

Communication between S7-400 (IO Controller) and S7-300 (I Slave) via IE/PB link

PROFINET IO and PROFIBUS DP

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Question

How is data exchanged between an S7-400 (PROFINET IO controller) and an S7-300 (I slave) via the IE/PB link gateway?

Answer

Follow the instructions and notes listed in this document for a detailed answer to the above question.

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1 Introduction

This document contains information about communication between an S7-400 station and an S7-300 station. A CP443-1 Advanced is used, which is configured as a PROFINET IO controller, in the S7-400. The S7-300 is connected as an I slave to the PROFINET IO controller via an IE/PB link.

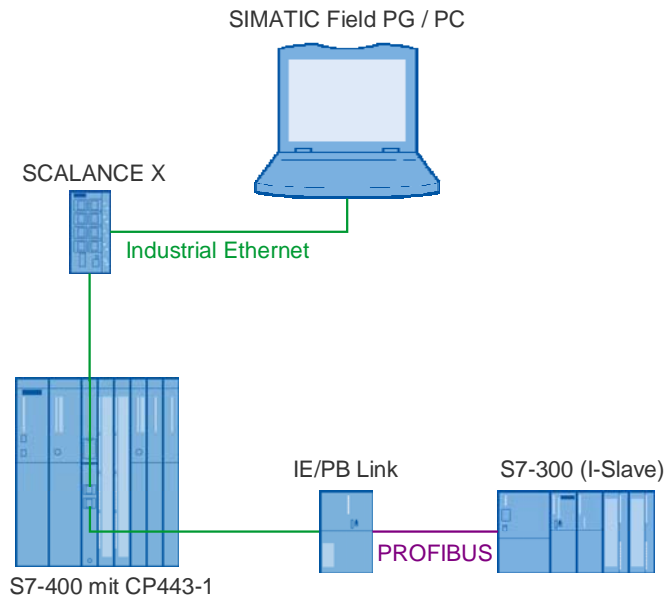
This document contains

- An overview of the sample program and plant configuration (see Chapter 2 and Chapter 3).
- Information about installing and commissioning the sample program (see Chapter 4).
- Information about operating the sample program (see Chapter 5).
- Other notes, tips and tricks, etc. (see Chapter 6).

2 Overview of the Sample Program

Plant Configuration

Figure 2-1



The S7-400 is connected to the Industrial Ethernet network via a CP443-1. The SCALANCE X and the IE/PB link are connected to the integrated 4-port switch of the CP443-1 Advanced. A CPU316-2 DP is connected as an I slave (intelligent DP slave) to the IE/PB link over PROFIBUS.

The SIMATIC field PG / PC is connected to the Industrial Ethernet network like the S7-400 and is used for the purposes of plant configuration and diagnostics.

3 Plant Configuration

This chapter contains an overview of the configuration and of the hardware and software components used to create the sample program.

3.1 Overview

The table provides an overview of the configuration used to create the sample program.

Table 3-1

Bus system	Industrial Ethernet and PROFIBUS
Communication protocol	PROFINET IO and PROFIBUS DP (real-time communication)
Communication partners	SIMATIC S7
Communications processors	CP443-1 Advanced
Services	S7 routing

In this sample program the real-time communication is used for data transmission.

Real-time communication is responsible for cyclic data exchange between the S7-400 and the IE/PB link. The CP443-1 Advanced with order number 6GK7443-1EX40-0XE0 is used as a communications processor. This CP supports PROFINET IO from firmware V2.0.

3.2 Hardware and Software Components Used

Hardware Components

The following modules were used to create the sample program.

Table 3-2

Hardware	Module	Order number	Firmware
S7-400	PS407 10A	6ES7407-0KA00-0AA0	
	CPU417-4	6ES7417-4XL04-0AB0	V4.0
	CP443-1 Advanced	6GK7443-1EX40-0XE0	V2.2
Industrial Ethernet switch	SCALANCE X208	6GK5208-0BA00-2AA3	
Gateway	IE/PB link	6GK1411-5AB00	V2.0
S7-300 (I slave)	PS307 5A	6ES7307-1EA00-0AA0	
	CPU316-2 DP	6ES7316-2AG00-0AB0	
Miscellaneous	Industrial Ethernet cable		
	PROFIBUS bus cable		
	PC with a network card and installed software		

Compatible CPUs or CPs can be used which have newer firmware installed, or which are upgrades to the versions used here.

An S7-300 CPU has been selected as an I slave. The CPU does not necessarily have to support PROFINET IO because it has been connected in a perfectly normal manner via PROFIBUS, and communication is also to be processed through it.

