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STEP 7 Block library "Plant Communication Concept V3.0"

User documentation

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1 Introduction

1.1 Overview

The PLC modules, which are structured under the title "Plant Communication Concept (= PCC)", are used for the unified communication of the "Plant Data Interface (PDI)" for the "Line Integration Concept (= LIS)" of the food and beverage industry.

The "Plant Data Interface (PDI)" defines specified content that complies with international standards such as those of the **OMAC User Group** or the **Weihenstephan Standard**, and transforms these into concrete data structures.

When doing this, it is important to transfer content reliably and to supply the interface with the correct information from the application. Based on the information in the interface, evaluations of the reliability of the machine and, for example, the frequency of specific fault messages, are frequently carried out. The information from the interface is connected in production mode with time models, for example, to calculate the availability of machines.

These unified data structures make it possible to combine individual machines of a production or packaging line in a uniform and interchangeable manner with a central administration / monitoring structure.

To keep the data exchange as efficient, safe and easy as possible, the "Plant Communication Concept (= PCC)" was developed. These components help the machine manufacturer (= OEM) to uniformly make the different data structures available on various combinations of hardware and interfaces.

Benefits

A uniform solution, which facilitates understanding and handling, has been created for all standard SIMATIC control series. Data consistency, transmission security, stability and functional monitoring are ensured.

In the current version 3.0, different protocols and different transmission media are also supported.

The library was created for minimal resource consumption and high flexibility.

To make the integration into the control program as sustainable as possible, only the absolutely necessary processing is carried out and, if possible, it is distributed over several CPU cycles. Furthermore, the memory consumption was reduced as much as possible through the scalability of the data volume and effective programming.

1.2 System requirements

The PLC blocks are available in a **STEP 7 V5.5** and in another **STEP 7 V14** library and can run on **S7-300 /400/1200/1500** (or compatible) controllers. All use-relevant program parts of the STEP 7 V5.5 library were created with the programming language "AWL" and can therefore be used without optional additional programs from STEP 7. For the STEP 7 V14 version, the programming language "SCL" was used uniformly. All blocks are intended for "optimized block access". Blocks are available in both libraries for the S7-300/400 control series.

Due to the block structure, the actual transmission can be adjusted relatively easily to unpredictable requirements (e.g. new firmware or newer communication blocks). The PCC library is therefore not subject to any hardware limitations. Due to the use of special functions in STEP 7 V14, however, the blocks can only be used as of **CPU firmware version 4.2**.

The transfer does not require and has no influence on the CPU system time. In the example project, an NTP synchronization was parameterized only to illustrate the general requirement.

Required resources for the control:

- **Cycle time 0-x ms** (asynchronous machining)
  A possible maximum CPU load depends on the scope and type of configuration. In typical use, however, this is less than 1 ms.
- **Work memory** (Dependent on the type and version)
  PDI data: 0.3 KByte
  Base program including calls and data: approx.11 KByte
  System blocks 3.5 KByte (depending on the protocol)
- Average **communication load** (PDI basic configuration)
  of the machine to line control: 265 bytes/sec.
  From line control to the machine: 31 bytes/sec.
- One **communication interface** (preferably PROFINET)

1.3 Supported communication protocols

Due to the different technical requirements, 3 protocols were added to the standard library. Due to the block structure, it can also be supplemented with additional protocols or blocks

Decision-making aids

- Most flexible application: Open TCP communication
- Network independence: S7 communication
- Quickest communication: PROFINET IO communication

Explanation of the type of connection parameters

- For “parameterized connections”, the communication partners are specified during engineering and corresponding parameters are set in specific dialogs of the hardware or network configuration. The connection is handled by the firmware.
- For "connections without parameterization", the connection setup is also handled in the user program. All parameters (e.g. IP address of the partner) can be changed in the program.

1.3.1 Open Ethernet TCP communication (=OC)

Features

- Open default (communication also possible with external controllers)
- Communication via CPU interface, CM or via CP
- Use even without configured connections

Further distinction

For S7-300 / 400, a distinction must also be made:

- Use of the integrated CPU interface (= OCT)
  So-called "T-blocks" are used

- Use of communications processors (=OCSR)
  Communication takes place using send/receive blocks and a configured connection

1.3.2 S7 Communication (=S7C)

Features

- Network-independent user interface: Identical handling for PN/ IE, PB and MPI
- Communication via CPU interface or via CP(CM)
- Communication via configured connections (S7 connection)
- Conditionally routable between the bus systems
- Acknowledgment by the remote application of the receipt of the data

Constraint

Protocol is not supported by all controllers (e.g. S7-1200).

1.3.3 PROFINET IO communication (=IDC)

Features

- Parameterized cyclic communication in the hardware configuration
- Transmission is ensured by the firmware - user program copies the data

Constraint

All network components used (including switches) must support the protocol.

2 Library

For each process data (PDI) interface to be transferred, one communication instance must be called up on each side. If several PDI interfaces are to be exchanged with a remote station (= machine), then several communication instances have to be implemented. One of these instances, present as a copy template "FB_PCC_MAIN_CALL", thus transmits exactly one complete "UDT_PDI" instance (= copy template "DB_PDI").

Example (One line corresponds to one communication instance):

Table 2-1

Machine (OEM)		
	Data	Block calls
Erector	DB_PDI	FB_PCC_MAIN_CALL
Packaging	DB_PDI_PREPARE	FB_PCC_MAIN_CALL_PREPARE
	DB_PDI_PACK	FB_PCC_MAIN_CALL_PACK
	DB_PDI_CLOSE	FB_PCC_MAIN_CALL_CLOSE
Palletizers	DB_PDI	FB_PCC_MAIN_CALL

Table 2-2

Line control		
	Block calls	Data
Erector	FB_PCC_MAIN_CALL_M101	DB_PDI_M101
Packaging	FB_PCC_MAIN_CALL_M102	DB_PDI_M102
	FB_PCC_MAIN_CALL_M103	DB_PDI_M103
	FB_PCC_MAIN_CALL_M104	DB_PDI_M104
Palletizers	FB_PCC_MAIN_CALL_M105	DB_PDI_M105

All PCC blocks support the option "optimized block access" and do not have to be retentive. Only the PDI data should be stored retentively.

To save the CPU resources, the processing may be divided over several call cycles depending on the necessity of the function.

The internal processing of the communication blocks is also distributed over several cycles. All the block calls should therefore be incorporated in the main program processing cycle (= OB1) as shown in the configuration example. This prevents the receipt of data from hindering the sender in the optimal communication process, and the data buffers are used optimally.

2.1 Versioning and compatibility

Each block of the library has a version identifier in the metadata. This may also be different from the version of the PCC library. For details, see also the block comments with the “version history”

The communication itself also distinguishes the version of the PDI data as well as the version of the communication message frame. These versions are partially checked in the program and give rise to corresponding error messages in the event of incompatibility.

The completely revised communication message frame from PCC V3 is not compatible with previous PCC versions. Due to the simplified application, replacing the communication blocks is recommended.

2.2 PCC block structure

The PCC blocks are identical for both communication endpoints. They are divided into the following areas:

Data block of the process data interface

This is instantiated in the copy template "**DB_PDI"** as data type "**UDT_PDI"**.

The user data is stored in this data area for transmission. These vary according to the standard used (OMAC or Weihenstephan).

The freely selectable structure is divided primarily into:

1. Basic data (BASIC) - minimum amount of data for connection
2. Control data (LCU) – data used for optional control of the machine
3. Energy data (PEC) - contains programmable energy measuring points at runtime
4. Parameter data (PARA) **-** measured values or additional user data
5. Plant-specific data - flexible data area for additional plant-specific data

For details on the structure and the data content, please refer to the documentation of the corresponding standard.

Communication data block

This is instantiated in the copy template **“DB_PCC”** as data type **“UDT_PCC”**.

This area contains configuration, diagnostics, and data caching areas for a communication instance. The arrays defined in this area are used dynamically and can be resized according to the PDI setup.

Blocks for data processing

The block “**FB_PCC_MAIN”** copies the data and controls the communication. Likewise, the communication connection is monitored and possibly also controlled depending on the protocol.

Blocks for calling the communication

Depending on the protocol used and the hardware used, the corresponding subroutines are called in **“FB_PCC_SUB_CALL”** . For special cases, the received raw data can still be edited or changed (e.g.: Integration of external controllers or versions)

Communication system blocks

To ensure a consistent library, all necessary Siemens system components (e.g.: "FC_TSEND", "FB_BSEND", "FC_PNIO_SEND", ...) are also included. Depending on the application, these can also be exchanged individually for more up-to-date modules.

Calling the blocks

The copy / template **“FB_PCC_MAIN_CALL”** is used for configuration and contains a multi-instance call of the PCC program parts.

2.3 Block nesting

The following representation illustrates the nesting of the blocks as used in the example project. The call is not mandatory, but it is recommended that the blocks be called in the same execution cycle.

The block “FB_PCC_SUB_CALL” must be selected protocol-specific or depending on the hardware used. Due to the nesting selected, all block numbers can be individually adapted in STEP 7 V5.5 as well.

Table 2-3

OB_CYCLE_EXEC (OB1)		
FB_PCC_MAIN_CALL	FB_PCC_MAIN (Know-how-protected)	FC_SERIALIZE*)
		FC_DESERIALIZE*)
		FX_MOVE_BLK_VARIANT*)
	FB_PCC_SUB_CALL	FB_TCON
		FB_TDISCON
		FB_TSEND
		FB_TRCV

*) Only STEP 7 TIA Portal

2.4 Block protection

The block protection for “FB_PCC_MAIN” is only used for version or change protection of the block and to ensure that the planned use is adhered to. If compilation is necessary for the hardware used (= error message when loading the program), then you can cancel this protection with the password “Siemens!F&B”.

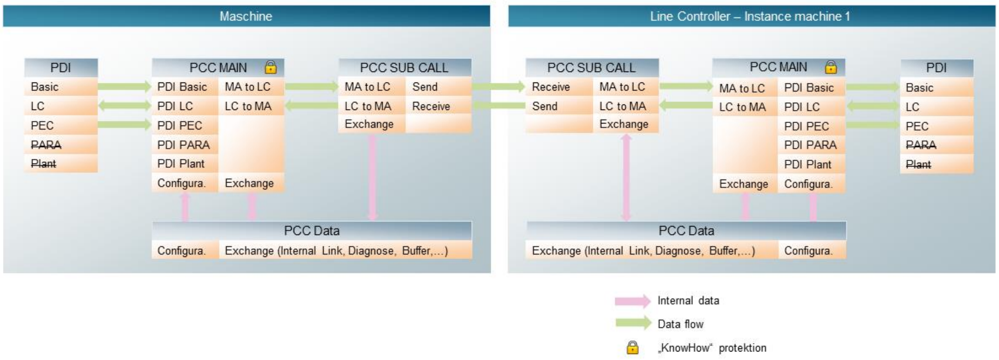
2.5 Data flow

The payload data length to be transmitted depends on the actual extent required. Reserve areas are not transferred. The communication block detects from its interconnection whether PDI areas should be transmitted or not. If connections are not interconnected or are “zeroed”, the data is regrouped accordingly.

The length of the data is checked for plausibility and compared on the receiving side. A different interconnection of the blocks leads to an error message.

The connection between preparation and transmission is illustrated below. The transfer direction of the individual PDI areas is also displayed.

Figure 2-1



2.6 Message frame structure

Regardless of the protocol, the PDI data to be transmitted is still packed into a message frame which ensures the following:

- Version control
- Prevention of different parameterization
- Completeness of data
- Optimization of the temporal monitoring
- Monitoring of data transmission in both directions
- Message frame consistency for small PDU sizes of the transmission path

For this purpose, additional “administrative data” are transmitted at the beginning and at the end of the user data as follows:

Table 2-4

Message frame	
Header (8 bytes)	Version (1 byte)
	Type (1 byte – 16#FE)
	Count M to LC (1 byte)
	Count LC to M (1 byte)
	Length (2 bytes)
	Max send time (2 bytes)
Used PDI data (88 – x byte)	Basic
	LC
	Parameter
	PEC
	Plant-specific
End Char (1 Byte – 16#FC)	

Version (1 byte)

Specifies the version number of the message frame structure and ensures the correct evaluation of the transmitted data structure.

Message frame type (1 byte)

Used to identify the type of user data contained in the message frame. There is currently only one type of message frame. A constant hexadecimal “FE” (= decimal 254) is transmitted.

Message frame counter machine to line control (1 byte)

Circulating transmission counter which indicates the message frames sent by the machine control. This is copied unchanged by the line control, after a validity check of the received message frame, into the send message frame. The communication is thus recognized on both sides as faulty, even if only one transmission direction does not work. The validity of the message frame is recognized by the correct length as well as by the content of the “header”.

Message frame counter line control to the machine (1 byte)

Circulating transmission counter which indicates the message frames sent by the line control. This is copied unchanged by the machine control, after a validity check of the received message frame, into the send message frame. The communication is thus recognized on both sides as faulty, even if only one transmission direction does not work. The validity of the message frame is recognized by the correct length as well as by the content of the “header”.

Length (2 bytes)

Specifies the number of bytes sent and is used, among other things, to check that the block has been connected to the same PDI structure on both sides.

Maximum transmission time (2 bytes)

Specifies the maximum transmission pause (in seconds) that there can be be between 2 transmission cycles. This value is needed for an optimization of the communication monitoring, because the parameterization and protocol selection can result in very different transmission speeds.

End character (1 byte)

To ensure complete transmission of the data, a constant hexadecimal "FC" (= decimal 252) is sent at the end.

3 Blocks

3.1 Data structure “UDT_PCC”

This data structure defines a communication instance (= communication for a PDI interface). This data type can be stored with the “optimized block access” option and the data does not have to be retained.

