostic functions for the various types of communication.

When configuring PROFINET communication, you also use the engineering tool SIMATIC iMap; for detailed information on SIMATIC iMap, refer to the manual Component based Automation - Configuring Plants with SIMATIC iMap /19/.

#### Programmed Communication Connections



In some situations, it is an advantage to set up communication connections not over the configuration interface of STEP 7 but program-controlled by specific applications.

As of STEP 7 V5.2 SP1, a function block is available for these applications that allows flexible transfer of data blocks with configuration data to an Ethernet CP.

## 1.3 PG/OP Communication via Industrial Ethernet

### Application

PG/OP communication provides functions that are already integrated in every SIMATIC S7/M7/C7 device.

A distinction must be made between the following two types of function:

- PG communication

PG communication with STEP 7 PLCs on Industrial Ethernet means the following:

- You can use the complete range of functions of STEP 7 on Industrial Ethernet.
- You can use programming, diagnostic, operating and monitoring functions on all modules in the SIMATIC S7 PLC via Industrial Ethernet.

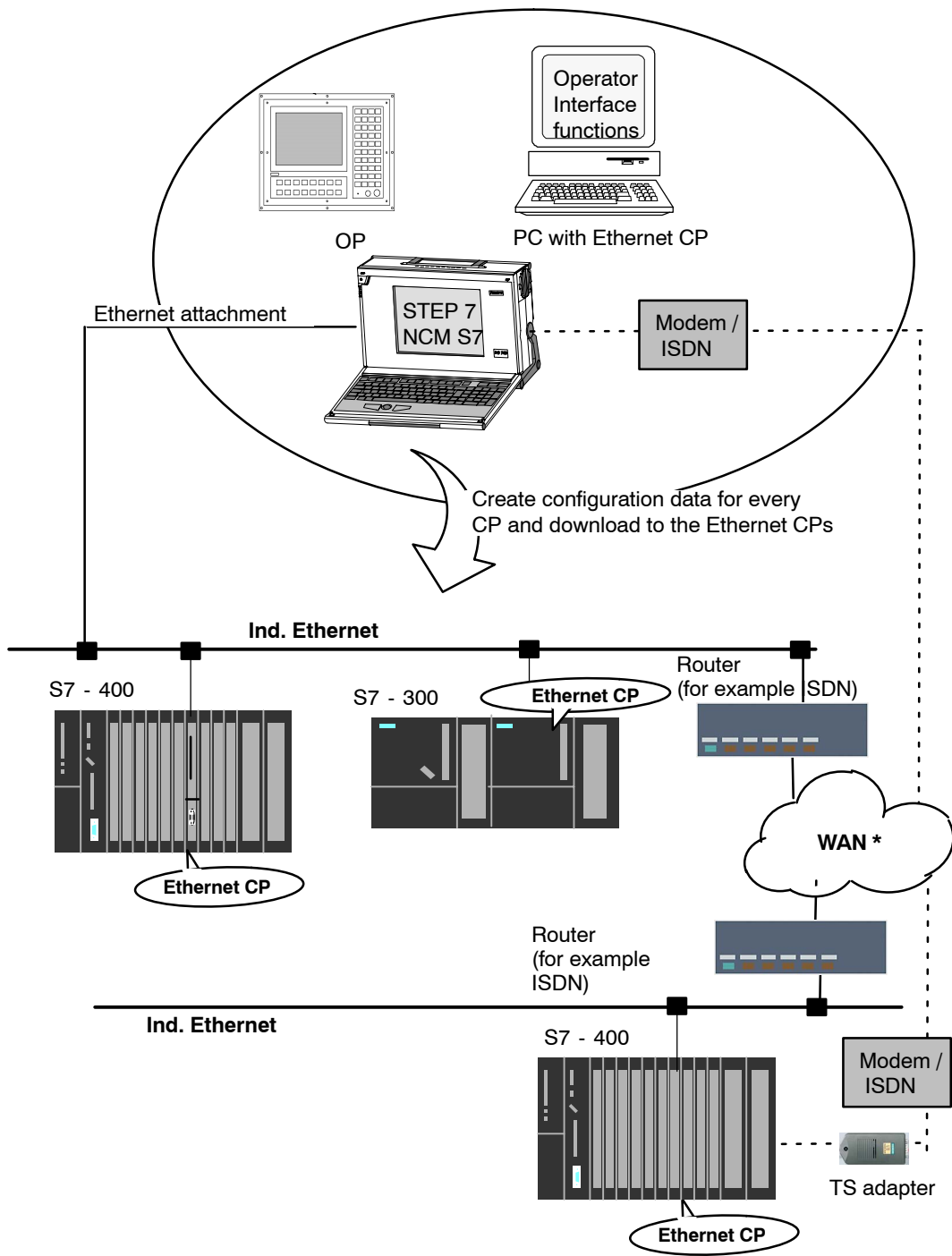
- OP Operation

PG/OP communication on Industrial Ethernet allows the operation and monitoring of all modules in a SIMATIC S7 PLC using operator interface systems (TD/OP).

The Ethernet CP acts as a “communications relay” that relays the PG/OP communication via Industrial Ethernet.

The following schematic illustrates how PG/OP communication can be used locally or remotely:

- Local over Ethernet modules in the PG
- Remote over Ethernet modules in the PG and over routers;  
(the option of a PG-PLC remote link with TeleService over a TS adapter is also shown)



\* over TCP/IP

Figure 1-2 Configuration for PG/OP Operation - Local and Remote



### 1.3.1 PG Communication with STEP 7 over Industrial Ethernet

#### Requirements for PG Communication

PG communication is possible when the following requirements are met:

- An Ethernet CP is installed in the PG or engineering station or there is a modem/ISDN interface for remote access.
- The Ethernet CP must have an address (default MAC address or set the IP address).

#### Networking the PG / Engineering Station

Depending on the configuration of the PG or Engineering Station, the following two situations are possible when using PG communication:

- PG / Engineering Station in the Configured Mode

If you select this configuration when you commission the PG / engineering station, the interfaces of the communication modules you are using are already known. The option in "Set PG/PC Interface" is automatically set to "PC-internal".

Once you have downloaded this configuration to your PG / engineering station, you can exchange PG functions with the accessible nodes in the network with STEP 7 without requiring any further settings.

- PG / Engineering Station in PG Operation

If your PG or engineering station is configured for this mode, you must specify the interface on the PG or engineering station explicitly with "Set PG/PC Interface".

Follow the steps outlined below:

1. Open the "Set PG/PC Interface" dialog box in the Windows Control Panel.
2. Set the PG/PC interface according to the CPs available on your PG and according to the bus attachment (interface parameter assignment used).

For more detailed information on the topic of PG operation and engineering station, refer to /4/.



### 1.3.2 OP Operation: Connecting Operator Interface Devices via Industrial Ethernet

#### Requirements

Operation allowing operator interface functions is possible when the following conditions are met:

- The following are installed in the operator control and monitoring device:
  - an Ethernet CP
  - SOFTNET S7 for Ind. Ethernet or software from the SIMATIC NET CD.
- The CPs in the S7 stations are supplied with a MAC/IP address (use the default MAC address or set an IP address).

#### Procedure

To be able to use S7 communication, address the required module in the SIMATIC S7 PLC on your operator interface system.



For more detailed information, please refer to the description of your operator control and monitoring devices and in /4/.

## 1.4 S7 Communication on Industrial Ethernet

### Application

S7 communication via Industrial Ethernet allows program-controlled communication using communication SFBs/FBs via configured S7 connections. Per job, up to 64 Kbytes of user data can be transmitted.

The Ethernet CP acts as an “S7 communication relay” by passing on the S7 functions via Industrial Ethernet. Depending on the configuration of the Ethernet CP, data transfer is on the basis of the ISO transport or the ISO-on-TCP protocol (TCP/IP with RFC 1006).

From the perspective of the user, S7 communication is identical over PROFIBUS and Industrial Ethernet.

### Nodes

Two situations must be distinguished depending on device type and plant configuration:

- **Client and server functionality at both ends**

S7 connections can be operated between the following nodes with the entire functionality of S7 communication:

- between S7 stations S7-300 and S7-400;
- between S7 stations and PC/PG stations with an Ethernet CP.

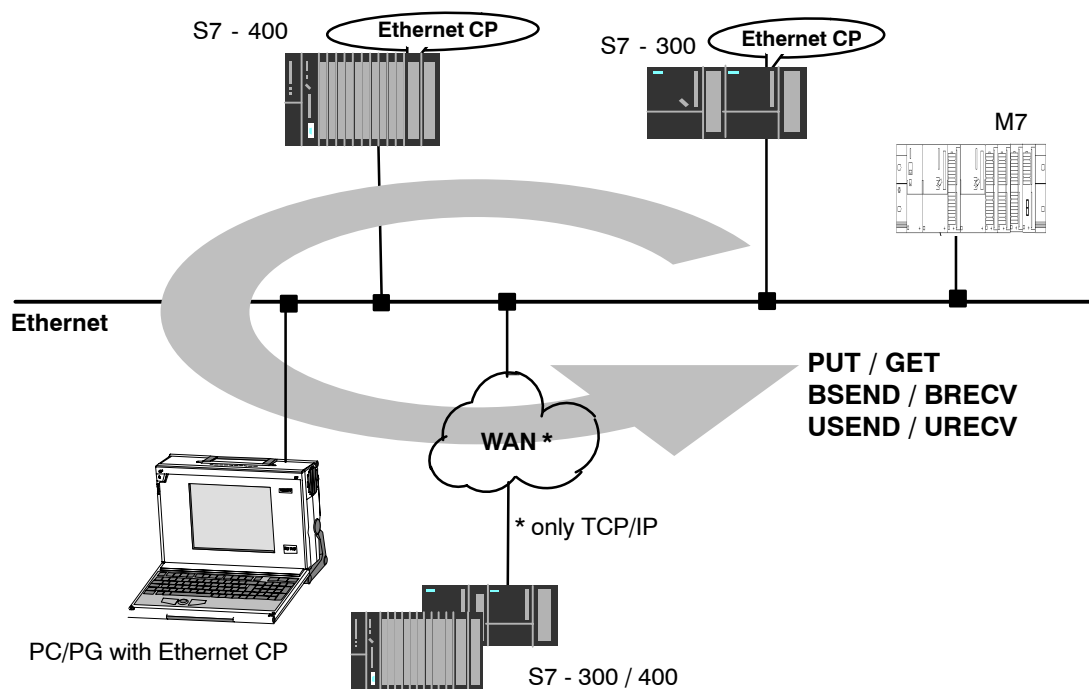
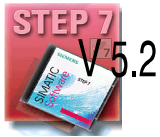


Figure 1-3 Nodes Communicating on S7 Connections over Industrial Ethernet

- **Client and server functionality at one end only (S7 connections configured at one end)**

In the following situations, write and read functions can be implemented with PUT / GET on one-ended S7 connections:



- S7 communication over router

PG/PC stations can access S7 stations if the PG/PC stations are connected to a different subnet or subnet type (PROFIBUS / Ethernet) via routers (for example, an IE/PB Link); in this case, S7 stations are servers.

S7 communication is possible over a gateway.

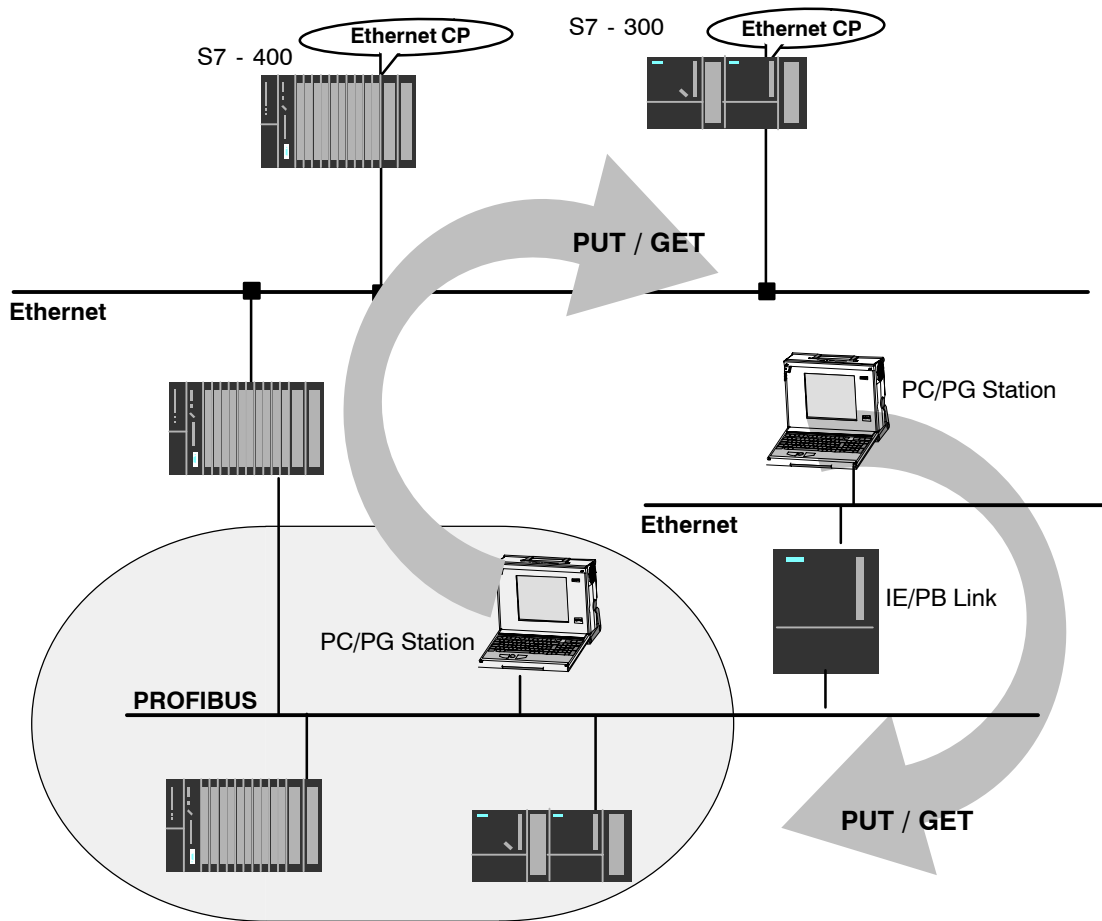


Figure 1-4 PC/PG station communicates over a gateway with S7 stations on an underlying PROFIBUS or Ethernet



For more detailed information on the features supported by your Ethernet CP, refer to the device-specific part of this manual /2/.

## Configuring S7 Connections

Create S7 connections to use S7 communication for data exchange between two SIMATIC S7 stations.

For more detailed information, refer to the STEP 7 Description /6/.

---

### Notice

S7 connections via routers are supported only within a STEP 7 project but not between partners in different STEP 7 projects of a multiproject!

---

## Interface in the User Program of the S7 Station

You use SFBs (for S7-400) and FBs (for S7-300) in the user program.

Block Type		Client	Server	Described in
SFB / FB12	BSEND	x	-	STEP 7 Documentation /8/
SFB / FB13	BRCV		x	
SFB / FB15	PUT	x	- 1)	
SFB / FB14	GET	x	- 1)	
SFB / FB8	USEND	x	-	
SFB / FB9	URCV	-	x	
SFC / FC62	CONTROL (S7-400) / C_CNTRL (S7-300)	x	x 2)	

1) you do not need to configure a connection on the server

2) for S7-300

---

### Notice

Please remember the following points regarding data consistency in your user program:

In the CPU of the S7 station, the read or written information is taken from the S7 user program into the operating system or copied from the operating system to the S7 user program in blocks of 8 or 32 bytes (depending on the firmware version).

If information in the word or double-word format is located across such boundaries, data inconsistency may arise during transmission using S7 communication!

For more detailed information, refer to the STEP 7 documentation /8/.

---

## Notes on S7 communication between PC/PG station and S7 station

Applications in a PC/PG station communicate with the S7 station over an OPC interface or SAPI-S7 interface for operator intervention, monitoring and control.

The S7 stations use the integrated communication SFBs/FBs (client and server functionality at both ends).

The following general requirements must be met by a PC/PG station for S7 communication:

- The following are installed in the PC/PG:
  - an Ethernet CP
  - there is an interface for S7 communication installed: SOFTNET S7 for Ind. Ethernet or software from the SIMATIC NET CD.
- The CPs in the S7 stations are supplied with a MAC/IP address (use the default MAC address or set an IP address).

To use S7 communication with the SIMATIC S7 PLC from a PC, address the required **CPU** module in the SIMATIC S7 PLC that you want to communicate with in your PC application.

## S7 communication via routers (one-ended client and server functionality)



It is possible to reach the S7 station from an application (OPC server) of the PC/PG station that is attached to another subnet. The subnets must be connected over a router such as the IE/PB Link. An S7 station or a PC connected to both subnets can also serve as a router.

In this configuration, the S7 station can only be addressed by the PC/PG station as a communications server on S7 connections configured at one end.

The requirements for the configuration of the PC/PG station are identical to those for operation in the same subnet (see above); the CP in the PC/PG station must also have routing capability.

In this situation, configure a **one-ended** S7 connection to the S7 station in the other subnet for the PC/PG station in STEP 7 NetPro. You can then read and write data in the S7 station in your user program using the services for S7 communication

## 1.5 S5-compatible Communication (SEND/RECEIVE Interface) <sup>1)</sup>

### Application

Using the SEND/RECEIVE interface, your S7 user program has access to S5-compatible communication with configured transport connections.

Data transmission over a configured transport connection is suitable for the following types of transmission:

- the reliable transmission of related blocks of data between two Ethernet nodes using
  - TCP (see /13/) with ISO-on-TCP connection (see /14/) or TCP connection;
  - ISO transport connection (not with PROFINET CBA).
- simple (unacknowledged) transfer of related blocks of data (datagram service) between two Ethernet nodes with UDP (User Datagram Protocol) on IP.

The SEND/RECEIVE interface is also suitable for sending E-mail (refer to the manual for the IT-CP /5/).

For TCP applications, there is an active network with IP protocol (see /16/)

### ISO Transport Connection

ISO transport provides services for the reliable transfer of data on configured connections. Due to segmentation (packet-oriented segmentation - the completeness of the message is detected) large amounts of data can be transmitted.

Transmission reliability is extremely high due to automatic repetition and additional field check mechanisms. The communications partner confirms reception of data and the sender receives a return value on the SEND/RECEIVE interface.

ISO transport is operated only on Industrial Ethernet and is optimized for high-performance operation at the self-contained manufacturing level.

1 The **previous name** of the SEND/RECEIVE interface was **S5S5 connections**

## IP (Internet Protocol)

For internetwork data transmission, the following services are available with suitable CPs such as the CP 443-1:

- ISO-on-TCP connection

ISO-on-TCP is intended for reliable, internetwork data transmission.

The ISO-on-TCP service corresponds to the TCP/IP standard (Transmission Control Protocol/Internet Protocol) with the RFC 1006 extension according to layer 4 of the ISO reference model (see /18/).

RFC 1006 extends the TCP protocol by allowing the transmission of blocks of data ("messages") assuming that both partners support RFC 1006.

Transmission reliability is extremely high due to automatic repetition and additional field check mechanisms. The communications partner confirms reception of data and the sender receives a return value on the SEND/RECEIVE interface.

- TCP connection

When using the SEND/RECEIVE interface on TCP connections, the Ethernet CP supports the socket interface (for example, Winsock.dll) to TCP/IP found on almost every system (PC or other system).

TCP is intended for reliable internetwork data transmission.

The TCP service complies with the TCP/IP standard (Transmission Control Protocol/Internet Protocol; see /18/).

- UDP connection

UDP is intended for simple internetwork data transmission without confirmation.

If the connection is suitably configured, broadcast and multicast frames can also be sent on UDP connections.

To avoid overload due to high broadcast load, the CP does not allow reception of UDP broadcasts. As an alternative, use the multicast function over a UDP connection. This allows you to register the CP as a node in a multicast group.

## SEND/RECEIVE interface

Data transfer is triggered by the user program. The interface to the user program in the SIMATIC S7 is formed by special SIMATIC S7 blocks of the type FC (functions).



## Stations

The SEND/RECEIVE interface allows program-controlled communication on Industrial Ethernet between the SIMATIC S7 PLC and the following:

- SIMATIC S7 PLC with Ethernet CP
- SIMATIC S5 PLC with Ethernet CP
- PC/PG with Ethernet CP
- Other station with Industrial Ethernet attachment

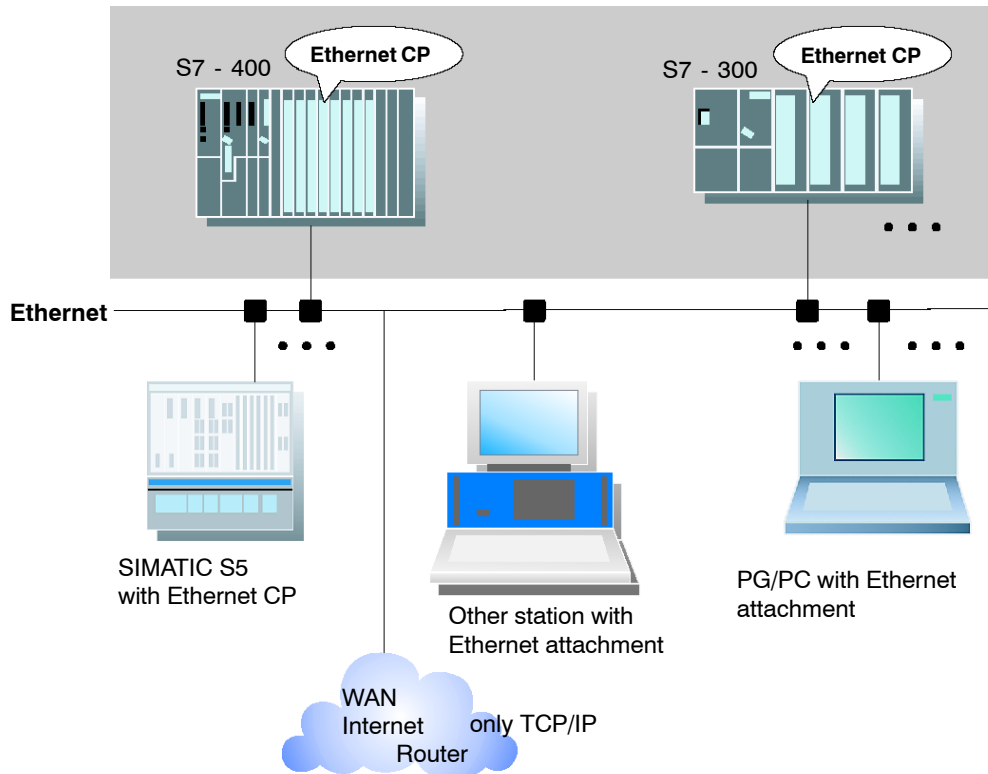


Figure 1-5 SIMATIC S7 PLC with Possible Communications Partners on the SEND/RECEIVE Interface

## 1.6 FETCH/WRITE Services (Server)

### Application

In addition to the SEND/RECEIVE interface, the FETCH/WRITE functionality provides further services for S5-compatible communication on configured transport connections.

The FETCH/WRITE interface is used primarily to attach SIMATIC S7 to SIMATIC S5 and to other non-S7 stations (for example PCs).

- **FETCH**

The partner on the connection (SIMATIC S5 or non-S7 station) can read system data on the SIMATIC S7 PLC.

- **WRITE**

The partner on the connection (SIMATIC S5 or non-S7 station) can write system data on the SIMATIC S7 PLC.

From the point of view of the SIMATIC S7 PLC, this is a **passive** communication function that simply needs to be configured, the communications partner initiates the connection establishment.



For further information, refer to the system documentation of the SIMATIC S5 PLC or the non-S7 station you are using.

### Connection Types

To access a station with FETCH or WRITE functions, a FETCH passive or WRITE passive connection must be configured on the SIMATIC S7 CPU. The following types are possible:

- ISO Transport
- ISO-on-TCP
- TCP

### Coordinating Access Using the User Program

You can use the FCs AG\_LOCK and AG\_UNLOCK to coordinate access.

With these FCs, you can coordinate access to system data areas by enabling and disabling the connections so that no inconsistent data is created and transferred.

### SIMATIC S5

On the SIMATIC S5 station, the FETCH/WRITE services are configured and started by READ ACTIVE/PASSIVE and WRITE ACTIVE/PASSIVE.

## 1.7 Networking Stations with STEP 7

### Configuring

To allow stations to communicate with each other the networks must be configured in the STEP 7 projects.

Configuring a network or subnet involves the following:

1. You create one or more subnets of the required subnet type in the project.
2. You select the properties of the subnet. Normally the default settings are adequate.
3. You connect the station “logically” to the subnet.
4. You set up connections for communication.

### Networking in a Multiproject



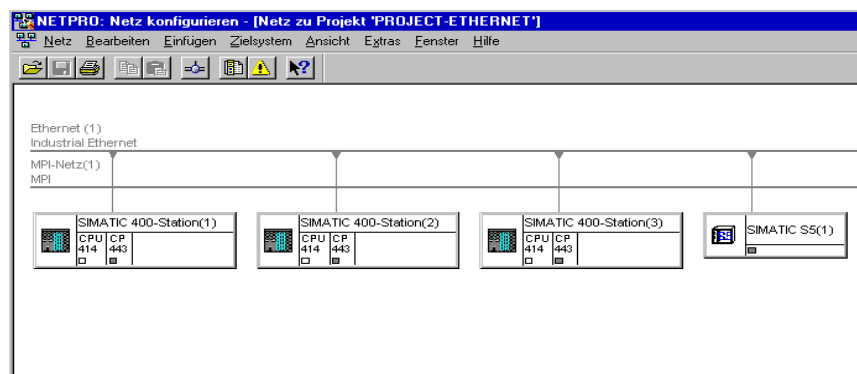
STEP 7 as of Version V5.2 supports configuration in a multiproject.

Using a multiproject, for example, you can create a project for distributed editing by various editors and distribute the stations to the projects according to their editors. To allow this, functions are available for branching and merging (sub) projects.

Interproject subnets and connections can be created.

### Tools

The SIMATIC Manager provides convenient tools for configuring and documenting networks (also graphically with NetPro).



HLP

The chapter describing network configuration in /6/ and the online help system also contain information about configuring SIMATIC S7 networks.

## Variants

Before configuring networks with STEP 7, you should be aware of the various configurations possible in the STEP 7 project. The following configurations are typical for stations networked with CPs:

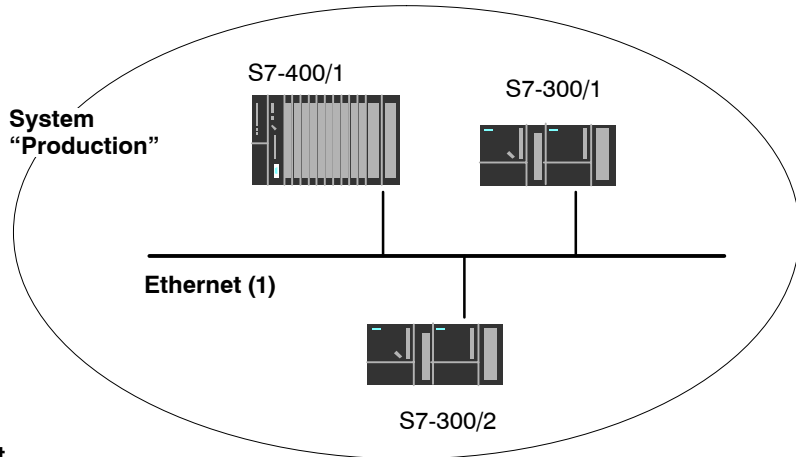
<b>Variant (examples)</b>	<b>Characteristics/Configuration</b>
1	1 subnet - 1 project
2	Additional SIMATIC S5 stations and stations with equipment of other vendors
3	2 or more subnets - 1 project
4	1 subnet - more than one project
5	More than one subnet - more than one project
6	Internetwork connections (TCP)

These variants will be used as a basis to illustrate how real configurations can be created in STEP 7 projects.

### 1.7.1 Network/Project Variant: One Subnet - One Project

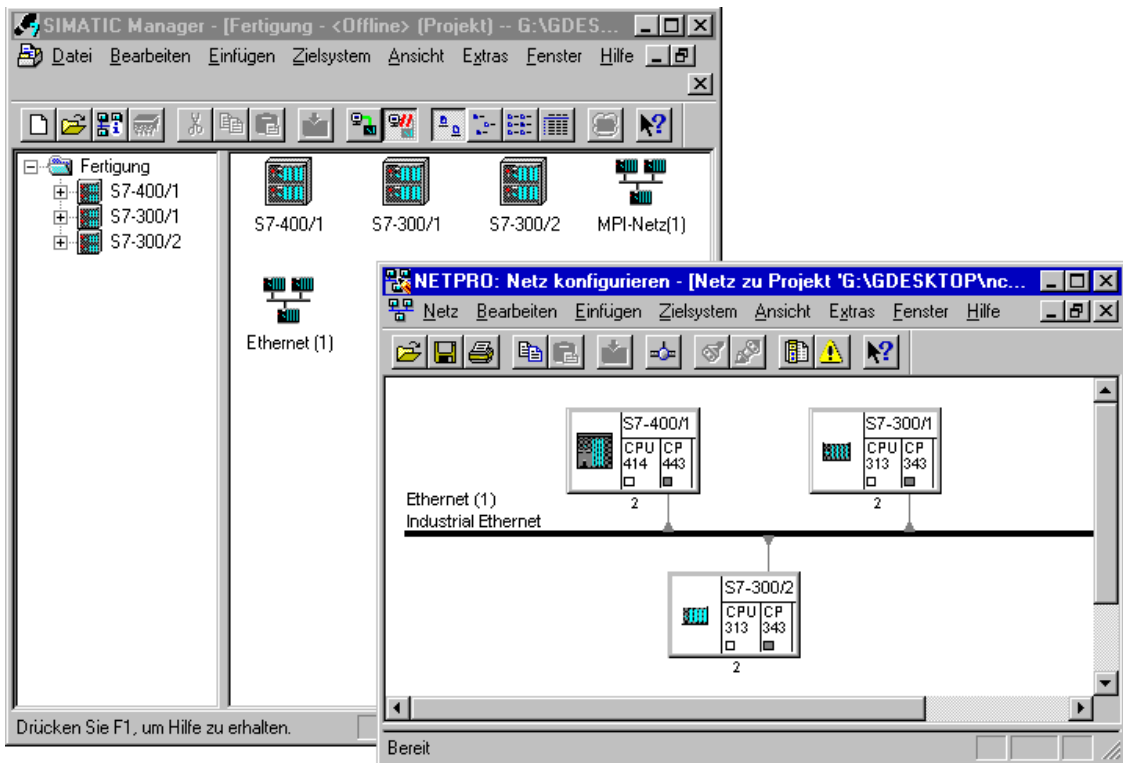
#### Configuration of the System

In the simplest case, your system consists of SIMATIC S7 stations connected by **one** subnet, for example of the type Industrial Ethernet.



#### View in a STEP 7 Project

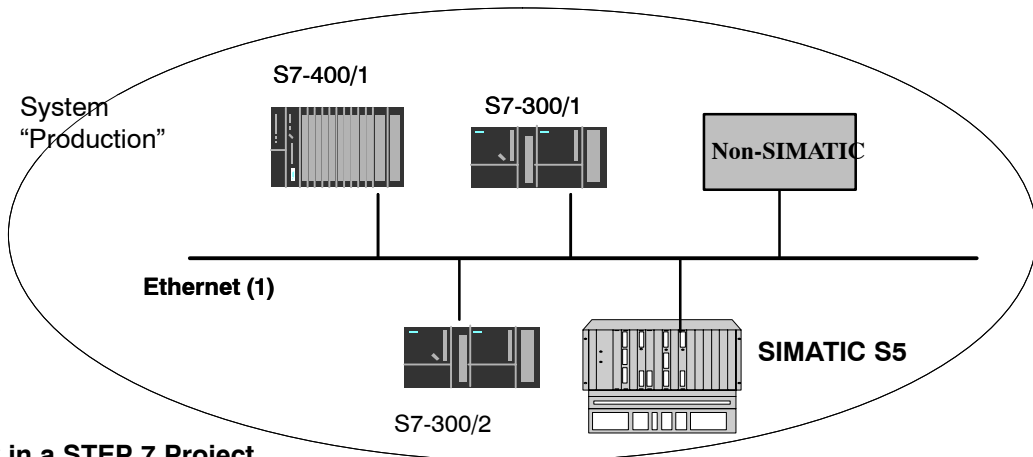
You create an Industrial Ethernet object in the STEP 7 project. Stations created in the same project refer to this object as soon as they are configured as network nodes.



## 1.7.2 Network/Project Variant: SIMATIC S5 and Non-SIMATIC Devices on the Subnet

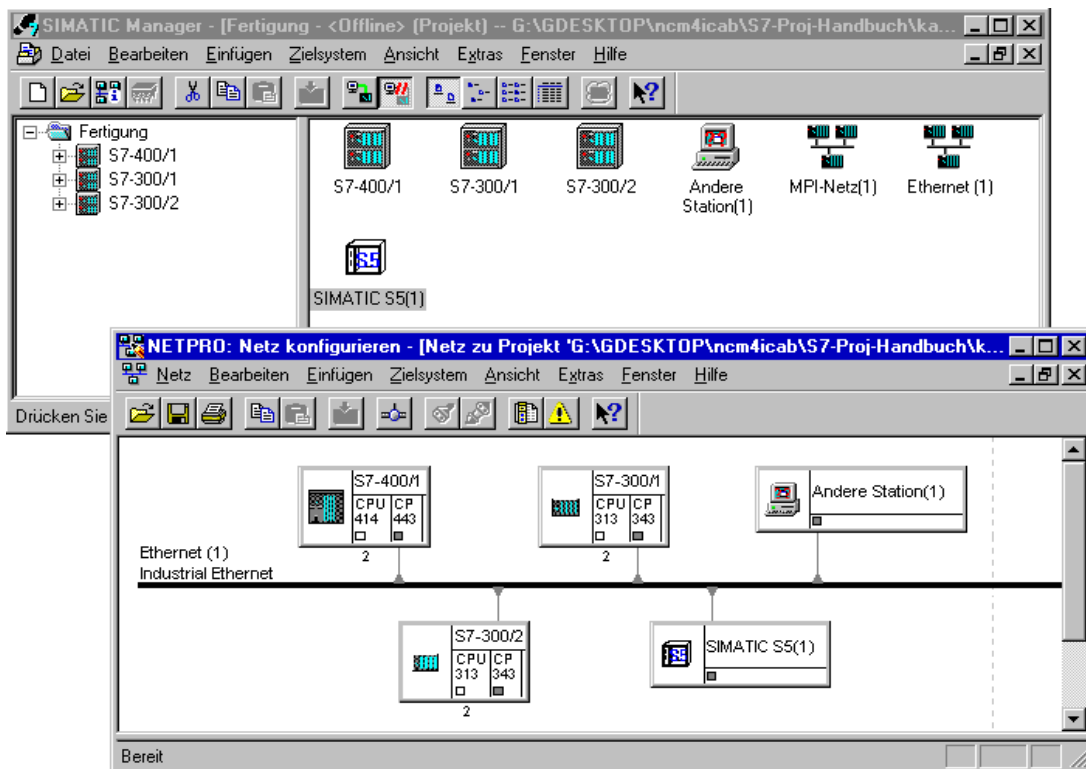
### Configuration of the System

In addition to SIMATIC S7 stations, SIMATIC S5 stations and non-SIMATIC devices can be included in your system.



### View in a STEP 7 Project

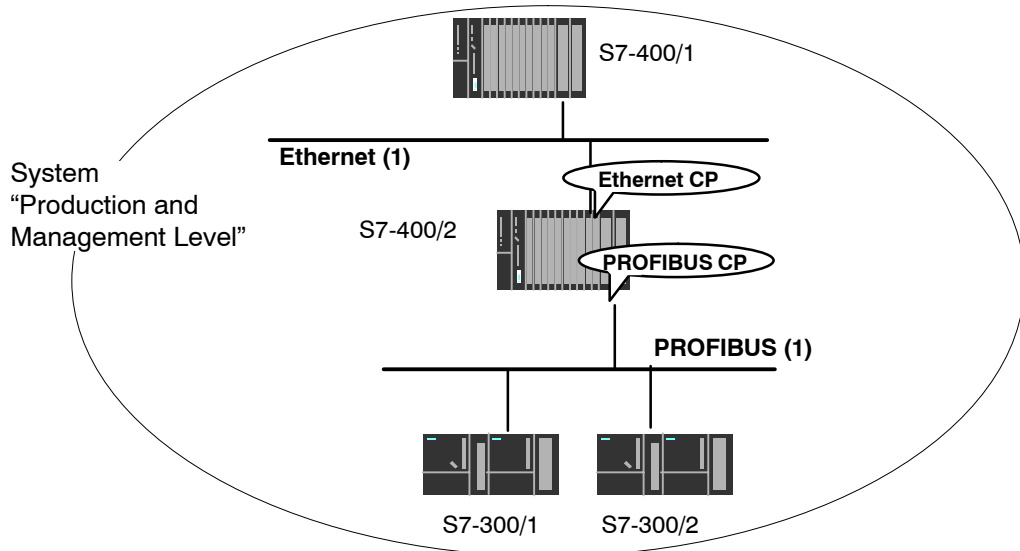
SIMATIC S5 stations you intend to include in the communication can be selected directly. Non-SIMATIC devices must be entered in the configuration as **Other stations**.



### 1.7.3 Network/Project Variant: Two or More Subnets - One Project

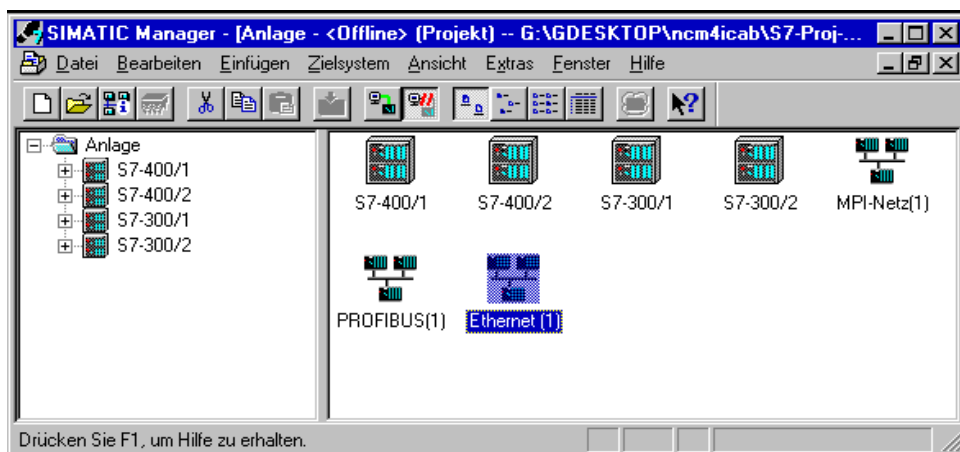
#### Configuration of the System

Due to the different tasks of the stations or due to the extent of the system it may be necessary to operate more than one network.



#### View in a STEP 7 Project

You can create the subnets in **one** STEP 7 project and configure the stations for communication.



This representation illustrates the following:

- More than one subnet can be managed in one project.
- Each station is created once in the project.
- Each station can be assigned to more than one subnet by assigning its CPs to different subnets.

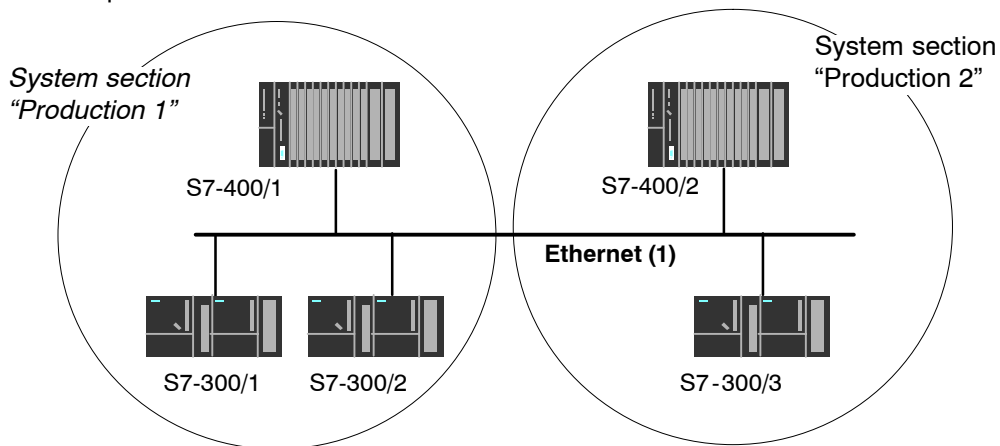
### 1.7.4 Network/Project Variant: One Subnet - More Than One (Sub)Project

#### Configuration of the System

In complex networked systems, during configuration it is sometimes more efficient to manage plant sections in different (sub) projects.

The situation can arise that communication takes place over an interproject subnet and that interproject connections must then also be created.

Example:



#### Organization in a Multiproject



User-friendly and consistent configuration of such communication is supported in STEP 7 as of Version V5.2 with the multiproject.

The functions for multiprojects in STEP 7 allow the following:

- Several projects can be managed in one multiproject and edited separately
- Projects can be branched and merged

Two different strategies can be distinguished in a multiproject:

- Several employees work at the same time on a multiproject in a networked environment. The projects of the multiproject are in different network folders. In this case, all connection partners are available for configuring connections.
- One employee manages the multiproject centrally. This person creates the structures for projects (when necessary locally) and contracts individual projects out for external editing. The central configuration engineer then returns these projects to the multiproject and synchronizes the interproject data with system support and where necessary the executes the required interproject functions.

In this case, agreement is necessary, for example, regarding the assignment of connection names because it will be far easier when synchronizing the projects to bring connections with identical connection names together.





HLP

The topic of multiprojects is dealt with in detail in the STEP 7 basic help.

Here, you will find information on the following topics:

- Requirements for interproject functions
- How to create multiprojects
- How to create a new project in a multiproject
- How to separate a project from a multiproject
- How to include projects in the multiproject
- How to synchronize projects in a multiproject
- Moving stations within a multiproject (when a station is moved from one project of a multiproject to another project of the same multiproject (for example using drag & drop), the interproject connections are retained).
- Possible problems in distributed projects and tips on how to avoid them

### Possibilities for stations outside the current project

The addition of the multiproject functionality means that the following situations can arise:

- Connection to a partner in an unknown project



The new multiproject functionality allows you to create a connection to a partner in an unknown project. In this case, you can specify a connection name as a reference in the properties dialog of the connection. When the projects are merged, STEP 7 then supports you with automatic synchronization of the separately configured connections.

The connection remains unspecified until the projects have been merged and the connections synchronized. Only following this synchronization can the configuration data be downloaded to the local station without inconsistencies.

You should therefore use this variant when you know that the projects will be merged in a multiproject.

- Specified connections with representative objects

To allow you to create specified connections to stations in a different project (for example production 2) or that are not managed with STEP 7, you can configure these stations as **other stations** (example in the project production 1).

This allows you to create consistent, fully specified configuration data and to download it to the local station.

It is also possible to create specified connections between these stations in different, independent projects. The stations can then communicate immediately over the created connections after the configuration data have been downloaded.

Use this variant when you want to operate projects separately due to the complexity.

Stations of the type SIMATIC S5 function in just the same way as representative objects.

### **Merging projects in the multiproject:**

If you have used the multiproject functions allowing you to use connections to a partner in an unknown project, STEP 7 will automatically attempt to synchronize two separately configured connections.

If you have configured projects with representative objects and want to merge these projects into a multiproject, you have the following options:

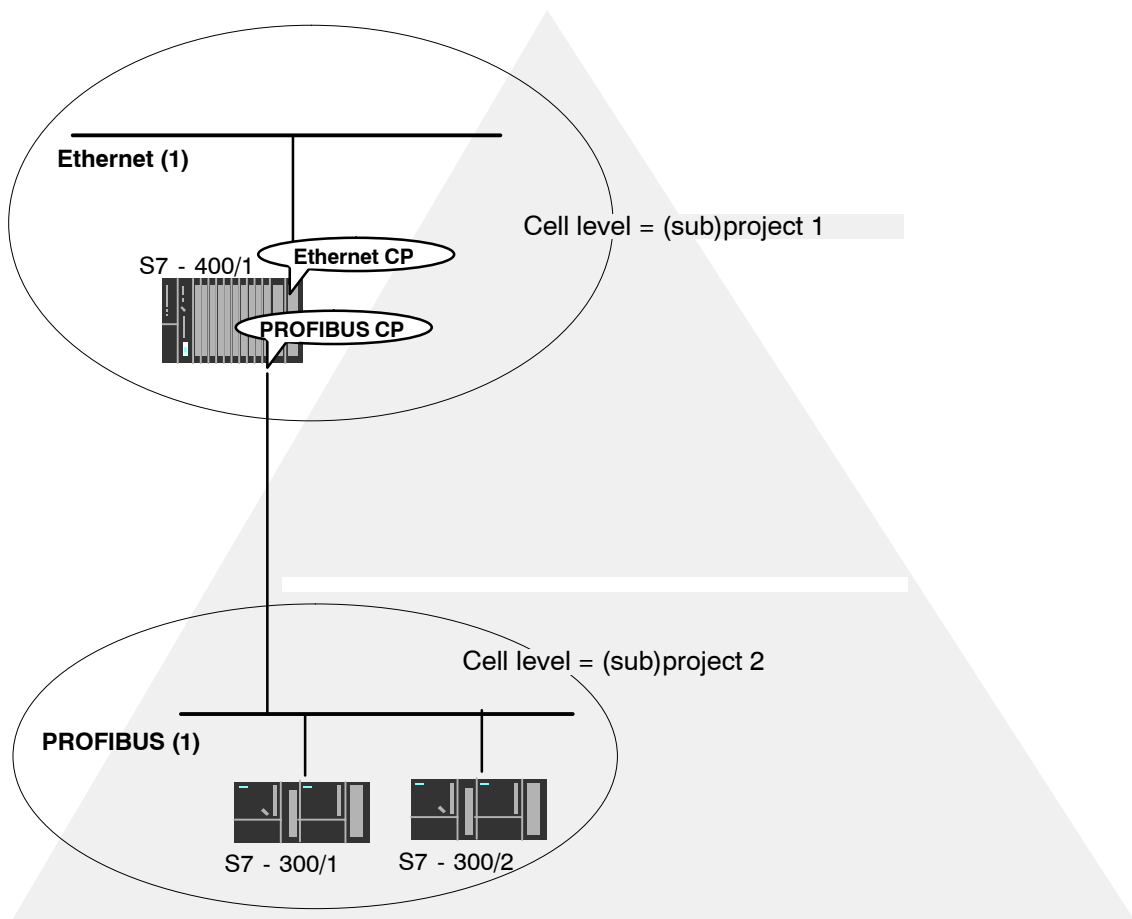
- You can leave the representative objects with the configured connections unchanged.
- You can reassign the connection partner and then delete the representative objects.

### 1.7.5 Network/Project Variant: Several Subnets in Several (Sub) Projects

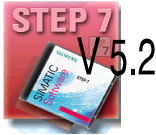
#### Configuration of the System

If several network types need to be used and if these need to be managed in different projects due to the different tasks of the stations or due to the large span of the plant, stations can be created as follows:

- Using (sub) projects in the “multiproject”
- by configuring “**Other stations / SIMATIC S5**” in the other project.



## Organization in a Multiproject



If you use a multiproject organization, follow the steps below to connect the S7-400/1 station to the PROFIBUS (1) subnet:

Create a subnet of the type PROFIBUS in both subprojects and merge these two subnets in NetPro.

## Representative Objects for Stations Outside the Current Project

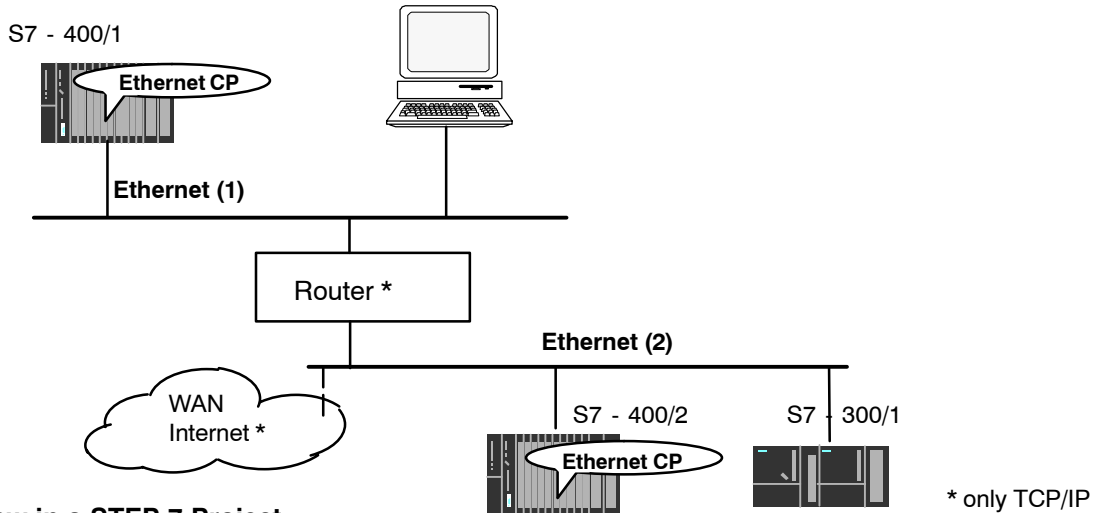
If you do not want to use the multiproject functions, you can fall back on the use of representative objects as used previously.

To be able to network the representative objects, you must once again create a subnet of the type PROFIBUS in both projects as shown in the example here.

### 1.7.6 Network/Project Variant: Connections between Subnets (TCP/IP)

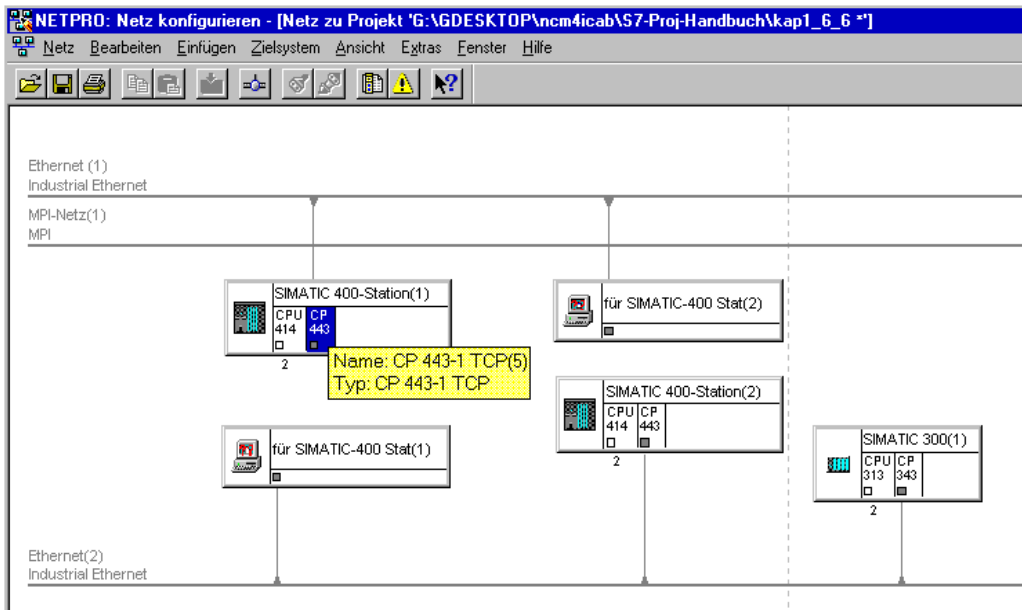
#### Configuration of the System

If connections are required to stations on network structures connected by routers due to the differing tasks of the stations or the large span of the network, the stations in the other project can be reached by configuring “**Other Stations**”.



#### View in a STEP 7 Project

If the stations in the two networks are managed in the same project, the networking appears as shown below in NetPro.



## 2 Characteristics of the Ethernet CPs

### 2.1 Communications Processors for S7-300

The modules are designed to match the components of the S7-300/C7-300 programmable logic controller and have the following features:

- Compact modules (single or double width) for simple installation on the S7 standard rail
- Can be used in central or expansion racks
- The operator controls and displays are all located on the front panel
- No fan necessary
- Direct backplane bus connection via the supplied bus connector
- Wide design: 8-pin RJ-45 female connector for connecting the CP to twisted pair Ethernet
- Narrow design: 2 x 8-pin RJ-45 jacks as 2-port switch for connecting the CP to twisted pair Ethernet
- The project engineering of the CP is possible over MPI or LAN/Industrial Ethernet. The version of STEP 7 released for the device type is necessary.

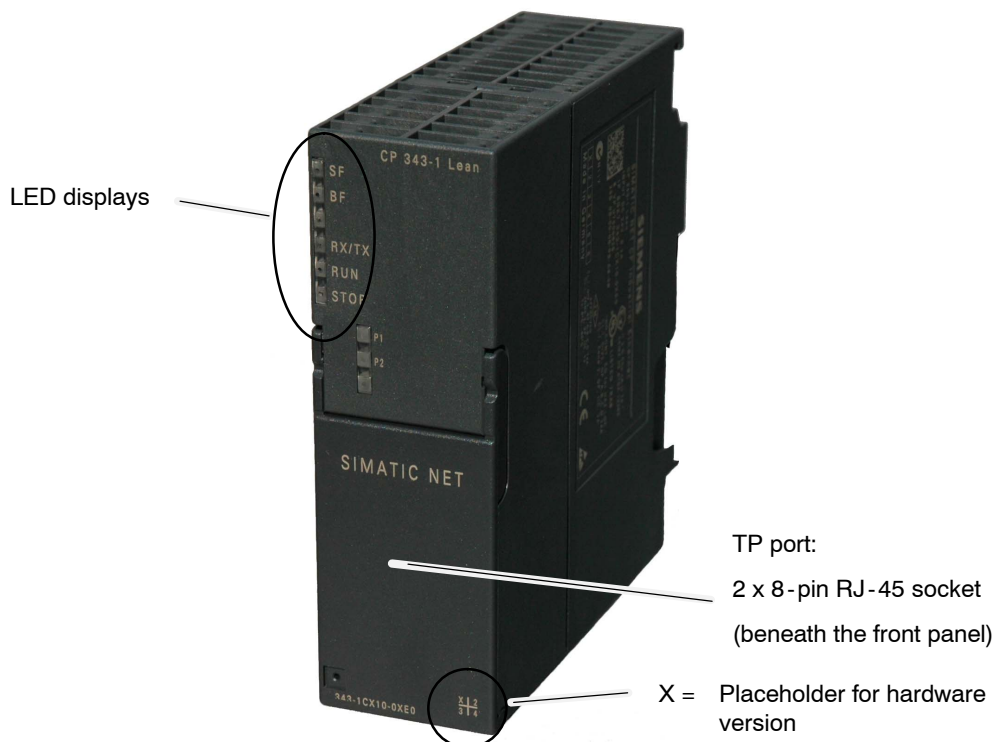


Figure 2-1 Example: Front View of the CP 343-1 Lean

## 2.2 Communications Processors for S7-400

The modules are designed to match the components of the S7-400 / S7-400H programmable logic controller and have the following features:

- Single-width modules for simple installation in the S7-400 / S7-400H rack
- Can be used in central or expansion racks
- The operator controls and displays are all located on the front panel
- No fan necessary
- 8-pin RJ-45 jack for attachment of the CP to twisted pair Ethernet and  
15-pin sub-D female connector with slide locking mechanism for attachment of the CP to Industrial Ethernet (depending on the module type, automatic switchover between AUI interface and Industrial Twisted Pair interface when the cable, AUI or ITP, is connected)  
or
- 4 x 8-pin RJ-45 jack for attachment of the CP to twisted pair Ethernet
- The project engineering of the CP is possible over MPI or LAN/Industrial Ethernet. The version of STEP 7 released for the device type is necessary.

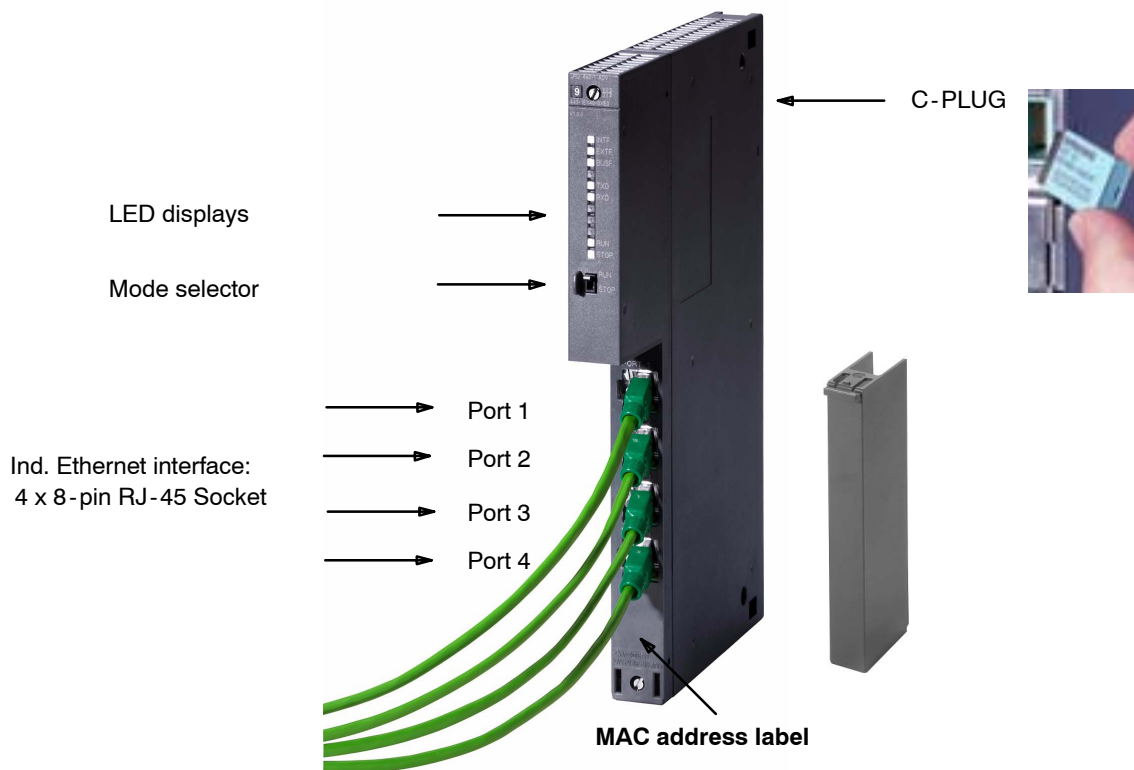


Figure 2-2 Example: Front View of a CP 443-1 Advanced

## 2.3 Slot Rules for SIMATIC S7-300

### 2.3.1 Permissible Slots

In the SIMATIC S7-300, there is no set slot assignment for the SIMATIC NET CPs. Slots 4 to 11 are permissible (1, 2 and 3 cannot be used for CPs).

The SIMATIC NET CPs can be installed both in the central rack and in an expansion rack, linked to the central rack via an IM 360/IM 361 (K-bus connection).

### 2.3.2 Number of SIMATIC NET CPs

The number of SIMATIC NET CPs that can be operated is not limited by the system (for example S7-300 CPU, slot rules etc.), but by the application (maximum cycle time of the application). The following components must be added into the calculation of the cycle time on top of the existing S7 user program:

- Execution time of the FCs:

For communication between the S7-300 CPU and SIMATIC NET CPs, blocks (FCs/FBs) are necessary. How often these blocks are called depends on the number of connections or the number of SIMATIC NET CPs. Depending on the amount of data transmitted, every block call extends the time required by the user program.

- Data conversion:

It may also be necessary for the information to be converted before transmission or after reception.

Please refer to the information in the relevant device manual.

### 2.3.3 Multicomputing

This functionality is not supported by the SIMATIC S7-300.



### 2.3.4 Removing / Inserting (Replacing Modules)

---

#### Note

Removing and inserting the SIMATIC NET CPs for the SIMATIC S7-300 while the power is on is not permitted.

You should also remember that by removing a module from the rack, all modules on the other side of it will be disconnected from the CPU.

---

A PG is required to download the configuration after replacing a module. If the CP supports the option of saving the configuration data on the CPU, it is also possible to replace a module without a PG (see CP-specific description).

### 2.3.5 Note on the S7-300 CPU: Connection Resources

Note that when using older S7-300 CPUs ( $\leq$  CPU 316), a maximum of four S7 type connections for CP communication are supported. Of these four connections, one is reserved for a PG and another for an OP (HMI = Human Machine Interface). The newer CPUs (from 10/99 onwards) support twelve and the CPU 318-2DP supports sixteen S7 connections.

As a result, the older S7-300 CPUs have only two “free” S7 connections available. These two connections can be used for S7 communication, for PROFIBUS-FMS, for longer data, or FETCH, WRITE and TCP connections with Industrial Ethernet.

---

#### Notice

Removing and inserting the SIMATIC NET CPs for the SIMATIC S7-300 while the power is on not permitted.

You should also remember that by removing a module from the rack, all modules on the other side of it will be disconnected from the CPU.

---

## 2.4 Slot Rules for SIMATIC S7-400

### 2.4.1 Permissible Slots

An S7-400 CP can be inserted both in the central rack and in the expansion rack with a K bus interface. For the total number of CPs you can install, please refer to the information on the relevant CP in the “Properties” chapter.

In the SIMATIC S7-400, there is no set slot assignment for the SIMATIC NET CPs. Slots 2 to 18 are permissible. Note, however, that depending on the power supply module installed, slot 1 may also occupy slots 2-3 (4 during redundant operation).

### 2.4.2 Number of SIMATIC NET CPs

The number of SIMATIC NET CPs that can be operated simultaneously is limited by the specific characteristics of the CPU. The exact number can be found in the CP-specific section of this manual.

### 2.4.3 Multicomputing

The communication load can be distributed by installing several SIMATIC NET CPs (distribution of load). If, however, you want to increase the number of available connection resources, you can insert several CPUs in a rack (multicomputing). All S7-400 CPUs in a rack can communicate via one or more SIMATIC NET CPs.

The following communication services support multicomputing:

- ISO transport connections
- ISO-on-TCP connections
- S7 functions
- TCP connections
- UDP connections
- E-mail connections

#### 2.4.4 Removing / Inserting (Replacing Modules)

Removing and inserting the SIMATIC NET CPs for the S7-400 while the power is on is possible without damaging the modules.

If a CP is replaced with a new CP with the same order number, the configuration data simply needs to be downloaded again if it is not stored on the CPU (see also CP-specific sections of this manual).