Software Components

- STEP 7 V5.3 SP3 or higher

4 Installation and Commissioning

4.1 Installation of the Sample Program

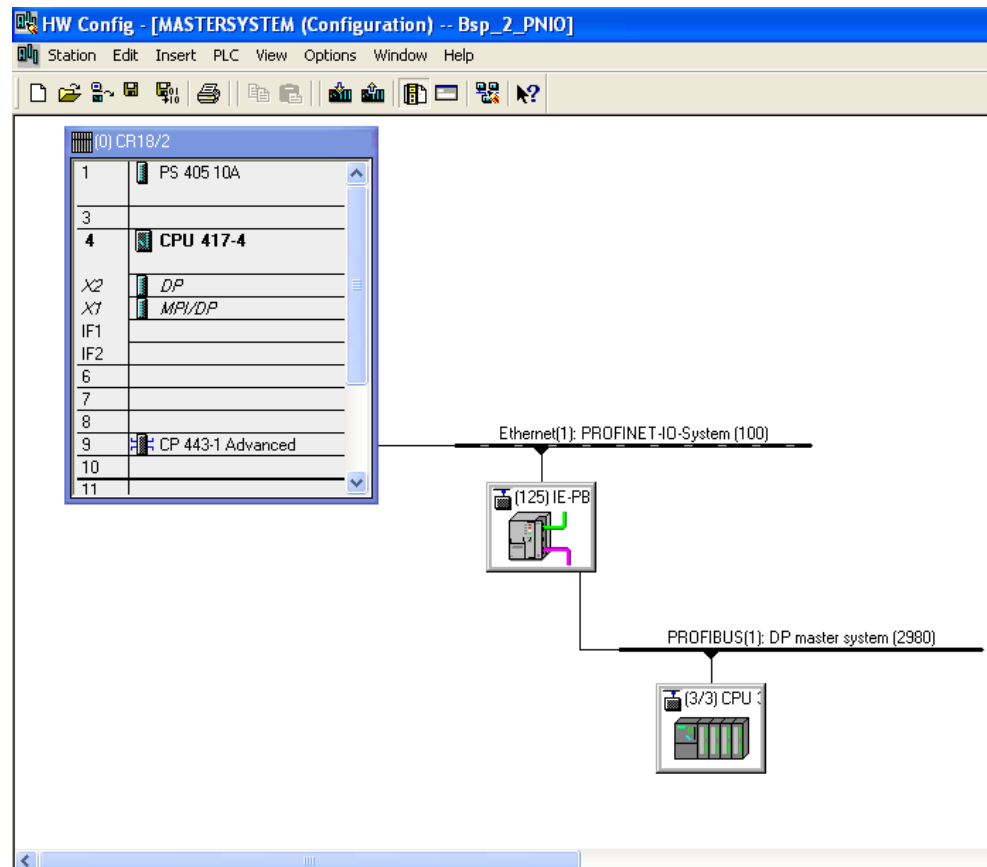
The sample program is a STEP 7 project that contains the complete hardware configuration including the user program of the S7-400 and S7-300 stations.

The STEP 7 project is available to download in the form of a ZIP file. Extract the file "QS_IE-PB-LINK-Routing.zip" to a separate directory. The STEP 7 project is unpacked automatically with all its subdirectories. You can then use the SIMATIC Manager to open and process the extracted STEP 7 project.

4.2 Commissioning the S7-400 Station

Open the hardware configuration of the S7-400 station.

Figure 4-1



Configuration of the CP443-1 Advanced as an I/O Controller

Right-click the CP 443-1 Advanced in the hardware configuration. Insert a new PROFINET IO system via the "Insert PROFINET IO system".

The PROFINET stations are connected to Industrial Ethernet cables via the integrated 4-port switch on the CP443-1 Advanced or via the SCALANCE X208. The Industrial Ethernet switches do not require any special settings. Enter an IP address and a subnet mask in the hardware configuration for the

CP443-1 Advanced, which is acting as an I/O Controller. This makes the Industrial Ethernet subnet the default for I/O devices which have to be connected later on.

Enter a (DNS-compatible) device name in the hardware configuration for the I/O devices. During initial commissioning, the device name is stored retentively in the I/O device (MMC in the case of ET200S/PN and C plug in the case of an IE/PB link and SCALANCE). The device name is comparable with the PROFIBUS address of a DP slave.