3.1.1 Configuration area

This area contains all the parameters that determine the mode of transmission.

Note Changes to communication parameters are sometimes only accepted by the respective blocks after the connection has been restarted or the “instance data” (or CPU restart) has been loaded. For additional information, refer to the online help of the communication blocks used in “FB_PCC_SUB_CALL”.

- **“Enable”** (default: “True”)
  Enable establishment of connection and communication. If this data point is “False”, the communication is also cleared during active connection control (with OCT).
- **“Reset”** (default: “False”)
  This data point interrupts the connection. All diagnostic counters and internally stored information are reset.
- **“ControllerSide”** (default: “False”)
  This indicates whether the block is used on the machine side (= interconnection “False”) or on the side of the line control (= interconnection “True”).
- **“EnableCheckChange”** (default: “True”)
  The transmission is basically cyclical, but if important information changes in the PDI data area (e.g.: commands), the transmission is triggered immediately. Monitoring for changes can be enabled or disabled with this data point if required.
- **“EnableCCPlantCmd”** (default: “True”)
  For the area of plant-specific payload data from the line control to the machine, due to the undefined content, the change monitoring for the immediate transmission can be set separately.
- **“EnableCCPlantStat”** (default: “False”)
  For the area of plant-specific payload data from the machine to the line control, due to the undefined content, the change monitoring for the immediate transmission can be set separately.
- **“PDI_Type”** (default: 1=OMAC)
  To check the plausibility of the interconnection or to enable change monitoring, the PDI type must be specified:
  - OMAC PDI Interface Version 2
  - Weihenstephan PDI Interface Version 2

- **“ConnectionId”** (default: 16)
  Identification number of the communication connection. For configured communication connections (OCSR or S7C), the number of the configured connection must be entered (Reference 5.2.2). If the connection is controlled by the user program (= PCC) (OCT), then a CPU-wide unique, but freely assignable number must be specified. The possible values can be found in the technical specification of the CPU used.
- **“MinPauseSendMs”** (default: 500 ms)
  The minimum pause between 2 send message frames in milliseconds is specified here. This pause time also prevents continuous transmission in the event of active data change monitoring in case of unexpected constant changes.
- **“MaxPauseSendMs”** (default: 1500 ms)
  The maximum pause between 2 send message frames in milliseconds is specified here. This pause time determines how often the data is cyclically transmitted.

Note

Interaction of the transmission rates as an example:

A new “Start” command is detected by change monitoring and transmitted immediately. However, the minimum pause time “MinPauseSendMs” is used to ensure that pauses between the message frames are also observed so as not to block the network.

A current measurement of energy consumption, however, is not monitored for change due to the constant fluctuations. This is transmitted periodically after the maximum pause time “MaxPauseSendMs” has expired.

- “**OPEN_COM.PartnerIP**” (default: 192.168.0.0)
  Specifies the IPv4 address of the partner station when using open TCP communication.
- “**OPEN_COM.PortLineCSide**” / “**OPEN_COM_T.PortLineCSide**” (default: 2200)
  Specifies the TCP port number of the line control when using the open Ethernet TCP communication (OCT).
- “**OPEN_COM.PortMachineSide**” / “**OPEN_COM_T.PortMachineSide**” (default: 2100)
  Specifies the TCP port number of the machine control when using the open Ethernet TCP communication (OCT).
- “**OPEN_COM.HwIdentifier**” (default: 64)
  Specifies the hardware identifier interfaces when using the open Ethernet TCP communication (OCT) (not to be confused with the hardware ID of the single port). A symbolic assignment can also be made using the system variables.
- “**OPEN_COM_T.LocalDeviceId**” (default: 2 corresponds to S7-300 CPU interface)
  Specifies the device ID of the hardware when using the open Ethernet TCP communication (OCT). Reference STEP 7 Online help of the block “FB_TCON” or at https://support.industry.siemens.com/cs/ww/en/view/51339682.
- “**OPEN_COM_SR.LADDR**” (default: 0)
  Specification of the access address of the communication processor when using the open Ethernet TCP communication (OCSR) with send/receive blocks.

- **“S7_COM.SR_PairID_CtM”** (default: 1)
  When using S7 communication, several send/receive blocks can be used over a single communication connection. However, an identical and unique number must be specified at both communication endpoints for this. At this point, the identification number for the transmission from the line control to the machine must be specified.
- “**S7_COM.SR_PairID_MtC**” (default: 2)
  As explained above, when using the S7 communication, an identification number for the transmission from the machine to the line control must be specified here.
- “**ID_COM.FirstInByte**” (default: 0)
  For PROFINET IO communication (IDC), the peripheral start address (number of the 1st byte) is specified for the input range here.
- “**ID_COM.FirstOutByte**” (default: 0)
  For PROFINET IO communication (IDC), the peripheral start address (number of the 1st byte) is specified for the output range here.
- “**ID_CP_COM.LADDR**” (default: 0)
  Specification of the access address of the communication processor when using the open PROFINET IO communication (IDC_CP) via CP.

3.1.2 Diagnostics area

This area contains all the information needed to correct or search for causes of a communication error.

- **“ComSumError”**
  If an error is detected during communication or parameterization, this is also output in binary form. For short-term disconnections such as a restart or the like, no communication error is reported.
- **“Connected”**
  An actively established connection to the remote station is displayed at this data point.
  This is only relevant if the connection is controlled by the user program (= PCC) (OCT), otherwise “True” is always displayed.
- **“ConfigError”**
  The currently detected configuration error is output here (see also 5.4.1):

Table 3-1

Code	Meaning
0	No error
8028	Invalid value for FB parameter "PDI_TYPE"
8032	Interconnection to the buffer of the transmit data is not a valid DB link
8034	Interconnection to the buffer of the received data is not a valid DB link
8036	Interconnection to PDI_Basic is not a valid DB link
8037	Interconnection to PDI_LCU_STAT is not a valid DB link
8038	Interconnection to PDI_LCU_CMD is not a valid DB link
8039	Interconnection to PDI_PARA is not a valid DB link
803A	Interconnection to PDI_PEC is not a valid DB link
803B	Interconnection to PDI_PLANT_STAT is not a valid DB link
803C	Interconnection to PDI_PLANT_CMD is not a valid DB link
8044	Length of the output range for the transmission data is invalid
8045	Length of the input range of the received data is invalid
8046	Length of the temporary data buffer is invalid
8047	Length of the transmit data buffer is invalid
8048	Length of the raw data receive buffer is invalid
8049	Length of sorted receive data buffer is invalid

Code	Meaning
8050	Interconnection to OMAC PDI_Basic has an invalid data length
8051	Interconnection to OMAC PDI_LCU_CMD has an invalid data length
8052	Interconnection to OMAC PDI_LCU_STAT has an invalid data length
8053	Interconnection to OMAC PDI_PARA has an invalid data length
8054	Interconnection to OMAC PDI_PEC has an invalid data length
8055	Interconnection to WS PDI_Basic has an invalid data length
8056	Interconnection to WS PDI_LCU_CMD has an invalid data length
8057	Interconnection to WS PDI_LCU_STAT has an invalid data length
8058	Interconnection to WS PDI_PARA has an invalid data length
8059	Interconnection to WS PDI_PEC has an invalid data length
805A	Length of the temporary data buffer is too small
805B	Length of the transmit data buffer is too small
805C	Length of the raw data receive buffer is too small
805D	Length of the output range for the transmission data is too small
805E	Length of the input range of the received data is too small
805F	Length of sorted receive data buffer is too small
8064	Transmit buffer write pointer has a wrong end position
8065	Receive buffer read pointer has a wrong end position
806F	Invalid configuration for open communication with T functions
8070	Invalid configuration for open communication with S/R functions
8071	Invalid configuration for S7 protocol communication
8072	Invalid configuration for direct PROFINET IO communication
8073	Invalid configuration for PROFINET IO communication with CP
8074	Invalid value for the communication protocol to be used
8079	Length of the received data does not match what is expected
807A	Received data has a difference in length in the header and in the receive block
807B	Received data has an invalid version number in the header (no compatible PCC version)
807C	Received data has an invalid message frame identifier (no PDI message frame received)
807D	Received data has an invalid identifier at the end (no complete message frame received)
8081	Error while copying the data from the send buffer to the output area
8082	Error copying data from the input area to the receive buffer
8083	Error while deserializing the message frame header from the received data
8084	Error while deserializing the PDI_Basic range from the received data
8085	Error while deserializing the PDI_LCU_STAT range from the received data
8086	Error while deserializing the PDI_PARA range from the received data
8087	Error while deserializing the PDI_PEC range from the received data
8088	Error while deserializing the PDI_PLANT_STAT range from the received data
8089	Error while deserializing the PDI_LCU_CMD range from the received data
808A	Error while deserializing the PDI_PLANT_CMD range from the received data
808D	Error while serializing the message frame header for sending
808E	Error while serializing the PDI_Basic range into the buffer
808F	Error while serializing the PDI_LCU_STAT range into the buffer
8090	Error while serializing the PDI_PARA range into the buffer
8091	Error while serializing the PDI_PEC range into the buffer
8092	Error while serializing the PDI_PLANT_STAT range into the buffer
8093	Error while serializing the PDI_LCU_CMD range into the buffer
8094	Error while serializing the PDI_PLANT_CMD range into the buffer

- **“TimeoutError”**
  Errors resulting from a runtime error are output here (see 5.4.2). These errors are determined by transient circumstances and may occur simultaneously as a result of a configuration error.

Table 3-2

Code	Meaning
0	No error
8101	Time-out when connecting to the partner station -> Repeat after a pause
8102	Time-out when sending the data to the partner station -> New connection after pause
8103	Time-out when disconnecting
810E	Undefined step number of the communication process
8119	No change of the received data within a period (= runtime monitoring)

- **LastErrorConnect, LastErrorDisconnect, LastErrorSend and LastErrorReceive**
  Status of the last called block for the communication. The value is deleted after a successful repetition of the operation. The evaluation of the status code can be looked up in the online help of the communication block used in “FB_PCC_SUB_CALL”.

Note

Example of “LastErrorConnect” = 80C4 with use of the open TCP communication:
→ "The connection cannot be established at the moment"

- **“UsedComType”**
  This data point is described by the "FB_PCC_SUB_CALL" block used and indicates the communication type.

Table 3-3

	Communication type
1.	Open communication with T-blocks (OCT)
2.	Open communication with send/receive blocks (OCSR)
3.	S7 communication (S7C)
4.	PROFINET IO communication with direct IO access (IDC)
5.	PROFINET IO communication with transfer blocks for CP (IDC_CP)

- **“ComPhase”**
  Communication phase in the following subdivisions:

Table 3-4

	Communication phase
1.	Standstill or reset of the communication
2.	Evaluation of the block interconnection
3.	Editing of the transmission data
4.	Transmission data review
5.	Checking the request to send the data
6.	Preparation for establishing a connection

	Communication phase
7.	Waiting for successful connection
8.	Sending of data
9.	Pause after sending the data
10.	Preparation for terminating a connection
11.	Waiting for successful connection

- **“CountConnect”**
  Counter of the attempts to establish a communication connection. If the connection is not controlled by the user program (= PCC) (OCT), this value has no meaning.
- **CountSent**
  Counter of the successfully sent message frames.

Note A successfully sent message frame does not necessarily mean that it has been accepted on the other side.

- **“CountReceived”**
  Counter of the successfully received message frames.
- **“CountByteToSend”**
  Specifies the number of bytes that are sent depending on the PDI interconnection and configuration (OMAC or Weihenstephan).
  The send buffers and, in the case of PROFINET IO communication, the I-device range to be transferred must be adapted according to this value.
- **“CountByteToReceive”**
  Specifies the number of bytes received, depending on the PDI interconnection and configuration (OMAC or Weihenstephan).
  The receive buffers and, in the case of PROFINET IO communication, the I-device range to be received must be adapted according to this value.

3.1.3 “SUB_CALL_INTERFACE” range

In this range, all necessary information is exchanged between the generic communication block "FB_PCC_MAIN" and the protocol and hardware-specific part "FB_PCC_SUB_CALL".

To ensure error-free communication, this data must not be affected.

The identifiers are based on the identifiers of the communication modules that are primarily used. If a special communication block is required, the meaning of the connections can be looked up in the online help of the communication blocks used in "FB_PCC_SUB_CALL".

3.1.4 “BUFFER_SEND_DATA” range

This buffer contained the complete transmission message frame at the time of transmission. To save storage space, the size can be adapted to the actual extent required.

The required length is calculated at runtime, depending on the configuration and wiring, and output in the diagnostics area under "DB_PCC" .PCC.CONFIG_DIAG.DIAG.CountByteToSend.

You can also determine the required length yourself (see 2.6).

Example for the machine side including reserves: Array [1..450] of bytes

3.1.5 “BUFFER_TEMP_DATA” range

This buffer is needed to prepare the send data. To save storage space, the size can be adapted to that of the send data buffer "BUFFER_SEND_DATA”.

Example for the machine side including reserves: Array [1..450] of bytes

3.1.6 “BUFFER_RCV_DATA” range

This buffer contains the received message frame raw data after confirmation by the receive block. Depending on the size of the PDI, the message frame can be received divided into several parts.

The required length is calculated at runtime, depending on the configuration and wiring, and output in the diagnostics area under "DB_PCC".PCC.CONFIG_DIAG.DIAG.CountByteToReceive.
You can also determine the required length yourself (see 2.6).

Example for the machine side including reserves: Array[1..100] of bytes

3.1.7 “BUFFER_RCV_SORTED” range

This buffer contains the complete receive message frame at the end of the message frame reception. To save memory space, the size of the receive data buffer "BUFFER_RCV_DATA" can be adjusted.