#### 2.4.5 Note on the S7-400 CPU: Connection Resources

Note that in the S7-400 CPU, one S7 connection is reserved for a PG and a further one for an OP (HMI = Human Machine Interface).

- Attaching the PG over MPI:

To execute ONLINE functions (for example module diagnostics) from a PG on an S7-400 CP via the MPI interface, two connection resources (addressing of the interface and the K-bus) are necessary on the S7-400 CPU. These two connection resources should be taken into account in the number of S7 connections.

Example: The CPU 412-1 has sixteen free resources for S7 functions available. If a PG is to be used for diagnostics on the S7-400 CP and is connected to the MPI interface, two connection resources are required on the S7-400 CPU, so that 14 connection resources remain available.

- PG connection via PROFIBUS or Industrial Ethernet

If the PG is connected to the LAN (PROFIBUS or Industrial Ethernet), in order to execute PG functions on the S7-400 CPU and diagnostics on an S7-400 CP, only **one** connection resource on the S7-400 CPU is necessary.

### 3 Operating the Ethernet CP with STEP 7/NCM S7

To attach a SIMATIC station to Industrial Ethernet via the Ethernet CP, configure the CP with the NCM S7 configuration software. The chapter explains the following:

- How the CP is configured in the STEP 7 project
- How the various network configurations are managed (setting up access to other systems)
- How to control and supply the CP with data using NCM S7



You will find further information in the following sources:

- When installing the Ethernet CP, please read the instructions in the device-specific Part B of this manual. This also contains further information about the performance of the Ethernet CP .
- For more information about the functions and applications of STEP 7 in which the NCM S7 option is integrated, please read the following topics:
  - For using the help functions, read the section Working with STEP 7 in /6/.
  - Configuring and assigning parameters to modules in /6/
  - Configuring networks in /6/. You will find this information in the online help with integrated in STEP 7 by selecting **Help ► Contents**.



HLP

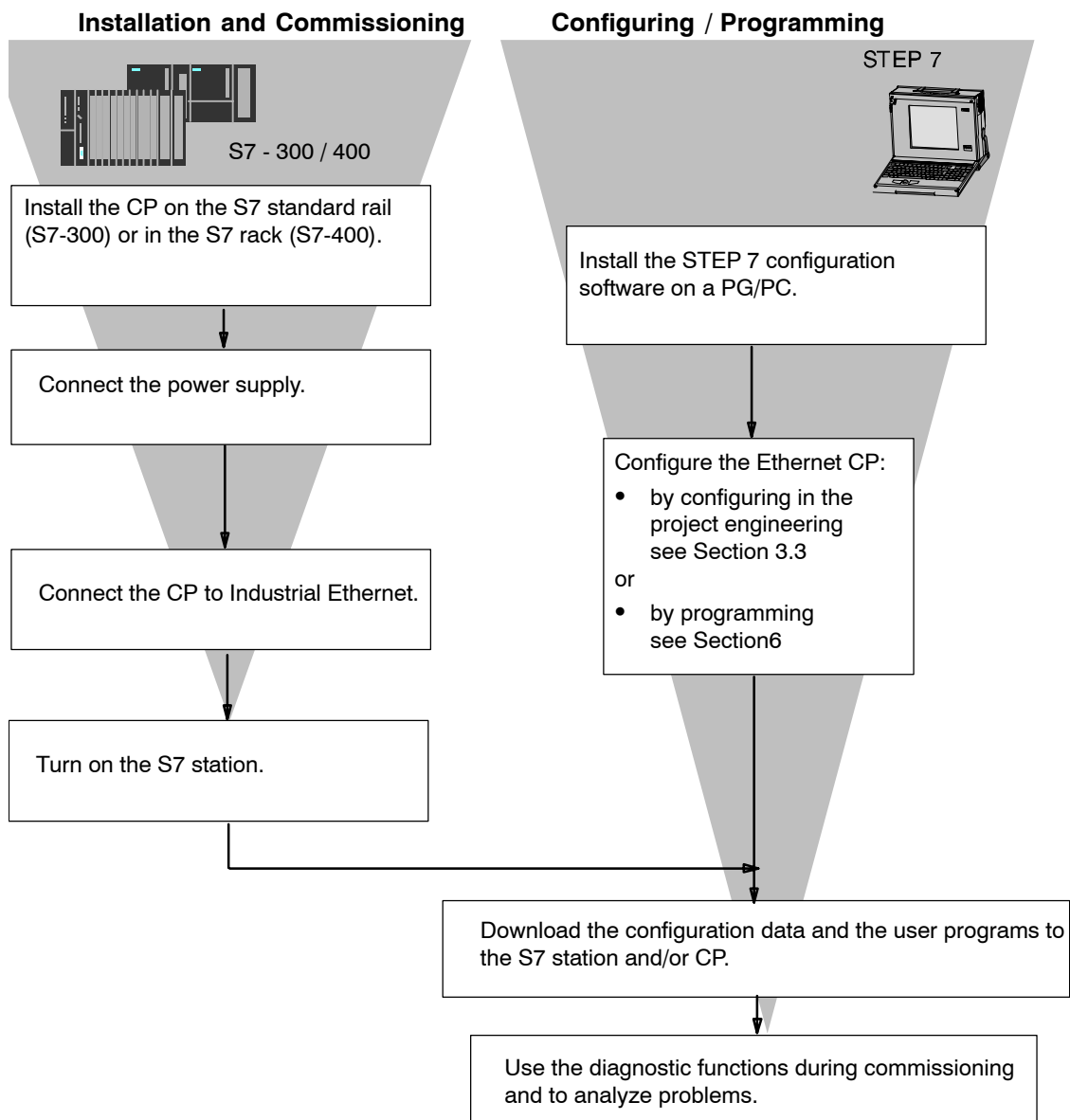
- You will find examples of configurations in the Primer.

### 3.1 How to Commission an Ethernet CP

The essential steps in commissioning an Ethernet CP are shown in the following overview:

#### Notice

The chart below shows the basic steps. Please read the device-specific instructions in "Installation and Commissioning" in the description of your CP (Manual Part B).



## 3.2 General Information on STEP 7 / NCM S7

### Installation

The functions of NCM S7 are available automatically immediately after installing STEP 7.

### Functions

NCM S7 consists of the following:

- CP-specific index dialogs that you call using the properties dialog box of the modules.
- Dialogs for the connection configuration
- Diagnostic functions that you obtain as follows:
  - Using the “Diagnostics” tab in the properties dialog
  - Using the standard Start menu of Windows with which you can call the SIMATIC program group
- Functions displayed with **SIMATIC ► NCM...** in the Start menu of Windows:
  - Diagnostics
  - Help for functions (FCs)
  - “Readme” file with current information about NCM
  - Firmware loader

### Access to Online Help of STEP 7 and NCM S7

With the online help, you can obtain the following information:



HLP

- You can display the contents of the STEP 7 basic help system with the **Help -> Contents** menu command.



- Context-sensitive help on the selected object using the **Help -> Context-Sensitive Help** menu command, the **F1** key or the **question mark** in toolbar.

You can then access further information relating to the current topic.

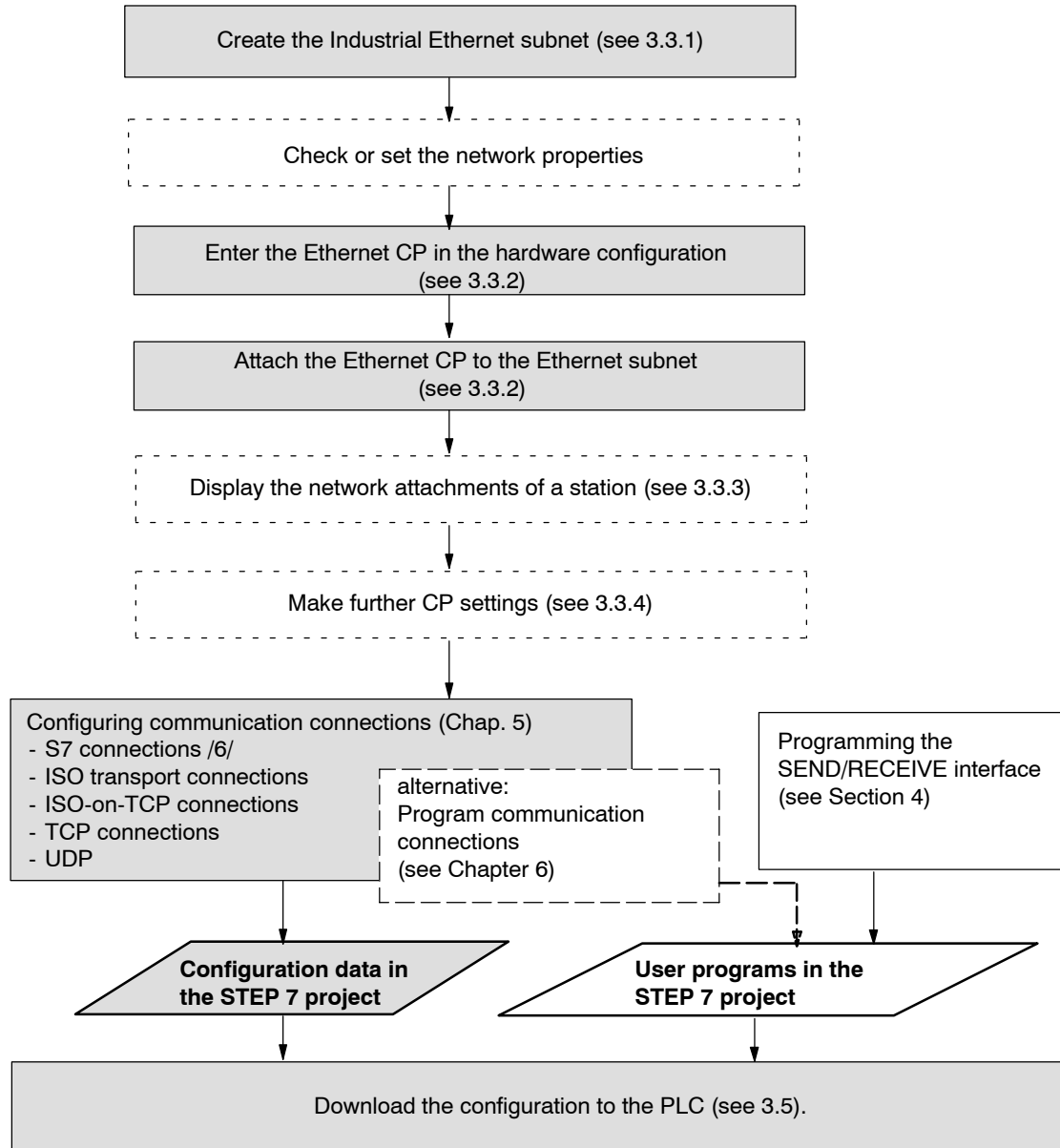
- Glossary for all STEP 7 applications by clicking the “**Glossary**” button

Please note that each STEP 7 application has its own contents and context-sensitive help.

### 3.3 Configuring - Follow the Steps Below

A CP is managed in an S7 project just as the other modules. You use STEP 7 to configure the hardware and create and manage the user software (see /6/).

Configuring a CP involves the following steps (the broken lines indicate options):



### 3.3.1 Creating an Industrial Ethernet Subnet

#### Aims

To be able to attach the SIMATIC stations to a subnet, you create the subnet in your project. This means that all the parameters for the entire subnet are managed centrally.

#### Procedure

It is advisable to create the subnet before you configure the stations since the assignment of the SIMATIC stations is then performed largely automatically.

It is also possible to create the subnet at a later point in time when configuring a CP. This is explained in more detail later in the chapter.

Follow the steps outlined below:

1. Select the project in the SIMATIC Manager.
2. Select **Insert ► Subnet ► Industrial Ethernet**.

**Result:** An object of the type network is created in the project. This allows all the SIMATIC stations created in the project to be attached to this subnet.

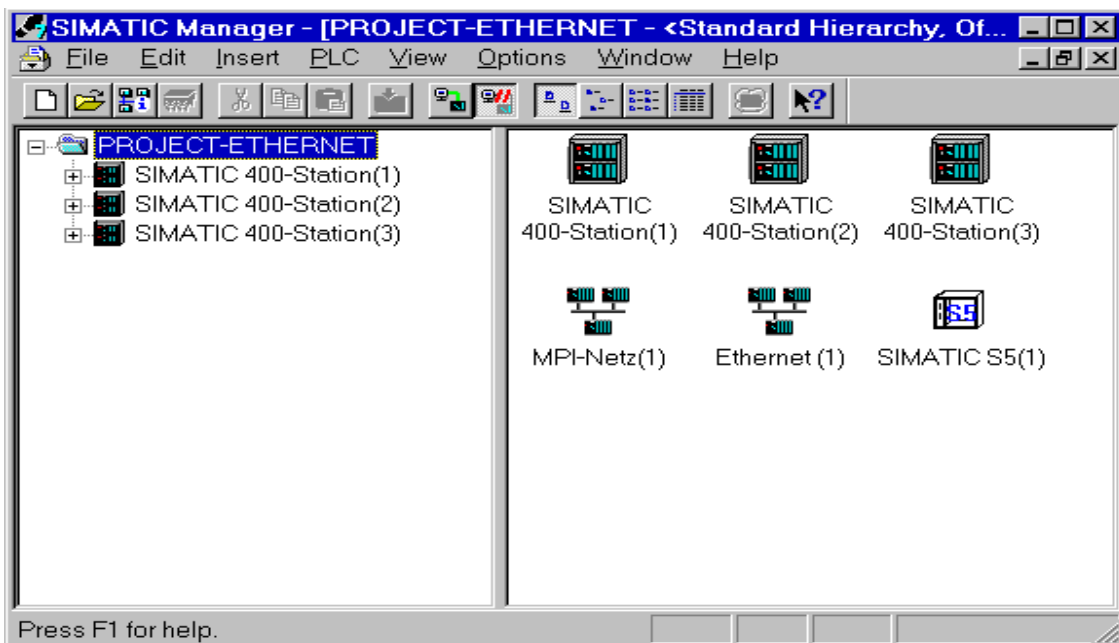


Figure 3-1 Project with Assigned Ethernet Network



3. If you prefer a NetPro graphic network display, select the network object “Ethernet” and confirm with **Edit ▶ Open Object**.

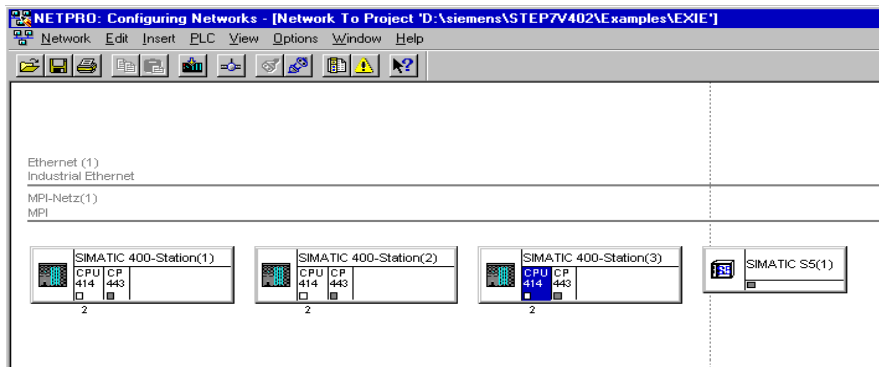


Figure 3-2 Graphic Network Representation (here showing stations not yet networked)

From this graphic representation, you can also activate all the functions for networking and configuring connections with the Ethernet CPs.

You can also create the subnets in NetPro! Open the catalog using the menu command **Insert ▶ Network Objects**.

## Organization in a Multiproject



If you use the multiproject form of organization, this has the following effects when creating subnets.

You create subnets initially in the subprojects as described above. To be able to network S7 stations, you will, for example, need to create a suitable subnet of the type Industrial Ethernet in each subproject.

If this is physically a subnet that extends beyond the boundaries of the subproject, you should first merge the subnets before configuring the communication connections between the S7 stations.

If you do not merge the subnets, NetPro assumes that you are connecting the subnets via routers and displays warning messages to this effect.

## Properties of Merged Subnets (Multiproject)

When you merge subnets, transferable subnet properties such as the subnet ID of the master subnet will be transferred to the other subnets of the group.

Some parameters relate specifically to a subproject and remain unchanged; these include, for example, descriptive parameters such as the name, author, and any comments.

---

**Notice**

Preserving Consistency in Merged Subnets

After merging the subnets, you should check the consistency throughout the multiproject using the menu command Network > Check Interproject Consistency in NetPro to make sure that there is consistency throughout the multiproject. This check detects, for example, S7 subnet IDs that are not unique within the multiproject.

---

### 3.3.2 Entering an Ethernet CP in the Hardware Configuration

#### Procedure

By installing and assigning the Ethernet CP in the rack of a SIMATIC station, you establish the logical attachment between the Internet CP and the subnet.

1. Select the station in your project that you want to attach to Industrial Ethernet using an Ethernet CP.
2. Select the CP in the hardware configuration just like any other module by selecting it in the hardware catalog and then selecting the slot in the rack.

You select CPs in the hardware catalog using a short text and the order number. Once you have installed NCM S7, the CPs are available in the catalog.

**Result:** The CP is assigned to the SIMATIC station.

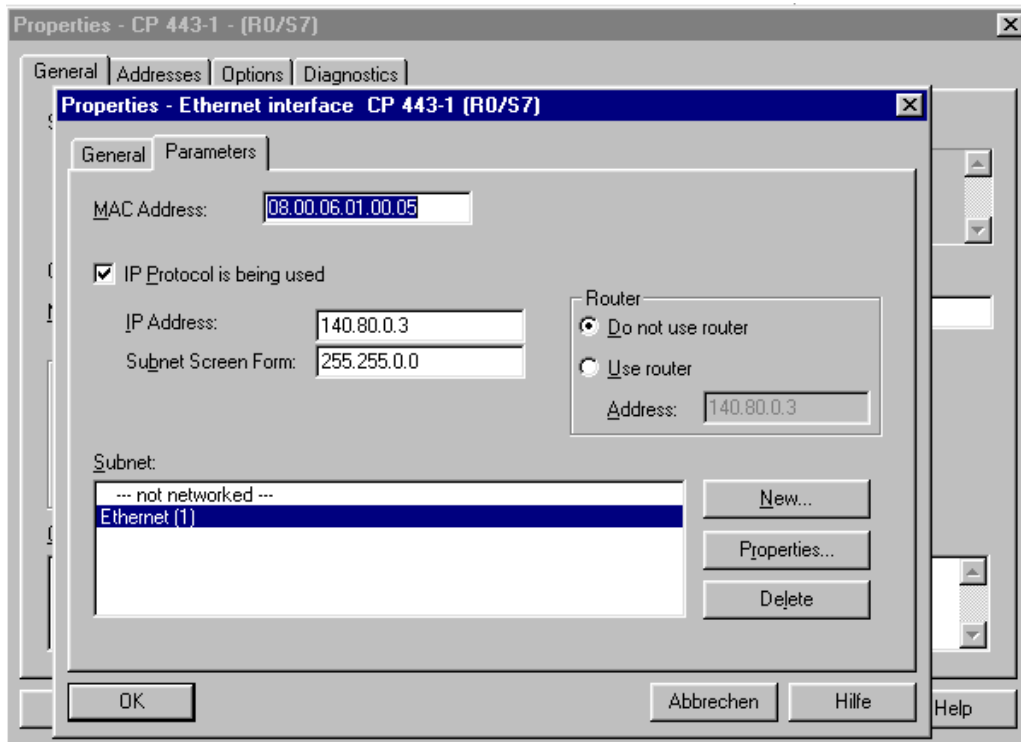


For information about the permitted slots, refer to /2/.

How to configure a module with STEP 7 is described in detail in /6/.

#### Subnet Attachment

To allow you to activate the network attachment of the Ethernet CP, the SIMATIC Manager displays the following dialog:



**Note**

You can open the dialog for setting the interface at any time from the Properties dialog of the CP in the “General” tab.

1. If you have not yet created a subnet in the project or have not yet created the selected subnet, you can now create a subnet. To do this, select the “New” button.

**Result:** An object of the type network is created in the project.

2. Check the addresses and if necessary change them. The system enters the next free address automatically.

You will find detailed information on the address ranges in the online help.

Please note the following additional information:

- MAC address

The latest Ethernet CPs are supplied with a default MAC address (address printed on the module). To be sure that you have a unique address assignment, do not enter a MAC address in the configuration (the option is deactivated). This means that the module automatically uses the factory-set address. If you want to use ISO services, we recommend that you enter the address printed on the module in the configuration.

---

**Note**

The “IP address” and “Subnet mask” input fields have no significance for ISO transport (option “IP protocol being used”).

---

3. Select the required subnet type in the “Subnet” list box.
4. You can display the properties dialog box for the selected subnet by clicking the Properties button.
5. Enter information specific to the subnet node in the “General” tab.
6. You must finally confirm your input with OK, otherwise the networking is not entered (refer to Point 3.).

**Result:** The CP is now configured as a network node for the corresponding S7 station.

### Setting Addresses in the Configuration and Addressing for the First Time

The address settings described here are made on the CP only after you download the configuration data.

With the latest Ethernet CPs, the situation is as follows:

To be able to reach the CP using these addresses before you download the configuration data, you can address the CP using its default MAC address and then supply it with project-specific address information.

This procedure of assigning an address the first time is described in Section 3.4.

### 3.3.3 Displaying the Network Attachments of a Station

#### Procedure

You can easily get an overview of the network attachment configurations of a SIMATIC station in one of the following ways:

- A graphic overview in NetPro;
- An overview in table form in the Properties dialog of the station

#### Graphic Overview in NetPro

The NetPro view provides you with a good overview of the networked stations:

Follow the steps below:

1. Double-click one of the network objects, for example Ethernet in your project in the SIMATIC Manager.

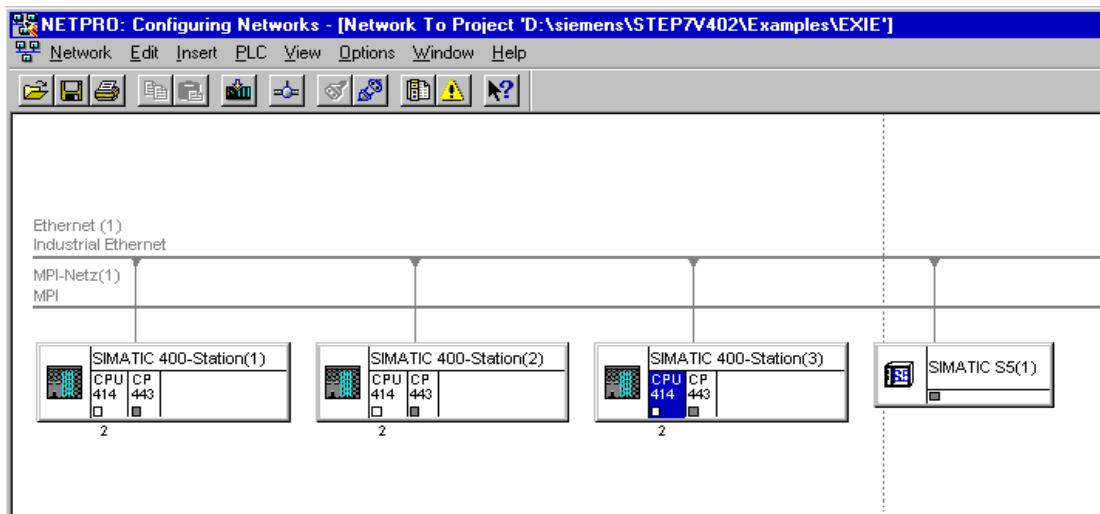


Figure 3-3 NetPro View of a Subnet of the Type Industrial Ethernet

## Overview in Table Form

The table view in the Properties dialog of the station provides a detailed overview of the components used for network attachment.

Follow the steps below:

1. Using the SIMATIC Manager, select the station in your project that you want to check.
2. Select the **object properties** using the menu command **Edit ▶ Object Properties** or by double-clicking on the station symbol.
3. Select the “Interfaces” tab.

### Result:

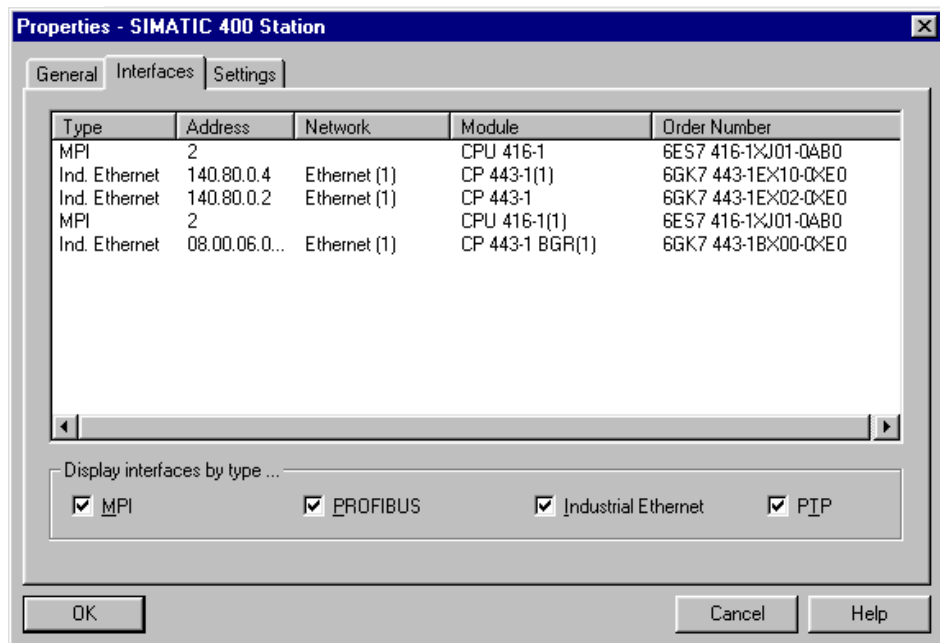


Figure 3-4 “Interface” Tab in the “SIMATIC 300/400” Properties Dialog Box

In the displayed dialog, you can see the subnet attachments that were configured for the SIMATIC station.

### 3.3.4 Setting Further CP Properties

#### Overview

In addition to the network attachment, you can also make further settings for the specific module or you can call functions.

1. Select the Ethernet CP in the hardware configuration.
2. Select **Edit ▶ Object Properties**. Depending on the type of CP you are using, the dialog includes other tabs in addition to the “General” tab described in Section 3.3.2:

Tabs	Settings for
General	Interface
Addresses	Interface parameters for the user program
Options	Time-of-day synchronization
└─	Data transfer
└─	Replace module without PG
└─	Ethernet profile for fault-tolerant connections
└─	Individual network settings
└─	Send keepalives for connections
└─	Multiplex OP connections / reserve internal CPU connection resources
Time-of-day synchronization	SIMATIC mode
└─	NTP mode (NTP: Network Time Protocol)
User	Specify user permissions for IT functions
Symbols	Symbolic access to variables using IT functions
DNS parameters	Specify the address for the domain name server for E-mail services
Diagnostics	Call NCM diagnostics (special diagnostics / module diagnostics)
Addressing	Select the station to initialize
└─	Assign configured IP parameters
IP Access Protection	Edit the IP access list
IP Configuration	Set the IP address
Port Parameters	Individual network settings
FTP	Create / modify file allocation table
PROFINET	Specify properties for PROFINET IO and PROFINET CBA





Please read the description of the Properties dialog of the CP in the integrated help. The functions are explained in detail there.

### Addresses Tab

The Addresses tab displays the address at which the module can be addressed by the user program. You require this address when calling the FCs for transport connections -> see Chapter 7).

#### Notice

Please note the following notes on S7-300 stations:

If you selected the “Update OB1 process image cyclically” option in the CPU configuration (default), you must set the module base address of the Ethernet CP outside the process image (base addresses in the “Addresses” tab).

Example: If the size of the process image selected for the CPU is 1024 (0...1023), the address for the Ethernet CP must be set equal to or higher than 1024.

### Options Tab

Depending on the CP type, you can make the following settings:

Table 3-1 Settings in the “Options” Tab


Option	Meaning / Effect
<ul style="list-style-type: none"> <li>Time-of-day synchronization</li> </ul>	<p>Here, you decide whether the CP passes on time-of-day frames or not. You require this function if you have several CPs in a station since only one CP (on the same network) is permitted to forward the time synchronization messages.</p> <p><b>Note</b> The time-of-day synchronization function does not exist for all module types.</p>
<ul style="list-style-type: none"> <li>Data transfer &gt; 240 bytes</li> </ul>	<p>With this option, you specify whether or not the CP will support jobs with a data length of more than 240 bytes (for S7-300 stations).</p> <p><b>Notes</b></p> <ul style="list-style-type: none"> <li>The transfer of more than 240 bytes of data is supported by newer version CPs. Please note the information in the product information bulletin / manual of the Ethernet CP. Please note the information in Section 7.1 on the newer CP types. </li> <li>Remember that with this configuration on an S7-300, one connection resource (free connection for S7 functions) of the S7-300 CPU is used. CPU connection resources are also used, for example, by S7-300 CPs, in the FMS mode or by PGs and OPs. For more detailed information about the maximum connection resources, refer to /1/.</li> </ul>

Table 3-1 Settings in the “Options” Tab , continued

Option	Meaning / Effect
<ul style="list-style-type: none"> <li>Replace module without PG</li> </ul>	<p>With this option, you can have the configuration data of the CP stored on the CPU. If you then replace CP, the configuration data for the new CP are downloaded automatically from the CPU when the CP is started up.</p> <p>If you select this option, the configuration data are stored long-term on the CPU instead of in the EPROM of the CP. Remember, however, that long-term storage on the CPU is only safe from power outages if the CPU is protected by battery backup or by using an S7 Memory Card.</p> <p><b>Note</b></p> <p>If you store the configuration data on the CPU, please read the note below.</p> <p>The following functions do not modify the configuration data on the CPU:</p> <ul style="list-style-type: none"> <li>Reset module memory</li> <li>Resetting to factory settings</li> <li>Assigning an IP address<sup>1)</sup> (using the target system selection in the SIMATIC Manager or the properties dialog in HW Config or NetPro)</li> </ul> <p>If you subsequently upload the configuration data from the CPU to a PG you will always object the configuration data that were previously on the CP (with parameters, connections, IP address).</p> <p>1) Note: You should only use the assign IP address function during commissioning; in other words, before downloading the configuration data.</p>
<ul style="list-style-type: none"> <li>Ethernet profile for fault-tolerant connections</li> </ul>	<p>Select this profile if you use fault-tolerant communication in your system. Fault-tolerant communication means that Industrial Ethernet is designed with redundancy and that you have configured fault-tolerant S7 connections.</p> <p>If you select the Ethernet profile for fault-tolerant connections here, the time response of the S7 connections is adapted. As a result, breakdowns of a connection are detected more quickly and the failover to redundant connections is faster.</p> <p><b>Note</b></p> <p>Select the Ethernet profile for fault-tolerant connections only when you actually use fault-tolerant S7 connections. Otherwise you must expect your system to be more susceptible to problems since, for example, the number of transfer or connection establishment attempts is reduced compared with non-redundant systems.</p>
<ul style="list-style-type: none"> <li>Individual network settings</li> </ul>	<p>Here, you can make fixed network settings, when necessary. As default, “Automatic Setting” is selected and this setting generally guarantees problem-free communication in most situations.</p> <p>If problems occur in communication (for example, when connections are not established or when there are often disturbances on the network), the reason may be that the selected or automatic network settings are not suitable. You can then select a network setting to suit your network configuration.</p>

Table 3-1 Settings in the “Options” Tab , continued

Option	Meaning / Effect
<ul style="list-style-type: none"> <li>Send keepalives for connections</li> </ul>	<p>Here, you can set the interval at which keepalives are sent to the partner of a communications connection. This setting decides the latest time after which the failure of a communications partner is detected.</p> <p>For all connection-oriented services, the Ethernet CP is configured so that keepalives are sent. This guarantees that connections are closed if a communications partner fails and that the connection resources are released. The setting made here applies to all TCP and ISO-on-TCP connections operated via the CP; a connection-oriented setting is not possible.</p> <p>Possible values:</p> <p><b>Default Setting:</b> 30 seconds</p> <p>Turn keepalives off 0 seconds</p> <p>Maximum value: 65535 seconds</p> <p>Notes / Recommendations:</p> <p>Remember that the keepalive mechanism can keep underlying connections established (for example, an ISDN telephone connection) although no user data are actually being transmitted. If this is not required, set the interval so high that the underlying connection is closed down when no further user data are sent before a keepalive is sent.</p>
<ul style="list-style-type: none"> <li>Multiplex OP connections / reserve internal CPU connection resources</li> </ul>	<p>To attach TD/OPs or HMI devices, you can optimize the connection resources on the S7-300 CPU by having up to 16 of these devices communication on a single CPU connection resource (multiplex mode).</p> <p>If you do not use this option, the number of operable TD/OPs or HMI devices depends on the number of available connection resources of the CPU you are using.</p> <p>As default, this option is deactivated. This means that a CPU connection resource is used for multiplex only when necessary.</p> <p>Configured S7 connections over the CP use the same multiplex channel as you use for multiplexing the HMI connections. If you configure S7 connections, this means that one CPU connection resource is already used.</p> <p>Please note: PG connections do not use the multiplexer; if you use a PG, one connection resource is always occupied.</p> <p>Note on Programming:</p> <p>When you use the multiplex mode, you must specify the rack/slot assignment of the CP for addressing on TD/OP/HMI connections instead of the rack/slot assignment of the CPU!</p> <p>Applications (for example ProAgent) that require block-related messages (Alarm_S: SFC17-19) are not supported in the multiplex mode.</p>

## Time-of-day Synchronization Tab

In this tab, you can make the settings for one of the two synchronization modes explained below:

- SIMATIC mode

If the CP receives MMS time-of-day frames, its local time is synchronized providing the NTP mode was not configured (MMS = Manufacturing Message Specification).

The advantage of this mode is the accuracy that is generally higher than achieved with the NTP mode.

- NTP mode (NTP: Network Time Protocol)

In the NTP mode, the CP sends time queries (in the client mode) at regular intervals to the NTP server in the subnet (LAN). Based on the replies from the server, the most reliable and most accurate time is calculated and the time of day on the station is synchronized.

The advantage of this mode is that the time of day can be synchronized beyond the boundaries of the subnet.

Some CPUs allow the time to be requested automatically from an NTP server. If you make use of this option on the CPU, you should disable forwarding of the time to the station by the CP. This prevents the time on the CPU obtained directly from the NTP server being overwritten by the time on the CP. Forwarding over the CP could result in less accuracy.

## Diagnostics Tab

In the “Diagnostics” tab, you can start NCM S7 Diagnostics.

See Chapter 8 Diagnostics for a description of the diagnostic functions themselves.

## Addressing Tab

In the “Addressing” tab, you can assign the previously configured IP address and IP parameters to the CP.

This is necessary before the configuration data can be downloaded to the CP over Ethernet.

For a detailed description, refer to Section 3.4.

## IP Access Protection Tab



Using IP access protection gives you the opportunity of restricting communication over the CP of the local S7 station to partners with specific IP addresses. Partners you have not authorized cannot access data of the S7 station over the CP using the IP protocol (S7 connections).

In this tab, you can activate or deactivate IP access protection and can enter IP addresses in an IP access control list (IP-ACL).

Attempted access that was blocked is registered on the CP. You can view these entries with NCM Diagnostics in the “IP access protection” object. If the CP has IT functionality, an archive file (LOG file) is also created in the file system of the CP and you can view this with a WEB browser. You will find the LOG file as an HTML file in the file system of the CP in the following folder:

- ram/security/IPLogFile.htm

As default, IP access protection is **deactivated**.

- IP access protection for configured connections with specified partners

If you want to restrict access to the precise set of partners you specify during connection configuration, you simply need to activate access protection. In this case, you do not need to enter IP addresses in the list.

Remember, however, that on unspecified connections, all other IP addresses (unconfigured in the project engineering) are unauthorized and are rejected. This automatic restriction to configured IP addresses does not apply to the programmed connections mode.

IP access protection relates to all connection types handled using the IP protocol (TCP, ISO-on-TCP, UDP)

- IP access protection for partners with specific IP addresses

To allow IP access for specific IP addresses, enter these IP addresses in the IP access control list.

The IP addresses you specify when you configure the connection always belong to the permitted IP addresses and do not, therefore, need to be entered explicitly in the IP-ACL. This also applies to IP addresses obtained dynamically over an E-mail connection from a DNS server.

- IP access protection for partners with unspecified connections

Passive connection establishment functions only with remote nodes that are entered in the IP-ACL.

---

### Notice

You can view the IP-ACL with NCM Diagnostics.

When IP access protection is activated, remember that in the following special case, the IP-ACL is displayed as being empty and IP access protection as being **deactivated**:

- There is no connection configured and
- there is no fixed IP address entered in the IP-ACL and
- and no dynamic IP address is currently being obtained.

As soon as an IP address is entered, for example dynamically, IP access protection is displayed as activated again.

---

## IP Configuration Tab



In this tab, you can decide the route and the method with which the IP address of the local S7 station is obtained and assigned.

With the options available here, it is also possible to assign IP addresses dynamically outside the STEP 7 configuration.

Table 3-2 Options in the “IP Configuration” Tab

Option	Meaning / Effect
<ul style="list-style-type: none"> <li>Set IP address in the “Properties - Ethernet Interface” dialog</li> </ul>	<p>This option is the default.</p> <p>It means that the IP address is set during the networking of the Ethernet CP. The IP address of the CP is therefore <b>fixed</b> in the configuration.</p> <p>You must select this option if you want to configure specified connections.</p>
<ul style="list-style-type: none"> <li>Obtain an IP address from a DHCP server</li> </ul>	<p>If you select this option, the IP address is obtained from a DHCP server when the S7 station starts up.</p> <p>The DHCP server is informed of the MAC address of the CP or the client ID that you can enter here.</p> <p>Requirement / Restriction:</p> <p>If you select this option, it is initially not possible to create a fully specified connection in the STEP 7 project because the local IP address is not known.</p> <p>You must therefore select “unspecified” with passive connection establishment as the connection type.</p> <p>Please not the following:</p> <p>If the connections are configured over the interface in the user program, you must use the option “Set IP address in the user program” as described below. This also applied if the IP address is obtained from a DHCP server.</p>
<ul style="list-style-type: none"> <li>Set IP address in the user program</li> </ul>	<p>With this option, you specify that the IP address is set over a user program interface (function block IP_CONFIG). This allows the IP address to be supplied dynamically during operation.</p> <p>In this situation, communication connections are created only over the user program interface; configuring connections using STEP 7 is not possible (relates to connections over IP: TCP, ISO-on-TCP, UDP).</p> <p>This setting does not preclude the IP address being obtained from a DHCP server. It is possible for the user program to instruct the module to obtain an IP address in this way.</p> <p>Further information:</p> <p>Read the section “Programmed Communication Connections” and refer to the example in the appendix of the manual.</p>
<ul style="list-style-type: none"> <li>Set IP address using a different method</li> </ul>	<p>With this option, you specify that the IP address is set by other services outside STEP 7.</p> <p>In this situation, configuring connections using STEP 7 is not possible (relates to connections over IP: TCP, ISO-on-TCP, UDP ).</p>

---

**Note**

You can query the IP address actually being used with NCM S7 Diagnostics.

---

**“Port Parameters” Tab**

Here, you can, when necessary, make fixed network settings for the transmission properties of every available port. As default, “Automatic Setting” is selected and this setting generally guarantees problem-free communication in most situations.

If problems occur in communication (for example, when connections are not established or when there are often disturbances on the network), the reason may be that the selected or automatic network settings are not suitable. You can then select a network setting to suit your network configuration.

### **“FTP” tab**

In this dialog, you can create / modify a file allocation table.

With the information in the file allocation table, it is possible to address data blocks in one or more CPUs (up to 4) in an S7 station.

Ethernet CP as FTP server for S7 CPU data

To transfer data with FTP, create data blocks in the CPU of your S7 station; due to their special structure, these are known here as file DBs.

When it receives an FTP command, the Ethernet CP as FTP server obtains the information about how the data blocks used in the S7 station for file transfer are mapped to files from a file allocation table (file file\_db.txt).

You can create the file allocation table as follows and transfer it to the CP:

- By entering it in the “FTP” folder described here;  
The file allocation table is then downloaded to the CP automatically along with the project engineering data.

- By creating a file\_db.txt file directly.

You must then download the file allocation table created in this way to the CP.

The file allocation table file\_db.txt is stored in the file system of the Ethernet CP in the /config folder.

### **“PROFINET” tab**

Here, you specify the properties of the Ethernet CP for PROFINET IO and PROFINET CBA.



Table 3-3 Options / Input Areas in the "PROFINET" Tab

Option / Input Area	Meaning / Effect
<ul style="list-style-type: none"> <li>• Mode</li> </ul>	<p>Depending on the type of CP device, you can select the possible modes here in which the S7 station can be operated on PROFINET.</p> <ul style="list-style-type: none"> <li>• PROFINET IO Controller With this option you decide whether or not the Ethernet CP is operated as a PROFINET IO controller. You can also make this setting by assigning a PROFINET IO system to the CP in HW Config using the context menu.</li> <li>• PROFINET IO device With this option you decide whether or not the Ethernet CP is operated as a PROFINET IO device. In a further step, you will also need to assign the CP to the PROFINET IO system as a PROFINET IO device.</li> </ul>
<ul style="list-style-type: none"> <li>• Device Name</li> </ul>	<p>Name of the device (according to DNS conventions). The device name must be unique on the Ethernet subnet. If the CP is operating as PROFINET IO controller, the device name is derived from the short identifier.</p> <p>STEP 7 gives you the option of adding the name of the IO system as part of the device name automatically. To use this feature, select the option "Use name in device/controller" in the properties of the PROFINET IO system".</p>
<ul style="list-style-type: none"> <li>• CBA communication</li> </ul>	<p>To be able to use the S7-station with PROFINET CBA, specify the CP to be used for the componentization for PROFINET CBA or SIMATIC iMap.</p>

### 3.3.5 “Substitute Objects” in the STEP 7 Project

#### Overview

Communication connections can be configured fully when the communications partners are available in the current project. For the stations on the Ethernet subnet, whose configuration data were not created in STEP 7 or whose configuration data are not managed in the currently active project, the following substitute objects can be created in the project:

- SIMATIC S5 stations
- PG/PC
- Other stations
  - for devices of other manufacturers
  - for SIMATIC S7 stations in another project (not necessary in a multiproject)

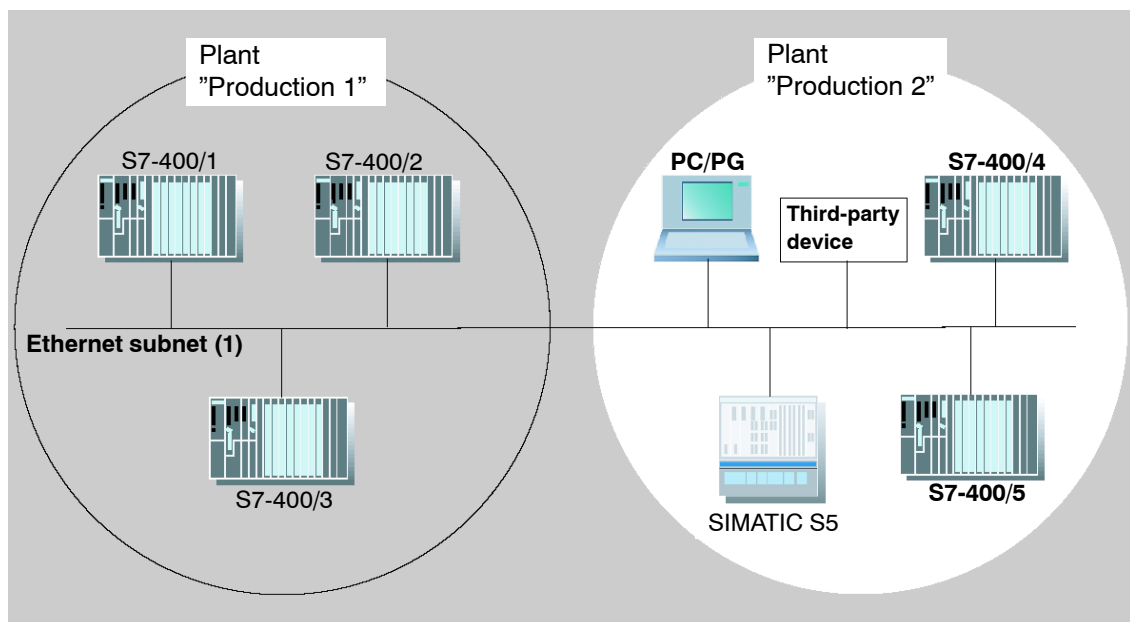
---

#### Note

Instead of creating substitute objects, you can also configure unspecified connections for connections to the stations listed above.

In the Properties dialog of these connections, you must then specify the full partner address. These partners do not appear in the NetPro plant view.

---



## Procedure

To enter a substitute object in the project, following the steps below:

1. Select the project in the SIMATIC Manager.
2. Select **Insert ► Station ►** and then as necessary **Other Station, PG/PC or SIMATIC S5**

**Possible result:** the selected object is created in the project.

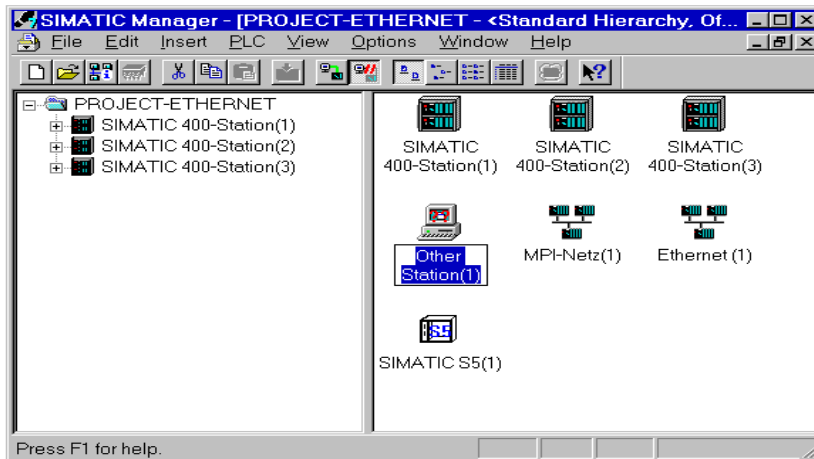


Figure 3-5 Project With Substitute Objects Configured

## Attaching Non-S7 Stations to the Subnet

The next step is to assign the substitute objects to the subnet, as follows:

1. Select the required object in the project and select **Edit ► Object Properties.**
2. In the Properties dialog box that is displayed select the “Interfaces” tab and click the “New” button (for example “Other Station”).

**Result:** The New Interface - Type Selection dialog box is displayed.

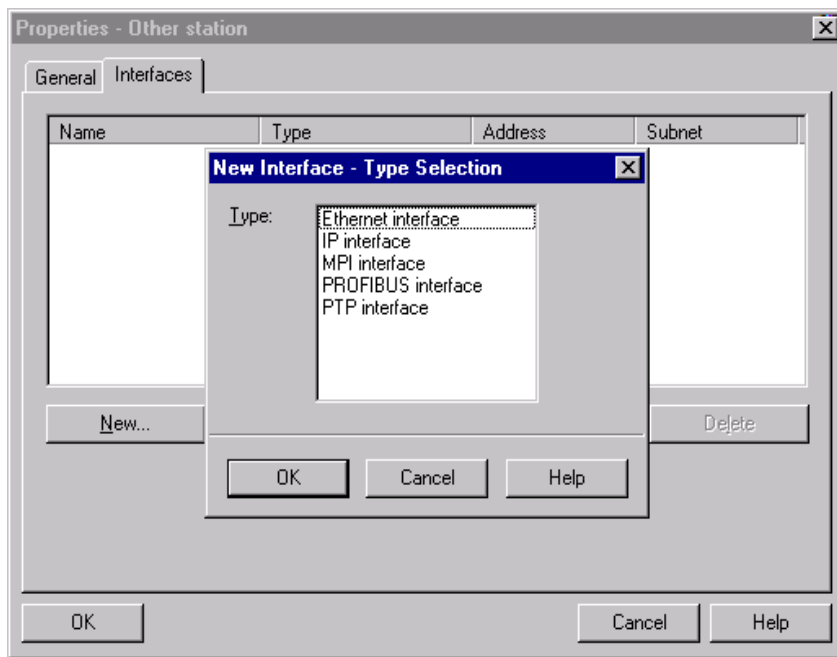


Figure 3-6 Selecting the Subnet Type for “Other Station” (Example)

3. Select a subnet.

**Result:** The “Properties - Ethernet Interface” dialog is displayed. Here, you can select the subnet, connect the station to the network and set the address (MAC, IP). All the SIMATIC stations in the project can establish communication relationships to this substitute object.

The addresses (MAP/IP) configured for the substitute object here must also be set on the station using the appropriate tool, for example COM 1430.

### 3.3.6 Configuring Communication Services

#### Setting Up Connections

You must set up connections for the connection-oriented services supported by the Industrial Ethernet CP, see also the Table in Section 1.2.

- S7 connections  
see the STEP 7 user manual /6/
- ISO transport connections  
see Section 5.4
- ISO-on-TCP connections  
see Section 5.5
- TCP connections  
see Section 5.6
- Connections for UDP  
see Section 5.7
- E-mail connections  
see manual for CPs with IT functionality /5/
- Interconnections for PROFINET CBA communication  
see manual Component based Automation - configuring plants with SIMATIC iMap/19/

The information in the STEP 7 user manual /6/ in the chapter “Creating Communication Connections Between Two Programmable Modules” also applies to the additional types of connection possible with the CPs.



You will find this information in the online help with integrated in STEP 7 by selecting **Help ► Contents**. Select the topic “Configuring Connections and Data Exchange”.

## 3.4 Assigning Addresses for the First Time (Applies to Latest CPs)

### Meaning of the Address Assignment - MAC Address and IP Address

The CP ships with a factory-set MAC address. Without further configuration, the device can only be accessed over the Ethernet port using this MAC address.

In its original state, you can already use the following functions via the CP using the ISO protocol and the factory-set MAC address:

- Download the defined configuration to the CP or CPU
- Run diagnostics on the CP or CPU

Before you can download defined configuration data to the device using an IP address, you must first assign an IP address to the CP.

### Assigning the Address - Options and Recommendations

There are three ways of assigning this address in STEP 7:

- Addressing by selecting the target system in the SIMATIC Manager

This option allows you to assign the address without having to set up a STEP 7 project. This is useful, for example, if you want to download defined configuration data you created offline to the S7 station.

This is described in Section 3.4.1.

- Addressing using the properties dialog in HW Config or NetPro

This option assumes that the CP was networked in STEP 7. The advantage of this method is that the IP parameters set during configuration in STEP 7 / NetPro can be used.

In the "Addressing" tab, you assign the previously configured IP address and IP parameters to the CP.

This is necessary before the configuration data can be downloaded to the CP over Ethernet.

This is described in Section 3.4.2.

- Downloading configuration data using the ISO protocol

A further variant is to download project engineering data with a defined IP address over the ISO protocol (see above); this applies to CPs that support the ISO protocol.

## Requirements

Before you can use the addressing described here, the CP must be obtainable online, which means:

- An attachment to the Ethernet LAN must already exist; there must be no routers between subnets in the path.
- The Ethernet port of your PG/PC must be accessible to STEP 7.

---

### Notice

The options for assigning an address as described here are available only if you have a module that can be reached using the default MAC address; such modules must support the PST (Primary Setup Tool) function. Please refer to the information in the relevant manual /2/.

---

### 3.4.1 Addressing by Selecting the Target System in the SIMATIC Manager

**Follow the steps below to assign the IP address the first time:**

1. Open the SIMATIC Manager
2. Select the menu command **PLC ► Assign Ethernet Address**.
3. Start a network search for available modules by selecting the “Browse...” button.
4. Select the CP with the matching MAC address from the components listed.
5. Enter the required IP parameters and assign them to the CP.

Result:

The CP is now accessible on Industrial Ethernet using the IP address.

---

### Note

You will find further detailed information on this procedure in the STEP 7 online help.

---

### Alternative Procedure

You can also follow the steps outlined below in the SIMATIC Manager:

1. Use the menu command **PLC► Display Accessible Nodes** to display the nodes that you can access over Industrial Ethernet.
2. Select the required node in the list displayed.
3. Then select the menu command **PLC► Ethernet Address**.

Result: The previously selected node is entered directly into the “Addressing” dialog. You cannot modify the MAC address of the node.

4. Enter the required IP parameters and assign them to the CP (see above under STEP 5.).

Result:

The CP is now accessible on Industrial Ethernet using the IP address.



### 3.4.2 Addressing using the Properties Dialog in HW Config or NetPro

**Follow the steps below to assign the IP address the first time:**

1. Open the SIMATIC Manager.
2. Define the configuration of your S7 station with the appropriate components in HW Config in an existing or newly created project.
3. When you create the CP, network it with an Industrial Ethernet subnet.  
When you create the CP in HW Config, the necessary dialog is displayed in which you can network the device and assign the IP address.
4. Select the "Addressing" tab in the properties dialog of the CP you want to address.  
The tab displayed is identical to the dialogs illustrated in Section 3.4.1.
5. Start a network search for available modules by selecting the "Browse..." button.
6. Select the CP with the matching MAC address from the components listed.
7. Assign the IP parameters taken from the networking to the CP by clicking the relevant button.

Result:

The CP is now accessible on Industrial Ethernet using the IP address.

---

#### **Note**

You will find further detailed information on this procedure in the STEP 7 online help.

---

## 3.5 Downloading the Configuration Data to the Target System

### Principle

The configuration data of the Ethernet CP are downloaded from the hardware configuration. All the configuration data of the S7 station are downloaded including the central configuration, all relevant DP master systems and all parameter settings.

The data of the **configured connections must also be downloaded**, see below.

### Type of Interface

You can download the configuration data to the S7 station on the following paths (interfaces):

- MPI interface

You can use this interface to download configuration data or when assigning a MAC/IP address for the first time (node initialization - for details, refer to the manual /2/ "Assigning Addresses for the First Time").

- Industrial Ethernet

Here, you use the PG mode of the Ethernet CP in the S7 station (see also Section 1.3).

Depending on the PG/PC interface used by the station on which you create your configuration, you can download the defined configuration data to the S7 station over the TCP/IP interface or over the ISO interface of STEP 7.

- When you download over the IP interface, the CP must already have been assigned an IP address; refer to Chapter 3.4.
- When you download over the ISO interface, you can use the preset MAC address. However, please note the following:

---

### Note

If you want to download the configuration data over the ISO interface to a CP with an unchanged, factory-set MAC address and you have configured a different MAC address in your STEP 7 project, you must start the download in NetPro or HW Config; this is the only way you will be prompted to enter the current MAC address. The SIMATIC Manager, on the other hand, aborts the download if the target station cannot be reached.

---

## Procedure

To download the configuration data to the S7 station, follow the steps outlined below:

1. Open the “Set PG/PC Interface” dialog box in the Windows Control Panel.
2. Set the PG/PC interface according to the CPs available on your PG and according to the bus attachment (interface parameter assignment used).



For more detailed information, refer to the integrated help system.

3. Change the CPU to the STOP mode (regardless of the type of interface - see above).
4. Select the menu command **PLC ▶ Download to Module**.

STEP 7 then guides you through dialog boxes. Note the additional information in the “STEP 7 User Manual”, Chapter “Configuring and Assigning Parameters to Modules” /6/.

## Deactivating the MAC Address in the Configuration

If you deactivate the use of the MAC address when you are configuring the CP, the CP can be reached via the preset MAC address, however you cannot define any ISO transport connections or S7 connections over ISO connections in your configuration.

## Non-volatile storage of the project engineering data (on CPs with data management)

You can download the configuration data step-by-step or all at once. If you download step-by-step, you will be prompted to start the download function separately for each module. You must select this method if you want to save the configuration data in non-volatile memory on the Ethernet CP. In this case, select the “Copy to ROM” button in the “Download” dialog for the CP.

## Downloading the Configured Connections

To download configured connections, you use a corresponding download function in the connection configuration (NetPro).

---

### Notice

If you have assigned a new address to the Ethernet CP or have configured connections, you must always download the connection configuration again.

Remember that you also make suitable address adaptations for the other stations or “substitute objects”.

---

### Relocating the CP in the Hardware Configuration

If you are using communication services with configured connections, the connection IDs also identify the slot of the CP. If you “drag” a CP you have already configured to a different slot, note the following:

---

#### **Notice**

If you drag the CP to a different slot, the data of the connection configuration are automatically updated. The data of the connection configuration must, however, be downloaded again!

---

## 4 SEND/RECEIVE Interface in the User Program

This chapter explains the following:

- How to send and receive data.
- Which data areas can be used on the S7 CPU.
- How to program the SEND/RECEIVE interface in the user program.



You will find further information in the following sources:

- For programming and configuring nodes for connections (for example a SIMATIC S5 PLC with the CP 1430 TCP, PC with CP 1613), please refer to the appropriate manuals.
- The FCs for programming connections are described in Section 7.3.
- Configuring the Ethernet CP with NCM S7 is described in Chapter 5.
- Programming communication connections over the interface in the user program is described in Chapter 6.

Sample programs:



Sample configurations and programs are available for the SEND/RECEIVE interface described here:

- In the sample project PROJECT\_ETHERNET that you can start immediately after installing NCM S7; for a description, refer to the Primer.
- On the Internet as downloadable sample projects; refer to the information in Appendix C “Support and Training”.



The Quick Start CD that can be ordered separately is a treasure-trove of sample programs and configurations.

You can order this directly over the Internet at:

<http://www4.ad.siemens.de/WW/news/en/21827955>

## 4.1 How the SEND/RECEIVE Interface Works on the CPU

### Functions (FCs)

The following functions (FCs) are available for handling communication on connections:

- AG\_SEND/AG\_LSEND/AG\_SSEND  
This block takes the user data from the specified user data area and transfers it to the Ethernet CP.
- AG\_RECV/AG\_LRECV/AG\_SRECV  
This block transfers received user data to the user data area specified in the call.

The diagram below illustrates the situation. Using the FCs AG\_SEND / AG\_LSEND / AG\_SSEND and AG\_RECV / AG\_LRECV / AG\_SRECV, the user program instructs the Ethernet CP to send or receive data on the configured connection.

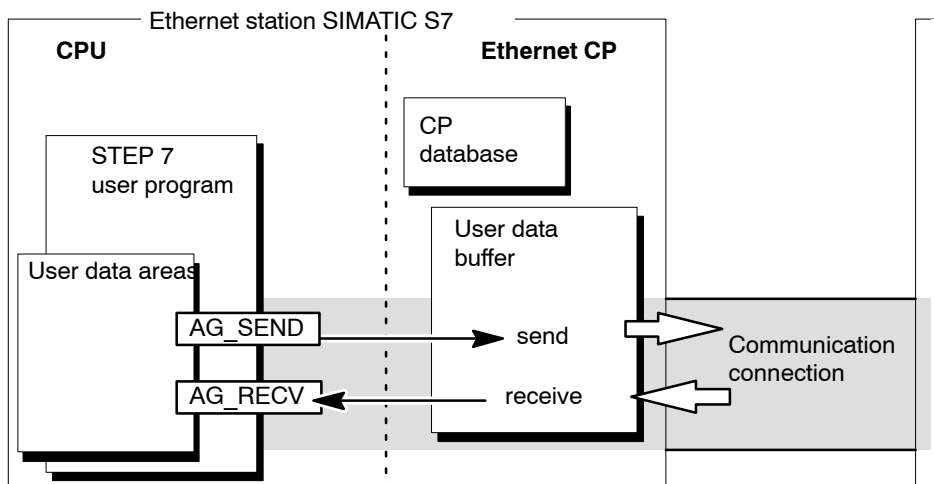


Figure 4-1 Interaction of the CPU and Ethernet CP on Connections

### Amounts of Data

The Ethernet CP can transfer the amounts of data shown in the table below per job on one connection:

Table 4-1

	ISO Transport	ISO-on-TCP	TCP	UDP
Sending	8192 bytes	8192 bytes	8192 bytes	2048 bytes
Receiving	8192 bytes	8192 bytes	8192 bytes	2048 bytes

## 4.2 Programming the SEND/RECEIVE Interface

### Principle of Job and Data Transfer

The user program triggers the transfer of the user data areas with FC calls and monitors the transfer by evaluating the return codes of the FCs.

The following parameters are transferred when the FCs are called:

- The number of the connection (ID)
- The location of the user data area in the CPU

For detailed information about the call interface see Chapter 7.

### Purpose of the FCs

Calling the function blocks has the following effects:

- The user data area is transferred to the Ethernet CP or received from the Ethernet CP.
- The execution of the job is confirmed positively or negatively in a status message.