Configuration of the I/O Devices

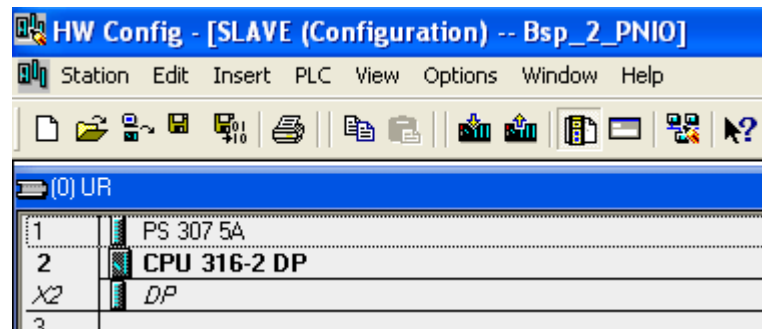
STEP 7 automatically allocates an IP address to each I/O device. The IP address for the I/O devices is allocated in ascending numerical order starting off from the IP address for the I/O controller. The IP addresses for the I/O devices which have been automatically allocated by STEP 7 can be changed. The IP addresses for the I/O devices must lie within the same subnet as those of the I/O controller because there is a plant-wide consistency check (device name, IP address) conducted in STEP 7. The remaining device-specific settings are defined in the same way as in PROFIBUS DP slaves.

4.3 Commissioning the S7-300 Station

Configuration of the S7-300 as an I Slave

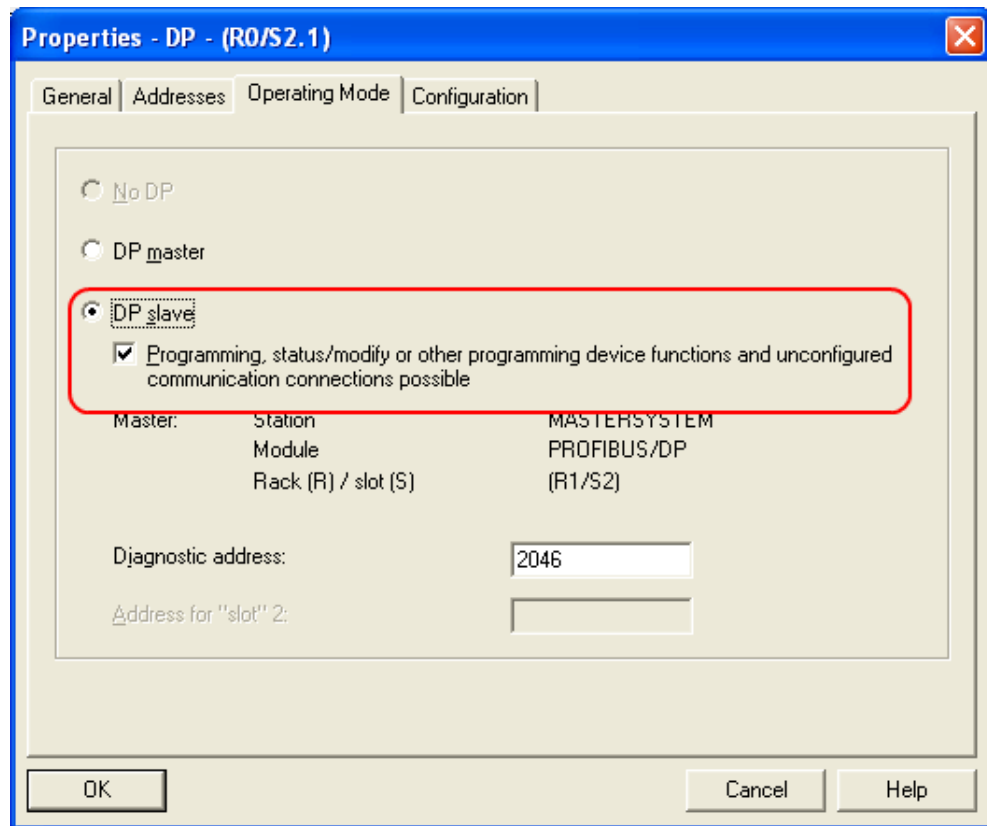
Insert a "SIMATIC 300 station" in STEP 7 and create the hardware configuration.