Example for the machine side including reserves: Array [1..100] of bytes

3.2 “FB_PCC_MAIN” block

This block is the heart of the communication. It copies the data and controls the communication for a PDI instance. The communication connection is monitored and possibly also controlled depending on the protocol.

Interconnection of the block:

- **CallCycle** (integer as input)
  For correct time processing, this input must be assigned with the call interval in milliseconds. This corresponds to the pause between 2 calls. For a cyclic call in OB1, the input must be interconnected with "OB1_PREV_CYCLE" from the temporary data area of the OB.
  For S7-1200 / 1500, this time is determined in the block itself, but this was not implemented in the S7-300 / 400 for performance reasons.
- **COM_ERROR** (binary output)
  If an error is detected during communication or parameterization, this is also output in binary form.
  For message frame repeats and temporary disconnections as restart or the

like, no communication error is reported. This error message can therefore also be reported as an alarm to a visualization, since it is actually a longer-lasting interruption.
No acknowledgment of this message is required.

- **EDG_NDR** (binary output)
  For each successfully received message frame, a signal for evaluating the data is output for the length of one program cycle.
- **CONFIG_DIAG** (structure as “InOut” link)
  Interconnection to the "UDT_PCC.CONFIG_DIAG" data structure with the configuration and diagnostics data
- **SUB_CALL_INTERFACE** (structure as “InOut” link)
  Interconnection to the data structure "UDT_PCC.SUB_CALL_INTERFACE" for internal data connection to "FB_PCC_SUB_CALL"
- **BUFFER_SEND_DATA, BUFFER_RCV_DATA, BUFFER_TEMP_DATA and BUFFER_RCV_SORTED** (one array as “InOut” link for each)
  Interconnection to the respective buffers of the data structure "UDT_PCC"
- **PDI_BASIC, PDI_LCU_CMD, PDI_LCU_STAT, PDI_PARA and PDI_PEC** (one variant as “InOut” link for each)
  Interconnection to the respective PDI areas.
  If a PDI area is not used or needed, it must not be connected (in STEP 7 V14 it must be assigned "NULL"). The interconnection must be identical for both communication partners. After changing the interconnection, with STEP 7 V5.5 it may be necessary to reload or initialize the instance DB of the call block.
- **PDI_PLANT_CMD** (variant as “InOut” link)
  Any data range, which is to be transferred system-specifically from the line control to the machine, as a structure. For further interconnection instructions see 5.1.1.
- **PDI_PLANT_STAT** (variant as “InOut” link)
  Any data range, which is to be transferred system-specifically from the machine to the line control, as a structure. For further interconnection instructions see 5.1.1.

3.3 Block “FB_PCC_SUB_CALL”

The "FB_PCC_SUB_CALL" block is used to transfer the send and receive buffers to the respective communication blocks. These differ depending on the protocol and the modules used. It may therefore happen that these blocks are not identical on the send and receive sides.

Depending on the selected variant, it may be necessary to parameterize a communication connection which defines the connection between the line control and the machine. See 5.2.

Depending on the STEP 7 version used, the following interconnections are implemented directly or via the "InOut" link:

1. Range of send data from the data structure "UDT_PCC" .BUFFER_SEND_DATA
2. Range of receive data in the data structure "UDT_PCC" .BUFFER_RCV_DATA
3. Range of the internal handshake with "FB_PCC_MAIN" via the data structure "UDT_PCC". SUB_CALL_INTERFACE

The following variants of the block are included:

3.3.1 Open Ethernet TCP communication with T-blocks (OCT)

This block exchanges the PDI data with the partner over a TCP connection. The parameterization and handling of the communication connection are handled exclusively in the user program. It is thus possible to set all the necessary parameters at a local operating option. The communication can be set in operation without a programming device or software.

The T-blocks used can be used with and without parameterized connections. However, the "FB_PCC_SUB_CALL" block included with PCC only works without parameterized connections.

Note For S7-300/400 and related controllers, use is only possible with the CPU-integrated Ethernet interface.

Internally, the following system blocks are called:

- FB_TSEND - Sending the data to the communication partner
- FB_TRCV - Receipt of the data from the communication partner
- FB_TCON - Establishing a connection
- FB_TDISCON - Connection termination

Necessary parameterization (see "UDT_PCC" - configuration area):

1. Ipv4 address of the communication partner
2. TCP port of the communication partner
3. TCP Port of your own side

3.3.2 Open Ethernet TCP communication with send/receive modules (OCSR)

This block exchanges the PDI data with the partner via an Ethernet CP using a parameterized TCP connection.

Use

This variant was integrated for S7-300/400 and related controllers for use of an additional communications processor (CP).

Internally, the following system blocks are called (differentiating according to control series):

Table 3-5

Block	Function
FC_AG_SEND/FC_AG_LSEND	Sending the data to the communication partner
FC_AG_RECV/FC_AG_LRECV	Receipt of the data from the communication partner

Establishment of a TCP connection under NetPro or device configuration> connections

1. Ipv4 address of the communication partner
2. TCP port of the communication partner

3. TCP Port of your own side
4. Active connection always on the part of the line control

3.3.3 S7 communication (S7C)

This block exchanges the PDI data with other Siemens "S7 family" devices.

Use

This variant was implemented because of its particular reliability as well as its flexibility. (S7 communication supports connections via PN/IE, PB and MPI.)

Internally, the following system blocks are called (differentiating according to control series):

Table 3-6

Block	Function
FB_BSEND/SFB_BSEND	Sending the data to the communication partner
FB_BRCV/SFB_BRCV	Receipt of the data from the communication partner

Establishment of an S7 connection under NetPro or device configuration> connections

1. Ipv4 address of the communication partner
2. TSAP ID of the communication partner
3. TSAP ID of your own side
4. Synchronization S7 subnet ID
5. Active connection (is always done by the line control)

3.3.4 PROFINET IO communication with direct IO access (IDC)

This block exchanges the PDI data via cyclic PROFINET IO communication. In this case, the line control of the IO controller and the machine is the I-device.

Note All network components (switches, etc.) must support PROFINET IO.

Use

This variant was chosen because of the particularly fast communication as well as the resource-saving implementation in the user program. The configured PROFINET IO range must be in the active process image of the controller.

Internally, the following system blocks are called:

Table 3-7

Block	Function
SFC_BLKMOV	Copying of the data into the process image of the controller

Required parameter assignment

The machine must export a GSD file, which is used for integration in the line control, from the hardware configuration.

3.3.5 PROFINET IO communication with transfer blocks for CP (IDC_CP)

This block exchanges the PDI data with a CP, which in turn exchanges it with the partner via cyclic PROFINET IO communication. In this case, the line control of the IO controller and the machine is the I-device.

Note All network components (switches, etc.) must support PROFINET IO.

Use

This variant was integrated for S7-300 for the use of an additional communication processor (CP) 343-1 Lean.

Internally, the following system blocks are called:

Table 3-8

Block	Function
FC_PNIO_SEND	Transfer of the data to the CP
Transfer of the data to the CP	Receipt of the data from the CP

Required parameter assignment

The machine must export a GSD file, which is used for integration in the line control, from the hardware configuration.

3.4 “FB_PCC_MAIN_CALL” block

This block is used as a template for the configuration and multi-instance call of the PCC program components for the transmission of a PDI interface. It must be called more often by the line control according to the number of PDI instances.

It can be called directly in the cyclic program (OB1) and contains a commented sample for the parameterization. For the respective use, unnecessary parameters (e.g. parameters of other protocols) can be marked as a comment or deleted.

Connection Description for „COM_ERROR“, „EDG_NDR“ as well as „CallCycle“ reference „FB_PCC_MAIN“.

The block is structured by regions into:

Configuration (copy template corresponds to OCT communication)

- **Control**
  Describes the data points for controlling the communication.
- **Use**
  Determines the basic usage. The template is used by the machine with OMAC V2 PDI interface.
- Parameters **of connection-based protocols (OCT, OCSR and S7C)**
  Parameters for the timing of the transmission, as well as the connection identifier.
- **“Open Ethernet TCP communication with T-blocks** (OCT)” parameters
  - Specification of the partner Ethernet IPv4 address
  - Specification of the local and remote TCP port number
  - Setting the hardware interface In STEP 7 TIA, the system variable for the symbolic hardware identifier can also be used here.
- **“Open communication with send/receive blocks** (OCSR)” parameter
  Specification of the hardware address of the communication processor (CP)
- Parameter “**S7 communication** (S7C)”
  S7 protocol-typical parameters for the block handshake.
- **“PROFINET IO communication with direct IO access** (IDC)” parameter
  - STEP 7 V5.5: Periphery start addresses for input and output range set.
  - STEP 7 V14: Symbolic transfer of the range at the "FB_PCC_SUB_CALL" call.
- **“PROFINET IO communication with transfer blocks for CP** (IDC_CP)” parameter
  Specification of the hardware address of the communication processor (CP) that serves as an I device.

Calling communication functions

Here, "FB_PCC_MAIN" and "FB_PCC_SUB_CALL" are called as a multi-instance.

- The interconnection of the PDI interface area must be adapted to the usage.
- For STEP 7 V14, the periphery area for the PROFINET IO input/output areas is symbolically transferred at the "FB_PCC_SUB_CALL" call.

4 Application in the project:

As an alternative to using the blocks of the respective library, program parts from the configuration sample can also be copied.

Plant data Interface (PDI Library)

1. Open the library or integrate it into the project (see online documentation of the respective STEP 7 version).
2. Depending on the standard used, you transfer the required PDI groups "BASIC", "LCU", "PARA" and "PEC" as data types (UDT) to the project library or project .
3. Transfer the plant-specific data type "**UDT_PDI"** from the template to the project and adapt the PDI group usage and the plant-specific area according to the current project.
4. Integrate the "UDT_PDI" in a data block or in this case transfer the copy template "**DB_PDI"** to the project.
5. Optionally, the observation template "**VAT_PDI"** can also be transferred to the project and adapted to its use.

Plant communication (PCC Library)

1. Open the library or integrate it into the project (see online documentation of the respective STEP 7 version).
2. Depending on the requirements, configure a **connection or the hardware** for the protocol used (see the documentation for the individual protocols in chapter 3.3).
3. Transfer the data type "**UDT_PCC"** to the project library or project.
4. Apply the protocol as well as the hardware- specific "**FB_PCC_SUB_CALL"** to the project. (Optionally also available as AWL source in STEP 7 V5.5.)
5. Apply the hardware-specific block "**FB_PCC_MAIN"** to the project.
6. Integrate the “UDT_PCC" in a data block or in this case transfer the finished copy template **“DB_PCC"** to the project.
7. Create the call block in which the two blocks "FB_PCC_MAIN" and "FB_PCC_SUB_CALL" are called. Alternatively, a finished copy template "**FB_PCC_MAIN_CALL"** can be added to the project. (Optionally also available as AWL source in STEP 7 V5.5.)
8. Make sure that the **configuration area in the DB (UDT_PCC)** is preassigned as required or is described during startup or cyclically.
9. Make sure that the project-specific use of the **PDI interface** also corresponds to the **interconnection on the "FB_PCC_MAIN"** call.
10. Optionally, the observation template **“VAT_PCC"** can also be transferred to the project and adapted to its use.

5 Configuration sample

5.1.1 Data interface (PDI)

Just like in a real project, first of all the PDI usage must be defined. The basis for this is the customer request, which represents the information content.

The structure can also differentiate for each machine. The plant-specific part should be defined by means of a UDT, which is integrated into the respective projects.

Table 5-1

Library	Length (bytes)		Project	Length (bytes)	
	M to LC	LC to M		M to LC	LC to M
WS_V2_BASIC	88				
WS_V2_LCU	44	24			
VS_V2_PARA	140				
WS_V2_PEC	124				
OMAC_V2_Basic	88		OMAC_Basic	88	
OMAC_V2_LCU	40	18	OMAC_LCU	40	18
OMAC_V2_PARA	142				
OMAC_V2_PEC	124		OMAC_PEC	124	
PLANT_SPEC	?	?	PLANT_SPEC	4	4
Longer user data				256	22
Message frame length				265	31

5.1.2 Communication (PCC)

The following information must be exchanged to set up the communication:

1. Plant-specific network (example: Usable areas, address of the machine, NTP server, remote maintenance addresses, ...)

- When using open TCP communication (OCT and OCSR):
  a. Ipv4 address of the partner
  b. TCP port of machine and line control
- When using the S7 communication (S7C):
  a. Ethernet Subnet ID
  b. TSAP port of machine and line control
  c. Message frame Identification (ID) of the blocks for the communication from machine to line control and vice versa
- When using PROFINET IO communication (IDC and IDC_CP):
  a. Unique assignment of PROFINET names
  b. Transfer of the GSD file from the machine manufacturer to the line integrator