### Procedure

Program the SEND/RECEIVE interface in the user program as follows:

1. Use the following functions (FCs) for data transmission on connections:
  - AG\_SEND / AG\_LSEND / AG\_SSEND for transferring the user data area to the Ethernet CP
  - AG\_RECV / AG\_LRECV / AG\_SRECV for entering data received from the Ethernet CP in the user data area
2. Evaluate the following bits in the FCs:
  - for AG\_SEND / AG\_LSEND / AG\_SSEND the parameters DONE, ERROR, STATUS
  - for AG\_RECV / AG\_LRECV / AG\_SRECV the parameters NDR, ERROR, STATUS

---

### Notice

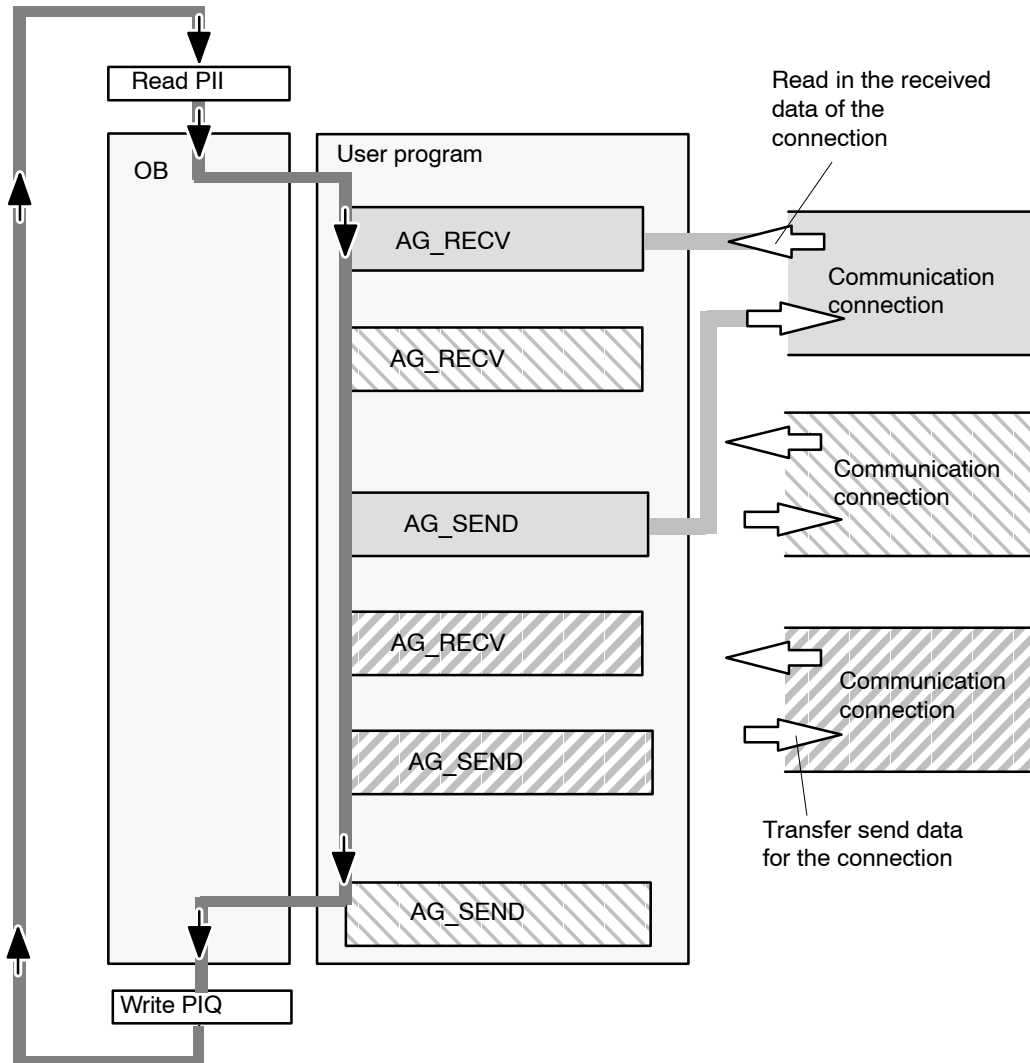
Connection numbers (IDs) must be taken from the configuration when programming.

To ensure correct parameter settings for the block calls, The LAD/STL/FBD editor in STEP 7 provides you with the option of accepting all the relevant parameters from the hardware configuration (HW Config) and from the connection configuration. For more information, refer to Section 7.2

---

### Calling FCs in the CPU Program

One possible sequence for FCs in conjunction with the organization and program blocks in the CPU cycle is illustrated in the following diagram.



Legend: Sequence of the CPU cycle  
 The different shading shows which connections and FC blocks belong together.

Figure 4-2 Typical Sequence of Function Calls in the CPU Cycle

The following points are illustrated by the diagram:

- The user program consisting of any number of blocks (OBs, FBs or FCs -> see also /6/ accesses several connections (Figure 4-2 illustrates three connections).



- At various points (event and program-controlled) the user program sends data on a connection using the AG\_SEND call.
- At various points in the CPU cycle, the user program accepts the data received on the connection using an AG\_RECV call.

---

**Note**

The blocks can also be called more than once in a cycle for the **same** communication connection.

---

### 4.3 Data Exchange S7 CPU <-> Ethernet CP

The Ethernet CP processes the send and receive jobs independent of the CPU cycle and requires one transmission time. The interface to the user program with the FCs is synchronized by an acknowledgment. Two situations must be distinguished:

- The CPU cycle is faster than the transmission time.
- The CPU cycle is slower than the transmission time.

---

#### Note

Please refer to the sequence charts for the FCs in Chapter 7. These charts show how to handle the SEND/RECEIVE interface in the user program for problem-free data exchange.

Remember the points below about the CPU cycle and transmission time.

---

#### FC Calls Faster than the Transmission Time

If a block is called again in the user program before data were transferred or received, the procedure is as follows on the interface of the FCs:

- AG\_SEND/AG\_LSEND/AG\_SSEND:  
No further job is accepted until the transmission of the data on the connection has been acknowledged by the Ethernet station. During this time, the user program receives the message "job active" until the Ethernet CP can accept the next job on the same connection.
- AG\_RECV/AG\_LRECV:  
The job is acknowledged with the message "no data available yet" if there are no received data on the Ethernet CP. The user program receives this message in the CPU cycle until the Ethernet CP has received data again on the connection.

### FC Calls Slower than the Transmission Time

If a block is called again before the data were completely transferred or received, the procedure is as follows on the interface of the FC blocks:

- AG\_SEND/AG\_LSEND/AG\_SSEND:  
The job is positively acknowledged. The Ethernet CP is ready to receive a new send job (at the earliest however with the next call).
- AG\_RECV/AG\_LRECV/AG\_SRECV:  
The job is acknowledged with “New Data Received” when the data have been transferred to the user program. Following this, the FC call can be repeated.

---

#### Notice

Remember that resource shortages can occur if the processing speeds on the sender and receiver are not the same (sender faster than receiver).

The sender receives a message from the FCs if problems occur (“No resources on the destination station”). (not with AG\_SRECV)

---

## 4.4 Additional Information

### 4.4.1 Programming Data Transfer on TCP Connections

#### Purpose of TCP Connections

TCP connections should be used above all for connections to systems of a different type if they do not support RFC1006.

For communication between devices of the SIMATIC family, you should use the more convenient ISO-on-TCP connections! The following sections explain certain special points to note.

#### Special Features

- Block types (FC calls)

Use only the following functions (FCs) for data transmission:

- With the older S7-CPs for S7-300, you must use FCs AG\_LSEND (FC 50) and AG\_LRECV (FC 60) on TCP connections!
- With the latest S7-CPs for S7-300, you also use FCs AG\_SEND (FC 5) and AG\_RECV (FC 6) for TCP connections.



- Frame length

On the TCP connections, the protocol contains no information about the end of a message and start of a new message.

The receiving station must therefore know how many bytes belong to a message and transfer an ANY pointer corresponding exactly to this length when FC AG\_LRECV is called. (Example: if 100 bytes of data are always transferred, the ANY pointer could appear as: P#DB100.DBX 0.0 Byte 100)

If you want to receive data with a variable length, follow the steps below:

Include information on the length of the user data in the frame before the actual user data. Initially, you should only evaluate the length information on the receiving station. Fetch the appropriate length of user data in another receive job by specifying an ANY pointer of the required length on the FC interface for fetching the actual user data.

## 4.4.2 Recommendations for Use with a High Communications Load

### Overview

The points below will help you to avoid overload situations on your CPU when using the Ethernet CPs.

In particular when you replace an older CP with a newer CP and are then confronted with overload problems, you should check your application for the pitfalls outlined below.

### Known Problems

- The functions for sending and receiving (FC5/FC6, FC50/FC60 or FC53/63) are often called cyclically in OB1. This leads to constant communication between the CPU and CP. As a result, other types of communication such as PG functions cannot be executed or only very slowly.
- HMI systems access data of the CPU too often using S7 functions. This slows down communication generally and there may be a lack of resources when SEND/RECEIVE FCs are called cyclically in OB1.

### Remedy

The recommendations below will help to avoid these situations:

- Do not call communication blocks cyclically in OB1!  
Communication should be called time-controlled in a suitable cyclic-interrupt OB. The call interval of this OB should be significantly higher than the average cycle time of your program.
- You should set a minimum cycle time that is higher than the average runtime of OB1. This frees resources for communication on the CPU. This is, for example, a remedy for existing applications when communication already takes place cyclically in OB1.
- If necessary, reduce the time taken for communication processing on the CPU by changing the parameters set for “cyclic load due to communication” in the properties dialog of the CPU.

## 5 Configuring Communication Connections

This chapter explains the following:

- The general aspects of configuring communication connections
- How to configure ISO transport, ISO-on-TCP, UDP and TCP connections
- How to use the connection configuration functions to specify communication partners that exchange data via UDP

You will find a description of the connection-specific properties dialogs in the following sections:

- ISO transport connections see Section 5.4
- ISO-on-TCP connections see Section 5.5
- TCP connections see Section 5.6
- UDP see Section 5.7



You will find further information in the following sources:

- For the properties of the configurable connection types, refer to Section 1.5
- There are situations in which communication connections are not set up over the configuration interface of STEP 7 but program-controlled by certain applications; see also Chapter 6.
- For the properties of the configurable connection type E-mail, refer to /5/.
- You will find information on the numbers of connections and amounts of data in Section 4.1.
- For information on configuring connections, refer to the online help of STEP 7 by selecting **Help ▶ Contents**.



HLP

## 5.1 Procedure

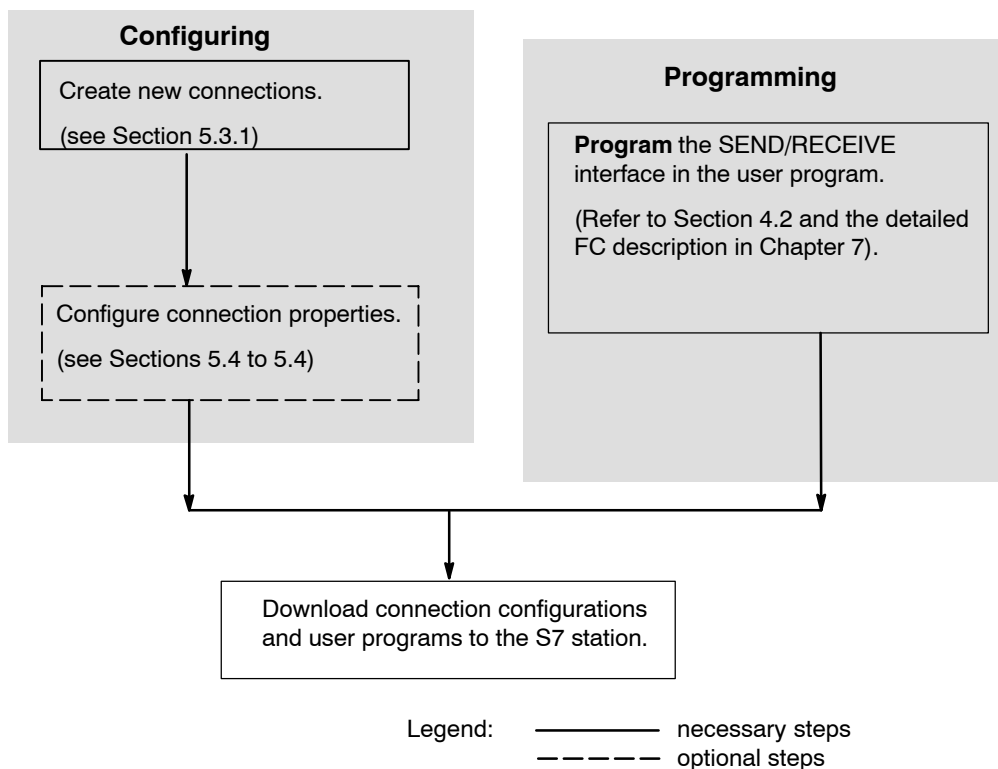
### Initial Situation

The steps described here assume the following:

1. You have created the local S7 station and the required partner stations in your STEP 7 projects (refer to the description in Chapter 3).
2. You have clarified the other station types with which connections must be established. You create substitute objects for these station types in your STEP 7 projects.

### Setting up Connections and Using Them in the User Program

The following steps are necessary to operate connections on the SIMATIC S7 PLC with the Ethernet CP:



## 5.2 Possible Connection Configurations

Communication connections are possible between the communication partners shown in the diagram below.

The communication partners can be in the same project or distributed in the subprojects of a multiproject.

Connections to communication partners outside a project are configured using the STEP 7 object "Partner other project" or using substitute objects such as "Other stations" or SIMATIC S5.

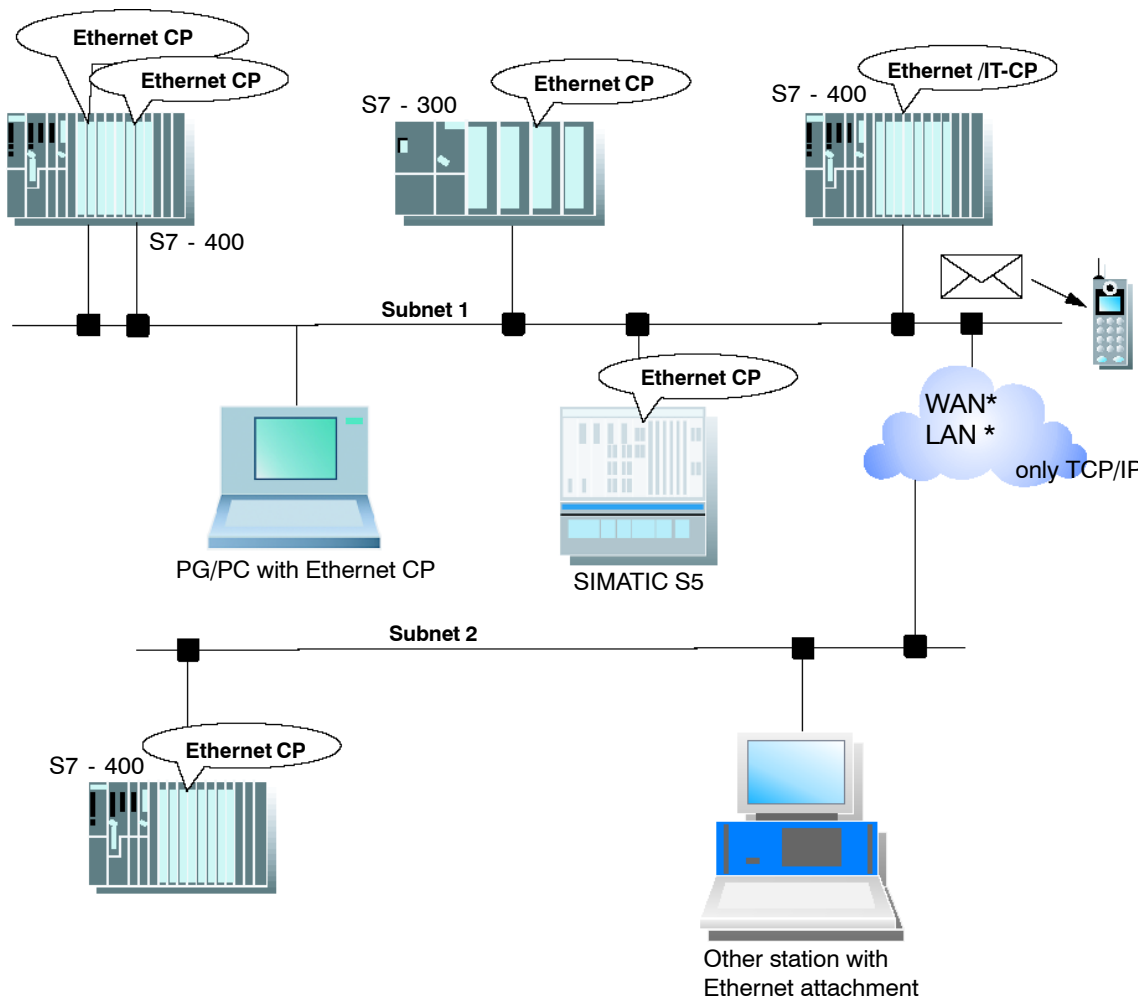
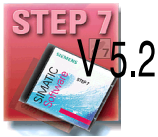


Figure 5-1 Possible Connections



## Organization in a Multiproject



If interproject subnets are configured, you can also configure connections over such subnets using STEP 7 V5.2. The endpoints of these connections can be located in different projects.

STEP 7 supports you both when creating interproject connections within a multiproject as well as when synchronizing connections that were configured without a multiproject context.

## 5.3 Connections

### Characteristics of a Connection

A communication connection allows program-controlled communication between two nodes on Industrial Ethernet with the following characteristics:

- The data transfer is bi-directional, in other words, it is possible to transmit and receive on the connection simultaneously.
- Both stations have the same rights, in other words, each station can trigger the send and receive procedures in response to events.
- The address of the communication partner is specified in the configuration.

Exceptions to this are:

- free UDP connections

Here, the address is specified at the FC interface in the user program.

- programmed communication connections (see Chapter 6)

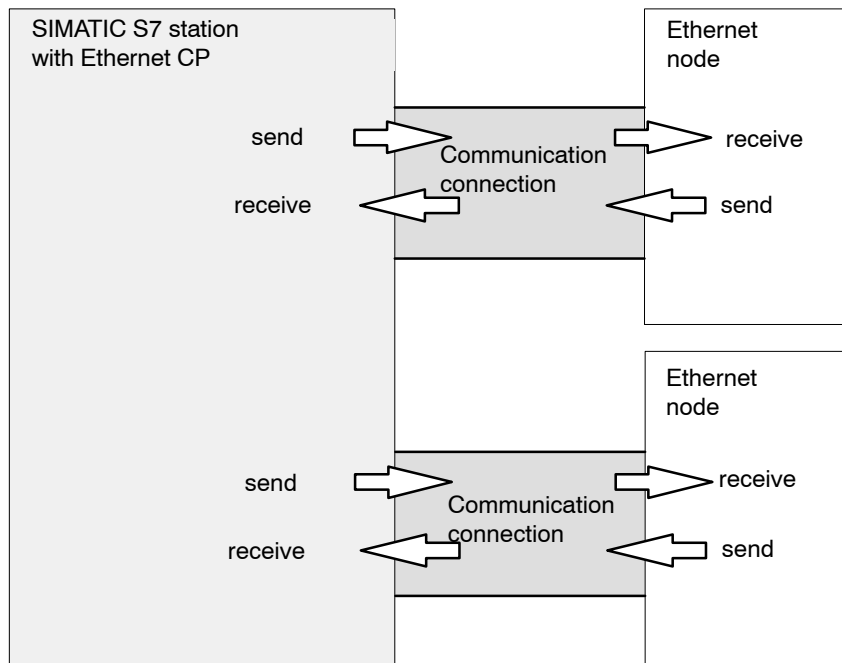


Figure 5-2 Sending and Receiving via one Communication Connection

**Note**

The term “connection” is also used here for UDP. Reason: During configuration (just as in TCP) the communication partners are assigned to each other and therefore logically “connected”. In actual fact, with UDP there is no explicit connection establishment between communication partners.

---

**Amounts of Data**

Refer to the manual /2/ supplied with the Ethernet CP for the number of communication connections supported by the Ethernet CP. The number of connections per station can be increased by adding more CPs.

The Ethernet CP can transfer the amounts of data shown in the table below per job on one connection:

Table 5-1

	<b>ISO Transport</b>	<b>ISO-on-TCP</b>	<b>TCP</b>	<b>UDP</b>
Sending	8192 bytes	8192 bytes	8192 bytes	2048 bytes
Receiving	8192 bytes	8192 bytes	8192 bytes	2048 bytes

**Notice**

The transfer of more than 240 bytes of data is supported by the current CPs. Older version CPs support data transfer with a data length of up to 240 bytes. Please note the information in Section 7 and in the manual of the Ethernet CP.

---

### Tasks of the Ethernet CP

When handling the data transfer on a connection, the Ethernet CP has the following tasks:

- When receiving

Receiving data from Ethernet and transferring it to the user data area on the CPU.

- When sending

Taking data from the user data area on the CPU and sending the data via Ethernet.

The connection is established automatically as soon as the partner is obtainable.

For a free UDP connection, the following functions are also necessary in addition to those above:

- When receiving

Entry of the sender of the message in the job header.

- When sending

Evaluation of the job header and addressing the partner

### Requirements for Configuring Connections

The Ethernet CP was entered in the hardware configuration and connected to the subnet.

As a bus node, the Ethernet CP has an address.

---

#### Notice

All stations not in the STEP 7 project must be configured with substitute objects (for example as "SIMATIC S5" or "Other stations").

or

Use the "unspecified" partner type when you create the connection.

---

### 5.3.1 New Connection

#### Principle

When you create new connections, you start from entered and networked stations. A connection is then configured starting from a station or CPU in the current S7 project and then selecting a destination station.

Due to the networking, the node addresses (MAC or IP addresses) of the two stations are already decided. The local/remote TSAPs (Transport Service Access Point) or ports at both ends of the connection are automatically assigned default values.

If the partner station is a station outside the current project or a non-S7 station, the remote TSAPs (Transport Service Access Point) or ports must be specified in the Properties dialog of the connection.

The endpoint of the connection to a SIMATIC S7 station is always a CPU. A separate connection table is created for each CPU and displays the connection partner and types of connections.

#### Creating a New Connection

To configure a new connection, the stations and their CPs must be configured and networked in the S7 project. To create a new connection, follow the steps below:

In NetPro, follow the steps below:

1. In NetPro, select the station or the CPU in the station from which you want to establish the connection.
2. Select the menu command **Insert ► New Connections** (also available with the right mouse button!)

**Result:** The following dialog appears on the screen.

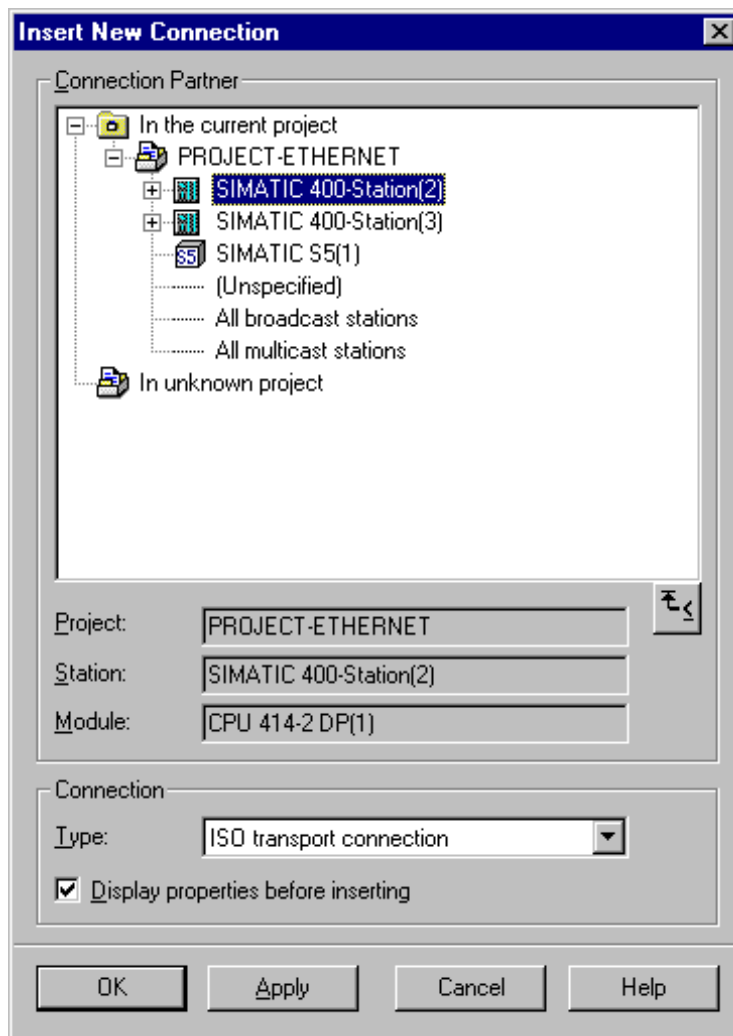


Figure 5-3 Layout of the “New Connection” Dialog (Example of an ISO Transport Connection)

3. Select the partner station to which you want to establish a connection (if several CPUs exist, please select the required CPU).
4. Select the connection type you want to use (for example ISO transport connection) in the “Type” box

When you confirm your input with **Apply**, the new connection is created and the “New Connection” dialog box remains open. This allows you to create further connections without needing to reopen the dialog box. The connection table is updated at the same time.

When you click **OK**, the connection is entered in the list, the dialog is terminated and the display in the main dialog is updated.

If you click **Cancel**, the dialog is terminated and the connection is not entered in the list.

## Handling Connections in a Multiproject



Interproject connections to a specified partner (for example, a CPU) are created in the same way as connections within a project (identical procedure). The dialog for selecting the connection partner has been extended and allows you not only to select the endpoint (module) but also the project within a multiproject to which the endpoint belongs.

The consistency of interproject connections is retained when you work with the projects of the multiproject:

- Interproject connections within a multiproject are implicitly broken when a project is taken out of the multiproject for distributed editing and the connection partner is located in the removed project.
- When the removed project is returned to the multiproject, STEP 7 automatically merges the broken connections consistently.

## Connections to Non-S7 Stations using Substitute Objects

If you want to configure connections to devices or stations that are not S7 stations, select a station of the type “SIMATIC S5”, “PC/PG” or “Other Station” as the destination station.

By creating these stations in NetPro and networking them, you have already specified the node addresses (MAC or IP addresses) of the two stations. You must specify the TSAP (Transport Service Access Point) for the destination station.

---

### Notice

Connections to non-S7 stations (for example SIMATIC S5) are generated as incompletely specified connections; in other words, the remote TSAP or port is empty. These connections must be specified in the Properties dialog.

---

### 5.3.2 Connections to Partners in Other Projects

There are various ways of creating connections to partners configured in other STEP 7 projects or with other tools outside the current STEP 7 project:

- Connections using substitute objects such as “SIMATIC S5”, “PC/PG”, “SIMATIC PC Station” or “Other Station”.

This method is described in the section above.

- Unspecified connections
- STEP 7 object “Partner in other project” (multiproject)



With this method, a connection is reserved in both subprojects that can be synchronized later by the system when the partner project is included in the multiproject.

In both projects, the same connection name must be configured in the properties of the connection. The connection name is used as a textual reference when the projects are merged. Based on the connection name it is possible to assign the connection partner and synchronize the connection properties.

Before the projects are merged, such connections are "unspecified connections" in terms of addressing; in other words, the partner addresses remain empty.

## Unspecified Connections

Connections to an as yet unknown device (for example a diagnostic unit) are configured as "unspecified" connections. They can be specified later in the Properties dialog.

You can create an unspecified connection simply by selecting station "unspecified" for the connection partner when you create the connection. The unspecified connection can be used in three ways (explained below based on the example of an ISO-on-TCP connection (ISO transport and TCP connections are analogous):

- Declare readiness for communication - passive connection establishment

The connection establishment is then set to passive (see settings in the General tab).

The address setting for the ISO-on-TCP connection is then as follows: The remote IP address and the remote TSAP are empty, in other words, they are not relevant for the CP. When the connection is established, any partner is accepted (partner = connection name that addresses the CP with the correct IP address and TSAP).

It is also possible to use a partial specification; in other words, communication is permitted with any partner that matches the specified TSAP.

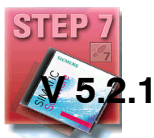
- Connection to a specific station in any project

The address setting for the ISO-on-TCP connection is then as follows: You can specify the remote IP address and the port of any destination station. The destination station can be in the current STEP 7 project or in another project.

Use this method if you have not created a substitute object for the partner station, for example SIMATIC S5, in the current project.

- IP Address Assignment over DHCP

If you select the option to obtain the IP address from a DHCP server, it is initially not possible to create a fully specified connection in the STEP 7 project because the local IP address is not known. You must therefore select "unspecified" with passive connection establishment as the connection type.





The following table lists the possible options.

Table 5-2

<b>Meaning for Connection Establishment</b>	<b>IP Address / MAC Address</b>	<b>TSAP / Port</b>	<b>Possible Connection Establishment</b>
by any partner	empty	empty	passive
by any partner via specific TSAP	empty	specified	passive
to or by a specific partner	specified	specified	active / passive

The free UDP connection is another variant. With this type of connection, the address of the connection partner is left open during configuration. The communication nodes are identified by address information in the communication job in the user program.

For further information, refer to the sections dealing with specific connections.

---

**Notice**







The number of connections possible per Ethernet CP can be found in the manual /2/supplied with the CP. If several CPs are installed in one station, the next CP is automatically selected if the limit is exceeded. The connections can be routed in the Properties dialog of the connection.

---

### 5.3.3 Further Functions

#### Toolbar

In the toolbar of the connection configuration dialog the following functions are available:

<p><b>Save</b></p> 	<p>To save the configured connection, select the Save function or click the save button.</p>
<p><b>Print</b></p> 	<p>You can print the entire connection table or individual sections of it by selecting the Print function or clicking the print button.</p> <p>The following print options are available:</p> <ul style="list-style-type: none"> <li>• Overview of all connections (complete connection table)</li> <li>• Overview of the selected connections (selected area)</li> <li>• Detailed printout of all connections (details of all connections)</li> <li>• Detailed printout of the selected connections (details of the selected area)</li> </ul>
<p><b>Change Connection Partners</b></p> 	<p>You assign a new partner station to the selected connection.</p> <p><b>Important!</b> Remember that this also changes the partner ID on connections of the SEND/RECEIVE interface. You may need to adapt your user program.</p>
<p><b>Insert Connection</b></p> 	<p>You create a new entry in the connection table.</p>
<p><b>Download</b></p> 	<p>You download the connection table to the PLC. For more detailed information call up the integrated help function.</p>
<p><b>Help</b></p> 	<p>If you require help or more information, select the Help function or click the help button.</p> <p>The help button provides you with context-related help. Using the help function you call a help dialog familiar from other Windows applications.</p>

#### Print Function in the “Overview” Tab

An additional function for printing the configured connections and configuration status is available in the “Overview” tab of the properties dialog of the connection.

### 5.3.4 Connections Without Assignment

#### Overview

This section explains the actions that can lead to a configured connection losing its assignment to the CP or being deleted.

#### Caution

Remember that in contrast to the S7 connections, the connections of the SEND/RECEIVE interface are assigned a CP-dependent ID. The actions below may require the ID to be modified so that the interface information in the user program must also be adapted.

#### Notice

If you replace one CP with another, this must provide at least the same services and have at least the same version. This is the only way to ensure that the connections configured over the CP remain consistent and can be used.

Table 5-3 Actions That Can Cause Changes to Configured Connections

Action	Consequences for the Connections	How to Establish the Connection Again
The CP (module) is moved to a different location in the hardware configuration (drag and drop)	The connections are retained. The connection IDs are automatically updated.	
The CP (module) is deleted in the hardware configuration. You receive the message "CP has n connections; the assignment will be lost in the connection table".	The connections remain <b>without assignment to a CP</b> in the connection table. In the "Overview" tab of the Properties dialog, the connections are identified with "!".	Once you have placed a CP in the hardware configuration and networked it: <ol style="list-style-type: none"> <li>1. Assign the CP in the connection properties dialog in the "Addresses" tab. <b>or</b> Reassign the connection using the menu option <b>Edit ► Connection Partner...</b></li> <li>2. Check the module start address and if necessary adapt it in the user program</li> <li>3. Adapt the connection ID in the user program.</li> <li>4. Download the connection configuration to the CP again.</li> </ol>

Table 5-3 Actions That Can Cause Changes to Configured Connections, continued

<b>Action</b>	<b>Consequences for the Connections</b>	<b>How to Establish the Connection Again</b>
Deleting the SIMATIC S7 station.	All the connections to this station are deleted within the project. Note: The does not apply to connections to a partner that uses a router.	Reconfigure the station and connections.
Deleting a remote station.	The connections of the stations in the project to remote stations remain <b>without assignment</b> in the connection table. In the "Overview" tab of the Properties dialog, the connections are identified with "!".	Reassign a remote station (or even a local station) using the menu option <b>Edit ► Connection Partner...</b>
Changing the subnet assignment of the CP.	The connections that were assigned via the CP remain without an assignment in the connection table. In the "Overview" tab of the Properties dialog, the connections are identified with "!". Note: The does not apply to connections if a router is used.	Reassign the connections using the menu option <b>Edit ► Connection Partner...</b> or in the "Addresses" tab of the properties dialog for the connection.

**Display (Example)**

The status of connections is displayed in the “Properties ISO Transport Connection” dialog in the “Overview” tab.

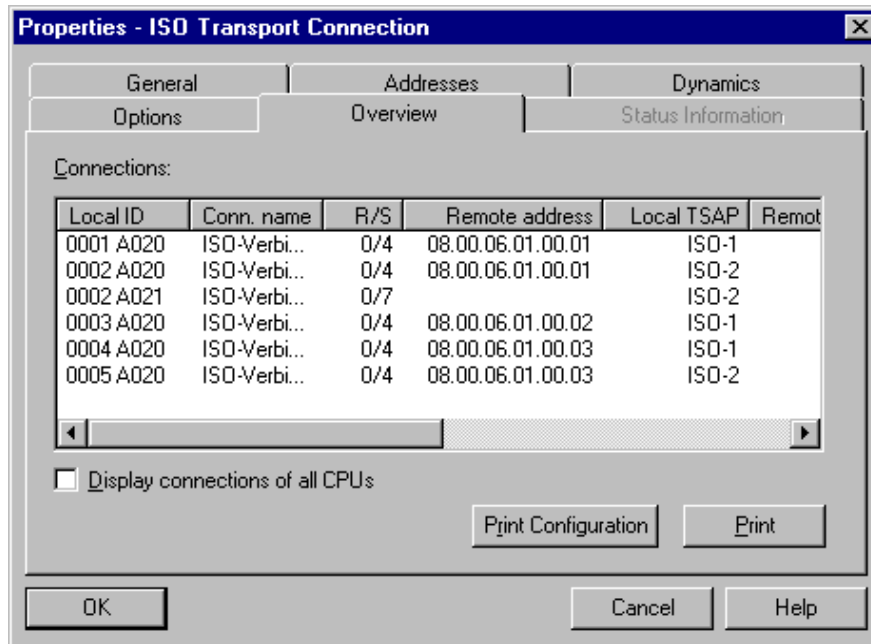


Figure 5-4 Status of the Connections in the “Overview” Tab (Example of ISO Transport Connections)

## 5.4 Configuring ISO Transport Connections

### Introduction

When you create a connection in the New dialog, you specify the connection type and, as far as possible, the connection partner.

When necessary, you can adapt other connection partners that are set as default when you create a new connection as described below.

### Opening the Dialog

To call the dialog for special connection properties, follow the steps outlined below:

1. Select the required connection in the connection table.
2. Select the menu option **Edit ► Object Properties**

**Result:** The “Properties ISO Transport Connection” dialog appears.

### Tabs

The following tabs are available for ISO transport connections:

- **General**  
Displays parameters that identify the connection.
- **Addresses**  
Displays the local and remote address information.
- **Dynamics**  
Displays the relevant timers and counters.
- **Options**  
Here, you can decide whether or not you want to use the connection for one of the access types FETCH or WRITE.
- **Overview**  
This is an overview of all the configured ISO transport connections of the selected station with their parameters and the status of the connection.
- **Status Information**  
This tab displays the current status information for the connection (valid at the time the dialog is opened). This information corresponds to the NCM Diagnostics display and is only available when the station can be reached online.

### 5.4.1 Specifying the Local Connection Endpoint

#### General Tab

This tab of the Properties dialog displays general connection parameters that identify the local connection endpoint.

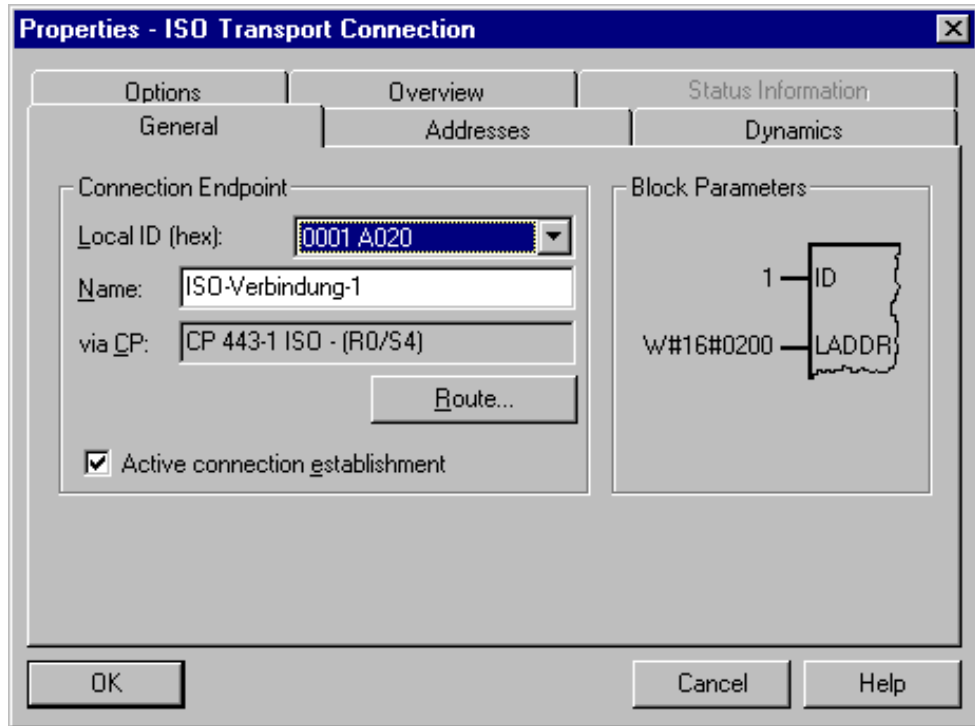


Figure 5-5 Layout of the Properties Dialog for the “General” Tab (ISO Transport Connections)

Attributes	Description	Access
<b>Local Endpoint</b>		
ID	The entry is identical to the Local ID parameter in the connection table.	Selectable
Name	When you create the connection, a name is proposed here for the connection endpoint along with a connection number as suffix. With unspecified connections, use this box to identify the partner.	Modifiable
Via CP	If the station contains more than one CP of the same type connected to the same subnet, you can select the connection route. -> "Route" button see Section 5.9.  If no CP is assigned (for example because the CP was previously deleted) "none" is displayed here.	Display only
Active Connection Establishment	With this option, you specify whether the connection is established by this S7 station. This is the default setting when the address of the partner is specified. ON: the connection is established actively. OFF: the connection is established by the partner. If you selected partner "unspecified" when you created the connection, the option is deselected as default. If you activate the option, you must also specify the address of the partner in the "Addresses" tab.  Note: Please note the effects on the mode. If you want to use the FETCH or WRITE mode (refer to the "Options" tab), the mode must be set to "Passive" for the S7 station.	Modifiable
<b>Block Parameters</b>		
ID	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection. The ID changes if the local ID is changed.	Display only
LADDR	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection.	Display only

### Connection Name (Reference) - Only in Multiproject



If you create a connection to a partner in another project that has not yet been merged with the current multiproject, you must specify a connection name as a reference (not to be confused with the name of the connection endpoint described above). Interproject connections can then be joined up based on this reference. As soon as the connections have been joined, the connection name (reference) is no longer relevant and is no longer displayed.



## 5.4.2 Specifying ISO Transport Addresses

### Address Parameters

An ISO transport connection is specified by the local and remote connection endpoint.

- Local addresses:  
Local MAC address and local TSAP (Transport Service Access Point)
- Remote addresses:  
Remote MAC address and remote TSAP

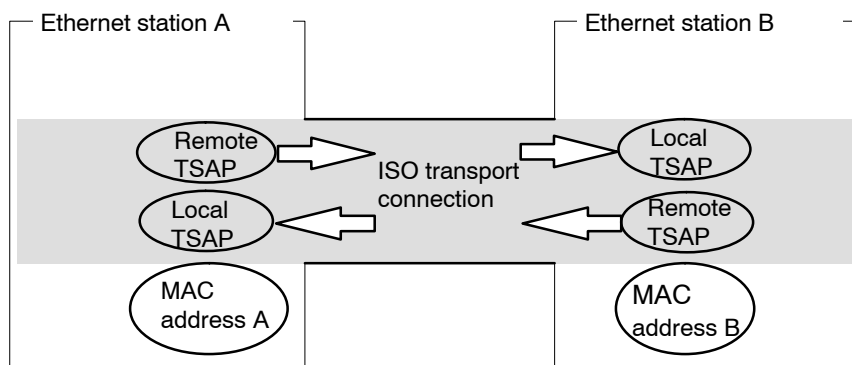


Figure 5-6 Sending and Receiving on **One** ISO Transport Connection

### Notice

The TSAPs of an ISO transport connection must match as follows:

Remote TSAP (on Ethernet CP) = local TSAP (in destination station);

Local TSAP (on Ethernet CP) = remote TSAP (in destination station);

## Addresses Tab

The addresses tab displays proposed values for the relevant local and remote address information. When connecting to non-S7 stations, you can set the TSAP addresses individually.

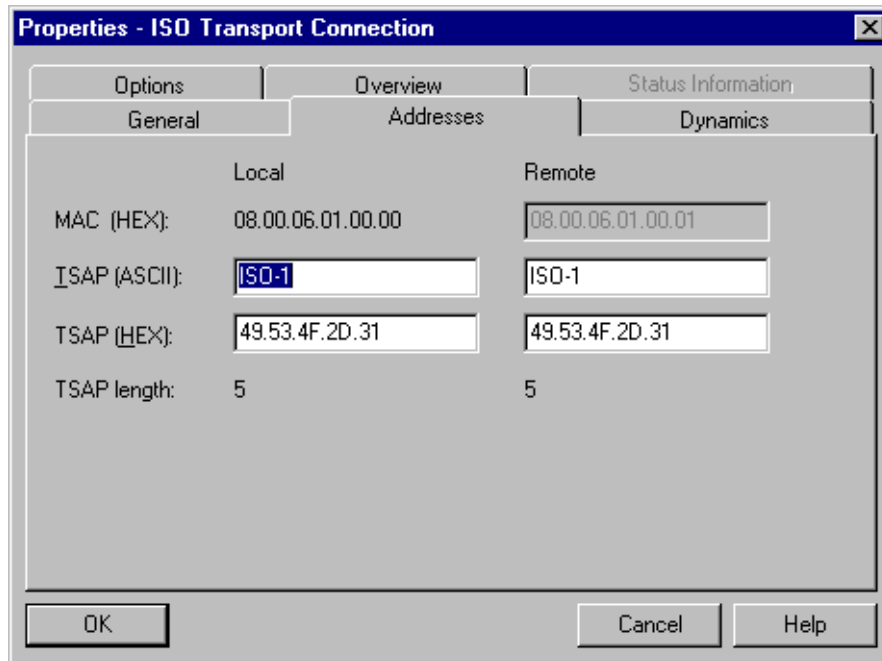


Figure 5-7 Layout of the “Addresses” Tab of the Properties Dialog with Default TSAPs

## TSAP Format

ISO transport connections have a TSAP length of 1 to 16 bytes. When you are entering values, the current length is displayed automatically (visible display: 16 ASCII characters). Local and remote TSAPs can be input as hexadecimal values or as ASCII strings. If you make your entries in ASCII, the characters you enter are also displayed in hexadecimal format. If you make your entries in hexadecimal, printable characters are displayed in ASCII (8 hexadecimal values are visible). If you enter nonprintable characters, the ASCII display is gray (no further ASCII entries possible) and the nonprintable characters are displayed as periods.

## Local and Remote TSAPs

Remote and local TSAPs can be identical since the connection is uniquely identified by the different MAC addresses. If you require more than one connection between two stations, the TSAPs must also be different.

## Default TSAPs

When configuring the local and remote TSAPs, there is a default value “ISO-1” for the first connection between the two partners (can be changed). For a new connection between the two partners, the default value “ISO-2” is proposed. With a new connection to a new partner, the value ISO-1 is used again.

## Addresses Tab - Unspecified ISO transport connection

If you select the partner type as “unspecified”, depending on your task, you can enter address information about the communication partner here. The options available to you are explained in detail in Section 5.3.1.

The Addresses tab shown here illustrates the situation in which the MAC address and the remote TSAP were not specified. If you do not make any further settings, this means that you are willing to accept a connection establishment request from any communication partner.

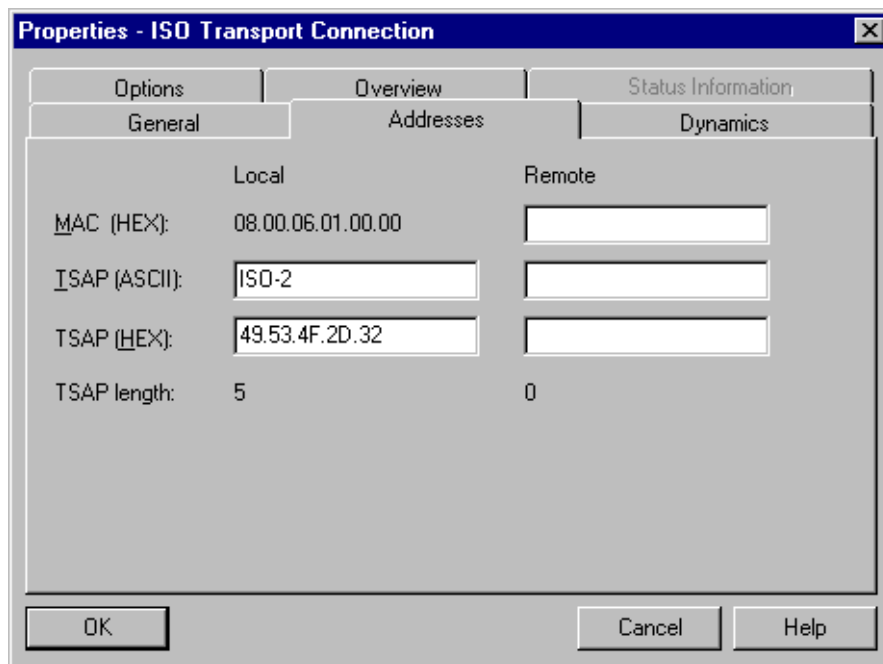


Figure 5-8 Layout of the “Addresses” Tab of the Properties Dialog for an Unspecified Connection

### 5.4.3 Specifying ISO Transport Dynamic Properties

#### Dynamics Tab

The Dynamics tab displays the relevant timers and counters of this connection. You can normally accept these default values.

If necessary, for example with connections to non-Simatic systems, you can set the timers and counters individually and influence the dynamic response of the connection.

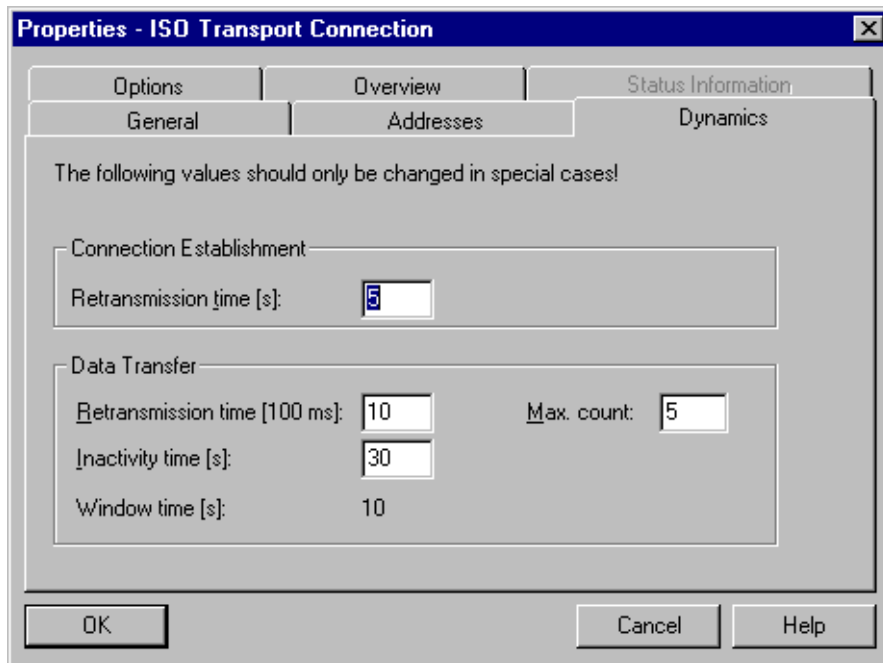


Figure 5-9 Layout of the “Dynamics” Tab of the Properties Dialog

Attributes	Description	Access
<b>Connection Establishment</b>		
Retransmission Time	The retransmission time specifies the interval after which an unsuccessful connection establishment attempt can be triggered again (1 - 60 s, default 5 s) - if connection establishment is active - if connection establishment is passive (-> irrelevant)	Modifiable -----
<b>Data Transfer</b>		
Retransmission time	This parameter specifies the interval after which an unsuccessful transmission attempt can be triggered again (100-30000 ms, default 1000 ms).	Modifiable

---

Attributes	Description	Access
Max. CMax. Count is the number of attempted transmissions including the first (1-100, default 5).ount		Modifiable
Inactivity Time	The inactivity time specifies the interval after which the connection is terminated if no sign of life is received from the partner (6-180 s, default 30 s).	Modifiable
Window Time	The window time specifies the interval at which sign of life frames are sent. For SIMATIC NET CPs, the window time is set to 1/3 of the inactivity time (2-60 s, default 10 s). Sign of life frames are sent to check the connection when there is no data traffic.	Display only

---

**Notice****Window Time and Inactivity Time**

The partner responds to a sign of life frame with a frame. They are therefore sent to the partner at the intervals of the window time. To avoid unwanted connection termination, the inactivity time should be at least three times as long as the window time.

---

### 5.4.4 Checking ISO Transport Connection Properties

#### Overview Tab

The Overview tab displays all previously configured ISO transport connections and their parameters for this station (information only).

For an example of this display, refer to Section 5.3.4.

Parameter	Description
Local ID	S7 Station: This is the connection ID of the ISO transport connection; PC Station: Identification number for the connection.
Name	Name entered for the connection endpoint.
CPU / Applications	If you display all the ISO transport connections being operated in this station in the multiprocessor mode (with PC stations: multiple applications), the CPU/application that is the endpoint of the particular connection is specified here.
R/S or via CP	With S7-CPs: Rack/slot of the local CP via which the connection is established. With PC stations: Display of the CP over which the connection is maintained.
Remote address	Specifies the remote MAC address of the connection on the Ethernet subnet.
Local TSAP	Transport <b>S</b> ervice <b>A</b> ccess <b>P</b> oint for the local connection endpoint.
Partner TSAP	Transport <b>S</b> ervice <b>A</b> ccess <b>P</b> oint for the remote connection endpoint.
Mode	Displays the mode configured in the "Options" tab.
Status	Indicates the current configuration of the connection. "Connections without assignment" are indicated by " <b>No local CP/No remote CP</b> " in the status column and a "!" character at the end of the "Local ID" (for example: 0002 A000!). Connections you are currently editing are also indicated by "!" at the end of the local ID.

You can set the column widths in the "Overview" tab individually.

#### Connection Overview with Multiple CPUs in an S7 Station

If you operate more than one CPU in your S7 station, you can click the button to extend the overview to the connections on all CPUs.

## 5.5 Configuring ISO-on-TCP Connections Properties

### Introduction

When you create a connection in the New dialog, you specify the connection type and, as far as possible, the connection partner.

When necessary, you can adapt other connection partners that are set as default when you create a new connection as described below.

### Opening the Dialog

To call the dialog for special connection properties, follow the steps outlined below:

1. Select the required connection in the connection table.
2. Select the menu option **Edit ► Object Properties**

**Result:** The “Properties ISO-on-TCP Connection” dialog appears.

### Tabs

The following tabs are available for ISO-on-TCP connections:

- **General**  
Displays parameters that identify the connection.
- **Addresses**  
Displays the local and remote address information.
- **Options**  
Here, you can decide whether or not you want to use the connection for one of the access types FETCH or WRITE.
- **Overview**  
This is an overview of all the configured ISO-on-TCP connections of the selected S7 station with their parameters and the status of the connection.
- **Status Information**  
This tab displays the current status information for the connection (valid at the time the dialog is opened). This information corresponds to that displayed by NCM diagnostics.

### 5.5.1 Specifying the Local Connection Endpoint

#### General Tab

This tab of the Properties dialog displays general connection parameters that identify the local connection endpoint.

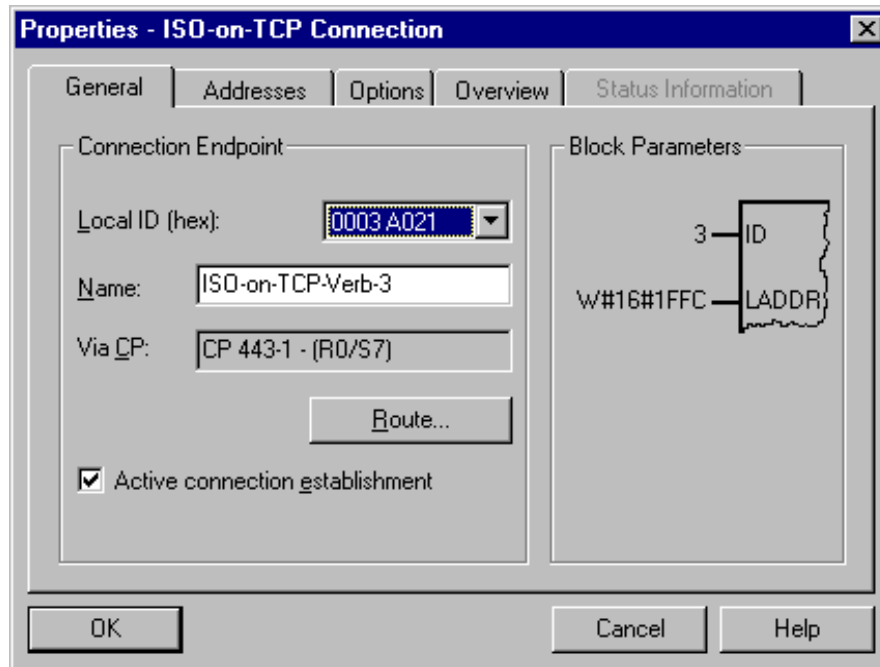


Figure 5-10 Layout of the "General" Tab in the Properties Dialog for ISO-on-TCP Connections



Parameter	Description	Access
<b>Local Endpoint</b>		
ID	The entry is identical to the Local ID parameter in the connection table.	Selectable
Name	When you create the connection, a name is proposed here along with a connection number as suffix. With unspecified connections, use this box to identify the partner.	Modifiable
Via CP	If the station contains more than one CP of the same type connected to the same subnet, you can select the connection route. -> "Route" button see Section 5.9. If no CP is assigned (for example because the CP has been deleted) "none" is displayed here.	Display only
Active Connection Establishment	With this option, you specify whether the connection is established by this S7 station. This is the default setting when the address of the partner is specified. ON: the connection is established actively. OFF: the connection is established by the partner. If you selected partner "unspecified" when you created the connection, the option is deselected as default. If you activate the option, you must also specify the address of the partner in the "Addresses" tab. Note: Please note the effects on the mode. If you want to use the FETCH or WRITE mode (refer to the "Options" tab), the mode must be set to "Passive" for the S7 station.	Modifiable
<b>Block Parameters</b>		
ID	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection. The ID changes if the local ID is changed.	Display only
LADDR	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection.	Display only

### Connection Name (Reference) - Only in Multiproject



If you create a connection to a partner in another project, that has not yet been merged with the current multiproject, you must enter a connection name as reference. Interproject connections can then be joined up based on this reference. As soon as the connections have been brought together, the connection name (reference) can no longer be entered.

## 5.5.2 Specifying ISO-on-TCP Addresses

### Address Parameters

A connection is specified by the local and remote connection endpoint.

- Local addresses:  
Local IP address and local TSAP  
(Transport Service Access Point)
- Remote addresses:  
Remote IP address and remote TSAP

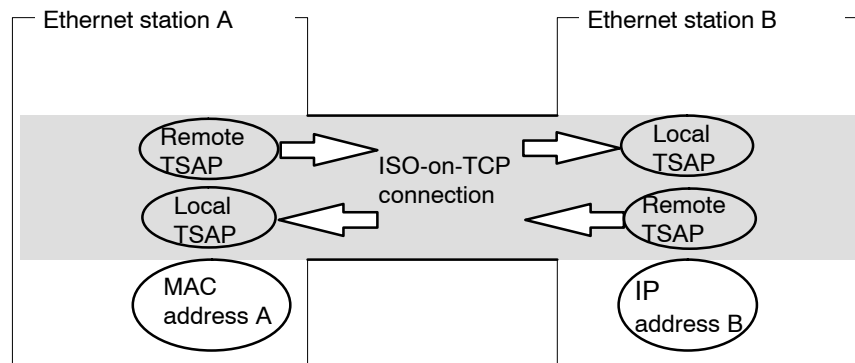


Figure 5-11 Sending and Receiving on **One** ISO-on-TCP Connection

The address parameters are configured with NCM S7 and saved in the CP database. Modifications and extensions to the Industrial Ethernet network topology do not therefore have any effect on the CPU user program.

### Notice

When you configure the Ethernet CP and the Ethernet destination station, the TSAPs of an ISO-on-TCP connection must cross match:  
 Remote TSAP (in Ethernet CP) = local TSAP (in destination station)  
 Local TSAP (in Ethernet CP) = remote TSAP (in destination station)

## Addresses Tab

The addresses tab displays proposed values for the relevant local and remote address information. If necessary, you can set the TSAP addresses individually.

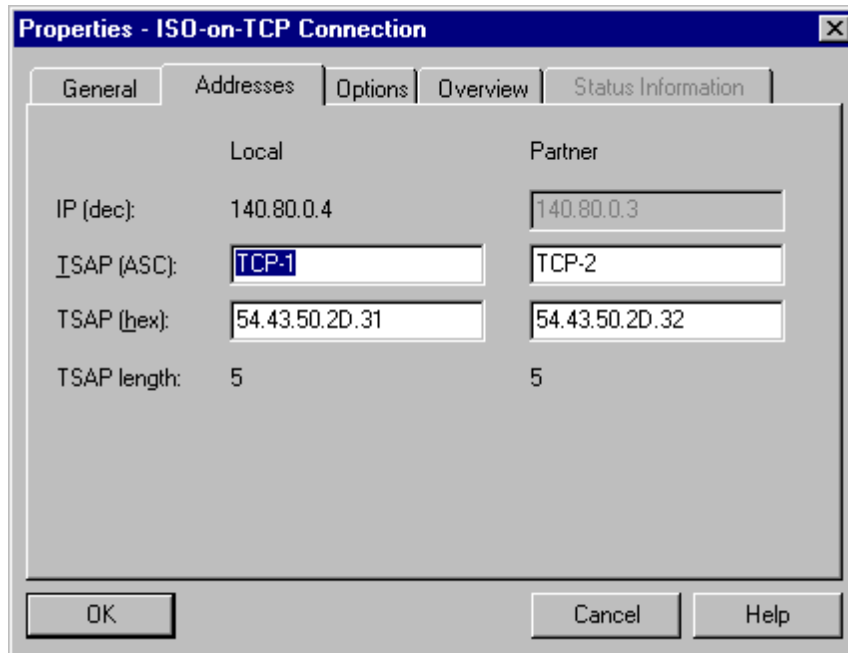


Figure 5-12 Layout of the “Addresses” Tab of the Properties Dialog with Default TSAPs for ISO-on-TCP Connections

## TSAP Format

ISO-on-TCP connections have a TSAP length of 1 to 16 bytes. When you are entering values, the current length is displayed automatically (visible display: 16 ASCII characters). Local and remote TSAPs can be input as hexadecimal values or as ASCII strings. If you make your entries in ASCII, the characters you enter are also displayed in hexadecimal format. If you make your entries in hexadecimal, printable characters are displayed in ASCII (8 hexadecimal values are visible). If you enter nonprintable characters, the ASCII display is gray (no further ASCII entries possible) and the nonprintable characters are displayed as periods.

## Local and Remote TSAPs

Remote and local TSAPs can be identical since the connection is uniquely identified by the different MAC addresses. If you require more than one connection between two stations, the TSAPs must also be different.

## Default TSAPs

When configuring the local and remote TSAPs, there is a default value “TCP-1” for the first connection between the two partners (can be changed). For a new connection between the two partners, the default value “TCP-2” is proposed. With a new connection to a new partner, the value TCP-1 is used again.

## Addresses Tab - Unspecified ISO-on-TCP Connection

If you select the partner type as “unspecified”, depending on your task, you can enter address information about the communication partner here. The options available to you are explained in detail in Section 5.3.1.

The Addresses tab shown here illustrates the situation in which the remote IP address and the remote TSAP were not specified. If you make no further entries, you are accepting connection establishment from any communication partner.

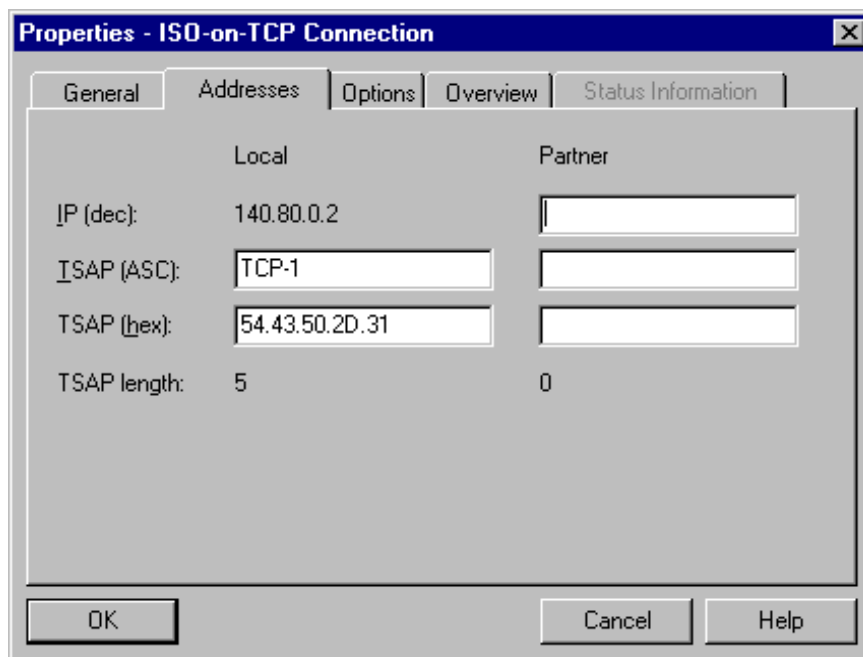


Figure 5-13 Layout of the “Addresses” Tab of the Properties Dialog for an Unspecified Connection

### 5.5.3 Checking ISO-on-TCP Connection Properties

#### Overview Tab

The overview shows all the configured ISO-on-TCP connections and their parameters (cannot be modified here).

You can adjust the width of the columns in the table.

For an example of this display, refer to Section 5.3.4 (the ISO transport connection).