Figure 4-2



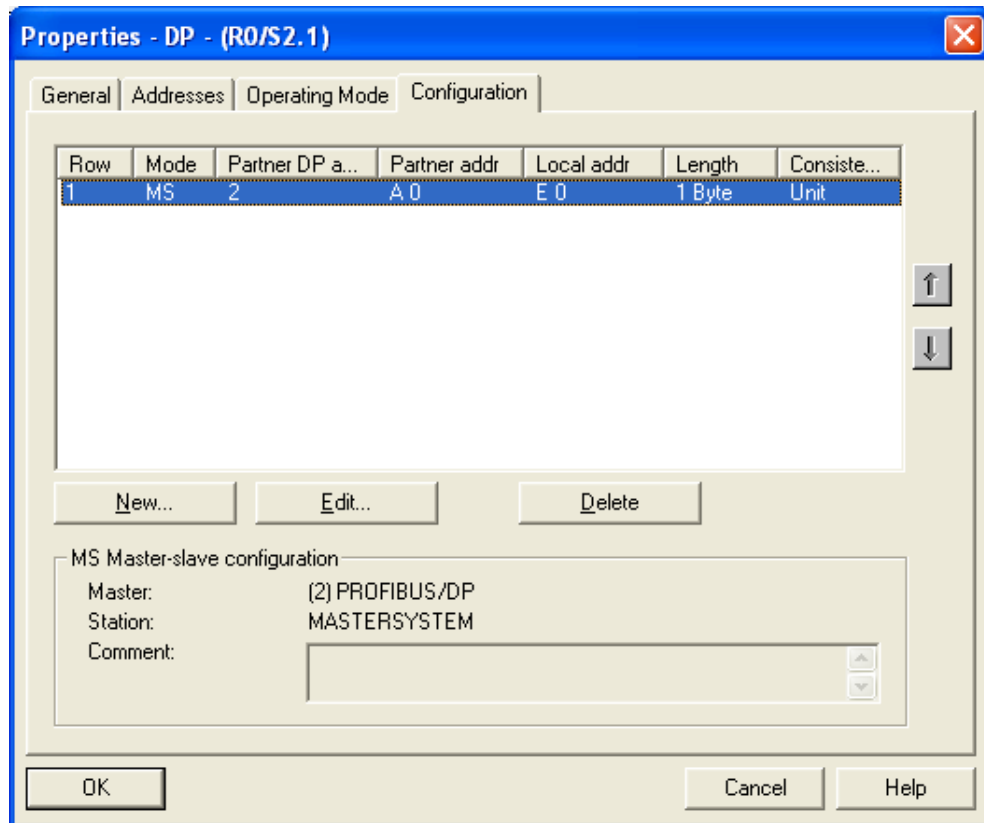
The S7-300 CPU must be configured as a DP slave. Double-click on the DP interface of the CPU in the hardware configuration to open the "Properties" dialog box of the DP interface. Switch to the "Mode" tab and set "DP slave" as the mode. In order to use the "Routing" function, enable the option "Programming, status/modify or other programming device functions and unconfigured communication connections possible".

Figure 4-3



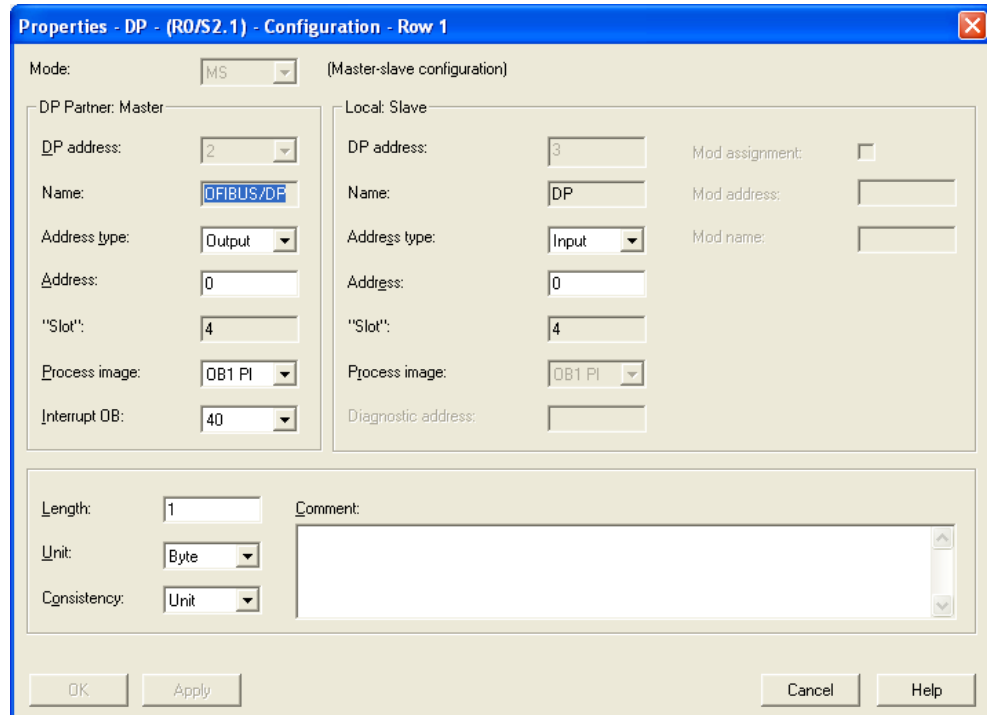
Switch to the "Configuration" tab in the "Properties" dialog box of the DP interface. Click the "New" button to create a new address assignment. If no address assignment has been created, the hardware configuration is inconsistent.