Machine side												Both sides			Line controller side						
Station	Step 7	Hardware Interface	Conn.ID Hex (W#16#...)	IPv4 Address	Port	TSAP	HW ID / LADDR / Device ID	PROFINET Name	GSD File	IN Address Range	OUT Address Range	Ethernet Subnet ID	Com ID LC to M	Com ID M to LC	IPv4 Address	Conn.ID Hex (W#16#...)	Port	TSAP	HW ID / LADDR / Device ID	IN Address Range	OUT Address Range
NTP Server															192.168.001.199						
M11 S71200 OCT	V14	CPU	500	192.168.001.011	2100		64								192.168.001.010	511	2211		64		
M12 S71200 IDC	V14	CPU		192.168.001.012				PN-IO-MA12	x	256-305	256-555				192.168.001.010					0-264	0-30
M13 S71500 OCT	V14	CPU	500	192.168.001.013	2100		64								192.168.001.010	513	2213		64		
M14 S71500 S7C	V14	CP	500	192.168.001.014		ACC						A320-0001	1	2	192.168.001.010	514		ACC			
M15 S71500 IDC	V14	CPU		192.168.001.015				PN-IO-MA15	x	256-305	256-555				192.168.001.010					265-529	31-61
M16 S71200 SIDC	V14	CPU	500	192.168.001.016				PN-IO-MA15	x	256-305	256-555				192.168.001.010					530-794	62-92
M17 S71500 OCT	V14	CM	500	192.168.001.017	2100		259								192.168.001.010	517	2217		64		
M18 S71500 OCT	V14	CP	500	192.168.001.018	2100		259								192.168.001.010	518	2218		64		
M21 S7300 OCT	V14	CPU	5	192.168.001.021	2100		2								192.168.001.010	521	2221		64		
M22 S7300 OCSR	V14	CP Lean	5	192.168.001.022	2100		256								192.168.001.010	522	2222		64		
M23 S7300 S7C	V14	CPU	5	192.168.001.023		10.02						A320-0001	1	2	192.168.001.010	523		23.01			
M24 S7300 IDC	V14	CPU		192.168.001.024				PN-IO-MA24	x	256-305	256-555				192.168.001.010					795-1059	93-123
M25 S7300 IDC CP	V14	CP Lean		192.168.001.025			256	PN-IO-MA25	x	0-49	0-299				192.168.001.010					1060-1324	124-154
M26 S7400 OCSR	V14	CP	5	192.168.001.026	2100		8189								192.168.001.010	526	2226		64		
M27 S7400 S7C	V14	CP	5	192.168.001.027		10.02						A320-0001	1	2	192.168.001.010	527		27.01			
M28 S7300 SIDC	V14	CPU		192.168.001.028				PN-IO-MA28	x	256-305	256-555				192.168.001.010					1325-1589	155-185
M31 S7300 OCT	V5.5	CPU	5	192.168.001.031	2100		2								192.168.001.010	531	2231		64		
M32 S7300 OCSR	V5.5	CP Lean	5	192.168.001.032	2100		256								192.168.001.010	532	2232		64		
M33 S7300 S7C	V5.5	CPU	5	192.168.001.033		10.02						A320-0001	1	2	192.168.001.010	533		33.01			
M34 S7300 IDC	V5.5	CPU		192.168.001.034				PN-IO-MA34	x	256-305	256-555				192.168.001.010					1590-1854	186-216
M35 S7300 IDC CP	V5.5	CP Lean		192.168.001.035			256	PN-IO-MA35	x	0-49	0-299				192.168.001.010					1855-2119	217-247
M36 S7400 OCSR	V5.5	CP	5	192.168.001.036	2100		8189								192.168.001.010	536	2236		64		
M37 S7400 S7C	V5.5	CP	5	192.168.001.037		10.02						A320-0001	1	2	192.168.001.010	537		37.01			
M38 S7300 SIDC	V5.5	CPU		192.168.001.038				PN-IO-MA38	x	256-305	256-555				192.168.001.010					2120-2384	248-278

Key:

Colored information must be agreed on between the communication partners.

5.1.3 Parameter assignment

As part of the application sample, you download two projects for STEP 7 V5.5 or STEP 7 (TIA Portal) V14.

The CPUs are configured in three groups:

Table 5-2

Machine	CPU family	Configuring
11-18	S7-1200/1500	STEP 7 (TIA Portal) V14
21-28	S7-300/400	STEP 7 (TIA Portal) V14
31-38	S7-300/400	STEP 7 V5.5:

STEP 7 (TIA Portal)-Project

Table 5-3

Machine	CPU	Interface[1]	Communication
11	S7-1200	PROFINET (integrated)	TCP with T-blocks (OCT)
12	S7-1200	PROFINET (integrated)	I-device with direct IO access (IDC)
13	S7-1500	PROFINET (integrated)	TCP with T-blocks (OCT)
14	S7-1500	CP	S7 communication (S7C) and parameterized connection[2]
15	S7-1500	PROFINET (integrated)	I-device with direct IO access (IDC)
16	S7-1200	PROFINET (integrated)	Resource-optimized I-device with direct IO access (SIDC)[3]
17	S7-1500	CM	TCP with T-blocks (OCT)
18	S7-1500	CP	TCP with T-blocks (OCT)
21	S7-300	PROFINET (integrated)	TCP with T-blocks (OCT)
22	S7-300	CP343-1 Lean	TCP communication with send/receive modules (OCSR) and parameterized connection
23	S7-300	PROFINET (integrated)	S7 communication (S7C) and parameterized connection
24	S7-300	PROFINET (integrated)	I-device with direct IO access (IDC)
25	S7-300	CP343-1 Lean	I-device with transfer blocks for CP (IDC_CP)
26	S7-400	CP	TCP communication with send/receive modules (OCSR) and parameterized connection
27	S7-400	CP	S7 communication (S7C) and parameterized connection
28	S7-300	PROFINET (integrated)	Resource-optimized I-device with direct IO access (SIDC)[4]

[1] CP = communication processor, CM = communication module

[2] Automatic determination of TSAP addresses using SIMATIC-ACC (SIMATIC Application Controlled Communication)

[3] Uses optimized blocks, which are only available for I-device communication on the machine side

[4] Uses optimized blocks, which are only available for I-device communication on the machine side

STEP 7 V5.5-Project

Table 5-4

Machine	CPU	Interface[5]	Communication
31	S7-300	PROFINET (integrated)	TCP with T-blocks (OCT)
32	S7-300	CP343-1 Lean	TCP communication with send/receive modules (OCSR) and parameterized connection
33	S7-300	PROFINET (integrated)	S7 communication (S7C) and parameterized connection
34	S7-300	PROFINET (integrated)	I-device with direct IO access (IDC)
35	S7-300	CP343-1 Lean	I-device with transfer blocks for CP (IDC_CP)
36	S7-400	CP	TCP communication with send/receive modules (OCSR) and parameterized connection
37	S7-400	CP	S7 communication (S7C) and parameterized connection
38	S7-300	PROFINET (integrated)	Resource-optimized I-device with direct IO access (SIDC)[6]

Comparison of the configured machines

The machines 22-28 and 32-38 correspond to each other largely up to the used STEP 7 version and the type of communication connection:

Table 5-5

Machine	Connection	Machine	Connection
22	TCP specified	32	TCP unspecified
23	S7 specified	33	S7 unspecified
24	Project-internal PROFINET IO coupling	34	I-Device via GSD
25	Project-internal PROFINET IO coupling	35	I-Device via GSD
26	TCP specified	36	TCP unspecified
27	S7 specified	37	S7 unspecified
28	Project-internal PROFINET IO coupling	38	I-Device via GSD

5.2 Configuration of the connections

5.2.1 Creating a TCP connection

Requirements

- Configured modules (e.g.: Rack, CPU, CP,…)
- Configuration of the Ethernet interface (e.g.: Subnet, IP address, subnet mask, router, ...)

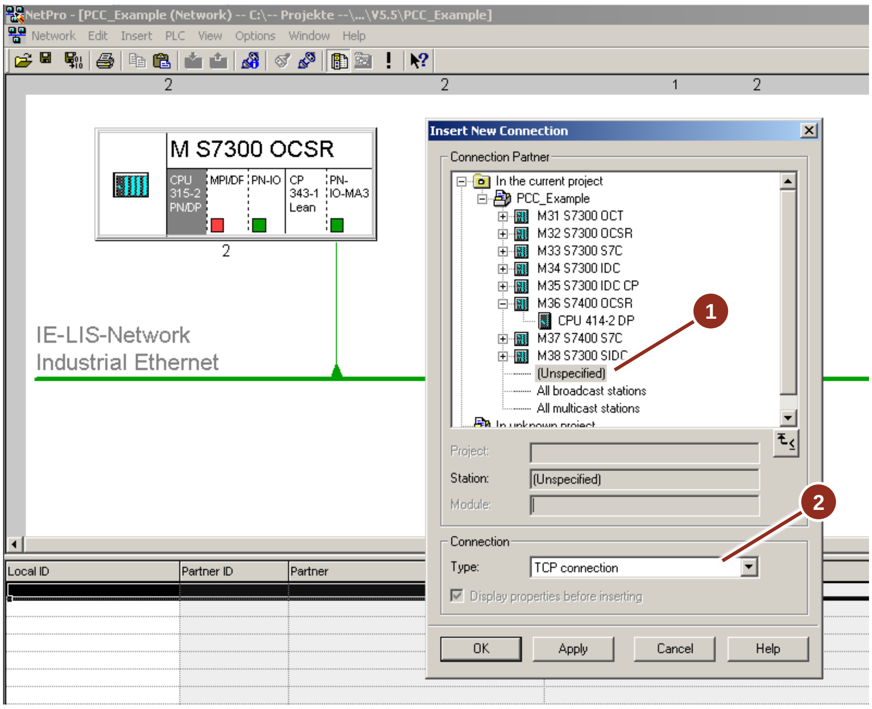
[5] CP = communication processor, CM = communication module

[6] Uses optimized blocks, which are only available for I-device communication on the machine side

Creating a TCP connection with STEP 7 V5.5

1. Open "NetPro" by selecting the network and "Open object (Ctrl + Alt + O)".
2. Select the CPU module of the station.
3. In the context menu, select "Insert new connection (Ctrl-N)"

Figure 5-1



Project:

Station: (Unspecified)

Module:

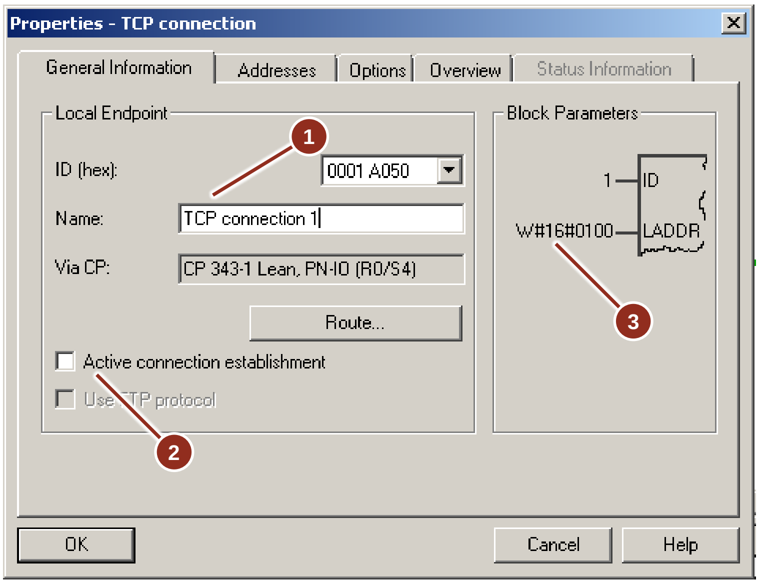
Connection

Type: TCP connection

☑ Display properties before inserting

4. In the dialog that opens, select "unspecified" if the control program of the partner controller is in another project (**1**).
5. Set the type of connection to "TCP connection" (**2**) and confirm with OK.

Figure 5-2



Local Endpoint

ID (hex): 0001 A050

Name: TCP connection 1

Via CP: CP 343-1 Lean, PN-IO (R0/S4)

□ Active connection establishment

□ Use FTP protocol

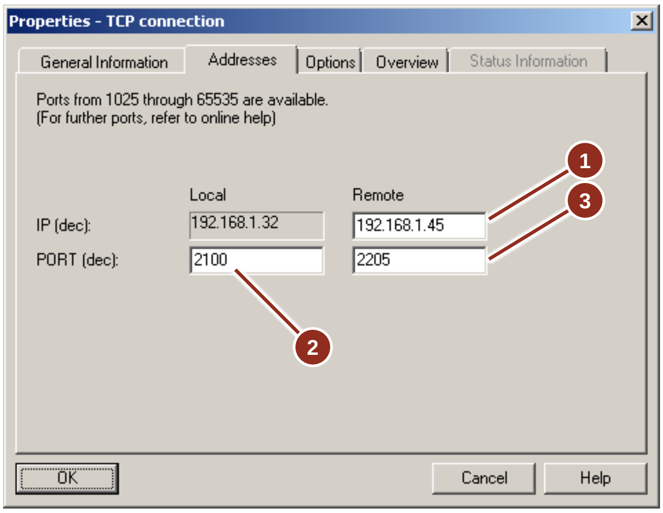
Block Parameters

1 — ID

W#16#0100 — LADDR

6. Enter a connection name (**1**) and select a free ID.
7. Put a checkmark next to "Check active connection setup" (**2**).[7]
8. Note the connection ID and LADDR (**3**). These must be specified later in the user program.