Parameter	Description
Local ID	This is the connection ID of the ISO-on-TCP connection (STEP 7 connection configuration; DWORD)
Name (loc. endpoint)	Entered connection name. This identifies the ISO-on-TCP connection.
CPU / Applications	If you display all the ISO transport connections being operated in this station in the multiprocessor mode (with PC stations: multiple applications), the CPU/application that is the endpoint of the particular connection is specified here.
R/S or via CP	With S7-CPs: Rack/slot of the local CP via which the connection is established. With PC stations: Display of the CP over which the connection is maintained.
Partner address	Specifies the remote IP address of the connection.
Local TSAP	Local Transport Service Access Point (8 characters default)
Remote TSAP	Remote transport service access point (8 characters default).
Mode	Displays the mode configured in the "Options" tab.
Status	Indicates the current configuration of the connection. "Connections without assignment" are indicated by " <b>No local CP/No remote CP</b> " in the status column and a "!" character at the end of the "Local ID" (for example: 0002 A000!). Connections you are currently editing are also indicated by "!" at the end of the local ID.

#### Connection Overview with Multiple CPUs in an S7 Station

If you operate more than one CPU in your S7 station, you can click the button to extend the overview to the connections on all CPUs.

## 5.6 Configuring TCP Connection Properties

### Introduction

When you create a connection in the New dialog, you specify the connection type and, as far as possible, the connection partner.

When necessary, you can adapt other connection partners that are set as default when you create a new connection as described below.

### Opening the Dialog

To call the dialog for special connection properties, follow the steps outlined below:

1. Select the required connection in the connection table.
2. Select the menu option **Edit ► Object Properties**

**Result:** The “Properties - TCP Connection” dialog appears.

### Tabs

The following tabs are available for TCP connections:

- **General**  
Displays parameters that identify the connection.
- **Addresses**  
Displays the local and remote address information.
- **Options**  
Here, you can decide whether or not you want to use the connection for one of the access types FETCH or WRITE.
- **Overview**  
This is an overview of all the configured TCP connections of the selected S7 station with their parameters and the status of the connection.
- **Status Information**  
This tab displays the current status information for the connection (valid at the time the dialog is opened). This information corresponds to that displayed by NCM diagnostics.

## 5.6.1 Specifying the Local Connection Endpoint

### General Tab

This tab of the Properties dialog displays general connection parameters that identify the local connection endpoint.

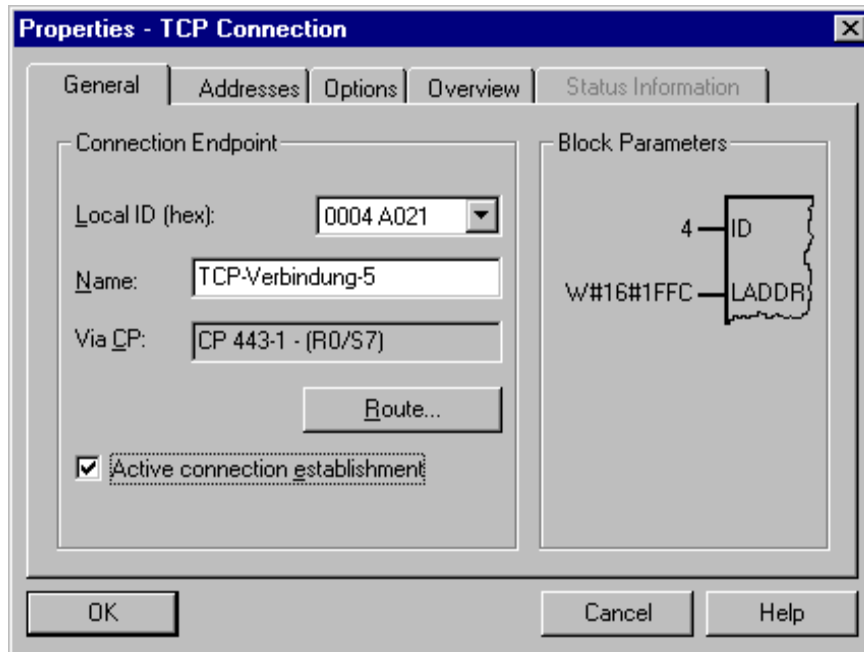


Figure 5-14 Layout of the “General” Tab in the Properties Dialog for TCP Connections

Attributes	Description	Access
<b>Local Endpoint</b>		
ID	The entry is identical to the Local ID parameter in the connection table.	Selectable
Name	When you create the connection, a name is proposed here along with a connection number as suffix. With unspecified connections, use this box to identify the partner.	Modifiable
Via CP	If the station contains more than one CP of the same type connected to the same subnet, you can select the connection route -> "Route", see Section 5.9. If no CP is assigned (for example because the CP has been deleted) "none" is displayed here.	Display only
Active Connection Establishment	With this option, you specify whether the connection is established by this S7 station. This is the default setting when the address of the partner is specified. If you selected partner "unspecified" when you created the connection, the option is deselected as default. If you activate the option, you must also specify the address of the partner in the "Addresses" tab. ON: the connection is established actively. OFF: the connection is established by the partner.	Modifiable
Use for FTP protocol	Selecting the option has the following effects: <ul style="list-style-type: none"> <li>• The TCP connection is now used as an FTP connection.</li> <li>• "Addresses" tab: The addresses are specified automatically (Port=21)</li> <li>• "Options" tab: The mode is set permanently to FTP.</li> <li>• The "Active connection establishment" option is irrelevant and cannot be set.</li> </ul> Configuration limits: see /2/ Precondition: The option can only be selected for an unspecified TCP connection.	Modifiable
<b>Block Parameters</b>		
ID	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection. The ID changes if the local ID is changed.	Display only
LADDR	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection.	Display only



### Connection Name (Reference) - Only in Multiproject



If you create a connection to a partner in another project, that has not yet been merged with the current multiproject, you must enter a connection name as reference. Interproject connections can then be joined up based on this reference. As soon as the connections have been brought together, the connection name (reference) can no longer be entered.

## 5.6.2 Specifying TCP Addresses

### Address Parameters and Connection Types

With TCP, the communication partners are addressed by the local and remote endpoints as follows:

- Local addresses:  
Local IP address and local port
- Remote addresses:  
Remote IP address and remote port

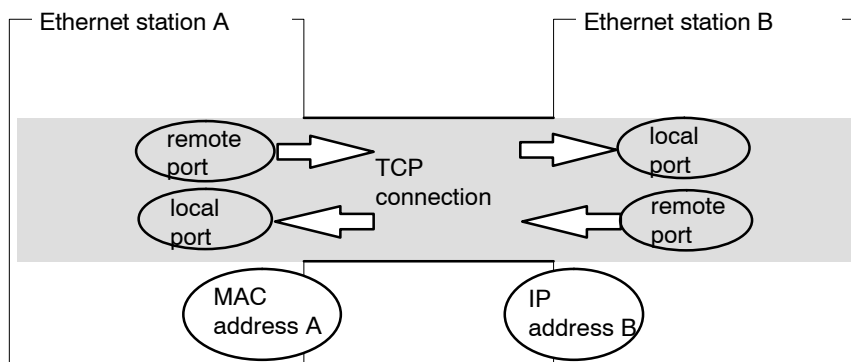


Figure 5-15 Sending and Receiving on One TCP Connection

Depending on the required connection type, the remote address parameters are either specified or left open during configuration.

- Specified TCP connection  
You specified a destination station when you created the connection.
- Unspecified TCP connection  
You entered “unspecified” for the connection partner when you created the connection.

### Addresses Tab - Specified TCP Connection

The addresses tab displays proposed values for the relevant local and remote address information. You can change the port settings individually.

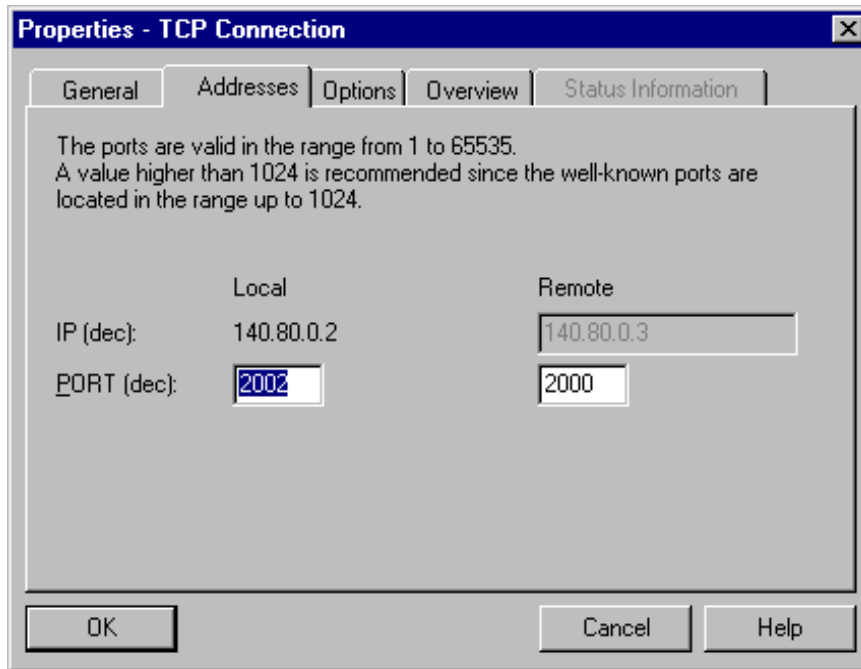


Figure 5-16 Layout of the Properties Dialog in the “Addresses” tab with DEFAULT Ports for TCP Connections

### Ports

The ports or port addresses define the access point to the user program within the station / CPU. They must be unique within the station / CPU!

The following table shows the range of values:

Table 5-4

Application / Note	Port Addresses
Fixed, must not be used!	0
Assigned as default, should not be used (well-known ports)	1 to 1024

Table 5-4 , Fortsetzung

Application / Note	Port Addresses
Range used by NCM in which a free port address is searched for and assigned. You can set any port address within this range.	from 2000 to 5000
Port addresses higher than 5000 are used by the system! Note: If you want to use these port addresses, please contact your system administrator.	from 5000...65535

The following port numbers are reserved; you should not use these for other purposes in the connection project engineering.

Table 5-5 Reserved Port Numbers

Protocol	Port Number	Service
TCP	20, 21	FTP
TCP	25	SMTP
TCP	80	HTTP
TCP	102	RFC1006
TCP	135	RPC-DCOM
UDP	161	SNMP_REQUEST
UDP	34964	PN IO
UDP	65532	NTP
UDP	65533	NTP
UDP	65534	NTP
UDP	65535	NTP

### Addresses Tab - Unspecified TCP Connection

If you select the partner type as “unspecified”, depending on your task, you can enter address information about the communication partner here. The options available to you are explained in detail in Section 5.3.1.

The Addresses tab shown here illustrates the situation in which the remote port but not the IP address was specified. If you make no further entries, you are accepting connection establishment with any communication partner that uses the specified port.

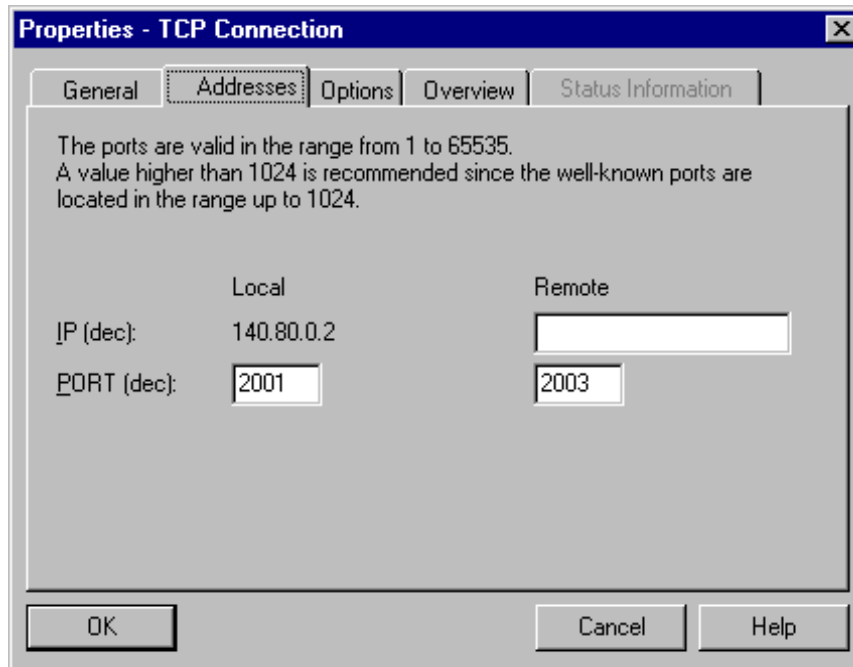


Figure 5-17

### 5.6.3 Checking TCP Connection Properties

#### Overview Tab

The overview shows all the previously configured TCP connections and their parameters (cannot be modified here).

You can adjust the width of the columns in the table.

For an example of this display, refer to Section 5.3.4 (the ISO transport connection).

Parameter	Description
ID	This is the connection ID of the TCP connection (STEP 7 connection configuration; DWORD).
Name (loc. endpoint)	Entered connection name. It identifies the TCP connection (8 character double width).
CPU / Applications	If you display all the ISO transport connections being operated in this station in the multiprocessor mode (with PC stations: multiple applications), the CPU/application that is the endpoint of the particular connection is specified here.
R/S or via CP	With S7-CPs: Rack/slot of the local CP via which the connection is established. With PC stations: Display of the CP over which the connection is maintained.
Partner address	Specifies the remote IP address of the connection.
Local port	Local port (8 characters default length)
Remote port	Remote port (8 characters default width)
Mode	Displays the mode configured in the "Options" tab.
Status	Indicates the current configuration of the connection. "Connections without assignment" are indicated by " <b>No local CP/No remote CP</b> " in the status column and a "!" character at the end of the "Local ID" (for example: 0002 A000!). Connections you are currently editing are also indicated by "!" at the end of the local ID.

#### Connection Overview with Multiple CPUs in an S7 Station

If you operate more than one CPU in your S7 station, you can click the button to extend the overview to the connections on all CPUs.

## 5.7 Configuring UDP Connection Properties

### Introduction

When you create a connection in the New dialog, you specify the connection type and, as far as possible, the connection partner.

When necessary, you can adapt other connection partners that are set as default when you create a new connection as described below.

### Opening the Dialog

To call the dialog for special connection properties, follow the steps outlined below:

1. Select the required connection in the connection table.
2. Select the menu option **Edit ▶ Object Properties**

**Result** The “Properties - UDP Connections“ dialog appears.

### Tabs

The following tabs are available for UDP connections:

- **General**  
Displays parameters that identify the connection.
- **Addresses**  
Displays the local and remote address information.
- **Overview**  
Overview of all configured UDP connections of the selected S7 station with corresponding parameters and the status of the connection.
- **Status Information**  
This tab displays the current status information for the connection (valid at the time the dialog is opened). This information corresponds to that displayed by NCM diagnostics.

### 5.7.1 Specifying the Local Connection Endpoint

#### General Tab

This tab of the Properties dialog displays general connection parameters that identify the local connection endpoint.

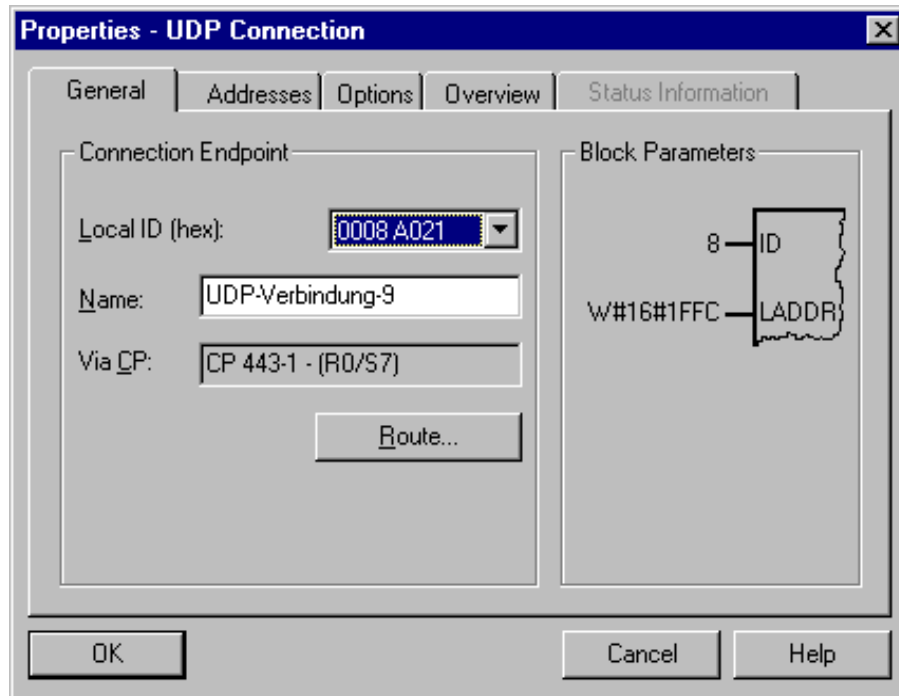


Figure 5-18 Layout of the "General" Tab in the Properties Dialog for UDP Connections

Attributes	Description	Access
<b>Local Endpoint</b>		
ID	The entry is identical to the Local ID parameter in the connection table.	Selectable
Name	When you create the connection, a name is proposed here along with a connection number as suffix. With unspecified connections, use this box to identify the partner.	Modifiable
Via CP	If the station contains more than one CP of the same type connected to the same subnet, you can select the connection route -> "Route", see Section 5.9. If no CP is assigned (for example because the CP has been deleted) "none" is displayed here.	Display only
<b>Block Parameters</b>		
ID	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection. The ID changes if the local ID is changed.	Display only
LADDR	This value must be entered as a block call parameter ID for calling the FC in the user program to identify the connection.	Display only

**Connection Name (Reference) - Only in Multiproject**



If you create a connection to a partner in another project, that has not yet been merged with the current multiproject, you must enter a connection name as reference. Interproject connections can then be joined up based on this reference. As soon as the connections have been brought together, the connection name (reference) can no longer be entered.



## 5.7.2 Specifying UDP Addresses

### Address Parameters and Connection Types

With UDP, the communication partners are addressed using the local and remote endpoint, as follows.

- Local addresses:  
Local IP address and local port
- Remote addresses:  
Remote IP address and remote port

---

#### Note

The term “connection” is also used here for UDP. Reason: During configuration (just as in TCP) the communication partners are assigned to each other and therefore logically “connected”. In actual fact, with UDP there is no explicit connection establishment between communication partners.

---

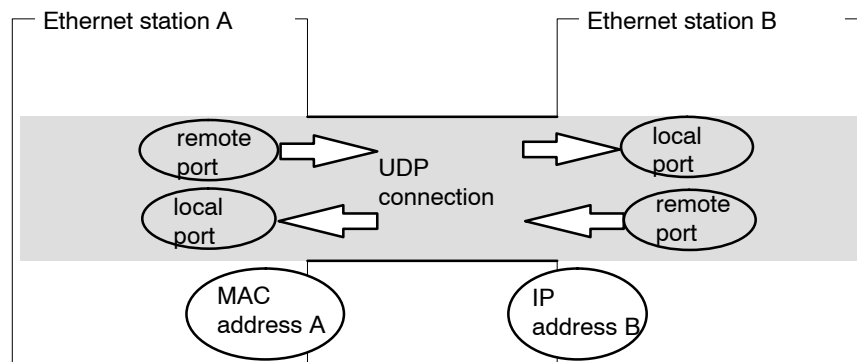


Figure 5-19 Sending and Receiving on One UDP Connection

Depending on the required connection type, the remote address parameters are either specified or left open during configuration.

- Specified UDP connection  
You specified a destination station when you created the connection.  
Configuring broadcast or multicast provides you with a further option (see Section 5.7.3 below).
- Unspecified UDP connection  
You entered “unspecified” for the connection partner when you created the connection.

### Addresses Tab - Specified UDP Connections

The addresses tab displays proposed values for the relevant local and remote address information. You can make the settings for the ports individually.

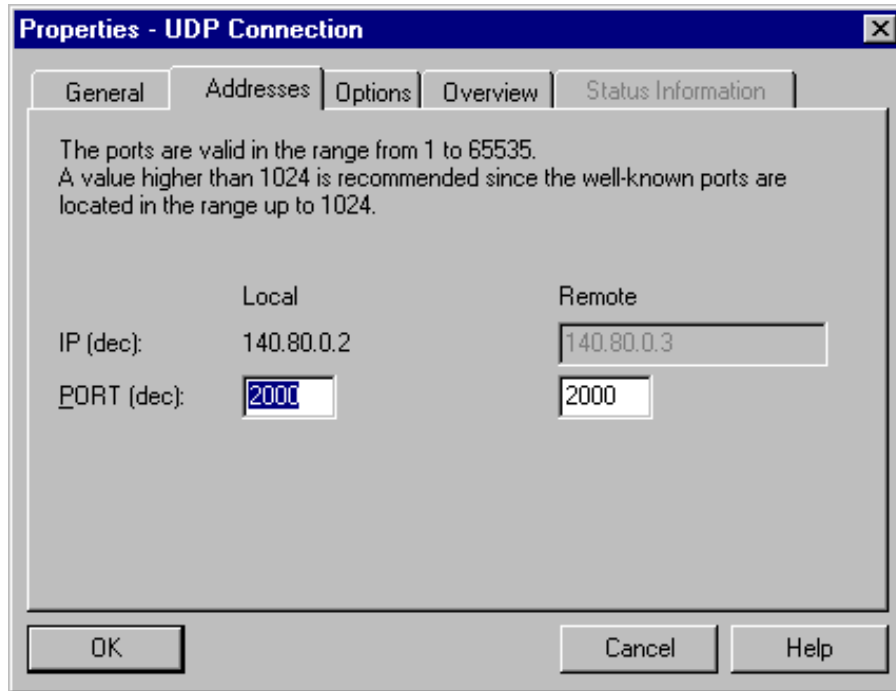


Figure 5-20 Layout of the Properties Dialog in the “Addresses” tab with DEFAULT Ports for UDP Connections

### Ports

The ports or port addresses define the access point to the user program within the station / CPU. They must be unique within the station / CPU!

The following table shows the range of values:

Table 5-6

Application / Note	Port Addresses
Fixed, must not be used!	0
Assigned as default, should not be used (well-known ports)	1 to 1024
Range used by NCM in which a free port address is searched for and assigned.	2000... onwards

The following port numbers are reserved; you should not use these for other purposes in the connection project engineering.

Table 5-7 Reserved Port Numbers

<b>Protocol</b>	<b>Port Number</b>	<b>Service</b>
TCP	20, 21	FTP
TCP	25	SMTP
TCP	80	HTTP
TCP	102	RFC1006
TCP	135	RPC-DCOM
UDP	161	SNMP_REQUEST
UDP	34964	PN IO
UDP	65532	NTP
UDP	65533	NTP
UDP	65534	NTP
UDP	65535	NTP

### Addresses Tab - Unspecified UDP Connection

An unspecified UDP connection can be used in two ways:

- Free UDP Connection

To configure a free UDP connection, select the “Address assignment in block” check box. The input boxes for the remote IP address and the remote port are then deactivated since the destination addresses are now specified by the user program.

- Connection to a remote station in a different project

You can specify the remote IP address and the port for any destination station. The destination station can be in the current STEP 7 project or in another project.

Please note:

Since no connection is actually established with UDP (datagram service), communication on the configured UDP connection is only possible when the partner addresses (IP address and port ) are specified.

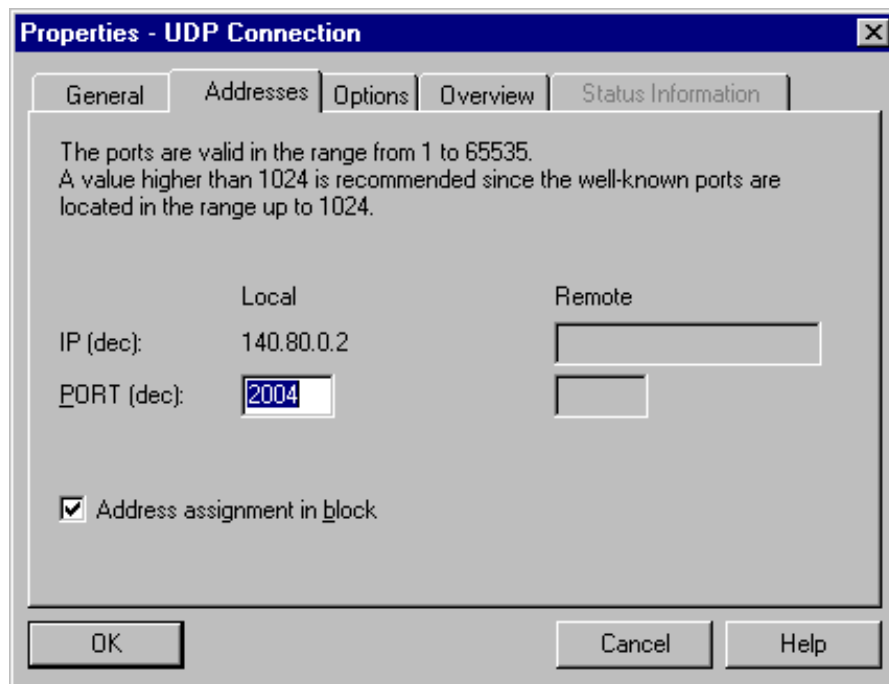


Figure 5-21 Layout of the Properties Dialog in the “Addresses” Tab for the “Free UDP Connection” Mode

### 5.7.3 UDP with Broadcast and Multicast

#### Application

When you select the connection partner, you have the following two extra options on UDP connections:

- Connection to all Broadcast Nodes

If you select the “all broadcast nodes”, you specify that UDP frames are sent to all obtainable broadcast nodes.

---

#### Notice

When using broadcast, you can only send with S7-CPs; reception is not possible (see below)!

---

- Connection to all Multicast Nodes

If you select “all multicast nodes” as the partner, you specify that UDP frames are sent to all nodes of a multicast group and that multicast frames can be received.

Multicast is a special, configurable connection option that is supported by Industrial Ethernet CPs only on UDP connections.

The frames are sent without acknowledgment because the UDP protocol has no provision for acknowledgments. This is designed to avoid floods of data resulting from the acknowledgments. If, for example, frames are sent to 100 partners, 100 acknowledgments (1 per partner) will arrive at the same time. The sending module would not be able to evaluate such a flurry of data.

#### When to Use Multicast instead of Broadcast?

To allow the simultaneous transmission of a frame to a number of partners, the connection option Multicast for UDP connections was introduced.

In contrast to the broadcast connection option, it is also possible to receive frames sent to several nodes in the multicast group on this connection type.

By specifying a particular group of recipients (multicast group), load on recipients for which the message is not intended is prevented. Multicast therefore represents a better solution than broadcast when frames are sent to groups of partner stations.

### **Why Does an S7-CP Prevent Reception on Broadcast Connections?**

It is often necessary for one station to send frames to a number of partner stations. It is important that the frames are sent at the same time and arrive and practically the same time. Sending and receiving broadcast frames is always required. A broadcast message is received by all nodes in the network.

A typical application is the sending of broadcast frames to find a MAC address for an IP address (ARP request).

For this reason, a communications module must accept broadcast frames and evaluate them in its software. The major disadvantage of this is that network performance sinks significantly if there are too many broadcast frames because each individual module needs to process all the broadcast frames to find out whether the frames were intended for it.

To avoid these disadvantages, S7-CPs handle broadcast as follows:

- Following reception, the broadcast frames are filtered out with high priority by all Ethernet CPs. This means that frames that cannot be interpreted are discarded immediately. Only frames that can be interpreted, for example an ARP request, are passed on over the LAN controller and evaluated. This prevents a negative influence on the other connections by broadcast frames.
- For the application, this means that the S7-CP cannot receive broadcast frames intended for the transfer of user data. It is, however, possible for the module to send broadcast frames within the network.

### Addresses Tab - Connection to all Broadcast Nodes

If you select “all broadcast nodes” as the connection partner, you specify that UDP frames are sent to all obtainable broadcast nodes.

In the “Addresses” tab, a valid broadcast address in the network is proposed for the partner under the IP address (IP).

You must enter a PORT address suitable for all partners you want to reach under PORT.

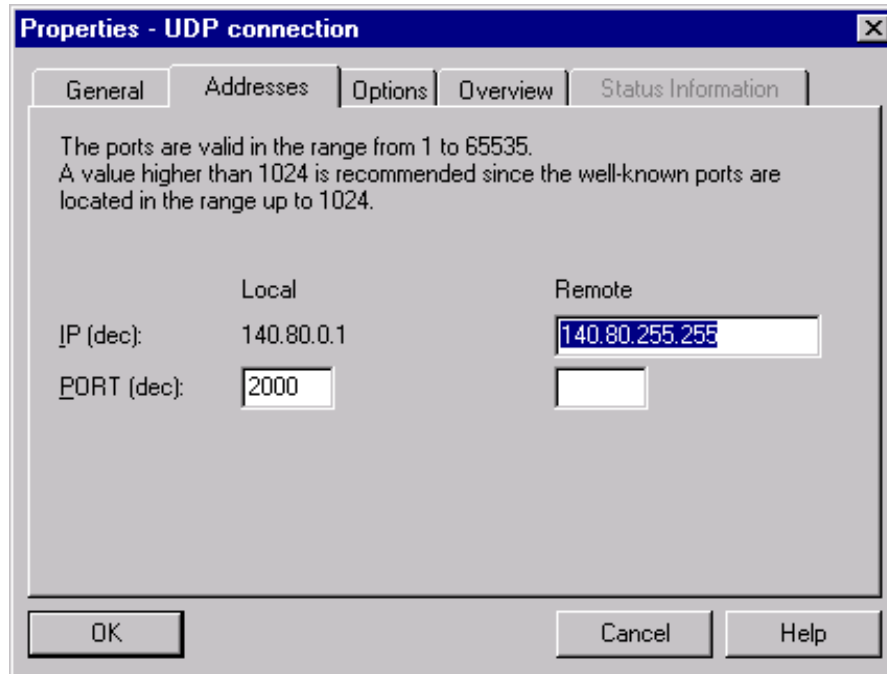


Figure 5-22 Layout of the Properties Dialog “Addresses” Tab for the “Broadcast” Mode

### Addresses Tab - Connection to all Multicast Nodes

By selecting “all multicast nodes” as the connection partner, you specify that

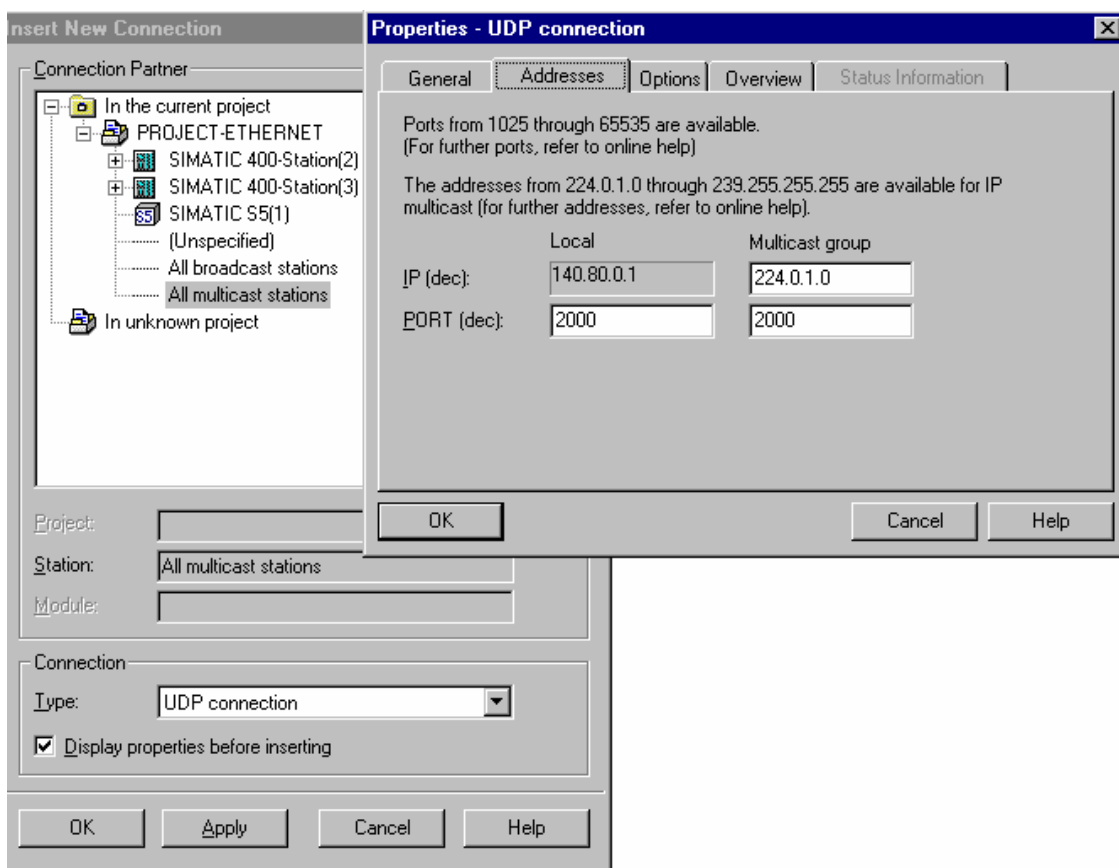
- sent UDP frames are delivered to all multicast nodes of the multicast group;
- the local device receives multicast frames in the specified multicast group.

The multicast group is specified using the IP address and the port addresses.

In the “Addresses” tab, an IP address in the network valid for multicast groups is proposed for the partner under IP address (IP). When using multicast, the partner is always a group of receivers (multicast group).

You must enter a PORT address suitable for all partners you want to reach under PORT.

In principle, is it possible to address several multicast groups with one IP address. To achieve this, you can create several UDP connections with the same IP address but different PORT addresses.





**Notice**

Make sure that the port used for multicast frames is different from the port addresses used for any configured UDP connections. If a configured UDP connection uses the same port address, these connections may be terminated by multicast frames.

**Notice**

Within a multicast group, you should assign identical PORT addresses for the local port and the partner port. This is the only way that frames can be sent and also received by the CP within a multicast group!

Note the following example of three nodes in the multicast group:

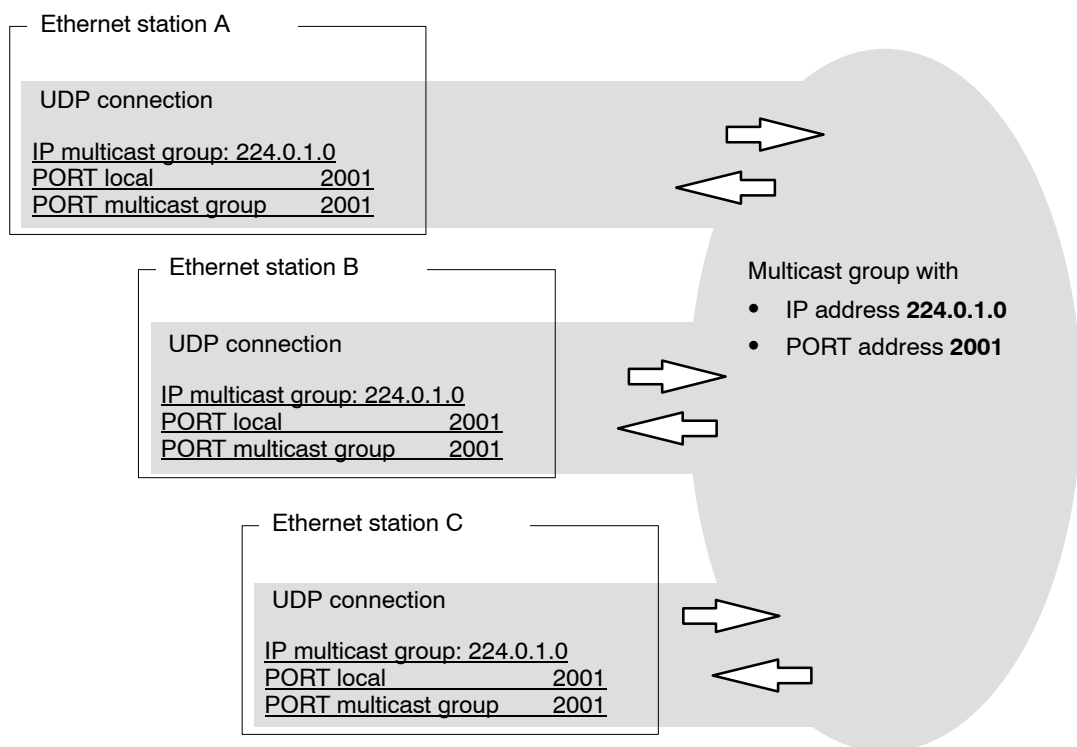


Figure 5-23 Sending and Receiving in a Multicast Group using Identical PORT Addresses

## IP Addresses for IP Multicast

- Possible Values

IP addresses from 224.0.0.0 to 239.255.255.255 can be used for IP multicast.

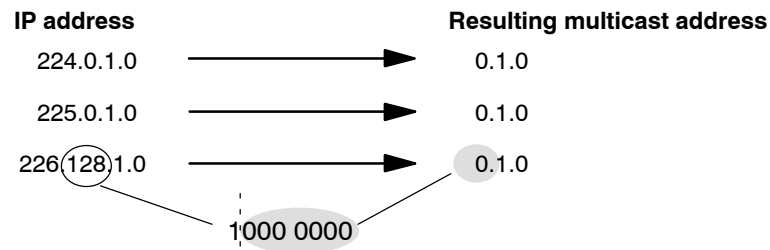
Since the IP addresses up to 224.0.0.255 are reserved for special purposes, we recommend that you use IP addresses starting at 224.0.1.0 (default) for IP multicast.

- Identification of the Multicast Group

A multicast group is not identified using the entire IP address; the first addressed byte and the most significant bit of the second address byte are ignored. This is an important feature that allows seemingly different IP addresses to address the same multicast group.

Example:

The following IP addresses address the same multicast group.



## 5.7.4 Checking the Properties of a UDP Connection

### Overview Tab

At the overview level, all the configured UDP connections and their parameters in this station are displayed (cannot be modified).

You can adjust the width of the columns in the table.

For an example of this display, refer to Section 5.3.4 (the ISO transport connection).

Parameter	Description
Local ID	This is the connection ID of the UDP connection (STEP 7 connection configuration; DWORD).
Name (loc. endpoint)	Entered connection name. This identifies the UDP connection (8 characters default length).
CPU / Applications	If you display all the ISO transport connections being operated in this station in the multiprocessor mode (with PC stations: multiple applications), the CPU/application that is the endpoint of the particular connection is specified here.
R/S	Rack/slot of the local CP via which the connection is established.
Partner address	Specifies the remote IP address of the connection.
Local port	Local port (8 characters default length)
Remote port	Remote port (8 characters default width)
Status	Indicates the current configuration of the connection. "Connections without assignment" are indicated by " <b>No local CP/No remote CP</b> " in the status column and a "!" character at the end of the "Local ID" (for example: 0002 A000!). Connections you are currently editing are also indicated by "!" at the end of the local ID.

### Connection Overview with Multiple CPUs in an S7 Station

If you operate more than one CPU in your S7 station, you can click the button to extend the overview to the connections on all CPUs.

## 5.7.5 Free UDP Connection

### Program-Controlled Addressing

A free UDP connection allows program-controlled addressing of the communication partner. Communication between two nodes on Industrial Ethernet has the following properties:

- Data transfer is bi-directional; in other words it is possible to send and receive on the UDP connection at the same time.
- The local node is specified in the configuration. The remote node is entered in the job header of the job buffer by the user program when it calls AG\_SEND. This allows any node on Ethernet/LAN/WAN to be reached.
- The IP address and the port of the sender can be read from the job header of AG\_RECV.

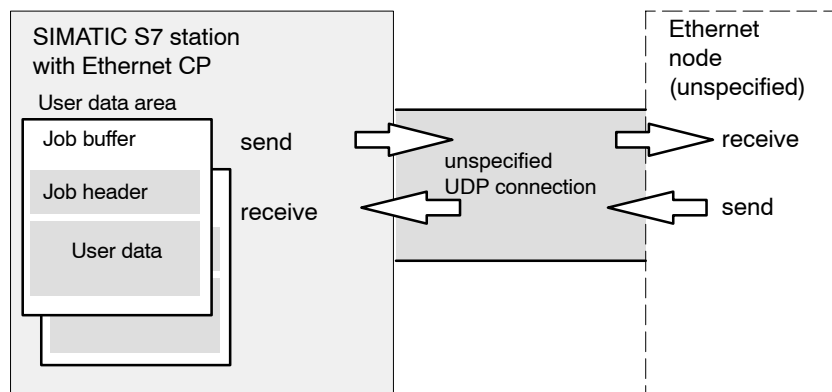


Figure 5-24 Sending and Receiving on an Unspecified UDP Connection with Programmed Addressing

### Amounts of Data

Refer to the manual [2] supplied with the Ethernet CP for the number of UDP connections supported by the Ethernet CP. The number of connections per station can be increased by adding more CPs.

Up to 2042 bytes of user data can be transferred per job buffer. The job header uses an additional 6 bytes.

## 5.8 FETCH/WRITE Mode

### FETCH/WRITE

The FETCH/WRITE services allow direct access to the system memory areas on the SIMATIC S7 CPU from SIMATIC S5, SIMATIC PC stations, or from devices of other ranges.

- FETCH: Read data directly
- WRITE: Write data directly

### Connection Types

The FETCH/WRITE services can be configured and used in SIMATIC S7 on the following connection types:

- ISO transport connections
- ISO-on-TCP connections
- TCP connections

### Configuration

Depending on the station type, the following modes can be configured for the connection endpoint:

- SIMATIC S7 Station: FETCH PASSIVE / WRITE PASSIVE

If you select the FETCH PASSIVE or WRITE PASSIVE mode for the ISO transport connection, you can access the system areas on a SIMATIC S7 PLC from a SIMATIC S5 station or other non-S7 station (unspecified connection).

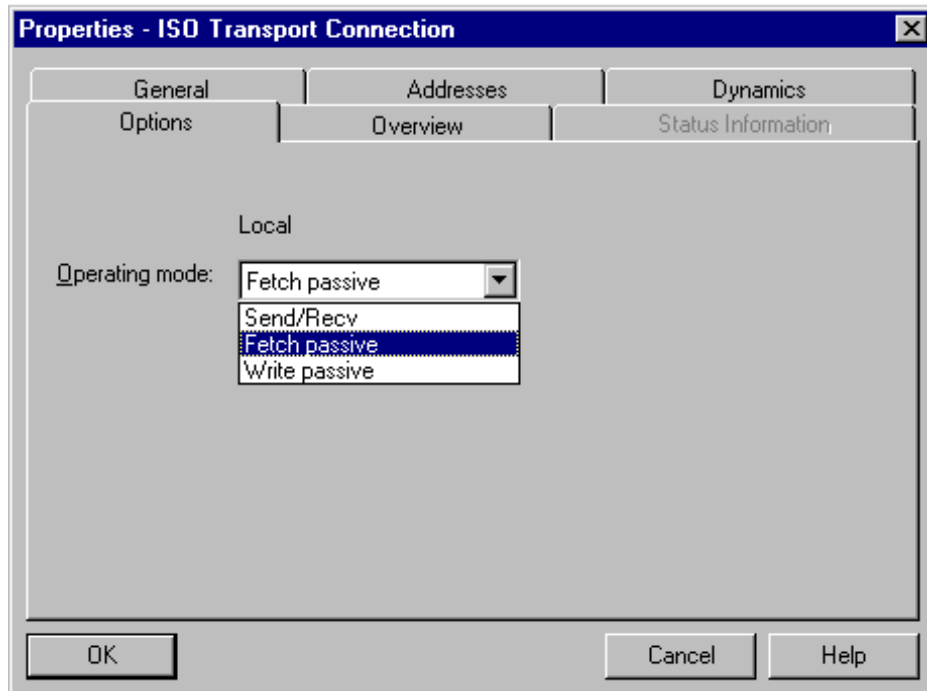


Figure 5-25 Configuring FETCH PASSIVE Based on the Example of an ISO Transport Connection

The connection can then only be used for this mode; sending or receiving with the FCs AG\_SEND/AG\_LSEND or AG\_RECV/AG\_LRECV is then no longer possible.

The connection is established passively; in other words, only the partner station (SIMATIC S5 station, a PC station, or a non-SIMATIC station) can establish the connection. The setting is made automatically in the “General” tab and cannot be changed.

---

#### Notice

Remember that with this configuration on an S7-300, one connection resource (free connection for S7 functions) of the S7-300 CPU is used. CPU connection resources are also used, for example, by S7-300 CPs, in the FMS mode or by PGs and OPs. For more detailed information about the maximum connection resources, refer to /1/.

---

- SIMATIC PC Station: FETCH ACTIVE / WRITE ACTIVE

If you select the FETCH ACTIVE or WRITE ACTIVE mode for the ISO transport connection, you can access the system areas on a SIMATIC S7 PLC or a SIMATIC S5 station from the PC station.

The connection establishment is active; in other words, the partner station must wait for connection establishment (passive connection establishment on the partner).

### **“S7 Addressing Mode” Option**

When you configure the `FETCH ACTIVE` / `WRITE ACTIVE` modes, you can select the addressing mode. This specifies how the addresses will be interpreted in the `FETCH/WRITE` call in the SIMATIC S7 station when accessing DBs:

- S7 addressing mode: byte address
- S5 addressing mode: word address

This makes it possible for applications to access S5 or S7 stations without needing to adapt the addresses. This is particularly interesting for existing S5 applications than can be used unchanged to access S7 stations.

As default, the addressing mode for access to SIMATIC S7 is set (option selected).

### **System Memory**

You can access the following address areas in the system memory on the SIMATIC S7 PLC using `FETCH` or `WRITE`:

- Data blocks (DB)  
(When accessing DBs, remember that the highest DB number is 255.)
- Bit memory (M, MB, MW, MD)
- Process image input table (I, IB, IW, ID)
- Process image output table (Q, QB, QW, QD)
- I/O area inputs (PIW, PID, PIB)
- I/O area outputs (PQW, PQD, PQB)
- Counters (C)
- Timers (T)

### **Links to Other Systems**

The `FETCH` and `WRITE` modes supported on ISO transport connections and ISO-on-TCP or TCP connections can be used with any other device to access the S7 system memory areas.

To be able to use this type of access, for example for PC applications, you need to know the PDU structure of the jobs. The required S7 or S5 headers for request and response frames are 16 bytes long and their structure is described in the Appendix.

**Messages in the Diagnostic Buffer**

As a result of FETCH/WRITE access, negative acknowledgments from the S7 CPU are possible. This then leads to corresponding connection-oriented entries in the diagnostic buffer that you can read out with NCM Diagnostics (see Section 8.5).

Table 5-8 Message Coding in the Diagnostic Buffer with FETCH/WRITE

<b>Coding</b>	<b>Meaning</b>
01 <sub>H</sub>	Hardware fault
03 <sub>H</sub>	Object access is not permitted.
05 <sub>H</sub>	Invalid address (syntax ID, area, type, bit number)
06 <sub>H</sub>	Data type not currently supported
07 <sub>H</sub>	Data type is not consistent.
0A <sub>H</sub>	The object does not exist or the end of the area has been exceeded.
FF <sub>H</sub>	Internal protocol error

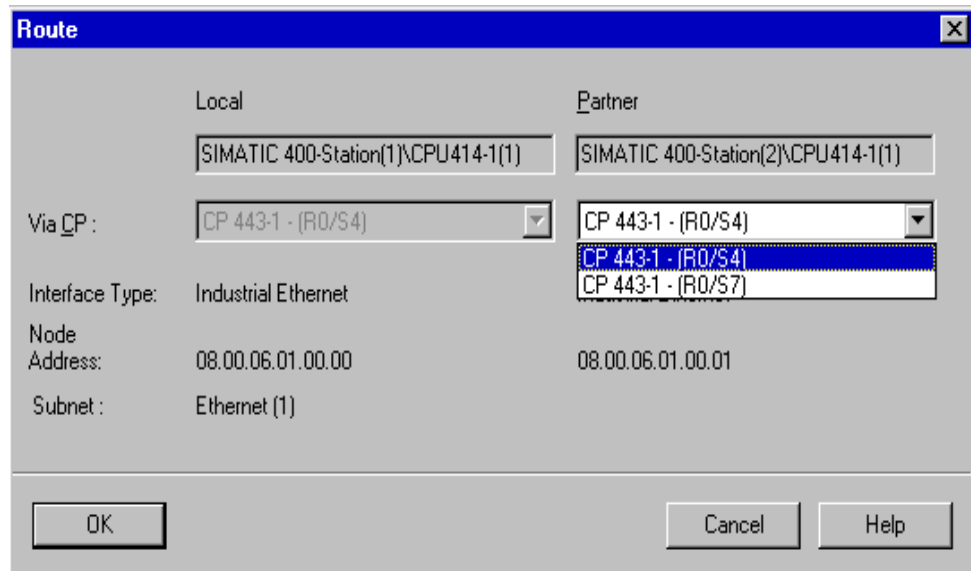


## 5.9 Routing to Distribute Load

### Routing to Distribute Load

If more than one CP of the same type exists in a station and is connected to the same subnet, the route can be selected.

Click the “Route” button in the “General” tab to display the route dialog:



If you have configured a load distribution on two or more Ethernet CPs at the local or remote end, you can assign the connection to the required route via the CP.

Parameter	Description
Via CP / Local	<p>If more than one Ethernet CP exists in the station via which connections operated you can select route here.</p> <p>The CPs are only displayed for selection if they are networked.</p> <p>If no CP is assigned (for example because the CP was deleted previously) “(None)” is displayed here.</p> <p>If there is only one CP plugged into the station, no selection is possible.</p>
Via CP / Partner (remote)	<p>Depending on the local selection, the possible remote CPs are displayed. All the CPs connected to the same subnet (networked) and the local CP can be selected.</p> <p><b>Alternatives</b> are only available when a connection is established to a remote station configured in the same project and the remote station has two or more CPs.</p> <p>If there is no CP assigned on the partner (for example because the CP was deleted previously) “None” is displayed here.</p> <p>If there is only one CP in the remote station, no selection is possible.</p> <p>If the partner is an “other station” or SIMATIC S5 PLC, one or more attachments are displayed for selection depending on the configuration and networking of the station.</p>

## 6 Programmed Communication Connections



In some situations, it is an advantage to set up communication connections not over the configuration interface of STEP 7 but program-controlled by a specific application.

Typical users who will find this useful are, for example, mass producers of machines who want to offer their customers a simple user interface but need to adapt the communication services to the operator input. The end user should not need knowledge of STEP 7.

As of STEP 7 V5.2 SP1, a function block is available for these applications that allows flexible transfer of data blocks with configuration data to an Ethernet CP.



You will find further information in the following sources:

- For the properties of the configurable connection types, refer to Section 5.
- For the properties of the configurable connection types E-mail connection and FTP connection, refer to /5/.
- After installing STEP 7 and the NCM S7 for Industrial Ethernet option, you will find a programmed example in the "Sample projects" tab of the SIMATIC Manager. This example is described in the appendix.
- You will find information on the numbers of connections and amounts of data in Section 4.1.

---

### Notice

Please note the supported connection types of the used CP-Type /2/ .

---

## 6.1 Overview

### Area of Application

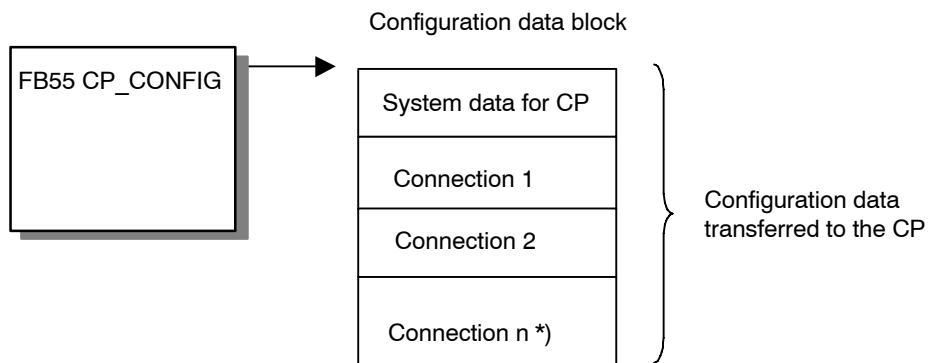
Communication connections can be freely configured controlled by the program.

### Interplay between Programming and Configuration

Connections are either configured using STEP 7 or configured by the user program while the S7 station is running. Mixing these variants on a CP is not possible!

### Principle

Configuration data for communication connections can be transferred to the CPU using the function block called in the user program.



\*)  $n_{\max} = 64$

The configuration DB can be loaded on the CP at any time. The previously applicable connections and configuration data (IP address, subnet mask, default router, NTP time server and other parameters) are overwritten.

The configuration DB can be loaded on the CP at any time. The previously valid connections are then overwritten.

Based on the configuration data, the Ethernet CP recognizes that the communication connections must be set up by the user program.

---

### Notice

As soon as the user program transfers the connection data via FB55 IP\_CONFIG, the CPU switches the CP briefly to STOP. The CP accepts the system data (including IP address) and the new connection data and processes it during startup (RUN).

---

---

**Note**

Read the description of FB55 IP\_CONFIG in Section 7.6.

---

### Configuration Limits

A maximum of 64 connections can be specified in FB55 CP\_CONFIG. The most important factor, however, is the maximum number of connections supported by the CP type you are using (see /2/).

### Special Features / Restrictions

- Consistency check only with STEP 7  
The connection configuration in STEP 7 involves consistency checks that are not possible or only possible with restrictions when using the programmed configuration!
- Connection configuration required on the partner  
When configuring specified connections in STEP 7, you implicitly create the connection for the partner; with a programmed configuration, this is not possible! In this case, you must configure suitable connections for the partner.
- DHCP / DNS is supported  
IP address assignment is also possible using DHCP/DNS even if you choose programmed configuration.
- No connection information when uploading  
When you upload the S7 station data in STEP 7, this does not contain the data of the programmed configuration.

## 6.2 Procedure

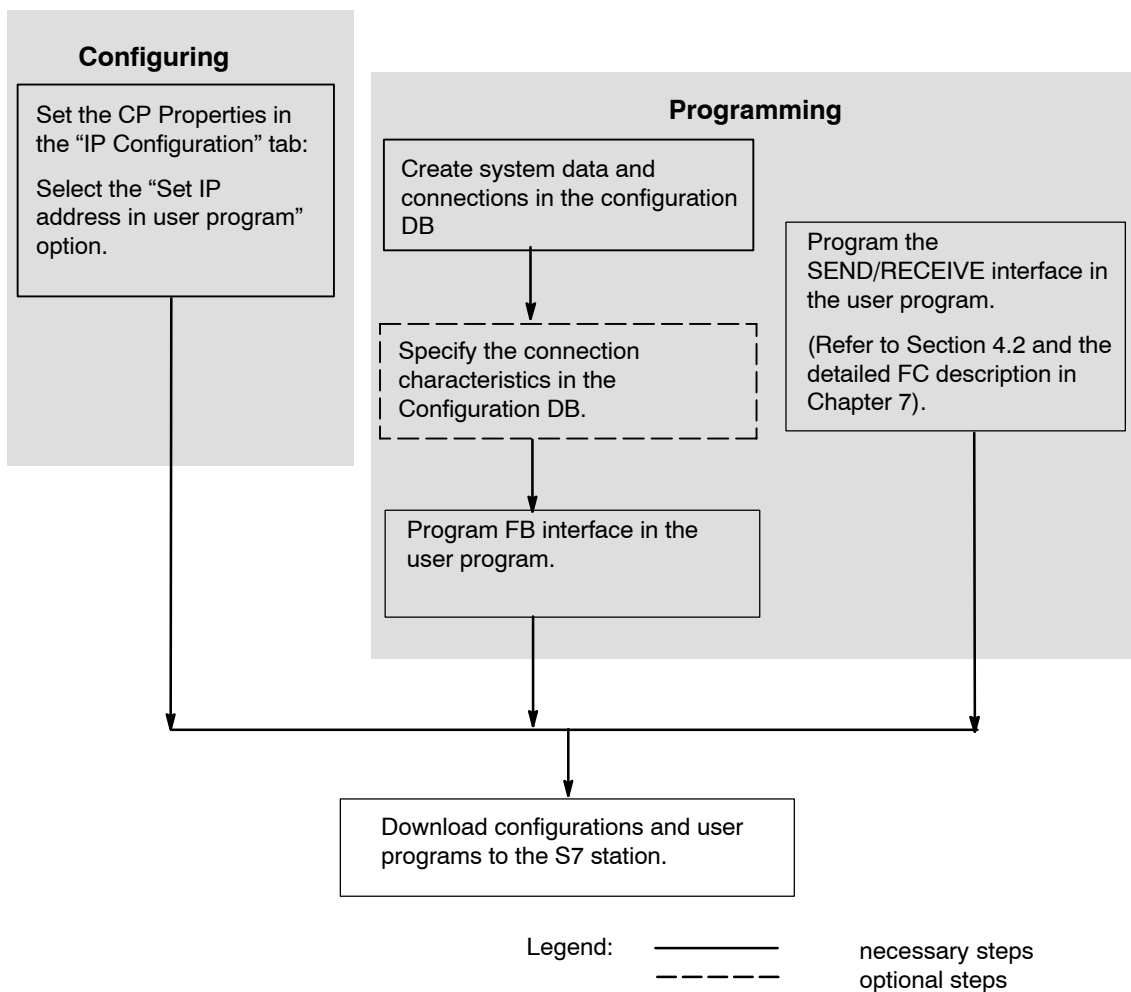
### Initial Situation

The steps described here assume the following:

1. You have created the local S7 station and the required partner stations in your STEP 7 projects (refer to the description in Chapter 3).
2. You have clarified the other station types with which connections must be established. You create substitute objects for these station types in your STEP 7 projects.

### Setting up Connections and Using Them in the User Program

Follow the steps outlined below to set up connections on the SIMATIC S7 PLC using the user program:



## 6.3 Configuration Data Block

### Meaning

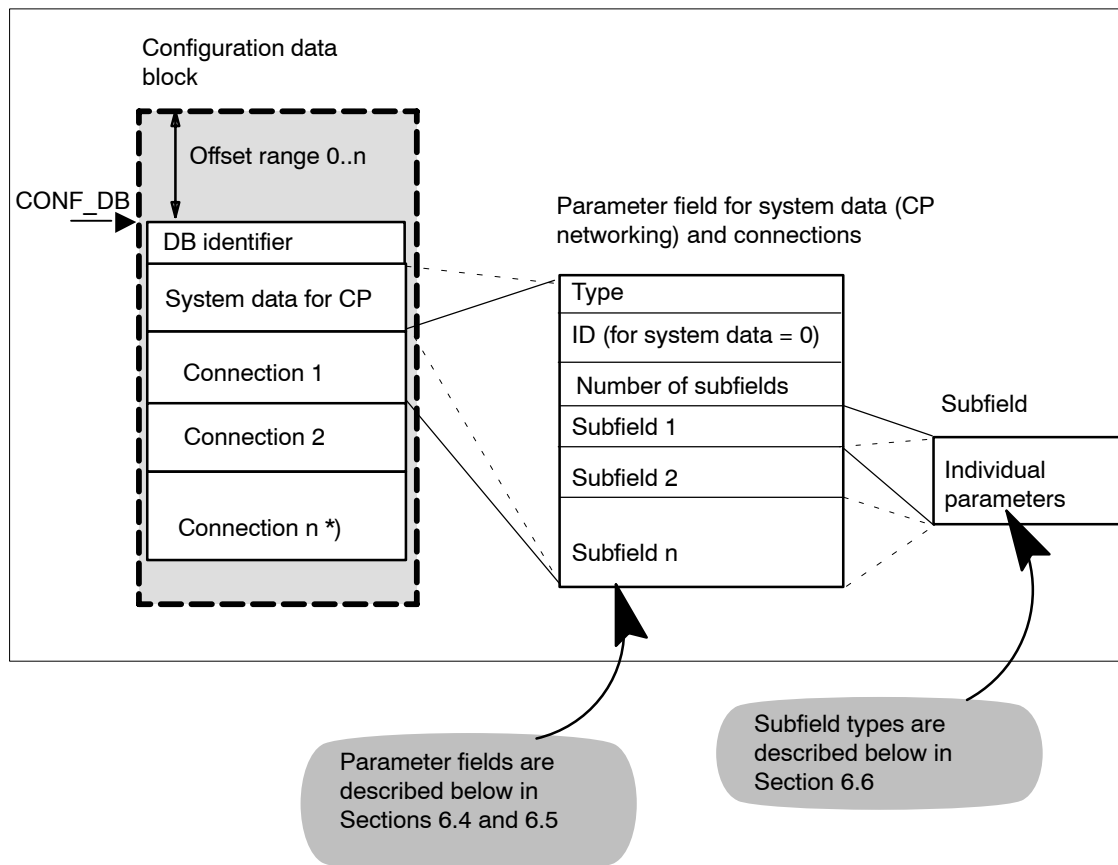
The configuration data block (CONF\_DB) contains all the connection data and configuration data (IP address, subnet mask, default router, NTP time server and other parameters) for an Ethernet CP. The configuration data block is transferred to the CP with function block FB55.

### Block and Data Structure

The graphic below shows the following:

- Structure resulting from parameter fields and subfields
  - The connections and specific system data are described by an identically structured parameter field.
  - Individual parameters are characterized by subfields.
- Offset range

The CONF\_DB can start at any point within a data block as specified by an offset range.



## Example

Below, you will find a sample of a configuration data block with the parameter field for system data and a parameter field for a TCP connection.

Table 6-1 CONF\_DB

STL	Ex- plana- tion
<pre> DATA_BLOCK DB271 TITLE=IP_CONFIG for 1 active nTCP connection, AUTHOR : Alfred //CP data : IP=200.12.1.144, Router=200.12.1.80 FAMILY : AS300 //Connection data: Destination IP addr=200.12.1.99, NAME : ipconf //Local port = 4001, remote port = 5001, estab=active VERSION : 1.0 //07-June-2005 STRUCT     DB_TYP :      INT := 1;      // // ----- System Data -----      sys_pb :      INT:=0;        // Subfield type: System data for CP     sys_id :      INT:= 0;        // System parameter ID, always 0     sys_sb_cnt:   INT:= 3;        // Number of subfields in                                 // System parameter field     ip_addr:      SUB_IP_V4;     // IP address of the CP     ip_netmask:   SUB_NETMASK;   // Subnet mask of the CP     ip_router:    SUB_DEF_ROUTER; // Default router  // ----- tcp VB 01 -----  tcp_pb_01       :      INT := 1;    // Subfield type: TCP connection tcp_id_01       :      INT := 1;    // 1. TCP_VB tcp_sb_cnt_01   :      int := 6;    // 6 Elements per TCP connection tcp_vb_ip_01    :      SUB_IP_V4;   // IP address of the partner tcp_loc_01      :      SUB_LOC_PORT; // tcp_rem_01      :      SUB_REM_PORT; // tcp_vb_01_name  :      CON_NAME_L;  // tcp_vb_01_kbus  :      SUB_KBUS_ADDR; // Relevant only for S7-400 rq_01           :      ACT_CN_REQ; //  // -----     END_STRUCT ; BEGIN tcp_loc_01.port  := 4001;           // Definition of ports when value of tcp_rem_01.port  := 5001;           // differs from predefinition ! END_DATA_BLOCK // ----- end "IP_CONF_DB_271" ----- </pre>	

The type definitions used in the sample DB follow.