Figure 4-4



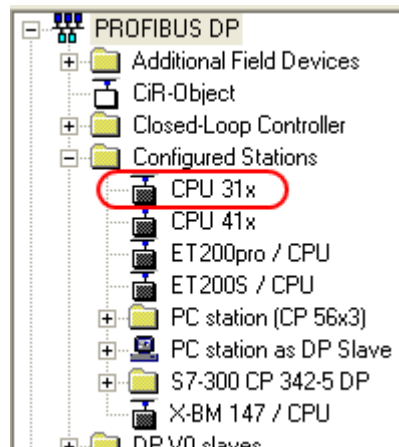
Input 0 in the DP slave is assigned to output 0 in the DP master. The input and output are configured with a length of 1 byte and with the consistency "unit".

Figure 4-5



Save and compile the hardware configuration for the S7-300 station. The S7-300, which is configured as a DP slave, is located in the hardware catalog under "PROFIBUS DP → Stations already configured".

Figure 4-6



As the S7-300 does not possess any further distributed I/O devices, further configuration is not necessary.

4.4 Allocating an IP Address to the I/O Controller and the I/O Devices

Checking the IP Address of the I/O Controller and of the I/O Devices

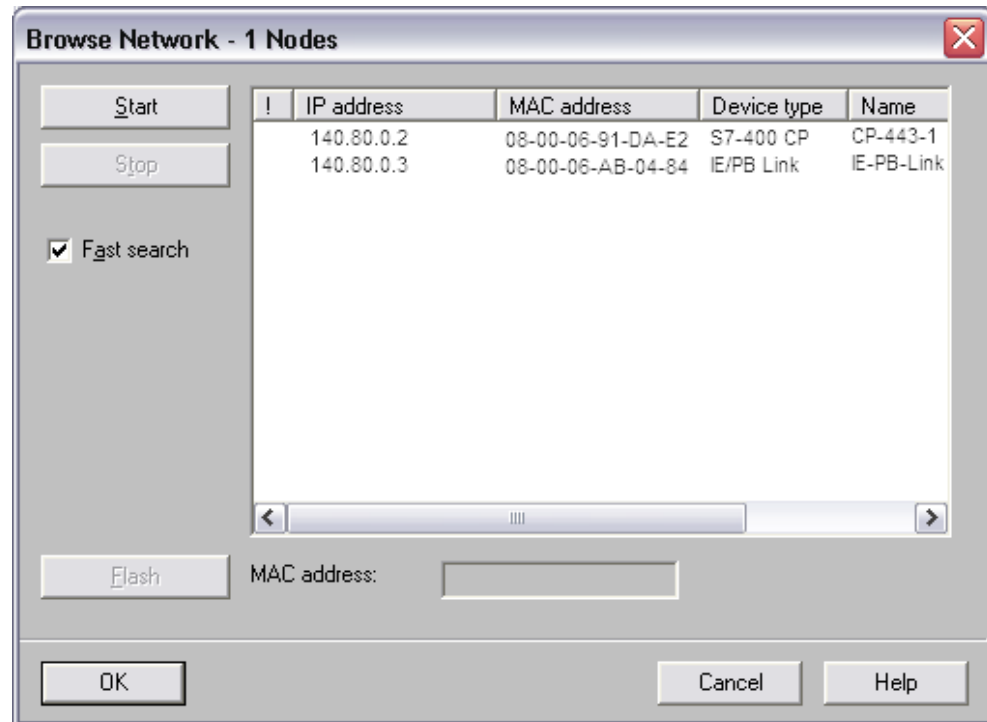
The local network can be browsed via STEP 7.

Open the "Edit Ethernet Users..." dialog box in the SIMATIC Manager via the menu "PLC → Edit Ethernet Users..." or in the hardware configuration via the menu "PLC → Ethernet → Edit Ethernet Users...".

Click the "Browse" button in the "Edit Ethernet Users..." dialog box. The IP address, MAC address and name of all the available devices are then displayed in the "Browse network" dialog box.