Fig. 5-3



Ports from 1025 through 65535 are available.
(For further ports, refer to online help)

	Local	Remote
IP (dec):	192.168.1.32	192.168.1.45
PORT (dec):	2100	2205

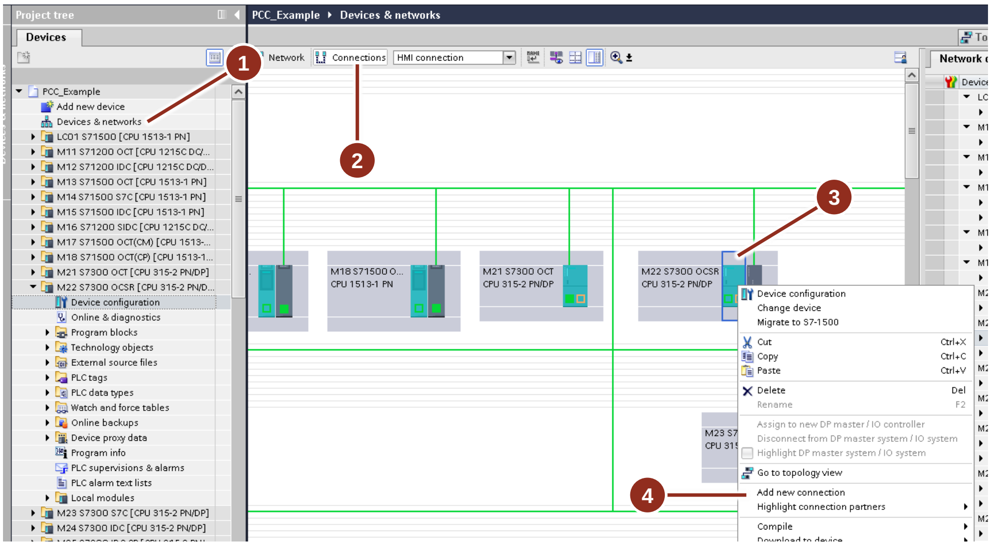
9. Enter the IPv4 address of the communication partner in the "Addresses" tab (**1**).
10. Enter your own (local) TCP port (**2**).
11. Enter the partner (remote) TCP port (**3**).

Creating a TCP connection with STEP 7 V14

1. Open "Devices & Networks" by double-clicking on the entry in the project tree (**1**).

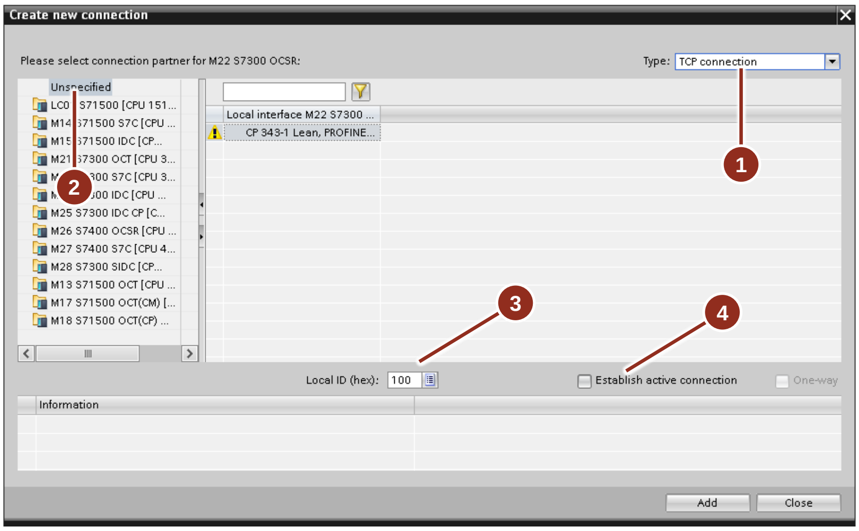
[7] For PCC, the endpoint of the line control is always the active participant

Figure 5-4


Project tree
Devices
PCC_Example ▸ Devices & networks
Network
Connections
HMI connection
PCC_Example
Add new device
Devices & networks
LC01 S71500 [CPU 1513-1 PN]
M11 S71200 OCT [CPU 1215C DC/...
M12 S71200 IDC [CPU 1215C DC/D...
M13 S71500 OCT [CPU 1513-1 PN]
M14 S71500 S7C [CPU 1513-1 PN]
M15 S71500 IDC [CPU 1513-1 PN]
M16 S71200 SIDC [CPU 1215C DC/...
M17 S71500 OCT(CM) [CPU 1513-...
M18 S71500 OCT(CP) [CPU 1513-1...
M21 S7300 OCT [CPU 315-2 PN/DP]
M22 S7300 OCSR [CPU 315-2 PN/D...
Device configuration
Online & diagnostics
Program blocks
Technology objects
External source files
PLC tags
PLC data types
Watch and force tables
Online backups
Device proxy data
Program info
PLC supervisions & alarms
PLC alarm text lists
Local modules
M23 S7300 S7C [CPU 315-2 PN/DP]
M24 S7300 IDC [CPU 315-2 PN/DP]
M18 S71500 O... CPU 1513-1 PN
M21 S7300 OCT CPU 315-2 PN/DP
M22 S7300 OCSR CPU 315-2 PN/DP
M23 S7 CPU 315
Device configuration
Change device
Migrate to S7-1500
Cut Ctrl+X
Copy Ctrl+C
Paste Ctrl+V
Delete Del
Rename F2
Assign to new DP master / IO controller
Disconnect from DP master system / IO system
Highlight DP master system / IO system
Go to topology view
Add new connection
Highlight connection partners
Compile
Download to device
1
2
3
4

2. Select the representation of the “connections" (**2**).
3. Select the CPU module of the station (**3**).
4. Select "Add new connection" from the context menu (**4**).

Figure 5-5



Please select connection partner for M22 S7300 OCSR:

Type: TCP connection

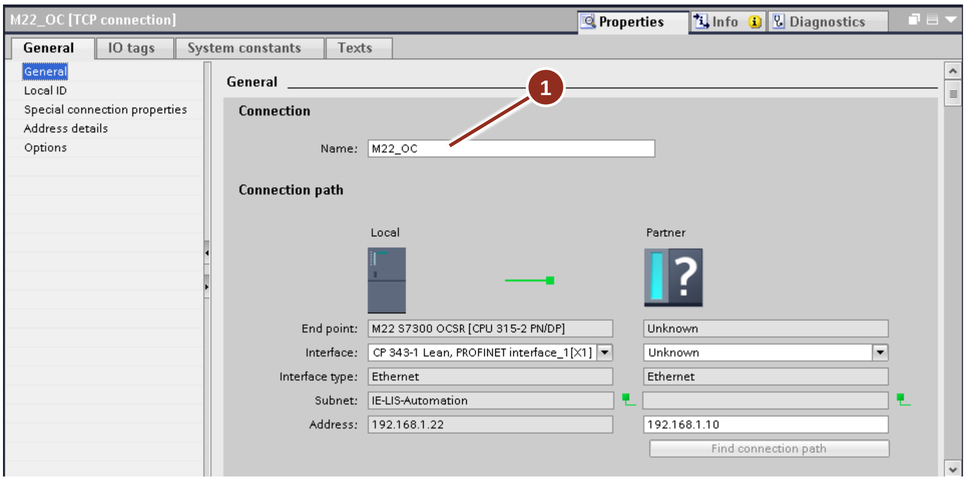
Local ID (hex): 100

☐ Establish active connection

5. Select "TCP Connection" as the connection type (**1**).
6. Select "unspecified" if the control program of the partner controller is located in another project (**2**).
7. Select a free connection ID (**3**).
8. Put a checkmark next to Check active connection setup (**4**).[8]
9. Confirm the creation of the new connection.

[8] For PCC, the endpoint of the line control is always the active participant

Figure 5-6



General

Connection

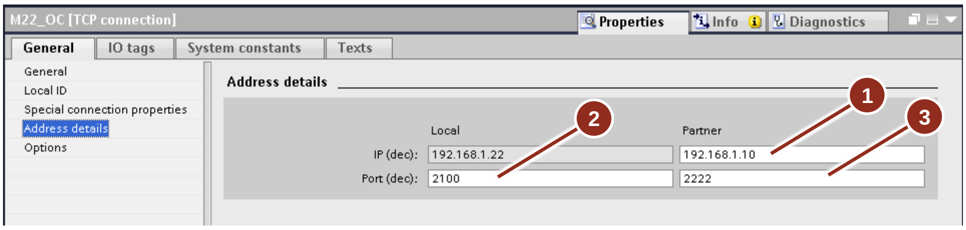
Name: M22_OC

Connection path

	Local	Partner
End point:	M22 S7300 OCSR [CPU 315-2 PN/DP]	Unknown
Interface:	CP 343-1 Lean, PROFINET interface_1[X1]	Unknown
Interface type:	Ethernet	Ethernet
Subnet:	IE-LIS-Automation	
Address:	192.168.1.22	192.168.1.10

10. Enter a connection name of your choice (**1**).

Figure 5-7

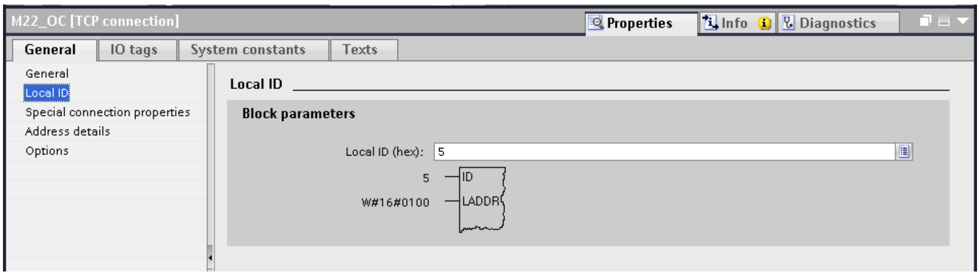


Address details

	Local	Partner
IP (dec):	192.168.1.22	192.168.1.10
Port (dec):	2100	2222

11. Enter the Ipv4 address of the partner (**1**)-
12. Enter your own (local) TCP port (**2**).
13. Enter the partner (remote) TCP port (**3**).

Figure 5-8



Local ID

Block parameters

Local ID (hex): 5

14. Note the connection ID and LADDR. These must be specified later in the user program.

5.2.2 Create S7 connection

Requirements

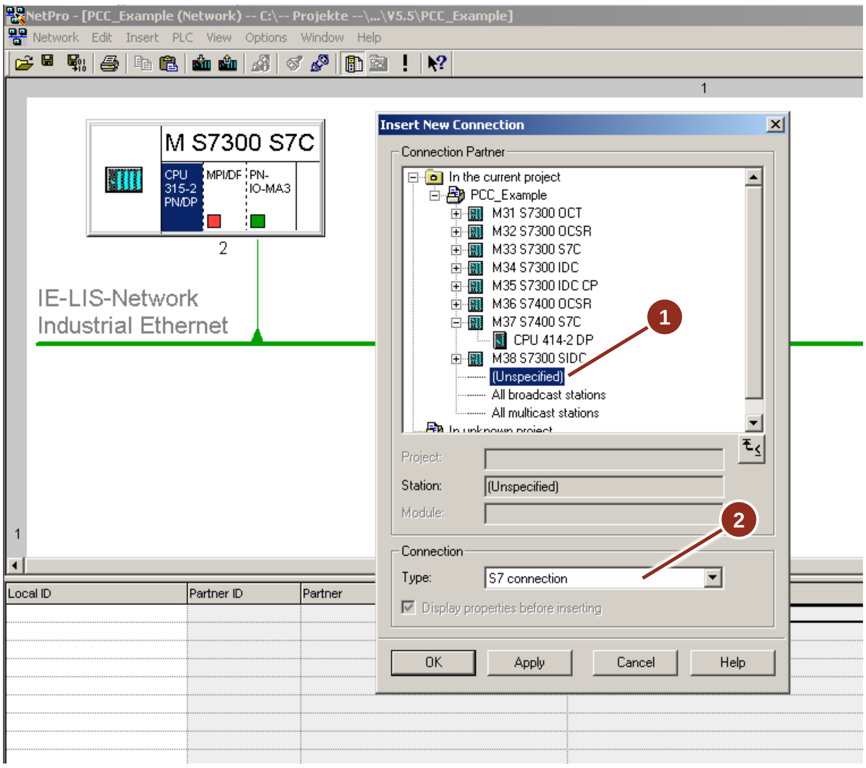
- Configured modules (e.g.: Rack, CPU, CP,…)
- Configuration of the Ethernet interface (e.g.: Subnet, IP address, subnet mask, router, ...)

Creating an S7 connection with STEP 7 V5.5

1. Open "NetPro" by selecting the network and "Open object (Ctrl + Alt + O)".
2. Select the CPU module of the station.

3. Select "Insert new connection (Ctrl-N)" from the context menu.

Figure 5-9


NetPro - [PCC_Example (Network) -- C:\-- Projekte --\...\V5.5\PCC_Example]
Network Edit Insert PLC View Options Window Help
1
M S7300 S7C
CPU 315-2 PN/DP
MPI/DP
PN-IO-MA3
2
IE-LIS-Network
Industrial Ethernet
1
Local ID
Partner ID
Partner
1
2

Insert New Connection

Connection Partner

- In the current project
  - PCC_Example
    - M31 S7300 OCT
    - M32 S7300 OCSR
    - M33 S7300 S7C
    - M34 S7300 IDC
    - M35 S7300 IDC CP
    - M36 S7400 OCSR
    - M37 S7400 S7C
      - CPU 414-2 DP
    - M38 S7300 SIDC
    - (Unspecified)
    - All broadcast stations
    - All multicast stations
- In unknown project

Project:

Station: (Unspecified)

Module:

Connection

Type: S7 connection

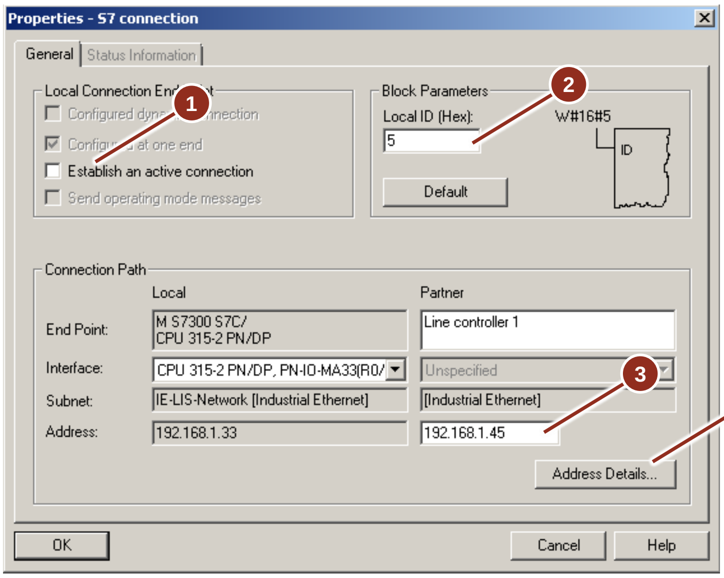
☑ Display properties before inserting

OK Apply Cancel Help

4. In the dialog that opens, select "unspecified" if the control program of the partner controller is in another project (**1**).