Table 6-2 Type Definitions for the System Data Subfield

STL	Ex- plana- tion
<pre>// Data structures IP Config TYPE "SUB_IP_V4" STRUCT id : int := 1; // ID for IP, V4-Addr. len: int := 8; // Subfield length b_3 : BYTE := b#16#C8; // IP_High 200. b_2 : BYTE := b#16#0C; // IP_ 12. b_1 : BYTE := b#16#01; // IP_ 1. b_0 : BYTE := b#16#90; // IP_Low 144 END_STRUCT; END_TYPE  TYPE "SUB_NETMASK" STRUCT id : int := 2; // ID for subnet mask len: int := 8; // Subfield length b_3 : BYTE := b#16#FF; // SNM_High b_2 : BYTE := b#16#FF; // SNM_ b_1 : BYTE := b#16#FF; // SNM_ b_0 : BYTE := b#16#00; // SNM_Low END_STRUCT; END_TYPE  TYPE "SUB_DEF_ROUTER" STRUCT id : int := 8; // ID_4 Router len: int := 8; // Subfield length r_3 : BYTE := b#16#C8; // R_High r_2 : BYTE := b#16#0C; // R_ r_1 : BYTE := b#16#01; // R_ r_0 : BYTE := b#16#50; // R_Low END_STRUCT; END_TYPE</pre>	



Table 6-3 Type Definitions for the Subfield TCP Connection

STL	Ex- plana- tion
<pre> TYPE "SUB_LOC_PORT" STRUCT id : int := 9; // ID_4_LOC_PORT len: int := 6; // Subfield length port: int := 2001; // Loc. Port END_STRUCT; END_TYPE  TYPE "SUB_REM_PORT" STRUCT id : int :=10; // ID_4_REM_PORT len: int := 6; // Subfield length port: int := 2002; // Rem. Port END_STRUCT; END_TYPE  TYPE "CON_NAME_L" // 24 characters ( NetPro Max ) STRUCT id : int := 18; // ID for CON Name len: int := 28; // 4+len(n[0..x]) c : ARRAY [1..24] of CHAR := 'V','B','_','N','a','m','e','_','2','4','C','h','a','r', 'a','c','t','e','r','s','_','0','0','1'; END_STRUCT; END_TYPE  TYPE "SUB_KBUS_ADDR" STRUCT id : int := 21; // ID for KBUS address len: int := 5; // addr: BYTE := B#16#04; // =R0/S4 END_STRUCT END_TYPE  TYPE "ACT_CN_REQ" STRUCT id : int := 22; // ID for CON REQ mode len: int := 5; // Subfield length w : BYTE := b#16#1; // = Active END_STRUCT; END_TYPE </pre>	

Note:

The structures listed here must also be entered in the symbol table.

Example of SUB\_IP\_V4 entry:

Symbol	Address	Data type
SUB_IP_V4	UDT 100	UDT 100

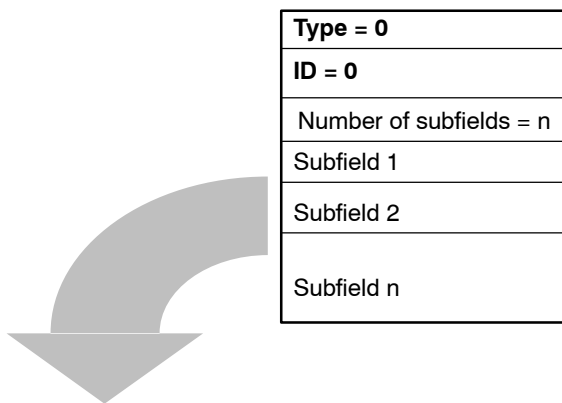
## 6.4 Parameter Field for System Data (CP Networking)

### Meaning

Below, you can see the subfields that are relevant for networking the CP. These must be specified in the parameter field for system data.

Some applications do not require all the subfield types - refer to the table for details.

### Structure



### Usable Subfields

Table 6-4

Subfield		Parameter	
ID	Type *)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A-171)	Use ( <u>m</u> andatory / <u>o</u> ptional)
1	SUB_IP_V4	Local IP address	m
2	SUB_NETMASK	-	m
8	SUB_DEF_ROUTER	-	m
4	SUB_DNS_SERV_ADDR	This subfield can occur from 0 to 4 times. The first entry is the primary DNS server.	o
14	SUB_DHCP_ENABLE	0: No DHCP 1: DHCP	o
15	SUB_CLIENT_ID	-	o

\*) The general properties of the subfield types are described below in Section 6.6.

## Example

Address	Name	Type	Initial Value	Comment
0.0	STRUCT			
+0.0	DB_TYP	WORD	W#16#1	Identifier
+2.0	FIELD_1	STRUCT		// Field 1 (here system data field)
+0.0	Type	INT	0	Type of data to be transferred 0 ... 5
+2.0	ID	INT	0	Connection ID (with system parameters 0)
+4.0	Subfield_Cnt	INT	3	Number of subfields belonging to this field
+6.0	Sub_field_1	STRUCT		// Subfield 1 SUB_IP_V4
+0.0	Sub_field_ID	INT	1	// Number of the subfield
+2.0	Sub_field_len	INT	8	// Length of the subfield in bytes
+4.0	STAT9	STRUCT		
+0.0	STAT10	BYTE	B#16#C0	
+1.0	STAT11	BYTE	B#16#6F	
+2.0	STAT12	BYTE	B#16#DE	
+3.0	STAT13	BYTE	B#16#6A	
=4.0	END_	STRUCT		
=8.0	END_	STRUCT		
+14.0	Sub_field_2	STRUCT		// Subfield 2 SUBNET_MASK
+0.0	Sub_field_ID	INT	2	// Number of the subfield
+2.0	Sub_field_len	INT	8	// Length of the subfield in bytes
+4.0	Parameter	STRUCT		SUBNET_MASK
+0.0	Value_1	BYTE	B#16#FF	
+1.0	Value_2	BYTE	B#16#FF	
+2.0	Value_3	BYTE	B#16#FF	
+3.0	Value_4	BYTE	B#16#0	
=4.0	END_	STRUCT		
=8.0	END_	STRUCT		
+22.0	Sub_field_3	STRUCT		// Subfield 3 default router
+0.0	Sub_field_ID	INT	8	// Number of the subfield
+2.0	Sub_field_len	INT	8	// Length of the subfield in bytes
+4.0	STAT9	STRUCT		
+0.0	STAT10	BYTE	B#16#C0	
+1.0	STAT11	BYTE	B#16#6F	
+2.0	STAT12	BYTE	B#16#DE	
+3.0	STAT13	BYTE	B#16#6A	
=4.0	END_	STRUCT		
=8.0	END_	STRUCT		

## 6.5 Parameter Fields for Connection Types

### General

Below, you will see which values need to be entered in the parameter fields and which subfields are used for the various connection types.

Some applications do not require all the subfield types - refer once again to the table for details.

---

### Note

Please read the explanations of the configurable connection properties for the individual connection type in Chapter 5!

---

### Connection ID

The ID parameter that precedes each connection parameter field beside the type ID is particularly important.

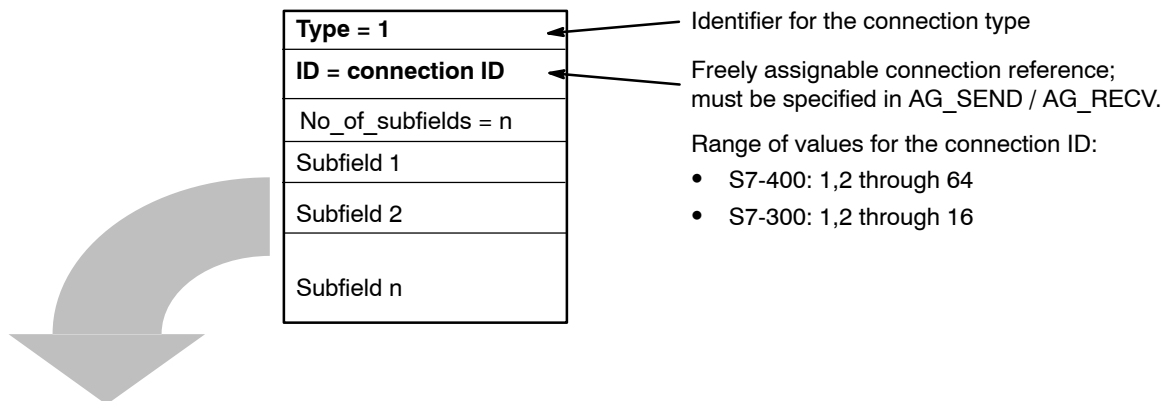
On programmed connections, you can assign this ID freely within the permitted range of values. You must then use this ID on the call interface of the FCs for the SEND/RECV interface to identify the connection.

Range of values for the connection ID:

- S7-400: 1,2 through 64
- S7-300: 1,2 through 16

## 6.5.1 Parameter Field for TCP Connection

### Structure



### Usable Subfields

Table 6-5

Subfield		Parameter	
ID	Type *)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A-171)	Use ( <u>m</u> andatory / <u>o</u> ptional)
1	SUB_IP_V4	IP address of the partner	m **)
9	SUB_LOC_PORT	-	m
10	SUB_REM_PORT	-	m **)
18	SUB_CONNECT_NAME	-	o
19	SUB_LOC_MODE	-	o
21	SUB_KBUS_ADR	This value is always set to 2 for CPs for the S7-300 and does not need to be specified.	m (for S7-400)
22	SUB_CON_ESTABL	-	m

\*) The general properties of the subfield types are described below in Section 6.6.

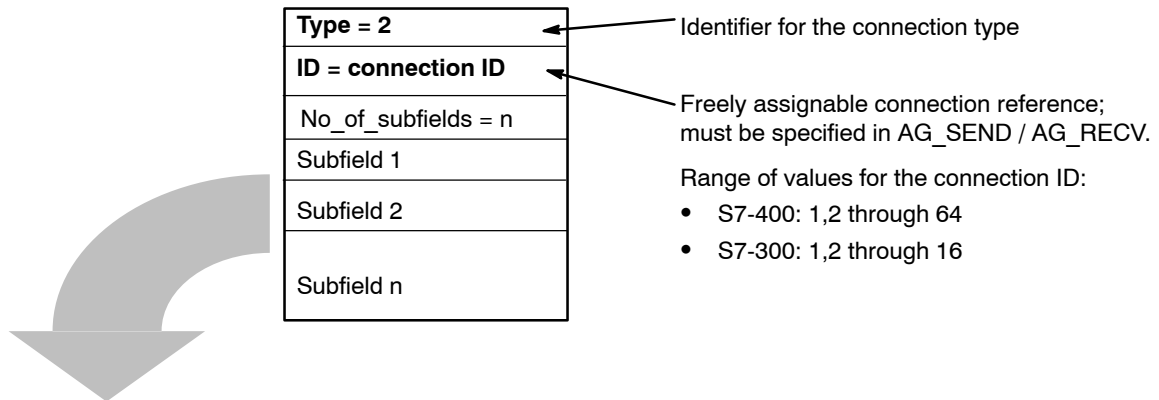
\*\*) Option using passive connection

### Note

Please read the description of the configurable connection properties for the TCP connection in Section 5.6!

## 6.5.2 Parameter Field for a UDP Connection

### Structure



### Usable Subfields

Table 6-6

Subfield		Parameter	
ID	Type *)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A-171)	Use ( <u>m</u> andatory / <u>o</u> ptional)
1	SUB_IP_V4	IP address of the partner	m
9	SUB_LOC_PORT	-	m
10	SUB_REM_PORT	-	m
18	SUB_CONNECT_NAME	-	o
19	SUB_LOC_MODE	-	o
21	SUB_KBUS_ADR	This value is always set to 2 for CPs for the S7-300 and does not need to be specified.	m (for S7-400)
23	SUB_ADDR_IN_DATABLOCK	If the "Free UDP connection" is selected for this parameter, the parameters SUB_IP_V4 and SUB_REM_PORT are omitted.	o

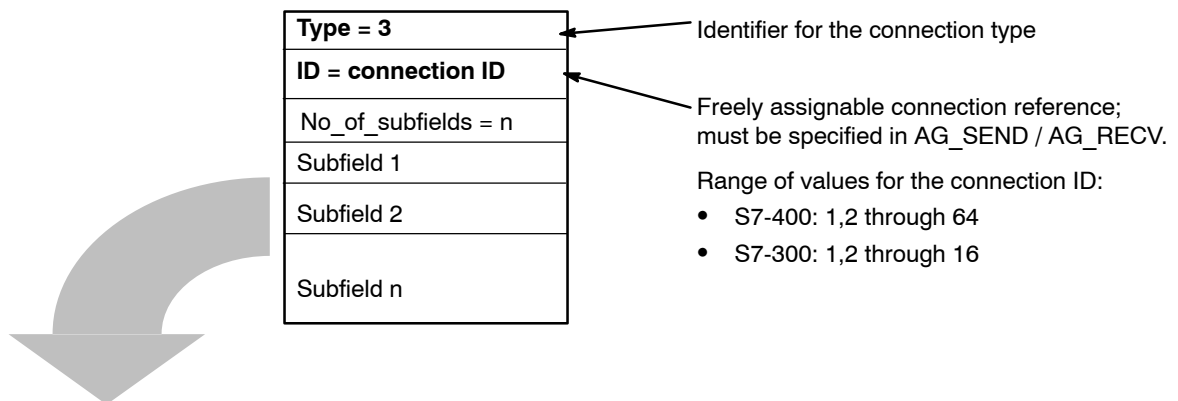
\*) The general properties of the subfield types are described below in Section 6.6.

### Note

Please read the description of the configurable connection properties for the for the UDP connection in Section 5.7!

### 6.5.3 Parameter Field for an ISO-on-TCP Connection

#### Structure



#### Usable Subfields

Table 6-7

Subfield		Parameter	
ID	Type *)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A-171)	Use ( <u>m</u> andatory / <u>o</u> ptional)
1	SUB_IP_V4	IP address of the partner	m **)
11	SUB_LOC_TSAP	-	m
12	SUB_REM_TSAP	-	m **)
18	SUB_CONNECT_NAME	-	o
19	SUB_LOC_MODE	-	o
21	SUB_KBUS_ADR	This value is always set to 2 for CPs for the S7-300 and does not need to be specified.	m (for S7-400)
22	SUB_CON_ESTABL	-	m

\*) The general properties of the subfield types are described below in Section 6.6.

\*\*) Option using passive connection

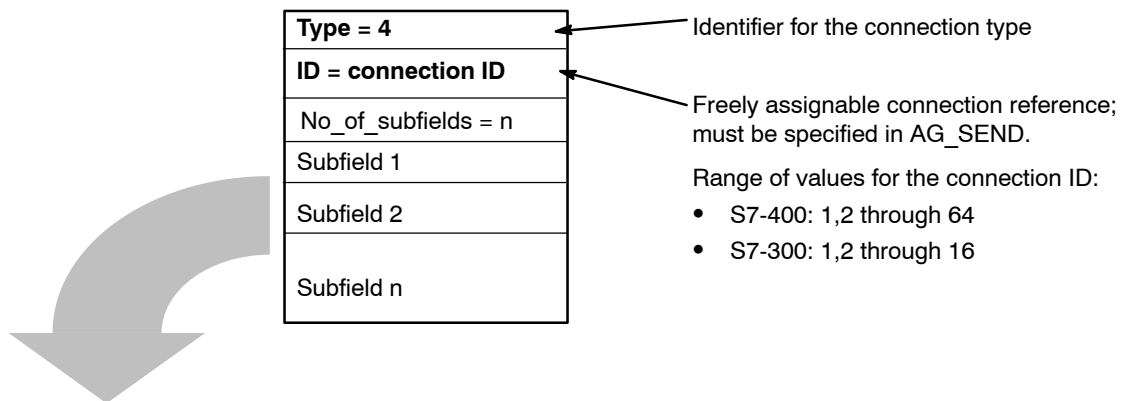
## 6.5.4 Parameter Field for an E-Mail Connection

### Meaning

To send E-mails, you must always set up **one** E-mail connection per IT-CP. The E-mail connection specifies the mail server, over which all the E-mails sent by the IT-CP are delivered.

You will find a detailed description of how to use the E-mail function with IT-CPs in /5/.

### Structure



### Usable Subfields

Table 6-8

Subfield		Parameter	
ID	Type *)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A-171)	Use (mandatory / optional)
1	SUB_IP_V4	IP address of the mail server, over which the E-mails are sent. The IP address can be specified in absolute or symbolic form. The symbolic form assumes that the IT-CP knows the address of the domain name server (DNS). This must be entered during configuration of the IT-CP in HW Config, for more detailed information, refer to the online help of HW Config.	m / o **)
3	SUB_DNS_NAME	DNS name of the E-mail server	m / o **)
13	SUB_EMAIL_SENDER	E-mail address of the sender	m
18	SUB_CONNECT_NAME	-	o



Table 6-8 , continued

Subfield		Parameter	
ID	Type *)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A - 171)	Use ( <u>m</u> andatory / <u>o</u> ptional)
21	SUB_KBUS_ADR	This value is always set to 0 for CPs for the S7-300 and does not need to be specified.	m (for S7-400)
22	SUB_CON_ESTABL	-	m

\*) The general properties of the subfield types are described below in Section 6.6.

\*\*\*) The parameters SUB\_IP\_V4 and SUB\_DNS\_NAME are mutually exclusive; one or the other must be specified.

---

**Note**

Mail server ports are well-known ports and do not need to be specified.

---

### 6.5.5 Parameter field for FTP connection

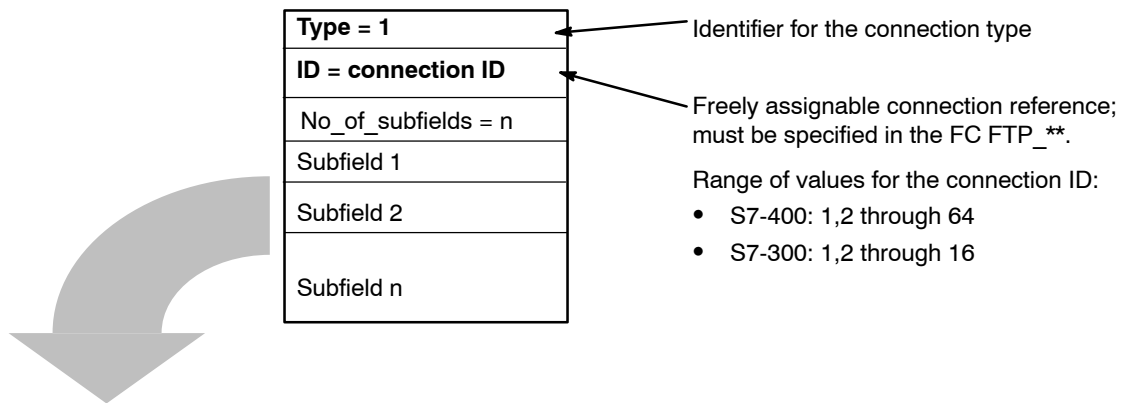
#### Meaning

To handle an FTP job sequence between the S7 station as FTP client and an FTP server, the IT-CP must set up a connection to the S7-CPU. This connection is known in this context as an FTP connection.

FTP connections are TCP connections, with the parameter SUB\_LOC\_MODE set to the "FTP" mode.

You will find a detailed description of how to use the FTP function with IT-CPs in /5/.

#### Structure



#### Usable Subfields

Table 6-9

Subfield		Parameter	
ID	Type*)	Special Features / Notes (Please refer also to the general description in Table 6-10 Page A-171)	Use (mandatory / optional)
18	SUB_CONNECT_NAME	-	o
19	SUB_LOC_MODE	here: 0x01 = FTP protocol	m
21	SUB_KBUS_ADR	This value is always set to 0 for CPs for the S7-300 and does not need to be specified.	m (for S7-400)

\*) The general properties of the subfield types are described below in Section 6.6.

## 6.6 Subfield types

Different parameters are required depending on the parameter field. Each parameter is described by a subfield. Which subfields are required is explained in the descriptions of the system data and the connection types in the previous sections.

Each subfield consists of the specific parameter section and the header (4 Byte).

### Example

The following excerpt from a CONF\_DB illustrates the structure of a subfield based on the example of the SUBNET\_MASK subfield type.

	Address	Name	Type	Initial Value	Comment
Header	+14.0	Sub_field_2	STRUCT		// Subfield 2 type SUBNET_MASK
	+0.0	Sub_field_ID	INT	2	// Subfield ID
	+2.0	Sub_field_len	INT	8	// Total length of the subfield in bytes
	+4.0	Parameter	STRUCT		Parameter range of SUBNET_MASK
Parameter	+0.0	Value_1	BYTE	B#16#FF	
	+1.0	Value_2	BYTE	B#16#FF	
	+2.0	Value_3	BYTE	B#16#FF	
	+3.0	Value_4	BYTE	B#16#0	
	=4.0	END_	STRUCT		
	=8.0	END_	STRUCT		

In total, the following subfield types are available:

Table 6-10

Subfield ID <sup>1)</sup>	Subfield type	Subfield length (in bytes)	Meaning of the Parameter
1	SUB_IP_V4	4 + 4	IP address according to IPv4
2	SUB_NETMASK	4 + 4	Subnet mask
3	SUB_DNS_NAME	Length of DNS name + 4	DNS name
4	SUB_DNS_SERV_ADDR	4 + 4	DNS server address
8	SUB_DEF_ROUTER	4 + 4	IP address of default router
9	SUB_LOC_PORT	2 + 4	Local port
10	SUB_REM_PORT	2 + 4	Remote port, also for E-mail connections
11	SUB_LOC_TSAP	TSAP length + 4	Local TSAP

Table 6-10 , continued

Subfield ID <sup>1)</sup>	Subfield type	Subfield length (in bytes)	Meaning of the Parameter
12	SUB_REM_TSAP	TSAP length + 4	Remote TSAP
13	SUB_EMAIL_SENDER	Length of the sender E-mail address + 4	E-mail address of the sender
14	SUB_DHCP_ENABLE	2 + 4	Obtain an IP address from a DHCP server <ul style="list-style-type: none"> <li>Possible values: <ul style="list-style-type: none"> <li>0 = no DHCP</li> <li>1 = DHCP</li> </ul> </li> </ul> (optional)
15	SUB_CLIENT_ID	Length of the client ID + 4	(optional)
18	SUB_CONNECT_NAME	Length of the name + 4	Name of the connection. Possible values are: a...z, A...Z, 0...9, -, _
19	SUB_LOC_MODE	1 + 4	Local mode of the connection <ul style="list-style-type: none"> <li>Possible values: <ul style="list-style-type: none"> <li>0x00 = SEND/RECV</li> <li>0x01 = FTP protocol (TCP connection only)</li> <li>0x10 = S5 addressing mode for FETCH/WRITE *)</li> <li>0x80 = FETCH *)</li> <li>0X40 = WRITE *)</li> </ul> </li> </ul> If you do not set the parameter, the default setting is SEND/RECV. *) Note: The specified codings can be can be combined by ORing them.
20	SUB_REM_MODE	1 + 4	Setting the mode on the communication partner. (not currently supported)
21	SUB_KBUS_ADR	5	KBUS address of the CPU (Relevant only for S7-400)
22	SUB_CON_ESTABL	1 + 4	Type of connection establishment. With this option, you specify whether the connection is established by this S7 station. <ul style="list-style-type: none"> <li>Possible values: <ul style="list-style-type: none"> <li>0 = passive</li> <li>1 = active</li> </ul> </li> </ul> Refer also to Chapter 5 under "Specifying the local connection endpoint" for the individual connection types.

Table 6-10 , continued

Subfield ID <sup>1)</sup>	Subfield type	Subfield length (in bytes)	Meaning of the Parameter
23	SUB_ADDR_IN_DATABLOCK	1 + 4	<p>Select free UDP connection.</p> <p>The remote node is entered in the job header of the job buffer by the user program when it calls AG_SEND. This allows any node on Ethernet/LAN/WAN to be reached.</p> <ul style="list-style-type: none"> <li>Possible values: <ul style="list-style-type: none"> <li>1 = free UDP connection.</li> <li>0 = otherwise</li> </ul> </li> </ul> <p>The parameter is practical only for a UDP connection.</p> <p>See also Section 5.7.5</p>
24	SUB_NTP_SERVER	4 + 4	<p>The sub-block defines an NTP server from which the CP can obtain its time via the NTP protocol.</p> <p>For the situation when one or more NTP servers are not obtainable, up to 4 sub-blocks of ID 24 can be defined.</p> <p>The sub-blocks of ID 24 may only be installed in the system parameter block type 0 / ID 0 (see Section 6.4).</p>

<sup>1)</sup> Note: ID numbers not listed are not currently used.

## 7 Programming FCs (Functions) and FBs for S7 Ethernet CPs

The interface to several communication services is implemented by ready-made program blocks (FCs and FBs). This chapter includes a detailed description of these blocks.

The description of each FC / FB includes the following sections and these may be extended by further information specific to the FC / FB:

- Meaning
- Call Interface
- How the Block Works
- Explanation of the Formal Parameters
- Condition Codes

This chapter provides you with information over and above the general information available in the online help for the FCs when programming in STEP 7.



You will find further information in the following sources:

- The communication FBs (BSEND, BRCV, PUT, GET, USEND, URCV, C\_CNTRL) for programming S7 communication are described in the STEP 7 Documentation /8/).

**Sample configurations and programs** are available for the SEND/RECEIVE interface described here:

- In the sample project PROJECT\_ETHERNET that you can start immediately after installing NCM S7; for a description, refer to the Primer.
- On the Internet as downloadable sample projects; refer to the information in Appendix C “Support and Training”.



The Quick Start CD that can be ordered separately is a treasure-trove of sample programs and configurations.

You can order this directly on the Internet at:

<http://support.automation.siemens.com/WW/view/en/574211>

Entry ID: 574211

## 7.1 General Notes on FCs / FBs

### Block Library

The functions (FCs) and function blocks (FBs) described here are supplied with the STEP 7 basic package unless indicated otherwise.

The following list shows the numbers of the FCs as they are supplied with the configuration tool. You can change these numbers.

Under SIMATIC\_NET\_CP, you can also see which folders contain blocks after installing the NCM S7 for Industrial Ethernet option (default setting in STEP 7 Setup). Please note that you must use different FCs for the S7-300 and S7-400 (separate libraries).

Communication Service / Functional Area	Block Type		SIMATIC Manager Library		Described in
			SIMATIC_NET_CP		
			CP 300	CP 400	
SEND/RECEIVE (S5-compatible communication)	FC5	AG_SEND	x	x	Section 7.3
	FC6	AG_RECV	x	x	Section 7.3
	FC50	AG_LSEND	x <sup>2)</sup>	x	Section 7.3
	FC60	AG_LRECV	x <sup>2)</sup>	x	Section 7.3
	FC53	AG_SSEND		x <sup>3)</sup>	Section 7.3
	FC63	AG_SRECV		x <sup>3)</sup>	Section 7.3
SEND/RECEIVE (S5-compatible communication)	FC7	AG_LOCK	x	x	Section 7.4
	FC8	AG_UNLOCK	x	x	Section 7.4
	FC10	AG_CNTRL	x	x <sup>3)</sup>	Section 7.5
Programmed communication connections	FB55	IP_CONFIG	x	x	Section 7.6
S7 communication	FB12	BSEND	x		STEP 7 Documentation /8/
	FB13	BRCV	x		
	FB15	PUT	x		
	FB14	GET	x		
	FB8	USEND	x		
	FB9	URCV	x		
	FC62	C_CNTRL	x		

Communication Service / Functional Area	Block Type		SIMATIC Manager Library		Described in
			SIMATIC_NET_CP		
			CP 300	CP 400	
FTP (IT-CPs)	FC40	FTP_CONNECT	x	x	SIMATIC NET IT-CP, Manual /5/
	FC41	FTP_STORE	x	x	
	FC42	FTP_RETRIEVE	x	x	
	FC43	FTP_DELETE	x	x	
	FC44	FTP_QUIT	x	x	
PROFINET CBA	FB88 <sup>1)</sup>	PN_InOut <sup>1)</sup>	x <sup>1)</sup>	x <sup>1)</sup>	Section 7.7
	FB90 <sup>1)</sup>	PN_InOut_Fast		x <sup>1)</sup>	Section 7.7
PROFINET IO	FC11	PNIO_SEND	x		Section 7.8
	FC12	PNIO_RECV	x		Section 7.8
	FB52	PNIO_RW_REC	x		Section 7.8
	FB54	PNIO_ALARM	x		Section 7.8

1) FB88 / FB90 is supplied along with the engineering tool SIMATIC iMap and is entered in the PROFINET system library when you install the STEP 7 add-on.

2) Not to be used with the current CPs and not part of the current SIMATIC\_NET\_CP library

3) depending on the CP type

### Which Block Version Should I Use?

The following descriptions also include information on differences between the various block versions. Please take note of the version identifiers of the blocks you are using.

The SIMATIC Manager block libraries installed with STEP 7 / NCM S7 contain the block versions that were current at the time of the STEP 7 release.

---

#### Note

We recommend that you always use the latest block versions for all module types.

You will find information on the current block versions and the current blocks to download from the Internet in our customer support.

<http://support.automation.siemens.com/WW/view/en/8797900>

With the older module types, this recommendation assumes that you are using the latest firmware for the particular block type.

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### Notice

In some sections, this chapter contains information on various CP versions for S7-300. These sections are indicated by the following symbol:



Newer CP types are CPs / module types with the following versions or higher:

CP 343-1 Lean

6GK7 343-1CX10-0XE0 version 1 or higher / firmware version V1.0 or higher

CP 343-1

6GK7 343-1EX30-0XE0 version 1 / as of firmware version V2.0 or higher

CP 343-1

6GK7 343-1EX21-0XE0 version 1 or higher / firmware version V1.0 or higher

CP 343-1 Advanced

6GK7 343-1GX21-0XE0 version 1 or higher / firmware version V1.0 or higher

CP 343-1 / CP 343-1 EX20

6GK7 343-1EX11-0XE0 version 1 or higher / firmware version V2.0 or higher

6GK7 343-1EX20-0XE0 version 1 or higher / firmware version V1.0 or higher

CP 343-1 IT / CP 343-1 IT GX20

6GK7 343-1GX11-0XE0 version 1 or higher / firmware version V2.0 or higher

6GK7 343-1GX20-0XE0 version 1 or higher / firmware version V1.0 or higher

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### FCs when modules are replaced

Module replacement in this sense means the replacement of a module with another module that may be a more recent version.

---

### Notice

Please remember that if you replace a module, you must only use the blocks permitted for the configured CP type in the user program.

This means:

- If you replace the module without adapting the configuration data to the possibly newer module type, you do not need to make any changes to the blocks used.
- If you replace the module and you do adapt the configuration data to the newer module type, you must use the block versions approved for this module type.

We recommend that you always use the latest block versions for all module types. With the older module types, this recommendation assumes that you are using the latest firmware for the particular block type.

You will find more information on replacing blocks in our Customer Support on the Internet.

---

The manuals for specific devices /2/ contain information on the compatibility of the S7-CPs and the corresponding blocks (FCs / FBs).

## 7.2 Setting Parameters for FC Calls

Before describing the FCs in detail, a few general comments on calling and setting parameters for FCs will be useful at this point.

It is possible to make the following general statements about the following parameter groups that occur in all FCs:

- Parameters for CP and connection assignment (input parameters)
- Parameters for specifying a CPU data area (input parameters)
- Status information (output parameters)

### Calling Communication Blocks for an S7-300

---

#### Caution

The communication blocks for S7-300 (SIMATIC NET block libraries for S7-300 in STEP 7) must not be called in more than one priority class! If, for example, you call a communication block in OB1 and in OB35, block execution could be interrupted by the higher-priority OB.

If you call blocks in more than one OB, you must write your program so that a communication block that is currently executing cannot be interrupted by another communication block (for example by disabling/enabling SFC interrupts).

---

#### 7.2.1 Parameters for CP and Connection Assignment (input parameters)

When you call an FC, you transfer the module start address of the Ethernet CP in the CPLADDR or LADDR parameter. The module start address of the Ethernet CP can be found in the properties dialog of the CP in the “Address/Input” tab (can be selected in the SIMATIC Manager or in HW Config).

With connection-oriented jobs, you must also reference the connection to be used by its connection ID. You will find this in the properties dialog of the connection under “Block parameters” (refer to the information in NetPro).

### Setting Block Parameters Automatically<sup>1)</sup>

To ensure correct parameter settings for the block calls, The LAD/STL/FBD editor in STEP 7 provides you with the option of accepting all the relevant parameters from the hardware configuration (HW Config) and from the connection configuration (NetPro).

When assigning the parameters for the block in the user program, follow the steps outlined below:

1. Select the block call and its block parameters;
2. Right-click and select the menu command “**Connections...**”.
3. Depending on the block type, you can now select the connection and/or module intended for the block from a list.
4. Confirm your selection; as far as possible, the available parameter values are entered in the block call.

### Response to Incorrect Addresses

---

#### Notice

If you inadvertently address not a CP but another module type, errors occur that cannot be indicated by the error messages of the FCs themselves.

---

## 7.2.2 Parameters for Specifying a CPU Data Area (input parameters)

### Specifying the Data Area on the CPU

When you call an FC, you transfer the address and length of the data area on the CPU in which the user data is available or will be stored or which can contain further parameter information.

The ANY pointer data type is used to address this area. For more detailed information on this data type, refer to the STEP 7 online help under the topic “Format of the Parameter Type ANY”. You will also find a detailed description of the ANY pointer in /17/.

1). This function is possible only with the block library ..V5.0 SP3 or later.

### 7.2.3 Status Information (output parameters)

For status evaluation, the following parameters must be evaluated in the user program:

- DONE or NDR  
These parameters (DONE with send jobs and NDR with receive jobs) signal (successful) completion of the job.
- ERROR  
This indicates that the job could not be executed error-free.
- STATUS  
This parameter supplies detailed information about the execution of the job. Status codes can be returned during execution of the job (DONE=0 and ERROR=0).

#### Evaluating Status Codes

Remember that the status codes DONE, NDR, ERROR, STATUS are updated at each block call.

#### Status Codes during CP Startup

With a complete restart or restart of the Ethernet CP (after activating a switch on the module), the output parameters of the FC are reset as follows:

- DONE = 0
- NDR = 0
- ERROR = 0
- STATUS = 8180<sub>H</sub> for AG\_RECV / AG\_LRECV or 8181<sub>H</sub> for AG\_SEND /AG\_LSEND

## 7.3 FCs for the SEND/RECEIVE Interface

### Overview

The following FCs are available for transferring data on the SEND/RECEIVE interface:

FC	Can be used with <sup>1)</sup>		Meaning
	S7-300	S7-400	
<b>AG_SEND (FC5)</b>	x	x	for sending data
<b>AG_RECV (FC6)</b>	x	x	for receiving data
<b>AG_LSEND (FC50)</b>		x	for sending data
<b>AG_LRECV (FC60)</b>		x	for receiving data
<b>AG_SSEND (FC53)</b>		x	for sending data
<b>AG_SRECV (FC63)</b>		x	for receiving data

<sup>1)</sup> Notes on the FCs for an S7-300 and S7-400

- S7-300:

With older versions of the Ethernet CPs, the data length per job is restricted to <=240 bytes (applies up to block version V3.0 of AG\_SEND / AG\_RECV).



With the latest versions of the Ethernet CPs, only FCs AG\_SEND and AG\_RECV are used; due to a new and more efficient internal protocol, the data up to 8192 bytes can be transferred.

- S7-400:

With FCs AG\_SEND / AG\_RECV the data length per job is restricted to <=240 bytes.

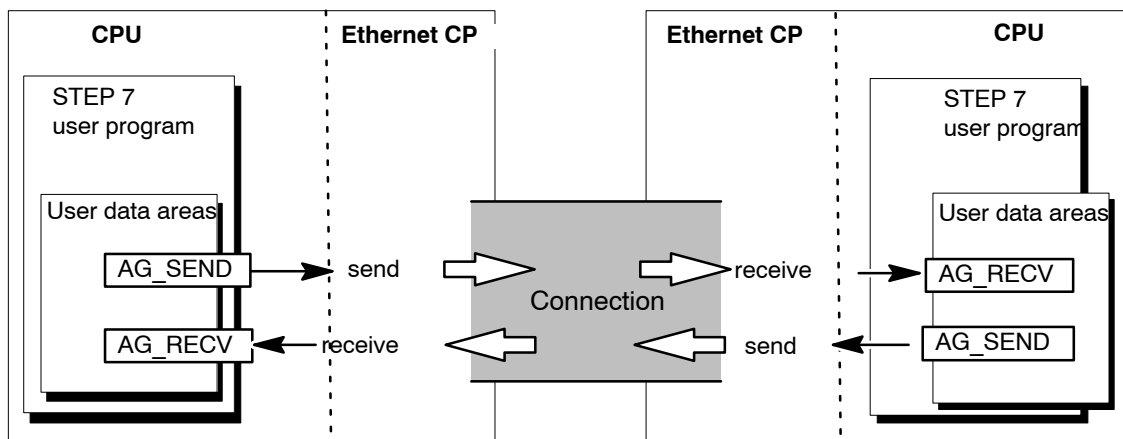
Longer data records (up to 8192 bytes) can be transferred with FCs AG\_LSEND or AG\_LRECV.

The FCs AG\_SSEND and AG\_SRECV are for accelerated transfer of data by using optimized block communication between CPU and CP in the S7 station. The fast communication has no effect on LAN communication. These two blocks are supported as of STEP 7 V5.4 SP3.

Please check the supported data area in the device-specific Part B of this manual for the S7-CP you are using. You will find an overview of the versions of the FCs/FBs in the documentation and block history.

### Application

The following diagram illustrates the use of the FCs described here for bi-directional data transfer on **one** configured connection.



**Note**

Unless specifically stated otherwise, the information on this and the following pages refers to AG\_SEND / AG\_LSEND / AG\_SSEND or AG\_RECV / AG\_LRECV / AG\_SRECV.

**Sample Programs**

Please note that the following sample programs are also available on the Internet.

- Sample program for the Send-Receive interface with the blocks FC5 (AG\_SEND) and FC6 (AG\_RECV) for S7-300:  
<http://support.automation.siemens.com/WW/view/en/17853532>
- Sample program for the Send-Receive interface with the blocks FC50 (AG\_LSEND) and FC60 (AG\_LRECV) for S7-400:  
<http://support.automation.siemens.com/WW/view/en/18513371>

## Specifying the Data Area on the CPU

When you call an FC, you transfer the address and length of the data area in the CPU. Remember, that the maximum length of the data area depends on the block type and block version being used.

- AG\_SEND and AG\_RECV

Up to version V3.0 of these blocks, a maximum of 240 bytes could be sent or received. The current block versions allow a data area of up to 8192 bytes for an S7-300. With an S7-400, the FCs AG\_LSEND / AG\_LRECV must still be used for larger data areas.

- AG\_LSEND / AG\_LRECV

Using the CPs of the S7-400 and with earlier versions of the S7-300, larger data areas can only be transferred with the FCs AG\_LSEND or AG\_LRECV. Please check the length of the data area in the product information.

- AG\_SSEND / AG\_SRECV

With CPs of the S7-400, that support PROFINET communication in conjunction with CPUs as of version 5.1, data can be transmitted at a higher transmission rate using the FCs AG\_SSEND and AG\_SRECV. For information on the CP types supported by CPUs as of version 5.1, refer to the manual of your CP (Section "Requirements for Use").

The following table shows the limit values for the data area of the various connection types.

Table 7-1 Maximum Data Length for the Various Connection Types

FC	ISO Transport	ISO-on-TCP	TCP	UDP
AG_LSEND (S7-400) AG_SEND (S7-300)	8192 bytes	8192 bytes	8192 bytes	2048 bytes
AG_SEND (S7-400)	240 bytes	240 bytes	240 bytes	240 bytes
AG_LRECV (S7-400) AG_RECV (S7-300)	8192 bytes	8192 bytes	8192 bytes	2048 bytes
AG_RECV (S7-400)	240 bytes	240 bytes	240 bytes	240 bytes
AG_SSEND (S7-400) AG_SRECV (S7-400)	1452 bytes	1452 bytes	1452 bytes	1452 bytes

**Note**

For information on the length of the data area you can transfer with older versions of the Ethernet CPs, refer to the product information bulletin / manual of the Ethernet CP you are using /2/.

**UDP connections: Use without a job header**

On specified connections, the address and job parameters are specified by the connection configuration. The user program only provides the user data in the UDP data area when sending with AG\_SEND / AG\_LSEND / AG\_SSEND or receives the data with AG\_RECV / AG\_LRECV / AG\_SRECV.

**UDP connections: Use with job header**

Free UDP connections require a job header in the user data area.

The following schematic illustrates the structure of the job buffer and the meaning and location of the parameters in the job header.

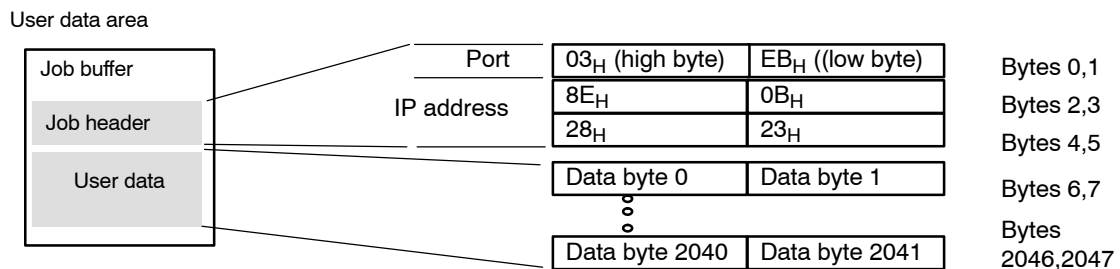


Figure 7-1 Sending and Receiving on a Free UDP Connection with Programmed Addresses

- In the diagram (entries in hexadecimal) the following IP address is assumed: 142.11.40.35 (example only);
- For the port address 1003, the following would be entered: for high byte: 03<sub>H</sub>; for low byte: EB<sub>H</sub>.
- The user data area can be up to 2048 bytes long. Up to 2042 bytes of user data can be transferred. 6 bytes are reserved for the job header.

Please note that the data length specified in the block call (LEN parameter) must include the header and the user data!



## Change Call Parameters only after Job Confirmation

---

### Notice

Once the job has been triggered, you can only change the call parameters of the FC call interface of the FCs AG\_SEND or AG\_RECV after the FC has confirmed completion of the job with DONE=1 or with ERROR=1.

If you do not keep to this rule, it is possible that the job will be aborted with an error.

---

## Status display on the FC call interface; Special case with FC versions (only for S7-300) \*)

With the FCs AG\_SEND (FC5) and AG\_RECV (FC6), you will receive the codes shown below in the following situations:

- CP is in STOP;
- Connection is not configured
- Connection is not established
- Connection is aborted;

Codes:

- AG\_SEND:  
DONE=0; ERROR=1; Status=8183<sub>H</sub>
- AG\_RECV:  
DONE=0; ERROR=0; Status=8180<sub>H</sub>  
or  
DONE=0; ERROR=1; Status=8183<sub>H</sub>

\*) applies to FCs as of version 4.0

### 7.3.1 FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND

#### Meaning of the Block

The FCs AG\_SEND / AG\_LSEND / AG\_SSEND pass data to the Ethernet CP for transfer over a configured connection.

The selected data area can be a memory bit area or a data block area.

Error-free execution of the function is indicated when the entire user data area could be sent over Ethernet.

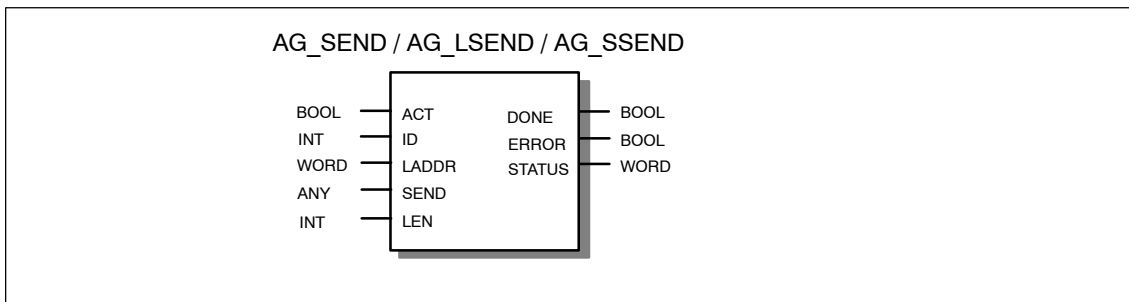
The way in which the FC functions depends on the CP type you are using. Please note the differences in the following section.

Note:

Unless otherwise stated, all the following information applies to equally to the FCs AG\_SEND, AG\_LSEND and AG\_SSEND.

#### Call

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fc 5</code>	<code>//AG_SEND block call</code>
<code>ACT := M 10.0</code>	<code>//Job triggered by memory bit</code>
<code>ID := MW 12</code>	<code>//Connection ID acc. to configuration</code>
<code>LADDR := W#16#0100</code>	<code>//LADDR 256 dec. in HW configuration</code>
<code>SEND := P#db99.dbx10.0 byte 240</code>	<code>//Buffer with send data</code>
<code>LEN := MW 14</code>	<code>//Length for send data</code>
<code>DONE := M 10.1</code>	<code>//Execution code</code>
<code>ERROR := M 10.2</code>	<code>//Error code</code>
<code>STATUS := MW 16</code>	<code>//Status code</code>

---

### Notice

Please note the following special feature on TCP connections:

With the older S7-CPs for S7-400, you must use FC AG\_LSEND on TCP connections!



With the latest S7-CPs for S7-300, you must also use FC AG\_SEND for TCP connections.

---

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### Note

If you want to use FC53 AG\_SSEND, you will need to select the "SPEED SEND/RECV" mode in the "Options" tab of the properties dialog for the configured connection in STEP 7 / NetPro.

---

## How the Block Works

The following diagrams illustrate the normal sequence of data transmission triggered in the user program using AG\_SEND.

The way in which the FC functions depends on the CP type you are using.

- Case a: Sequence with older CP types

With older CP types, the transfer of the entire data area regardless of its length is started after the first block call by the CP.



- Case b: Sequence with newer CP types (S7-300 only!)

With the newer CP types, data transfer has been optimized. In particular with longer data records, this allows a much higher data throughput on the interface between the CPU and CP.

FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND - continued

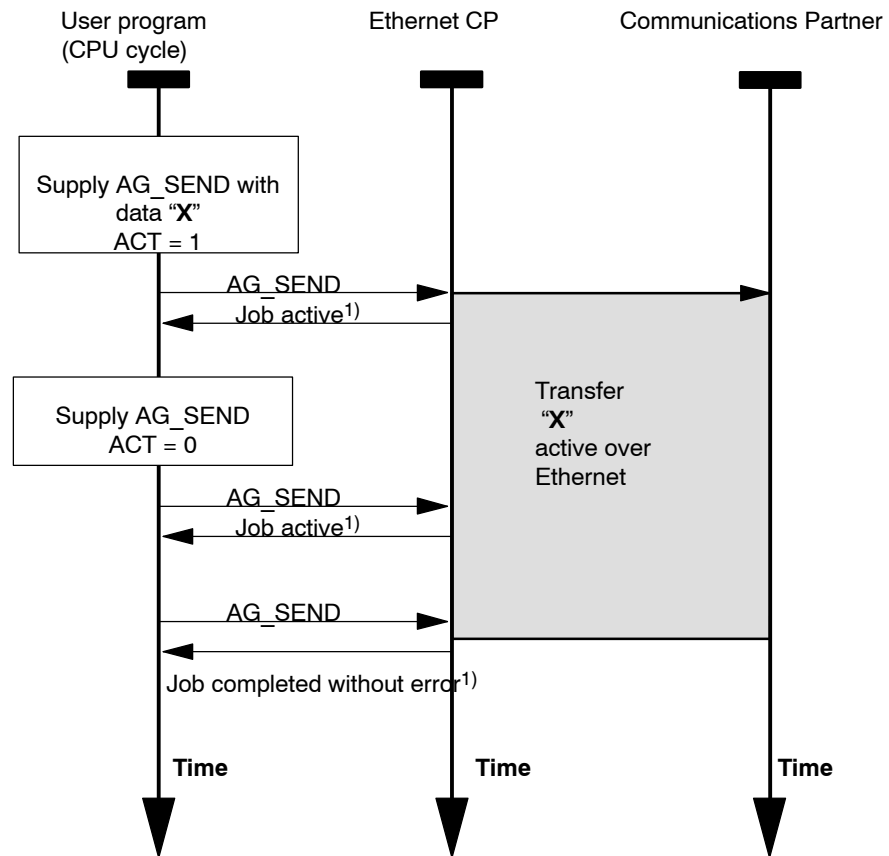
- Case a: Sequence with older CP types

The send job is executed as soon as the parameter ACT = 1 is passed.

Following this, the parameter ACT = 0 must be passed in at least one further call.

The status code in the output parameters DONE, ERROR and STATUS is updated in each block call and can be evaluated. To update the status code without starting a new send job, start a new block call with the parameter ACT = 0.

Refer to the sample program at the end of Section 7.3.1.



Legend:

<sup>1)</sup> Parameter transfer DONE, ERROR, STATUS

FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND - continued



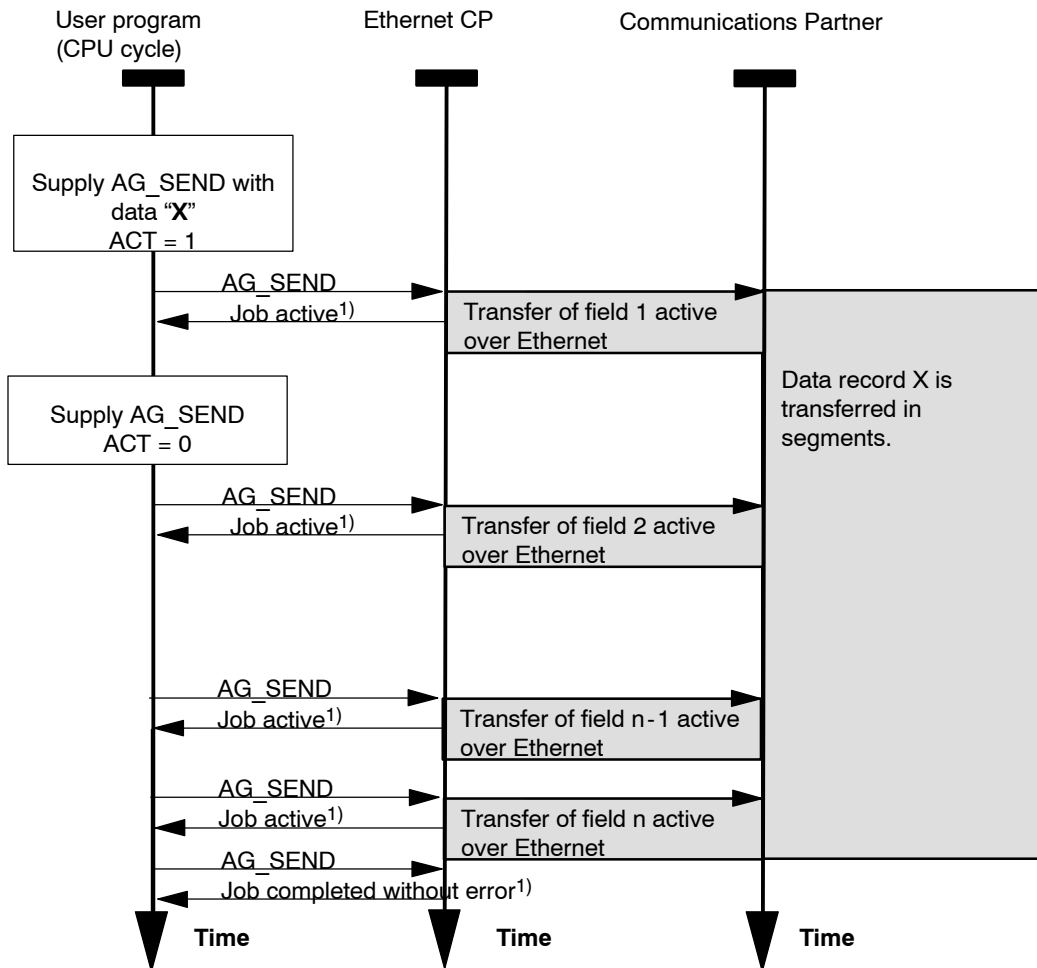
- Case b: Sequence with newer CP types (S7-300 only!)

The send job is started as soon as the parameter ACT = 1 is passed.

In contrast to case a, the protocol used here to transfer the data segments (each 240 bytes of user data) requires the FC to be called again for each segment.

Depending on the length of the user data, you must therefore continue to call the FC with ACT=0 until transfer of the entire data record is indicated; at least one call with ACT=0 is always necessary. The data is transferred to the communication partner in segments of 240 bytes.

The status code in the output parameters DONE, ERROR and STATUS is updated in each block call and can be evaluated.



Legend:  
 1) Parameter transfer DONE, ERROR, STATUS

FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND - continued

**Note**

In principle, it is possible to call the FC more than once within the CPU cycle to speed up the handling of the job. Do not forget, however, that this increases the load during the CPU cycle (the load differs depending on the CPU type)!

**Explanation of the Formal Parameters**

The following table explains all the formal parameters for the AG\_SEND / AG\_LSEND / AG\_SSEND functions.

Parameter	Declaration	Type	Possible Values	Remarks
ACT	INPUT	BOOL	0,1	If an FC is called with ACT=1, LEN bytes are sent from the ISO transport data area specified with the SEND parameter. If an FC is called with ACT = 0, the status codes DONE, ERROR and STATUS are updated.
ID	INPUT	INT	1,2...64 (S7-400) 1,2...16 (S7-300)	The connection number of the connection is specified in the parameter ID. (See Configuration Section 5.3.1)
LADDR	INPUT	WORD		Module start address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
SEND	INPUT	ANY		Specifies the address and length. The address of the data area refers to one of the following: - Bit memory - Data block area

## FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND - continued

Parameter	Declaration	Type	Possible Values	Remarks
LEN	INPUT	INT	<p><b>On ISO Transport and ISO-on-TCP / TCP:</b> 1,2, to 8192 (or up to "length specified for SEND parameter")</p> <p><b>On UDP:</b> 1,2,...2048 (or up to "length specified for SEND parameter")</p>	<p>Number of bytes to be sent from the data area with this job. The possible values range from 1 to length specified for the SEND parameter.</p> <ul style="list-style-type: none"> <li>Note the block type: <ul style="list-style-type: none"> <li>S7-300 With older versions of FC AG_SEND (up to V3.0), the data area is always restricted to a maximum of 240 bytes. The current versions allow up to 8192 bytes (2048 bytes for UDP).</li> <li>S7-400 With FC AG_SEND, the data area is restricted to a maximum of 240 bytes.</li> </ul> </li> <li>Note on the S7-400: Data transfer may be restricted to <math>LEN \leq 240</math> bytes with older versions of the CP firmware! For further information, see /2/</li> <li>Improved performance with shorter data records: Transfer of data records up to <b>240</b> bytes results in better performance regardless of the block type used.</li> </ul>
DONE	OUTPUT	BOOL	0: Job active 1: done	<p>This parameter indicates whether or not the job was completed without errors. As long as DONE = 0, no further job can be triggered. DONE is set to 0 by the CP when it accepts a new job. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.</p>
ERROR	OUTPUT	BOOL	0: - 1: error	<p>For the meaning of this parameter in conjunction with the DONE and STATUS parameters, refer to the following table.</p>
STATUS	OUTPUT	WORD	see following table	<p>Status code The following table shows the condition codes formed by the DONE and ERROR parameters.</p>

FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND - continued

**Condition Codes**

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

**Note**

For entries coded with 8Fxx<sub>H</sub> in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the "Calls" tab.

Table 7-2 Condition Codes for AG\_SEND / AG\_LSEND / AG\_SSEND

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	Job completed without error.
0	0	0000 <sub>H</sub>	No job being executed.
0	0	8181 <sub>H</sub>	Job active.
0	1	7000 <sub>H</sub>	This code is possible only with the S7-300: the FC was called with ACT=0; the job has not yet been processed.
0	1	8183 <sub>H</sub>	No configuration or the ISO/TCP service has not yet started on the Ethernet CP.
0	1	8184 <sub>H</sub>	<ul style="list-style-type: none"> <li>Illegal type specified for the SEND parameter.</li> <li>System error (the source data area is incorrect).</li> </ul>
0	1	8185 <sub>H</sub>	LEN parameter longer than SEND source area.
0	1	8186 <sub>H</sub>	ID parameter invalid. <ul style="list-style-type: none"> <li>ID != 1,2....16 (S7-300).</li> <li>ID != 1,2....64.(S7-400)</li> </ul>
0	1	8302 <sub>H</sub>	No receive resources on the destination station; the receiving station cannot process received data quickly enough or has not prepared any receive resources.
0	1	8304 <sub>H</sub>	The connection is not established. The send job should only be attempted again after waiting for at least 100 ms.
0	1	8311 <sub>H</sub>	The destination station cannot be obtained under the specified Ethernet address.
0	1	8312 <sub>H</sub>	Ethernet error on the CP.
0	1	8F22 <sub>H</sub>	Source area invalid, for example: Area does not exist in the DB LEN parameter < 0
0	1	8F24 <sub>H</sub>	Area error reading a parameter.
0	1	8F28 <sub>H</sub>	Alignment error reading a parameter.
0	1	8F32 <sub>H</sub>	Parameter contains a DB number that is too high.



## FC5 AG\_SEND / FC50 AG\_LSEND / FC53 AG\_SSEND - continued

Table 7-2 Condition Codes for AG\_SEND / AG\_LSEND / AG\_SSEND

DONE	ERROR	STATUS	Meaning
0	1	8F33 <sub>H</sub>	DB number error.
0	1	8F3A <sub>H</sub>	Area not loaded (DB).
0	1	8F42 <sub>H</sub>	Timeout reading a parameter from the I/O area.
0	1	8F44 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack.
0	1	8F7F <sub>H</sub>	Internal error, e.g. illegal ANY reference. e.g. parameter LEN=0
0	1	8090 <sub>H</sub>	<ul style="list-style-type: none"> <li>• Module with this module start address does not exist.</li> <li>• The FC used does not match the system family being used (different FCs must be used for S7-300 and S7-400).</li> </ul>
0	1	8091 <sub>H</sub>	Module start address not at a double word boundary.
0	1	8092 <sub>H</sub>	In the ANY reference, a type other than BYTE is specified. (S7-400 only)
0	1	80A4 <sub>H</sub>	The communication bus connection between the CPU and CP is not established. (Only with newer CPU versions)
0	1	80B0 <sub>H</sub>	The module does not recognize the data record.
0	1	80B1 <sub>H</sub>	The specified length (in the LEN parameter) is incorrect.
0	1	80B2 <sub>H</sub>	The communication bus connection between the CPU and CP is not established.
0	1	80C0 <sub>H</sub>	The data record cannot be read.
0	1	80C1 <sub>H</sub>	The specified data record is currently being processed.
0	1	80C2 <sub>H</sub>	There are too many jobs pending.
0	1	80C3 <sub>H</sub>	CPU resources (memory) occupied.
0	1	80C4 <sub>H</sub>	Communication error (occurs temporarily and a repetition in the user program will often remedy the problem).
0	1	80D2 <sub>H</sub>	Module start address incorrect.

### 7.3.2 FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV

#### Meaning of the Block

The AG\_RECV / AG\_LRECV / AG\_SRECV function receives the data transferred on a configured connection from the Ethernet CP.

The data area specified for the receive data can be a memory bit area or a data block area.

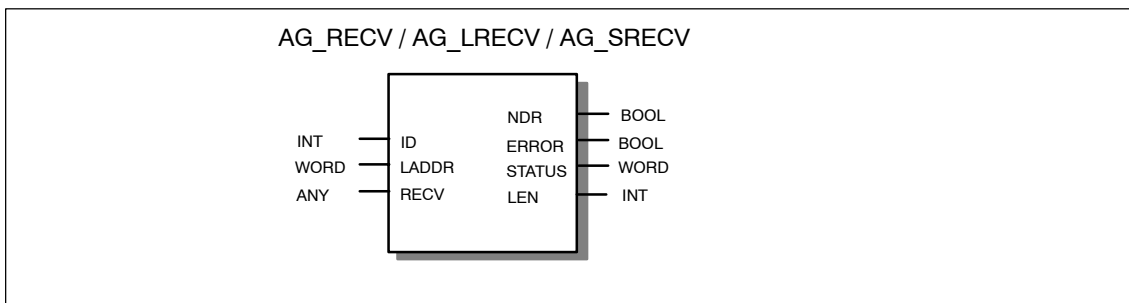
Error-free execution is indicated when the data could be received from the Ethernet CP.

Note:

Unless otherwise stated, all the following information applies equally to the FCs AG\_RECV, AG\_LRECV and AG\_SRECV.

#### Call

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fc 6</code>	<code>//AG_RECV block call</code>
<code>ID := MW 40</code>	<code>//Connection ID acc. to configuration</code>
<code>LADDR := W#16#0100</code>	<code>//=LADDR 256 dec. in hardware configuration</code>
<code>RECV := P#M 0.0 BYTE 100</code>	<code>//Buffer for received data</code>
<code>NDR := DB 110.DBX 0.6</code>	<code>//Received code</code>
<code>ERROR := DB 110.DBX 0.7</code>	<code>//Error code</code>
<code>STATUS := DB 110.DBW 2</code>	<code>//Status code</code>
<code>LEN := DB 110.DBW 4</code>	<code>//Received data length</code>

---

**Notice**

Please note the following special feature on TCP connections:

With the older S7-CPs for S7-300, you must use FC AG\_LRECV on TCP connections!



With the latest S7-CPs for S7-300, you must also use FC AG\_RECV for TCP connections.

---

**Note**

If you want to use FC63 AG\_SRECV, you will need to select the "SPEED SEND/RECV" mode in the "Options" tab of the properties dialog for the configured connection in STEP 7 / NetPro.