If you have to adapt the IP address of a device in accordance with the hardware configuration, select the device in the "Browse network" dialog box and click "OK".

Figure 4-7



Enter the IP address and the subnet mask for the selected device in the "Edit Ethernet Users..." dialog box. Click the "Assign IP configuration" button in order to assign the IP address and the subnet mask to the device.

Figure 4-8

Edit Ethernet Node

Ethernet node

MAC address: 08-00-06-91-DA-E2

Nodes accessible online

Set IP configuration

Use IP parameters

IP address: 140.80.0.2 Gateway

Subnet mask: 255.255.0.0 Do not use router

Use router

Address: 140.80.0.2

Obtain IP address from a DHCP server

Identified by

Client ID MAC address Device name

Client ID:

Assign device name

Device name: CP-443-1-Advanced

Reset to factory settings

If you have assigned the IP address and the subnet mask, which you have entered in the hardware configuration, to the CP443-1 Advanced, you can then upload the hardware configuration for the S7-400 to the CPU via the Industrial Ethernet CP443-1 Advanced.

4.5 Commissioning the I/O Devices

The creation of addresses is based on the allocation of device names. These device names must be unique within the system.

Initial Commissioning

Enter the name of the I/O device in the "Properties" dialog box in the hardware configuration. The IE/PB link is used as an I/O device in this example. Once the I/O device, that is to say the IE/PB link, is inserted in the hardware configuration on the PROFINET IO system, the device name is allocated.

The I/O device is allocated via the menu "PLC → Ethernet -> Assign device names", the I/O device is selected and the device name is allocated. The device name is stored retentively in the I/O device (MMC in the case of ET200S/PN and C plug in the case of an IE/PB link and SCALANCE).

Figure 4-9

Edit Ethernet Node

Ethernet node

MAC address: 08-00-06-91-DA-E2 Nodes accessible online
Browse...

Set IP configuration

Use IP parameters

IP address: 140.80.0.2 Gateway
Subnet mask: 255.255.0.0 Do not use router
 Use router
Address: 140.80.0.2

Obtain IP address from a DHCP server

Identified by

Client ID MAC address Device name

Client ID:

Assign IP Configuration

Assign device name

Device name: CP-443-1-Advanced Assign Name

Reset to factory settings

Reset

Close Help

Spare Parts Scenario

If an I/O device is defective, the new I/O device is assigned the name of the defective I/O device. The device name is once again stored tentatively in the I/O device (MMC in the case of ET200S/PN and C plug in the case of an IE/PB link and SCALANCE). The module is now easy to exchange. It is automatically incorporated in ongoing operation.

4.6 NETPRO Overview

In the SIMATIC Manager, open NetPro via the menu "Options → Configure Network".

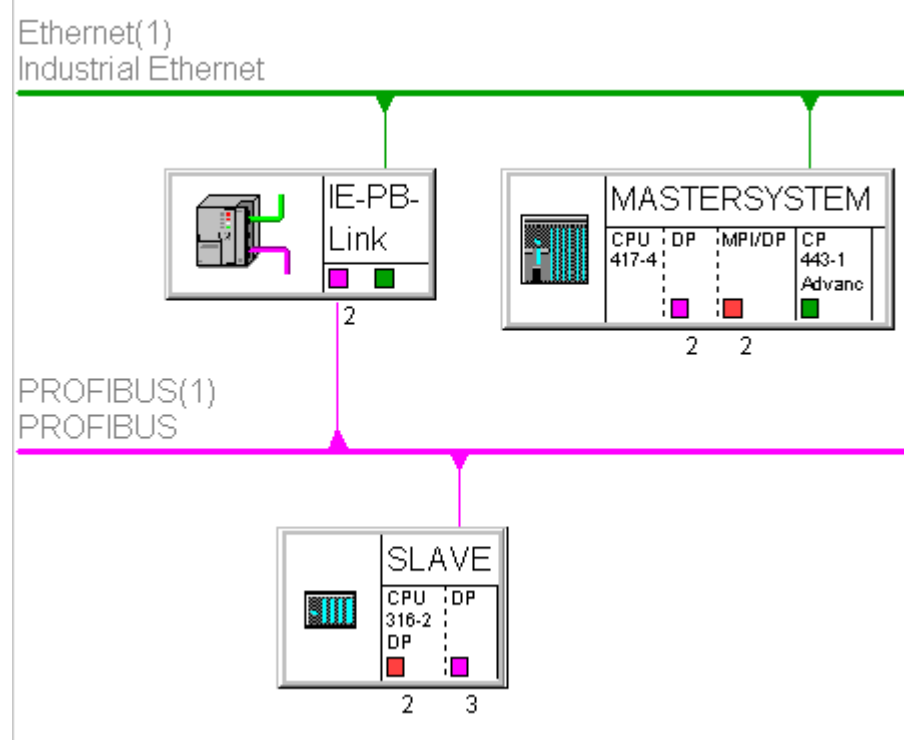
The Industrial Ethernet and PROFIBUS are connected via the IE/PB link. This gives rise to a physical connection between the CPU417-4 and the I slave CPU316-2 DP.