5. Set the type of connection to “S7 connection” (**2**) and confirm with OK.

Figure 5-10



Properties - S7 connection

General | Status Information

Local Connection Endpoint

□ Configured dynamic connection

☑ Configured at one end

□ Establish an active connection

□ Send operating mode messages

Block Parameters

Local ID (Hex): 5

Default

Connection Path

	Local	Partner
End Point:	M S7300 S7C/ CPU 315-2 PN/DP	Line controller 1
Interface:	CPU 315-2 PN/DP, PN-IO-MA33(R0/	Unspecified
Subnet:	IE-LIS-Network [Industrial Ethernet]	[Industrial Ethernet]
Address:	192.168.1.33	192.168.1.45

Address Details...

OK Cancel Help

6. Put a checkmark next to "Check active connection setup" (**1**).[9]

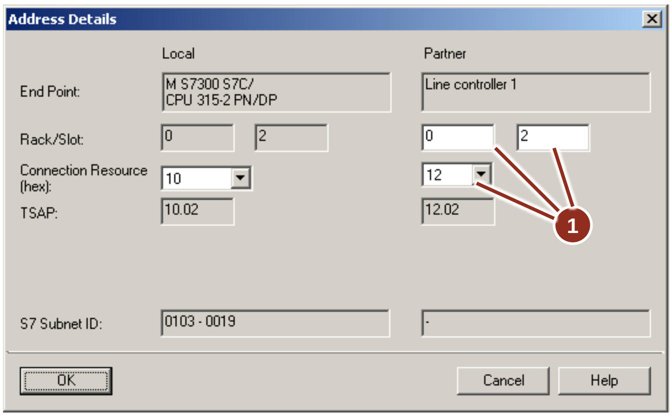
7. Enter a free connection ID (**2**).

8. Enter the Ipv4 address of the partner (**3**).

[9] For PCC, the endpoint of the line control is always the active participant

9. Open the address-detail dialog (**4**).

Figure 5-11

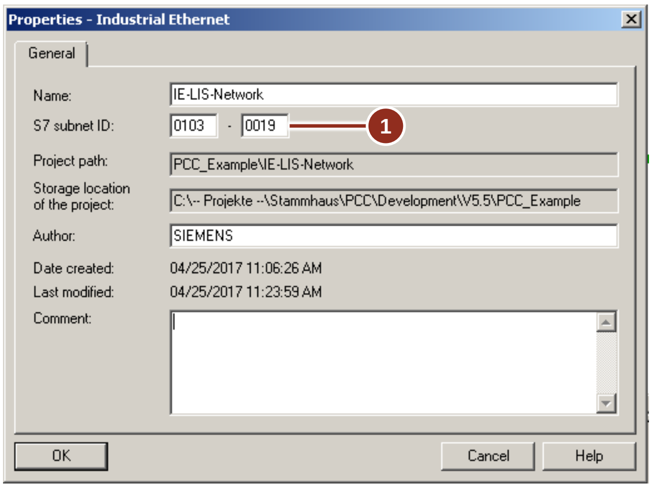


Address Details

	Local		Partner	
End Point:	M S7300 S7C/ CPU 315-2 PN/DP		Line controller 1	
Rack/Slot:	0	2	0	2
Connection Resource (hex):	10		12	
TSAP:	10.02		12.02	
S7 Subnet ID:	0103 - 0019		-	

10. Determine the TSAP (Transport Service Access Point) ID by specifying free connection resources and the rack and slot of the CPU module (**1**).
For S7 connections, the network subnet ID (Fig. 5-12, **1**) must be set identically in the project of both communication partners. This can be controlled in the dialog of the connection or set in the properties of the IE network.

Fig. 5-12



Properties - Industrial Ethernet

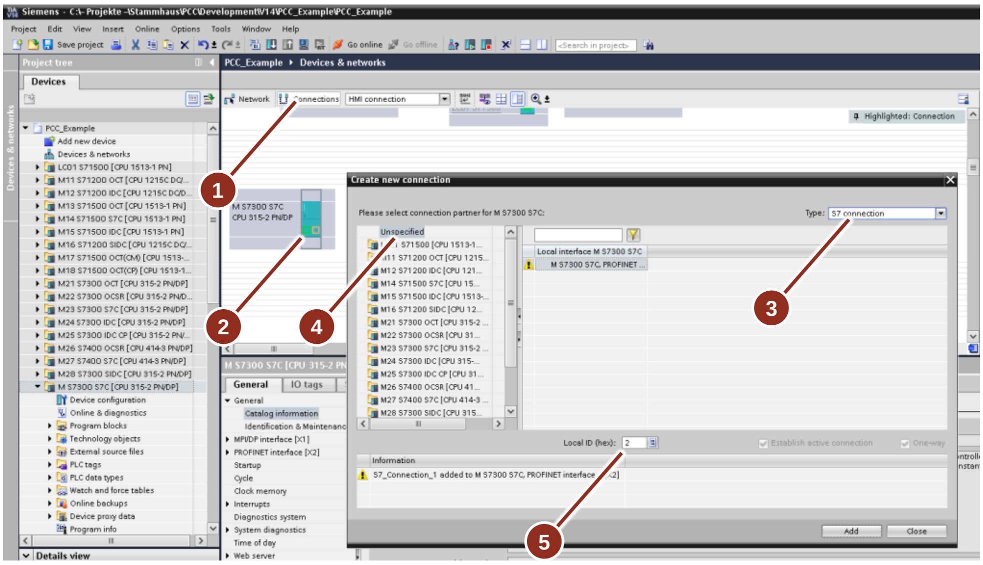
General

Name:	IE-LIS-Network
S7 subnet ID:	0103 - 0019
Project path:	PCC_Example\IE-LIS-Network
Storage location of the project:	C:\-- Projekte --\Stammhaus\PCC\Development\V5.5\PCC_Example
Author:	SIEMENS
Date created:	04/25/2017 11:06:26 AM
Last modified:	04/25/2017 11:23:59 AM
Comment:	

Creating an S7 connection with STEP 7 V14

1. Open “Devices & Networks” by “double-clicking” on the entry in the project tree.

Figure 5-13



Create new connection

Please select connection partner for M S7300 S7C:

Type: S7 connection

Unspecified

Local interface M S7300 S7C

M S7300 S7C, PROFINET ...

Local ID (hex): 2

☑ Establish active connection ☑ One-way

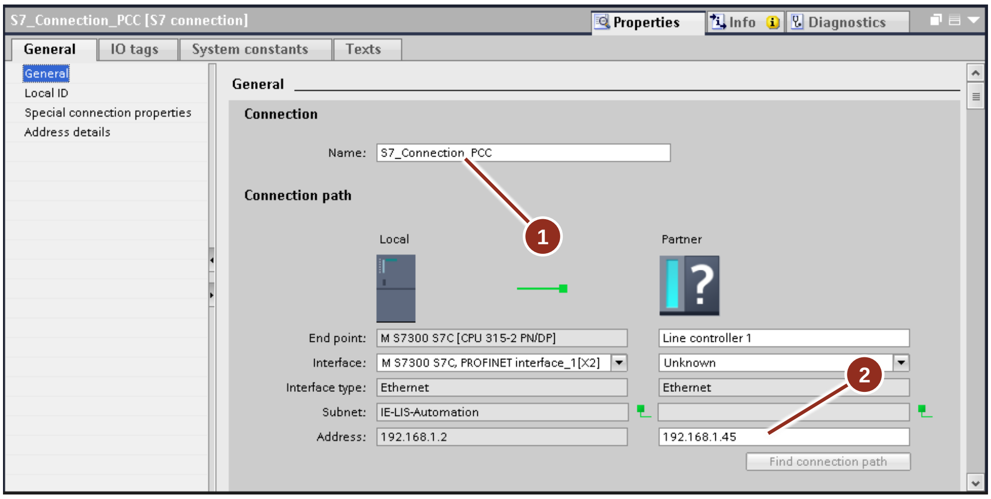
Information

S7_Connection_1 added to M S7300 S7C, PROFINET interface [X2]

Add | Close

2. Select the representation of the “connections” (1).
3. Select the CPU module of the station (2).
4. In the shortcut menu, select “Add new connection".
5. Select "S7 Connection" as the connection type (**3**).
6. Select "unspecified" if the control program of the partner controller is located in another project (**4**).
7. Select a free connection ID (**5**).
8. Confirm the creation of the new connection.

Figure 5-14



General

Connection

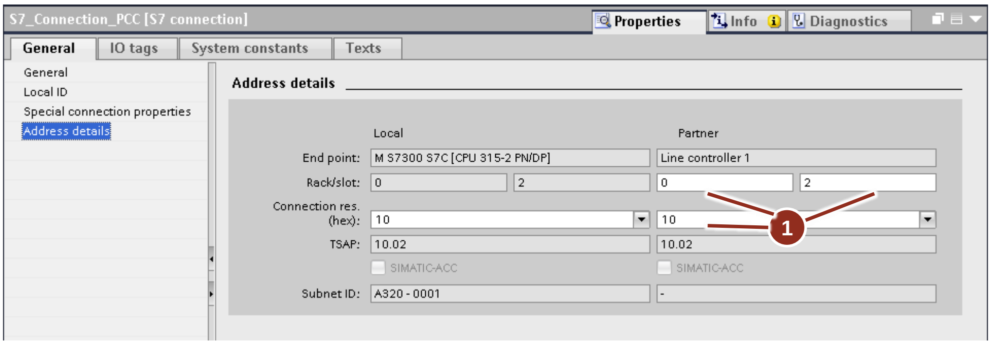
Name: S7_Connection_PCC

Connection path

	Local	Partner
End point:	M S7300 S7C [CPU 315-2 PN/DP]	Line controller 1
Interface:	M S7300 S7C, PROFINET interface_1[X2]	Unknown
Interface type:	Ethernet	Ethernet
Subnet:	IE-LIS-Automation	
Address:	192.168.1.2	192.168.1.45

9. Enter a connection name of your choice (**1**).
10. Enter the Ipv4 address of the partner (**2**).

Figure 5-15



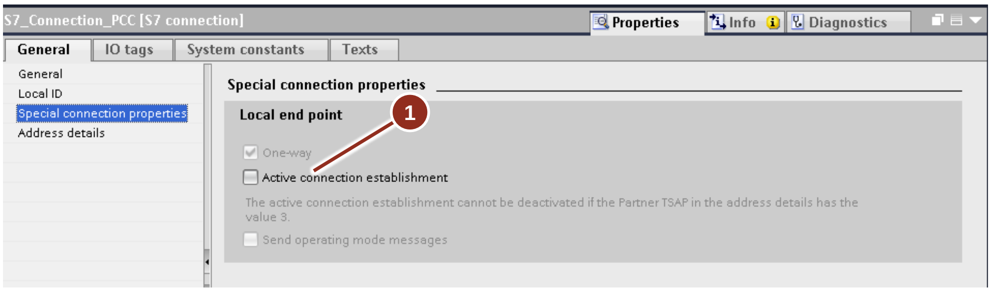
S7_Connection_PCC [S7 connection]

Address details

	Local		Partner	
End point:	M S7300 S7C [CPU 315-2 PN/DP]		Line controller 1	
Rack/slot:	0	2	0	2
Connection res. (hex):	10		10	
TSAP:	10.02		10.02	
	□ SIMATIC-ACC		□ SIMATIC-ACC	
Subnet ID:	A320 - 0001		-	

11. Set the TSAP address by specifying free connection resources and the rack and slot of the CPU module (**1**).

Figure 5-16



S7_Connection_PCC [S7 connection]

Special connection properties

Local end point

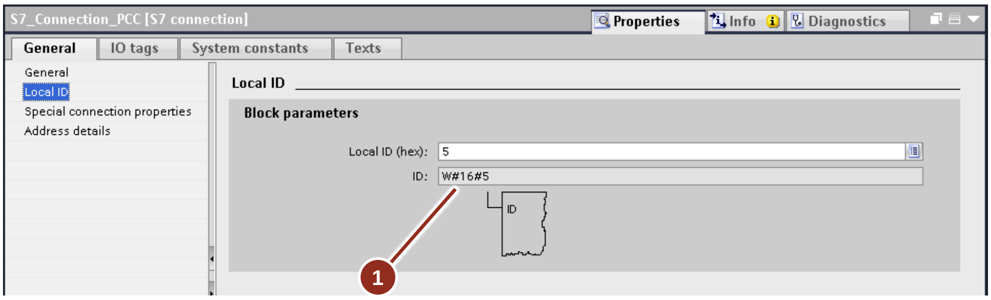
☑ One-way

□ Active connection establishment

The active connection establishment cannot be deactivated if the Partner TSAP in the address details has the value 3.

□ Send operating mode messages

12. Put a checkmark next to "Check active connection setup" (**1**).[10]



S7_Connection_PCC [S7 connection]

Local ID

Block parameters

Local ID (hex): 5

ID: W#16#5

13. Note the connection ID (**1**). This must be specified later in the user program.

5.3 Hardware configuration I-device

Handling

The procedure described assumes that the I-device and the IO controller are located in different automation projects, as is often the case with PCC. If both are in the same project, then no export/import is necessary, but only a corresponding creation of the transfer areas.