---

**How the Block Works**

The following diagram illustrates the normal sequence of data acceptance triggered by an AG\_RECV in the user program.

Each AG\_RECV job in the user program is acknowledged by the Ethernet CP with an entry in the output parameters NDR, ERROR and STATUS.

The way in which the FC functions depends on the CP type you are using.

- Case a: Sequence with older CP types

With older CP types, the transfer of the entire data area regardless of its length is started after the first block call by the CP.



- Case b: Sequence with newer CP types (S7-300 only!)

With the newer CP types, optimized data transfer on the SEND/RECEIVE interface is available. In particular with longer data records, this allows a much higher data throughput on the interface between the CPU and CP.

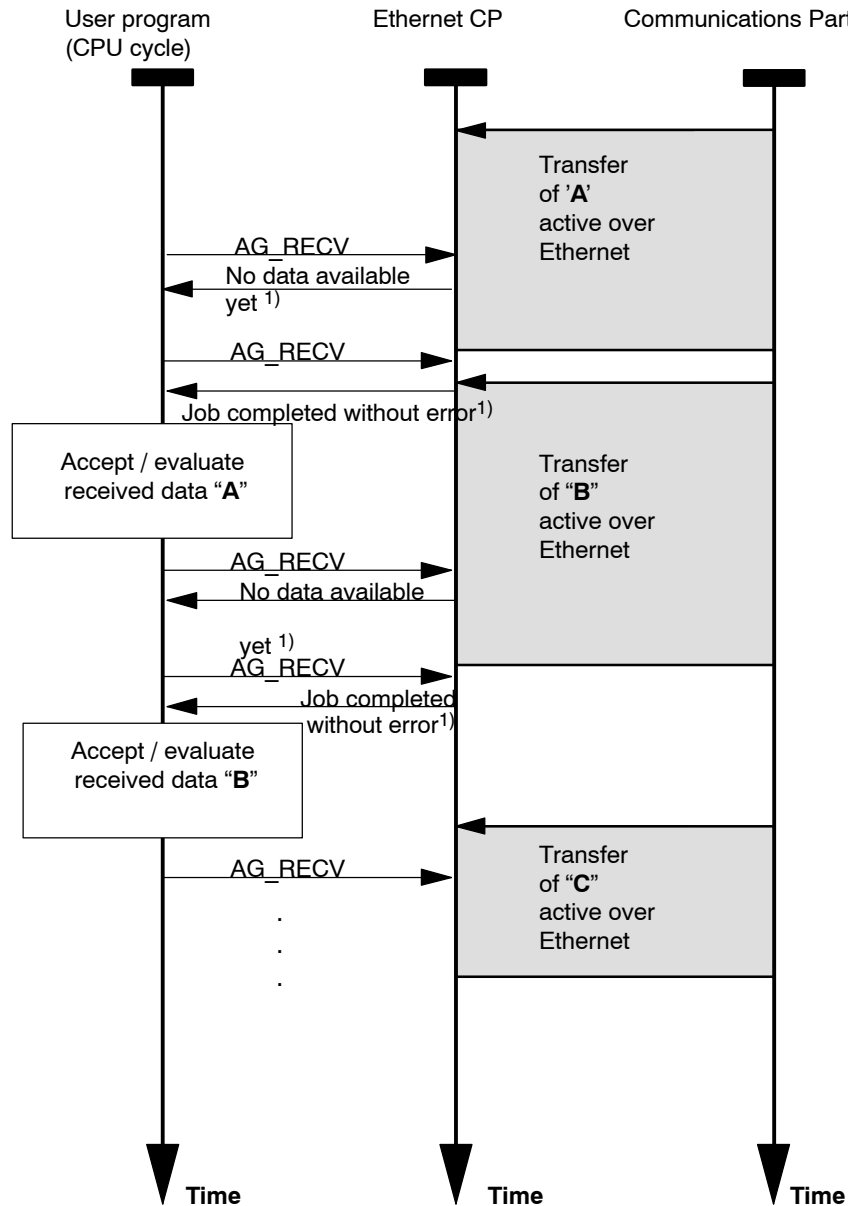
FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV - continued

- Case a: Sequence with older CP types

When the FC is called, the user program prepares the buffer for the received data and instructs the CP to enter the received data there.

As soon as a data record has been entered fully and consistently in the receive buffer, this is indicated by the parameter NDR = 1 in one of the next FC calls.

The status code in the output parameters NDR, ERROR, and STATUS is updated in each block call and can be evaluated.



Legend:  
 1) Parameter transfer NDR, ERROR, STATUS

FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV - continued



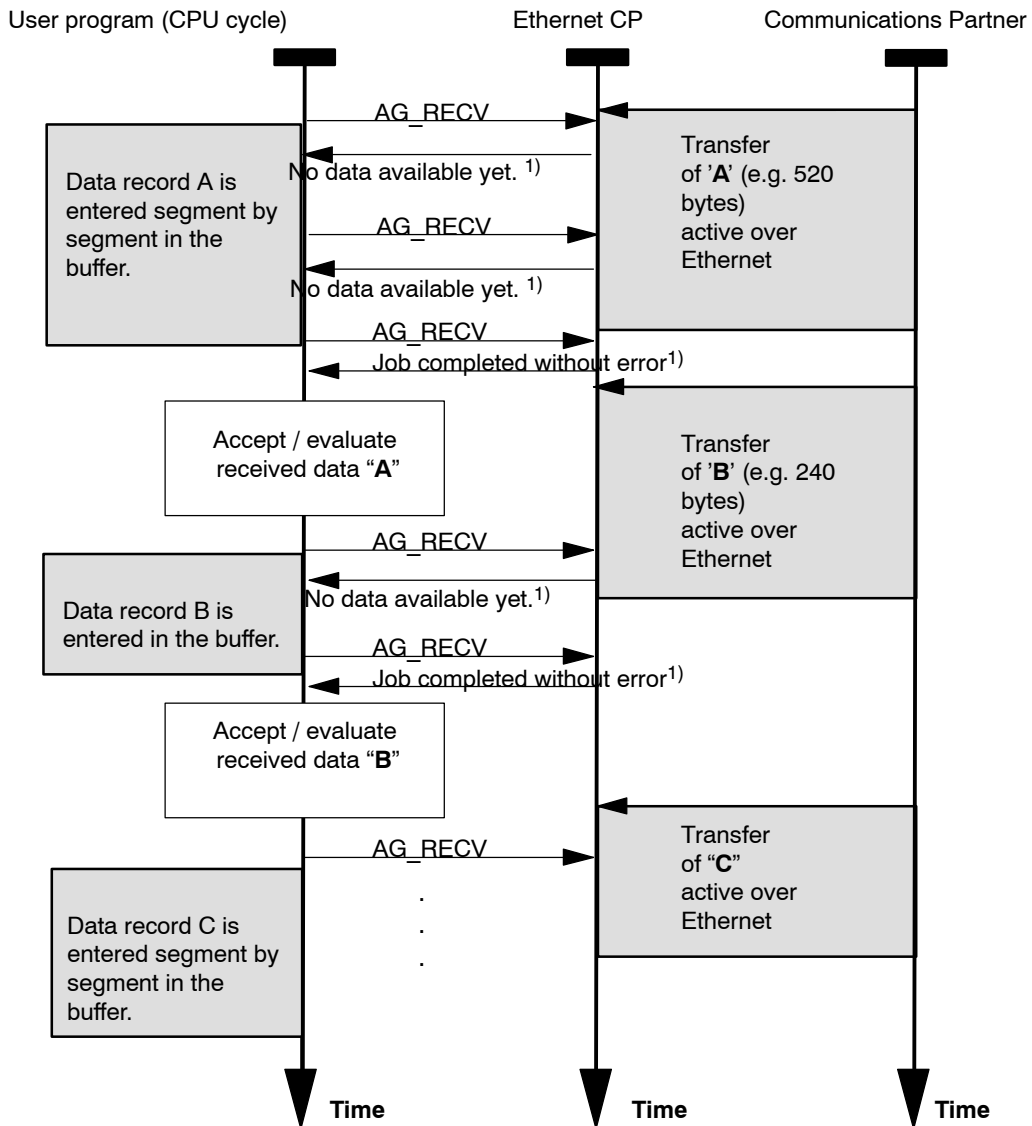
- Case b: Sequence with newer CP types (S7-300 only!)

When the FC is called, the user program prepares the buffer for the received data and instructs the CP to enter the received data there.

In contrast to case a, the protocol used here to transfer the data to the receive buffer requires the FC to be called again for each data segment (240 bytes of user data).

Depending on the length of the user data, you must therefore continue to call the FC until transfer of the entire data record is indicated by the parameter NDR = 1.

The status code in the output parameters NDR, ERROR, and STATUS is updated in each block call and can be evaluated.



Legend:  
<sup>1)</sup> Parameter transfer NDR, ERROR, STATUS

FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV - continued

**Explanation of the Formal Parameters**

The following table explains all the formal parameters for the AG\_RECV / AG\_LRECV / AG\_SRECV function.

Parameter	Declaration	Type	Possible Values	Remarks
ID	INPUT	INT	1,2...64 (S7-400) 1,2...16 (S7-300)	The connection number of the ISO transport connection is specified in the ID parameter (See Configuration Section 5.3.1)
LADDR	INPUT	WORD		Module start address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
RECV	INPUT	ANY		Specifies the address and length. The address of the data area refers to one of the following: - Bit memory - Data block area Note on length: Performance is improved when transferring data records up to <b>212</b> bytes if you also restrict the length to 212 with the RECV parameter.
NDR	OUTPUT	BOOL	0: - 1: new data	This parameter indicates whether new data were received. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the DONE and STATUS parameters, refer to the following table.
STATUS	OUTPUT	WORD	see following table	Status code For the meaning of this parameter in conjunction with the NDR and ERROR parameters, refer to the following table.

## FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV - continued

Parameter	Declaration	Type	Possible Values	Remarks
LEN	OUTPUT	INT	<p><b>On ISO Transport and ISO-on-TCP:</b> 1,2...8192</p> <p><b>On UDP:</b> 1,2...2048</p>	<p>Specifies the number of bytes accepted from the Ethernet CP and entered in the data area.</p> <ul style="list-style-type: none"> <li>Note the block type: <ul style="list-style-type: none"> <li>S7-300 With older versions of FC AG_RECV (up to V3.0), the data area is always restricted to a maximum of 240 bytes. The current versions allow up to 8192 bytes (2048 bytes for UDP).</li> <li>S7-400 With FC AG_RECV, the data area is restricted to a maximum of 240 bytes.</li> </ul> </li> </ul>

## Condition Codes

The following table shows the codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

## Note

For entries coded with 8Fxx<sub>H</sub> in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the "Calls" tab.

Table 7-3 Condition Codes for AG\_RECV / AG\_LRECV / AG\_SRECV

NDR	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	New data accepted.
0	0	8180 <sub>H</sub>	No data available yet. (not with AG_SRECV)
0	0	8181 <sub>H</sub>	Job active.
0	1	8183 <sub>H</sub>	<ul style="list-style-type: none"> <li>The configuration is missing;</li> <li>The ISO transport service has not yet started on the Ethernet CP;</li> <li>The connection is not established.</li> </ul>
0	1	8184 <sub>H</sub>	<ul style="list-style-type: none"> <li>Illegal type specified for the RECV parameter;</li> <li>System error.</li> </ul>
0	1	8185 <sub>H</sub>	Destination buffer (RECV) is too short.

## FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV - continued

Table 7-3 Condition Codes for AG\_RECV / AG\_LRECV / AG\_SRECV

NDR	ERROR	STATUS	Meaning
0	1	8186 <sub>H</sub>	ID parameter invalid. ID != 1,2....16 (S7-300). ID != 1,2....64.(S7-400)
0	1	8304 <sub>H</sub>	The connection is not established. The send job should only be attempted again after waiting for at least 100 ms.
0	1	8F23 <sub>H</sub>	Source area invalid, for example: Area does not exist in the DB.
0	1	8F25 <sub>H</sub>	Area error writing a parameter.
0	1	8F29 <sub>H</sub>	Alignment error writing a parameter.
0	1	8F30 <sub>H</sub>	Parameter is in the write-protected first current data block.
0	1	8F31 <sub>H</sub>	Parameter is in the write-protected second current data block.
0	1	8F32 <sub>H</sub>	Parameter contains a DB number that is too high.
0	1	8F33 <sub>H</sub>	DB number error.
0	1	8F3A <sub>H</sub>	Destination area not loaded (DB).
0	1	8F43 <sub>H</sub>	Timeout writing a parameter to the I/O area.
0	1	8F45 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack.
0	1	8F7F <sub>H</sub>	Internal error, e.g. illegal ANY reference.
0	1	8090 <sub>H</sub>	<ul style="list-style-type: none"> <li>No module with this address exists or the CPU is in STOP mode;</li> <li>The FC used does not match the system family being used (different FCs must be used for S7-300 and S7-400).</li> </ul>
0	1	8091 <sub>H</sub>	Module start address not at a double word boundary.
0	1	8092 <sub>H</sub>	In the ANY reference, a type other than BYTE is specified. (S7-400 only)
0	1	80A0 <sub>H</sub>	Negative acknowledgment reading from the module.
0	1	80A4 <sub>H</sub>	The communication bus connection between the CPU and CP is not established.
0	1	80B0 <sub>H</sub>	The module does not recognize the data record.
0	1	80B1 <sub>H</sub>	Destination area invalid.
0	1	80B2 <sub>H</sub>	The communication bus connection between the CPU and CP is not established.
0	1	80C0 <sub>H</sub>	The data record cannot be read.
0	1	80C1 <sub>H</sub>	The specified data record is currently being processed.
0	1	80C2 <sub>H</sub>	There are too many jobs pending.
0	1	80C3 <sub>H</sub>	CPU resources (memory) occupied.



FC6 AG\_RECV / FC60 AG\_LRECV / FC63 AG\_SRECV - continued

Table 7-3 Condition Codes for AG\_RECV / AG\_LRECV / AG\_SRECV

<b>NDR</b>	<b>ERROR</b>	<b>STATUS</b>	<b>Meaning</b>
0	1	80C4 <sub>H</sub>	Communication error (occurs temporarily and a repetition in the user program will often remedy the problem).
0	1	80D2 <sub>H</sub>	Module start address incorrect.

## 7.4 FCs for Access Coordination with FETCH/WRITE

### Overview

The following FCs are available for FETCH/WRITE function to coordinate access:

FC	can be used with:		Meaning
	S7-300	S7-400	
<b>AG_LOCK (FC7)</b>	x	x	Locks external data access with FETCH/WRITE.
<b>AG_UNLOCK (FC8)</b>	x	x	Releases external data access with FETCH/WRITE.

### Caution when Configuring

If you use FCs AG\_LOCK and AG\_UNLOCK, you must specify the following information for S7-400 stations in the configuration:

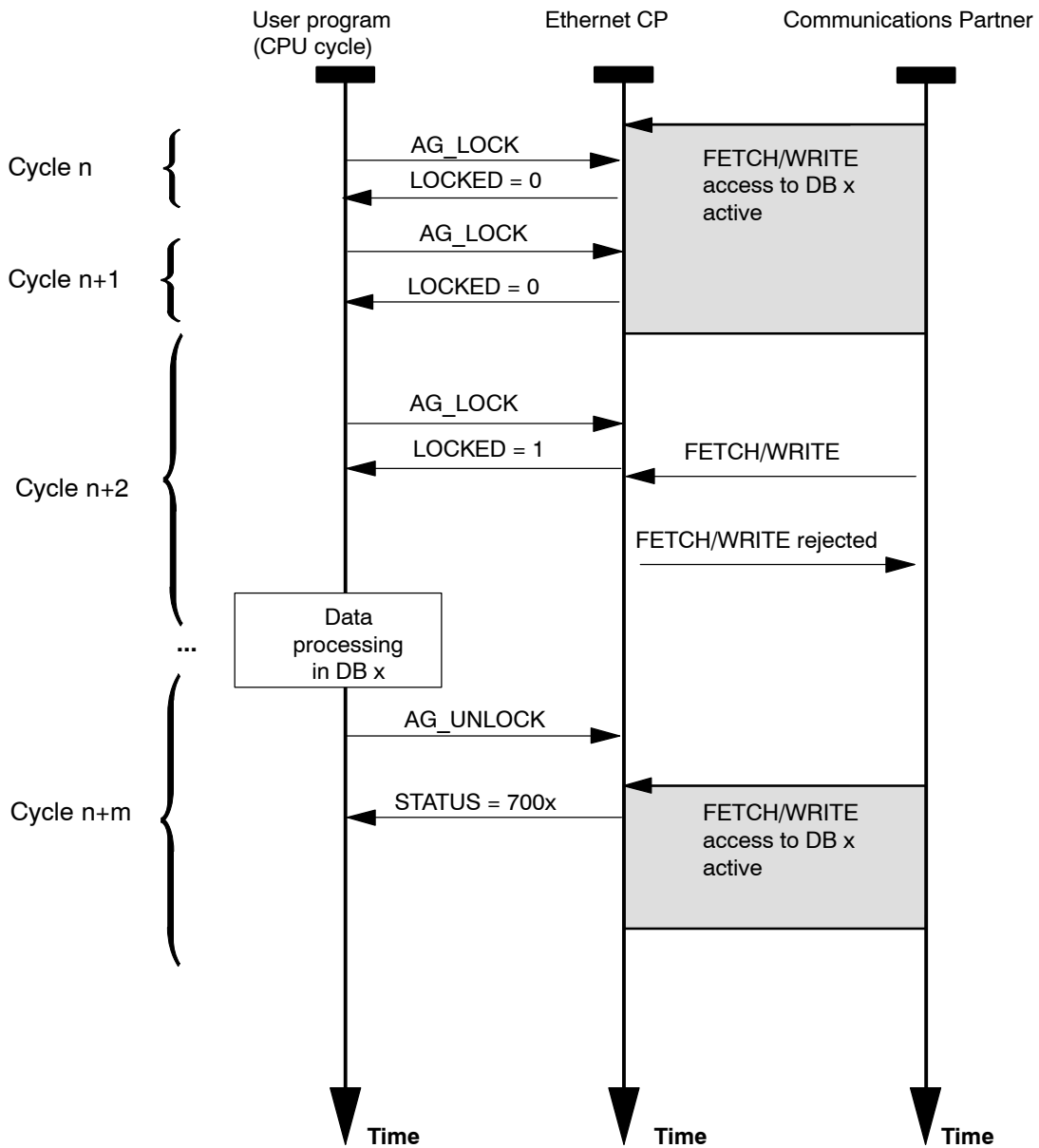
- in HW Config  
In the “Addresses” tab, select the “Address setting for LOCK/UNLOCK” option if this option is available.

### How the Block Works

With these FCs, you can coordinate access to system memory areas so that no inconsistent data are created and transferred. The control is from the user program in the S7 CPU that can, if necessary disable an external FETCH/WRITE access using an AG\_LOCK call. After a certain time or after the local write/read access is completed, an AG\_UNLOCK job can be used to enable external access again.

Another advantage is that this access lock only applies to the FETCH/WRITE connection specified in the call. If more than one FETCH/WRITE connection is configured, these can, for example, be used for certain specific system areas and a selective access coordination can be implemented.

The following diagram illustrates the usual chronological sequence of memory access coordination controlled in the user program with AG\_LOCK and AG\_UNLOCK.



The lock job must first be monitored in the user program using the code in the return parameter `LOCKED`. As long as `LOCKED=0` is indicated, it must be assumed that there is still a `FETCH/WRITE` access active.

If `LOCKED=1` is indicated, this shows that the lock is active; data can now be modified by the user program.

The status code is updated at each block call.

### 7.4.1 FC7 AG\_LOCK

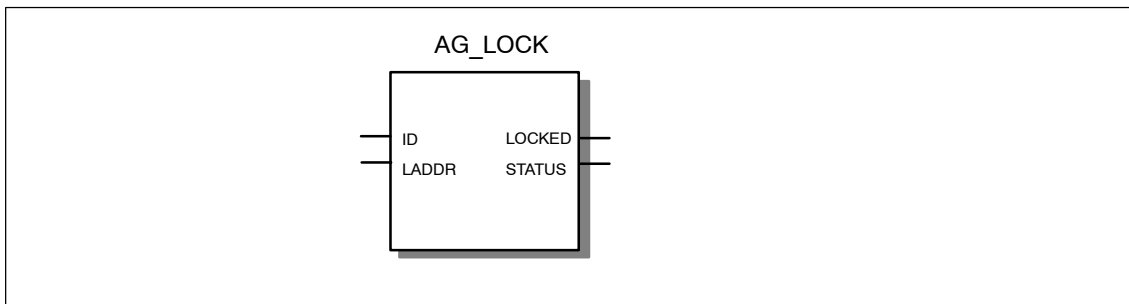
#### Meaning of the Block

Using the AG\_LOCK block the data exchange using FETCH or WRITE on the connection selected with the parameter ID is disabled. The LOCKED output indicates whether or not the lock was successful. If the lock was not successful, the job must be triggered again in a later CPU cycle.

The STATUS output indicates the status of the CP for this connection.

#### Call

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fc 7</code>	<code>//Block call</code>
<code>ID := DB 100.DBW 2</code>	<code>//Connection ID acc. to configuration</code>
<code>LADDR := W#16#0100</code>	<code>//LADDR 256 dec. in hardware configuration</code>
<code>LOCKED := DB 100.DBX 0.6</code>	<code>//Status code of access lock</code>
<code>STATUS := DB 100.DBW 4</code>	<code>//Status code</code>

#### Explanation of the Formal Parameters

The following table explains all the formal parameters for the AG\_LOCK function:

## FC7 AG\_LOCK - continued

Parameter	Declaration	Type	Possible Values	Remarks
ID	INPUT	INT	1,2...16 for S7-300 1,2...64 for S7-400	The connection number of the connection is specified in the parameter ID. (See Configuration Section 5.3.1)
LADDR	INPUT	WORD		Module start address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
LOCKED	OUTPUT	BOOL	0: not (yet) locked 1: locked	Shows the status of the access lock requested on the specified FETCH/WRITE connection.
STATUS	OUTPUT	WORD	see following table	Status code For meaning, refer to the table below.

**Condition Codes**

The following table shows the STATUS code that must be evaluated by the user program.

Table 7-4 AG\_LOCK Condition Codes

STATUS	Meaning
7000 <sub>H</sub>	CP is not processing a job
7001 <sub>H</sub>	FETCH active
7002 <sub>H</sub>	WRITE active
8183 <sub>H</sub>	FETCH/WRITE not configured for this connection (S7-400 only)
8186 <sub>H</sub>	ID number not in permitted range (e.g. 1...64 with S7-400 Industrial Ethernet CPs)
80A4 <sub>H</sub>	The communication bus connection between the CPU and CP is not established. (Only with newer CPU versions)
80B0 <sub>H</sub>	The module does not recognize the data record.
80B1 <sub>H</sub>	The specified length (in the LEN parameter) is incorrect.
80B2 <sub>H</sub>	The communication bus connection between the CPU and CP is not established.
80C0 <sub>H</sub>	The data record cannot be read.
80C1 <sub>H</sub>	The specified data record is currently being processed.
80C2 <sub>H</sub>	There are too many jobs pending.
80C3 <sub>H</sub>	CPU resources (memory) occupied.

FC7 AG\_LOCK - continued

Table 7-4 AG\_LOCK Condition Codes, Fortsetzung

<b>STATUS</b>	<b>Meaning</b>
80C4 <sub>H</sub>	Communication error (occurs temporarily and a repetition in the user program will often remedy the problem).
80D2 <sub>H</sub>	Module start address incorrect.

## 7.4.2 FC8 AG\_UNLOCK

### Meaning of the Block

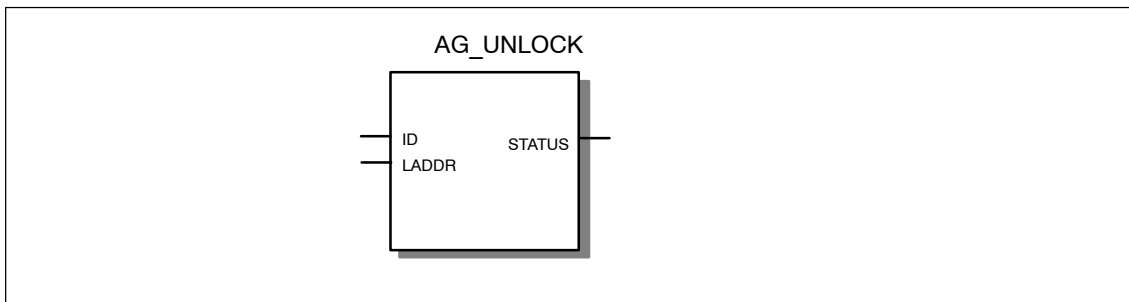
Using the AG\_UNLOCK function, the external access to system areas on the S7 CPU with FETCH or WRITE on the connection specified by the ID parameter is released.

The next external FETCH/WRITE job to arrive for the CP can then be processed.

The AG\_UNLOCK follows an access lock with AG\_LOCK.

### Call

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fc 8</code>	<code>//Block call</code>
<code>ID := DB 100.DBW 2</code>	<code>//Connection ID acc. to configuration</code>
<code>LADDR := W#16#0100</code>	<code>//LADDR 256 dec. in hardware configuration</code>
<code>STATUS := DB 100.DBW 4</code>	<code>//Status code</code>

### How the Block Works

To release the connection again, the LOCK request bit must be cleared by the FC again. The FC also shows the current status using error messages.

### Explanation of the Formal Parameters

The following table explains all the formal parameters for the AG\_UNLOCK function:

## FC8 AG\_UNLOCK - continued

Parameter	Declaration	Type	Possible Values	Remarks
ID	INPUT	INT	1,2...16 for S7-300 1,2...64 for S7-400	The connection number of the connection is specified in the parameter ID. (See Configuration Section 5.3.1)
LADDR	INPUT	WORD		Module start address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
STATUS	OUTPUT	WORD	see following table	Status code For meaning, refer to the table below.

**Condition Codes**

The following table shows the STATUS code that must be evaluated by the user program.

Table 7-5 AG\_UNLOCK Condition Codes

STATUS	Meaning
7000 <sub>H</sub>	CP is not processing a job
7001 <sub>H</sub>	FETCH active
7002 <sub>H</sub>	WRITE active
8183 <sub>H</sub>	FETCH/WRITE not configured for this connection (S7-400 only)
8186 <sub>H</sub>	ID number not in permitted range (e.g. 1...64 with S7-400 Industrial Ethernet CPs)
80A4 <sub>H</sub>	The communication bus connection between the CPU and CP is not established. (Only with newer CPU versions)
80B0 <sub>H</sub>	The module does not recognize the data record.
80B1 <sub>H</sub>	The specified length (in the LEN parameter) is incorrect.
80B2 <sub>H</sub>	The communication bus connection between the CPU and CP is not established.
80C0 <sub>H</sub>	The data record cannot be read.
80C1 <sub>H</sub>	The specified data record is currently being processed.
80C2 <sub>H</sub>	There are too many jobs pending.
80C3 <sub>H</sub>	CPU resources (memory) occupied.
80C4 <sub>H</sub>	Communication error (occurs temporarily and a repetition in the user program will often remedy the problem).
80D2 <sub>H</sub>	Module start address incorrect.



## 7.5 FC 10 AG\_CNTRL

### How It Works

With the AG\_CNTRL function, you can diagnose connections. When necessary, you can initialize connection establishment again using the FC.

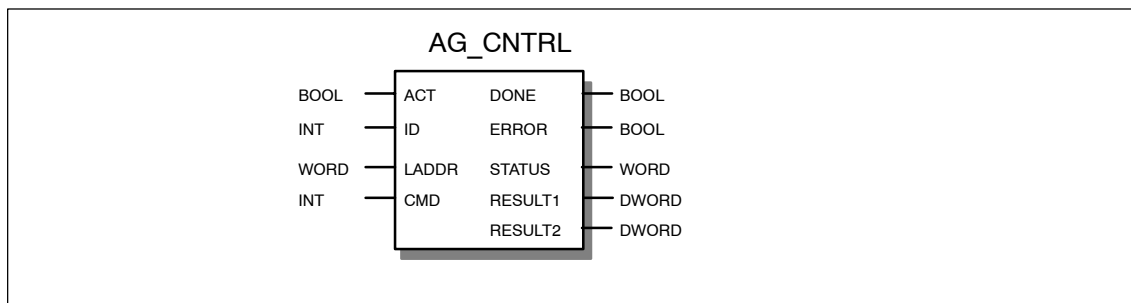
The following actions are possible by setting commands:

- Reading out connection information  
Based on status information, you can decide whether or not it would be useful to reset all or individual connections of the CP.
- Resetting configured connections  
You can reset individual or all connections of a CP.

The commands of the AG\_CNTRL function (FC) are permitted only for SEND/RECV connections based on the ISO / RFC / TCP / UDP protocols.

### Call Interface

Call interface in FBD representation



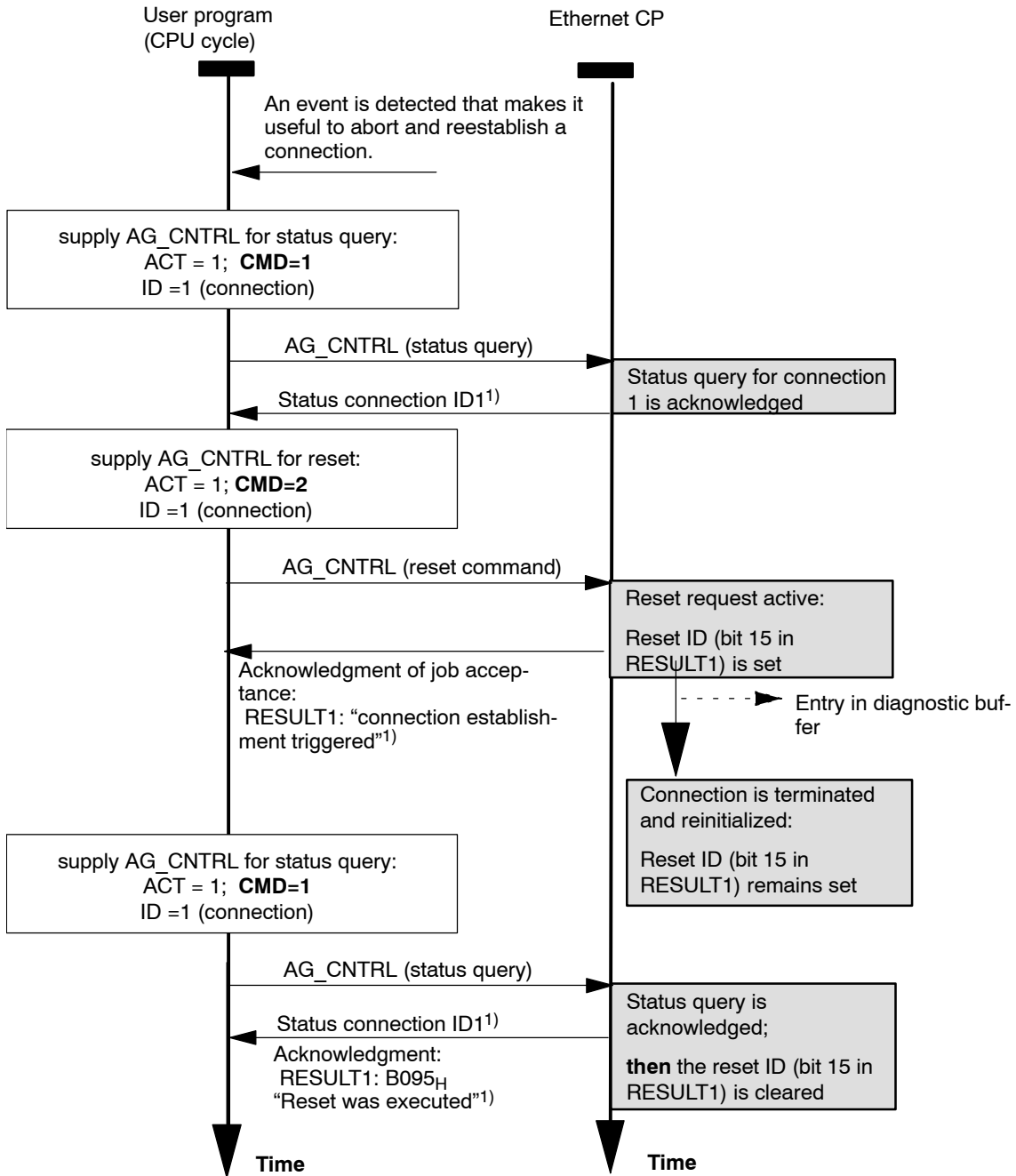
Example in STL representation

STL	Explanation
<code>call fc 10</code>	<code>//AG_CNTRL block call</code>
<code>ACT := M1.0</code>	<code>//Job triggered by memory bit</code>
<code>ID := MW8</code>	<code>//Connection ID acc. to configuration</code>
<code>LADDR := W#16#100</code>	<code>//=LADDR 256 dec. in hardware configuration</code>
<code>CMD := MW6</code>	<code>//=Command ID</code>
<code>DONE := M20.1</code>	<code>//Execution code</code>
<code>ERROR := M20.2</code>	<code>//Error code</code>
<code>STATUS := MW22</code>	<code>//Status code</code>
<code>RESULT1 := MD24</code>	<code>//Job result 1</code>
<code>RESULT2 := MD28</code>	<code>//Job result 2</code>

FC10 AG\_CNTRL - Continued

**How the Block Works**

The following diagram shows a typical sequence of AG\_CNTRL jobs in the user program.



Legend:

<sup>1)</sup> Parameter transfer DONE, ERROR, STATUS and RESULT1/2

The diagram shows how the connection status is initially queried and then, in a second job, how the connection termination is triggered with the reset command.

## FC10 AG\_CNTRL - Continued

The reset ID (bit 15 in RESULT1) is set on the CP. If there is a status query later, it is therefore clearly recognizable whether the connection has been reset due to a reset job. The reset ID is cleared on the CP only after this status query (or as a result of an explicit CN\_CLEAR\_RESET command)

**Notice**

The block must be called with ACT = 1; if it is called with ACT=0, there is no function call and the block is exited again immediately.

Since the job result of FC10 is obtained synchronous to the call, it can be called again in the same cycle.

**Explanation of the Formal Parameters**

The following table explains all the formal parameters for the AG\_UNLOCK function:

Parameter	Declaration	Type	Possible Values	Meaning / Remark
ACT	INPUT	BOOL	0,1	The FC must be called with ACT=1. If it is called with ACT=0, there is no function call and the block is exited again immediately.
ID	INPUT	INT	<ul style="list-style-type: none"> <li>• 1, 2, ..., n,</li> <li>or</li> <li>• 0</li> </ul>	The connection number of the connection is specified in the parameter ID. The connection number can be found in the configuration. n is the maximum number of connections and is dependent on the product (S7-300 or S7-400). (See also Configuration Section 5.3.1)  If the call addresses all connections (_ALL function with CMD 3 or 4), 0 must be specified as the ID.
LADDR	INPUT	WORD		Module start address  When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
CMD	INPUT	INT	See Table 7-7	Command to FC AG_CNTRL.
DONE	OUTPUT	BOOL	0: Job still being processed or not yet triggered  1: Job executed	This parameter indicates whether or not the job was completed without errors.  For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.  Note: If DONE=1, RESULT can be evaluated

## FC10 AG\_CNTRL - Continued

Parameter	Declaration	Type	Possible Values	Meaning / Remark
ERROR	OUTPUT	BOOL	0: No error 1: Error	Error code For the meaning of this parameter in conjunction with the DONE and STATUS parameters, refer to the following table 7-6.
STATUS	OUTPUT	WORD	See Table 7-6	Status code For the meaning of this parameter in conjunction with the DONE and ERROR parameters, refer to the following table 7-6.
RESULT1	OUTPUT	DWORD	See Table 7-7	Information returned according to the command sent to FC AG_CNTRL.
RESULT2	OUTPUT	DWORD	See Table 7-7	Only to be evaluated for S7-400: Part 2 of information returned according to the command sent to FC AG_CNTRL.

### Condition Codes

The following table 7-6 shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

The command results must also be evaluated in the RESULT1/2 parameters according to Table 7-7.

Table 7-6 AG\_CNTRL Codes

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	A job (CMD) was transferred successfully to the CP (for example RESET) or a status was read successfully from the CP. The RESULT1/2 parameters can be evaluated.
0	0	0000 <sub>H</sub>	There has been no block call yet or the block was called with ACT=0.
0	0	8181 <sub>H</sub>	Job active The block call must be repeated with the same parameters until DONE or ERROR is signaled.
0	1	8183 <sub>H</sub>	No configuration or the service has not yet started on the Ethernet CP.
0	1	8186 <sub>H</sub>	The ID parameter is invalid. The permitted ID depends on the selected command; see CMD parameter in Table 7-7.
0	1	8187 <sub>H</sub>	The CMD parameter is invalid.
0	1	8188 <sub>H</sub>	Sequence error in the ACT control (Note: this code does not occur in the product version of the CP / firmware).

## FC10 AG\_CNTRL - Continued

Table 7-6 AG\_CNTRL Codes

DONE	ERROR	STATUS	Meaning
0	1	8189 <sub>H</sub>	The CP version / firmware used does not support FC10. The code is set when you call a CP 3431 -EX20 with firmware as of V1.3.9; with other CP types, the code 80B0 <sub>H</sub> is set instead. Note: FC10 in version V1.0 is supported by the CPs as of CP 343-1 EX21/GX21; this code does not occur with these modules.
0	1	8090 <sub>H</sub>	<ul style="list-style-type: none"> <li>• No module with this module start address exists.</li> </ul> or <ul style="list-style-type: none"> <li>• The FC used does not match the system family being used (different FCs must be used for S7-300 and S7-400).</li> </ul> or <ul style="list-style-type: none"> <li>• The function is not supported by this module.</li> </ul>
0	1	8091 <sub>H</sub>	The module start address is not on a double-word boundary.
0	1	80B0 <sub>H</sub>	The module does not recognize the data record.
0	1	80C0 <sub>H</sub>	The data record cannot be read.
0	1	80C1 <sub>H</sub>	The specified data record is currently being processed.
0	1	80C2 <sub>H</sub>	There are too many jobs pending.
0	1	80C3 <sub>H</sub>	CPU resources (memory) occupied.
0	1	80C4 <sub>H</sub>	Communication error The error occurs temporarily; it is usually best to repeat the job in the user program.
0	1	80D2 <sub>H</sub>	The module start address is incorrect.

## FC10 AG\_CNTRL - Continued

**Commands and Evaluating the Job Results**

The following table shows you the possible commands and the results that can be evaluated in the RESULT1/2 parameters.

Table 7-7 Commands to FC AG\_CNTRL

CMD	Meaning	
0	NOP – no operation The block executes without a job being sent to the CP.	
	RESULT (for CMD = 0)	
	Parameter	Hex value/range
	RESULT1	0000 0001 <sub>H</sub>
	RESULT2	0000 0000 <sub>H</sub>
	Meaning	
	Executed without error	
	Default	

CMD	Meaning		
1	CN_STATUS – connection status This command returns the status of the connection selected with the ID. The CP is selected in the LADDR parameter. If bit 15 (reset ID) is set, this is automatically reset (this action corresponds to the CN_CLEAR_RESET job - see CMD = 5).		
	RESULT (for CMD = 1)		Meaning
	Parameter	Hex value/range	
	RESULT1	0000 000* <sub>H</sub>	Bits 0-3: Codes for the send direction (excluded values: 0x2)
		Bit 0	Connection Type
		0	• No send and receive connection
		1	• Connection reserved for send and receive jobs
		Bit 1	Status of current job
		0	• No send job being executed
		1	• Send job being executed
		Bits 2+3	Previous job:
		00	• No information available on previous send job
		01	• Previous send job completed successfully
		10	• Previous send job not completed successfully

## FC10 AG\_CNTRL - Continued

RESULT (for CMD = 1)			Meaning
Parameter	Hex value/range	Bit/value	
RESULT1	0000 00*0 <sub>H</sub>		Bits 4-7: Codes for the receive direction (excluded values: 0x2)
		Bit 4	Connection Type
		0	<ul style="list-style-type: none"> <li>No send and receive connection</li> </ul>
		1	<ul style="list-style-type: none"> <li>Connection reserved for send and receive jobs</li> </ul>
		Bit 5	Status of current job
		0	<ul style="list-style-type: none"> <li>No receive job being executed</li> </ul>
		1	<ul style="list-style-type: none"> <li>Receive job being executed</li> </ul>
		Bits 6+7	Previous job:
		00	<ul style="list-style-type: none"> <li>No information available on previous receive job</li> </ul>
		01	<ul style="list-style-type: none"> <li>Previous receive job completed successfully</li> </ul>
		10	<ul style="list-style-type: none"> <li>Previous receive job not completed successfully</li> </ul>
RESULT1	0000 0*00 <sub>H</sub>		Bits 8-11: Codes for FETCH/WRITE (excluded values: 0x3,0x7,0x8,0xB,0xF)
		Bit 8	Connection type:
		0	<ul style="list-style-type: none"> <li>No FETCH connection</li> </ul>
		1	<ul style="list-style-type: none"> <li>Connection reserved for FETCH jobs</li> </ul>
		Bit 9	Connection type:
		0	<ul style="list-style-type: none"> <li>No WRITE connection</li> </ul>
		1	<ul style="list-style-type: none"> <li>Connection reserved for WRITE jobs</li> </ul>
		Bit 10	Job status (FETCH/WRITE):
		0	<ul style="list-style-type: none"> <li>Job status OK</li> </ul>
		1	<ul style="list-style-type: none"> <li>Job status NOT OK</li> </ul> <p>This ID is set in the following situations:</p> <ul style="list-style-type: none"> <li>The job was acknowledged negatively by the CPU</li> <li>The job could not be forwarded to the CPU because the connection was in the "LOCKED" status.</li> <li>The job was rejected because the FETCH/WRITE header did not have the correct structure.</li> </ul>
		Bit 11	Status of FETCH/WRITE job
		0	<ul style="list-style-type: none"> <li>No job active</li> </ul>
		1	<ul style="list-style-type: none"> <li>Job from LAN active</li> </ul>

FC10 AG\_CNTRL - Continued

RESULT (for CMD = 1)			Meaning
Parameter	Hex value/range	Bit/value	
RESULT1	0000 *000 <sub>H</sub>		Bits 12-15: General CP information (excluded values: 0x3,0xB)
		Bit 12 + 13	Information on connection status: (only available for SEND/RECV connections based on the ISO/RFC/TCP protocols, with UDP, the corresponding internal information is output)
		00	• Connection is terminated
		01	• Connection establishment active
		10	• Connection termination active
		11	• Connection is established
		Bit 14	CP information:
0	• CP in STOP		
1	• CP in Run		
RESULT1	**** 0000 <sub>H</sub>	Bit 15	Reset ID
		0	• FC10 has not yet reset a connection or the reset ID was cleared.
		1	• The control block has executed a connection reset.
RESULT1	**** 0000 <sub>H</sub>		Bits 16-31: Reserved 0 – reserved for later expansions
RESULT2	0000 0000 <sub>H</sub>		- reserved for later expansions



## FC10 AG\_CNTRL - Continued

CMD	Meaning	
2	<p>CN_RESET – connection reset</p> <p>This command resets the connection selected with ID.</p> <p>The CP is selected in the LADDR parameter.</p> <p>Resetting the connection means that a connection is aborted and established again (active or passive depending on the configuration).</p> <p>An entry is also generated in the diagnostic buffer in which the job result can be found.</p>	
	RESULT (for CMD = 2)	
	Parameter	Hex value/range
	RESULT1	0000 0001 <sub>H</sub>
		0000 0002 <sub>H</sub>
	RESULT2	0000 0000 <sub>H</sub>
	Meaning	
		<p>The reset job was transferred to the CP successfully.</p> <p>The connection abort and subsequent connection establishment were triggered.</p>
		<p>The reset job could not be transferred to the CP because the service has not started on the CP (for example, CP in Stop).</p>
		Default

CMD	Meaning	
3	<p>CN_STATUS_ALL – all connections status</p> <p>This command returns the connection status of all connections (established/terminated) in the RESULT1/2 parameters (at total of 8 bytes of group information).</p> <p>The ID parameter must be set to "0" (checked for 0).</p> <p>The CP is selected in the LADDR parameter.</p> <p>When necessary, you can obtain detailed information about a terminated or unconfigured connection using a further connection status call with CMD=1.</p>	
	RESULT (for CMD = 3)	
	Parameter	Hex value/range
	RESULT1	**** ***_H
	RESULT2	**** ***_H
	Meaning	
		<p>32 bits: Connection 1 - 32</p> <ul style="list-style-type: none"> <li>• 0 – connection terminated / not configured</li> <li>• 1 – connection established</li> </ul>
		<p>32 bits: Connection 33 - 64</p> <ul style="list-style-type: none"> <li>• 0 – connection terminated / not configured</li> <li>• 1 – connection established</li> </ul>

## FC10 AG\_CNTRL - Continued

CMD	Meaning	
4	CN_RESET_ALL – all connections reset This command resets all connections. The ID parameter must be set to "0" (checked for 0). The CP is selected in the LADDR parameter. Resetting the connections means that connections are aborted and established again (active or passive depending on the configuration). An entry is also generated in the diagnostic buffer in which the job result can be found.	
	RESULT (for CMD = 4)	
	Parameter	Hex value/range
	RESULT1	0000 0001 <sub>H</sub>
		The reset job was transferred to the CP successfully. The connection abort and subsequent connection establishment of all connections were triggered.
	RESULT1	0000 0002 <sub>H</sub>
		The reset job could not be transferred to the CP because the service has not started on the CP (for example, CP in Stop).
	RESULT2	0000 0000 <sub>H</sub>
		Default

CMD	Meaning	
5	CN_CLEAR_RESET – Clear the reset ID This command resets the reset ID (bit 15 in RESULT1) for the connection selected with ID. The CP is selected in the LADDR parameter. This job executes automatically when the connection status is read (CMD=1); the separate job described here is therefore only required in special situations.	
	RESULT (for CMD = 5)	
	Parameter	Hex value/range
	RESULT1	0000 0001 <sub>H</sub>
		The clear job was transferred to the CP successfully.
	RESULT1	0000 0002 <sub>H</sub>
		The clear job could not be transferred to the CP because the service has not started on the CP (for example, CP in Stop).
	RESULT2	0000 0000 <sub>H</sub>
		Default

## FC10 AG\_CNTRL - Continued

CMD	Meaning	
6	CN_DISCON - connection disconnect This command resets the connection selected with ID and LADDR. The connection reset is achieved by a connection abort.. Any data in the stack is lost without any message being displayed. There is then no automatic establishment of the connection. The connection can be established again by the control job CN_STARTCON. A diagnostic buffer entry is generated that can be found in the job result.	
	RESULT (for CMD = 6)	
	Parameter	Hex value/range
	RESULT1	0000 0001 <sub>H</sub>
		Meaning
		The job was transferred to the CP successfully. The connection abort was initiated.
	RESULT1	0000 0002 <sub>H</sub>
		The connection abort job could not be transferred to the CP because the service has not started on the CP (for example, CP in STOP).
	RESULT2	0000 0000 <sub>H</sub>
		Default

CMD	Meaning	
7	CN_STARTCON - start connection This command establishes a connection selected with ID and LADDR and aborted earlier with the control job CN_DISCON. A diagnostic buffer entry is generated that can be found in the job result.	
	RESULT (for CMD = 7)	
	Parameter	Hex value/range
	RESULT1	0000 0001 <sub>H</sub>
		Meaning
		The connection establishment job was transferred to the CP successfully. The connection establishment was initiated.
	RESULT1	0000 0002 <sub>H</sub>
		The connection establishment job could not be transferred to the CP because the service has not started on the CP (for example, CP in STOP).
	RESULT2	0000 0000 <sub>H</sub>
		Default

## 7.6 FB55 IP\_CONFIG for Programmed Communication Connections

### Meaning of the Block

Connections can be specified in a DB (configuration DB) and transferred to the CP with an FB.

You can use this variant of programmed communication connections as an alternative to connection configuration with STEP 7.

With the function block FB55, a configuration data block (CONF\_DB) is transferred to the CP. The configuration data block contains all the connection data for an Ethernet CP.

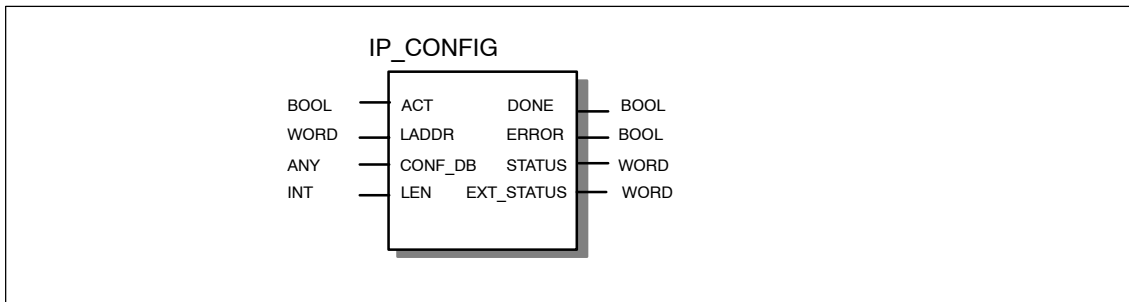
Depending on the size of the configuration DB, the data may be transferred to the CP in several segments. This means that the FB must continue to be called until the FB signals complete transfer by setting the DONE bit to 1.

### Note

Read the description of the configuration data block CONF\_DB in Section 6.

### Call

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fb 55</code>	<code>//IP_CONFIG block call</code>
<code>ACT := M 10.0</code>	<code>//Job initiated by memory bit</code>
<code>LADDR := W#16#0100</code>	<code>//=LADDR 256 dec. in hardware configuration</code>
<code>CONF_DB := P#db99.dbx10.0 byte 240</code>	<code>//Data block with connection data</code>
<code>LEN := MW 14</code>	<code>//Length info for the connection data</code>
<code>DONE := M 10.1</code>	<code>//Execution code</code>
<code>ERROR := M 10.2</code>	<code>//Error code</code>
<code>STATUS := MW 16</code>	<code>//Status code</code>
<code>EXT_STATUS := MW 18</code>	<code>//Cause of error in connection data</code>

## FB55 IP\_CONFIG - continued

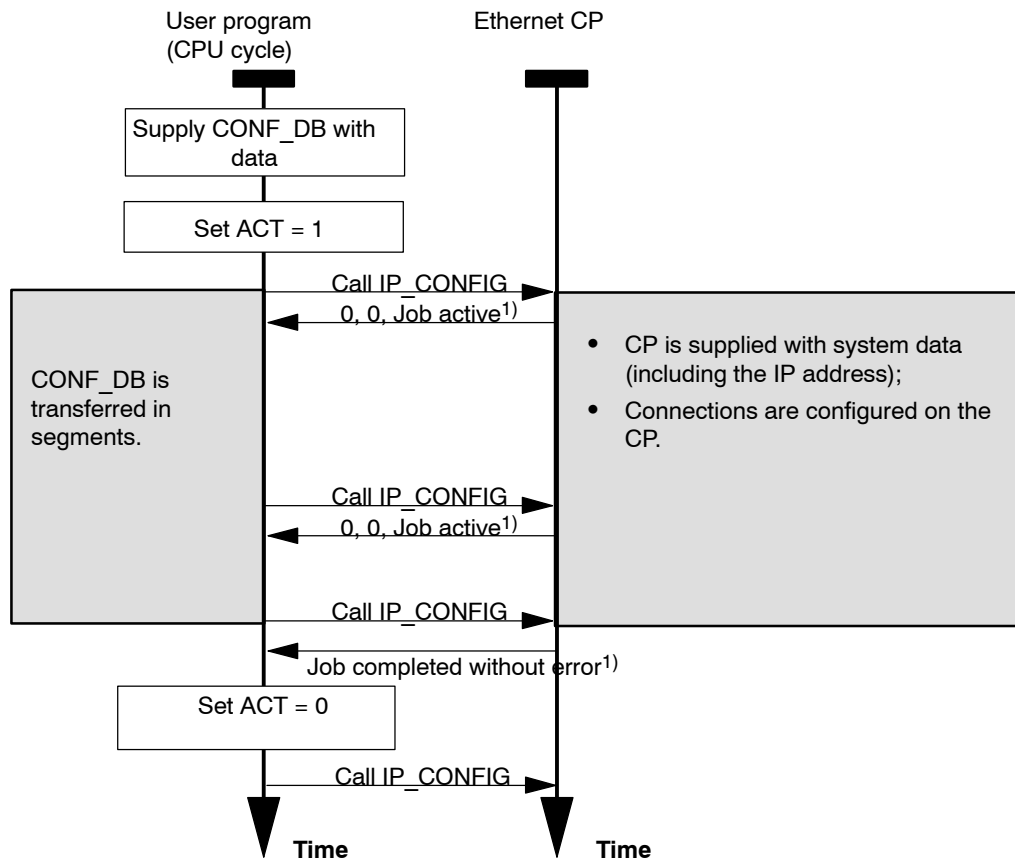
**How It Works**

The following diagram illustrates the normal sequence of connection configuration triggered by an IP\_CONFIG in the user program.

The job executes as soon as the parameter ACT is transferred with value 1.

Due to the segmented transfer of the CONF\_DB, you will need to repeat the job with ACT = 1 until completion of the job is indicated in the parameters DONE, ERROR, and STATUS.

If you want to transfer a connection configuration again later, the parameter ACT must first be transferred with value 0 in at least one further call.

**Notice**

The data transferred with the configuration DB are stored in volatile memory on the CP and must be downloaded to the CP again following a power down!

FB55 IP\_CONFIG - continued

**Explanation of the Formal Parameters**

The following table explains the formal parameters for the call interface of the IP\_CONFIG function block :

Parameter	Declaration	Type	Possible Values	Remarks
ACT	INPUT	BOOL	0,1	When the FB is called with ACT = 1, the DBxx is sent to the CP. If the FB is called with ACT = 0, only the status codes DONE, ERROR and STATUS are updated.
LADDR	INPUT	WORD		Module start address When you configure the CP with STEP 7 hardware configuration, the module start address is displayed in the configuration table. Specify this address here.
CONF_DB	INPUT	ANY		The parameter points to the start address of the configuration data area in a data block (type: byte).
LEN	INPUT	INT		Length information in bytes for the configuration data area.
DONE	OUTPUT	BOOL	0: - 1: new data	The parameter indicates whether the configuration data area was completely transferred. Remember that it may be necessary to call the FB several times depending on the size of the configuration data area (in several cycles) until the DONE parameter is set to 1 to signal completion of the transfer. For the meaning of this parameter in conjunction with the ERROR and STATUS parameters, refer to the following table.
ERROR	OUTPUT	BOOL	0: - 1: error	Error code For the meaning of this parameter in conjunction with the NDR and STATUS parameters, refer to the following table.
STATUS	OUTPUT	WORD	see following table	Status code For the meaning of this parameter in conjunction with the NDR and ERROR parameters, refer to the following table.
EXT_STATUS	OUTPUT	WORD		If an error occurs in the execution of a job, the parameter indicates which parameter was detected as the cause of the error in the configuration DB. High byte: Index of the parameter field Low byte: Index of the subfield within the parameter field

## FB55 IP\_CONFIG - continued

**Reserved Port Numbers**

The following local port numbers are reserved; you should not use these for other purposes in the connection project engineering.

Table 7-8 Reserved Port Numbers

Protocol	Port number	Service
TCP	20, 21	FTP
TCP	25	SMTP
TCP	80	HTTP
TCP	102	RFC1006
TCP	135	RPC-DCOM
UDP	161	SNMP_REQUEST
UDP	34964	PN IO
UDP	65532	NTP
UDP	65533	NTP
UDP	65534	NTP
UDP	65535	NTP

**Condition Codes**

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Table 7-9 Condition Codes for FB55 IP\_CONFIG

DONE	ERROR	STATUS	Meaning
General codes relating to job execution			
1	0	0000 <sub>H</sub>	Job completed without errors
0	0	8181 <sub>H</sub>	Job active
Errors detected on the interface between CPU and CP.			
0	1	80A4 <sub>H</sub>	<ul style="list-style-type: none"> <li>Communication error on the K-bus</li> <li>or</li> <li>Data error: Configuration by the user program is not set.</li> </ul>
0	1	80B1 <sub>H</sub>	The amount of data to be sent exceeds the upper limit permitted for this service. (upper limit = 16 Kbytes)
0	1	80C4 <sub>H</sub>	Communication error The error can occur temporarily; it is usually best to repeat the job in the user program.
0	1	80D2 <sub>H</sub>	Configuration error The module you are using does not support this service.

## FB55 IP\_CONFIG - continued

Table 7-9 Condition Codes for FB55 IP\_CONFIG, continued

DONE	ERROR	STATUS	Meaning
Errors detected in the evaluation of the FB in the CPU or on the interface between CPU and CP.			
0	1	8183 <sub>H</sub>	The CP rejects the requested data record number.
0	1	8184 <sub>H</sub>	System error or illegal parameter type<F 9>. (data type of the ANY pointer CONF_DB not OK) (Currently only the byte data type is accepted)
0	1	8185 <sub>H</sub>	The value of the LEN parameter is larger than the CONF_DB less the reserved header (4 bytes) or the length information is incorrect.
0	1	8186 <sub>H</sub>	Illegal parameter detected The ANY pointer CONF_DB does not point to a data block.
0	1	8187 <sub>H</sub>	Illegal status of the FB Data in the header of CONF_DB was possibly overwritten.
Further errors detected on the interface between the CPU and CP.			
0	1	8A01 <sub>H</sub>	The status code in the data record is invalid (value is >= 3).
0	1	8A02 <sub>H</sub>	There is no job running on the CP; the FB, however, expected an acknowledgment for a completed job.
0	1	8A03 <sub>H</sub>	There is no job running on the CP and the CP is not ready; the FB triggered the first job to read a data record.
0	1	8A04 <sub>H</sub>	There is no job running on the CP and the CP is not ready; the FB nevertheless expected an acknowledgment for a completed job.
0	1	8A05 <sub>H</sub>	There is a job running, but there was no acknowledgment; the FB nevertheless triggered the first job for a read data record job.
0	1	8A06 <sub>H</sub>	A job is complete but the FB nevertheless triggered the first job for a read data record job.
Errors detected when evaluating the FB on the CP.			
0	1	8B01 <sub>H</sub>	Communication error The DB could not be transferred
0	1	8B02 <sub>H</sub>	Parameter error Double parameter field
0	1	8B03 <sub>H</sub>	Parameter error The subfield in the parameter field is not permitted.
0	1	8B04 <sub>H</sub>	Parameter error The length specified in the FB does not match the length of the parameter fields / subfields.
0	1	8B05 <sub>H</sub>	Parameter error The length of the parameter field is invalid.
0	1	8B06 <sub>H</sub>	Parameter error The length of the subfield is invalid.
0	1	8B07 <sub>H</sub>	Parameter error The ID of the parameter field is invalid.
0	1	8B08 <sub>H</sub>	Parameter error The ID of the subfield is invalid.



## FB55 IP\_CONFIG - continued

Table 7-9 Condition Codes for FB55 IP\_CONFIG, continued

DONE	ERROR	STATUS	Meaning
0	1	8B09 <sub>H</sub>	System error The connection does not exist
0	1	8B0A <sub>H</sub>	Data error The content of the subfield is not correct.
0	1	8B0B <sub>H</sub>	Structure error A subfield exists twice.
0	1	8B0C <sub>H</sub>	Data error The parameter does not contain all the necessary parameters.
0	1	8B0D <sub>H</sub>	Data error The CONF_DB does not contain a parameter field for system data.
0	1	8B0E <sub>H</sub>	Data error / structure error The CONF_DB type is invalid.
0	1	8B0F <sub>H</sub>	System error The CP does not have enough resources to process CONF_DB completely.
0	1	8B10 <sub>H</sub>	Data error Configuration by the user program is not set.
0	1	8B11 <sub>H</sub>	Data error The specified type of the parameter field is invalid.
0	1	8B12 <sub>H</sub>	Data error Too many connections were specified (either in total or too many for a specific type; for example, only one E-mail connection is possible).
0	1	8B13 <sub>H</sub>	CP-internal error
Further errors detected on the program interfaces within the CPU (SFC errors).			
0	1	8F22 <sub>H</sub>	Area length error reading a parameter (e.g. DB too short).
0	1	8F23 <sub>H</sub>	Area length error writing a parameter (e.g. DB too short).
0	1	8F24 <sub>H</sub>	Area error reading a parameter.
0	1	8F25 <sub>H</sub>	Area error writing a parameter.
0	1	8F28 <sub>H</sub>	Alignment error reading a parameter.
0	1	8F29 <sub>H</sub>	Alignment error writing a parameter.
0	1	8F30 <sub>H</sub>	The parameter is in the write-protected first current data block.
0	1	8F31 <sub>H</sub>	The parameter is in the write-protected second current data block.
0	1	8F32 <sub>H</sub>	The parameter contains a DB number that is too high.
0	1	8F33 <sub>H</sub>	DB number error
0	1	8F3A <sub>H</sub>	The target area was not loaded (DB).
0	1	8F42 <sub>H</sub>	Timeout reading a parameter from the I/O area.
0	1	8F43 <sub>H</sub>	Timeout writing a parameter to the I/O area.
0	1	8F44 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack.

## FB55 IP\_CONFIG - continued

Table 7-9 Condition Codes for FB55 IP\_CONFIG, continued

<b>DONE</b>	<b>ERROR</b>	<b>STATUS</b>	<b>Meaning</b>
0	1	8F45 <sub>H</sub>	Address of the parameter to be written is disabled in the accessed rack.
0	1	8F7F <sub>H</sub>	Internal error For example, an illegal ANY reference was detected.

## 7.7 FB88 PN\_InOut / FB90 PN\_InOut\_Fast blocks for PROFINET CBA

### How It Works

The task of function block FB88 / FB90 is to transfer data from the interface DB to the CP and from the CP to the interface DB. The interface DB itself is the interface to the user program.

FB88 / FB90 is called cyclically. It is also possible to call FB88 /FB90 more than once in a cycle.

At its interface, FB88 /FB90 only needs to be supplied with the module address of the CP.

To ensure data consistency, you can only modify the data to be transferred or start to read the received data when the job is completed (DONE=1 or ERROR=1).

As soon as DONE=1 or ERROR=1 are set, the transfer is complete or has been terminated with an error message. Data can now be evaluated or set again. Data will only be transferred with the next call.

In your user program, make sure that on completion of data transfer FB88 /FB90 is called again only after all the input data have been read and all output data have been written to the interface DB.

Calling the FB88 / FB90 blocks time-driven is permitted in principle. Refer to the notes on this mode later in this chapter.