The IE/PB link is connected

- as an I/O device to the CP443-1 Advanced I/O controller.
- DP master for the I slave CPU316-2 DP.

In the CPU417-4 you can access the configured inputs and outputs in the I slave CPU316-2 DP via CP443-1 Advanced and the IE/PB link.

Figure 4-10



4.7 Completing Commissioning

Save and compile the configuration. Upload the configuration to the S7-400 CPU in order to complete it.

4.7.1 Uploading the S7-400 Station (PROFINET IO Controller)

The S7-400 station (PROFINET IO controller) can be uploaded via MPI or Industrial Ethernet.

Requirement for Uploading via Industrial Ethernet

- CP443-1 Advanced must possess a valid IP address (see section 4.2).
- Set the "S7ONLINE (STEP 7)" access point to the used interface parameterization "TCP/IP → Network card" via the menu "Options → Set PG/PC interface" in the SIMATIC Manager.

4.7.2 Uploading the S7-300 Station (I Slave)

The S7-300 station (I slave) must be uploaded for the very first time via MPI so that the CPU receives its addresses, etc. Every additional upload can then take place via Industrial Ethernet because the CP443-1 Advanced and the IE/PB link PN I/O support the "routing" function.

4.8 Organization Blocks Required in the Program

OB82, OB83, OB85, OB86

OBs 82, 83, 85 and 86 are error OBs. They are required in this example to prevent the CPU going into "STOP" mode during startup. The reason for this is the IE/PB link with the PROFIBUS stations connected.

For the purposes of configuration, the CPU transmits the necessary system data blocks (SDBs) with all the important hardware information to the individual devices. The PROFIBUS stations cannot be reached directly, this can only be done via the IE/PB link. This means that the IE/PB link also performs the configuration for its stations. If the CPU has now sent all the configuration data, it assumes that all the modules are ready.

This is not correct because the IE/PB link has to pass on its own configuration first. The CPU, on the other hand, already attempts to create the process image and accesses areas which have not been configured yet.

The error OBs are called, preventing the CPU from going into "STOP" mode. The OBs are blank in this sample program. They can be written in order to respond to errors.

5 Operation of the Sample Program

During loading over Industrial Ethernet, you can check by the LEDs of the I slave whether it is also being loaded. This means that the CPU of the I slave must switch to "RUN" mode without an error. In this case only the green LED is on.

6 Other Notes, Tips and Tricks, etc.

This chapter gives you more notes, tips and tricks for the commissioning and working of the sample program.

6.1 Not Possible to Download Hardware Configuration, Connection or Blocks to the CPU

If it is not possible to download the hardware configuration, connection or blocks to the CPU, make the following checks and take the following measures to remedy the situation.

Table 6-1

Check	Remedy
<p>If you are loading the CPU via MPI, check that the MPI cable is connected on the SIMATIC Field PG and on the MPI or MPI/DP interface of the CPU.</p> <p>If the MPI cable is not connected to the SIMATIC Field PG and to the MPI or MPI/DP interface of the CPU, no connection can be established between the two stations.</p>	<p>Connect the MPI cable to the RS485 interface of the SIMATIC Field PG and to the MPI or MPI/DP interface of the CPU.</p>
<p>If you perform the download via Industrial Ethernet, check that the Industrial Ethernet cables are connected to all the devices and to the switch.</p> <p>If the Industrial Ethernet cables are not connected to all the devices and to the switch, a connection cannot be established between the stations.</p>	<p>Connect the Industrial Ethernet cable to the RJ45 socket on the SIMATIC Field PGs and to the RJ45 socket on the device.</p>
<p>Check the settings in "Set PG/PC interface...".</p> <p>The interface parameters used must be assigned to the access point of the application "S7ONLINE (STEP 7)".</p> <p>If the settings in "Set PG/PC interface..." are not correct, no connection can be established between the stations.</p>	<p>Go to <i>Start</i> → <i>SIMATIC</i> → <i>STEP 7</i> and select the menu item "Set PG/PC interface".</p> <p>If you perform the download via MPI, select the module to which the MPI cable on the SIMATIC Field PG is connected under "Interface parameters used", for example CP5611(MPI).</p> <p>If you perform the download via Industrial Ethernet, select the module to which the Industrial Ethernet cable on the SIMATIC Field PG is connected under "Interface parameters used", for example TCP/IP → network card.</p> <p>Apply the settings with "OK".</p>
<p>Open the hardware configuration. The hardware configuration in the STEP 7 project must match the configuration of the S7-400 and S7-300 stations.</p>	<p>Change the hardware configuration in the STEP 7 project to match the configuration of the S7-400 and S7-300 stations.</p>
<p>Check that the CPU has been completely reset.</p>	<p>If the CPU has not been completely reset, perform a complete reset of the S7-400 or S7-300 CPU.</p>
<p>Check the IP address of the SIMATIC Field PG / PC. The IP address of the SIMATIC Field PG / PC must lie within the same subnet as the IP addresses of the</p>	<p>Change the IP address of the SIMATIC Field PG / PC or the IP addresses of the PROFINET IO devices so that IP addresses are located in the same subnet.</p>