Requirements

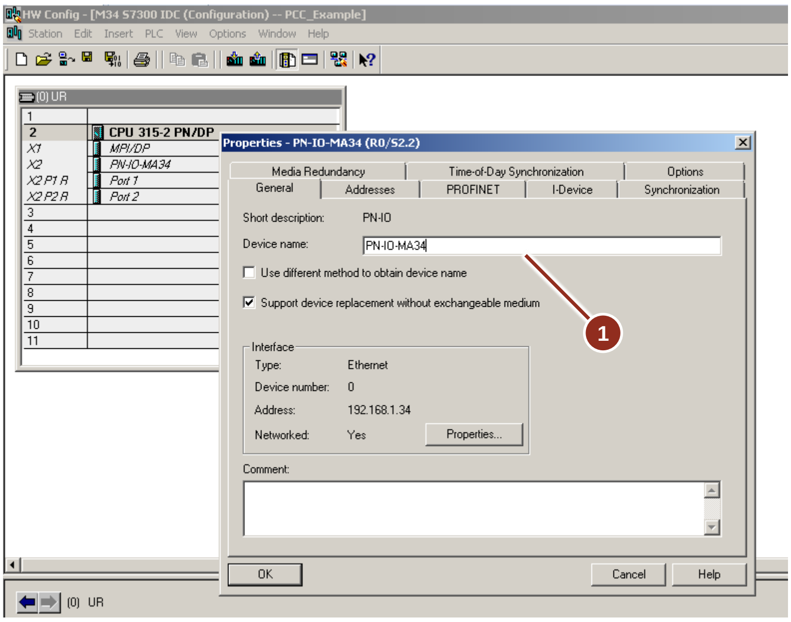
- Configured modules (e.g.: Rack, CPU, CP,…)
- Configuration of the PROFINET interface (e.g.: Subnet, IP address, subnet mask, router, ...)

[10] For PCC, the endpoint of the line control is always the active participant

Configuration I-device with STEP 7 V5.5

1. Open "HW Config" by selecting "Station>" Hardware and "Open Object (Ctrl + Alt + O)".

Fig. 5-17



1	
2	CPU 315-2 PN/DP
X1	MPI/DP
X2	PN-IO-MA34
X2 P1 R	Port 1
X2 P2 R	Port 2
3	
4	
5	
6	
7	
8	
9	
10	
11	

Short description: PN-IO

Device name: PN-IO-MA34

□ Use different method to obtain device name

☑ Support device replacement without exchangeable medium

Interface

Type: Ethernet

Device number: 0

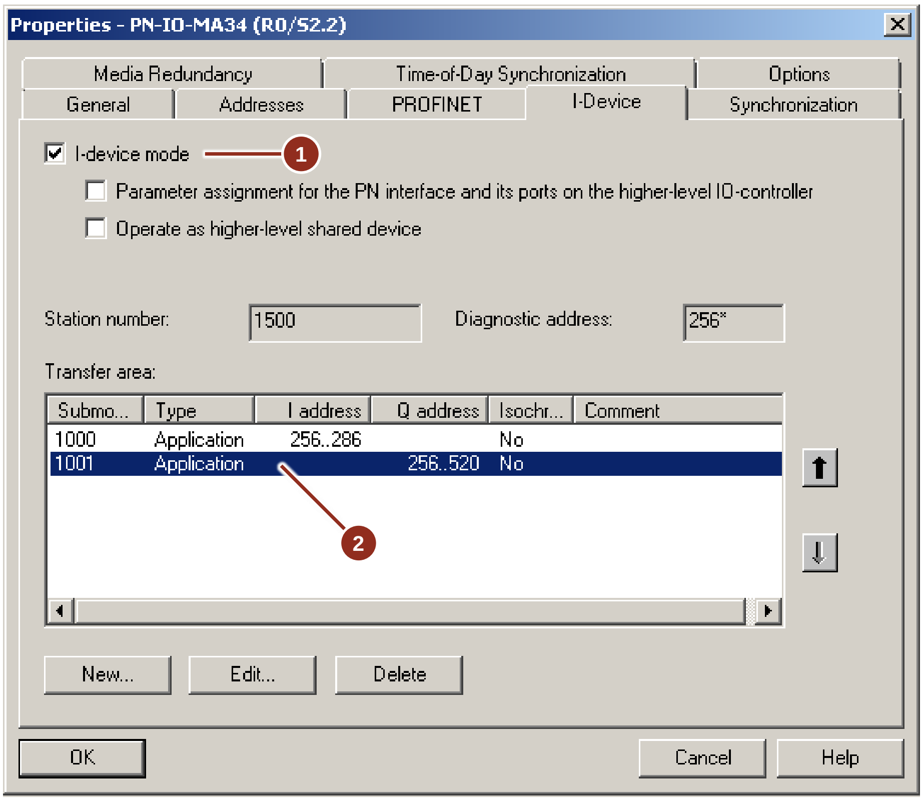
Address: 192.168.1.34

Networked: Yes

Comment:

2. Assign a unique device name in the properties of the PROFINET interface (**1**). This name identifies the device on the network by the controller.

Figure 5-18



☑ I-device mode

□ Parameter assignment for the PN interface and its ports on the higher-level IO-controller

□ Operate as higher-level shared device

Station number: 1500

Diagnostic address: 256*

Transfer area:

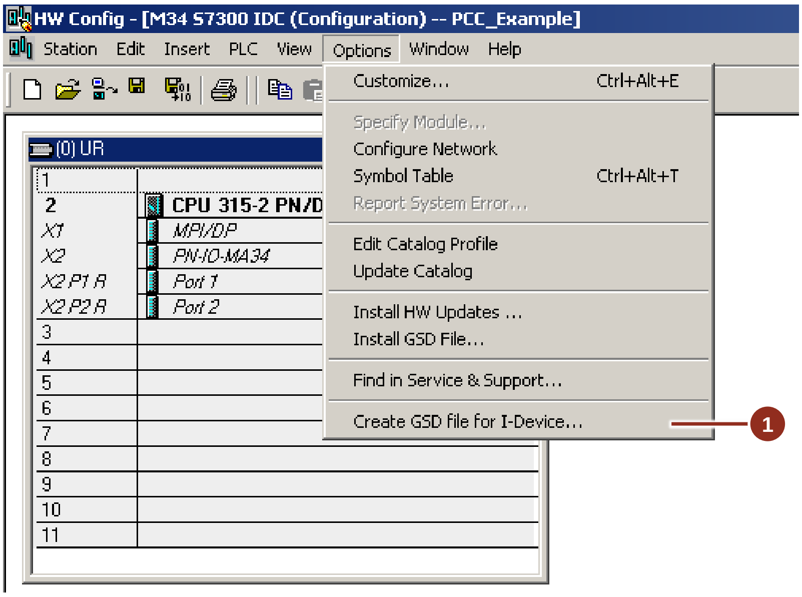
Submo...	Type	I address	Q address	Isochr...	Comment
1000	Application	256..286		No	
1001	Application		256..520	No	

3. Put a checkmark next to next to the I-device function (**1**).

4. In the table of transfer areas, enter the data lengths to be transmitted for sending and receiving (**2**). The required lengths are calculated at runtime depending on the configuration and interconnection and output in the diagnostics area:
 "DB_PCC" .PCC.CONFIG_DIAG.DIAG.CountByteToSend = Length of the output data "DB_PCC" .PCC.CONFIG_DIAG.DIAG.CountByteToReceive = Length of the input data
For certain modules, the length is limited for each individual entry. In this case, 2 consecutive entries with the corresponding total length must be created.
You can also determine the lengths yourself (see 2.6).

Note If you work with direct IO access, the transfer area must be in the process image of the controller. Depending on the CPU type, this can be controlled or adjusted in the properties of the CPU under “Cycle/size of process image"

Figure 5-19

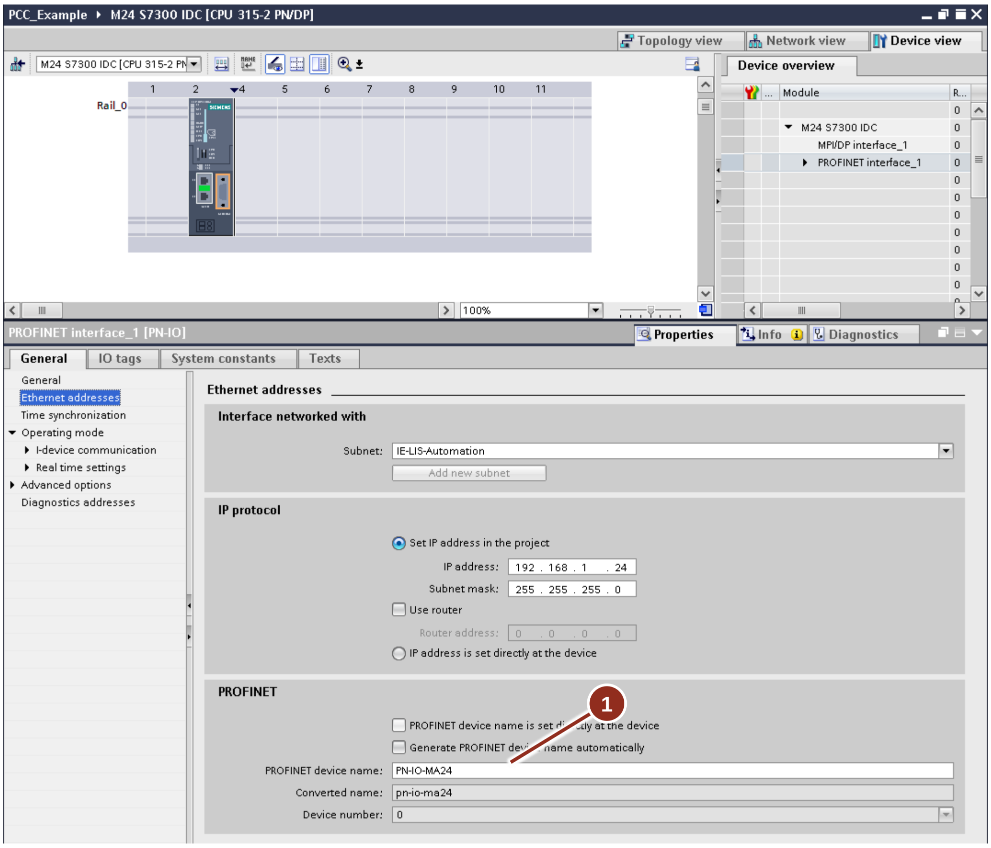


5. In the hardware configurator, under the menu item "Extras"> "Create GSD file for I-device ..." (**1**) create a GSD file of the station and export it. The GSD file is imported in the line control project and contains all necessary information for communication with the I-device.

Configuration I-device with STEP 7 V14

1. Open “Device configuration” by “double-clicking” on the entry in the project tree.

Figure 5-20



PCC_Example ▸ M24 S7300 IDC [CPU 315-2 PN/DP]

Topology view | Network view | Device view

Device overview

Module	R...
M24 S7300 IDC	0
MPI/DP interface_1	0
PROFINET interface_1	0

PROFINET interface_1 [PN-IO]

General | IO tags | System constants | Texts

Ethernet addresses

Interface networked with

Subnet: IE-LIS-Automation

Add new subnet

IP protocol

● Set IP address in the project

IP address: 192 . 168 . 1 . 24

Subnet mask: 255 . 255 . 255 . 0

□ Use router

Router address: 0 . 0 . 0 . 0

○ IP address is set directly at the device

PROFINET

□ PROFINET device name is set directly at the device

□ Generate PROFINET device name automatically

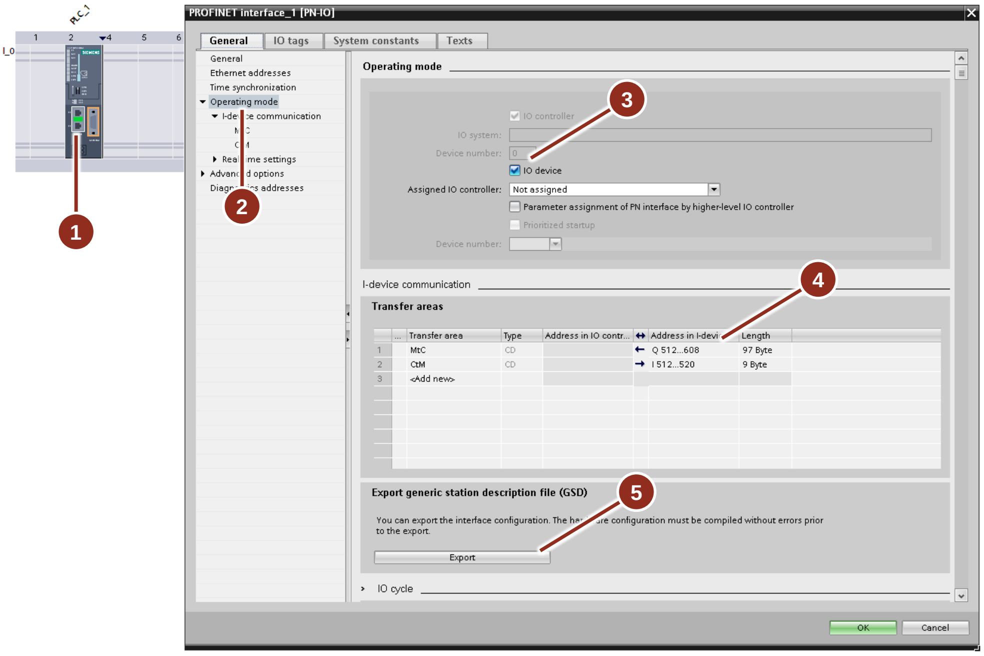
PROFINET device name: PN-IO-MA24

Converted name: pn-io-ma24

Device number: 0

2. Assign a unique device name in the properties of the PROFINET interface (**1**). This name identifies the device on the network by the controller.