### Differences between FB88 and FB90

The activities of the function blocks FB90 and FB88 on the interface to the user program are largely identical. You can use FB90 with certain CP/CPU types with an S7-400; refer to the information in the manual of the CP.

If FB90 is approved for the CP type being used, we recommend that you use it. This allows you to achieve shorter reaction times than with FB88. However, note the constraints regarding its use.

The following points apply:

- The interface parameters are identical;
- For FB90, there are several additional codes in the STATUS parameter;
- With some errors, there are different codes in the STATUS parameter of FB88 and FB90;
- There are differences in the configuration limits of the interface DB (see relevant manual).

FB88 PN\_InOut / FB90 PN\_InOut\_Fast - continued

**Note**

For more detailed information on handling the interface DB, refer to the SIMATIC iMap documentation /19/.

**Notice**

When you reload user program blocks, data consistency is only guaranteed if the CPU is first changed to STOP.

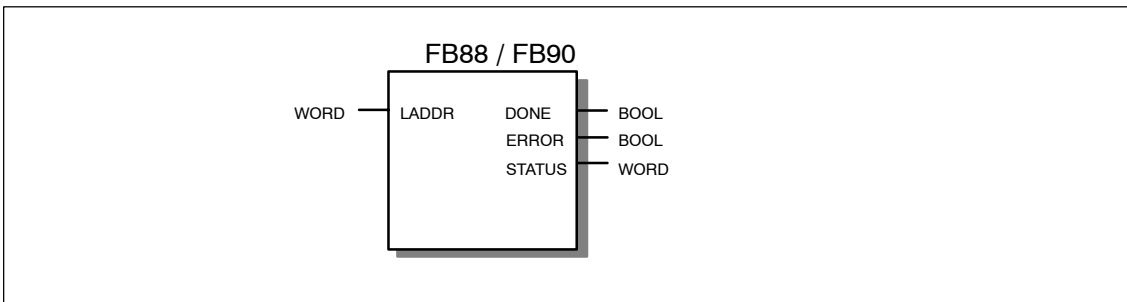
**How supplied - block library**

FB88 and FB90 are supplied with SIMATIC iMap. There are different block types for S7-300 and S7-400.

After installation, the blocks are available in the PROFINET Library under "PROFINET\_System\_Library/CP300 or /CP400".

**Call Interface**

Call interface in FBD representation



Call example in STL representation

STL	Explanation
<code>Call FB 88 , DB88</code>	<code>//Block call with instance DB88</code>
<code>LADDR := W#16#0120</code>	
<code>DONE := M 99.1</code>	
<code>ERROR := M 99.0</code>	
<code>STATUS := MW 104</code>	

**Explanation of the Formal Parameters**

The following table explains all the formal parameters for FB88 / FB90:

## FB88 PN\_InOut / FB90 PN\_InOut\_Fast - continued

Parameter	Declaration	Type	Remarks
LADDR	INPUT	WORD	Module start address When you configure the CP with STEP 7 HW Config, the module start address is displayed in the configuration table. Specify this address here. Do not modify the parameter until the job is completed (DONE=1 or ERROR=1).
DONE	OUTPUT	BOOL	Reports the (positive) completion of a job.
ERROR	OUTPUT	BOOL	This indicates that the job could not be executed error-free.
STATUS	OUTPUT	WORD	This parameter supplies detailed information about the execution of the job. Status codes can be returned during execution of the job (DONE=0 and ERROR=0).

### Evaluating Status Codes

Remember that the status codes DONE, ERROR, STATUS are updated at each block call.

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

Table 7-10 Codes for PN\_InOut (FB88) and PN\_InOut\_Fast (FB90)

DONE	ERROR	STATUS	Meaning
1	0	0000 <sub>H</sub>	Job completed without error.
0	0	0000 <sub>H</sub>	No job being processed; the block can be called
0	0	8181 <sub>H</sub>	<ul style="list-style-type: none"> <li>• Job active.</li> </ul> or <ul style="list-style-type: none"> <li>• (only with FB90) : Connection establishment to addressed module active (see also information under 8090<sub>H</sub>).</li> </ul>
0	1	8183 <sub>H</sub>	(S7-300 only) The service has not yet started; data acceptance is not yet possible.
0	1	8184 <sub>H</sub>	<ul style="list-style-type: none"> <li>• Bad instance DB, generally triggered by illegal writing of the instance DB by the user program.</li> </ul> or <ul style="list-style-type: none"> <li>• (only with FB90) Bad send or receive job.</li> </ul>
0	1	8085 <sub>H</sub>	(only with FB90) Bad interface DB.

## FB88 PN\_InOut / FB90 PN\_InOut\_Fast - continued

Table 7-10 Codes for PN\_InOut (FB88) and PN\_InOut\_Fast (FB90), continued

DONE	ERROR	STATUS	Meaning
0	1	8090 <sub>H</sub>	(S7-400 only) Parameter assignment error An incorrect module address was specified; the address points to an empty slot. Note (only with FB90): In the following cases, the value 8181 <sub>H</sub> is shown in STATUS (job active); In actual fact, there is no communication: <ul style="list-style-type: none"> <li>The address points to a slot that contains a different module type.</li> <li>The addressed module is configured for PROFINET CBA operation.</li> </ul>
0	1	80A1 <sub>H</sub>	(only with FB90) Possible communications errors: <ul style="list-style-type: none"> <li>Station-internal connection to addressed module being terminated;</li> <li>The configuration limits for connections of the CPU has been exceeded;</li> <li>The interface is being reinitialized.</li> </ul>
0	1	80B0 <sub>H</sub>	(S7-300 only) Block error: The data record number is wrong. This status can also occur after the following actions: <ul style="list-style-type: none"> <li>Cold or warm restart after power DOWN/UP</li> <li>Cold or warm restart on the CPU</li> </ul>
0	1	80B1 <sub>H</sub>	(S7-300 only) Block error: Data record length or offset wrong.
0	1	80B3 <sub>H</sub>	(S7-300 only) Parameter error: Wrong CP address.
0	1	80C1 <sub>H</sub>	(S7-300 only) Temporary error: The specified data record is currently being processed.
0	1	80C2 <sub>H</sub>	(S7-300 only) Temporary error: There is a job bottleneck; the data record cannot be read yet.
0	1	80C3 <sub>H</sub>	(S7-300 only) Temporary error: Resources (memory) in use.
0	1	80C4 <sub>H</sub>	(S7-300 only) Communication error: occurs temporarily and a repetition in the user program will often remedy the problem.
0	1	80D0 <sub>H</sub>	(S7-300 only) Configuration error: The maximum number of blocks of input and output data has been exceeded; the interface DB is too large.

## FB88 PN\_InOut / FB90 PN\_InOut\_Fast - continued

Table 7-10 Codes for PN\_InOut (FB88) and PN\_InOut\_Fast (FB90), continued

DONE	ERROR	STATUS	Meaning
0	1	80D1 <sub>H</sub>	(S7-300 only) Configuration error Possible Causes: <ul style="list-style-type: none"> <li>The interface of the configured component does not match the one used in the program (outputs).</li> <li>The wrong module was inserted; The PROFINET service is not supported.</li> </ul>
0	1	80D2 <sub>H</sub>	(S7-300 only) Configuration error Possible Causes: <ul style="list-style-type: none"> <li>The interface of the configured component does not match the one used in the program (inputs).</li> <li>The wrong module was inserted; The PROFINET service is not supported.</li> <li>Parameter error: Wrong CP address</li> </ul>
0	1	8322 <sub>H</sub>	(only with FB90) Bad interface DB.
0	1	8332 <sub>H</sub>	(only with FB90) The number of the interface DB is too high.
0	1	833A <sub>H</sub>	(only with FB90) Access to the interface DB is not possible (possibly because the interface DB was deleted).
0	1	8623 <sub>H</sub>	(only with FB90) Bad interface DB.
0	1	863A <sub>H</sub>	(only with FB90) Access to the interface DB is not possible (possibly because the interface DB was deleted).

To find out which SFCs are used that are relevant for error evaluation, display the properties dialog of the FB described here in the "Calls" tab.

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**Note**

For entries with the coding 8Fxx<sub>H</sub> (for S7-300) or 8xxx<sub>H</sub> (for S7-400) under STATUS, note the information in the Reference Manual STEP 7 Standard and System Functions. The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

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### Status Codes during CP Startup

With a complete restart or restart of the PROFINET CP (after activating a switch on the module), the output parameters of the block are reset as follows:

- DONE = 0
- ERROR = 0
- STATUS = 8181<sub>H</sub>

### Time-driven call - recommendation on application

If your application requires time-driven transfer of the CBA data instead of cyclic or event-driven processing, we recommend the following procedure to call the FB88 / FB90 blocks.

If you use a time-driven call, remember that the block must be called repeatedly after it has been started until the DONE flag is set. To allow the CBA data to be copied between the CPU and CP without any longer interruptions, the follow-on calls should be as fast as possible and independent of the timing.

Note the following recommendations for programming:

- The timing is provided by a timer OB; The timer OB should only cause the first call for the PROFINET CBA blocks FB88 or FB90 not by calling the block directly but, for example, by setting a start flag.
- The call of the PROFINET CBA blocks FB88 and FB90 should then always be made in OB1; OB1 starts the call as soon as the start flag is set by the timer OB.
- After the first block call, this is repeated in OB1 until the DONE bit is set (or until an error occurs); the start flag must then be reset.

Result:

The CBA user data can be copied between the CPU and CP without any significant interruption thanks to separating the timer OB from the actual block calls in OB1. You can select the interval between the first calls depending on the requirements of your application.



## 7.8 FCs and FBs for PROFINET IO

### Overview

The FCs listed below are available for transferring data cyclically on the PROFINET IO interface. The significance of the FCs differs depending on how you use the CP (as a PROFINET IO controller or PROFINET IO device) in an S7 station.

FC	can be used with:		Meaning
	S7-300	S7-400	
<b>PNIO_SEND (FC11)</b>	x	-	<ul style="list-style-type: none"> <li>On the PROFINET IO controller Sending process output data to the PROFINET IO devices.</li> <li>On the PROFINET IO device Forwarding process input data to the PROFINET IO controller.</li> </ul>
<b>PNIO_RECV (FC12)</b>	x	-	<ul style="list-style-type: none"> <li>On the PROFINET IO controller Receiving input data from the PROFINET IO devices.</li> <li>On the PROFINET IO device Receiving process output data from the PROFINET IO controller.</li> </ul>

The FBs listed below are available for transferring data (data records, alarm information) acyclically on the PROFINET IO interface. The two blocks can only be used in PROFINET IO controller mode.

FB	can be used with:		Meaning
	S7-300	S7-400	
<b>PNIO_RW_REC (FB52)</b>	x	-	<ul style="list-style-type: none"> <li>Read data record (from a PROFINET IO device)</li> <li>Write data record (to a PROFINET IO device)</li> </ul>
<b>PNIO_ALARM (FB54)</b>	x	-	Receive alarm information from the PROFINET IO devices

### 7.8.1 FC11 PNIO\_SEND

The PNIO\_SEND FC is used to transfer data in the PROFINET IO controller or PROFINET IO device modes of the CP.

- Operation as PROFINET IO controller

The block transfers the process data (outputs) of a specified output area to the CP to be forwarded to PROFINET IO devices and as status display returns the IO consumer status (IOCS) of the outputs of the PROFINET IO devices.

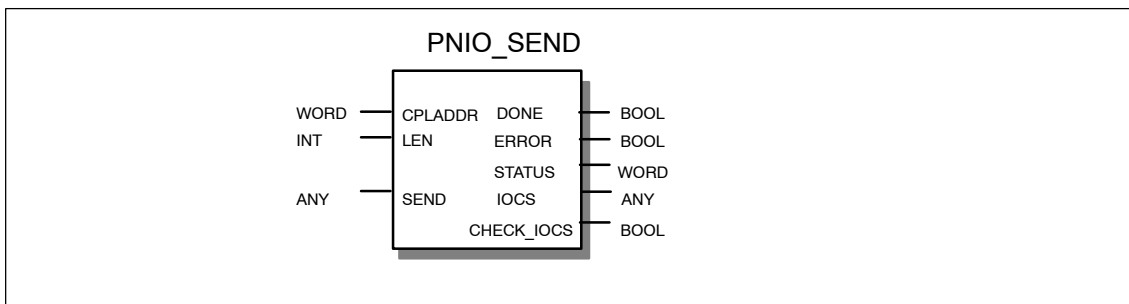
- Operation as PROFINET IO device

The block reads the preprocessed process inputs of the CPU on the PROFINET IO device and transfers them to the PROFINET IO controller (configured I addresses); the block also returns the IO Consumer Status (IOCS) of the PROFINET IO controller as a status display.

The preprocessed process data is available in a DB or bit memory area.

#### Call Interface

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fc 11</code>	//PNIO_SEND block call
<code>CPLADDR :=W#16#0100</code>	//Module address from hardware configuration
<code>LEN :=20</code>	//Length of the data area
<code>IOCS :=P#DB10.DBX20.0 BYTE 3</code>	//Per send data byte one bit status in DB10
<code>DONE :=M 70.0</code>	//Address for return parameter DONE
<code>ERROR :=M 70.1</code>	//Address for return parameter ERROR
<code>STATUS :=MW 72</code>	//Address for return parameter STATUS
<code>CHECK_IOCS :=M 70.2</code>	//Address for return parameter CHECK_IOCS
<code>SEND :=P#DB10.DBX0.0 BYTE 20</code>	//Data area to be transferred from DB10 //(20 bytes)

#### Explanation of the Formal Parameters

The following table explains all the formal parameters for FC11:

## FC11 PNIO\_SEND - continued

Parameter	Declaration	Type	Possible Values	Remarks
CPLADDR	INPUT	WORD	-	Module start address
SEND	IN_OUT	ANY (as VARTYPE only BYTE is permitted)	<p>The address of the data area points to one of the alternatives:</p> <ul style="list-style-type: none"> <li>• Memory bit area</li> <li>• Data block area</li> </ul>	<p>Specifies the address and length.</p> <p>Controller mode: The length should match the total length of the distributed IO configured in HW Config, whereby address gaps are also transmitted.</p> <p>Device mode: The data structure results from the order of the slots of the input modules configured for this PROFINET IO device on the PROFINET IO controller line and their length without address gaps.</p> <p>(Please note the more extensive explanations or examples for your CP in the device-specific Part B of this manual)</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>• The block begins to transfer the data at address 0 regardless of how you configured the addresses (regardless of the lowest configured address).</li> <li>• Specifying an I/O area is not permitted since you must first change the IOCS for GOOD before data can be accepted in the I/O.</li> </ul>
LEN	INPUT	INT	<p>Value &gt; 0</p> <p>The maximum total length of the data areas to be transferred can be found in the device-specific Part B of this manual in the "Performance Data" chapter. They may differ for controller or device mode.</p>	<p>Length of the data area to be transferred in bytes.</p> <p>The transfer of the data always begins with address 0 regardless of the configuration. Please note that the IO address "0" with a length of 1 is included.</p> <p>Controller mode:</p> <ul style="list-style-type: none"> <li>• The highest configured address of the devices must be specified here. The individual areas are not grouped together.</li> <li>• The data is transferred in the order of the logical addresses (as with PROFIBUS DP).</li> </ul> <p>Device mode:</p> <ul style="list-style-type: none"> <li>• The data is transferred in the order of the slots corresponding to the configuration of the input modules on the PROFINET IO controller line for this PROFINET IO device.</li> <li>• Note Make sure that the length programmed here and the configuration of the PROFINET IO controller are consistent. The entire data area length including any gaps is transferred for the device.</li> </ul>

## FC11 PNIO\_SEND - continued

Parameter	Declaration	Type	Possible Values	Remarks
DONE	OUTPUT	BOOL	0: - 1: New data accepted	This parameter indicates whether or not the job was completed without errors.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code
STATUS	OUTPUT	WORD	-	Status code See Table 7-11 Page A-237
CHECK_IOCS	OUTPUT	BOOL	0: All IOCS set to GOOD 1: At least one IOCS set to BAD	Auxiliary bit that indicates whether or not it is necessary to evaluate the IOCS status area
IOCS	OUTPUT	ANY (as VARTYPE only BYTE is permitted)	The address of the data area points to one of the alternatives: <ul style="list-style-type: none"> <li>Memory bit area</li> <li>Data block area</li> </ul> Length: For the maximum value, refer to the device-specific Part B of this manual in the "Performance Data" chapter. This may differ for controller or device mode.	A status bit is transferred per byte of user data. The length information depends on the length in the LEN parameter (one bit per byte) = (Length LEN + 7 / 8) Controller mode: Address gaps are also transferred according to the SEND parameter. Address gaps are transferred with the status GOOD. Device mode: Address gaps are not transferred. The block begins the transfer of the status for address 0. Notes: <ul style="list-style-type: none"> <li>The minimum length of the ANY pointer is (length LEN + 7 / 8)</li> </ul>

**Note**

Remember that all output parameters may only be evaluated when the block signals either DONE = 1 or ERROR = 1.

**Notice**

You must assume that the returned IOCS status does not arrive time-synchronized with the data (SEND parameter) but delayed by one user program cycle. This means: User data and IOCS are not consistent.

## FC11 PNIO\_SEND - continued

**Condition Codes**

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

**Note**

For entries coded with 8Fxx<sub>H</sub> in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the "Calls" tab.

Table 7-11 Condition Codes PNIO\_SEND

DONE	ERROR	STATUS	Meaning
0	0	8180 <sub>H</sub>	<ul style="list-style-type: none"> <li>• Data transfer active;</li> <li>or</li> <li>• The CP is in STOP mode</li> </ul>
1	0	0000 <sub>H</sub>	New data transferred without error.
0	1	8183 <sub>H</sub>	<ul style="list-style-type: none"> <li>• PROFINET IO configuration missing;</li> <li>or</li> <li>• wrong CPLADDR;</li> <li>or</li> <li>• The CP is in STOP mode</li> </ul> <p>Extra in device mode:</p> <ul style="list-style-type: none"> <li>• The connection between PROFINET IO controller and PROFINET IO device is down,</li> <li>or</li> <li>• PROFINET IO controller not reachable</li> <li>or</li> <li>• Total lengths (configuration and LEN parameter) are not consistent.</li> </ul>
0	1	8184 <sub>H</sub>	System error or illegal parameter type<F 9>.
0	1	8185 <sub>H</sub>	LEN parameter longer than SEND source area.
0	1	8F22 <sub>H</sub>	Area length error reading a parameter (e.g. DB too short).
0	1	8F23 <sub>H</sub>	Area length error writing a parameter (e.g. DB too short).
0	1	8F24 <sub>H</sub>	Area error reading a parameter.
0	1	8F25 <sub>H</sub>	Area error writing a parameter.
0	1	8F28 <sub>H</sub>	Alignment error reading a parameter.
0	1	8F29 <sub>H</sub>	Alignment error writing a parameter.
0	1	8F30 <sub>H</sub>	Parameter is in the write-protected 1st act. data block.

## FC11 PNIO\_SEND - continued

Table 7-11 Condition Codes PNIO\_SEND, continued

DONE	ERROR	STATUS	Meaning
0	1	8F31 <sub>H</sub>	Parameter is in the write-protected 2nd act. data block.
0	1	8F32 <sub>H</sub>	Parameter contains a DB number that is too high.
0	1	8F3A <sub>H</sub>	Destination area is not loaded (DB).
0	1	8F42 <sub>H</sub>	Timeout reading a parameter from the I/O area.
0	1	8F43 <sub>H</sub>	Timeout writing a parameter to the I/O area.
0	1	8F44 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack.
0	1	8F45 <sub>H</sub>	Address of the parameter to be written is disabled in the accessed rack.
0	1	8F7F <sub>H</sub>	Internal error, e.g. illegal ANY reference.
0	1	8090 <sub>H</sub>	Module with this address does not exist.
0	1	80A0 <sub>H</sub>	Negative acknowledgment reading from the module.
0	1	80A1 <sub>H</sub>	Negative acknowledgment writing to the module.
0	1	80B0 <sub>H</sub>	The module does not recognize the data record.
0	1	80B1 <sub>H</sub>	<ul style="list-style-type: none"> <li>• The specified data record length is wrong.</li> <li>or</li> <li>• The CP changes to STOP.</li> </ul>
0	1	80C0 <sub>H</sub>	The data record cannot be read.
0	1	80C1 <sub>H</sub>	The specified data record is currently being processed.
0	1	80C2 <sub>H</sub>	There are too many jobs pending.
0	1	80C3 <sub>H</sub>	Resources occupied (memory).
0	1	80C4 <sub>H</sub>	Communication error: (occurs temporarily and a repetition in the user program will often remedy the problem).

## 7.8.2 FC12 PNIO\_RECV

The PNIO\_RECV FC is used to accept data in the PROFINET IO controller or PROFINET IO device CP modes.

- Operation as PROFINET IO controller

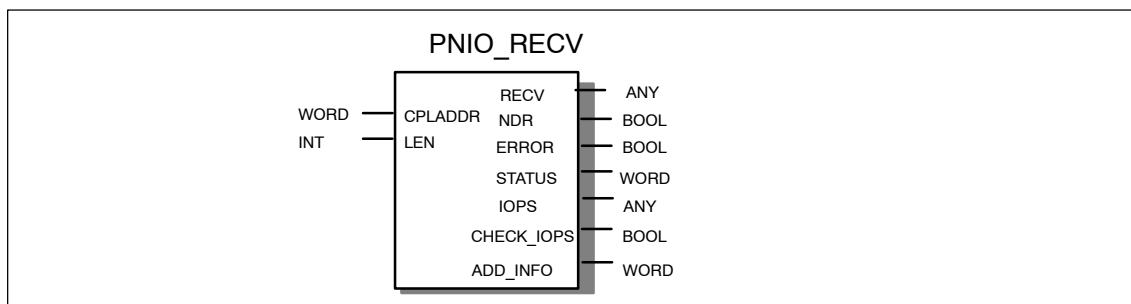
The block accepts the process data from PROFINET IO devices (inputs of the controller) and transfers the IO provider status (IOPS) from the PROFINET IO devices to the specified input areas.

- Operation as PROFINET IO device

The block receives the data transferred by the PROFINET IO controller (configured O addresses) as well as the IO Provider Status (IOPS) of the PROFINET IO controller and writes them to the data areas on the CPU of the PROFINET IO device reserved for the process outputs.

### Call Interface

Call interface in FBD representation



Example in STL representation

STL	Explanation
<code>call fc 12</code>	//PNIO_RECV block call
<code>CPLADDR :=W#16#0100</code>	//Module address from hardware configuration
<code>LEN :=7</code>	//Length of the data area
<code>IOPS :=P#DB11.DBX7.0 BYTE 1</code>	//Per receive data byte one status bit in DB11
<code>NDR :=M 74.0</code>	//Address for return parameter NDR
<code>ERROR :=M 74.1</code>	//Address for return parameter ERROR
<code>STATUS :=MW76</code>	//Address for return parameter STATUS
<code>CHECK_IOPS :=M74.2</code>	//Address for return parameter CHECK_IOPS
<code>ADD_INFO :=MW 26</code>	//Diagnostic information
<code>RECV :=P#DB11.DBX0.0 BYTE 7</code>	//Received data in DB11 (7 bytes)

## FC 12 PNIO\_RECV - continued

**Explanation of the Formal Parameters**

The following table explains all the formal parameters for FC12:

Parameter	Declaration	Type	Possible Values	Remarks
CPLADDR	INPUT	WORD	-	Module start address
RECV	IN_OUT	ANY (as VARTYPE only BYTE is permitted)	<p>The address of the data area points to one of the alternatives:</p> <ul style="list-style-type: none"> <li>Memory bit area</li> <li>Data block area</li> </ul>	<p>Specifies the address and length.</p> <p>Controller mode: The length should match the total length of the distributed IO configured in HW Config, whereby address gaps are also transmitted.</p> <p>Device mode: The data structure results from the order of the slots of the output modules configured for this PROFINET IO device on the PROFINET IO controller line and their length without address gaps.</p> <p>Notes:</p> <ul style="list-style-type: none"> <li>The block begins to transfer the data at address 0 regardless of how you configured the addresses (regardless of the lowest configured address).</li> <li>Specifying an I/O area is not permitted since you must first change the IOPS for GOOD before data can be accepted in the I/O.</li> </ul>



## FC 12 PNIO\_RECV - continued

Parameter	Declaration	Type	Possible Values	Remarks
LEN	INPUT	INT	Value > 0 The maximum total length of the data to be transferred can be found in the device-specific Part B of this manual in the "Performance Data" chapter. They may differ for controller or device mode.	Length of the data area to be transferred in bytes. The transfer of the data always begins with address 0 regardless of the configuration. Please note that the IO address "0" with a length of 1 is included. Controller mode: <ul style="list-style-type: none"> <li>The highest configured address of the devices must be specified here. The individual areas are not grouped together.</li> <li>The data is transferred in the order of the logical addresses (as with PROFIBUS DP).</li> </ul> Device mode: <ul style="list-style-type: none"> <li>The data is transferred in the order of the slots corresponding to the configuration of the input modules on the PROFINET IO controller line for this PROFINET IO device.</li> <li>Note Make sure that the length programmed here and the configuration of the PROFINET IO controller are consistent. The entire data area length including any gaps is transferred for the device.</li> </ul>
NDR	OUTPUT	BOOL	0: - 1: Data accepted	This parameter indicates whether or not the job was completed without errors.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code
STATUS	OUTPUT	WORD	-	Status code See Table 7-12 Page A-243
CHECK_IOPS	OUTPUT	BOOL	0: All IOPS set to GOOD 1: At least one IOPS set to BAD	Auxiliary bit that indicates whether or not it is necessary to evaluate the IOPS status area.

## FC 12 PNIO\_RECV - continued

Parameter	Declaration	Type	Possible Values	Remarks
IOPS	OUTPUT	ANY (as VARTYPE only BYTE is permitted)	<p>The address of the data area points to one of the alternatives:</p> <ul style="list-style-type: none"> <li>Memory bit area</li> <li>Data block area</li> </ul> <p>Length: For the maximum value, refer to the device-specific Part B of this manual in the "Performance Data" chapter. This may differ for controller or device mode.</p>	<p>A status bit is transferred per byte of user data.</p> <p>The length information depends on the length in the RECV parameter (one bit per byte) = (Length LEN + 7/ 8)</p> <p>Controller mode: Address gaps are also transferred according to the RECV parameter. Address gaps are transferred with the status GOOD.</p> <p>Device mode: Address gaps are not transferred.</p> <p>The block begins the transfer of the status for address 0.</p> <p>Note:</p> <ul style="list-style-type: none"> <li>The minimum length of the ANY pointer is (length LEN + 7/ 8)</li> </ul>
ADD_INFO	OUTPUT	WORD	<p>Additional Diagnostic Information</p> <p>In controller mode:</p> <ul style="list-style-type: none"> <li>0: No alarm</li> <li>&gt;0: Number of pending alarms</li> </ul> <p>In device mode, the parameter is always = 0.</p>	<p>Parameter Expansion</p> <p>Note: The ADD_INFO parameter is also updated when there are no INPUT addresses configured on the PROFINET IO controller. In this case, the PNIO_RECV block is called with a length LEN &gt; 0 (for example LEN = 1 byte). It then transfers an address gap of 1 byte.</p> <p>The parameter expansion can be used as of firmware V2.0 of the CP 343-1. In older firmware versions, the parameter is reserved.</p>

**Note**

Remember that all output parameters may only be evaluated when the block signals either NDR = 1 or ERROR = 1.

**Condition Codes**

The following table shows the codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

## FC 12 PNIO\_RECV - continued

**Note**

For entries coded with 8Fxx<sub>H</sub> in STATUS, refer to the information in the STEP 7 Standard and System Functions reference manual. The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

To find out which SFCs are used and are relevant for error evaluation, display the properties dialog of the FC described here in the "Calls" tab.

Table 7-12 Condition Codes PNIO\_RECV

NDR	ERROR	STATUS	Meaning
0	0	8180 <sub>H</sub>	<ul style="list-style-type: none"> <li>• Data acceptance active;</li> <li>or</li> <li>• The CP is in STOP mode</li> </ul>
1	0	0000 <sub>H</sub>	New data accepted without error.
0	1	8183 <sub>H</sub>	<ul style="list-style-type: none"> <li>• PROFINET IO configuration missing;</li> <li>or</li> <li>• wrong CPLADDR;</li> <li>or</li> <li>• The CP is in STOP mode</li> </ul> <p>Extra in device mode:</p> <ul style="list-style-type: none"> <li>• The connection between PROFINET IO controller and PROFINET IO device is down,</li> <li>or</li> <li>• PROFINET IO controller not reachable</li> <li>or</li> <li>• Total lengths (configuration and LEN parameter) are not consistent.</li> </ul>
0	1	8184 <sub>H</sub>	System error or illegal parameter type<F 9>.
0	1	8185 <sub>H</sub>	Destination buffer (RECV) is too short.
0	1	8F22 <sub>H</sub>	Area length error reading a parameter (e.g. DB too short).
0	1	8F23 <sub>H</sub>	Area length error writing a parameter (e.g. DB too short).
0	1	8F24 <sub>H</sub>	Area error reading a parameter.
0	1	8F25 <sub>H</sub>	Area error writing a parameter.
0	1	8F28 <sub>H</sub>	Alignment error reading a parameter.
0	1	8F29 <sub>H</sub>	Alignment error writing a parameter.
0	1	8F30 <sub>H</sub>	Parameter is in the write-protected 1st act. data block.
0	1	8F31 <sub>H</sub>	Parameter is in the write-protected 2nd act. data block.
0	1	8F32 <sub>H</sub>	Parameter contains a DB number that is too high.
0	1	8F3A <sub>H</sub>	Destination area is not loaded (DB).
0	1	8F42 <sub>H</sub>	Timeout reading a parameter from the I/O area.

## FC 12 PNIO\_RECV - continued

Table 7-12 Condition Codes PNIO\_RECV, continued

NDR	ERROR	STATUS	Meaning
0	1	8F43 <sub>H</sub>	Timeout writing a parameter to the I/O area.
0	1	8F44 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack.
0	1	8F45 <sub>H</sub>	Address of the parameter to be written is disabled in the accessed rack.
0	1	8F7F <sub>H</sub>	Internal error, e.g. illegal ANY reference.
0	1	8090 <sub>H</sub>	Module with this address does not exist.
0	1	80A0 <sub>H</sub>	Negative acknowledgment reading from the module.
0	1	80A1 <sub>H</sub>	Negative acknowledgment writing to the module.
0	1	80B0 <sub>H</sub>	The module does not recognize the data record.
0	1	80B1 <sub>H</sub>	<ul style="list-style-type: none"> <li>• The specified data record length is wrong.</li> <li>or</li> <li>• The CP changes to STOP.</li> </ul>
0	1	80C0 <sub>H</sub>	The data record cannot be read.
0	1	80C1 <sub>H</sub>	The specified data record is currently being processed.
0	1	80C2 <sub>H</sub>	There are too many jobs pending.
0	1	80C3 <sub>H</sub>	Resources occupied (memory).
0	1	80C4 <sub>H</sub>	Communication error: (occurs temporarily and a repetition in the user program will often remedy the problem).

### 7.8.3 General Response of the FCs for PROFINET IO

#### IO Consumer Status (IOCS) and IO Provider Status (IOPS)

The two communication partners - CPU/CP on the one hand and IO device on the other - both have status information for the data (GOOD or BAD). This status information is transferred parallel to the data. The status of the partner that sends the data is called IOPS (IO Provider Status), the status of the receiving partner is called IOCS (IO Consumer Status).

The IOPS and IOCS status are not necessarily identical. It is, for example, possible that the S7-300 CPU is in STOP mode (output disable or no PROFINET IO blocks active). In this case, the CP as PROFINET IO controller transfers the BAD status to the IO devices.

### Relationship between Block Call and IO Data

- Operation as PROFINET IO controller

As a PROFINET IO controller, the CP does not monitor the cyclic calls of the PNIO\_SEND/RECV blocks. If the blocks are not called, the last transferred IO data and IOCS/IOPS data are taken as valid.

- Operation as PROFINET IO device

FC11 and FC12 each have their own watchdog. Depending on the CPU cycle time, the connection to the PROFINET IO controller is terminated if one of the two blocks is no longer called following the initialization phase.

### Optimizing data transfer (only when operating as PROFINET IO controller)

It is possible to call the blocks with a length (LEN parameter) that is shorter than the configured total length of the IO data on the PNIO chain.

You can use this so that time-critical data is transferred in every CPU cycle whereas non critical data is not transferred in every cycle.

Example:

You could, for example, transfer only the first data area (time-critical data) in every cycle and the total length of the configured IO data in every second cycle. To do this, you must place the time-critical data in the lower area (starting at IO address 0) during configuration.

### 7.8.4 Data Consistency

The entire input or output data area of the PNIO controller is always transferred in its entirety and is therefore consistent.

- Operation as PROFINET IO controller

Regardless of this, using the length information in the block call, you can also read or output an input or output area smaller than the configured area consistently.

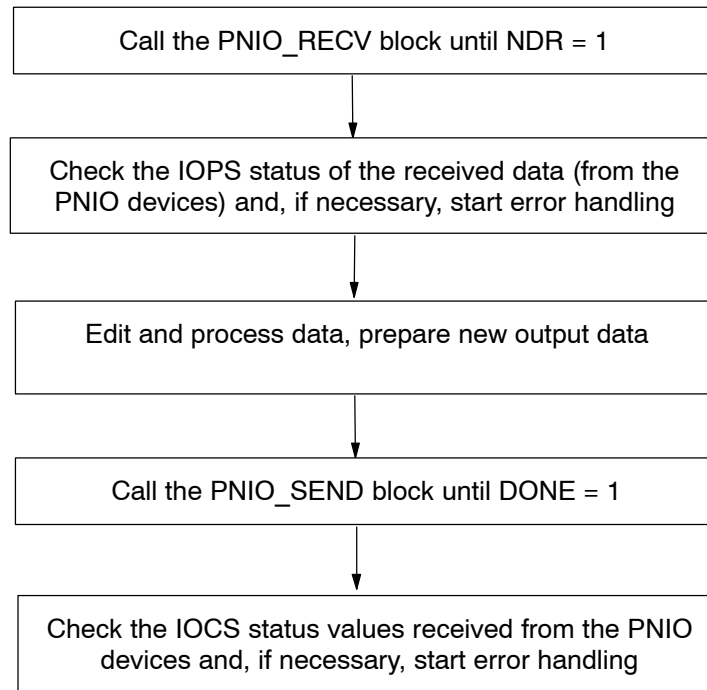
Note: You should, however, bear in mind that in terms of the "IO user data" within a PROFINET IO system, data consistency can only be guaranteed within the individual IO slots. This applies regardless of the fact that consistent data transfer between CPU and IO controller is guaranteed for the blocks described here.

### Block call

To guarantee data consistency, you must, however, only access the IO data when the block has completed free of errors (output parameter NDR = TRUE). You must also check that the IOCS or IOPS status for the data is GOOD.

### Example

In a normal situation (depending on the total length of the IO data), the block will run over several user program cycles until the condition code DONE/NDR = 1 is signaled.



Note: The user program cycle and the cycle of the IO data exchange between the PNIO controller and PNIO devices are independent of each other.

### 7.8.5 Substitute Values

The setting of substitute values is supported for the two following operational situations:

- Substitute values during startup (operating mode change on the CPU from STOP to RUN)
- Substitute values if problems are detected (remove/insert or station failure/return)

#### Substitute Values during Startup

You can initialize the outputs with substitute values by setting a memory bit ("start-up" memory bit) in the start-up OB. In cyclic mode (OB1), evaluate this "start-up" memory bit to call the PNIO\_SEND block with the initialization values when appropriate.

### Substitute values if a problem occurs (only when operating as PROFINET IO controller)

If there is a fault (device/submodule failed), you can find out which submodules have failed by querying the status information IOCS / IOPS status. You then have the option of setting substitute values.

#### 7.8.6 FB 52 PNIO\_RW\_REC

FB52 is used both for the “read data record” and the “write data record” function in PROFINET IO controller mode. FB52 can only execute one of the functions at any one time. The “read data record” or “write data record” function is controlled by the WRITE\_REC parameter.

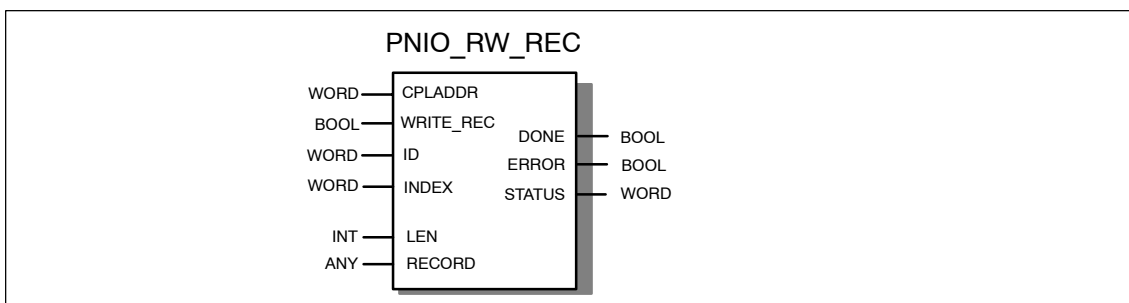
Example: The CP can be informed of the location ID and plant designation using the “write data record” function. This is done using the maintenance data record “IM1” with index AFF1<sub>H</sub>.

You will find details of the supported data records and their structure at the following Internet address:

<http://support.automation.siemens.com/WW/view/en/19289930>

### Call Interface

Call interface in FBD representation:



Example in STL representation:

STL	Explanation
CALL FB 52, DB 52	// PNIO_RW_REC block call (read/write data record)
CPLADDR := W#16#0110	// Module address from hardware configuration
WRITE_REC := M 1.1	// TRUE: write data record; FALSE: read data record
ID := W#16#86A	// Logical address of the module to be addressed
INDEX := W#16#8000	// Data record number
DONE := M 1.3	// Address for return parameter DONE
ERROR := M 1.1	// Address for return parameter ERROR
STATUS := MW 12	// Address for return parameter STATUS
LEN := MW 16	// Length of the data record that was read or will be written in bytes
RECORD := P#DB3.DBX0.0 BYTE 80	// Destination or source of the data record to be transferred (here max. 80 bytes)

### Explanation of the Formal Parameters

The following table explains all the formal parameters for FB52:

Parameter	Declaration	Data type	Possible Values	Remarks
CPLADDR	INPUT	WORD	-	Module start address
WRITE_REC	INPUT	BOOL	0: Read data record 1: Write data record	Job type; The parameter must not be changed while the block is executing.
ID	INPUT	WORD		Logical address of the PROFINET IO component (module or submodule). Bit 15 must be set for an output module. (Example of output address 5: ID:=DW#16#8005). For a mixed module, the lower of the two addresses must be specified.
Index	INPUT	WORD	See vendor information for the data record numbers supported by the module.	Data record number that the user wants to read or write.
DONE	OUTPUT	BOOL	0: - 1: Data record transferred successfully	This parameter indicates whether or not the job was completed without errors.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code



Parameter	Declaration	Data type	Possible Values	Remarks
STATUS	OUTPUT	WORD	0: No error Other value: Error (see Table 7-13)	Status code
LEN	IN_OUT	INT	The maximum length is 480 bytes.	<ul style="list-style-type: none"> <li>Read data record: OUTPUT parameter only; after a successful read, the length of the read data record is indicated; otherwise 0.</li> <li>Write data record: INPUT parameter only; length of the data record to be written is entered here by the user. The length must match the definition of the data record.</li> </ul>
RECORD	IN_OUT	ANY (as VARTYPE, BYTE, WORD and DWORD are permitted)	<p>The address of the data area points to one of the alternatives:</p> <ul style="list-style-type: none"> <li>Memory bit area</li> <li>Data block area</li> </ul> <p>The length of the any pointer must be greater than or equal to the definition of the data record.</p>	<ul style="list-style-type: none"> <li>Read data record: OUTPUT parameter only; after a successful read, the data of the data record is stored here. If the length of the ANY pointer is too low, as much data as possible is transferred.</li> <li>Write data record: INPUT parameter only; the data to be written from the data record is stored here by the user. The length of the ANY pointer must be at least as long as specified by the LEN parameter.</li> </ul>

### Condition Codes

The following table shows the condition codes formed by the DONE, ERROR and STATUS parameters that must be evaluated by the user program.

---

#### Note

For entries with the coding 8Fxx<sub>H</sub> note the information under STATUS in the Reference Manual "STEP 7 - System and Standard Functions for S7-300 and S7-400". The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

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Table 7-13 PNIO\_RW\_REC codes

DONE	ERROR	STATUS	Meaning
0	0	8180 <sub>H</sub>	Data transfer active
1	0	0000 <sub>H</sub>	Data record transferred successfully
0	1	8183 <sub>H</sub>	<ul style="list-style-type: none"> <li>• No PNIO controller configuration,</li> <li>• wrong CPLADDR</li> <li style="padding-left: 20px;">or</li> <li>• CP in STOP mode</li> </ul>
0	1	8184 <sub>H</sub>	System error or illegal parameter type
0	1	8185 <sub>H</sub>	Destination buffer (RECORD) is too short.
0	1	8F22 <sub>H</sub>	Area length error reading a parameter (e.g. DB too short)
0	1	8F23 <sub>H</sub>	Area length error writing a parameter (e.g. DB too short)
0	1	8F24 <sub>H</sub>	Area error reading a parameter
0	1	8F25 <sub>H</sub>	Area error writing a parameter
0	1	8F28 <sub>H</sub>	Alignment error reading a parameter
0	1	8F29 <sub>H</sub>	Alignment error writing a parameter
0	1	8F30 <sub>H</sub>	Parameter is in the write-protected first active data block
0	1	8F31 <sub>H</sub>	Parameter is in the write-protected second active data block
0	1	8F32 <sub>H</sub>	Parameter contains a DB number that is too high
0	1	8F3A <sub>H</sub>	Destination area not loaded (DB)
0	1	8F42 <sub>H</sub>	Timeout reading a parameter from the I/O area
0	1	8F43 <sub>H</sub>	Timeout writing a parameter to the I/O area
0	1	8F44 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack
0	1	8F45 <sub>H</sub>	Address of the parameter to be written is disabled in the accessed rack
0	1	8F7F <sub>H</sub>	Internal error, e.g. illegal ANY reference.
0	1	8090 <sub>H</sub>	Module with this address does not exist
0	1	80A0 <sub>H</sub>	Negative acknowledgment reading from the module
0	1	80A1 <sub>H</sub>	Negative acknowledgment writing to the module
0	1	80A3 <sub>H</sub>	General PROFINET IO context management error
0	1	80A9 <sub>H</sub>	PROFINET IO device or module reports an illegal type
0	1	80B0 <sub>H</sub>	Module does not recognize the data record
0	1	80B1 <sub>H</sub>	<ul style="list-style-type: none"> <li>• The specified data record length is wrong</li> <li style="padding-left: 20px;">or</li> <li>• The CP changes to STOP</li> </ul>
0	1	80B2 <sub>H</sub>	The logical address or the configured slot is not in use
0	1	80B4 <sub>H</sub>	PROFINET IO device or module signaling access to an illegal area
0	1	80B6 <sub>H</sub>	PROFINET IO device or module denies access
0	1	80B8 <sub>H</sub>	The module is signaling an illegal parameter

Table 7-13 PNIO\_RW\_REC codes

<b>DONE</b>	<b>ERROR</b>	<b>STATUS</b>	<b>Meaning</b>
0	1	80C0 <sub>H</sub>	The data record cannot be read
0	1	80C1 <sub>H</sub>	The specified data record is currently being processed
0	1	80C2 <sub>H</sub>	There are too many jobs pending
0	1	80C3 <sub>H</sub>	Resources occupied (memory)
0	1	80C4 <sub>H</sub>	Communication error: (occurs temporarily and a repetition in the user program will often remedy the problem).

### 7.8.7 FB 54 PNIO\_ALARM

FB54 is used for alarm evaluation by a CP 343-1 operating as PROFINET IO controller and should be called in its user program when the ADD\_INFO parameter in FC12 is not equal to 0. After complete and error-free transfer of all OUTPUT parameters of FB54, the received alarms are acknowledged automatically.

The alarms are forwarded to the user program in the chronological order in which they were signaled. Older alarms that have not yet been signaled to the user program and that become invalid due to more recent alarms are not deleted by the newer alarms.

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#### Note

As long as the block has not yet been called, the alarms are acknowledged automatically in the CP.

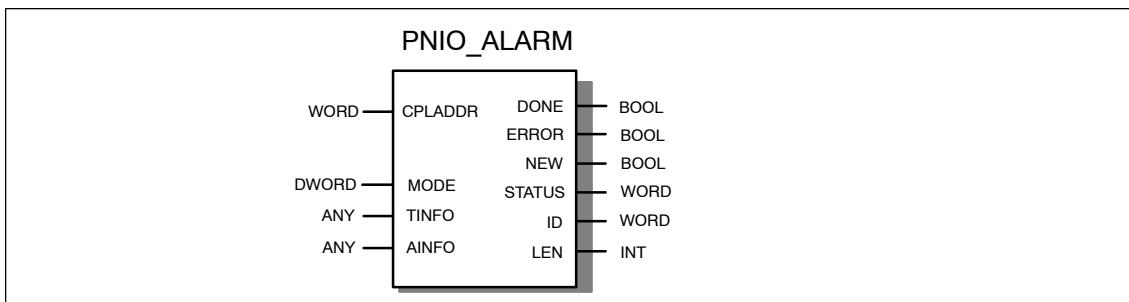
If FB54 has been called (at least) once in the user program, it must continue to be called to acknowledge pending alarms. This is the situation when FC12 signals a value not equal to "0" in the ADD\_INFO parameter.

If FB54 is no longer called after it has been called once or more in the user program, alarms are not acknowledged and there is no guarantee that the IO image will be updated correctly. This can occur, for example, following a station return alarm. The need to call FB54 can only be reset by restarting the CP (power cycle).

---

### Call Interface

Call interface in FBD representation



Example in STL representation:

STL	Explanation
CALL FB 54, DB 54	// PNIO_ALARM block call (read/write data record)
CPLADDR := W#16#0110	// Module address from hardware configuration
DONE := M 1.1	// Address for return parameter DONE
ERROR := M 1.2	// Address for return parameter ERROR
NEW := M 1.3	// TRUE: A new alarm was received
STATUS := MW 12	// Error code of the SFB or PNIO-Ctrl
ID := MW 14	// Logical base address of the component (module or submodule) from which an alarm was received
LEN := MW 16	// Length of the received alarm information (AINFO)
MODE := MD 18	// RESERVED (value always = 0)
TINFO := P#DB4.DBX0.0 BYTE 32	// (task information) Destination area for OB start information and management information; fixed length 32 bytes of diagnostic information
AINFO := P#DB4.DBX32.0 BYTE 532	// (alarm information) Destination area for header information and additional alarm information

### Explanation of the Formal Parameters

The following table explains all the formal parameters for FB54:

Parameter	Declaration	Data type	Possible Values	Remarks
CPLADDR	INPUT	WORD	-	Start address of the module that caused the problem
DONE	OUTPUT	BOOL	0: - 1: Alarm information transferred successfully	This parameter indicates whether or not the job was completed without errors. If DONE = 1, the NEW parameter must also be checked.
ERROR	OUTPUT	BOOL	0: - 1: Error	Error code
NEW	OUTPUT	BOOL	0: Data transfer active or no new alarm 1: New alarm received and acknowledged	If DONE = 1 and NEW = 1, a new received alarm is signaled.
STATUS	OUTPUT	WORD	0: No error Other value: Error (see Table 7-14)	Status code

Parameter	Declaration	Data type	Possible Values	Remarks
ID	OUTPUT	WORD		Logical start address of the PNIO component that triggers the alarm (module or submodule). For an output module, bit 15 is set (example of output address 5: ID:=DW#16#8005). For a mixed module, the lower of the two addresses is specified.
LEN	OUTPUT	INT		Length of the received alarm information (AINFO)
MODE	IN_OUT	DWORD	0	Reserved
TINFO	IN_OUT	ANY (as VARTYPE, BYTE, WORD and DWORD are permitted)	The address of the data area points to one of the alternatives: <ul style="list-style-type: none"> <li>Memory bit area</li> <li>Data block area</li> </ul> The length of the ANY pointer must be >= 32 bytes.	task information Destination area for the alarm management information. The error OB start information (OB header = byte 0...19 of TINFO) is reproduced as far as possible by the CP firmware. See also <sup>1)</sup>
AINFO	IN_OUT	ANY (as VARTYPE, BYTE, WORD and DWORD are permitted)	The address of the data area points to one of the alternatives: <ul style="list-style-type: none"> <li>Memory bit area</li> <li>Data block area</li> </ul> The length of the ANY pointer must be greater than or equal to the maximum additional alarm information that can be expected, maximum 1432 bytes (see LEN parameter)	alarm information Destination area for header information and additional alarm information. If the ANY pointer AINFO is too low, the information will be truncated. See also <sup>1)</sup>

<sup>1)</sup> Reference Manual "STEP 7 - System and Standard Functions for S7-300 and S7-400", receiving an alarm with SFB54 "RALRM"

### Condition Codes

The following table shows the condition codes formed by the DONE, NEW, ERROR and STATUS parameters that must be evaluated by the user program.

**Note**

For entries with the coding 8Fxx<sub>H</sub> note the information under STATUS in the Reference Manual "STEP 7 - System and Standard Functions for S7-300 and S7-400". The chapter describing error evaluation with the RET\_VAL output parameter contains detailed information.

Table 7-14 Condition Codes PNIO\_ALARM

DONE	NEW	ERROR	STATUS	Meaning
0	0	0	8180 <sub>H</sub>	Data transfer active
1	1	0	0000 <sub>H</sub>	Alarm data successfully transferred and alarm acknowledged
1	0	0	0000 <sub>H</sub>	No alarm data exist
0	0	1	8183 <sub>H</sub>	<ul style="list-style-type: none"> <li>• No PNIO controller configuration,</li> <li>• wrong CPLADDR</li> <li style="padding-left: 20px;">or</li> <li>• CP in STOP mode</li> </ul>
0	0	1	8184 <sub>H</sub>	System error or illegal parameter type
0	0	1	8185 <sub>H</sub>	Destination buffer (TINFO or AINFO) is too short
0	0	1	8F22 <sub>H</sub>	Area length error reading a parameter (e.g. DB too short)
0	0	1	8F23 <sub>H</sub>	Area length error writing a parameter (e.g. DB too short)
0	0	1	8F24 <sub>H</sub>	Area error reading a parameter
0	0	1	8F25 <sub>H</sub>	Area error writing a parameter
0	0	1	8F28 <sub>H</sub>	Alignment error reading a parameter
0	0	1	8F29 <sub>H</sub>	Alignment error writing a parameter
0	0	1	8F30 <sub>H</sub>	Parameter is in the write-protected first active data block
0	0	1	8F31 <sub>H</sub>	Parameter is in the write-protected second active data block
0	0	1	8F32 <sub>H</sub>	Parameter contains a DB number that is too high
0	0	1	8F3A <sub>H</sub>	Destination area not loaded (DB)
0	0	1	8F42 <sub>H</sub>	Timeout reading a parameter from the I/O area
0	0	1	8F43 <sub>H</sub>	Timeout writing a parameter to the I/O area
0	0	1	8F44 <sub>H</sub>	Address of the parameter to be read is disabled in the accessed rack
0	0	1	8F45 <sub>H</sub>	Address of the parameter to be written is disabled in the accessed rack
0	0	1	8F7F <sub>H</sub>	Internal error, e.g. illegal ANY reference.
0	0	1	8090 <sub>H</sub>	Module with this address does not exist
0	0	1	80A0 <sub>H</sub>	Negative acknowledgment reading from the module

Table 7-14 Condition Codes PNIO\_ALARM

DONE	NEW	ERROR	STATUS	Meaning
0	0	1	80A1 <sub>H</sub>	Negative acknowledgment writing to the module
0	0	1	80B0 <sub>H</sub>	Module does not recognize the data record
0	0	1	80B1 <sub>H</sub>	<ul style="list-style-type: none"> <li>• The specified data record length is wrong</li> <li style="padding-left: 20px;">or</li> <li>• The CP changes to STOP</li> </ul>
0	0	1	80C0 <sub>H</sub>	The data record cannot be read
0	0	1	80C1 <sub>H</sub>	The specified data record is currently being processed
0	0	1	80C2 <sub>H</sub>	There are too many jobs pending
0	0	1	80C3 <sub>H</sub>	Resources occupied (memory)
0	0	1	80C4 <sub>H</sub>	Communication error: (occurs temporarily and a repetition in the user program will often remedy the problem).



## 7.9 Configuration limits / Resources Required by the FCs and FBs

### Notice

Please note the version information of the blocks. Blocks with other versions have different resource requirements.

Table 7-15 Information for FCs / FBs with an S7-400

NAME	Version	FC/FB no.	Load memory bytes	Work memory bytes	MC7 Bytes	Local data Bytes
AG_SEND	1.1	FC5	732	576	540	20
AG_RECV	1.1	FC6	656	522	486	20
AG_LOCK	1.0	FC7	272	200	164	6
AG_UNLOCK	1.0	FC8	256	186	150	6
AG_LSEND	3.0	FC50	1044	846	810	52
AG_LRECV	3.0	FC60	1190	992	956	58
AG_SSEND	1.0	FC53	1642	1386	1350	118
AG_SRECV	1.0	FC63	1600	1356	1320	122
PN_InOut	1.3	FB88	2678	2234	2198	48
PN_InOut_Fast	1.0	FB90	2906	2266	2230	48

Table 7-16 Information for FCs / FBs with an S7-300

NAME	Version	FC/FB no.	Load memory bytes	Work memory bytes	MC7 Bytes	Local data Bytes
AG_SEND	4.2	FC5	1976	1664	1628	50
AG_RECV	4.7	FC6	1440	1206	1170	40
AG_LOCK	4.0	FC7	748	636	600	34
AG_UNLOCK	4.0	FC8	712	604	568	32
AG_CNTRL	1.0	FC10	1402	1138	1102	82
IP_CONFIG	1.1	FB55	2478	2056	2020	62
PN_InOut	1.5	FB88	2470	2066	2030	54
PNIO_SEND	1.0	FC11	1272	1058	1022	42
PNIO_RECV	1.0	FC12	1122	928	892	42
PNIO_RW_REC	1.0	FB52	1648	1390	1354	62
PNIO_ALARM	1.0	FB54	1178	970	934	62

## 8 NCM S7 Diagnostics

The NCM S7 Diagnostics described here provides dynamic information on the operating state of the communication functions of online CPs.

This chapter provides a general overview of the individual diagnostic functions.

The following checklist will help you to recognize several typical problems and their possible causes and shows how you can use the NCM S7 for PROFIBUS diagnostics tool to remedy the situation.



Further information is available from the following sources:

- When you are working with the diagnostic tool, the integrated help system provides you with context-related support.
- You will find detailed information on working with STEP 7 programs in the Help on STEP 7, which includes the topic “Diagnosing Hardware”

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### Note

NCM S7 Diagnostics supports not only diagnostics for CPs (communication modules) but also other module types such as the IE/PB Link. In this chapter, the term CP is therefore synonymous with all modules with which you can run NCM S7 diagnostic functions.

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## 8.1 Overview

### Diagnostic Options in STEP 7

STEP 7 provides you with a graded concept allowing you to query information about the status of your SIMATIC S7 components and functions and to sort out problems in a variety of different situations. These options cover the following:

- **Hardware Diagnostics and Troubleshooting with STEP 7**

Hardware diagnostics provides dynamic information on the operating mode of modules including CPs when the S7 station is online.

You can recognize the existence of diagnostic information for a module by the diagnostics icon in the project window of the SIMATIC Manager. Diagnostic icons show the status of the corresponding module and also the operating mode of CPUs.

Detailed diagnostic information is displayed in the “module information” that you can open by double-clicking a diagnostic icon in the quick view or the diagnostic view.

- **Communication Diagnostics with NCM S7 Diagnostics**

The NCM S7 Diagnostics described here provides dynamic information on the operating state of the communication functions of online CPs or modules.

- **HW Config Provides Static Information**

Static information means the configured communication properties of an online or offline CP and you can display this at any time using the hardware configuration shown by HW Config.

### What You Should Already Know

You should be familiar with the basic information in Chapter 2 on the significance of NCM 7 and working with it. This means that you know how to connect the Ethernet CP to the PG and how to control the module using the PG.

### Where to Find Further Information



Further information is available from the following sources:

- Information about the communication services is available in the appropriate chapters in this manual.
- When you are working with the diagnostic tool, the integrated help system provides you with context-related support.
- You will find detailed information on working with STEP 7 programs in the Help on STEP 7, which includes the topic “Diagnosing Hardware”.

## 8.2 Functions of NCM S7 Diagnostics

### Functions

The diagnostic functions can be grouped as follows:

- General diagnostic and statistical functions
- Type and mode-dependent diagnostic functions

### General diagnostic and statistical functions

Regardless of the configured mode of the Ethernet CP, the following diagnostic functions are possible:

- Querying the operating mode on Ethernet
- Querying the event messages recorded on the Ethernet CP (diagnostic buffer)

### Mode-Dependent Functions

Depending on the configured mode of the Ethernet CP, the following diagnostic functions are possible:

- Diagnostics of ISO transport connections
- Diagnostics of ISO-on-TCP connections
- Diagnostics of TCP connections
- Diagnostics of UDP connections
- Diagnostics of E-mail connections
- Diagnostics of TCP connections for PROFINet

## 8.2.1 Installing and Starting NCM S7 Diagnostics

### Installation

NCM S7 Diagnostics is an integrated component of the NCM S7 for Industrial Ethernet optional package.

NCM S7 Ethernet Diagnostics is installed along with NCM S7 for Ethernet on your PG.

There are several ways in which you can start the diagnostic tool:

- Aus dem Standard-Startmenü von Windows 95/NT über die Programmgruppe SIMATIC.

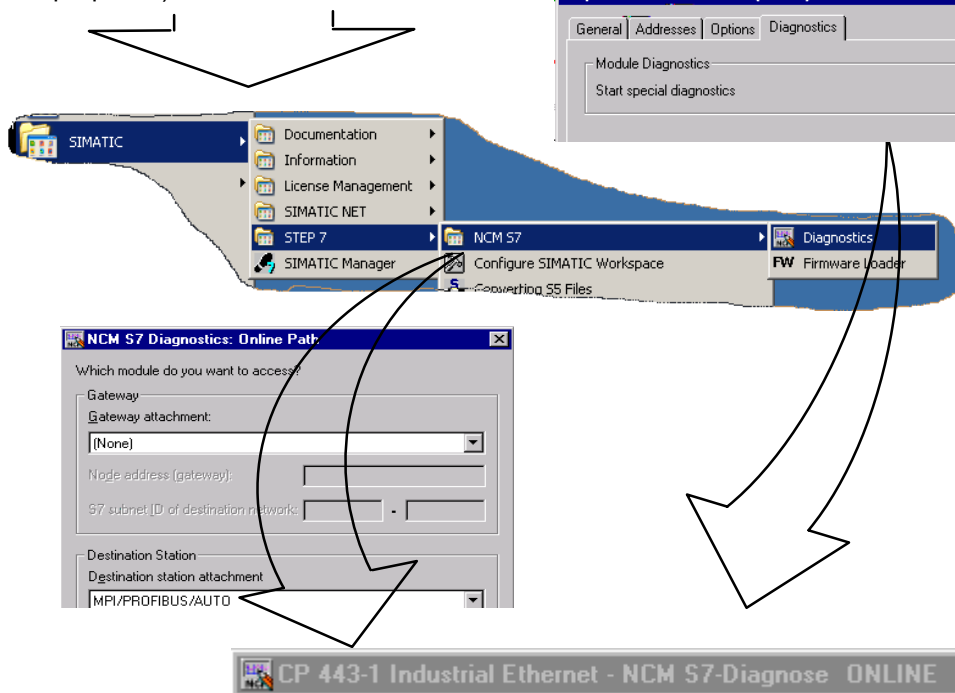
Wählen Sie diese Möglichkeit, wenn Sie das STEP 7-Projekt, in dem der CP konfiguriert wurde, auf Ihrem PG nicht verfügbar ist (Servicezwecke).

- Aus dem Eigenschaftendialog des jeweiligen CP von Ihrem STEP 7-Projekt aus.

#### Alternative 1

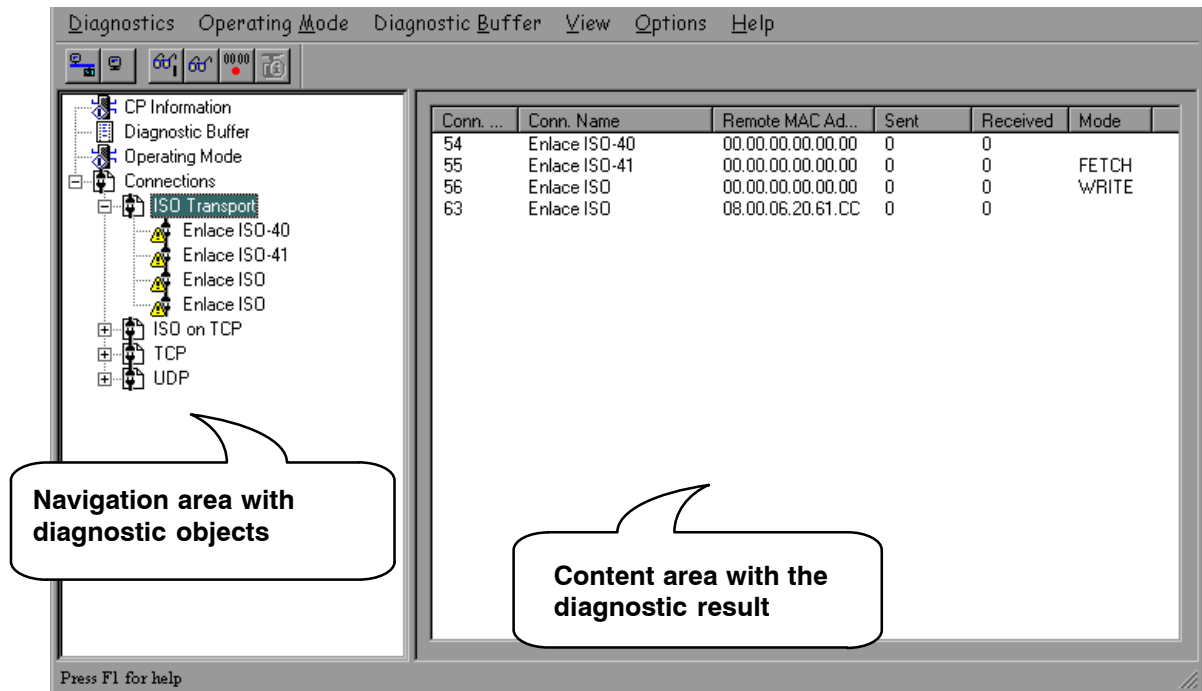
- From the standard Start menu of Windows (program group SIMATIC►...►NCM).