Check	Remedy
PROFINET IO devices.	
Check the names of the PROFINET IO device.	<ul style="list-style-type: none"> Check the names which have been allocated for each I/O device. Select the PROFINET IO system in the hardware configuration. Check the device names via the menu "PLC → Ethernet → Check device names". Ensure that the I/O device itself is configured with the device name (check with flashing), Where necessary, re-allocate the device name via the menu "PLC → Ethernet → Allocate device names". Save and compile the hardware configuration anew and reload the configuration.

6.2 Variable Table Operation does not Work

If it is not possible to operate the variable table, make the following checks and take the following measures to remedy the situation.

Table 6-2

Check	Remedy
Check whether "Monitor variables" function is activated.	Activate the "Monitor variable" function by means of the menu <code>Variable → Monitor</code> .
Check that the control value entered by you for transmitted data lies within the valid range of values.	Enter the control value in the variable table for the transmitted data from the valid value range between 0 and 128.

6.3 CPU Goes into "STOP" Mode after Loading the Hardware Configuration

If the CPU goes into "STOP" mode after loading the hardware configuration, make the following checks and take the following measures to remedy the situation.

Table 6-3

Check	Remedy
Check if the CPU goes into "STOP" mode after loading the hardware configuration.	If the CPU switches to "STOP" mode after the hardware configuration has been loaded, switch the CPU to "STOP" and then back to "RUN" (warm start) without an overall reset.
Check if the CPU goes into "STOP" mode again after the restart.	<ul style="list-style-type: none"> Mark the CPU which is in "STOP" mode in the SIMATIC Manager and select "PLC → Diagnostics/Settings → Module State". Switch to the "Diagnostics Buffer" tab in the "Module State" dialog box in order to find the cause via the messages displayed. You may have to load a certain OB, such as OB85, into the CPU. This is

Check	Remedy
	<p>necessary when operating a DP slave on an IE/PB link, for example, because the CPU cannot tell parameters have been assigned to all the terminals. The OB may remain blank.</p> <ul style="list-style-type: none"> • Another message indicates that an address has been accessed which appears to be non-existent. Check the configured addresses of your I/O devices and synchronize them with the source code.

6.4 Error Signaled by the LEDs on the Modules

If an error is signaled by the LEDs on a module, make the following checks and take the following measures to remedy the situation.

Table 6-4

Check	Remedy
<p>Check the LEDs of the modules. You will find a description of the LED displays in the manual for the devices.</p>	<ul style="list-style-type: none"> • If, for example, the SF (group errors) and RUN LED displays turn green on the IE/PB link, this indicates that the address or device name is incorrectly configured. • Check the name of the I/O device, which is indicating the error, in the hardware configuration and the name which you have allocated to the device yourself. The two must be identical. • Adapt the name of the device. Save and compile the hardware configuration and load it into the CPU again.

6.5 Tips

IP Addresses

The PROFINET IO device should not be allocated an IP address because the system performs the allocation of the IP address, and it alone determines the device name. In the case of DP slaves which are connected to an IE/PB link, it remains important, of course, to state the PROFIBUS address in the hardware configuration.

Exchange of Components

When individual components are exchanged (for a component of a different type), the hardware configuration must be adapted, of course. There is no need to change the IP address. It is simply a matter of checking or allocating the name of the device. STEP 7 then performs the configuration of the IP address. Everything remains transparent for the user.

If a component has to be exchanged for an identical model (replacement), there is no need to change the hardware configuration. The module exchange can be performed without a PG when using the MMC or the C plug!