Figure 5-21



PROFINET interface_1 [PN-IO]

General | IO tags | System constants | Texts

General
Ethernet addresses
Time synchronization
Operating mode
I-device communication
MtC
CtM
Real time settings
Advanced options
Diagnostics addresses

Operating mode

☑ IO controller

IO system:

Device number: 0

☑ IO device

Assigned IO controller: Not assigned

□ Parameter assignment of PN interface by higher-level IO controller

□ Prioritized startup

Device number:

I-device communication

Transfer areas

	...	Transfer area	Type	Address in IO contr...	↔	Address in I-devi...	Length
1		MtC	CD		←	Q 512...608	97 Byte
2		CtM	CD		→	I 512...520	9 Byte
3		<Add new>					

Export generic station description file (GSD)

You can export the interface configuration. The hardware configuration must be compiled without errors prior to the export.

Export

IO cycle

OK | Cancel

3. Mark the interface (**1**) and then under "Properties" select the menu item "Operating mode" (**2**). Put a checkmark next to next to the I-device function (**3**).
4. In the table of transfer areas, enter the data lengths to be transmitted for sending and receiving (**4**). The required lengths are calculated at runtime depending on the configuration and interconnection and output in the diagnostics area:
   "DB_PCC" .PCC.CONFIG_DIAG.DIAG.CountByteToSend = Length of the output data "DB_PCC" .PCC.CONFIG_DIAG.DIAG.CountByteToReceive = Length of the input data
   For certain modules, the length is limited for each individual entry. In this case, 2 consecutive entries with the corresponding total length must be created.
   You can also determine the lengths yourself (see 2.6).

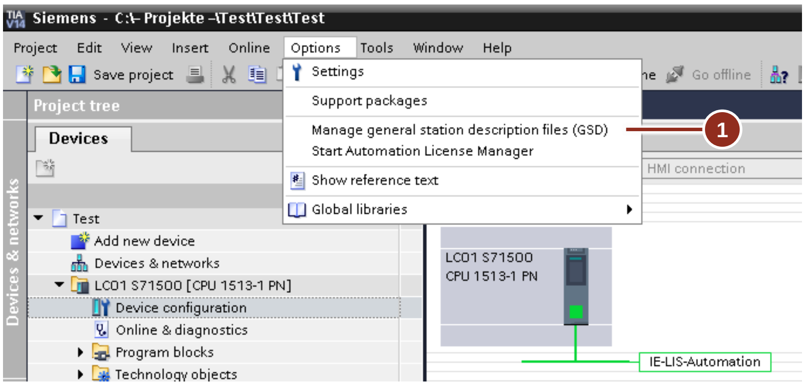
Note If you work with direct IO access, the transfer area must be in the process image of the controller. Depending on the CPU type, this can be controlled or adjusted in the properties of the CPU under “Cycle/size of process image"

5. Under "Export device description (GSD)" (**point 5**), export the GSD file. The GSD file is imported in the line control project and contains all necessary information for communication with the I-device.

Configuration IO controller with STEP 7 V14

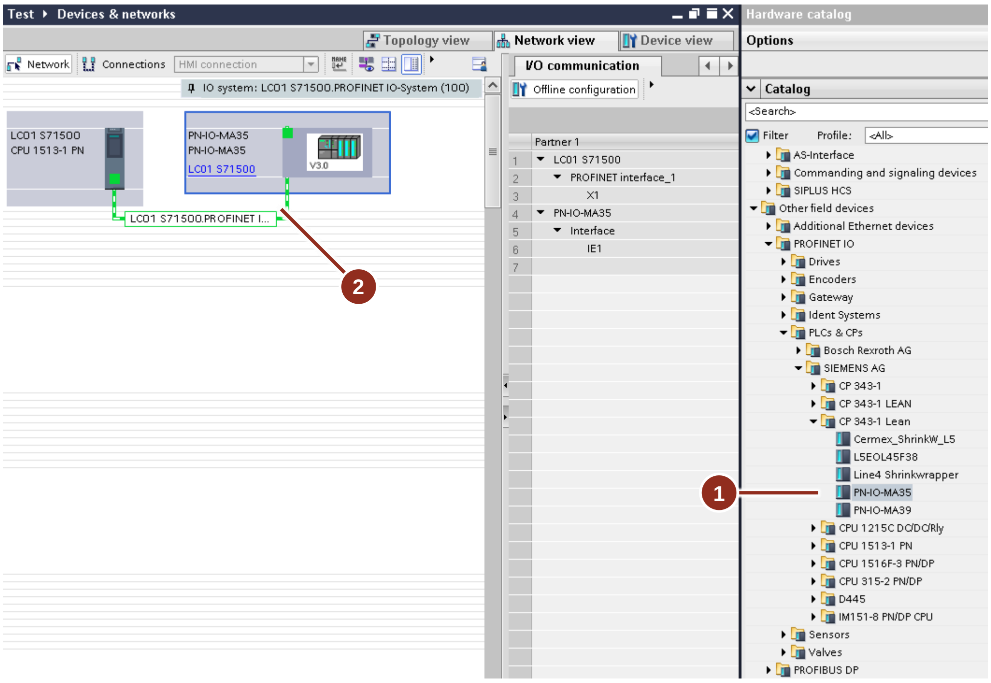
1. Open “Device configuration” by “double-clicking” on the entry in the project tree.

Figure 5-22



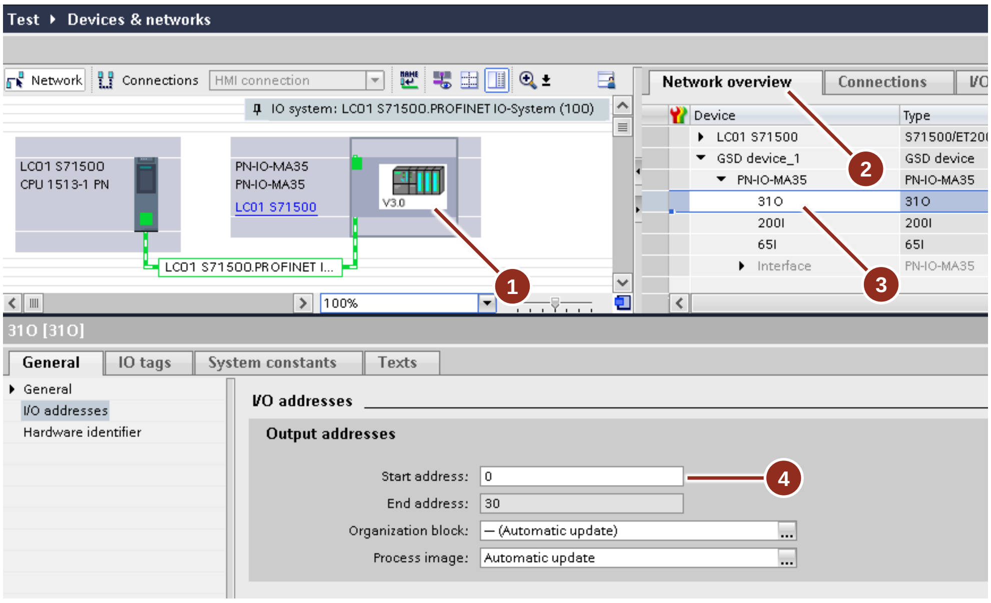
2. Import the I-device GSD files into the automation project under the menu item "Tools"> "Manage device description files (GSD)" (**1**).

Figure 5-23



3. In the catalog under "Other field devices"> "PROFINET IO"> "PLCs & CPs", select the previously imported I-device (**1**) and drag it to the corresponding network in your project.
4. Determine the desired IO controller by selecting the "Link" of the added station (**2**).

Figure 5-24



Device	Type
LC01 S71500	S71500/ET200
GSD device_1	GSD device
PN-IO-MA35	PN-IO-MA35
310	310
200I	200I
65I	65I
Interface	PN-IO-MA35

I/O addresses

Output addresses

Start address: 0

End address: 30

Organization block: --- (Automatic update)

Process image: Automatic update

5. Now check the transfer area after selecting the I-device (**1**) in the "Network view" tab with the "Network" view in the "Network overview" tab (**2**). The assignment to the I/O area of the IO controller can now be adapted directly in the table (**3**) or in the properties (**4**).

The I/O areas set for the individual stations must be specified later in the user program.

5.4 Error messages used

In general, all errors are not evaluated in every library version (STEP 7 V5.5 or V14). This list only contains the sum of all error codes.

5.4.1 Configuration error

Invalid value for FB parameter "PDI_TYPE” (8028)

The value of the configuration parameter "PDI_Type" could not be assigned a corresponding type.

Interconnection to <Range> is not a valid DB link (8032-803C)

Only interconnections to data blocks with a byte length> 0 are permitted.

Length <range> is invalid DB-Link (8044-8049)

When specifying dynamic arrays, only positive ranges with a length> 0 are allowed.

Interconnection to <range> has an invalid data length (8050-8059)

Depending on the type and version (parameter "PDI_Type"), lengths of the individual areas are stored. If structures with wrong lengths are interconnected, the corresponding error message appears.

The length of the <range> is too short (805A-805F)

If the length of the interconnected dynamic array is too short, the corresponding error message appears. The required length is determined by the interconnection of the PDI areas.

Transmit buffer write pointer has a wrong end position (8064)

After the formation of the transmission data, the total length does not give the expected value. This can occur due to incorrect connection of the PDI data or due to an error in the "serialization" of optimized data areas.

Receive buffer read pointer has a wrong end position (8065)

After evaluation of the received data, the total length does not give the expected value. This can occur due to incorrect connection of the PDI data or due to an error in the "deserialization" in optimized data areas.

Invalid configuration for <protocol> (806F-8073)

Implausible parameters have been detected for the respective protocol ("ComType" described in "FB_PCC_SUB_CALL")

Invalid value for the communication protocol to be used (8074)

The value of the "ComType" parameter (described by "FB_PCC_SUB_CALL") could not be assigned to a corresponding communication protocol.

Length of the received data does not match what is expected (8079)

The sum of the received message frame segments does not correspond to the expected length. The length of the expected data is calculated from the sum of the interconnected PDI structures. The interconnection of the PDI structures must be identical on both endpoints of the communication!

This error can also occur sporadically if individual message frame segments are missing. The cause can also be an extremely slow or unstable communication.

Received data has a difference in length in the header and in the receive block (807A)

The sum of the received message frame segments does not correspond to the length of the transmitted data described in the header. The cause may be a faulty use or interconnection of the receive blocks in the "FB_PCC_SUB_CALL" block.

This error can also occur sporadically if individual message frame segments are missing. The cause can also be an extremely slow or unstable communication.

Received data has an invalid version number in the header (no compatible PCC version) (807B)

The PCC blocks check the version of the protocol used by transferring an identifier in the header. Both communication endpoints must use identical versions of the blocks.

Received data has an invalid message frame identifier (no PDI message frame received) (807C)

The received data does not correspond to the message frame identifier valid for PCC The cause can be, inter alia, multiple connections. Check "ConnectionId" for uniqueness!

Received data has an invalid identifier at the end (no complete message frame received) (807D)

The received data is missing the "end" identifier of the message frame. This can occur with PROFINET IO communication if the data lengths parameterized in the hardware configuration do not correspond to the complete data volume

Error copying data from <range> to <range> (8081-8082)

The copy function has reported an error This can occur, among other things, in read-only data areas.

Error deserializing the <range> from the received data (8083-808A)

The function for deserializing the data has reported an error. This can occur, for example, in read-only data areas as well as with invalid PDI interconnection.

Error serializing the <range> in the buffer (808E-8094)

The function for serializing the data has reported an error. This can occur, for example, with invalid PDI interconnection.

5.4.2 Runtime error

Time-out when connecting to the partner station -> Repeat after a pause (8101)

The connection to the remote station took longer than expected. After a short break, the connection is restarted.

Time-out when sending the data to the partner station -> New connection after a pause (8102)

Sending the data to the remote station took longer than expected. After a short pause, a connection is restarted.

Time-out when disconnecting (8103)

The connection to the remote station could not be successfully terminated. The disconnection is aborted and, if necessary, a new connection is started.

Undefined step number of the communication process (810E)

An internal error has occurred during the communication process. A connection is restarted.

No change of the received data within a period (= runtime monitoring) (8119)

No new data was received for a set period of time. This message is the result of all communications problems and the basis for monitoring the successful transmission.

6 Appendix

6.1 Service and Support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, and application examples – all the information you need is accessible with just a few mouse clicks at:
https://support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts.

You send queries to Technical Support via Web form:
https://support.industry.siemens.com/My/ww/en/requests

Service offer

Our range of services includes, inter alia, the following:

- Product trainings
- Plant data services
- Spare parts services
- Repair services
- On-site and maintenance services
- Retrofitting and modernization services
- Service programs and contracts

You can find detailed information on our range of services in the service catalog:
https://support.industry.siemens.com/cs/sc

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
https://support.industry.siemens.com/cs/ww/en/sc/2067

6.2 Links and Literature

Table 6-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Entry page of the application sample https://support.industry.siemens.com/cs/ww/en/view/98278624
\3\	Which "local_device_id" do you parameterize in order to establish a connection with FB65 "TCON" for Open User Communication (OUC) via Industrial Ethernet? https://support.industry.siemens.com/cs/ww/en/view/51339682

6.3 Change documentation

Table 6-2

Version	Date	Modifications
V1.0	02/2018	First version