Use this method if the STEP 7 project in which the CP was configured is not available on your PG (for service purposes).



## Structure

In the same way, for example, as the SIMATIC Manager, NCM S7 Diagnostics appears as a separate two-part application window with a menu and toolbar:



- In the **navigation area** on the left-hand side, you will find the hierarchically arranged diagnostic objects.

You have an overview of the available diagnostic functions at all times. The object structure displayed in the navigation area is adapted to the type of CP you are currently checking and the functions and connections configured for the CP.

- In the **content area**, on the right-hand side, you will see the result of the diagnostic function you selected in the navigation area.

## Operation

- By selecting a diagnostic object in the navigation area with the mouse, you execute the diagnostic function.
- Using the **menu bar and toolbar**, you control the sequence of the diagnostics with context-sensitive menu commands.

## 8.2.2 General Menu Commands

### Overview

When running diagnostic functions, the following menu commands have general significance. Depending on the context, other functions may be available; for more detailed information refer to the online help for NCM Diagnostics.

Table 8-1 Meaning of the Menu Commands

Menu	Meaning
Diagnostics► Open Online Connection...	With this menu command, you can establish a connection to a different CP you want to check without having to quit and restart the diagnostic tool. The current diagnostic connection is closed.
Diagnostics► Close Online Connection...	If you want to use more than one diagnostic connection at the same time, you can start NCM S7 diagnostics more than once.
Operating Mode►	You can control the CP as follows:
Stop a module	Stops the CP.
Start a module	Starts the CP if the RUN/STOP switch is set to RUN.
Reset module memory	<p>With certain CP types, for example the CP 443-1, you can reset the CP memory. This function must be confirmed before it is executed.</p> <p>Following this memory reset, the CP retains the preset MAC address and the retentive parameters. The CP is therefore immediately ready for downloads.</p> <p>The retentive parameters include:</p> <ul style="list-style-type: none"> <li>• IP address and IP parameters</li> <li>• A newly set MAC address</li> <li>• LAN settings</li> </ul>
Resetting to factory settings	<p>With some modules, it is possible to reset to the factory settings.</p> <p>When you reset to the factory settings, the retentive parameters are also deleted. After this, the module retains only the factory-set MAC address (as shipped).</p>
Format the C-PLUG for this module	<p>Here, you will see information on the C-PLUG inserted in the module.</p> <p>The C-PLUG can be deleted and formatted for use in the module.</p>
View ► Update	Each time you activate this menu command, the displayed diagnostic and status information is updated once.
View ► Update Cyclically	<p>Using this menu command, you activate and deactivate the automatic (cyclic off) updating of the displayed diagnostic and status information.</p> <p>You can set the interval between update points with the menu command <b>Options ► Customize</b>.</p>

Table 8-1 Meaning of the Menu Commands

Menu	Meaning
Options▶Customize	<p>With this menu command, you set the general parameters for the diagnostic session.</p> <ul style="list-style-type: none"> <li>• Dialog update time This sets the interval at which the diagnostic data is updated in a contents area when cyclic updating is selected.</li> <li>• Maximum size of the diagnostic buffer log file This sets the maximum size of the file that is created with the menu command Diagnostic Buffer &gt; Save Cyclically...(specified in Kbytes)</li> </ul>
Help▶	<p>You can obtain help about the current diagnostic function As an alternative, you can also press the F1 key.</p> <p>Remember that you can also call up context-related help for some of the diagnostic functions. To obtain help, position the cursor on the output field and press the F1 key.</p>

**Note**

If the connection to the CP is terminated during the diagnostic session, the following message is displayed: "The online connection was terminated".

You can reestablish the connection to the CP with the corresponding acknowledgment in the dialog. The connection is then automatically reestablished whenever possible.



## 8.3 Starting Diagnostics

### 8.3.1 Establishing a Connection to the Ethernet CP

#### Initial Situation

Establish the physical connection between the PG and the SIMATIC S7 Station. There are two ways of doing this:

- MPI
- Industrial Ethernet (ISO protocol)
- Industrial Ethernet TCP/IP (IP protocol)
- PROFIBUS

#### Ways of Starting Diagnostics

You can start NCM Diagnostics from the following STEP 7 functions or dialogs:

- CP properties dialog
- Windows Start menu
- Connections properties dialog (NetPro)
- Hardware configuration HW Config

These possibilities are described below.

### 8.3.2 Starting Diagnostics from the CP Properties Dialog

If the project data are available on your PG/PC, follow the steps outlined below:

1. Select the S7 station in the project and open the hardware configuration (HW Config).
2. Select the CP and open the Properties dialog.
3. Select the "Diagnostics" dialog.
4. Select the "Run" button.

Result:

NCM S7 Diagnostics is opened. The path is set automatically to match the current connection in STEP 7.

### 8.3.3 Starting Diagnostics from the Windows Start Menu

If there are no configuration data on your PG/PC, follow the steps outlined below to start diagnostics with a connected CP:

1. Open the Windows Start menu and select the command **SIMATIC ► STEP 7 ► Diagnostics**

NCM S7 Diagnostics is started with the message “No online connection to the CP” in the contents area.

2. In the displayed dialog “NCM S7 Diagnostics”, select the interface to match your hardware configuration.

Depending on the type of network attachment you have, you will be prompted to specify an address:

Table 8-2 Possible Settings for the Online Paths - without Parameters for Internetworking

Attachment on Destination Station	Node Address	Location of the Module Rack / Slot
MPI	MPI address of the CP if this has its own MPI address. Otherwise specify the MPI address of the CPU.	Rack/slot no. of the CP to be checked. If you specify the MPI address of the CP, you can simply use the default setting “0/0”. With this setting, the CP whose address was specified as the node address is accessed.
PROFIBUS	PROFIBUS address of the PROFIBUS CP via which the S7 station is reached.	Rack/slot no. of the CP to be checked.
Industrial Ethernet	MAC address of the Ethernet CP via which the S7 station is reached. Entered in hexadecimal.	Rack/slot no. of the CP to be checked. If you specify “0/0”, the CP specified with the node address is accessed directly.
Industrial Ethernet TCP/IP	IP address of the Industrial Ethernet CP via which the S7 station is reached. Entered in decimal. Example: IP address decimal 142.120.9.134	Rack/slot no. of the CP to be checked. If you specify “0/0”, the CP specified with the node address is accessed directly.

## Examples of an Online Path without Gateway

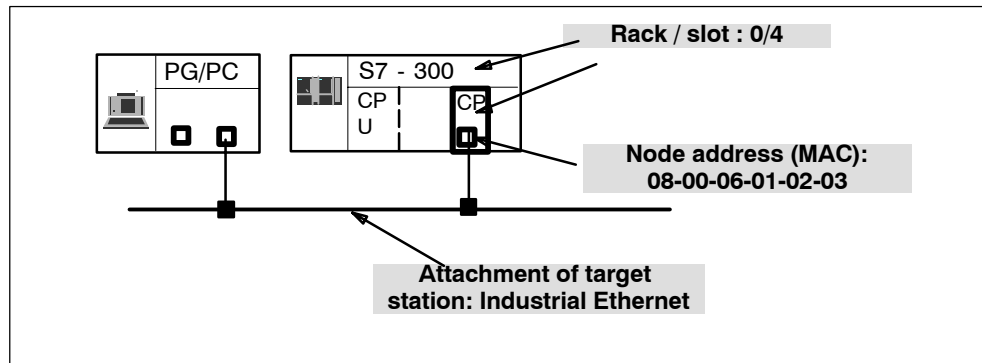


Figure 8-1 CP requiring diagnostics can be reached directly

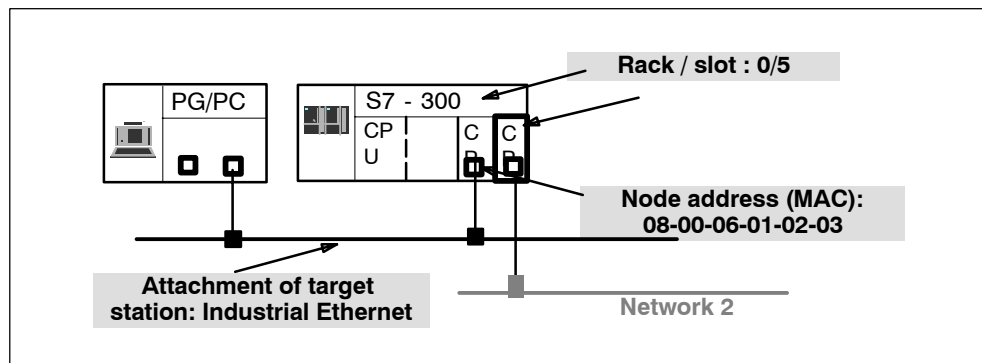


Figure 8-2 The CP requiring diagnostics is accessible indirectly over another CP

### 8.3.4 Using a Gateway

#### Case a: One gateway

If the CP you want to check with diagnostic functions can only be reached via a gateway, you must select the device and specify its node address in the local network.

You must also specify the S7 subnet ID of the destination network:

The subnet ID consists of two numbers separated by a dash:

- One number for the project
- One number for the subnet

You will find the subnet ID in the object properties of the subnet in the STEP 7 project. The subnet ID is also printed out with the network configuration.

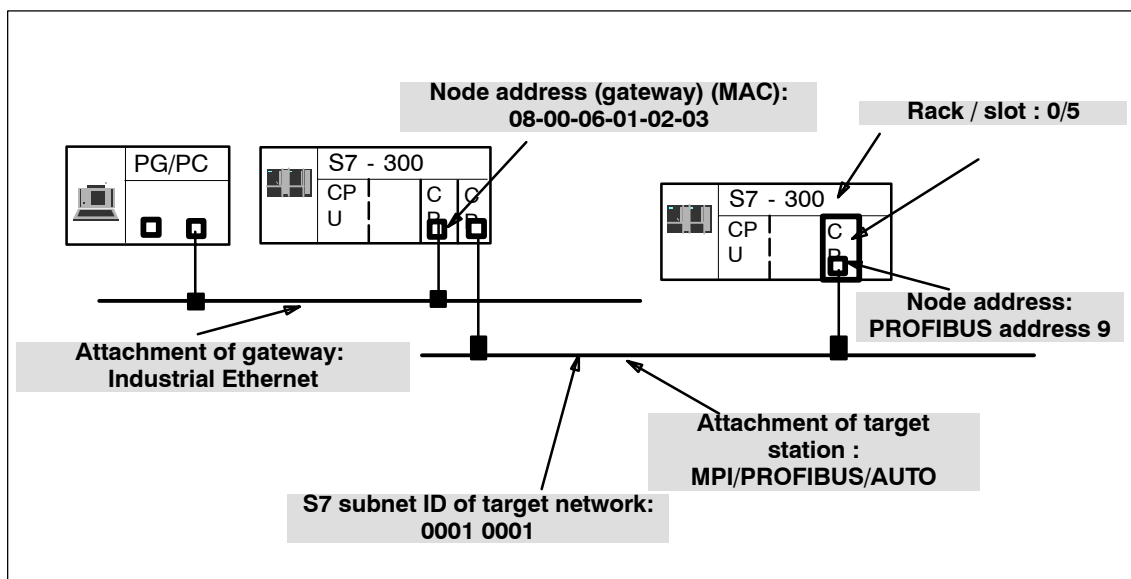


Figure 8-3 Example of the Parameter Settings for the Online Path with one Gateway

### Case b: Several Gateways

If the CP requiring diagnostics can only be reached over several gateways, you only specify the first gateway.

Routing over the other gateways is done automatically.

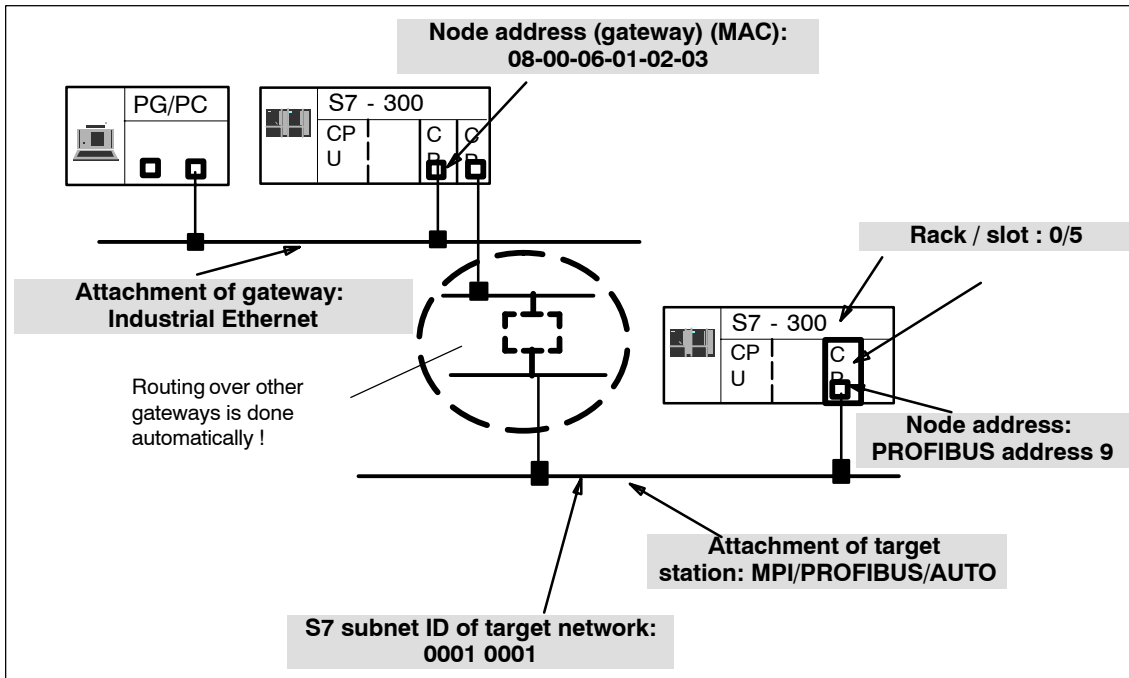


Figure 8-4 Example of the Parameter Settings for the Online Path with Several Gateways

### 8.3.5 Using the PC Station - Setting a Gateway with “PC internal”

There is a special situation when you use your PC/PG as a PC station and have therefore set the interface to PC internal (local) in “Setting the PG/PC Interface”. You must then set parameter values for the gateway, even when you do not need to go through any other gateway to reach the target station.

Select the following settings:

- Gateway attachment: MPI/PROFIBUS/AUTO
- Node address (gateway)

Enter the index of the module here.

The index is the virtual slot address of the component (can be displayed using the Station Configuration Editor). The index is identical to the slot number selected during configuration of the PC station in STEP 7 HW Config!

- S7 subnet ID of destination network:

Follow the same steps as described for setting the gateway.

Tip:

You do not need to make these settings for the gateway if you select one of the following options:

- Start NCM Diagnostics from the Properties dialog of the CP.
- When setting up your module, do **not** select the interface as PC internal (local) in “Set PG/PC Interface”.

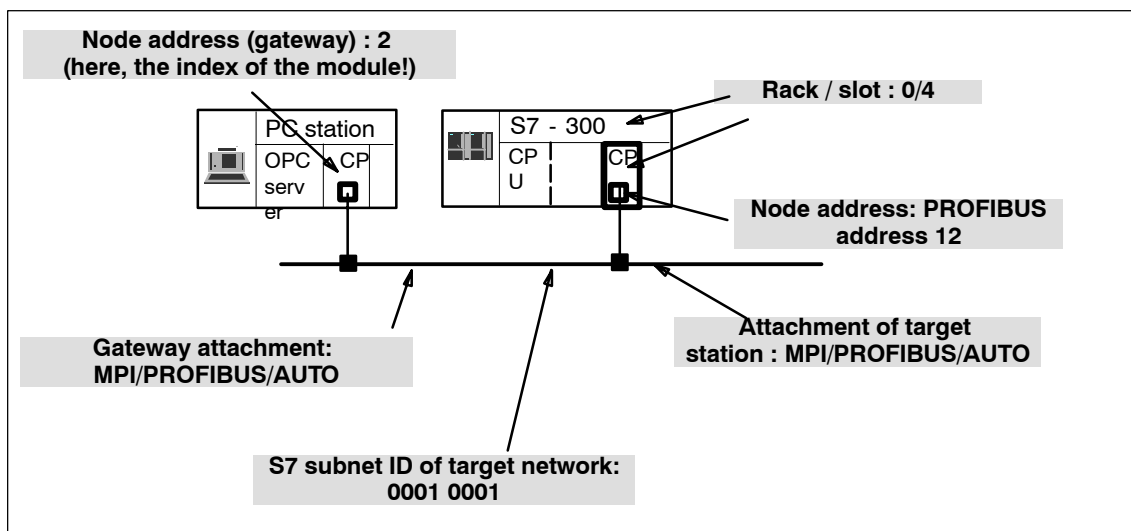


Figure 8-5 Example of Settings with “PC internal”

### 8.3.6 Other Ways of Starting Diagnostics

#### Starting in the properties dialog of the connections:

1. Select the **PLC►Activate Connection Status** menu command to activate online access.
2. Select the “Special Diagnostics” button in the “Status Information” tab.

#### Starting in the hardware configuration tool HW Config:

1. With the S7 station online, select the **PLC►Module Status** menu command;
2. Select the “Special Diagnostics” button in the dialog that is opened.

---

**Note**

To operate several diagnostic connections at the same time, you can start NCM S7 Diagnostics more than once.

You can also start NCM S7 Diagnostics twice with an online connection to the same CP; this can, for example, be useful if you want to monitor the diagnostic buffer at the same time as running diagnostic functions on a connection.

Requirement: You have an online connection available via the LAN (ISO or TCP/IP) on the one hand and an online connection via the communication (K) bus on the other (alternatively via the CPU or via PG channel routing via a further CP).

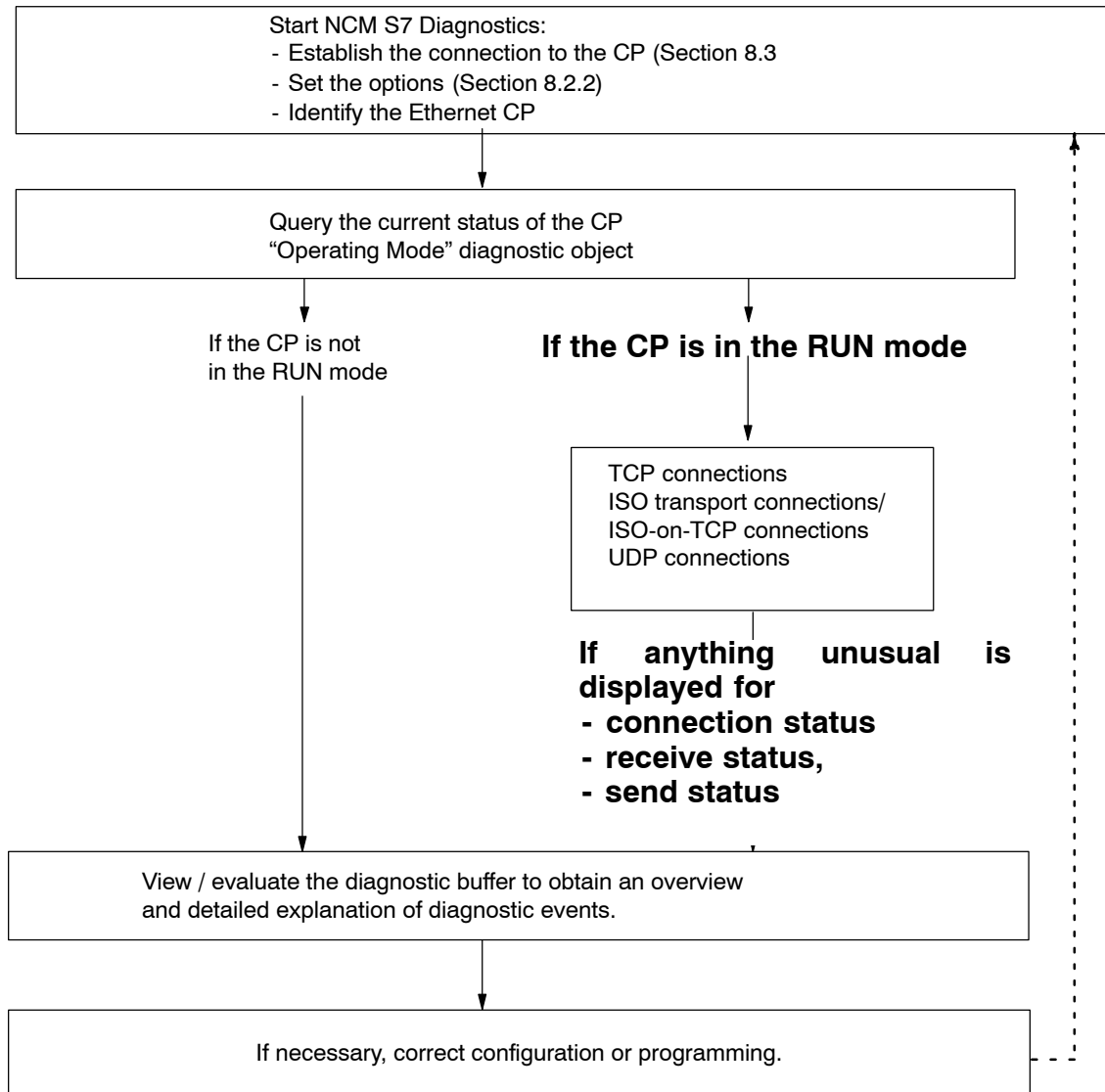
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## 8.4 How to Use Diagnostics

### Procedure

To use diagnostics efficiently, particularly when working with the diagnostic tool for the first time, the following procedure can be recommended.

1. Use the sequence shown below as a basis for using diagnostics:



2. Clarify your problem or task using the check list in Section 8.6 and select the diagnostic function based on the recommendation there.



## 8.5 Starting Diagnostic Functions Explicitly

The following table shows the diagnostic options that exist in the available functions.

Table 8-3 General Diagnostic and Statistical Functions

Diagnostic Functions / Diagnostic Object	Diagnostic Aims	Special Features
CP information	The aim is to identify the CP to which NCM S7 Diagnostics is connected and to find out the current mode.	
Mode	Here, the aim is to find out the current operating mode of the Ethernet CP as a module in the S7-300/400 and as a node on Industrial Ethernet and, if necessary, to modify the mode (menu command <b>Operating Mode</b> ▶ <b>Stop Module / Start Module / Reset Memory / Reset to Factory Settings</b> ).	
Diagnostic buffer	General error diagnostics using diagnostic buffers To display and decode event messages recorded on the CP in detail. The diagnostic buffer provides you with detailed information about all the communication services of the CP.	Event messages are recorded on the CP in a ring buffer. The ring buffer can contain up to 50 entries. In NCM S7, on the other hand, up to 500 messages can be saved! All the CP functions can generate event messages. When you call the diagnostic object, the messages are read out and displayed. The latest message is displayed in the top line with the highest consecutive number. If you double-click a previously selected event message, you display a help text explaining the message in greater detail.

### Note

The event messages in the ring buffer of the CPs are deleted following power cycle OFF/ON (S7-CPs) or after booting (PC stations).

When necessary, use the option of logging to a file if you want to see the history of the event messages later.

For more detailed information, refer to the online help on the “Diagnostic buffer” diagnostic object.

Table 8-4 Mode-Dependent Functions

Diagnostic Functions / Diagnostic Object	Diagnostic Aims	Special Features
To display and monitor communication connections. You obtain an overview or detailed information in the contents area depending on the diagnostic object you select.		
Connections	<ul style="list-style-type: none"> <li>• Overview of All Connection Types Used</li> </ul>	By double-clicking the objects in the contents area, you can display detailed information.
Connections ► Type	<ul style="list-style-type: none"> <li>• Overview of all the communication connections of a particular type, for example all TCP connections;</li> <li>• Information on the connection status</li> </ul>	
Connections ► Type ► Type-connection-n	<ul style="list-style-type: none"> <li>• Detailed information about the status of a communication connection.</li> </ul>	

## 8.6 Checklist for “Typical Problems” in a System

### Meaning

The following lists contain several typical problems and their possible causes and how you can use the NCM S7 Ethernet Diagnostics tool to remedy the situation.

The checklists deal with the following topics:

1. Checklist for General CP Functions
2. Communication Connections Checklist

### Note

In the column “Identifying the Cause and Remedy”, you will see the diagnostic function recommended for dealing with the problem shown in bold face.

### 8.6.1 Checklist for General CP Functions

Table 8-5 Checklist for Typical Problems When Operating a CP in a System

Problem	Possible Cause	Identifying the Cause and Remedy
The Ethernet CP will not change to the RUN mode.	Invalid configuration loaded on the Ethernet CP.	<p><b>Yellow STOP LED and red SF LED lit continuously.</b></p> <p><b>Call up the diagnostic buffer in NCM S7 Ethernet Diagnostics.</b></p> <p>Example of an entry CP STOP due to invalid CP parameter assignment</p> <p>What to do: Correct the configuration of the Ethernet CP.</p>
	Switch set to STOP on the Ethernet CP.	<p><b>Query the operating mode in NCM S7 Diagnostics.</b></p> <p>Operating mode: STOP, Cause: switch set to STOP</p> <p>What to do: Change the switch to RUN on the Ethernet CP</p>

## 8.6.2 Communication Connections Checklist

Table 8-6 Checklist for Typical Problems with ISO Transport / ISO-on-TCP / UDP Connections

Problem	Possible Cause	Identifying the Cause and Remedy
No data transfer on an ISO transport connection / ISO-on-TCP connection or only in one direction.	AG-SEND and AG-RECV are not called in the user program. or Receive or send buffer too small or incorrect.	<b>Check the user program.</b> <b>Evaluate status bytes in AG-SEND and AG-RECV.</b> What to do: If necessary, configure FC blocks. If necessary, correct ANY pointer.
	The connection is not established.	Evaluate status bytes of the FC blocks or evaluate diagnostic buffer. What to do: Change the address parameters (MAC/IP address, TSAP).
Data transfer too slow	Receiving device too slow	<b>Evaluate diagnostic buffer.</b> Entry: "No receive resources on destination station XX". What to do: Delay the send trigger or check the destination station and optimize reception.
The complete data field is not sent on an ISO transport / ISO-on-TCP/UDP connection.	LEN parameter for AG-SEND is set to the wrong value.	What to do: Set the LEN parameter to the required size.
The complete data field is not sent on an ISO transport / ISO-on-TCP/UDP connection.	The buffer specified with the ANY pointer is too small.	What to do: Correct the LEN parameter and the ANY pointer.

## 9 Firmware Loader

This chapter will familiarize you with the uses and handling of the Firmware Loader.

The Firmware Loader allows you to download more recent firmware versions to the SIMATIC NET modules.

For more detailed information on the various load options, refer to the integrated help.

## 9.1 Application

### Firmware

Here, firmware means the system programs in the SIMATIC NET modules.

### Uses of the Firmware Loader

The Firmware Loader allows you to download more recent firmware versions to the SIMATIC NET modules. It is used on the following:

- PROFIBUS modules
- Industrial Ethernet modules
- Modules for Gateways (for example, IE/PB Link)

### Installation

The firmware loader is available when you have installed NCM S7 on your PG/PC.

### Load Files

The Firmware Loader supports the following file types:

- <file>.FWL

A file form that contains extra information that can be displayed in the dialogs of the firmware loader in addition to the information of the LAD file form. Based on this information, the firmware loader can check the firmware for compatibility with the device.



For detailed information, read the documentation, for example, the README file shipped with the load file.

This information is displayed even after reading in the FWL file into the firmware loader.

### Working with the Firmware Loader

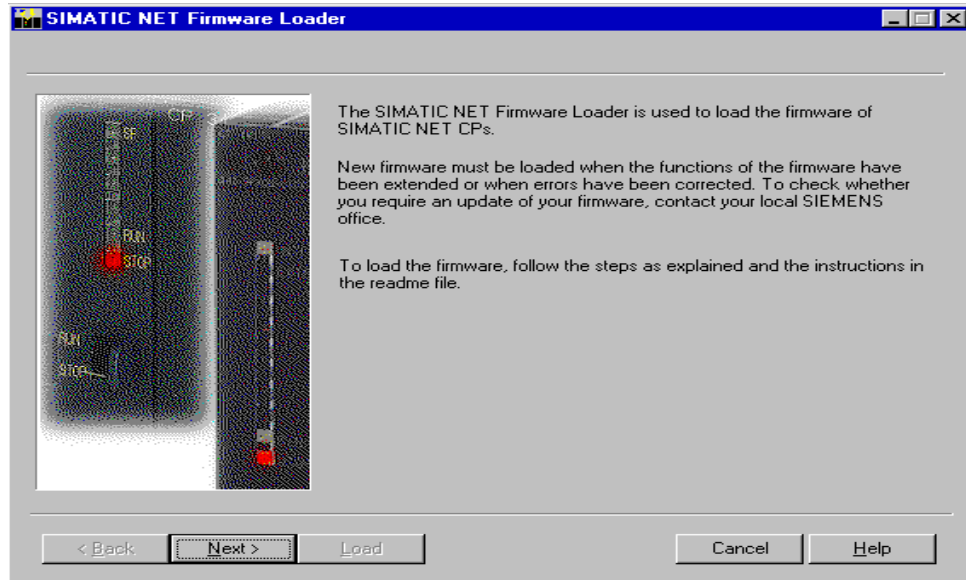
Depending on the module type, the downloading is prepared and executed in three or four steps.

For more detailed information, refer to the next section and the dialog boxes themselves.

## 9.2 Loading Firmware

### Starting the Download

Open the Windows Start menu and select the menu command **SIMATIC ► STEP 7 ► NCM S7 ► Firmware Loader**.



Select the **Next** button and follow the instructions displayed in the dialog box.



#### Caution

Make sure that the load file you are using is intended as an update for the version of the firmware contained on your module. If you are in any doubt, contact your local Siemens advisor.



#### Caution

Remember that interrupting the download can lead to an inconsistent state on the module!

For more information, read the description of the relevant device in Part B of this manual.

For more detailed information on the various load options, refer to the integrated help.



# A Pinout

## A.1 24 V DC Connector

Terminal	Function
L+	+24 V
M	Ground

## A.2 RJ-45 Jack for Twisted Pair Ethernet

### CPs with One Connector

Pin No.	Signal Name	Function
1	TD	TP- / Transmit +
2	TD_N	TP- / Transmit -
3	RD	TP- / Receive +
4	-	-
5	-	-
6	RD_N	TP- / Receive -
7	-	-
8	-	-

The pinning of the RJ-45 jack corresponds to the IEEE802.3 twisted pair interface.

### CPs with Multiport Switch

Pin No.	Signal Name	Function
1	RD	TP- / Receive +
2	RD_N	TP- / Receive -
3	TD	TP- / Transmit +
4	-	-
5	-	-
6	TD_N	TP- / Transmit -
7	-	-
8	-	-

## A.3 Connector for Industrial Ethernet

### Pinning - 15-Pin Sub-D Female Connector

Pin No.	Signal Name	Function
1	MEXT	External ground, shield
2	CLSN	Collision +
3	TRMT / TPETXD	Transmit + / TPE Transmit Data +
4	Ground	Ground 5 V
5	RCV / TPERXD	Receive + / TPE Receive Data +
6	M 15 V	Ground 15 V
7	TPE_SEL	Switchover AUI/ITP
8	Ground	Ground 5 V
9	CLSN_N	Collision -
10	TRMT_N / TPEXTXD_N	Transmit - / TPE Transmit Data -
11	Ground	Ground 5 V
12	RCV_N / TPERXD_N	Receive - / TPE Receive Data -
13	P15 V	+15 V
14	Ground	Ground 5 V
15	-	-

The pin assignment complies with IEEE 802.3 AUI interface.

The signals TPETXD / TPETXD\_N and TPERXD / TPERXD\_N form the ITP interface.

## A.4 Connector for PROFIBUS

### 9-pin D-sub female connector for PROFIBUS (used with IE/PB Link)

Pin No.	Signal Name	PROFIBUS Designation	Used in RS485
1	PE	Protective earth	yes
2	-	-	-
3	RxD/TxD-P	Data line B	yes
4	RTS (AG)	Control-A	-
5	M5V2	Data reference potential	yes
6	P5V2	Power supply plus	yes
7	BATT	-	-
8	RxD/TxD-N	Data line-A	yes
9	-	-	-

## B Standards and Approvals for SIMATIC NET S7-CPs

### Product Description:

- 
- CP 343-1 Lean (CX00) Order no.: 6GK7 343-1CX00-0XE0
- CP 343-1 Lean (CX10) Order no.: 6GK7 343-1CX10-0XE0
- CP 343-1 (EX11) Order no.: 6GK7 343-1EX11-0XE0
- CP 343-1 (EX20) Order no.: 6GK7 343-1EX20-0XE0
- CP 343-1 (EX21) Order no.: 6GK7 343-1EX21-0XE0
- CP 343-1 (EX30) Order no.: 6GK7 343-1EX30-0XE0
- CP 343-1 Advanced Order no.: 6GK7 343-1GX21-0XE0
- CP 343-1 IT Order no.: 6GK7 343-1GX20-0XE0
- CP 343-1 PN Order no.: 6GK7 343-1HX00-0XE0
- CP 443-1 (EX11) Order no.: 6GK7 443-1EX11-0XE0
- CP 443-1 (EX20) Order no.: 6GK7 443-1EX20-0XE0
- CP 443-1 IT Order no.: 6GK7 443-1GX11-0XE0
- CP 443-1 Advanced (EX40) Order no.: 6GK7 443-1EX40-0XE0
- CP 443-1 Advanced (EX41) Order no.: 6GK7 443-1EX41-0XE0
- IE/PB Link Order no.: 6GK1411-5AA00
- IE/PB Link PN IO Order no.: 6GK1411-5AB00
- IWLAN/PB Link PN IO Order no.: 6GK1417-5AB00

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### Note

You will find the valid approvals on the type plate of the relevant product.

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### IEC 61131–2

The SIMATIC NET S7-CPs listed above meet the requirements and criteria of the standard IEC 61131–2 (Programmable Logic Controllers, Part 2: Equipment Requirements and Tests).

## CE mark



The SIMATIC NET S7-CPs listed above meet the requirements and aims of the following EU directives and comply with the harmonized European standards (EN) for programmable logic controllers published in the Official Journal of the European Communities:

- 89/336/EEC "Electromagnetic Compatibility" (EMC Directive)
- 94/9/EEC „Equipment and Protective Systems for Use in Potentially Explosive Atmospheres (Explosion Protection Directive)

The EU conformity certificates are available for the responsible authorities according to the above-mentioned EU directive at the following address:

- Siemens Aktiengesellschaft  
Bereich A&D  
Industrielle Kommunikation SIMATIC NET  
Postfach 4848  
D-90327 Nuremberg  
Germany

## EMC Directive

The SIMATIC NET S7-CPs listed above are designed for use in an industrial environment.

Area of Application	Requirements	
	Noise emission	Noise immunity
Industrial	EN 61000-6-4 : 2001	EN 61000-6-2 : 2001

## Explosion Protection Directive



Complying with EN 60079-15 (Electrical apparatus for potentially explosive atmospheres; Type of protection „n“)



II 3 G EEx nA II T4

KEMA 03ATEX1225 X

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### Note

When using (installing) SIMATIC NET products in hazardous area zone 2, make absolutely sure that the associated conditions are adhered to!

You will find these conditions here:

- In the SIMATIC NET Manual Collection
- On the Internet at the address

<http://support.automation.siemens.com/WW/view/en/13702947>

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### Machinery Directive

The product remains a component in compliance with Article 4(2) of the EC Machinery Directive 89/392/EEC.

According to the directive on machines, we are obliged to point out that this product is intended solely for installation in a machine. Before the final product is started up, it must be established that it conforms to the directive 89/392/EEC.

### Installation Guidelines

The product meets the requirements if you adhere to the installation and safety instructions contained in this manual and in the documentation /1/, /3/ and /4/.



### Warning

Personal injury and damage to property may occur.

By installing expansions that are not approved for SIMATIC S7 CPs or their target systems, the requirements and regulations regarding safety and electromagnetic compatibility may be violated.

Only use expansions approved for the system.

---

### Notice for Australia



The SIMATIC NET S7 CPs listed above meet the requirements of the AS/NZS 2064 standard (Class A).

### Notice for Canada

This class A digital device meets the requirements of the Canadian ICES-003 standard.

## AVIS CANADIEN

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

## UL and CSA Approval

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### Note

You can recognize which of the following UL/CSA or cULus approvals apply to your product by the markings on the type plate.

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### UL Approval



UL Recognition Mark Underwriters Laboratories (UL) according to standard UL 508:

- Report E 85972

### CSA Approval



CSA Certification Mark Canadian Standard Association (CSA) according to standard C 22.2 No. 142:

- Certification Record 063533-C-000

### cULus Approval, Hazardous Location



CULUS Listed 7RA9 IND. CONT. EQ. FOR HAZ. LOC.

Underwriters Laboratories Inc. according to

HAZ. LOC.

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)
- UL 1604 (Hazardous Location)
- CSA-213 (Hazardous Location)

APPROVED for Use in

- Cl. 1, Div. 2, GP. A, B, C, D T4A
- Cl. 1, Zone 2, GP. IIC T4
- Cl. 1, Zone 2, AEx nC IIC T4



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**Warning**

Explosion Hazard -

Do not disconnect while circuit is live unless area is known to be non hazardous.

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**Warning**

Explosion Hazard -

Substitution of components may impair suitability for Class I, Division 2.

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**Note**

This equipment is suitable for use in Class I, Division 2, Group A, B, C, D or non-hazardous locations only.

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**Notice**

For devices with C-PLUG memory: The C-PLUG memory module may only be inserted or removed when the power is off.

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Note the following information:

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**Note**

The system must be set up according to the regulations of the NEC (National Electrical Code).

When used in environments corresponding to Class I, Division 2 (see above), the SIMATIC NET S7 CPs must be installed in an enclosure.

---

**FM Approval**



Factory Mutual Approval Standard Class Number 3611, Class I, Division 2, Group A, B, C, D, T4 or Class I, Zone 2, Group IIC, T4.



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**Warning**

Personal injury and damage to property may occur.

In hazardous areas, injury to persons or damage to equipment can result if you make or break an electrical circuit during operation of a SIMATIC NET S7 CP (for example with plug-in connectors, fuses, switches).

**WARNING - EXPLOSION HAZARD: DO NOT DISCONNECT EQUIPMENT WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.**

When used in hazardous areas (division 2 or zone 2), the device must be installed in an enclosure.

---



# C References and Literature

## Manuals and Further Information

- /1/ For installation and commissioning of the CP
- SIMATIC S7  
S7-300 Automation System
- Hardware and Installation: Installation manual
  - Module Data: Reference manual
- Siemens AG
- and
- SIMATIC S7  
S7-400, M7-400 Automation System
- Hardware and Installation: Installation manual
  - Module Data: Reference manual
- Siemens AG
- /2/ For using and configuring the CP  
Manual  
S7-CPs for Industrial Ethernet - Configuring and Commissioning  
Part of
- the manual package NCM S7 for SIMATIC NET CPs
  - the online documentation in STEP 7
- Siemens AG
- /3/ For using and configuring the CP  
NCM S7 for SIMATIC NET CPs "Primer"  
Part of
- the manual package NCM S7 for PROFIBUS
  - the online documentation in STEP 7
- Siemens AG
- /4/ SIMATIC NET , Instructions  
Commissioning PC Stations  
Part of
- the manual package for NCM S7 for Industrial Ethernet
  - the online documentation in STEP 7
- Siemens AG

- /5/ SIMATIC NET IT-CP, Instructions  
Part of  
- the manual package NCM S7 for Industrial Ethernet  
- the online documentation in STEP 7 / option NCM S7 for Industrial Ethernet  
Siemens AG
- /6/ SIMATIC Configuring Hardware and Connections with STEP 7  
Part of the STEP 7 documentation package STEP 7 Basic Knowledge  
Part of the online documentation of STEP 7  
Siemens AG
- /7/ SIMATIC - Programming with STEP 7  
Part of the STEP 7 documentation package STEP 7 Basic Knowledge  
Part of the online documentation of STEP 7  
Siemens AG
- /8/ SIMATIC STEP 7 reference manuals with manuals for  
- LAD / CSF / STL  
- System software for S7-300/400 System and Standard Functions  
Part of the online documentation in STEP 7  
Siemens AG
- /9/ For installing and operating an Industrial Ethernet network  
SIMATIC NET manual Industrial Twisted Pair Networks  
Siemens AG
- /10/ Ethernet, IEEE 802.3  
(ISO 8802-3)
- /11/ For installing and operating an Industrial Ethernet network  
SIMATIC NET manual for Triaxial Networks for Industrial Ethernet
- /12/ Lokale Netze -  
Kommunikationsplattform der 90er Jahre  
Andreas Zenk  
Addison-Wesley  
ISBN 3-89319-567-X
- /13/ TCP/IP  
Internet-Protokolle im professionellen Einsatz  
Mathias Hein  
International Thomson Publishing  
ISBN 3-8266-400-4  
ITP Online-Center: <http://www.ora.de>

- /14/** RFC1006 (Request For Comment)
  
- /15/** RFC793 (TCP)
  
- /16/** RFC791 (IP)
  
- /17/** On the topic of programming:  
Automation with STEP 7 in STL and SCL  
User Manual, Programming Manual  
Berger, H. / Publicis-MCD-Verlag, 2001
  
- /18/** On project engineering of PROFINET components and systems:  
  
Basic help in the SIMATIC iMap engineering tool  
Siemens AG
  
- /19/** On project engineering of PROFINET CBA components and systems:  
  
Component based Automation - Configuring Plants with SIMATIC iMap  
Manual  
Siemens AG
  
- /20/** On the use and project engineering of PROFINET IO  
From PROFIBUS DP to PROFINET IO  
Manual  
Siemens AG
  
- /21/** On the use and project engineering of PROFINET IO  
PROFINET IO System Description  
Manual  
Siemens AG
  
- /22/** Communication with SIMATIC  
System Manual  
Siemens AG

## Order Numbers

The order numbers for the SIEMENS documentation listed above can be found in the catalogs "SIMATIC NET Industrial Communication, Catalog IK PI" and "SIMATIC Programmable Controllers SIMATIC S7 / M7 / C7".

You can obtain these catalogs and any further information you require from your local SIEMENS office or national head office.



Some of the documents listed here are also on the Manual Collection CD supplied with every S7-CP.

## D Glossary

D.1	General Section .....	A-293
D.2	Industrial Ethernet .....	A-298
D.3	PROFINET .....	A-300

### D.1 General Section

#### **Baud rate**

-> transmission rate

#### **Broadcast**

A broadcast is like "calling all stations": Using **one** broadcast frame, you can reach all nodes that are prepared to accept broadcast frames.

#### **Bus segment**

Part of a -> subnet. Subnets can consist of bus segments and connectivity devices such as repeaters and bridges. Segments are transparent for addressing.

#### **Client**

A client is a device or, in general terms, an object that requests a service from a -> server.

#### **Configuration data**

Parameters that determine the modes and functions of a -> CP. They are set and downloaded using the NCM S7 configuration tool.

#### **CP**

Communications Processor. Module for communications tasks.

#### **CSMA/CD**

CSMA/CD (Carrier Sense Multiple Access with Collision Detection); a transmission technique.

#### **Frame**

A message from one PROFIBUS/Ethernet station/node to another.

**Frame header**

A frame header consists of an identifier for the -> frame and the source and destination address.

**Frame trailer**

A frame trailer consists of a checksum and the end identifier of the -> frame.

**Functions (FCs)**

STEP 7 code blocks of the type "function".

**Gateway**

Intelligent connectivity device that connects local area-> networks of different types at the ISO Layer 7 level.

**Industrial Ethernet**

A LAN system complying with IEEE 802.3 (ISO 8802-2)

**Multicast**

A multicast is like "calling all group stations": Using **one** multicast frame, you can reach all the nodes that belong to the multicast group and that are prepared to receive frames.

**NCM S7 for Industrial Ethernet**

Configuration software for configuration and diagnostic functions on an Ethernet CP.

**NCM S7 for PROFIBUS**

Configuration software for configuration and diagnostic functions on a PROFIBUS CP.

**Network**

A network consists of one or more interconnected -> subnets with any number of -> nodes. Several networks can exist side by side.

**PC station**

PC station means a PC with communications modules and applications. This PC is intended, for example, to communicate with SIMATIC S7 devices during process control tasks. These PCs equipped with runtime software are also known as runtime stations.

The PC station is configured in SIMATIC NCM PC / STEP 7 for communication with SIMATIC S7 devices.

The required runtime software is available on the PC station after APC (Advanced PC Configuration) is installed.

**PG operation**

A mode of the PROFIBUS/Ethernet CP in which the SIMATIC S7-CPU is programmed, configured or diagnosed over PROFIBUS/Ethernet. This mode is handled by the S7 functions.

**PROFINET**

Standard of the PROFIBUS Users organization defining a heterogeneous communications and engineering model.

**Protocol**

A set of rules for transferring data. Using these rules, both the formats of the frames and the data flow are specified.

**Process image**

The process image is a special memory area in the programmable logic controller. At the start of the cyclic program, the signal states of the input modules are transferred to the process input image. At the end of the cyclic program, the process output image is transferred as a signal state to the output modules.

**Segment**

Synonym for -> Bus segment.

**Server**

A server is a device, or in general terms, an object that provides certain services. A service is started at the instigation of a -> client.

**Services**

Services provided by a communication protocol.

### **SIMATIC NET**

Siemens SIMATIC Network and Communication. Product name for -> networks and network components from Siemens. (previously SINEC)

### **SIMATIC NET Ind. Ethernet**

SIMATIC NET LAN system for industrial applications based on Ethernet. (previously SINEC H1)

### **SIMATIC NCM PC**

SIMATIC NCM PC allows STEP 7-compatible configuration for SIMATIC NET PC components and replaces the previous PC configuration tools COML S7 and COM PROFIBUS PC Edition. By sharing a common database with STEP 7, fully integrated configuration including all protocols is ensured.

### **SINEC**

Previous product name for-> networks and network components from Siemens. Now: SIMATIC NET

### **Station**

A station is identified by a

- MAC address in the Ethernet network
- PROFIBUS address in the PROFIBUS network

### **Subnet**

A subnet is part of a -> network whose parameters (for example -> PROFIBUS) must be matched. The subnet includes bus components and all the attached stations. Subnets can, for example, be connected together by -> gateways to form a network.

A -> system consists of several subnets with unique -> subnet numbers. A subnet consists of several -> stations with unique -> PROFIBUS or MAC addresses (Industrial Ethernet).

### **System**

This means all the electrical equipment within a system. A system includes, among other things, programmable logic controllers, devices for operation and monitoring, bus systems, field devices, actuators, supply lines.



**Transport layer**

The transport layer is layer 4 of the ISO/OSI reference model for open system interconnection. The purpose of the transport layer is to transfer data reliably from device to device. Transport connections can be used for the transmission.

**Transport interface**

The transport interface of a SIMATIC S5 PLC is the access to the connection-oriented services of the transport layer on the CP. The transport interface presents itself to the control program in the form of handling blocks (HDBs).

**TSAP**

Transport Service Access Point

**Transmission rate**

According to DIN 44302, this is the number of binary decisions transmitted per time unit. The unit is bps. The set or selected transmission rate depends on various conditions, for example the distance across the network.

**Watchdog**

Mechanism for monitoring operability.

## D.2 Industrial Ethernet

### Base address

Logical address of a module in S7 systems.

- For PROFIBUS

The PROFIBUS base address is the address starting at which all addresses that are calculated automatically in the project are assigned.

- For Industrial Ethernet

The base MAC address is the address starting at which all addresses that are calculated automatically in the project are assigned.

### Ind. Ethernet station

A station is identified by a -> MAC address in -> Industrial Ethernet.

### ISO-on-TCP

Transport layer connection (layer 4 communication complying with ISO) simulated on TCP.

On an ISO-on-TCP connection, messages can be exchanged in both directions. TCP provides the data flow communication without segmenting the data into messages. ISO, on the other hand, is message-oriented. With ISO-on-TCP, this mechanism is simulated on TCP. This is described in RFC1006 (Request For Comment).

ISO-on-TCP connections allow program/event-controlled communication via Ethernet from a SIMATIC S7 PLC to

- SIMATIC S7 PLC with Ethernet CP
- SIMATIC S5 PLC with Ethernet CP
- PC/PG with Ethernet CP
- any system

**ISO Transport Connection**

Communication connection of the transport layer (with the CP/COM 143 previously S5S5 connection).

ISO transport connections allow program/event-controlled communication on Industrial Ethernet between SIMATIC S7 PLCs and

- SIMATIC S7 PLC with Ethernet CP
- SIMATIC S5 with an Ethernet CP (e.g. CP 143 or CP 1430)
- PC/PG with Ethernet CP (for example CP 1613)
- Any system using the ISO transport protocol (ISO 8073)

The transfer of blocks of data on an ISO transport connection is bi-directional.

**MAC address**

Address to distinguish between different stations connected to a common transmission medium (Industrial Ethernet).

**Media Access Control (MAC)**

Mechanisms for controlling access by a station to a common transmission medium shared with other stations.

**RFC1006**

see ISO-on-TCP

**S5S5 connection**

see ISO transport connection

**Subnet mask**

The subnet mask specifies which parts of an IP address are assigned to the network number. The bits in the IP address whose corresponding bits in the subnet mask have the value 1 are assigned to the network number.

**Subnet number**

A -> system consists of several -> subnets with unique subnet numbers.

**TCP/IP**

TCP = Transport Connection Protocol; IP = Internet Protocol

**UDP**

User Datagram Protocol. User Datagram Protocol: datagram service for simple internetwork transmission without acknowledgment.

## D.3 PROFINET

### Component based Automation

Concept for implementing modular, distributed automation applications on the basis of open standards and data communication. Component based Automation is an expansion of Totally Integrated Automation (TIA).

### Device

In PROFINET CBA: part of the PROFINET component that contains the hardware-specific data of the PROFINET component. In SIMATIC iMap, a device is the software representation of the physical device for which the PROFINET component was created. It is displayed in the network view of SIMATIC iMap as an object with one or more bus attachments. The following distinction is made according to the communication functionality: -> PROFINET devices and -> PROFIBUS devices.

### Interconnection

General: Logical data connection between two objects.  
With PROFINET CBA in SIMATIC iMap: Connection between two technological functions. An output is interconnected with an input of the same type. Interconnections are represented in SIMATIC iMap by lines.

### Network view

With PROFINET CBA: View of the devices and the networks (Ethernet, PROFIBUS) in SIMATIC iMap.

### Plant view

With PROFINET CBA: View of the technological functions of the automation system and its interconnections in SIMATIC iMap. One chart is displayed in the plant view.

### PROFIBUS device

In PROFINET CBA: A PROFIBUS device has only one PROFIBUS attachment as a slave. It does not take part directly in PROFINET communication but is linked using a proxy PROFINET device.

## **PROFINET**

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

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

The experience gained in both systems was and is integrated in PROFINET. PROFINET as an Ethernet-based automation standard from PROFIBUS International (previously PROFIBUS Users Organization e.V.) defines a heterogeneous communication, automation and engineering model.

## **PROFINET device**

With PROFINET CBA: A device on Ethernet is a PROFINET device. A PROFINET device can also have a PROFIBUS attachment as master and proxy PROFINET device for PROFIBUS devices.

## **PROFINET device, proxy**

A PROFINET device that has the role of the master for PROFIBUS devices. This allows PROFIBUS slaves to be included in PROFINET communication.

## **PROFINET IO**

Heterogeneous communication and engineering model for real-time communication between PROFINET components. PROFINET IO, for example, provides protocol elements for cyclic transfer of productive data.

## **PROFINET component**

With PROFINET CBA: Software representation of a technological module with defined functionality. An automation system is made up of several PROFINET components.

A PROFINET component always includes a technological function and the corresponding device.

## **SIMATIC IMap**

Engineering tool from Siemens for PROFINET CBA. Allows the configuration, commissioning, and monitoring of modular, distributed automation systems based on the PROFINET standard.

## **SIMATIC iMap - STEP 7 AddOn**

Software for the SIMATIC iMap interface to STEP 7.

## E Linking to Other Systems with FETCH/WRITE

The FETCH and WRITE modes supported on ISO transport connections, TCP, and ISO-on-TCP connections can be used with any other device to access the S7 system memory areas.

To be able to use this type of access, for example for PC applications, you need to know the PDU structure of the jobs. The required S7 or S5 header for request and response frames are 16 bytes long and their structure is described in this chapter.

### a) Structure of WRITE Frames

The meaning and values of parameters shown without values in the following table can be found in the section "Parameter Values".

**WRITE request frame**

0	System ID	= "S"
1		= "5"
2	Length of header	= 16d.
3	ID OP code	= 01
4	Length OP code	= 03
5	OP code	= 03
6	ORG field	= 03
7	Length ORG field	= 08
8	ORG ID	
9	DBNR	
A	Start address	High Byte
B		Low Byte
C	Length	High Byte
D		Low Byte
E	Empty field	= FFh.
F	Length empty field	= 02
<b>Data up to 64 K</b>		

**WRITE acknowledgment frame**

0	System ID	= "S"
1		= "5"
2	Length of header	= 16d.
3	ID OP code	= 01
4	Length OP code	= 03
5	OP code	= 04
6	Ack field	= 0Fh
7	Length ack field	= 03
8	Error field	= No
9	Empty field	= FFh
A	Length empty field	= 07
B	free	
C		
D		
E		
F		

**a) Structure of FETCH Frames**

The meaning and values of parameters shown without values in the following table can be found in the section "Parameter Values".

**FETCH request frame**

0	System ID	= "S"
1		= "5"
2	Length of header	= 16d.
3	ID OP code	= 01
4	Length OP code	= 03
5	OP code	= 05
6	ORG field	= 03
7	Length ORG field	= 08
8	ORG ID	
9	DBNR	
A	Start address	High Byte
B		Low Byte
C	Length	High Byte
D		Low Byte
E	Empty field	= FFh.
F	Length empty field	= 02

**FETCH response frame**

0	System ID	= "S"
1		= "5"
2	Length of header	= 16d.
3	ID OP code	= 01
4	Length OP code	= 03
5	OP code	= 06
6	Ack field	= 0Fh
7	Length ack field	= 03
8	Error field	= No
9	Empty field	= FFh
A	Length empty field	= 07
B	free	
C		
D		
E		
F		
Data up to 64 K but only if Error no. = 0		

**Parameter Values**

<b>S7 Address Area</b>	<b>DB</b>	<b>M</b>	<b>I</b>	<b>Q</b>
ORG ID	01 <sub>H</sub> Source/dest. data from/to data block in main memory	02 <sub>H</sub> Source/dest. data from/to flag area	03 <sub>H</sub> Source/dest. data from/to process image of the inputs (PII)	04 <sub>H</sub> Source/dest. data from/to process image of the outputs (PIQ)
DBNR	DB, from which the source data are taken or to which the dest data are transferred	irrelevant	irrelevant	irrelevant
permitted range	1...255			
Start address	DW number, from which the data are taken or written to	Flag byte no., from which the data are taken or written to	Input byte no., from which the data are taken or written to	Output byte no., from which the data are taken or written to
permitted range	0...2047	0...255	0...127	0...127
Length	Length of the source/dest. data field in words	Length of the source/dest. data field in bytes	Length of the source/dest. data field in bytes	Length of the source/dest. data field in bytes
permitted range	1...2048	1...256	1...128	1...128



<b>S7 Address Area</b>	<b>PI/PQ</b>	<b>C</b>	<b>T</b>
ORG ID	05 <sub>H</sub> Source/dest. data from/to in I/O modules. With source data input modules, with dest data output modules	06 <sub>H</sub> Source/dest data from/to counter cells	07 <sub>H</sub> Source/dest data from/to timer cells
DBNR	irrelevant	irrelevant	irrelevant
Start address  permitted range	I/O byte no., from which the data are taken or written to  0...127 digital I/Os 128...255 analog I/Os	Number of the counter cell from which the data are taken or written to  0...255	Number of the timer cell from which the data are taken or written to  0...255
Length  permitted range	Length of the source/dest. data field in bytes  1...256	Length of the source/dest. data field in words (counter cell = 1 word)  1	Length of the source/dest. data field in words (counter cell = 1 word)  1

## F Document History

This section provides an overview of the previous releases of this manual and the functional expansions in STEP 7 and NCM S7.

### **New in release 07 / STEP7 V5.4 SP2 (C79000 -G8976 -C182 -07)**

Apart from various adaptations to the currently available devices, the following modifications were included:

- Configuration of the CP mode PROFINET IO device or controller  
Certain CP 343-1 device types can be operated in the PROFINET IO controller or PROFINET IO device modes.
- Additional information in the block description  
New blocks for user programs of the CP 343-1 in the PROFINET IO controller mode:
  - FB52 PNIO\_RW\_REC
  - FB54 PNIO\_ALARM
- Introduction of Web diagnostics for the new CP 343-1 types

### **New in release 06 / STEP7 V5.4 SP1 (C79000 -G8976 -C182 -06)**

Apart from various adaptations to the currently available devices and the current version of STEP 7/NCM S7 V5.4 SP1, the following modifications were included:

- Configuration of the CP mode PROFINET IO device  
Depending on the device type certain CPs can be configured and operated in the PROFINET IO controller or PROFINET IO device modes.
- Corrections and additions to the block description  
Corrections and additions have been made to the following FCs/FBs.
  - FC11 PNIO\_SEND
  - FC12 PNIO\_RECVThese FCs are now also used for the PROFINET IO device mode of the CP 343-1 Lean.

### **New in release 05 / STEP7 V5.4 (C79000 -G8976 -C182 -05)**

Apart from various adaptations to the currently supplied devices and the current version of STEP 7/NCM S7 V5.4, the following features were included:

- New blocks for user programs
  - There is a new block FB90 PN\_InOut\_Fast (previously known as: PN\_IO\_X) available for PROFINET CBA.
- Corrections and additions to the block description

Corrections or additions have been made to the following FCs/FBs.

- FB88 PN\_InOut / FB90 PN\_InOut\_Fast
- FB55 IP\_CONFIG
- FC11 PNIO\_SEND
- FC 12 PNIO\_RECV

#### **New in release 04 / STEP7 V5.3 SP3 (C79000-G8976-C182-03)**

Apart from various adaptations to the currently supplied devices and the current version of STEP 7/NCM S7 V5.4, the following features were included:

- New blocks for user programs
  - There is a new block FB90 PN\_IO\_X available for PROFINET CBA.

#### **New in release 03 / STEP 7 V5.3 SP3 (C79000-G8976-C182-03)**

Apart from various adaptations to the currently supplied devices and the current version of STEP 7/NCM S7 V5.3 SP2/SP3, the following features were included:

- New blocks for user programs
  - There is a new block FC10 AG\_CNTRL available for the SEND/RECEIVE interface
  - There are also detailed sample programs for the SEND/RECEIVE interface on the Web. You will also find the link in Section 7.
- Expanded sample of programmed communication connections in Section 6.
- Printed version - General Part A and Device Description Part B separate

Due to the increasing size, the printed version has been divided into two volumes.

#### **New in release 01 / STEP 7 V5.3 SP0 (C79000-G8976-C182-01)**

- New structure of the manual

In this release we have put together the previously separate manuals NCM S7 and S7 CPs in one manual.

This also takes into account that the NCM S7 configuration tool is no longer installed separately for PROFIBUS and Industrial Ethernet. The functions of NCM S7 are now installed automatically when STEP 7 is installed.

- Range of devices described: S7 CPs and gateways

The devices described in detail in Part B now include not only the CPs for SIMATIC S7 but also the gateway IE/PB Link. This step was taken in particular due to the special significance for PROFINET applications.

#### **New in release 07 / STEP 7 V5.2 SP1 (C79000-G8976-C129-07)**

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**Note**

This is the last release before the two manuals “NCM S7 for Ind. Ethernet” and “Device Manual S7-CPs for Ind. Ethernet” were merged.

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This manual also includes specially marked passages that apply specifically to and require version 5.2 SP1 of the NCM S7for Industrial Ethernet configuration software and version 5.2 SP1 of the STEP 7 software.

These include new functions for IP configuration:

- IP Access Protection

Using IP access protection gives you the opportunity of restricting access to the local S7 station to partners with specific IP addresses.

- Configuring connections from the user program

In some situations, it is an advantage to set up communication connections not over the configuration interface of STEP 7 but program-controlled by specific applications.

As of STEP 7 V5.2 SP1, a function block is available for these applications that allows flexible transfer of data blocks with configuration data to an Ethernet CP.

The description of the configuration for FETCH / WRITE services has been extended.

**New in release 06 / STEP7 V5.2 (C79000 - G8976 - C129 - 06)**

- S7 communication over routers (single-ended client and server functionality) via an IE/PB Link or CP.
- Multiprojects

With the new multiproject functionality, projects can be split up and distributed for engineering and then merged again.

**New in release 05 / STEP7 V5.1 SP3 (C79000 - G8976 - C129 - 05)**

- Configuring multicast and broadcast on UDP connections.  
See Chapter 5.
- The blocks AG\_SEND and AG\_RECV can now be used for “long data packets” with an S7-300. See Chapter 7.
- The S7 CPs for Ind. Ethernet are now supplied with a default MAC address allowing configuration data to be downloaded over Ethernet without a “node initialization”.

**New in release 04 / up to STEP 7 V5.1 SP2 (C79000 -G8976 -C129-04)**

- The FETCH/WRITE mode is now supported on TCP connections. See Chapter 5.
- The FETCH/WRITE mode can be coordinated in the user program by the new FCs AG\_LOCK and AG\_UNLOCK. See Chapter 7.
- NCM Diagnostics has a completely revised user interface. See Chapter 8  
The description of NCM S7 Diagnostics has been restructured. While this manual provides you with an overview and checklists, the online help provides you with detailed information on the diagnostic events.

**This was new in release 02 / STEP7 V5.3 SP2 (C79000 -G8900 -C182-02)**

- New blocks for user programs  
New FCs and FBs are available for PROFINET services. Descriptions that were temporarily included in new releases of the specific device manuals are now included in this general part.
- Range of devices described: S7 CPs and gateways  
The devices described in detail in Part B now include not only the CPs for SIMATIC S7 but also the gateway IWLAN/PB Link PN IO. This step was taken in particular due to the special significance for PROFINET applications.

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